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Bear Creek Valley Mercury Sources Remedial Site Evaluation for the U.S. Department of Energy Oak Ridge Site Oak Ridge, Tennessee

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Bear Creek Valley Mercury Sources Remedial Site Evaluation for the U.S. Department of Energy Oak Ridge Site Oak Ridge, Tennessee

Date Issued—August 2024

Prepared for the
U.S. Department of Energy
Office of Environmental Management

United Cleanup Oak Ridge LLC
under contract 89303322DEM000067

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FIGURES

TABLES

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ACRONYMS

amsl	above mean sea level
AWQC	ambient water quality criteria
BCK	Bear Creek kilometer
BCT	Bear Creek transect
BCV	Bear Creek Valley
BYBY	Boneyard/Burnyard
COC	contaminant of concern
CR	Clinch River
CSM	conceptual site model
DOC	dissolved organic carbon
DOE	U.S. Department of Energy
EFPC	East Fork Poplar Creek
EMDF	Environmental Management Disposal Facility
EPA	U.S. Environmental Protection Agency
FY	fiscal year
HCDA	Hazardous Chemical Disposal Area
HCK	Hinds Creek kilometer
LEFPC	Lower East Fork Poplar Creek
NT	North Tributary
OREIS	Oak Ridge Environmental Information System
ORR	Oak Ridge Reservation
OU	operable unit
ppb	parts per billion
QA	quality assurance
redox	oxidation-reduction potential
RER	Remediation Effectiveness Report
RI	remedial investigation
ROD	Record of Decision
RSE	remedial site evaluation
SAP	Sampling and Analysis Plan
TDEC	Tennessee Department of Environment and Conservation
TOC	total organic carbon
UEFPC	Upper East Fork Poplar Creek
WRRP	Water Resources Restoration Program
Y-12	Y-12 National Security Complex

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EXECUTIVE SUMMARY

This report presents results of the Bear Creek Valley (BCV) mercury sources remedial site evaluation (RSE) conducted in fiscal year 2024. The objective of the BCV mercury sources RSE is to evaluate potential sources of mercury and methylmercury within the BCV Watershed, as included in the mercury-management approach for Bear Creek in the *Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee* (DOE/OR/01-2794&D2/R2), to determine if active remediation is warranted. The U.S. Department of Energy collected and evaluated the BCV mercury sources RSE data, including channel sediment, creek bank and floodplain soil, and surface water. All sampling was conducted as planned between December 2023 and April 2024, per the *Bear Creek Valley Mercury Sources Remedial Site Evaluation Sampling and Analysis Plan, Oak Ridge, Tennessee* (DOE/OR/01-2958&D2), with the exception of a few changes due to field conditions and stream morphology. This BCV mercury sources RSE did not identify a source of mercury that significantly contributes to Bear Creek mercury contamination or mercury bioaccumulation in fish, or that would warrant active remediation. In addition, all Bear Creek surface water samples collected in this evaluation had mercury concentrations less than the 51-ng/L ambient water quality criteria level.

The results of this evaluation add significant data to the Bear Creek mercury conceptual model in several ways. Data did not identify one or more specific principal source(s) of mercury to Bear Creek that would indicate an early Comprehensive Environmental Response, Compensation, and Liability Act of 1980 action for mercury management/reduction. The distribution of mercury in floodplain and creek bank soils and channel sediment shows the highest concentrations in BCV headwater areas upstream of the confluence with North Tributary-3. The vicinity of the Reeves Road crossing of Bear Creek, where beaver ponds have been prevalent for several years, stands out as an inflection point in the valley-wide mercury concentration gradient. A key finding of the evaluation comes from the data provided through the mercury sequential extraction analyses that document a majority of the mercury in BCV floodplain soil, creek bank soil, and channel sediment is associated with organic components of the media. This result contrasts significantly from conditions in East Fork Poplar Creek, where mercury is predominantly associated with more strongly bound fractions of the mercury sequential extraction series. The mercury association with organic components of Bear Creek media may play a key role in the apparent ease of methylation and subsequent bioaccumulation in aquatic biota.

Although this BCV mercury sources RSE determines no action is required, enhanced monitoring of instream mercury and methylmercury concentrations and flux rates and further development of the mercury bioaccumulation conceptual model continue under the mercury technology development program.

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1. INTRODUCTION

This report presents results of the Bear Creek Valley (BCV) mercury sources remedial site evaluation (RSE) conducted in fiscal year (FY) 2024. Introductory information about the BCV mercury sources RSE objective, site description, summary of potential mercury source areas, summary of historical BCV monitoring results, and report content is provided below.

1.1 REMEDIAL SITE EVALUATION OBJECTIVE

The objective of the BCV mercury sources RSE is to evaluate potential sources of mercury and methylmercury within the BCV Watershed, as included in the mercury-management approach for Bear Creek in the *Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee* (DOE/OR/01-2794&D2/R2; Environmental Management Disposal Facility [EMDF] Record of Decision [ROD]), to determine if active remediation is warranted. The BCV Watershed is located in the north-central portion of the Oak Ridge Reservation (ORR) west of the Y-12 National Security Complex (Y-12) (Figure 1.1). Y-12 began operations in the 1940s as part of the Manhattan Project for the purpose of enriching uranium for the first atomic bombs. Since that time, the Y-12 missions have changed, and in the 1950s, new processes for separating lithium used large amounts of mercury. Although process functions were performed adjacent to BCV in the Y-12 Main Plant area, wastes from operations at Y-12 were disposed in pits, trenches, and burial grounds in the 2800-acre BCV Watershed.

The *Bear Creek Valley Mercury Sources Remedial Site Evaluation Sampling and Analysis Plan, Oak Ridge, Tennessee* (DOE/OR/01-2958&D2; BCV Mercury Sources RSE Sampling and Analysis Plan [SAP]) identified the locations, media, and sampling methodology to support the RSE objectives. Impacts of source areas and hydrology on mercury concentrations are assessed in channel sediment, creek bank and floodplain soils, and surface water at multiple sampling transects throughout the length of the stream. The data quality objectives for the BCV mercury sources RSE and the BCV Mercury Sources RSE SAP were presented and discussed with the Project Team, comprised of representatives of the Tennessee Department of Environment and Conservation (TDEC), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy (DOE), and the contractor (United Cleanup Oak Ridge LLC), on June 29, 2023. Results of the RSE are combined with biota data from fall 2023 to evaluate potential mercury source areas in BCV. The BCV Mercury Sources RSE SAP is included as Appendix A of this document.

1.2 BACKGROUND

1.2.1 Site Description

The BCV Watershed is located at the western end of Y-12 in the north-central portion of the ORR west of the Upper East Fork Poplar Creek (UEFPC) Watershed (Figure 1.1). BCV contains closed and active waste disposal facilities. The boundary between the BCV Watershed and the UEFPC Watershed is defined by a surface water divide between eastward-flowing East Fork Poplar Creek (EFPC) and westward-flowing Bear Creek (Figure 1.2). The integration point for Bear Creek is at Bear Creek kilometer (BCK) 9.2, where more than 99% of the available water from the eastern portion of BCV passes through this location either as surface water or groundwater. As illustrated in Figure 1.2, the BCV Administrative Watershed is subdivided into three zones based on end use. The subareas of BCV investigated under the BCV Mercury Sources RSE SAP represent geographic areas located at or downstream from potential DOE on-site source areas. Based on the EMDF ROD, the end use for Zone 1 and Zone 2 will be revised to restricted recreational and controlled industrial, respectively, which will be codified in an upcoming non-significant change to the *Record of Decision for the Phase I Activities in Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1750&D4; BCV Phase I ROD). The following sections briefly summarize the BCV geography, geology, and hydrogeologic conceptual model.

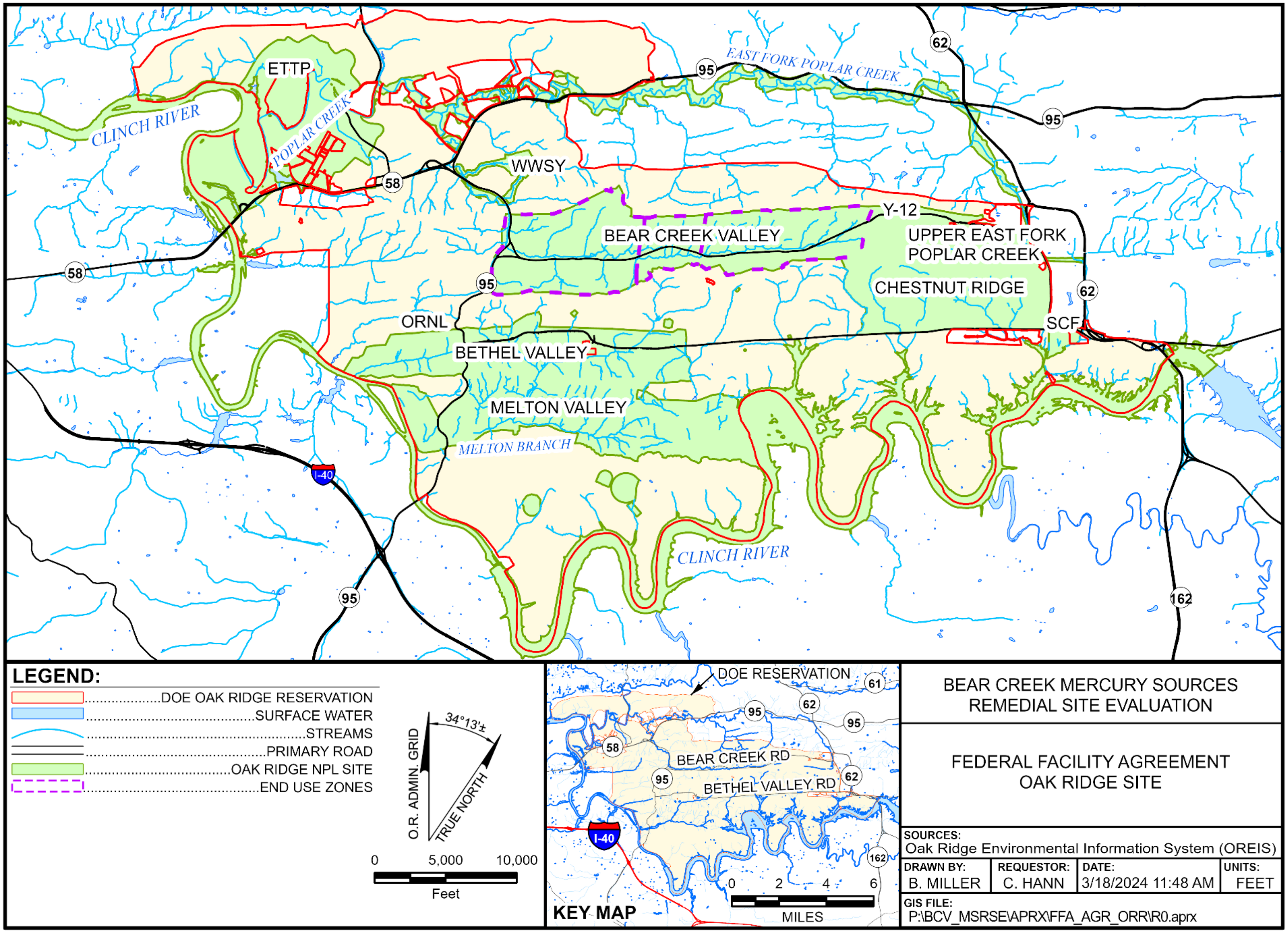

Figure 1.1. BCV within the Oak Ridge Site.

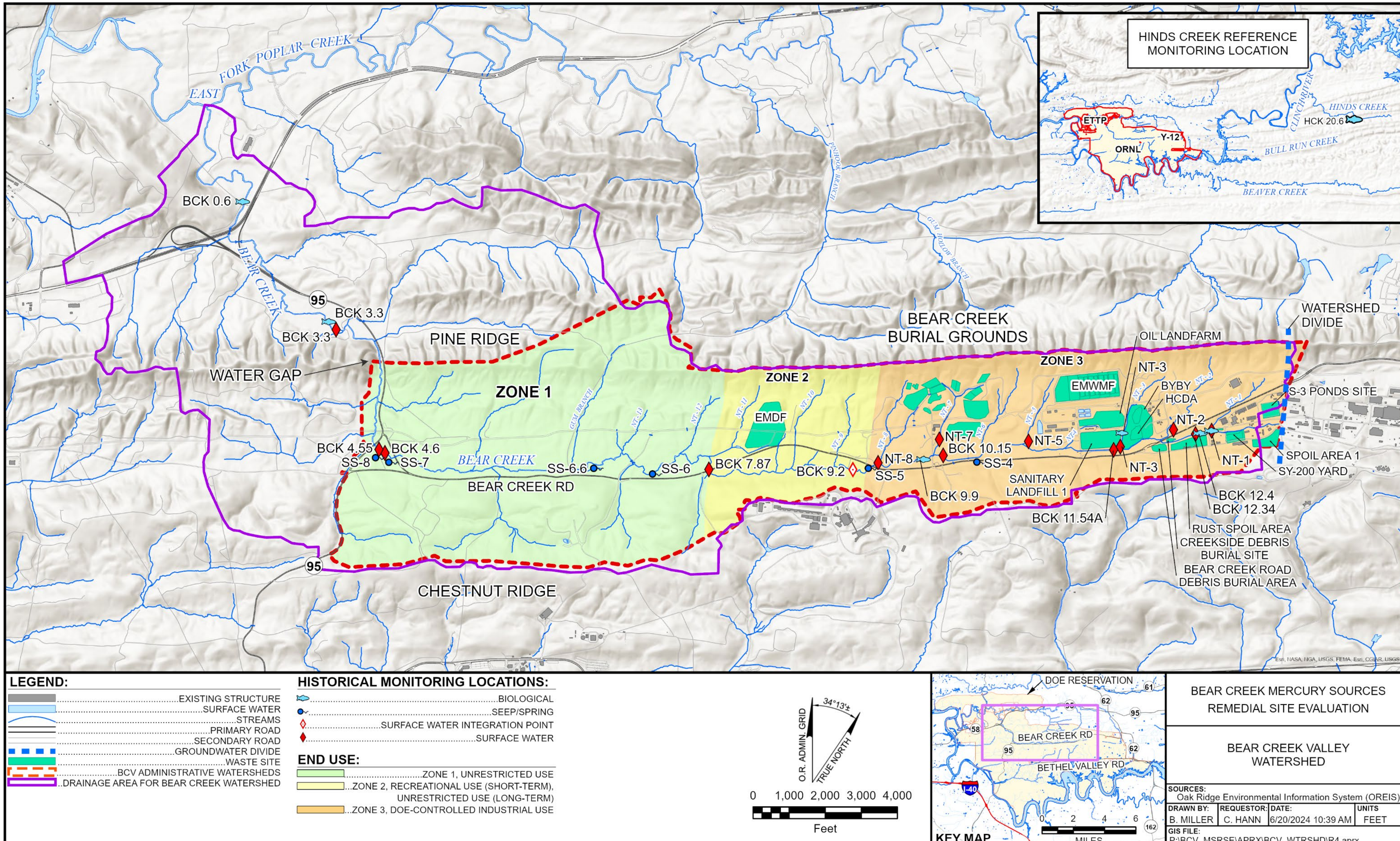

Figure 1.2. BCV Watershed and historic monitoring locations.

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1.2.1.1 Geography

The ORR is approximately 32,500 acres and is located within and adjacent to the corporate limits of the City of Oak Ridge, Tennessee, in Roane and Anderson Counties. The ORR is bounded to the east, south, and west by the Clinch River (CR) and on the north by the City of Oak Ridge. The area west of the ORR and the CR is comprised of rural, residential, and industrial park areas.

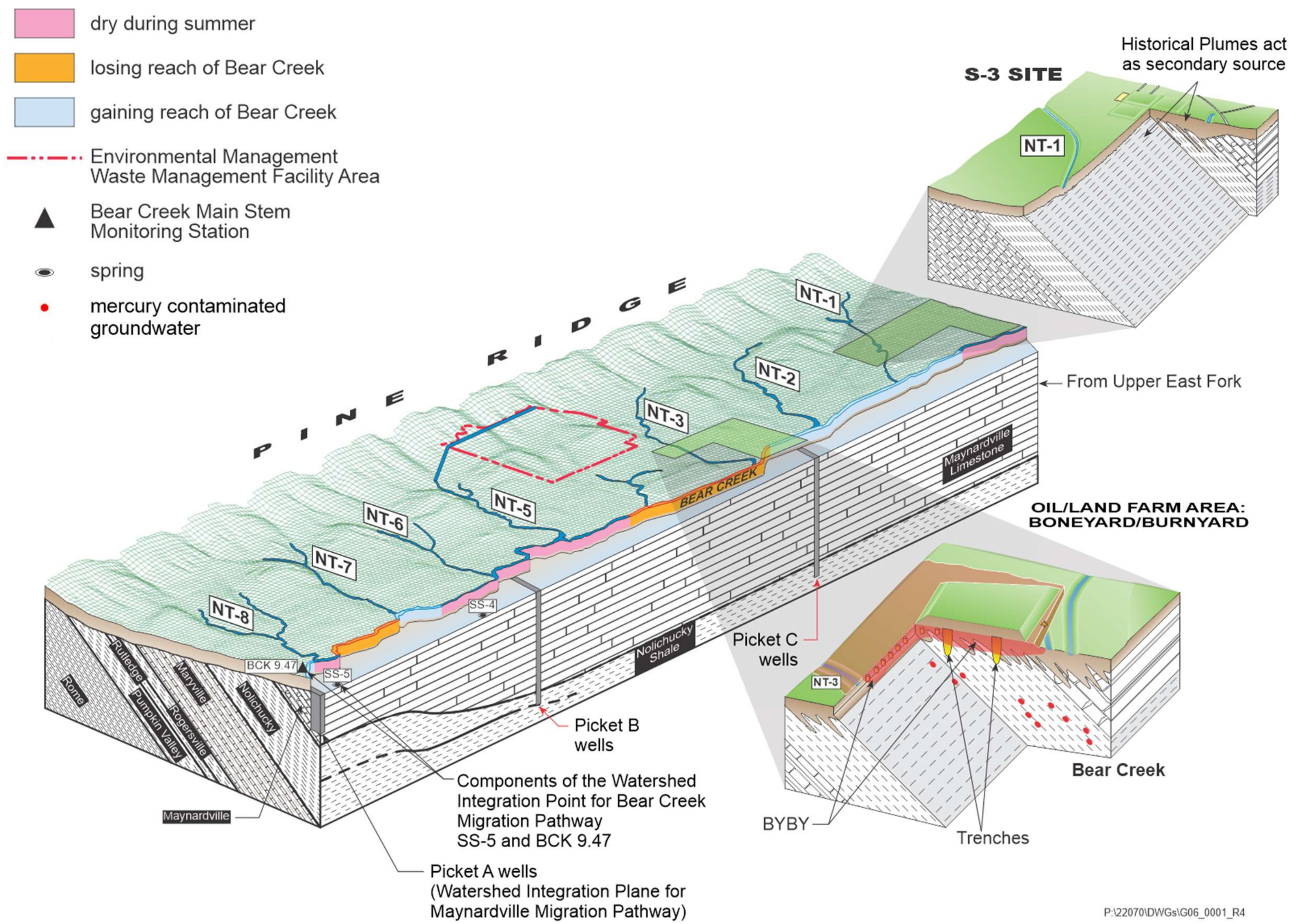
The entire BCV Watershed is approximately 4800 acres and encompasses two principal drainage areas: (1) the catchment area of Bear Creek and its tributaries between the western end of Y-12 to approximately 0.25 miles west of State Route 95 (enclosed between Pine Ridge and Chestnut Ridge), also described as the BCV Administrative Watershed; and (2) an area between the Bear Creek water gap in Pine Ridge and the confluence with EFPC (Figure 1.2). The BCV Administrative Watershed is approximately 2800 acres and lies within the north-central portion of the ORR, approximately 0.75 miles south of the industrial/residential portion of the City of Oak Ridge (Figure 1.2).

Bear Creek is wholly contained on the ORR and originates in the eastern portion of the watershed near the former S-3 Site. It then flows west along strike of BCV to State Route 95 and thereafter flows north and empties into EFPC 12.87 km (8 miles) downstream. The average gradient of the creek is 30 ft/mile, dropping from nearly 1000 ft above mean sea level (amsl) at its headwaters to 760 ft amsl at its confluence with EFPC. A series of tributaries draining the south flank of Pine Ridge and springs along the southern edge of BCV are key contributors to the flow in Bear Creek (Figure 1.2).

1.2.1.2 BCV Watershed hydrogeological conceptual model

A full description of the hydrogeologic conceptual model for the BCV Watershed may be found in the *Report on the Remedial Investigation for Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1455&D2; BCV Remedial Investigation [RI]). Groundwater flow and contaminant transport within the bedrock geologic units are important factors in the migration of contaminants from the watershed. Bedrock geologic units strike northeast-southwest, parallel to the axis of the valley, with predominantly shale formations underlying the central and northern portions of the valley and most major waste disposal units (Figure 1.3). In the northern portion of the valley, shallow groundwater and storm flow through unconsolidated material and weathered bedrock are important components of groundwater recharge and contaminant migration from source units to Bear Creek and its tributaries. Waste and contamination at the sources in BCV are situated in the subsurface, and shallow groundwater is the principal mechanism and pathway for release of contaminants. After release, most contaminants travel via short pathways in shallow groundwater (i.e., storm flow zone) to be discharged into tributaries to Bear Creek. Some contaminants, in particular those from the S-3 Ponds, remain entrained in groundwater and discharge directly into the underlying stratum.

The southern portion of the valley is underlain by the Maynardville Limestone, a 200-ft-thick limestone formation, containing a well-developed karst network created by dissolution and enlargement of fractures and joints. The underlying geology results in an asymmetric topographic cross-section of the valley, with the lowest elevations on the south side coincident with the Maynardville Limestone. Groundwater flow in the Maynardville Limestone occurs in both shallow and deep karst features, and corresponding flow rates and volumes are much higher than in the shale-dominated formation underlying the central and north portions of the valley. Large, individual springs or groups of springs mark the locations of discharge from both the shallow and deep karst flow systems into the surface water system. In addition, surface water flow in Bear Creek is highly connected with groundwater in the underlying Maynardville Limestone through karst features and losing and gaining reaches of the creek. Because of these characteristics, the interconnected Bear Creek channel and underlying karst system act as the principal hydraulic drain for the valley and are part of the carbonate aquifer system in the BCV conceptual site model (CSM).



BCK = Bear Creek kilometer BCV = Bear Creek Valley BYBY = Boneyard/Burnyard NT = North Tributary SS = surface spring

Figure 1.3. BCV hydrogeologic CSM for Upper Bear Creek.

By comparison, the shale-dominated formations in the central and northern portions of the valley function as aquitards. Because of the karst conditions in the Maynardville Limestone, during late summer into autumn, reaches of Bear Creek (much of the reach from North Tributary [NT]-4 to NT-8) are prone to becoming dry (Figure 1.3). During the drought season, these reaches of Bear Creek are not supportive of fish, although small populations may persist in scattered pools and tributary streams.

The climate of the Oak Ridge area and its surroundings may be broadly classified as humid subtropical. The term “humid” indicates the region receives an overall surplus of precipitation compared to the levels of evaporation and transpiration throughout the year, while the “subtropical” designation indicates the region experiences a wide range of seasonal temperatures. Average annual precipitation in Oak Ridge is 56.3 in. Wet deposition is a major source of mercury entering aquatic and terrestrial ecosystems, where it can cause significant ecological and human health risks. The wet deposition of mercury is, therefore, measured globally by the Mercury Deposition Network. The total mercury wet deposition in the southeastern United States is relatively high (Xiaotian et al. 2002); the wet deposition in East Tennessee in 2022 was approximately 14 $\mu g/m^2$; however, site-specific data for Bear Creek are not available. Surface water total mercury concentrations have historically been relatively low, but mercury concentrations in fish collected in Bear Creek are relatively high, occasionally exceeding the EPA-recommended ambient water quality criterion (AWQC) for mercury (0.3 µg/g in fish) (ORNL/TM-2023/3069).

Recently, the Oak Ridge National Laboratory conducted special studies of Bear Creek to better understand the biotic and abiotic factors contributing to mercury concentrations in fish in Bear Creek. These field studies focused on gaining an understanding of the processes controlling mercury methylation and bioaccumulation, with beaver dams and periphyton being key areas of interest. Studies included understanding the role of beaver dams in mercury dynamics in Bear Creek (2017–2018), evaluating the effects of fine-grained sediment deposition (2019), investigating the potential role tributaries to Bear Creek may have on mercury and methylmercury in the main channel (2020–2021), and evaluating periphyton relationships (2021). These special studies were documented in the *Bear Creek Special Studies Report 2021* (ORNL/SPR-2021/2162).

A 2022 data compilation report for mercury in Bear Creek (ORNL/TM-2023/3069) summarized data from compliance and investigatory studies to begin building a conceptual model to understand the processes affecting mercury transport and transformation in the Bear Creek Watershed and to highlight key knowledge gaps in understanding these processes. Future work will build on the summary presented in the data compilation report to develop a conceptual model that outlines the key environmental parameters that correlate with methylmercury concentrations and bioaccumulation in Bear Creek. A conceptual model will help to understand the processes affecting mercury transport and transformation in the Bear Creek Watershed and to highlight key knowledge gaps in understanding these processes. The conceptual model will ultimately provide a strong technical basis for prioritizing new data collection and optimizing potential mitigation actions or best management practices, with the goal of lowering fish tissue mercury concentrations.

1.2.2 Summary of Potential Mercury Source Areas

BCV contains multiple historical waste management and disposal areas that received mercury-contaminated waste streams from Y-12 operations from 1943–1993, in addition to having materials storage areas and construction storage areas (Figure 1.2). The BCV RI and associated decision documents cite mercury as a potential contaminant of concern (COC) in BCV at the following locations:

- Boneyard/Burnyard (BYBY)
- Oil Landfarm, Hazardous Chemical Disposal Area (HCDA)

- S-3 Ponds Site
- Sanitary Landfill 1
- Bear Creek Road Debris Burial
- Creekside Debris Burial

A source control action performed under the BCV Phase I ROD at the remediated BYBY (*Phased Construction Completion Report for the Bear Creek Valley Boneyard/Burnyard Remediation Project at the Y-12 National Security Complex, Oak Ridge, Tennessee* [DOE/OR/01-2077&D2]) focused on excavating mercury-contaminated soil along NT-3. Mercury surface water results in BCV are consistently below Tennessee general AWQC (TDEC 2019); however, until recent years, fish tissue concentrations have remained above or near the EPA-recommended AWQC for mercury (0.3 µg/g in fish). The BCV RI indicated some elevated soil mercury concentrations exist, generally within an order of magnitude of the background criterion (0.34 mg/kg); however, historical mercury and methylmercury data for sediment and soil that may contribute to concentrations in fish are limited. The baseline risk assessment in the BCV RI stated "the sources of mercury and PCBs to the BCV fish are currently unknown."

The *Remedial Investigation Report on Bear Creek Valley Operable Unit 2 (Rust Spoil Area, Spoil Area 1, and SY-200 Yard) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1273&D2; BCV Operable Unit [OU] 2 RI) identified mercury as a COC for human health for the SY-200 Yard, which was a former equipment storage yard used to store nonradioactive contaminated equipment from the 1950s to 1986. Mercury contamination was discovered during construction in 1990, and a soil cover was placed over the site. While other areas (Spoil Area 1 and the Rust Spoil Area) had mercury as a contaminant of potential concern in the BCV OU 2 RI, the baseline risk assessment did not identify mercury as a COC for these areas. The BCV OU 2 RI indicated there were isolated areas of elevated mercury concentrations at the SY-200 Yard; free mercury was observed in some of the borings during the BCV OU 2 RI. The *Record of Decision for Bear Creek Operable Unit 2 (Spoil Area 1 and SY-200 Yard) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/02-1435&D2; BCV OU 2 ROD) identified the SY-200 Yard as the area with mercury, and access controls and surveillance and maintenance of the SY-200 Yard soil cover are ongoing.

1.2.3 Summary of Historical Bear Creek Valley Mercury Data

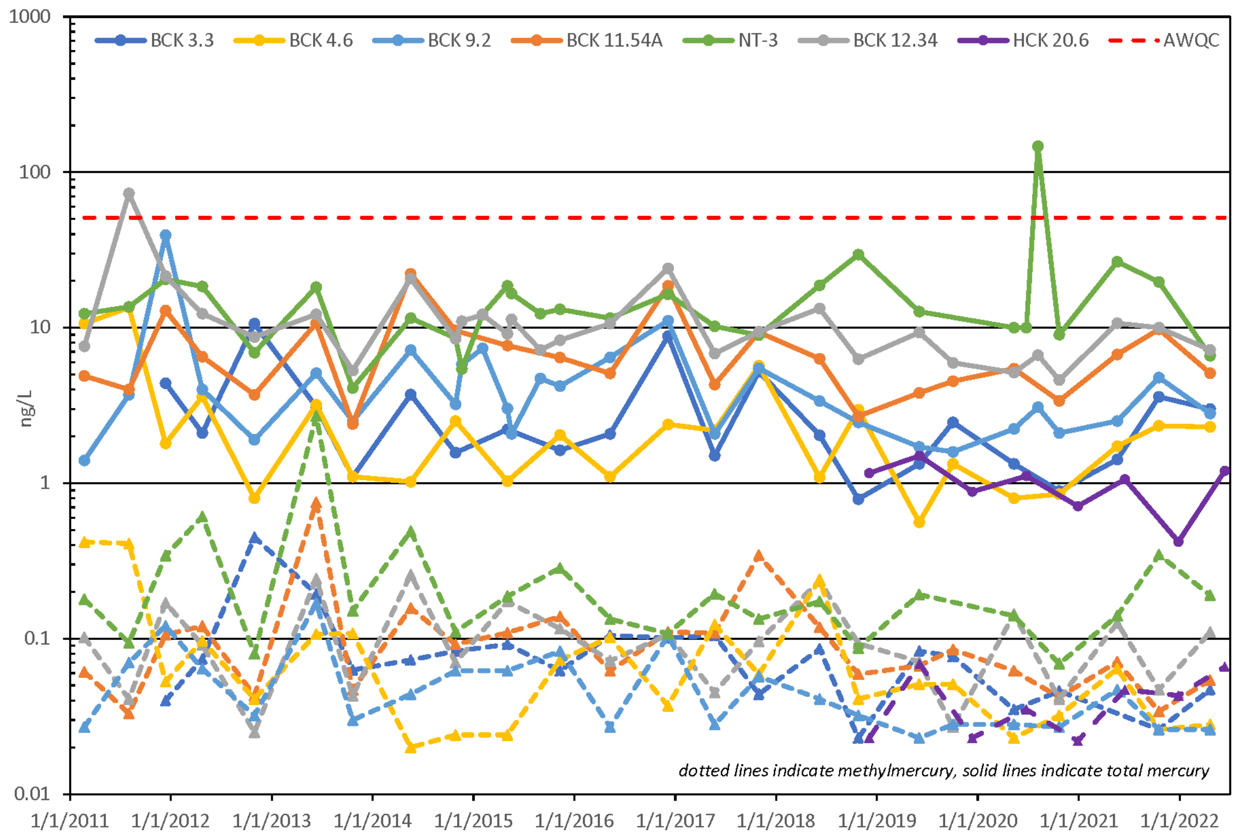
Mercury data for sediment, surface water, and biota in BCV are available in the Oak Ridge Environmental Information System (OREIS). However, prior to this BCV mercury sources RSE, sediment data were limited, and no methylmercury data were available for BCV sediment in OREIS. Twenty-nine data points for total mercury in BCV sediment were available ranging from 1993–2011: 7 locations in Zone 1, 2 locations in Zone 2, and 20 locations in Zone 3. Concentrations ranged from non-detected to 6.9-mg/kg total mercury.

As shown in Table 1.1, under the *Bear Creek Valley Watershed Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-2457&D4), surface water and biota sampling have been performed. Results are reported annually in a Remediation Effectiveness Report (RER) or every 5 years in a Five-Year Review Report. Surface water data since 2011 (Figure 1.4) show a steady or declining trend, with mercury below AWQC, with few exceptions. Mercury concentrations are generally higher upstream and decrease downstream; methylmercury concentrations are more variable upstream to downstream. Additional evaluation of historical mercury and methylmercury surface water data is included in Chapter 4. Fish tissue data are presented in Section 4.2.

Table 1.1. Routine surface water and biota sampling in Bear Creek

Medium	Performance standard	Sampling frequency	Parameter	Monitoring location
Surface water	AWQC	Semiannual (Q1 and Q3)	Total mercury and methylmercury	BCK 3.3, BCK 4.55, BCK 9.2, BCK-11.54A, BCK 12.34, NT-3, SS-4, and SS-5
		Semiannual (Q2 and Q4) in year before FYR	Total mercury	BCK 4.55, BCK 9.2, BCK 12.34, NT-3, and NT-8
		Annual in year before FYR	Total mercury	BCK-7.87 and NT-1
		Annual in year before FYR	Methylmercury	NT-5
	Trend monitoring	Quarterly	Bicarbonate, carbonate, chloride, fluoride, and sulfate	NT-1, NT-2, NT-3, SS-4, and SS-5
		Semiannual		NT-7 and NT-8
		Quarterly in year before FYR		NT-5
	Water quality	Semiannual	Total suspended solids and total dissolved solids	NT-7 and NT-8
		Quarterly in year before FYR		BCK 4.55, BCK-7.87, BCK 9.2, BCK 12.34, NT-1, NT-3, NT-5, and NT-8
Biota	Baseline sampling	Semiannual	Mercury and methylmercury	BCK 3.3, BCK 9.9, and HCK 20.6 (whole-body stoneroller minnows and rock bass fillets); BCK 12.4 (whole-body stoneroller minnows)
		Annual in year before FYR	Mercury and methylmercury	BCK 9.9 (whole-body caddisflies)

AWQC = ambient water quality criteria
BCK = Bear Creek kilometer
FYR = Five-Year Review
HCK = Hinds Creek kilometer
NT = North Tributary
Q = quarter
SS = surface spring



AWQC = ambient water quality criteria BCK = Bear Creek kilometer HCK = Hinds Creek kilometer NT = North Tributary

Figure 1.4. Surface water data for mercury and methylmercury in Bear Creek, NT-3, and Hinds Creek, 2011–2022.

1.3 REPORT CONTENT

Chapter 2 presents information about implementing the BCV Mercury Sources SAP, including scope of work and changes from the BCV Mercury Sources RSE SAP during field implementation. Chapter 3 summarizes monitoring results for all media collected during the BCV mercury sources RSE. Chapter 4 presents other surface water monitoring data collected by the Water Resources Restoration Program (WRRP) and presents the 2023 biota data collected for the upcoming 2025 RER. The report conclusions and recommendations are presented in Chapter 5. Chapter 6 lists references cited in the report. This report contains six appendices with supporting information:

- Appendix A. BCV Mercury Sources RSE SAP, including TDEC and EPA comments on the D1 version of the document.
- Appendix B. Photographs of Transect Locations.
- Appendix C. Analytical Data Summary Tables by Media.
- Appendix D. Particle Size Analysis.
- Appendix E. BCV RSE Analyte Correlations.
- Appendix F. WRRP Surface Water Total Mercury and Methylmercury Longitudinal Data Plots for Bear Creek.

2. IMPLEMENTATION OF THE BEAR CREEK VALLEY MERCURY SOURCES REMEDIAL SITE EVALUATION SAMPLING AND ANALYSIS PLAN

2.1 SCOPE OF WORK

Field implementation, sample collection, laboratory analysis, and data management activities were consistent with the BCV Mercury Sources RSE SAP and were conducted within the framework of plans, procedures, and protocols under the WRRP that help ensure all data collected are managed in a manner consistent with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 requirements. The *Quality Assurance Project Plan for the Water Resources Restoration Program, U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee* (UCOR-4049) identifies and implements quality assurance (QA) requirements for use in sample collection, laboratory analysis, and data management of environmental media monitoring activities. The *Data Management Implementation Plan for the Water Resources Restoration Program, Oak Ridge, Tennessee* (UCOR-4160) serves as the project-level plan for managing all data collected by the WRRP. Together, these plans identify the procedures that are followed in collecting, handling, and maintaining custody of, as well as in verifying, validating, and retaining environmental and laboratory data used by the WRRP to prepare Federal Facility Agreement documents. Additional requirements governing fieldwork and sample collection, including QA/quality control samples are specified in the *Quality Assurance Plan for Environmental Characterization and Monitoring, Oak Ridge, Tennessee* (UCOR-4189).

A list of sampling locations along Bear Creek and its tributaries includes transects for the collection of channel sediment, creek bank and floodplain soils, and surface water (Table 2.1). Samples collected per the BCV Mercury Sources RSE SAP and any deviations from the BCV Mercury Sources RSE SAP due to field conditions are shown on Table 2.2. Sample transects are identified by increasing numbered locations (e.g., Bear Creek transect [BCT]1, BCT2) from the most downstream locations northwest of Tennessee Highway 58 to the most upstream location (BCT15) that is located near the western end of the Y-12 facility (Figure 2.1). Location HCTREF is the project reference site on Hinds Creek near Clinton, Tennessee. A conceptual diagram of the transect sampling is included as Figure 2.2.

Table 2.1. List of transect locations in BCV

Sample group	Location
LOWBCV	BCT1 (downstream of BCK 0.6)
	BCT2 (upstream of BCK 0.6; beaver dam previously viewed near this transect was no longer present)
	BCT3 (downstream of BCK 3.3; downstream of beaver dam)
	BCT4 (downstream of BCK 3.3; in beaver pond)
BCV ZONE 1	BCT5 (downstream of BCK 4.55; beaver dam previously viewed near this transect was no longer present)
	BCT6 (downstream of BCK 4.55; beaver dam previously viewed near this transect was no longer present)
	BCT7 (downstream of BCK 7.87 at the confluence of NT-13/Bear Creek; downstream of westernmost beaver dam)
	BCT8 (downstream of BCK 7.87 at the confluence of NT-13/Bear Creek; upstream of westernmost beaver dam)
	BCT9 (downstream of BCK 7.87; upstream of two beaver dams; southeast of Reeves Road/Haul Road)
BCV ZONE 2	BCT10 (downstream of surface water integration point BCK 9.2; upstream of EMDF)

Table 2.1. List of transect locations in BCV (cont.)

Sample group	Location
BCV ZONE 3	BCT11 (upstream of NT-8 and BCK 9.9)
	BCT12A (upstream of NT-3 confluence of NT-3/Bear Creek)
	BCT12B (downstream of BYBY at the confluence of NT-3/Bear Creek)
	BCT13 (upstream of BYBY, EMWMF, and NT-3)
	BCT14 (downstream of SY-200 Yard, Spoil Area 1, S-3 Ponds Site, and BCK 12.34)
	BCT15 (downstream of SY-200 Yard, Spoil Area 1, and S-3 Ponds Site at NT-1)
Hinds Creek	HCTREF (HCK 20.6 reference site)

BCK = Bear Creek kilometer
BCT = Bear Creek transect
BCV = Bear Creek Valley
BYBY = Boneyard/Burnyard
EMDF = Environmental Management Disposal Facility
EMWMF = Environmental Management Waste Management Facility
HCK = Hinds Creek kilometer
HCTREF = Hinds Creek transect reference site
NT = North Tributary

Table 2.2. Sampling summary by location

Transect location	Floodplain soil	Upper creek bank soil	Lower creek bank soil	Channel sediment	Surface water	Sequential extraction		
						Floodplain soil	Creek bank soil	Sediment
BCT1	x	x	x	--	x	NS	NS	NS
BCT2	x	x	x	--	x	NS	NS	NS
BCT3	x	x	x	x	x	NS	NS	NS
BCT4	x	x	x	x	x	NS	NS	NS
BCT5	x	x	x	--	x	x	x	--
BCT6	x	x	x	--	x	x	x	--
BCT7	x	x	--	x	x	x	x	x
BCT8	x	x	--	x	x	x	x	x
BCT9	x	x	--	x	x	x	x	x
BCT10	x	x	x	x	x	NS	NS	NS
BCT11	x	x	x	x	x	x	x	x
BCT12A	x	x	x	x	x	NS	NS	NS
BCT12B	x	x	x	x	x	x	x	x
BCT13	x	x	x	x	x	NS	NS	NS
BCT14	x	x	x	x	x	x	x	x
BCT15	x	x	x	x	x	NS	NS	NS
HCTREF	x	x	x	--	x	x	x	--

-- Indicates sample unable to be collected either due to lack of fine-grained material or limited creek bank exposure.
x Indicates sample collected.

BCT = Bear Creek transect
HCTREF = Hinds Creek transect reference site
NS = sequential extraction was not planned for this location; therefore, no sample was collected

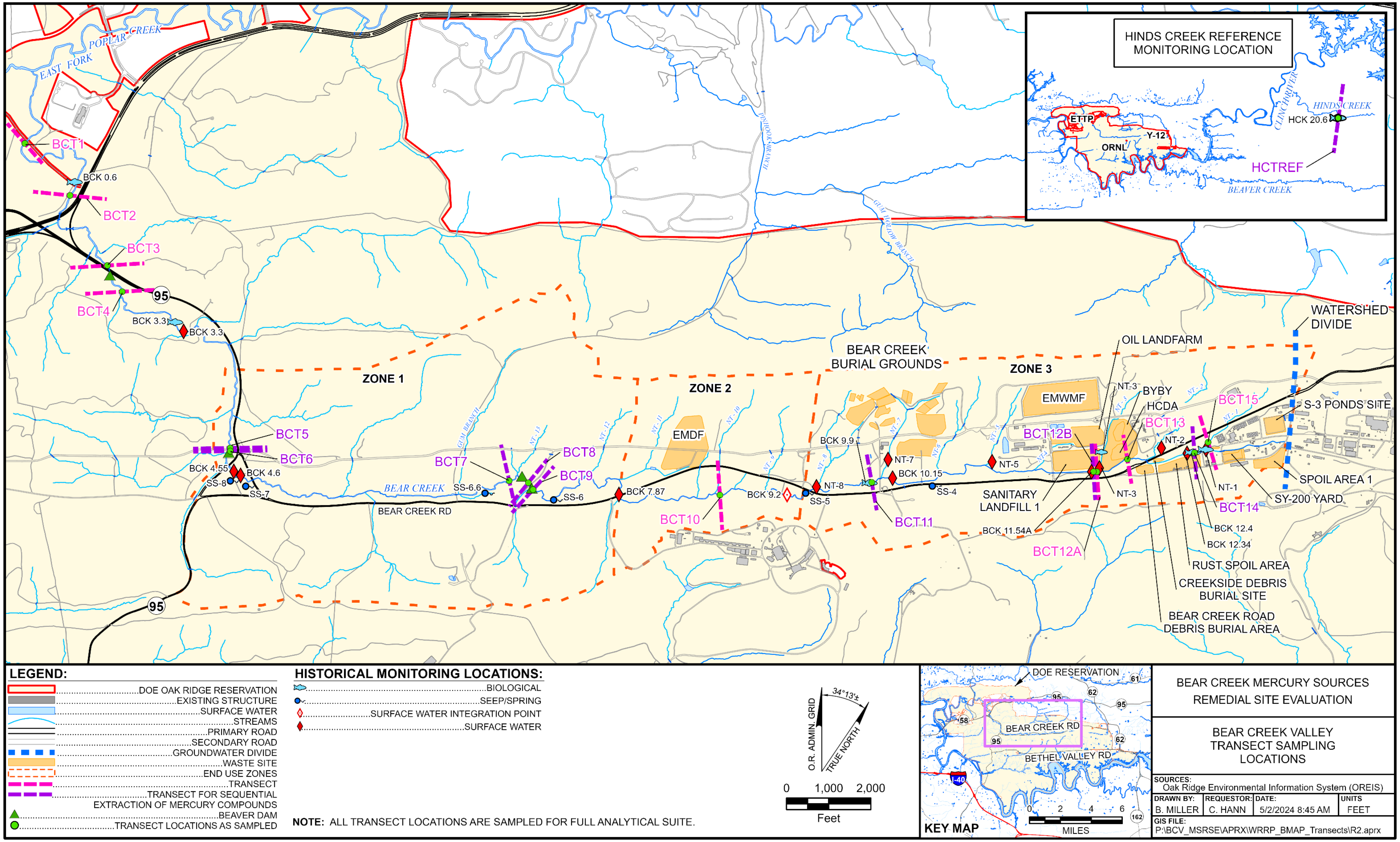


Figure 2.1. BCV transect locations.

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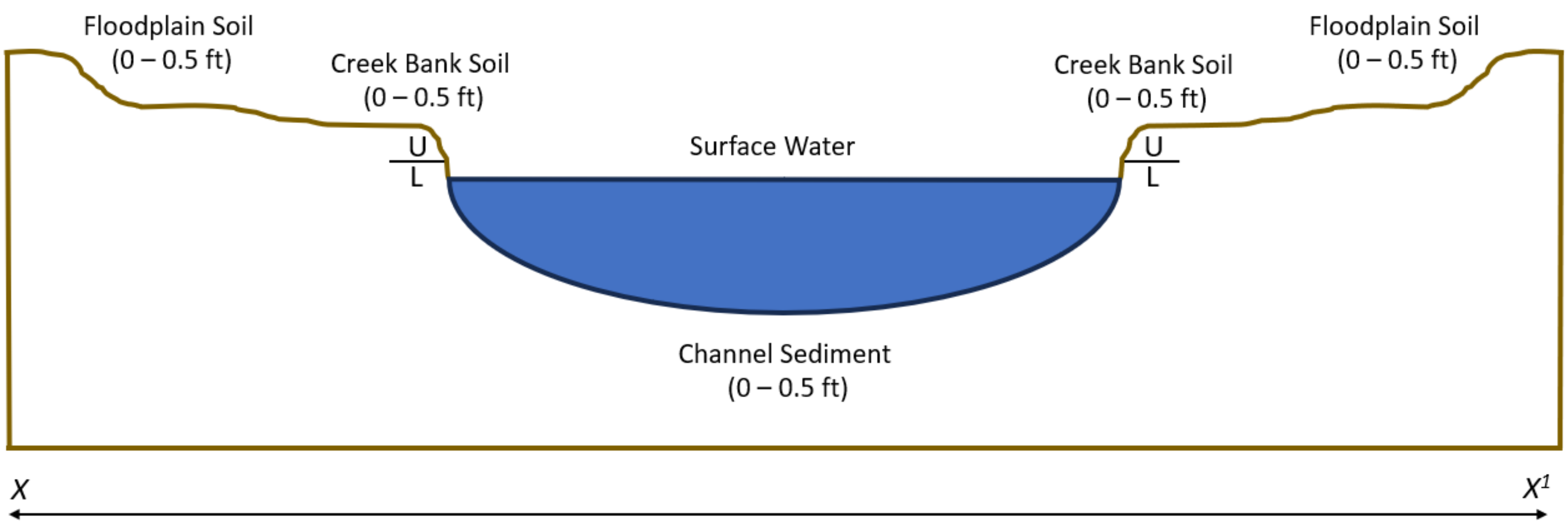


L = lower   U = upper

Figure 2.2. BCV RSE transect conceptual diagram.

2.1.1 Channel Sediment Sampling

Channel sediment samples were collected at 12 transect monitoring locations following PROC-ES-2302, *Sediment Sampling*. No channel sediment was sampled at BCT1, BCT2, BCT5, BCT6, or the reference site HCTREF (Hinds Creek kilometer [HCK] 20.6), because no fine-grained sediment was observed at these locations. Sediment was collected to an approximate depth of 0.5 ft and was run through a 1-mm sieve until adequate sample volume was achieved. All channel sediment samples were analyzed for mercury, methylmercury, metals, total organic carbon (TOC), anions, and particle size (Table 2.3). In addition, sequential extraction of mercury was conducted at select transect locations—BCT7, BCT8, BCT9, BCT11, BCT12B, and BCT14. Planned sequential extraction at locations BCT5 and BCT6 and the reference site HCTREF (HCK 20.6) was not possible due to lack of fine-grained sediment at these locations.

Table 2.3. Summary of field and laboratory measurements

Medium	Field measurement	Laboratory measurement
Surface water	Temperature	Dissolved and total mercury
	Dissolved oxygen	Dissolved and total methylmercury
	Turbidity	Metals
	pH	Phosphorous (total)
	Specific conductance (conductivity)	Total organic carbon
	Oxidation-reduction potential	Dissolved organic carbon
		Total dissolved solids
		Total suspended solids
		Anions (chloride, fluoride, nitrate-nitrite as nitrogen, sulfate, and sulfide)
Sediment and soil	None	Total mercury
		Total methylmercury
		Metals
		Total organic carbon
		Particle size analysis
		Anions (chloride, fluoride, nitrate, nitrite, sulfate, and sulfide)
		Sequential extraction of mercury (select locations)

2.1.2 Creek Bank Soil Sampling

Creek bank soil was collected at 16 transect monitoring locations as well as at a single reference site—HCTREF (HCK 20.6)—following PROC-ES-2300, *Soil Sampling*. Except for transects BCT7, BCT8, and BCT9, at which ponding limited the height of the banks, creek bank soil was divided in half into upper and lower sections as follows (Figure 2.2):

- For the upper section of the creek bank soils, samples were collected from the upper half of the exposed bank face on each side of the creek. The upper creek bank samples from both sides were composited into a single sample.
- For the lower section of the creek bank soils, samples were collected from the lower half of the exposed bank face on each side of the creek. The lower creek bank samples from both sides were composited into a single sample.

- At BCT7, BCT8, and BCT9, an aliquot of soil material was collected from each side of the bank and composited into a single sample. These samples were treated as upper bank soil samples for evaluations.

All creek bank soil samples were analyzed for mercury, methylmercury, metals, TOC, anions, and particle size (Table 2.3). In addition, sequential extraction of mercury was conducted at select transect locations—BCT5, BCT6, BCT7, BCT8, BCT9, BCT11, BCT12B, and BCT14—and the reference site HCTREF (HCK 20.6).

2.1.3 Floodplain Soil Sampling

Floodplain soils were collected at each of the 16 transect monitoring locations as well as at a single reference site—HCTREF (HCK 20.6)—following PROC-ES-2300, *Soil Sampling*.

Floodplain soil was collected from the upper 0.5 ft on either side of Bear Creek to generate a single composite sample representing both sides of the floodplain (Figure 2.2). Loose organic material, such as leaves or brush, was removed prior to collection. All floodplain soil samples were analyzed for mercury, methylmercury, metals, TOC, anions, and particle size (Table 2.3). In addition, sequential extraction of mercury was conducted at select transect locations—BCT5, BCT6, BCT7, BCT8, BCT9, BCT11, BCT12B, and BCT14—and the reference site HCTREF (HCK 20.6).

2.1.4 Surface Water Sampling

Surface water samples were collected at each of the 16 transect monitoring locations as well as at a single reference site—HCTREF (HCK 20.6)—following PROC-ES-2203, *Surface Water Sampling – Manual and Automated*.

Because filtered (dissolved) and unfiltered (total) mercury and methylmercury sample volumes were collected for analysis, a peristaltic pump was used to push water through a 0.45-µm filter in addition to the grab method for unfiltered samples. Surface water sampling was conducted before channel sediment was collected to avoid interference between media. All surface water samples were analyzed for total and dissolved mercury and methylmercury, metals, phosphorous, TOC, dissolved organic carbon (DOC), total dissolved solids, total suspended solids, and anions.

2.1.5 Speciation of Mercury via Sequential Extraction

Sequential extractions of soils allow the concentrations of mercury compounds in the soil that belong to different classes (e.g., water soluble, weak acid soluble, organo-complexed, strongly complexed, mineral bound) to be assessed. Understanding the fractionation of mercury into these different classes provides an understanding of the potential solid-phase forms of mercury and, therefore, its propensity to enter the dissolved phase, be transported, and methylated. Eight transect locations (BCT5, BCT6, BCT7, BCT8, BCT9, BCT11, BCT12B, and BCT14), as well as a reference site (HCTREF [HCK 20.6]), were sampled for mercury speciation/sequential extraction analysis. Sufficient mass of solid material from the channel sediment, creek bank soil, and floodplain soil at each selected transect for mercury speciation/sequential extraction was composited into samples from each of the three representative media types (i.e., three composite samples per transect). Sediment was collected to an approximate depth of 0.5 ft and passed through a 1-mm sieve until adequate sample volume was achieved. For creek bank soil, one sample was collected from each side of the bank by removing the upper 0.5 ft of bank soil surface just above the water level and was composited. For floodplain soil, samples were collected from the upper 0.5 ft on each side of the creek to generate a composite sample representing both sides of the floodplain. Planned sequential extraction for channel sediment at locations BCT5 and BCT6 and the reference site HCTREF (HCK 20.6) was not possible due to lack of fine-grained sediment at these locations.

2.2 CHANGES FROM THE BEAR CREEK VALLEY MERCURY SOURCES REMEDIAL SITE EVALUATION SAMPLING AND ANALYSIS PLAN

As described in the BCV Mercury Sources RSE SAP, transect locations were adjusted based on field conditions and sampling viability. The following locations were moved during the site reconnaissance prior to field implementation:

- BCT1 and BCT2 were moved further downstream because the beaver dams previously viewed at these locations were no longer in place.
- BCT15 was moved further downstream due to accessibility issues.

During the field sampling, the following samples were not collected (Table 2.2):

- No channel sediment was sampled at BCT1, BCT2, BCT5, BCT6, or the reference site HCTREF (HCK 20.6) because no fine-grained sediment was observed at these locations. Planned sequential extraction of channel sediment at locations BCT5 and BCT6 and the reference site HCTREF (HCK 20.6) was also not performed because no fine-grained sediment was encountered.
- Due to ponding at locations BCT7, BCT8, and BCT9, upper and lower creek bank soil was not divided into separate samples, and a single bank soil sample was collected.

3. BEAR CREEK VALLEY MERCURY SOURCES REMEDIAL SITE EVALUATION RESULTS

The following sections summarize results of sampling and analyses conducted for the BCV mercury sources RSE. Figure 2.1 shows the BCV mercury sources RSE transect sampling locations. Table 3.1 lists the sample location names and describes the location habitat characteristic with respect to association with open channel flow condition versus beaver ponds. Appendix B contains photographs of transect locations and substrate at each location.

Table 3.1. Sample location site characteristics

Location identifier	Site characteristic
BCT1	Open channel
BCT2	Open channel
BCT3	Open channel downstream of beaver dam/pond
BCT4	In beaver pond
BCT5	Open channel at washed-out small beaver dam
BCT6	Open channel upstream of former beaver pond
BCT7	Channel immediately downstream of beaver dam complex
BCT8	In large beaver pond downstream of Reeves Road
BCT9	In large beaver pond upstream of Reeves Road
BCT10	Open channel in former beaver pond
BCT11	Open channel upstream of BCK 9.9
BCT12A	Open channel upstream of NT-3
BCT12B	Open channel downstream of NT-3
BCT13	Open channel upstream of closed access road to HCDA (depositional due to culvert inflow restriction)
BCT14	Open channel downstream of BCK 12.34
BCT15	Open channel of NT-1
HCTREF	Open channel of reference site Hinds Creek

BCK = Bear Creek kilometer
BCT = Bear Creek transect
HCDA = Hazardous Chemical Disposal Area
HCTREF = Hinds Creek transect reference site
NT = North Tributary

3.1 SURFACE WATER DATA

Field parameters were measured in surface water at each transect location (Table 3.2). Table 3.2 includes the average daily flow rate measured at the Bear Creek integration point (BCK 9.2), which is the most downstream continuous flow monitoring station on Bear Creek. Surface water samples were collected on the dates that sediment and soil samples were collected at each sample transect location (December 2023 through February 2024) and, consequently, temporal variation exists in the dataset. Surface water physicochemical conditions indicate the stream water is well oxygenated, has positive electrochemistry (oxidation-reduction potential [redox]), and is near-neutral in pH. The longitudinal conductivity profile reflects the S-3 Ponds groundwater plume influx at the headwater (near transect BCT15), with generally decreasing conductivity in downstream samples. Because of the wide range of flow conditions during the initial sampling, surface water in Bear Creek was resampled on a single day in April 2024 to measure field parameters and to analyze total and dissolved mercury and methylmercury. Field parameters measured in the April 2024 sample data are included in Table 3.3. The daily average flow rate at BCK 9.2 was 3909 L/min on April 16, 2024.

Table 3.2. Bear Creek mercury sources RSE transects surface water field parameters from the initial sampling event

Location	Date	Conductivity (µmho/cm)	Dissolved oxygen (ppm)	pH (units)	Redox (mV)	Temperature (°C)	Turbidity (NTU)	BCK 9.2 daily average flow (L/min)
BCT15-SW	01/03/24	669	13.36	6.96	182.8	4.2	2	1331
BCT14-SW	12/28/23	534	12.11	7.22	154	9.6	6	4199
BCT13-SW	01/31/24	483	11.01	8.00	149	7.8	6	4796
BCT12A-SW	01/29/24	440	10.16	7.85	140	8.8	7	6892
BCT12B-SW	01/29/24	402	9.79	7.58	108	8.1	9	6892
BCT11-SW	01/31/24	323	10.06	8.12	140	7.8	6	4796
BCT10-SW	01/31/24	332	10.66	7.81	161	9.8	9	4796
BCT9-SW	02/05/24	263	9.9	8.11	139	9.9	5	2726
BCT8-SW	02/05/24	308	11.14	8.01	114	8.9	6	2726
BCT7-SW	02/07/24	338	11.75	8.29	92	5.7	13	2594
BCT6-SW	02/01/24	194	10.54	8.14	118	7.4	6	4419
BCT5-SW	02/01/24	143	9.87	7.78	133	7.4	7	4419
BCT4-SW	01/08/24	230	10.61	8.29	149	7.6	5	1258
BCT3-SW	01/08/24	239	11.76	7.74	179	6.1	4	1258
BCT2-SW	01/04/24	268	11.88	7.73	170.5	6.0	4	1262
BCT1-SW	12/18/23	355.6	10.56	8.22	161	8.2	3	1837
HCTREF-SW	02/02/24	269	10.94	8.07	96	5.9	6	4254

BCK = Bear Creek kilometer
BCT = Bear Creek transect
HCTREF = Hinds Creek transect reference site
NTU = nephelometric turbidity unit
ppm = parts per million
redox = oxidation-reduction potential
RSE = remedial site evaluation
SW = surface water

Table 3.3. Bear Creek mercury sources RSE transects surface water field parameters, April 2024

Location	Date	Conductivity (µmho/cm)	Dissolved oxygen (ppm)	pH (units)	Redox (mV)	Temperature (°C)	Turbidity (NTU)
BCT15-SW	04/16/24	556	9.11	7.14	230.6	17.3	9
BCT14-SW	04/16/24	684	8.80	7.46	235.3	16.2	5
BCT13-SW	04/16/24	460	9.23	7.82	206.5	15.9	7
BCT12A-SW	04/16/24	393	9.49	7.96	199.1	15.7	4
BCT12B-SW	04/16/24	349	9.36	7.91	211.1	15.6	7
BCT11-SW	04/16/24	333	9.41	7.96	222.6	15.9	6
BCT10-SW	04/16/24	295	9.59	7.82	219	15.4	5
BCT9-SW	04/16/24	278	7.97	7.56	229.5	16.7	6
BCT8-SW	04/16/24	292	9.83	7.74	15.4	16.8	6
BCT7-SW	04/16/24	283	6.59	7.64	24.1	18.1	9
BCT6-SW	04/16/24	239	8.65	7.69	28.6	16.4	4
BCT5-SW	04/16/24	240	7.60	7.71	19.9	16.4	6
BCT4-SW	04/16/24	232	8.48	7.84	13.2	16.8	6
BCT3-SW	04/16/24	278	8.10	7.66	14.5	16.6	1
BCT2-SW	04/16/24	240	8.18	7.95	-1.7	19.2	5
BCT1-SW	04/16/24	298	10.96	8.02	-7.9	19.0	5
HCTREF-SW	04/17/24	289	9.50	8.10	244.1	18.2	5

BCT = Bear Creek transect
HCTREF = Hinds Creek transect reference site
NTU = nephelometric turbidity unit
ppm = parts per million
redox = oxidation-reduction potential
RSE = remedial site evaluation
SW = surface water

Table 3.4 includes analyte results for total and dissolved mercury and methylmercury, nitrate, phosphorus, sulfate, sulfide, TOC, and DOC from the initial surface water sampling event. A comprehensive surface water chemical data summary is included in Appendix C.

Samples collected in this investigation show Bear Creek surface water mercury concentrations were less than the 51-ng/L AWQC level, with the highest measured total mercury concentration of 22 ng/L at BCT13 (dissolved mercury at BCT13 was 3.8 ng/L). Sample transect BCT13 is located upstream of NT-3 that drains the former BYBY, which was the source of significant mercury discharge into Bear Creek prior to its remediation by excavation in the early 2000s. Measured surface water mercury concentrations decrease downstream from BCT13; in the most downstream sample locations (BCT1 and BCT2), total and dissolved mercury are only slightly greater than values at the Hinds Creek reference site.

Surface water TOC and DOC are highest in the Bear Creek headwater samples and decrease in the downstream direction to levels similar to those measured in Hinds Creek.

Nitrate is highest (84.8 mg/L) at the Bear Creek headwater (BCT15) where groundwater from the S-3 Ponds nitrate plume emerges into NT-1. Nitrate concentrations decrease with distance downstream from the headwater source; in the most downstream sample transects (BCT1 and BCT2), the nitrate concentrations are less than those measured in Hinds Creek.

Phosphorus, a nutrient to aquatic and terrestrial plants, was detected in BCT12B at a concentration of 0.037 J mg/L; however, phosphorous was not detected in any other Bear Creek or Hinds Creek surface water samples at the 0.018-mg/L detection limit.

Sulfide, a factor in microbial methylation of mercury, was not detectable in any of the surface water samples at the 0.033-mg/L detection limit. Given the high dissolved oxygen and redox values of approximately 100 mV and greater, the absence of sulfide is expected.

Figure 3.1 is a graph of the mercury and methylmercury (total and dissolved concentrations) in the longitudinal transect from BCT15 downstream to BCT1, with the HCTREF data shown at the extreme right. From the highest measured mercury concentration (22 ng/L) at BCT13, the total mercury concentrations decrease downstream. Dissolved mercury maximum concentrations (4.3 ng/L) occur both upstream and downstream of NT-3 at BCT12A and BCT12B, with decreasing concentrations downstream. Methylmercury exhibits a more complex signature.

Table 3.5 includes the results of the April 2024 surface water sampling event for total and dissolved mercury and methylmercury. Figure 3.2 presents the April 2024 data for total and dissolved mercury and methylmercury graphically. In the April 2024 sampling event, the highest concentrations of dissolved mercury and methylmercury occurred at BCT13 near the entry to the former HCDA and upstream of NT-3. At BCT7, total mercury exhibited a concentration spike that was only weakly reflected in the dissolved mercury data. The total mercury concentration spike is suspected to reflect suspended solids in the sample. In addition to the highest total and dissolved methylmercury concentration at BCT13, elevated concentrations were measured in surface water at BCT9, BCT8, and BCT7, which are associated with the beaver pond complex near the Reeves Road crossing of Bear Creek.

Figure 3.3 shows the ratios of dissolved and total methylmercury to mercury for the April 2024 sampling event. The ratio generally increases in the downstream direction to a high of nearly 18% dissolved methylmercury at BCT2 and a high of approximately 7% total methylmercury at BCT1.

Figure 3.4 shows the nitrate, sulfate, TOC, and DOC surface water concentrations from the initial sampling event at Bear Creek and the Hinds Creek reference site.

Table 3.4. Summary of selected analytes in surface water at BCT locations collected from the initial sampling event

Chemical name	Units	BCT15			BCT14			BCT13			BCT12A			BCT12B			BCT11			BCT10		
		Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual
Dissolved organic carbon	mg/L	F	2.62	--	F	2.7	--	F	2.04	--	F	2.36	--	F	2.212.76	--	F	1.86	--	F	1.56	--
Total organic carbon	mg/L	UF	2.67	--	UF	2.62	--	UF	2.27	--	UF	2.34	--	UF	2.59	--	UF	1.79	--	UF	1.49	--
Mercury	ng/L	UF	1.4	--	UF	6.9	--	UF	22	--	UF	13	--	UF	13	--	UF	6.7	--	UF	4.5	--
Mercury	ng/L	F	0.64	--	F	3.2	--	F	3.8	--	F	4.3	--	F	4.3	--	F	1.9	--	F	1.8	--
Methylmercury	ng/L	UF	0.066	J	UF	0.17	--	UF	0.088	--	UF	0.064	J	UF	0.098	--	UF	0.063	J	UF	0.051	J
Methylmercury	ng/L	F	0.05	J	F	0.076	J	F	0.074	J	F	0.072	J	F	0.075	J	F	0.043	J	F	0.064	J
Nitrate/Nitrite as nitrogen	mg/L	UF	84.8	--	UF	19.4	--	UF	11.3	--	UF	5.35	--	UF	3.56	--	UF	3.48	--	UF	1.83	--
Phosphorous	mg/L	UF	0.018	U	UF	0.018	U	UF	0.018	U	UF	0.018	U	UF	0.037	J	UF	0.018	U	UF	0.018	U
Sulfate	mg/L	UF	31.5	--	UF	33.4	--	UF	26.3	--	UF	21.7	--	UF	20.9	--	UF	20.6	--	UF	15.9	--
Sulfide	mg/L	UF	0.033	U	UF	0.033	U	UF	0.033	U	UF	0.033	U	UF	0.033	U	UF	0.033	U	UF	0.033	U

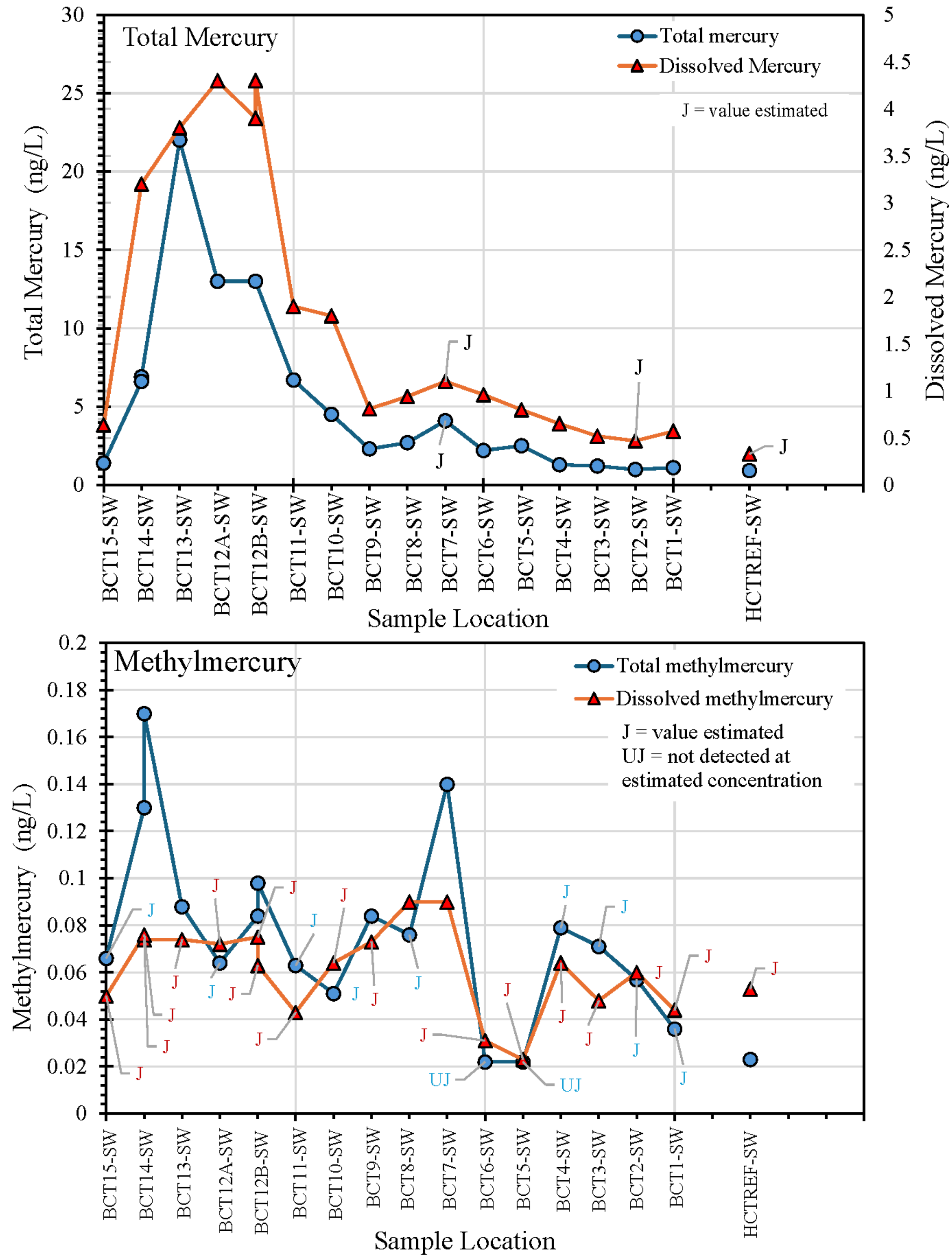
Chemical name	Units	BCT9			BCT8			BCT7			BCT6			BCT5			BCT4			BCT3		
		Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual
Dissolved organic carbon	mg/L	F	1.57	--	F	1.61	--	F	1.5	--	F	1.3	--	F	1.34	--	F	1.64	--	F	1.57	--
Total organic carbon	mg/L	UF	1.81	--	UF	1.46	--	UF	1.4	J	UF	1.26	--	UF	1.24	--	UF	1.61	--	UF	1.64	--
Mercury	ng/L	UF	2.3	--	UF	2.7	--	UF	4.1	J	UF	2.2	--	UF	2.5	--	UF	1.3	--	UF	1.2	--
Mercury	ng/L	F	0.81	--	F	0.94	--	F	1.1	J	F	0.96	--	F	0.8	--	F	0.65	--	F	0.52	--
Methylmercury	ng/L	UF	0.084	--	UF	0.076	J	UF	0.14	--	UF	0.022	UJ	UF	0.022	UJ	UF	0.079	J	UF	0.071	J
Methylmercury	ng/L	F	0.073	J	F	0.09	--	F	0.09	--	F	0.031	J	F	0.023	J	F	0.064	J	F	0.048	J
Nitrate/Nitrite as nitrogen	mg/L	UF	2	--	UF	1.91	--	UF	1.59	--	UF	0.735	--	UF	0.695	--	UF	1.05	--	UF	0.994	--
Phosphorous	mg/L	UF	0.018	U	UF	0.018	U	UF	0.018	U	UF	0.018	U	UF	0.018	U	UF	0.018	U	UF	0.018	U
Sulfate	mg/L	UF	18.8	--	UF	19.3	--	UF	16.6	--	UF	9.62	--	UF	9.6	--	UF	31.6	--	UF	30.7	--
Sulfide	mg/L	UF	0.033	U	UF	0.033	U	UF	0.033	U	UF	0.033	U	UF	0.033	U	UF	0.033	U	UF	0.033	U

Chemical name	Units	BCT2			BCT1			HCTREF		
		Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual	Filtered	Result[a]	Lab qual
Dissolved organic carbon	mg/L	F	1.48	--	F	1.85	--	F	1.42	--
Total organic carbon	mg/L	UF	1.46	--	UF	1.79	--	UF	1.15	--
Mercury	ng/L	UF	0.99	--	UF	1.1	--	UF	0.91	--
Mercury	ng/L	F	0.47	J	F	0.57	--	F	0.39	J
Methylmercury	ng/L	UF	0.057	J	UF	0.036	J	UF	0.023	J
Methylmercury	ng/L	F	0.06	J	F	0.044	J	F	0.025	J
Nitrate/Nitrite as nitrogen	mg/L	UF	0.59	--	UF	0.555	--	UF	0.85	--
Phosphorous	mg/L	UF	0.018	U	UF	0.018	U	UF	0.018	U
Sulfate	mg/L	UF	29.2	--	UF	30.7	--	UF	8.04	--
Sulfide	mg/L	UF	0.033	U	UF	0.033	U	UF	0.033	U

Table 3.4. Summary of selected analytes in surface water at BCT locations collected from the initial sampling event (cont.)

[a]Result is the maximum of the filtered and unfiltered samples.
-- Indicates no qualifier; detection.

BCT = Bear Creek transect
F = filtered sample
HCTREF = Hinds Creek transect reference site
J = estimated value
Lab = laboratory
qual = qualifier
U = not detected at reported quantitation limit
UF = unfiltered sample
UJ = not detected at estimated value



[a]All detections were significantly less than the ambient water quality criterion of 51 ng//L.
BCT = Bear Creek transect HCTREF = Hinds Creek transect reference site SW = surface water

Figure 3.1. Total and dissolved mercury and methylmercury for the initial surface water sampling event, upstream to downstream[a].

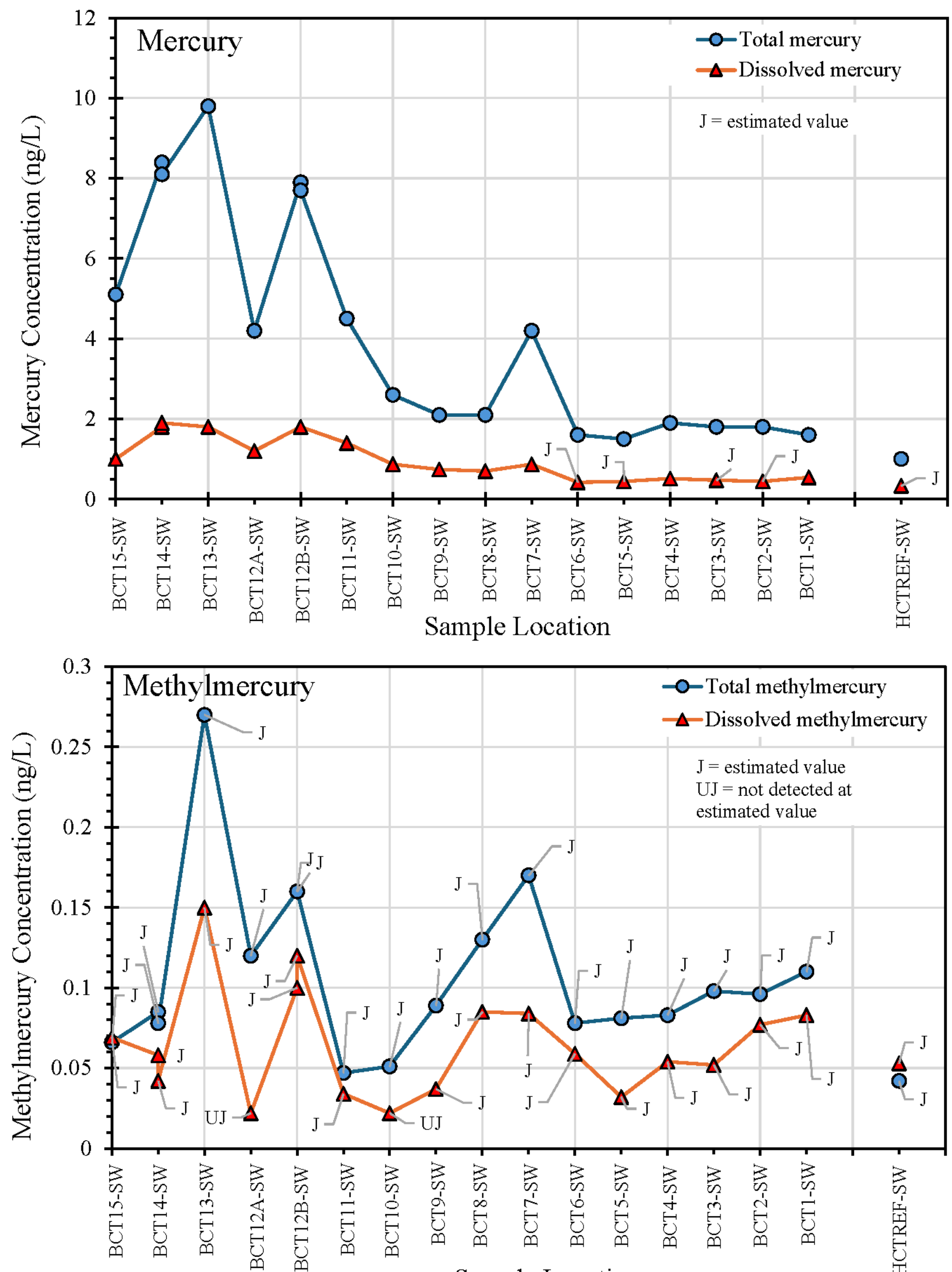
Table 3.5. Surface water total and dissolved mercury and methylmercury, April 2024 sampling event

Location identifier	Sample type	Collection date	Mercury (ng/L)				Methylmercury (ng/L)				Ratios			
			Total		Dissolved		Total		Dissolved		Percent dissolved		Methylmercury/Mercury	
			Result	Lab qualifier	Result	Lab qualifier	Result	Lab qualifier	Result	Lab qualifier	Total mercury	Methyl-mercury	Total	Dissolved
HCTREF-SW	REG	04/17/24	1	--	0.33	J	0.042	J	0.053	J	33%	126%	4%	16%
BCT15-SW	REG	04/16/24	5.1	--	1	--	0.066	J	0.069	J	20%	105%	1%	7%
BCT14-SW	REG	04/16/24	8.4	--	1.8	--	0.085	J	0.058	J	21%	68%	1%	3%
BCT14-SW	FR	04/16/24	8.1	--	1.9	--	0.078	J	0.042	J	23%	54%	1%	2%
BCT13-SW	REG	04/16/24	9.8	--	1.8	--	0.27	J	0.15	J	18%	56%	3%	8%
BCT12B-SW	REG	04/16/24	7.9	--	1.8	--	0.16	J	0.1	J	23%	63%	2%	6%
BCT12B-SW	FR	04/16/24	7.7	--	1.8	--	0.16	J	0.12	J	23%	75%	2%	7%
BCT12A-SW	REG	04/16/24	4.2	--	1.2	UJ	0.12	J	0.022	U	29%	18%	3%	2%
BCT11-SW	REG	04/16/24	4.5	--	1.4	--	0.047	J	0.034	J	31%	72%	1%	2%
BCT10-SW	REG	04/16/24	2.6	--	0.87	--	0.051	J	0.022	UJ	33%	43%	2%	3%
BCT9-SW	REG	04/16/24	2.1	--	0.74	--	0.089	J	0.037	J	35%	42%	4%	5%
BCT8-SW	REG	04/16/24	2.1	--	0.7	--	0.13	J	0.085	J	33%	65%	6%	12%
BCT7-SW	REG	04/16/24	4.2	--	0.87	--	0.17	J	0.084	J	21%	49%	4%	10%
BCT6-SW	REG	04/16/24	1.6	--	0.42	J	0.078	J	0.059	J	26%	76%	5%	14%
BCT5-SW	REG	04/16/24	1.5	--	0.44	J	0.081	J	0.032	J	29%	40%	5%	7%
BCT4-SW	REG	04/16/24	1.9	--	0.51	--	0.083	J	0.054	J	27%	65%	4%	11%
BCT3-SW	REG	04/16/24	1.8	--	0.47	J	0.098	J	0.052	J	26%	53%	5%	11%
BCT2-SW	REG	04/16/24	1.8	--	0.44	J	0.096	J	0.077	J	24%	80%	5%	18%
BCT1-SW	REG	04/16/24	1.6	--	0.54	--	0.11	J	0.083	J	34%	75%	7%	15%
BCV maximum	--	--	**9.8**	--	**1.9**	--	**0.27**	--	**0.15**	--	**35%**	**105%**	**7%**	**18%**
BCV average	--	--	**4.3**	--	**1.0**	--	**0.11**	--	**0.07**	--	**27%**	**61%**	**3.5%**	**7.9%**
Standard error	--	--	**0.68**	--	**0.13**	--	**0.01**	--	**0.01**	--	**1.2%**	**4.6%**	**0.5%**	**1.1%**

Table 3.5. Surface water total and dissolved mercury and methylmercury, April 2024 sampling event (cont.)

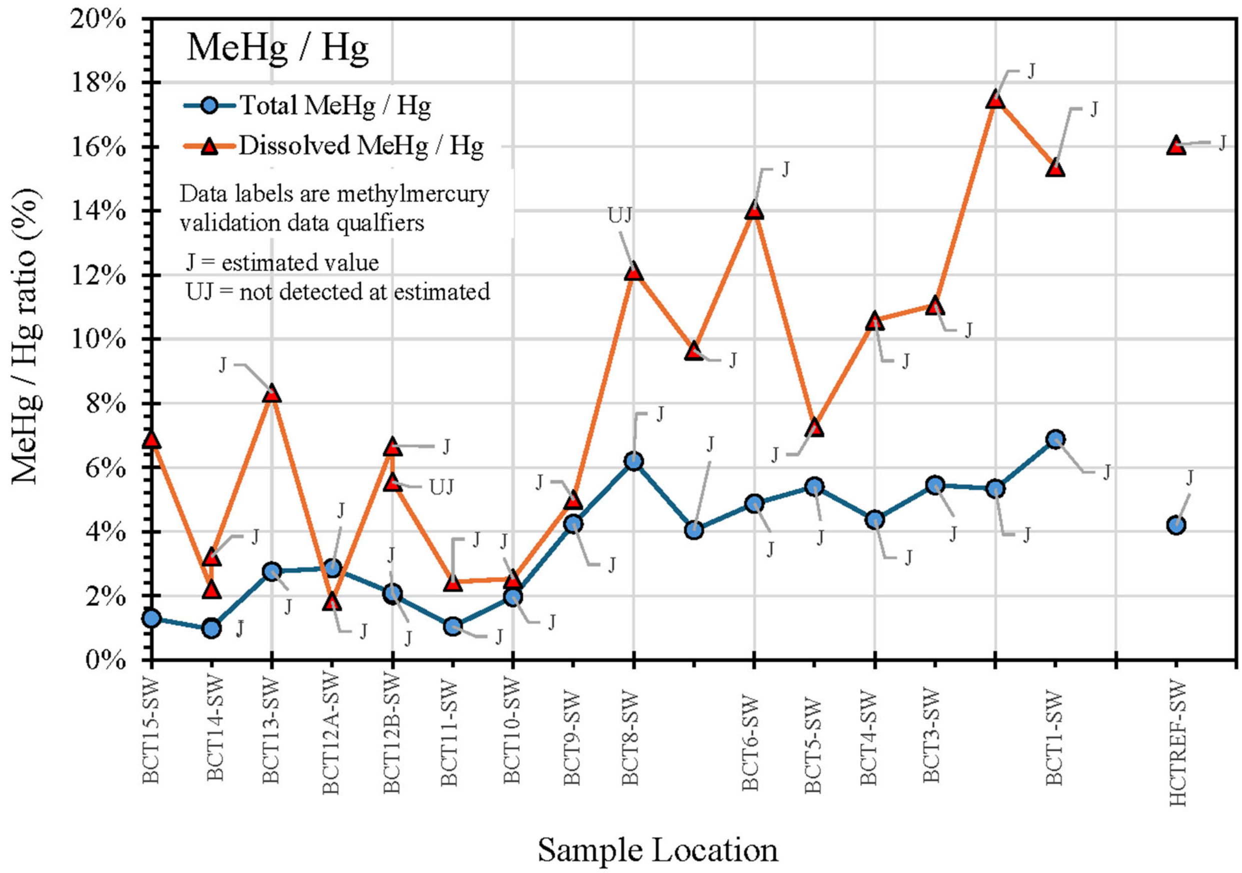
-- Indicates no qualifier; detection.

BCT = Bear Creek transect
BCV = Bear Creek Valley
FR = field replicate sample
HCTREF = Hinds Creek transect reference site
J = estimated value.
Lab = laboratory
REG = regular sample
SW = surface water
U = not detected at reported quantitation limit
UJ = not detected at estimated value



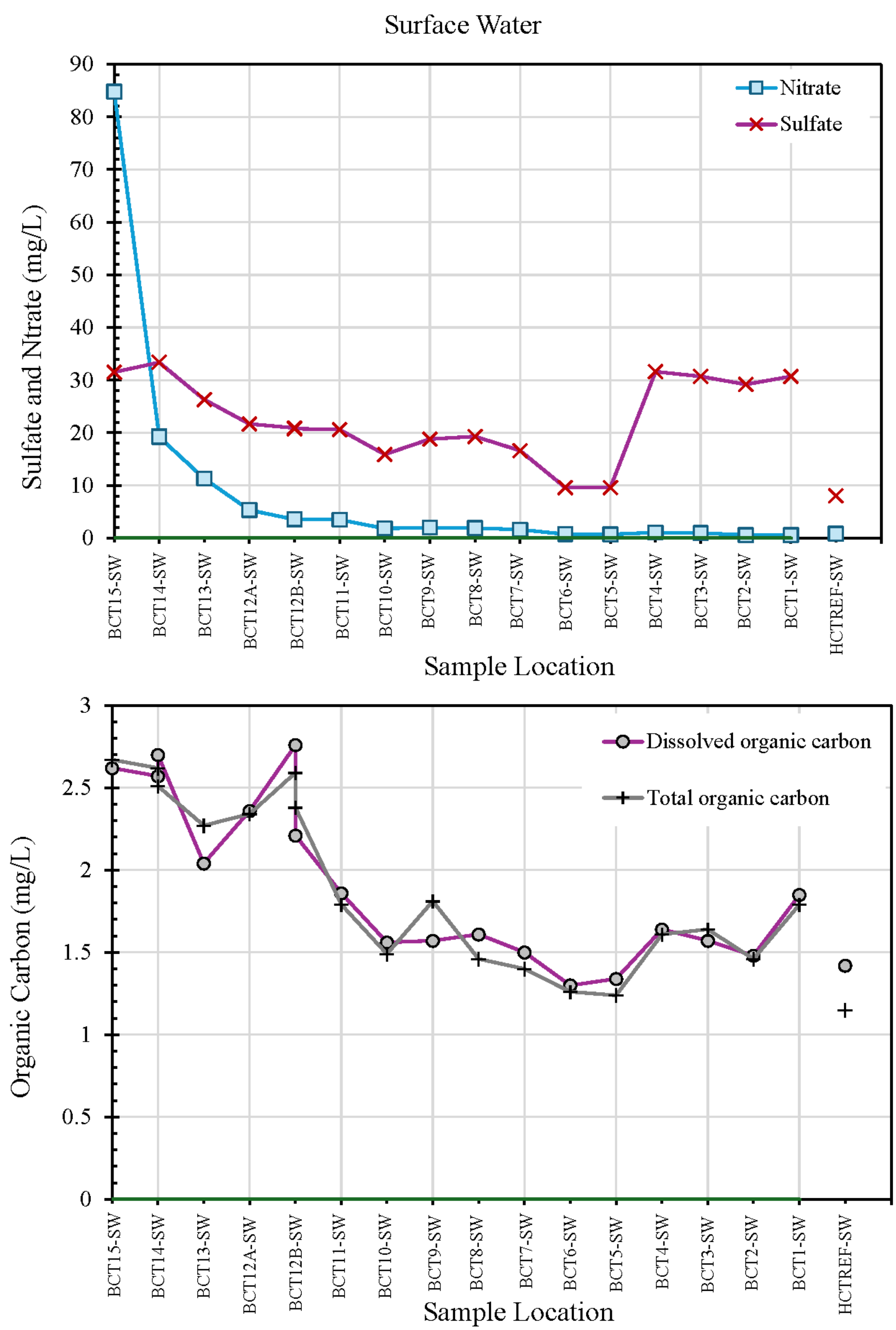
BCT = Bear Creek transect HCTREF = Hinds Creek transect reference site SW = surface water

Figure 3.2. Total and dissolved mercury and methylmercury for the April 2024 surface water sampling event, upstream to downstream.



BCT = Bear Creek transect   HCTREF = Hinds Creek transect reference site   Hg = mercury   MeHg = methylmercury   SW = surface water

Figure 3.3. Total and dissolved methylmercury to mercury ratios for the April 2024 surface water sampling event, upstream to downstream.



BCT = Bear Creek transect HCTREF = Hinds Creek transect reference site SW = surface water

Figure 3.4. Concentration graphs for selected analytes in Bear Creek (upstream to downstream) and Hinds Creek reference site surface water, original sampling event dates.

3.2 FLOODPLAIN SOIL, CREEK BANK SOIL, AND CHANNEL SEDIMENT DATA

3.2.1 Soil and Sediment Particle Size

Soil and sediment samples were collected for particle size analysis at each sample transect location. Lower bank soil samples were not obtained at BCT7, BCT8, and BCT9 due to beaver ponds that limited the height of the banks (Table 2.2). Soils at all locations tend to be silt and clay dominated, while channel sediments are more evenly graded and include medium and fine sand along with silt and generally little clay-size material. Particle size results are included in Table 3.6 and are shown graphically in Figure 3.5. Particle size analysis reports provided by S&ME Inc., are included in Appendix D.

3.2.2 Soil and Sediment Chemical Characteristics

Samples of floodplain soil, creek bank soil, and channel sediment were collected with the following exceptions: lower bank soil was not available at sample locations BCT7, BCT8, and BCT9; and fine-grained channel sediment was not available at BCT1, BCT2, BCT5, BCT6, and HCTREF (Figure 2.1 and Table 2.2).

Table 3.7 includes results for selected analytes measured in the floodplain and creek bank soils and channel sediment at each transect location. Data are arranged in columns by location from upstream to downstream and in rows by floodplain soil, creek bank soil (upper and lower intervals), and channel sediment to allow comparison of the vertical relationships of analyte concentrations at each site. Figures 3.6 through 3.9, respectively, present graphs of the chemical constituents included in Table 3.7 for the floodplain soil, upper creek bank soil, lower creek bank soil, and channel sediment.

Mercury concentrations in the sampled BCV soils and channel sediment are comparatively low. (Note the laboratory reported mercury and methylmercury concentrations in soil and sediment in units of µg/kg, equivalent to parts per billion [ppb]). The maximum measured mercury concentration in floodplain soil was 3500 µg/kg at BCT12A, upstream of the NT-3 confluence with Bear Creek. The maximum measured mercury concentration in creek bank soil was 7100 µg/kg at BCT13, located near the former HCDA entrance. The maximum measured mercury concentration in channel sediment was 530 µg/kg at BCK12A, upstream of the confluence of NT-3 with Bear Creek and downstream of the HCDA.

The highest methylmercury concentrations in the sampled BCV soils and channel sediment are 1.7 µg/kg in floodplain soil at BCT12B, downstream of the NT-3 confluence; 0.87 µg/kg in creek bank soil at BCT7; and 0.82 µg/kg in channel sediment at BCT9 in a beaver pond.

TOC in BCV soil and channel sediment is variable, with generally higher concentrations in the Bear Creek headwaters area than farther downstream. Floodplain soil samples exhibit higher TOC than creek bank soils. Channel sediment TOC concentrations are typically lower than those of the floodplain and creek bank soils.

None of the sediment sample locations downstream of Reeves Road that had sediment suitable for sieving for analysis contained mercury at levels greater than the threshold effect concentration (MacDonald et al. 2000).

Figure 3.10 shows the methylmercury to total mercury ratios for the Bear Creek channel sediment (where samples were available) compared with the methylmercury to total mercury ratios for surface water samples collected on April 16, 2024. The graphs demonstrate generally increasing ratios in the downstream flow direction. Annotations on the graphs show increased methylmercury to total mercury ratios in channel sediment and surface water in and downstream of beaver pond-affected stream reaches.

Table 3.6. Bear Creek and Hinds Creek soil and sediment particle size data

Location	Sample description	Maximum particle size	Percent gravel (4.75 to 75 mm) (%)	Percent coarse sand (2 to 4.75 mm) (%)	Percent medium sand (0.425 to 2 mm) (%)	Percent fine sand (0.075 to 0.425 mm) (%)	Percent silt (0.002 to 0.075 mm) (%)	Percent clay (<0.002 mm) (%)	Percent moisture (%)
				Floodplain soil					
BCT1-FP	Dark Brown Clay	#20	0	0	1	10	80.6	8.4	22
BCT2-FP	Light Brown Clay with Sand	#4	0	1	4	20	66.6	8.4	19.9
BCT3-FP	Tan Clay with Sand	3/8 in.	2	2	6	13	65.2	11.8	20.1
BCT4-FP	Brown Sandy Clay	#10	0	0	3	39	49.9	8.1	25.2
BCT5-FP	Brown Silty Sand	3/4 in.	0	1	12	46	30.7	10.3	23.9
BCT6-FP	Brown Silt with Sand	3/4 in.	4	2	3	17	61.2	12.8	21.8
BCT7-FP	Brown Sandy Silt	3/8 in.	0	0	3	37	50	10	36.4
BCT8-FP	Brown Silty Sand with Gravel	3/4 in.	17	7	14	20	34.3	7.7	36.1
BCT9-FP	Brown Clay with Sand	3/8 in.	0	2	5	15	59.9	18.1	28.1
BCT10-FP	Brown Sandy Clay	3/8 in.	1	0	6	33	52.8	7.2	24
BCT11-FP	Brown Clay with Sand	3/8 in.	0	1	1	23	63.1	11.9	22.7
BCT12A-FP	Brown Clay with Sand	3/8 in.	0	1	7	13	65	14	25.3
BCT12B-FP	Brown Sandy Clay	3/4 in.	4	4	14	13	52.5	12.5	23.5
BCT12B-FP	Brown Sandy Clay	3/4 in.	2	2	16	18	50.5	11.5	20
BCT13-FP	Brown Sandy Clay	#4	0	1	10	34	40	15	27.3
BCT14-FP	Brown Clay with Sand	#10	0	0	6	13	65	16	28.6
BCT14-FP	Brown Clay with Sand	#4	0	0	6	15	63.9	15.1	28.7
BCT15-FP	Brown Clay with Sand	3/4 in.	2	2	4	18	60.6	13.4	33.3
HCTREF-FP	Brown Sandy Silt	3/4 in.	6	1	13	24	48.1	7.9	20.9
				Upper creek bank soil					
BCT1-BSU	Dark Brown Clay with Sand	#20	0	0	1	23	66.6	9.4	22.4
BCT2-BSU	Brown Clay with Sand	#4	0	0	2	14	70.3	13.7	20
BCT3-BSU	Light Brown Clay with Sand	3/8 in.	6	3	6	3	68.1	13.9	18.2
BCT4-BSU	Brown Sandy Clay	#10	0	0	4	34	53.6	8.4	23.4
BCT5-BSU	Brown Sandy Silt	3/8 in.	2	3	7	36	40.3	11.7	19.6

Table 3.6. Bear Creek and Hinds Creek soil and sediment particle size data (cont.)

Location	Sample description	Maximum particle size	Percent gravel (4.75 to 75 mm) (%)	Percent coarse sand (2 to 4.75 mm) (%)	Percent medium sand (0.425 to 2 mm) (%)	Percent fine sand (0.075 to 0.425 mm) (%)	Percent silt (0.002 to 0.075 mm) (%)	Percent clay (<0.002 mm) (%)	Percent moisture (%)
BCT6-BSU	Brown Sandy Silt	3/4 in.	3	2	6	31	47.1	10.9	20.6
BCT7-BS	Brown Sandy Silt	3/4 in.	1	0	10	32	46.1	10.9	30.2
BCT8-BS	Brown Silty Sand	3/4 in.	13	10	14	25	31.5	6.5	29.7
BCT9-BS	Brown Sandy Silt	3/4 in.	5	4	10	20	48.8	12.2	28.5
BCT10-BSU	Brown Clay with Sand	3/8 in.	1	0	1	21	71.4	5.6	18.8
BCT11-BSU	Brown Clay with Sand	3/8 in.	0	1	2	20	64.9	12.1	20.9
BCT12A-BSU	Brown Clay with Sand	3/4 in.	5	2	3	10	65.5	14.5	22.3
BCT12B-BSU	Brown Clay with Sand	3/8 in.	4	2	4	7	68.9	14.1	20.3
BCT12B-BSU	Brown Sandy Clay	3/4 in.	5	2	5	16	59.2	12.8	21.1
BCT13-BSU	Grayish Brown Sandy Clay	3/8 in.	2	1	6	23	52.8	15.2	27.1
BCT14-BSU	Yellowish Brown Clay	#10	0	0	5	9	62.9	23.1	18.3
BCT14-BSU	Yellowish Brown Clay	#10	0	0	5	9	63.8	22.2	17.9
BCT15-BSU	Brown Clay with Sand	#4	0	1	3	19	64.5	12.5	34.1
HCTREF-BSU	Brown Sandy Silt	3/8 in.	1	2	6	36	45.3	9.7	21.3
Lower creek bank soil									
BCT1-BSL	Dark Brown Clay with Sand	#4	1	1	6	17	65	10	23.9
BCT2-BSL	Brown Sandy Clay	#4	4	3	11	19	50.5	12.5	22.6
BCT3-BSL	Tan Clay	#10	0	0	2	7	78.6	12.4	21.6
BCT4-BSL	Light Brown Clay with Sand	#4	0	0	5	24	59.9	11.1	27.6
BCT5-BSL	Brown Clay with Sand	#4	0	0	2	24	60.6	13.4	22.7
BCT6-BSL	Brown Silty Sand	3/4 in.	1	1	13	39	33.6	12.4	23.2
BCT10-BSL	Brown Clay with Sand	3/8 in.	1	1	5	20	62.8	10.2	24.8
BCT11-BSL	Brown Clay with Sand	3/8 in.	2	1	4	22	60.7	10.3	23
BCT12B-BSL	Brown Sandy Clay	3/4 in.	1	1	5	24	53.3	15.7	21.2
BCT12B-BSL	Brown Clay	#10	0	0	2	4	78.9	15.1	21.8
BCT12A-BSL	Brown Sandy Clay	3/8 in.	1	1	5	24	52.4	16.6	26.9
BCT13-BSL	Brown Sandy Clay	3/4 in.	3	3	5	24	58.1	6.9	28.3

Table 3.6. Bear Creek and Hinds Creek soil and sediment particle size data (cont.)

Location	Sample description	Maximum particle size	Percent gravel (4.75 to 75 mm) (%)	Percent coarse sand (2 to 4.75 mm) (%)	Percent medium sand (0.425 to 2 mm) (%)	Percent fine sand (0.075 to 0.425 mm) (%)	Percent silt (0.002 to 0.075 mm) (%)	Percent clay (<0.002 mm) (%)	Percent moisture (%)
BCT14-BSL	Brown Clay	#10	0	0	3	12	59.6	25.4	19.3
BCT14-BSL	Light Brown Clay	#10	0	0	2	10	60	28	19.5
BCT15-BSL	Brown Sandy Clay	#4	0	1	5	25	57.8	11.2	39.3
HCTREF-BSL	Brown Sandy Silt	3/8 in.	1	3	7	35	40.8	13.2	35
Channel sediment									
BCT1-CH	Poorly Graded Gravel with Sand	3/4 in.	61	28	10	0	0	0	--
BCT2-CH	Brown Silty Sand	#10	0	0	72	11	13.8	3.2	--
BCT3-CH	Brown Sand with Silt	#10	0	0	57	36	3.3	3.7	27.9
BCT4-CH	Brown Silty Sand	#10	0	0	66	19	11.7	3.3	23.1
BCT5-CH	Brown Poorly Graded Sand with Silt	#4	0	1	75	15	7.2	1.8	--
BCT6-CH	Brown Silty Sand	#4	0	0	61	10	26.3	2.7	--
BCT7-CH	Grayish Brown Silt	#20	0	0	2	12	81.9	4.1	31.5
BCT8-CH	Brown Well-graded Sand with Silt	#10	0	0	67	25	4.2	3.8	29.4
BCT9-CH	Brown Silty Sand	3/8 in.	0	0	10	21	63.1	5.9	31.6
BCT10-CH	Brown Silty Sand	#10	0	0	44	35	18.5	2.5	23.8
BCT11-CH	Brown Well-graded Sand with Silt	3/8 in.	1	1	53	34	6	5	22.9
BCT12B-CH	Brown Poorly Graded Sand with Silt	#10	0	0	44	45	6.3	4.7	29.2
BCT12B-CH	Brown Silty Sand	#10	0	0	41	15	40.2	3.8	30.4
BCT12A-CH	Brown Silty Sand	#4	0	0	40	38	13.5	8.5	31.8
BCT13-CH	Brown Well-graded Sand with Silt	3/4 in.	2	0	55	35	2.7	5.3	30.3
BCT14-CH	Yellowish Brown Clay	#10	0	0	7	7	57	29	37
BCT14-CH	Yellowish Brown Clay	#10	0	0	6	4	60.5	29.5	38.2
BCT15-CH	Dark Brown Sandy Clay	#10	0	0	29	19	44.5	7.5	38.6
HCTREF-CH	Brown Well-graded Sand	3/4 in.	2	53	41	1	2.5	0.5	--

-- Indicates no qualifier; detection.

BCT = Bear Creek transect
BSL = lower creek bank soil
BSU = upper creek bank soil

CH = channel sediment
FP = floodplain soil
HCTREF = Hinds Creek transect (reference site)

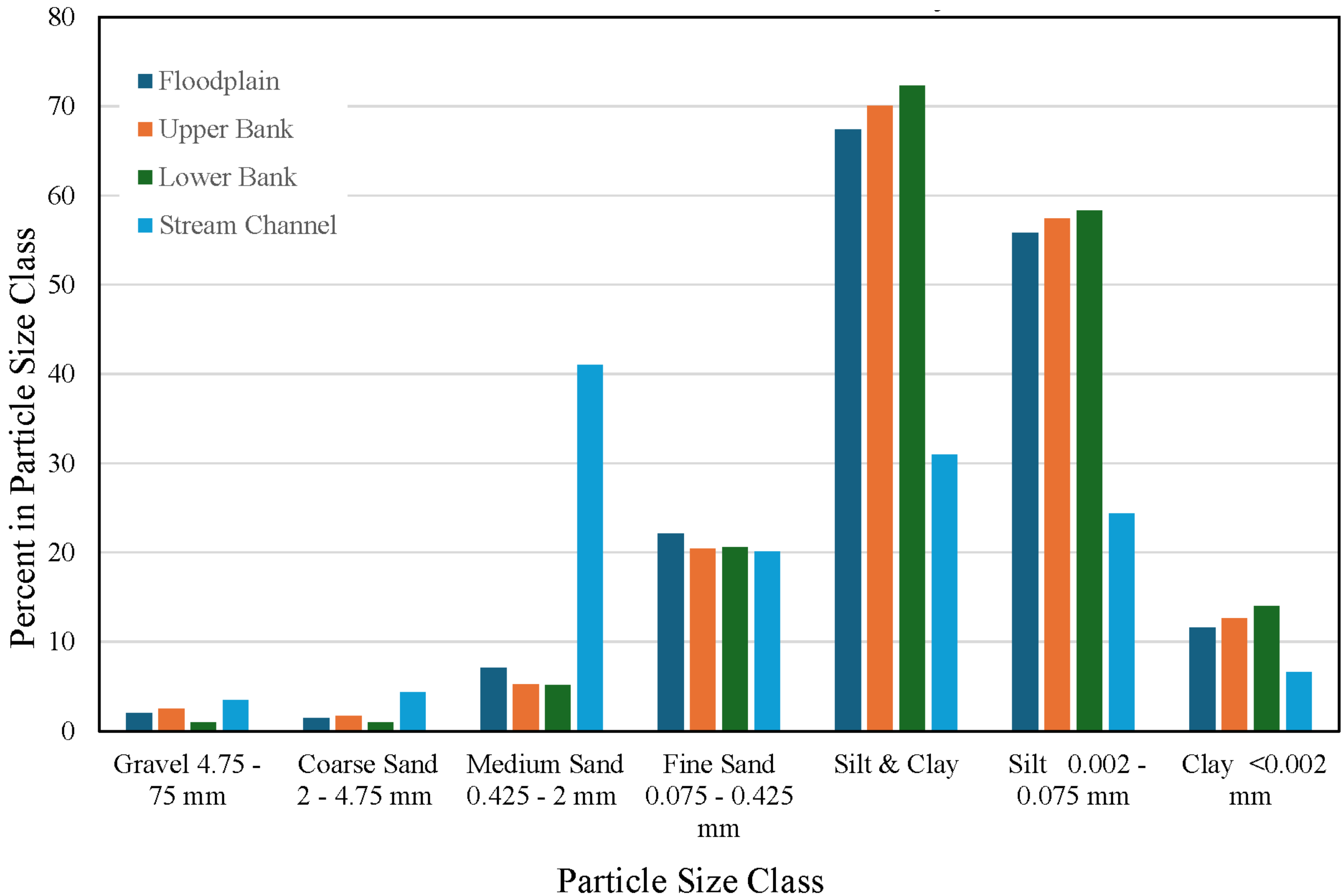


Figure 3.5. Bear Creek floodplain soil, creek bank soil, and channel sediment average particle size distributions.

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Table 3.7. Summary of selected analyte concentrations in BCTs floodplain soil, upper and lower creek bank soil, and channel sediment samples

Chemical name	Units	BCT15		BCT14		BCT13		BCT12A		BCT12B		BCT11		BCT10		BCT9		BCT8	
		Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual
Floodplain soil																			
Mercury	µg/kg	470	--	740	--	3300	--	3500	--	3000	--	810	J	640	--	380	--	270	--
Methylmercury	µg/kg	0.57	--	0.48	--	0.51	--	0.7	--	1.7	--	0.17	--	0.16	J	0.4	--	0.51	--
Nitrate	mg/kg	15.8	--	2.82	--	1.5	--	2.57	--	3.78	--	2.69	--	1.56	--	3.99	--	2.59	--
Nitrite	mg/kg	0.445	U	0.448	U	0.446	U	0.429	U	0.422	U	0.421	U	0.423	U	0.441	U	0.488	U
Phosphorous	mg/kg	270	--	296	--	244	--	291	--	248	--	223	--	213	--	227	--	250	--
Sulfate	mg/kg	16.1	--	6.64	--	21.4	J	6	--	3.65	J	3.85	J	3.08	J	10.6	--	14.2	--
Sulfide	mg/kg	19.2	J	15.2	J	22.2	J	32.6	J	23.4	J	30.4	J	30.7	J	40.9	--	59.1	--
Total organic carbon average	mg/kg	26,600	--	39,200	--	25,500	--	33,600	--	31,900	--	15,800	--	20,200	--	18,900	--	24,200	--
Upper creek bank soil																			
Mercury	µg/kg	420	--	59	--	7100	--	860	--	1900	--	230	J	75	--	550	--	180	--
Methylmercury	µg/kg	0.17	--	0.04	J	0.77	J	0.42	--	0.28	--	0.13	--	0.098	J	0.23	--	0.48	--
Nitrate	mg/kg	29.2	--	0.395	U	1.35	--	1.33	--	1.71	--	2.03	--	0.403	U	4.4	--	0.889	J
Nitrite	mg/kg	0.473	U	0.395	U	0.438	U	0.397	U	0.413	U	0.402	U	0.403	U	0.429	U	0.442	U
Phosphorous	mg/kg	255	--	110	--	250	--	202	--	196	--	174	--	114	--	242	--	241	--
Sulfate	mg/kg	27.8	--	11.9	--	25.7	J	3.29	J	3.78	J	4.29	J	2.48	J	9.36	--	9.28	--
Sulfide	mg/kg	39.7	--	24	J	21.7	J	21.1	J	17.4	J	10.9	U	23.7	J	43.3	--	36	--
Total organic carbon average	mg/kg	26,900	--	3790	--	25,000	--	13,400	--	10,500	--	11,200	--	4810	--	18,800	--	22,100	--
Lower creek bank soil																			
Mercury	µg/kg	320	--	41	--	1600	--	1600	--	1300	--	120	J	150	--	NA	--	NA	--
Methylmercury	µg/kg	0.25	--	0.017	UJ	0.71	J	0.26	--	0.14	--	0.17	--	0.056	J	NA	--	NA	--
Nitrate	mg/kg	88.5	--	23.1	--	1.7	--	1.2	J	1.73	--	2.18	--	1.28	--	NA	--	NA	--
Nitrite	mg/kg	0.525	U	0.407	U	0.434	U	0.443	U	0.411	U	0.408	U	0.417	U	NA	--	NA	--
Phosphorous	mg/kg	239	--	79	--	215	--	215	--	172	--	174	--	187	--	NA	--	NA	--
Sulfate	mg/kg	31.9	--	74.9	--	26.8	J	6.02	--	4.72	J	7.87	--	6.35	J	NA	--	NA	--
Sulfide	mg/kg	25.9	J	12	J	20	J	32.5	J	21.3	J	28.2	J	23.6	J	NA	--	NA	--
Total organic carbon average	mg/kg	24,200	--	7950	--	15,900	--	16,600	--	12,700	--	8920	--	9000	--	NA	--	NA	--
Channel sediment																			
Mercury	µg/kg	**430**	--	83	--	**340**	--	**530**	--	**330**	--	160	J	95	J	**440**	--	110	--
Methylmercury	µg/kg	0.031	J	0.042	J	0.19	--	0.4	--	0.23	--	0.1	--	0.27	--	0.82	--	0.17	--
Nitrate	mg/kg	32.4	--	14.8	--	1.33	J	0.975	J	1.01	J	1.43	--	1.08	J	0.894	J	0.459	U
Nitrite	mg/kg	0.531	U	0.51	U	0.438	U	0.445	U	0.461	U	0.414	U	0.429	U	0.445	U	0.459	U
Phosphorous	mg/kg	245	--	106	--	259	--	185	--	196	--	253	--	375	--	138	--	360	--
Sulfate	mg/kg	34.3	--	36.3	--	18.3	--	14	--	13	--	9.4	--	33.7	--	35.5	--	25	--
Sulfide	mg/kg	30.7	J	14	J	17.8	J	12.7	U	12.6	U	11.1	U	12.8	J	36.4	--	36.7	--
Total organic carbon average	mg/kg	21,200	--	4420	--	6760	--	7710	--	7160	--	6320	--	8390	--	10,800	--	5080	--

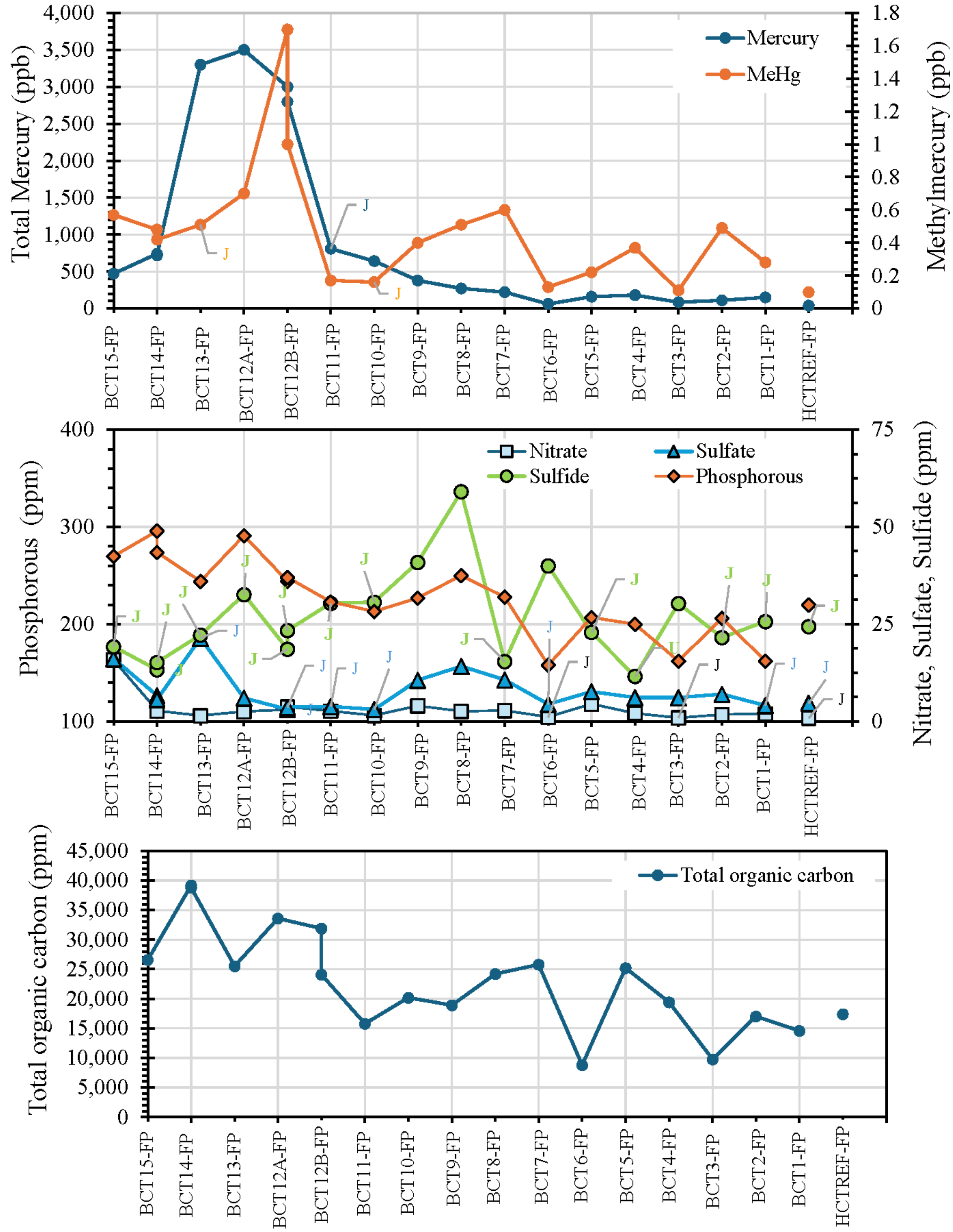
Table 3.7. Summary of selected analyte concentrations in BCTs floodplain soil, upper and lower creek bank soil, and channel sediment samples (cont.)

Chemical name	Units	BCT7		BCT6		BCT5		BCT4		BCT3		BCT2		BCT1		HCTREF	
		Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual	Result	Lab qual
Floodplain soil																	
Mercury	µg/kg	220	--	62	--	160	--	180	--	86	--	110	--	150	--	40	--
Methylmercury	µg/kg	0.6	--	0.13	--	0.22	--	0.37	--	0.11	--	0.49	--	0.28	--	0.1	--
Nitrate	mg/kg	2.79	--	1.13	J	4.47	--	2.09	--	0.938	J	1.76	--	1.97	--	0.841	J
Nitrite	mg/kg	0.479	U	0.395	U	0.832	J	0.434	U	0.402	U	0.39	U	0.42	U	0.41	U
Phosphorous	mg/kg	228	--	158	--	207	--	200	--	162	--	206	--	162	--	220	--
Sulfate	mg/kg	10.7	--	4.42	J	7.66	--	6.12	--	6.13	--	6.99	--	4.09	J	4.7	J
Sulfide	mg/kg	15.4	J	40	--	22.9	J	11.6	U	30.3	--	21.6	J	25.7	J	24.4	J
Total organic carbon average	mg/kg	25,800	--	8810	--	25,200	--	19,400	--	9760	--	17,000	--	14,600	--	17,400	--
Upper creek bank soil																	
Mercury	µg/kg	200	--	34	--	200	--	100	--	32	--	120	--	150	--	28	--
Methylmercury	µg/kg	0.87	--	0.017	UJ	0.094	--	0.41	--	0.025	J	0.24	--	0.4	--	0.016	UJ
Nitrate	mg/kg	1.38	--	1.04	J	0.969	J	1.42	--	1.09	J	1.43	--	1.96	--	1.06	J
Nitrite	mg/kg	0.449	U	0.394	U	0.391	U	0.404	U	0.4	U	0.404	U	0.423	U	0.392	U
Phosphorous	mg/kg	189	--	145	--	146	--	154	--	158	--	136	--	179	--	113	--
Sulfate	mg/kg	11.9	--	3.46	J	2.8	J	7.66	--	4.05	J	6.99	--	3.98	J	9.5	--
Sulfide	mg/kg	15	J	26.3	J	22.1	J	17.4	J	18	J	34.9	--	20.7	J	21.8	J
Total organic carbon average	mg/kg	16,700	--	5990	--	10,400	--	11,800	--	6640	--	7350	--	14,600	--	6850	--
Lower creek bank soil																	
Mercury	µg/kg	NA	--	33	--	42	--	66	--	24	J	41	--	180	--	30	--
Methylmercury	µg/kg	NA	--	0.018	UJ	0.018	UJ	0.18	--	0.033	J	0.062	--	0.26	--	0.04	J
Nitrate	mg/kg	NA	--	0.856	J	0.851	J	1.81	--	0.41	U	1.09	J	2.11	--	0.49	U
Nitrite	mg/kg	NA	--	0.425	U	0.411	U	0.45	U	0.41	U	0.405	U	0.408	U	0.49	U
Phosphorous	mg/kg	NA	--	133	--	144	--	181	--	144	--	159	--	176	--	184	--
Sulfate	mg/kg	NA	--	10.1	--	6.28	--	11.6	--	16.1	--	20.8	--	6.88	--	8.56	--
Sulfide	mg/kg	NA	--	27.6	J	43.6	--	31.3	J	23.6	J	11.3	U	15.9	J	31.1	J
Total organic carbon average	mg/kg	NA	--	5850	--	7840	--	10,700	--	5320	--	5550	--	11,200	--	12,300	--
Channel sediment																	
Mercury	µg/kg	86	--	NA	--	NA	--	26	J	29	J	NA	--	NA	--	21[a]	--
Methylmercury	µg/kg	0.25	--	NA	--	NA	--	0.057	J	0.063	J	NA	--	NA	--	0.186[a]	--
Nitrate	mg/kg	0.464	U	NA	--	NA	--	1.1	J	1.22	J	NA	--	NA	--	NA	--
Nitrite	mg/kg	0.464	U	NA	--	NA	--	0.419	U	0.455	U	NA	--	NA	--	NA	--
Phosphorous	mg/kg	131	--	NA	--	NA	--	340	--	239	--	NA	--	NA	--	NA	--
Sulfate	mg/kg	20.6	--	NA	--	NA	--	10.4	--	22.1	--	NA	--	NA	--	NA	--
Sulfide	mg/kg	13.1	J	NA	--	NA	--	27.6	J	24.4	J	NA	--	NA	--	NA	--
Total organic carbon average	mg/kg	7250	--	NA	--	NA	--	2500	--	2440	--	NA	--	NA	--	11,000[a]	--

[a]Data provided courtesy of Scott Brooks, Oak Ridge National Laboratory, Environmental Science Division.

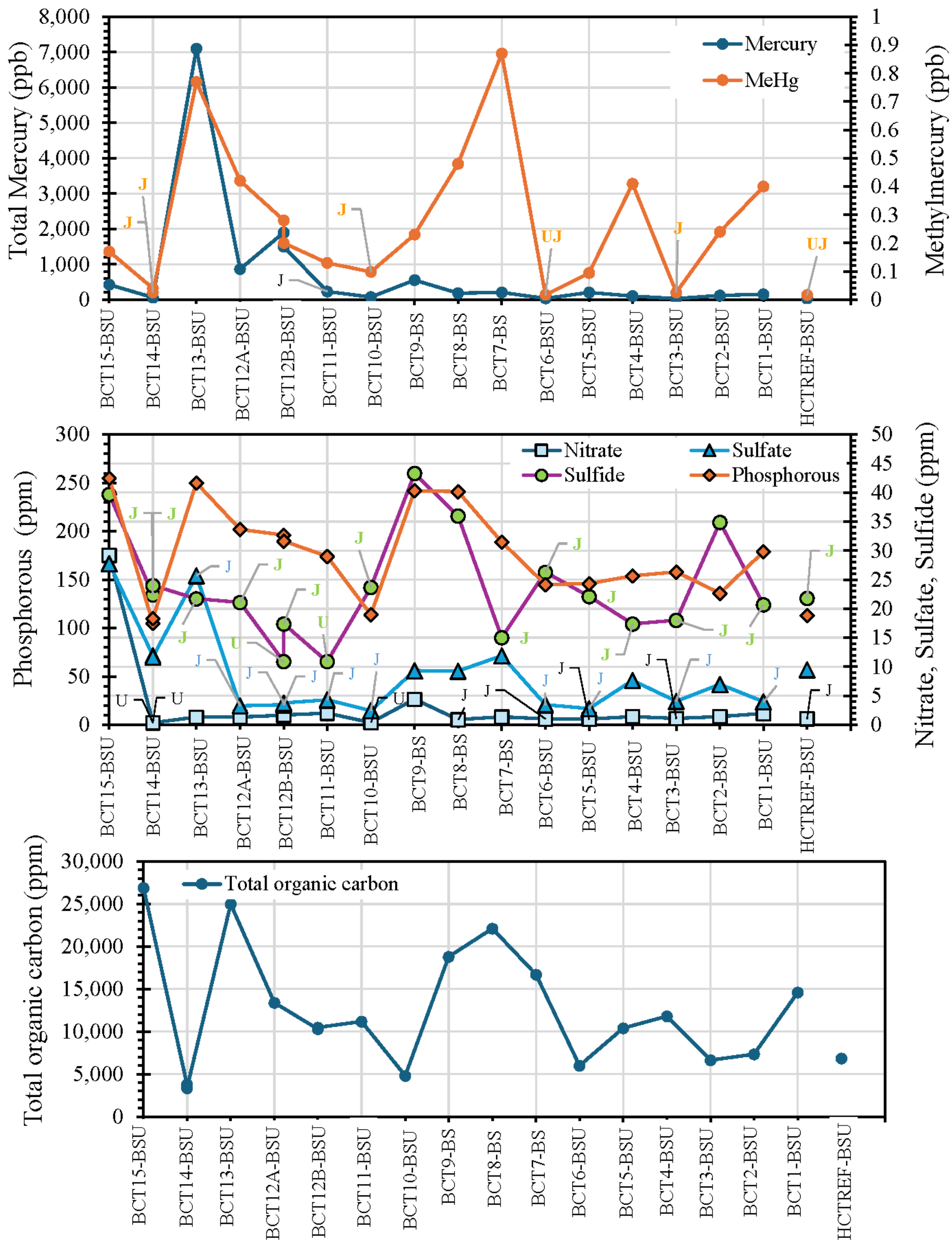
Bold indicates channel sediment mercury concentration is greater than sediment threshold effect concentration (180 µg/kg) and is less than probable effect concentration (1060 µg/kg).
-- Indicates no qualifier; detection.

BCT = Bear Creek transect
J = estimated value
Lab = laboratory
NA = not analyzed
qual = qualifier
U = not detected at reported quantitation limit
UJ = not detected at estimated value



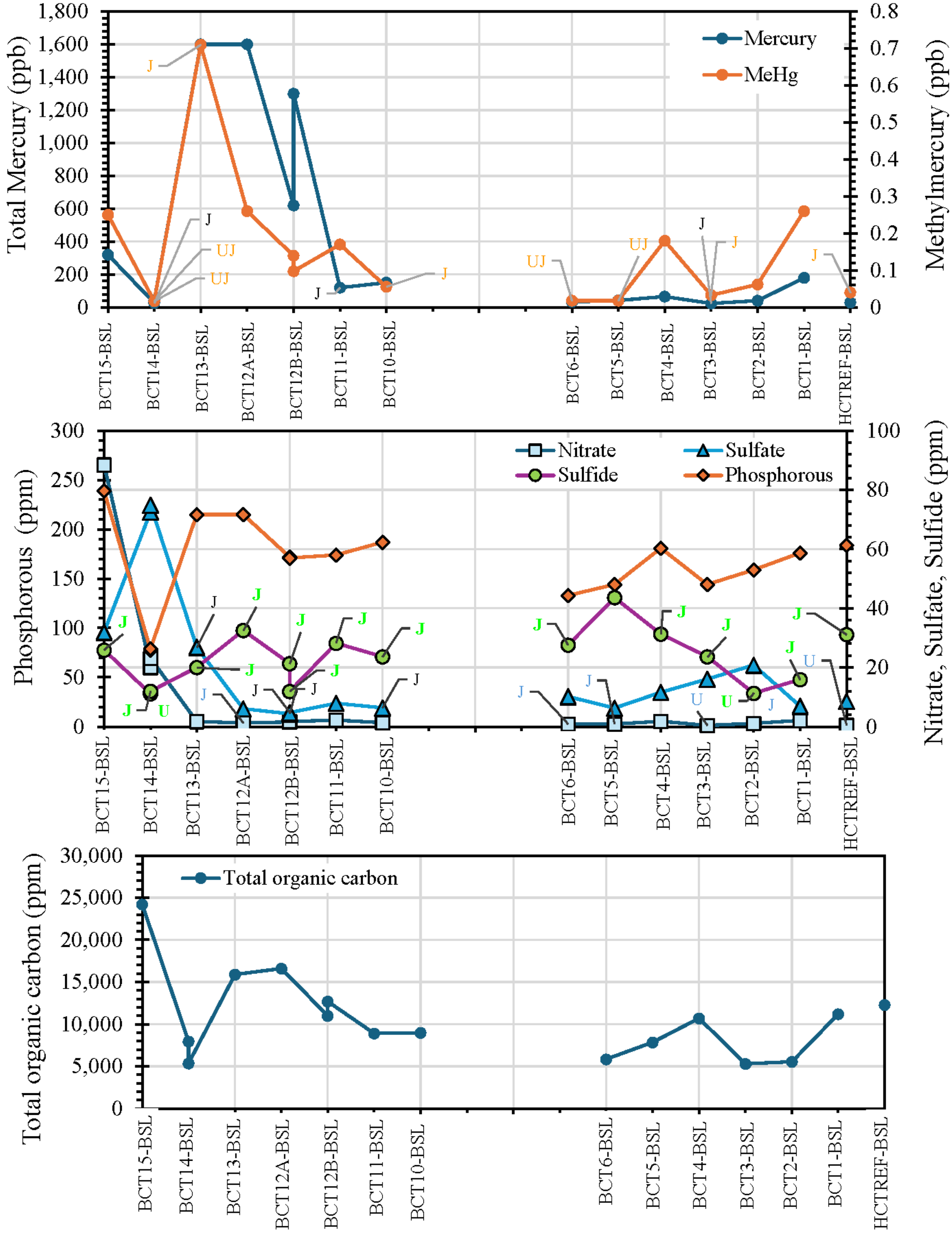
BCT = Bear Creek transect FP = floodplain HCTREF = Hinds Creek transect reference site J = estimated value MeHg = methylmercury
ppb = parts per billion ppm = parts per million

Figure 3.6. BCT (upstream to downstream) and Hinds Creek floodplain soil chemical data.



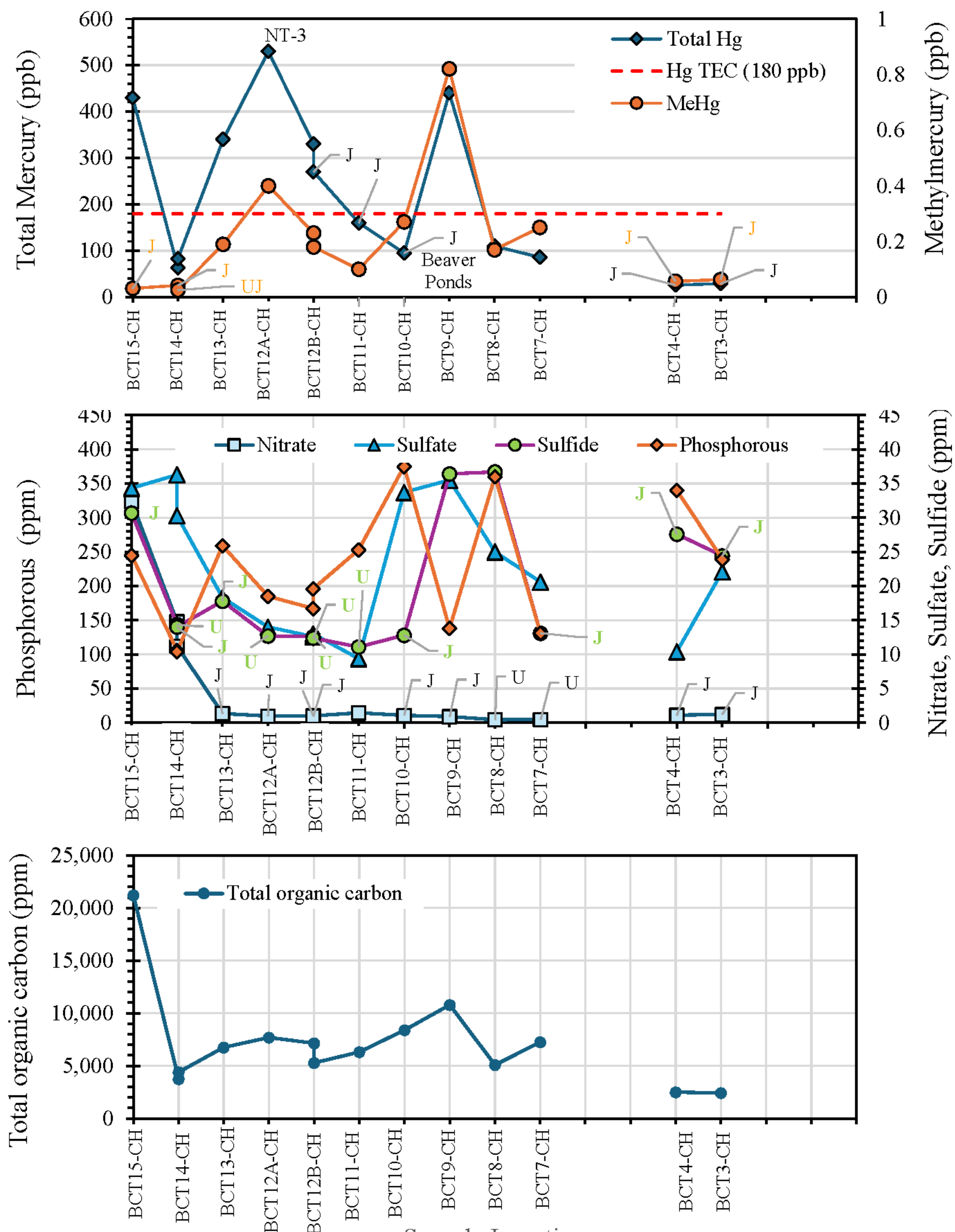
BCT = Bear Creek transect BSU = upper creek bank soil HCTREF = Hinds Creek transect reference site MeHg = methylmercury
ppb = parts per billion ppm = parts per million

Figure 3.7. BCT (upstream to downstream) and Hinds Creek upper creek bank soil chemical data.



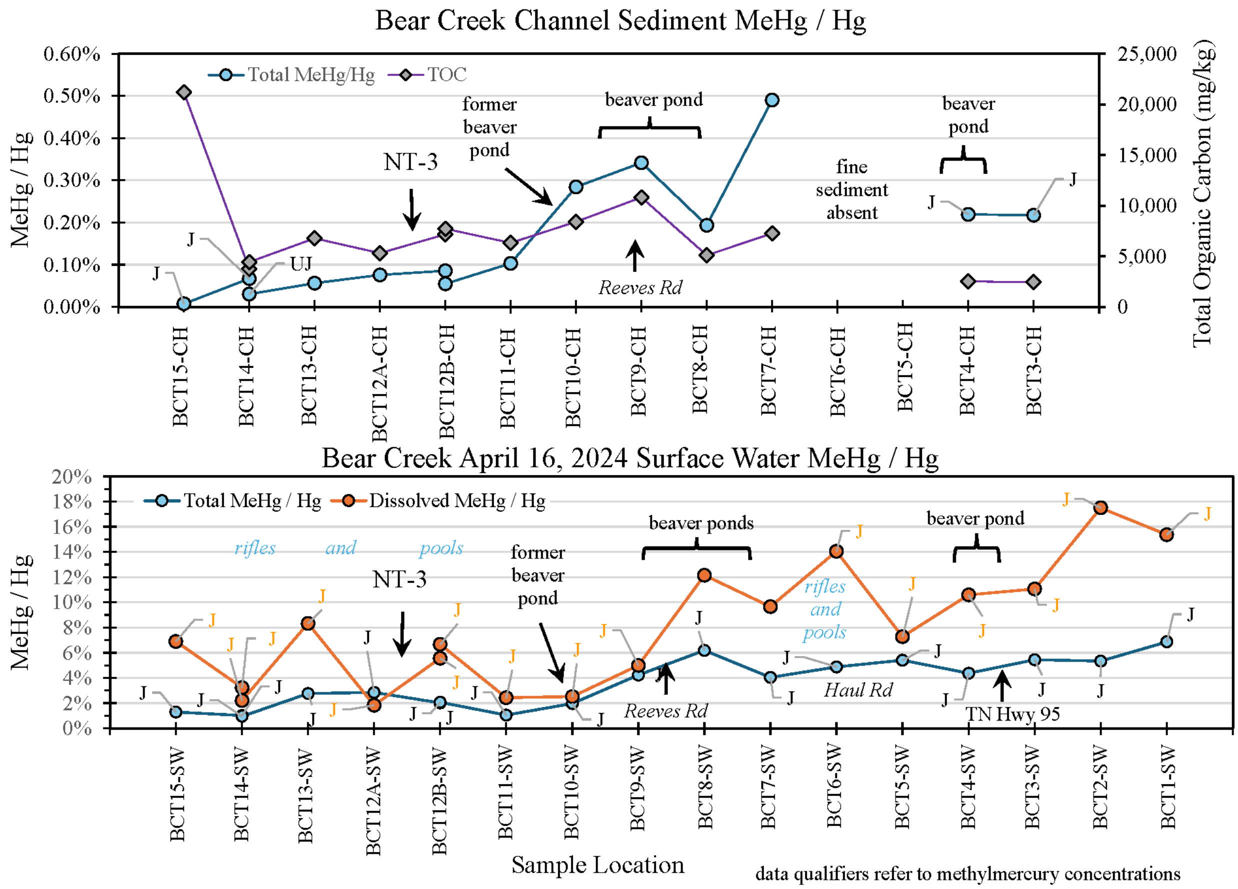
BCT = Bear Creek transect BSL = lower creek bank soil HCTREF = Hinds Creek transect reference site J = estimated value
MeHg = methylmercury ppb = parts per billion ppm = parts per million UJ = not detected at estimated value

Figure 3.8. BCT (upstream to downstream) and Hinds Creek lower creek bank soil chemical data.



BCT = Bear Creek transect Ch = channel sediment Hg = mercury J = estimated value MeHg = methylmercury
NT = North Tributary TEC = threshold effect concentration U = not detected at reported quantitation limit
UJ = not detected at estimated value

Figure 3.9. BCT (upstream to downstream) channel sediment chemical data.



BCT = Bear Creek transect CH = channel sediment Hg = mercury J = estimated value MeHg = methylmercury NT = North Tributary
TOC = total organic carbon UJ = not detected at estimated value

Figure 3.10. Bear Creek channel sediment and April 2024 surface water percent methylmercury, shown upstream to downstream.

3.3 BEAR CREEK VALLEY SOIL AND SEDIMENT MERCURY SEQUENTIAL EXTRACTIONS

Mercury sequential extractions were conducted on floodplain soil, creek bank soil, and channel sediment at select Bear Creek transect locations (BCT14, BCT12B, BCT11, BCT9, BCT8, BCT7, BCT6, and BCT5 and the reference site HCTREF) (Figure 2.1) using EPA Method SW846-3200M (modified). Because of very coarse sediment texture, or absence of sediment due to channel scour to bedrock, channel sediment was not suitable for sequential mercury extraction at locations BCT6, BCT5, and HCTREF. Table 3.8 includes the seven mercury extraction fractions and the relative ease of extraction (e.g., Fraction 0, volatile "gaseous" mercury, through Fraction 7, insoluble mercury contained in mineral crystal lattice positions requiring total dissolution of mineral phase for extraction).

Table 3.9 includes the results of the mercury sequential extraction analyses conducted on the Bear Creek transect samples. Measured mercury concentrations in each sample fraction are included along with sample result qualifiers and the percentage of the sum of measured total mercury in the sample. Table 3.9 also includes the average concentration of mercury in each extracted fraction for samples collected at each Bear Creek transect as well as the Hinds Creek reference site. Table 3.9 is organized with data from upstream sample transects to the left and progressing downstream to the right.

Table 3.8. Mercury sequential extraction method fractions and descriptions

Extraction step	Description and presumptive forms
F0 – Volatile Elemental Mercury (gas purging)	Volatile forms
F1 – Water Soluble Mercury (anoxic deionized water)	Water soluble
F2 – pH 2 Soluble Mercury (0.1 M acetic acid + 0.01 M hydrochloric acid)	Low pH soluble mercury forms; human stomach acid equivalent
F3 – 1N Potassium Hydroxide Extractable Mercury	Organically bound mercury
F4 – 12N Nitric Acid Soluble Mercury	Strongly complexed, non-silicate- or non-sulfide-bound mercury
F5 – Aqua Regia Soluble Mercury (3:1 concentrated hydrochloric acid to concentrated nitric acid)	Sulfide-bound mercury
F6 – Mineral-bound Mercury (hydrofluoric, nitric, and hydrochloric acid mixture, high-pressure–high-temperature digestion)	Silicate- or aluminosilicate-bound mercury

F = fraction
M = molarity
N = normality

As summarized, the potassium hydroxide extracted fraction predominates in mercury concentration in most cases for Bear Creek floodplain soil, creek bank soil, and channel sediment.

The mercury sequential extraction results are shown graphically as the percentage extracted in each fraction and the sum of measured mercury (µg/kg or ppb) for floodplain soils (Figure 3.11), creek bank soils (Figure 3.12), and channel sediment (Figure 3.13). In the floodplain soil (Figure 3.11), the dominance of organic-associated mercury extracted in the F3 potassium hydroxide step is obvious in most samples. The Hinds Creek reference site exhibits more mineral-bound (F6) mercury fraction in the floodplain soils than any of the Bear Creek sites. Creek bank soils (Figure 3.12) also exhibit a high proportion of organic-associated mercury, except at the headwater sample location (BCT14) where more strongly bound fraction (F4) mercury dominates. At the Hinds Creek site, a large component of mineral-bound (F6) mercury in creek bank soil was also present, as it was in the floodplain soil. Where channel sediment samples were available (Figure 3.13), organic-associated mercury exhibits an apparent increasing trend in the downstream direction from the headwater (BCT14) to BCT7 located immediately downstream of the Reeves Road crossing of Bear Creek. As noted in Table 3.1, sample locations BCT8 and BCT9 are located within beaver ponds and location BCT7 is located immediately downstream of the BCT8 beaver pond. Channel sediment suitable for the sequential mercury extraction analysis was not available at locations BCT5 and BCT6 or at the Hinds Creek reference site.

Figures 3.14 through 3.22 show data graphs of the sequential mercury extraction results for floodplain soil, creek bank soil, and channel sediment (where available) for each sample location. These graphs portray the vertical distribution of the mercury forms at each sample location.

Table 3.9. Results of mercury sequential extraction analyses from floodplain soil, creek bank soil, and channel sediment at eight BCT locations and at the Hinds Creek reference site

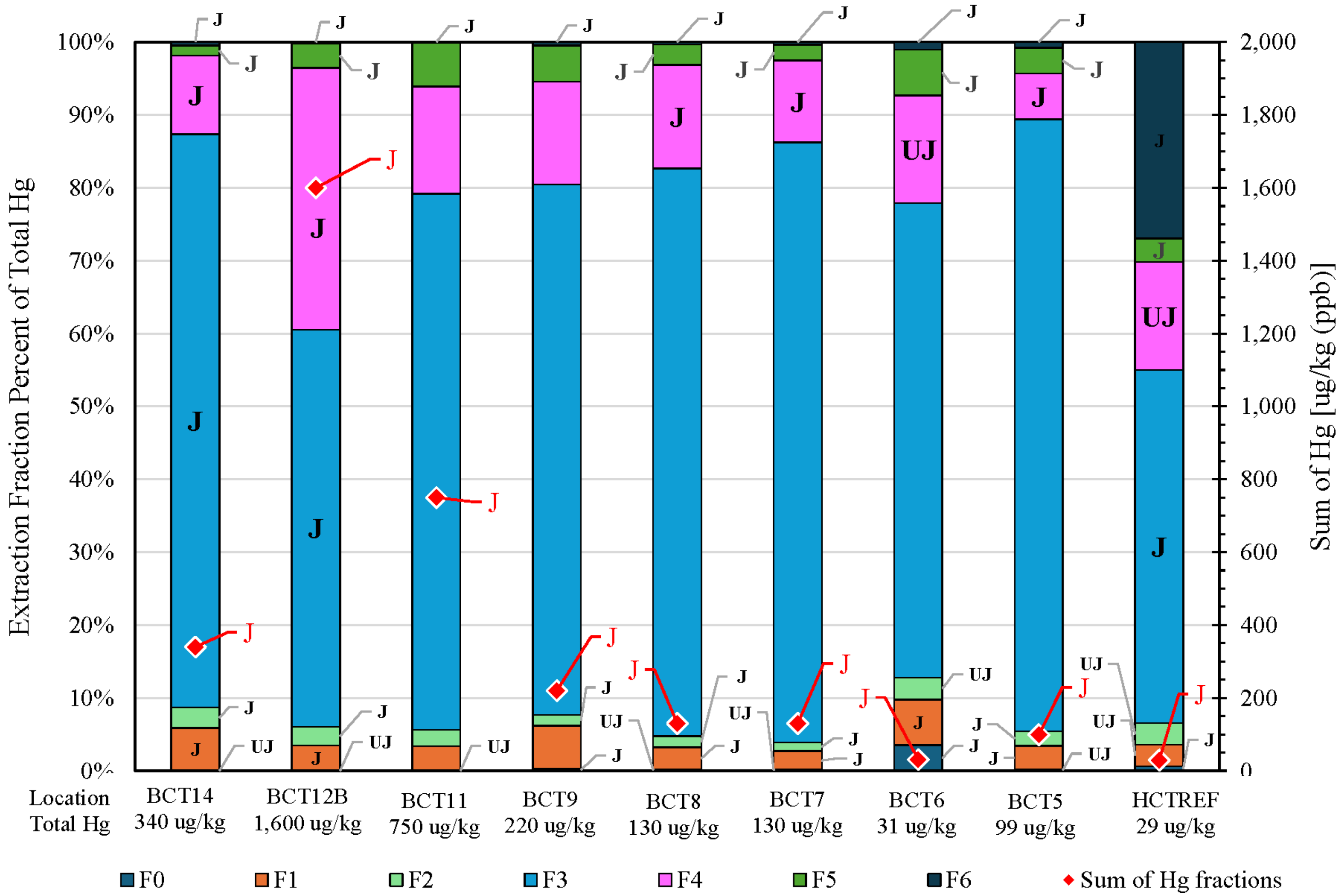
Chemical name	Units	BCT14			BCT12B			BCT11			BCT9			BCT8		
		Result	Percent of sum	Lab qual	Result	Percent of sum	Lab qual	Result	Percent of sum	Lab qual	Result	Percent of sum	Lab qual	Result	Percent of sum	Lab qual
Floodplain soil																
Mercury (F0) – Volatile Elemental Mercury	µg/kg	0.18	0.1%	UJ	0.18	0.0%	UJ	0.17	0.0%	UJ	0.56	0.3%	J	0.22	0.2%	UJ
Mercury (F1) – Water Soluble Mercury	µg/kg	20	5.9%	J	54	3.4%	J	25	3.3%	--	13	5.9%	--	3.9	3.0%	J
Mercury (F2) – pH 2 Soluble Mercury	µg/kg	9.7	2.9%	J	40	2.5%	J	17	2.3%	--	3.3	1.5%	J	1.9	1.5%	J
Mercury (F3) – 1N Potassium Hydroxide Extractable Mercury	µg/kg	270	79.4%	J	850	53.1%	J	550	73.3%	--	160	72.7%	--	99	76.2%	--
Mercury (F4) – 12N Nitric Acid Soluble Mercury	µg/kg	37	10.9%	J	560	35.0%	J	110	14.7%	--	31	14.1%	--	18	13.8%	J
Mercury (F5) – Aqua Regia Soluble Mercury	µg/kg	4.7	1.4%	J	53	3.3%	J	45	6.0%	--	11	5.0%	--	3.6	2.8%	J
Mercury (F6) – Mineral-bound Mercury	µg/kg	1.7	0.5%	J	2.6	0.2%	J	0.73	0.1%	J	1	0.5%	J	0.4	0.3%	J
Mercury (FS) – Total Mercury by Summation	µg/kg	340	--	J	1600	--	J	750	--	--	220	--	J	130	--	J
Bank soil																
Mercury (F0) – Volatile Elemental Mercury	µg/kg	0.17	0.8%	UJ	0.17	0.0%	UJ	0.18	0.1%	J	0.18	0.1%	UJ	0.2	0.2%	UJ
Mercury (F1) – Water Soluble Mercury	µg/kg	1.1	5.2%	UJ	26	3.1%	J	7.1	4.4%	--	8.8	3.5%	--	2.8	3.3%	J
Mercury (F2) – pH 2 Soluble Mercury	µg/kg	1.1	5.2%	UJ	20	2.4%	J	3.5	2.2%	J	4.9	2.0%	--	2.1	2.5%	J
Mercury (F3) – 1N Potassium Hydroxide Extractable Mercury	µg/kg	2.2	10.5%	UJ	390	46.4%	J	120	75.0%	--	200	80.0%	--	65	76.5%	--
Mercury (F4) – 12N Nitric Acid Soluble Mercury	µg/kg	17	81.0%	J	150	17.9%	J	15	9.4%	J	25	10.0%	--	12	14.1%	J
Mercury (F5) – Aqua Regia Soluble Mercury	µg/kg	3.1	14.8%	J	250	29.8%	J	9.3	5.8%	--	6.8	2.7%	--	3	3.5%	J
Mercury (F6) – Mineral-bound Mercury	µg/kg	1.3	6.2%	J	6.8	0.8%	J	0.93	0.6%	J	0.82	0.3%	J	0.36	0.4%	UJ
Mercury (FS) – Total Mercury by Summation	µg/kg	21	--	J	840	--	J	160	--	J	250	--	J	85	--	J
Channel sediment																
Mercury (F0) – Volatile Elemental Mercury	µg/kg	7.4	13.5%	J	0.19	0.1%	J	0.52	0.5%	J	0.18	0.1%	UJ	0.2	0.2%	UJ
Mercury (F1) – Water Soluble Mercury	µg/kg	1.3	2.4%	UJ	6.5	3.0%	--	5.3	5.5%	--	8.6	3.6%	--	3.4	3.9%	J
Mercury (F2) – pH 2 Soluble Mercury	µg/kg	1.3	2.4%	UJ	5.6	2.5%	J	4.3	4.4%	J	4.8	2.0%	--	1.3	1.5%	J
Mercury (F3) – 1N Potassium Hydroxide Extractable Mercury	µg/kg	2.7	4.9%	UJ	99	45.0%	--	37	38.1%	--	170	70.8%	--	70	79.5%	--
Mercury (F4) – 12N Nitric Acid Soluble Mercury	µg/kg	32	58.2%	J	20	9.1%	--	8.3	8.6%	J	43	17.9%	--	9.6	10.9%	J
Mercury (F5) – Aqua Regia Soluble Mercury	µg/kg	23	41.8%	J	85	38.6%	--	40	41.2%	--	11	4.6%	--	2.7	3.1%	J
Mercury (F6) – Mineral-bound Mercury	µg/kg	0.46	0.8%	J	0.91	0.4%	J	1.9	2.0%	J	1.2	0.5%	J	0.71	0.8%	J
Mercury (FS) – Total Mercury by Summation	µg/kg	55	--	J	220	--	J	97	--	J	240	--	J	88	--	J

Table 3.9. Results of mercury sequential extraction analyses from floodplain soil, creek bank soil, and channel sediment at eight BCT locations and at the Hinds Creek reference site (cont.)

Chemical name	Units	BCT7			BCT6			BCT5			Bear Creek average		HCTREF		
		Result	Percent of sum	Lab qual	Result	Percent of sum	Lab qual	Result	Percent of sum	Lab qual	Average result	Average percent	Result	Percent of sum	Lab qual
Floodplain soil															
Mercury (F0) – Volatile Elemental Mercury	µg/kg	0.2	0.2%	UJ	1.4	4.5%	J	0.17	0.2%	UJ	0.37	0.7%	0.22	0.8%	J
Mercury (F1) – Water Soluble Mercury	µg/kg	3.4	2.6%	J	2.5	8.1%	J	3.2	3.2%	J	14	4.4%	1.1	3.8%	UJ
Mercury (F2) – pH 2 Soluble Mercury	µg/kg	1.6	1.2%	J	1.2	3.9%	UJ	2	2.0%	J	8.6	2.4%	1.1	3.8%	UJ
Mercury (F3) – 1N Potassium Hydroxide Extractable Mercury	µg/kg	110	84.6%	--	26	83.9%	--	83	83.8%	--	241	74.3%	18	62.1%	
Mercury (F4) – 12N Nitric Acid Soluble Mercury	µg/kg	15	11.5%	J	5.9	19.0%	UJ	6.2	6.3%	J	88	16.0%	5.5	19.0%	UJ
Mercury (F5) – Aqua Regia Soluble Mercury	µg/kg	2.9	2.2%	J	2.5	8.1%	J	3.5	3.5%	J	14	4.0%	1.2	4.1%	J
Mercury (F6) – Mineral-bound Mercury	µg/kg	0.47	0.4%	J	0.42	1.4%	J	0.76	0.8%	J	2.0	4.3%	10	34.5%	J
Mercury (FS) – Total Mercury by Summation	µg/kg	130	--	J	31	--	J	99	--	J	--	--	29	--	J
Bank soil															
Mercury (F0) – Volatile Elemental Mercury	µg/kg	0.19	0.2%	UJ	0.18	0.7%	UJ	0.93	1.1%	J	0.29	0.5%	0.37	1.1%	J
Mercury (F1) – Water Soluble Mercury	µg/kg	3.3	3.0%	J	1.5	6.0%	J	4.4	5.1%	J	4.3	4.8%	2.8	8.5%	J
Mercury (F2) – pH 2 Soluble Mercury	µg/kg	1.3	1.2%	J	1.2	4.8%	UJ	1.6	1.9%	J	2.3	2.8%	1.1	3.3%	UJ
Mercury (F3) – 1N Potassium Hydroxide Extractable Mercury	µg/kg	86	78.2%	--	19	76.0%	--	68	79.1%	--	77	65.5%	13	39.4%	
Mercury (F4) – 12N Nitric Acid Soluble Mercury	µg/kg	14	12.7%	J	5.9	23.6%	UJ	6.8	7.9%	J	13	20.5%	5.3	16.1%	UJ
Mercury (F5) – Aqua Regia Soluble Mercury	µg/kg	2.2	2.0%	J	4.5	18.0%	--	4.4	5.1%	--	4.9	6.8%	1.2	3.6%	J
Mercury (F6) – Mineral-bound Mercury	µg/kg	0.34	0.3%	UJ	0.48	1.9%	J	0.72	0.8%	J	2.4	6.6%	16	48.5%	J
Mercury (FS) – Total Mercury by Summation	µg/kg	110	--	J	25	--	J	86	--	J	--	--	33	--	J
Channel sediment															
Mercury (F0) – Volatile Elemental Mercury	µg/kg	0.21	0.4%	UJ	NA	--	--	NA	--	--	1.5	2.47%	NA	--	--
Mercury (F1) – Water Soluble Mercury	µg/kg	1.6	3.1%	J	NA	--	--	NA	--	--	4.5	3.56%	NA	--	--
Mercury (F2) – pH 2 Soluble Mercury	µg/kg	1.6	3.1%	J	NA	--	--	NA	--	--	3.2	2.66%	NA	--	--
Mercury (F3) – 1N Potassium Hydroxide Extractable Mercury	µg/kg	45	88.2%	--	NA	--	--	NA	--	--	71	54.44%	NA	--	
Mercury (F4) – 12N Nitric Acid Soluble Mercury	µg/kg	6.6	12.9%	UJ	NA	--	--	NA	--	--	20	19.60%	NA	--	--
Mercury (F5) – Aqua Regia Soluble Mercury	µg/kg	2.4	4.7%	J	NA	--	--	NA	--	--	27	22.34%	NA	--	--
Mercury (F6) – Mineral-bound Mercury	µg/kg	0.38	0.7%	UJ	NA	--	--	NA	--	--	0.93	0.88%	NA	--	--
Mercury (FS) – Total Mercury by Summation	µg/kg	51	--	J	NA	--	--	NA	--	--	--	--	NA	--	--

-- Indicates no qualifier; detection or not applicable.

BCT = Bear Creek transect
F = fraction
HCTREF = Hinds Creek transect reference site
J = estimated value
Lab = laboratory
N = normality
NA = not analyzed
qual = qualifier
UJ = not detected at estimated value

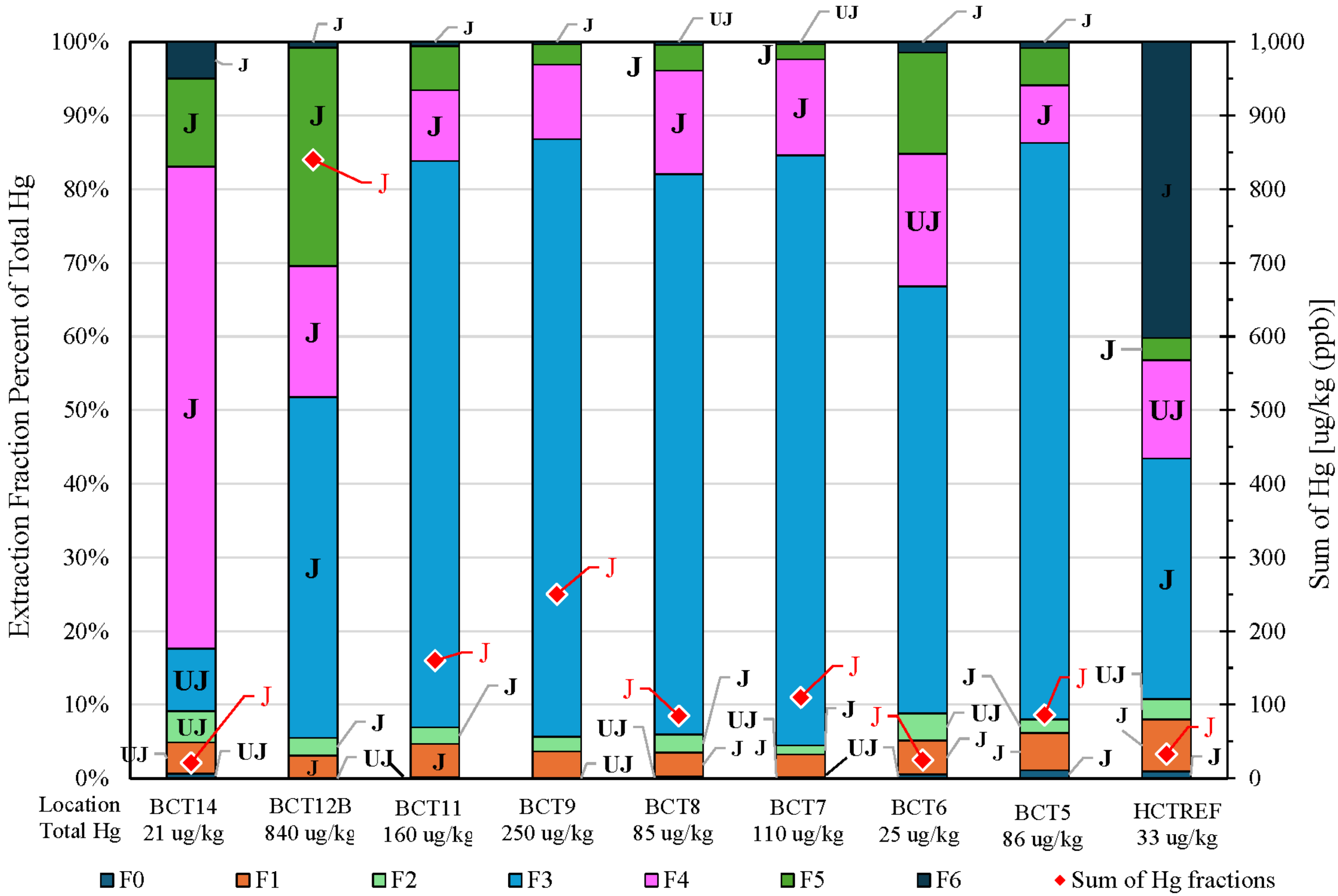


See Table 3.8 for definition of mercury extraction fractions

Data qualifiers refer to detected Hg concentration

BCT = Bear Creek transect HCTREF = Hinds Creek transect reference site Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.11. Results of Bear Creek floodplain soil sequential mercury extraction.

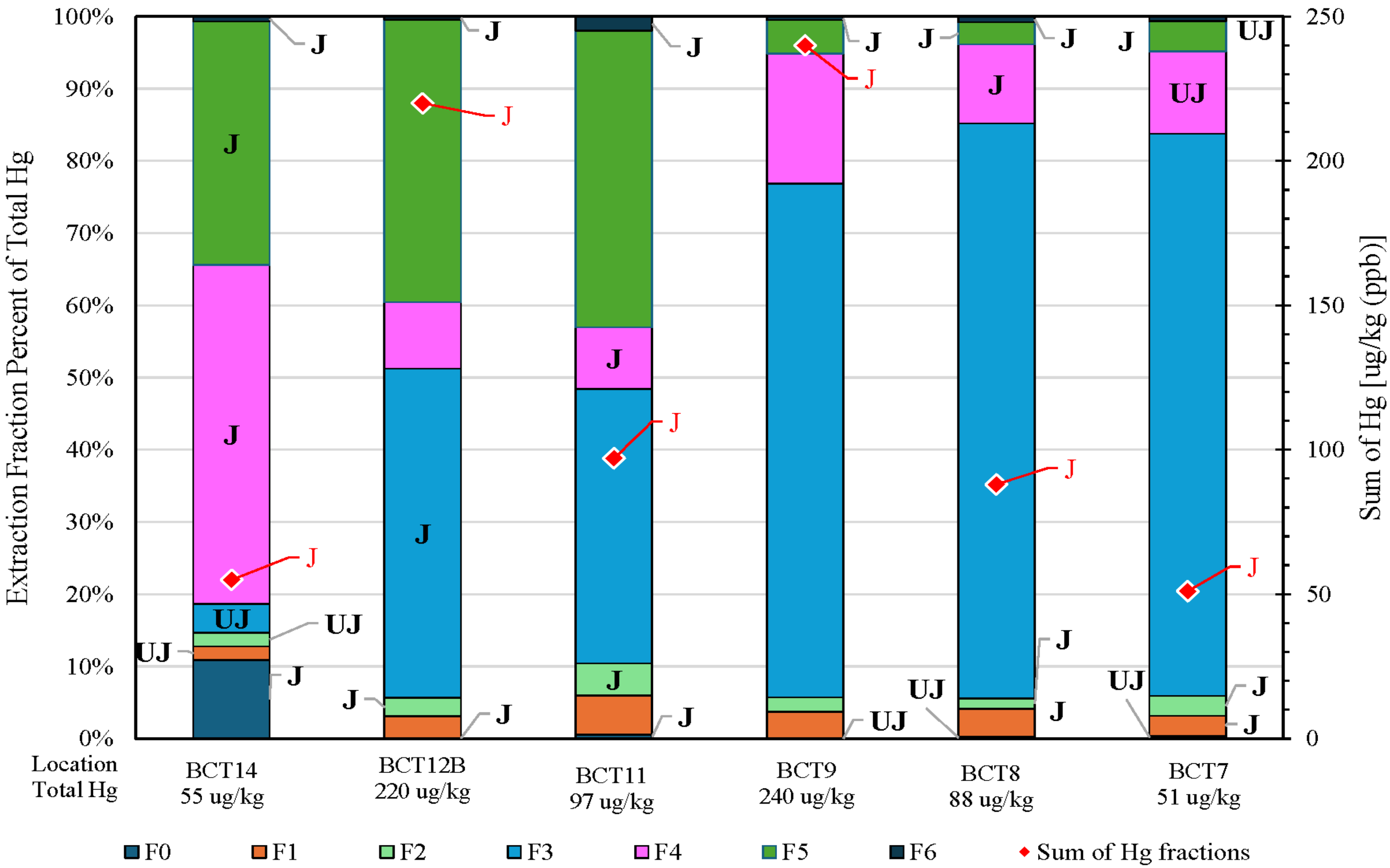


See Table 3.8 for definition of mercury extraction fractions

Data qualifiers refer to detected Hg concentration

BCT = Bear Creek transect HCTREF = Hinds Creek transect reference site Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.12. Results of Bear Creek bank soil sequential mercury extraction.

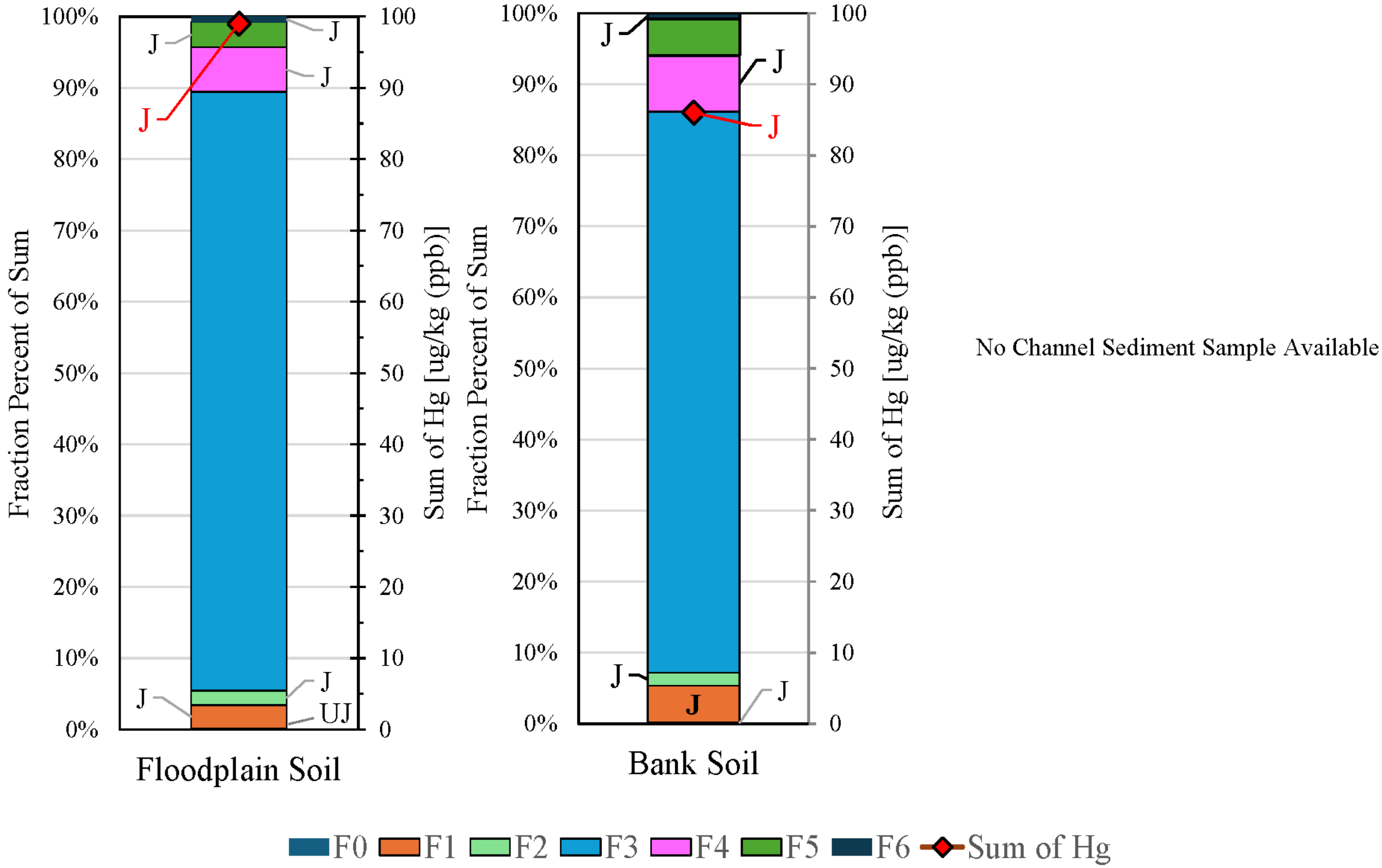


See Table 3.8 for definition of mercury extraction fractions

Data qualifiers refer to detected Hg concentration

BCT = Bear Creek transect Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.13. Results of Bear Creek channel sediment sequential mercury extraction.

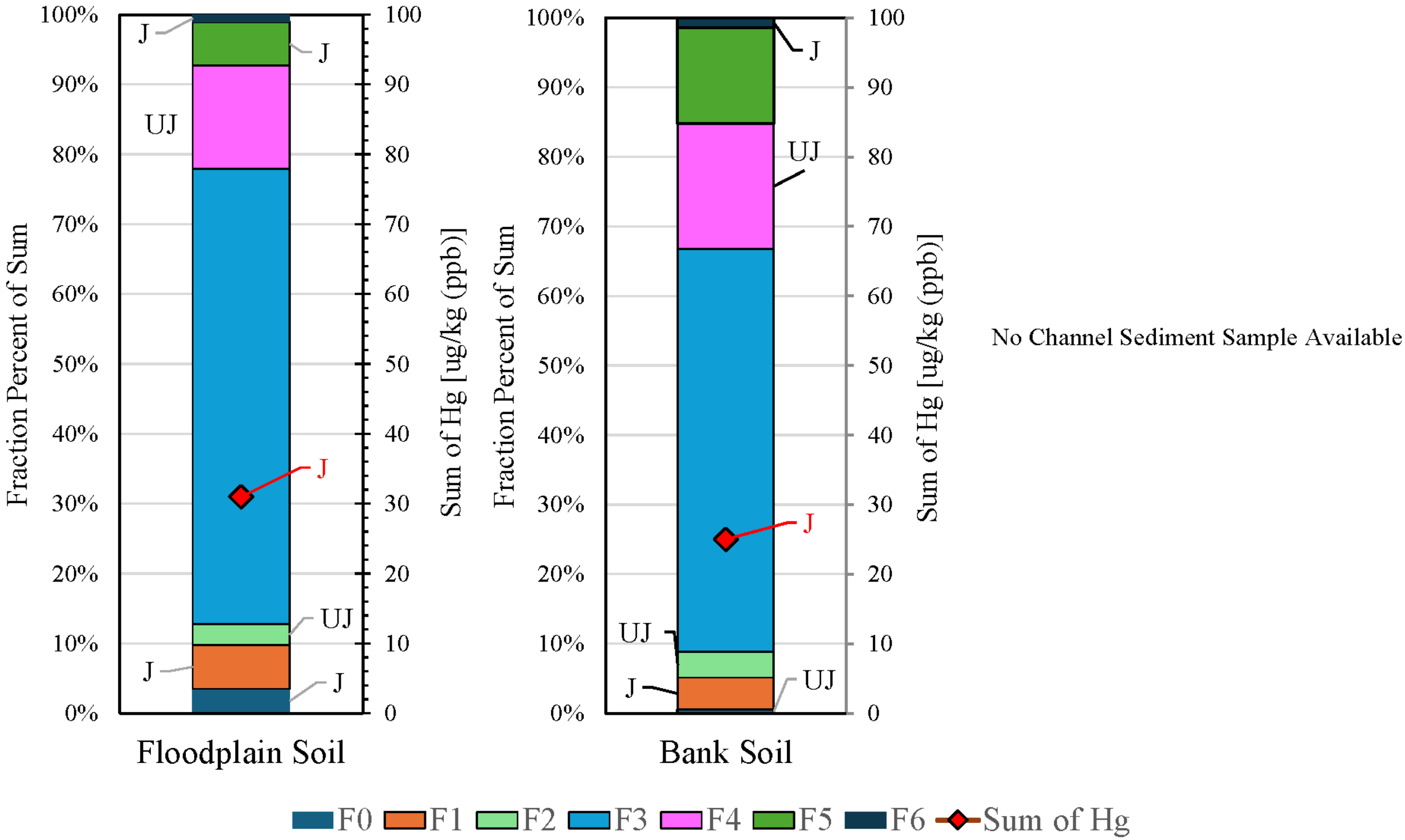


See Table 3.8 for definition of mercury extraction fractions

Data qualifiers refer to detected Hg concentration

Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.14. Sequential mercury extraction results at location BCT5.

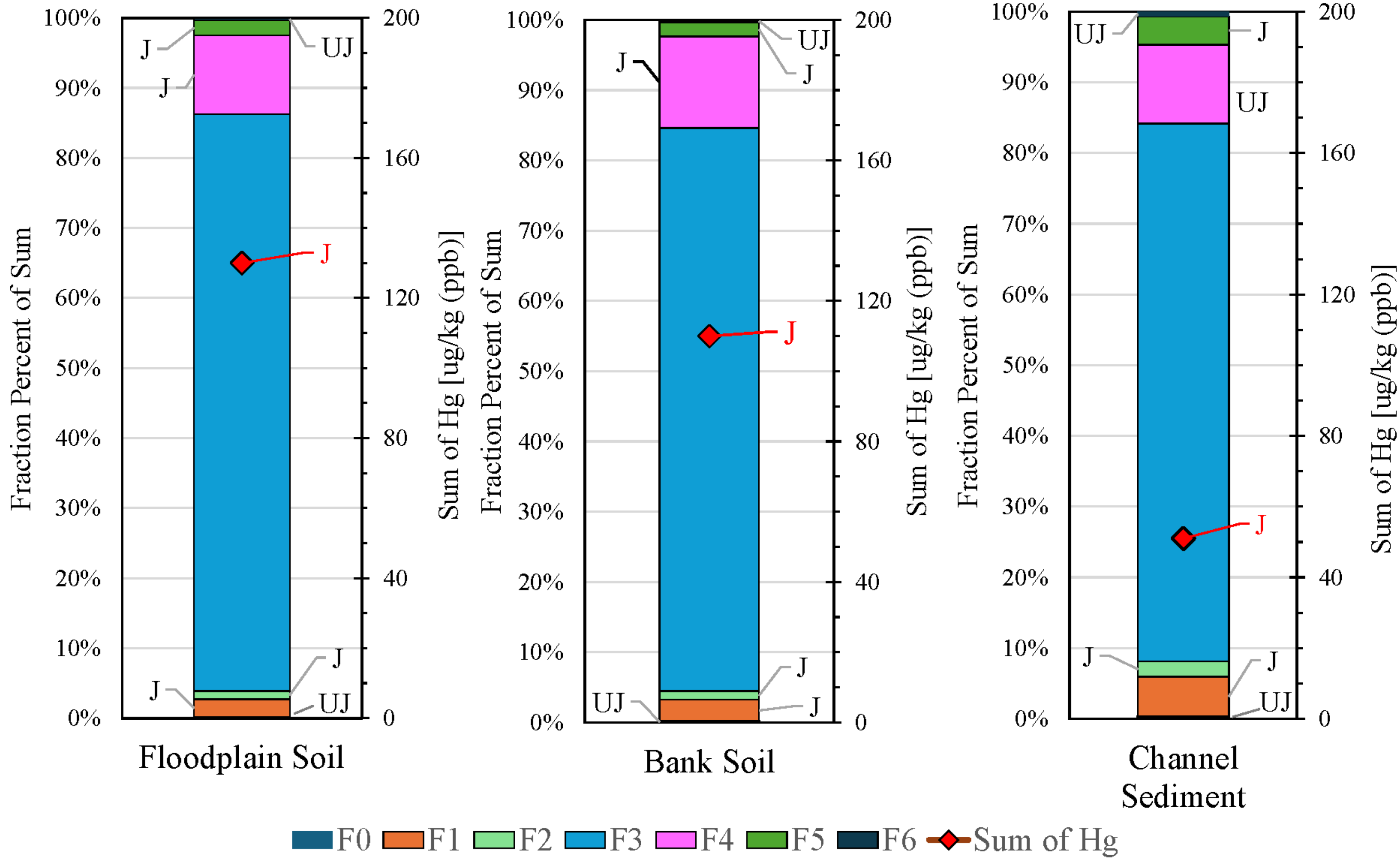


See Table 3.8 for definition of mercury extraction fractions

Data qualifiers refer to detected Hg concentration

Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.15. Sequential mercury extraction results at location BCT6.

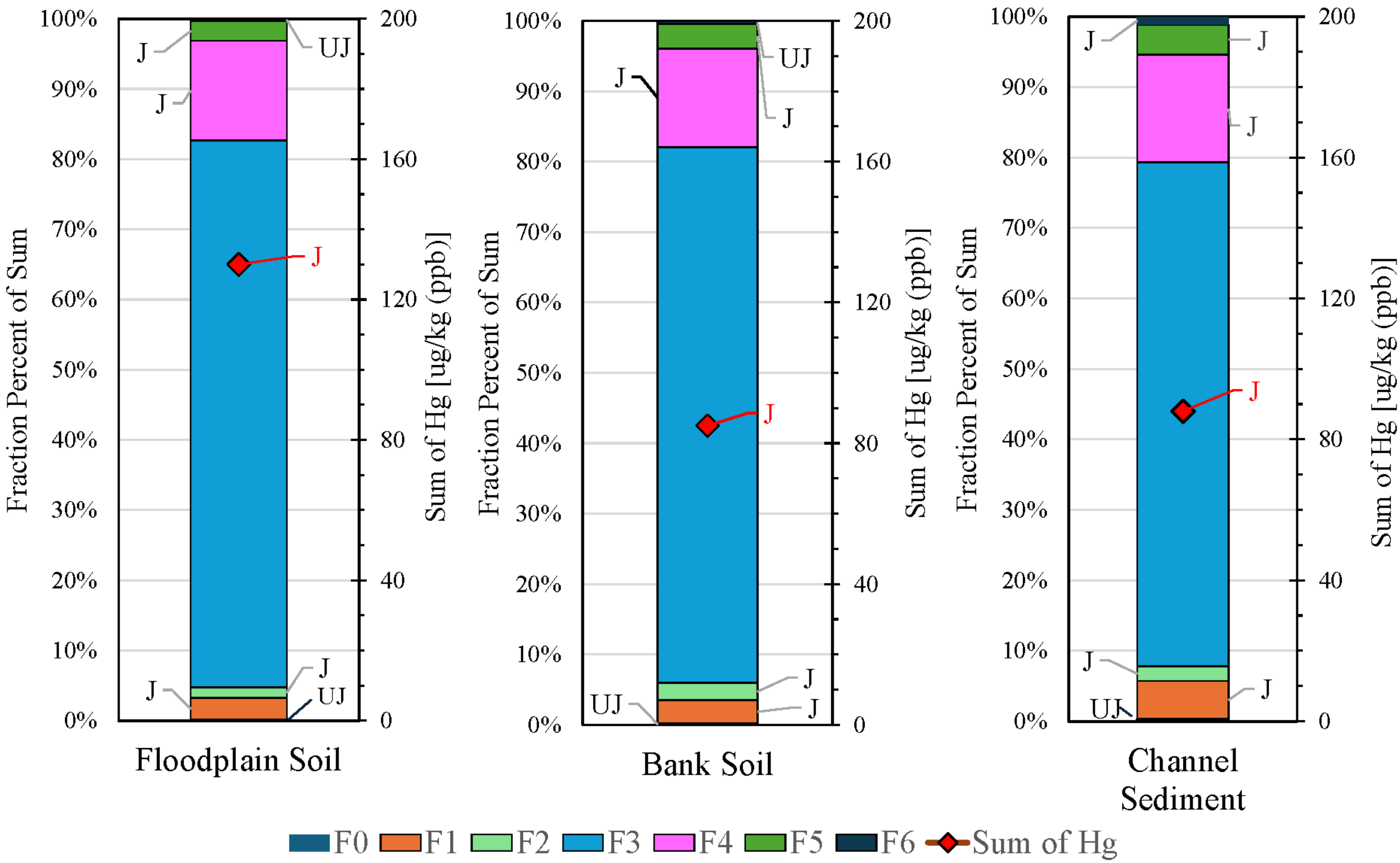


See Table 3.8 for definition of mercury extraction fractions

Data qualifiers refer to detected Hg concentration

Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

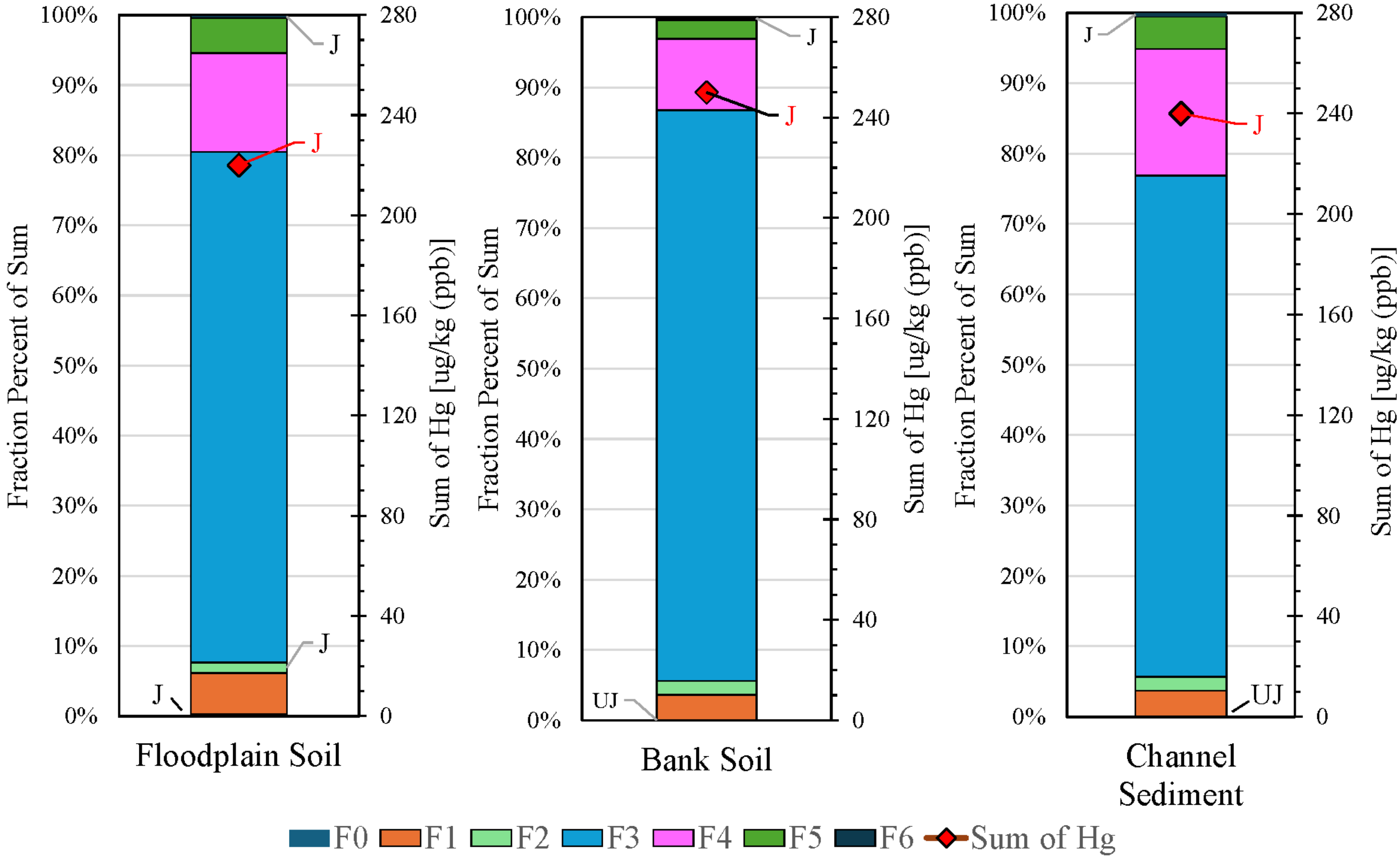
Figure 3.16. Sequential mercury extraction results at location BCT7.



See Table 3.8 for definition of mercury extraction fractions
Data qualifiers refer to detected Hg concentration

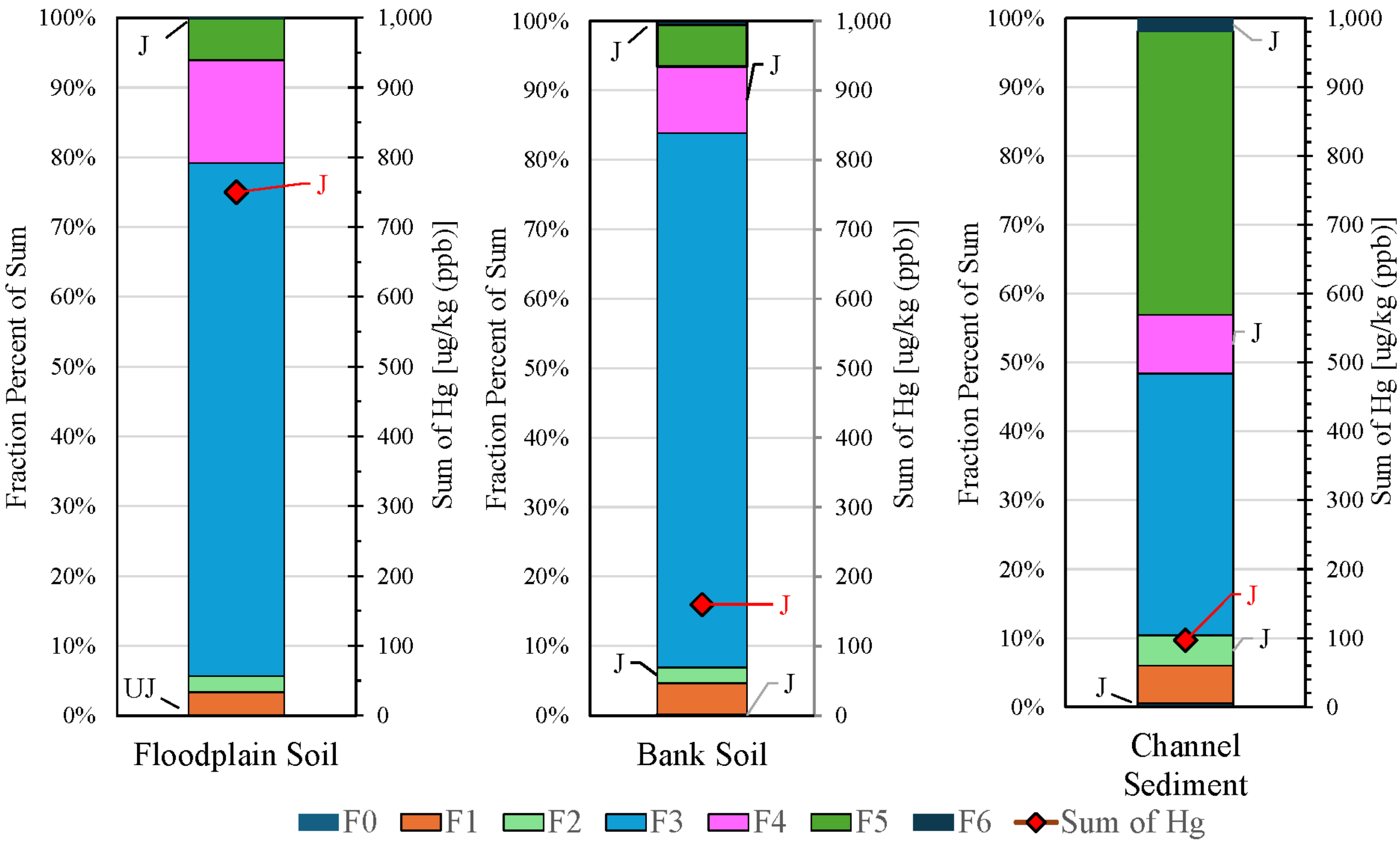
Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.17. Sequential mercury extraction results at location BCT8.



Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.18. Sequential mercury extraction results at location BCT9.

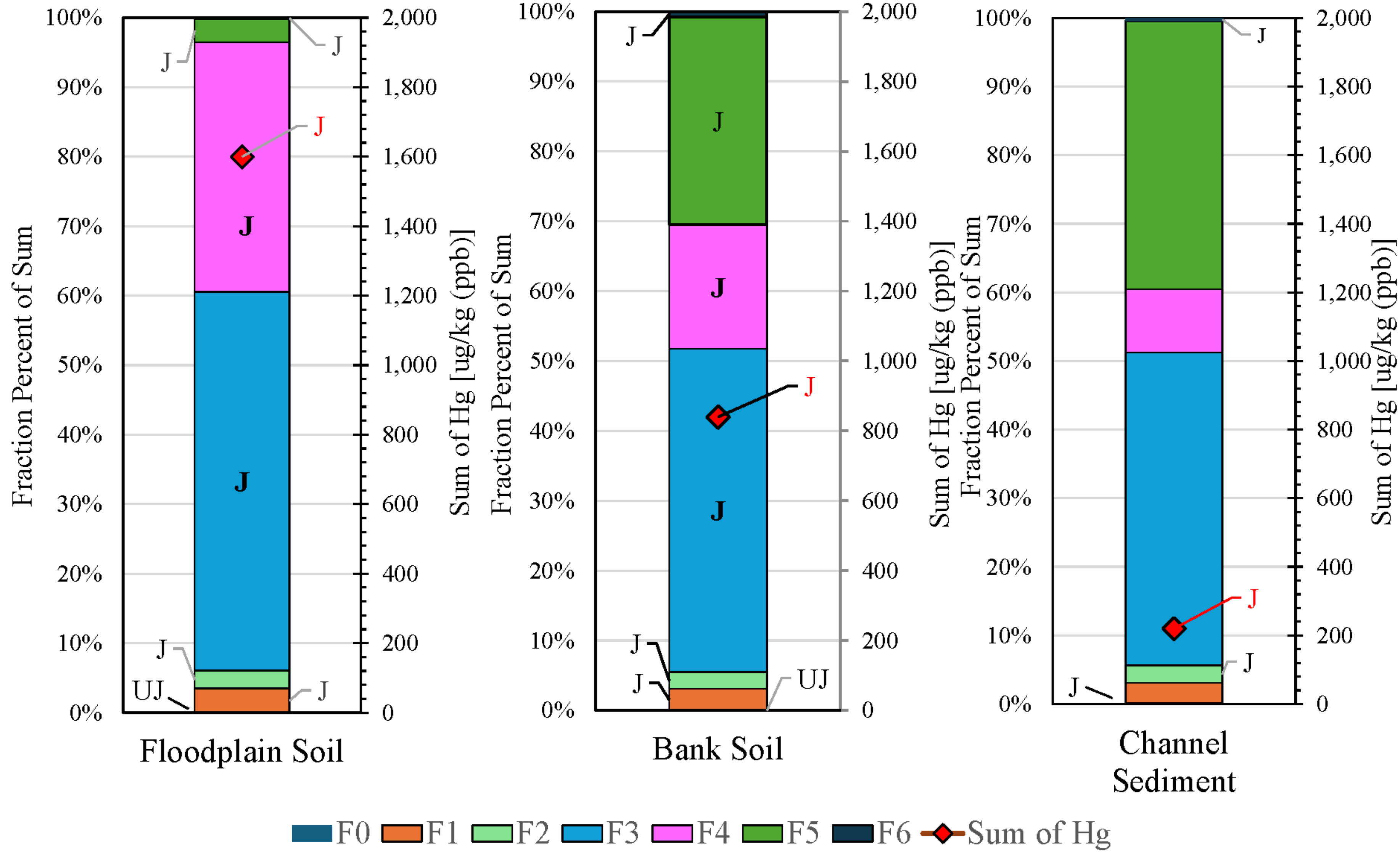


See Table 3.8 for definition of mercury extraction fractions

Data qualifiers refer to detected Hg concentration

Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.19. Sequential mercury extraction results at location BCT11.

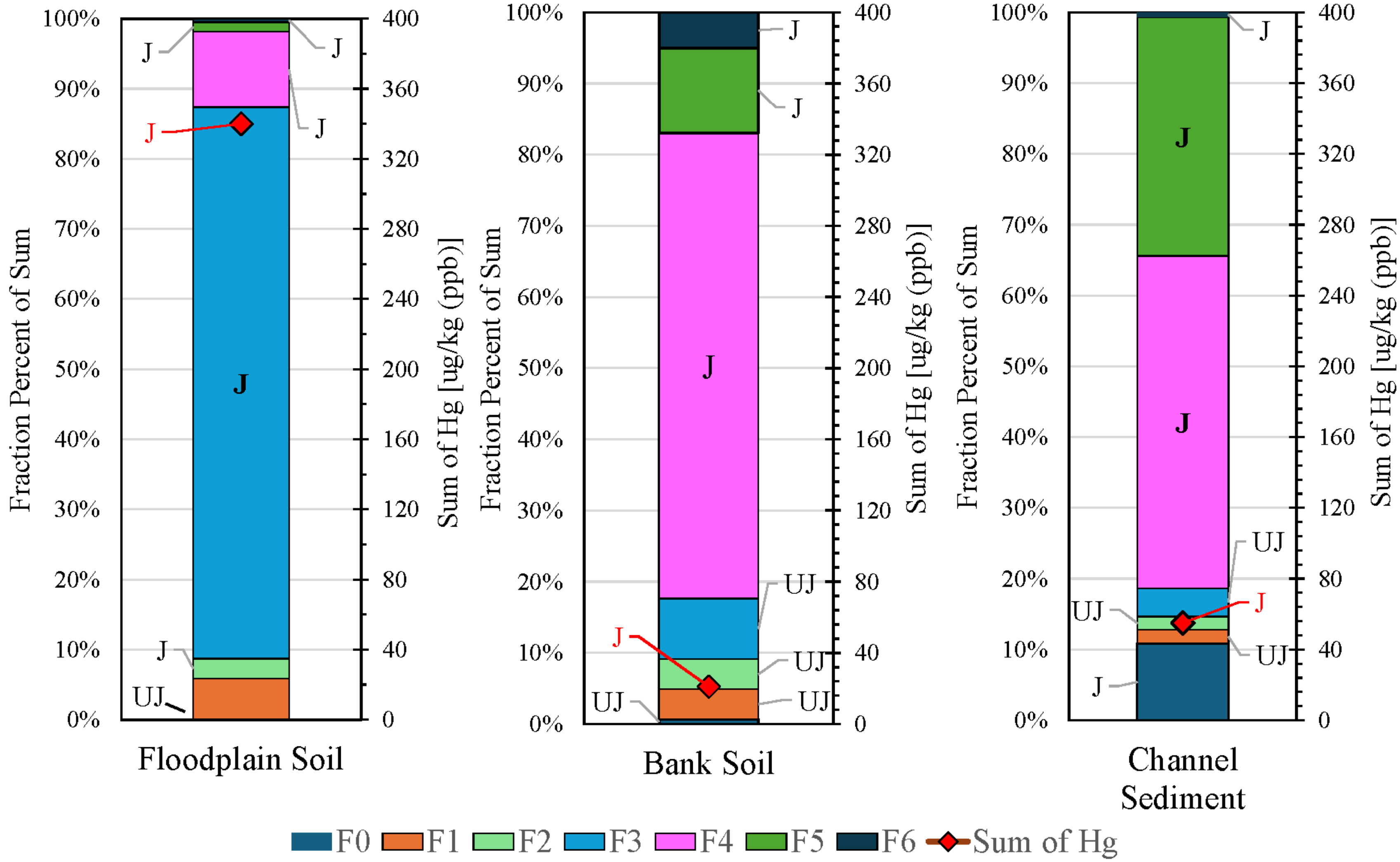


See Table 3.8 for definition of mercury extraction fractions

Data qualifiers refer to detected Hg concentration

Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.20. Sequential mercury extraction results at location BCT12B.

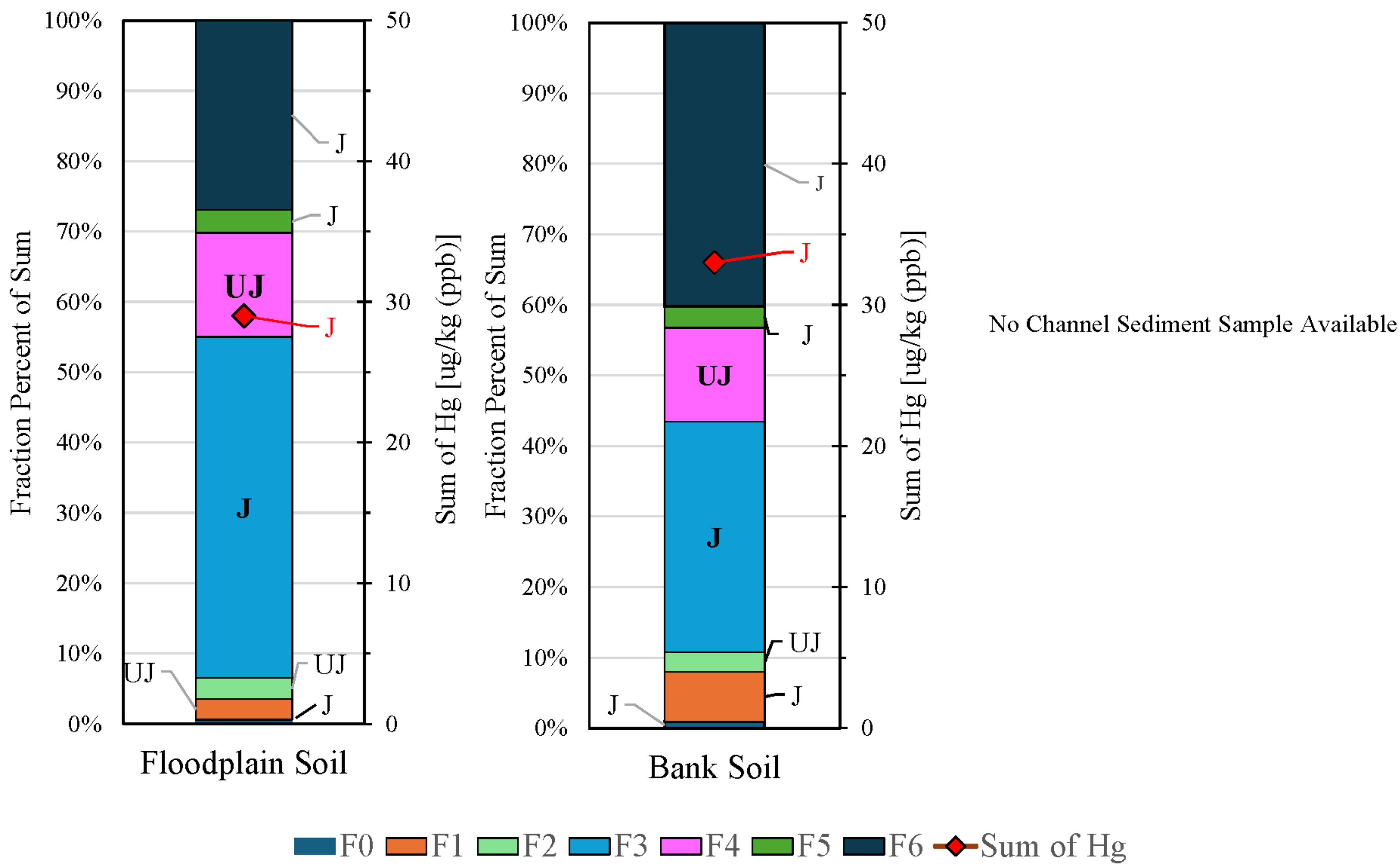


See Table 3.8 for definition of mercury extraction fractions

Data qualifiers refer to detected Hg concentration

Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.21. Sequential mercury extraction results at location BCT14.



See Table 3.8 for definition of mercury extraction fractions
Data qualifiers refer to detected Hg concentration

Hg = mercury J = estimated value ppb = parts per billion UJ = not detected at estimated value

Figure 3.22. Sequential mercury extraction results at the Hinds Creek reference site (HCTREF).

3.3.1 Analyte Correlation Evaluations

Results of analyses of Bear Creek floodplain and bank soil samples (combined and separately) and Bear Creek stream sediment samples were evaluated for analyte pairwise and multivariate correlation. Correlation results are included in Appendix E. The pairwise correlation tables contain the correlation coefficient for each analyte pair and use a color scheme to reflect the degree of significance of each correlation pair. Combinations that result in correlations that are significant at the 0.05 significance level are highlighted. The pairwise correlations showed many strong and significant correlations among metals, including mercury.

3.4 BEAR CREEK VALLEY MERCURY COMPARISON TO LOWER EAST FORK POPLAR CREEK

From 1953–1983, use of mercury for lithium isotope separation processes at Y-12 created mercury-contaminated waste that was disposed in BCV waste disposal areas as well as large releases of mercury to the EFPC. Section 1.2.2 summarized information regarding mercury-contaminated waste disposals in BCV. The UEFPC Watershed and the BCV Watershed are separated by a watershed divide located on the eastern side of BCV (Figure 1.2).

Mercury concentrations in floodplain and creek bank soil and channel sediment in Bear Creek are much lower than those of the Lower East Fork Poplar Creek (LEFPC). The purposes of this comparison are to contrast the conditions between the two watersheds and to highlight some differences thought to contribute to apparent higher bioaccumulation rates for mercury in fish in Bear Creek. Data are not amenable to statistical comparisons due to discrepancies in data availability and sparse sample results from several studies that limit statistical test feasibility.

Sequential mercury extraction data for Bear Creek show a different partitioning of mercury than those reported for LEFPC (Crowther et al., 2021). Table 3.10 includes the average percentages of extraction fractions F3, F4, and F5 for channel sediment in both watersheds. Channel sediment in Bear Creek contains a much greater percentage (54.44%) of mercury associated with the organic component extraction step (F3) than is reported for LEFPC (4.63%). The fraction of mercury removed in extraction step F3 has been correlated with mercury methylation potential in aquatic sediments (ORNL/TM-2016/578). By extension of this concept to the conditions extant in Bear Creek, and the strong association of mercury with the F3 extraction step, its organic carbon association (Table 3.9 and Figures 3.11 through 3.13) may be a key factor in the observed Bear Creek mercury bioaccumulation.

Table 3.10. Comparison of channel sediment sequential mercury extraction steps F3, F4, and F5 averages in Bear Creek and LEFPC

Extraction step	Bear Creek	LEFPC[a]
F3 – 1N Potassium Hydroxide Extractable Mercury	54.44%	4.63%
F4 – 12N Nitric Acid Soluble Mercury	19.60%	18.20%
F5 – Aqua Regia Soluble Mercury (3:1 concentrated hydrochloric acid to concentrated nitric acid)	22.34%	76.39%

[a]Averages calculated from combined data in Tables S6.3, S7.1, and S7.2 for three sampling locations in LEFPC reported in Crowther et al., 2021, "Supporting information for use of sequential extraction and mercury stable isotope analysis to assess remobilization of sediment-bound legacy mercury," *Environ. Sci.: Processes Impacts*, 23:756-775.

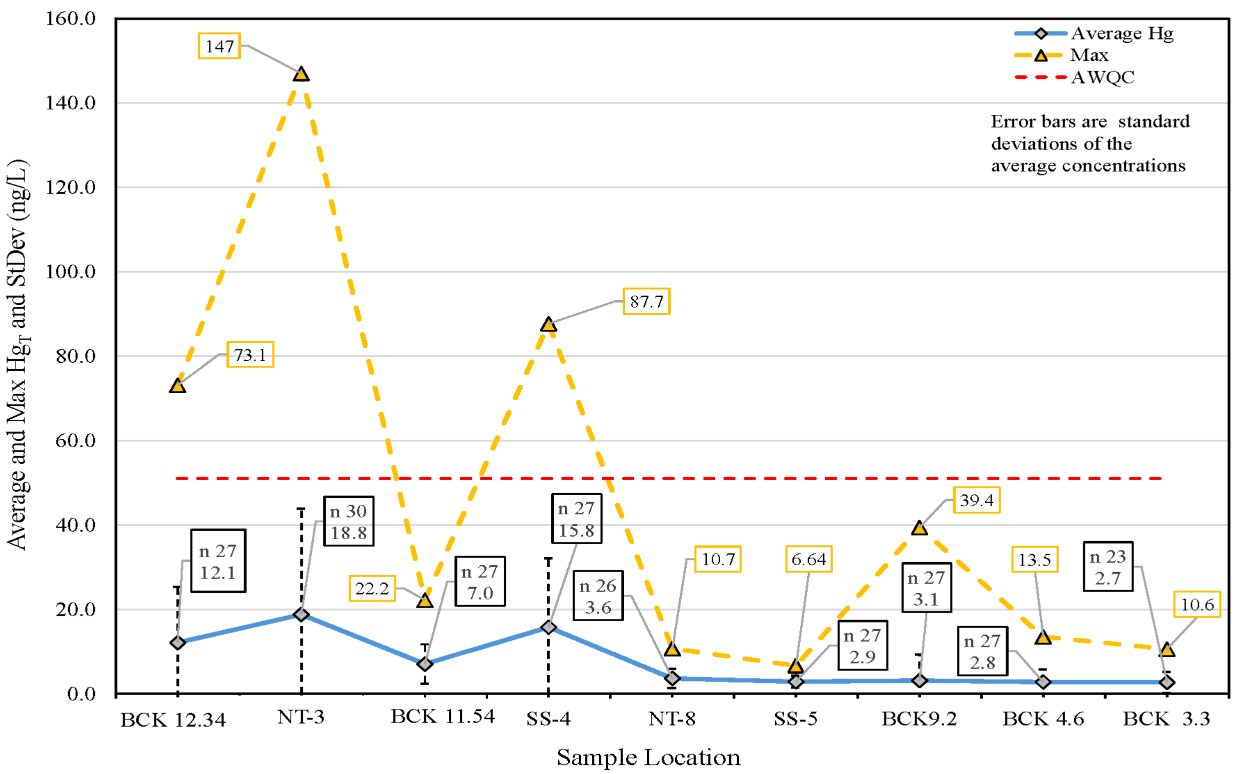
F = fraction
LEFPC = Lower East Fork Poplar Creek
N = normality

In addition to readily binding mercury, organic matter can serve as an electron donor to mercury-methylating bacteria. Bravo et al. (2017) found that, in boreal lakes, phytoplankton-derived organic compounds (relatively low molecular weight) enhance the mercury-methylation rates; whereas, methylation rates in lakes dominated with terrigenous organic compounds (relatively high molecular weights) had lower methylation rates but contained higher methylmercury concentrations.

4. WATER RESOURCES RESTORATION PROGRAM BEAR CREEK MONITORING RESULTS

4.1 SURFACE WATER DATA

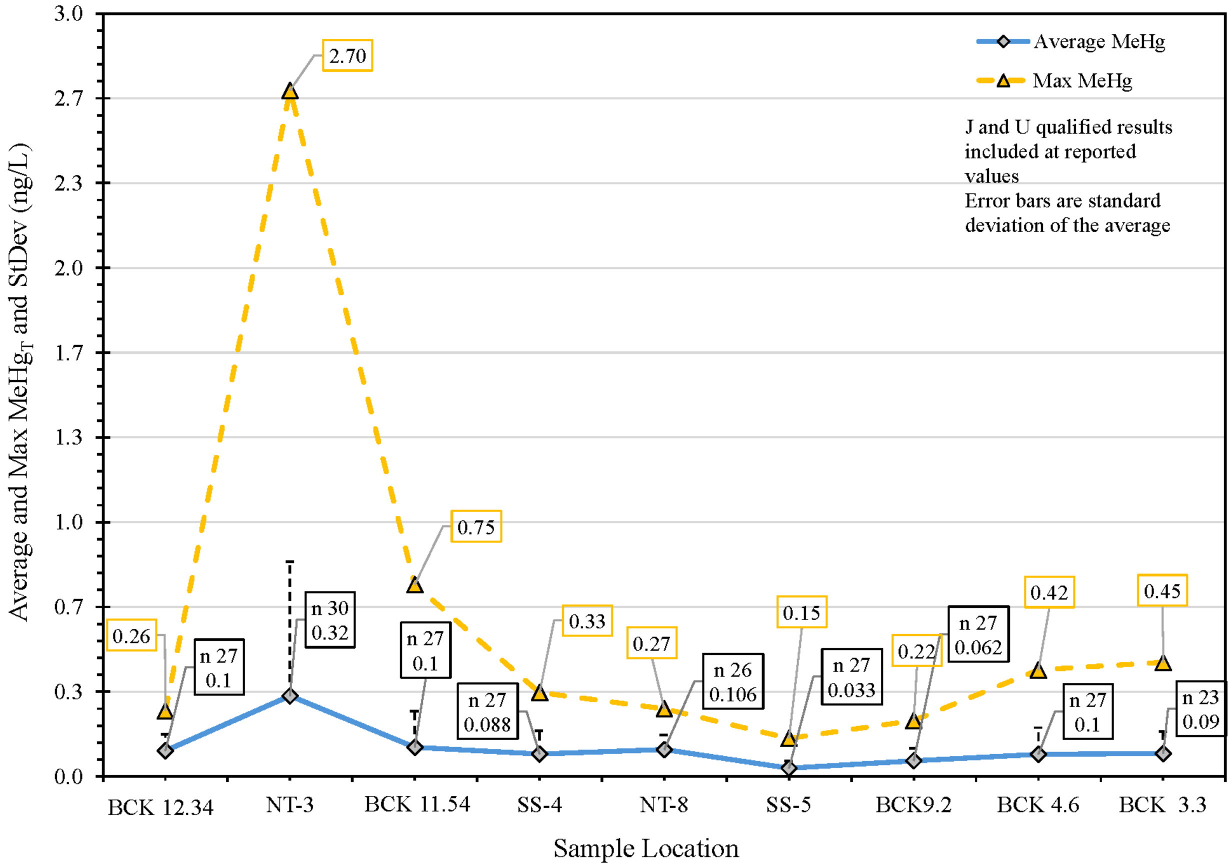
The WRRP began regular semiannual sampling of total mercury and methylmercury in surface water in 2011. These surface water data are collected approximately in sync with the Biological Monitoring and Abatement Program biota sampling in Bear Creek. Six sample locations are located in Zone 3 where continuous flow is measured, one is located in Zone 3 where flow is not measured (surface spring SS-4), and two are located farther downstream where flow is not measured coincident with sampling (BCK 4.6 and BCK 3.3) (Figure 4.1). While this dataset is not inclusive of all surface water mercury and methylmercury values for the time period, it is the Environmental Management Program dataset that provides same-day, snapshot data from stations arrayed along the length of Bear Creek, inclusive of key tributary and spring inputs to the Bear Creek mainstem. Appendix F provides the WRRP surface water total mercury and methylmercury longitudinal data plots for Bear Creek.



AWQC = ambient water quality criteria BCK = Bear Creek kilometer Hg = mercury HgT = total mercury Max = maximum
NT = North Tributary SS = surface spring StDev = standard deviation

Figure 4.1. Summary of WRRP surface water total mercury data, 2011–2023.

Figure 4.1 summarizes total mercury data, with average, standard deviation of the average, and maximum concentrations and the 51-ng/L surface water AWQC as a reference. As shown in this dataset, the measured maximum concentration has exceeded AWQC only at BCK 12.34 at the Bear Creek headwater, at NT-3, and in spring SS-4, all three of which are in the upper half of Zone 3. The maximum detected mercury result at NT-3 (August 2020) contained 17.1 mg/L of suspended solids, which raises the possibility that particle-associated mercury is a possible mode of mercury transport in NT-3. Figure 4.2 summarizes methylmercury results. Methylmercury non-detected results are included at the reported value.

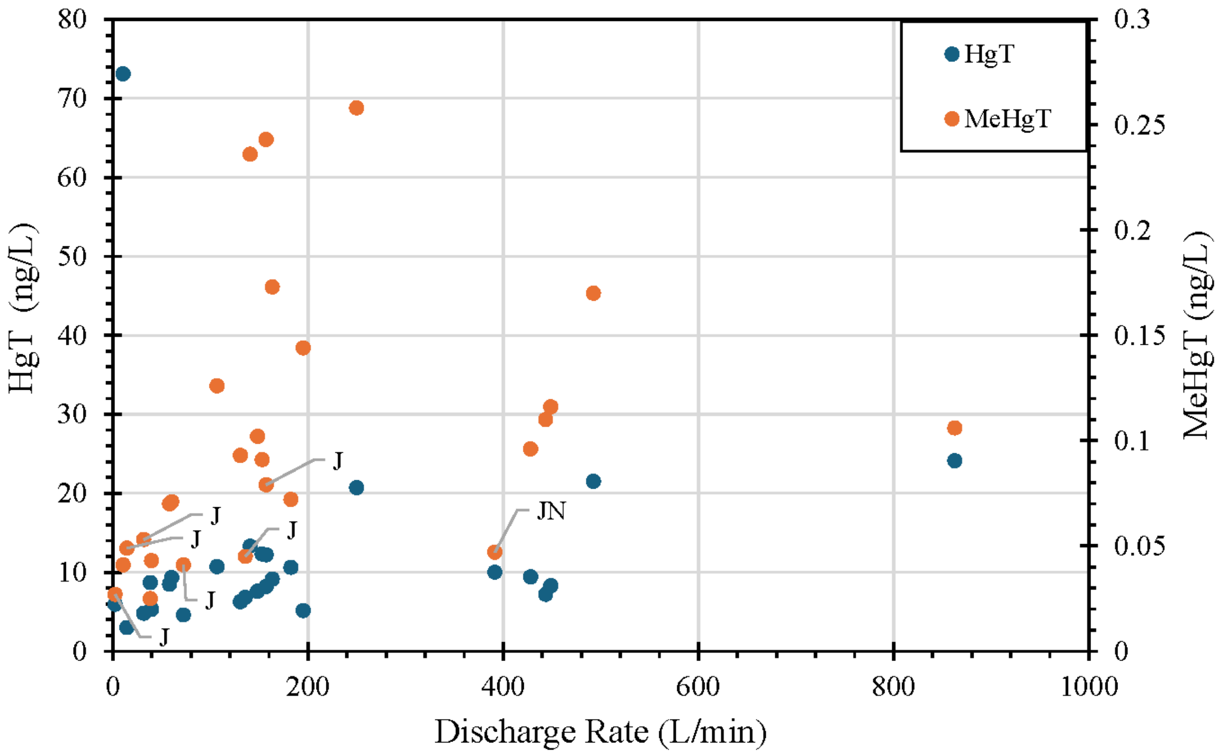


BCK = Bear Creek kilometer J = estimated value Max = maximum MeHg = methylmercury NT = North Tributary
SS = surface spring StDev = standard deviation UJ = not detected at estimated value

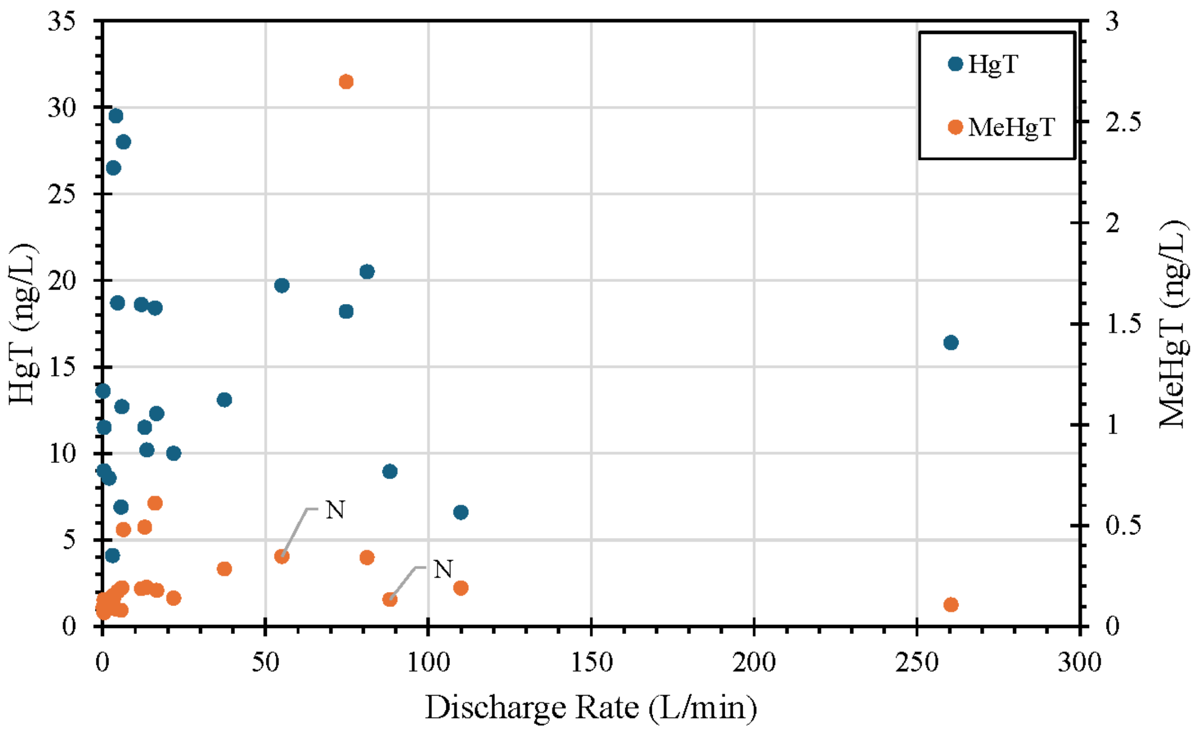
Figure 4.2. Summary of WRRP surface water methylmercury data, 2011–2023.

Figures 4.3 through 4.5 show the flow rate versus total mercury and methylmercury concentrations for BCK 12.34, NT-3 (BC-NT3), BCK 11.54A, NT-8 (BC-NT8), SS-5, and BCK 9.2. In most of the graphs, there is little apparent correlation between daily average flow rate and concentration. However, higher flow rates cause increased sediment transport, and with the strong particle retention of mercury, its mass transport can be greatly increased during high flow events.

Mercury and methylmercury flux rates (mg/day) were calculated using the daily average flow rate from the continuous monitoring records and the reported mercury concentration for each site. Figure 4.6 shows the calculated total mercury flux rate for each monitoring location on each sampled date. The daily average flow rate at BCK 9.2 is shown as an indicator of watershed flow conditions. For the BCK 9.2 flux rate data, labels indicate the total mercury concentration and the calculated daily flux rate. Figure 4.6 shows the responsiveness of the flux rate for all locations to the total flow state as indicated at BCK 9.2.

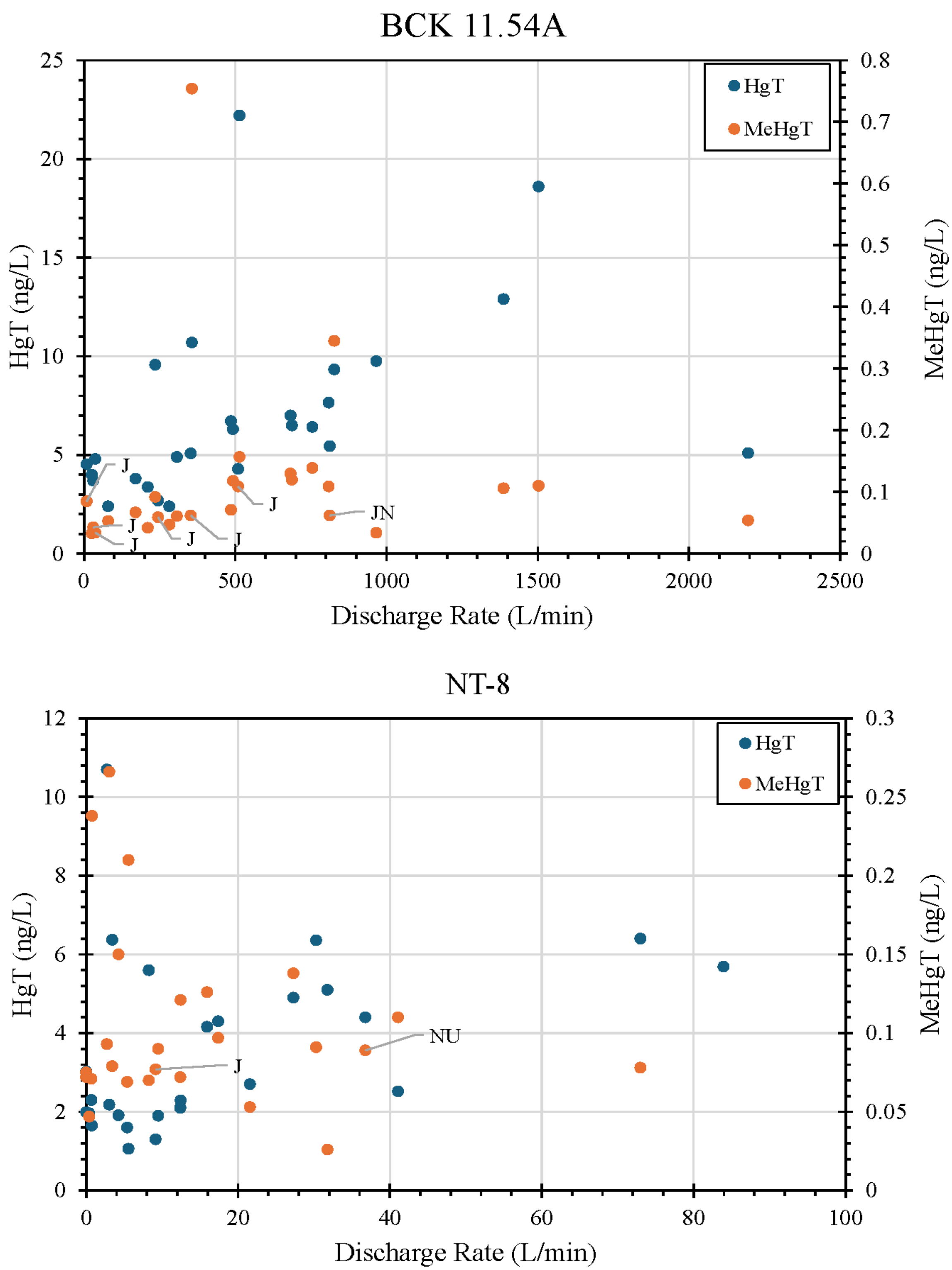


NT-3



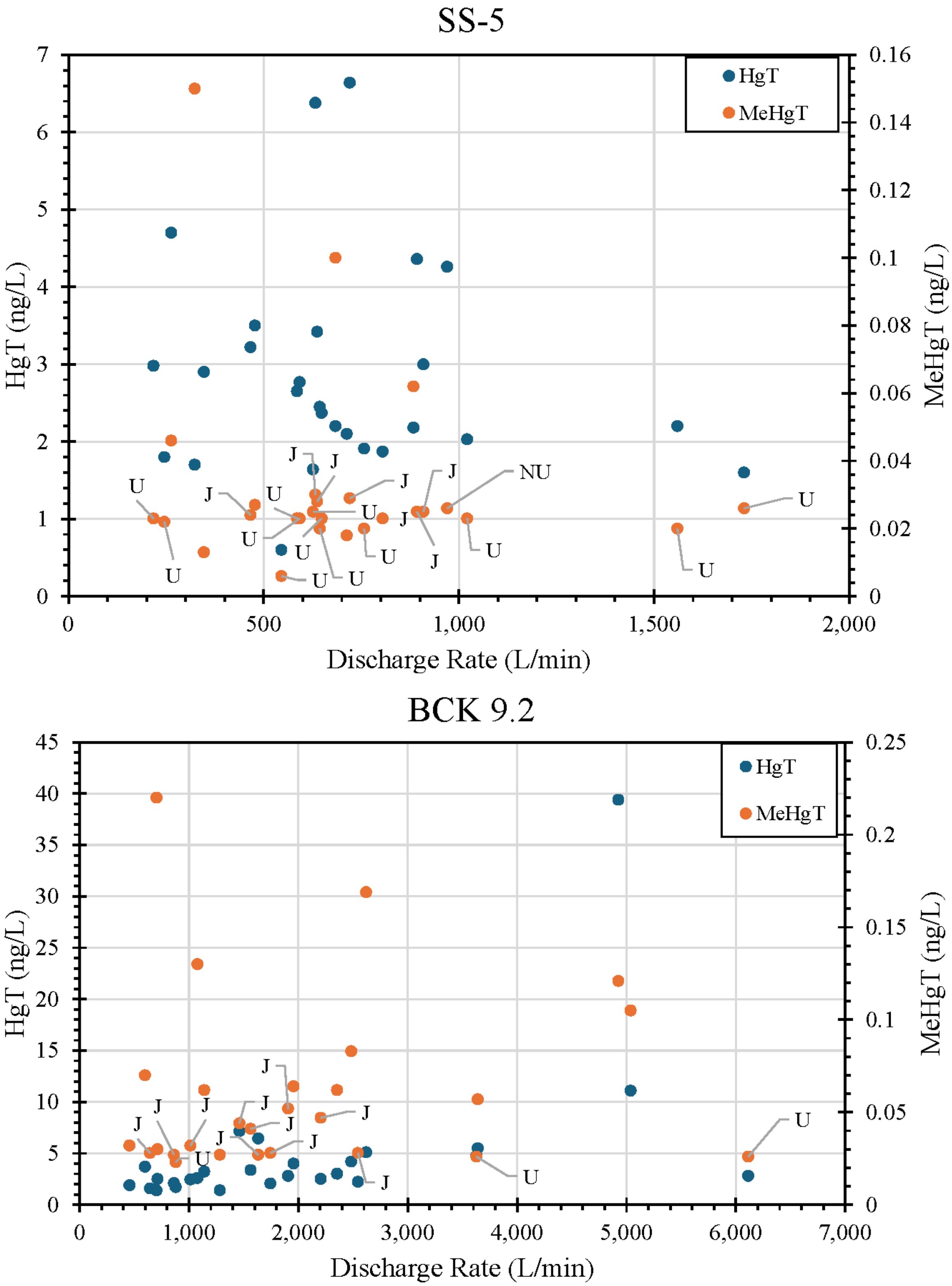
BCK = Bear Creek kilometer HgT = total mercury J = estimated value MeHgT = total methylmercury
JN = matrix spike outside limits; estimated value N = matrix spike outside limits NT = North Tributary

Figure 4.3. Flow rate versus total mercury and methylmercury concentrations at BCK 12.34 and Bear Creek NT-3.



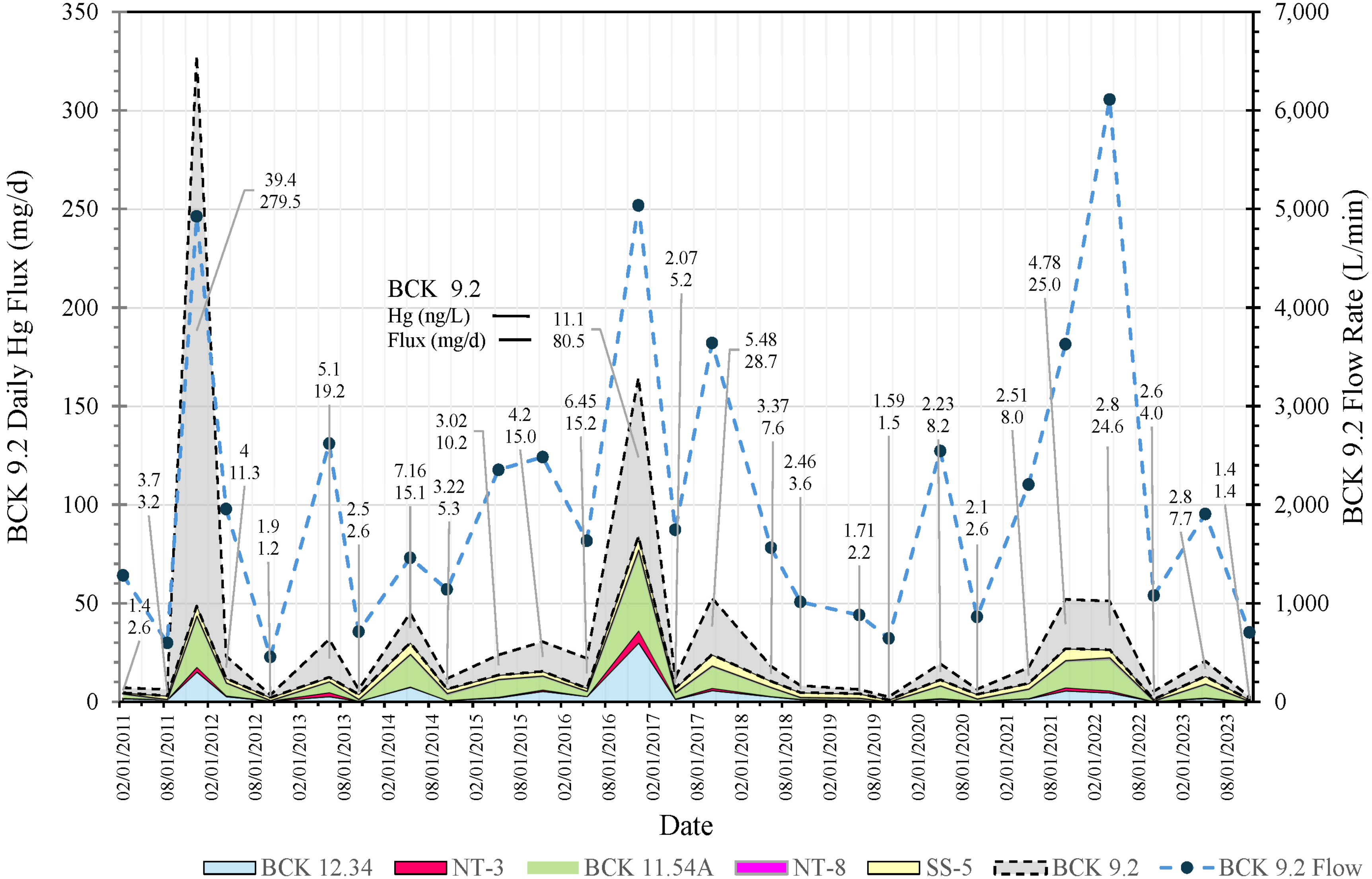
BCK = Bear Creek kilometer HgT = total mercury J = estimated value MeHgT = total methylmercury
JN = matrix spike outside limits; estimated value NU = matrix spike outside limits; not detected at reported quantitation limit
NT = North Tributary

Figure 4.4. Flow rate versus total mercury and methylmercury concentrations at BCK 11.54A and Bear Creek NT-8.



BCK = Bear Creek kilometer HgT = total mercury J = estimated value MeHgT = total methylmercury
NU = matrix spike outside limits; not detected at reported quantitation limit SS = surface spring
U = not detected at reported quantitation limit

Figure 4.5. Flow rate versus total mercury and methylmercury concentrations at spring SS-5 and BCK 9.2.



BCK = Bear Creek kilometer Hg = mercury NT = North Tributary SS = surface spring

Figure 4.6. Daily total mercury flux rate for surface water flow measurement stations.

The proportions of calculated daily mercury flux are shown in Figure 4.7. Monitoring location contributions are stacked, with the most upstream location (BCK 12.34) at the bottom and subsequent downstream monitoring locations stacked upward in sequence. Although the NT-3 stream was a historic major source of mercury to Bear Creek prior to BYBY remediation, the post-remediation mercury flux contribution to Bear Creek is minimal. Also confirmed is the negligible contribution from NT-8. The mercury flux measured at BCK 12.34 originates from contaminant discharges associated with the S-3 Ponds groundwater plume.

The flux increase observed between the small NT-3 contribution and the BCK 11.54A flume location is attributed largely to the general increase in flow, because the average and maximum mercury concentration decreases at BCK 11.54A as compared to the upstream locations (Figure 4.1). Spring SS-5 contributes a significant flux of mercury from the Maynardville Limestone karst flow system that is a subsurface channel for contaminant migration originating from multiple upstream sources. At BCK 9.2, the Zone 3 BCV Phase I ROD surface water integration point, the increased flow and decreased average mercury concentration relative to upstream locations accounts for approximately 50% of the Zone 3 surface water total mercury flux.

Figure 4.8 shows the estimated daily flux rate of total methylmercury at the monitored locations. Similar to the total mercury flux rate, the methylmercury flux rate is dominated by water flow variability. Figure 4.9 shows the stacked flux estimates for total methylmercury. Laboratory data qualifiers are shown on Figure 4.9 as a note of caution in interpreting the figure, because many of the laboratory results are estimated or non-detected results.

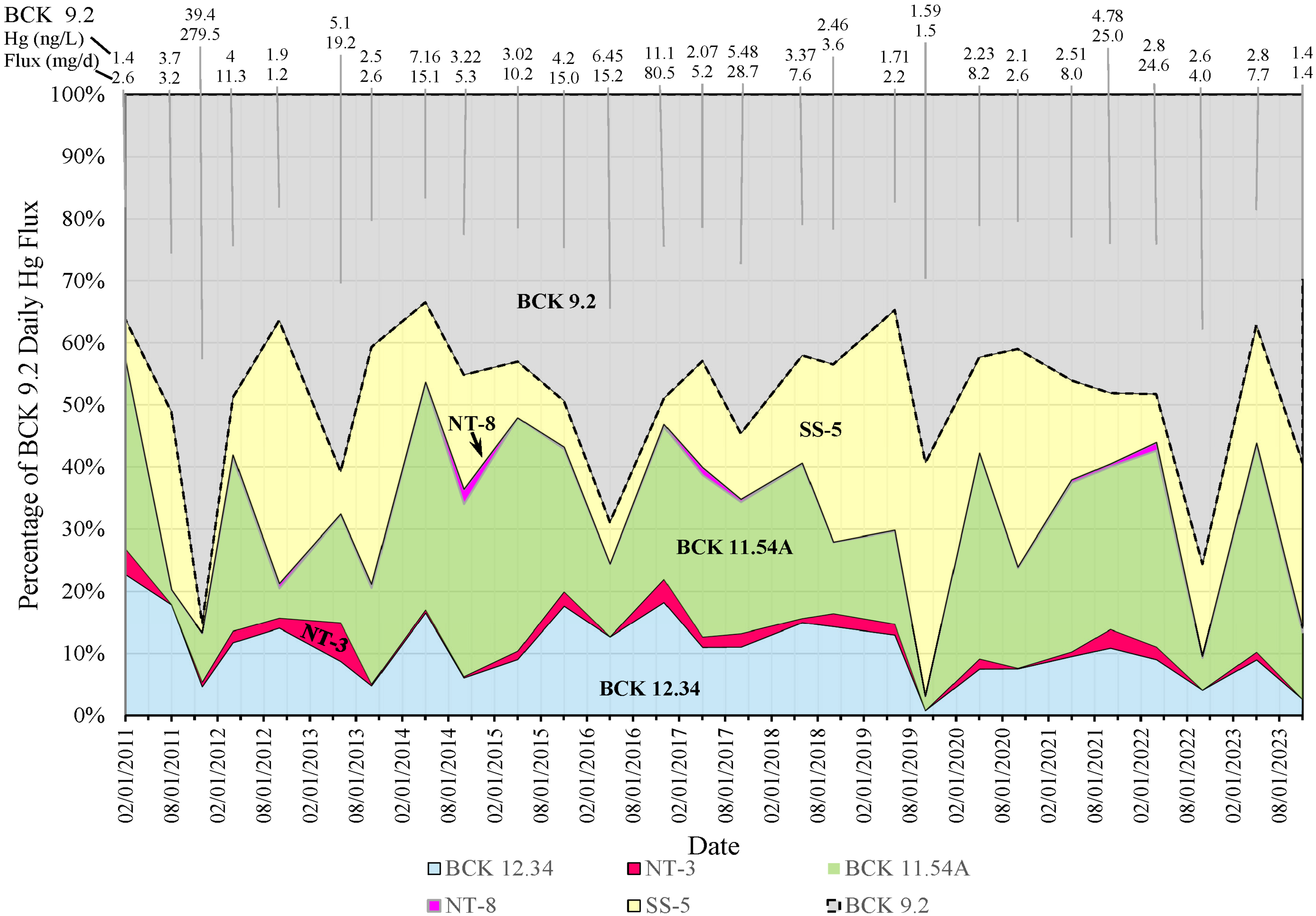
The WRRP snapshot total mercury data for Bear Creek and tributary water sources indicate concentrations are generally less than the 51-ng/L AWQC level, with occasional higher concentrations in the headwater reach. Sampling conducted during the BCV mercury sources RSE demonstrated that, at baseflow conditions, an average of 27% (+/- 5%) of mercury in surface water was dissolved, with the remaining 73% being associated with filterable solids. Surface water concentrations higher than 51 ng/L are associated with presence of elevated solids in samples.

The distribution of total mercury flux in Zone 3 Bear Creek monitoring data does not point to a specific strong source of mercury entering Bear Creek. The increasing flux in the downstream flow direction is dominated by the increasing flow volume as concentration data tend to gradually decrease. This characteristic suggests mercury entering Bear Creek downstream of the known source associated with the S-3 Ponds area is derived from dispersed mercury that may be associated with secondary contamination of creek bank and floodplain soil.

4.2 BIOLOGICAL DATA

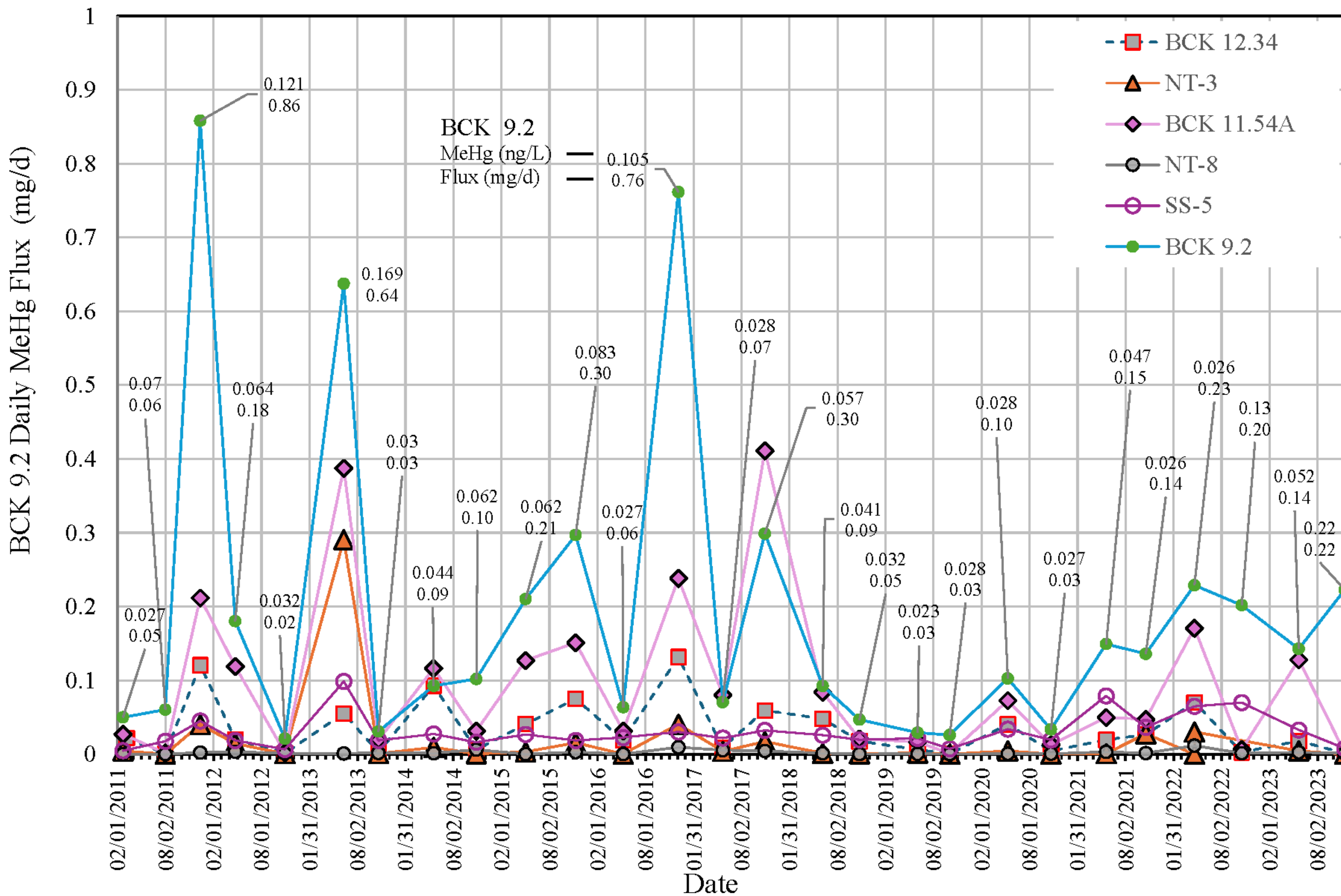
Aquatic biological monitoring of stream sites in the BCV Watershed is used to evaluate stream ecological conditions over time, providing an important measure of the effectiveness of both past and potential future remedial and abatement actions in the watershed. Long-term trends of monitored sunfish show that, despite significant fluctuation, mean mercury concentrations in fish (Figure 4.10) have been generally declining in the last 10 years and are at, below, or just above the fish tissue criterion (0.3 µg/g). Virtually all (approximately 100%) of the mercury in fish fillets in Bear Creek is methylmercury.

Mercury concentrations in rock bass (*Ambloplites rupestris*) collected in Bear Creek remained low in 2023, with concentrations at BCK 3.3 and BCK 9.9 approaching and dropping below the EPA-recommended fish-based AWQC of 0.3 µg/g in October 2023 (Figure 4.10). The fish-based AWQC of 0.3 µg/g is derived for human health risks and is not a BCV Phase I ROD-specified goal; it is, thus, used for comparison purposes only. However, concentrations remain slightly elevated with respect to fish collected from the reference site (HCK 20.6; Figure 4.10). Decreases in fish tissue mercury concentrations have coincided with decreases in aqueous methylmercury concentrations in Bear Creek (ORNL/SPR-2021/2162). The decrease in aqueous methylmercury concentrations and availability of larger fish could be attributed to the significant changes in habitat due to fluctuations in beaver activity over the past few years.



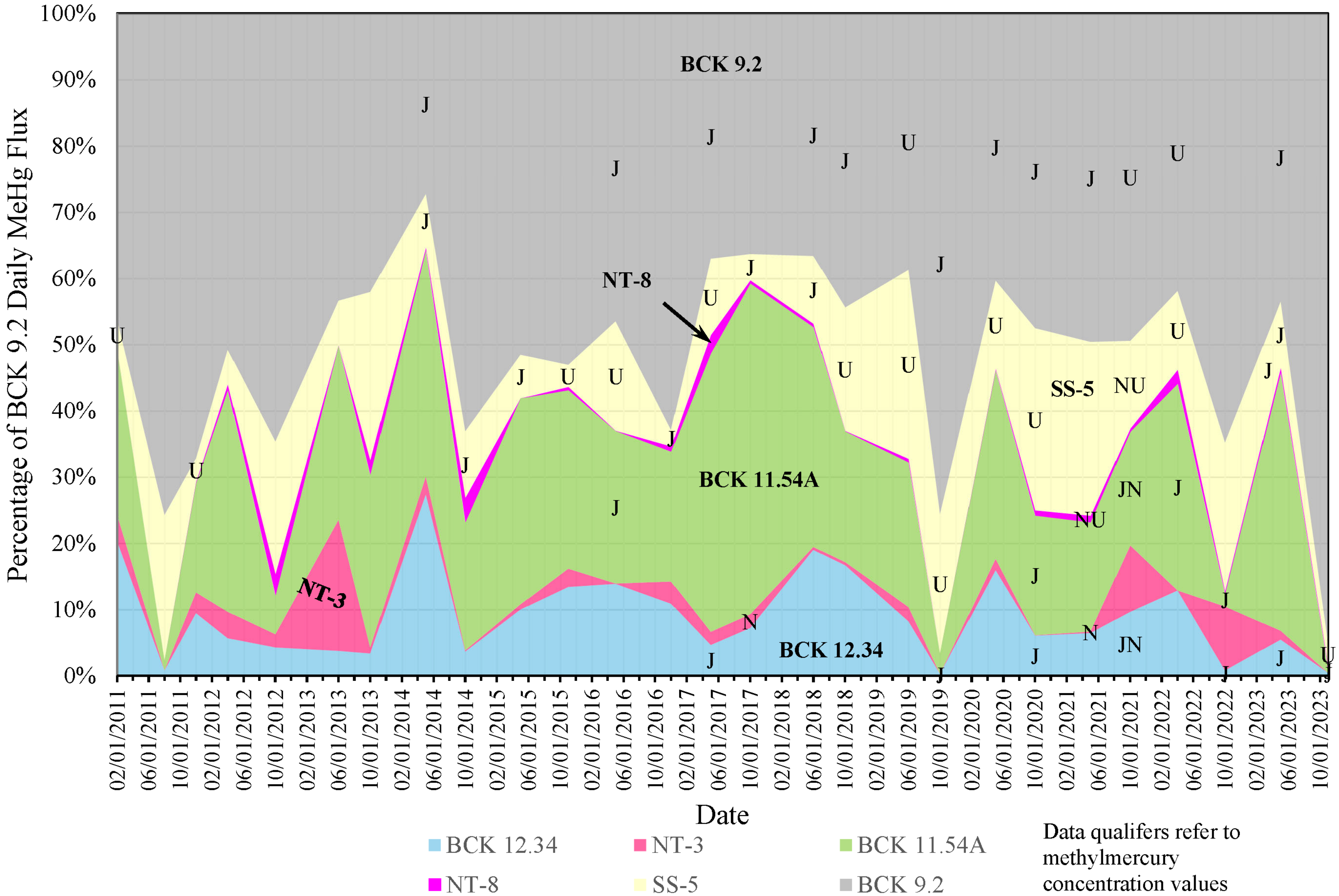
BCK = Bear Creek kilometer Hg = mercury NT = North Tributary SS = surface spring

Figure 4.7. Bear Creek Zone 3 surface water total mercury flux proportions measured at various monitoring stations.



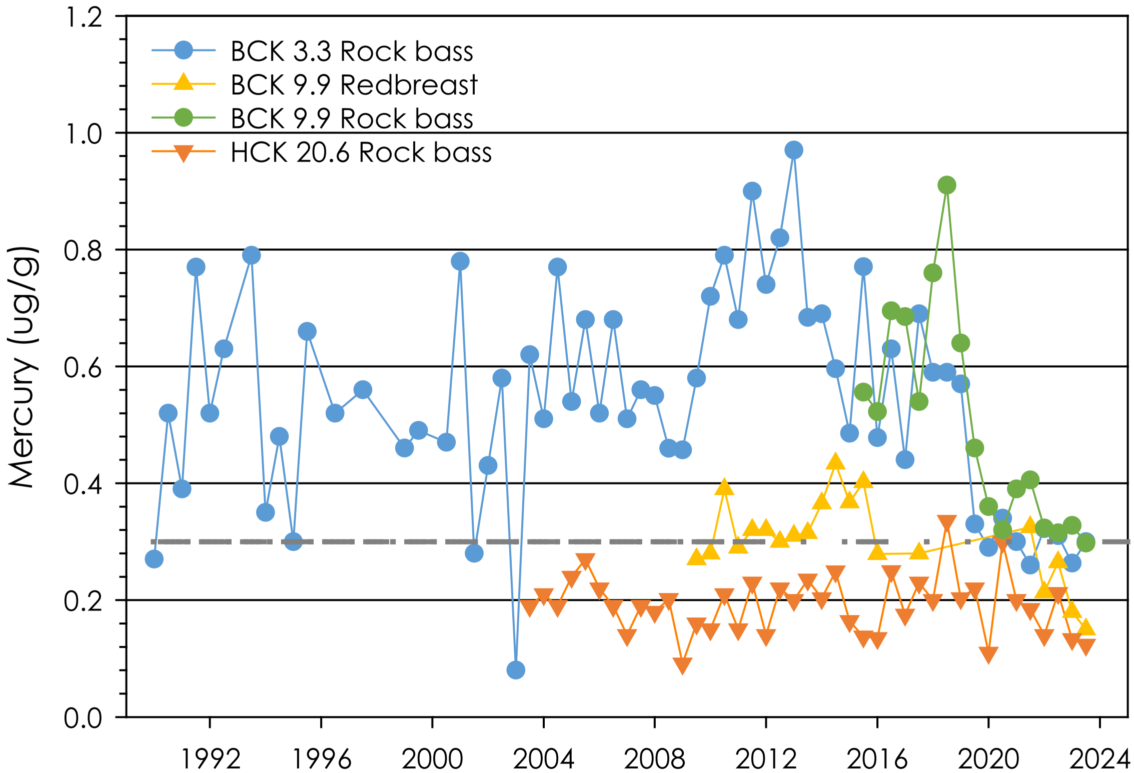
BCK = Bear Creek kilometer MeHg = methylmercury NT = North Tributary SS = surface spring

Figure 4.8. Bear Creek Zone 3 estimated total methylmercury daily flux rates.



BCK = Bear Creek kilometer J = estimated value JN = matrix spike outside limits; estimated value MeHg = methylmercury NT = North Tributary
NU = matrix spike outside limits; not detected at reported quantitation limit SS = surface spring U = not detected at reported quantitation limit

Figure 4.9. Bear Creek Zone 3 estimated total methylmercury flux proportions measured at various monitoring stations.



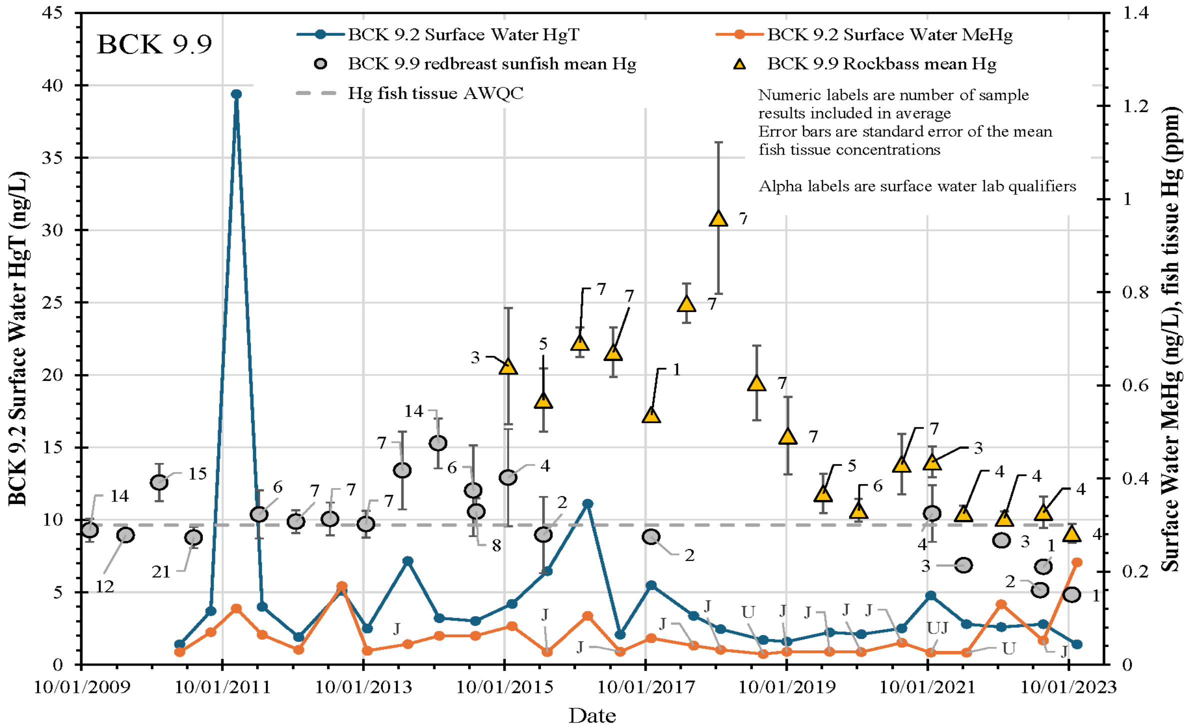
BCK = Bear Creek kilometer HCK = Hinds Creek kilometer

Figure 4.10. Average concentrations of mercury in Bear Creek fish.

The habitat through the middle-lower stretches (BCK 9.9 to BCK 4.5) of the stream had historically been poor for rock bass such that, in the early 2010s, this species could not be found and redbreast sunfish (*Lepomis auritus*) were collected as a surrogate species. Starting in 2015, as beaver-impounded sections of the middle-lower stretches of the stream created deeper pools, rock bass were present in larger numbers and in larger sizes for bioaccumulation collection. The lack of large beaver dams in FYs 2021–2023 coincided with the smaller numbers and size of rock bass available for collection. In addition, overharvesting is a concern in smaller streams like Bear Creek. Projects that require continual monitoring of larger fish or specific investigations that require increased harvesting can lead to the temporary extirpation of larger size classes of fish from sections of stream. In 2023, the sample sizes and species of fish used for bioaccumulation monitoring were significantly lower than in previous years, as fish were not available for collection despite multiple collection events. Populations of targeted fish species may require additional time to recover. Under equivalent exposure conditions in the stream, larger fish are expected to have higher tissue mercury concentrations. Future monitoring will determine whether fish mercury concentrations remain low as fish populations recover and whether the overall decreasing trend observed throughout the stream continues.

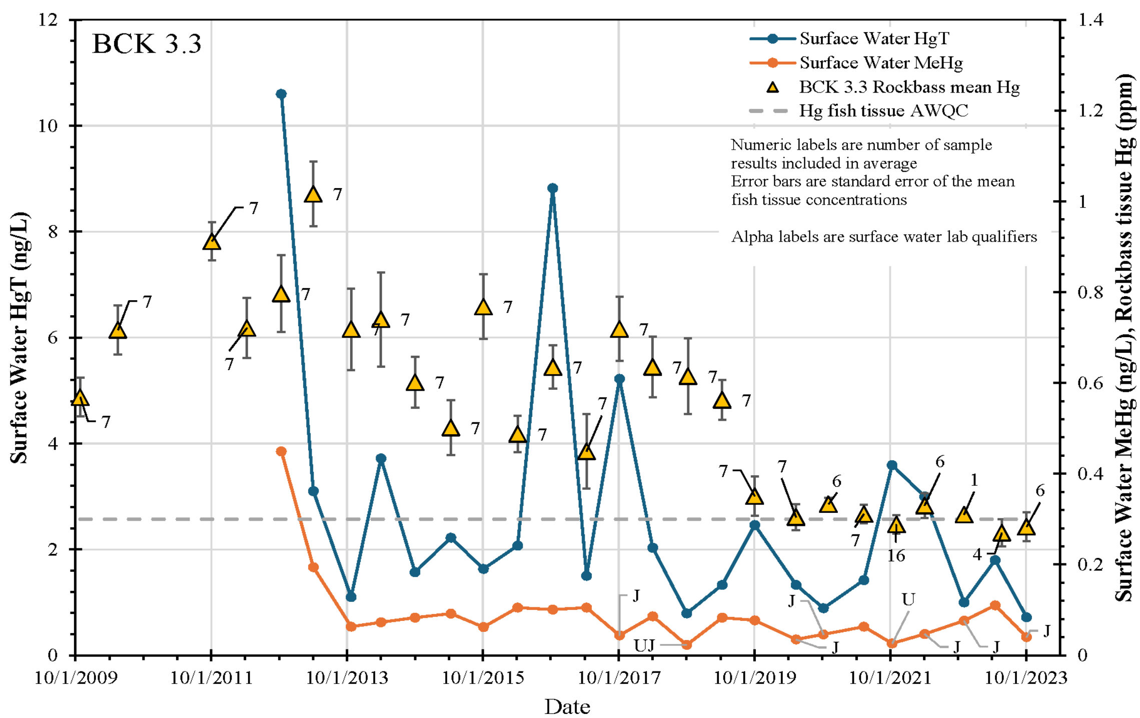
Figures 4.11 and 4.12 compare total mercury and methylmercury concentrations at BCK 9.9 and BCK 3.3, respectively, relative to fish tissue concentrations. Surface water concentrations for mercury and methylmercury are consistently well below the AWQC of 51 ng/L.

Fish tissue concentrations for rock bass at BCK 3.3 have decreased since the maximum in the early 2010s, and redbreast sunfish concentrations at BCK 9.9 have declined over the same period. Rock bass concentrations have fluctuated at BCK 9.9 over the same period but have declined sharply since the maximum in 2017–2018.



AWQC = ambient water quality criteria BCK = Bear Creek kilometer Hg = mercury HgT = total mercury
MeHg = methylmercury ppm = parts per million

Figure 4.11. Mercury and methylmercury concentrations in surface water and total mercury fish tissue concentrations at BCK 9.9.



AWQC = ambient water quality criteria BCK = Bear Creek kilometer Hg = mercury HgT = total mercury
MeHg = methylmercury ppm = parts per million

Figure 4.12. Mercury and methylmercury concentrations in surface water and total mercury fish tissue concentrations at BCK 3.3.

5. CONCLUSIONS AND RECOMMENDATIONS

This report presents results of the BCV mercury sources RSE conducted in FY 2024. The objective of the BCV mercury sources RSE is to evaluate potential sources of mercury and methylmercury within the BCV Watershed, as included in the mercury-management approach for Bear Creek in the EMDF ROD, to determine if active remediation is warranted. DOE collected and evaluated the BCV mercury sources RSE data, including channel sediment, creek bank and floodplain soil, and surface water, at transects along Bear Creek. All sampling was conducted as planned between December 2023 and April 2024, per the BCV Mercury Sources RSE SAP, with the exception of a few changes due to field conditions and stream morphology.

5.1 CONCLUSIONS

Transect data showed total mercury in surface water was highest at BCT13 (9.8 ng/L) upstream of NT-3, with decreasing concentrations downstream. Dissolved mercury was highest (1.2 ng/L to 1.9 ng/L) in the stream reach that includes BCT14, BCT13, BCT12A, BCT12B, and BCT11, with decreasing concentrations downstream. Total and dissolved mercury exhibited very little change in concentration in Bear Creek downstream of BCT7 (total mercury 1.5 ng/L to 1.9 ng/L and dissolved mercury 0.42 ng/L to 0.54 ng/L). Dissolved mercury comprised an average of 27% of the total mercury concentration, with the remaining 73% of the mercury being associated with filterable solids. All Bear Creek surface water samples collected in this investigation had mercury concentrations less than the 51-ng/L AWQC level.

Methylmercury in surface water exhibited concentration behavior similar to the pattern for total mercury, with the highest concentration measured at BCT13 (0.27 J ng/L). A significant secondary peak of methylmercury was measured in surface water at sample locations BCT9, BCT8, and BCT7, all of which are associated with beaver ponds. The ratio of methylmercury to total mercury increased in the downstream portion of Bear Creek. The ratio of dissolved methylmercury to total mercury was higher than for total methylmercury to total mercury. The maximum ratio was measured at BCT2, where the dissolved methylmercury was nearly 18% of the concentration of total mercury.

Floodplain and creek bank soil mercury and methylmercury concentrations were highest downstream from BCK 12.34 and upstream of NT-3 (BCT12B, BCT12A, and BCT13), and decrease farther downstream. Locally, near beaver ponds at the Reeves Road crossing (BCT7, BCT8, and BCT9), there is increased methylmercury in soil (especially in upper bank soils). TOC in floodplain soils is highest at BCT14 (39,200 mg/kg), with decreasing concentrations downstream. TOC concentrations furthest downstream at BCT1, BCT2, and BCT3 (9760 mg/kg to 17,000 mg/kg) were similar to those at the Hinds Creek reference site (17,400 mg/kg). Channel sediment exhibited the highest mercury concentration at BCT12A (530 µg/kg) upstream of the NT-3 confluence, with a second peak at BCT9 (440 µg/kg) in a beaver pond upstream of the Reeves Road crossing. Channel sediment TOC was highest at location BCT15 (21,200 mg/kg), located on NT-1. Due to stream channel morphology and scour, suitable fine-grained channel sediment was not available to sample at the Hinds Creek reference site and at Bear Creek transects BCT1, BCT2, BCT5, and BCT6.

Results of mercury sequential extraction analyses in Bear Creek floodplain soil samples revealed the majority of mercury was associated with extraction of organic-associated (F3) mercury. Most of the creek bank soil mercury sequential extraction analyses showed the largest fraction of mercury to be extracted with the organic (F3) extraction step; however, the majority of mercury in the creek bank soil at BCT14 was found in the F4 extraction step, thus suggesting mercury sulfide. Mercury sequential extraction analyses of channel sediment similarly showed a strong presence of organic-associated (F3) mercury, with the majority of mercury at BCT14 found in the F4 (presumed sulfide) step, although a significant fraction at BCT14 was extracted in the F5 step that indicates very strongly bound mercury. The F5 fraction was also significant in channel sediment as far downstream as BCT11, which is downstream of the NT-7 confluence with Bear Creek near BCK 9.9.

The WRRP total mercury and methylmercury flux evaluation at gauged locations in the eastern half of BCV (Zone 3) suggests the dominant effect at play under varying flow conditions is transport of particle-associated mercury that increases with increasing flow rates.

Despite low aqueous mercury concentrations in Bear Creek, the fish fillet concentrations are relatively high, likely due to high methylation efficiency and efficient trophic transfer. Fish fillet concentrations were approaching and dropping below the EPA-recommended fish-based AWQC of 0.3 µg/g in fillets in October 2023, but as previously mentioned, mercury concentrations in fish in this creek have fluctuated significantly in recent years with habitat changes. Heavy sampling in this creek has led to a decline in fish numbers and sizes in 2023; the fish collected in 2023 were smaller than average, which could affect mercury concentrations. If populations recover and/or habitat changes in the creek to facilitate mercury methylation, concentrations in fish may increase above AWQC. Future monitoring will determine whether fish mercury concentrations remain low as fish populations recover and whether the overall decreasing trend observed throughout the stream continues.

Overall, mercury contamination of surface water, floodplain and creek bank soil, and channel sediment is highest in the upper reaches of Bear Creek, with decreasing concentrations downstream. The increasing mercury flux in the downstream flow direction is dominated by the increasing flow volume, as concentration data tend to gradually decrease. This characteristic suggests mercury entering Bear Creek downstream of the known source associated with the S-3 Ponds area is derived from dispersed mercury that may be associated with secondary contamination of creek bank and floodplain soil. Although the mercury contamination is widespread in the media sampled, concentrations are low compared to other ORR mercury-contaminated sites and fish concentrations continue to decrease. This BCV mercury sources RSE did not identify a source of mercury that significantly contributes to the Bear Creek mercury contamination or that would warrant active remediation.

5.2 RECOMMENDATIONS

As summarized throughout this report, an impressive number of both water quality and discharge measurements along Bear Creek exists. Nevertheless, there are far fewer coordinated water-quality-plus-discharge-measurement campaigns with a specific emphasis on total versus dissolved mercury and methylmercury. Although the baseflow analysis of total versus dissolved mercury and methylmercury conducted in this investigation showed approximately 73% of the mercury and 39% of the methylmercury were particle-associated, there are no event-based (i.e., precipitation-driven flows), coordinated, discharge and water quality sampling campaigns. To assess total and dissolved fluxes of mercury and other solutes in addition to those available at established stations in Zone 3, an additional coordinated flow measurement and sampling location is being installed under the technical development program:

- A BCK 1 monitoring station is under development and will be equipped with a pressure transducer and multiparameter sonde (temperature, pH, specific conductance, dissolved oxygen, and nitrate). These continuous monitoring instruments may be supplemented with manual or programmed auto-sampling for mercury and methylmercury or other constituents. These measurements can provide flux data at one location.

To fully assess mass loading in Bear Creek, additional gaging stations along Bear Creek could be installed. In addition to obtaining discharge measurements and mass loading in Bear Creek, it is important to understand the biological factors controlling mercury methylation and trophic transfer in this creek. Although periphyton play an important role in mercury methylation in stream systems, how the periphyton community changes spatially and temporally in Bear Creek, and how these changes relate to methylmercury concentrations in the stream, are yet to be understood.

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APPENDIX A.
D2 VERSION OF THE BEAR CREEK VALLEY MERCURY SOURCES REMEDIAL SITE EVALUATION SAMPLING AND ANALYSIS PLAN, OAK RIDGE, TENNESSEE (DOE/OR/01-2958&D2) THAT INCLUDES TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION AND U.S. ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE D1 VERSION OF THE DOCUMENT

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DOE/OR/01-2958&D2

Bear Creek Valley Mercury Sources Remedial Site Evaluation Sampling and Analysis Plan Oak Ridge, Tennessee

DOE/OR/01-2958&D2

Bear Creek Valley Mercury Sources Remedial Site Evaluation Sampling and Analysis Plan Oak Ridge, Tennessee

Date Issued—August 2024

Prepared by the
Water Resources Restoration Program
United Cleanup Oak Ridge LLC

Prepared for the
U.S. Department of Energy
Office of Environmental Management

United Cleanup Oak Ridge LLC
under contract 89303322DEM000067

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CONTENTS

FIGURES

TABLES

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ACRONYMS

AWQC	ambient water quality criteria
BCK	Bear Creek kilometer
BCT	Bear Creek transect
BCV	Bear Creek Valley
BRA	baseline risk assessment
BYBY	Boneyard/Burnyard
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	contaminant of concern
CSM	conceptual site model
DMIP	Data Management Implementation Plan
DOE	U.S. Department of Energy
DQO	data quality objective
EMDF	Environmental Management Disposal Facility
EPA	U. S. Environmental Protection Agency
FFA	Federal Facility Agreement
HCK	Hinds Creek kilometer
MDL	method detection limit
NT	North Tributary
OREIS	Oak Ridge Environmental Information System
ORR	Oak Ridge Reservation
OU	operable unit
PQL	practical quantitation limit
QA	quality assurance
QAPP	Quality Assurance Project Plan
RI	remedial investigation
ROD	Record of Decision
RRL	requested reporting limit
RSE	remedial site evaluation
SAP	Sampling and Analysis Plan
SMO	Sample Management Office
TDEC	Tennessee Department of Environment and Conservation
UEFPC	Upper East Fork Poplar Creek
WRRP	Water Resources Restoration Program
Y-12	Y-12 National Security Complex

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1. SAMPLING OBJECTIVES

1.1 OBJECTIVE

The objective of the Bear Creek Valley (BCV) mercury sources remedial site evaluation (RSE) is to evaluate potential sources of mercury and methylmercury within the BCV Watershed, as outlined in the mercury-management approach for Bear Creek in the *Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee* (DOE/OR/01-2794&D2/R2; Environmental Management Disposal Facility [EMDF] Record of Decision [ROD]). The BCV Watershed is located in the north-central portion of the Oak Ridge Reservation (ORR) west of the Y-12 National Security Complex (Y-12). Y-12 began operations in the 1940s as part of the Manhattan Project for the purpose of enriching uranium for the first atomic bombs. Since that time, the Y-12 missions have changed, and in the 1950s, new processes for separating lithium used large amounts of mercury. Although process functions were performed adjacent to BCV in the Y-12 Main Plant Area, waste from operations at Y-12 were disposed in pits, trenches, and burial grounds in the 2800-acre BCV Watershed.

Prior remedial investigations (RIs) (e.g., *Report on the Remedial Investigation of Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* [DOE/OR/01-1455&D2; BCV RI]) and decision documents in BCV cite mercury as a potential contaminant of concern (COC). A source control action performed under the *Record of Decision for the Phase I Activities in Bear Creek Valley at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1750&D4; BCV Phase I ROD) at the remediated Boneyard/Burnyard (BYBY) (*Phased Construction Completion Report for the Bear Creek Valley Boneyard/Burnyard Remediation Project at the Y 12 National Security Complex, Oak Ridge, Tennessee* [DOE/OR/01-2077&D2]) focused on excavating mercury-contaminated soil along North Tributary (NT)-3. Mercury surface water results in BCV are consistently below Tennessee general ambient water quality criteria (AWQC) (TDEC 2019); however, fish tissue concentrations remain above or near the U.S. Environmental Protection Agency (EPA)-recommended AWQC for mercury (0.3 µg/g in fish). Mercury and methylmercury data for sediment and soil that may contribute to concentrations in fish are limited.

This BCV Mercury Sources RSE Sampling and Analysis Plan (SAP) identifies the locations, media, and sampling methodology that will support the RSE objectives. Impacts of source areas and hydrology on mercury concentrations will be assessed in associated channel sediment, creek bank and floodplain soils, and surface water at multiple sampling transects throughout the length of the stream. Results of this evaluation will be combined with biota data to evaluate potential mercury source areas in BCV to support the RSE and any recommendations made therein.

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2. PROJECT INFORMATION

2.1 INTRODUCTION

This section contains information about BCV and potential sources of mercury in BCV and summarizes existing mercury data in BCV. Information in this section serves to provide a context for the sampling discussed in later sections of this BCV Mercury Sources RSE SAP.

2.2 BACKGROUND

2.2.1 Site Description

The BCV Watershed is located at the western end of Y-12 in the north-central portion of the ORR west of the Upper East Fork Poplar Creek (UEFPC) Watershed (Figure 2.1). BCV contains closed and active waste disposal facilities. The boundary between the BCV and UEFPC Watersheds is defined by a surface water divide between eastward-flowing East Fork Poplar Creek and westward-flowing Bear Creek. The integration point for Bear Creek is at Bear Creek kilometer (BCK) 9.2 where more than 99% of the available water from the eastern portion of BCV passes through this location either as surface water or groundwater. As illustrated in Figure 2.1, the BCV Watershed is subdivided into three zones based on end use. The subareas of BCV to be investigated under this BCV Mercury Sources RSE SAP represent geographic areas located at or downstream from potential U.S. Department of Energy (DOE) on-site source areas. Based on the EMDF ROD, the end use for Zone 1 and Zone 2 will be revised to restricted recreational and controlled industrial, respectively, which will be codified in an upcoming modification to the BCV Phase I ROD.

2.2.2 Summary of Potential Mercury Source Areas

BCV contains multiple historical waste management and disposal areas that received mercury-contaminated waste streams from Y-12 operations from 1943–1993, in addition to having materials storage areas and construction storage areas (Figure 2.1). There are two RODs for BCV that identify mercury as a COC—the BCV Phase I ROD; and the *Record of Decision for Bear Creek Operable Unit 2 (Spoil Area 1 and SY-200 Yard) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/02-1435&D2; BCV Operable Unit [OU]2 ROD). The BCV Phase I ROD cited mercury as a COC posing environmental hazards due to migration from BYBY. BYBY is a former mercury source area that was remediated using hydraulic controls and excavation of visible waste material; Bear Creek tributary NT-3 runs through BYBY. The BCV RI identified mercury as a COC for human health for the following: BYBY, Oil Landfarm, Hazardous Chemical Disposal Area, S-3 Ponds Site, Sanitary Landfill 1, Bear Creek Road Debris Burial, and Creekside Debris Burial. The BCV RI indicated some elevated soil mercury concentrations exist, generally within an order of magnitude of the background criterion (0.34 mg/kg). The baseline risk assessment (BRA) in the BCV RI stated "the sources of mercury and PCBs to the BCV fish are currently unknown."

The Remedial Investigation Report on Bear Creek Valley Operable Unit 2 (Rust Spoil Area, Spoil Area 1, and SY-200 Yard) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee (DOE/OR/01-1273&D2; BCV OU2 RI) identified mercury as a COC for human health for the SY-200 Yard, which was a former equipment storage yard used to store nonradioactive contaminated equipment from the 1950s to 1986. Mercury contamination was discovered during construction in 1990, and a soil cover was placed over the site. While other areas (Spoil Area 1 and the Rust Spoil Area) had mercury as a contaminant of potential concern in the BCV OU2 RI, the BRA did not identify mercury as a COC for these areas. The BCV OU2 RI indicated mercury concentrations were elevated at the SY-200 Yard but were generally within an order of magnitude of background; however, free mercury was seen in some of the borings at the SY-200 Yard during the BCV OU2 RI. The BCV OU2 ROD identified the SY-200 Yard as the area with mercury.

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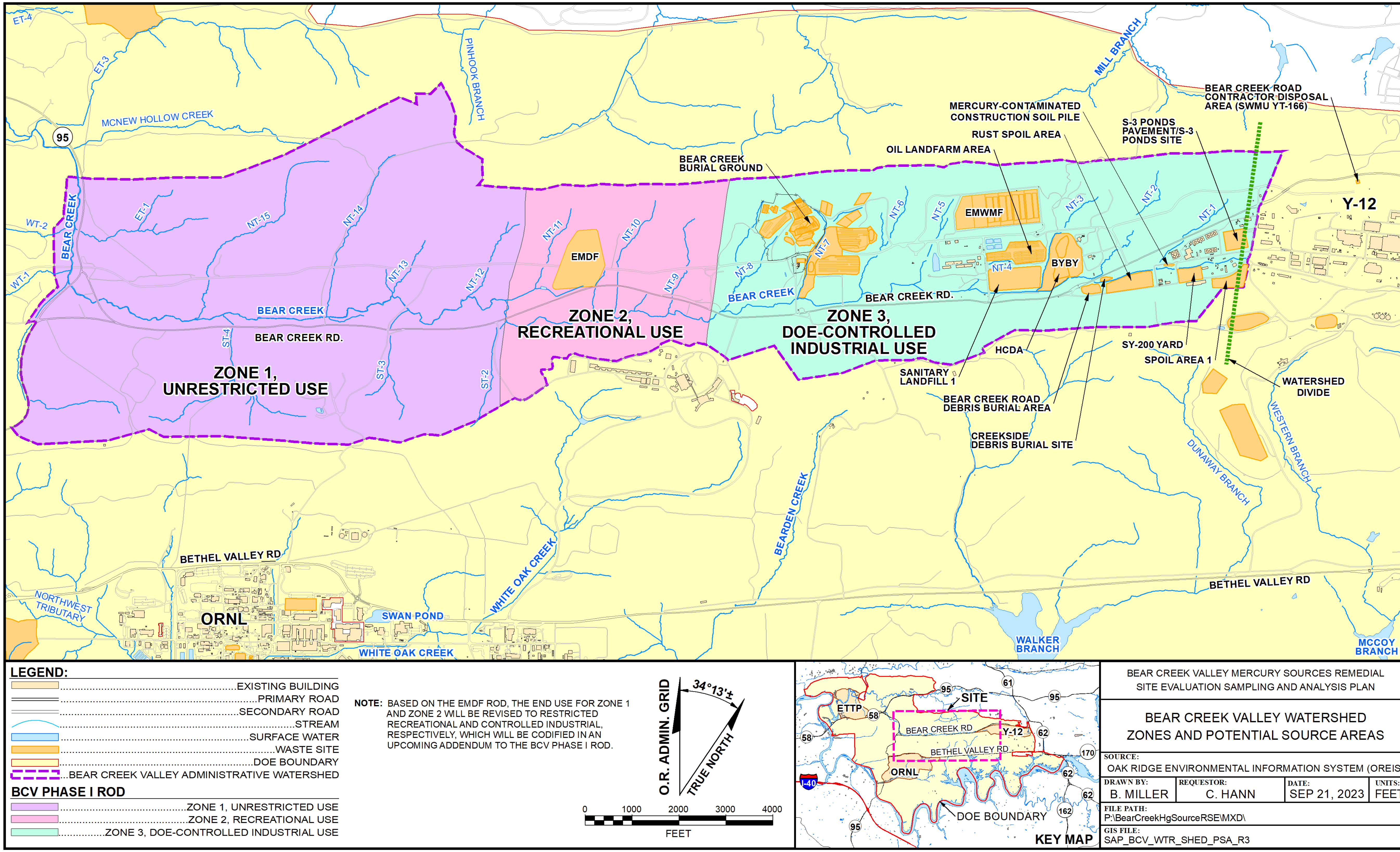

Figure 2.1. BCV Watershed zones and potential source areas.

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2.3 SUMMARY OF EXISTING BEAR CREEK VALLEY MERCURY DATA

Mercury data for sediment, surface water, and biota in BCV are available in the Oak Ridge Environmental Information System (OREIS). However, sediment data are limited, and no methylmercury data are available for BCV sediment in OREIS. Twenty-nine data points for total mercury in BCV sediment are available ranging from 1993–2011: 7 locations in Zone 1, 2 locations in Zone 2, and 20 locations in Zone 3. Concentrations range from non-detect to 6.9 mg/kg total mercury.

As shown in Table 2.1, under the *Bear Creek Valley Watershed Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-2457&D4), surface water and biota sampling have been performed. Results are reported annually in a Remediation Effectiveness Report or every 5 years in a Five-Year Review. Surface water data since 2011 (Figure 2.2) show a steady or declining trend, with mercury below AWQC, with very few exceptions. Mercury concentrations are generally higher upstream and decrease downstream; methylmercury concentrations are more variable upstream to downstream. Long-term trends of monitored sunfish show that, despite significant fluctuation, mean mercury concentrations in fish (Figure 2.3) have been generally declining in the last 10 years and are below or just above the fish tissue criterion (0.3 µg/g) as of 2022.

Table 2.1. Current surface water and biota sampling in Bear Creek

Medium	Performance standard	Sampling frequency	Parameter	Monitoring location
Surface water	AWQC	Semiannual (Q1 and Q3)	Total mercury and methylmercury	BCK 3.3, BCK 4.55, BCK 9.2, BCK-11.54A, BCK 12.34, NT-3, SS-4, and SS-5
		Semiannual (Q2 and Q4) in year before FYR	Total mercury	BCK 4.55, BCK 9.2, BCK 12.34, NT-3, and NT-8
		Annual in year before FYR	Total mercury	BCK-7.87 and NT-1
		Annual in year before FYR	Methylmercury	NT-5
	Trend monitoring	Quarterly	Bicarbonate, carbonate, chloride, fluoride, and sulfate	NT-1, NT-2, NT-3, SS-4, and SS-5
		Semiannual		NT-7 and NT-8
		Quarterly in year before FYR		NT-5
	Water quality	Semiannual	Total suspended solids and total dissolved solids	NT-7 and NT-8
		Quarterly in year before FYR		BCK 4.55, BCK-7.87, BCK 9.2, BCK 12.34, NT-1, NT-3, NT-5, and NT-8
Biota	Baseline sampling	Semiannual	Mercury and methylmercury	BCK 3.3, BCK 9.9, and HCK 20.6 (whole-body stoneroller minnows and rock bass fillets); BCK 12.4 (whole-body stoneroller minnows)
		Annual in year before FYR	Mercury and methylmercury	BCK 9.9 (whole-body caddisflies)

AWQC = ambient water quality criteria
BCK = Bear Creek kilometer
FYR = Five-Year Review
HCK = Hinds Creek kilometer
NT = North Tributary
Q = quarter
SS = surface spring

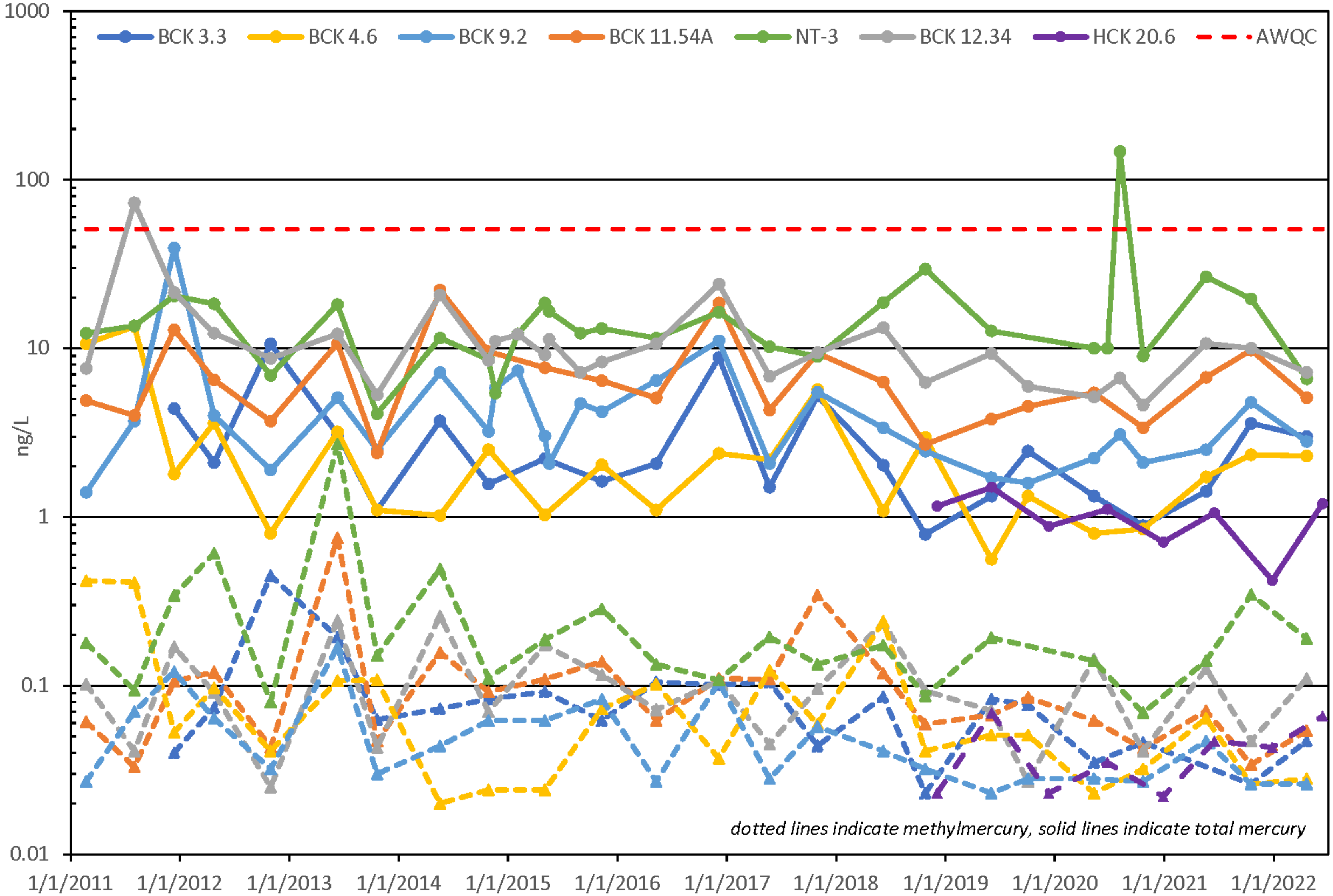

Figure 2.2. Surface water data for mercury and methylmercury in Bear Creek, NT-3, and Hinds Creek, 2011–2022.

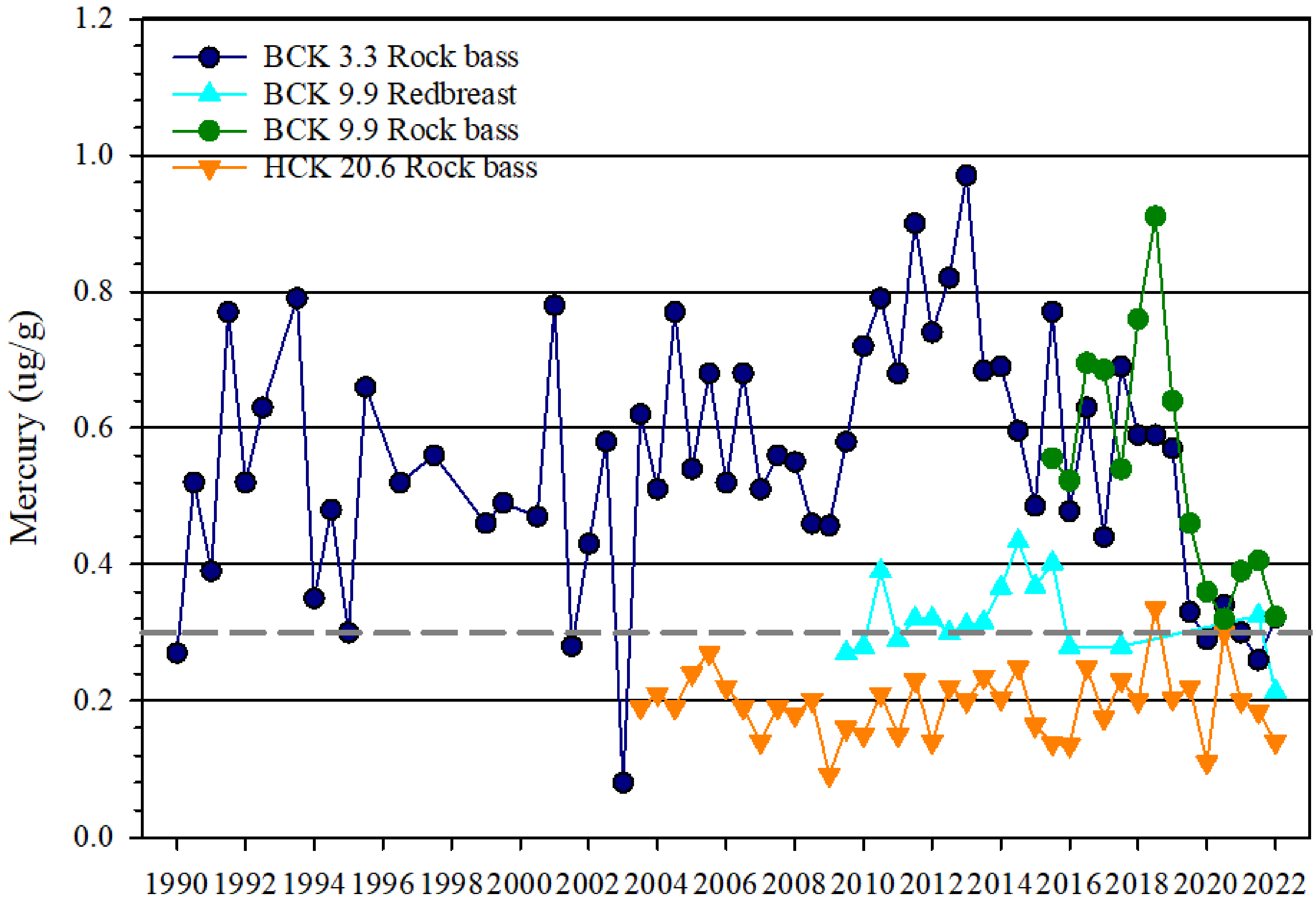

Figure 2.3. Average concentrations of mercury in Bear Creek fish.

Recently, the Oak Ridge National Laboratory conducted special studies of Bear Creek to better understand the biotic and abiotic factors contributing to mercury concentrations in fish in Bear Creek. These field studies focused on gaining an understanding of the processes controlling mercury methylation and bioaccumulation, with beaver dams and periphyton being key areas of interest. Studies included understanding the role of beaver dams in contributing to mercury dynamics in Bear Creek (2017–2018), evaluating the effects of fine-grained sediment deposition (2019), investigating the potential role tributaries to Bear Creek may have on mercury and methylmercury in the main channel (2020–2021), and evaluating periphyton relationships (2021). These special studies were documented in the *Bear Creek Special Studies Report 2021* (ORNL/SPR-2021/2162).

3. DATA QUALITY OBJECTIVES SUMMARY

The Data Quality Objective (DQO) Process provides systematic planning for decision-making and is an important tool for defining the type, quality, and quantity of data needed to make defensible decisions. EPA developed the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA/240/B-06/001) for implementing the DQO Process as part of its Quality System, an Agency-wide program for environmental data. The DQO Process is a seven-step iterative planning approach used to prepare plans for environmental data-collection activities. It provides a systematic approach for defining criteria that a data-collection design should satisfy, including identifying when, where, and how to collect samples or measurements; determining tolerable decision error rates; and specifying the number of samples or measurements that should be collected. DQOs define the purpose of the data-collection effort, clarify what the data should represent to satisfy this purpose, and specify the performance requirements for the quality of information to be obtained from the data. These outputs, which are developed in the first six steps, are then used in the seventh and final step of the DQO Process to develop a data-collection design that meets all performance criteria and other design requirements and constraints.

DOE, EPA, and Tennessee Department of Environment and Conservation (TDEC) representatives attended a DQO meeting held on June 29, 2023. Appendix A provides the meeting minutes and a copy of the presentation. The BCV Mercury Sources RSE project DQOs are summarized below.

3.1 DATA QUALITY OBJECTIVE STEP 1: STATE THE PROBLEM

The first step in the DQO Process is to concisely describe the problem to be studied. Review of prior studies and existing information is necessary to gain a sufficient understanding to define the problem (i.e., conceptual site model [CSM]). The problem statement identified during the DQO meeting is:

- There are insufficient data along Bear Creek and its tributaries to determine if there are potential sources of mercury and methylmercury in channel sediment and creek bank and floodplain soils that may be contributing to exceedances of fish tissue criterion in prior years.

3.2 DATA QUALITY OBJECTIVE STEP 2: IDENTIFY GOALS OF THE STUDY

Step 2 of the DQO Process is to identify how data will be used to meet the objectives and what questions the study will attempt to resolve. The goals of the BCV Mercury Sources RSE project are to:

- Determine if there are areas (channel sediment and creek bank and floodplain soils) along Bear Creek and its tributaries that are potential sources of mercury and methylmercury that may affect fish.
- Obtain data from various hydrologic settings (pools, beaver ponds, etc.) that may contribute to mercury methylation and its bioaccumulation in the environment of Bear Creek and a reference location (e.g., Hinds Creek).

3.3 DATA QUALITY OBJECTIVE STEP 3: IDENTIFY INFORMATION INPUTS

This step is to identify the information that needs to be obtained and the measurements that need to be taken to achieve the goals of the study. This information is necessary so that proper data may be collected to resolve the problem statement. The information inputs for the BCV Mercury Sources RSE project are to:

- Review potential sources of mercury and methylmercury in Bear Creek and its tributaries.
- Review existing historical biota, surface water, sediment, and special studies data in Bear Creek, its tributaries, and a reference site (Hinds Creek kilometer [HCK] 20.6).

- Collect additional surface water, channel sediment, creek bank soil, and floodplain soil data along Bear Creek and its tributaries from selected transects.
- Collect additional surface water, channel sediment, creek bank soil, and floodplain soil data from the reference site (HCK 20.6).

3.4 DATA QUALITY OBJECTIVE STEP 4: DEFINE THE STUDY AREA BOUNDARY

The purpose of this step is to clarify the site characteristics that the environmental measurements are intended to represent. In this step, time periods and spatial area to which decisions will apply (i.e., determine when and where data will be collected) are specified. Practical constraints that could interfere with sampling also are identified in this step. The BCV Mercury Sources RSE study area boundaries follow:

- Spatial – Bear Creek, its tributaries, and a reference location and limited surrounding creek bank soil and floodplain soil.
- Vertical – shallow channel sediment, creek bank soil, and floodplain soil (0 to 0.5 ft).
- Temporal – samples anticipated to be collected in December 2023 to meet the RSE milestone of September 2024.

3.5 DATA QUALITY OBJECTIVE STEP 5: DEVELOP THE ANALYTICAL APPROACH

This step is to develop an analytic approach that will guide how the study results are analyzed and conclusions are drawn from the data. The key steps for the analytical approach are to:

- Prepare an initial CSM to include all available information on potential mercury sources and historic sediment and surface water monitoring data from Bear Creek.
- Field-locate transects in potential source areas and pool areas (e.g., upstream of beaver dams) in Bear Creek and the mouths of tributaries (e.g., NT-3) based on the reconnaissance survey. Field-locate a reference site.
- Collect surface water, channel sediment, creek bank soil, and floodplain soil samples at transects to determine mercury and methylmercury concentrations along Bear Creek, its tributaries, and the reference site (HCK 20.6).
- Assess and document physical stream conditions (e.g., channel morphology, substrate) at each transect.
- Analyze samples for mercury, methylmercury, nutrients (e.g., sulfate, total phosphorus, nitrate-nitrite as nitrogen, organic carbon), particle size analysis, and mercury speciation/sequential extraction at select locations.
- Screen mercury surface water data against applicable TDEC AWQC.
- Compare concentrations in channel sediment and creek bank and floodplain soil in and around Bear Creek and its tributaries to the reference site (HCK 20.6) concentrations.

3.6 DATA QUALITY OBJECTIVE STEP 6: SPECIFY THE PERFORMANCE OR ACCEPTANCE CRITERIA

The purpose of this step is to derive the performance or acceptance criteria that the collected data will need to achieve to minimize the possibility of either making erroneous conclusions or failing to keep uncertainty in estimates to within acceptable levels. Sampling uncertainty and associated decision errors are managed by increasing the number of field samples, which is more effective than controlling measurement uncertainty by repeated laboratory analyses. By designing the data-collection process appropriately, the level of uncertainty in the data can be controlled to achieve acceptable results. Thus, errors in decisions based on environmental data may be managed effectively by complying with the requirements of the *Quality Assurance Project Plan for the Water Resources Restoration Program, U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee* (UCOR-4049; Water Resources Restoration Program [WRRP] Quality Assurance Project Plan [QAPP]). New data will be obtained under approved WRRP procedures and quality programs and will be archived in OREIS.

3.7 DATA QUALITY OBJECTIVE STEP 7: DEVELOP THE PLAN FOR OBTAINING DATA

The purpose of this step is to identify a field investigation sampling design that meets performance criteria, as specified in the preceding steps of the DQO Process. The output of this step is development of this BCV Mercury Sources RSE SAP. The sampling and analysis approach (Chapters 4 and 5) presents the plan for generating data for the BCV mercury sources RSE that satisfies the DQO and is sufficient to make decisions that achieve RSE requirements.

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4. SAMPLING AND ANALYSIS PLAN – SAMPLE LOCATION SELECTION

The work contained within this BCV Mercury Sources RSE SAP is consistent with a framework of plans, procedures, and protocols under the WRRP that help ensure all data collected are managed in a manner consistent with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requirements. In accordance with this overall objective, the WRRP has developed the WRRP QAPP to identify and implement quality assurance (QA) requirements for use in sample collection, laboratory analysis, and data management of environmental media monitoring activities. The *Data Management Implementation Plan for the Water Resources Restoration Program, Oak Ridge, Tennessee* (UCOR-4160; WRRP Data Management Implementation Plan [DMIP]) serves as the project-level plan for managing all data collected by the WRRP. Together, these plans identify the procedures that are followed in collecting, maintaining custody of, and handling samples, as well as in verifying, validating, and retaining environmental and laboratory data used by the WRRP in preparation of Federal Facility Agreement (FFA) documents.

Sample collection, laboratory analysis, and data management activities performed under this BCV Mercury Sources RSE SAP will follow the requirements of approved, relevant WRRP procedures, as detailed in the WRRP QAPP and WRRP DMIP. Additional requirements governing fieldwork and sample collection, specified in the *Quality Assurance Plan for Environmental Characterization and Monitoring, Oak Ridge, Tennessee* (UCOR-4189), will also apply as appropriate. Per EPA's Uniform Federal Policy, a SAP/QAPP checklist will be submitted under separate cover for EPA approval. The approved checklist will be retained in Appendix F of the WRRP QAPP.

A list of sampling locations along Bear Creek and its tributaries includes transects meeting the requirements of DQO Process Steps 4 and 5 (define the study area boundary and develop the analytical approach) for the collection of channel sediment, creek bank and floodplain soils, and surface water, which was identified in the DQO meeting (Table 4.1 and Figure 4.1). A conceptual diagram of the transect sampling plan is included as Figure 4.2 and is described in Sections 4.1 through 4.4.

4.1 SEDIMENT

Channel sediment samples will be collected at each of the 16 transect monitoring locations as well as at a single reference site (HCK 20.6) following PROC-ES-2302, *Sediment Sampling*. Sediment will be collected to an approximate depth of 0.5 ft and run through a 1-mm sieve until adequate sample volume is achieved.

4.2 SOIL

Both creek bank and floodplain soils will be collected at each of the 16 transect monitoring locations as well as at a single reference site (HCK 20.6) following PROC-ES-2300, *Soil Sampling*. However, collection of these two soil types will vary as follows:

- Creek bank soils will be divided in half into upper and lower sections based on in-field conditions as follows (Figure 4.2):
  - For the upper section of the creek bank soils, samples will be collected by removing the surface soil on the upper half of each side of the bank. The upper creek bank samples on each side will be composited into a single sample.
  - For the lower section of the creek bank soils, samples will be collected by removing the surface soil on the lower half (above the creek level) of each side of the bank. The lower creek bank samples on each side will be composited into a single sample.
- Floodplain soil will be collected from the upper 0.5 ft on either side of Bear Creek to generate a composite sample representing both sides of the floodplain (Figure 4.2). Loose organic material, such as leaves or brush, will be removed prior to collection.

Table 4.1. List of transect locations in BCV

Sample group	Location
LOWBCV	BCT1 (upstream of BCK 0.6; downstream of beaver dam)
	BCT2 (upstream of BCK 0.6; upstream of beaver dam)
	BCT3 (downstream of BCK 3.3; downstream of beaver dam)
	BCT4 (downstream of BCK 3.3; upstream of beaver dam)
BCV ZONE 1	BCT5 (downstream of BCK 4.55; downstream of beaver dam)
	BCT6 (downstream of BCK 4.55; upstream of beaver dam)
	BCT7 (downstream of BCK 7.87 at the confluence of NT-13/Bear Creek; downstream of westernmost beaver dam)
	BCT8 (downstream of BCK 7.87 at the confluence of NT-13/Bear Creek; upstream of westernmost beaver dam)
	BCT9 (downstream of BCK 7.87; upstream of two beaver dams; southeast of Reeves Road/Haul Road)
BCV ZONE 2	BCT10 (downstream of surface water integration point BCK 9.2; upstream of EMDF)
BCV ZONE 3	BCT11 (upstream of NT-8 at BCK 9.9)
	BCT12A (upstream of NT-3 at the confluence with Bear Creek)
	BCT12B (downstream of BYBY at the confluence of NT-3/Bear Creek)
	BCT13 (upstream of BYBY, EMWMF, and NT-3)
	BCT14 (downstream of SY-200 Yard, Spoil Area 1, and S-3 Ponds Site)
	BCT15 (downstream of S-3 Ponds Site)
Hinds Creek	HCTREF (HCK 20.6 reference site)

BCK = Bear Creek kilometer
BCT = Bear Creek transect
BCV = Bear Creek Valley
BYBY = Boneyard/Burnyard
EMDF = Environmental Management Disposal Facility
EMWMF = Environmental Management Waste Management Facility
HCK = Hinds Creek kilometer
HCTREF = Hinds Creek transect reference site
NT = North Tributary

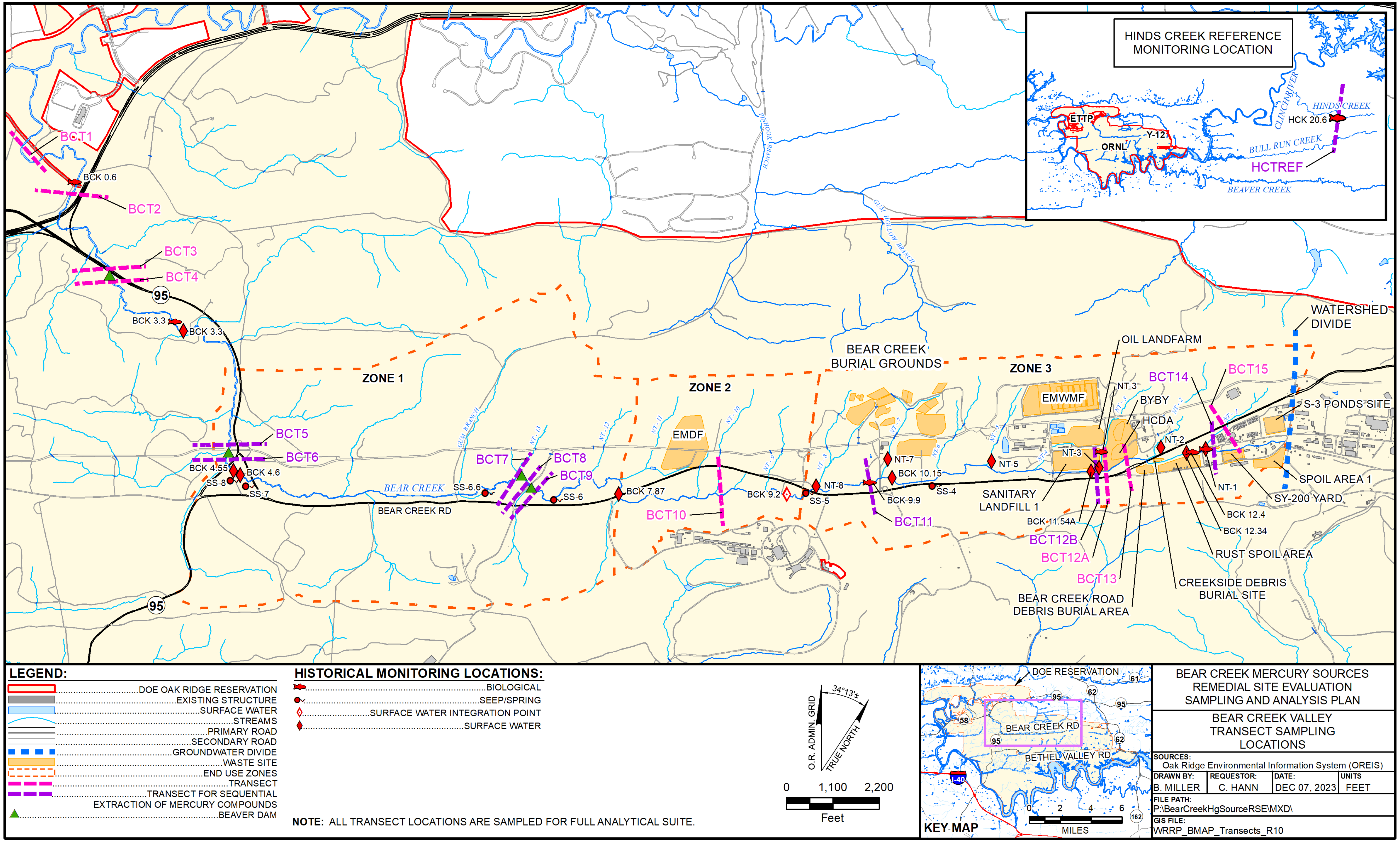

Figure 4.1. BCV transect sampling locations.

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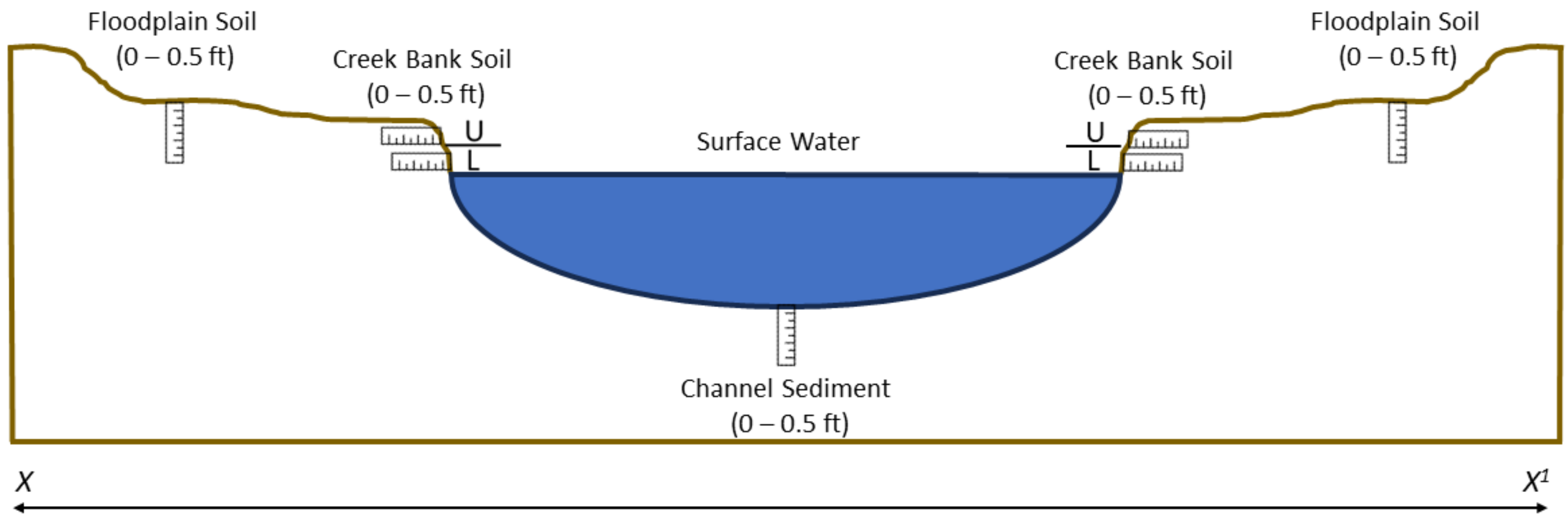

Figure 4.2. BCV RSE transect diagram.

4.3 SURFACE WATER

Surface water samples will be collected at each of the 16 transect monitoring locations as well as at a single reference site (HCK 20.6) following PROC-ES-2203, *Surface Water Sampling – Manual and Automated*.

Because filtered and unfiltered mercury and methylmercury sample volumes are to be collected for analysis, a peristaltic pump will be required for filtration in addition to the grab method. Surface water sampling should be conducted before channel sediment is collected to avoid interference between media.

4.4 SEQUENTIAL EXTRACTION OF MERCURY COMPOUNDS

Eight transect locations, as well as a reference location (HCK 20.6), will be sampled for mercury speciation/sequential extraction analysis. Sufficient mass of solid material from the channel sediment, creek bank soil, and floodplain soil at each selected transect for mercury speciation/sequential extraction will be composited into samples from each of the three representative media types (i.e., three composite samples per transect). Sediment will be collected to an approximate depth of 0.5 ft and passed through a 1-mm sieve until adequate sample volume is achieved. For creek bank soil, one sample will be collected from each side of the bank by removing the upper 0.5 ft of bank soil surface just above the water level and composited. For floodplain soil, samples will be collected from the upper 0.5 ft on each side of the creek to generate a composite sample representing both sides of the floodplain.

Locations for this analysis are shown on Figure 4.1 and include one at the reference site (HCK 20.6); one downstream of the SY-200 Yard, Spoil Area 1, and S-3 Ponds Site (Bear Creek transect [BCT]14); one downstream of BYBY at the confluence of Bear Creek and NT-3 (BCT12B); one upstream of NT-8 at BCK 9.9 (BCT11); three downstream of BCK 7.87 at the confluence of Bear Creek and NT-13 in proximity to two prominent beaver dams (BCT7, BCT8, and BCT9); and two downstream of BCK 4.55 in proximity to a beaver dam (BCT5 and BCT6).

4.5 FINAL SELECTION OF SAMPLING LOCATIONS

Table 4.1 presents the transect sample locations for the BCV mercury sources RSE. These locations along Bear Creek were selected based on their location downgradient of and/or in the vicinity of potential source areas, where biota and surface water sampling have historically occurred, and in the vicinity of ponds. Physical stream conditions (e.g., channel morphology, substrate) at each transect were assessed in the selection process.

Actual field locations may be adjusted based on field conditions and sampling viability. Deviations from this BCV Mercury Sources RSE SAP will be documented in the field logbook and in the BCV mercury sources RSE.

5. SAMPLING AND ANALYSIS PLAN – ANALYTICAL PROGRAM

5.1 SUITE OF ANALYTES AND METHODS

The planned suite of analytes and methods of analysis for all samples to be collected during the BCV mercury sources RSE are listed in Appendix B (Tables B.1 through B.3) and summarized in Table 5.1. The suite is based on discussions and input received during the DQO Process; consideration of primary COCs mercury and methylmercury from potential mercury source areas within the BCV Watershed; and the standard suite of analytes and analytical methods used for sediment, soil, and surface water by the WRRP. As such, results for the analyte suite will be consistent with and comparable to the water quality database for the ORR that is maintained in OREIS. As shown in Appendix B, each of the parameter groups for identified analytes corresponds with a table in the latest version of the WRRP QAPP, which has been revised to add the BCVRSE, S-BCVRSE, and HGSEQ parameter groups for this project.

Table 5.1. Summary of field and analytical parameters

Medium	Field parameter	Analytical parameter
Surface water	Temperature	Dissolved and total mercury
	Dissolved oxygen	Dissolved and total methylmercury
	Turbidity	Metals
	pH	Phosphorous (total)
	Specific conductance (conductivity)	Total organic carbon
	Oxidation-reduction potential	Dissolved organic carbon
		Total dissolved solids
		Total suspended solids
		Anions (chloride, fluoride, nitrate-nitrite as nitrogen, sulfate, and sulfide)
Sediment and soil	None	Total mercury
		Total methylmercury
		Metals
		Total organic carbon
		Particle size analysis
		Anions (chloride, fluoride, nitrate, nitrite, sulfate, and sulfide)
		Sequential extraction of mercury compounds

5.2 LABORATORY-DEFINED VALUES AND REQUESTED REPORTING LIMITS

To develop the analytical program, different values were considered for each analyte.

5.2.1 Laboratory-Defined Values

Laboratory-defined values for the BCV mercury sources RSE analytes and analytical methods are listed in Appendix B (Tables B.2 and B.3) and discussed below.

5.2.1.1 MDLs

Method detection limits (MDLs) apply to non-radionuclide analytes and are defined as the minimum concentration of an analyte that can be measured and reported with a 99% confidence that the analyte is present in the sample with a concentration greater than zero. Analyte concentrations at the MDL have a 50% chance of being reported as a non-detect or a false negative, and analyte concentrations near the MDL cannot be quantified with statistical rigor. Values above the MDL but below the practical quantitation limit (PQL) indicate the analyte is likely present in the sample, although at concentrations below those that can be quantified with statistical significance (DOD/DOE 2013).

5.2.1.2 PQLs

PQLs apply to non-radionuclide analytes and are defined as the lowest concentration of an analyte that produces a quantitative result within specified limits of precision and bias. The PQL is typically greater than the MDL. PQLs are dependent on the acceptance limits for precision and bias selected for the requirements of the program. For many projects, the PQL is required to be at or above the lowest concentration of the laboratory standards used in method calibration for an analyte. Measurements falling between the MDL and PQL assure the presence of an analyte with confidence, but their numeric values are estimates and not quantified numbers (DOD/DOE 2013).

5.2.2 Requested Reporting Limits

Requested reporting limits (RRLs), referred to as reporting limits in the *Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (DOD/DOE 2013), are concentration levels for specific constituents within a sample that are specified by the project. The RRLs are defined so that obtained sediment, soil, and surface water data meet all project requirements for reporting quantitative data with known precision and bias for a specific analyte in a specific matrix. For the BCVRSE, S-BCVRSE, and HGSEQ parameter groups, the laboratory is being requested to report detections with respect to the MDLs, which are generally lower than the RRLs. The RRLs, if met, ensure project data can be successfully screened against appropriate criteria and standards. For most WRRP projects, laboratories are requested to report detections of chemical analytes with respect to the MDL.

5.3 ANALYTICAL METHODS

Analytical methods for sediment, soil, and surface water analyses are summarized in Appendix B, Table B.2 (water) and Table B.3 (soil and sediment) and correspond to methods listed by parameter group in the latest version of the WRRP QAPP for each analyte. All analytical methods are EPA standard procedures routinely employed by Oak Ridge Sample Management Office (SMO) contract laboratories.

Discussions during the DQO Process resulted in development of the BCVRSE, S-BCVRSE, and HGSEQ parameter groups (WRRP QAPP) which are unique to the BCV mercury sources RSE. These parameter groups were developed to specify analytes (e.g., mercury, methylmercury, nutrients, particle size analysis, and total organic carbon) and methods for the sequential extraction of mercury in sediment and soil for the BCV mercury sources RSE. For surface water samples collected, AWQC may be used for comparison purposes only, but are not a required screening level.

5.4 FIELD ANALYTICAL SAMPLING AND LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

All relevant QA and quality control procedures and requirements specified in the WRRP QAPP (field collection) and for the SMO (laboratory analyses) are incorporated by reference for compliance. No changes in WRRP and SMO procedures incorporated under the WRRP QAPP are anticipated for the BCV mercury sources RSE.

Appendix B provides the planning tables that will be used for the BCV mercury sources RSE, including locations, sampling methods, frequencies, analyses, and reporting levels. Final selection of locations will be decided as described in Section 4.5 of this BCV Mercury Sources RSE SAP.

5.5 ANALYTICAL MEDIA CONSIDERATIONS

Surface water (Appendix B, Table B.2) will be analyzed for dissolved and total mercury, dissolved and total methylmercury, total phosphorous, dissolved organic carbon, total dissolved solids, total suspended solids, total organic carbon, anions (e.g., chloride, fluoride, nitrate-nitrite as nitrogen, sulfate, and sulfide), and metals. Both filtered and unfiltered surface water samples will be collected for mercury and methylmercury as part of this suite. Field parameters collected at the time of sampling are temperature, dissolved oxygen, turbidity, pH, specific conductivity, and oxidation-reduction potential.

Sediment and soil (Appendix B, Table B.3) will be analyzed for total mercury and methylmercury, particle size analysis, total organic carbon, anions (e.g., chloride, fluoride, nitrate, nitrite, sulfate, and sulfide), and metals. Sediment and soil will also have additional analysis performed for mercury speciation. This analysis will provide data for volatile elemental mercury, water soluble mercury, pH2 soluble mercury, 1N potassium hydroxide extractable mercury, 12N nitric acid soluble mercury, aqua regia soluble mercury residue, and mineral-bound mercury.

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6. SAMPLING AND ANALYSIS PLAN – DATA MANAGEMENT

6.1 DATA VERIFICATION AND VALIDATION

All data will be verified following WRRP QAPP and WRRP DMIP requirements. All mercury and methylmercury data will be validated following the WRRP QAPP and WRRP DMIP. Level 4 data packages will be required for all analyses completed under the BCV Mercury Sources RSE project. Verification and validation will be conducted by United Cleanup Oak Ridge LLC/RSI Entech staff and/or their validation subcontractor.

6.2 DATA STORAGE

All data will be stored in the Project Environmental Measurements System following required procedures and WRRP QAPP requirements and will be archived in OREIS.

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7. PROJECT ORGANIZATION, SCHEDULE, AND REPORTING

7.1 ORGANIZATION

The EMDF ROD outlined the mercury-management approach for Bear Creek that included an RSE. The DOE Environmental Management Program is the responsible organization for implementing the RSE under the CERCLA process, with coordination and approval by EPA and TDEC in accordance with the FFA. The Project Team is comprised of representatives from DOE, EPA, and TDEC. The DOE Environmental Management Program will use the WRRP, a contractor-implemented organization, for support in executing BCV Mercury Sources RSE project monitoring. The WRRP has comprehensive procedures for sampling and provides data for use in making watershed-management decisions related to remedial action effectiveness and contaminant trends on the ORR. WRRP support will include QA, sampling and analysis, and data management resources. Additional details about WRRP organizations, roles, and responsibilities are provided in the WRRP QAPP.

7.2 SCHEDULE

Fieldwork described in this BCV Mercury Sources RSE SAP is anticipated to be conducted in December 2023. Data evaluation and preparation of the BCV Mercury Sources RSE Report will occur between January and September 2024 (FFA Appendix E milestone: September 30, 2024).

7.3 REPORTING

Sampling activities, sampling results, and data evaluation will be summarized in the BCV Mercury Sources RSE Report that has an FFA Appendix E milestone date of September 30, 2024.

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8. REFERENCES

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PROC-ES-2302. *Sediment Sampling*, latest revision, United Cleanup Oak Ridge LLC, Oak Ridge, TN.

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APPENDIX A.
DATA QUALITY OBJECTIVE PRESENTATION AND MEETING MINUTES FOR THE BEAR CREEK VALLEY MERCURY SOURCES REMEDIAL SITE EVALUATION

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BEAR CREEK VALLEY (BCV) MERCURY SOURCES REMEDIAL SITE EVALUATION (RSE) DATA QUALITY OBJECTIVES (DQO) MEETING MINUTES BCV

DATE: June 29, 2023; 2 p.m.

ATTENDEES:

Sam Scheffler – DOE
Roger Petrie – DOE
Dana Casey – TDEC
Cody Juneau – TDEC
Courtney Thomason – TDEC
Brad Stephenson – TDEC
Randy Young– TDEC
Jana Dawson – EPA (ph)
Eddie Arnold – UCOR, presenter
Sid Garland – UCOR
Diana Turner – UCOR
Bob Bock – UCOR (ph)
Lynn Sims – UCOR
Annette Primrose – UCOR (ph)
Scott Brooks – ORNL-ESD
Natalie Landry – ORNL-ESD
Chris DeRolph – ORNL-ESD (ph)
Terry Mathews – ORNL-ESD
Sally Absher – Leidos (ph)

PURPOSE: The objective of the meeting is to review the history and sources of mercury in Bear Creek and to present DQOs and proposed sampling for the BCV Mercury Sources RSE.

AGENDA (Slide 2):

- Introduction, Safety Topic
- BCV Mercury Sources RSE Milestone
- Site Background
- Previous Investigations
- DQO steps
- Proposed transects and analytes
- RSE schedule

INTRODUCTION, SAFETY TOPIC (Slide 3): Eddie Arnold introduced the participants in the conference room and online and presented a brief safety topic about fireworks in anticipation of the upcoming 4th of July holiday.

BCV Mercury Sources RSE Milestone (Slide 4)

The BCV Mercury Sources RSE Milestone is 9/30/2024 as part of the Federal Facility Agreement (FFA) Appendix E. The RSE is being conducted per an agreement as part of the Environmental Management Disposal Facility (EMDF) Record of Decision (ROD).

NOTE: The remainder of these minutes only includes notes for slides in which there was additional discussion. For slides on which there were no additional questions, comments, or discussions, only the slide title is presented. The final DQO Presentation is attached to these minutes.

Site Background - BCV History (Slide 5)

Oak Ridge Reservation [figure] (Slide 6)

BCV Site Location [figure] (Slide 7)

- Randy Young prompted DOE to explain why the RSE/milestone was in place.
- Roger Petrie explained that Bear Creek is currently listed as impaired and under the anti-degradation rule, no new discharges of mercury from EMDF are allowed; this is not possible, so to

construct the EMDF Treatment Facility, DOE agreed to follow a sequence of events in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to address mercury offsets to get the EMDF ROD signed. The first CERCLA step is the RSE, which DOE has committed to perform. The purpose of the DQO is to present the activities required to complete the RSE.

- Randy Young also clarified for EPA that there was a short discussion while waiting for others to join the call between Randy Young and Roger Petrie about polychlorinated biphenyls (PCBs). DOE stated that PCBs will not be an issue for this facility because DOE expects the PCB inventory to be less than that for EMWMF and for the wastewater treatment to remove all PCBs before discharge to Bear Creek. Therefore, they are not addressed in this approach. Roger Petrie also stated that DOE will develop an offset approach for PCBs if needed. Randy Young asked about potential risks to the cleanup program if landfill operations are impacted by PCB discharge and advised DOE to not take unnecessary risks. Roger Petrie maintained that DOE does not believe it will be an issue and is willing to take the risk in this approach of developing offsets later if necessary. NOTE: During comment resolution on the meeting minutes DOE confirmed that EPA Method 1668 (congener method) will be utilized for comparison of surface water PCB results to the AWQC as applicable.
- Roger Petrie clarified that because the EMDF facility is new, the anti-degradation rule applies, but other existing facilities' discharges are grandfathered in and the anti-degradation rule doesn't apply.

BCV Decision Documents – BCV Mercury Sources [BCV Phase 1 RI and ROD] (Slide 8)

- Randy Young had a question about the second bullet on the slide: has the BCV Phase I RI been looked at enough to know how much of a problem mercury is at Sanitary Landfill 1?
- UCOR clarified that mercury was not a contaminant of concern (COC) for the landfill in the BCV Phase I ROD.

BCV Decision Documents – BCV Mercury Sources [BCV OU2 RI and ROD] (Slide 9)

Potential BCV Mercury Sources [figure] (Slide 10)

BCV Mercury Sources – SY-200 Yard (Slide 11)

- Randy Young asked for clarification on the timing/approval of the cover/cap at the SY-200 Yard
- UCOR and DOE responded that it was part of the BCV OU-2 ROD which was pre-FFA

BCV Mercury Sources – Spoil Area 1 (Slide 12)

BCV Mercury Sources – NT-3 (Slide 13)

BCV Mercury Sources – Others (Slide 14)

- Dana Casey asked what defines minor level of mercury.
- Eddie Arnold responded that it is likely over background, but that they were generally very minor exceedances
- Brad Stephenson asked for further clarification in the case of 58-83 mg/kg, if that was also considered minor
- Eddie Arnold clarified that at the time it was considered minor, as the wording is from the BCV Phase I RI

Previous Investigations – Current Surface Water and Biota Sampling in Bear Creek [fig.] (Slide 15)

Previous Investigations– Current Surface Water and Biota Sampling in Bear Creek [table] (Slide 16)

Previous Investigations – Summary of Historical Surface Water Data (Slide 17)

- Jana Dawson asked for clarification about mercury vs methylmercury, generation vs release.
- Eddie Arnold clarified that the evaluation is from the perspective of the effect on biota.

Previous Investigations – Summary of Historical Biota Data (Slide 18)

- Eddie Arnold invited input from ORNL.
- Terry Mathews mentioned that there had been recent habitat changes that affected mercury methylation but that mercury in fish has been trending downward in the last few years. Additionally, mercury (in fish) at the reference site (where there is no DOE input) has increased; Bear Creek is now around background.
- Randy Young asked if there were any other things that might be addressed regarding habitat in a remedy for mercury or methylmercury.
- Terry Mathews clarified that best management practices and beaver management are being followed – beavers are not necessarily bad for habitat but exacerbate mercury methylation, so beaver management is one of the best things to do. Terry added that mercury methylation is discussed later in the presentation and that the focus is on watershed-scale practices.

Previous Investigations – Summary of Historical Sediment Data [figure] (Slide 19)

Previous Investigations – Summary of Historical Sediment Data (Slide 20)

- Courtney Thomason asked about details regarding historical sediment samples – if they were grab samples, what was the depth, etc.
- Eddie Arnold responded that the few samples were mostly surface grab samples (under 6 inches), with a few deeper samples. Concentrations were low and no methylmercury data was collected except during the ORNL special studies.

Previous Investigations – Summary of Special Studies Data (Slide 21)

Previous Investigations – Summary of Special Studies Data (Slide 22)

- Scott Brooks presented special studies data (slides 22-26) and oriented viewers to figures.
- Although concentrations are elevated at NT-3 and at the borrow area near Highway 95 due to beaver impoundment, mass loading is thought to be low due to the small amount of discharge.

Previous Investigations – Summary of Special Studies Data (Slide 23)

Previous Investigations – Summary of Special Studies Data (Slide 24)

Previous Investigations – Summary of Special Studies Data (Slide 25)

- There are two properties of methylmercury that are important in this case: 1) that it is bioaccumulative 2) that periphyton is known to be a source of methylmercury generation; both factors lead to high levels of methylmercury in periphyton.
- Cody Juneau asked if methylmercury at NT-3 (tributaries) is much higher.
- Scott Brooks clarified that the tributaries are represented by the orange triangles and confirmed that methylmercury is very high at NT-3 relative to other samples, but also cautioned that it is only a single sample and difficult to separate from pond muck. More data are needed to draw conclusions.

Previous Investigations – Summary of Special Studies Data (Slide 26)

- Terry Mathews followed up on Randy Young's previous questions about other actions that may be performed watershed-wide. Studies have indicated that periphyton is a potential contributor of methylmercury to the creek. Chris DeRolph has been using drones to look spatially at periphyton communities and habitat throughout the creek.
- Courtney Thomason asked if microbes have been evaluated separately from periphyton.
- Scott Brooks responded that they have in East Fork but not in BCV.
- Brad Stephenson asked how often surface water is sampled.
- Scott Brooks responded that NT-3 was sampled once or twice; Eddie Arnold responded that WRRP does regular quarterly sampling there.

DQO Steps (Slide 27)

- Eddie Arnold resumed presenting.

DQO Step 1. State the Problem (Slide 28)

DQO Step 2. Identify the Goals of the Study (Slide 29)

- TDEC and Roger Petrie discussed that the goal of the study was to find mercury sources to offset, if possible, not to do an RI, but that data show finding mercury sources to offset may be difficult.
- Discussion continued that mercury concentrations in fish need to be below 0.3 ppt because of the anti-degradation rule. So in addition to the RSE, fish need to be monitored to see if they remain below 0.3 ppt. It's not strictly about mass of mercury produced by EMDF as that will be very small.

DQO Step 3. Identify Information Inputs (Slide 30)

DQO Step 4. Define the Study Area Boundary (Slide 31)

DQO Step 5. Develop the Analytical Approach (Slide 32)

- Cody Juneau asked that mercury speciation be quickly explained.
- Terry Mathews responded that it is sequential extraction – an iterative process with increasingly harsh digestion which results in a percentage of mercury coming off at each step; this determines how tightly bound the mercury is.

DQO Step 6. Specify the Performance or Acceptance Criteria (Slide 33)

DQO Step 7. Develop the Plan for Obtaining Data (Slide 34)

Proposed Transect Locations (Slide 35)

- Eddie Arnold clarified that there is a general idea of locations but transects will be field-located based on access.

Proposed Transect Locations [figure] (Slide 36)

Beaver Dams near BCK 7.0 [figure] (Slide 37)

- Courtney Thomason asked about sediment deposition not associated with beavers.
- Eddie Arnold responded that overbank depositional areas are limited and the upper portion of Bear Creek is often dry.
- Courtney Thomason asked if there will be any effort to locate any non-beaver depositional areas in the lower portion of Bear Creek.
- Eddie Arnold responded that there will be an effort but added that the substrate doesn't lend itself to fine-grained sediment deposition in non-beaver areas.

Transect Sampling (Slide 38)

- Dana Casey asked if there is reason to think that there would be mercury deeper than 6 inches that could connect to the surface water.
- Eddie Arnold agreed that it is a possibility but the groundwater data do not indicate that.
- TDEC, UCOR, DOE, and ORNL participated in a discussion of shallow groundwater and concluded it is out of the scope for the RSE but would be an interesting topic for a separate investigation. NOTE: During comment resolution on the meeting minutes TDEC clarified the recommendation that shallow groundwater sampling should be included in the project scope.
- There was discussion to clarify the goal of this RSE and whether that was to find mercury sources, methylmercury sources, or sources of methylation, and DOE reiterated that this is a source investigation for mercury and methlymercury.

Transect Sampling Diagram (Slide 39)

Analytical Suite (Slide 40)

RSE Schedule (Slide 41)

- Eddie Arnold reviewed the schedule and TDEC asked about what happens afterward/schedule going forward.

- Roger Petrie and TDEC discussed hypothetical future actions, and UCOR mentioned that those discussions are better left until after the results of the RSE.
- Roger Petrie reiterated that this is a very tight schedule but that it can be met. Other valid questions that arose during today's discussion may eventually be addressed but cannot be added to this RSE due to schedule.
- Randy Young agreed but anticipated that TDEC will have several comments. Brad Stephenson also mentioned that TDEC wants EMDF to succeed and this RSE is a big part of getting there and of signing the ROD.

Wrap Up

- There were no additional comments or questions on the BCV RSE DQO presentation.
- TDEC said that they had some data they would share.
- Eddie Arnold mentioned that minutes might be delayed due to the upcoming July 4 holiday.

There were no further questions or comments. The meeting was adjourned at 3:33 pm.

Respectfully submitted

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UCOR
United Cleanup Oak Ridge LLC

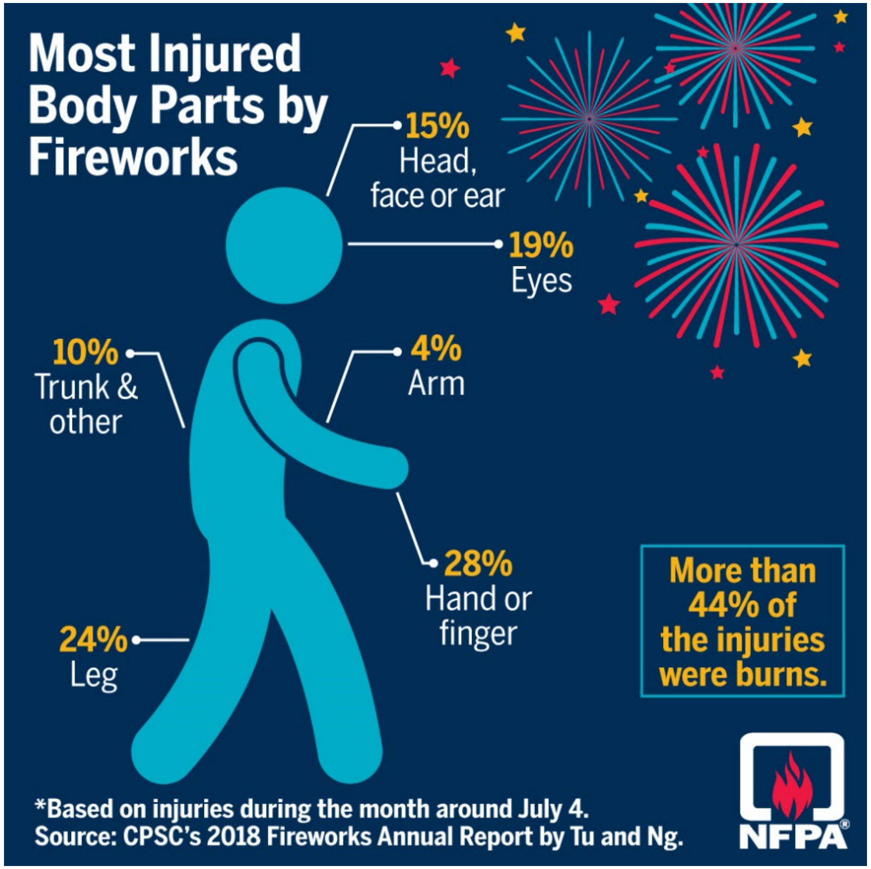
Bear Creek Valley (BCV) Mercury Sources Remedial Site Evaluation (RSE) Data Quality Objectives (DQOs)

June 29, 2023

Agenda

1. Introductions, Safety Topic
2. BCV Mercury Sources RSE Milestone
3. Site Background
   - BCV History
   - BCV Decision Documents
   - Potential BCV Mercury Sources
4. Previous Investigations
   - Current surface water and biota sampling in Bear Creek
   - Summary of historical data
   - Summary of special studies data
5. DQO steps
6. Proposed transects and analytes
7. RSE Schedule

Safety Topic – Fireworks!!!



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BCV Mercury Sources RSE Milestone

FY 2023 – 2025 Federal Facility Agreement Milestones

Appendix E

Project/Subproject	FY 2023 Milestone	FY 2024 Milestone	FY 2025 Milestone
BCV Mercury Sources		RSE 9/30/24	

A-12

As part of the Environmental Management Disposal Facility Record of Decision (EMDF ROD; DOE/OR/01-2794&D2/R2) it was agreed to conduct a RSE (40 CFR 300.420)

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United Cleanup Oak Ridge LLC

Site Background - BCV History

- BCV contains multiple historical waste management and disposal areas that received mercury contaminated waste streams from Y-12 operations from 1943 to 1993 in addition to having materials storage areas and construction storage areas.
- East of the BCV Watershed is the Upper East Fork Poplar Creek (UEFPC) Watershed including the operational portion of the Y-12 plant. The boundary between the two watersheds is defined by a surface water divide that is between the eastward-flowing EFPC and westward-flowing Bear Creek.
- The Integration Point (IP) for Bear Creek is at BCK 9.2 where more than 99% of the available water from the eastern portion of BCV passes through this location either as surface water or groundwater.
- BCV has two RODs that identify mercury as a constituent of concern (COC): BCV OU2 ROD and BCV Phase I ROD.

UCOR United Cleanup Oak Ridge LLC

Oak Ridge Reservation

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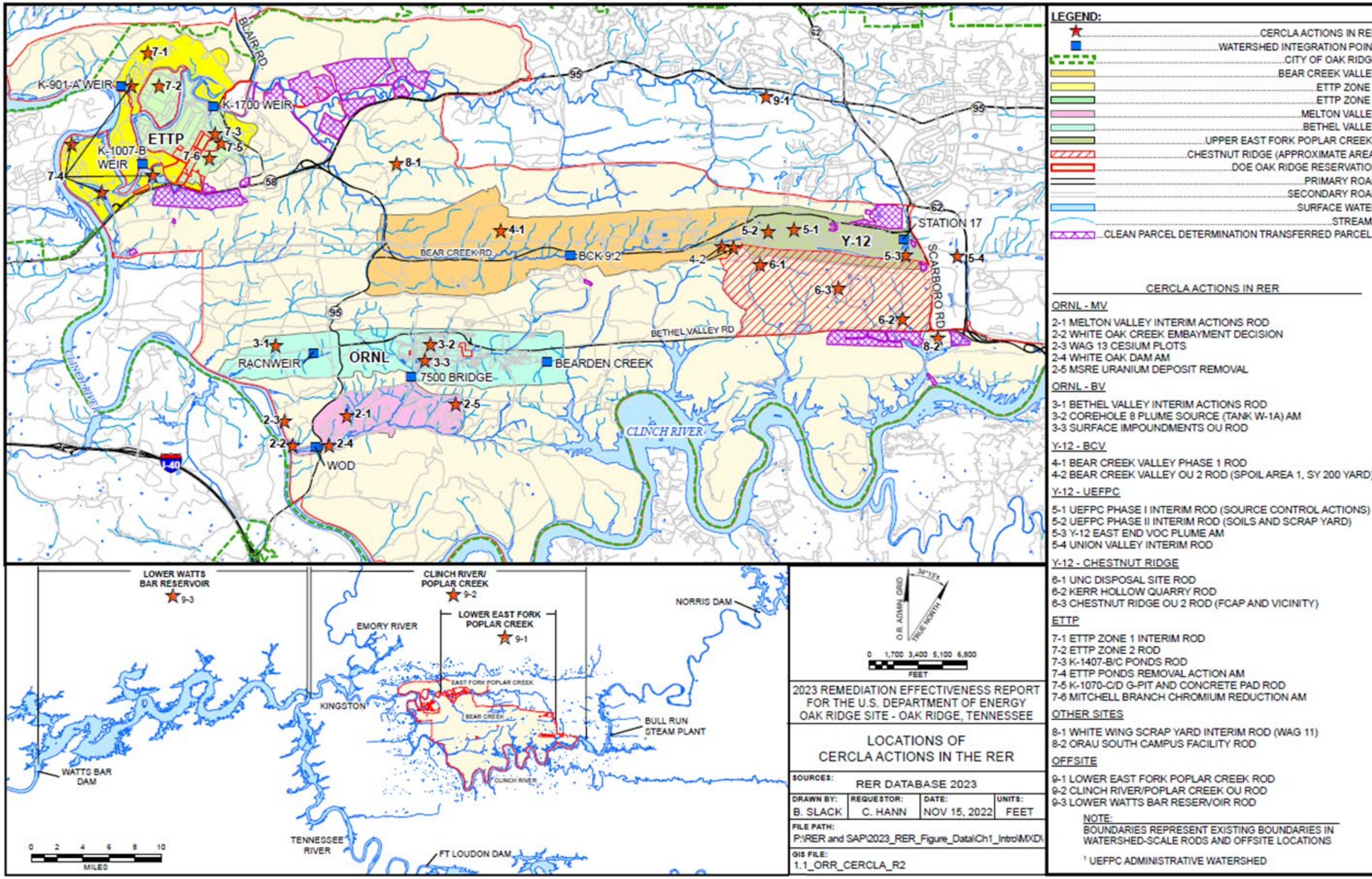
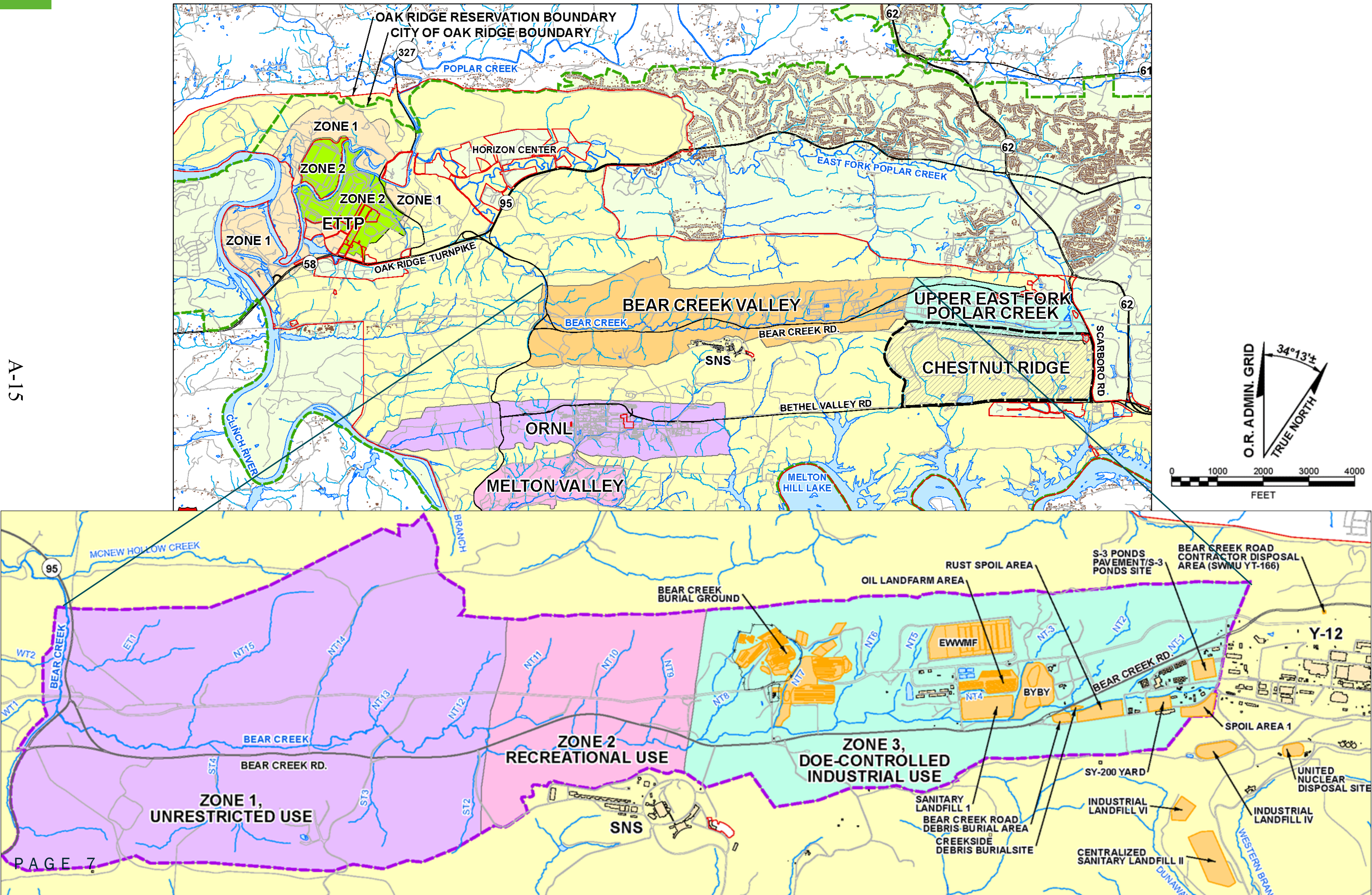


BCV Site Location



BCV Decision Documents – BCV Mercury Sources

BCV Phase I ROD (DOE/OR/01-1750&D4) and BCV Phase I Remedial Investigation (RI) (DOE/OR/01-1455&D2)

- The BCV Phase I ROD cited mercury as a COC posing environmental hazards due to migration from the Boneyard/Burnyard (BYBY). No other mention of mercury in the BCV Phase I ROD.
- The BCV Phase I RI identified mercury as a COC (human health) for BYBY, Oil Landfarm (OLF), Hazardous Chemical Disposal Area (HCDA), S-3 site, Sanitary Landfill 1, Bear Creek Road Debris Burial, and Creekside Debris Burial.
- The BCV Phase I RI indicated there were some elevated soil mercury concentrations, generally within an order of magnitude of background criterion (0.34 mg/kg).
- The Baseline Risk Assessment (BRA) in the BCV Phase I RI stated: *the sources of mercury and PCBs to the BCV fish are currently unknown.*

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BCV Decision Documents – BCV Mercury Sources

BCV OU2 ROD (DOE/OR/02-1435&D2) and BCV OU2 RI (DOE/OR/01-1273&D2)

- The BCV OU2 ROD identified two areas with mercury, SY-200 and Spoil Area 1. No other mention of mercury in the BCV OU2 ROD.
- The BCV OU2 RI identified mercury as a COC (human health) for SY-200. While Spoil Area 1 and the Rust Spoil Area had mercury as a contaminant of potential concern (COPC), the BRA did not identify mercury as a COC for these areas.
- The BCV OU2 RI indicated that mercury concentrations were elevated at SY-200 but were generally within an order of magnitude of background; however, free mercury was seen in some of the borings during the BCV OU2 RI.

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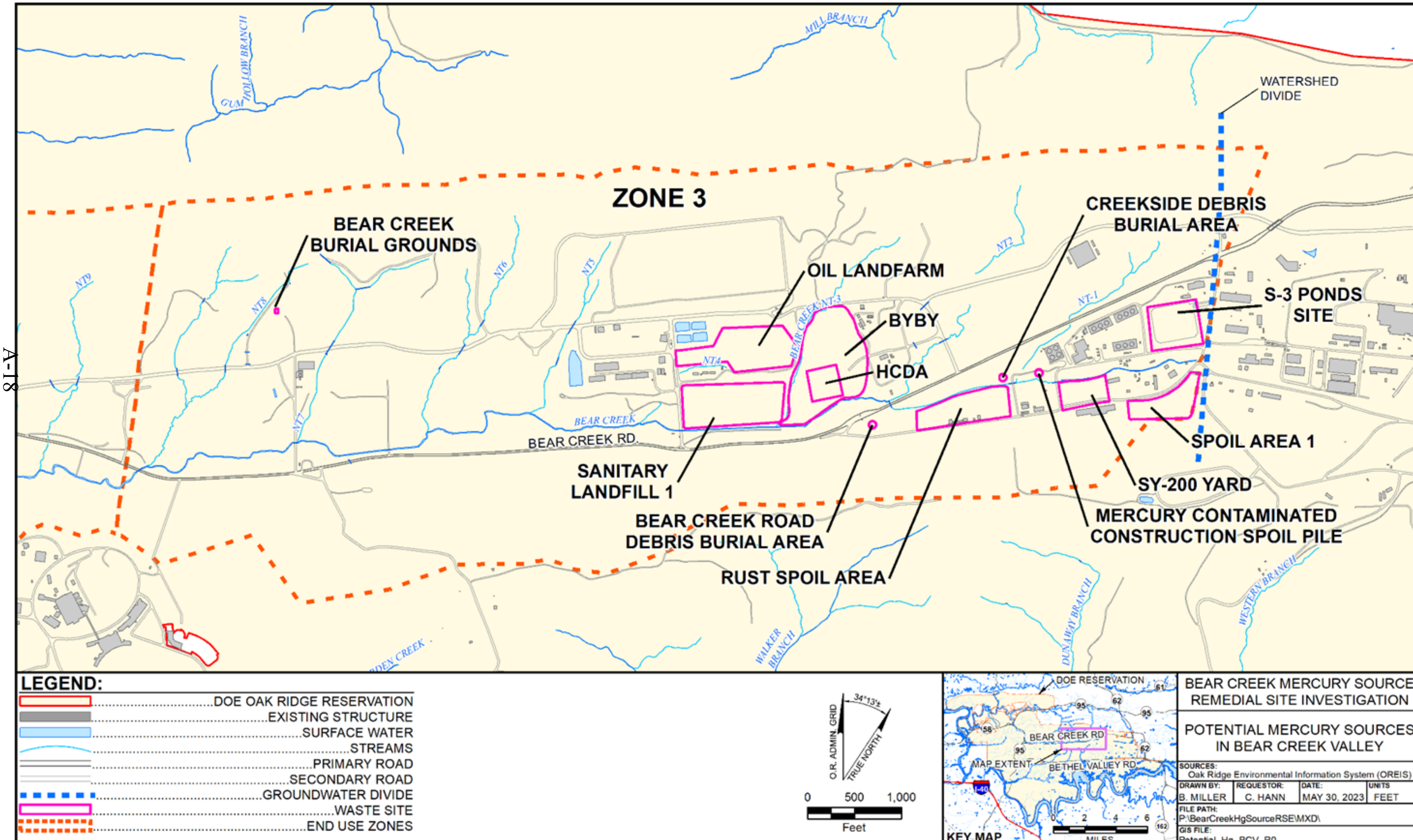
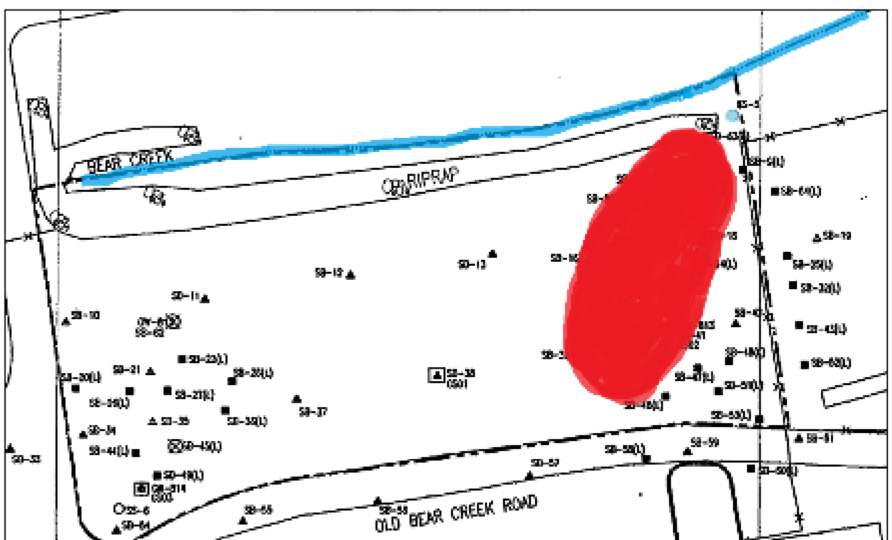
Potential BCV Mercury Sources



BCV Mercury Sources – SY-200 Yard



A-19

- SY-200 Yard was a former equipment storage yard used to store nonradioactive contaminated equipment, mercury flasks, etc. from the 1950s to 1986
- In 1990, construction of the Environmental Support Facility began at the site. During construction, mercury was detected at high levels (up to 816 mg/kg) in excavated soils and visible mercury was noted
- Construction was paused and a 3 to 5 ft soil cover was placed across the site

- Bear Creek shown in blue
- Red area is high mercury area at SY-200 Yard from human health risk assessment
- Soil borings in the red area had visible mercury

(DOE/OR/01-1273&D2)

BCV Mercury Sources- Spoil Area 1

- Spoil Area 1 was used for the disposal of what was characterized as uncontaminated construction debris from Y-12, but soil and groundwater studies confirmed the presence of heavy metals and radionuclides
- Mercury exceeded its MCL in a groundwater sample collected from a small intermittent seep near the base of the landfill; no constituents exceeded risk-based levels in surface water samples collected at the site
- Mercury was elevated in soil relative to background; however, mercury was not identified as a COC in soil in the BCV OU2 RI for Spoil Area 1

(DOE/OR/01-1273&D2, DOE/OR/01-2895&D2)

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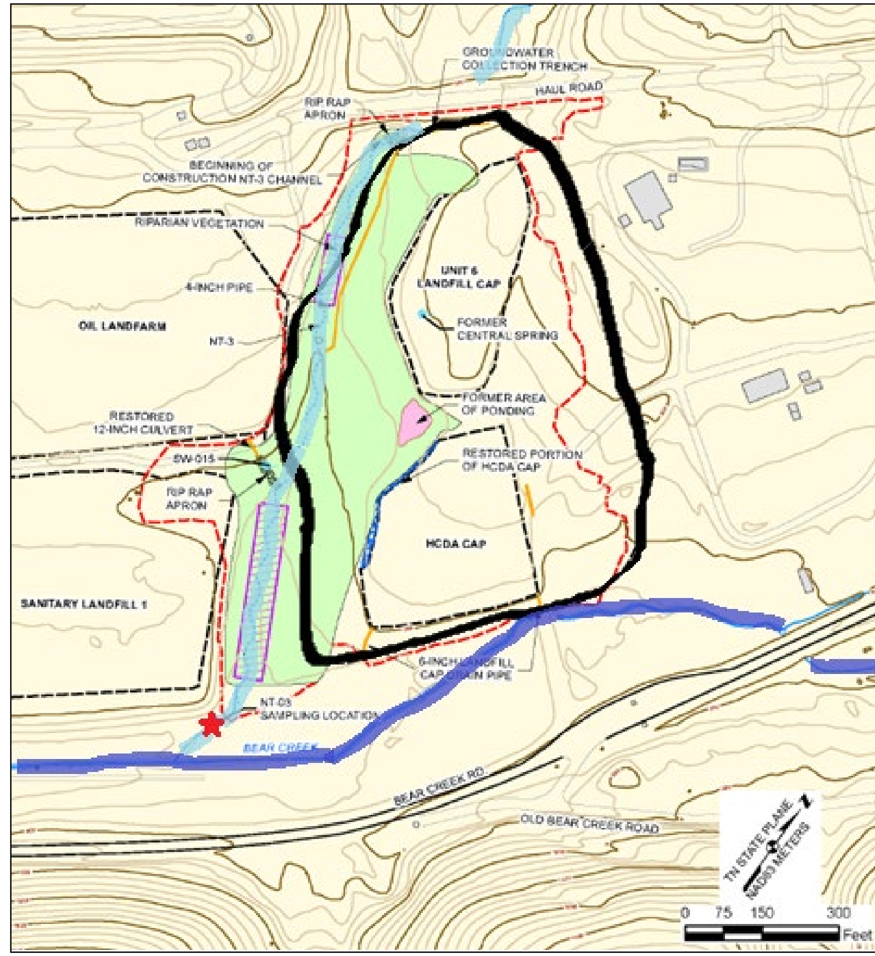
BCV Mercury Sources – NT-3

NT-3 at the Boneyard/Burnyard (BYBY) is a remediated former strong mercury source

- BYBY was a visual cleanup
- Surface water sample in August 2020 had a mercury concentration (147 ng/L) above the AWQC
- It was concluded that it was a statistical outlier based on the available data and attributed to mercury adsorbed to suspended sediment (TDS 17.1 mg)

(DOE/OR/01-2895&D2/V1)



- Bear Creek shown in dark blue
- NT-3 tributary in light blue
- BYBY outlined in black
- NT-03 sampling point shown as red star

BCV Mercury Sources - Others

S-3 Pond Pathway 3 to NT-1

- Minor mercury contributions from mercury-contaminated fill materials (58-83 mg/kg in soil)

Other sites (BCBG, OLF, HCDA, Sanitary Landfill 1, Bear Creek Road Debris Burial, Creekside Debris Burial, and Rust Spoil Area)

- Minor mercury contributions

(DOE/OR/01-1455/V1&D2)

Previous Investigations - Current Surface Water and Biota Sampling in Bear Creek

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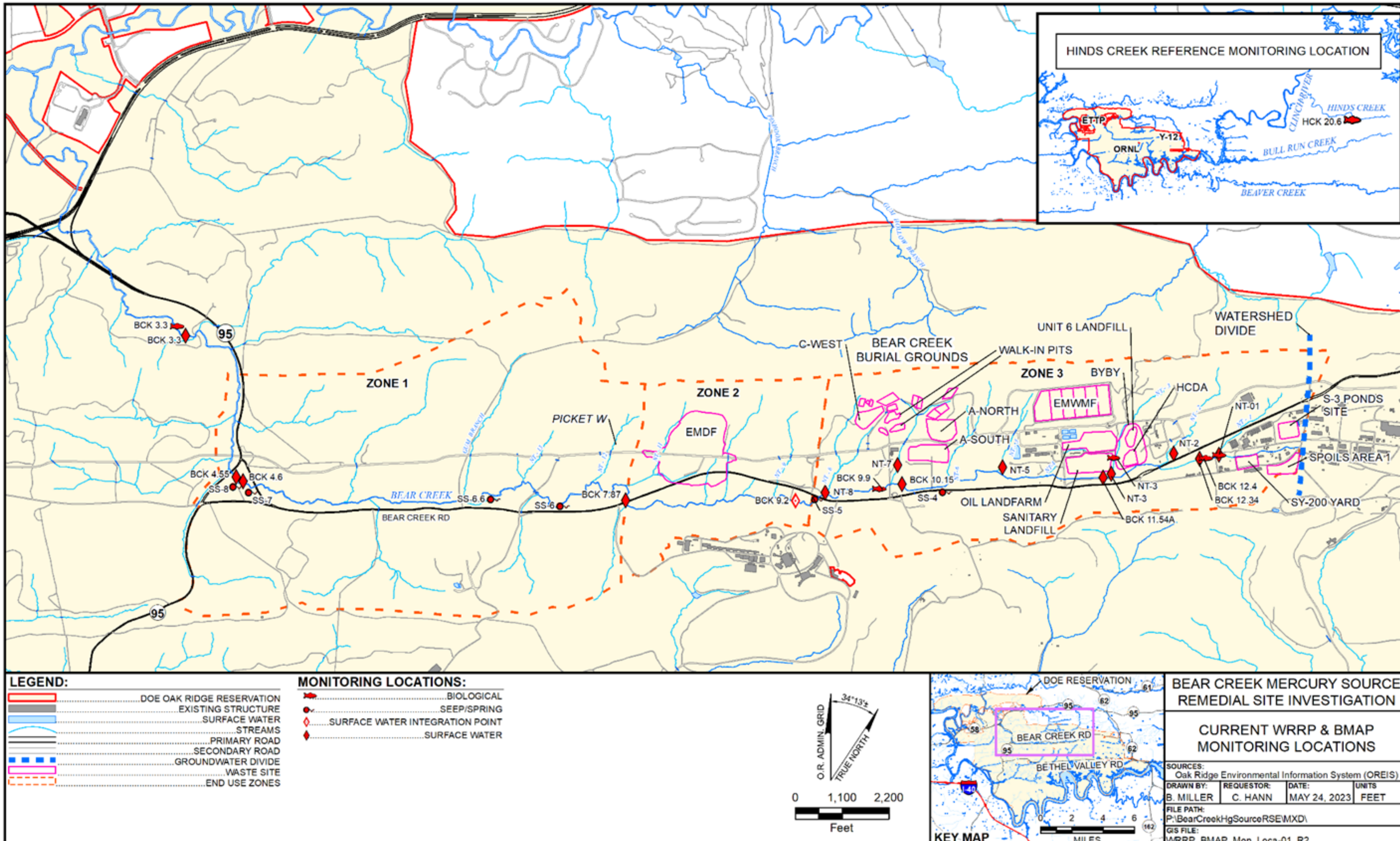

Previous Investigations - Current Surface Water and Biota Sampling in Bear Creek

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Media	Performance standard	Sampling frequency	Parameters	Monitoring Locations
Surface water	AWQC	Semi-annual (Q1 and Q3)	Total Hg and MeHg	BCK 3.3, BCK 4.55, BCK 9.2, BCK-11.54A, BCK 12.34, NT-03, NT-08, SS-4, and SS-5
		Semi-annual (Q2 and Q4) (year before FYR)	Total Hg	BCK 4.55, BCK 9.2, BCK 12.34, NT-03, and NT-08
		Annual (year before FYR)	Total Hg	BCK-07.87 and NT-01
		Annual (year before FYR)	MeHg	NT-05
	Trend monitoring	Quarterly	Bicarbonate, carbonate, chloride, fluoride, and sulfate	NT-01, NT-02, NT-03, SS-4, and SS-5
		Semi-annual	Bicarbonate, carbonate, chloride, fluoride, and sulfate	NT-07 and NT-08
		Quarterly (year before FYR)	Bicarbonate, carbonate, chloride, fluoride, and sulfate	NT-05
	Water quality	Semi-annual	Total suspended solids and total dissolved solids.	NT-07 and NT-08
		Quarterly (year before FYR)	Total suspended solids and total dissolved solids.	BCK 9.2, BCK-07.87, BCK 4.55, NT-03, BCK-12.34, NT-01, NT-05, and NT-08
Biota	Baseline sampling	Semi-annual	Hg and MeHg	BCK 3.3, BCK 9.9, and HCK 20.6 (whole-body stoneroller minnows and rock bass fillets) BCK 12.4 (whole-body stoneroller minnows)
		Annual (year before FYR)	Hg and MeHg	BCK-9.9 (whole body caddisflies)

Previous Investigations - Summary of Historical Surface Water Data

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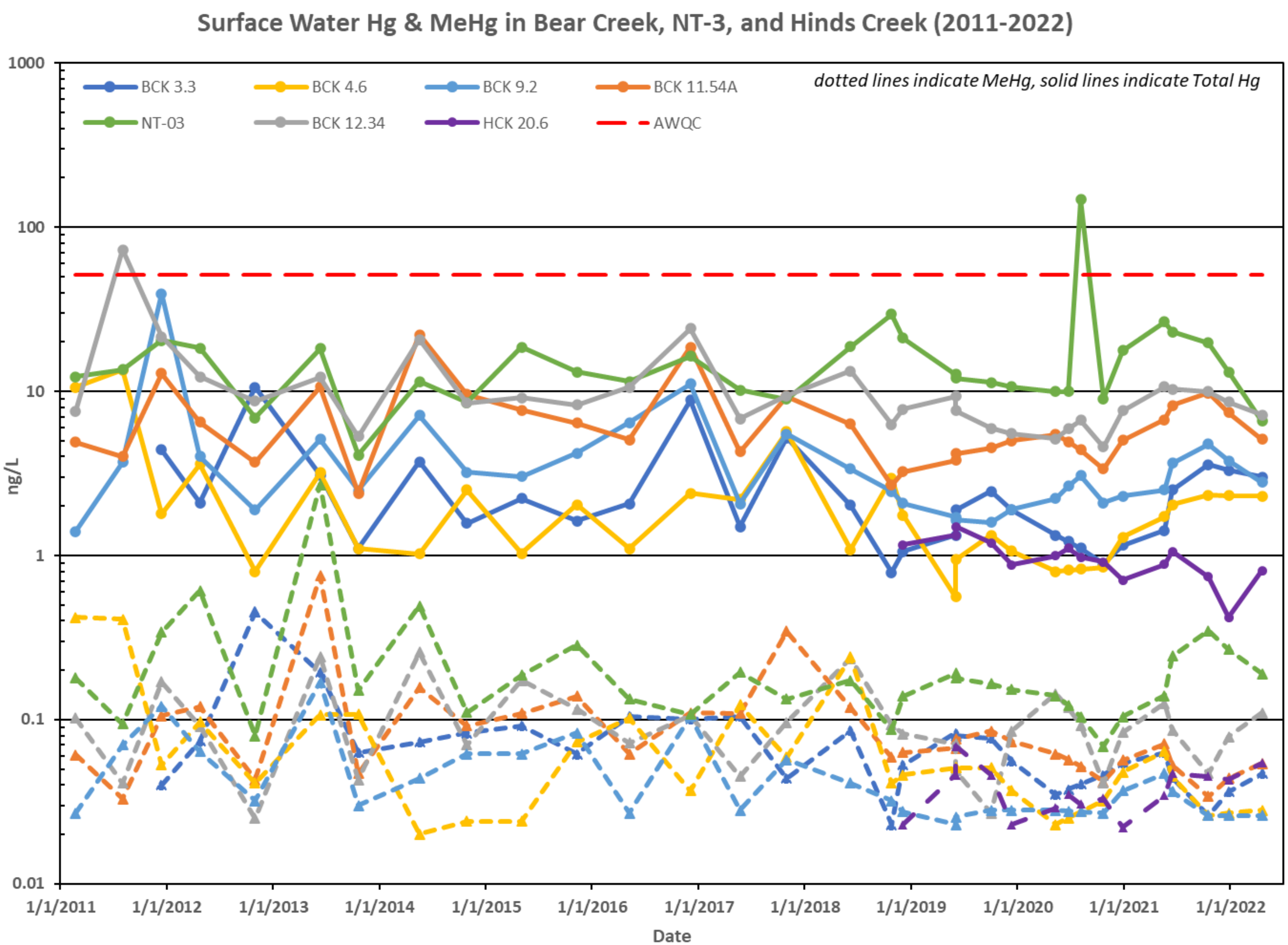

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Previous Investigations - Summary of Historical Biota Data

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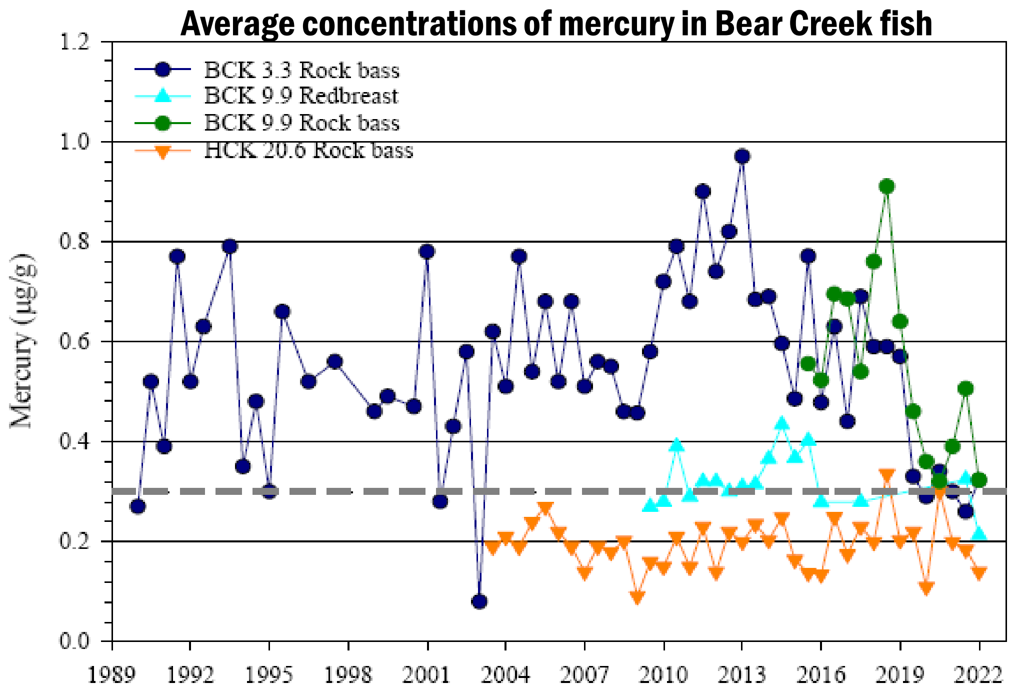
- FY 2022 total mercury concentrations were well below the mercury AWQC (51 ng/L) in surface water
  - BCK 3.3 (3.59 ng/L), BCK 4.6 (2.34 ng/L), BCK 9.2 (4.78 ng/L), BCK 11.54A (9.76 ng/L), BCK 12.34 (10 ng/L), and NT-03 (19.7 ng/L)
  - Fish tissue concentrations in Bear Creek remain near the fish tissue criterion (0.3 µg/g).



Dashed line indicates EPA-recommended AWQC for mercury (0.3 µg/g in fish).

Previous Investigations - Summary of Historical Sediment Data

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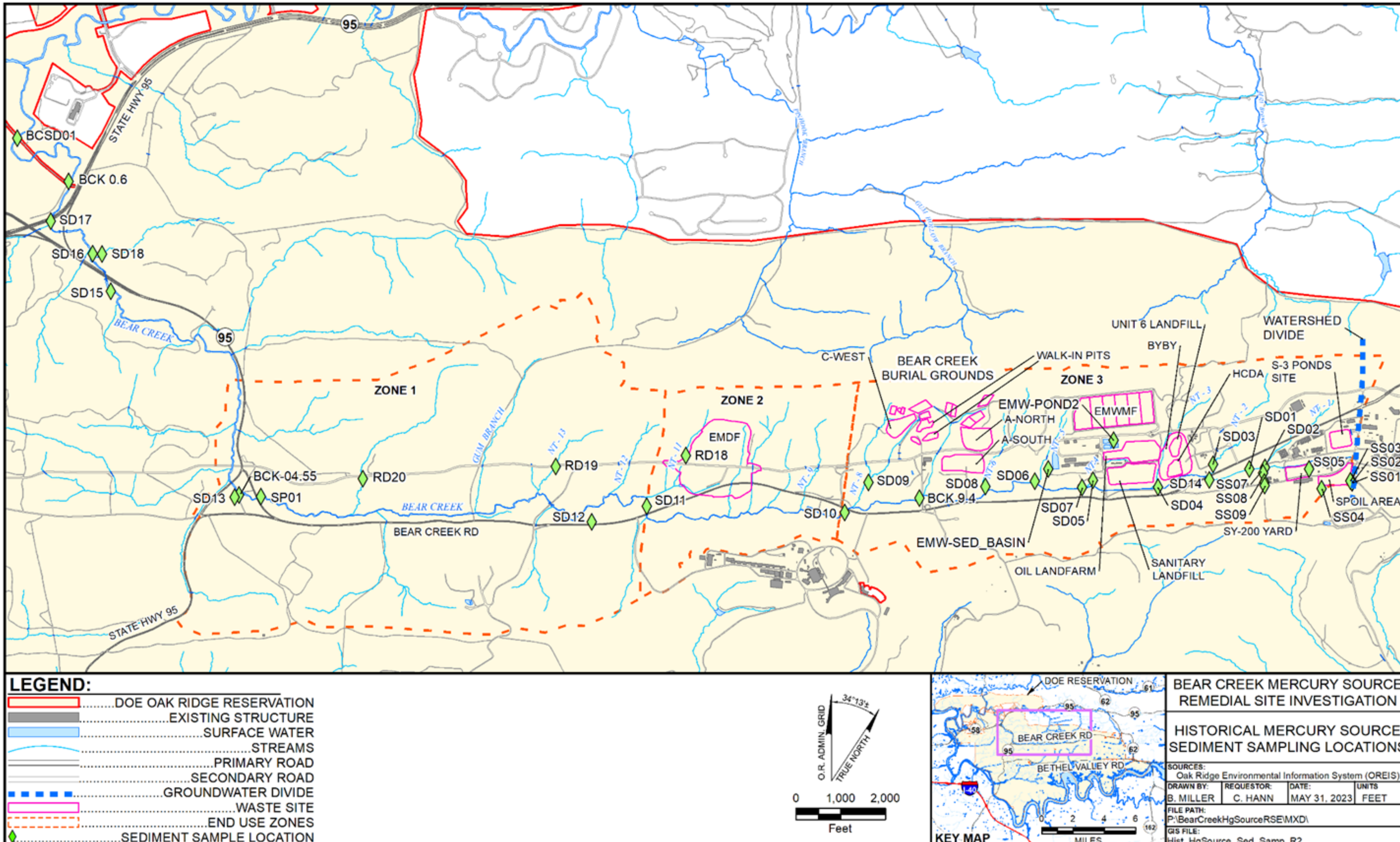

Previous Investigations - Summary of Historical Sediment Data

Limited historical sediment data for Bear Creek are available in OREIS (primarily sampled 2011 and earlier)

- Zone 1: 7 locations, 6 in May 1995 and 1 in June 2005
  - Concentrations ranged from 0.14U – 0.97 mg/kg total mercury
- Zone 2: 2 locations sampled in May 1995
  - Concentrations were ND and 0.16 mg/kg total mercury
- Zone 3: 20 locations sampled December 1993 – April 2011
  - Concentrations ranged from 0.0189J – 6.9 mg/kg total mercury

No methylmercury data are available for sediment with the exception of limited special studies data discussed later in this presentation.

Previous Investigations - Summary of Special Studies Data

Special studies of Bear Creek were conducted between 2017 and 2021 to better understand the biotic and abiotic factors contributing to mercury concentrations in fish in Bear Creek. The focus of these field studies was to gain an understanding of the processes controlling mercury methylation and bioaccumulation with beaver dams and periphyton being key areas of interest. Studies included:

- Understanding the role of beaver dams in contributing to mercury dynamics in Bear Creek (2017-2018)
- Evaluating the effects of fine-grained sediment deposition (2019)
- Investigation of the potential role that tributaries to Bear Creek may have on mercury and methylmercury in the main channel (2020-2021)
- Periphyton relationships (2021)

Previous Investigations - Summary of Special Studies Data

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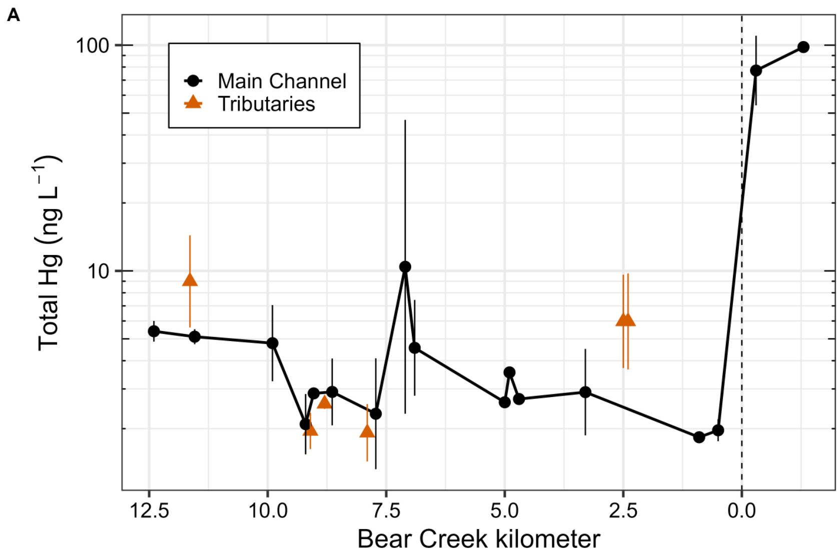
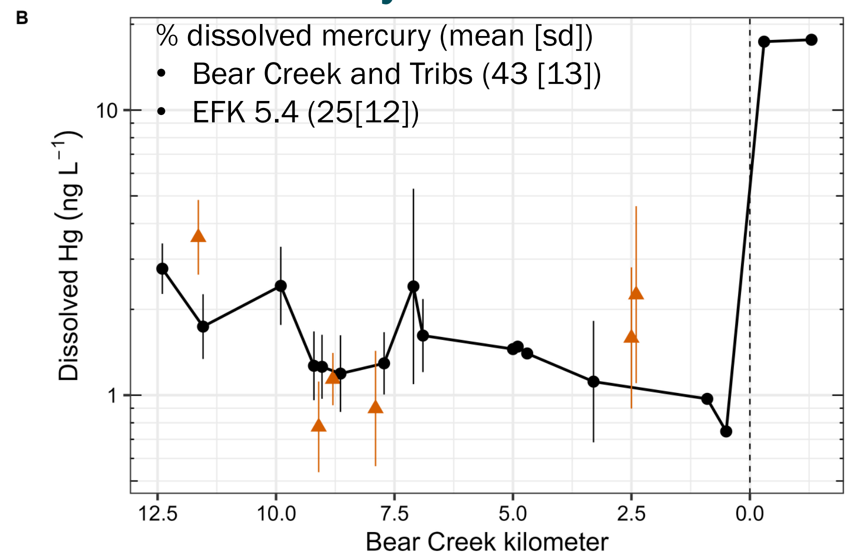
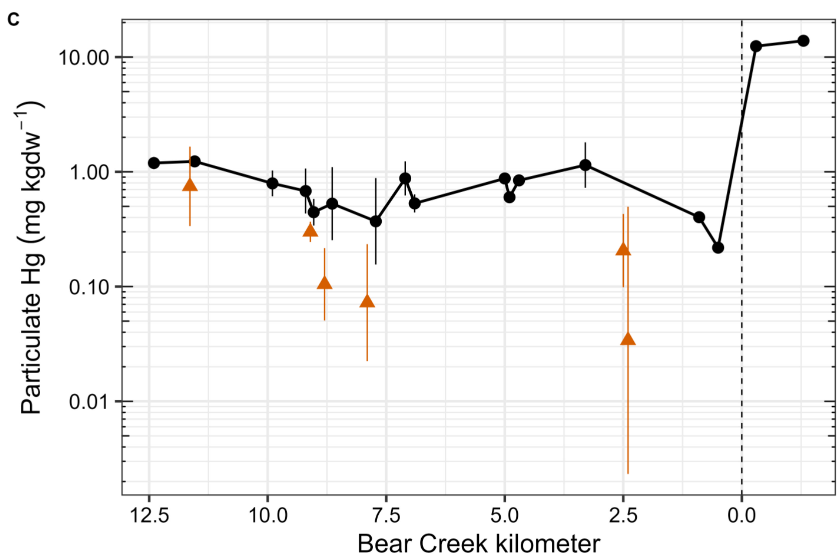
Bear Creek Surface Water mercury







- Total mercury and dissolved mercury concentrations decrease downstream in Bear Creek
- Higher concentrations in NT-03 and beaver pond but mass loading likely small

Previous Investigations - Summary of Special Studies Data

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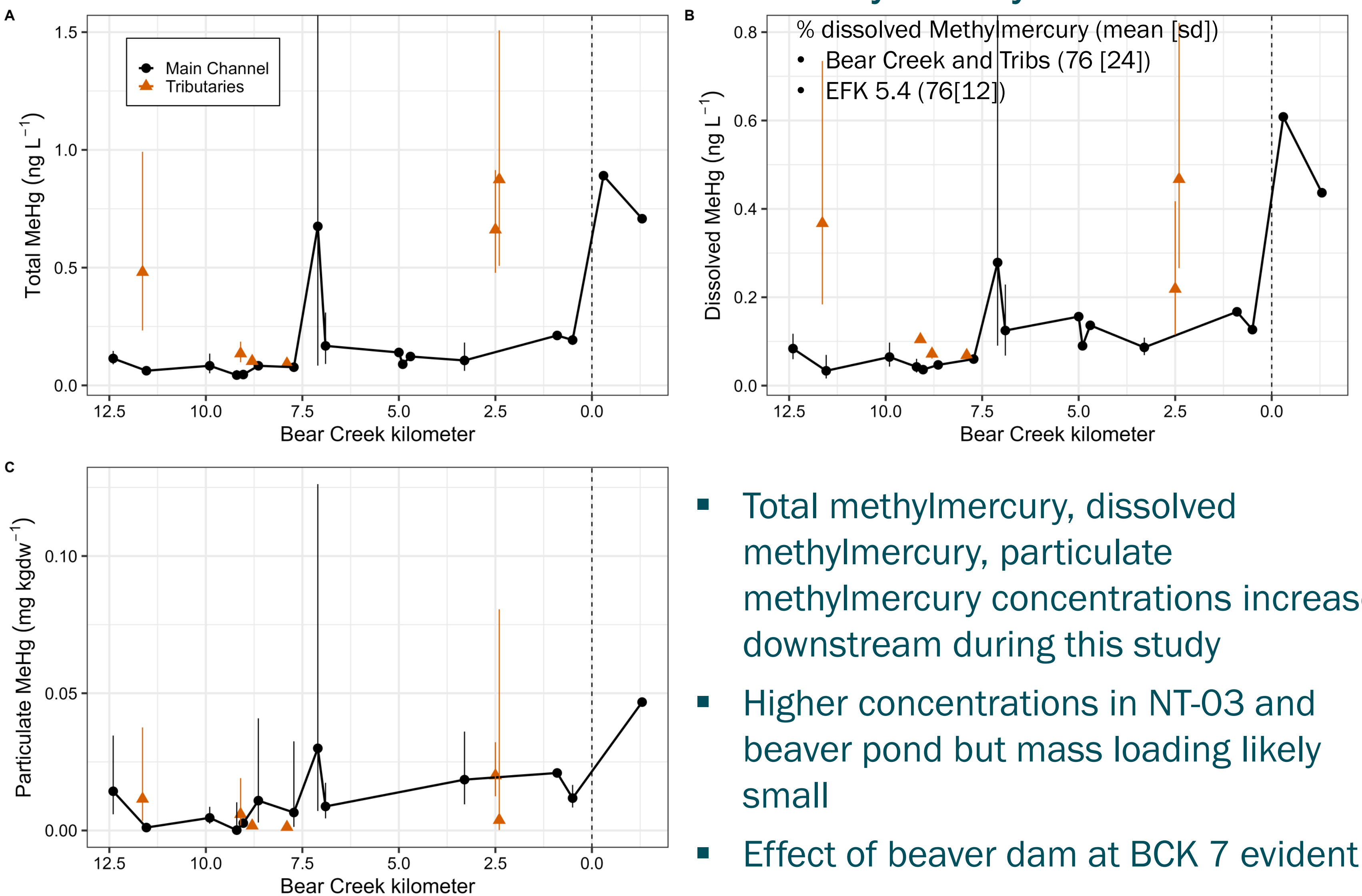
Bear Creek Surface Water methylmercury



- Total methylmercury, dissolved methylmercury, particulate methylmercury concentrations increase downstream during this study
- Higher concentrations in NT-03 and beaver pond but mass loading likely small
- Effect of beaver dam at BCK 7 evident

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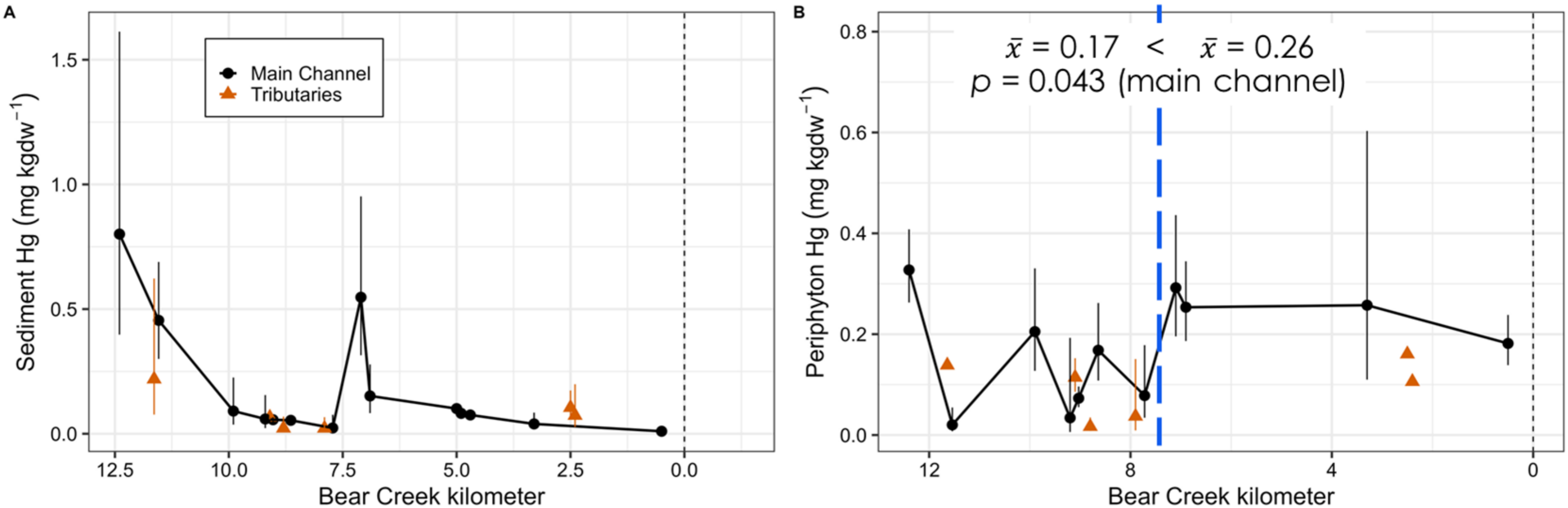
Previous Investigations - Summary of Special Studies Data

Total mercury in sediments (A) and periphyton (B) along Bear Creek



Flow is from left to right on each panel. The vertical dashed line marks the confluence of Bear Creek with EFPC.

- Sediment mercury concentration decreases downstream
- Effect of the former beaver dam at BCK 7 is evident
- Tributary sediments are comparable to Bear Creek
- Total mercury concentrations in periphyton in lower section of Bear Creek is higher than in the upper section
- Total mercury in periphyton is, on average, 1.4 times greater than in co-located sediment

Previous Investigations - Summary of Special Studies Data

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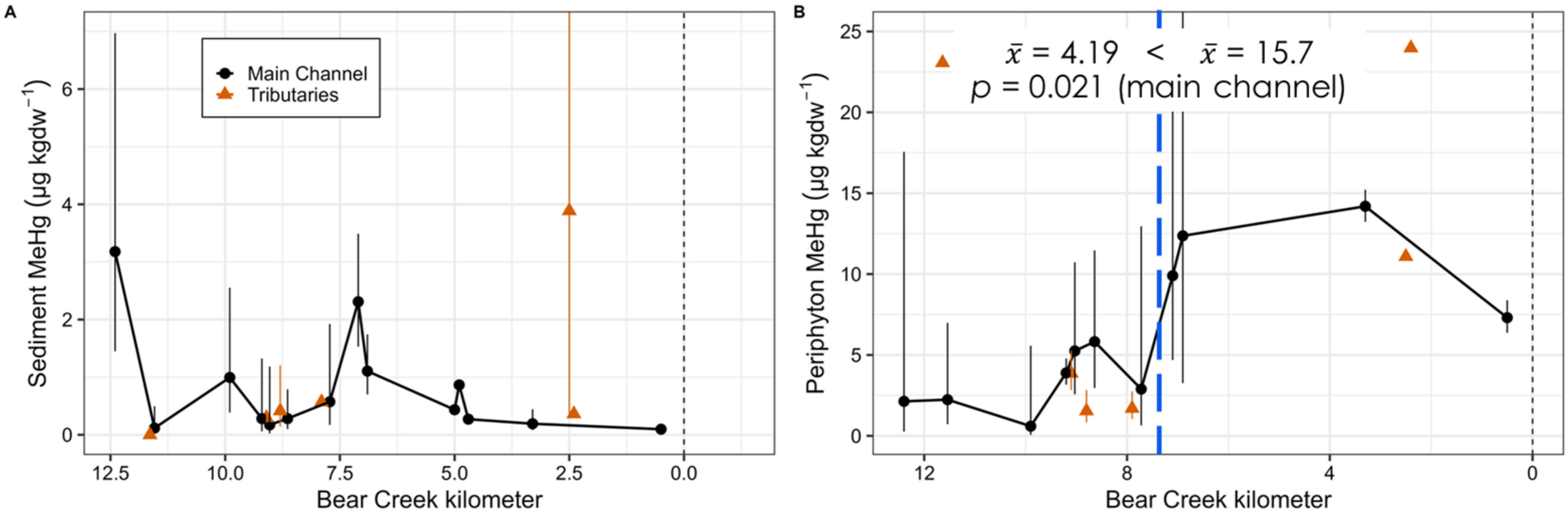
Methylmercury in sediments (A) and periphyton (B) along Bear Creek

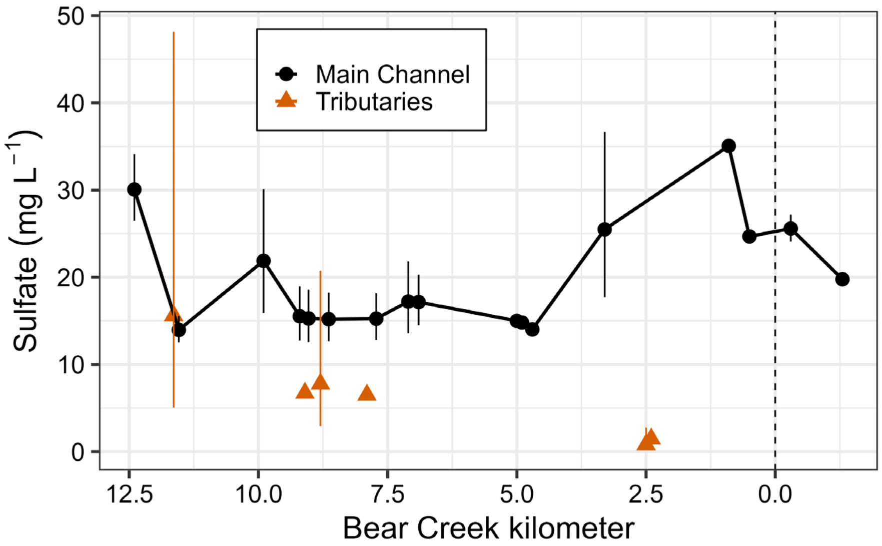


Flow is from left to right on each panel. The vertical dashed line marks the confluence of Bear Creek with EFPC.

- Sediment methylmercury concentration is variable with no strong spatial trend
- Effect of the former beaver dam at BCK 7 is evident
- Methylmercury in periphyton is higher in lower Bear Creek compared to upper
- Periphyton methylmercury in NT-3 and outlet of beaver pond is substantially greater than other locations
- Total methylmercury in periphyton is, on average, 5.6 times greater than in co-located sediment

Previous Investigations - Summary of Special Studies Data

Sulfate concentrations along Bear Creek



- Sulfate concentrations were consistent within the sampled reach but elevated relative to NT-09, NT-10, and NT-11
- The higher sulfate concentrations in lower Bear Creek coincide with relatively higher periphyton methylmercury concentrations in those sample locations

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DQO Steps

United States Environmental Protection Agency | Office of Environmental Information Washington, DC 20460 | EPA/240/B-06/001 February 2006

EPA

Guidance on Systematic Planning Using the Data Quality Objectives Process

EPA QA/G-4

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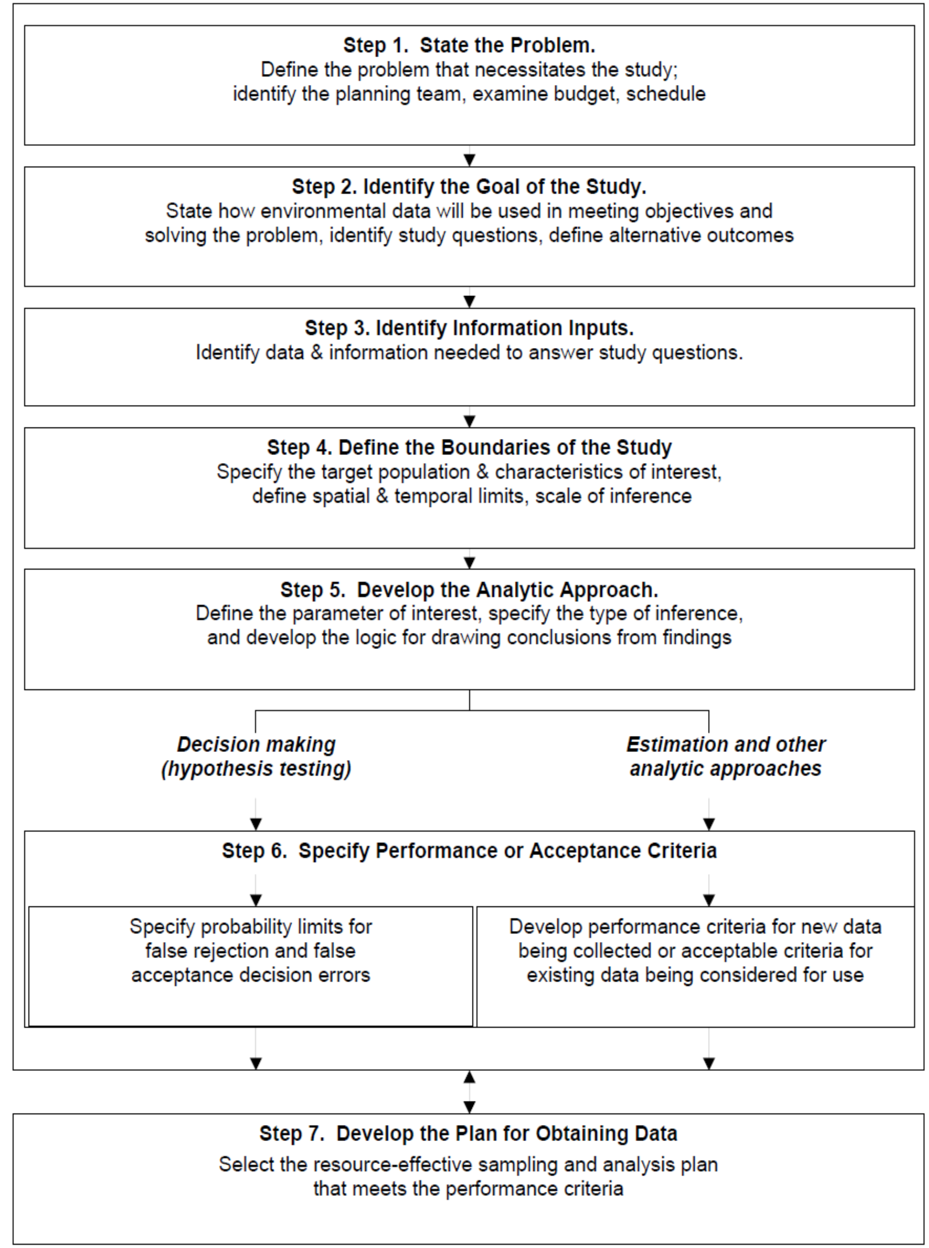

DQO Step 1. State the Problem

- There are insufficient data along Bear Creek and its tributaries to determine if there are potential sources of mercury and methylmercury in sediment and floodplain soils that may be contributing to exceedances of fish tissue criterion in prior years

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DQO Step 2. Identify the Goals of the Study

- Determine if there are areas (channel sediment, creek bank, and floodplain soils) along Bear Creek and its tributaries that are potential sources of mercury and methylmercury that may affect fish
- Obtain data from various hydrologic settings (i.e., pools, beaver ponds, etc.) that may contribute to mercury methylation and its bioaccumulation in the environment of Bear Creek and a reference location (e.g., Hinds Creek)

DQO Step 3. Identify Information Inputs

- Review potential sources of mercury and methylmercury in Bear Creek and its tributaries
- Review existing historical biota, surface water, sediment, and special studies data in Bear Creek, its tributaries, and reference site
- Collect additional surface water, channel sediment, creek bank, and floodplain soils data along Bear Creek and its tributaries from selected transects
- Collect additional surface water, channel sediment, creek bank, and floodplain soils data from the reference site

DQO Step 4. Define the Study Area Boundary

- Spatial
  – The study boundary is Bear Creek, its tributaries, and a reference location and limited surrounding creek bank sediment and floodplain soil
- Temporal
  – Collect samples in Fall 2023 to meet the RSE milestone of September 2024

DQO Step 5. Develop the Analytical Approach

- Collect surface water, channel sediment, creek bank, and floodplain soils to determine mercury and methylmercury concentrations along Bear Creek, its tributaries, and the reference site
- Analytical parameters will include mercury, methylmercury, nutrients (e.g., sulfate, phosphate, nitrogen, organic carbon, etc.), particle size analysis (PSA), and mercury speciation at select locations
- Transects will be field-located in potential source areas and pool areas (e.g., upstream of beaver dams) in Bear Creek and the mouths of tributaries (e.g., NT-3) based on a reconnaissance survey

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DQO Step 6. Specify the Performance or Acceptance Criteria

- New data will be obtained under UCOR/RSI approved procedures and quality programs and will be archived in OREIS.

DQO Step 7. Develop the Plan for Obtaining Data

- Compile all available information on potential mercury and methylmercury sources, existing surface water, sediment, and biota data (BMAP)
- Evaluate existing data
- Conduct additional characterization fieldwork:
  - Identify locations to conduct surface water, channel sediment, creek bank, and floodplain soil transect sampling.
  - Identify reference site location for surface water, channel sediment, creek bank, and floodplain soil sampling.

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Proposed Transect Locations

- Proposed transects along Bear Creek are based on the following*:
  - Locations downgradient and in the vicinity of potential source areas
  - Locations where sampling for biota and surface water have historically occurred
  - Locations in the vicinity of beaver ponds

*Exact transect locations are subject to change based on access and other field factors.

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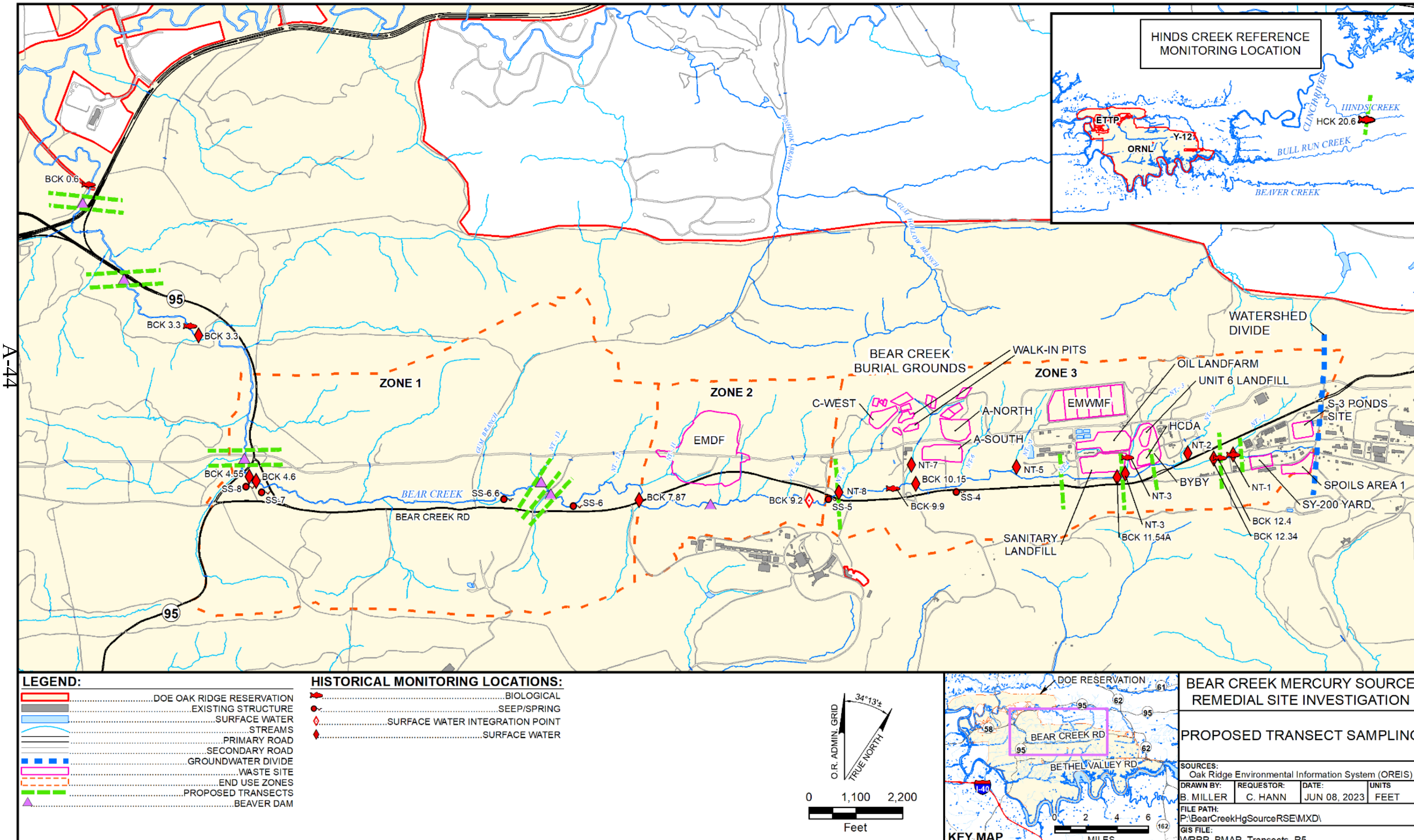
Proposed Transect Locations



Beaver Dams near BCK 7.0

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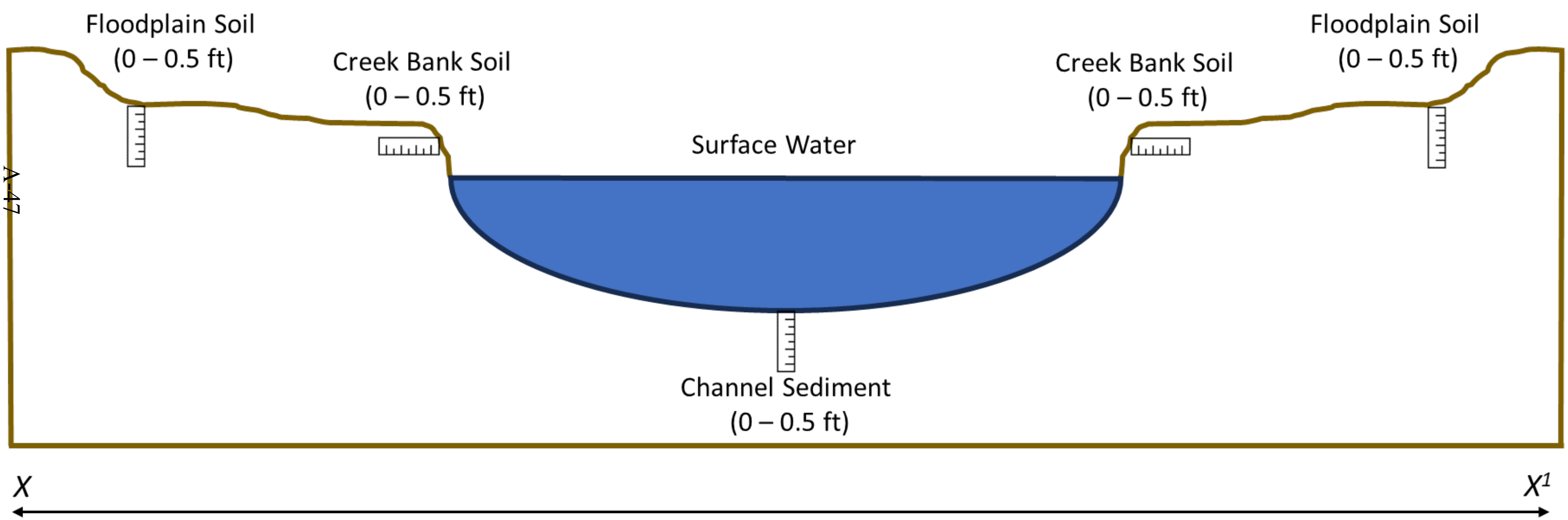
Transect Sampling

- **Channel sediment**
  - Collect 1-2 samples of channel sediment (0 – 0.5 ft) at each transect (number of samples at each transect will be based on width of Bear Creek at each location)
- **Creek bank sediment**
  - Collect 2 samples of bank sediment (0 – 0.5 ft) at each transect (one on each bank)
- **Floodplain soil**
  - Collect 2 samples of floodplain soil (0 – 0.5 ft) in the vicinity of Bear Creek (one on each side of Bear Creek)
- **Surface water**
  - Collect 1 surface water sample at each transect

Transect Sampling Diagram



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Analytical Suite

- Analyze channel sediment, creek bank, and floodplain soils for mercury, methylmercury, nutrients, PSA, and organic carbon
- Analyze surface water for mercury, methylmercury, nutrients, and organic carbon
- Additional mercury speciation partitioning in select sampling transects based on hydrologic setting

RSE Schedule

Activity	Date(s)
Historical Data Review and DQO Preparation	May/June 2023
DQO Meeting	June 2023
Prepare and Review RSE Sampling and Analysis Plan (SAP; FFA secondary document)	July/August 2023
Submit RSE SAP	August 2023
Perform RSE Sediment and Surface Water Sampling	September - November 2023
Data Evaluation (SED, SW, and 2023 Fish Tissue)	January - March 2024
Prepare and Review RSE D1	April - September 2024
Submit BCV Mercury Sources RSE D1	FFA App E: September 30, 2024

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APPENDIX B.
BEAR CREEK VALLEY MERCURY SOURCES
REMEDIAL SITE EVALUATION SAMPLING AND ANALYSIS PLAN TABLES

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Table B.1. Sample groups for the BCV mercury sources RSE

Sample group[a]	Location[b]	Sampling point[b]	Monitoring frequency[c]	Matrix[d]	Sample type[e]	Dup[f]	Analyte/parameter group[g]
LOWBCV	BCT1 (upstream of BCK 0.6; downstream of beaver dam)	BCT1-BSL	Q1	SO	C		S-BCVRSE
		BCT1-BSU		SO	C		S-BCVRSE
		BCT1-CH		SE	C		S-BCVRSE
		BCT1-FP		SO	C		S-BCVRSE
		BCT1-SW		WS	G		BCVRSE(+F)
	BCT2 (upstream of BCK 0.6; upstream of beaver dam)	BCT2-BSL	Q1	SO	C		S-BCVRSE
		BCT2-BSU		SO	C		S-BCVRSE
		BCT2-CH		SE	C		S-BCVRSE
		BCT2-FP		SO	C		S-BCVRSE
		BCT2-SW		WS	G		BCVRSE(+F)
	BCT3 (downstream of BCK 3.3; downstream of beaver dam)	BCT3-BSL	Q1	SO	C		S-BCVRSE
		BCT3-BSU		SO	C		S-BCVRSE
		BCT3-CH		SE	C		S-BCVRSE
		BCT3-FP		SO	C		S-BCVRSE
		BCT3-SW		WS	G		BCVRSE(+F)
	BCT4 (downstream of BCK 3.3; upstream of beaver dam)	BCT4-BSL	Q1	SO	C		S-BCVRSE
		BCT4-BSU		SO	C		S-BCVRSE
		BCT4-CH		SE	C		S-BCVRSE
		BCT4-FP		SO	C		S-BCVRSE
		BCT4-SW		WS	G		BCVRSE(+F)
BCV ZONE 1	BCT5 (downstream of BCK 4.55; downstream of beaver dam)	BCT5-BSL	Q1	SO	C		S-BCVRSE
		BCT5-BSU		SO	C		S-BCVRSE
		BCT5-CH		SE	C		S-BCVRSE, HGSEQ
		BCT5-FP		SO	C		S-BCVRSE, HGSEQ
		BCT5-SW		WS	G		BCVRSE(+F)
		BCT5-BS		SO	C		HGSEQ
	BCT6 (downstream of BCK 4.55; upstream of beaver dam)	BCT6-BSL	Q1	SO	C		S-BCVRSE
		BCT6-BSU		SO	C		S-BCVRSE
		BCT6-CH		SE	C		S-BCVRSE, HGSEQ
		BCT6-FP		SO	C		S-BCVRSE, HGSEQ
		BCT6-SW		WS	G		BCVRSE(+F)
		BCT6-BS		SO	C		HGSEQ

Table B.1. Sample groups for the BCV mercury sources RSE (cont.)

Sample group[a]	Location[b]	Sampling point[b]	Monitoring frequency[c]	Matrix[d]	Sample type[e]	Dup[f]	Analyte/parameter group[g]
BCV ZONE 1	BCT7 (downstream of BCK 7.87 at the confluence of NT-13/Bear Creek; downstream of westernmost beaver dam)	BCT7-BSL	Q1	SO	C		S-BCVRSE
		BCT7-BSU		SO	C		S-BCVRSE
		BCT7-CH		SE	C		S-BCVRSE, HGSEQ
		BCT7-FP		SO	C		S-BCVRSE, HGSEQ
		BCT7-SW		WS	G		BCVRSE(+F)
		BCT7-BS		SO	C		HGSEQ
	BCT8 (downstream of BCK 7.87 at the confluence of NT-13/Bear Creek; upstream of westernmost beaver damn)	BCT8-BSL	Q1	SO	C		S-BCVRSE
		BCT8-BSU		SO	C		S-BCVRSE
		BCT8-CH		SE	C		S-BCVRSE, HGSEQ
		BCT8-FP		SO	C		S-BCVRSE, HGSEQ
		BCT8-SW		WS	G		BCVRSE(+F)
		BCT8-BS		SO	C		HGSEQ
	BCT9 (downstream of BCK 7.87; upstream of two beaver dams; southeast of Reeves Road/Haul Road)	BCT9-BSL	Q1	SO	C		S-BCVRSE
		BCT9-BSU		SO	C		S-BCVRSE
		BCT9-CH		SE	C		S-BCVRSE, HGSEQ
		BCT9-FP		SO	C		S-BCVRSE, HGSEQ
		BCT9-SW		WS	G		BCVRSE(+F)
		BCT9-BS		SO	C		HGSEQ
BCV ZONE 2	BCT10 (downstream of surface water integration point BCK 9.2; upstream of EMDF)	BCT10-BSL	Q1	SO	C		S-BCVRSE
		BCT10-BSU		SO	C		S-BCVRSE
		BCT10-CH		SE	C		S-BCVRSE
		BCT10-FP		SO	C		S-BCVRSE
		BCT10-SW		WS	G		BCVRSE(+F)
BCV ZONE 3	BCT11 (upstream of NT-8 at BCK 9.9)	BCT11-BSL	Q1	SO	C		S-BCVRSE
		BCT11-BSU		SO	C		S-BCVRSE
		BCT11-CH		SE	C		S-BCVRSE, HGSEQ
		BCT11-FP		SO	C		S-BCVRSE, HGSEQ
		BCT11-SW		WS	G		BCVRSE(+F)
		BCT11-BS		SO	C		HGSEQ

Table B.1. Sample groups for the BCV mercury sources RSE (cont.)

Sample group[a]	Location[b]	Sampling point[b]	Monitoring frequency[c]	Matrix[d]	Sample type[e]	Dup[f]	Analyte/parameter group[g]
BCV ZONE 3	BCT12A (upstream of NT-3 confluence with Bear Creek)	BCT12A-BSL	Q1	SO	C		S-BCVRSE
		BCT12A-BSU		SO	C		S-BCVRSE
		BCT12A-CH		SE	C		S-BCVRSE
		BCT12A-FP		SO	C		S-BCVRSE
		BCT12A-SW		WS	G		BCVRSE(+F)
	BCT12B (downstream of BYBY at the confluence of NT-3/Bear Creek)	BCT12B-BSL	Q1	SO	C	X	S-BCVRSE
		BCT12B-BSU		SO	C		S-BCVRSE
		BCT12B-CH		SE	C		S-BCVRSE, HGSEQ
		BCT12B-FP		SO	C		S-BCVRSE, HGSEQ
		BCT12B-SW		WS	G		BCVRSE(+F)
		BCT12B-BS		SO	C		HGSEQ
	BCT13 (upstream of BYBY, EMWMF, and NT-3)	BCT13-BSL	Q1	SO	C		S-BCVRSE
		BCT13-BSU		SO	C		S-BCVRSE
		BCT13-CH		SE	C		S-BCVRSE
		BCT13-FP		SO	C		S-BCVRSE
		BCT13-SW		WS	G		BCVRSE(+F)
	BCT14 (downstream of SY-200 Yard, Spoil Area 1, and S-3 Ponds Site)	BCT14-BSL	Q1	SO	C	X	S-BCVRSE
		BCT14-BSU		SO	C		S-BCVRSE
		BCT14-CH		SE	C		S-BCVRSE, HGSEQ
		BCT14-FP		SO	C		S-BCVRSE, HGSEQ
		BCT14-SW		WS	G		BCVRSE(+F)
		BCT14-BS		SO	C		HGSEQ
	BCT15 (downstream of S-3 Ponds Site)	BCT15-BSL	Q1	SO	C		S-BCVRSE
		BCT15-BSU		SO	C		S-BCVRSE
		BCT15-CH		SE	C		S-BCVRSE
		BCT15-FP		SO	C		S-BCVRSE
		BCT15-SW		WS	G		BCVRSE(+F)
Hinds Creek	HCTREF (HCK 20.6 reference site)	HCTREF-BSL	Q1	SO	C		S-BCVRSE
		HCTREF-BSU		SO	C		S-BCVRSE
		HCTREF-CH		SE	C		S-BCVRSE, HGSEQ
		HCTREF-FP		SO	C		S-BCVRSE, HGSEQ
		HCTREF-SW		WS	G		BCVRSE(+F)
		HCTREF-BS		SO	C		HGSEQ

Table B.1. Sample groups for the BCV mercury sources RSE

[a] Sample group

BCV = Bear Creek Valley Watershed sample group number

LOWBCV = Lower Bear Creek Valley

Samples in each group will be collected during as short a time period as possible, following the schedule provided

[b] Location and sampling point

BCK = Bear Creek kilometer
BCT = Bear Creek transect
BS = creek bank soil
BSL = creek bank soil (lower)
BSU = creek bank soil (upper)
BYBY = Boneyard/Burnyard
CH = channel sediment
EMDF = Environmental Management Disposal Facility
EMWMF = Environmental Management Waste Management Facility
FP = floodplain soil
HCK = Hinds Creek
HCTREF = Hinds Creek transect reference site
NT = northern tributary
SW = surface water
SY = scrap yard

[c] Monitoring frequency

Q = quarter of the fiscal year (e.g., Q1, Q2, Q3, Q4)

[d] Matrix

SE = sediment
SO = soil
WS = surface water

[e] Sample type

G = grab sample
C = composite sample

[f] Duplicate

X = field duplicate sample will be collected for all analyte/parameter groups except HGSEQ

Field duplicate samples will be collected concurrently with the investigative samples and sent to the laboratory responsible for analyses of the investigative sample. Field duplicates will be collected at a frequency of 10% of the samples collected (i.e., 1 to 10 total samples collected equal 1 field duplicate; 1 to 20 total samples collected equal 2 field duplicates) or as specified in the task-specific work control document (e.g., Sampling and Analysis Plans [SAPs]), in accordance with the *Quality Assurance Project Plan for the Water Resources Restoration Program, U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee* (UCOR-4049; Water Resources Restoration Program [WRRP] Quality Assurance Project Plan [QAPP]). Deviations from this Remedial Site Evaluation (RSE) SAP will be documented in the field logbook and in the BCV Mercury Sources RSE. Changes will be documented, as appropriate in the field, as well as in the Project Environmental Measurements System

[g] Analyte/parameter group

See Tables D.56 through D.58 in the WRRP QAPP for a list of parameter groups and analytes

BCVRSE(+F) = Both a filtered and unfiltered sample are obtained by sampling personnel for the designated metals analysis to be performed by the laboratory. Otherwise, only an unfiltered sample is obtained and analyzed for metals

Table B.2. Analytes, RRLs, and screening levels for water for the BCV mercury sources RSE

WRRP QAPP[a] parameter group	Analyte	CAS number	Analytical method[b]	Units	Laboratory MDL	Laboratory PQL	RRL[c]	Screening levels[d]				
								Surface water				
								DWS	CCC	CMC	W&O	OOC
BCVRSE	**Field parameters**											
	Water temperature	NA	NA	°C	--	--	--	--	--	--	--	--
	Dissolved oxygen	7782-44-7	NA	mg/L	--	--	--	--	--	--	--	--
	Turbidity	NA	NA	NTU	--	--	--	--	--	--	--	--
	pH	NA	NA	pH	--	--	--	--	--	--	--	--
	Specific conductance (conductivity)	NA	NA	µmhos/cm	--	--	--	--	--	--	--	--
	Oxidation-reduction potential	NA	NA	mV	--	--	--	--	--	--	--	--
	Metals											
	Mercury	7439-97-6	EPA-1631	ng/L	0.08	0.5	0.5	2000	770	1400	50	51
	Methylmercury	22967-92-6	EPA-1630	ng/L	0.026	0.08	0.02	--	--	--	--	--
	Aluminum	7429-90-5	SW846-6010 or SW846-6020	mg/L	0.0193	0.05	0.05	--	--	--	--	--
	Antimony	7440-36-0	SW846-6010 or SW846-6020	mg/L	0.001	0.003	0.003	0.006	--	--	0.0056	0.64
	Arsenic	7440-38-2	SW846-6010 or SW846-6020	mg/L	0.005	0.03	0.005	0.01	0.15	0.34	0.01	0.01
	Barium	7440-39-3	SW846-6010 or SW846-6020	mg/L	0.001	0.005	0.005	2	--	--	--	--
	Beryllium	7440-41-7	SW846-6010 or SW846-6020	mg/L	0.0002	0.0005	0.001	0.004	--	--	--	--
	Boron	7440-42-8	SW846-6010 or SW846-6020	mg/L	0.0052	0.015	0.01	--	--	--	--	--
	Cadmium	7440-43-9	SW846-6010 or SW846-6020	mg/L	0.0003	0.001	0.00013	0.005	0.00072	0.0018	--	--
	Calcium	7440-70-2	SW846-6010 or SW846-6020	mg/L	0.05	0.2	0.01	--	--	--	--	--
	Chromium	7440-47-3	SW846-6010 or SW846-6020	mg/L	0.003	0.01	0.005	0.1	0.074	0.57	--	--
	Cobalt	7440-48-4	SW846-6010 or SW846-6020	mg/L	0.0003	0.001	0.005	--	--	--	--	--
	Copper	7440-50-8	SW846-6010 or SW846-6020	mg/L	0.0003	0.002	0.005	--	0.009	0.013	--	--
	Iron	7439-89-6	SW846-6010 or SW846-6020	mg/L	0.033	0.1	0.01	--	--	--	--	--
	Lead	7439-92-1	SW846-6010 or SW846-6020	mg/L	0.0005	0.002	0.002	0.005	0.0025	0.065	--	--
	Lithium	7439-93-2	SW846-6010 or SW846-6020	mg/L	0.003	0.01	0.01	--	--	--	--	--
	Magnesium	7439-95-4	SW846-6010 or SW846-6020	mg/L	0.11	0.3	0.05	--	--	--	--	--
	Manganese	7439-96-5	SW846-6010 or SW846-6020	mg/L	0.001	0.005	0.005	--	--	--	--	--
	Nickel	7439-98-7	SW846-6010 or SW846-6020	mg/L	0.0006	0.002	0.01	0.1	0.052	0.47	0.61	4.6
	Potassium	7440-02-0	SW846-6010 or SW846-6020	mg/L	0.05	0.15	0.025	--	--	--	--	--
	Selenium	7440-09-7	SW846-6010 or SW846-6020	mg/L	0.006	0.03	0.0025	0.05	0.0031	0.02	0.17	4.2
	Silicon	7782-49-2	SW846-6010 or SW846-6020	mg/L	0.025	0.1	0.01	--	--	--	--	--
	Silver	7440-22-4	SW846-6010 or SW846-6020	mg/L	0.0003	0.001	0.0015	--	--	0.0032	--	--
	Sodium	7440-23-5	SW846-6010 or SW846-6020	mg/L	0.1	0.3	0.01	--	--	--	--	--
	Strontium	7440-24-6	SW846-6010 or SW846-6020	mg/L	0.002	0.01	0.005	--	--	--	--	--
	Thallium	7440-28-0	SW846-6010 or SW846-6020	mg/L	0.0006	0.002	0.001	0.002	--	--	0.00024	0.00047
	Uranium	7440-61-1	SW846-6010 or SW846-6020	mg/L	0.000067	0.0002	0.004	--	--	--	--	--
	Vanadium	7440-62-2	SW846-6010 or SW846-6020	mg/L	0.001	0.005	0.01	--	--	--	--	--
	Zinc	7440-66-6	SW846-6010 or SW846-6020	mg/L	0.0033	0.02	0.01	--	0.12	0.12	7.4	26

Table B.2. Analytes, RRLs, and screening levels for water for the BCV mercury sources RSE (cont.)

WRRP QAPP[a] parameter group	Analyte	CAS number	Analytical method[b]	Units	Laboratory MDL	Laboratory PQL	RRL[c]	Screening levels[d]				
								Surface water				
								DWS	CCC	CMC	W&O	OOC
BCVRSE (cont)	**Miscellaneous parameters**											
	Phosphorus (total)	7723-14-0	SW846-6020	mg/L	0.018	0.05	0.05	--	--	--	--	--
	Total organic carbon	E701250	SW846-9060	mg/L	0.33	1	1	--	--	--	--	--
	Dissolved organic carbon	E701250	SW846-9060	mg/L	0.33	1	1	--	--	--	--	--
	Total dissolved solids	E1642222	SM-2540 C	mg/L	3.4	5	10	500	--	--	--	--
	Total suspended solids	E1642818	SM-2540 D	mg/L	1.14	5	5	--	--	--	--	--
	Anions											
	Chloride	16887-00-6	EPA-300.0	mg/L	0.067	0.2	0.01	--	--	--	--	--
	Fluoride	16984-48-8	EPA-300.0	mg/L	0.033	0.1	0.05	--	--	--	--	--
	Sulfate	14808-79-8	EPA-300.0	mg/L	0.133	0.4	0.1	--	--	--	--	--
	Sulfide	18496-25-8	SM-4500-S2 D	mg/L	0.033	0.1	0.1	--	--	--	--	--
	Nitrate-nitrite as nitrogen	E701177	EPA-353.2	mg/L	0.017	0.05	0.1	10	--	--	--	--

[a] UCOR-4049. *Quality Assurance Project Plan for the Water Resources Restoration Program, U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee* , latest revision, United Cleanup Oak Ridge LLC, Oak Ridge, TN.
[b] An alternative method or alternate technique may be used to achieve the RRLs.
[c] RRLs are defined so that the data obtained meet program/project requirements for reporting quantitative data. For this parameter group, the laboratory is being requested to report detections with respect to the MDLs, which are generally lower than the RRLs.
[d] Screening levels listed here are for potential comparison purposes only and are not required performance goals.

-- = not available or not applicable
BCV = Bear Creek Valley
CAS = Chemical Abstracts Service
CCC = Tennessee Department of Environment and Conservation fish and aquatic life criterion continuous concentration criteria, Chapter 1200-4-3-.03(3)
CMC = Tennessee Department of Environment and Conservation fish and aquatic life criterion maximum concentration criteria, Chapter 1200-4-3-.03(3)
DWS = Tennessee Department of Environment and Conservation domestic water supply criteria, Chapter 1200-4-3-.03(1).
EPA = U.S. Environmental Protection Agency
MDL = method detection limit
NA = not applicable
NTU = nephelometric turbidity unit
OOC = Tennessee Department of Environment and Conservation recreation organisms only criteria, Chapter 1200-4-3-.03(4)
PQL = practical quantitation limit
QAPP = Quality Assurance Project Plan
RRL = requested reporting limit
RSE = remedial site evaluation
SW846 = EPA test methods for evaluating solid waste, physical/chemical methods
W&O = Tennessee Department of Environment and Conservation recreation water and organisms criteria, Chapter 1200-4-3-.03(4)
WRRP = Water Resources Restoration Program

Table B.3. Analytes, RRLs, and screening levels for sediment and soil for the BCV mercury sources RSE

WRRP QAPP[a] parameter group	Analyte	CAS number	Analytical method[b]	Units	Laboratory MDL	Laboratory PQL	RRL[c]	Screening level
S-BCVRSE	**Metals**							
	Mercury	7439-97-6	SW846-7471	mg/kg	0.009	0.03	0.1	Compare to reference site
	Methylmercury	22967-92-6	EPA-1630 (modified)	ng/g	0.017	0.058	0.017	Compare to reference site
	Aluminum	7429-90-5	SW846-6010 or SW846-6020	mg/kg	6.8	20	1	Compare to reference site
	Antimony	7440-36-0	SW846-6010 or SW846-6020	mg/kg	0.33	2	0.5	Compare to reference site
	Arsenic	7440-38-2	SW846-6010 or SW846-6020	mg/kg	0.338	1	0.5	Compare to reference site
	Barium	7440-39-3	SW846-6010 or SW846-6020	mg/kg	0.1	0.5	0.5	Compare to reference site
	Beryllium	7440-41-7	SW846-6010 or SW846-6020	mg/kg	0.1	0.5	0.1	Compare to reference site
	Boron	7440-42-8	SW846-6010 or SW846-6020	mg/kg	1	5	1	Compare to reference site
	Cadmium	7440-43-9	SW846-6010 or SW846-6020	mg/kg	0.02	0.2	0.1	Compare to reference site
	Calcium	7440-70-2	SW846-6010 or SW846-6020	mg/kg	8	25	5	Compare to reference site
	Chromium	7440-47-3	SW846-6010 or SW846-6020	mg/kg	0.15	1	0.5	Compare to reference site
	Cobalt	7440-48-4	SW846-6010 or SW846-6020	mg/kg	0.15	0.5	0.5	Compare to reference site
	Copper	7440-50-8	SW846-6010 or SW846-6020	mg/kg	0.3	2	0.5	Compare to reference site
	Iron	7439-89-6	SW846-6010 or SW846-6020	mg/kg	8	25	1	Compare to reference site
	Lead	7439-92-1	SW846-6010 or SW846-6020	mg/kg	0.33	2	0.3	Compare to reference site
	Lithium	7439-93-2	SW846-6010 or SW846-6020	mg/kg	0.4	2	1	Compare to reference site
	Magnesium	7439-95-4	SW846-6010 or SW846-6020	mg/kg	8.5	30	5	Compare to reference site
	Manganese	7439-96-5	SW846-6010 or SW846-6020	mg/kg	0.2	1	0.5	Compare to reference site
	Molybdenum	7439-98-7	SW846-6010 or SW846-6020	mg/kg	0.2	1	1	Compare to reference site
	Nickel	7440-02-0	SW846-6010 or SW846-6020	mg/kg	0.15	0.5	1	Compare to reference site
	Potassium	7440-09-7	SW846-6010 or SW846-6020	mg/kg	6.4	25	5	Compare to reference site
	Selenium	7782-49-2	SW846-6010 or SW846-6020	mg/kg	0.36	1	0.5	Compare to reference site
	Silver	7440-22-4	SW846-6010 or SW846-6020	mg/kg	0.1	0.5	0.5	Compare to reference site
	Sodium	7440-23-5	SW846-6010 or SW846-6020	mg/kg	7	25	5	Compare to reference site
	Thallium	7440-28-0	SW846-6010 or SW846-6020	mg/kg	0.14	0.4	0.2	Compare to reference site
	Uranium	7440-61-1	SW846-6010 or SW846-6020	mg/kg	0.0132	0.04	5	Compare to reference site

Table B.3. Analytes, RRLs, and screening levels for sediment and soil for the BCV mercury sources RSE (cont.)

WRRP QAPP[a] parameter group	Analyte	CAS number	Analytical method[b]	Units	Laboratory MDL	Laboratory PQL	RRL[c]	Screening level
S-BCVRSE (cont)	Vanadium	7440-62-2	SW846-6010 or SW846-6020	mg/kg	0.1	0.5	1	Compare to reference site
	Zinc	7440-66-6	SW846-6010 or SW846-6020	mg/kg	0.4	2	0.5	Compare to reference site
	Miscellaneous parameters							
	Total organic carbon	E701250	SW846-9060	mg/kg	200	500	1	--
	Particle size analysis	NA	ASTM-D6913	--	--	--	--	--
	Anions							
	Chloride	16887-00-6	SW846-9056	mg/kg	0.72	2	0.72	--
	Fluoride	16984-48-8	SW846-9056	mg/kg	0.34	1	0.34	--
	Nitrate	14797-55-8	SW846-9056	mg/kg	0.33	1	0.33	--
	Nitrite	14797-65-0	SW846-9056	mg/kg	0.33	1	0.33	--
	Sulfate	14808-79-8	SW846-9056	mg/kg	1.33	4	1.33	--
	Sulfide	18496-25-8	SW846-9030/9034	mg/kg	9	25	9	--
HGSEQ	Mercury (F0)	NA	SW846-3200 (modified)	ug/kg	3.6	21	3.6	--
	Mercury (F1)	NA	SW846-3200 (modified)	ug/kg	240	740	240	--
	Mercury (F2)	NA	SW846-3200 (modified)	ug/kg	240	740	240	--
	Mercury (F3)	NA	SW846-3200 (modified)	ug/kg	240	740	240	--
	Mercury (F4)	NA	SW846-3200 (modified)	ug/kg	240	740	240	--
	Mercury (F5)	NA	SW846-3200 (modified)	ug/kg	41	370	41	--
	Mercury (F6)	NA	SW846-3200 (modified)	ug/kg	0.11	1.2	0.11	--

[a] UCOR-4049. *Quality Assurance Project Plan for the Water Resources Restoration Program, U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee* , latest revision, United Cleanup Oak Ridge LLC, Oak Ridge, TN.
[b] An alternative method or alternate technique may be used to achieve the RRLs.
[c] RRLs are defined so that the data obtained meet program/project requirements for reporting quantitative data. For this parameter group, the laboratory is being requested to report detections with respect to the MDLs, which are generally lower than the RRLs.

-- = not available or not applicable
ASTM = American Standard Test Method
BCV = Bear Creek Valley
CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency
MDL = method detection limit

Table B.3. Analytes, RRLs, and screening levels for sediment and soil for the BCV mercury sources RSE (cont.)

Mercury (F0) = volatile elemental mercury
Mercury (F1) = water soluble mercury
Mercury (F2) = pH2 soluble mercury
Mercury (F3) = 1N potassium hydroxide extractable mercury
Mercury (F4) = 12N nitric acid soluble mercury
Mercury (F5) = aqua regia soluble mercury residue
Mercury (F6) = mineral-bound mercury
NA = not available
PQL = practical quantitation limit
QAPP = Quality Assurance Project Plan
RRL = requested reporting limit
RSE = remedial site evaluation
SW846 = EPA test methods for evaluating solid waste, physical/chemical methods
WRRP = Water Resources Restoration Program

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COMMENT RESPONSE FORM

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UCOR
United Cleanup Oak Ridge LLC

Comment Resolution Form

Document Number: DOE/OR/01-2958&D1	Document Title: *Bear Creek Valley Mercury Sources Remedial Site Evaluation Sampling and Analysis Plan, Oak Ridge, Tennessee*	
Name of Reviewer: Jana Dawson	**Organization:** U.S. Environmental Protection Agency	**Date Comments Transmitted:** November 15, 2023

Comment No.	Sect./Page	Comment	Response
1	Section 2.2.2/Page 3	Section 2.2.2 (Summary of Mercury Source Areas) page 3 states "The baseline risk assessment (BRA) in the BCV RI stated "the sources of mercury and PCBs to the BCV fish are currently unknown." While it was noted in the meeting minutes that DOE does not believe PCB discharge from the EMDF will be an issue with regards to attainment of Ambient Water Quality Criteria (AWQC) in Bear Creek for PCBs, it would seem appropriate and cost effective to also conduct PCB analyses for the surface water and fish tissue samples that will be collected as part of this mercury source investigation in order to identify the source of both mercury and PCBs into Bear Creek. EPA strongly recommends adding the PCB analyses to this sampling effort.	Clarification. Analysis of PCBs in surface water and fish is already conducted in Bear Creek as part of the annual routine and Five-Year Review (FYR) sampling, as outlined in the BCV RAR CMP and as reported in the annual Remediation Effectiveness Report and FYR. The EMDF ROD mercury-management approach is the catalyst to this focused RSE to recognize if there are non-point source reductions that could offset the point source discharge at EMDF. As stated in Section 3.1 (Data Quality Objective Step 1: State the Problem), there are insufficient data along Bear Creek and its tributaries to determine if there are potential sources of mercury and methylmercury in channel sediment and creek bank and floodplain soils that may be contributing to exceedances of fish tissue criterion in prior years. As stated in Section 3.2 (Data Quality Objective Step 2: Identify the Goals of the Study), the purposes of this RSE are to: 1. Determine if there are areas (channel sediment and creek bank and floodplain soils) along Bear Creek and its tributaries that are potential sources of mercury and methylmercury that may affect fish. 2. Obtain data from various hydrologic settings (pools, beaver ponds, etc.) that may contribute to mercury methylation and its bioaccumulation in the environment of Bear Creek and a reference location (e.g., Hinds Creek).

Comment No.	Sect./Page	Comment	Response
			No change to the document proposed.
2	Section 2.2.2/Page 3	Section 2.2.2 (Summary of Mercury Source Areas) page 3 states "The BCV OU2 RI indicated mercury concentrations were elevated at the SY-200 Yard but were generally within an order of magnitude of background; however, free mercury was seen in some of the borings during the BCV OU2 RI. The BCV OU2 ROD identified the SY-200 Yard as the area with mercury." Please describe how much certainty there is that the location of the observed free mercury in soil borings was from soil bores collected at the SY-200 Yard since the SAP indicates there was initially some uncertainty about where the observations of free mercury were identified.	Clarification. The second paragraph in Section 2.2.2 was revised as follows: "The BCV OU2 RI indicated mercury concentrations were elevated at the SY-200 Yard but were generally within an order of magnitude of background; however, free mercury was seen in some of the borings at the SY-200 Yard during the BCV OU2 RI."
3	Section 4	Section 4 (Sampling and Analysis Plan – Sample Location Selection) does not propose any soil samples near suspected or known mercury source areas. By only sampling Bear Creek transects and associated bank/floodplain soils immediately next to transect location, how will it be determined which of the potential source areas are contributing mercury to Bear Creek. For example, a transect is proposed at BCT-14, which is stated to be downstream of the SY-200 Yard, Spoil Area 1, and S-3 Ponds Site. If elevated mercury is identified at this transect, how will it be determined which of the areas - SY-200 Yard area, the Soil Area 1, and/or S-3 Ponds are the main contributors of mercury to Bear Creek? The SAP does not appear to include sufficient samples to identify specific source areas of mercury. Please provide a response and/or SAP edits to state how specific source areas will be identified, and further, how such areas may be delineated to identify the extent of mercury migrating to Bear Creek, if elevated mercury is detected at any of the transects/ mercury-source investigation samples.	Clarification. As stated in Section 3.2 (Data Quality Objective Step 2: Identify the Goals of the Study), the purposes of this RSE are to: 1. Determine if there are areas (channel sediment and creek bank and floodplain soils) along Bear Creek and its tributaries that are potential sources of mercury and methylmercury that may affect fish. 2. Obtain data from various hydrologic settings (pools, beaver ponds, etc.) that may contribute to mercury methylation and its bioaccumulation in the environment of Bear Creek and a reference location (e.g., Hinds Creek). As stated in Section 3.1 (Data Quality Objective Step 1: State the Problem), there are insufficient data along Bear Creek and its tributaries to determine if there are potential sources of mercury and methylmercury in channel sediment and creek bank and floodplain soils that may be contributing to exceedances of fish tissue criterion in prior years. Data collected as part of this RSE will determine if there is any evidence these potential source areas (SY-200 Yard, Spoil Area 1, and S-3 Ponds Site) are contributing mercury to Bear Creek. If elevated mercury is detected in sediment or soil at transect

Comment No.	Sect./Page	Comment	Response
			BCT-14, downgradient of these source areas, then additional evaluation may be required, as discussed in the mercury-management approach in the EMDF ROD. During field reconnaissance for BCV Mercury Sources RSE sample transect locations, an additional transect was included in the planned work. Sample transect BCT-12 was split into BCT-12A (upstream of NT-3) and BCT-12B (downstream of NT-3) to further refine data resolution at a formerly remediated area (BYBY). Revised Figure 4.1 is attached at the end of these comment responses. Revisions to the BCV Mercury Sources RSE SAP to reflect this change have been made, as applicable.

Attachment

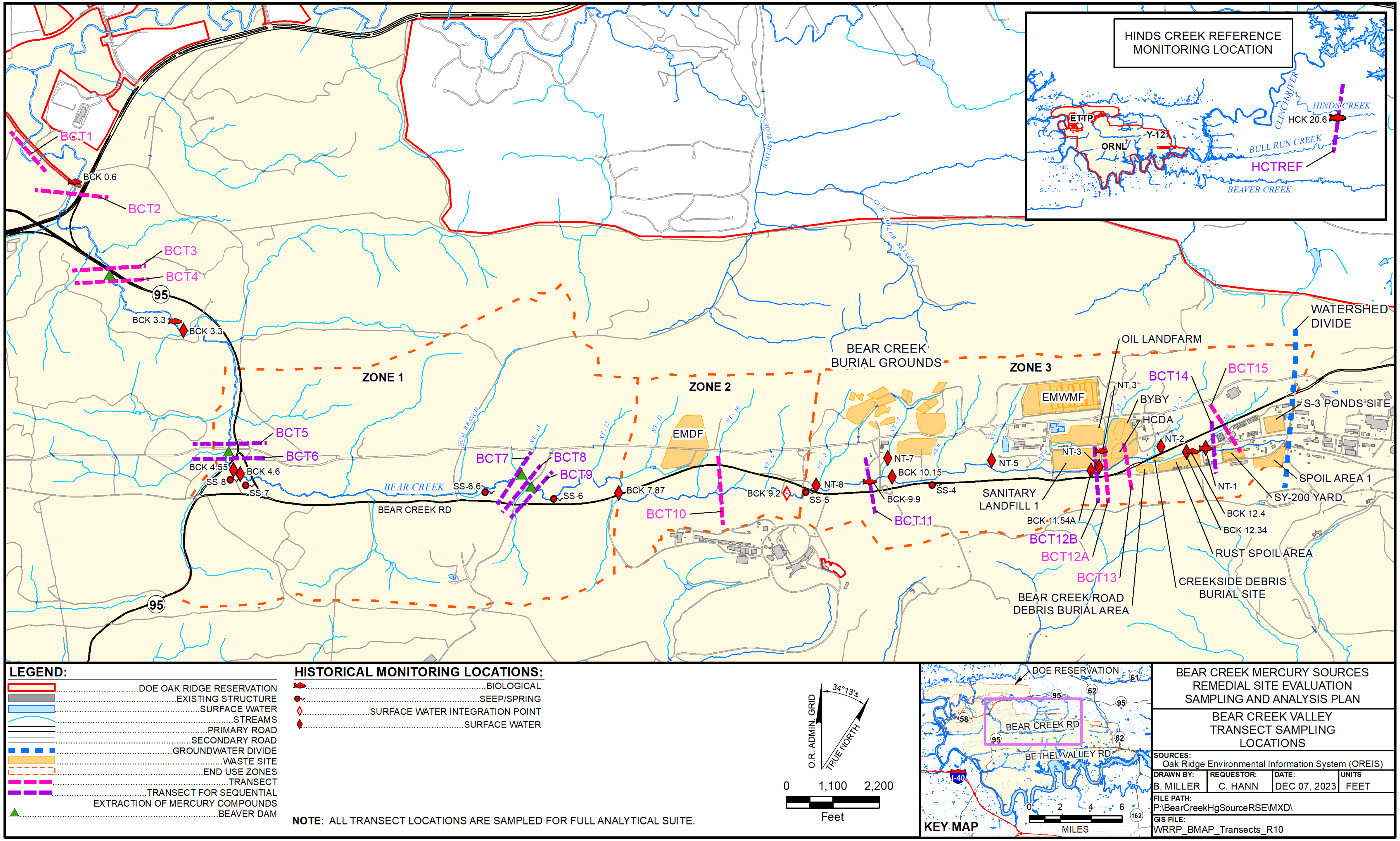

Figure 4.1. BCV transect sampling locations. (Revised based on EPA comment 3 and TDEC general comment 4)

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TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
COMMENT RESPONSE FORM

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UCOR United Cleanup Oak Ridge LLC

Comment Resolution Form

Document Number: DOE/OR/01-2958&D1	Document Title: *Bear Creek Valley Mercury Sources Remedial Site Evaluation Sampling and Analysis Plan, Oak Ridge, Tennessee*	
Name of Reviewer: Dana Casey/Cody Juneau	**Organization:** Tennessee Department of Environment and Conservation	**Date Comments Transmitted:** December 5, 2023

Comment No.	Sect./Page	Comment	Response
		General	
1		Section 1 or Section 2 should introduce the point that this Remedial Site Evaluation (RSE) is driven by the Environmental Management Disposal Facility (EMDF) Record of Decision (ROD). This important context is not presented until Section 7.1. As described in the EMDF ROD, the effective implementation of this RSE is required to identify mercury methylation areas in Bear Creek which currently prevent the creek from being in compliance with applicable water quality standards.	Agree. Text in the first paragraph in Section 1.1 was revised as follows: "The objective of the Bear Creek Valley (BCV) mercury sources remedial site evaluation (RSE) is to evaluate potential sources of mercury and methylmercury within the BCV Watershed, as outlined in the mercury-management approach for Bear Creek in the *Record of Decision for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal at the Environmental Management Disposal Facility, Oak Ridge, Tennessee* (DOE/OR/01-2794&D2/R2; Environmental Management Disposal Facility [EMDF] Record of Decision [ROD]). The BCV Watershed is located in…"
2		Please clarify the objective. Section 1.1 states the objective "is to evaluate potential sources of mercury and methylmercury within the Bear Creek Valley (BCV) Watershed." However, the EMDF ROD states the RSE will "evaluate mercury methylation in Bear Creek ... " These objectives do not directly align as the first implies finding any mercury within the watershed while the second implies evaluating only those sources contributing to the water quality of Bear Creek. The proposed sampling aligns with the objective stated in the ROD (e.g., only sampling to a depth of 0.5 ft. when there is a potential for mercury at greater soil depths), not the watershed-wide objective stated in this SAP. The FFA parties should discuss and be in agreement on the objective of this effort.	Clarification. The Bear Creek Valley Watershed is the administrative name that is used to refer to projects within this watershed. As discussed in the mercury-management approach outlined in the EMDF ROD, the plan for reducing mercury loading and restoring Bear Creek to meet recreational use designations (as measured in fish tissue concentrations) may be a phased approach. The approach may recognize non-point source reductions to offset the point source discharge at EMDF, following treatment or other measures, to permanently reduce loading and potentially reduce the rate of mercury methylation. As stated in Section 3.2 (Data Quality Objective Step 2: Identify the Goals of the Study) and as agreed upon during the DQO meeting held on June 29, 2023, the purposes of this RSE are to: 1. Determine if there are areas (channel sediment and creek bank and floodplain soils) along Bear Creek and

Comment No.	Sect./Page	Comment	Response
			its tributaries that are potential sources of mercury and methylmercury that may affect fish. 2. Obtain data from various hydrologic settings (pools, beaver ponds, etc.) that may contribute to mercury methylation and its bioaccumulation in the environment of Bear Creek and a reference location (e.g., Hinds Creek). As stated in Section 3.1 (Data Quality Objective Step 1: State the Problem), there are insufficient data along Bear Creek and its tributaries to determine if there are potential sources of mercury and methylmercury in channel sediment and creek bank and floodplain soils that may be contributing to exceedances of fish tissue criterion in prior years. Based on this statement of the problem, this RSE SAP includes collection of sediment, creek bank soil, and floodplain soil data, as well as surface water data. In addition, as part of the RSE, additional parameters will be collected that may contribute to a better understanding of mercury methylation in Bear Creek. No change to the document proposed.
3		The sampling plan seems to ignore bank soils along the sides of the stream channel that are not within the top 0"-6". Sampling bank soils midway between the stream bottom and the floodplain top may shed some light on the potential for mercury/methylmercury to be migrating/leaching out of the soils and into the stream. Additionally, sampling of pore water within the shallow soils or mid-stream bank should be considered as part of a full effort to characterize mercury within the watershed.	Clarification. See responses to specific comments 4 and 6.
4		While there are sampling locations identified in upper Bear Creek that are both collocated and independent of beaver dams, that does not appear to be the case in lower Bear Creek. Consider adding some sampling locations in lower Bear Creek that are not co-located with beaver dams. This was discussed as part of the SAP Data Quality Objectives (DQO) meeting.	Clarification. It should be noted beaver activity has been increasing in the lower portions of Bear Creek. However, during field reconnaissance conducted in November 2023, the beaver dam located near transect locations BCT1 and BCT2 was determined to no longer be present. As stated in Section 4.5 of the BCV Mercury Sources RSE SAP, actual field locations may be adjusted based on field conditions and sampling viability. Additional field reconnaissance in the vicinity of BCT1 and BCT2 was

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			conducted on December 7, 2023, and it was determined that location BCT1 will be moved slightly further downstream since the beaver dam is gone. Figure 4.1 was revised to show the new location and is attached at the end of these comment responses. Note that transects BCT10 and BCT11 are also located in the lower reaches of Bear Creek (near the EMDF and the Bear Creek Burial Grounds, respectively) and are not associated with beaver dams.
Specific			
1	Page 3, Section 2.2.1, last sentence	Revise the text to indicate when the BCV Phase I ROD addendum is projected to be submitted.	Clarification. The date associated with this change to the BCV Phase I ROD is anticipated to be sometime in FY 2024; however, it is suggested this detail not be added to the RSE SAP because this detail is not germane to implementing the field event. The last sentence of Section 2.2.1 was revised as follows: "Based on the EMDF ROD, the end use for Zone 1 and Zone 2 will be revised to restricted recreational and controlled industrial, respectively, which will be codified in an upcoming modification to the BCV Phase I ROD."
2	Page 7, second paragraph, last sentence	Data provided in Table 4.13 of the 2023 Remediation Effectiveness Report (RER) do not align with this statement. Even the averages often exceed the fish tissue criterion. Delete this sentence and instead provide the range of mercury levels in rock bass and redbreast sunfish sampled in Bear Creek.	Clarification. The last sentence in the second paragraph in Section 2.3 was revised as follows: "Long-term trends of monitored sunfish show that, despite significant fluctuation, mean mercury concentrations in fish (Figure 2.3) have been generally declining in the last 10 years and are below or just above the fish tissue criterion (0.3 µg/g) as of 2022. Note that a typographical error on Figure 2.3 was also fixed. Revised Figure 2.3 is attached at the end of these comment responses.
3	Page 12, Section 3.4, last bullet and Page 27, Section 7.2	As appropriate, revise the text to update the sampling and data evaluation/reporting schedules.	Agree. The third bullet in Section 3.4 was revised as follows: "Temporal – samples anticipated to be collected in December 2023 to meet the RSE milestone of September 2024." In Section 7.2, the first sentence was revised as follows: "Fieldwork described in this BCV Mercury Sources RSE

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			SAP is anticipated to be conducted in December 2023. Data evaluation…”
4	Page 15, Section 4.2, first bullet &sub-bullets	Revise the text to define upper and lower. Based on Figure 4.2, it appears these intervals are 0 to 3 inches and 3-6 inches (0 to 0.25 ft and 0.25 to 0.5 ft, respectively).	Clarification. As stated in the first bullet, the creek bank soils will be divided in half into upper and lower sections. This division of the upper and lower intervals will be defined based on the in-field height of the creek bank soil. Creek bank soil samples for each upper and lower interval will be collected from 0 to 0.5 ft within each interval. For additional clarification, text in the first bullet was revised as follows: “Creek bank soils will be divided in half into upper and lower sections based on in-field conditions as follows (Figure 4.2):” Text in the first sub-bullet was revised as follows: “For the upper section of the creek bank soils, samples will be collected by removing the surface soil on the upper half of each side of the bank. The upper…” The text in the second sub-bullet was revised as follows: “For the lower section of the creek bank soils, samples will be collected by removing the surface soil on the lower half (above the creek level) of each side of the bank. The lower…” Note that Figure 4.2 (transect diagram) was also replaced and is attached at the end of these comment responses.
5	Page 22, Section 5.3, second paragraph, last sentence	Revise the text as follows: "For surface water samples collected, analytical results will be compared with Ambient Water Quality Criteria (AWQC)." The text encourages confusion by implying AWQC are not required screening levels when they will almost certainly be Applicable or Relevant & Appropriate Requirements (ARARs) in the forthcoming BCV ROD.	Disagree. The final BCV ROD (FFA Appendix J date 2039) will address any AWQC exceedances in Bear Creek. The RSE SAP compares available surface water data to AWQC for comparison purposes only. No change to the document proposed.
6	Page A-6 [DQO Meeting Minutes], Transect	As stated in a follow-up note in the meeting minutes, TDEC recommends including hyporheic zone/shallow groundwater sampling in the RSE scope. There are two reasons for this recommendation.	Clarification. While hyporheic zone/shallow groundwater sampling in Bear Creek could be informative, the hyporheic push-point sampling that was conducted within the sediment bars in the East Fork Poplar Creek channel

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	Sampling (Slide 38), Bullet 3	First, it is important to develop a more complete conceptual site model of mercury in Bear Creek to identify sources of mercury or methyl mercury. U.S. Department of Energy (DOE) research in a similar setting on the ORR finds that although the observed increase in methylmercury concentration and flux from upstream to downstream is related to instream methylation by periphyton and other biological activity (Watson, et al., 2016), this is not the only source of mercury and methylation in the stream. The researchers hypothesize methylmercury may be produced in hyporheic zones where anoxic, reducing geochemical environments may be conducive to methylation, resulting in dissolved methyl mercury concentrations in groundwater up to 10x greater than in surface water (Watson et al. 2016). More recent research supports that hypothesis, finding "additional sources of dissolved mercury inputs to East Fork Poplar Creek (EFPC) at baseflow during this study predominantly arise from the hyporheic zone," with up to 1 /3 of downstream mercury discharging from hyporheic zone shallow groundwater and riparian inputs (Demers et al. 2018). The shallow/hyporheic zone groundwater "shows a strong, positive correlation between dissolved Mercury (Hg) and dissolved Methylmercury (MeHg)," whereas, historically, there has been a poor correlation between the two in surface water (Watson et al. 2016). Second, the purpose of the mercury management strategy in the EMDF ROD that drives this RSE is to support the potential need to offset future mercury discharges from EMDF. Failure to identify and remove or treat sources of mercury or methyl mercury to offset EMDF discharges carries a risk the parties will be unable to develop the substantive equivalents to load allocations and waste load allocations, as envisioned in the EMDF ROD. This has the potential to impact TDEC's ability to approve mercury discharge limits for mercury that meet DOE's waste disposal and wastewater treatment needs while preventing discharges that do not "cause or contribute" to further violation of the methyl mercury standard. Demers,J.D., Blum,J.D., Brooks, S.C., Donovan, P.M., Riscassi, A.L., Miller, C.L., Zheng, W., Gu, 8., 2018, Hg isotopes reveal in-stream processing and legacy inputs in East Fork Poplar Creek, Oak Ridge, Tennessee, USA, Environmental Science: Processes &	does not translate well to the shallow bedrock environment at Bear Creek where there are limited areas of gravely sediment accumulation. Much or most of the bed in Bear Creek is exposed bedrock that does not allow for “textbook” hyporheic exchange. Where some unconsolidated sediments accumulate, they are often large-enough grain size that there is likely little methylmercury production (not an anoxic environment and low water residence time). Lateral exchange with shallow saturated zones adjacent to the channel may occur at certain times of the year, but there is no indication of broader mercury contamination in those zones. In addition, the bank soils along Bear Creek are comprised primarily of tight clays that are not conducive to groundwater transmission. Please note that, historically, ESD has conducted special studies in Bear Creek. One of the special studies looked into conducting porewater sampling in Bear Creek similar to the work completed in East Fork Poplar Creek. During that special studies investigation, it was impossible to conduct the sampling due to no (or a very thin veneer of) unconsolidated sediment, which did not allow for the advancement of push points, and ESD collected sediment samples as a contingency. As discussed in the mercury-management approach in the EMDF ROD, additional evaluation may be required if non-point source mercury contributors are identified in the RSE. No change to the document proposed.

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		Impacts, 20(4), p. 686-707; https://pubs.rsc.org/en/content/articlelanding/2018/em/c7em00538e	

Attachments

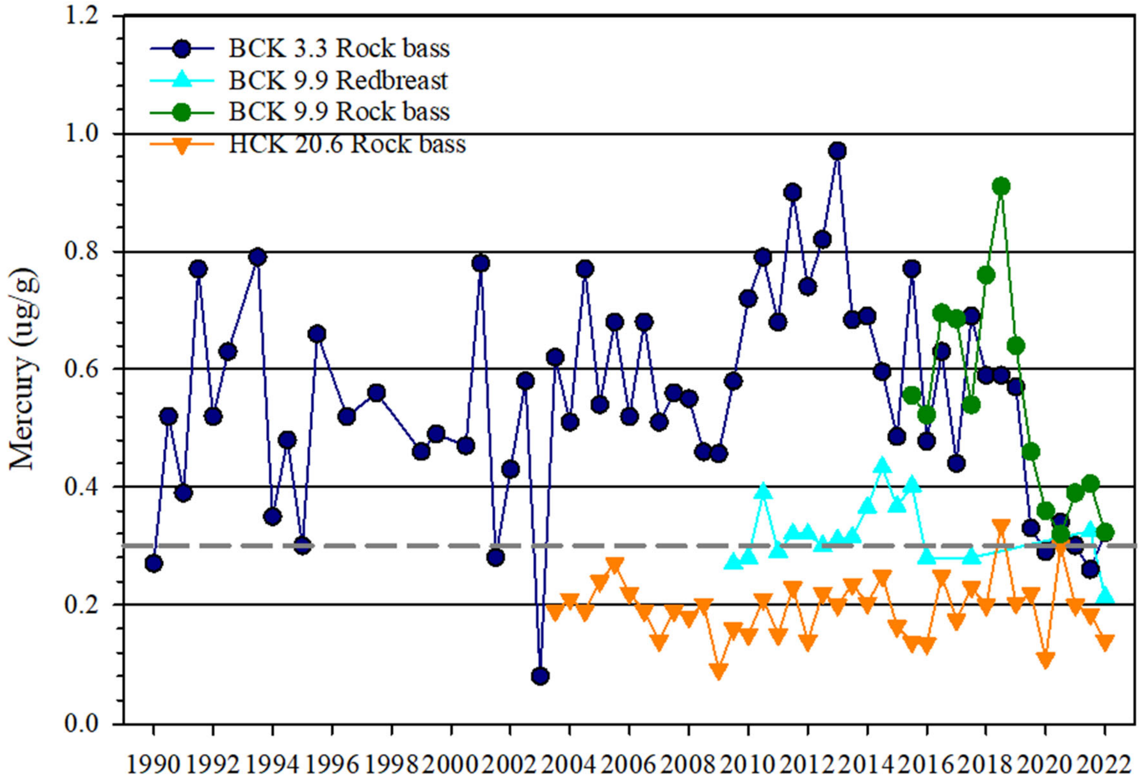

Figure 2.3. Average concentrations of mercury in Bear Creek fish. (Revised based on TDEC specific comment 2)

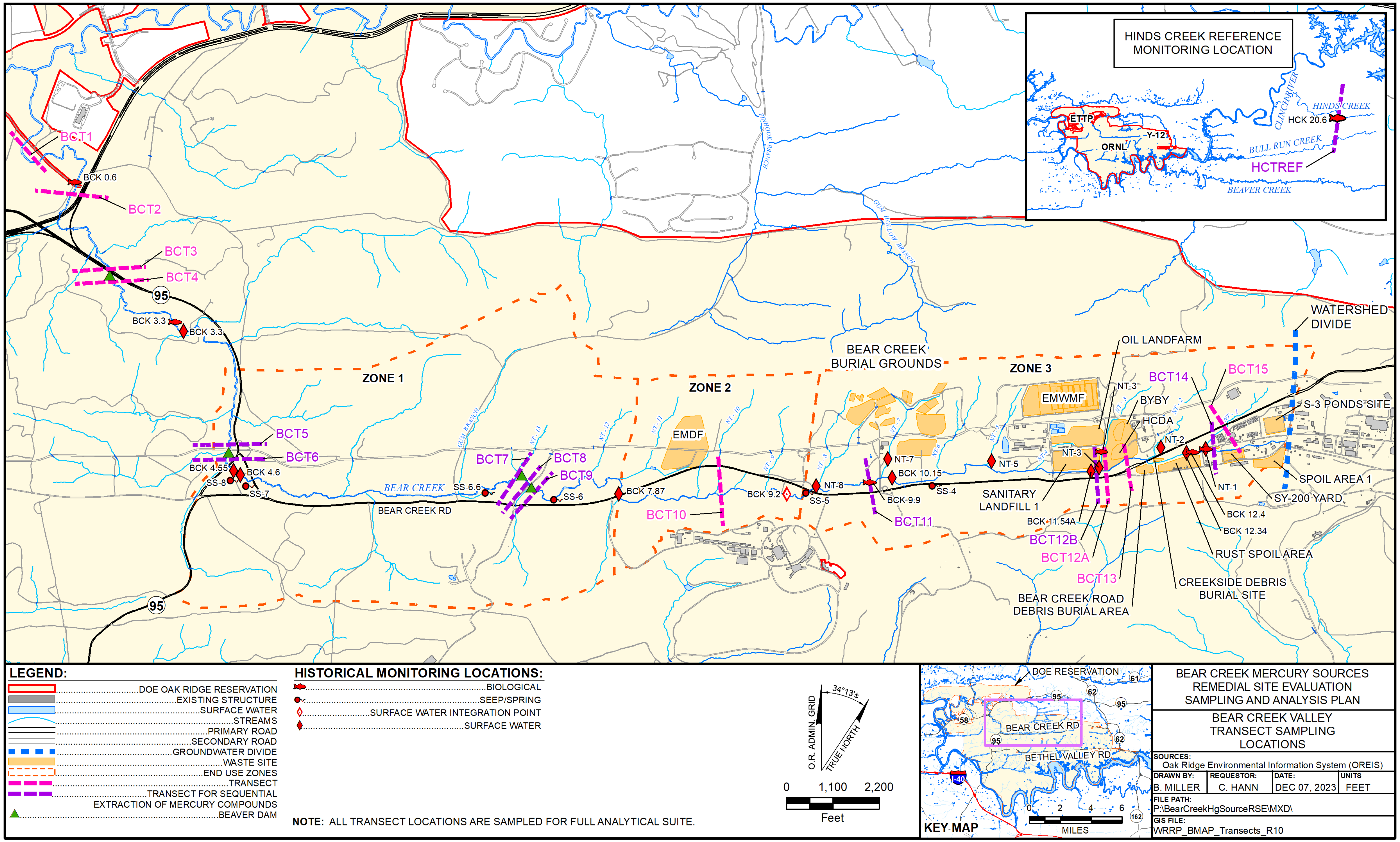

Figure 4.1. BCV transect sampling locations. (Revised based on TDEC general comment 4 and EPA comment 3)

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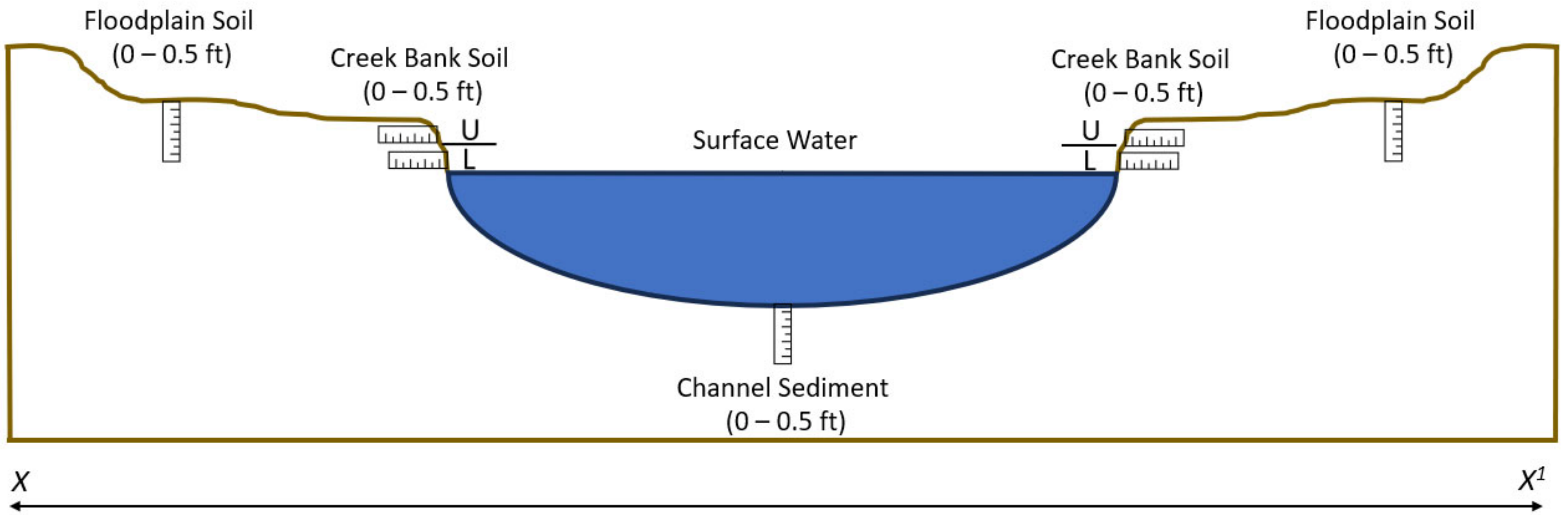

Figure 4.2. BCV RSE transect diagram. (Revised based on TDEC specific comment 4)

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APPENDIX B.
PHOTOGRAPHS OF TRANSECT LOCATIONS

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Figure B.1. Transect BCT1.

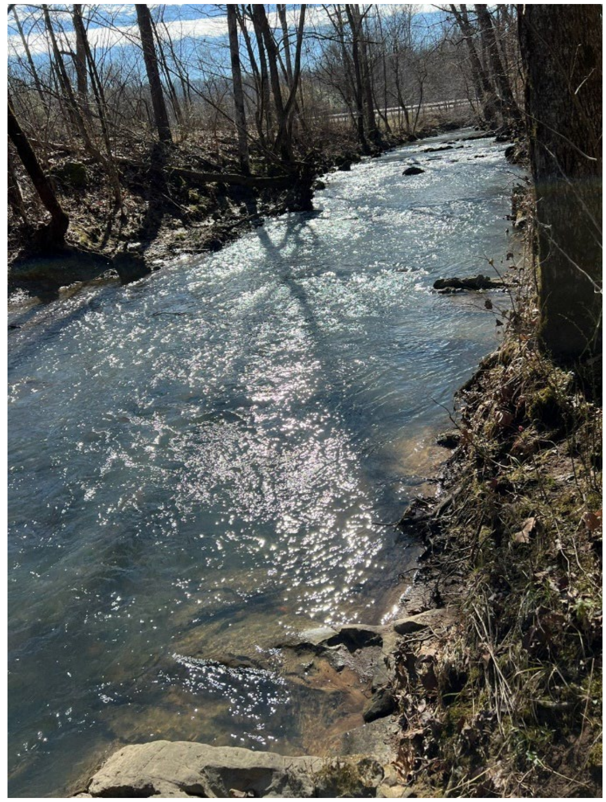

Figure B.2. Transect BCT2 – upstream.

Figure B.3. Transect BCT2 – downstream.

Figure B.4. Transect BCT2 – substrate.

Figure B.5. Transect BCT3 – downstream.

Figure B.6. Transect BCT3 – upstream.

Figure B.7. Transect BCT4 – upstream.

Figure B.8. Transect BCT4 – substrate.

Figure B.9. Transect BCT5 (downstream of dam) and transect BCT6 (upstream of dam); beaver dam was destroyed by a rain event.

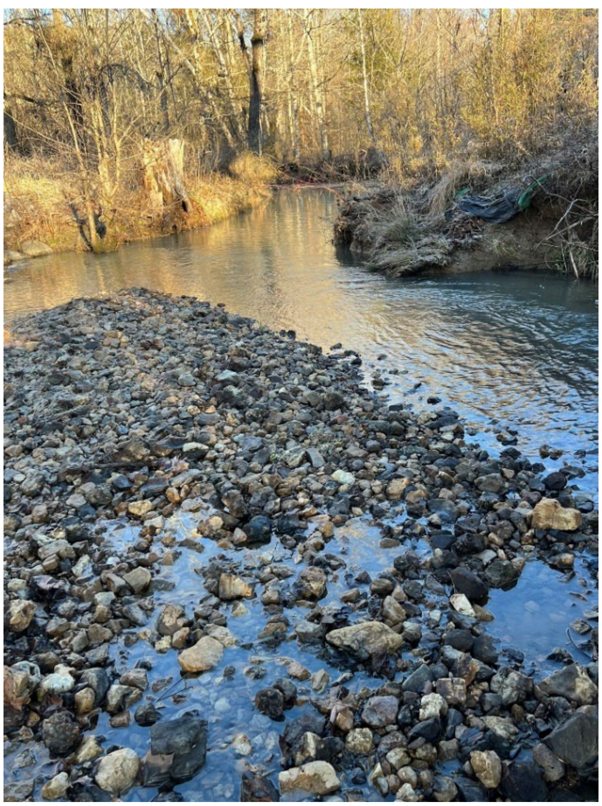

Figure B.10. Transect BCT6.

Figure B.11. Transects BCT5 and BCT6 – substrate.

Figure B.12. Transect BCT7.

Figure B.13. Transect BCT8.

Figure B.14. Transect BCT9 – downstream.

Figure B.15. Transect BCT9 – upstream.

Figure B.16. Transect BCT10 – upstream.

Figure B.17. Transect BCT10 – downstream.

Figure B.18. Transect BCT10 – substrate.

Figure B.19. Transect BCT11 – downstream.

Figure B.20. Transect BCT11 – upstream.

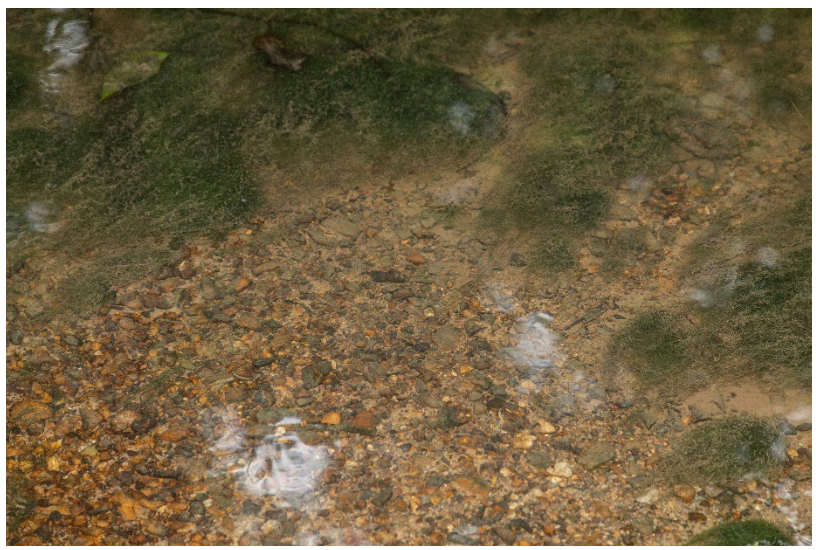

Figure B.21. Transect BCT11 – substrate.

Figure B.22. Transect BCT12B – downstream.

Figure B.23. Transect BCT12B – upstream.

Figure B.24. Transect BCT12B – substrate.

Figure B.25. Transect BCT12A – downstream.

Figure B.26. Transect BCT12A – upstream.

Figure B.27. Transect BCT12A – substrate.

Figure B.28. Transect BCT13 – upstream.

Figure B.29. Transect BCT13 – downstream.

Figure B.30. Transect BCT14 – downstream.

Figure B.31. Transect BCT14 – upstream.

Figure B.32. Transect BCT15 – downstream.

Figure B.33. Transect BCT15 – upstream.

Figure B.34. Transect BCT15 – substrate.

Figure B.35. Transect HCTREF.

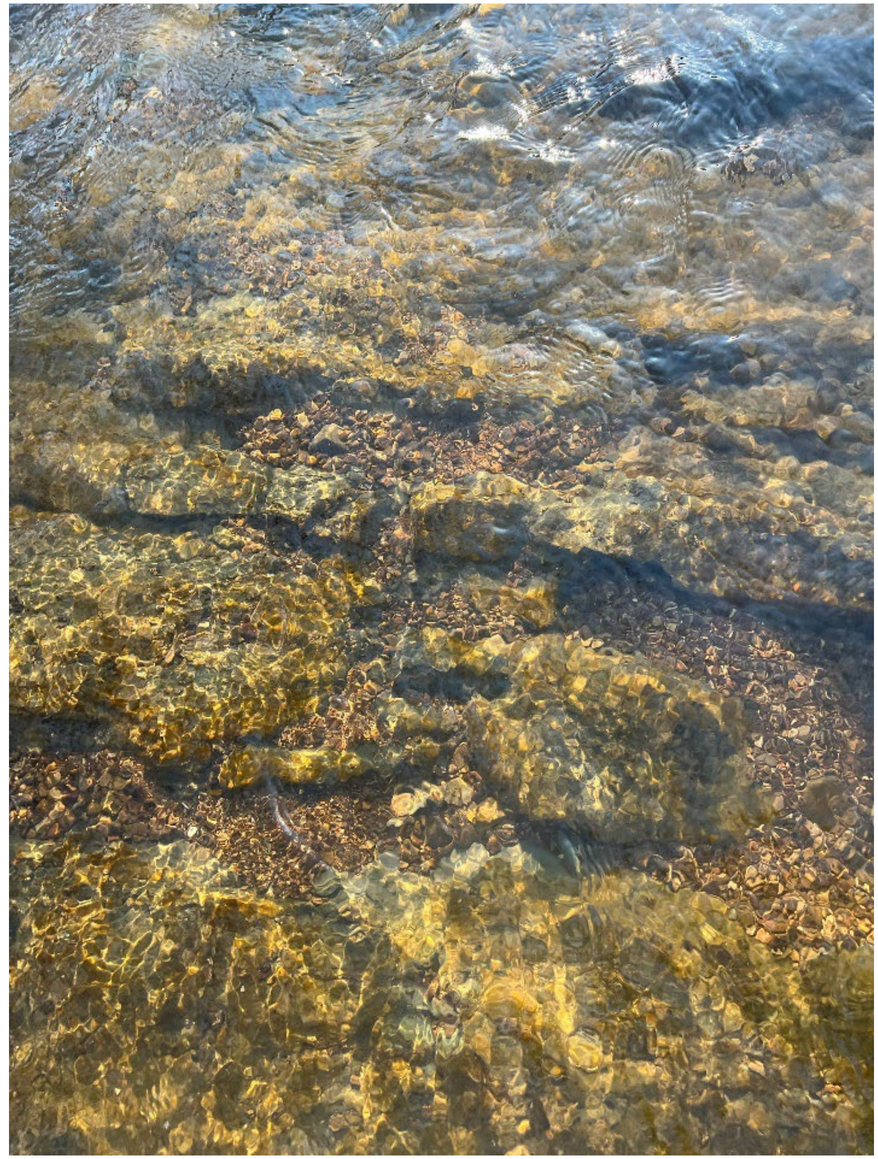

Figure B.36. Transect HCTREF – substrate.

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APPENDIX C.
ANALYTICAL DATA SUMMARY TABLES BY MEDIA

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Table C.1. BCV RSE unfiltered surface water data for the initial sampling event

Chemical	CAS	Units	BCT1-SW	BCT2-SW	BCT3-SW	BCT4-SW	BCT5-SW	BCT6-SW	BCT7-SW	BCT8-SW	BCT9-SW	BCT10-SW	BCT11-SW	BCT12B-SW	BCT12B-SW-D	BCT12A-SW	BCT13-SW	BCT14-SW	BCT14-SW-D	BCT15-SW	HCTREF-SW
Physical																					
Conductivity	N237	umho/cm	355.6	268	239	230	143	194	338	308	263	332	323	402	--	440	483	534	--	669	269
Dissolved oxygen	N328	ppm	10.56	11.88	11.76	10.61	9.87	10.54	11.75	11.14	9.9	10.66	10.06	9.79	--	10.16	11.01	12.11	--	13.36	10.94
Redox	NS215	mV	161	170.5	179	149	133	118	92	114	139	161	140	108	--	140	149	154	--	182.8	96
Temperature	N908	deg C	8.2	6	6.1	7.6	7.4	7.4	5.7	8.9	9.9	9.8	7.8	8.1	--	8.8	7.8	9.6	--	4.2	5.9
pH	N704	Std Unit	8.22	7.73	7.74	8.29	7.78	8.14	8.29	8.01	8.11	7.81	8.12	7.58	--	7.85	8	7.22	--	6.96	8.07
Anions																					
Chloride	16887006	mg/L	8.09	7.64	8.56	8.73	18	17.6	22.5	26.6	26.7	35.4	47.3	58.9	59.3	87.1	88.7	32.2	32.2	18.2	8
Fluoride	16984488	mg/L	0.105 J	0.121	0.131	0.13	0.117 J	0.116 J	0.15	0.16	0.156	0.164 J	0.207 J	0.232 J	0.233 J	0.255 J	0.318 J	0.402	0.395	0.467	0.101 J
Nitrate/Nitrite as nitrogen	N2788	mg/L	0.555	0.59	0.994	1.05	0.695	0.735	1.59	1.91	2	1.83	3.48	3.56	3.53	5.35	11.3	19.2	19.4	84.8	0.85
Sulfate	14808798	mg/L	30.7	29.2	30.7	31.6	9.6	9.62	16.6	19.3	18.8	15.9	20.6	20.8	20.9	21.7	26.3	33.4	33.4	31.5	8.04
Metals																					
Aluminum	7429905	mg/L	0.083	0.0985	0.159	0.112	0.228	0.978	0.517	0.181	0.177	0.189	0.142	0.317	0.32	0.22	0.198	0.0873	0.0838	0.206	0.106
Antimony	7440360	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	7440382	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Barium	7440393	mg/L	0.0613	0.059	0.0585	0.0557	0.0521	0.0494	0.0707	0.0711	0.0674	0.0718	0.0823	0.0788	0.0882	0.104	0.117	0.116	0.119	0.209 J	0.057
Beryllium	7440417	mg/L	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U
Boron	7440428	mg/L	0.029	0.0253	0.0272	0.0247	0.0189	0.0186	0.0383	0.0372	0.0391	0.0391	0.0394	0.0211 J	0.0164 J	0.0201 J	0.0272	0.0533	0.0558	0.0653	0.00877 J
Cadmium	7440439	mg/L	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	0.00104	0.00104	0.00836	3.0E-04 U
Calcium	7440702	mg/L	50	48.1	49.6	48.1	40.1	39.4	53.9	56.7	53.2	54.6	64	55.9	61.4	73.6	93.9	99	100	148	46.6
Chromium	7440473	mg/L	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Cobalt	7440484	mg/L	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	4.3E-04 J	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.8E-04 J	3.5E-04 J	0.00235	3.0E-04 U
Copper	7440508	mg/L	3.3E-04 J	3.0E-04 U	3.1E-04 J	3.0E-04 U	6.5E-04 J	3.5E-04 J	5.5E-04 J	4.0E-04 J	3.5E-04 J	3.4E-04 J	5.9E-04 J	6.3E-04 J	6.8E-04 J	5.6E-04 J	5.3E-04 J	6.0E-04 J	0.00113 J	5.5E-04 J	3.3E-04 J
Iron	7439896	mg/L	0.154	0.164	0.236	0.197	0.219	0.196	0.556	0.229	0.224	0.174	0.216	0.411	0.42	0.322	0.239	0.223	0.22	0.204	0.17
Lead	7439921	mg/L	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U
Lithium	7439932	mg/L	0.00452 J	0.00534 J	0.00539 J	0.00491 J	0.00527 J	0.00551 J	0.00879 J	0.0102	0.0109	0.0126	0.00976 J	0.00554 J	0.00559 J	0.00738 J	0.00956 J	0.00941 J	0.0099 J	0.00888 J	0.003 U
Magnesium	7439954	mg/L	14.3	13.7	13.6	13.3	10.3	9.53	12.3	12.9	12.2	12.3	13	10.7	11.7	13.3	14.2	14.5	14.6	24.4	13.9
Manganese	7439965	mg/L	0.0216	0.0146	0.0328	0.0373	0.018	0.0171	0.161	0.034	0.0204	0.0095	0.0157	0.039	0.0413	0.0533	0.0768	0.278	0.28	2.1	0.0231
Mercury	7439976	mg/L	1.1E-06 =	9.9E-07 =	1.2E-06 =	1.3E-06 =	2.5E-06 =	2.2E-06 =	4.1E-06 J	2.7E-06 =	2.3E-06 =	4.5E-06 =	6.7E-06 =	1.3E-05 =	1.3E-05 =	1.3E-05 =	2.2E-05 =	6.9E-06 =	6.6E-06 =	1.4E-06 =	9.1E-07 =
Molybdenum	7439987	mg/L	4.0E-04 J	5.1E-04 J	5.5E-04 J	4.0E-04 J	2.0E-04 U	2.0E-04 U	2.6E-04 J	3.1E-04 J	2.9E-04 J	2.5E-04 J	3.0E-04 J	2.8E-04 J	3.0E-04 J	3.8E-04 J	3.5E-04 J	6.3E-04 J	5.1E-04 J	3.2E-04 J	2.0E-04 U
Nickel	7440020	mg/L	6.0E-04 U	6.0E-04 U	6.3E-04 J	6.0E-04 U	7.5E-04 J	6.0E-04 U	6.0E-04 U	6.1E-04 J	6.7E-04 J	6.0E-04 U	8.0E-04 J	9.8E-04 J	0.00101 J	0.00109 J	0.00139 J	0.00377	0.00362	0.0228	6.0E-04 U
Phosphorous	7723140	mg/L	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.037 J	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U
Potassium	7440097	mg/L	1.77	1.55	1.59	1.49	1.22	1.13	1.55	1.56	1.43	1.52	1.77	1.75	1.89	2.05	2.3	2.53	2.56	3.1 J	1.82
Selenium	7782492	mg/L	0.006 U	0.00796 J	0.0117 J	0.0111 J	0.006 U	0.0101 J	0.006 U	0.0137 J	0.006 U	0.0105 J	0.0129 J	0.00752 J	0.0111 J	0.006 U	0.00741 J	0.006 U	0.00896 J	0.00982 J	0.00631 J
Silicon	7440213	mg/L	3.83	4.23	4.1	3.9	3.5	3.35	3.82	3.51	3.3	3.5	3.45	3.75	4.09	3.59	3.53	3.28	3.34	4.33	3.56
Silver	7440224	mg/L	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U
Sodium	7440235	mg/L	5.62	5.74	6.21	5.99	8.85	8.69	10.9	13	12	16.6	21.3	25.9 J	28.2 J	36.2 J	39.6	24	24.4	21.6	4.25
Strontium	7440246	mg/L	0.156	0.156	0.169	0.165	0.0669	0.0695	0.117	0.109	0.114	0.106	0.149	0.135	0.139	0.19	0.252	0.291	0.297	0.432	0.067
Thallium	7440280	mg/L	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U
Uranium	7440611	mg/L	0.0112	0.0139	0.0153	0.0152	0.0168	0.0174	0.0334	0.0403	0.0408	0.0452	0.0378	0.0517	0.051	0.0727	0.089	0.134	0.137	0.0135	1.6E-04 J
Vanadium	7440622	mg/L	0.00101 J	0.001 U	0.001 U	0.001 U	0.00108 J	0.001 U	0.001 U	0.00139 J	0.0011 J	0.001 U	0.001 U	0.00122 J	0.00126 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Zinc	7440666	mg/L	0.0033 U	0.0033 U	0.0052 J	0.00377 J	0.0033 U	0.0033 U	0.00519 J	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.00358 J	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.00804 J	0.0033 U
Other																					
Methylmercury	22967926	mg/L	3.6E-08 J	5.7E-08 J	7.1E-08 J	7.9E-08 J	2.2E-08 UJ	2.2E-08 UJ	1.4E-07 =	7.6E-08 J	8.4E-08 =	5.1E-08 J	6.3E-08 J	9.8E-08 =	8.4E-08 =	6.4E-08 J	8.8E-08 =	1.7E-07 =	1.3E-07 =	6.6E-08 J	2.3E-08 J
Wet chemistry																					
Dissolved solids	N340	mg/L	196	200	209	186	136	150	221	226	230	247	284	287	286	373	485	428	413	676	167
Sulfide	18496258	mg/L	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U	0.033 U
Suspended solids	N873	mg/L	1.01 J	0.57 U	4.89	0.7 J	1.47 J	3.33	15.9	2.28 U	2.28 U	3.75	2.45 J	2.3 J	3.46 J	0.57 U	2.86 J	3.1	4.6	15.4	8 J
Total organic carbon average	NS2302	mg/L	1.79	1.46	1.64	1.61	1.24	1.26	1.4 J	1.46	1.81	1.49	1.79	2.38	2.59	2.34	2.27	2.51	2.62	2.67	1.15
Turbidity	N1036	NTU	3	4	4	5	7	6	13	6	5	9	6	9	--	7	6	6	--	2	6

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

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

UJ = Analyte or compound was not detected above the reported detection limit, and the reported detection limit is approximated due to quality deficiency.

= Validated result, which is detected and unqualified.

-- = Analyte or compound not sampled for.

BCV = Bear Creek Valley CAS = Chemical Abstract Service RSE = remedial site evaluation

Table C.2. BCV RSE filtered surface water data for the initial sampling event

Chemical	CAS	Units	BCT1-SW	BCT2-SW	BCT3-SW	BCT4-SW	BCT5-SW	BCT6-SW	BCT7-SW	BCT8-SW	BCT9-SW	BCT10-SW	BCT11-SW	BCT12B-SW	BCT12B-SW-D	BCT12A-SW	BCT13-SW	BCT14-SW	BCT14-SW-D	BCT15-SW	HCTREF-SW
Metals																					
Aluminum	7429905	mg/L	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0193 U	0.0202 J	0.0778	0.0193 U
Antimony	7440360	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Arsenic	7440382	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Barium	7440393	mg/L	0.0612	0.0568	0.0559	0.055	0.0481	0.0481	0.0654	0.0672	0.0697	0.0697	0.0815	0.0833	0.0798	0.103	0.116	0.114	0.122	0.212	0.0552
Beryllium	7440417	mg/L	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U	2.0E-04 U
Boron	7440428	mg/L	0.0267	0.0256	0.0256	0.0261	0.0187	0.0177	0.036	0.039	0.0381	0.0422	0.0383	0.0177 J	0.0164 J	0.0198 J	0.0263	0.0548	0.052	0.066	0.00938 J
Cadmium	7440439	mg/L	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	8.6E-04 J	9.5E-04 J	0.0085	3.0E-04 U
Calcium	7440702	mg/L	50.2	49.1	48.6	48.5	38.6	39.3	51.9	54.3	55.3	54.6	65.1	59.6	59.6	74.8	93.7	99.3	100	150	45.4
Chromium	7440473	mg/L	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Cobalt	7440484	mg/L	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	0.00233	3.0E-04 U
Copper	7440508	mg/L	3.1E-04 J	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.1E-04 J	3.0E-04 U	3.0E-04 U	3.5E-04 J	4.8E-04 J	4.1E-04 J	4.1E-04 J	3.6E-04 J	5.2E-04 J	5.2E-04 J	5.7E-04 J	3.0E-04 U
Iron	7439896	mg/L	0.0462 J	0.0466 J	0.0443 J	0.041 J	0.033 U	0.033 U	0.0407 J	0.0335 J	0.033 U	0.033 U	0.0333 J	0.0599 J	0.0535 J	0.0566 J	0.0431 J	0.0719 J	0.033 U	0.0906 J	0.033 U
Lead	7439921	mg/L	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U	5.0E-04 U
Lithium	7439932	mg/L	0.00454 J	0.00502 J	0.0047 J	0.00478 J	0.00526 J	0.00509 J	0.00861 J	0.0102	0.00998 J	0.0132	0.00988 J	0.00541 J	0.00544 J	0.00713 J	0.00908 J	0.00948 J	0.01	0.00901 J	0.003 U
Magnesium	7439954	mg/L	14.3	13.4	13.3	13.2	9.71	9.9	11.4	12.1	12.2	12.3	13	11.4	11.3	13.4	14.2	14.6	14.8	23.6	13.6
Manganese	7439965	mg/L	0.0195	0.0131	0.0221	0.035	0.0143	0.0134	0.104	0.029	0.015	0.00578	0.00697	0.0317	0.032	0.0474	0.0696	0.252	0.25	2.04	0.0196
Mercury	7439976	mg/L	5.7E-07 =	4.7E-07 J	5.2E-07 =	6.5E-07 =	8.0E-07 =	9.6E-07 =	1.1E-06 J	9.4E-07 =	8.1E-07 =	1.8E-06 =	1.9E-06 =	4.3E-06 =	3.9E-06 =	4.3E-06 =	3.8E-06 =	3.2E-06 =	3.2E-06 =	6.4E-07 =	3.9E-07 J
Molybdenum	7439987	mg/L	3.5E-04 J	4.7E-04 J	4.5E-04 J	3.7E-04 J	2.0E-04 U	2.0E-04 U	2.4E-04 J	3.4E-04 J	3.4E-04 J	2.3E-04 J	2.9E-04 J	2.9E-04 J	3.0E-04 J	3.6E-04 J	3.6E-04 J	5.0E-04 J	4.9E-04 J	3.6E-04 J	2.0E-04 U
Nickel	7440020	mg/L	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	0.00158 J	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.3E-04 J	6.9E-04 J	6.8E-04 J	9.2E-04 J	0.00126 J	0.0035	0.00316	0.0237	6.0E-04 U
Phosphorous	7723140	mg/L	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U	0.018 U
Potassium	7440097	mg/L	1.73	1.57	1.48	1.47	1.11	1.1	1.45	1.51	1.47	1.49	1.77	1.81	1.85	1.98	2.25	2.48	2.56	3.15	1.69
Selenium	7782492	mg/L	0.006 U	0.006 U	0.0133 J	0.00643 J	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.00754 J	0.0141 J	0.0228 J	0.0108 J	0.006 U	0.006 U	0.006 U
Silicon	7440213	mg/L	3.77	4.04	3.85	3.78	3.12	3.18	3.22	3.13	3.24	3.31	3.37	3.59	3.58	3.37	3.35	3.16	3.31	4.15	3.32
Silver	7440224	mg/L	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U	3.0E-04 U
Sodium	7440235	mg/L	5.6	5.78	6.18	6.01	8.54	8.62	10.6	12.5	12.6	16.4	21.7	27.4 J	27.5 J	36.8 J	39.9	24.2	24.7	22.5	4.16
Strontium	7440246	mg/L	0.152	0.165	0.166	0.165	0.0702	0.0676	0.115	0.113	0.112	0.108	0.148	0.144	0.145	0.187	0.247	0.289	0.284	0.444	0.068
Thallium	7440280	mg/L	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U	6.0E-04 U
Uranium	7440611	mg/L	0.0109	0.0124	0.0149	0.0149	0.0169	0.0165	0.0313	0.0413	0.0401	0.0465	0.0369	0.0553	0.0557	0.0724	0.0887	0.134	0.138 J	0.0136	1.7E-04 J
Vanadium	7440622	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Zinc	7440666	mg/L	0.0033 U	0.00845 J	0.0034 J	0.00347 J	0.0033 U	0.0033 U	0.00331 J	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.0147 J	0.0146 J	0.0033 U
Other																					
Methylmercury	22967926	mg/L	4.4E-08 J	6.0E-08 J	4.8E-08 J	6.4E-08 J	2.3E-08 J	3.1E-08 J	9.0E-08 =	9.0E-08 =	7.3E-08 J	6.4E-08 J	4.3E-08 J	6.3E-08 J	7.5E-08 J	7.2E-08 J	7.4E-08 J	7.4E-08 J	7.6E-08 J	5.0E-08 J	2.5E-08 J
Wet chemistry																					
Dissolved organic carbon	NS248	mg/L	1.85	1.48	1.57	1.64	1.34	1.3	1.5	1.61	1.57	1.56	1.86	2.21	2.76	2.36	2.04	2.7	2.57	2.62	1.42

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

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

= Validated result, which is detected and unqualified.

-- = Analyte or compound not sampled for.

BCV = Bear Creek Valley CAS = Chemical Abstract Service RSE = remedial site evaluation

Table C.3. BCV RSE unfiltered surface water data from April 2024

Chemical	CAS	Units	BCT1-SW	BCT2-SW	BCT3-SW	BCT4-SW	BCT5-SW	BCT6-SW	BCT7-SW	BCT8-SW	BCT9-SW	BCT10-SW	BCT11-SW	BCT12B-SW	BCT12B-SW-D	BCT12A-SW	BCT13-SW	BCT14-SW	BCT14-SW-D	BCT15-SW	HCTREF-SW
Physical																					
Conductivity	N237	umho/cm	298	240	278	232	240	239	283	292	278	295	333	349	--	393	460	684	--	556	289
Dissolved oxygen	N328	ppm	10.96	8.18	8.1	8.48	7.6	8.65	6.59	9.83	7.97	9.59	9.41	9.36	--	9.49	9.23	8.8	--	9.11	9.5
Redox	NS215	mV	-7.9	-1.7	14.5	13.2	19.9	28.6	24.1	15.4	229.5	219	222.6	211.1	--	199.1	206.5	235.3	--	230.6	244.1
Temperature	N908	deg C	19	19.2	16.6	16.8	16.4	16.4	18.1	16.8	16.7	15.4	15.9	15.6	--	15.7	15.9	16.2	--	17.3	18.2
pH	N704	Std Unit	8.02	7.95	7.66	7.84	7.71	7.69	7.64	7.74	7.56	7.82	7.96	7.91	--	7.96	7.82	7.46	--	7.14	8.1
Metals																					
Mercury	7439976	mg/L	1.6E-06 =	1.8E-06 =	1.8E-06 =	1.9E-06 =	1.5E-06 =	1.6E-06 =	4.2E-06 =	2.1E-06 =	2.1E-06 =	2.6E-06 =	4.5E-06 =	7.9E-06 =	7.7E-06 =	4.2E-06 =	9.8E-06 =	8.4E-06 =	8.1E-06 =	5.1E-06 =	1.0E-06 =
Other																					
Methylmercury	22967926	mg/L	1.1E-07 J	9.6E-08 J	9.8E-08 J	8.3E-08 J	8.1E-08 J	7.8E-08 J	1.7E-07 J	1.3E-07 J	8.9E-08 J	5.1E-08 J	4.7E-08 J	1.6E-07 J	1.6E-07 J	1.2E-07 J	2.7E-07 J	8.5E-08 J	7.8E-08 J	6.6E-08 J	4.2E-08 J
Wet chemistry																					
Turbidity	N1036	NTU	5	5	1	6	6	4	9	6	6	5	6	7	--	4	7	5	--	9	5

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

= Validated result, which is detected and unqualified.

-- = Analyte or compound not sampled for.

BCV = Bear Creek Valley CAS = Chemical Abstract Service RSE = remedial site evaluation

Table C.4. BCV RSE filtered surface water data from April 2024

Chemical	CAS	Units	BCT1-SW	BCT2-SW	BCT3-SW	BCT4-SW	BCT5-SW	BCT6-SW	BCT7-SW	BCT8-SW	BCT9-SW	BCT10-SW	BCT11-SW	BCT12B-SW	BCT12B-SW-D	BCT12A-SW	BCT13-SW	BCT14-SW	BCT14-SW-D	BCT15-SW	HCTREF-SW
Metals																					
Mercury	7439976	mg/L	5.4E-07 =	4.4E-07 J	4.7E-07 J	5.1E-07 =	4.4E-07 J	4.2E-07 J	8.7E-07 =	7.0E-07 =	7.4E-07 =	8.7E-07 =	1.4E-06 =	1.8E-06 =	1.8E-06 =	1.2E-06 =	1.8E-06 =	1.8E-06 =	1.9E-06 =	1.0E-06 =	3.3E-07 J
Other																					
Methylmercury	22967926	mg/L	8.3E-08 J	7.7E-08 J	5.2E-08 J	5.4E-08 J	3.2E-08 J	5.9E-08 J	8.4E-08 J	8.5E-08 J	3.7E-08 J	2.2E-08 UJ	3.4E-08 J	1.0E-07 J	1.2E-07 J	2.2E-08 UJ	1.5E-07 J	5.8E-08 J	4.2E-08 J	6.9E-08 J	5.3E-08 J

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ = Analyte or compound was not detected above the reported detection limit, and the reported detection limit is approximated due to quality deficiency.

= Validated result, which is detected and unqualified.

BCV = Bear Creek Valley CAS = Chemical Abstract Service RSE = remedial site evaluation

Table C.5. BCV RSE floodplain soil data

Chemical	CAS	Units	BCT1-FP	BCT2-FP	BCT3-FP	BCT4-FP	BCT5-FP	BCT6-FP	BCT7-FP	BCT8-FP	BCT9-FP	BCT10-FP	BCT11-FP	BCT12B-FP	BCT12B-FP-D	BCT12A-FP	BCT13-FP	BCT14-FP	BCT14-FP-D	BCT15-FP	HCTREF-FP
Anions																					
Chloride	16887006	mg/kg	2.41 J	2.1 J	4.18	3.2	5.47	2.46	6.31 J	6.85 J	7.93 J	2.53 J	5.82	2.67	2.43	4.73	3.06	3.19	5.48	8.94	2.65
Fluoride	16984488	mg/kg	1.16 J	1.31	2.08	1.05 J	1.7 J	2.23 J	2.32	2.04	3.29	1.48	3.68 J	6.54	4.18	4.37	13.1	2.36	2.44	5.75	1.08 J
Nitrate	14797558	mg/kg	1.97	1.76	0.938 J	2.09	4.47	1.13 J	2.79	2.59	3.99	1.56	2.69	3.78	3.04	2.57	1.5	2.72	2.82	15.8	0.841 J
Nitrite	14797650	mg/kg	0.42 U	0.39 U	0.402 U	0.434 U	0.832 J	0.395 U	0.479 U	0.488 U	0.441 U	0.423 U	0.421 U	0.422 U	0.389 U	0.429 U	0.446 U	0.448 U	0.446 U	0.445 U	0.41 U
Sulfate	14808798	mg/kg	4.09 J	6.99	6.13	6.12	7.66	4.42 J	10.7	14.2	10.6	3.08 J	3.85 J	3.65 J	3.08 J	6	21.4 J	5.67	6.64	16.1	4.7 J
Metals																					
Aluminum	7429905	mg/kg	5180	5000	5840	4920	5250	6920	5280	7470 J	8010 J	4950	5600	7430	6910	12,500	7000	8720	8620	10,200	5580
Antimony	7440360	mg/kg	0.412 U	0.375 U	0.399 U	0.372 U	0.425 U	0.387 U	0.47 U	0.487 U	0.452 U	0.375 U	0.389 U	1 J	0.691 J	1.19 J	0.835 J	0.453 U	1.16 J	0.421 U	0.407 U
Arsenic	7440382	mg/kg	2.51	3	3.36	3.48	4.79	4.27	3.27	4.22	8.89	4.22	4.27	5.75	4.85	7.3	5.37	7.14	7.93	4.35	3.56
Barium	7440393	mg/kg	79.6	104	60.7	83.5	87.3	74.8	93.3	106	75	78.8	89.9	84.8	78.5	177	161	88.3	85	283	74.4
Beryllium	7440417	mg/kg	0.539 J	0.56 J	0.414 J	0.584	0.499 J	0.481 J	0.649 J	0.894	0.783	0.252 J	0.624	0.251 J	0.205 J	0.445 J	0.379 J	0.137 U	0.129 U	1.01	0.45 J
Boron	7440428	mg/kg	1.25 U	1.14 U	6.06	5.52 J	1.29 U	1.17 U	1.86 J	9.74	8.59	1.68 J	3.42 J	2.49 J	1.1 U	3.81 J	1.37 U	1.6 J	1.75 J	4.35 J	1.23 U
Cadmium	7440439	mg/kg	0.612	0.464	0.238	0.479	0.926	0.139 J	1.31	1.56	1.6	2.65	1.04	6.04	7.86	6.95	6.93	0.197 J	0.201 J	10.3	0.0799 J
Calcium	7440702	mg/kg	1780	2030	1260	2300	3230	1480	5630	8190 E	2850 E	1770	1870	2330	1690	2240	27,300	3200	3000	5680	1890
Chromium	7440473	mg/kg	10.7	12.6	11.2	10.7	18	18	13.9	23.8	19.3	13.6	13.2	14.9	14.3	20.1	19.1	23.8	19.3	23.2	15.5
Cobalt	7440484	mg/kg	9.1	10	6.48	9.58	10.6	12	10.2	12.4	13.3	11.1	13.5	12.6	12	18.3	17.4	9.31	8.51	25.5	10.9
Copper	7440508	mg/kg	7.65	8.3	6.34	7.27	9.96	9.03	8.65	11.8	16	9.05	12.2	28.7	19	29.3	19.2	15.1	14.5	14	9.87
Iron	7439896	mg/kg	11,600	12,600	11,500	12,000	13,600	18,800	12,500	19,400 J	18,800 J	11,600	14,200	13,400	14,300	19,900	20,500	20,000	17,900	22,400	14,200
Lead	7439921	mg/kg	12.7	12.9	9.62	10.4	15 J	15.6 J	11.9	13.5 J	16.4 J	17.4	22.6	32.8	31.3	43.6	21.6	21.9	21	16.4	15.3 J
Lithium	7439932	mg/kg	12.2	12.6	12.7	12	13.7	10.1	15.8	17.9	19.4	19.2	12.2	23.1	23.4	24.9	24.7	11.5	13	16.9	11.9
Magnesium	7439954	mg/kg	1180	1380	1240	1210	1520	1010	2540	3670	1340	795	863	971	913	1260	2040	861	843	5370	1270
Manganese	7439965	mg/kg	827	975	448	836	905	1120	922	994	682	1140	1170	964	900	1230	2460	1150	1070	5180	728
Mercury	7439976	mg/kg	0.15 =	0.11 =	0.086 =	0.18 =	0.16 =	0.062 =	0.22 =	0.27 =	0.38 =	0.64 =	0.81 J	2.8 =	3 =	3.5 =	3.3 =	0.74 =	0.72 =	0.47 =	0.04 =
Molybdenum	7439987	mg/kg	0.308 J	0.295 J	0.348 J	0.249 J	0.257 U	0.234 U	0.285 U	0.295 U	0.274 U	0.578 J	0.672 J	0.982 J	0.901 J	0.971 J	0.87 J	0.496 J	0.441 J	0.29 J	0.246 U
Nickel	7440020	mg/kg	13.9	13.3	9.77 J	13.9 J	12.3	9.17	13.2	17 E	17.1 E	18.3 J	14	31.5 J	18.9 J	42.1 J	34.5 J	14.8	14.4	75.7	10.7
Phosphorous	7723140	mg/kg	162	206	162	200	207	158	228	250	227	213	223	244	248	291	244	274	296	270	220
Potassium	7440097	mg/kg	641	661	711	617	616	640	564	821	728	394	550 J	676	521	848	572	583	599	1300	699
Selenium	7782492	mg/kg	0.86 J	0.952 J	0.798 J	1.02 J	1.49	1.27	0.941 J	0.874 J	1.02 J	1.36	1.48	1.47	1.48	2.02	1.67	1.23 J	1.24 J	2.34	1.21
Silicon	7440213	mg/kg	2550	2470	2080	1880	557	552	1460	1780	1940	1800	2970	2690	2590	3290	2670	2550	2460	1040	496
Silver	7440224	mg/kg	0.135 J	0.168 J	0.121 U	0.113 U	0.643 U	0.586 U	0.142 U	0.148 U	0.685 U	0.114 U	0.118 U	0.235 J	0.11 U	0.121 U	0.298 J	0.137 U	0.129 U	1.19	0.616 U
Sodium	7440235	mg/kg	8.73 U	7.96 U	8.46 U	7.89 U	9.43 J	12.5 J	25.2 J	34.2 J	30.8 J	7.96 U	16 J	8.35 U	7.73 U	10.3 J	15.9 J	11.5 J	11.6 J	78.6	9.58 J
Strontium	7440246	mg/kg	4.33	5.77	4.6	7.21	6.42	5.47	8.84	9.74	6.36	4.95	6.79	8.27	8.92	9.44	15	10.9	11.7	17.1	5.53
Thallium	7440280	mg/kg	0.159 U	0.167 U	0.152 U	0.172 U	0.181 U	0.176 U	0.195 U	0.204 U	0.19 J	0.157 U	0.179 U	0.163 U	0.173 U	0.199 J	0.167 U	0.199 J	0.201 J	0.186 U	0.155 U
Uranium	7440611	mg/kg	11.6	7.17	4.59	10.1	16.1	3.3	16.9	16.8	30.1	41.7	19.9	63.6	78	106	16.5	4.61	5.48	7.08	0.35
Vanadium	7440622	mg/kg	13	13.9	14.9	13.5	18.4	23.6	13.3	21.8	29.9	15.6	18.2	19.8	25.3	31.5	22.8	38.4	32.1	16.4	18
Zinc	7440666	mg/kg	28.1	29.9	20.6	29.1	36.1	23.6	34.9 J	46.3	56.8	32.2	31.2 J	64.7	51.2	74.9	68.9	53.6	52.1	64.7	35.5
Other																					
Methylmercury	22967926	mg/kg	2.8E-04 =	4.9E-04 =	1.1E-04 =	3.7E-04 =	2.2E-04 =	1.3E-04 =	6.0E-04 =	5.1E-04 =	4.0E-04 =	1.6E-04 J	1.7E-04 =	0.001 =	0.0017 =	7.0E-04 =	5.1E-04 J	4.8E-04 =	4.2E-04 =	5.7E-04 =	1.0E-04 =
Sequential extraction																					
Mercury (F0) - volatile elemental mercury	NS1021	mg/kg	--	--	--	--	1.7E-04 UJ	0.0014 J	2.0E-04 UJ	2.2E-04 UJ	5.6E-04 J	--	1.7E-04 UJ	1.8E-04 UJ	--	--	--	1.8E-04 UJ	--	--	2.2E-04 J
Mercury (F1) - water soluble mercury	NS1022	mg/kg	--	--	--	--	0.0032 J	0.0025 J	0.0034 J	0.0039 J	0.013 =	--	0.025 =	0.054 J	--	--	--	0.02 J	--	--	0.0011 UJ
Mercury (F2) - pH 2 soluble mercury	NS1023	mg/kg	--	--	--	--	0.002 J	0.0012 UJ	0.0016 J	0.0019 J	0.0033 J	--	0.017 =	0.04 J	--	--	--	0.0097 J	--	--	0.0011 UJ
Mercury (F3) - 1N potassium hydroxide extractable mercury	NS1024	mg/kg	--	--	--	--	0.083 =	0.026 =	0.11 =	0.099 =	0.16 =	--	0.55 =	0.85 J	--	--	--	0.27 J	--	--	0.018 J
Mercury (F4) - 12N nitric acid soluble mercury	NS1025	mg/kg	--	--	--	--	0.0062 J	0.0059 UJ	0.015 J	0.018 J	0.031 =	--	0.11 =	0.56 J	--	--	--	0.037 J	--	--	0.0055 UJ
Mercury (F5) - aqua regia soluble mercury	NS1026	mg/kg	--	--	--	--	0.0035 J	0.0025 J	0.0029 J	0.0036 J	0.011 =	--	0.045 =	0.053 J	--	--	--	0.0047 J	--	--	0.0012 J
Mercury (F6) - mineral-bound mercury	NS1027	mg/kg	--	--	--	--	7.6E-04 J	4.2E-04 J	4.7E-04 J	4.0E-04 J	0.001 J	--	7.3E-04 J	0.0026 J	--	--	--	0.0017 J	--	--	0.01 J
Mercury (FS) - total mercury by summation	NS1028	mg/kg	--	--	--	--	0.099 =	0.031 =	0.13 =	0.13 =	0.22 =	--	0.75 =	1.6 J	--	--	--	0.34 J	--	--	0.029 J
Wet chemistry																					
Moisture	N544	%	22	19.9	20.1	25.2	23.9	21.8	36.4	36.1	28.1	24	22.7	23.5	20	25.3	27.3	28.6	28.7	33.3	20.9
Sulfide	18496258	mg/kg	25.7 J	21.6 J	30.3	11.6 U	22.9 J	40	15.4 J	59.1	40.9	30.7 J	30.4 J	23.4 J	18.6 J	32.6 J	22.2 J	13.3 J	15.2 J	19.2 J	24.4 J
Total organic carbon average	NS2302	mg/kg	14,600	17,000	9760	19,400	25,200	8810	25,800	24,200	18,900	20,200	15,800	24,100	31,900	33,600	25,500	39,200	38,800	26,600	17,400

E = Estimated, matrix interference.

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

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

UJ = Analyte or compound was not detected above the reported detection limit, and the reported detection limit is approximated due to quality deficiency.

= Validated result, which is detected and unqualified.

-- = Analyte or compound not sampled for.

BCV = Bear Creek Valley CAS = Chemical Abstract Service RSE = remedial site evaluation

Table C.6. BCV RSE creek bank soil data

Chemical	CAS	Units	BCT1-BSL	BCT1-BSU	BCT2-BSL	BCT2-BSU	BCT3-BSL	BCT3-BSU	BCT4-BSL	BCT4-BSU	BCT5-BS	BCT5-BSL	BCT5-BSU	BCT6-BS	BCT6-BSL	BCT6-BSU	BCT7-BS	BCT8-BS	BCT9-BS	BCT10-BSL	BCT10-BSU	BCT11-BS	BCT11-BSL	BCT11-BSU
Anions																								
Chloride	16887006	mg/kg	2.29 J	2.32 J	2.9	2.65	7.5	3.5	3.91	2.65	--	13	2.42	--	4.83	2.96	14.1 J	9.9 J	11.8 J	3.3	1.95 J	--	13.8	9.28
Fluoride	16984488	mg/kg	1.89	0.858 J	1.91	2.64	5.34	4.11	1.99	2.17	--	3.37 J	2.66 J	--	2.18 J	2.25 J	3.02	1.82	2.68	3.65	2.64	--	4.1 J	3.83 J
Nitrate	14797558	mg/kg	2.11	1.96	1.09 J	1.43	0.41 U	1.09 J	1.81	1.42	--	0.851 J	0.969 J	--	0.856 J	1.04 J	1.38	0.889 J	4.4	1.28	0.403 U	--	2.18	2.03
Nitrite	14797650	mg/kg	0.408 U	0.423 U	0.405 U	0.404 U	0.41 U	0.4 U	0.45 U	0.404 U	--	0.411 U	0.391 U	--	0.425 U	0.394 U	0.449 U	0.442 U	0.429 U	0.417 U	0.403 U	--	0.408 U	0.402 U
Sulfate	14808798	mg/kg	6.88	3.98 J	20.8	6.99	16.1	4.05 J	11.6	7.66	--	6.28	2.8 J	--	10.1	3.46 J	11.9	9.28	9.36	6.35 J	2.48 J	--	7.87	4.29 J
Metals																								
Aluminum	7429905	mg/kg	4370	5430	7570	6560	5900	7330	4930	5280	--	5670	5100	--	7030	6340	5160	7320 J	7900 J	5790	3530	--	5520	5410
Antimony	7440360	mg/kg	0.432 U	0.421 U	0.418 U	0.362 U	0.401 U	0.655 J	0.41 U	0.405 U	--	0.942 J	0.356 U	--	0.367 U	0.351 U	0.47 U	0.419 U	0.435 U	0.376 U	0.672 J	--	0.406 J	0.365 U
Arsenic	7440382	mg/kg	3.3	2.58	7.59	3.12	2.95	3.13	3.6	3.5	--	3.04	4.58	--	3.91	4.79	2.79	5.99	5.39	4.05	2.59	--	3.41	3.15
Barium	7440393	mg/kg	62.7	89.5	92.5	116	68	62.1	92.1	77	--	75.6	58.3	--	138	103	87.7	68.6	95.1	79.8	42.1	--	90.2	86.7
Beryllium	7440417	mg/kg	0.428 J	0.586 J	0.717	0.609	0.463 J	0.446 J	0.55 J	0.56 J	--	0.431 J	0.398 J	--	0.721	0.563	0.534 J	1.01	1.04	0.145 J	0.104 U	--	0.659	0.601
Boron	7440428	mg/kg	3.49 J	1.28 U	1.27 U	1.1 U	4.13 J	4.26 J	5.23 J	4.11 J	--	1.24 U	1.08 U	--	1.11 U	1.07 U	1.42 U	13.8	8.14	3.01 J	1.04 U	--	3.56 J	3.12 J
Cadmium	7440439	mg/kg	1.11	0.623	0.129 J	0.278	0.0384 J	0.0484 J	0.301	0.247	--	0.094 J	0.575	--	0.0801 J	0.092 J	0.621	1.53	2.24	0.872	0.106 J	--	0.29	0.378
Calcium	7440702	mg/kg	2760	1680	1540	1820	1260	4440	3370	1520	--	1360	1550	--	1670	1470	3440	3530 E	2790 E	3060	633	--	1870	1890
Chromium	7440473	mg/kg	9.36	11.7	20.2	11.2	9.76	10.3	10.4	11.6	--	14	14.3	--	24.4	18.1	10.9	34.8	22.4	15.3	8.49	--	16.7	12.4
Cobalt	7440484	mg/kg	6.74	9.58	14.1	12.8	8.28	8.5	9.13	9.72	--	11.7	8.8	--	12.5	15.5	9.24	13.4	15.1	11.3	6.62	--	14.6	13.9
Copper	7440508	mg/kg	8.21	8.04	8.06	8.52	5.63	8.19	11.8	6.9	--	8.12	5.96	--	7.69	8.84	6.17	9.33	11.2	8.91	6.84	--	7.2	8.44
Iron	7439896	mg/kg	9380	12,500	20,500	14,600	11,200	12,000	11,200	12,000	--	12,600	14,000	--	21,500	16,400	10,400	25,400 J	18,400 J	13,900	8010	--	14,700	13,400
Lead	7439921	mg/kg	10.2	12.3	14.8	16.6	10.4	12.5	10	11.8	--	14.4 J	15.8 J	--	15.1 J	17.1 J	12.8	15.7 J	17.9 J	14.5	10.1	--	15.5	15
Lithium	7439932	mg/kg	14.5	12.2	9.4	11.1	10.2	14	10.3	9.98	--	9.78	12.8	--	12.8	11.5	12.3	16.6	18.7	13.4	7.71	--	10.3	9.48
Magnesium	7439954	mg/kg	1030	1240	1520	1420	989	1500	1560	1070	--	875	692	--	1250	1030	1540	1920	1400	1610	459	--	1070	1060
Manganese	7439965	mg/kg	635	842	767	1360	547	505	745	688	--	886	567	--	1760	1350	1210	583	951	1030	401	--	1380	1250
Mercury	7439976	mg/kg	0.18 =	0.15 =	0.041 =	0.12 =	0.024 J	0.032 =	0.066 =	0.1 =	--	0.042 =	0.2 =	--	0.033 =	0.034 =	0.2 =	0.18 =	0.55 =	0.15 =	0.075 =	--	0.12 J	0.23 J
Molybdenum	7439987	mg/kg	0.355 J	0.345 J	0.495 J	0.421 J	0.445 J	0.312 J	0.257 J	0.245 U	--	0.248 U	0.216 U	--	0.222 U	0.213 U	0.327 J	0.254 U	0.264 U	0.418 J	0.315 J	--	0.527 J	0.555 J
Nickel	7440020	mg/kg	11.7	13.8	10.8	15.8	8.33 J	10.1 J	12.3 J	12.3 J	--	8.44	9.01	--	11.8	10.3	8.23	17.5 E	19.7 E	12.5 J	5.39 J	--	9.63	9.1
Phosphorous	7723140	mg/kg	176	179	159	136	144	158	181	154	--	144	146	--	133	145	189	241	242	187	114	--	174	174
Potassium	7440097	mg/kg	642	718	773	661	576	797	598	606	--	562	471	--	595	663	420	826	841	451	246	--	624 J	612 J
Selenium	7782492	mg/kg	0.873 J	0.832 J	1.08 J	0.801 J	1.04 J	0.924 J	0.971 J	0.949 J	--	1.33	1.14 J	--	1.84	1.34	1.04 J	0.883 J	1.04 J	1.2	0.842 J	--	1.34	1.22 J
Silicon	7440213	mg/kg	1910	2530	3050	2870	2050	2040	2080	2100	--	517	443	--	460	508	1490	1850	1960	1820	1240	--	2640	2450
Silver	7440224	mg/kg	0.131 U	0.128 J	0.267 J	0.326 J	0.121 U	0.124 J	0.124 U	0.123 U	--	0.621 U	0.54 U	--	0.556 U	0.533 U	0.194 J	0.635 U	0.906 J	0.114 U	0.104 U	--	0.11 U	0.111 U
Sodium	7440235	mg/kg	9.16 U	8.93 U	8.86 U	7.68 U	22 J	7.14 U	8.7 U	8.59 U	--	33.6	9.79 J	--	27.3 J	14.4 J	36 J	34.9 J	41.5 J	10.4 J	7.26 U	--	28 J	23.4 J
Strontium	7440246	mg/kg	6.27	5.33	5.39	6.11	5.68	14.4	7.23	5.95	--	5.92	5.01	--	6.96	5.37	8.23	8.32	5.81	6.2	2.72	--	6	5.84
Thallium	7440280	mg/kg	0.179 U	0.162 U	0.173 U	0.169 U	0.167 U	0.174 J	0.167 U	0.154 U	--	0.152 U	0.174 U	--	0.167 U	0.149 U	0.18 U	0.184 U	0.18 U	0.166 U	0.168 U	--	0.172 U	0.172 U
Uranium	7440611	mg/kg	17.4	9.91	1.35	2.98	0.864	1.08	6.61	4.88	--	1.43	14.6	--	0.658	3.18	11.5	14.3	38.7	11.4	1.61	--	3.27	3.45
Vanadium	7440622	mg/kg	10.6	13.9	21.7	16.9	14.2	16.1	13.4	14.6	--	18.1	20.6	--	22.3	22.2	11.9	32	23.7	18	10.5	--	17.7	16.4
Zinc	7440666	mg/kg	22.9	30.7	23	28.9	15.9	20.2	27.3	23	--	22.3	22.6	--	25.3	23.7	20.6 J	42.5	38.5	29.1	12.7	--	21.5 J	22.3 J
Other																								
Methylmercury	22967926	mg/kg	2.6E-04 =	4.0E-04 =	6.2E-05 =	2.4E-04 =	3.3E-05 J	2.5E-05 J	1.8E-04 =	4.1E-04 =	--	1.8E-05 UJ	9.4E-05 =	--	1.8E-05 UJ	1.7E-05 UJ	8.7E-04 =	4.8E-04 =	2.3E-04 =	5.6E-05 J	9.8E-05 J	--	1.7E-04 =	1.3E-04 =
Sequential extraction																								
Mercury (F0) - volatile elemental mercury	NS1021	mg/kg	--	--	--	--	--	--	--	--	9.3E-04 J	--	--	1.8E-04 UJ	--	--	1.9E-04 UJ	2.0E-04 UJ	1.8E-04 UJ	--	--	1.8E-04 J	--	--
Mercury (F1) - water soluble mercury	NS1022	mg/kg	--	--	--	--	--	--	--	--	0.0044 J	--	--	0.0015 J	--	--	0.0033 J	0.0028 J	0.0088 =	--	--	0.0071 =	--	--
Mercury (F2) - pH 2 soluble mercury	NS1023	mg/kg	--	--	--	--	--	--	--	--	0.0016 J	--	--	0.0012 UJ	--	--	0.0013 J	0.0021 J	0.0049 =	--	--	0.0035 J	--	--
Mercury (F3) - 1N potassium hydroxide extractable mercury	NS1024	mg/kg	--	--	--	--	--	--	--	--	0.068 =	--	--	0.019 =	--	--	0.086 =	0.065 =	0.2 =	--	--	0.12 =	--	--
Mercury (F4) - 12N nitric acid soluble mercury	NS1025	mg/kg	--	--	--	--	--	--	--	--	0.0068 J	--	--	0.0059 UJ	--	--	0.014 J	0.012 J	0.025 =	--	--	0.015 J	--	--
Mercury (F5) - aqua regia soluble mercury	NS1026	mg/kg	--	--	--	--	--	--	--	--	0.0044 =	--	--	0.0045 =	--	--	0.0022 J	0.003 J	0.0068 =	--	--	0.0093 =	--	--
Mercury (F6) - mineral-bound mercury	NS1027	mg/kg	--	--	--	--	--	--	--	--	7.2E-04 J	--	--	4.8E-04 J	--	--	3.4E-04 UJ	3.6E-04 UJ	8.2E-04 J	--	--	9.3E-04 J	--	--
Mercury (FS) - total mercury by summation	NS1028	mg/kg	--	--	--	--	--	--	--	--	0.086 =	--	--	0.025 =	--	--	0.11 =	0.085 =	0.25 =	--	--	0.16 =	--	--
Wet chemistry																								
Moisture	N544	%	23.9	22.4	22.6	20	21.6	18.2	27.6	23.4	--	22.7	19.6	--	23.2	20.6	30.2	29.7	28.5	24.8	18.8	--	23	20.9
Sulfide	18496258	mg/kg	15.9 J	20.7 J	11.3 U	34.9	23.6 J	18 J	31.3 J	17.4 J	--	43.6	22.1 J	--	27.6 J	26.3 J	15 J	36	43.3	23.6 J	23.7 J	--	28.2 J	10.9 U
Total organic carbon average	NS2302	mg/kg	11,200	14,600	5550	7350	5320	6640	10,700	11,800	--	7840	10,400	--	5850	5990	16,700	22,100	18,800	9000	4810	--	8920	11,200

Table C.6. BCV RSE creek bank soil data (cont.)

Chemical	CAS	Units	BCT12B-BS	BCT12B-BSL	BCT12B-BSL-D	BCT12B-BSU	BCT12B-BSU-D	BCT12A-BSL	BCT12A-BSU	BCT13-BSL	BCT13-BSU	BCT14-BS	BCT14-BSL	BCT14-BSL-D	BCT14-BSU	BCT14-BSU-D	BCT15-BSL	BCT15-BSU	HCTREF-BS	HCTREF-BSL	HCTREF-BSU
Anions																					
Chloride	16887006	mg/kg	--	6.88	2.84	3.07	2.75	3.98	2.54	5.88	5.13	--	81.3	94.5	6.79	3.44	24.8	11.1	--	4.25	2.68
Fluoride	16984488	mg/kg	--	15.9	20.5	18.5	17.6	12.1	12.7	24.7	15.6	--	5.24	5.6	0.407 U	0.639 J	13.6	9.56	--	2.49 J	3.09 J
Nitrate	14797558	mg/kg	--	1.73	1.56	1.71	1.65	1.2 J	1.33	1.7	1.35	--	20	23.1	0.395 U	0.372 U	88.5	29.2	--	0.49 U	1.06 J
Nitrite	14797650	mg/kg	--	0.411 U	0.408 U	0.413 U	0.385 U	0.443 U	0.397 U	0.434 U	0.438 U	--	0.407 U	0.403 U	0.395 U	0.372 U	0.525 U	0.473 U	--	0.49 U	0.392 U
Sulfate	14808798	mg/kg	--	4.72 J	4.34 J	3.78 J	3.46 J	6.02	3.29 J	26.8 J	25.7 J	--	72.6	74.9	11.9	11.7	31.9	27.8	--	8.56	9.5
Metals																					
Aluminum	7429905	mg/kg	--	8190	8510	8240	8220	10,500	9870	8310	8030	--	9450	9010	10,200	9910	9020	8430	--	7010	5570
Antimony	7440360	mg/kg	--	0.392 U	0.377 U	1.34 J	0.842 J	0.45 U	0.633 J	0.846 J	1.46 J	--	0.382 U	1.05 J	0.385 U	0.396 U	1.56 J	0.471 U	--	0.49 U	0.39 U
Arsenic	7440382	mg/kg	--	4.35	4.06	5.64	6.72	6.07	5.66	5.49	5.98	--	5.12	4.12	4.61	4.83	4.54	3.99	--	3.3	1.85
Barium	7440393	mg/kg	--	150	147	102	104	136	151	167	165	--	44.2	44.5	47.1	45.6	602	380	--	102	77
Beryllium	7440417	mg/kg	--	0.407 J	0.462 J	0.379 J	0.42 J	0.474 J	0.562 J	0.407 J	0.275 J	--	0.417 J	0.357 J	0.449 J	0.414 J	1.29	0.982	--	0.53 J	0.445 J
Boron	7440428	mg/kg	--	1.19 U	1.14 U	1.11 U	1.09 U	2.67 J	1.24 U	1.23 U	1.2 U	--	1.16 U	2.15 J	2.71 J	3.62 J	7.1 J	5.75 J	--	1.48 U	1.18 U
Cadmium	7440439	mg/kg	--	4.26	4.04	6.1	7.37	6.84	5.52	16.4	8.44	--	0.27	0.15 J	0.0598 J	0.0604 J	15.5	7.95	--	0.106 J	0.0364 J
Calcium	7440702	mg/kg	--	2830	2900	1680	1760	4690	3830	6150	7960	--	4590	4750	1000	992	6600	7960	--	3160	3290
Chromium	7440473	mg/kg	--	18.1	18.2	17.7	18.5	18.8	18.7	18.6	20.1	--	22.9	20.9	23.2	17.5	12.5 J	15	--	17.7	13.9
Cobalt	7440484	mg/kg	--	14.6	17.2	16.1	13.9	16.1	19.4	20.4	15.3	--	13.4	11.9	16.1	15.3	46.2	24.8	--	10.6	8.52
Copper	7440508	mg/kg	--	14.2	21	18.9	18.5	21.7	17.9	17	31.3	--	5.43	4.48	5.44	5.04	15.1	13.7	--	9.97	6.93
Iron	7439896	mg/kg	--	16,600	18,000	17,100	15,400	19,400	17,800	19,100	18,400	--	38,000	30,200	48,700	46,500	16,700	16,800	--	15,500	12,900
Lead	7439921	mg/kg	--	20.6	28.8	27.9	22.2	28.6	23.6	25.4	32.9	--	15.9	13.1	14.6	14.2	21.7	17.7	--	14.1 J	11.5 J
Lithium	7439932	mg/kg	--	24	20.5	24.3	32.6	20.6	22.4	28.8	29.9	--	9.94	10.9	9.86	10	18.8	16.8	--	16.4	11.8
Magnesium	7439954	mg/kg	--	1240	1190	943	932	1920	1310	1230	2200	--	804	833	556	550	2630	3300	--	1680	1440
Manganese	7439965	mg/kg	--	1610	1990	996	941	1610	1740	2420	2030	--	534	485	448	403	10,100	5620	--	847	694
Mercury	7439976	mg/kg	--	1.3 =	0.62 =	1.9 =	1.5 =	1.6 =	0.86 =	1.6 =	7.1 =	--	0.026 J	0.041 =	0.059 =	0.054 =	0.32 =	0.42 =	--	0.03 =	0.028 =
Molybdenum	7439987	mg/kg	--	0.683 J	0.849 J	0.729 J	0.691 J	0.801 J	0.377 J	1.18 J	0.644 J	--	0.519 J	0.351 J	0.242 J	0.437 J	0.307 U	0.315 J	--	0.297 U	0.236 U
Nickel	7440020	mg/kg	--	23.1 J	33.1 J	28.6 J	27.9 J	38 J	39.5 J	60.6 J	38.7 J	--	11.2 J	8.93 J	7.34 J	6.12 J	120	63.3	--	11.2	9.24
Phosphorous	7723140	mg/kg	--	172	171	190	196	215	202	215	250	--	77.9	79	105	110	239	255	--	184	113
Potassium	7440097	mg/kg	--	559	563	582	596	678	586	585	650	--	626	624	541	533	730	768	--	731	548
Selenium	7782492	mg/kg	--	1.46	1.29	1.56	1.81	1.7	1.77	1.87	1.81	--	0.48 J	0.471 J	0.507 J	0.528 J	2.35	1.99	--	1.52	1.31
Silicon	7440213	mg/kg	--	2980	3020	2660	2540	3560	3220	2520	2930	--	2830	2770	2750	2870	2680	2700	--	687	490
Silver	7440224	mg/kg	--	0.119 U	0.114 U	0.111 U	0.109 U	0.136 U	0.124 U	0.167 J	0.578 J	--	1.52	1.3	1.83	1.76	1.36	0.943	--	0.742 U	0.591 U
Sodium	7440235	mg/kg	--	11 J	9.75 J	7.77 U	7.65 U	17.9 J	13.6 J	22.6 J	18.1 J	--	77.5	112	8.16 U	8.4 U	77.4	64.5	--	17.8 J	13.4 J
Strontium	7440246	mg/kg	--	9.32	8.24	7.75	8.32	13.4	19.4	17.4	18.1	--	11.2	11.3	5.14	5.21	24.6	20.2	--	7.78	4.44
Thallium	7440280	mg/kg	--	0.16 U	0.155 U	0.159 U	0.187 J	0.18 U	0.177 U	0.191 U	0.195 J	--	0.154 J	0.159 J	0.154 J	0.163 U	0.194 U	0.187 U	--	0.18 U	0.174 U
Uranium	7440611	mg/kg	--	30.3	33.8	60.7	68.6	36.5	81.4	24.8	17.6	--	5.06	4.91	1.33	1.43	7.6	6.86	--	0.46	0.435
Vanadium	7440622	mg/kg	--	22.4	24.5	22.9	21.1	27.6	22.3	21.8	22.2	--	25	24.4	28.9	27.1	16.3	16.3	--	18.3	15.6
Zinc	7440666	mg/kg	--	46.5	57.5	49.5	48.7	75	52.1	62.9	79.9	--	11.6	10.6	11.3	9.39	61.2	58.6	--	35.6	26.2
Other																					
Methylmercury	22967926	mg/kg	--	9.8E-05 =	1.4E-04 =	2.8E-04 =	2.0E-04 =	2.6E-04 =	4.2E-04 =	7.1E-04 J	7.7E-04 J	--	1.7E-05 UJ	1.7E-05 UJ	4.0E-05 J	2.5E-05 J	2.5E-04 =	1.7E-04 =	--	4.0E-05 J	1.6E-05 UJ
Sequential extraction																					
Mercury (F0) - volatile elemental mercury	NS1021	mg/kg	1.7E-04 UJ	--	--	--	--	--	--	--	--	1.7E-04 UJ	--	--	--	--	--	--	3.7E-04 J	--	--
Mercury (F1) - water soluble mercury	NS1022	mg/kg	0.026 J	--	--	--	--	--	--	--	--	0.0011 UJ	--	--	--	--	--	--	0.0028 J	--	--
Mercury (F2) - pH 2 soluble mercury	NS1023	mg/kg	0.02 J	--	--	--	--	--	--	--	--	0.0011 UJ	--	--	--	--	--	--	0.0011 UJ	--	--
Mercury (F3) - 1N potassium hydroxide extractable mercury	NS1024	mg/kg	0.39 J	--	--	--	--	--	--	--	--	0.0022 UJ	--	--	--	--	--	--	0.013 J	--	--
Mercury (F4) - 12N nitric acid soluble mercury	NS1025	mg/kg	0.15 J	--	--	--	--	--	--	--	--	0.017 J	--	--	--	--	--	--	0.0053 UJ	--	--
Mercury (F5) - aqua regia soluble mercury	NS1026	mg/kg	0.25 J	--	--	--	--	--	--	--	--	0.0031 J	--	--	--	--	--	--	0.0012 J	--	--
Mercury (F6) - mineral-bound mercury	NS1027	mg/kg	0.0068 J	--	--	--	--	--	--	--	--	0.0013 J	--	--	--	--	--	--	0.016 J	--	--
Mercury (FS) - total mercury by summation	NS1028	mg/kg	0.84 J	--	--	--	--	--	--	--	--	0.021 J	--	--	--	--	--	--	0.033 J	--	--
Wet chemistry																					
Moisture	N544	%	--	21.2	21.8	20.3	21.1	26.9	22.3	28.3	27.1	--	19.3	19.5	18.3	17.9	39.3	34.1	--	35	21.3
Sulfide	18496258	mg/kg	--	11.9 J	21.3 J	17.4 J	10.9 U	32.5 J	21.1 J	20 J	21.7 J	--	11.1 U	12 J	22.4 J	24 J	25.9 J	39.7	--	31.1 J	21.8 J
Total organic carbon average	NS2302	mg/kg	--	12,700	11,000	10,300	10,500	16,600	13,400	15,900	25,000	--	7950	5370	3790	3360	24,200	26,900	--	12,300	6850

E = Estimated, matrix interference.

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

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

UJ = Analyte or compound was not detected above the reported detection limit, and the reported detection limit is approximated due to quality deficiency.

= Validated result, which is detected and unqualified.

-- = Analyte or compound not sampled for.

BCV = Bear Creek Valley CAS = Chemical Abstract Service RSE = remedial site evaluation

Table C.7. BCV RSE channel sediment data

Chemical	CAS	Units	BCT3-CH	BCT4-CH	BCT7-CH	BCT8-CH	BCT9-CH	BCT10-CH	BCT11-CH	BCT12B-CH	BCT12B-CH-D	BCT12A-CH	BCT13-CH	BCT14-CH	BCT14-CH-D	BCT15-CH
Anions																
Chloride	16887006	mg/kg	4.36	3.53	9.88 J	11.5 J	12.9 J	11.5	14.4	21.2	20.5	32.6	31.2	20.9	25	11.5
Fluoride	16984488	mg/kg	0.905 J	0.884 J	1.17 J	1.62	1.83	1.53 J	2.01 J	3.67 J	3.6 J	3.78 J	4.58 J	8.6	9	6.06
Nitrate	14797558	mg/kg	1.22 J	1.1 J	0.464 U	0.459 U	0.894 J	1.08 J	1.43	1.01 J	0.959 J	0.975 J	1.33 J	11.2	14.8	32.4
Nitrite	14797650	mg/kg	0.455 U	0.419 U	0.464 U	0.459 U	0.445 U	0.429 U	0.414 U	0.458 U	0.461 U	0.445 U	0.438 U	0.51 U	0.493 U	0.531 U
Sulfate	14808798	mg/kg	22.1	10.4	20.6	25	35.5	33.7	9.4	13	12.6	14	18.3	30.3	36.3	34.3
Metals																
Aluminum	7429905	mg/kg	5890	5690	2770	7670 J	5950 J	7040	6130	4830	5990	6510	8230	10,900	10,800	15,400
Antimony	7440360	mg/kg	1.45 J	2.15 J	0.44 U	0.406 U	0.417 U	0.725 J	0.652 J	0.422 U	0.428 U	0.423 U	0.452 U	1.33 J	1.32 J	0.509 U
Arsenic	7440382	mg/kg	6.22	9.8	1.78	15.1	3.46	7.02	11	9.84	8.56	12.2	13.2	5.93	6	6.99
Barium	7440393	mg/kg	71.4	56.4	47.4	80.6	77.8	107	137	176	259	324	615	364	310	1590
Beryllium	7440417	mg/kg	1.03	1.11	0.309 J	1.2	0.901	1.36	1.12	0.497 J	0.545 J	0.61 J	0.775	1.1	1.09	2.56
Boron	7440428	mg/kg	3.74 J	7.31	1.33 U	9.31	3.93 J	9.82	6.2	1.28 U	1.3 U	1.28 U	1.37 U	1.43 U	7.43	10.4
Cadmium	7440439	mg/kg	0.207 J	0.26	0.249 J	1.52	1.36	0.925	2.81	3.18	3.03	2.96	4.7	4.51	5.01	38.5
Calcium	7440702	mg/kg	1220	984	2270	2310 E	3380 E	3670	7510	4890	4830	6500	5600	4730	4630	7680
Chromium	7440473	mg/kg	30.9	51	8.12	55.7	12.7	76	39.6	27.1	31	38.5	48.8	32.8	37.3	25.4 J
Cobalt	7440484	mg/kg	12	16.4	4.99	19.3	11.1	25.8	18.3	19.1	25.2	27.2	36.5	42	39.4	106
Copper	7440508	mg/kg	8.23	7.54	3.43	7.51	10.7	11.4	10.2	9.89	11	12.4	17.3	14	13.9	25.4
Iron	7439896	mg/kg	23,800	32,100	7120	29,600 J	12,000 J	44,400	34,100	31,700	35,700	42,900	49,000	52,300	53,200	30,700
Lead	7439921	mg/kg	15.9	16.2	5.17	19.4 J	13.1 J	25.1	22.9	21.3 J	27.3 J	35.2 J	42.9 J	35	28.3	37.7
Lithium	7439932	mg/kg	12.4	9.81	8.4	16.7	17.3	11.1	16.7	10.3	11.3	13.5	14.1	12.3	12.4	23.9
Magnesium	7439954	mg/kg	1380	1290	1230	1420	1350	1990	2780	1280	1050	1320	1430	1320	1300	2390
Manganese	7439965	mg/kg	817	733	478	1140	641	1430	1900	2200	2890	3380	7000	4360	3930	29,600
Mercury	7439976	mg/kg	0.029 J	0.026 J	0.086 =	0.11 =	0.44 =	0.095 J	0.16 J	0.33 =	0.27 J	0.53 =	0.34 =	0.083 =	0.063 =	0.43 =
Molybdenum	7439987	mg/kg	0.546 J	1.14 J	0.267 U	0.246 U	0.253 U	1.15 J	1.22 J	0.255 U	0.259 U	0.256 U	0.274 U	0.41 J	0.435 J	0.703 J
Nickel	7440020	mg/kg	18.3 J	20.1 J	6	22.8 E	17.3 E	24.5	23.1	22.3	30.2	27.2	39.5	38.7 J	34.5 J	289
Phosphorous	7723140	mg/kg	239	340	131	360	138	375	253	196	167	185	259	104	106	245
Potassium	7440097	mg/kg	763	570	395	746	556	610 J	659 J	375	407	478	718	873	853	976
Selenium	7782492	mg/kg	0.778 J	0.903 J	0.581 J	0.965 J	0.666 J	1.21 J	1.64	1.84	1.8	2.19	2.23	1.43 J	1.47 J	2.89
Silicon	7440213	mg/kg	2130	1750	991	1550	1870	3490	2310	458 J	520 J	489 J	572 J	3740	3630	3040
Silver	7440224	mg/kg	0.298 J	0.266 J	0.133 U	0.615 U	0.126 U	0.118 U	0.122 U	0.639 U	0.648 U	0.641 U	1.37 U	2.51	2.51	4.25
Sodium	7440235	mg/kg	9.66 U	8.76 U	22.8 J	35.8 J	42 J	30.3 J	36.8 J	29.4 J	33.1	48	56.2	37.7	34.6	75.9
Strontium	7440246	mg/kg	6.52	4.31	3.89	5.85	4.69	7.23	20.2	20.9	10.5	11.8	25.9	13	13.4	25.5
Thallium	7440280	mg/kg	0.18 U	0.175 U	0.177 U	0.176 U	0.189 U	0.174 U	0.162 U	0.183 U	0.173 U	0.187 U	0.196 U	0.217 J	0.225 U	0.206 U
Uranium	7440611	mg/kg	2.36	4.36	3.29	19.9	12	8.27	8.98	7.53	8.54	15.4	14.6	19.8	19.8	11.1
Vanadium	7440622	mg/kg	31.5	46.1	5.97	43	15.5	45.6	39.6	27.1	36.2	41.3	43.6	35.3	35	26.3
Zinc	7440666	mg/kg	34.7	37.6	15.5 J	46.9	31.7	62.8 J	44.1 J	117	60.8	60.8	63.1	50.5	50.1	116
Other																
Methylmercury	22967926	mg/kg	6.3E-05 J	5.7E-05 J	2.5E-04 =	1.7E-04 =	8.2E-04 =	2.7E-04 =	1.0E-04 =	1.8E-04 =	2.3E-04 =	4.0E-04 =	1.9E-04 =	2.5E-05 UJ	4.2E-05 J	3.1E-05 J
Sequential extraction																
Mercury (F0) - volatile elemental mercury	NS1021	mg/kg	--	--	2.1E-04 UJ	2.0E-04 UJ	1.8E-04 UJ	--	5.2E-04 J	1.9E-04 J	--	--	--	0.0074 J	--	--
Mercury (F1) - water soluble mercury	NS1022	mg/kg	--	--	0.0016 J	0.0034 J	0.0086 =	--	0.0053 =	0.0065 =	--	--	--	0.0013 UJ	--	--
Mercury (F2) - pH 2 soluble mercury	NS1023	mg/kg	--	--	0.0016 J	0.0013 J	0.0048 =	--	0.0043 J	0.0056 J	--	--	--	0.0013 UJ	--	--
Mercury (F3) - 1N potassium hydroxide extractable mercury	NS1024	mg/kg	--	--	0.045 =	0.07 =	0.17 =	--	0.037 =	0.099 =	--	--	--	0.0027 UJ	--	--
Mercury (F4) - 12N nitric acid soluble mercury	NS1025	mg/kg	--	--	0.0066 UJ	0.0096 J	0.043 =	--	0.0083 J	0.02 =	--	--	--	0.032 J	--	--
Mercury (F5) - aqua regia soluble mercury	NS1026	mg/kg	--	--	0.0024 J	0.0027 J	0.011 =	--	0.04 =	0.085 =	--	--	--	0.023 J	--	--
Mercury (F6) - mineral-bound mercury	NS1027	mg/kg	--	--	3.8E-04 UJ	7.1E-04 J	0.0012 J	--	0.0019 J	9.1E-04 J	--	--	--	4.6E-04 J	--	--
Mercury (FS) - total mercury by summation	NS1028	mg/kg	--	--	0.051 =	0.088 =	0.24 =	--	0.097 =	0.22 =	--	--	--	0.055 J	--	--
Wet chemistry																
Moisture	N544	%	27.9	23.1	31.5	29.4	31.6	23.8	22.9	29.2	30.4	31.8	30.3	37	38.2	38.6
Sulfide	18496258	mg/kg	24.4 J	27.6 J	13.1 J	36.7	36.4	12.8 J	11.1 U	12.4 U	12.6 U	12.7 U	17.8 J	14 J	14.4 U	30.7 J
Total organic carbon average	NS2302	mg/kg	2440	2500	7250	5080	10,800	8390	6320	5290	7160	7710	6760	4420	3760	21,200

E = Estimated, matrix interference.

J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

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

UJ = Analyte or compound was not detected above the reported detection limit, and the reported detection limit is approximated due to quality deficiency.

= Validated result, which is detected and unqualified.

-- = Analyte or compound not sampled for.

BCV = Bear Creek Valley CAS = Chemical Abstract Service RSE = remedial site evaluation

APPENDIX D.
PARTICLE SIZE ANALYSIS

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FLOODPLAIN SOIL

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Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

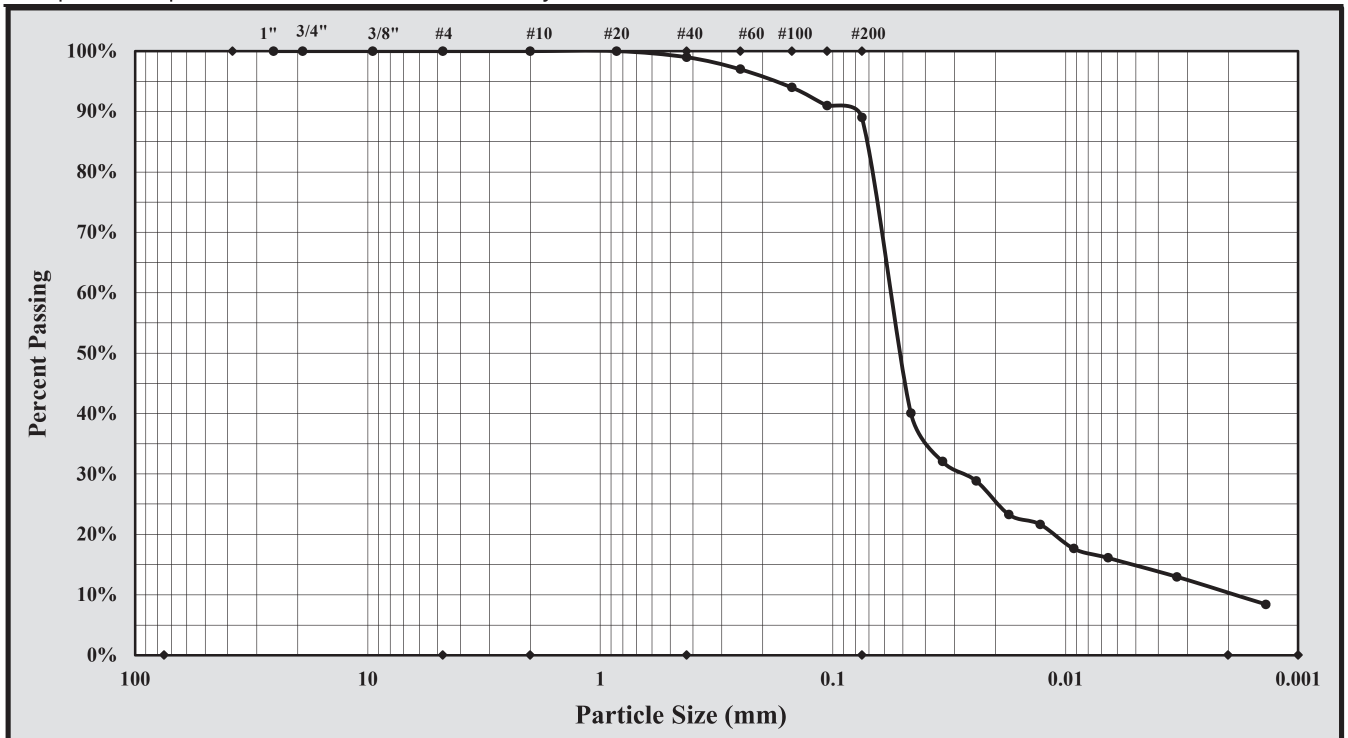
BCT1-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/23/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/2/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0039-03 Type: REG	Sample Date:	1/4/2024
		Depth:	NP

Sample Description: Dark Brown Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#20	Gravel:	0%	Medium Sand:	1%
Silt & Clay (% Passing #200):	89%	Total Sand:	11%	Fine Sand:	10%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	8.4%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Victoria Igoe	*[signature]*	Senior Engineering Technician	2/23/2024
Technical Responsibility	*Signature*	*Position*	*Date*

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

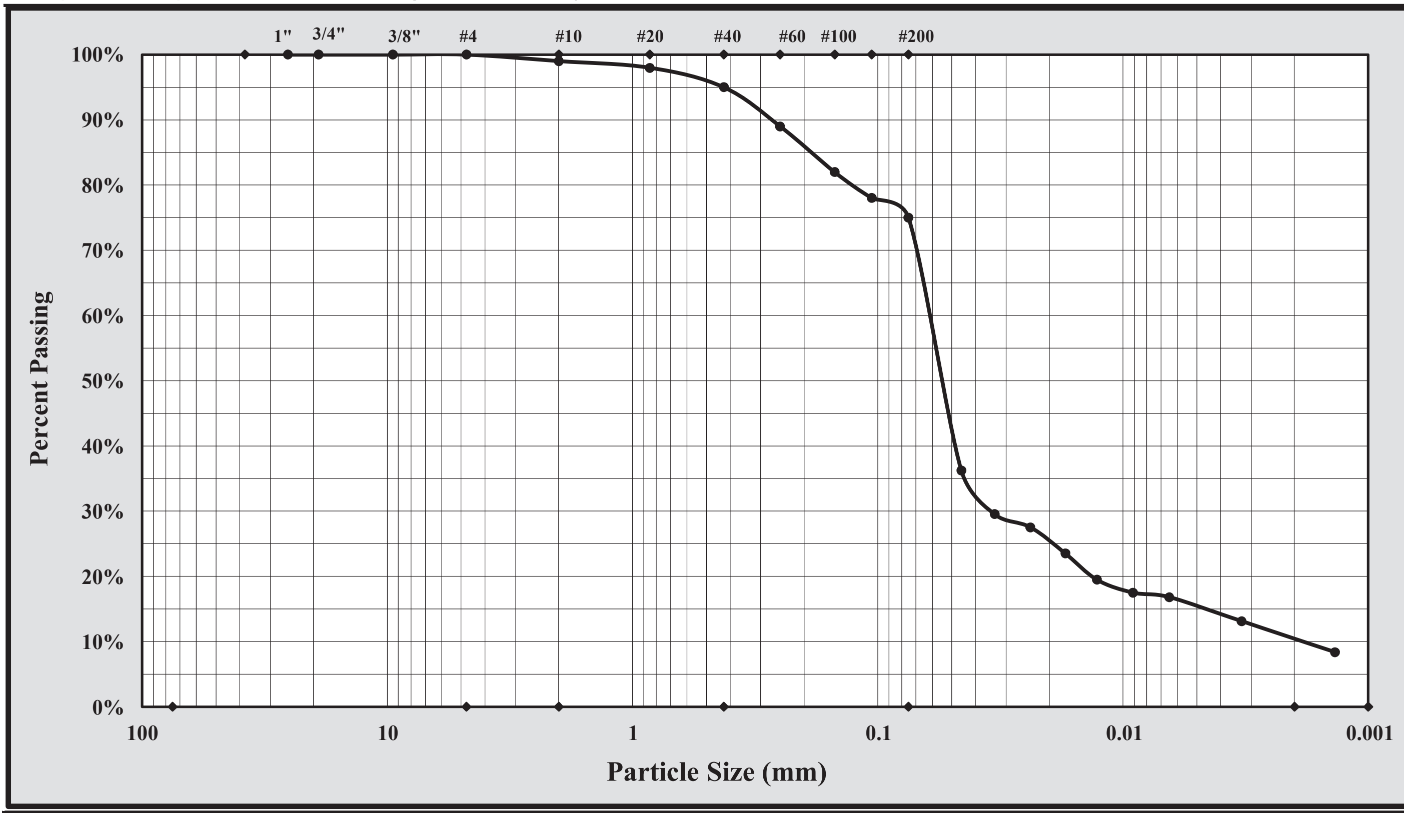
BCT2-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/19/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/7/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0042-03 Type: REG	Sample Date:	1/4/2024
		Depth:	NP

Sample Description: Light Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	4%
Silt & Clay (% Passing #200):	75%	Total Sand:	25%	Fine Sand:	20%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	8.4%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

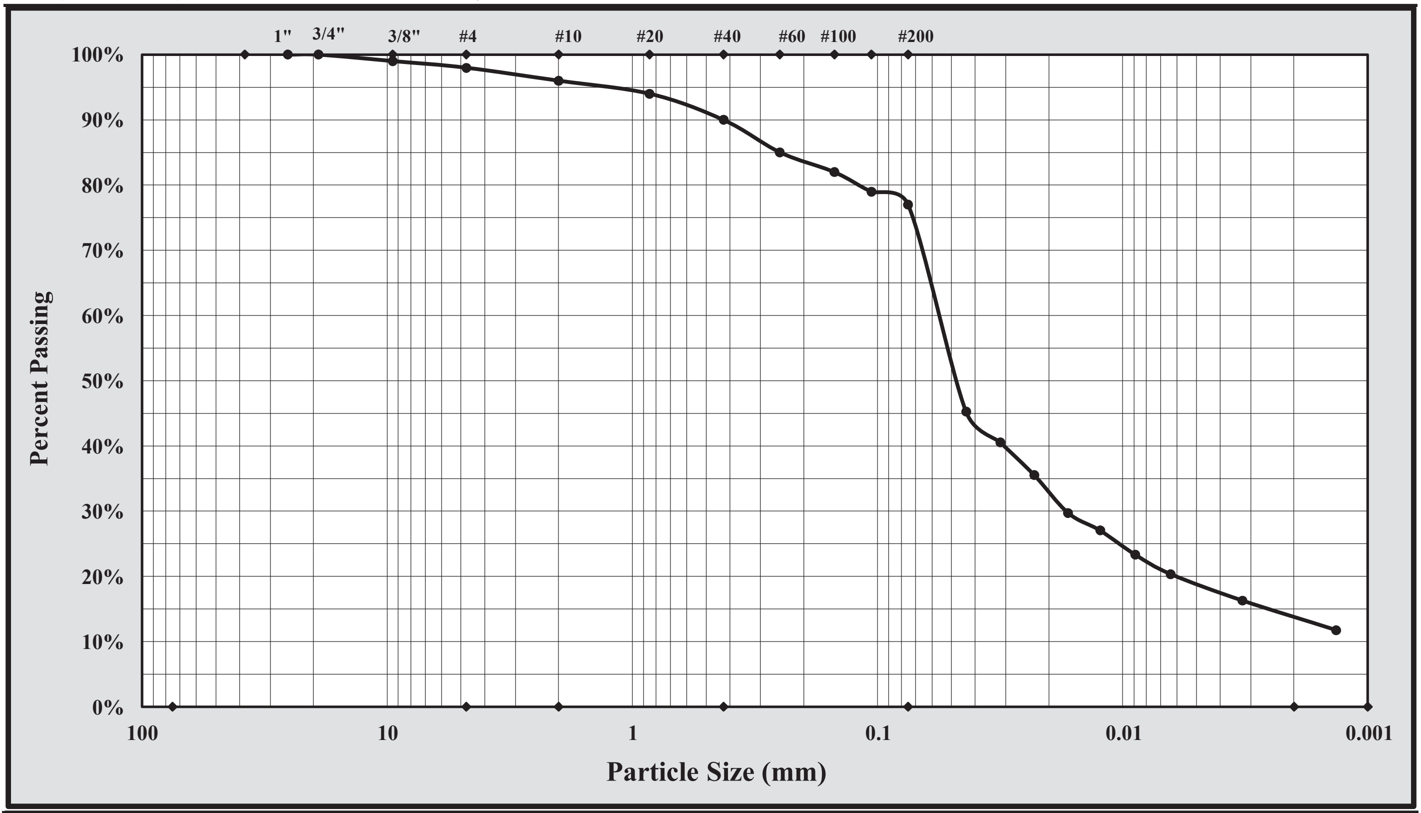
BCT3-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/19/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/7/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0045-03 Type: REG	Sample Date:	1/8/2024
		Depth:	NP

Sample Description: Tan Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8"	Gravel:	2%	Medium Sand:	6%
Silt & Clay (% Passing #200):	77%	Total Sand:	21%	Fine Sand:	13%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	11.8%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

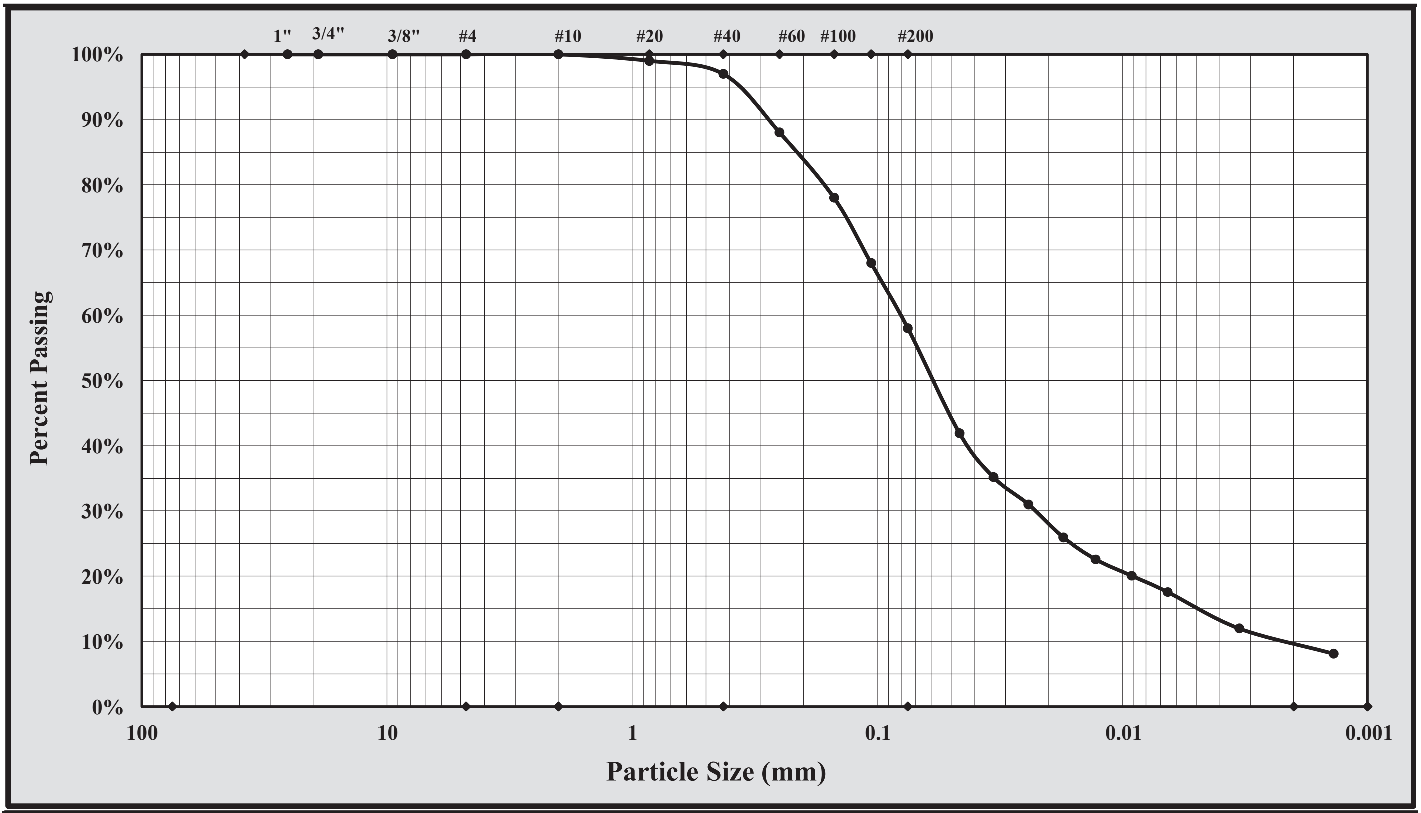
BCT4-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	1/0/1900
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0048-03 Type: REG	Sample Date:	1/8/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	3%
Silt & Clay (% Passing #200):	58%	Total Sand:	42%	Fine Sand:	39%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	8.1%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

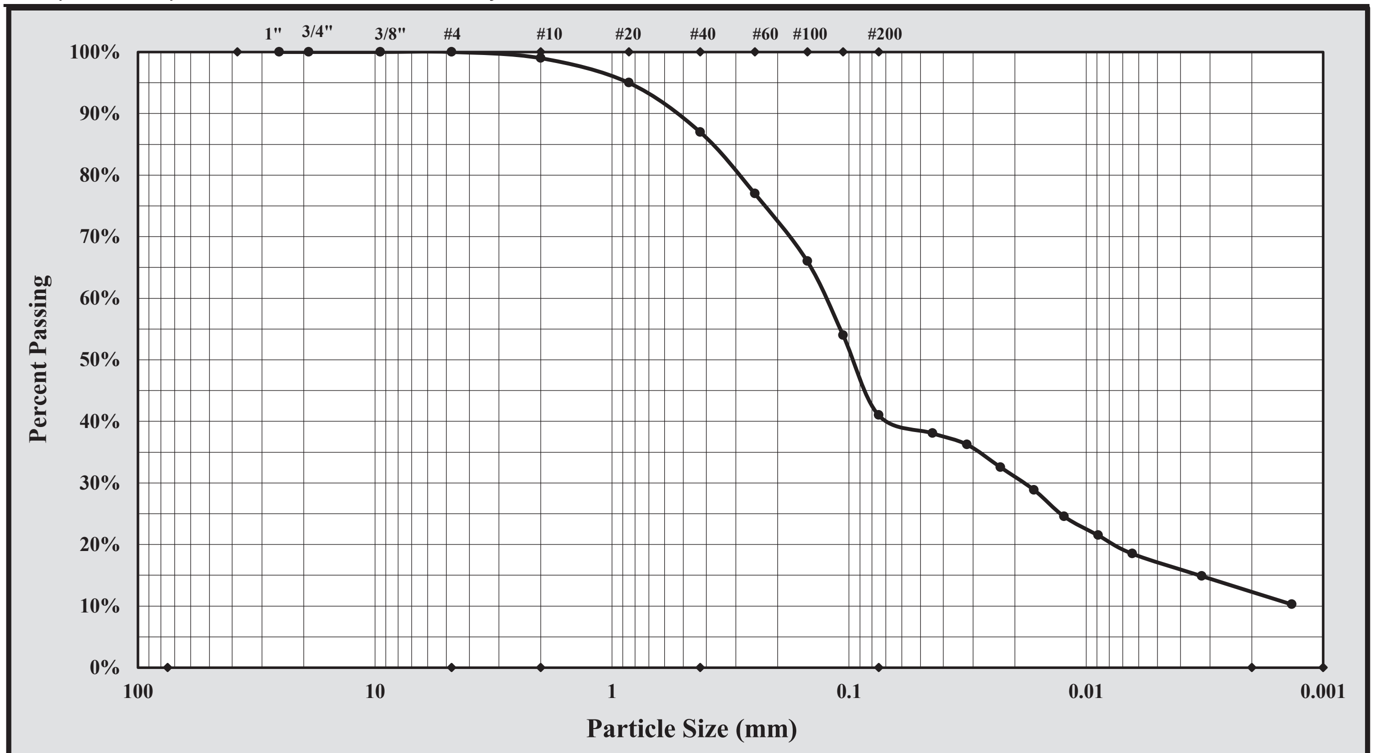
BCT5-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/12/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/7/24-3/1/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0051-04 Type: REG	Sample Date:	2/1/2024
		Depth:	NP

Sample Description: Brown Silty Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	0%	Medium Sand:	12%
Silt & Clay (% Passing #200):	41%	Total Sand:	59%	Fine Sand:	46%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	10.3%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/12/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

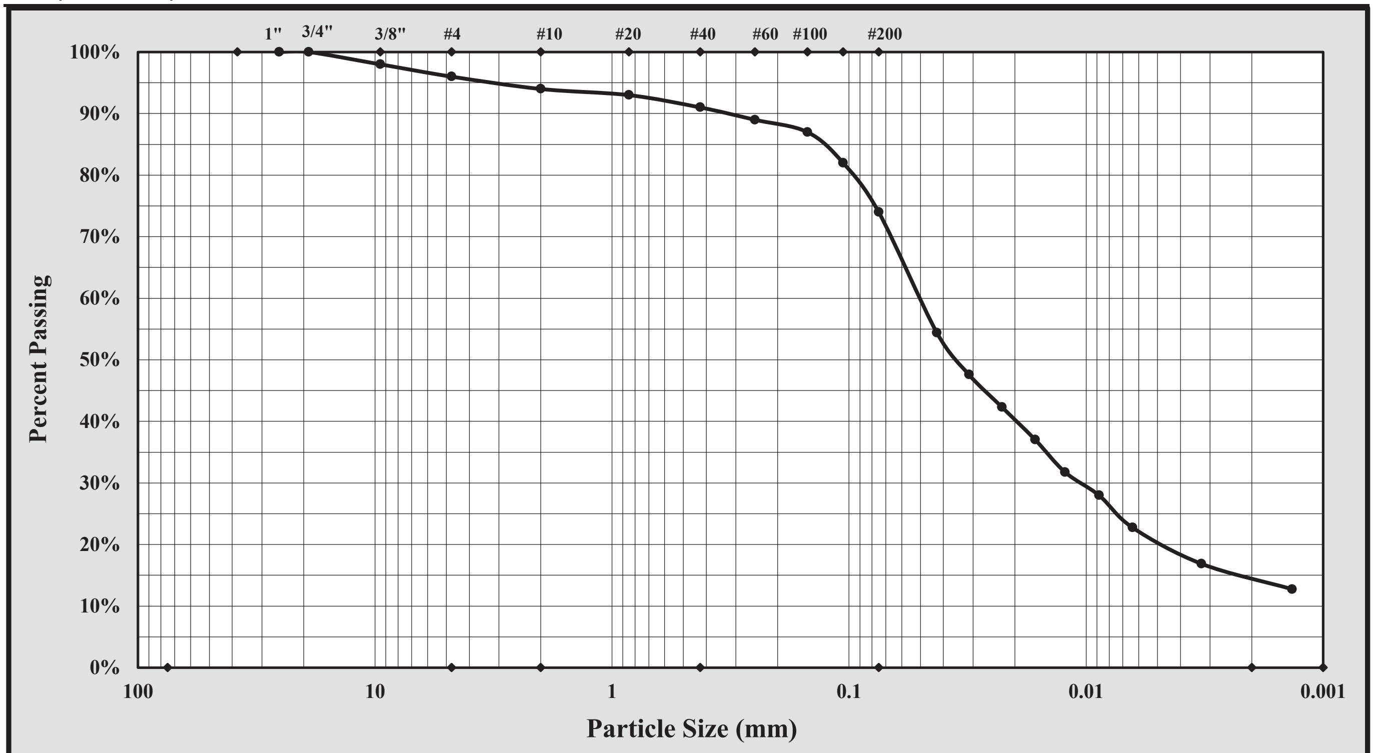
BCT6-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/15/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/10/24-3/13/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0055-04 Type: REG	Sample Date:	2/1/2024
		Depth:	NP

Sample Description: Brown Silt with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	4%	Medium Sand:	3%
Silt & Clay (% Passing #200):	74%	Total Sand:	22%	Fine Sand:	17%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	12.8%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/15/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

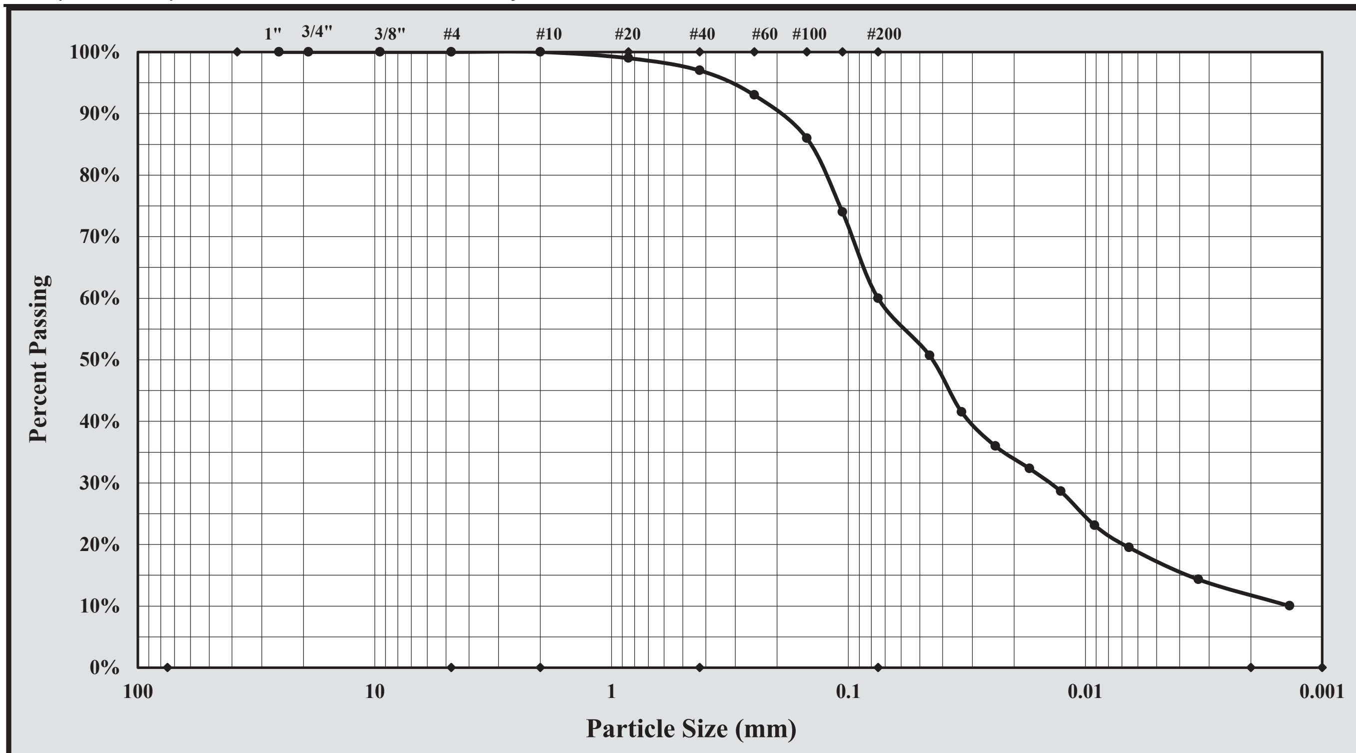
BCT7-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/15/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/10/24-3/13/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0059-04 Type: REG	Sample Date:	2/7/2024
		Depth:	NP

Sample Description: Brown Sandy Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	0%	Medium Sand:	3%
Silt & Clay (% Passing #200):	60%	Total Sand:	40%	Fine Sand:	37%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	10.0%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/15/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

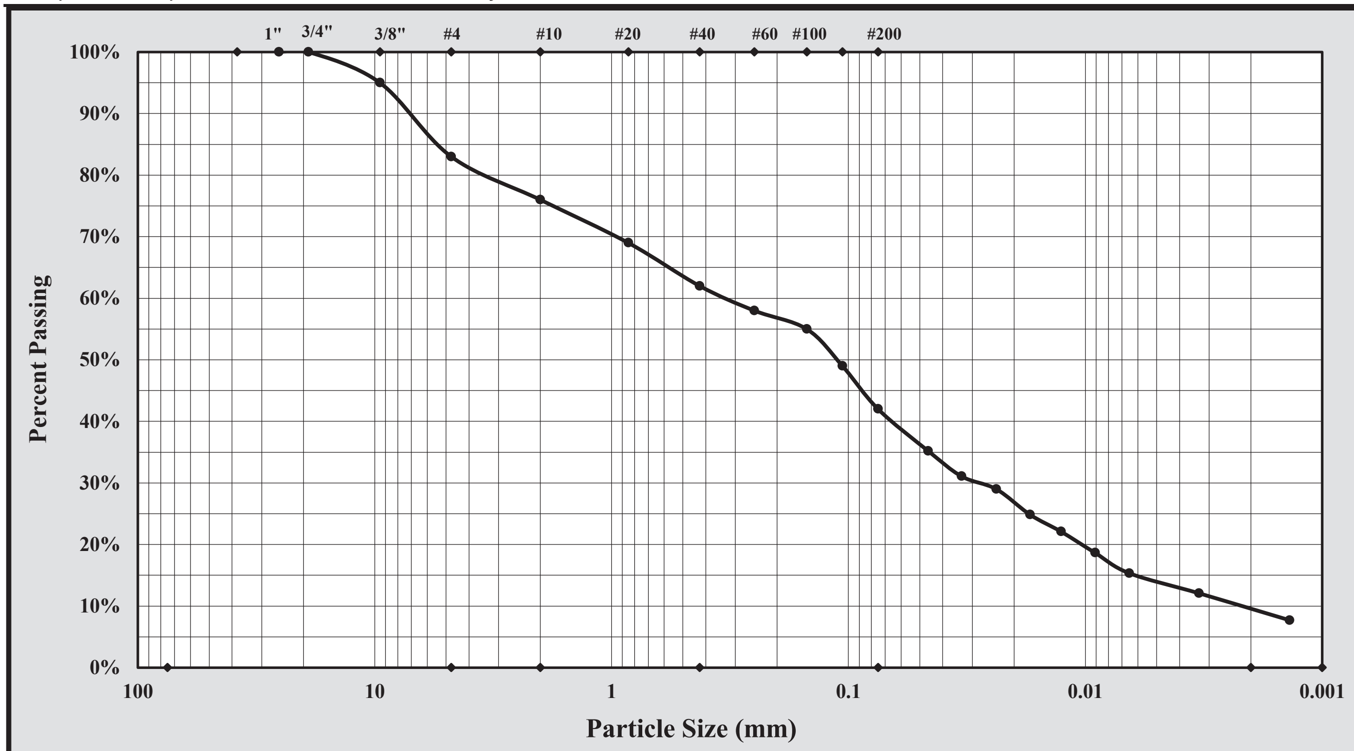
BCT8-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/18/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/12/24-3/14/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0081-04 Type: REG	Sample Date:	2/5/2024
		Depth:	NP

Sample Description: Brown Silty Sand with Gravel



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	17%	Medium Sand:	14%
Silt & Clay (% Passing #200):	42%	Total Sand:	41%	Fine Sand:	20%
Assumed Specific Gravity:	2.65	Coarse Sand:	7%	Clay:	7.7%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	*[signature]*	Lab Services Manager	3/18/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

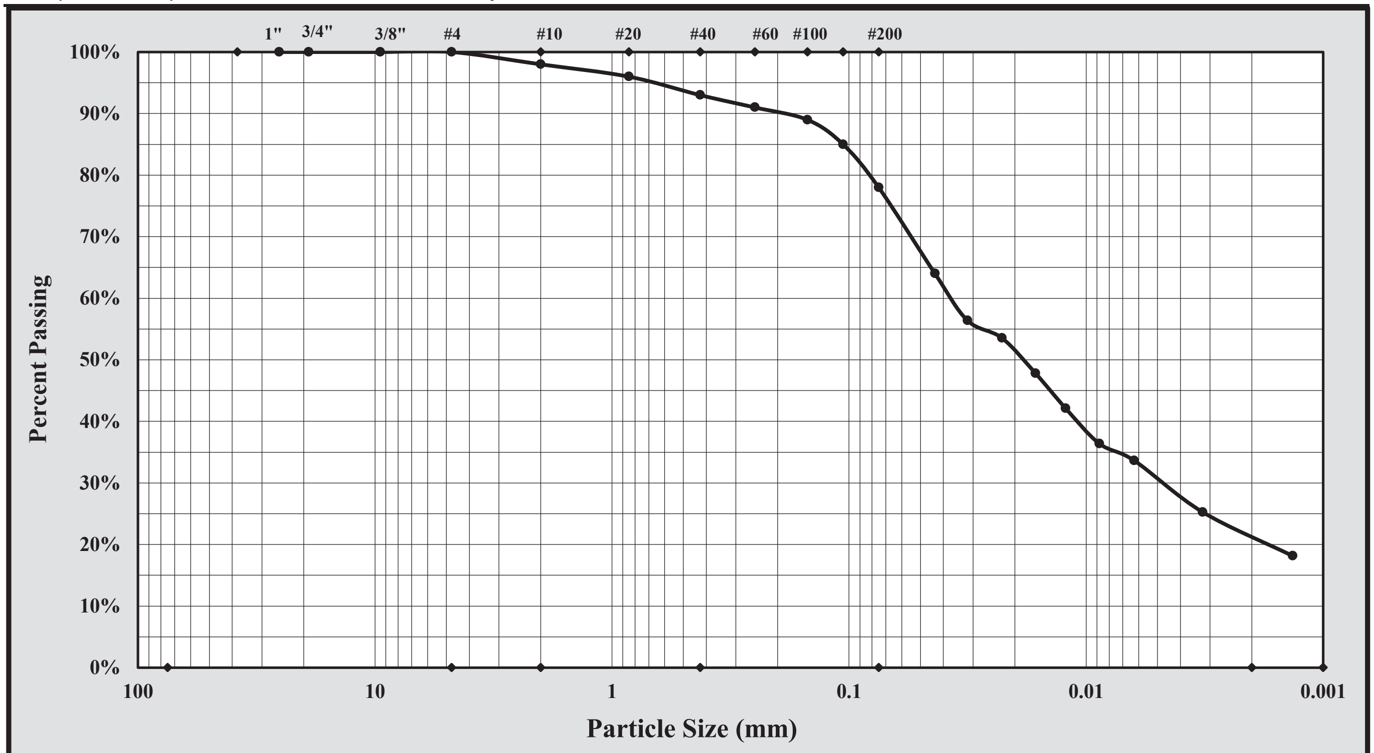
BCT9-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/14/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/10/24-3/13/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0070-04 Type: REG	Sample Date:	2/5/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8"	Gravel:	0%	Medium Sand:	5%
Silt & Clay (% Passing #200):	78%	Total Sand:	22%	Fine Sand:	15%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	18.1%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/14/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

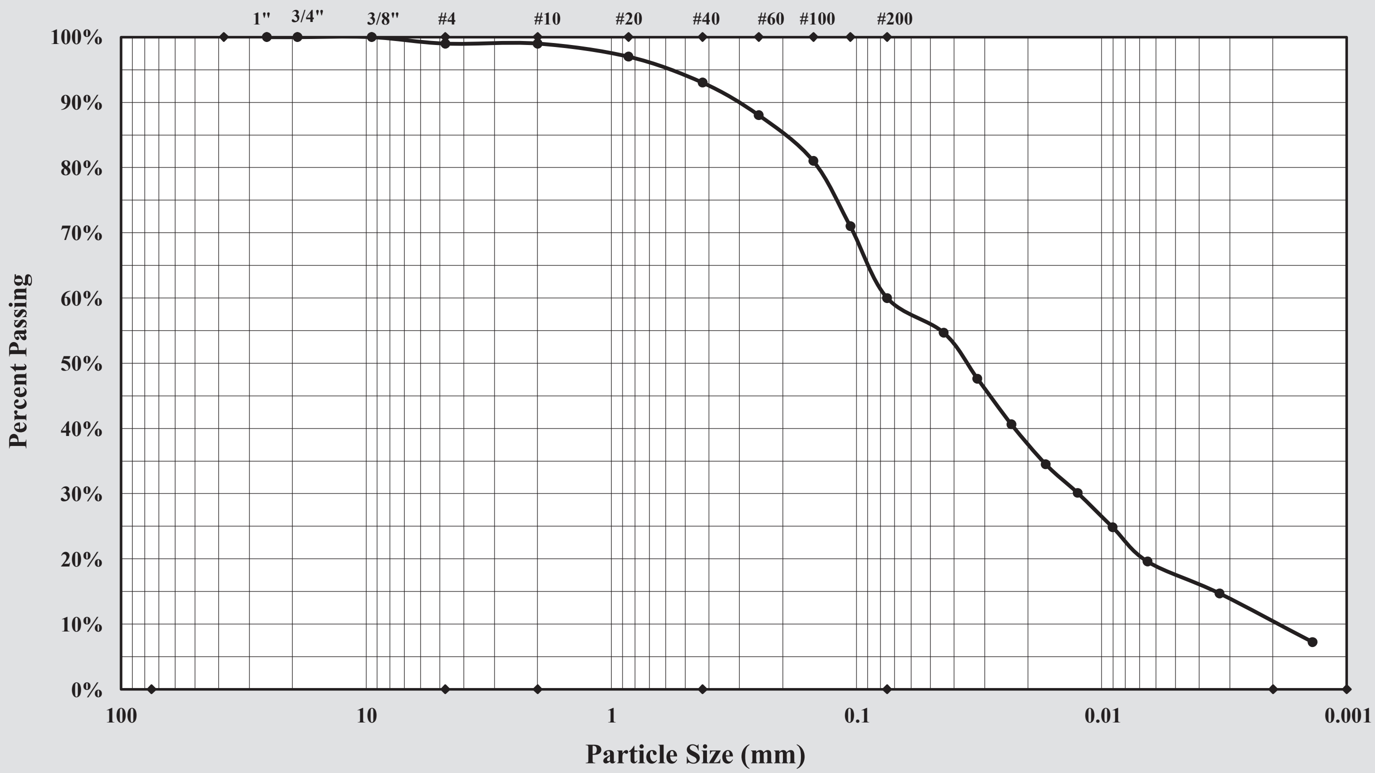
BCT10-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/17/24-2/20/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0074-03 Type: REG	Sample Date:	1/11/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	1%	Medium Sand:	6%
Silt & Clay (% Passing #200):	60%	Total Sand:	39%	Fine Sand:	33%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	7.2%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

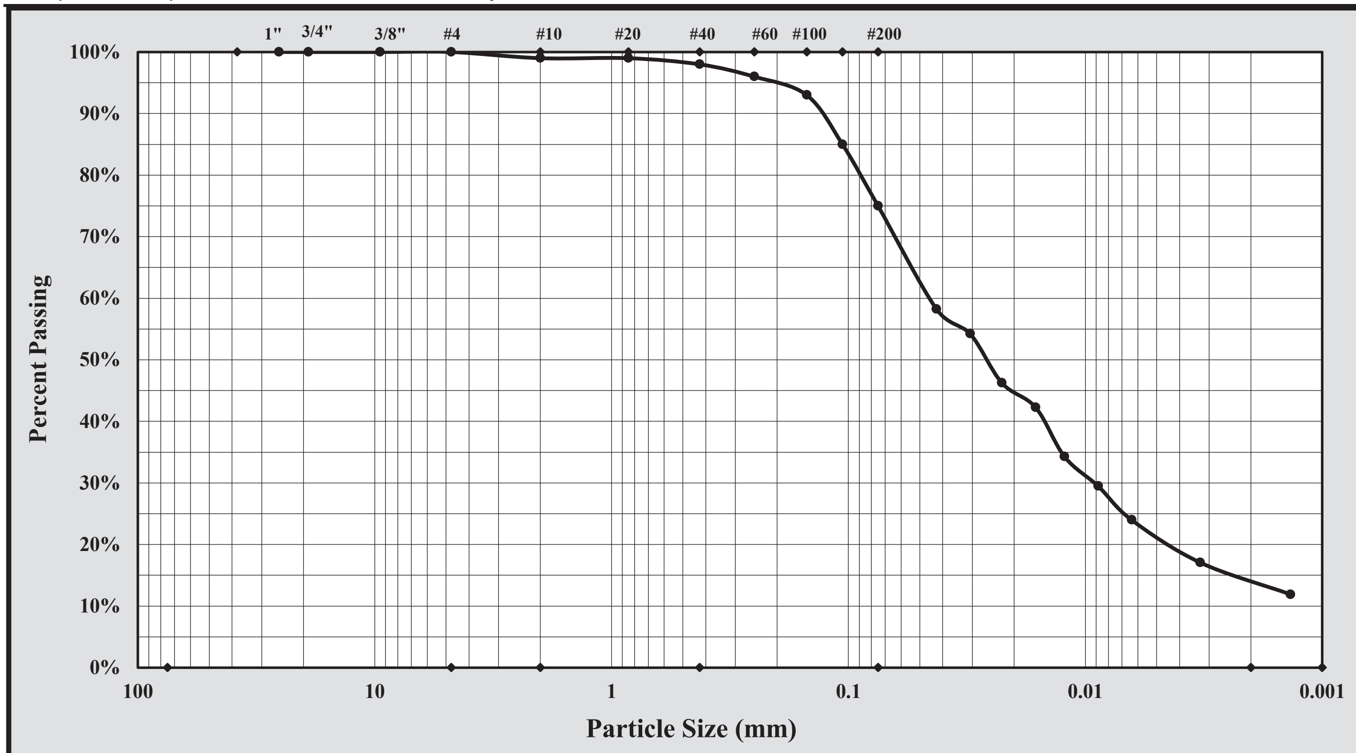
BCT11-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/18/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/12/24-3/14/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0077-04 Type: REG	Sample Date:	1/31/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	0%	Medium Sand:	1%
Silt & Clay (% Passing #200):	75%	Total Sand:	25%	Fine Sand:	23%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	11.9%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman		Lab Services Manager	3/18/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

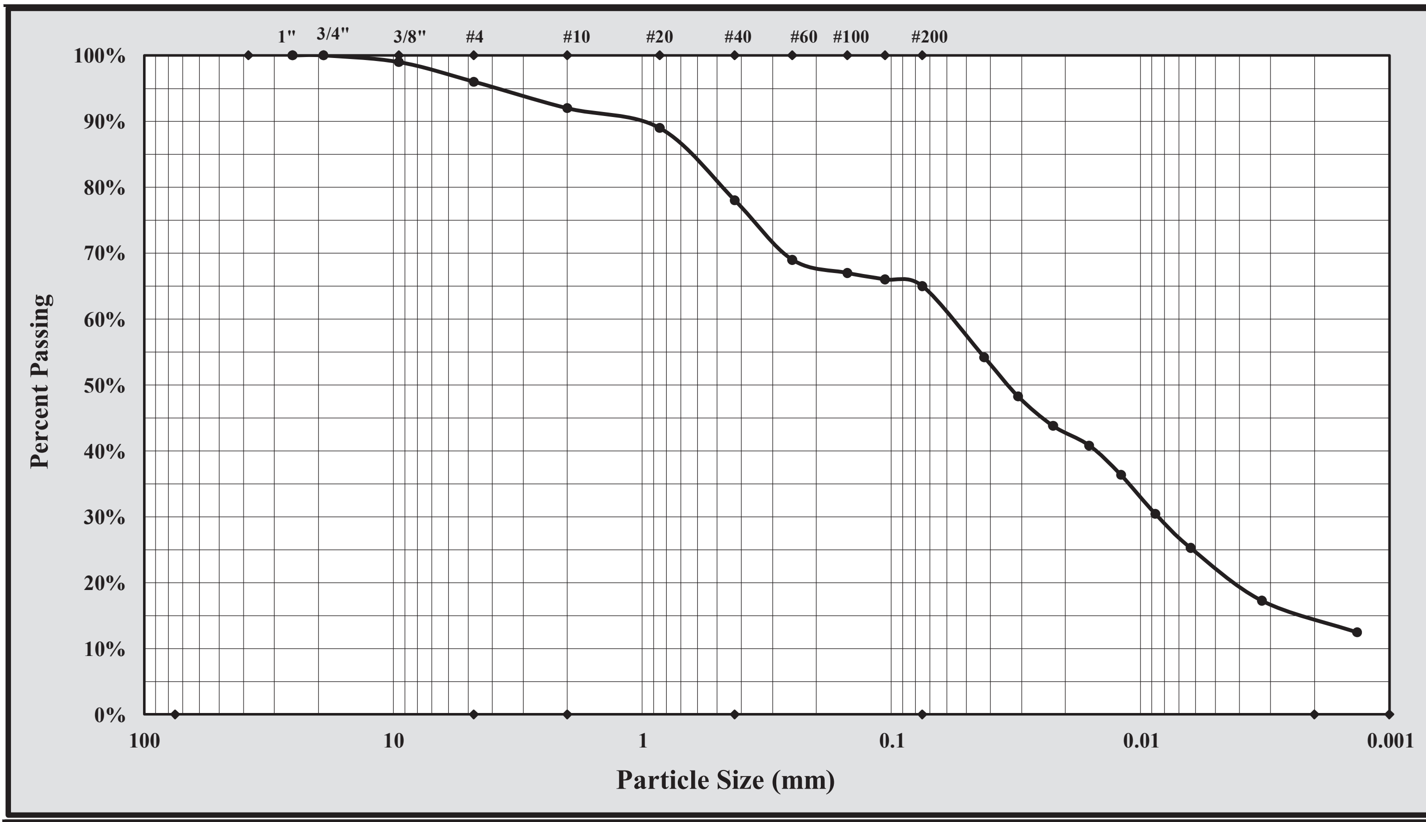
BCT12B-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	1/0/1900
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0065-04 Type: REG	Sample Date:	1/10/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	4%	Medium Sand:	14%
Silt & Clay (% Passing #200):	65%	Total Sand:	31%	Fine Sand:	13%
Assumed Specific Gravity:	2.65	Coarse Sand:	4%	Clay:	12.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

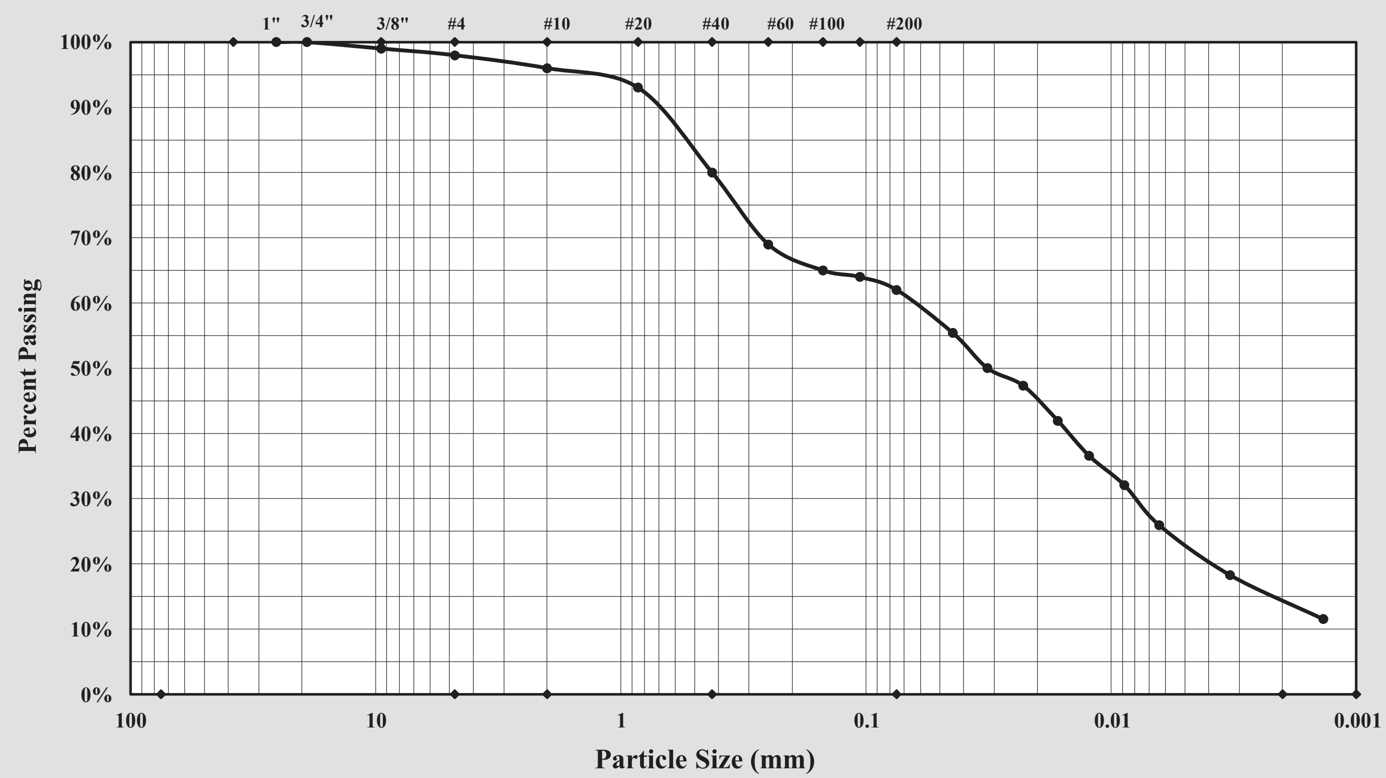
BCT12B-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0066-03 Type: REG	Sample Date:	1/11/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	2%	Medium Sand:	16%
Silt & Clay (% Passing #200):	62%	Total Sand:	36%	Fine Sand:	18%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	11.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

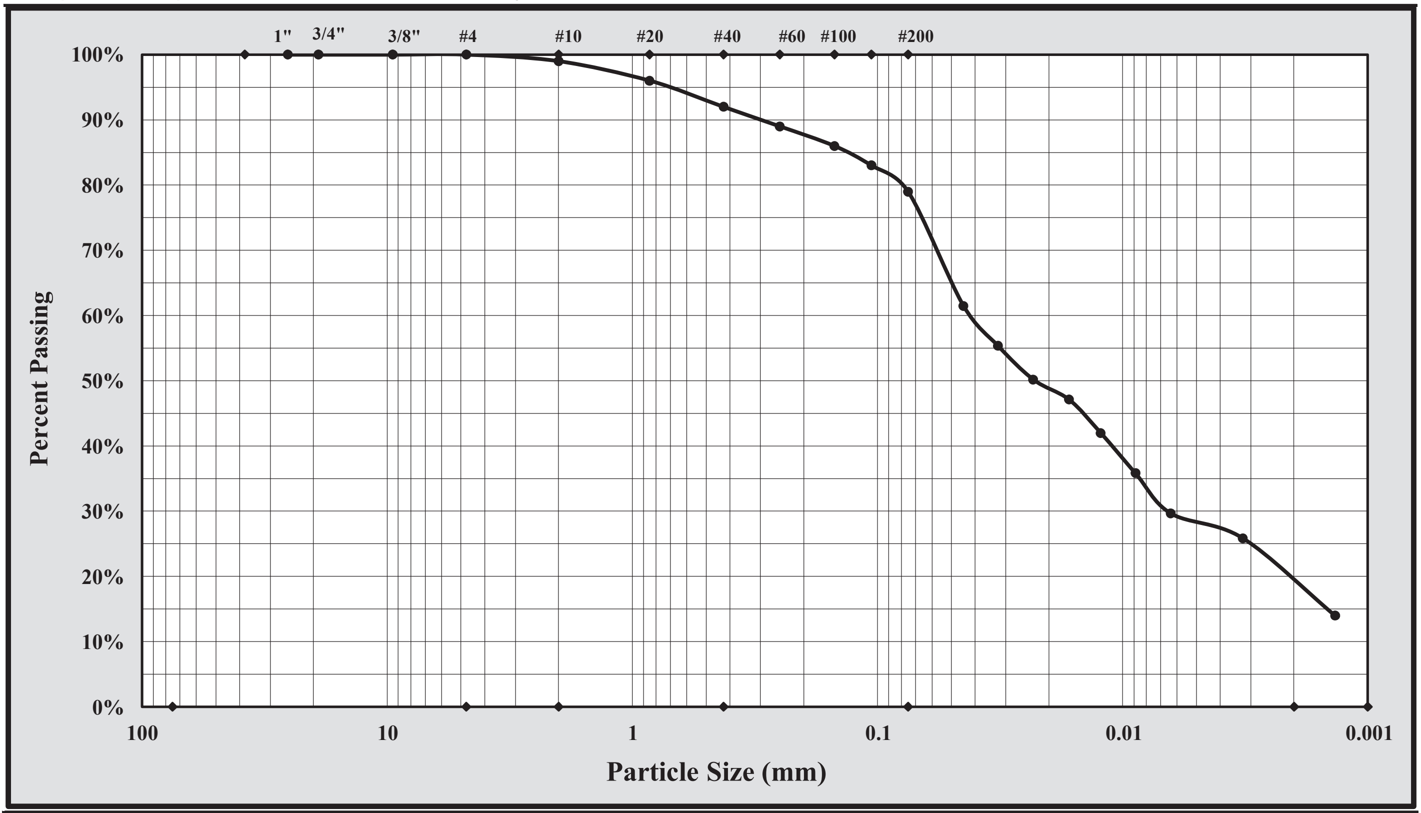
BCT12A-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/22/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/20/24-2/22/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0106-03 Type: REG	Sample Date:	1/10/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	0%	Medium Sand:	7%
Silt & Clay (% Passing #200):	79%	Total Sand:	21%	Fine Sand:	13%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	14.0%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/22/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
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Log No.: 43-4016

Particle-Size Distribution

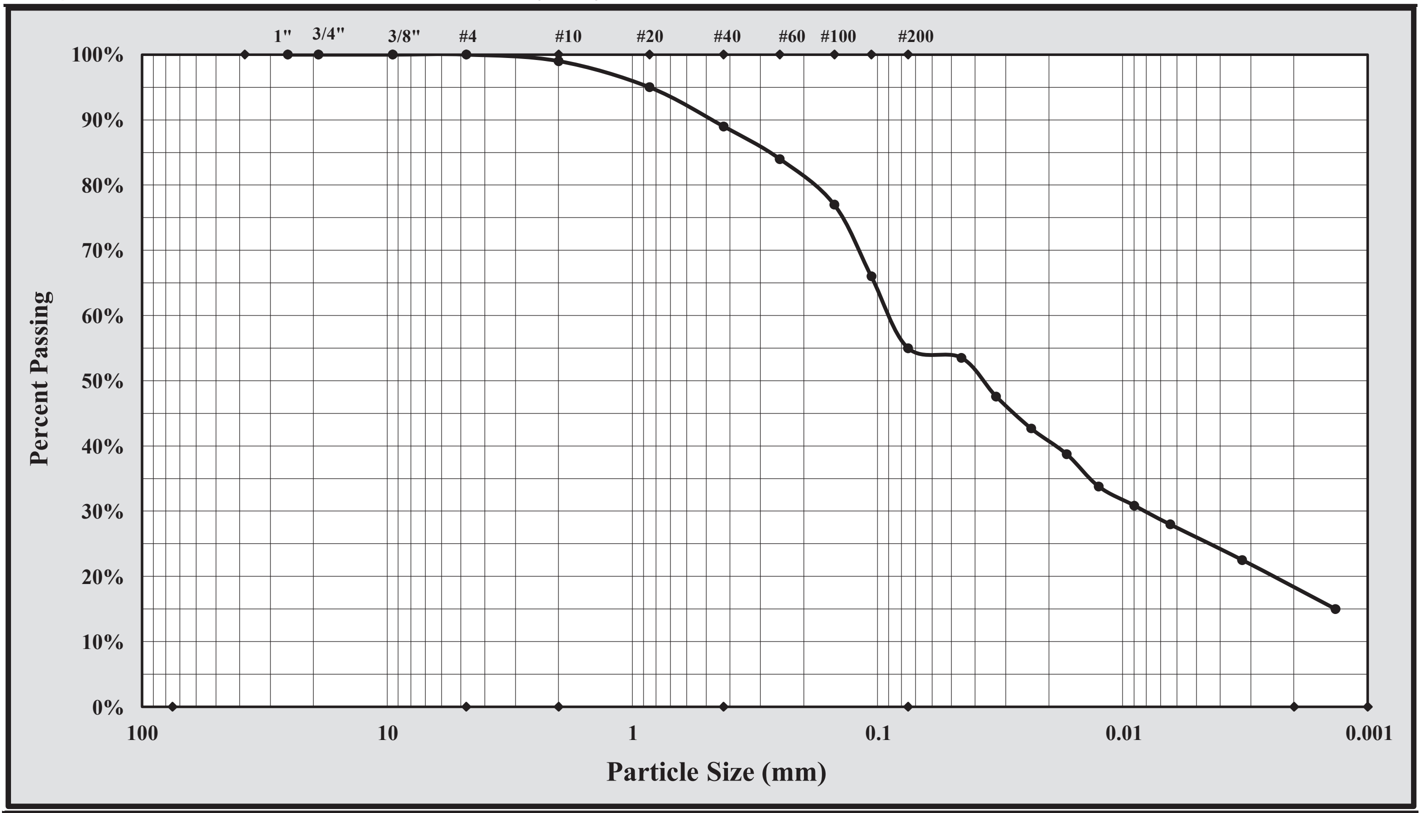
BCT13-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/17/24-2/20/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0085-03 Type: REG	Sample Date:	1/11/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	10%
Silt & Clay (% Passing #200):	55%	Total Sand:	45%	Fine Sand:	34%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	15.0%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

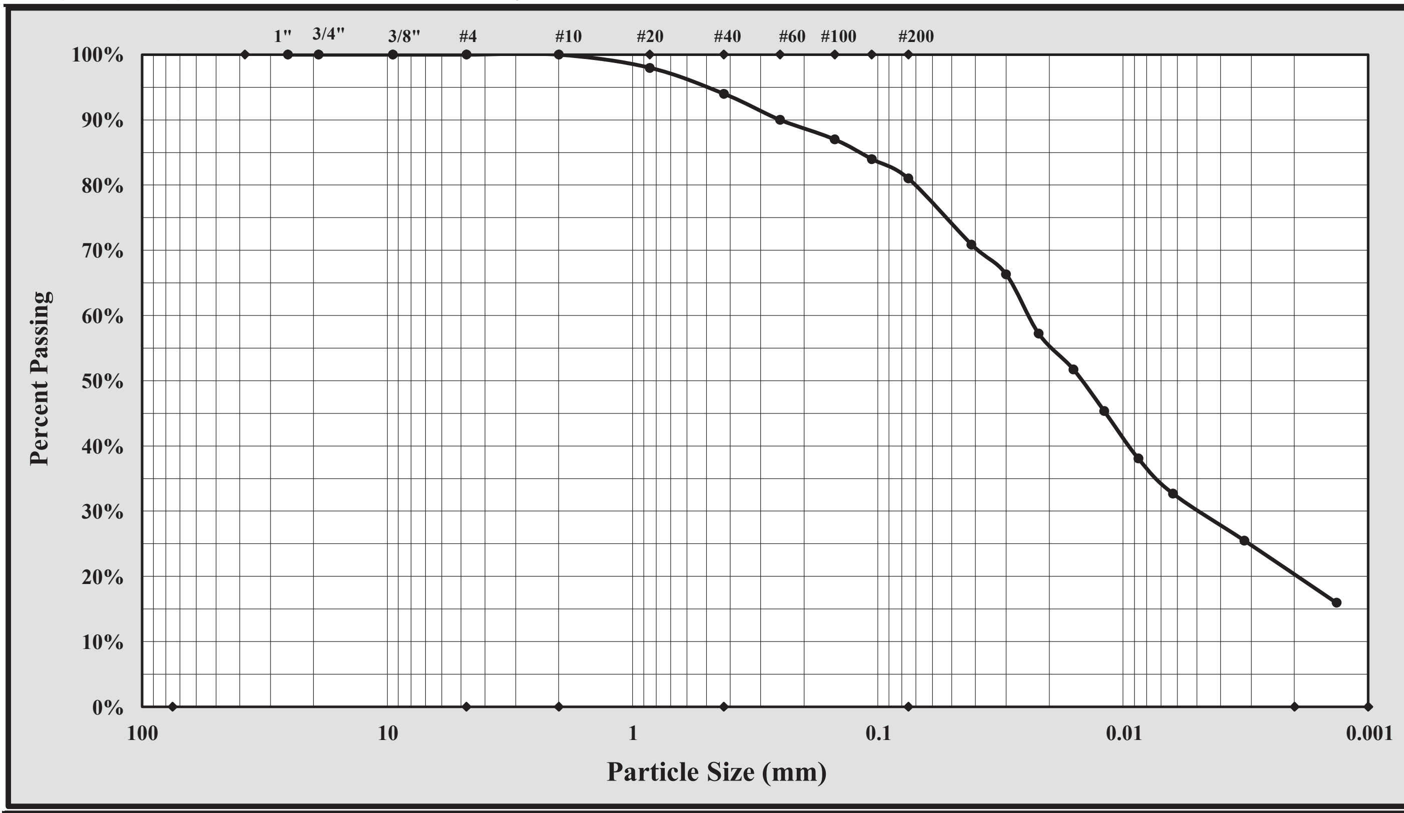
BCT14-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/22/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/20/24-2/22/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0090-04 Type: REG	Sample Date:	12/28/2023
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	6%
Silt & Clay (% Passing #200):	81%	Total Sand:	19%	Fine Sand:	13%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	16.0%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/22/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

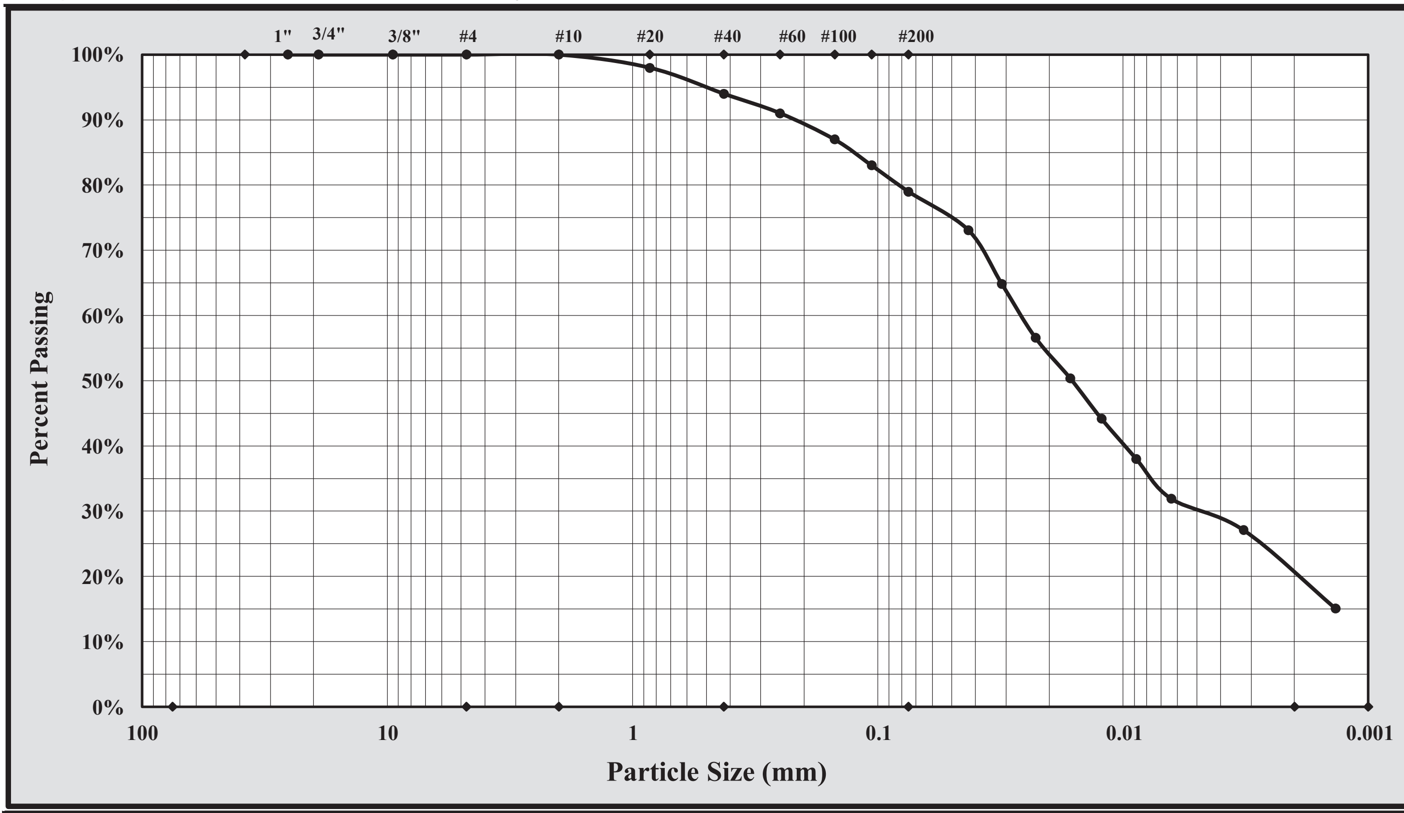
BCT14-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/22/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/20/24-2/22/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0091-03 Type: REG	Sample Date:	12/28/2023
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	6%
Silt & Clay (% Passing #200):	79%	Total Sand:	21%	Fine Sand:	15%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	15.1%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/22/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
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Particle-Size Distribution

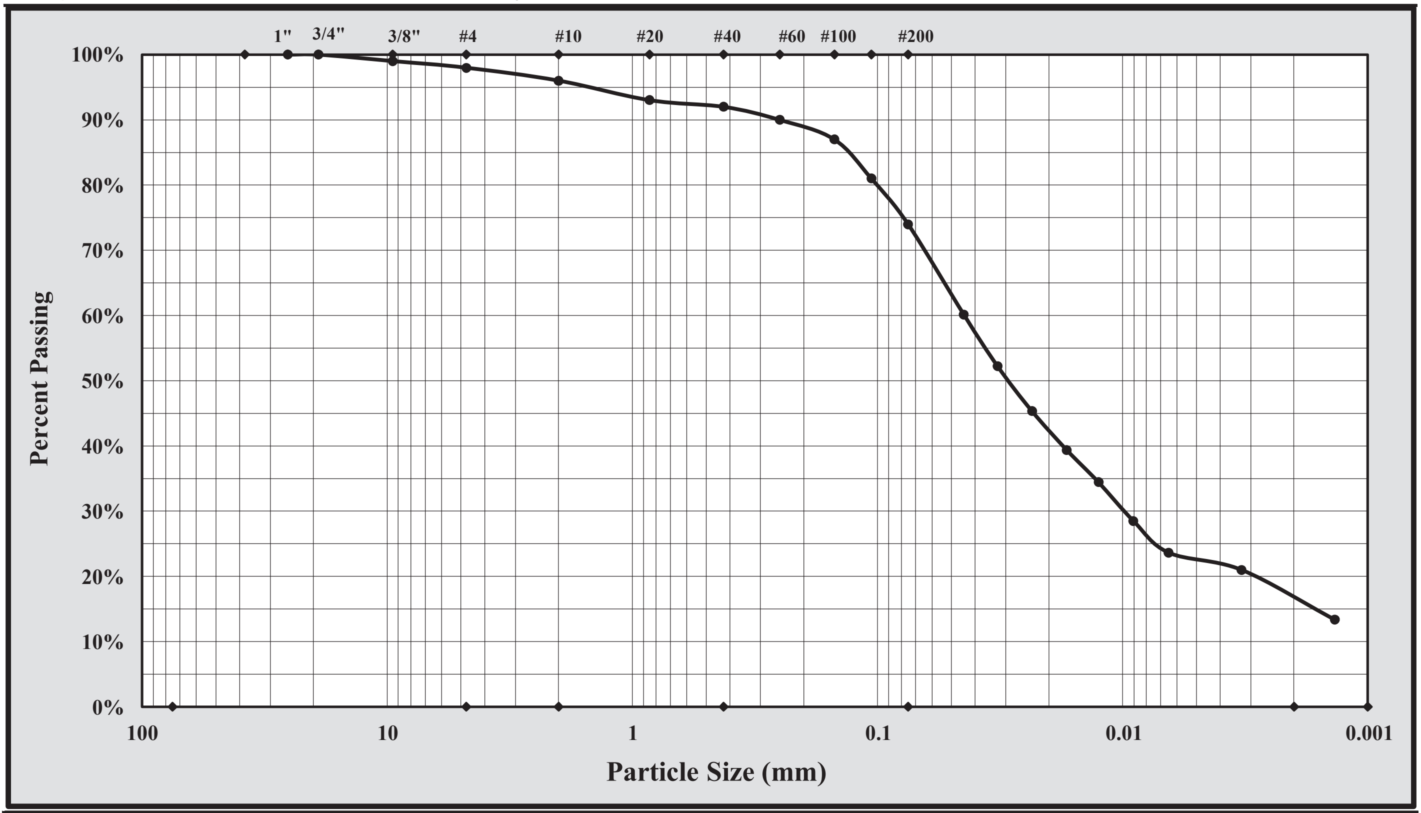
BCT15-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/22/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/20/24-2/22/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0095-03 Type: REG	Sample Date:	1/3/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	2%	Medium Sand:	4%
Silt & Clay (% Passing #200):	74%	Total Sand:	24%	Fine Sand:	18%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	13.4%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/22/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
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Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

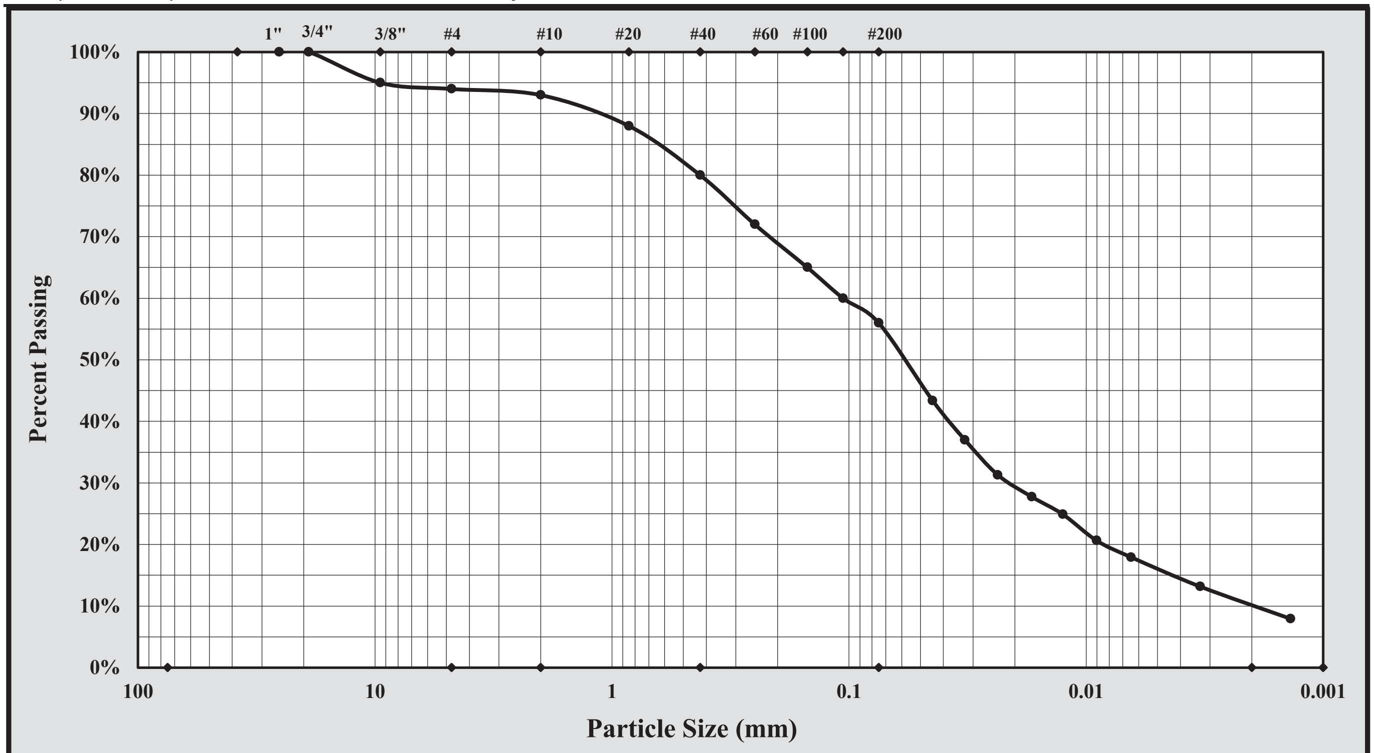
HCTREF-FP

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/18/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/12/24-3/14/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0098-04 Type: REG	Sample Date:	2/2/2024
		Depth:	NP

Sample Description: Brown Sandy Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4"	Gravel:	6%	Medium Sand:	13%
Silt & Clay (% Passing #200):	56%	Total Sand:	38%	Fine Sand:	24%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	7.9%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/18/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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Particle-Size Distribution

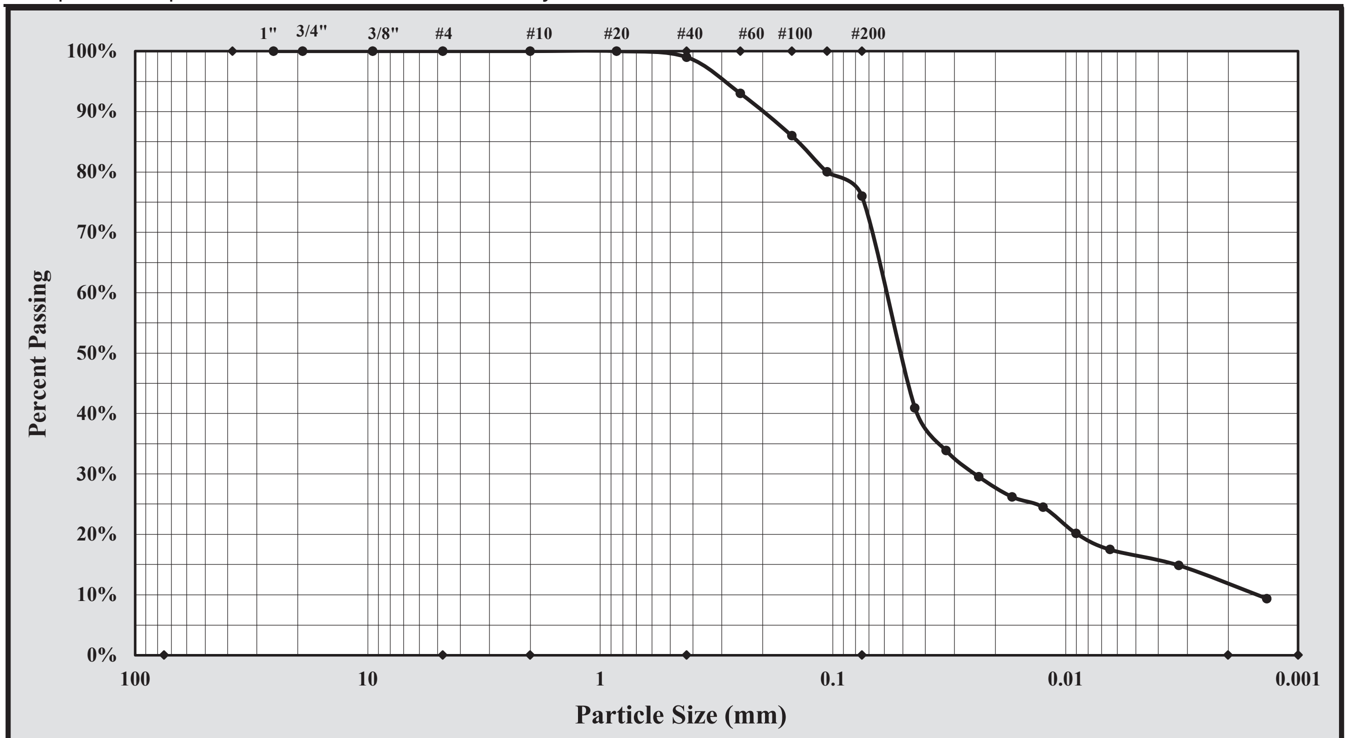
BCT1-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/23/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0038-03 Type: REG	Sample Date:	1/4/2024
		Depth:	NP

Sample Description: Dark Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#20	Gravel:	0%	Medium Sand:	1%
Silt & Clay (% Passing #200):	76%	Total Sand:	24%	Fine Sand:	23%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	9.4%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Victoria Igoe	*Victoria Igoe*	Senior Engineering Technician	2/23/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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Particle-Size Distribution

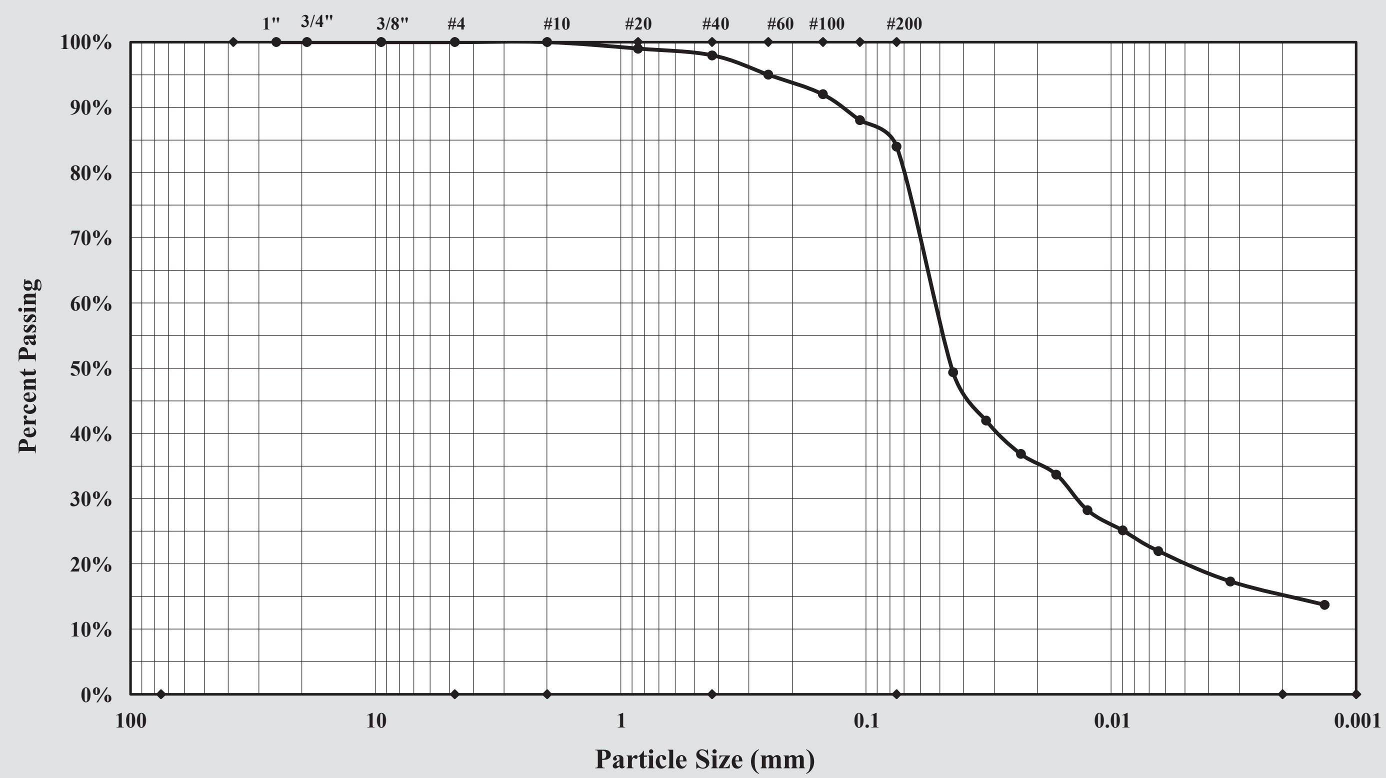
BCT2-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/16/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0041-03 Type: REG	Sample Date:	1/4/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	2%
Silt & Clay (% Passing #200):	84%	Total Sand:	16%	Fine Sand:	14%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	13.7%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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Particle-Size Distribution

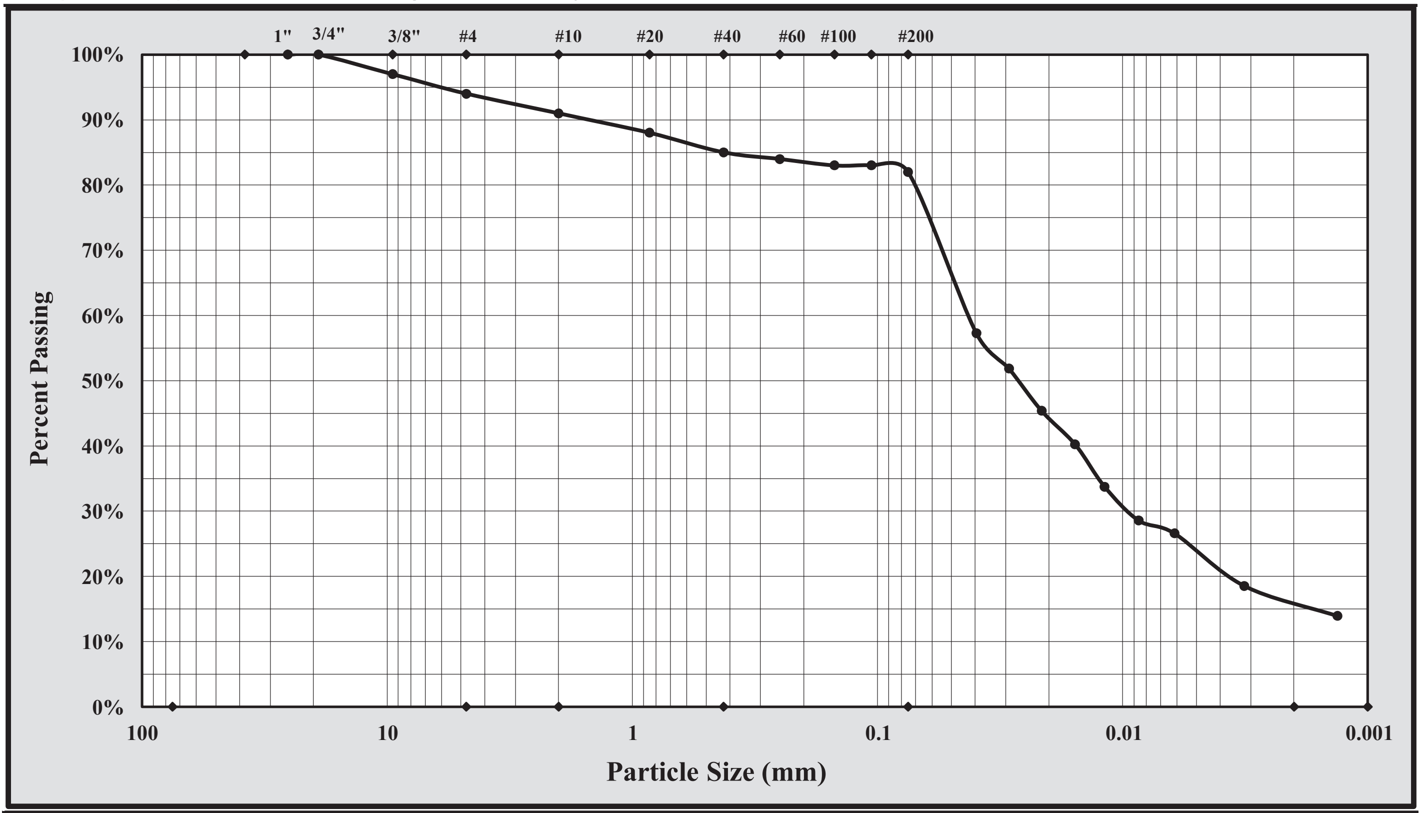
BCT3-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/19/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/7/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0044-03 Type: REG	Sample Date:	1/8/2024
		Depth:	NP

Sample Description: Light Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8"	Gravel:	6%	Medium Sand:	6%
Silt & Clay (% Passing #200):	82%	Total Sand:	12%	Fine Sand:	3%
Assumed Specific Gravity:	2.65	Coarse Sand:	3%	Clay:	13.9%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
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Log No.: 43-4016

Particle-Size Distribution

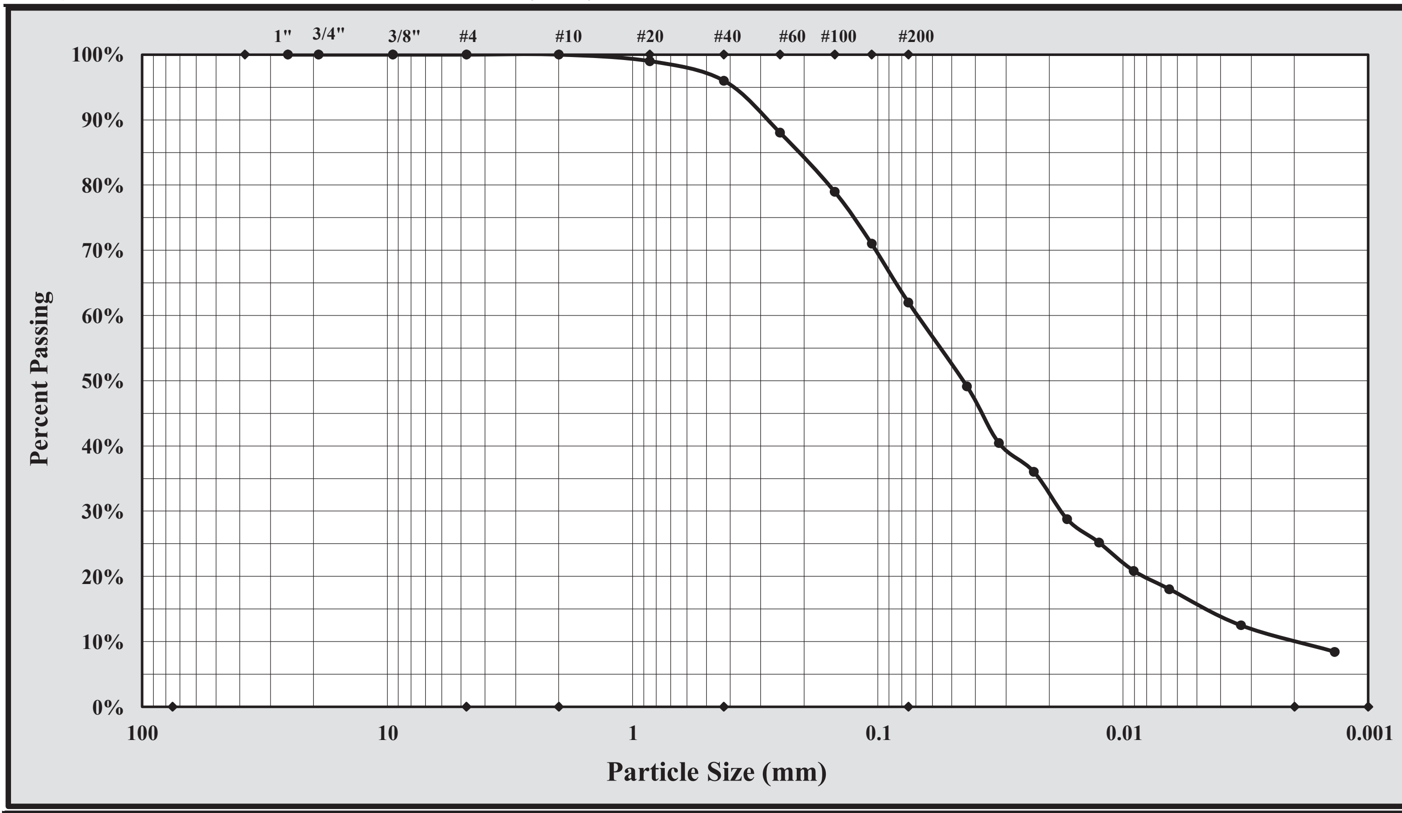
BCT4-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	1/0/1900
Project Name:	UCOR-Geotech	Test Start Date:	2/7/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0047-03 Type: REG	Sample Date:	1/8/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	4%
Silt & Clay (% Passing #200):	62%	Total Sand:	38%	Fine Sand:	34%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	8.4%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

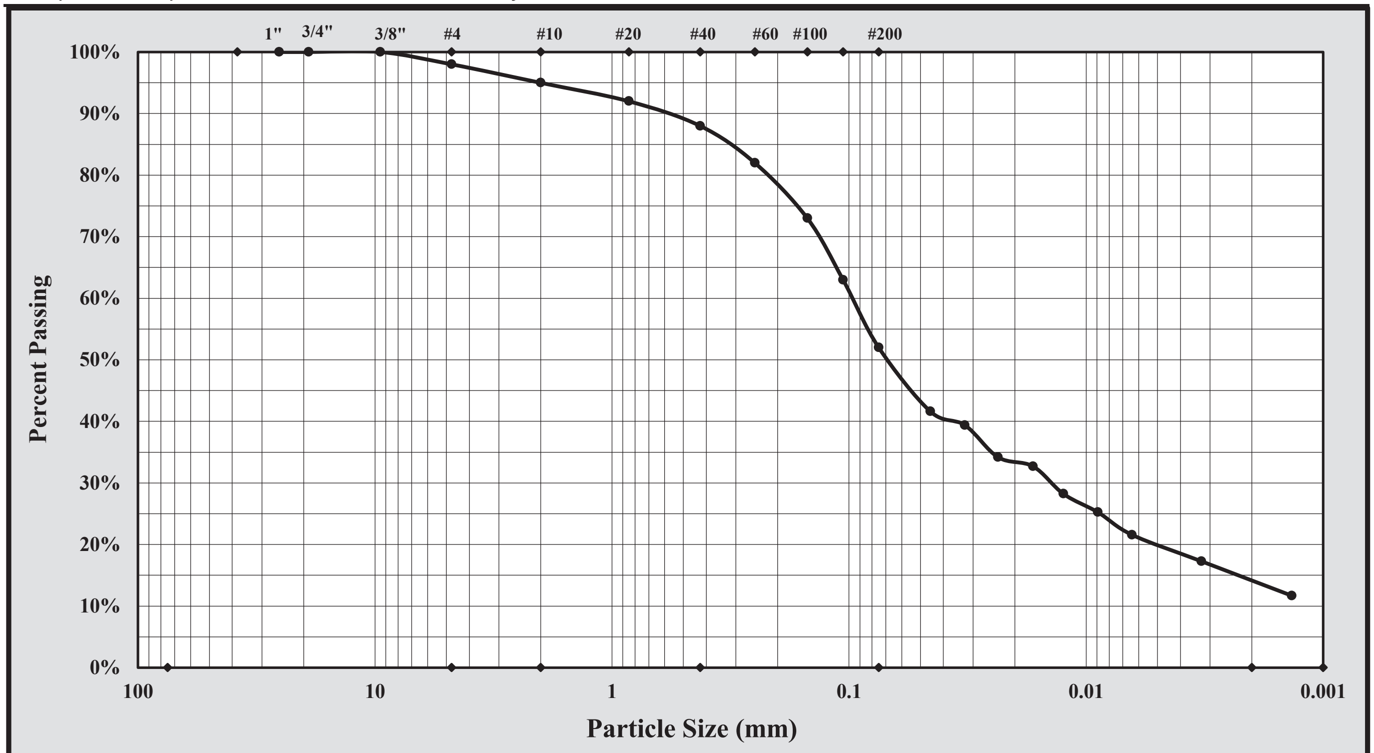
BCT5-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/12/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/7/24-3/11/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0050-03 Type: REG	Sample Date:	2/1/2024
		Depth:	NP

Sample Description: Brown Sandy Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	2%	Medium Sand:	7%
Silt & Clay (% Passing #200):	52%	Total Sand:	46%	Fine Sand:	36%
Assumed Specific Gravity:	2.65	Coarse Sand:	3%	Clay:	11.7%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/12/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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Particle-Size Distribution

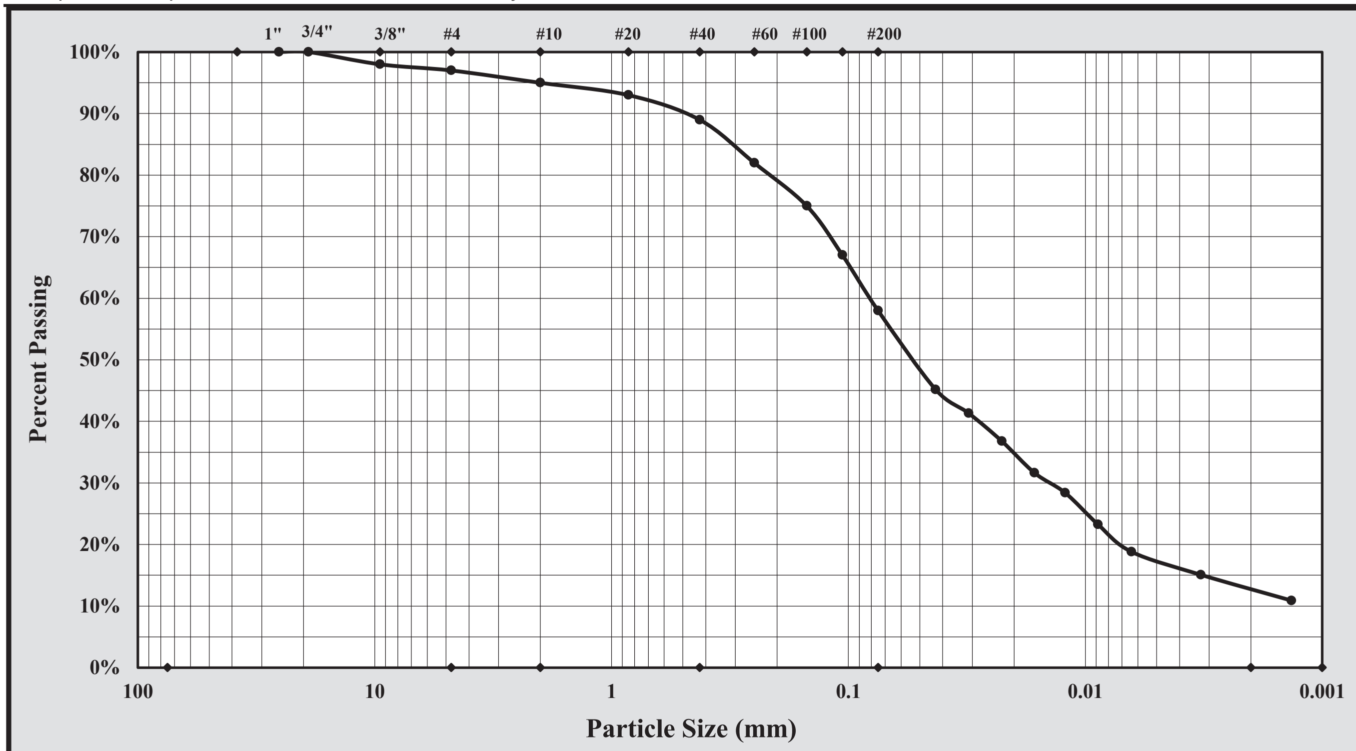
BCT6-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/14/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/10/24-3/13/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0054-03 Type: REG	Sample Date:	2/1/2024
		Depth:	NP

Sample Description: Brown Sandy Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	3%	Medium Sand:	6%
Silt & Clay (% Passing #200):	58%	Total Sand:	39%	Fine Sand:	31%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	10.9%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/14/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
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Particle-Size Distribution

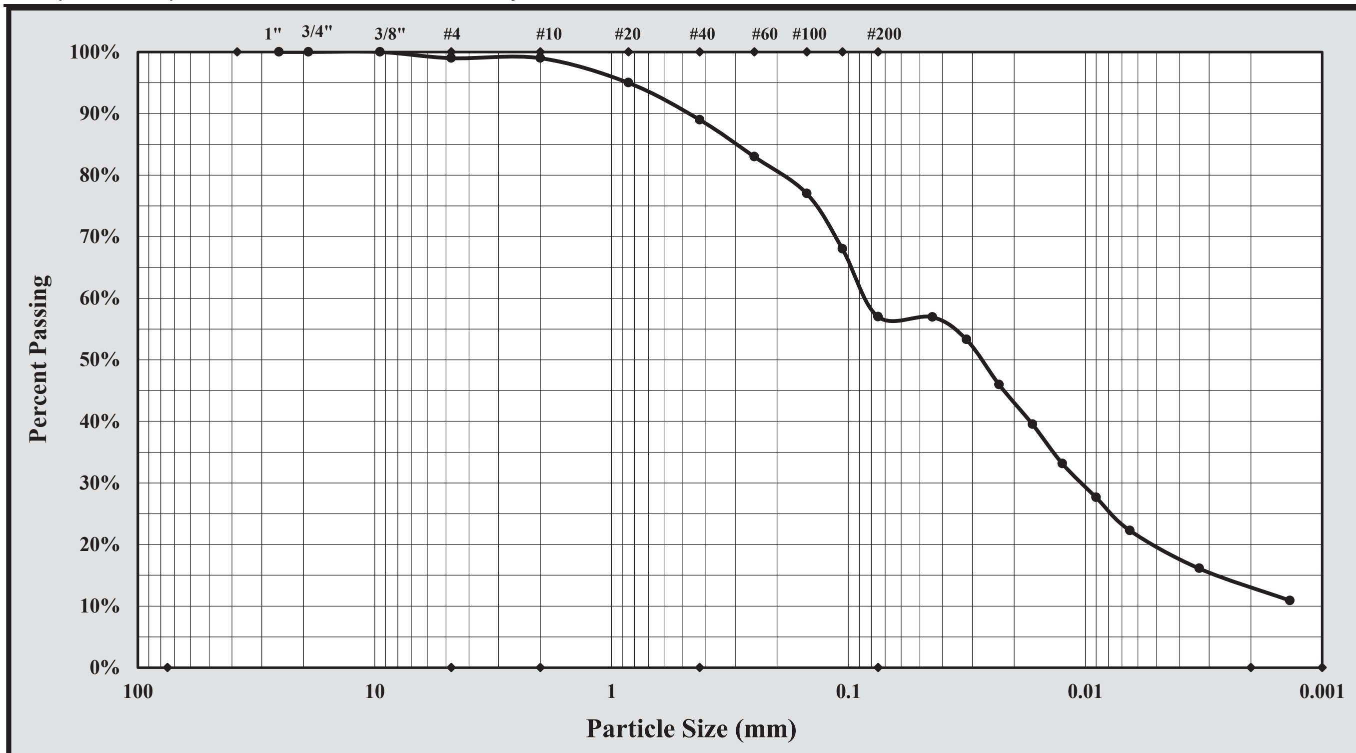
BCT7-BS

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/14/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/10/24-3/13/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0057-03 Type: REG	Sample Date:	2/7/2024
		Depth:	NP

Sample Description: Brown Sandy Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4"	Gravel:	1%	Medium Sand:	10%
Silt & Clay (% Passing #200):	57%	Total Sand:	42%	Fine Sand:	32%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	10.9%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/14/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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Particle-Size Distribution

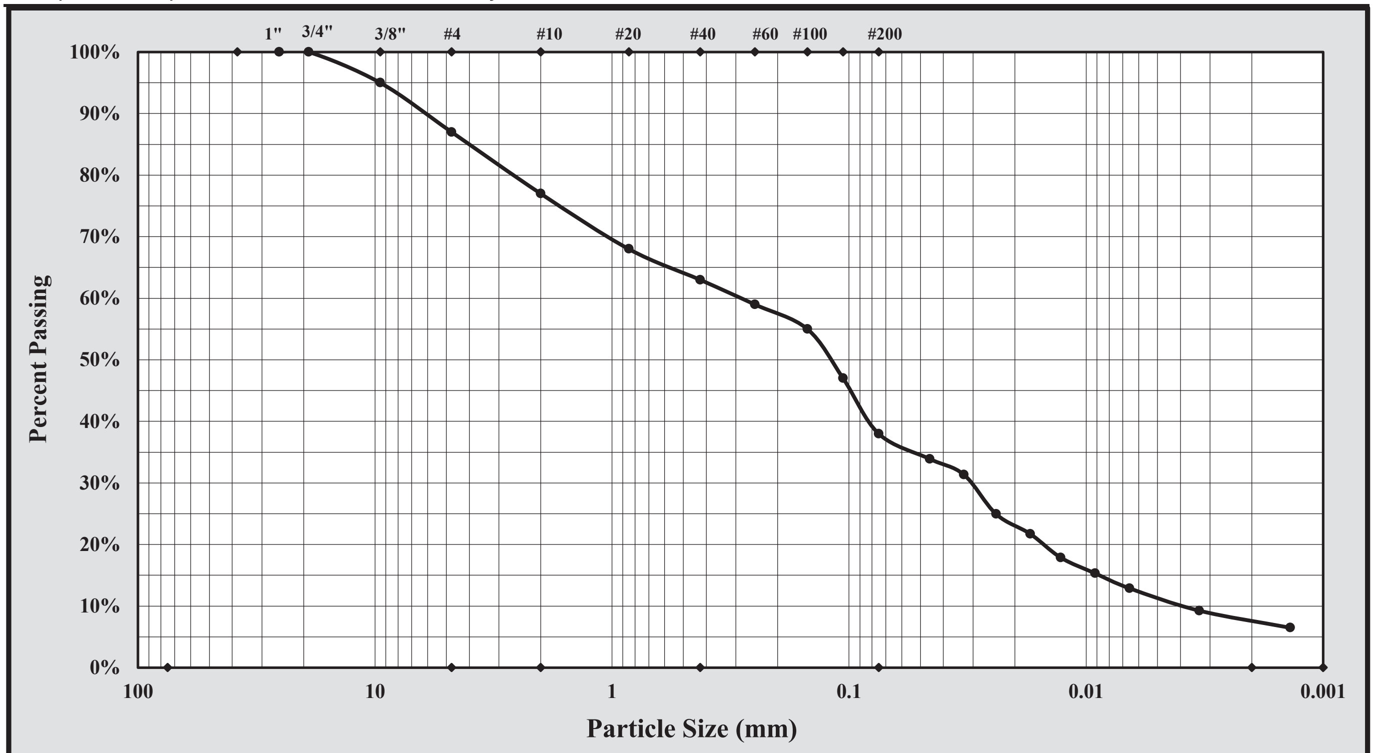
BCT8-BS

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142			Report Date:	3/18/2024
Project Name:	UCOR-Geotech			Test Start Date:	3/12/24-3/14/24
Client Name:	RSI EnTech, LLC				
Address:	203 Victorious Blvd., Oak Ridge, TN 37830				
Sample ID:	BCR0079-03	Type:	REG	Sample Date:	2/5/2024
				Depth:	NP

Sample Description: Brown Silty Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4"	Gravel:	13%	Medium Sand:	14%
Silt & Clay (% Passing #200):	38%	Total Sand:	49%	Fine Sand:	25%
Assumed Specific Gravity:	2.65	Coarse Sand:	10%	Clay:	6.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/18/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
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Particle-Size Distribution

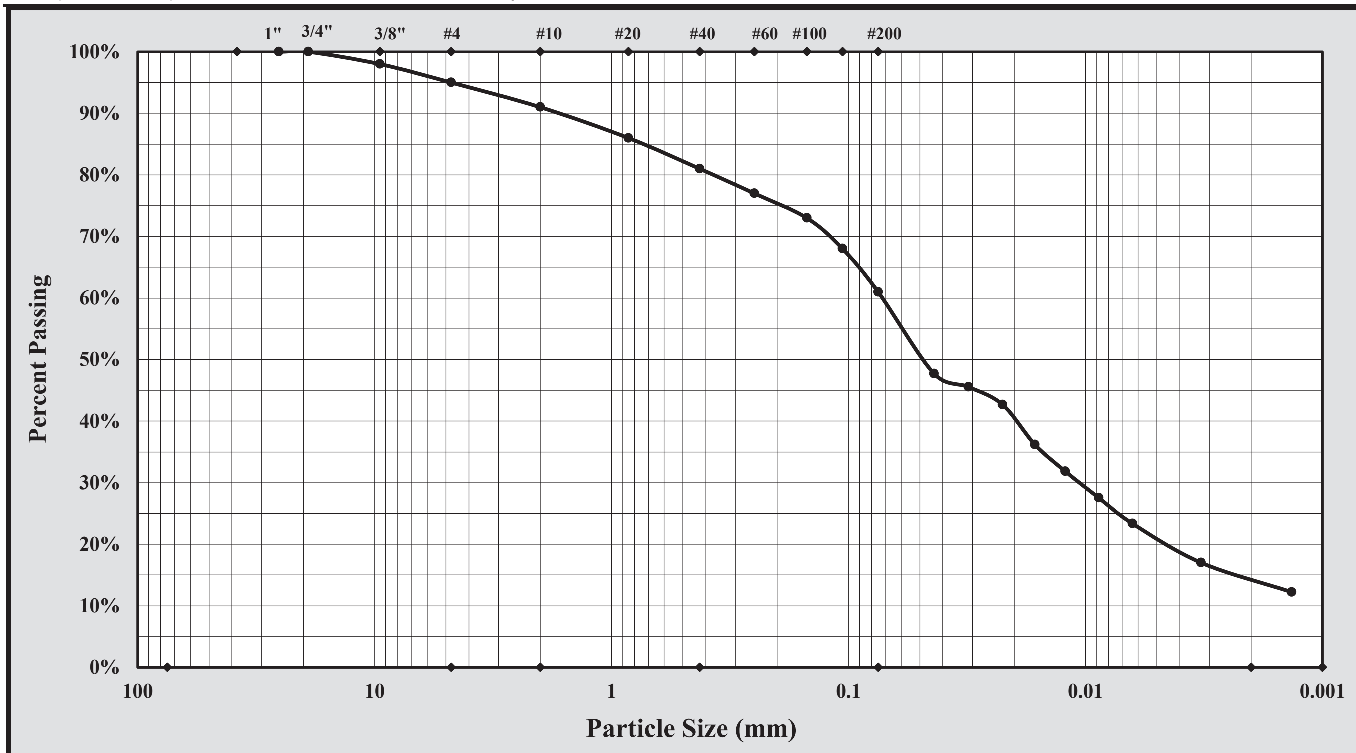
BCT9-BS

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/15/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/10/24-3/13/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0068-03 Type: REG	Sample Date:	2/5/2024
		Depth:	NP

Sample Description: Brown Sandy Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	5%	Medium Sand:	10%
Silt & Clay (% Passing #200):	61%	Total Sand:	34%	Fine Sand:	20%
Assumed Specific Gravity:	2.65	Coarse Sand:	4%	Clay:	12.2%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/15/2024
Technical Responsibility	*Signature*	*Position*	*Date*

This report shall not be reproduced, except in full, without the written approval of S&ME, Inc.

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

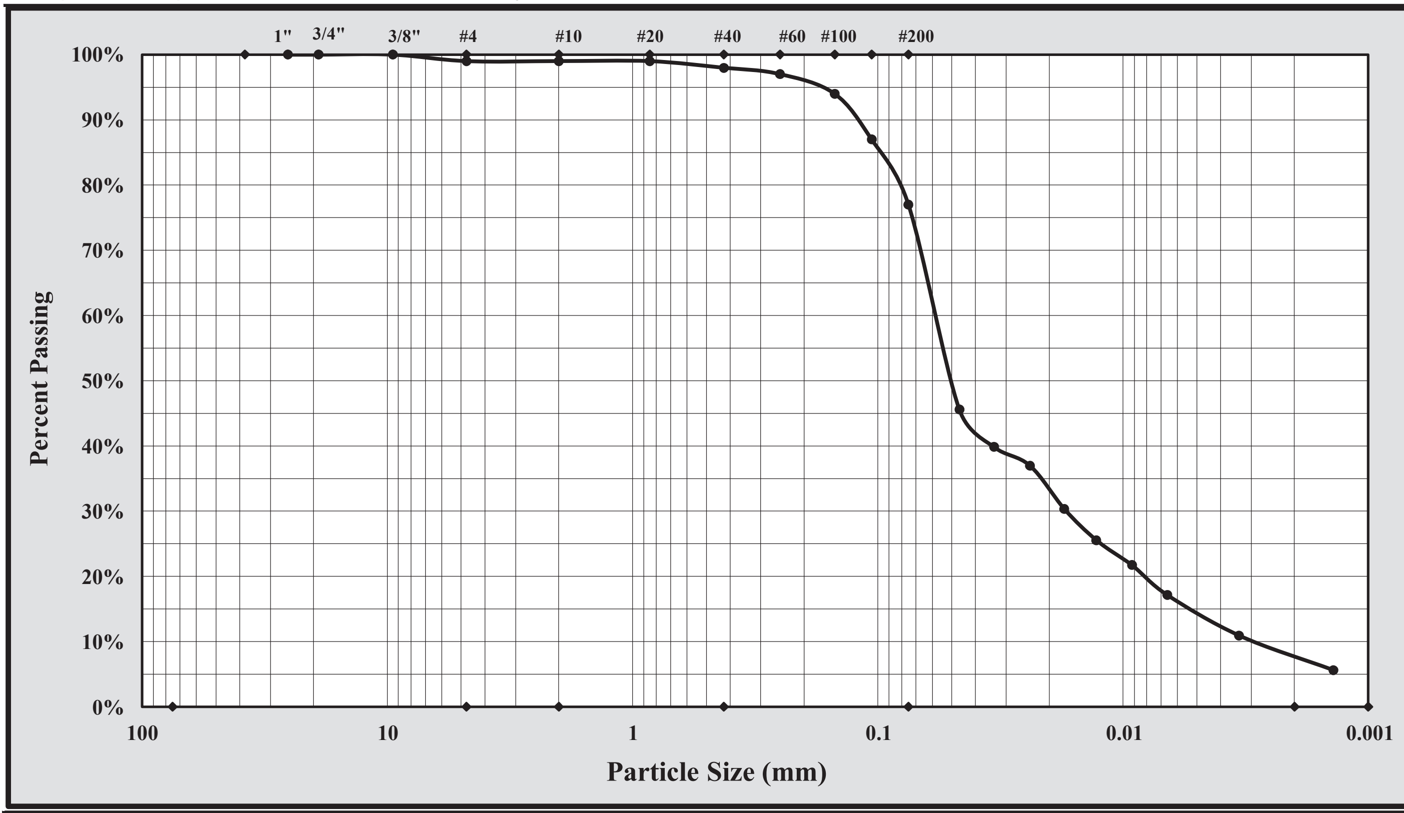
BCT10-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0073-03 Type: REG	Sample Date:	1/11/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	1%	Medium Sand:	1%
Silt & Clay (% Passing #200):	77%	Total Sand:	22%	Fine Sand:	21%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	5.6%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

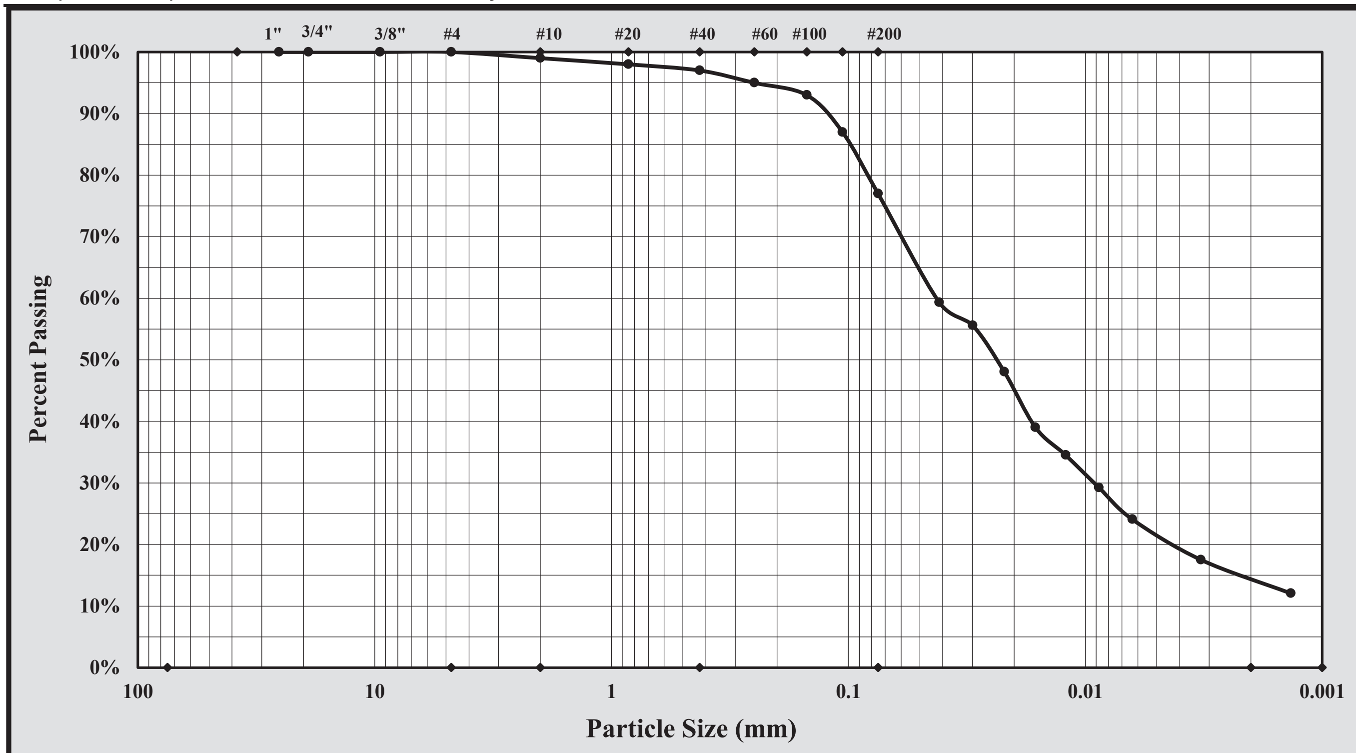
BCT11-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/18/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/12/24-3/14/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0076-03 Type: REG	Sample Date:	1/31/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8"	Gravel:	0%	Medium Sand:	2%
Silt & Clay (% Passing #200):	77%	Total Sand:	23%	Fine Sand:	20%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	12.1%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/18/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

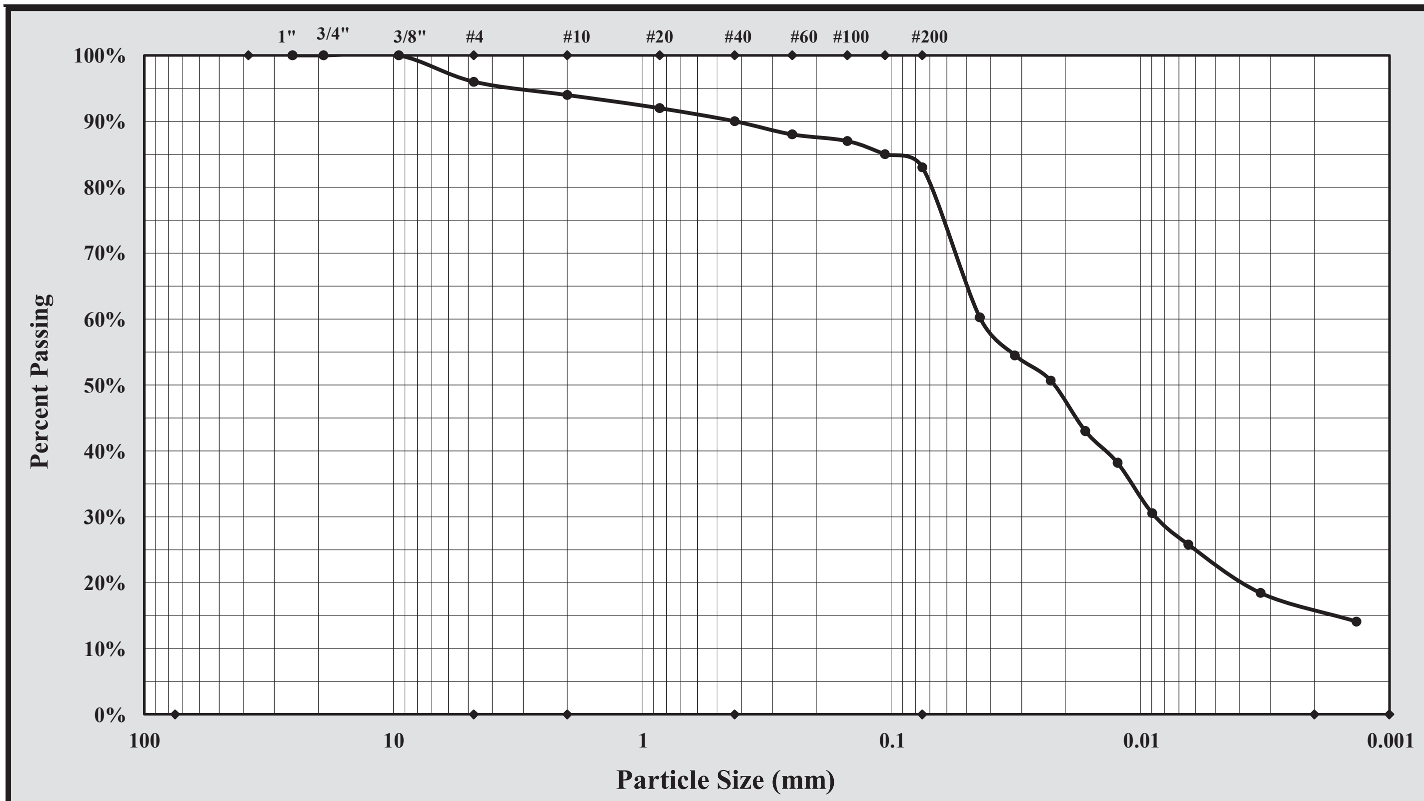
BCT12B-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/19/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0063-03 Type: REG	Sample Date:	1/10/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	4%	Medium Sand:	4%
Silt & Clay (% Passing #200):	83%	Total Sand:	13%	Fine Sand:	7%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	14.1%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	*[signature]*	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

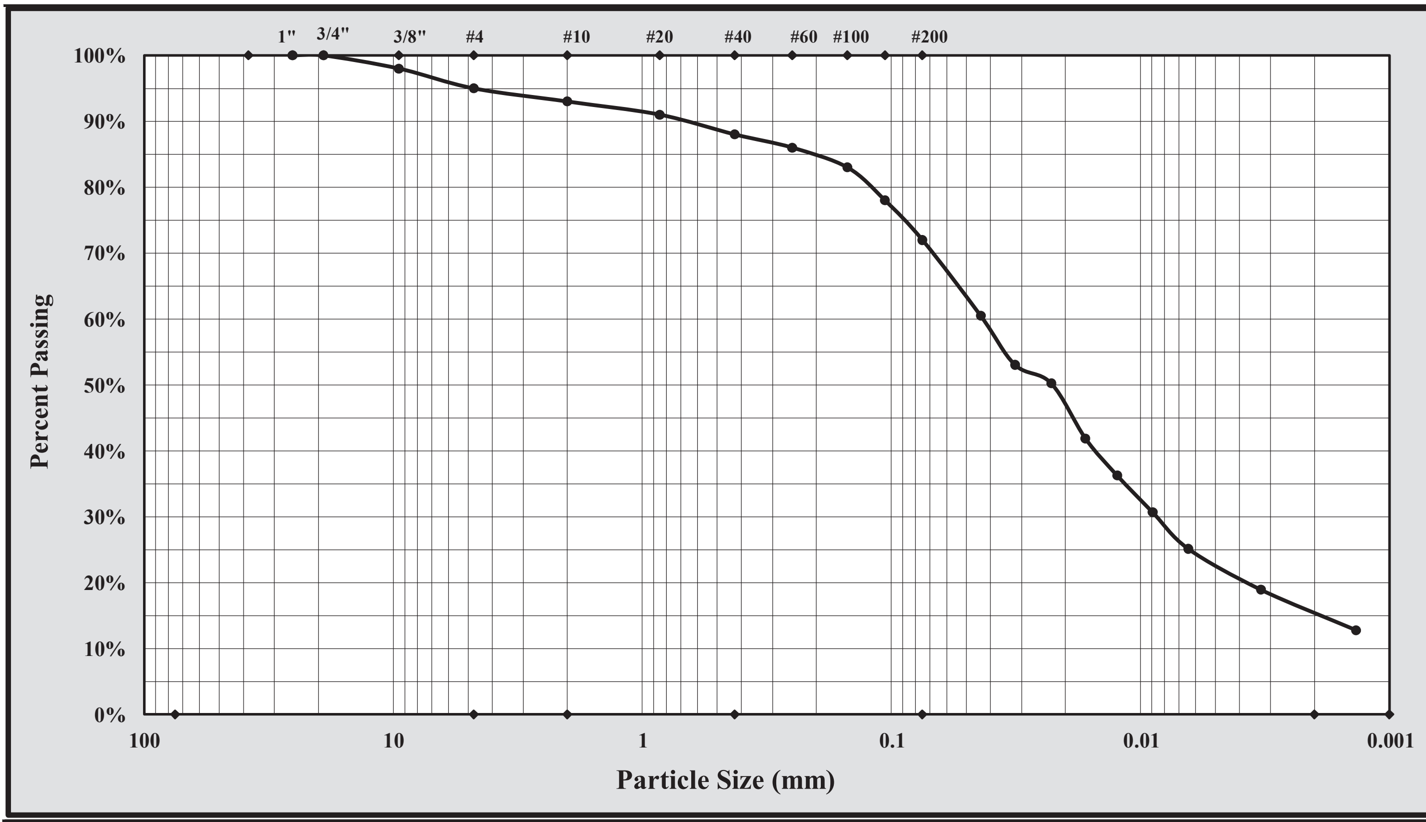
BCT12B-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/19/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0064-03 Type: REG	Sample Date:	1/10/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	5%	Medium Sand:	5%
Silt & Clay (% Passing #200):	72%	Total Sand:	23%	Fine Sand:	16%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	12.8%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

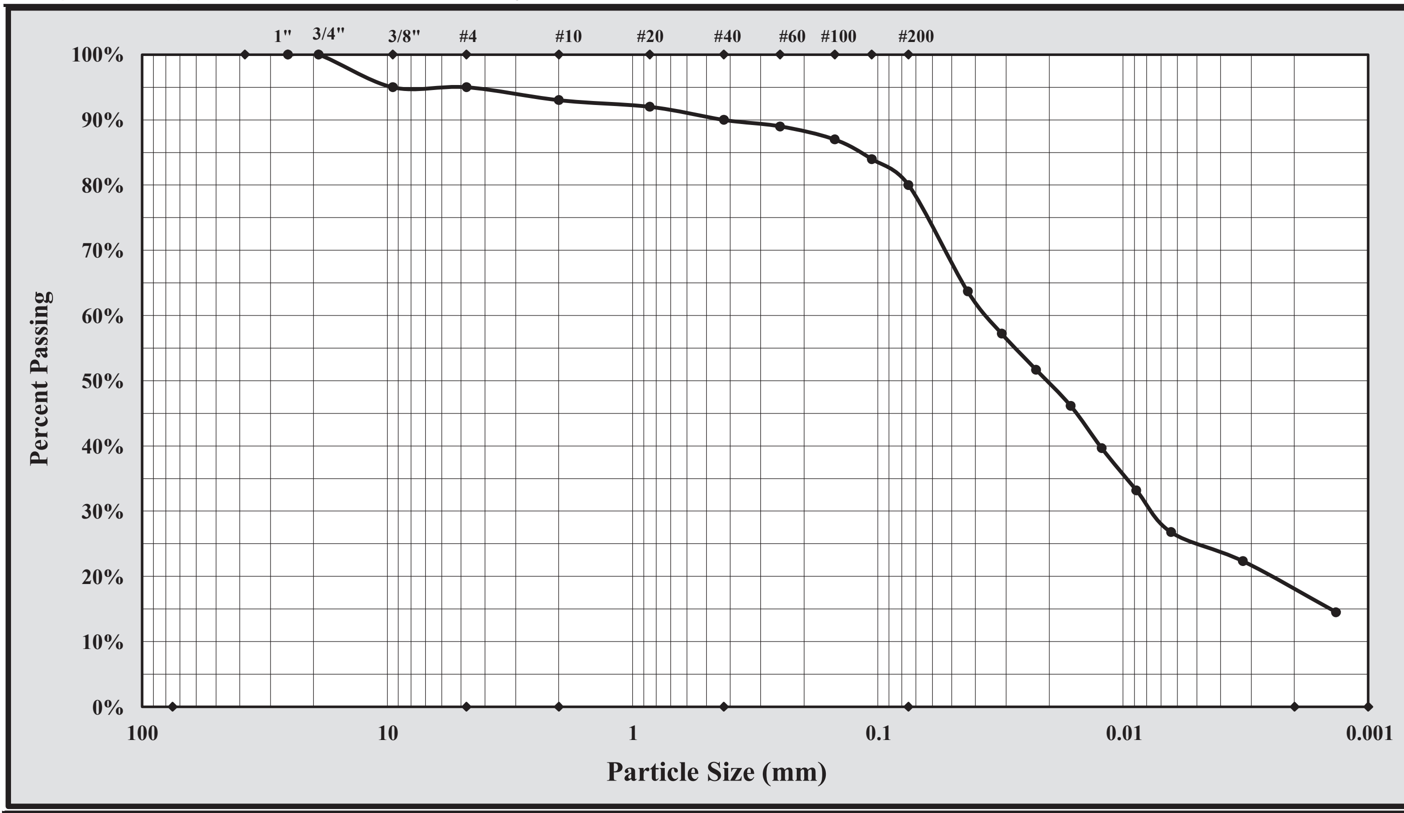
BCT12A-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/22/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/20/24-2/22/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0105-03 Type: REG	Sample Date:	1/10/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	5%	Medium Sand:	3%
Silt & Clay (% Passing #200):	80%	Total Sand:	15%	Fine Sand:	10%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	14.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/22/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

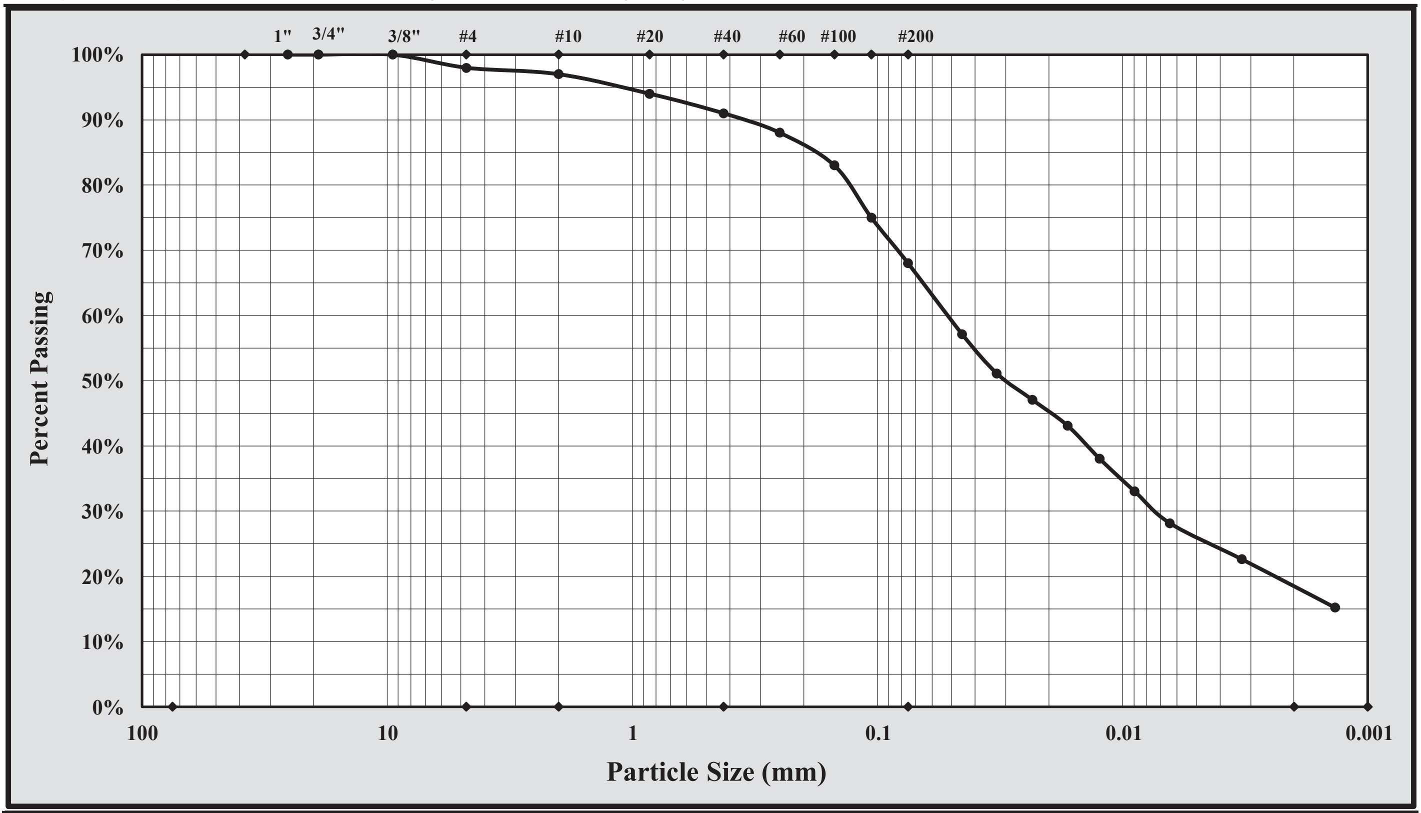
BCT13-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0084-03 Type: REG	Sample Date:	1/11/2024
		Depth:	NP

Sample Description: Grayish Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	2%	Medium Sand:	6%
Silt & Clay (% Passing #200):	68%	Total Sand:	30%	Fine Sand:	23%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	15.2%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

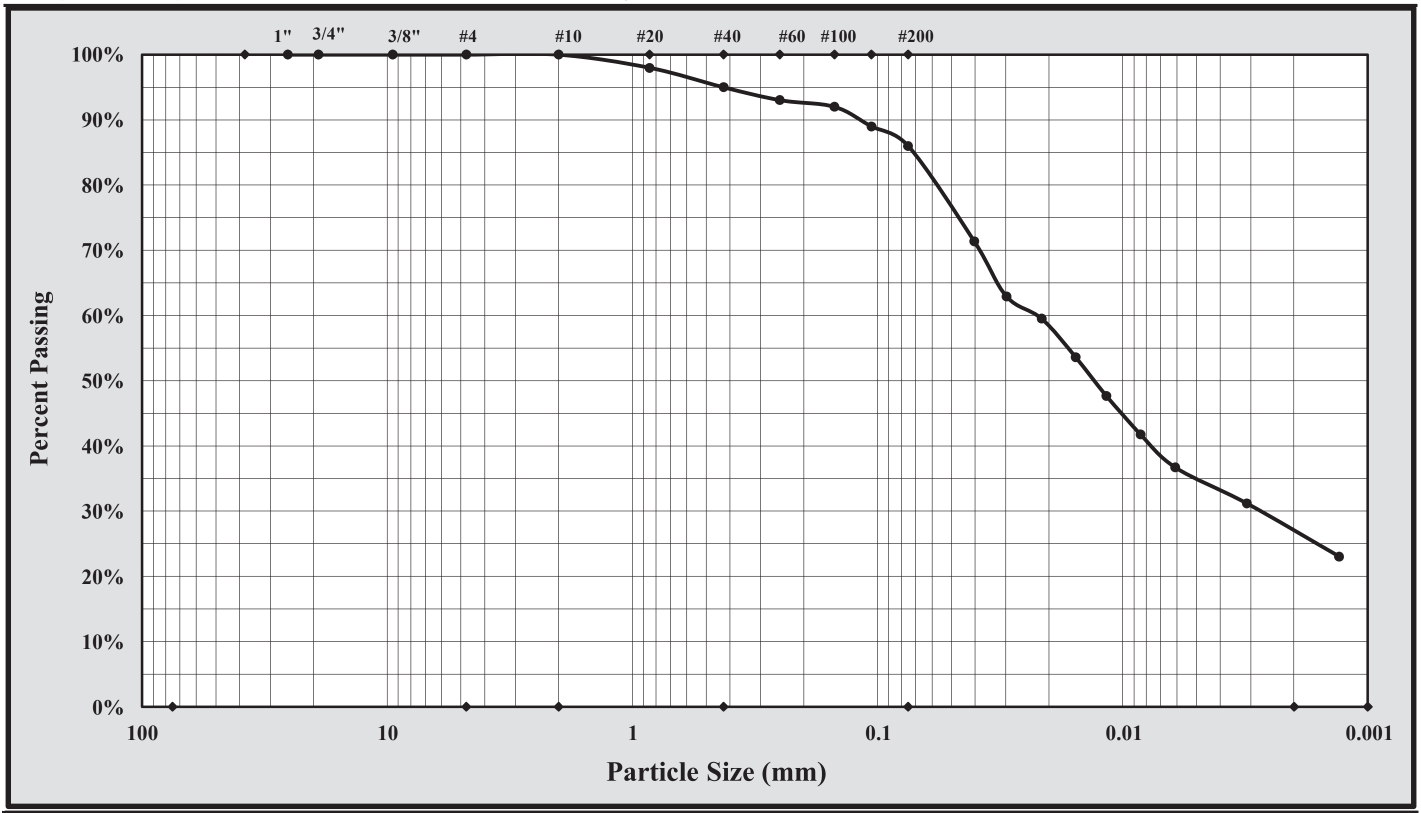
BCT14-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/17/24-2/20/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0088-03 Type: REG	Sample Date:	1/2/2024
		Depth:	NP

Sample Description: Yellowish Brown Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	5%
Silt & Clay (% Passing #200):	86%	Total Sand:	14%	Fine Sand:	9%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	23.1%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

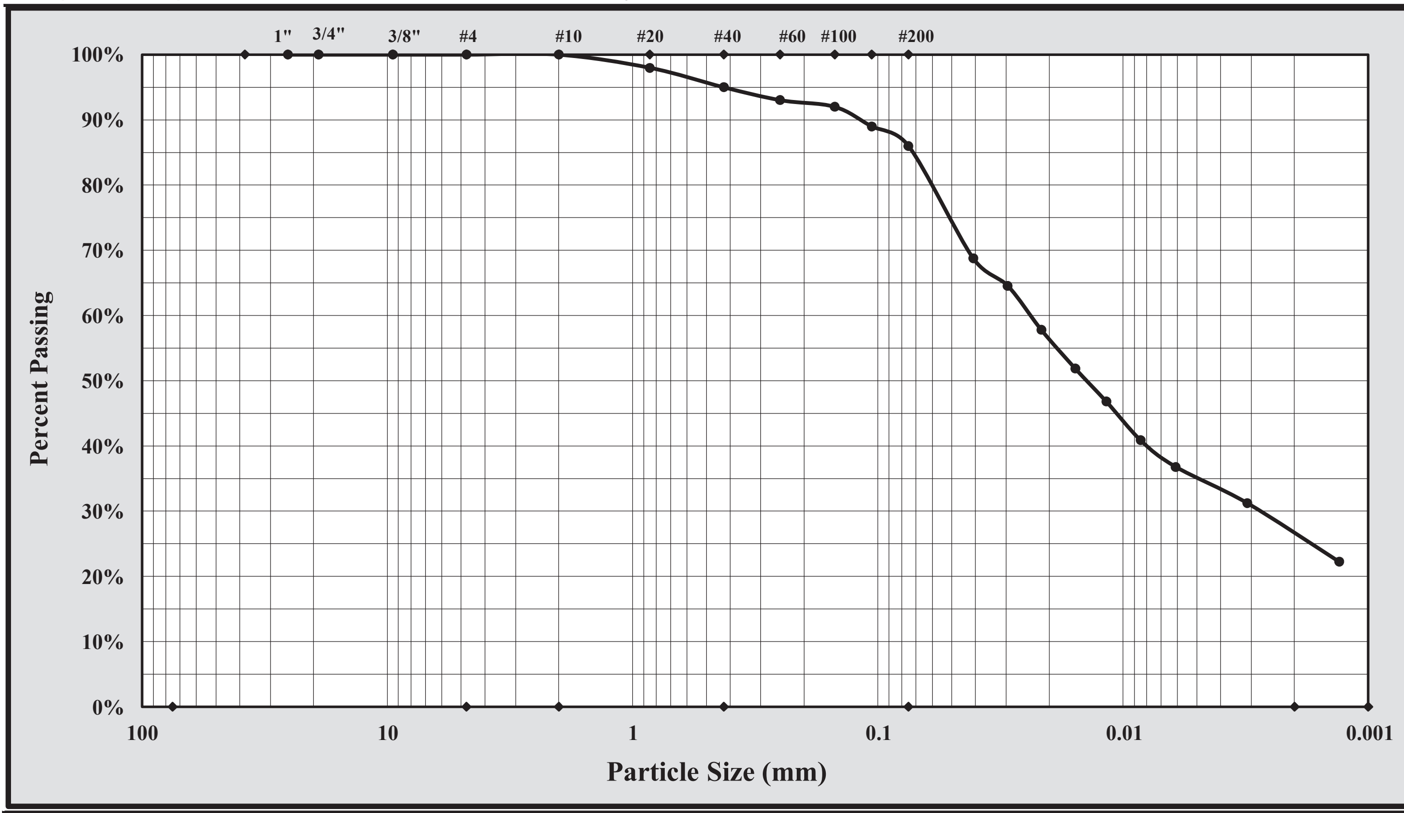
BCT14-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/21/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0089-03 Type: REG	Sample Date:	1/2/2024
		Depth:	NP

Sample Description: Yellowish Brown Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	5%
Silt & Clay (% Passing #200):	86%	Total Sand:	14%	Fine Sand:	9%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	22.2%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/21/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

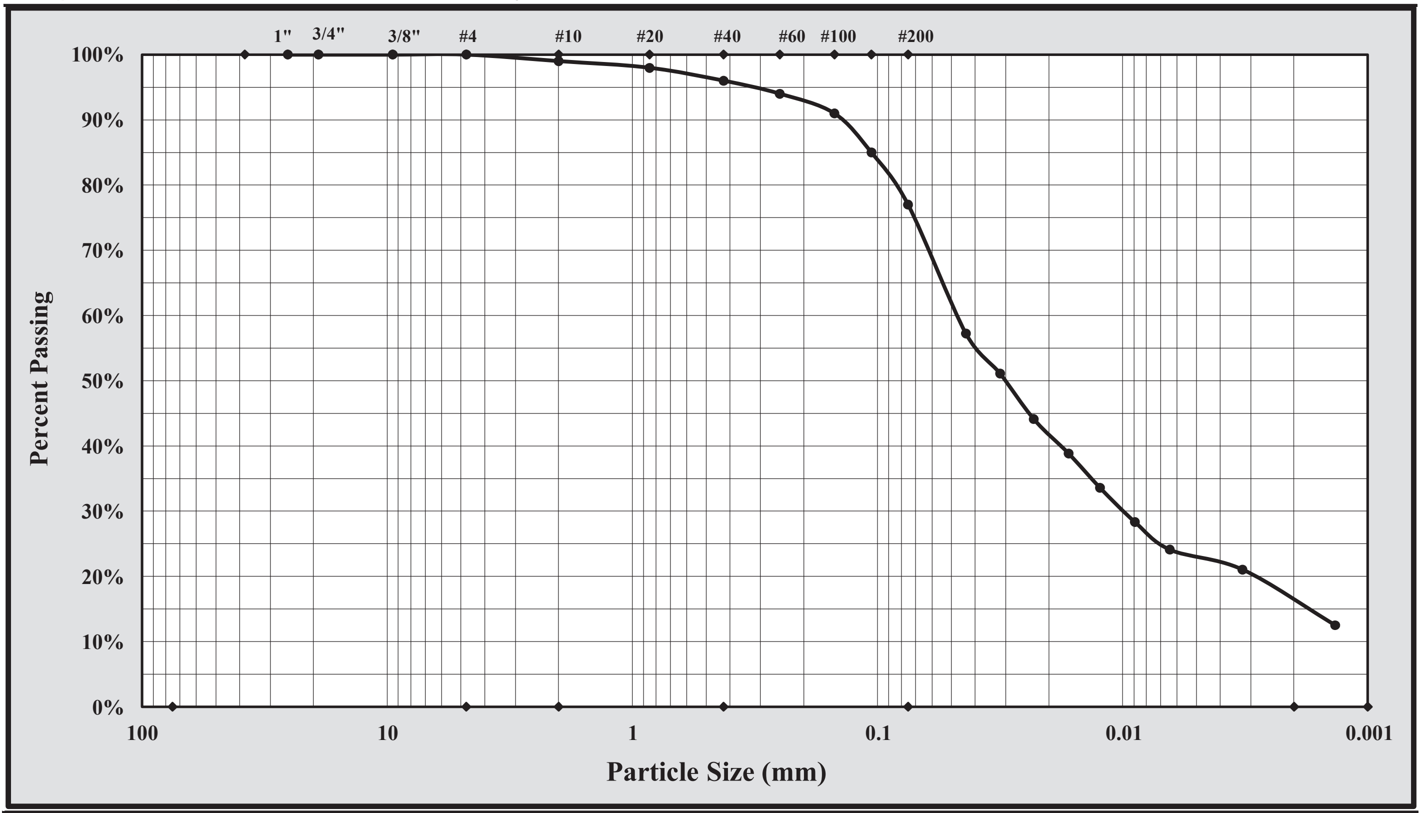
BCT15-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/21/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/17/24-2/20/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0094-03 Type: REG	Sample Date:	NP
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	3%
Silt & Clay (% Passing #200):	77%	Total Sand:	23%	Fine Sand:	19%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	12.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/21/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

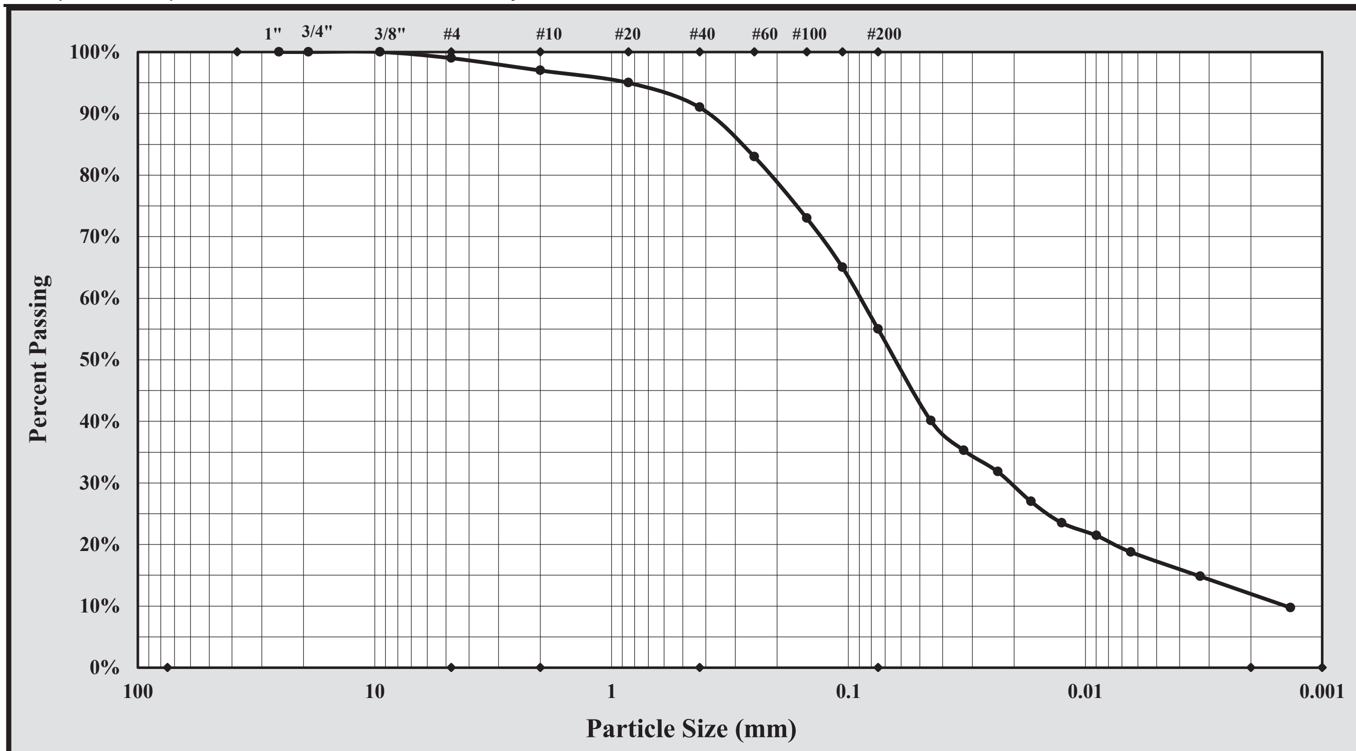
HCTREF-BSU

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/18/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/12/24-3/14/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0097-03 Type: REG	Sample Date:	2/2/2024
		Depth:	NP

Sample Description: Brown Sandy Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	1%	Medium Sand:	6%
Silt & Clay (% Passing #200):	55%	Total Sand:	44%	Fine Sand:	36%
Assumed Specific Gravity:	2.65	Coarse Sand:	2%	Clay:	9.7%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman		Lab Services Manager	3/18/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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LOWER CREEK BANK SOIL

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Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

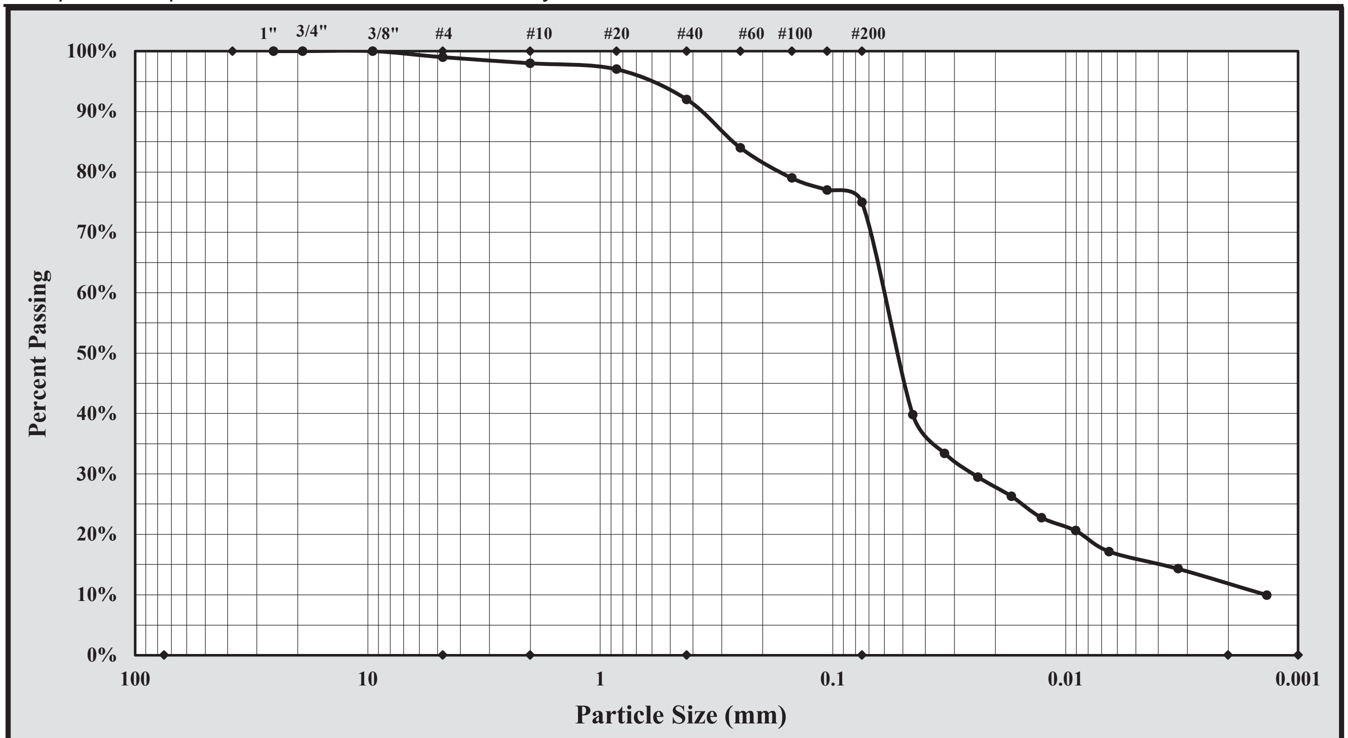
BCT1-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/23/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0037-03 Type: REG	Sample Date:	1/4/2024
		Depth:	NP

Sample Description: Dark Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	1%	Medium Sand:	6%
Silt & Clay (% Passing #200):	75%	Total Sand:	24%	Fine Sand:	17%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	10.0%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Victoria Igoe	Victoria Igoe	Senior Engineering Technician	2/23/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

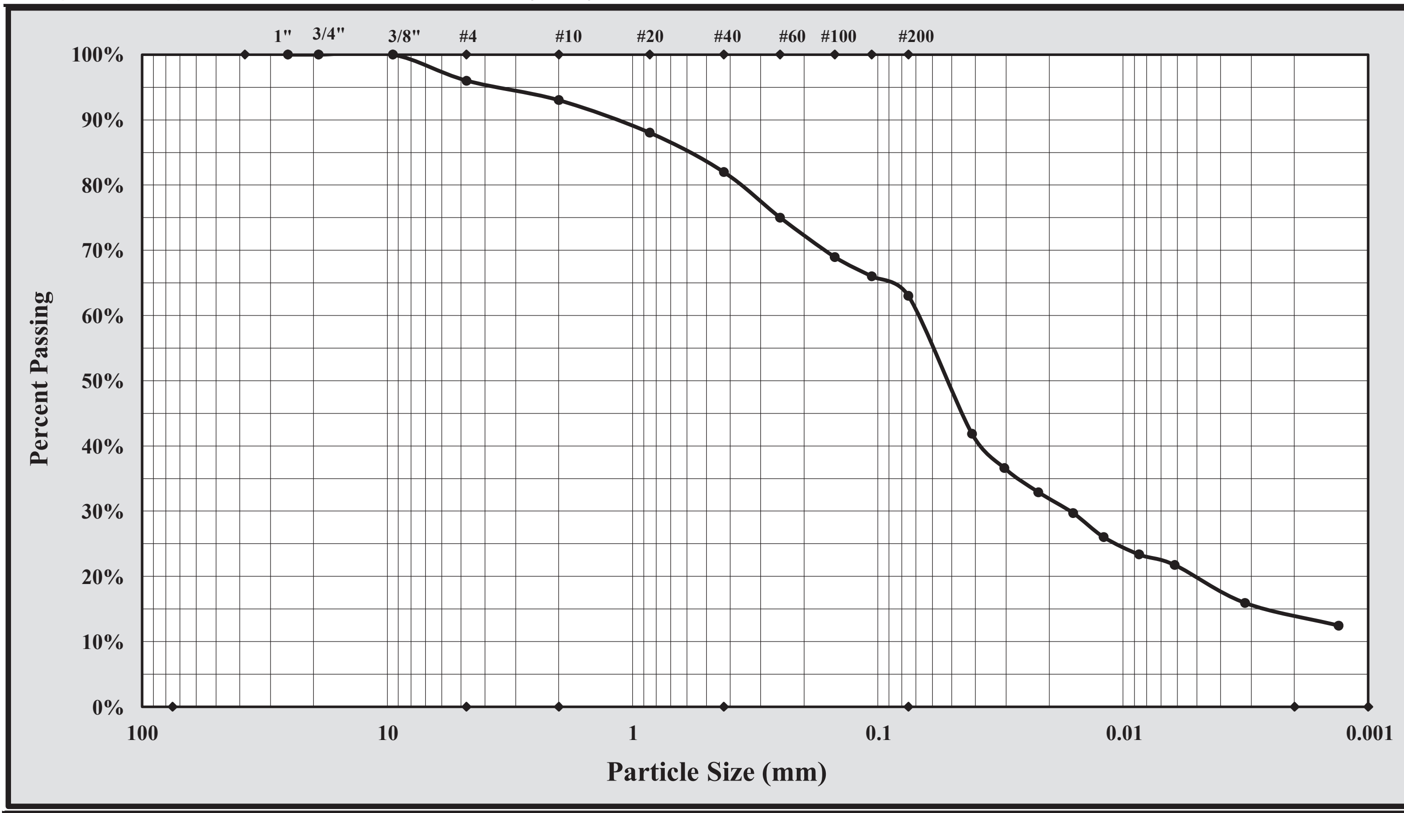
BCT2-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/16/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0040-03 Type: REG	Sample Date:	1/4/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	4%	Medium Sand:	11%
Silt & Clay (% Passing #200):	63%	Total Sand:	33%	Fine Sand:	19%
Assumed Specific Gravity:	2.65	Coarse Sand:	3%	Clay:	12.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	Tyle Cop	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

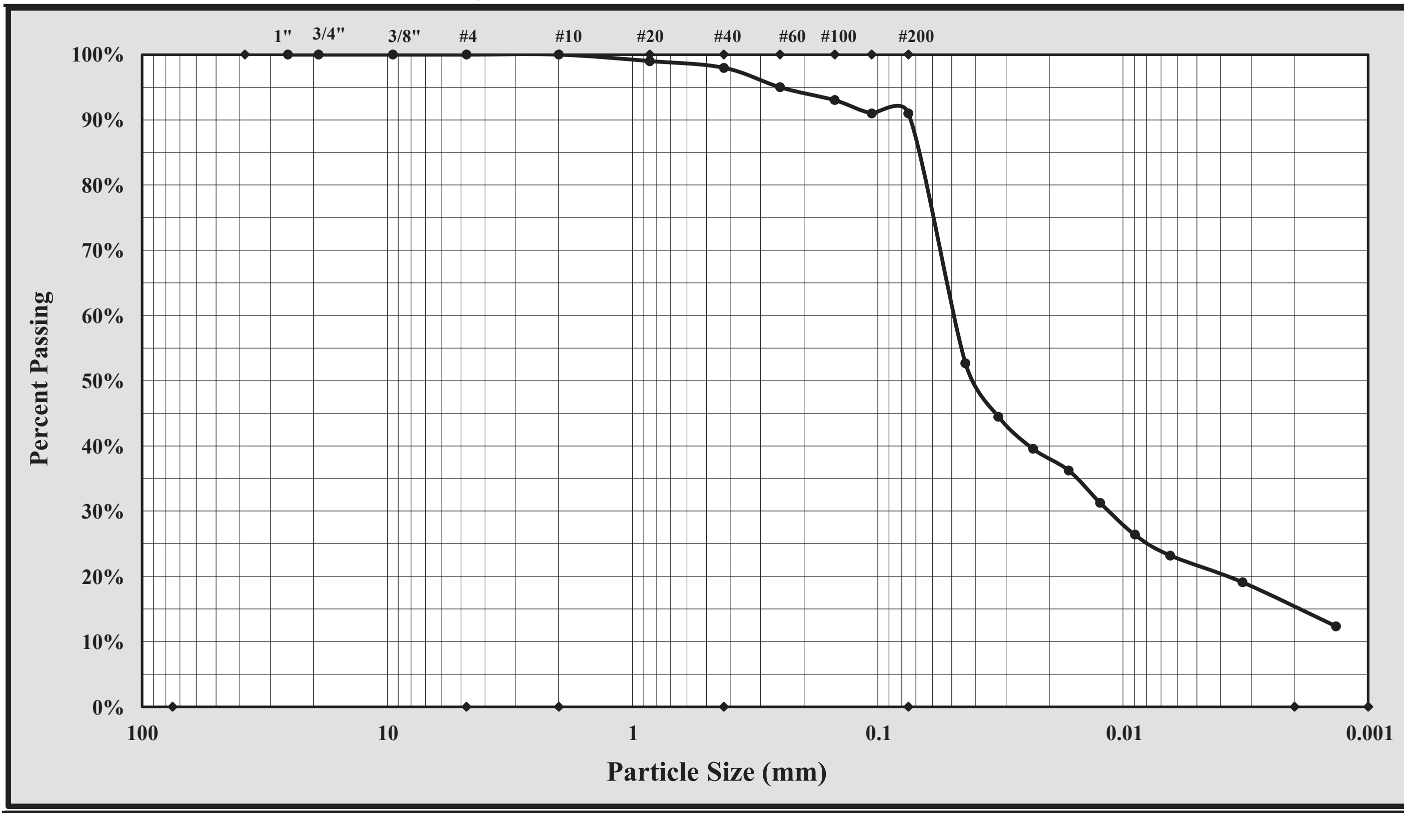
BCT3-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/19/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/7/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0043-03 Type: REG	Sample Date:	1/4/2024
		Depth:	NP

Sample Description: Tan Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	2%
Silt & Clay (% Passing #200):	91%	Total Sand:	9%	Fine Sand:	7%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	12.4%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

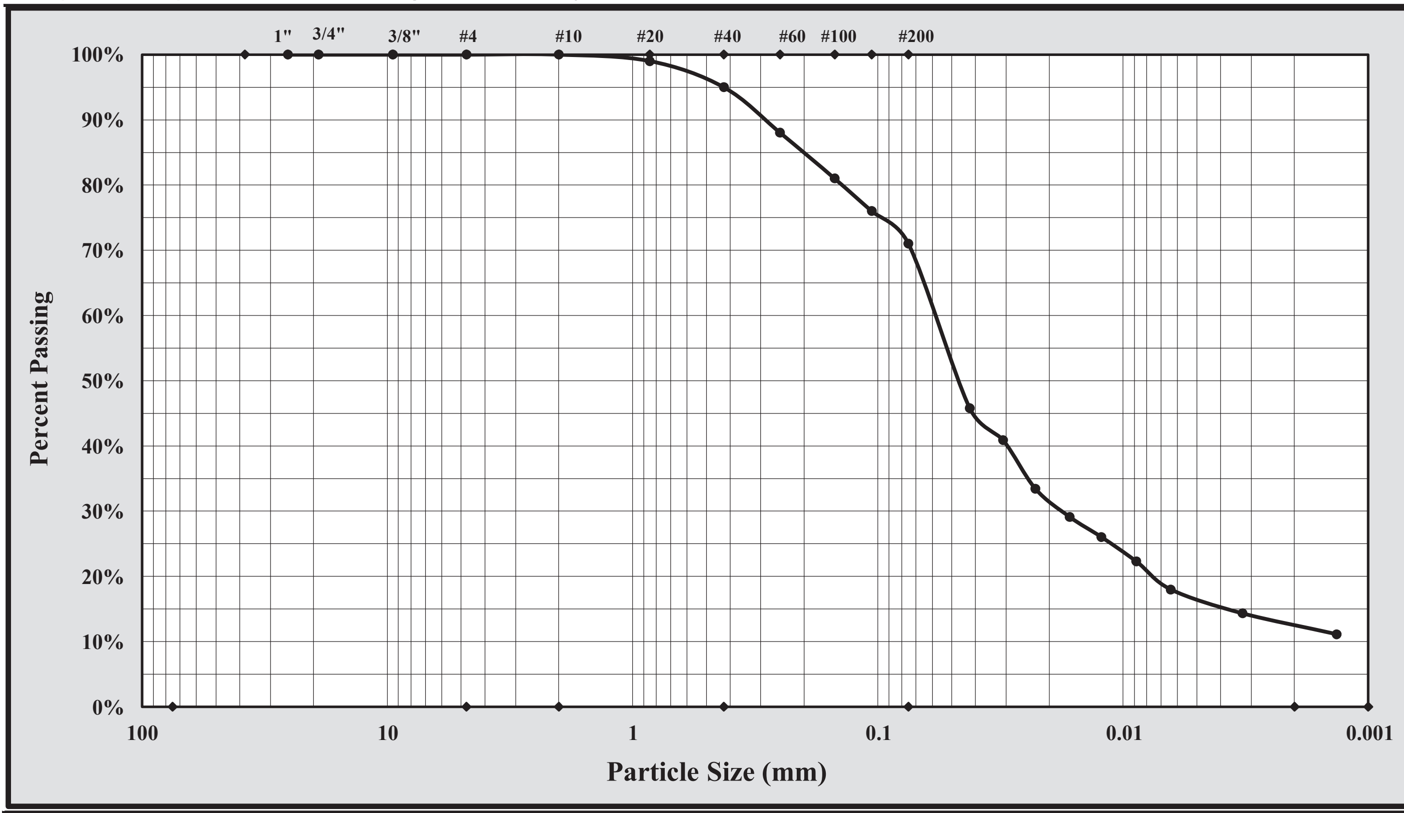
BCT4-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/16/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/7/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0046-03 Type: REG	Sample Date:	1/8/2024
		Depth:	NP

Sample Description: Light Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	5%
Silt & Clay (% Passing #200):	71%	Total Sand:	29%	Fine Sand:	24%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	11.1%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman		Lab Services Manager	2/16/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

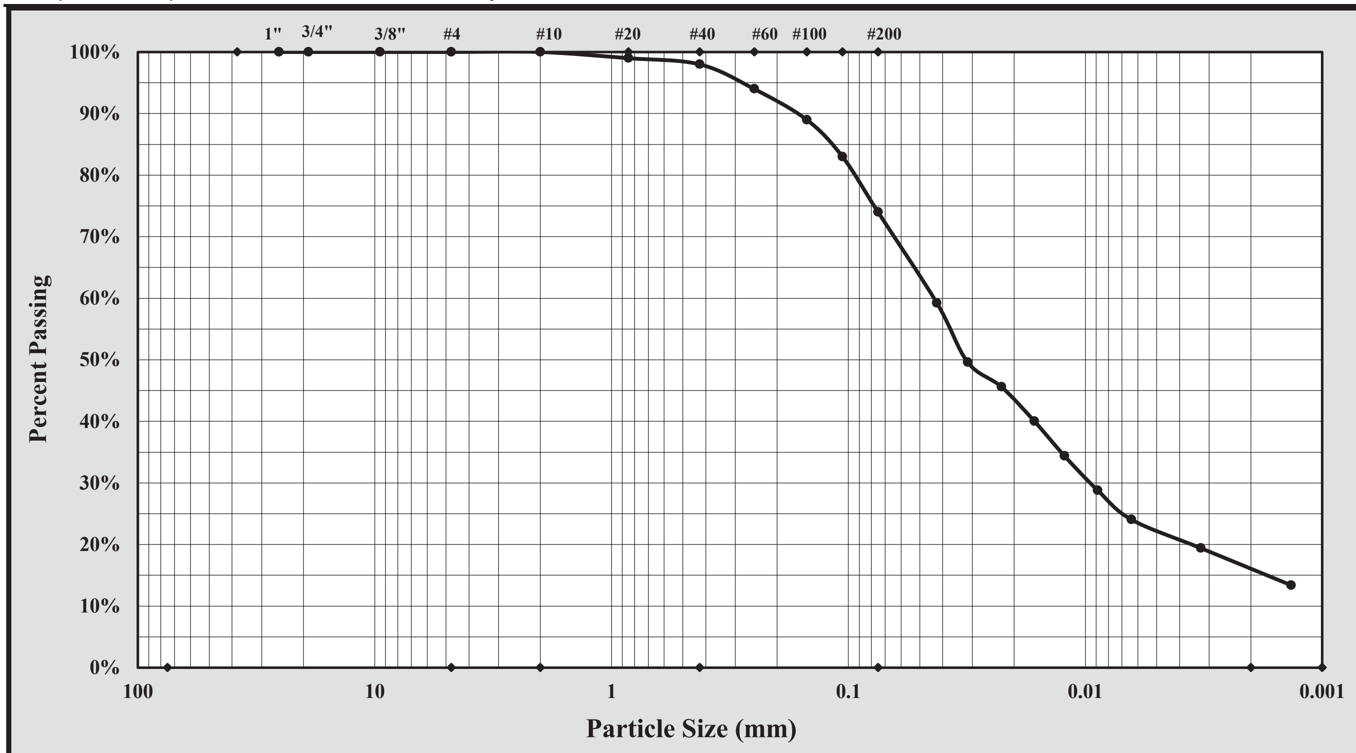
BCT5-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/12/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/7/24-3/11/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0049-03 Type: REG	Sample Date:	2/1/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	2%
Silt & Clay (% Passing #200):	74%	Total Sand:	26%	Fine Sand:	24%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	13.4%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/12/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

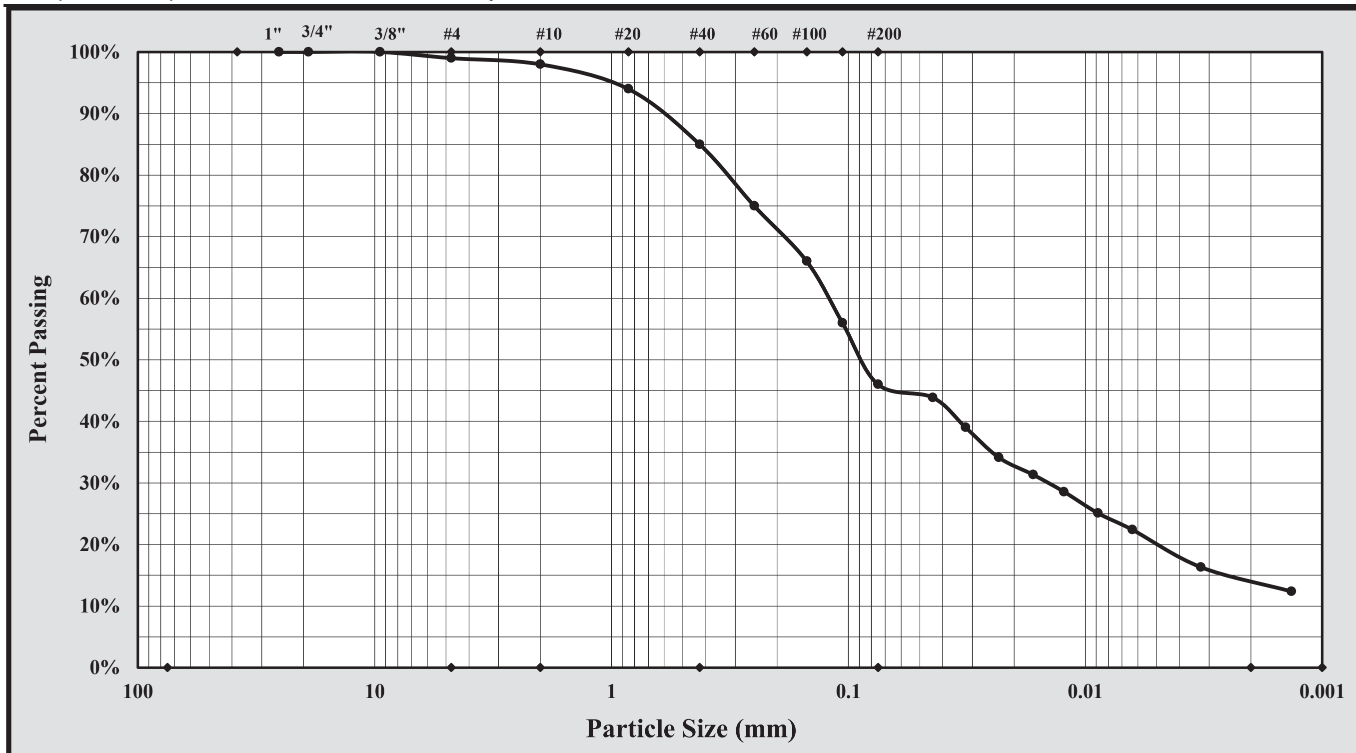
BCT6-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/14/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/10/24-3/13/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0053-03 Type: REG	Sample Date:	2/1/2024
		Depth:	NP

Sample Description: Brown Silty Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4"	Gravel:	1%	Medium Sand:	13%
Silt & Clay (% Passing #200):	46%	Total Sand:	53%	Fine Sand:	39%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	12.4%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/14/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

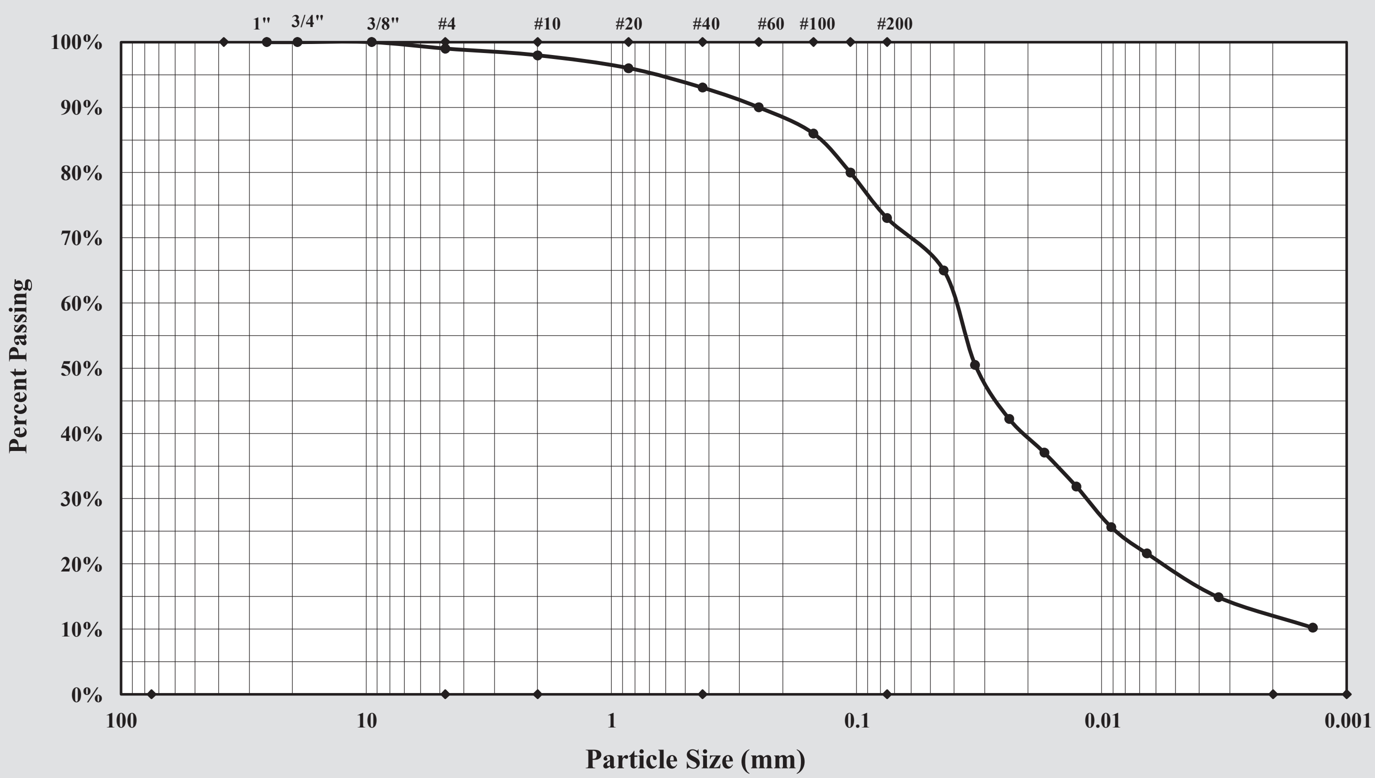
BCT10-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0072-03 Type: REG	Sample Date:	1/11/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	1%	Medium Sand:	5%
Silt & Clay (% Passing #200):	73%	Total Sand:	26%	Fine Sand:	20%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	10.2%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

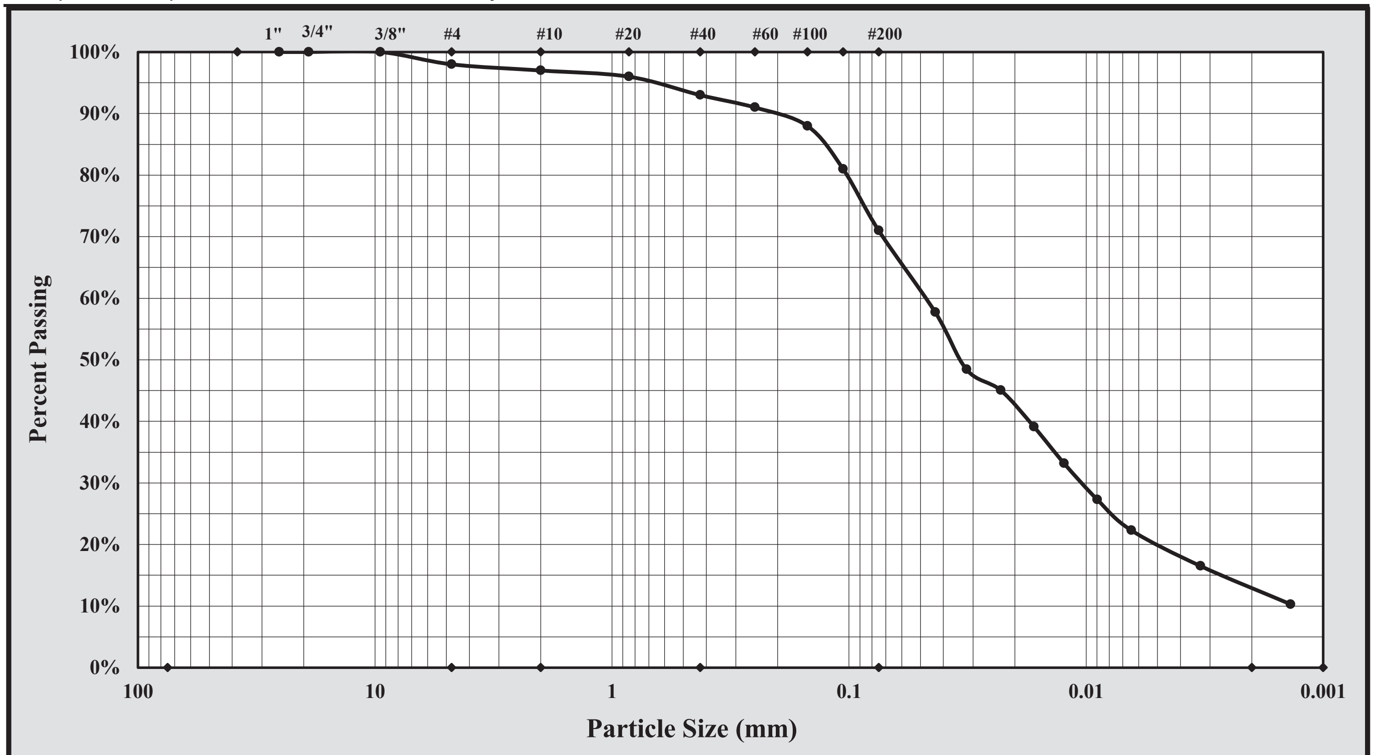
BCT11-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/14/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/10/24-3/13/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0075-03 Type: REG	Sample Date:	1/31/2024
		Depth:	NP

Sample Description: Brown Clay with Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	2%	Medium Sand:	4%
Silt & Clay (% Passing #200):	71%	Total Sand:	27%	Fine Sand:	22%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	10.3%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	Tyle Cop	Lab Services Manager	3/14/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

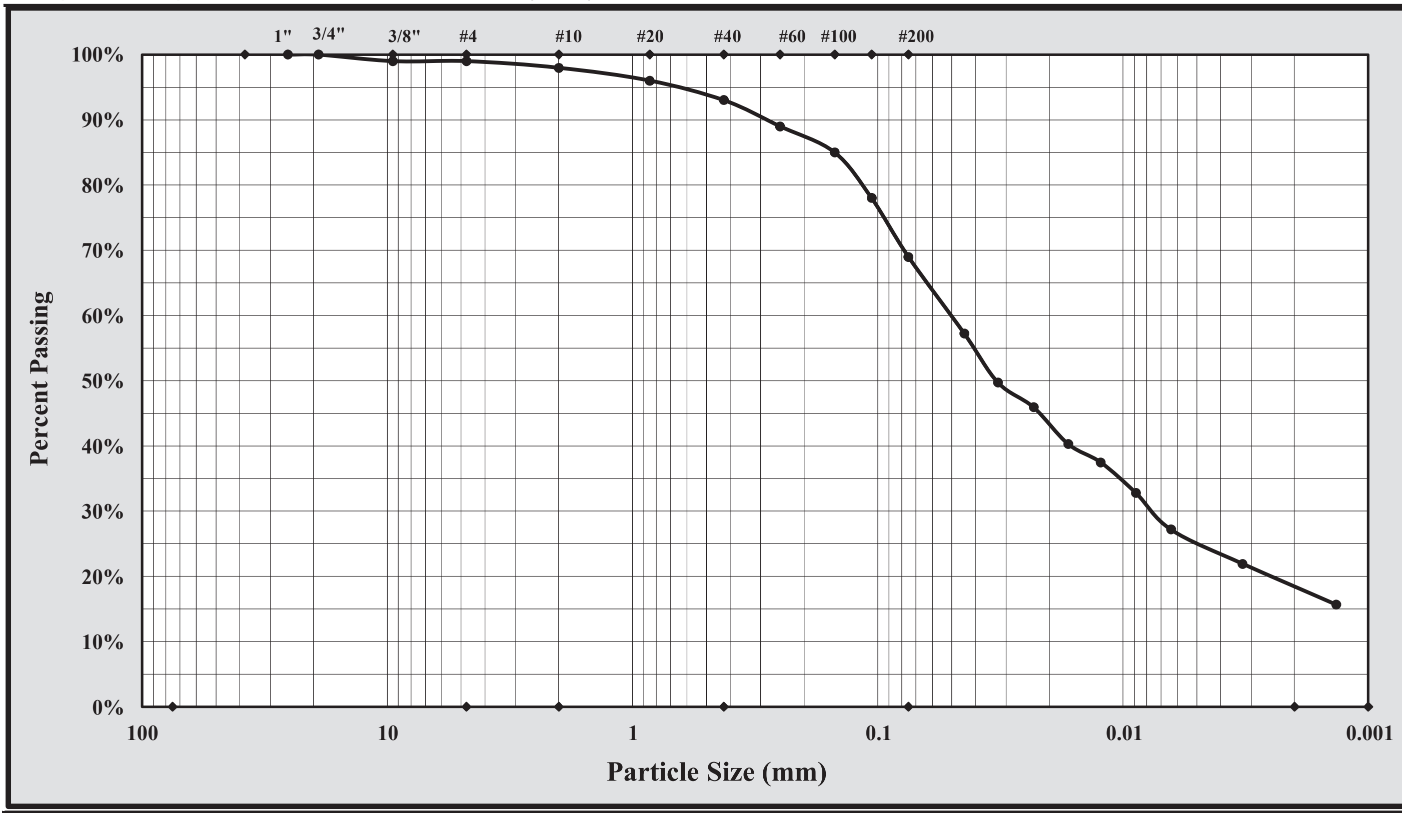
BCT12B-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/19/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/7/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0061-03 Type: REG	Sample Date:	1/10/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	1%	Medium Sand:	5%
Silt & Clay (% Passing #200):	69%	Total Sand:	30%	Fine Sand:	24%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	15.7%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019

Particle-Size Distribution

BCT12B-BSL

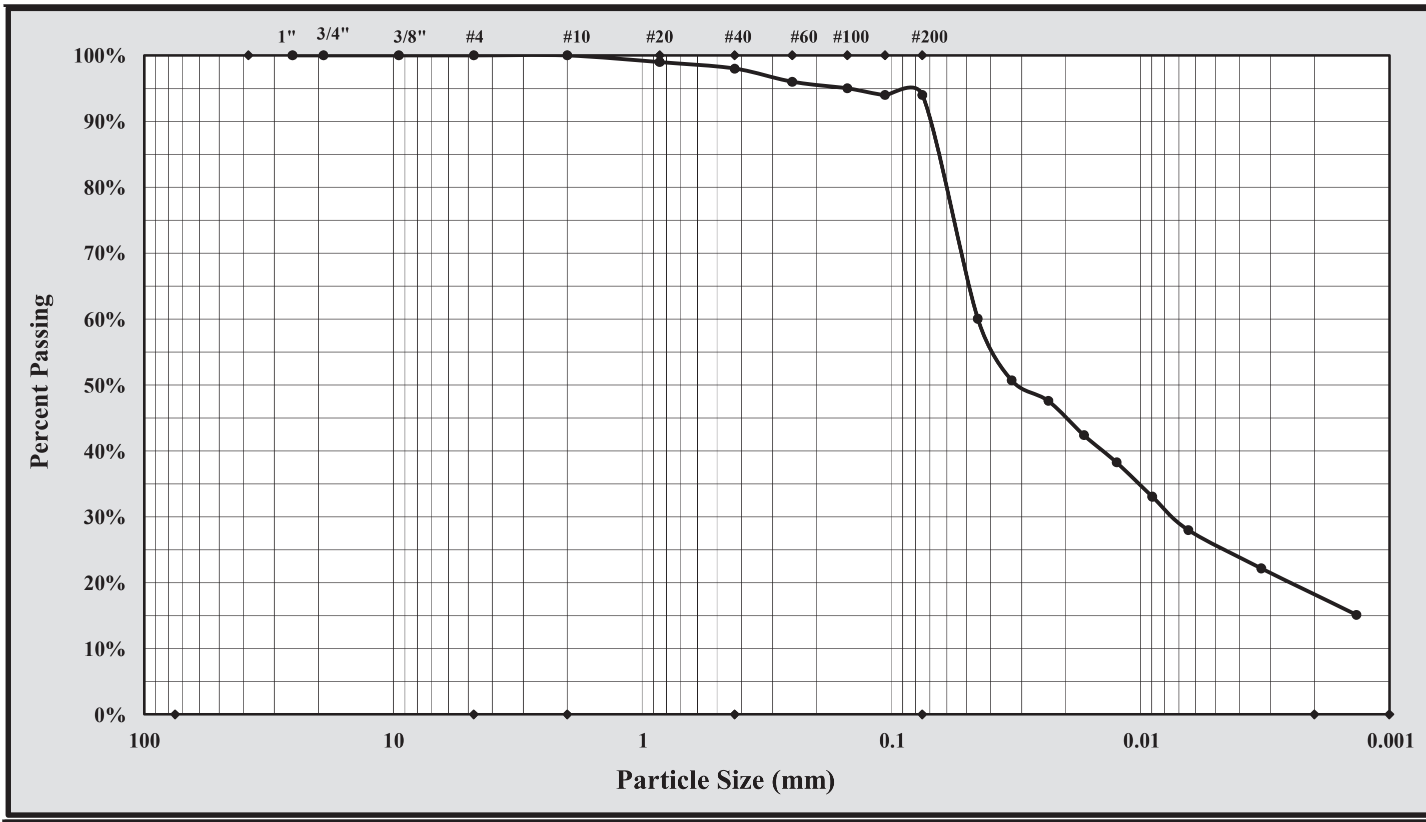
Log No.: 43-4016

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	1/0/1900
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0062-03 Type: REG	Sample Date:	1/10/2024
		Depth:	NP

Sample Description: Brown Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	2%
Silt & Clay (% Passing #200):	94%	Total Sand:	6%	Fine Sand:	4%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	15.1%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

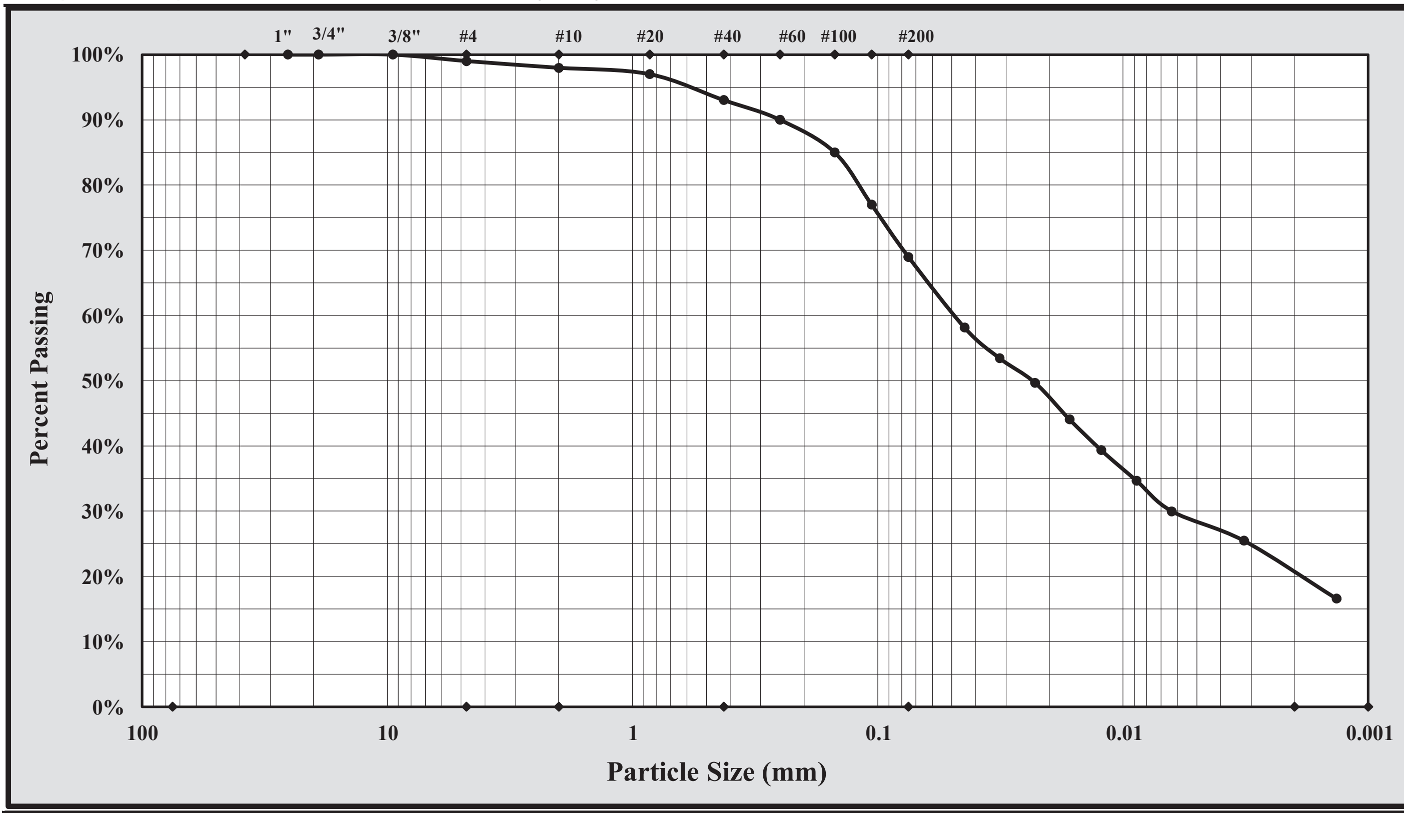
BCT12A-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/22/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/20/24-2/22/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0104-03 Type: REG	Sample Date:	1/10/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	1%	Medium Sand:	5%
Silt & Clay (% Passing #200):	69%	Total Sand:	30%	Fine Sand:	24%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	16.6%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/22/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

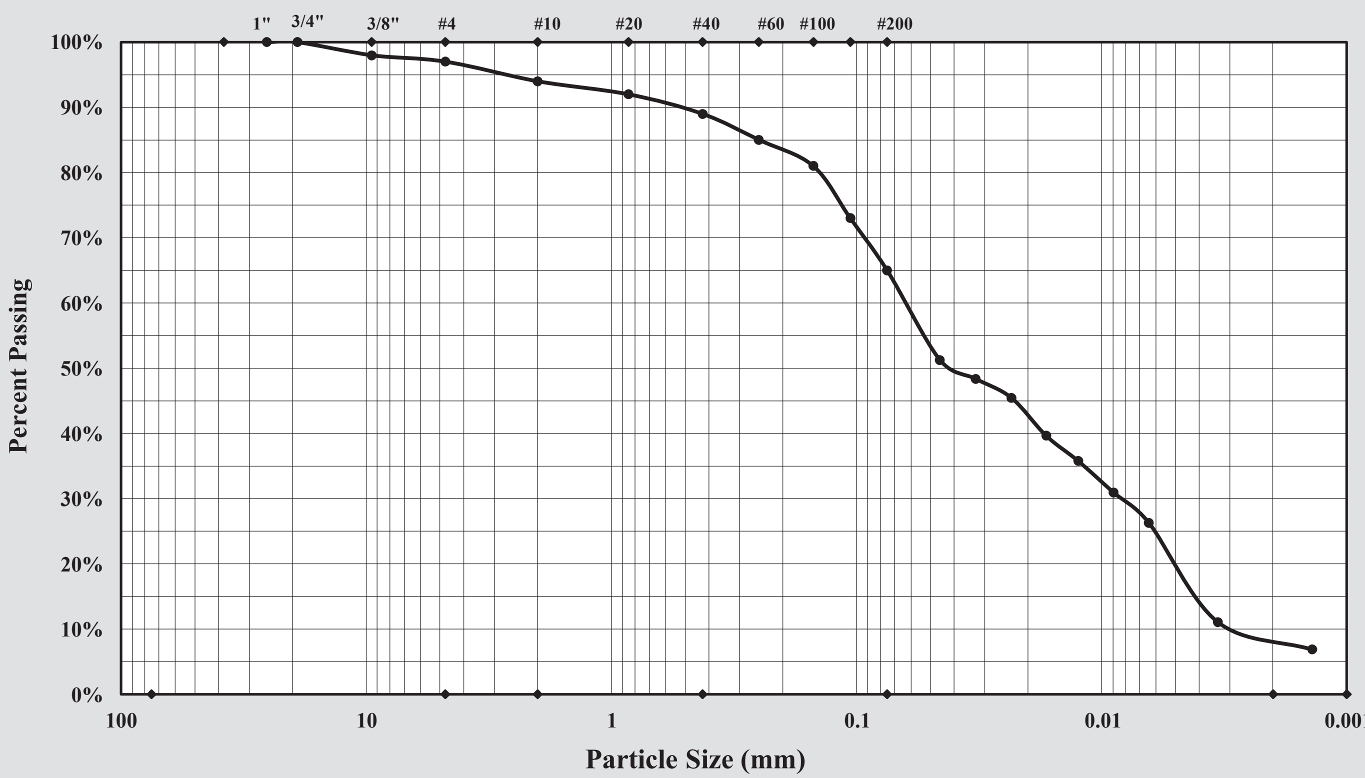
BCT13-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0083-03 Type: REG	Sample Date:	1/11/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	3%	Medium Sand:	5%
Silt & Clay (% Passing #200):	65%	Total Sand:	32%	Fine Sand:	24%
Assumed Specific Gravity:	2.65	Coarse Sand:	3%	Clay:	6.9%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

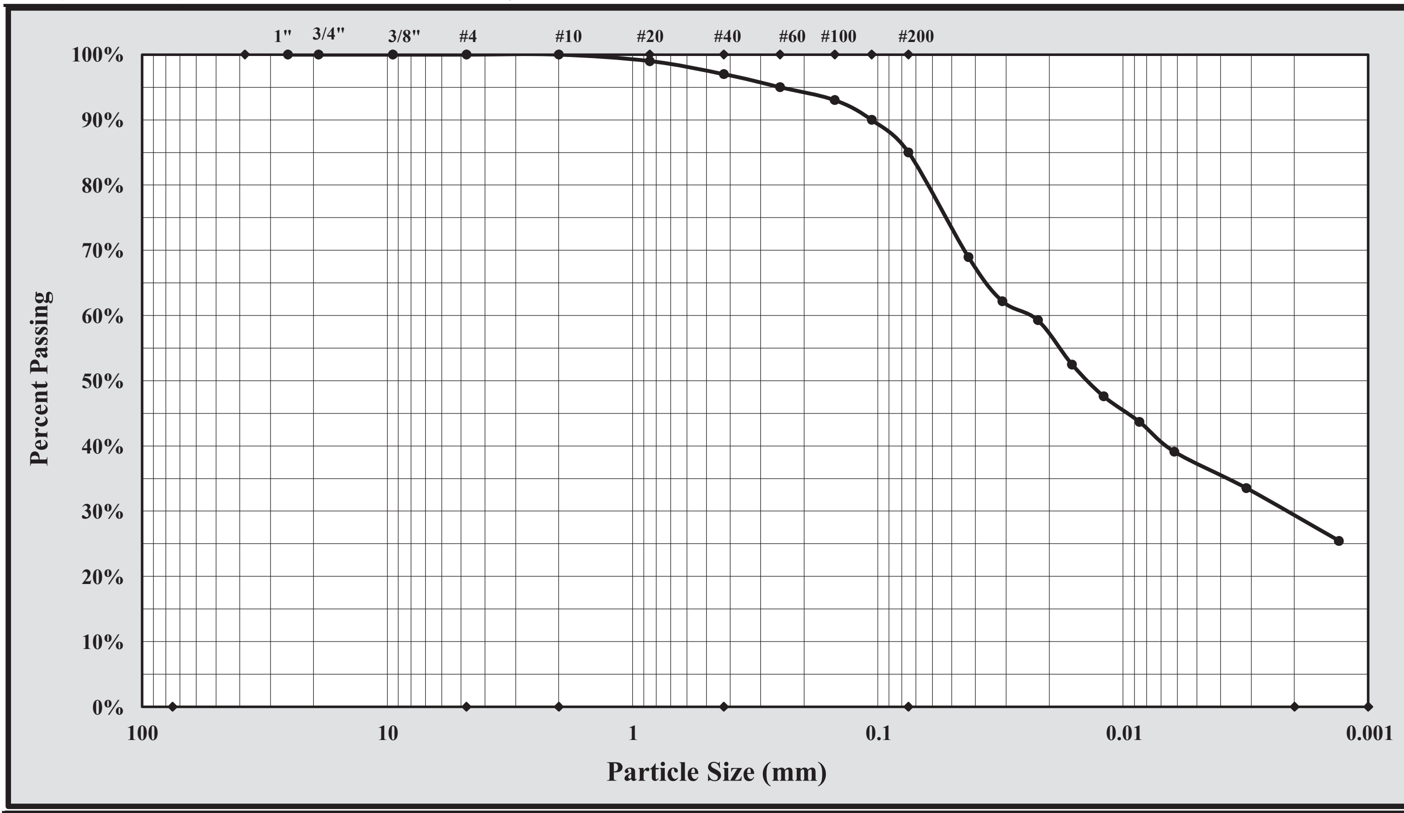
BCT14-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0086-03 Type: REG	Sample Date:	1/2/2024
		Depth:	NP

Sample Description: Brown Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	3%
Silt & Clay (% Passing #200):	85%	Total Sand:	15%	Fine Sand:	12%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	25.4%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

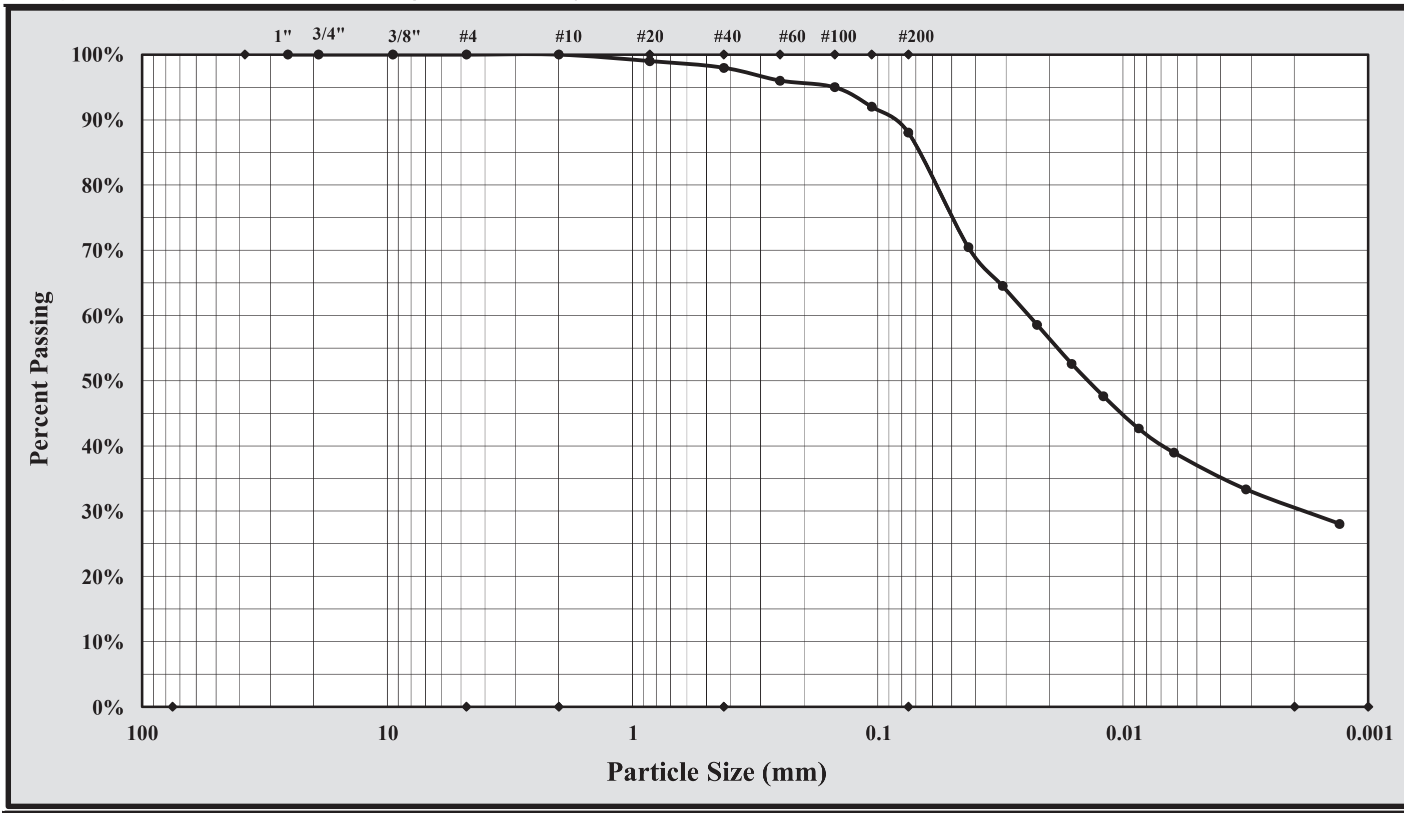
BCT14-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/20/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/12/24-2/16/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0087-03 Type: REG	Sample Date:	1/2/2024
		Depth:	NP

Sample Description: Light Brown Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	2%
Silt & Clay (% Passing #200):	88%	Total Sand:	12%	Fine Sand:	10%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	28.0%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/20/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

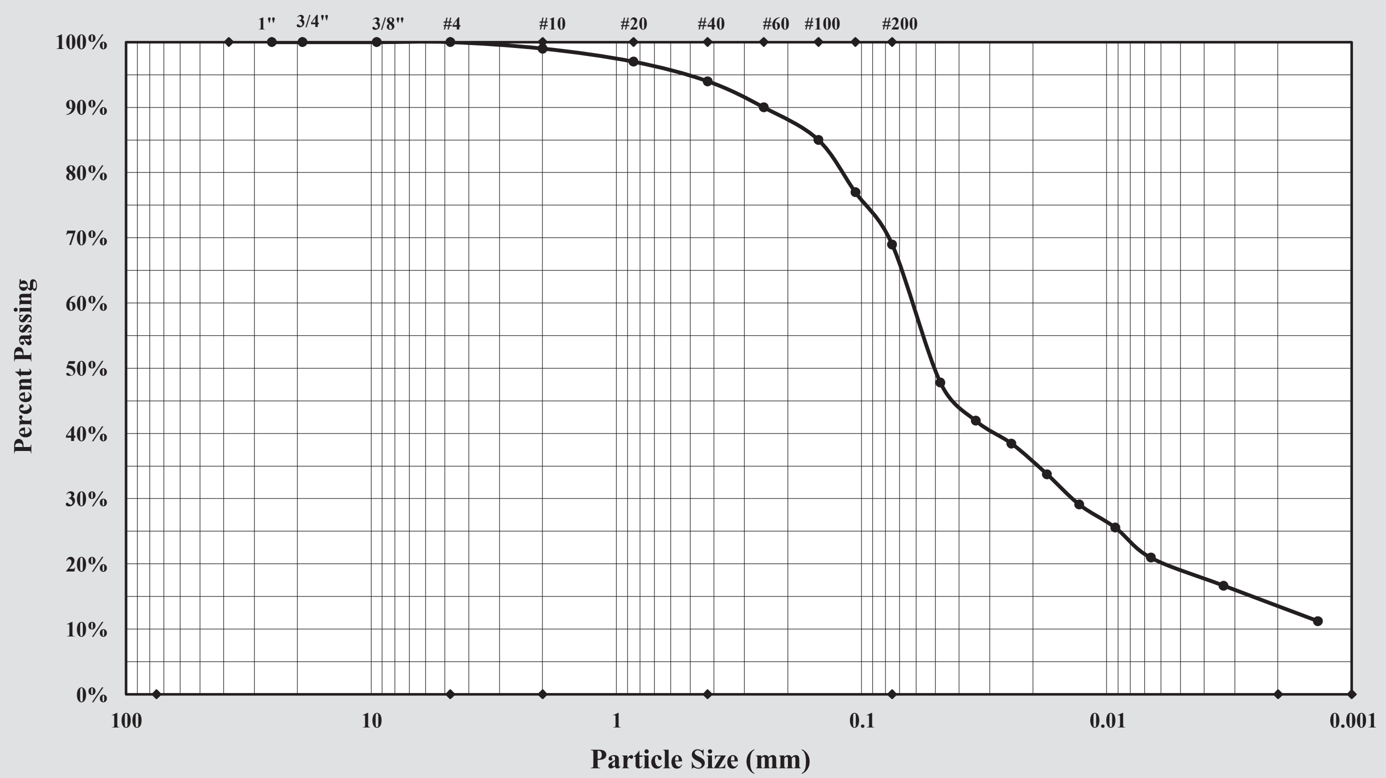
BCT15-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/22/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/20/24-2/22/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BRC0093-03 Type: REG	Sample Date:	1/3/2024
		Depth:	NP

Sample Description: Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	5%
Silt & Clay (% Passing #200):	69%	Total Sand:	31%	Fine Sand:	25%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	11.2%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	2/22/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

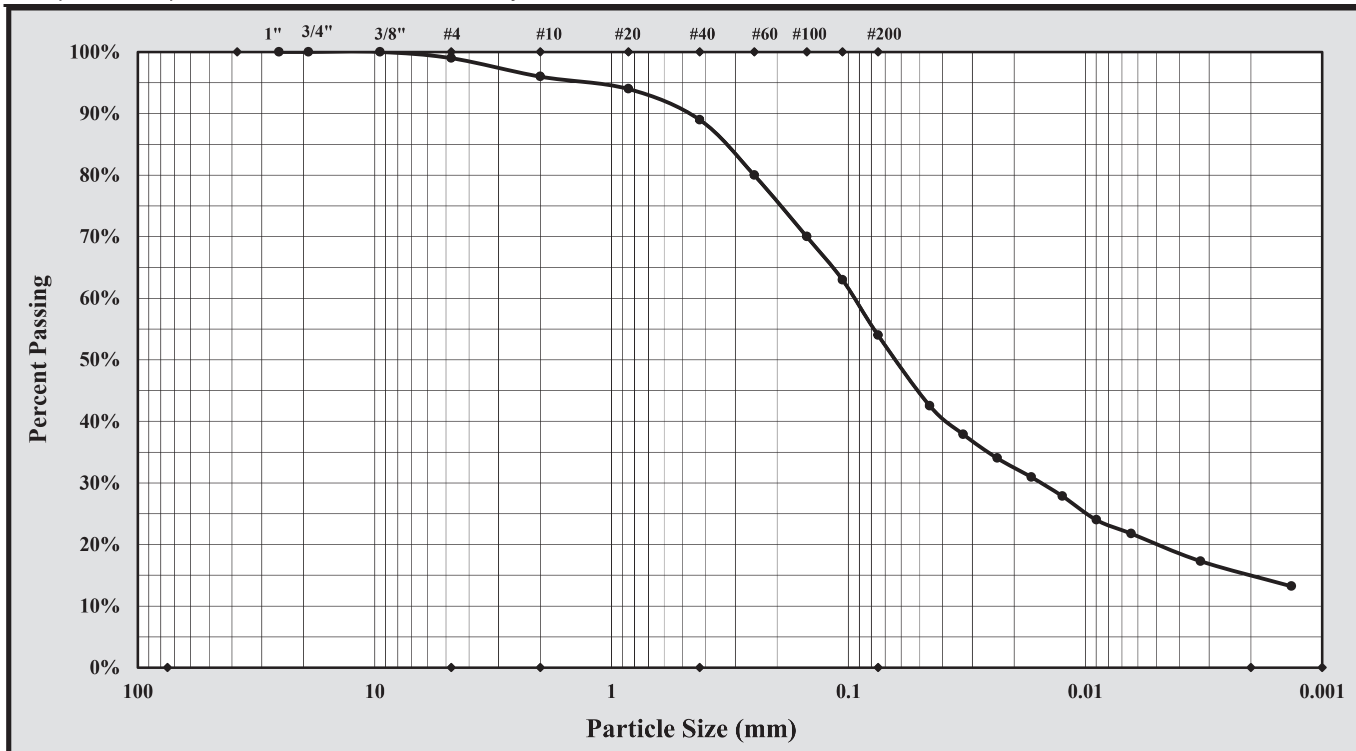
HCTREF-BSL

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/18/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/12/24 - 3/14/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0096-03 Type: REG	Sample Date:	2/2/2024
		Depth:	NP

Sample Description: Brown Sandy Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	1%	Medium Sand:	7%
Silt & Clay (% Passing #200):	54%	Total Sand:	45%	Fine Sand:	35%
Assumed Specific Gravity:	2.65	Coarse Sand:	3%	Clay:	13.2%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/18/2024
Technical Responsibility	*Signature*	*Position*	*Date*

CHANNEL SEDIMENT

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Form No: TR-D6913-WH-1Ga
Revision No. 0
Revision Date: 08/30/17
Quality Assurance

Sieve Analysis of Soils

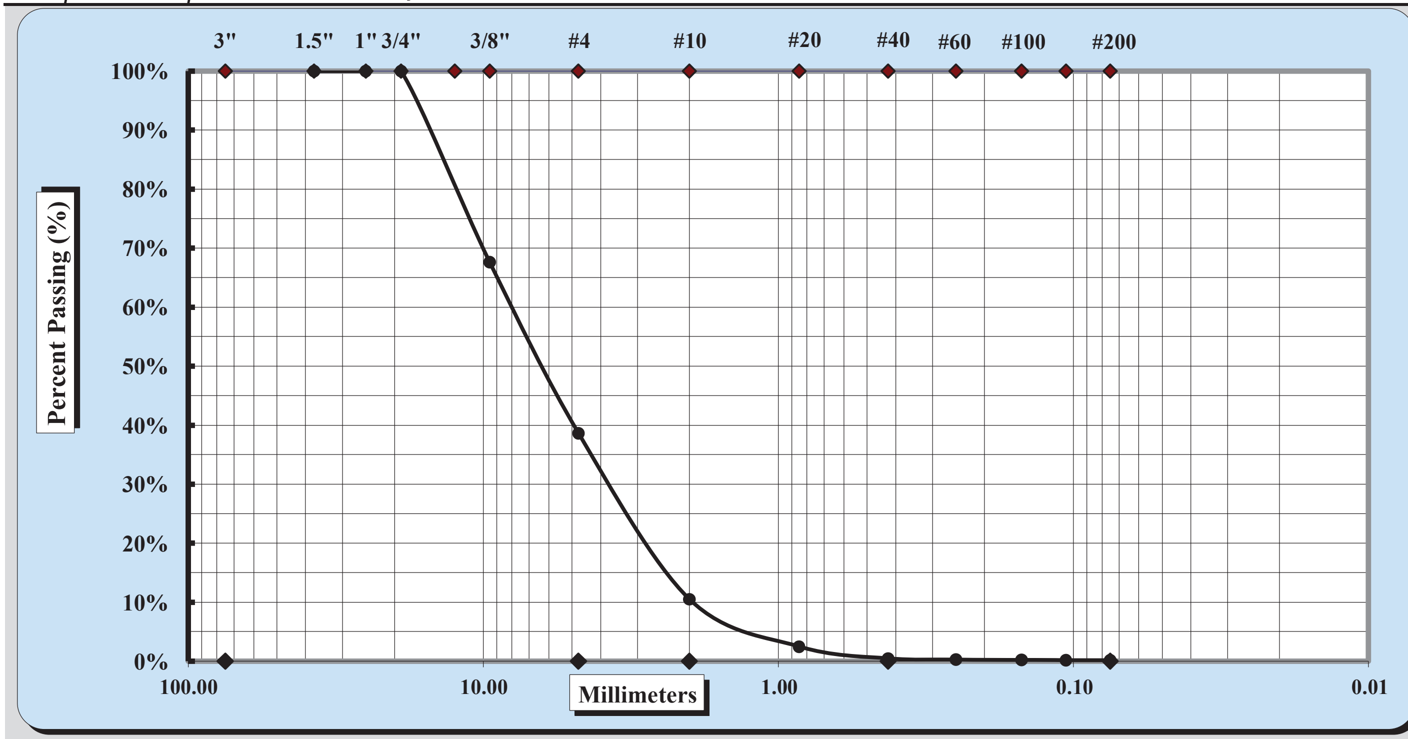
BCT1-CH

ASTM D6913 Method A

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

Project #:	**23430142**	Report Date:	2/22/2024
Project Name:	UCOR-Geotech	Test Date(s):	1/30/2024
Client Name:	RSI EnTech, LLC		
Client Address:	Oak Ridge, TN		
Sample ID: BCR0019-03	Type: REG	Sample Date:	1/4/2024
Sample Log No.: 43-4016	Sample:	Depth:	NP

Sample Description: Poorly Graded Gravel with Sand



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm (#10)		
Medium Sand	< 2.00 mm and > 0.425 mm (#40)		

Maximum Particle Size	3/4	Coarse Sand	28%	Fine Sand	0%
Gravel	61%	Medium Sand	10%	Silt & Clay	0%
Liquid Limit:	TNP	Plastic Limit:	TNP	Plastic Index:	TNP

Description of Sand & Gravel Particles: Rounded ☐ Angular ☒
Hard & Durable ☒ Soft ☐ Weathered & Friable ☐

Notes / Deviations / References:

Tyler Copeman	[signature]	Lab Services Manager	2/22/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

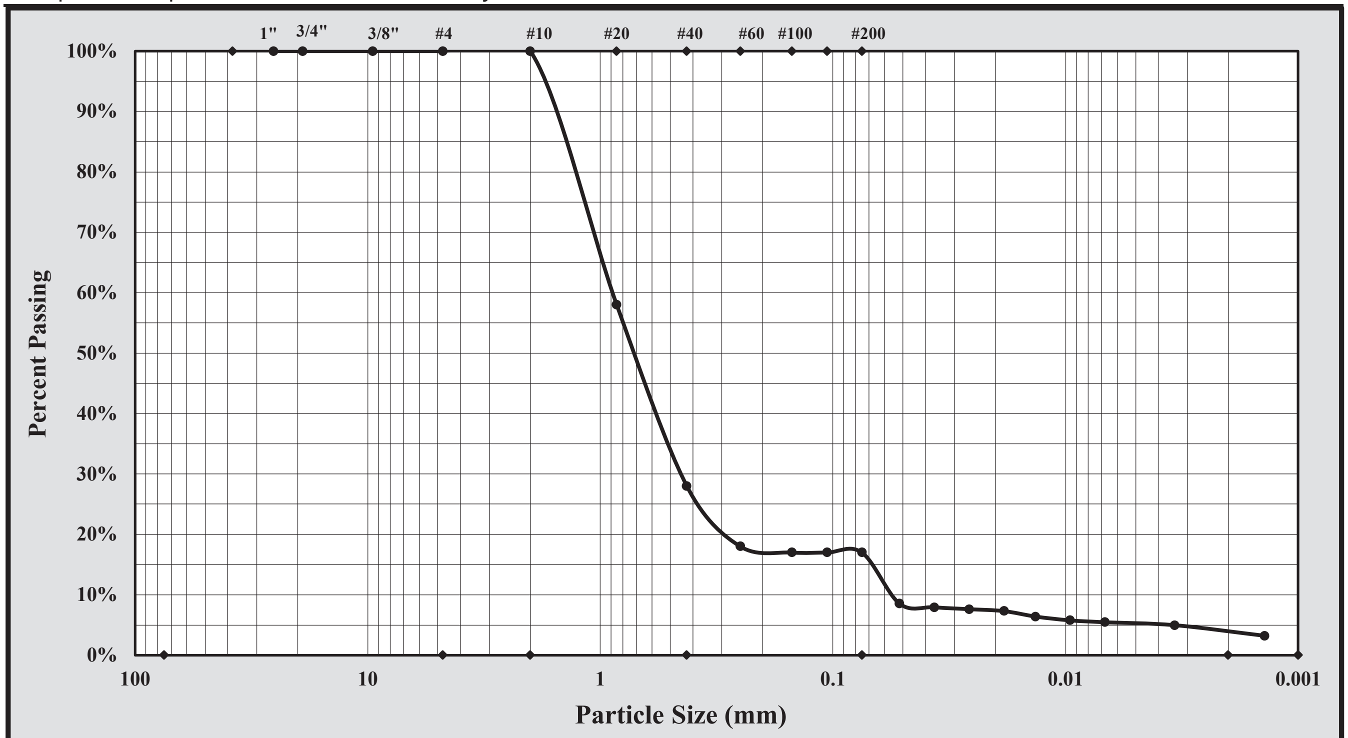
BCT2-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/23/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0020-03 Type: REG	Sample Date:	1/4/2024
		Depth:	NP

Sample Description: Brown Silty Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	72%
Silt & Clay (% Passing #200):	17%	Total Sand:	83%	Fine Sand:	11%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	3.2%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Victoria Igoe	[signature]	Senior Engineering Technician	2/23/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

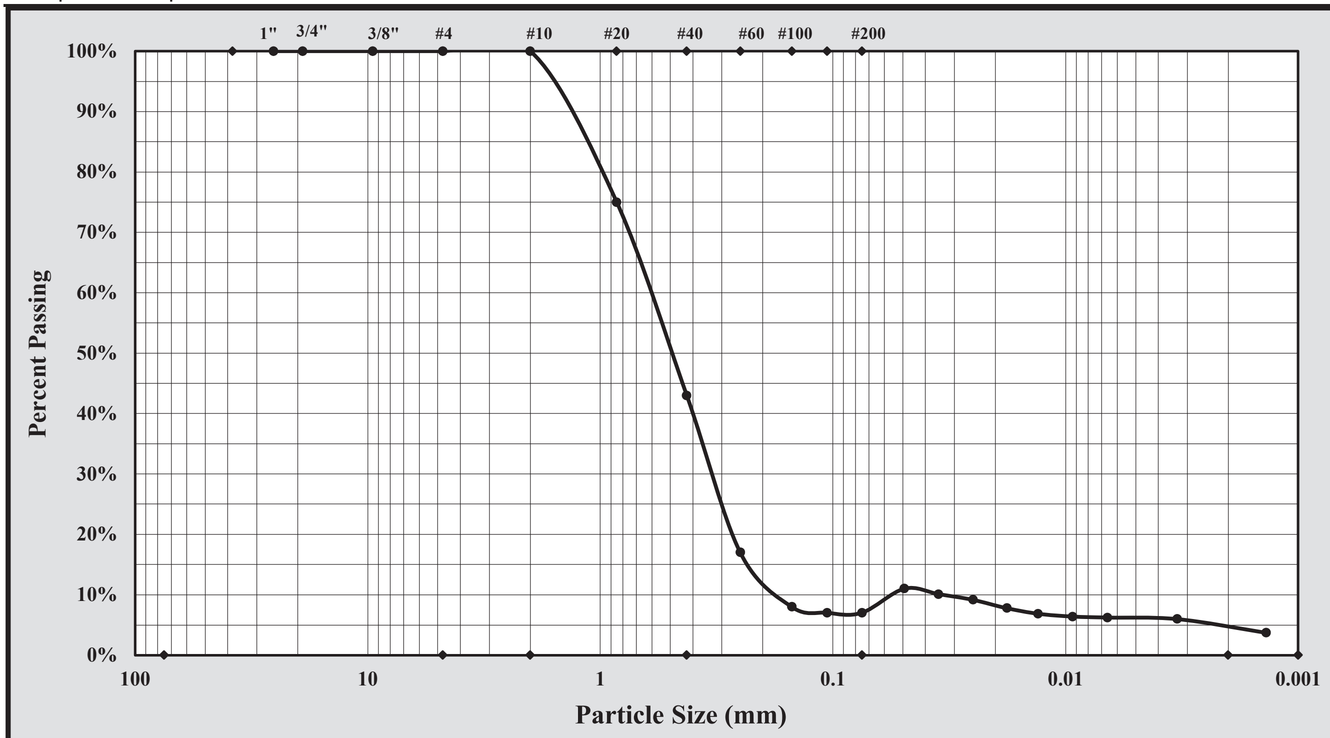
BCT3-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/23/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0021-03 Type: REG	Sample Date:	1/8/2024
		Depth:	NP

Sample Description: Brown Sand with Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	57%
Silt & Clay (% Passing #200):	7%	Total Sand:	93%	Fine Sand:	36%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	3.7%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Victoria Igoe	*(signature)*	Senior Engineering Technician	2/23/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
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Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

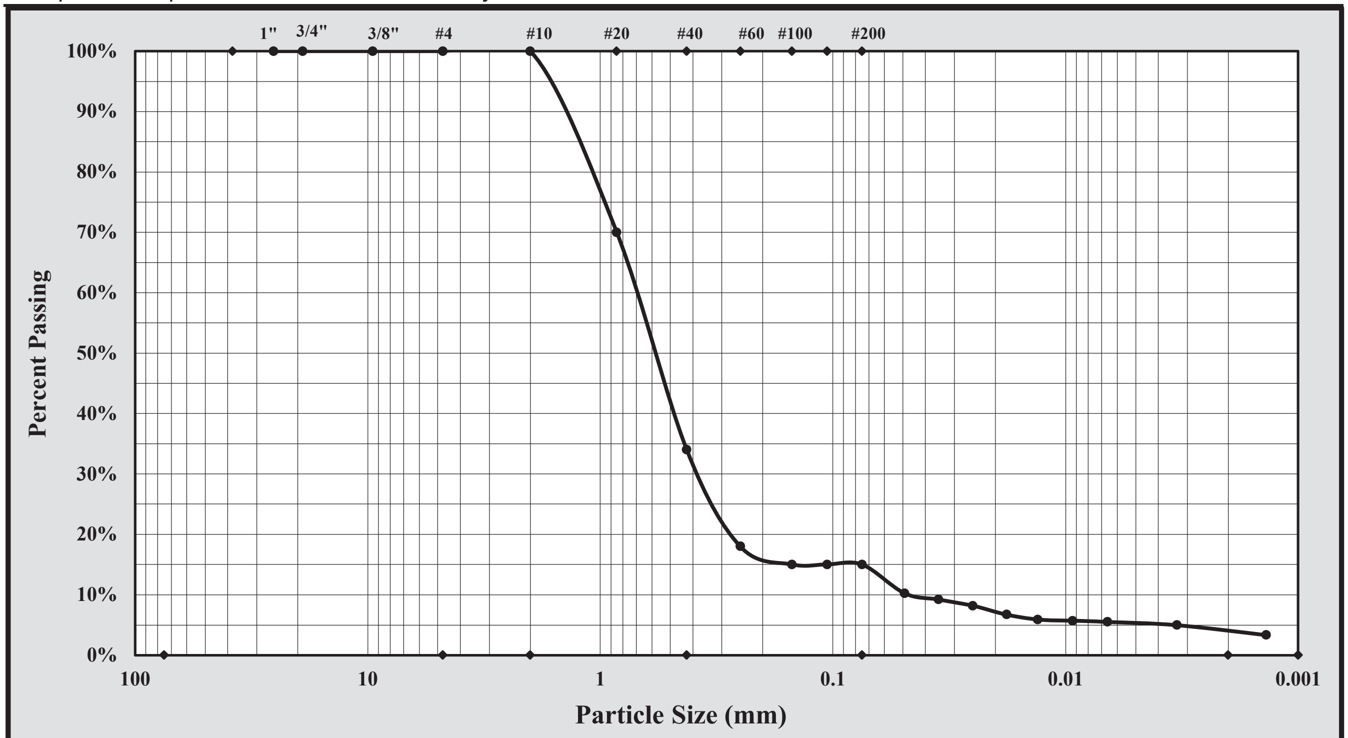
BCT4-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/23/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0022-03 Type: REG	Sample Date:	1/8/2024
		Depth:	NP

Sample Description: Brown Silty Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	66%
Silt & Clay (% Passing #200):	15%	Total Sand:	85%	Fine Sand:	19%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	3.3%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Victoria Igoe	*Victoria Igoe*	Senior Engineering Technician	2/23/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

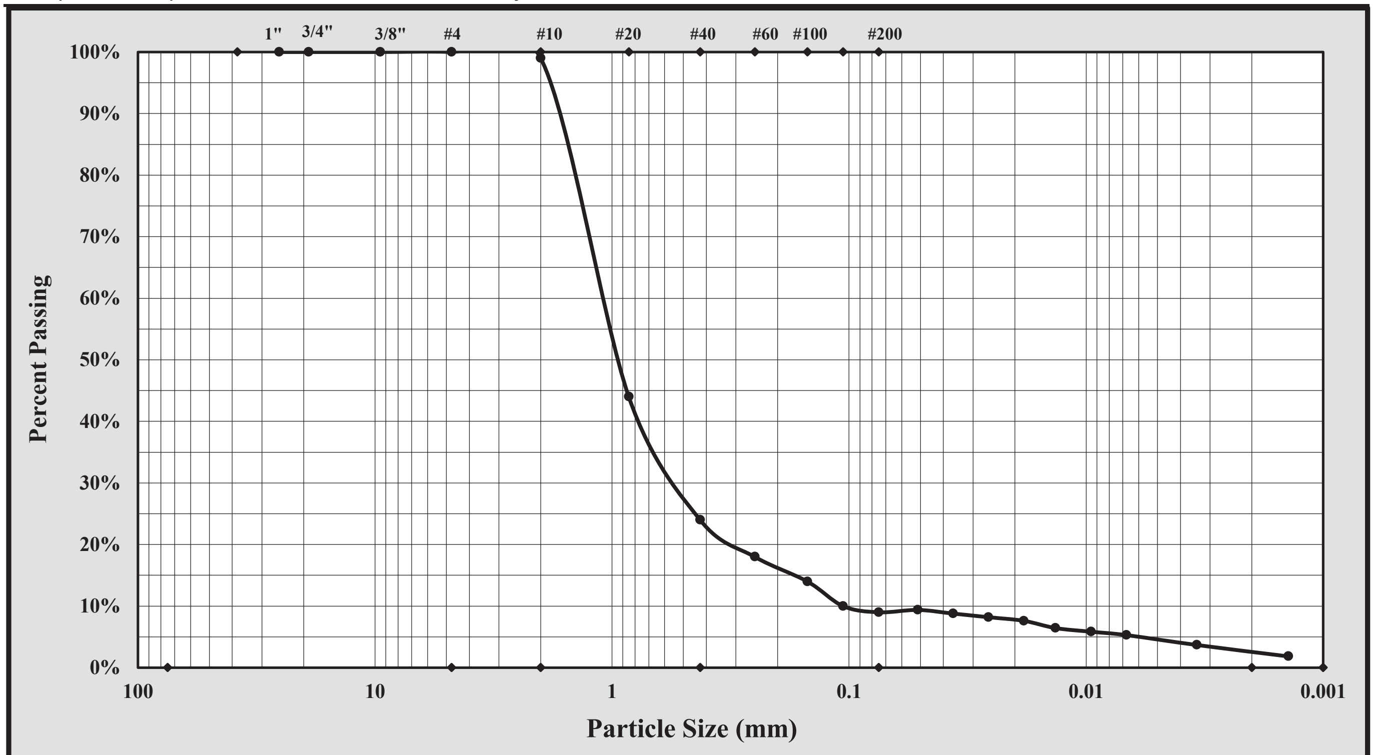
BCT5-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/8/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/3/24-3/6/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0023-04 Type: REG	Sample Date:	2/1/2024
		Depth:	NP

Sample Description: Brown Poorly Graded Sand with Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	75%
Silt & Clay (% Passing #200):	9%	Total Sand:	91%	Fine Sand:	15%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	1.8%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/8/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

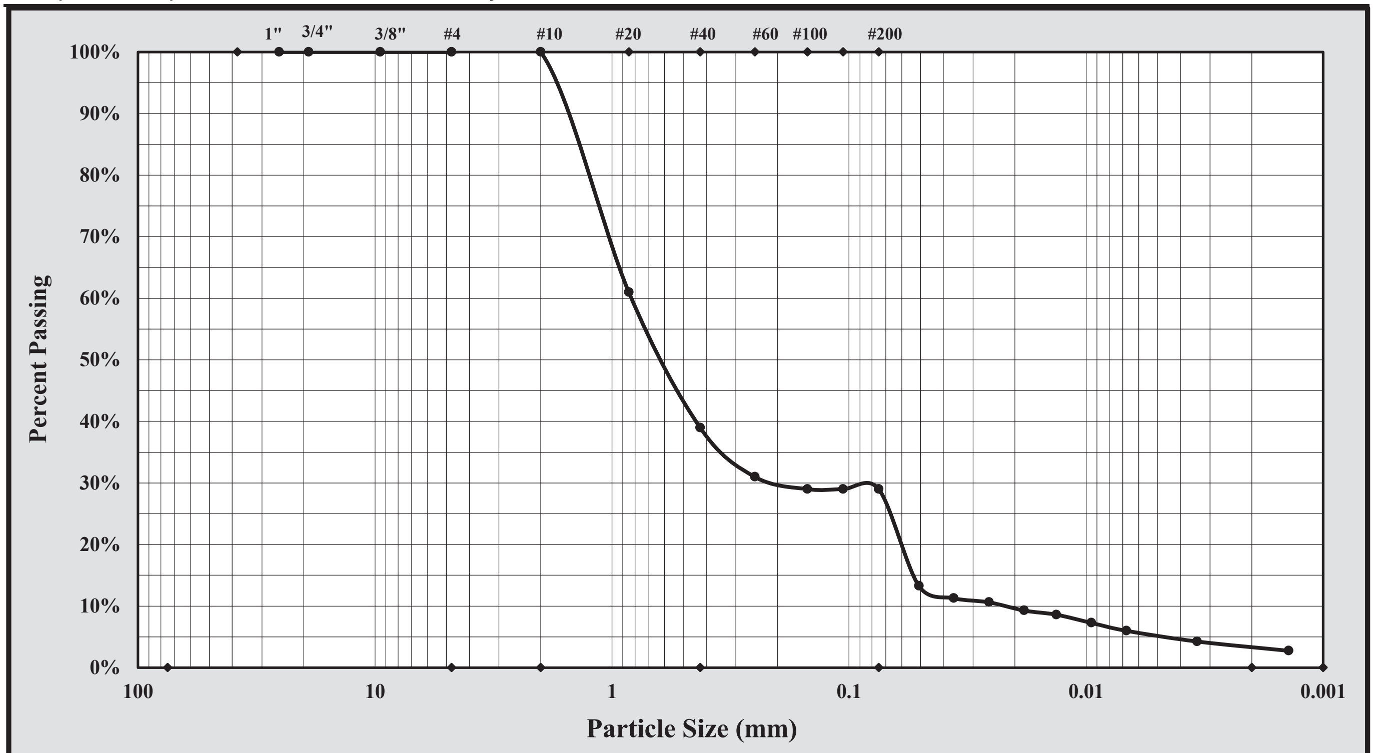
BCT6-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/8/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/3/24-3/6/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0024-04 Type: REG	Sample Date:	2/1/2024
		Depth:	NP

Sample Description: Brown Silty Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	61%
Silt & Clay (% Passing #200):	29%	Total Sand:	71%	Fine Sand:	10%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	2.7%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/8/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

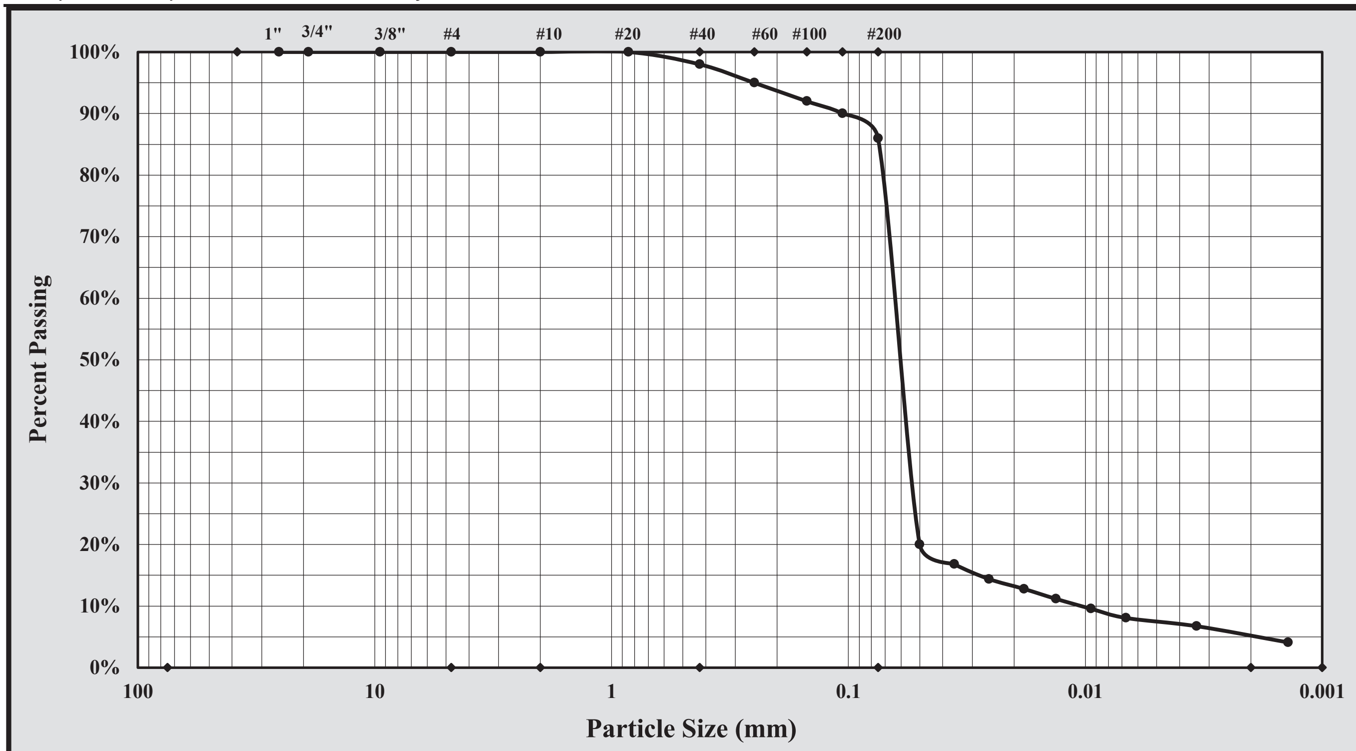
BCT7-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/8/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/3/24-3/6/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0025-04 Type: REG	Sample Date:	2/7/2024
		Depth:	NP

Sample Description: Grayish Brown Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#20	Gravel:	0%	Medium Sand:	2%
Silt & Clay (% Passing #200):	86%	Total Sand:	14%	Fine Sand:	12%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	4.1%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	Tyler Copeman (signature)	Lab Services Manager	3/8/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

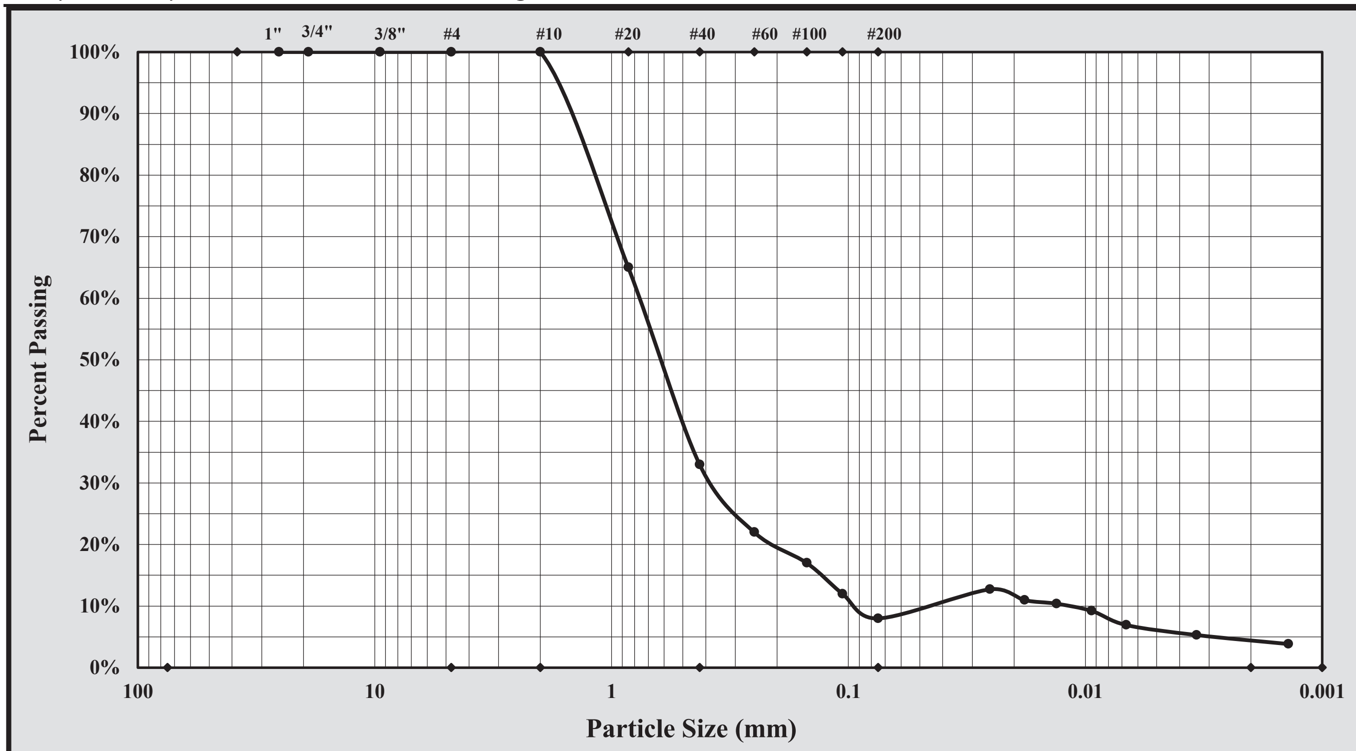
BCT8-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/19/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/7/24-3/11/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0031-04 Type: REG	Sample Date:	2/5/2024
		Depth:	NP

Sample Description: Brown Well-graded Sand with Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	67%
Silt & Clay (% Passing #200):	8%	Total Sand:	92%	Fine Sand:	25%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	3.8%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/19/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

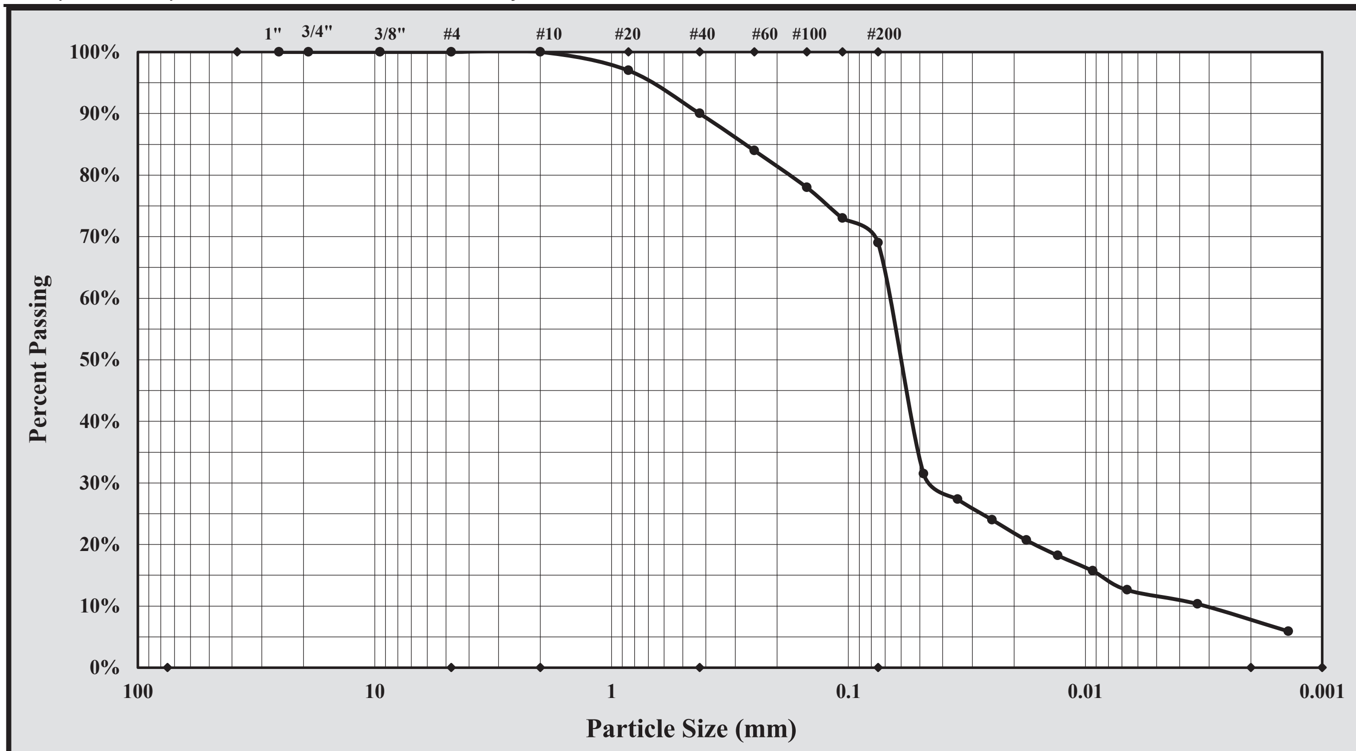
BCT9-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/8/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/3/24 - 3/6/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0028-04 Type: REG	Sample Date:	2/5/2024
		Depth:	NP

Sample Description: Brown Sandy Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8''	Gravel:	0%	Medium Sand:	10%
Silt & Clay (% Passing #200):	69%	Total Sand:	31%	Fine Sand:	21%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	5.9%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/8/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
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Revision Date: 03/18/2019
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Particle-Size Distribution

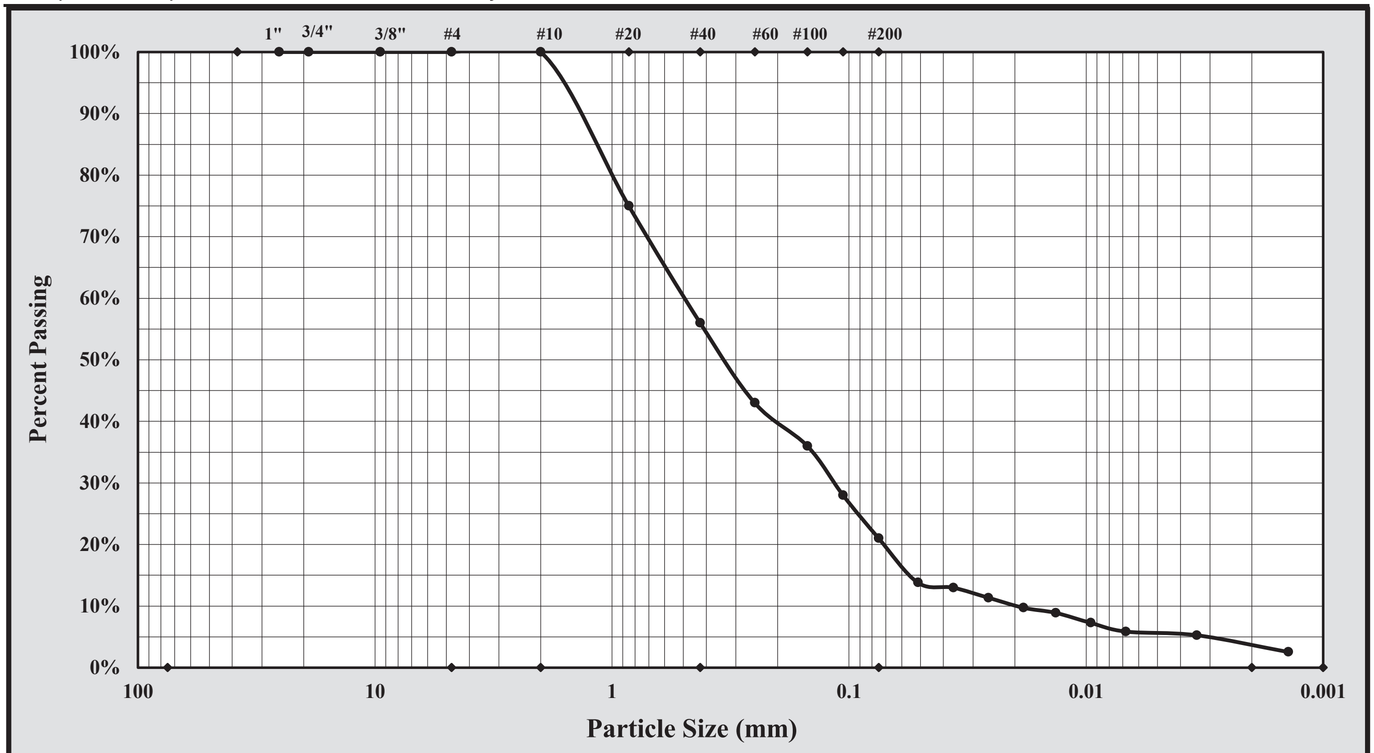
BCT10-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/12/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/3/24-3/6/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0029-03 Type: REG	Sample Date:	1/31/2024
		Depth:	NP

Sample Description: Brown Silty Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	44%
Silt & Clay (% Passing #200):	21%	Total Sand:	79%	Fine Sand:	35%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	2.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/12/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

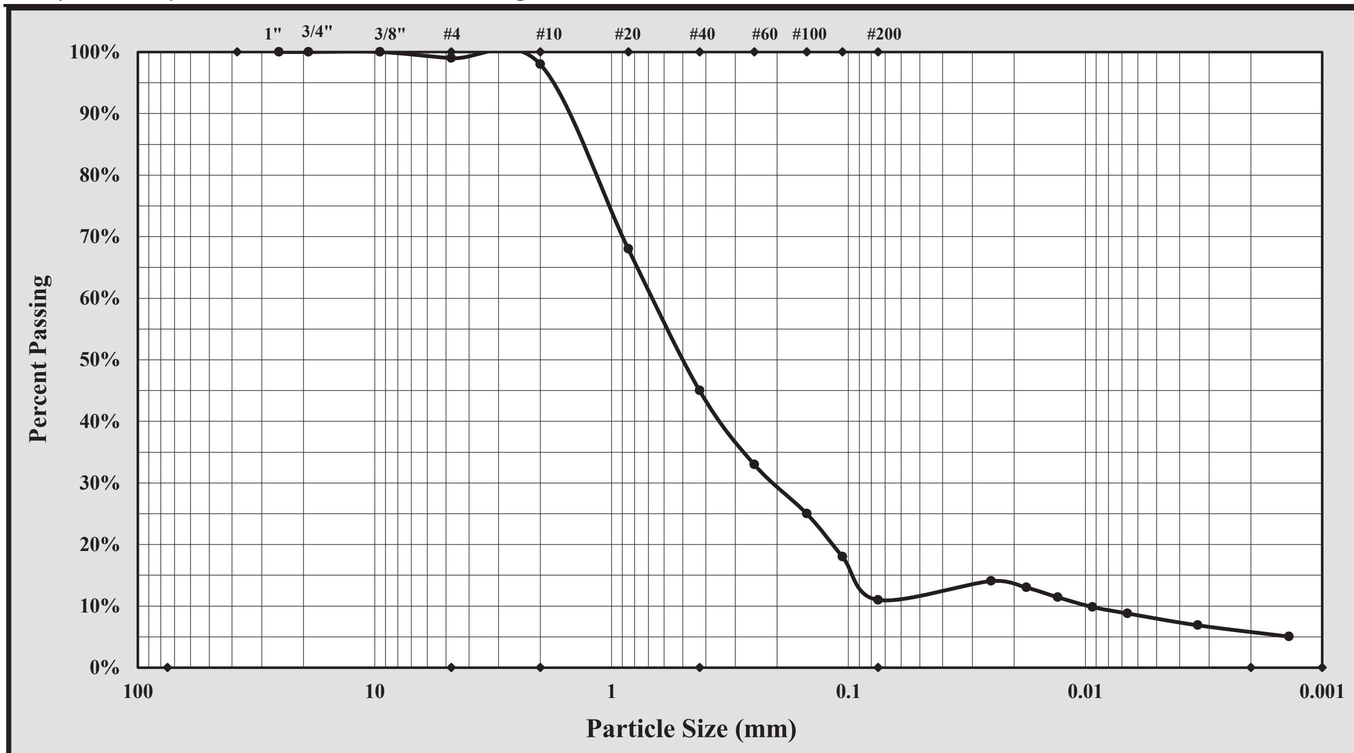
BCT11-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/12/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/7/24-3/11/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0030-04 Type: REG	Sample Date:	1/31/2024
		Depth:	NP

Sample Description: Brown Well-graded Sand with Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/8"	Gravel:	1%	Medium Sand:	53%
Silt & Clay (% Passing #200):	11%	Total Sand:	88%	Fine Sand:	34%
Assumed Specific Gravity:	2.65	Coarse Sand:	1%	Clay:	5.0%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/12/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
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Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

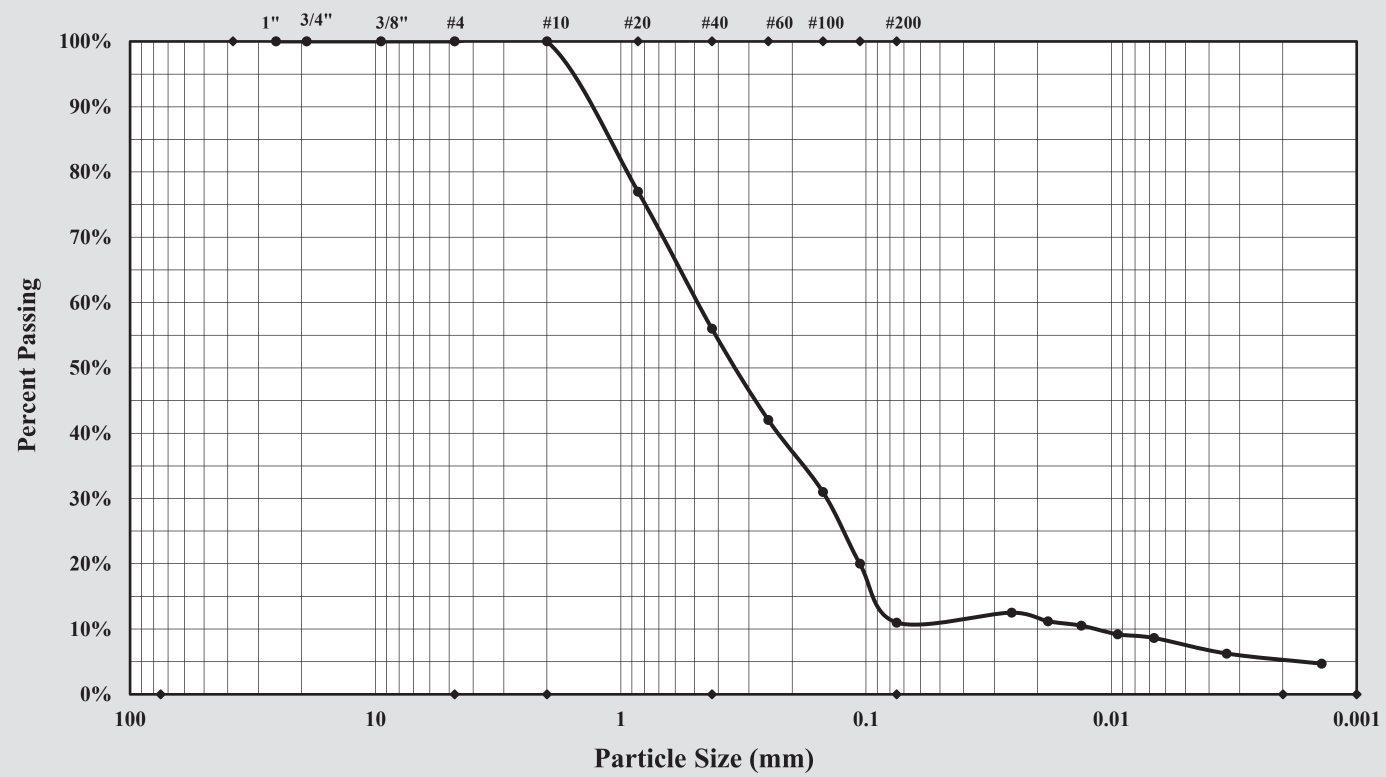
BCT12B-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/8/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/3/24-3/6/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0026-04 Type: REG	Sample Date:	1/29/2024
		Depth:	NP

Sample Description: Brown Poorly Graded Sand with Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	44%
Silt & Clay (% Passing #200):	11%	Total Sand:	89%	Fine Sand:	45%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	4.7%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman		Lab Services Manager	3/8/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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Log No.: 43-4016

Particle-Size Distribution

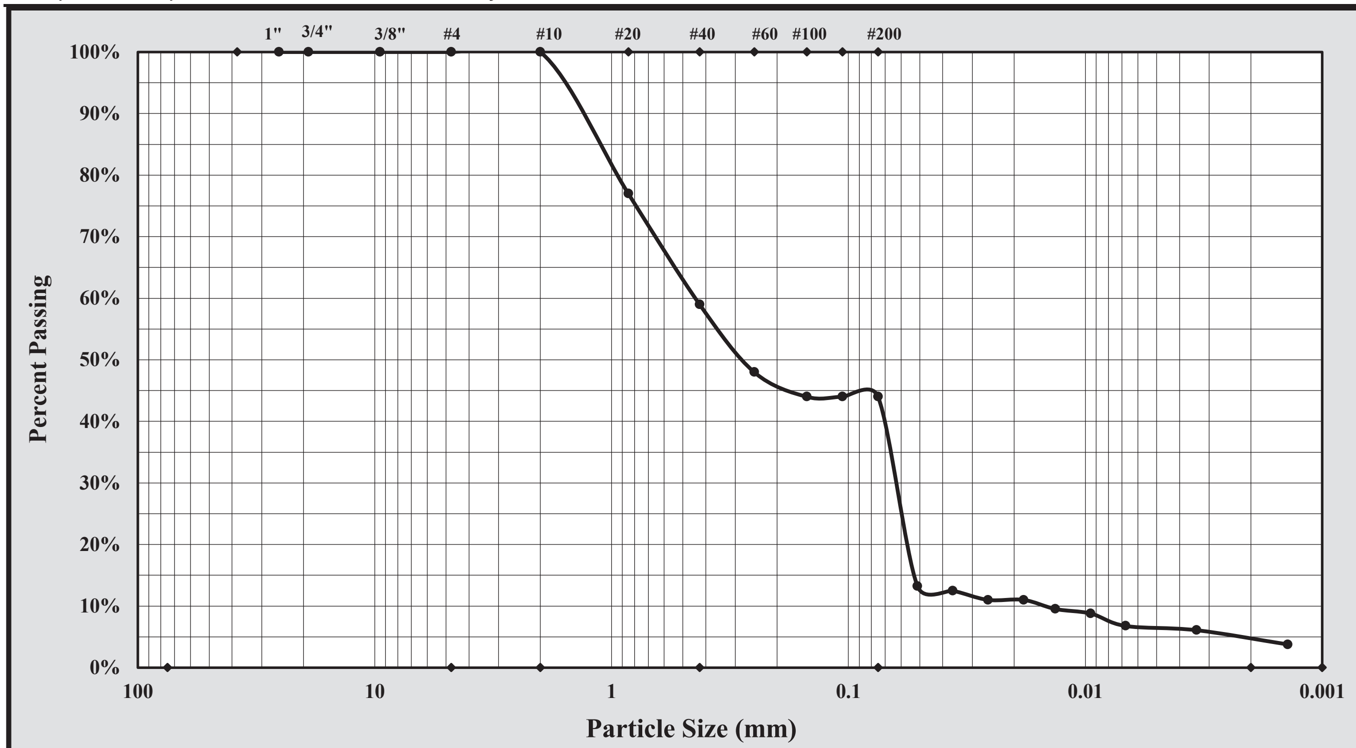
BCT12B-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/8/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/3/24-3/6/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0027-04 Type: REG	Sample Date:	1/29/2024
		Depth:	NP

Sample Description: Brown Silty Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	41%
Silt & Clay (% Passing #200):	44%	Total Sand:	56%	Fine Sand:	15%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	3.8%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	Tyle Cop	Lab Services Manager	3/8/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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Particle-Size Distribution

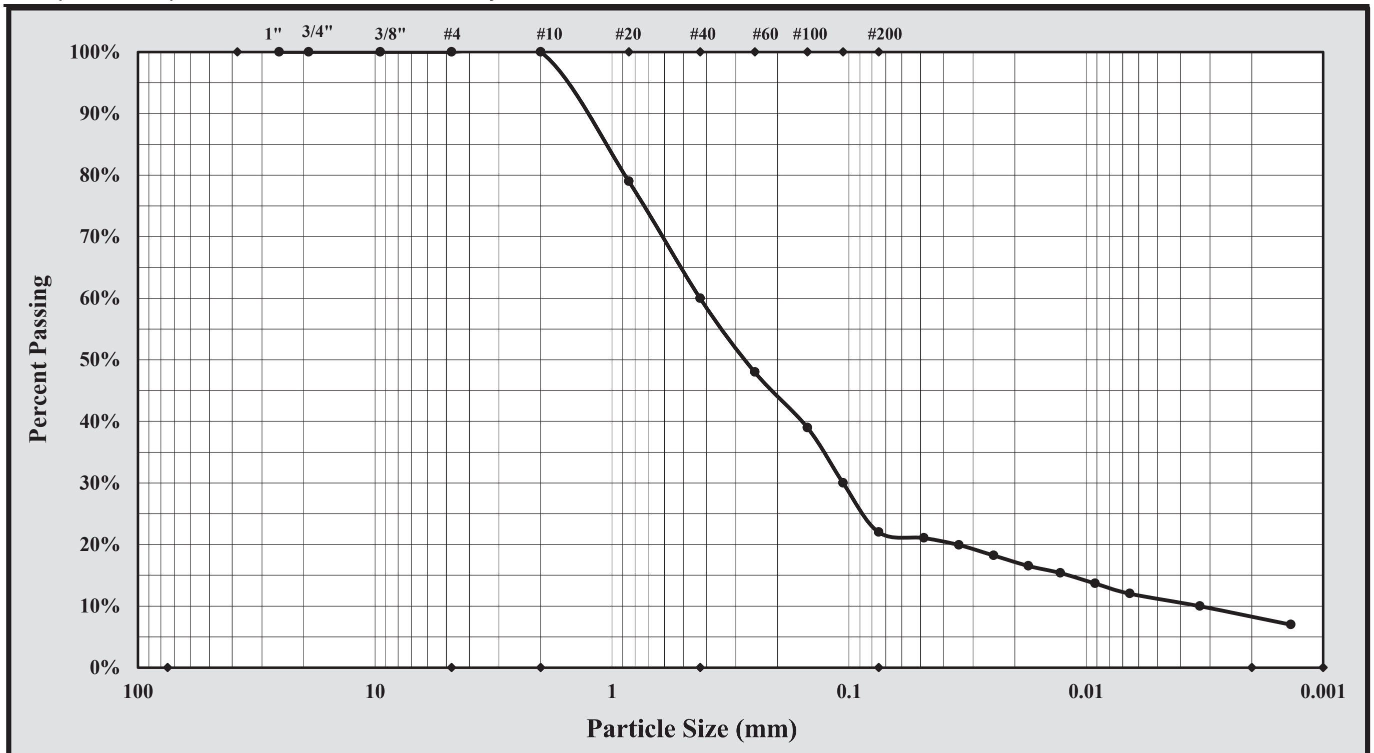
BCT12A-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/18/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/12/24-3/14/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0103-03 Type: REG	Sample Date:	1/29/2024
		Depth:	NP

Sample Description: Brown Silty Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#4	Gravel:	0%	Medium Sand:	40%
Silt & Clay (% Passing #200):	22%	Total Sand:	78%	Fine Sand:	38%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	8.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/18/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

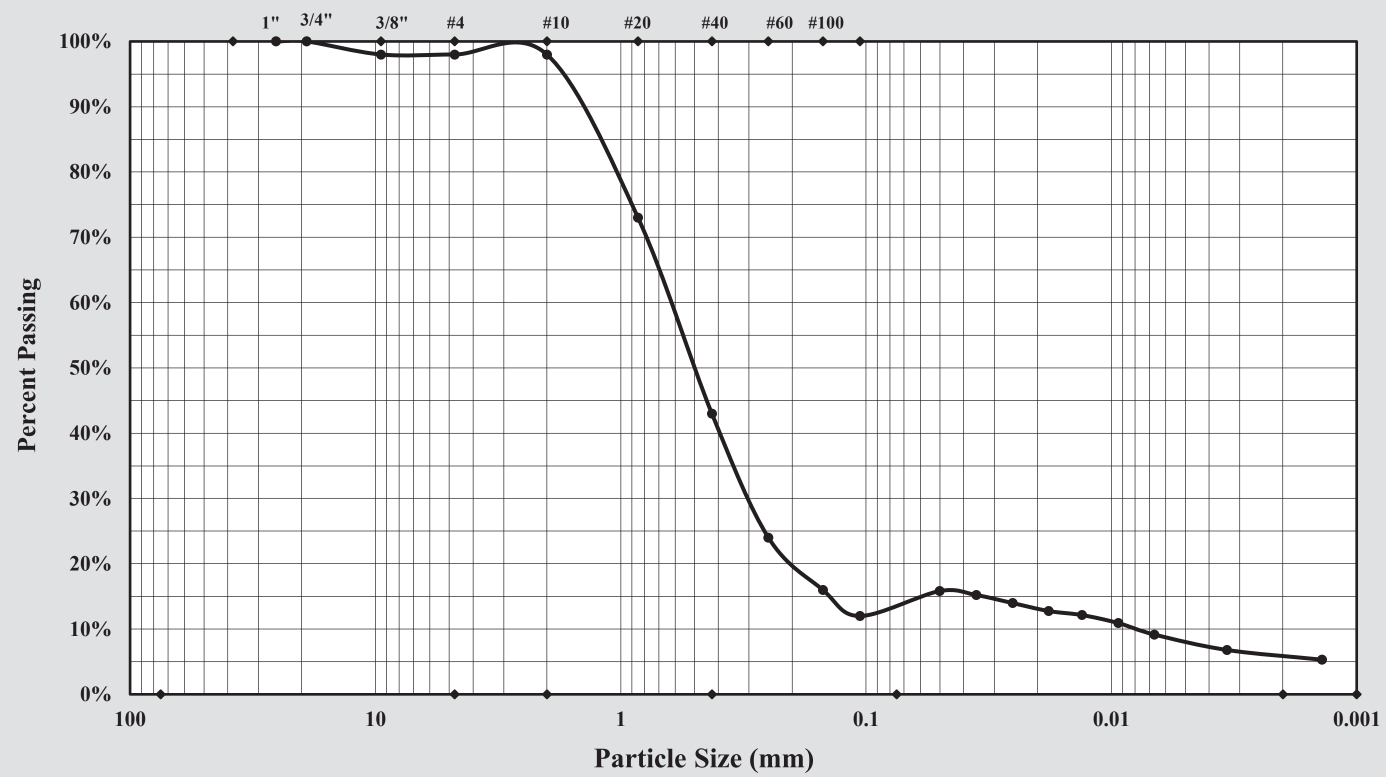
BCT13-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/12/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/7/24-3/11/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0032-03 Type: REG	Sample Date:	1/29/2024
		Depth:	NP

Sample Description: Brown Well-graded Sand with Silt



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4"	Gravel:	2%	Medium Sand:	55%
Silt & Clay (% Passing #200):	8%	Total Sand:	90%	Fine Sand:	35%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	5.3%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/12/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

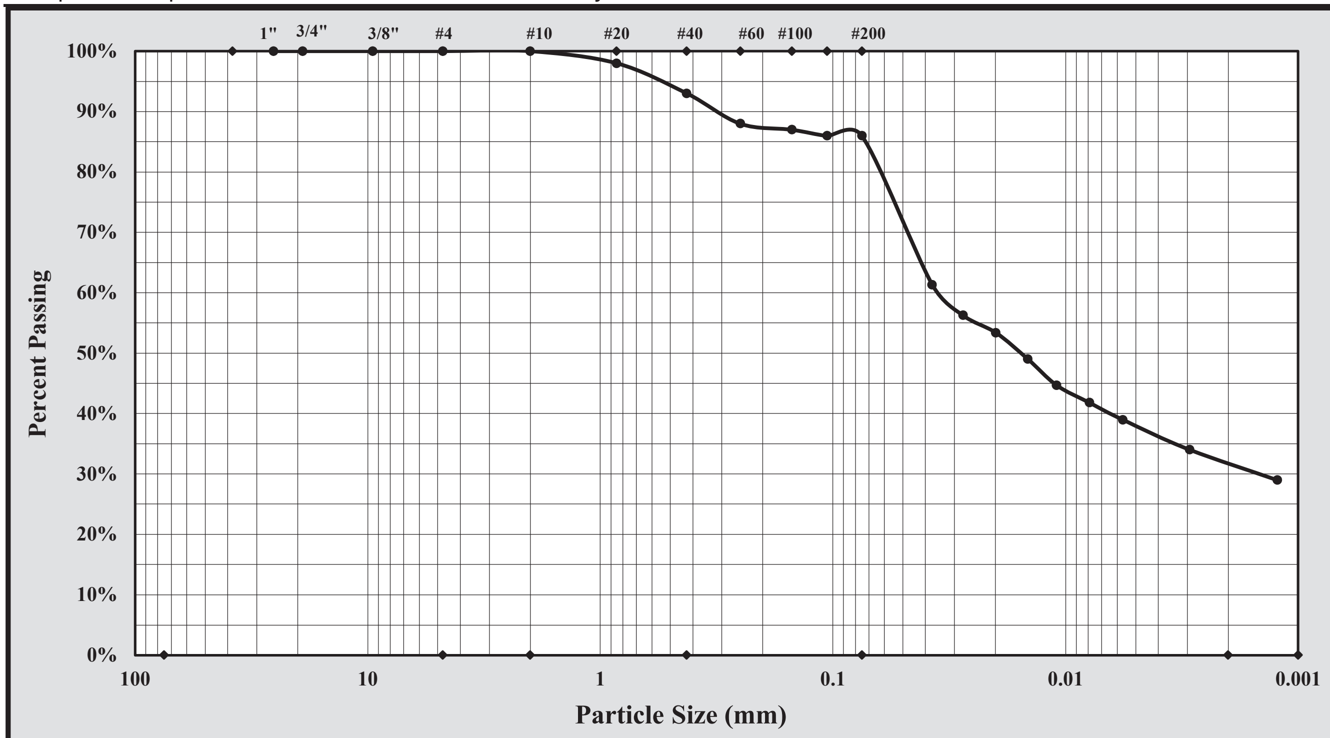
BCT14-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/23/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0033-04 Type: REG	Sample Date:	1/2/2024
		Depth:	NP

Sample Description: Yellowish Brown Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	7%
Silt & Clay (% Passing #200):	86%	Total Sand:	14%	Fine Sand:	7%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	29.0%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Victoria Igoe	*[signature]*	Senior Engineering Technician	2/23/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

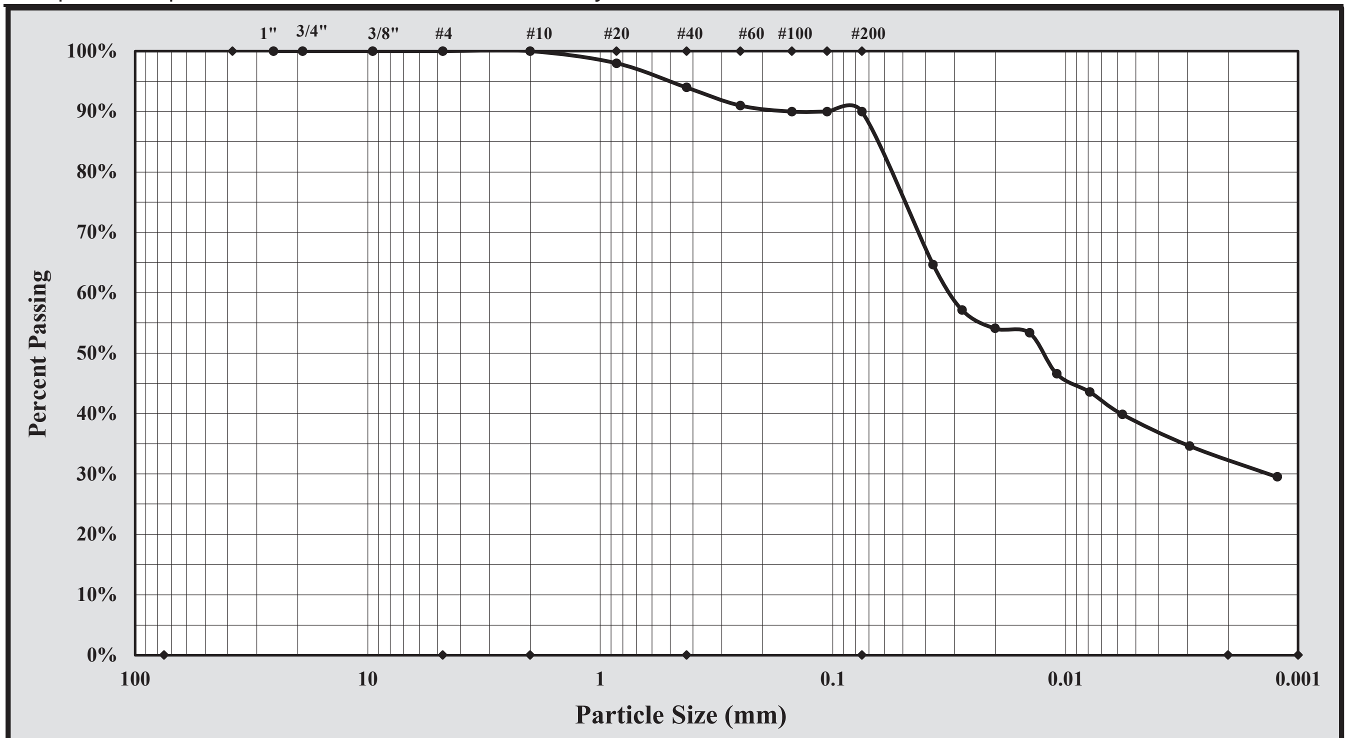
BCT14-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/23/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0034-04 Type: REG	Sample Date:	1/2/2024
		Depth:	NP

Sample Description: Yellowish Brown Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	6%
Silt & Clay (% Passing #200):	90%	Total Sand:	10%	Fine Sand:	4%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	29.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Victoria Igoe	[signature]	Senior Engineering Technician	2/23/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

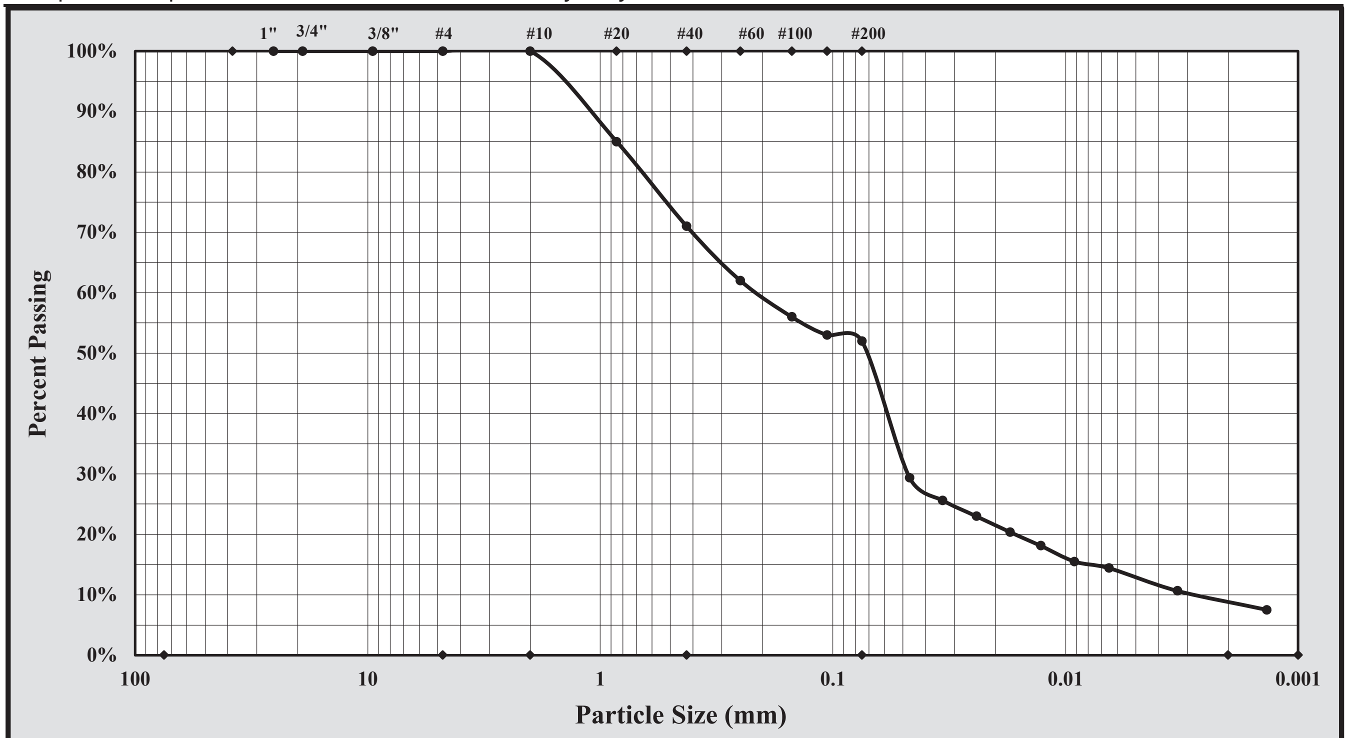
BCT15-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	2/23/2024
Project Name:	UCOR-Geotech	Test Start Date:	2/1/2024
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0035-03 Type: REG	Sample Date:	1/3/2024
		Depth:	NP

Sample Description: Dark Brown Sandy Clay



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	#10	Gravel:	0%	Medium Sand:	29%
Silt & Clay (% Passing #200):	52%	Total Sand:	48%	Fine Sand:	19%
Assumed Specific Gravity:	2.65	Coarse Sand:	0%	Clay:	7.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Victoria Igoe	*[signature]*	Senior Engineering Technician	2/23/2024
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D7928-3
Revision No. 0
Revision Date: 03/18/2019
Log No.: 43-4016

Particle-Size Distribution

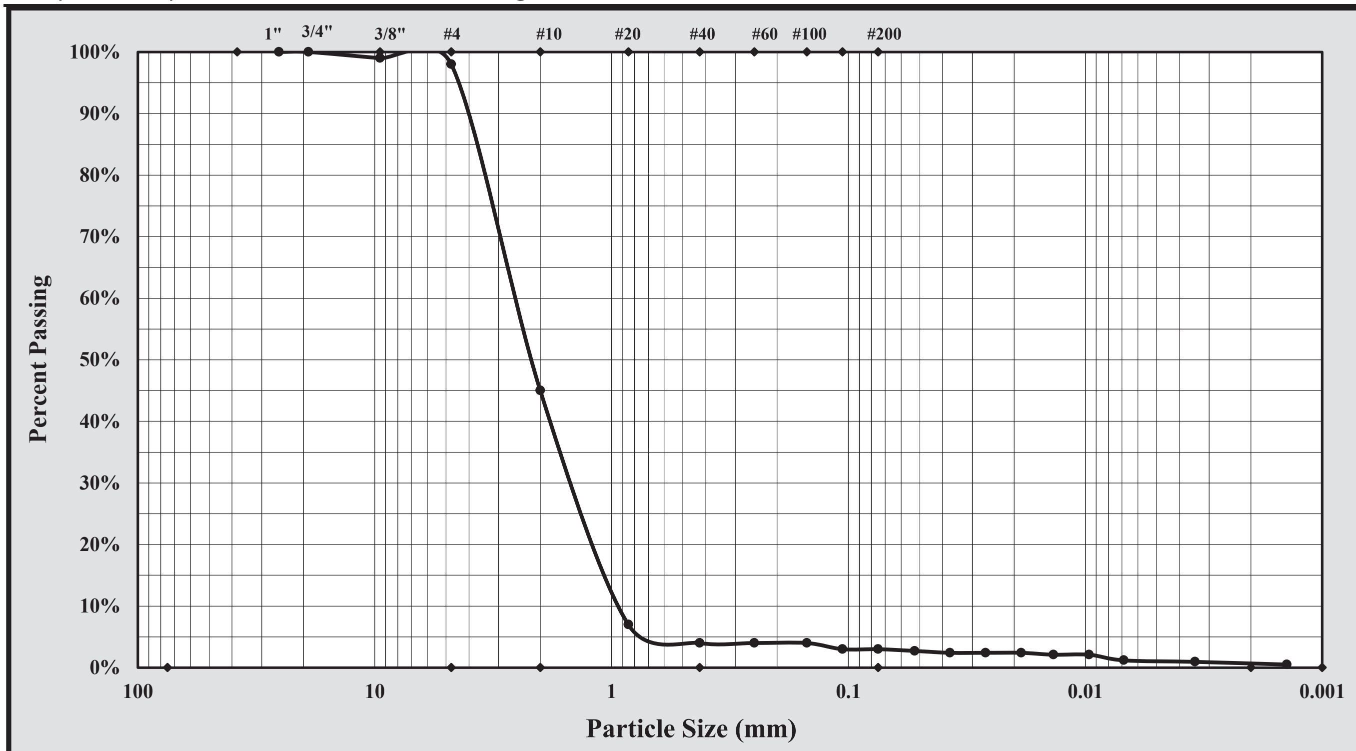
HCTREF-CH

ASTM D7928 & D6913

S&ME, Inc., 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	23430142	Report Date:	3/12/2024
Project Name:	UCOR-Geotech	Test Start Date:	3/7/24-3/11/24
Client Name:	RSI EnTech, LLC		
Address:	203 Victorious Blvd., Oak Ridge, TN 37830		
Sample ID:	BCR0036-04 Type: REG	Sample Date:	2/2/2024
		Depth:	NP

Sample Description: Brown Well-graded Sand



Cobbles	< 300 mm (12") and > 75 mm	Fine Sand	< 0.425 mm and > 0.075 mm
Gravel	< 75 mm and > 4.75 mm (#4)	Silt and Clay	< 0.075 mm
Coarse Sand	< 4.75 mm and >2.00 mm	Clay	<0.002 mm
Medium Sand	< 2.00 mm and > 0.425 mm		

Maximum Particle Size:	3/4''	Gravel:	2%	Medium Sand:	41%
Silt & Clay (% Passing #200):	3%	Total Sand:	95%	Fine Sand:	1%
Assumed Specific Gravity:	2.65	Coarse Sand:	53%	Clay:	0.5%
Liquid Limit	TNP	Plastic Limit	TNP	Plastic Index	TNP

References / Comments / Deviations:

Tyler Copeman	[signature]	Lab Services Manager	3/12/2024
Technical Responsibility	*Signature*	*Position*	*Date*

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APPENDIX E.
BEAR CREEK VALLEY REMEDIAL SITE EVALUATION ANALYTE CORRELATIONS

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E.1. MULTIVARIATE ANALYSIS

Results of analyses of Bear Creek floodplain and bank soil samples (combined) and Bear Creek channel sediment samples were evaluated for analyte pairwise and multivariate correlation. Correlations range from -1 (perfect negative correlation) to +1 (perfect positive correlation). Negative correlations indicate that, as concentrations of one variable increase, the concentrations of the second variable decrease. Positive correlations indicate that, as concentrations of one variable increase, the concentrations of the second variable also increase. Correlations close to zero indicate no correlation between the variables. When all concentrations for both pairs of variables were detected, the Pearson correlation was calculated because it uses all the information available in ratio concentration data. When at least one concentration in either variable was not detected, Kendall's tau correlation was calculated because it allows for non-detections (Helsel 2005). With each correlation, a two-sided *p*-value was also calculated to test the null hypothesis of zero correlation versus the alternative hypothesis that the correlation is not zero. A *p*-value is the probability of observing a test statistic at least as large as the one observed given the null hypothesis is true. A significance level of 0.05 was used to determine whether a correlation was significantly different from zero. At least one-half of the concentrations for both variables must be detected to calculate the correlation. Individual pairwise significance levels were not adjusted for multiple comparisons because the purpose of the correlations was to identify analytes as potential candidate variables for multivariate regressions.

The pairwise correlation tables were used to identify analytes that are significantly correlated with mercury in soil and sediment. The tables contain the correlation coefficient for each analyte pair and use a color scheme to reflect the degree of significance of each correlation pair. Correlations that test the null hypothesis of zero correlation and are significant at the 0.05 significance level are highlighted by significance. Table E.1 contains all pairwise correlations for floodplain and creek bank soil combined. Table E.2 contains all pairwise correlations for floodplain and creek bank soil combined for particle size #10. Table E.3 contains all pairwise correlations for all sediment combined. To examine correlation with particle size, Table E.4 contains all pairwise correlations for sediment combined for particle size #10. There were insufficient sediment data to calculate correlations for the other particle sizes.

Combinations resulting in correlations that are significant at the 0.05 significance level are highlighted by significance:

- Two-sided *p*-values ranging between 0.01 and 0.05 are highlighted in blue.
- Two-sided *p*-values ranging between 0.001 and < 0.01 are highlighted in green.
- Two-sided *p*-values ranging between 0.0001 and < 0.001 are highlighted in yellow.
- Two-sided *p*-values that are < 0.0001 are highlighted in red.

Non-highlighted correlations are not significant at the 0.05 significance level. Two-sided *p*-values for correlations are highly influenced by the number of samples used in the correlations. For example, a correlation of 0.8 will likely be highly significant when the number of samples (n) = 48 samples are used, but may not be significant when n = 3.

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Table E.1. Analyte pairwise correlation matrix for Bear Creek floodplain and creek bank soils

Chemical	Freq. of detection	Anions				Sequential extraction							Other inorganics	Wet chemistry	
		Chloride	Fluoride	Nitrate	Sulfate	Mercury (F1)	Mercury (F2)	Mercury (F3)	Mercury (F4)	Mercury (F5)	Mercury (F6)	Mercury (FS)	Methylmercury	Sulfide	TOC
Chloride	48 / 48	NA	0.067	0.219	0.853	0.061	0.076	0.061	0.107	-0.305	-0.443	-0.311	-0.003	0.091	-0.061
Fluoride	48 / 48	0.067	NA	0.155	0.277	0.667	0.473	0.667	0.687	0.866	0.168	0.933	0.089	-0.050	0.145
Nitrate	44 / 48	0.219	0.155	NA	0.167	0.424	0.412	0.485	0.382	0.455	0.290	0.473	0.332	-0.089	0.468
Sulfate	48 / 48	0.853	0.277	0.167	NA	-0.121	-0.290	-0.182	-0.076	-0.543	-0.382	-0.492	0.100	-0.010	0.052
Aluminum	48 / 48	0.255	0.458	0.111	0.343	0.394	0.382	0.333	0.412	0.039	0.229	0.186	0.068	0.093	0.337
Arsenic	48 / 48	0.070	0.316	0.166	0.165	0.321	0.492	0.260	0.339	0.109	0.339	0.185	0.196	0.034	0.430
Barium	48 / 48	0.092	0.452	0.264	0.322	0.364	0.168	0.364	0.321	0.072	-0.137	0.104	0.319	0.051	0.387
Beryllium	46 / 48	0.257	-0.093	0.245	0.217	0.061	0.107	0.061	0.076	0.091	-0.351	0.076	0.081	0.140	0.092
Boron	26 / 48	0.347	0.003	0.282	0.213	0.254	0.288	0.191	0.288	0.350	-0.144	0.208	0.100	0.189	0.176
Cadmium	48 / 48	0.029	0.792	0.433	0.303	0.485	0.534	0.485	0.504	0.724	0.015	0.872	0.529	0.039	0.466
Calcium	48 / 48	0.071	0.395	0.372	0.355	-0.061	-0.168	-0.121	-0.015	-0.318	-0.351	-0.247	0.324	-0.056	0.385
Chromium	48 / 48	0.216	0.142	0.068	0.254	-0.031	0.140	-0.031	-0.016	-0.326	-0.016	-0.259	0.092	0.121	0.292
Cobalt	48 / 48	0.205	0.538	0.220	0.376	0.182	0.351	0.182	0.199	0.354	0.015	0.237	0.160	0.092	0.308
Copper	48 / 48	-0.137	0.629	0.257	0.023	0.576	0.595	0.515	0.565	0.750	0.473	0.889	0.383	0.152	0.598
Iron	48 / 48	0.473	0.113	0.089	0.502	0.062	0.171	0.000	0.078	-0.226	-0.016	-0.196	0.095	0.119	-0.004
Lead	48 / 48	-0.018	0.617	0.212	0.047	0.485	0.718	0.485	0.504	0.862	0.382	0.941	0.234	0.098	0.494
Lithium	48 / 48	-0.101	0.781	0.226	0.088	0.424	0.443	0.364	0.473	0.416	0.137	0.566	0.394	0.057	0.477
Magnesium	48 / 48	-0.002	0.145	0.127	0.232	-0.242	-0.290	-0.242	-0.199	-0.389	-0.473	-0.359	0.234	0.105	0.442
Manganese	48 / 48	0.132	0.435	0.226	0.339	0.273	0.076	0.273	0.229	0.215	-0.168	0.198	0.250	0.032	0.347
Mercury	48 / 48	-0.097	0.551	0.373	0.119	0.939	0.809	0.939	0.962	0.843	0.260	0.977	0.546	-0.031	0.464
Molybdenum	32 / 48	0.015	0.350	0.102	-0.045	0.599	0.523	0.599	0.604	0.399	0.181	0.604	0.172	-0.178	0.051
Nickel	48 / 48	0.097	0.624	0.394	0.334	0.424	0.565	0.424	0.473	0.657	0.199	0.805	0.438	0.077	0.469
Phosphorous	48 / 48	-0.247	0.233	0.416	-0.092	0.394	0.473	0.394	0.443	0.164	0.168	0.308	0.553	0.090	0.907
Potassium	48 / 48	0.048	-0.016	0.210	0.141	-0.121	0.076	-0.121	-0.076	-0.121	0.076	-0.070	0.130	0.167	0.348
Selenium	48 / 48	-0.157	0.595	0.132	0.038	0.154	0.202	0.215	0.109	0.610	0.326	0.557	0.119	0.050	0.417
Silicon	48 / 48	0.147	0.435	0.192	0.235	0.788	0.840	0.788	0.809	0.680	0.137	0.669	0.207	-0.069	0.210
Sodium	32 / 48	0.635	0.321	0.197	0.394	-0.061	-0.076	-0.061	-0.046	-0.091	-0.504	-0.046	0.033	0.157	0.182
Strontium	48 / 48	0.204	0.662	0.313	0.459	0.394	0.290	0.333	0.443	0.051	-0.137	0.231	0.339	-0.057	0.461
Uranium	48 / 48	-0.113	0.373	0.342	-0.178	0.606	0.534	0.667	0.565	0.728	0.199	0.843	0.479	0.025	0.416
Vanadium	48 / 48	0.131	0.210	0.021	0.106	0.273	0.382	0.212	0.290	0.017	0.229	0.131	0.023	0.174	0.357
Zinc	48 / 48	-0.146	0.638	0.316	0.086	0.394	0.473	0.333	0.443	0.395	0.412	0.563	0.465	0.112	0.731
Mercury (F1)	16 / 18	0.061	0.667	0.424	-0.121	NA	0.779	0.862	0.768	0.673	0.211	0.911	0.290	-0.061	0.273
Mercury (F2)	13 / 18	0.076	0.473	0.412	-0.290	0.779	NA	0.801	0.743	0.653	0.170	0.824	0.092	0.046	0.229
Mercury (F3)	17 / 18	0.061	0.667	0.485	-0.182	0.862	0.801	NA	0.749	0.603	0.131	0.931	0.290	-0.061	0.273
Mercury (F4)	14 / 18	0.107	0.687	0.382	-0.076	0.768	0.743	0.749	NA	0.631	0.208	0.772	0.308	-0.046	0.260
Mercury (F5)	18 / 18	-0.305	0.866	0.455	-0.543	0.673	0.653	0.603	0.631	NA	0.257	0.557	0.076	0.152	0.155
Mercury (F6)	16 / 18	-0.443	0.168	0.290	-0.382	0.211	0.170	0.131	0.208	0.257	NA	0.191	-0.092	-0.046	0.229
Mercury (FS)	18 / 18	-0.311	0.933	0.473	-0.492	0.911	0.824	0.931	0.772	0.557	0.191	NA	0.277	-0.046	0.386
Methylmercury	43 / 48	-0.003	0.089	0.332	0.100	0.290	0.092	0.290	0.308	0.076	-0.092	0.277	NA	-0.078	0.569
Sulfide	45 / 48	0.091	-0.050	-0.089	-0.010	-0.061	0.046	-0.061	-0.046	0.152	-0.046	-0.046	-0.078	NA	0.027
TOC	48 / 48	-0.061	0.145	0.468	0.052	0.273	0.229	0.273	0.260	0.155	0.229	0.386	0.569	0.027	NA

Table E.1. Analyte pairwise correlation matrix for Bear Creek floodplain and creek bank soils (cont.)

Chemical	Freq. of detection	Metals													
		Aluminum	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium
Chloride	48 / 48	0.255	0.070	0.092	0.257	0.347	0.029	0.071	0.216	0.205	-0.137	0.473	-0.018	-0.101	-0.002
Fluoride	48 / 48	0.458	0.316	0.452	-0.093	0.003	0.792	0.395	0.142	0.538	0.629	0.113	0.617	0.781	0.145
Nitrate	44 / 48	0.111	0.166	0.264	0.245	0.282	0.433	0.372	0.068	0.220	0.257	0.089	0.212	0.226	0.127
Sulfate	48 / 48	0.343	0.165	0.322	0.217	0.213	0.303	0.355	0.254	0.376	0.023	0.502	0.047	0.088	0.232
Aluminum	48 / 48	NA	0.650	0.421	0.089	0.124	0.551	0.194	0.612	0.590	0.595	0.665	0.681	0.529	0.315
Arsenic	48 / 48	0.650	NA	0.107	-0.026	0.117	0.356	0.153	0.627	0.293	0.591	0.439	0.619	0.530	0.014
Barium	48 / 48	0.421	0.107	NA	0.268	-0.068	0.740	0.335	0.045	0.918	0.346	0.047	0.310	0.331	0.577
Beryllium	46 / 48	0.089	-0.026	0.268	NA	0.270	0.086	0.094	0.094	0.219	0.039	0.150	-0.010	-0.049	0.334
Boron	26 / 48	0.124	0.117	-0.068	0.270	NA	0.134	0.158	0.013	0.056	0.025	0.039	-0.082	0.070	0.158
Cadmium	48 / 48	0.551	0.356	0.740	0.086	0.134	NA	0.417	0.173	0.782	0.675	0.123	0.633	0.754	0.437
Calcium	48 / 48	0.194	0.153	0.335	0.094	0.158	0.417	NA	0.193	0.313	0.338	0.140	0.186	0.419	0.432
Chromium	48 / 48	0.612	0.627	0.045	0.094	0.013	0.173	0.193	NA	0.249	0.272	0.706	0.342	0.324	0.265
Cobalt	48 / 48	0.590	0.293	0.918	0.219	0.056	0.782	0.313	0.249	NA	0.393	0.303	0.432	0.407	0.478
Copper	48 / 48	0.595	0.591	0.346	0.039	0.025	0.675	0.338	0.272	0.393	NA	0.084	0.910	0.828	0.205
Iron	48 / 48	0.665	0.439	0.047	0.150	0.039	0.123	0.140	0.706	0.303	0.084	NA	0.219	0.106	0.062
Lead	48 / 48	0.681	0.619	0.310	-0.010	-0.082	0.633	0.186	0.342	0.432	0.910	0.219	NA	0.769	0.020
Lithium	48 / 48	0.529	0.530	0.331	-0.049	0.070	0.754	0.419	0.324	0.407	0.828	0.106	0.769	NA	0.229
Magnesium	48 / 48	0.315	0.014	0.577	0.334	0.158	0.437	0.432	0.265	0.478	0.205	0.062	0.020	0.229	NA
Manganese	48 / 48	0.364	0.061	0.982	0.164	-0.111	0.724	0.341	0.036	0.918	0.269	0.062	0.235	0.268	0.579
Mercury	48 / 48	0.387	0.437	0.173	-0.021	0.071	0.538	0.428	0.203	0.203	0.862	0.092	0.779	0.746	0.100
Molybdenum	32 / 48	0.217	0.203	0.170	-0.304	-0.102	0.282	0.066	0.039	0.237	0.211	0.102	0.346	0.198	-0.153
Nickel	48 / 48	0.558	0.260	0.929	0.170	0.140	0.914	0.367	0.141	0.919	0.527	0.122	0.484	0.547	0.573
Phosphorous	48 / 48	0.366	0.487	0.424	0.116	0.232	0.529	0.371	0.315	0.375	0.640	-0.078	0.518	0.568	0.509
Potassium	48 / 48	0.505	0.242	0.360	0.353	0.299	0.291	0.113	0.405	0.375	0.225	0.218	0.143	0.173	0.690
Selenium	48 / 48	0.471	0.291	0.717	0.008	-0.131	0.764	0.302	0.197	0.697	0.617	-0.044	0.615	0.589	0.434
Silicon	48 / 48	0.469	0.374	0.215	0.019	0.068	0.372	0.182	0.040	0.307	0.472	0.254	0.501	0.384	-0.027
Sodium	32 / 48	0.306	0.129	0.236	0.324	0.173	0.189	0.355	0.334	0.324	0.130	0.332	0.211	0.141	0.282
Strontium	48 / 48	0.596	0.293	0.773	0.081	0.161	0.798	0.539	0.220	0.756	0.534	0.201	0.448	0.559	0.563
Uranium	48 / 48	0.483	0.510	0.071	-0.052	0.098	0.430	0.013	0.174	0.185	0.707	0.023	0.760	0.699	-0.080
Vanadium	48 / 48	0.706	0.825	-0.025	-0.039	0.020	0.173	0.100	0.794	0.189	0.485	0.635	0.594	0.379	-0.084
Zinc	48 / 48	0.624	0.579	0.540	0.095	0.026	0.784	0.492	0.371	0.549	0.900	0.094	0.783	0.827	0.476
Mercury (F1)	16 / 18	0.394	0.321	0.364	0.061	0.254	0.485	-0.061	-0.031	0.182	0.576	0.062	0.485	0.424	-0.242
Mercury (F2)	13 / 18	0.382	0.492	0.168	0.107	0.288	0.534	-0.168	0.140	0.351	0.595	0.171	0.718	0.443	-0.290
Mercury (F3)	17 / 18	0.333	0.260	0.364	0.061	0.191	0.485	-0.121	-0.031	0.182	0.515	0.000	0.485	0.364	-0.242
Mercury (F4)	14 / 18	0.412	0.339	0.321	0.076	0.288	0.504	-0.015	-0.016	0.199	0.565	0.078	0.504	0.473	-0.199
Mercury (F5)	18 / 18	0.039	0.109	0.072	0.091	0.350	0.724	-0.318	-0.326	0.354	0.750	-0.226	0.862	0.416	-0.389
Mercury (F6)	16 / 18	0.229	0.339	-0.137	-0.351	-0.144	0.015	-0.351	-0.016	0.015	0.473	-0.016	0.382	0.137	-0.473
Mercury (FS)	18 / 18	0.186	0.185	0.104	0.076	0.208	0.872	-0.247	-0.259	0.237	0.889	-0.196	0.941	0.566	-0.359
Methylmercury	43 / 48	0.068	0.196	0.319	0.081	0.100	0.529	0.324	0.092	0.160	0.383	0.095	0.234	0.394	0.234
Sulfide	45 / 48	0.093	0.034	0.051	0.140	0.189	0.039	-0.056	0.121	0.092	0.152	0.119	0.098	0.057	0.105
TOC	48 / 48	0.337	0.430	0.387	0.092	0.176	0.466	0.385	0.292	0.308	0.598	-0.004	0.494	0.477	0.442

Table E.1. Analyte pairwise correlation matrix for Bear Creek floodplain and creek bank soils (cont.)

Chemical	Freq. of detection	Metals												
		Manganese	Mercury	Molybdenum	Nickel	Phosphorous	Potassium	Selenium	Silicon	Sodium	Strontium	Uranium	Vanadium	Zinc
Chloride	48 / 48	0.132	-0.097	0.015	0.097	-0.247	0.048	-0.157	0.147	0.635	0.204	-0.113	0.131	-0.146
Fluoride	48 / 48	0.435	0.551	0.350	0.624	0.233	-0.016	0.595	0.435	0.321	0.662	0.373	0.210	0.638
Nitrate	44 / 48	0.226	0.373	0.102	0.394	0.416	0.210	0.132	0.192	0.197	0.313	0.342	0.021	0.316
Sulfate	48 / 48	0.339	0.119	-0.045	0.334	-0.092	0.141	0.038	0.235	0.394	0.459	-0.178	0.106	0.086
Aluminum	48 / 48	0.364	0.387	0.217	0.558	0.366	0.505	0.471	0.469	0.306	0.596	0.483	0.706	0.624
Arsenic	48 / 48	0.061	0.437	0.203	0.260	0.487	0.242	0.291	0.374	0.129	0.293	0.510	0.825	0.579
Barium	48 / 48	0.982	0.173	0.170	0.929	0.424	0.360	0.717	0.215	0.236	0.773	0.071	-0.025	0.540
Beryllium	46 / 48	0.164	-0.021	-0.304	0.170	0.116	0.353	0.008	0.019	0.324	0.081	-0.052	-0.039	0.095
Boron	26 / 48	-0.111	0.071	-0.102	0.140	0.232	0.299	-0.131	0.068	0.173	0.161	0.098	0.020	0.026
Cadmium	48 / 48	0.724	0.538	0.282	0.914	0.529	0.291	0.764	0.372	0.189	0.798	0.430	0.173	0.784
Calcium	48 / 48	0.341	0.428	0.066	0.367	0.371	0.113	0.302	0.182	0.355	0.539	0.013	0.100	0.492
Chromium	48 / 48	0.036	0.203	0.039	0.141	0.315	0.405	0.197	0.040	0.334	0.220	0.174	0.794	0.371
Cobalt	48 / 48	0.918	0.203	0.237	0.919	0.375	0.375	0.697	0.307	0.324	0.756	0.185	0.189	0.549
Copper	48 / 48	0.269	0.862	0.211	0.527	0.640	0.225	0.617	0.472	0.130	0.534	0.707	0.485	0.900
Iron	48 / 48	0.062	0.092	0.102	0.122	-0.078	0.218	-0.044	0.254	0.332	0.201	0.023	0.635	0.094
Lead	48 / 48	0.235	0.779	0.346	0.484	0.518	0.143	0.615	0.501	0.211	0.448	0.760	0.594	0.783
Lithium	48 / 48	0.268	0.746	0.198	0.547	0.568	0.173	0.589	0.384	0.141	0.559	0.699	0.379	0.827
Magnesium	48 / 48	0.579	0.100	-0.153	0.573	0.509	0.690	0.434	-0.027	0.282	0.563	-0.080	-0.084	0.476
Manganese	48 / 48	NA	0.116	0.219	0.917	0.375	0.335	0.692	0.160	0.310	0.757	-0.020	-0.059	0.478
Mercury	48 / 48	0.116	NA	0.378	0.333	0.470	0.055	0.454	0.412	0.104	0.419	0.507	0.335	0.718
Molybdenum	32 / 48	0.219	0.378	NA	0.224	0.112	-0.126	0.146	0.557	-0.120	0.183	0.270	0.164	0.145
Nickel	48 / 48	0.917	0.333	0.224	NA	0.516	0.415	0.765	0.322	0.148	0.843	0.274	0.100	0.704
Phosphorous	48 / 48	0.375	0.470	0.112	0.516	NA	0.447	0.523	0.254	0.227	0.493	0.455	0.342	0.789
Potassium	48 / 48	0.335	0.055	-0.126	0.415	0.447	NA	0.296	0.069	0.115	0.348	0.070	0.205	0.391
Selenium	48 / 48	0.692	0.454	0.146	0.765	0.523	0.296	NA	0.063	0.283	0.658	0.377	0.165	0.713
Silicon	48 / 48	0.160	0.412	0.557	0.322	0.254	0.069	0.063	NA	-0.074	0.379	0.416	0.260	0.395
Sodium	32 / 48	0.310	0.104	-0.120	0.148	0.227	0.115	0.283	-0.074	NA	0.333	0.024	0.187	0.175
Strontium	48 / 48	0.757	0.419	0.183	0.843	0.493	0.348	0.658	0.379	0.333	NA	0.205	0.181	0.682
Uranium	48 / 48	-0.020	0.507	0.270	0.274	0.455	0.070	0.377	0.416	0.024	0.205	NA	0.384	0.566
Vanadium	48 / 48	-0.059	0.335	0.164	0.100	0.342	0.205	0.165	0.260	0.187	0.181	0.384	NA	0.463
Zinc	48 / 48	0.478	0.718	0.145	0.704	0.789	0.391	0.713	0.395	0.175	0.682	0.566	0.463	NA
Mercury (F1)	16 / 18	0.273	0.939	0.599	0.424	0.394	-0.121	0.154	0.788	-0.061	0.394	0.606	0.273	0.394
Mercury (F2)	13 / 18	0.076	0.809	0.523	0.565	0.473	0.076	0.202	0.840	-0.076	0.290	0.534	0.382	0.473
Mercury (F3)	17 / 18	0.273	0.939	0.599	0.424	0.394	-0.121	0.215	0.788	-0.061	0.333	0.667	0.212	0.333
Mercury (F4)	14 / 18	0.229	0.962	0.604	0.473	0.443	-0.076	0.109	0.809	-0.046	0.443	0.565	0.290	0.443
Mercury (F5)	18 / 18	0.215	0.843	0.399	0.657	0.164	-0.121	0.610	0.680	-0.091	0.051	0.728	0.017	0.395
Mercury (F6)	16 / 18	-0.168	0.260	0.181	0.199	0.168	0.076	0.326	0.137	-0.504	-0.137	0.199	0.229	0.412
Mercury (FS)	18 / 18	0.198	0.977	0.604	0.805	0.308	-0.070	0.557	0.669	-0.046	0.231	0.843	0.131	0.563
Methylmercury	43 / 48	0.250	0.546	0.172	0.438	0.553	0.130	0.119	0.207	0.033	0.339	0.479	0.023	0.465
Sulfide	45 / 48	0.032	-0.031	-0.178	0.077	0.090	0.167	0.050	-0.069	0.157	-0.057	0.025	0.174	0.112
TOC	48 / 48	0.347	0.464	0.051	0.469	0.907	0.348	0.417	0.210	0.182	0.461	0.416	0.357	0.731

Table E.1. Analyte pairwise correlation matrix for Bear Creek floodplain and creek bank soils (cont.)

Correlation is significant at the 0.05 significance level where 0.01 ≤ two-sided *p*-value ≤ 0.05.
Correlation is significant at the 0.01 significance level where 0.001 ≤ two-sided *p*-value < 0.01.
Correlation is significant at the 0.001 significance level where 0.0001 ≤ two-sided *p*-value < 0.001.
Correlation is significant at the 0.0001 significance level where two-sided *p*-value < 0.0001.
Pearson correlations are calculated when both variables have all detections.
Kendall tau correlations are calculated when there is at least one non-detection in one or both variables, but at least half detections in each variable.
Freq. = frequency
NA = not applicable
TOC = Total organic carbon average

Table E.2. Correlation matrix for soil analytes for BCV RSE for locations with particle size #10

Chemical	Freq. of detection	Anions				Other inorganics	Wet chemistry		Metals					
		Chloride	Methylmercury	Nitrate	Sulfate	Methylmercury	Sulfide	TOC	Aluminum	Arsenic	Barium	Beryllium	Boron	Cadmium
Chloride	6 / 6	NA	0.647	0.138	0.995	-0.733	0.067	-0.258	0.459	0.138	-0.645	-0.333	-0.507	0.121
Fluoride	6 / 6	0.647	NA	0.414	0.694	-0.200	-0.200	-0.243	0.044	-0.093	-0.309	-0.333	-0.388	-0.257
Nitrate	4 / 6	0.138	0.414	NA	-0.138	0.138	-0.690	0.552	0.000	0.414	0.276	-0.138	-0.276	0.552
Sulfate	6 / 6	0.995	0.694	-0.138	NA	-0.733	0.333	-0.337	0.446	0.072	-0.689	-0.333	-0.479	0.050
Aluminum	6 / 6	0.459	0.044	0.000	0.446	-0.200	0.333	-0.023	NA	0.651	-0.641	-0.600	-0.744	-0.429
Arsenic	6 / 6	0.138	-0.093	0.414	0.072	0.200	-0.067	0.735	0.651	NA	0.138	-0.733	-0.825	-0.064
Barium	6 / 6	-0.645	-0.309	0.276	-0.689	0.733	-0.333	0.755	-0.641	0.138	NA	0.333	0.235	0.405
Beryllium	5 / 6	-0.333	-0.333	-0.138	-0.333	0.067	-0.200	0.067	-0.600	-0.733	0.333	NA	0.867	0.200
Boron	6 / 6	-0.507	-0.388	-0.276	-0.479	-0.067	-0.067	-0.358	-0.744	-0.825	0.235	0.867	NA	0.333
Cadmium	6 / 6	0.121	-0.257	0.552	0.050	0.067	-0.733	0.354	-0.429	-0.064	0.405	0.200	0.333	NA
Calcium	6 / 6	0.818	0.474	0.966	0.764	0.067	-0.733	0.335	0.351	0.503	-0.145	-0.067	-0.621	0.420
Chromium	6 / 6	0.433	-0.045	0.276	0.391	0.333	0.067	0.245	0.953	0.824	-0.429	-0.600	-0.820	-0.231
Cobalt	6 / 6	0.391	-0.229	0.000	0.391	-0.200	0.067	-0.451	0.782	0.155	-0.823	-0.067	-0.240	-0.234
Copper	6 / 6	-0.292	-0.204	0.276	-0.360	0.733	-0.333	0.968	0.108	0.813	0.682	0.333	-0.490	0.116
Iron	6 / 6	0.461	-0.098	0.357	0.460	0.000	0.000	-0.343	0.906	0.327	-0.824	-0.276	-0.435	-0.334
Lead	6 / 6	0.202	-0.008	0.357	0.143	0.138	0.000	0.675	0.688	0.992	0.067	-0.828	-0.887	-0.137
Lithium	6 / 6	-0.055	-0.151	0.414	-0.134	0.067	-0.467	0.919	0.036	0.681	0.610	-0.333	-0.300	0.496
Magnesium	6 / 6	-0.222	0.057	0.000	-0.237	0.200	-0.333	0.226	-0.927	-0.452	0.682	0.600	0.570	0.670
Manganese	6 / 6	-0.332	-0.255	0.414	-0.408	0.600	-0.467	0.988	-0.179	0.622	0.844	0.200	-0.234	0.414
Mercury	6 / 6	-0.270	-0.233	0.414	-0.340	0.733	-0.333	0.968	0.163	0.842	0.645	0.067	-0.499	0.128
Molybdenum	5 / 6	0.733	0.467	0.414	0.467	-0.467	-0.200	0.067	0.467	0.333	-0.200	-0.600	-0.467	-0.067
Nickel	6 / 6	-0.055	-0.180	0.552	-0.142	0.467	-0.600	0.841	-0.313	0.426	0.742	0.067	-0.119	0.751
Phosphorous	6 / 6	-0.551	-0.340	0.276	-0.610	0.733	-0.333	0.939	-0.214	0.554	0.882	0.333	-0.128	0.236
Potassium	6 / 6	0.464	0.329	0.690	0.411	-0.200	-0.733	0.351	-0.366	0.042	0.319	0.200	-0.073	0.780
Selenium	6 / 6	-0.646	-0.114	0.000	-0.667	0.467	-0.067	0.708	-0.587	0.149	0.951	0.067	0.139	0.157
Silicon	6 / 6	0.539	0.078	0.138	0.526	-0.067	0.200	-0.094	0.984	0.599	-0.698	-0.467	-0.751	-0.397
Sodium	3 / 6	0.745	0.894	0.386	0.596	-0.447	-0.149	0.000	0.298	0.149	-0.298	-0.447	-0.298	-0.149
Strontium	6 / 6	0.577	0.349	0.828	0.511	0.200	-0.600	0.634	0.405	0.769	0.093	-0.200	-0.764	0.298
Thallium	3 / 6	0.183	0.183	0.378	0.000	0.183	-0.183	0.365	0.183	0.730	0.183	-0.730	-0.730	0.000
Uranium	6 / 6	0.021	-0.325	0.552	-0.059	0.333	-0.733	0.512	-0.401	0.070	0.522	-0.067	0.275	0.982
Vanadium	6 / 6	0.142	-0.120	0.138	0.094	0.200	0.200	0.537	0.817	0.957	-0.086	-0.733	-0.830	-0.275
Zinc	6 / 6	-0.394	-0.275	0.414	-0.464	0.600	-0.467	0.986	-0.110	0.671	0.826	0.200	-0.286	0.281
Methylmercury	5 / 6	-0.733	-0.200	0.138	-0.733	NA	-0.067	0.467	-0.200	0.200	0.733	0.067	-0.067	0.067
Sulfide	5 / 6	0.067	-0.200	-0.690	0.333	-0.067	NA	-0.600	0.333	-0.067	-0.333	-0.200	-0.067	-0.733
TOC	6 / 6	-0.258	-0.243	0.552	-0.337	0.467	-0.600	NA	-0.023	0.735	0.755	0.067	-0.358	0.354

Table E.2. Correlation matrix for soil analytes for BCV RSE for locations with particle size #10 (cont.)

Chemical	Freq. of detection	Metals											
		Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury	Molybdenum	Nickel
Chloride	6 / 6	0.818	0.433	0.391	-0.292	0.461	0.202	-0.055	-0.222	-0.332	-0.270	0.733	-0.055
Fluoride	6 / 6	0.474	-0.045	-0.229	-0.204	-0.098	-0.008	-0.151	0.057	-0.255	-0.233	0.467	-0.180
Nitrate	4 / 6	0.966	0.276	0.000	0.276	0.357	0.357	0.414	0.000	0.414	0.414	0.414	0.552
Sulfate	6 / 6	0.764	0.391	0.391	-0.360	0.460	0.143	-0.134	-0.237	-0.408	-0.340	0.467	-0.142
Aluminum	6 / 6	0.351	0.953	0.782	0.108	0.906	0.688	0.036	-0.927	-0.179	0.163	0.467	-0.313
Arsenic	6 / 6	0.503	0.824	0.155	0.813	0.327	0.992	0.681	-0.452	0.622	0.842	0.333	0.426
Barium	6 / 6	-0.145	-0.429	-0.823	0.682	-0.824	0.067	0.610	0.682	0.844	0.645	-0.200	0.742
Beryllium	5 / 6	-0.067	-0.600	-0.067	0.333	-0.276	-0.828	-0.333	0.600	0.200	0.067	-0.600	0.067
Boron	6 / 6	-0.621	-0.820	-0.240	-0.490	-0.435	-0.887	-0.300	0.570	-0.234	-0.499	-0.467	-0.119
Cadmium	6 / 6	0.420	-0.231	-0.234	0.116	-0.334	-0.137	0.496	0.670	0.414	0.128	-0.067	0.751
Calcium	6 / 6	NA	0.490	0.071	0.256	0.187	0.522	0.506	0.011	0.267	0.277	0.467	0.487
Chromium	6 / 6	0.490	NA	0.666	0.346	0.798	0.846	0.275	-0.805	0.093	0.398	0.200	-0.016
Cobalt	6 / 6	0.071	0.666	NA	-0.392	0.969	0.179	-0.356	-0.808	-0.564	-0.331	-0.067	-0.516
Copper	6 / 6	0.256	0.346	-0.392	NA	-0.255	0.772	0.833	0.046	0.937	0.996	-0.200	0.704
Iron	6 / 6	0.187	0.798	0.969	-0.255	NA	0.358	-0.238	-0.896	-0.478	-0.191	0.276	-0.497
Lead	6 / 6	0.522	0.846	0.179	0.772	0.358	NA	0.605	-0.497	0.557	0.796	0.414	0.368
Lithium	6 / 6	0.506	0.275	-0.356	0.833	-0.238	0.605	NA	0.240	0.896	0.857	0.467	0.807
Magnesium	6 / 6	0.011	-0.805	-0.808	0.046	-0.896	-0.497	0.240	NA	0.365	0.001	-0.467	0.577
Manganese	6 / 6	0.267	0.093	-0.564	0.937	-0.478	0.557	0.896	0.365	NA	0.928	-0.067	0.876
Mercury	6 / 6	0.277	0.398	-0.331	0.996	-0.191	0.796	0.857	0.001	0.928	NA	-0.200	0.692
Molybdenum	5 / 6	0.467	0.200	-0.067	-0.200	0.276	0.414	0.467	-0.467	-0.067	-0.200	NA	0.067
Nickel	6 / 6	0.487	-0.016	-0.516	0.704	-0.497	0.368	0.807	0.577	0.876	0.692	0.067	NA
Phosphorous	6 / 6	0.017	0.013	-0.593	0.924	-0.508	0.482	0.818	0.310	0.959	0.914	-0.200	0.724
Potassium	6 / 6	0.725	-0.171	-0.427	0.175	-0.431	0.035	0.440	0.666	0.397	0.154	0.200	0.752
Selenium	6 / 6	-0.192	-0.427	-0.888	0.688	-0.836	0.096	0.558	0.593	0.788	0.644	0.067	0.584
Silicon	6 / 6	0.388	0.940	0.816	0.031	0.920	0.649	-0.055	-0.909	-0.246	0.081	0.333	-0.313
Sodium	3 / 6	0.447	0.000	-0.298	-0.298	0.000	0.232	0.298	-0.298	-0.149	-0.298	0.745	0.000
Strontium	6 / 6	0.918	0.595	-0.056	0.603	0.112	0.775	0.721	-0.057	0.555	0.621	0.333	0.609
Thallium	3 / 6	0.365	0.548	-0.183	0.183	0.189	0.756	0.730	-0.183	0.365	0.183	0.548	0.365
Uranium	6 / 6	0.409	-0.174	-0.290	0.286	-0.365	-0.015	0.634	0.650	0.565	0.300	-0.067	0.831
Vanadium	6 / 6	0.373	0.917	0.374	0.659	0.543	0.960	0.492	-0.687	0.402	0.698	0.333	0.155
Zinc	6 / 6	0.192	0.146	-0.531	0.971	-0.431	0.611	0.863	0.261	0.989	0.962	-0.067	0.801
Methylmercury	5 / 6	0.067	0.333	-0.200	0.733	0.000	0.138	0.067	0.200	0.600	0.733	-0.467	0.467
Sulfide	5 / 6	-0.733	0.067	0.067	-0.333	0.000	0.000	-0.467	-0.333	-0.467	-0.333	-0.200	-0.600
TOC	6 / 6	0.335	0.245	-0.451	0.968	-0.343	0.675	0.919	0.226	0.988	0.968	0.067	0.841

Table E.2. Correlation matrix for soil analytes for BCV RSE for locations with particle size #10 (cont.)

Chemical	Freq. of detection	Metals									
		Phosphorous	Potassium	Selenium	Silicon	Sodium	Strontium	Thallium	Uranium	Vanadium	Zinc
Chloride	6 / 6	-0.551	0.464	-0.646	0.539	0.745	0.577	0.183	0.021	0.142	-0.394
Fluoride	6 / 6	-0.340	0.329	-0.114	0.078	0.894	0.349	0.183	-0.325	-0.120	-0.275
Nitrate	4 / 6	0.276	0.690	0.000	0.138	0.386	0.828	0.378	0.552	0.138	0.414
Sulfate	6 / 6	-0.610	0.411	-0.667	0.526	0.596	0.511	0.000	-0.059	0.094	-0.464
Aluminum	6 / 6	-0.214	-0.366	-0.587	0.984	0.298	0.405	0.183	-0.401	0.817	-0.110
Arsenic	6 / 6	0.554	0.042	0.149	0.599	0.149	0.769	0.730	0.070	0.957	0.671
Barium	6 / 6	0.882	0.319	0.951	-0.698	-0.298	0.093	0.183	0.522	-0.086	0.826
Beryllium	5 / 6	0.333	0.200	0.067	-0.467	-0.447	-0.200	-0.730	-0.067	-0.733	0.200
Boron	6 / 6	-0.128	-0.073	0.139	-0.751	-0.298	-0.764	-0.730	0.275	-0.830	-0.286
Cadmium	6 / 6	0.236	0.780	0.157	-0.397	-0.149	0.298	0.000	0.982	-0.275	0.281
Calcium	6 / 6	0.017	0.725	-0.192	0.388	0.447	0.918	0.365	0.409	0.373	0.192
Chromium	6 / 6	0.013	-0.171	-0.427	0.940	0.000	0.595	0.548	-0.174	0.917	0.146
Cobalt	6 / 6	-0.593	-0.427	-0.888	0.816	-0.298	-0.056	-0.183	-0.290	0.374	-0.531
Copper	6 / 6	0.924	0.175	0.688	0.031	-0.298	0.603	0.183	0.286	0.659	0.971
Iron	6 / 6	-0.508	-0.431	-0.836	0.920	0.000	0.112	0.189	-0.365	0.543	-0.431
Lead	6 / 6	0.482	0.035	0.096	0.649	0.232	0.775	0.756	-0.015	0.960	0.611
Lithium	6 / 6	0.818	0.440	0.558	-0.055	0.298	0.721	0.730	0.634	0.492	0.863
Magnesium	6 / 6	0.310	0.666	0.593	-0.909	-0.298	-0.057	-0.183	0.650	-0.687	0.261
Manganese	6 / 6	0.959	0.397	0.788	-0.246	-0.149	0.555	0.365	0.565	0.402	0.989
Mercury	6 / 6	0.914	0.154	0.644	0.081	-0.298	0.621	0.183	0.300	0.698	0.962
Molybdenum	5 / 6	-0.200	0.200	0.067	0.333	0.745	0.333	0.548	-0.067	0.333	-0.067
Nickel	6 / 6	0.724	0.752	0.584	-0.313	0.000	0.609	0.365	0.831	0.155	0.801
Phosphorous	6 / 6	NA	0.157	0.872	-0.311	-0.298	0.356	0.183	0.407	0.377	0.978
Potassium	6 / 6	0.157	NA	0.186	-0.296	0.149	0.597	0.000	0.741	-0.211	0.271
Selenium	6 / 6	0.872	0.186	NA	-0.668	0.000	0.083	0.183	0.285	-0.043	0.797
Silicon	6 / 6	-0.311	-0.296	-0.668	NA	0.149	0.400	0.183	-0.394	0.761	-0.186
Sodium	3 / 6	-0.298	0.149	0.000	0.149	NA	0.298	0.306	-0.149	0.149	-0.149
Strontium	6 / 6	0.356	0.597	0.083	0.400	0.298	NA	0.548	0.359	0.622	0.518
Thallium	3 / 6	0.183	0.000	0.183	0.183	0.306	0.548	NA	0.365	0.548	0.365
Uranium	6 / 6	0.407	0.741	0.285	-0.394	-0.149	0.359	0.365	NA	-0.153	0.445
Vanadium	6 / 6	0.377	-0.211	-0.043	0.761	0.149	0.622	0.548	-0.153	NA	0.478
Zinc	6 / 6	0.978	0.271	0.797	-0.186	-0.149	0.518	0.365	0.445	0.478	NA
Methylmercury	5 / 6	0.733	-0.200	0.467	-0.067	-0.447	0.200	0.183	0.333	0.200	0.600
Sulfide	5 / 6	-0.333	-0.733	-0.067	0.200	-0.149	-0.600	-0.183	-0.733	0.200	-0.467
TOC	6 / 6	0.939	0.351	0.708	-0.094	0.000	0.634	0.365	0.512	0.537	0.986

Correlation is significant at the 0.05 significance level where 0.01 ≤ two-sided *p*-value ≤ 0.05.
Correlation is significant at the 0.01 significance level where 0.001 ≤ two-sided *p*-value < 0.01.
Correlation is significant at the 0.001 significance level where 0.0001 ≤ two-sided *p*-value < 0.001.
Correlation is significant at the 0.0001 significance level where two-sided *p*-value < 0.0001.
Pearson correlations are calculated when both variables have all detections.
Kendall tau correlations are calculated when there is at least one non-detection in one or both variables, but at least half detections in each variable.
BCV = Bear Creek Valley
Freq. = frequency
NA = not applicable
RSE = remedial site evaluation
TOC = Total organic carbon aver

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Table E.3. Analyte pairwise correlation matrix for Bear Creek channel sediment

Chemical	Freq. of detection	Anions				Sequential extraction								Other inorganics	Wet chemistry	
		Chloride	Fluoride	Nitrate	Sulfate	Mercury (F0)	Mercury (F1)	Mercury (F2)	Mercury (F3)	Mercury (F4)	Mercury (F5)	Mercury (F6)	Mercury (FS)	Methylmercury	Sulfide	TOC
Chloride	12 / 12	NA	0.615	0.094	-0.090	0.653	0.067	0.067	-0.200	0.467	0.588	0.200	0.069	0.165	-0.318	0.043
Fluoride	12 / 12	0.615	NA	0.351	0.387	0.653	0.067	0.067	-0.200	0.467	0.211	0.200	-0.224	-0.253	-0.171	0.321
Nitrate	10 / 12	0.094	0.351	NA	-0.015	0.159	-0.031	0.000	-0.092	0.061	0.122	0.061	0.000	-0.565	-0.063	-0.137
Sulfate	12 / 12	-0.090	0.387	-0.015	NA	0.000	-0.200	-0.467	0.067	0.467	-0.565	-0.333	0.009	0.228	0.388	0.453
Aluminum	12 / 12	0.179	0.737	0.412	0.523	0.653	-0.467	-0.467	-0.467	0.200	0.048	-0.067	-0.159	-0.353	0.109	0.650
Arsenic	12 / 12	0.389	0.022	-0.046	-0.486	0.163	-0.067	-0.067	-0.067	-0.200	0.261	0.333	-0.045	-0.260	-0.109	-0.214
Barium	12 / 12	0.212	0.610	0.443	0.307	0.653	-0.067	-0.067	-0.333	0.333	0.540	0.067	-0.046	-0.288	-0.078	0.823
Beryllium	12 / 12	-0.304	0.294	0.321	0.474	0.064	-0.067	-0.333	-0.067	0.067	-0.198	0.333	-0.141	-0.358	0.295	0.658
Boron	8 / 12	-0.277	-0.032	0.272	0.381	0.163	-0.061	-0.122	-0.061	0.031	-0.031	0.031	-0.031	-0.381	0.358	0.064
Cadmium	12 / 12	-0.005	0.501	0.382	0.359	0.653	-0.067	-0.067	-0.333	0.333	0.495	0.067	-0.069	-0.283	-0.047	0.873
Calcium	12 / 12	0.603	0.572	0.382	-0.018	0.490	0.200	0.200	-0.067	0.067	0.598	0.600	0.066	-0.047	-0.326	0.594
Chromium	12 / 12	0.058	-0.079	-0.015	-0.057	0.327	-0.200	-0.200	-0.200	-0.067	0.122	0.200	-0.271	-0.311	-0.047	-0.288
Cobalt	12 / 12	0.167	0.661	0.473	0.392	0.490	-0.200	-0.200	-0.200	0.467	0.356	-0.067	-0.166	-0.352	-0.047	0.792
Copper	12 / 12	0.373	0.688	0.504	0.371	0.490	0.200	0.200	-0.067	0.600	0.449	0.067	0.311	-0.170	-0.078	0.744
Iron	12 / 12	0.626	0.607	0.351	-0.019	0.653	-0.067	-0.067	-0.333	0.333	0.433	0.067	-0.221	-0.388	-0.295	-0.132
Lead	12 / 12	0.739	0.758	0.382	0.089	0.653	-0.067	-0.067	-0.333	0.333	0.535	0.067	-0.026	-0.262	-0.140	0.330
Lithium	12 / 12	0.026	0.308	0.202	0.359	0.000	0.414	0.138	0.276	0.414	-0.165	0.552	0.312	0.043	0.236	0.749
Magnesium	12 / 12	-0.156	0.046	0.369	0.024	0.163	0.200	-0.067	-0.067	0.067	0.163	0.600	-0.154	-0.275	0.094	0.479
Manganese	12 / 12	0.066	0.530	0.504	0.336	0.653	-0.067	-0.067	-0.333	0.333	0.512	0.067	-0.143	-0.301	-0.140	0.855
Mercury	12 / 12	0.593	0.309	-0.046	0.052	-0.490	1.000	0.733	0.733	0.333	0.367	0.600	0.983	0.537	-0.140	0.630
Molybdenum	6 / 12	-0.282	-0.121	0.434	-0.086	0.738	-0.258	-0.258	-0.603	-0.086	0.430	0.258	-0.086	-0.362	-0.088	-0.155
Nickel	12 / 12	-0.053	0.463	0.473	0.365	0.653	-0.067	-0.067	-0.333	0.333	0.494	0.067	0.041	-0.295	-0.078	0.864
Phosphorous	12 / 12	-0.371	-0.449	0.076	-0.166	-0.163	0.200	0.200	0.200	-0.200	-0.024	0.333	-0.081	-0.321	0.140	-0.107
Potassium	12 / 12	-0.068	0.528	0.565	0.514	0.490	-0.333	-0.600	-0.333	0.333	-0.311	0.067	-0.434	-0.492	0.295	0.317
Selenium	12 / 12	0.588	0.631	0.382	-0.050	0.327	0.200	0.200	-0.067	0.067	0.852	0.333	0.103	-0.269	-0.202	0.598
Silicon	12 / 12	-0.342	0.315	0.443	0.668	0.653	-0.200	-0.467	-0.467	0.200	-0.283	0.200	-0.413	-0.285	0.140	0.206
Sodium	10 / 12	0.594	0.748	0.215	0.199	0.327	0.200	-0.067	-0.067	0.600	0.067	0.333	0.333	-0.015	0.000	0.382
Strontium	12 / 12	0.531	0.587	0.473	-0.132	0.327	0.200	0.200	-0.067	0.067	0.880	0.333	0.155	-0.321	-0.233	0.462
Uranium	12 / 12	0.633	0.619	0.000	0.339	0.163	-0.067	-0.333	-0.067	0.333	-0.237	0.067	-0.158	0.107	0.109	0.106
Vanadium	12 / 12	0.249	0.070	0.015	-0.321	0.163	-0.067	-0.067	-0.067	-0.200	0.412	0.333	-0.068	-0.388	-0.109	-0.346
Zinc	12 / 12	0.308	0.478	0.321	0.052	0.327	-0.067	-0.067	-0.067	0.333	0.913	0.067	0.486	-0.216	-0.171	0.582
Mercury (F0)	3 / 6	0.653	0.653	0.159	0.000	NA	-0.490	-0.327	-0.817	0.000	0.327	0.000	-0.327	-0.817	-0.254	-0.653
Mercury (F1)	5 / 6	0.067	0.067	-0.031	-0.200	-0.490	NA	0.733	0.733	0.333	0.333	0.600	0.867	0.467	-0.138	0.600
Mercury (F2)	5 / 6	0.067	0.067	0.000	-0.467	-0.327	0.733	NA	0.467	0.067	0.333	0.333	0.600	0.467	-0.414	0.600
Mercury (F3)	5 / 6	-0.200	-0.200	-0.092	0.067	-0.817	0.733	0.467	NA	0.333	0.067	0.333	0.600	0.733	0.138	0.600
Mercury (F4)	5 / 6	0.467	0.467	0.061	0.467	0.000	0.333	0.067	0.333	NA	0.200	0.200	0.467	0.067	0.276	-0.067
Mercury (F5)	6 / 6	0.588	0.211	0.122	-0.565	0.327	0.333	0.333	0.067	0.200	NA	0.467	0.478	-0.214	-0.552	-0.026
Mercury (F6)	5 / 6	0.200	0.200	0.061	-0.333	0.000	0.600	0.333	0.333	0.200	0.467	NA	0.733	0.067	-0.138	0.200
Mercury (FS)	6 / 6	0.069	-0.224	0.000	0.009	-0.327	0.867	0.600	0.600	0.467	0.478	0.733	NA	0.728	0.000	0.753
Methylmercury	12 / 12	0.165	-0.253	-0.565	0.228	-0.817	0.467	0.467	0.733	0.067	-0.214	0.067	0.728	NA	-0.264	0.160
Sulfide	9 / 12	-0.318	-0.171	-0.063	0.388	-0.254	-0.138	-0.414	0.138	0.276	-0.552	-0.138	0.000	-0.264	NA	-0.078
TOC	12 / 12	0.043	0.321	-0.137	0.453	-0.653	0.600	0.600	0.600	-0.067	-0.026	0.200	0.753	0.160	-0.078	NA

Table E.3. Analyte pairwise correlation matrix for Bear Creek channel sediment (cont.)

Chemical	Freq. of detection	Metals													
		Aluminum	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium
Chloride	12 / 12	0.179	0.389	0.212	-0.304	-0.277	-0.005	0.603	0.058	0.167	0.373	0.626	0.739	0.026	-0.156
Fluoride	12 / 12	0.737	0.022	0.610	0.294	-0.032	0.501	0.572	-0.079	0.661	0.688	0.607	0.758	0.308	0.046
Nitrate	10 / 12	0.412	-0.046	0.443	0.321	0.272	0.382	0.382	-0.015	0.473	0.504	0.351	0.382	0.202	0.369
Sulfate	12 / 12	0.523	-0.486	0.307	0.474	0.381	0.359	-0.018	-0.057	0.392	0.371	-0.019	0.089	0.359	0.024
Aluminum	12 / 12	NA	0.120	0.874	0.842	0.350	0.859	0.541	0.104	0.943	0.902	0.440	0.702	0.733	0.405
Arsenic	12 / 12	0.120	NA	0.044	0.022	-0.064	-0.063	0.254	0.597	0.054	0.137	0.544	0.483	0.174	0.102
Barium	12 / 12	0.874	0.044	NA	0.729	0.127	0.963	0.640	-0.138	0.973	0.929	0.231	0.664	0.713	0.410
Beryllium	12 / 12	0.842	0.022	0.729	NA	0.826	0.824	0.331	0.195	0.816	0.708	0.151	0.344	0.751	0.630
Boron	8 / 12	0.350	-0.064	0.127	0.826	NA	0.095	0.032	0.286	0.286	0.064	0.032	0.127	0.226	0.432
Cadmium	12 / 12	0.859	-0.063	0.963	0.824	0.095	NA	0.568	-0.195	0.960	0.850	0.064	0.483	0.767	0.494
Calcium	12 / 12	0.541	0.254	0.640	0.331	0.032	0.568	NA	-0.049	0.617	0.716	0.430	0.717	0.587	0.630
Chromium	12 / 12	0.104	0.597	-0.138	0.195	0.286	-0.195	-0.049	NA	-0.010	0.040	0.670	0.326	-0.141	0.182
Cobalt	12 / 12	0.943	0.054	0.973	0.816	0.286	0.960	0.617	-0.010	NA	0.928	0.328	0.677	0.705	0.449
Copper	12 / 12	0.902	0.137	0.929	0.708	0.064	0.850	0.716	0.040	0.928	NA	0.457	0.820	0.719	0.432
Iron	12 / 12	0.440	0.544	0.231	0.151	0.032	0.064	0.430	0.670	0.328	0.457	NA	0.830	-0.017	0.125
Lead	12 / 12	0.702	0.483	0.664	0.344	0.127	0.483	0.717	0.326	0.677	0.820	0.830	NA	0.386	0.224
Lithium	12 / 12	0.733	0.174	0.713	0.751	0.226	0.767	0.587	-0.141	0.705	0.719	-0.017	0.386	NA	0.586
Magnesium	12 / 12	0.405	0.102	0.410	0.630	0.432	0.494	0.630	0.182	0.449	0.432	0.125	0.224	0.586	NA
Manganese	12 / 12	0.867	-0.018	0.987	0.798	0.127	0.993	0.584	-0.158	0.972	0.885	0.129	0.555	0.742	0.464
Mercury	12 / 12	0.300	0.147	0.503	0.076	-0.159	0.420	0.648	-0.308	0.407	0.570	0.062	0.492	0.524	0.059
Molybdenum	6 / 12	0.052	0.052	0.017	0.569	0.452	-0.017	0.017	0.224	0.121	0.052	0.190	0.017	-0.053	0.417
Nickel	12 / 12	0.857	-0.061	0.954	0.849	0.191	0.997	0.525	-0.159	0.957	0.840	0.058	0.464	0.758	0.490
Phosphorous	12 / 12	0.047	0.549	-0.055	0.369	0.350	-0.021	-0.204	0.812	0.019	-0.022	0.216	0.018	0.057	0.298
Potassium	12 / 12	0.842	0.108	0.611	0.793	0.509	0.616	0.252	0.175	0.684	0.648	0.341	0.471	0.640	0.405
Selenium	12 / 12	0.704	0.405	0.830	0.453	0.064	0.714	0.857	0.093	0.804	0.866	0.565	0.886	0.549	0.423
Silicon	12 / 12	0.524	-0.357	0.206	0.660	0.572	0.317	0.057	0.250	0.375	0.289	0.218	0.073	0.258	0.468
Sodium	10 / 12	0.565	0.199	0.657	0.015	-0.016	0.687	0.657	-0.076	0.473	0.595	0.229	0.565	0.605	0.417
Strontium	12 / 12	0.582	0.358	0.716	0.326	0.000	0.587	0.822	0.004	0.661	0.769	0.494	0.790	0.488	0.475
Uranium	12 / 12	0.479	0.475	0.221	0.125	0.127	0.128	0.384	0.231	0.285	0.366	0.523	0.573	0.389	-0.059
Vanadium	12 / 12	0.165	0.801	-0.051	0.142	0.127	-0.147	0.122	0.882	0.050	0.148	0.788	0.508	-0.055	0.149
Zinc	12 / 12	0.620	0.273	0.695	0.456	0.191	0.654	0.586	0.112	0.721	0.716	0.409	0.654	0.429	0.279
Mercury (F0)	3 / 6	0.653	0.163	0.653	0.163	0.064	0.653	0.490	0.327	0.490	0.490	0.653	0.653	0.000	0.163
Mercury (F1)	5 / 6	-0.467	-0.067	-0.067	-0.067	-0.061	-0.067	0.200	-0.200	-0.200	0.200	-0.067	-0.067	0.414	0.200
Mercury (F2)	5 / 6	-0.467	-0.067	-0.067	-0.333	-0.122	-0.067	0.200	-0.200	-0.200	0.200	-0.067	-0.067	0.138	-0.067
Mercury (F3)	5 / 6	-0.467	-0.067	-0.333	-0.067	-0.061	-0.333	-0.067	-0.200	-0.200	-0.067	-0.333	-0.333	0.276	-0.067
Mercury (F4)	5 / 6	0.200	-0.200	0.333	0.067	0.031	0.333	0.067	-0.067	0.467	0.600	0.333	0.333	0.414	0.067
Mercury (F5)	6 / 6	0.048	0.261	0.540	-0.198	-0.031	0.495	0.598	0.122	0.356	0.449	0.433	0.535	-0.165	0.163
Mercury (F6)	5 / 6	-0.067	0.333	0.067	0.333	0.031	0.067	0.600	0.200	-0.067	0.067	0.067	0.067	0.552	0.600
Mercury (FS)	6 / 6	-0.159	-0.045	-0.046	-0.141	-0.031	-0.069	0.066	-0.271	-0.166	0.311	-0.221	-0.026	0.312	-0.154
Methylmercury	12 / 12	-0.353	-0.260	-0.288	-0.358	-0.381	-0.283	-0.047	-0.311	-0.352	-0.170	-0.388	-0.262	0.043	-0.275
Sulfide	9 / 12	0.109	-0.109	-0.078	0.295	0.358	-0.047	-0.326	-0.047	-0.047	-0.078	-0.295	-0.140	0.236	0.094
TOC	12 / 12	0.650	-0.214	0.823	0.658	0.064	0.873	0.594	-0.288	0.792	0.744	-0.132	0.330	0.749	0.479

Table E.3. Analyte pairwise correlation matrix for Bear Creek channel sediment (cont.)

Chemical	Freq. of detection	Metals												
		Manganese	Mercury	Molybdenum	Nickel	Phosphorous	Potassium	Selenium	Silicon	Sodium	Strontium	Uranium	Vanadium	Zinc
Chloride	12 / 12	0.066	0.593	-0.282	-0.053	-0.371	-0.068	0.588	-0.342	0.594	0.531	0.633	0.249	0.308
Fluoride	12 / 12	0.530	0.309	-0.121	0.463	-0.449	0.528	0.631	0.315	0.748	0.587	0.619	0.070	0.478
Nitrate	10 / 12	0.504	-0.046	0.434	0.473	0.076	0.565	0.382	0.443	0.215	0.473	0.000	0.015	0.321
Sulfate	12 / 12	0.336	0.052	-0.086	0.365	-0.166	0.514	-0.050	0.668	0.199	-0.132	0.339	-0.321	0.052
Aluminum	12 / 12	0.867	0.300	0.052	0.857	0.047	0.842	0.704	0.524	0.565	0.582	0.479	0.165	0.620
Arsenic	12 / 12	-0.018	0.147	0.052	-0.061	0.549	0.108	0.405	-0.357	0.199	0.358	0.475	0.801	0.273
Barium	12 / 12	0.987	0.503	0.017	0.954	-0.055	0.611	0.830	0.206	0.657	0.716	0.221	-0.051	0.695
Beryllium	12 / 12	0.798	0.076	0.569	0.849	0.369	0.793	0.453	0.660	0.015	0.326	0.125	0.142	0.456
Boron	8 / 12	0.127	-0.159	0.452	0.191	0.350	0.509	0.064	0.572	-0.016	0.000	0.127	0.127	0.191
Cadmium	12 / 12	0.993	0.420	-0.017	0.997	-0.021	0.616	0.714	0.317	0.687	0.587	0.128	-0.147	0.654
Calcium	12 / 12	0.584	0.648	0.017	0.525	-0.204	0.252	0.857	0.057	0.657	0.822	0.384	0.122	0.586
Chromium	12 / 12	-0.158	-0.308	0.224	-0.159	0.812	0.175	0.093	0.250	-0.076	0.004	0.231	0.882	0.112
Cobalt	12 / 12	0.972	0.407	0.121	0.957	0.019	0.684	0.804	0.375	0.473	0.661	0.285	0.050	0.721
Copper	12 / 12	0.885	0.570	0.052	0.840	-0.022	0.648	0.866	0.289	0.595	0.769	0.366	0.148	0.716
Iron	12 / 12	0.129	0.062	0.190	0.058	0.216	0.341	0.565	0.218	0.229	0.494	0.523	0.788	0.409
Lead	12 / 12	0.555	0.492	0.017	0.464	0.018	0.471	0.886	0.073	0.565	0.790	0.573	0.508	0.654
Lithium	12 / 12	0.742	0.524	-0.053	0.758	0.057	0.640	0.549	0.258	0.605	0.488	0.389	-0.055	0.429
Magnesium	12 / 12	0.464	0.059	0.417	0.490	0.298	0.405	0.423	0.468	0.308	0.475	-0.059	0.149	0.279
Manganese	12 / 12	NA	0.441	0.086	0.989	-0.008	0.622	0.762	0.273	0.595	0.638	0.146	-0.101	0.669
Mercury	12 / 12	0.441	NA	-0.328	0.391	-0.327	-0.092	0.635	-0.377	0.657	0.477	0.343	-0.124	0.501
Molybdenum	6 / 12	0.086	-0.328	NA	0.086	0.362	0.328	0.086	0.534	-0.174	0.086	-0.259	0.155	0.017
Nickel	12 / 12	0.989	0.391	0.086	NA	0.034	0.623	0.692	0.334	0.534	0.555	0.097	-0.122	0.653
Phosphorous	12 / 12	-0.008	-0.327	0.362	0.034	NA	0.161	-0.009	0.122	-0.107	-0.074	-0.086	0.675	0.098
Potassium	12 / 12	0.622	-0.092	0.328	0.623	0.161	NA	0.371	0.650	0.229	0.358	0.381	0.191	0.222
Selenium	12 / 12	0.762	0.635	0.086	0.692	-0.009	0.371	NA	-0.037	0.565	0.884	0.353	0.303	0.794
Silicon	12 / 12	0.273	-0.377	0.534	0.334	0.122	0.650	-0.037	NA	-0.015	-0.065	0.086	0.056	0.007
Sodium	10 / 12	0.595	0.657	-0.174	0.534	-0.107	0.229	0.565	-0.015	NA	0.443	0.534	-0.107	0.382
Strontium	12 / 12	0.638	0.477	0.086	0.555	-0.074	0.358	0.884	-0.065	0.443	NA	0.250	0.228	0.732
Uranium	12 / 12	0.146	0.343	-0.259	0.097	-0.086	0.381	0.353	0.086	0.534	0.250	NA	0.304	0.185
Vanadium	12 / 12	-0.101	-0.124	0.155	-0.122	0.675	0.191	0.303	0.056	-0.107	0.228	0.304	NA	0.258
Zinc	12 / 12	0.669	0.501	0.017	0.653	0.098	0.222	0.794	0.007	0.382	0.732	0.185	0.258	NA
Mercury (F0)	3 / 6	0.653	-0.490	0.738	0.653	-0.163	0.490	0.327	0.653	0.327	0.327	0.163	0.163	0.327
Mercury (F1)	5 / 6	-0.067	1.000	-0.258	-0.067	0.200	-0.333	0.200	-0.200	0.200	0.200	-0.067	-0.067	-0.067
Mercury (F2)	5 / 6	-0.067	0.733	-0.258	-0.067	0.200	-0.600	0.200	-0.467	-0.067	0.200	-0.333	-0.067	-0.067
Mercury (F3)	5 / 6	-0.333	0.733	-0.603	-0.333	0.200	-0.333	-0.067	-0.467	-0.067	-0.067	-0.067	-0.067	-0.067
Mercury (F4)	5 / 6	0.333	0.333	-0.086	0.333	-0.200	0.333	0.067	0.200	0.600	0.067	0.333	-0.200	0.333
Mercury (F5)	6 / 6	0.512	0.367	0.430	0.494	-0.024	-0.311	0.852	-0.283	0.067	0.880	-0.237	0.412	0.913
Mercury (F6)	5 / 6	0.067	0.600	0.258	0.067	0.333	0.067	0.333	0.200	0.333	0.333	0.067	0.333	0.067
Mercury (FS)	6 / 6	-0.143	0.983	-0.086	0.041	-0.081	-0.434	0.103	-0.413	0.333	0.155	-0.158	-0.068	0.486
Methylmercury	12 / 12	-0.301	0.537	-0.362	-0.295	-0.321	-0.492	-0.269	-0.285	-0.015	-0.321	0.107	-0.388	-0.216
Sulfide	9 / 12	-0.140	-0.140	-0.088	-0.078	0.140	0.295	-0.202	0.140	0.000	-0.233	0.109	-0.109	-0.171
TOC	12 / 12	0.855	0.630	-0.155	0.864	-0.107	0.317	0.598	0.206	0.382	0.462	0.106	-0.346	0.582

Table E.3. Analyte pairwise correlation matrix for Bear Creek channel sediment (cont.)

Correlation is significant at the 0.05 significance level where 0.01 ≤ two-sided *p*-value ≤ 0.05.
Correlation is significant at the 0.01 significance level where 0.001 ≤ two-sided *p*-value < 0.01.
Correlation is significant at the 0.001 significance level where 0.0001 ≤ two-sided *p*-value < 0.001.
Correlation is significant at the 0.0001 significance level where two-sided *p*-value < 0.0001.
Pearson correlations are calculated when both variables have all detections.
Kendall tau correlations are calculated when there is at least one non-detection in one or both variables, but at least half detections in each variable.
Freq. = frequency
NA = not applicable
TOC = Total organic carbon average

Table E.4. Correlation matrix for sediment analytes for BCV RSE for locations with particle size #10

Chemical	Freq. of detection	Anions				Sequential extraction								Other inorganics	Wet chemistry	
		Chloride	Fluoride	Nitrate	Sulfate	Mercury (F0)	Mercury (F1)	Mercury (F2)	Mercury (F3)	Mercury (F4)	Mercury (F5)	Mercury (F6)	Mercury (FS)	Methylmercury	Sulfide	TOC
Chloride	7 / 7	NA	0.783	0.000	0.347	0.522	-0.333	-0.333	-0.333	0.959	0.467	-0.334	0.057	0.190	-0.309	0.105
Fluoride	7 / 7	0.783	NA	0.143	0.578	0.817	-0.333	-0.333	-0.333	0.978	-0.012	-0.744	-0.427	-0.388	-0.143	0.387
Nitrate	6 / 7	0.000	0.143	NA	0.333	0.817	-0.333	-0.333	-0.333	1.000	0.333	-0.333	-0.333	-0.619	0.143	0.048
Sulfate	7 / 7	0.347	0.578	0.333	NA	0.817	-1.000	-1.000	-1.000	0.521	-0.735	-0.997	-0.950	-0.103	0.048	0.470
Aluminum	7 / 7	0.292	0.733	0.238	0.700	0.817	-1.000	-1.000	-1.000	0.678	-0.587	-0.993	-0.871	-0.476	0.143	0.827
Antimony	4 / 7	-0.444	-0.514	0.206	-0.206	1.000	-0.817	-0.817	-0.817	0.817	0.000	-0.817	-0.817	-0.103	0.103	-0.617
Arsenic	7 / 7	-0.107	-0.402	-0.714	-0.412	-0.817	0.333	0.333	0.333	-0.991	-0.323	0.478	0.100	0.329	0.143	-0.201
Barium	7 / 7	0.134	0.555	0.333	0.454	0.817	-0.333	-0.333	-0.333	0.982	0.378	-0.425	-0.042	-0.419	-0.143	0.938
Beryllium	7 / 7	-0.214	0.280	0.143	0.580	0.000	-0.333	-0.333	-0.333	-0.101	-0.995	-0.745	-0.945	-0.402	0.429	0.854
Boron	6 / 7	0.000	0.143	0.238	0.524	0.000	-0.333	-0.333	-0.333	-0.333	-1.000	-0.333	-0.333	-0.238	0.333	0.619
Cadmium	7 / 7	0.056	0.487	0.143	0.436	0.817	-0.333	-0.333	-0.333	1.000	0.209	-0.578	-0.217	-0.417	0.048	0.944
Calcium	7 / 7	0.575	0.730	0.238	0.544	0.000	0.333	0.333	0.333	0.814	0.730	-0.009	0.379	-0.046	-0.238	0.867
Chromium	7 / 7	-0.207	-0.466	-0.524	0.108	0.000	-0.333	-0.333	-0.333	-0.687	-0.847	-0.183	-0.549	0.606	-0.048	-0.282
Cobalt	7 / 7	0.198	0.617	0.333	0.545	0.817	-0.333	-0.333	-0.333	0.974	-0.031	-0.757	-0.444	-0.395	0.048	0.937
Copper	7 / 7	0.260	0.650	0.619	0.581	0.817	-0.333	-0.333	-0.333	0.996	0.279	-0.518	-0.146	-0.343	-0.238	0.932
Iron	7 / 7	0.733	0.635	0.048	0.501	0.817	-0.333	-0.333	-0.333	0.973	-0.033	-0.758	-0.446	0.167	-0.429	-0.056
Lead	7 / 7	0.695	0.892	0.238	0.656	0.817	-0.333	-0.333	-0.333	0.999	0.244	-0.548	-0.182	-0.165	-0.048	0.722
Lithium	7 / 7	-0.011	0.349	0.195	0.479	0.000	-0.333	-0.333	-0.333	-0.726	-0.817	-0.130	-0.503	-0.345	0.390	0.844
Magnesium	7 / 7	-0.130	0.169	0.238	0.609	0.000	-0.333	-0.333	-0.333	-0.663	-0.864	-0.215	-0.577	-0.007	0.333	0.897
Manganese	7 / 7	0.055	0.489	0.333	0.439	0.817	-0.333	-0.333	-0.333	0.996	0.285	-0.512	-0.140	-0.419	-0.143	0.945
Mercury	7 / 7	0.349	0.411	-0.048	0.139	-0.817	1.000	1.000	1.000	-0.141	0.943	0.883	0.996	0.047	-0.143	0.855
Molybdenum	5 / 7	-0.369	-0.293	0.195	0.000	1.000	-0.817	-0.817	-0.817	0.817	0.000	-0.817	-0.817	-0.098	0.000	0.000
Nickel	7 / 7	0.002	0.441	0.238	0.422	0.817	-0.333	-0.333	-0.333	1.000	0.198	-0.587	-0.228	-0.413	-0.048	0.946
Phosphorous	7 / 7	-0.689	-0.799	-0.333	-0.198	-0.817	0.333	0.333	0.333	-0.978	-0.395	0.409	0.023	0.423	0.333	-0.035
Potassium	7 / 7	0.003	0.525	0.619	0.742	0.817	-1.000	-1.000	-1.000	0.303	-0.875	-0.949	-0.997	-0.676	0.333	0.465
Selenium	7 / 7	0.377	0.612	0.143	0.363	0.000	0.333	0.333	0.333	0.541	0.931	0.362	0.695	-0.170	-0.143	0.923
Silicon	7 / 7	0.137	0.484	0.524	0.870	0.817	-1.000	-1.000	-1.000	0.696	-0.567	-0.990	-0.858	-0.275	-0.143	0.282
Silver	4 / 7	0.252	0.467	0.817	0.467	1.000	-0.817	-0.817	-0.817	0.817	0.000	-0.817	-0.817	-0.700	0.233	0.117
Sodium	5 / 7	0.580	0.781	0.098	0.586	0.817	-1.000	-1.000	-1.000	0.333	-0.333	-1.000	-1.000	-0.390	0.098	0.390
Strontium	7 / 7	0.519	0.641	0.333	0.233	0.000	0.333	0.333	0.333	0.466	0.959	0.442	0.755	-0.114	-0.333	0.785
Uranium	7 / 7	0.642	0.592	-0.238	0.525	0.000	-0.333	-0.333	-0.333	0.034	-0.973	-0.828	-0.981	-0.003	0.238	0.102
Vanadium	7 / 7	-0.194	-0.530	-0.429	-0.321	-0.817	0.333	0.333	0.333	-0.897	-0.610	0.170	-0.224	0.521	-0.143	-0.562
Zinc	7 / 7	0.432	0.379	-0.048	0.070	0.000	0.333	0.333	0.333	0.004	0.981	0.806	0.972	0.215	-0.333	0.767
Mercury (F0)	2 / 3	0.522	0.817	0.817	0.817	NA	-0.817	-0.817	-0.817	0.817	0.000	-0.817	-0.817	-0.817	0.000	-0.817
Mercury (F1)	2 / 3	-0.333	-0.333	-0.333	-1.000	-0.817	NA	1.000	1.000	-0.333	0.333	1.000	1.000	1.000	-0.333	1.000
Mercury (F2)	2 / 3	-0.333	-0.333	-0.333	-1.000	-0.817	1.000	NA	1.000	-0.333	0.333	1.000	1.000	1.000	-0.333	1.000
Mercury (F3)	2 / 3	-0.333	-0.333	-0.333	-1.000	-0.817	1.000	1.000	NA	-0.333	0.333	1.000	1.000	1.000	-0.333	1.000
Mercury (F4)	3 / 3	0.959	0.978	1.000	0.521	0.817	-0.333	-0.333	-0.333	NA	0.197	-0.588	-0.229	-0.697	-0.333	-0.271
Mercury (F5)	3 / 3	0.467	-0.012	0.333	-0.735	0.000	0.333	0.333	0.333	0.197	NA	0.677	0.909	0.567	-1.000	0.891
Mercury (F6)	3 / 3	-0.334	-0.744	-0.333	-0.997	-0.817	1.000	1.000	1.000	-0.588	0.677	NA	0.922	0.990	-0.333	0.938
Mercury (FS)	3 / 3	0.057	-0.427	-0.333	-0.950	-0.817	1.000	1.000	1.000	-0.229	0.909	0.922	NA	0.858	-0.333	0.999
Methylmercury	7 / 7	0.190	-0.388	-0.619	-0.103	-0.817	1.000	1.000	1.000	-0.697	0.567	0.990	0.858	NA	-0.333	-0.103
Sulfide	6 / 7	-0.309	-0.143	0.143	0.048	0.000	-0.333	-0.333	-0.333	-0.333	-1.000	-0.333	-0.333	-0.333	NA	-0.048
TOC	7 / 7	0.105	0.387	0.048	0.470	-0.817	1.000	1.000	1.000	-0.271	0.891	0.938	0.999	-0.103	-0.048	NA

Table E.4. Correlation matrix for sediment analytes for BCV RSE for locations with particle size #10 (cont.)

Chemical	Freq. of detection	Metals														
		Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium
Chloride	7 / 7	0.292	-0.444	-0.107	0.134	-0.214	0.000	0.056	0.575	-0.207	0.198	0.260	0.733	0.695	-0.011	-0.130
Fluoride	7 / 7	0.733	-0.514	-0.402	0.555	0.280	0.143	0.487	0.730	-0.466	0.617	0.650	0.635	0.892	0.349	0.169
Nitrate	6 / 7	0.238	0.206	-0.714	0.333	0.143	0.238	0.143	0.238	-0.524	0.333	0.619	0.048	0.238	0.195	0.238
Sulfate	7 / 7	0.700	-0.206	-0.412	0.454	0.580	0.524	0.436	0.544	0.108	0.545	0.581	0.501	0.656	0.479	0.609
Aluminum	7 / 7	NA	-0.514	-0.297	0.920	0.847	0.429	0.907	0.827	-0.398	0.955	0.935	0.191	0.847	0.847	0.706
Antimony	4 / 7	-0.514	NA	-0.309	-0.514	-0.206	-0.309	-0.514	-0.617	0.103	-0.309	-0.206	0.103	-0.412	-0.474	-0.309
Arsenic	7 / 7	-0.297	-0.309	NA	-0.299	-0.229	-0.143	-0.252	-0.302	0.276	-0.316	-0.431	-0.345	-0.409	0.061	-0.304
Barium	7 / 7	0.920	-0.514	-0.299	NA	0.859	0.333	0.996	0.852	-0.524	0.990	0.974	-0.062	0.767	0.871	0.771
Beryllium	7 / 7	0.847	-0.206	-0.229	0.859	NA	0.905	0.890	0.591	-0.139	0.874	0.831	-0.128	0.522	0.856	0.895
Boron	6 / 7	0.429	-0.309	-0.143	0.333	0.905	NA	0.333	0.238	0.238	0.524	0.238	0.048	0.429	0.390	0.810
Cadmium	7 / 7	0.907	-0.514	-0.252	0.996	0.890	0.333	NA	0.814	-0.491	0.982	0.957	-0.127	0.714	0.896	0.794
Calcium	7 / 7	0.827	-0.617	-0.302	0.852	0.591	0.238	0.814	NA	-0.391	0.878	0.913	0.321	0.949	0.663	0.662
Chromium	7 / 7	-0.398	0.103	0.276	-0.524	-0.139	0.238	-0.491	-0.391	NA	-0.439	-0.445	0.291	-0.358	-0.394	0.052
Cobalt	7 / 7	0.955	-0.309	-0.316	0.990	0.874	0.524	0.982	0.878	-0.439	NA	0.988	0.063	0.824	0.853	0.792
Copper	7 / 7	0.935	-0.206	-0.431	0.974	0.831	0.238	0.957	0.913	-0.445	0.988	NA	0.135	0.865	0.791	0.800
Iron	7 / 7	0.191	0.103	-0.345	-0.062	-0.128	0.048	-0.127	0.321	0.291	0.063	0.135	NA	0.547	-0.290	-0.024
Lead	7 / 7	0.847	-0.412	-0.409	0.767	0.522	0.429	0.714	0.949	-0.358	0.824	0.865	0.547	NA	0.544	0.541
Lithium	7 / 7	0.847	-0.474	0.061	0.871	0.856	0.390	0.896	0.663	-0.394	0.853	0.791	-0.290	0.544	NA	0.718
Magnesium	7 / 7	0.706	-0.309	-0.304	0.771	0.895	0.810	0.794	0.662	0.052	0.792	0.800	-0.024	0.541	0.718	NA
Manganese	7 / 7	0.906	-0.514	-0.273	0.996	0.890	0.333	1.000	0.816	-0.491	0.982	0.960	-0.121	0.717	0.888	0.798
Mercury	7 / 7	0.620	-0.926	-0.030	0.807	0.491	0.333	0.792	0.871	-0.505	0.772	0.778	-0.097	0.689	0.682	0.569
Molybdenum	5 / 7	-0.098	0.422	-0.098	-0.098	0.390	0.293	-0.098	-0.195	0.098	0.098	0.195	0.195	0.000	-0.250	0.293
Nickel	7 / 7	0.891	-0.412	-0.252	0.990	0.905	0.429	0.998	0.789	-0.467	0.973	0.947	-0.160	0.680	0.895	0.813
Phosphorous	7 / 7	-0.345	0.000	0.502	-0.269	0.133	0.429	-0.191	-0.429	0.739	-0.268	-0.335	-0.385	-0.573	-0.032	0.231
Potassium	7 / 7	0.810	-0.103	-0.302	0.626	0.743	0.429	0.633	0.389	-0.315	0.656	0.619	0.026	0.481	0.721	0.493
Selenium	7 / 7	0.821	-0.514	-0.259	0.933	0.666	0.333	0.909	0.956	-0.507	0.927	0.939	0.090	0.854	0.735	0.685
Silicon	7 / 7	0.557	0.206	-0.629	0.316	0.529	0.333	0.298	0.317	0.219	0.418	0.462	0.581	0.499	0.203	0.515
Silver	4 / 7	0.583	-0.126	-0.467	0.583	0.117	0.233	0.467	0.467	-0.583	0.467	0.583	0.000	0.467	0.538	0.233
Sodium	5 / 7	0.878	-0.580	0.000	0.781	0.293	0.390	0.878	0.683	-0.195	0.683	0.488	0.195	0.781	0.650	0.293
Strontium	7 / 7	0.684	-0.514	-0.267	0.818	0.429	0.143	0.777	0.922	-0.651	0.794	0.828	0.092	0.822	0.598	0.474
Uranium	7 / 7	0.439	-0.514	0.365	0.136	0.104	0.333	0.115	0.340	0.073	0.222	0.174	0.487	0.471	0.329	-0.020
Vanadium	7 / 7	-0.645	0.206	0.478	-0.727	-0.455	-0.048	-0.701	-0.606	0.868	-0.668	-0.700	0.211	-0.556	-0.631	-0.356
Zinc	7 / 7	0.476	-0.617	-0.082	0.682	0.328	0.333	0.655	0.845	-0.420	0.653	0.687	0.020	0.668	0.490	0.494
Mercury (F0)	2 / 3	0.817	1.000	-0.817	0.817	0.000	0.000	0.817	0.000	0.000	0.817	0.817	0.817	0.817	0.000	0.000
Mercury (F1)	2 / 3	-1.000	-0.817	0.333	-0.333	-0.333	-0.333	-0.333	0.333	-0.333	-0.333	-0.333	-0.333	-0.333	-0.333	-0.333
Mercury (F2)	2 / 3	-1.000	-0.817	0.333	-0.333	-0.333	-0.333	-0.333	0.333	-0.333	-0.333	-0.333	-0.333	-0.333	-0.333	-0.333
Mercury (F3)	2 / 3	-1.000	-0.817	0.333	-0.333	-0.333	-0.333	-0.333	0.333	-0.333	-0.333	-0.333	-0.333	-0.333	-0.333	-0.333
Mercury (F4)	3 / 3	0.678	0.817	-0.991	0.982	-0.101	-0.333	1.000	0.814	-0.687	0.974	0.996	0.973	0.999	-0.726	-0.663
Mercury (F5)	3 / 3	-0.587	0.000	-0.323	0.378	-0.995	-1.000	0.209	0.730	-0.847	-0.031	0.279	-0.033	0.244	-0.817	-0.864
Mercury (F6)	3 / 3	-0.993	-0.817	0.478	-0.425	-0.745	-0.333	-0.578	-0.009	-0.183	-0.757	-0.518	-0.758	-0.548	-0.130	-0.215
Mercury (FS)	3 / 3	-0.871	-0.817	0.100	-0.042	-0.945	-0.333	-0.217	0.379	-0.549	-0.444	-0.146	-0.446	-0.182	-0.503	-0.577
Methylmercury	7 / 7	-0.476	-0.103	0.329	-0.419	-0.402	-0.238	-0.417	-0.046	0.606	-0.395	-0.343	0.167	-0.165	-0.345	-0.007
Sulfide	6 / 7	0.143	0.103	0.143	-0.143	0.429	0.333	0.048	-0.238	-0.048	0.048	-0.238	-0.429	-0.048	0.390	0.333
TOC	7 / 7	0.827	-0.617	-0.201	0.938	0.854	0.619	0.944	0.867	-0.282	0.937	0.932	-0.056	0.722	0.844	0.897

Table E.4. Correlation matrix for sediment analytes for BCV RSE for locations with particle size #10 (cont.)

Chemical	Freq. of detection	Metals													
		Manganese	Mercury	Molybdenum	Nickel	Phosphorous	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Uranium	Vanadium	Zinc
Chloride	7 / 7	0.055	0.349	-0.369	0.002	-0.689	0.003	0.377	0.137	0.252	0.580	0.519	0.642	-0.194	0.432
Fluoride	7 / 7	0.489	0.411	-0.293	0.441	-0.799	0.525	0.612	0.484	0.467	0.781	0.641	0.592	-0.530	0.379
Nitrate	6 / 7	0.333	-0.048	0.195	0.238	-0.333	0.619	0.143	0.524	0.817	0.098	0.333	-0.238	-0.429	-0.048
Sulfate	7 / 7	0.439	0.139	0.000	0.422	-0.198	0.742	0.363	0.870	0.467	0.586	0.233	0.525	-0.321	0.070
Aluminum	7 / 7	0.906	0.620	-0.098	0.891	-0.345	0.810	0.821	0.557	0.583	0.878	0.684	0.439	-0.645	0.476
Antimony	4 / 7	-0.514	-0.926	0.422	-0.412	0.000	-0.103	-0.514	0.206	-0.126	-0.580	-0.514	-0.514	0.206	-0.617
Arsenic	7 / 7	-0.273	-0.030	-0.098	-0.252	0.502	-0.302	-0.259	-0.629	-0.467	0.000	-0.267	0.365	0.478	-0.082
Barium	7 / 7	0.996	0.807	-0.098	0.990	-0.269	0.626	0.933	0.316	0.583	0.781	0.818	0.136	-0.727	0.682
Beryllium	7 / 7	0.890	0.491	0.390	0.905	0.133	0.743	0.666	0.529	0.117	0.293	0.429	0.104	-0.455	0.328
Boron	6 / 7	0.333	0.333	0.293	0.429	0.429	0.429	0.333	0.333	0.233	0.390	0.143	0.333	-0.048	0.333
Cadmium	7 / 7	1.000	0.792	-0.098	0.998	-0.191	0.633	0.909	0.298	0.467	0.878	0.777	0.115	-0.701	0.655
Calcium	7 / 7	0.816	0.871	-0.195	0.789	-0.429	0.389	0.956	0.317	0.467	0.683	0.922	0.340	-0.606	0.845
Chromium	7 / 7	-0.491	-0.505	0.098	-0.467	0.739	-0.315	-0.507	0.219	-0.583	-0.195	-0.651	0.073	0.868	-0.420
Cobalt	7 / 7	0.982	0.772	0.098	0.973	-0.268	0.656	0.927	0.418	0.467	0.683	0.794	0.222	-0.668	0.653
Copper	7 / 7	0.960	0.778	0.195	0.947	-0.335	0.619	0.939	0.462	0.583	0.488	0.828	0.174	-0.700	0.687
Iron	7 / 7	-0.121	-0.097	0.195	-0.160	-0.385	0.026	0.090	0.581	0.000	0.195	0.092	0.487	0.211	0.020
Lead	7 / 7	0.717	0.689	0.000	0.680	-0.573	0.481	0.854	0.499	0.467	0.781	0.822	0.471	-0.556	0.668
Lithium	7 / 7	0.888	0.682	-0.250	0.895	-0.032	0.721	0.735	0.203	0.538	0.650	0.598	0.329	-0.631	0.490
Magnesium	7 / 7	0.798	0.569	0.293	0.813	0.231	0.493	0.685	0.515	0.233	0.293	0.474	-0.020	-0.356	0.494
Manganese	7 / 7	NA	0.789	-0.098	0.998	-0.196	0.631	0.910	0.308	0.583	0.781	0.779	0.101	-0.704	0.655
Mercury	7 / 7	0.789	NA	-0.293	0.777	-0.252	0.133	0.936	-0.143	0.233	0.586	0.943	0.103	-0.597	0.969
Molybdenum	5 / 7	-0.098	-0.293	NA	0.000	0.488	0.098	-0.098	0.390	-0.120	-0.150	-0.098	-0.390	0.000	-0.098
Nickel	7 / 7	0.998	0.777	0.000	NA	-0.145	0.626	0.893	0.297	0.467	0.781	0.751	0.075	-0.684	0.639
Phosphorous	7 / 7	-0.196	-0.252	0.488	-0.145	NA	-0.262	-0.356	-0.143	-0.467	-0.195	-0.542	-0.235	0.651	-0.266
Potassium	7 / 7	0.631	0.133	0.098	0.626	-0.262	NA	0.370	0.665	0.700	0.488	0.226	0.407	-0.585	-0.066
Selenium	7 / 7	0.910	0.936	-0.098	0.893	-0.356	0.370	NA	0.174	0.350	0.683	0.951	0.166	-0.661	0.883
Silicon	7 / 7	0.308	-0.143	0.390	0.297	-0.143	0.665	0.174	NA	0.350	0.195	0.005	0.256	-0.141	-0.181
Silver	4 / 7	0.583	0.233	-0.120	0.467	-0.467	0.700	0.350	0.350	NA	0.538	0.467	0.117	-0.583	0.117
Sodium	5 / 7	0.781	0.586	-0.150	0.781	-0.195	0.488	0.683	0.195	0.538	NA	0.586	0.683	-0.488	0.488
Strontium	7 / 7	0.779	0.943	-0.098	0.751	-0.542	0.226	0.951	0.005	0.467	0.586	NA	0.140	-0.727	0.926
Uranium	7 / 7	0.101	0.103	-0.390	0.075	-0.235	0.407	0.166	0.256	0.117	0.683	0.140	NA	0.016	0.029
Vanadium	7 / 7	-0.704	-0.597	0.000	-0.684	0.651	-0.585	-0.661	-0.141	-0.583	-0.488	-0.727	0.016	NA	-0.490
Zinc	7 / 7	0.655	0.969	-0.098	0.639	-0.266	-0.066	0.883	-0.181	0.117	0.488	0.926	0.029	-0.490	NA
Mercury (F0)	2 / 3	0.817	-0.817	1.000	0.817	-0.817	0.817	0.000	0.817	1.000	0.817	0.000	0.000	-0.817	0.000
Mercury (F1)	2 / 3	-0.333	1.000	-0.817	-0.333	0.333	-1.000	0.333	-1.000	-0.817	-1.000	0.333	-0.333	0.333	0.333
Mercury (F2)	2 / 3	-0.333	1.000	-0.817	-0.333	0.333	-1.000	0.333	-1.000	-0.817	-1.000	0.333	-0.333	0.333	0.333
Mercury (F3)	2 / 3	-0.333	1.000	-0.817	-0.333	0.333	-1.000	0.333	-1.000	-0.817	-1.000	0.333	-0.333	0.333	0.333
Mercury (F4)	3 / 3	0.996	-0.141	0.817	1.000	-0.978	0.303	0.541	0.696	0.817	0.333	0.466	0.034	-0.897	0.004
Mercury (F5)	3 / 3	0.285	0.943	0.000	0.198	-0.395	-0.875	0.931	-0.567	0.000	-0.333	0.959	-0.973	-0.610	0.981
Mercury (F6)	3 / 3	-0.512	0.883	-0.817	-0.587	0.409	-0.949	0.362	-0.990	-0.817	-1.000	0.442	-0.828	0.170	0.806
Mercury (FS)	3 / 3	-0.140	0.996	-0.817	-0.228	0.023	-0.997	0.695	-0.858	-0.817	-1.000	0.755	-0.981	-0.224	0.972
Methylmercury	7 / 7	-0.419	0.047	-0.098	-0.413	0.423	-0.676	-0.170	-0.275	-0.700	-0.390	-0.114	-0.003	0.521	0.215
Sulfide	6 / 7	-0.143	-0.143	0.000	-0.048	0.333	0.333	-0.143	-0.143	0.233	0.098	-0.333	0.238	-0.143	-0.333
TOC	7 / 7	0.945	0.855	0.000	0.946	-0.035	0.465	0.923	0.282	0.117	0.390	0.785	0.102	-0.562	0.767

Table E.4. Correlation matrix for sediment analytes for BCV RSE for locations with particle size #10 (cont.)

Correlation is significant at the 0.05 significance level where 0.01 ≤ two-sided *p*-value ≤ 0.05.
Correlation is significant at the 0.01 significance level where 0.001 ≤ two-sided *p*-value < 0.01.
Correlation is significant at the 0.001 significance level where 0.0001 ≤ two-sided *p*-value < 0.001.
Correlation is significant at the 0.0001 significance level where two-sided *p*-value < 0.0001.
Pearson correlations are calculated when both variables have all detections.
Kendall tau correlations are calculated when there is at least one non-detection in one or both variables, but at least half detections in each variable.
BCV = Bear Creek Valley
Freq. = frequency
NA = not applicable
RSE = remedial site evaluation
TOC = Total organic carbon average

The pairwise correlation tables were used to identify analytes that are significantly correlated with mercury in soil and sediment. For example, Table E.1 for all soil combined shows the variables most highly correlated with mercury and having all detected concentrations were fluoride, cadmium, copper, lead, lithium, zinc, aluminum, arsenic, calcium, nickel, phosphorous, selenium, silicon, strontium, uranium, vanadium, and total organic carbon (TOC) (exclusive of the sequential extraction results that are expected to be correlated with mercury and have only n = 18 samples). The correlation analysis was used as an exploratory tool to identify analytes that would likely be good predictors for mercury. Because there were so many analytes and the dataset has a relatively small number of samples, the number of probable predictors needed to be subset before using them in the multivariate models.

Four multivariate model selection methods using information criteria were used to evaluate all possible $2^k - 1$ subset models simultaneously for k independent variables in the model. These four criteria are described in more detail in Section E.2. SAS® version 9.4 was used to evaluate all possible subset models using the four criteria (Beal 2007). For example, if k = 10 variables were selected as the most correlated (and detected) with mercury from Tables E.1 and E.3, and then all possible $2^{10} - 1 = 1023$ subset models were evaluated simultaneously. Four information criteria were calculated for each subset model and were sorted in ascending order from smallest to largest for each criterion. The four criteria may not agree which model is best. In that case, professional judgment is used to select the overall best model using the guiding statistical principle of parsimony, which of the four criteria agree, and historical experience in Bear Creek Valley soil and sediment. From a statistical perspective, a more parsimonious (fewer independent parameters) is preferred over models with more independent parameters. Multicollinearity was considered and examined for each of the final models and found not to be a problem because the purpose of the modeling is exploratory and not predictive given the relatively small number of samples.

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E.2. INFORMATION CRITERIA METHODS

The following sections describe various criteria methods.

E.2.1 AKAIKE'S INFORMATION CRITERION

Akaike (1973) introduced the concept of information criteria as a tool for optimal model selection. Other authors who use the Akaike's Information Criterion (AIC) for model selection include Akaike (1987) and Bozdogan (1987, 2000). AIC is a function of the number of observations n, the sum of squared errors (SSE), and the number of independent variables k, as shown in Equation 1.

$$AIC = n \cdot \ln\left(\frac{SSE}{n}\right) + 2k \qquad \text{(Equation 1)}$$

The first term in Equation 1 is a measure of the model lack of fit, while the second term—$2k$—is a penalty term for additional parameters in the model. Therefore, as the number of independent variables k included in the model increases, the lack of fit term decreases while the penalty term increases. Conversely, as variables are dropped from the model, the lack of fit term increases while the penalty term decreases. The model with the smallest AIC is deemed the "best" model because it minimizes the difference from the given model to the "true" model.

E.2.2 AKAIKE'S INFORMATION CRITERION CORRECTED

When the sample size n is small, AIC tends to select models that have too many parameters (i.e., AIC tends to overfit). To address such potential overfitting, AIC corrected (AICc) was developed. AICc is AIC with a correction for small sample sizes, as shown in Equation 2.

$$AICc = AIC + \frac{2k(k+1)}{n-k-1} \qquad \text{(Equation 2)}$$

The second term in Equation 2 is an additional penalty term that discourages AIC from overfitting the model. Thus, AICc is essentially AIC with an extra penalty term for the number of parameters. Note that, as $n \to \infty$, the extra penalty term converges to 0, and thus AICc converges to AIC. The formula for AIC includes k but not k^2. In other words, AIC is a first-order estimate of the information loss; whereas, AICc is a second-order estimate. The model with the smallest AICc is deemed the "best" model because it minimizes the difference from the given model to the "true" model.

E.2.3 BAYESIAN INFORMATION CRITERION

Sawa (1978) developed a model selection criterion that was derived from a Bayesian modification of the AIC criterion. Bayesian Information Criterion (BIC) is a function of the number of observations (n), the SSE, the pure error variance fitting the full model (σ^2), and the number of independent variables (k), as shown in Equation 3.

$$BIC = n \cdot \ln\left(\frac{SSE}{n}\right) + \frac{2(k+2)n\sigma^2}{SSE} - \frac{2n^2\sigma^4}{SSE^2} \qquad \text{(Equation 3)}$$

The penalty term for BIC is more complex than the AIC penalty term and is a function of n, the SSE, and σ^2, in addition to k. The model with the smallest BIC is deemed the "best" model because it minimizes the difference from the given model to the "true" model.

E.2.4 SCHWARZ BAYESIAN CRITERION

Schwarz (1978) developed a model selection criterion that was derived from a Bayesian modification of the AIC criterion. Schwarz Bayesian Criterion (SBC) is a function of the number of observations (*n*), the SSE, and the number of independent variables (*k*), as shown in Equation 4.

$$SBC = n \cdot \ln\left(\frac{SSE}{n}\right) + k \ln n \qquad \text{(Equation 4)}$$

The penalty term for SBC is similar to AIC in Equation 4, but it uses a multiplier of ln *n* for *k* instead of a constant 2, by incorporating the sample size *n*. The model with the smallest SBC is deemed the "best" model because it minimizes the difference from the given model to the "true" model.

E.3. SOIL RESULTS

The modeling began as a descriptive process because the dataset is too small to establish definitive predictive models. For exploratory purposes, four different selection criteria were used for model evaluation to see which models were the best for each of the four information criteria using mercury as the dependent variable. The scores from these four criteria cannot be compared with each other because they score the models differently.

E.3.1 FLOODPLAIN AND CREEK BANK SOIL COMBINED

From Table E.1, the following analytes were selected that were significantly correlated with mercury and had all detected concentrations: fluoride, cadmium, copper, lead, lithium, zinc, aluminum, arsenic, calcium, nickel, phosphorous, selenium, silicon, strontium, uranium, vanadium, and TOC average. The sequential extraction analytes were excluded from consideration because there were only 18 samples, compared to 48 samples for the other analytes. Including even 1 sequential extraction analyte would reduce the dataset to 18 records, which would further limit the number of regressors that could be considered in the model because the number of regressors could exceed the number of observations. The best model with the lowest AIC score using all floodplain and creek bank soil data has an AIC = -71.4113, an adjusted R^2 = 0.8864, a root mean square error (RMSE) = 0.4274, an F = 34.35, an F *p*-value = < 0.0001, and *k* = 11 variables (not counting the intercept).

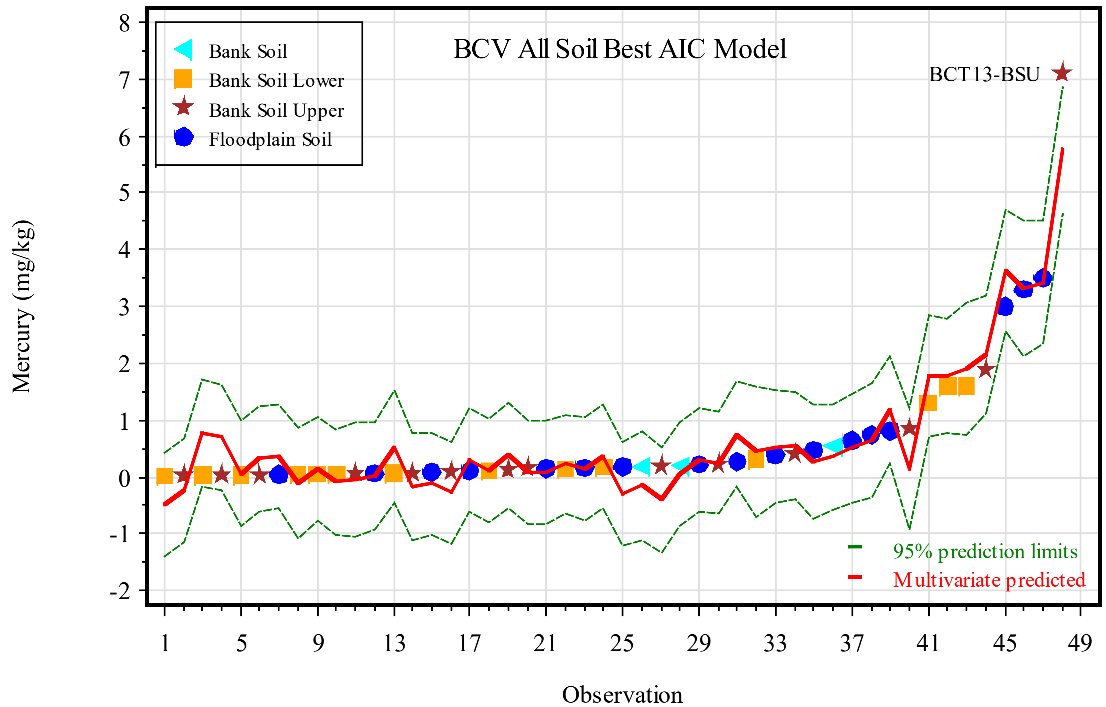
Table E.5 shows the parameter estimates, standard errors, student's t-statistics, and two-sided *p*-values for the best AIC model.

Table E.5. Model statistics for all soil for best AIC model

Independent variable	Parameter estimate (mg/kg)	Standard error (mg/kg)	Student's t-statistic	Two-sided *p*-value
Intercept	-2.31956	0.43593	-5.32	<0.0001
Fluoride	-0.09391	0.02596	-3.62	0.0009
Cadmium	0.1079	0.06458	1.67	0.1034
Copper	0.19591	0.04088	4.79	<0.0001
Lead	0.09284	0.03024	3.07	0.0041
Lithium	0.12433	0.03412	3.64	0.0008
Zinc	-0.03543	0.01313	-2.70	0.0105
Calcium	5.68E-05	2.09E-05	2.72	0.0101
Nickel	-0.02166	0.00983	-2.20	0.0341
Silicon	1.27E-04	8.67E-05	1.46	0.1524
Uranium	-0.03002	0.00564	-5.32	<0.0001
Vanadium	-0.04043	0.0154	-2.63	0.0127

AIC = Akaike Information Criterion

Table E.5 shows cadmium and silicon do not significantly contribute to the model with *p*-values of 0.1034 and 0.1524, respectively. Figure E.1 is a plot that shows the multivariate-predicted concentrations and 95% prediction limits compared with the actual mercury concentrations. Different symbols for the bank soil, bank soil lower, bank soil upper, and floodplain soil are shown to see if there are any patterns by soil type. Figure E.1 shows the soil types are scattered fairly uniformly throughout the distribution. All concentrations, except BCT13-BSU, are within the 95% prediction limits.



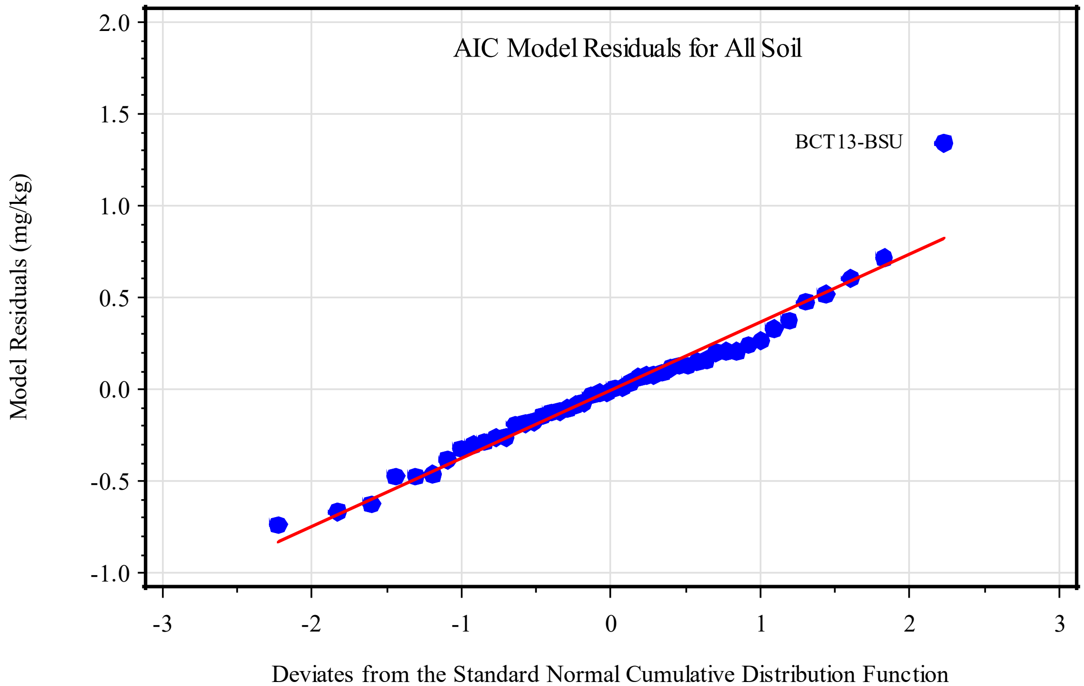
AIC = Akaike's Information Criterion
BCV = Bear Creek Valley
BSU = upper creek bank soil

Figure E.1. Best AIC model for all soil.

Figure E.2 shows a normal probability plot of the best AIC model residuals. Model residuals were tested for normality using the Shapiro-Wilk (SW) test, which showed the residuals are approximately normally distributed at the 0.05 significance level, with an SW *p*-value = 0.0572. All residuals, except BCT13-BSU, plot approximately linearly along the regression line.

The best model with the lowest AICc, BIC, and SBC scores using all floodplain and creek bank soil data has an AICc = -65.9029, a BIC = -63.6272, an SBC = -52.7544, an adjusted R^2 = 0.8766, an RMSE = 0.44547, an F = 42.74, an F *p*-value = < 0.0001, and k = 8 variables (not counting the intercept). Both the BIC and SBC scores are more than 1 lower than the BIC and SBC scores of the model with the next lowest scores. This indicates the model is considerably better than the model with the next lowest BIC and SBC scores.

Table E.6 shows the parameter estimates, standard errors, student's t-statistics, and two-sided *p*-values for the best AICc, BIC, and SBC model.



AIC = Akaike Information Criterion BSU = upper creek bank soil

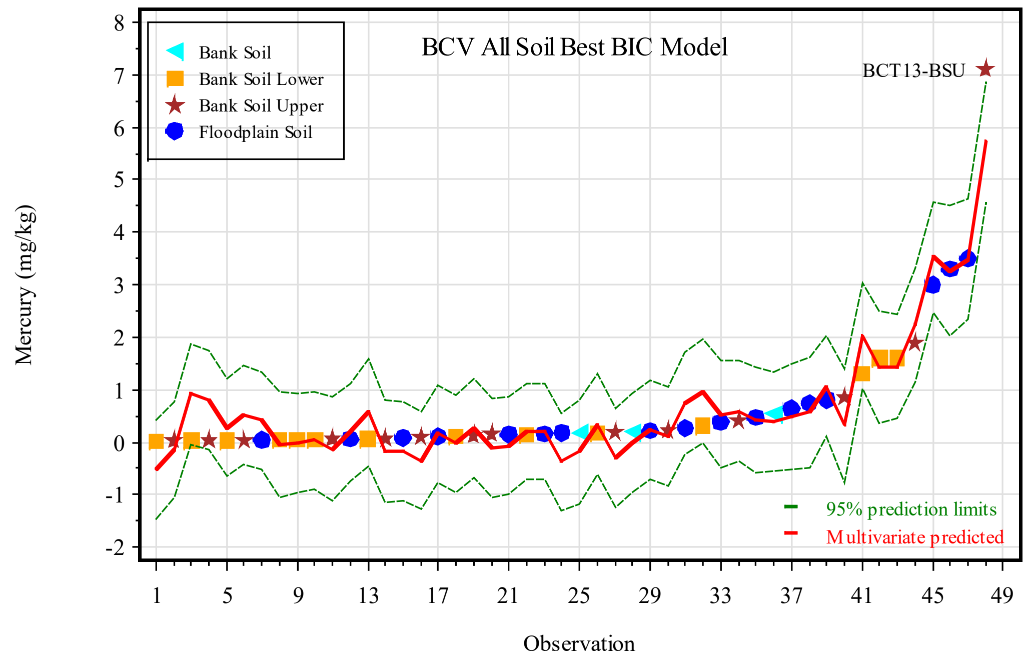
Figure E.2. AIC model residuals for all soil.

Table E.6. Model statistics for all soil for best AICc, BIC, and SBC model

Independent variable	Parameter estimate (mg/kg)	Standard error (mg/kg)	Student's t-statistic	Two-sided *p*-value
Intercept	-2.5047	0.3638	-6.88	<0.0001
Fluoride	-0.0841	0.02264	-3.71	0.0006
Copper	0.22741	0.03789	6.00	<0.0001
Lead	0.08844	0.03037	2.91	0.0059
Lithium	0.14225	0.03163	4.50	<0.0001
Zinc	-0.05004	0.00974	-5.14	<0.0001
Calcium	6.53E-05	2.14E-05	3.05	0.0041
Uranium	-0.02853	0.00568	-5.02	<0.0001
Vanadium	-0.03417	0.01455	-2.35	0.024

AICc = Akaike's Information Criterion
BIC = Bayesian Information Criterion
SBC = Schwarz Bayesian Criterion

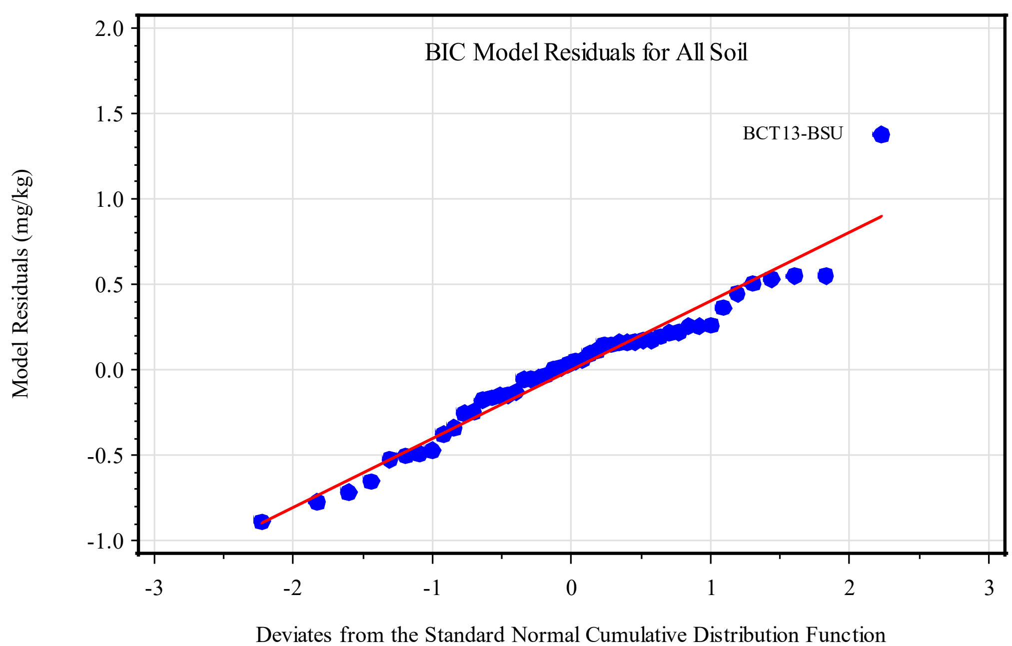
Table E.6 shows all variables significantly contribute to the model at the 0.05 significance level. Figure E.3 is a plot that shows the multivariate-predicted concentrations and 95% prediction limits compared with the actual mercury concentrations. Different symbols for the bank soil, bank soil lower, bank soil upper, and floodplain soil are shown to see if there are any patterns by soil type. Figure E.3 shows the soil types are scattered fairly uniformly throughout the distribution. All concentrations, except BCT13-BSU, are within the 95% prediction limits.



AICc = Akaike's Information Criterion corrected
BCV = Bear Creek Valley
BIC = Bayesian Information Criterion
BSU = upper creek bank soil
SBC = Schwarz Bayesian Criterion

Figure E.3. Best AICc, BIC, and SBC model for all soil.

Figure E.4 shows a normal probability plot of the best AICc, BIC, and SBC model residuals. Model residuals were tested for normality using the SW test, which showed the residuals are approximately normally distributed at the 0.05 significance level, with an SW p-value = 0.0618. All residuals, except BCT13-BSU, plot approximately linearly along the regression line.



AICc = Akaike's Information Criterion corrected
BIC = Bayesian Information Criterion
BSU = upper creek bank soil
SBC = Schwarz Bayesian Criterion

Figure E.4. AICc, BIC, and SBC model residuals for all soil.

A comparison of the best AIC model (Table E.5) with the best model determined by AICc, BIC, and SBC (Table E.6) shows the preferred model to be the AICc, BIC, and SBC model because it is more parsimonious (k = 8 variables instead of k = 11 for AIC). AIC tends to overfit the data by selecting more variables compared to other information criteria. The AIC model also selected two variables that did not significantly contribute to the model. Because AICc, BIC, and SBC agree on the same model and it is more parsimonious than the AIC model, the model shown in Table E.6 was selected as the best overall model for predicting mercury for all soil data combined.

E.3.2 FLOODPLAIN SOIL

There are n = 17 samples from the floodplain soil. Pearson correlations were calculated between all 29 analytes detected in all 17 samples. The following analytes were significantly correlated with mercury at the 0.05 significance level and had all detected concentrations: fluoride, aluminum, cadmium, copper, lead, lithium, phosphorous, selenium, silicon, uranium, zinc, methylmercury, and TOC. The sequential extraction analytes were excluded from consideration because there were only 9 samples, compared to 17 samples for the other analytes. Including even one sequential extraction analyte would reduce the dataset to nine records, which would further limit the number of regressors that could be considered in the model because the number of regressors could exceed the number of observations.

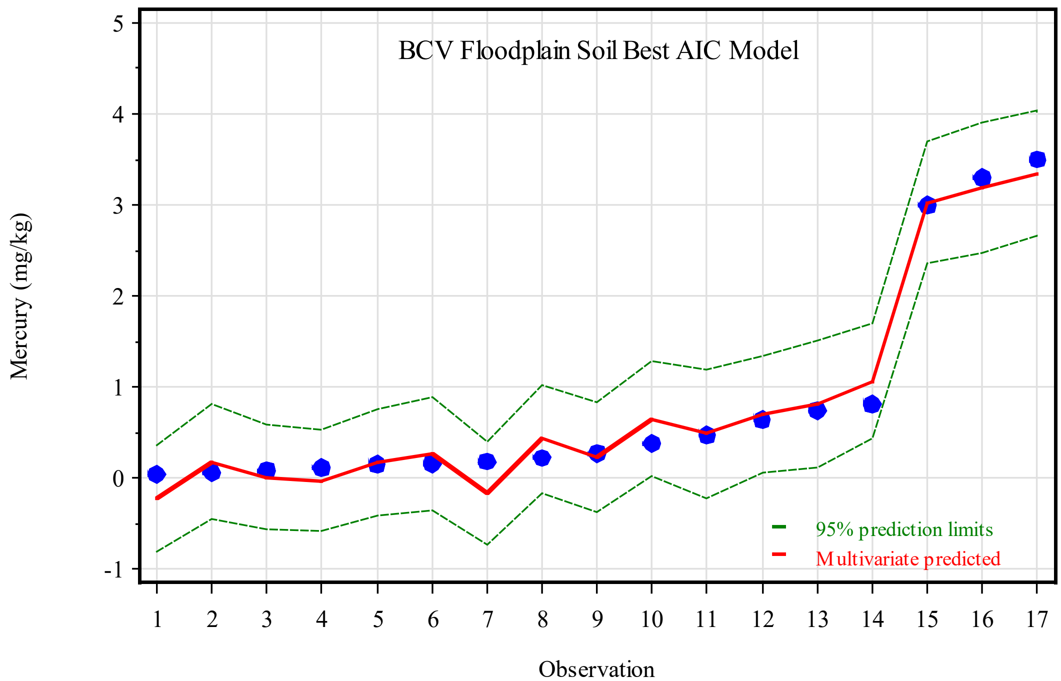
The best model with the lowest AIC score using all floodplain soil data has an AIC = -44.8449, an adjusted R^2 = 0.9627, an RMSE = 0.2296, an F = 60.03, an F p-value = < 0.0001, and k = 7 variables (not counting the intercept). Table E.7 shows the parameter estimates, standard errors, student's t-statistics, and two-sided p-values for the best AIC model for floodplain soil.

Table E.7. Model statistics for floodplain soil for AIC model

Independent variable	Parameter estimate (mg/kg)	Standard error (mg/kg)	Student's t-statistic	Two-sided p-value
Intercept	-0.33472	0.44576	-0.75	0.4719
Fluoride	0.2668	0.03355	7.95	<0.0001
Copper	-0.05141	0.03447	-1.49	0.17
Lead	0.08922	0.02337	3.82	0.0041
Phosphorous	-0.00428	0.00368	-1.16	0.2749
Selenium	-0.4963	0.20929	-2.37	0.0418
Uranium	0.01332	0.00516	2.58	0.0297
TOC	2.89E-05	1.69E-05	1.71	0.1218

AIC = Akaike's Information Criterion
TOC = total organic carbon

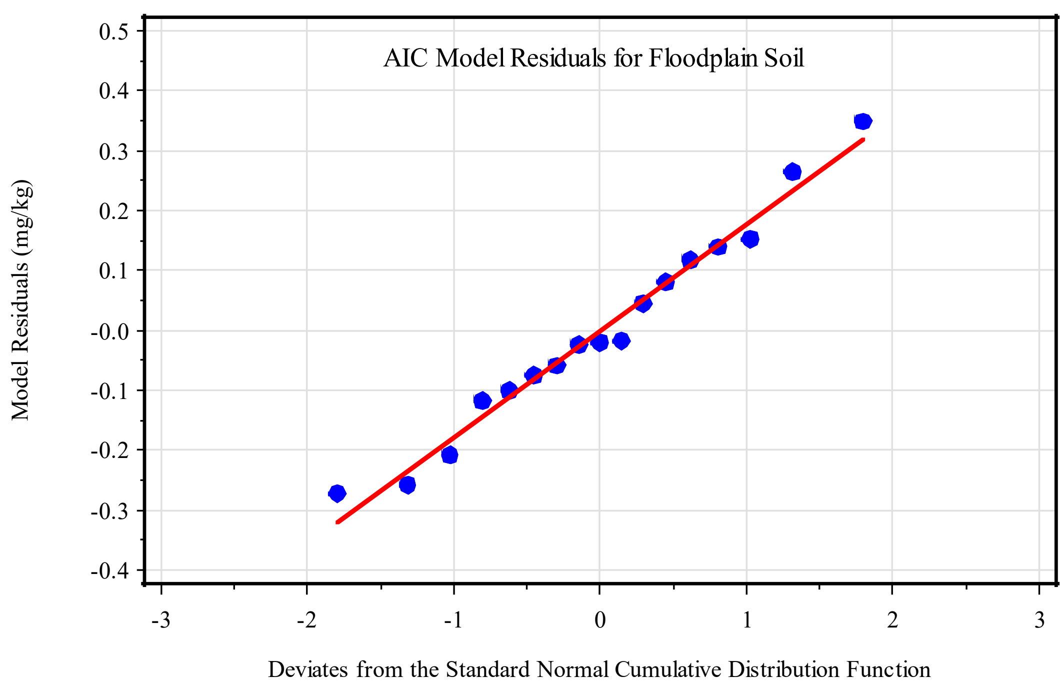
Table E.7 shows the intercept, copper, phosphorous, and TOC do not significantly contribute to the model at the 0.05 significance level. Figure E.5 is a plot that shows the multivariate-predicted concentrations and 95% prediction limits compared with the actual mercury concentrations. Figure E.5 shows all concentrations are within the 95% prediction limits.



AIC = Akaike Information Criterion BCV = Bear Creek Valley

Figure E.5. Best AIC model for floodplain soil.

Figure E.6 shows a normal probability plot of the best AIC model residuals. Model residuals were tested for normality using the SW test, which showed the residuals are approximately normally distributed at the 0.05 significance level, with an SW *p*-value = 0.8977. All residuals plot approximately linearly along the regression line.



AIC = Alaike Information Criterion

Figure E.6. AIC model residuals for floodplain soil.

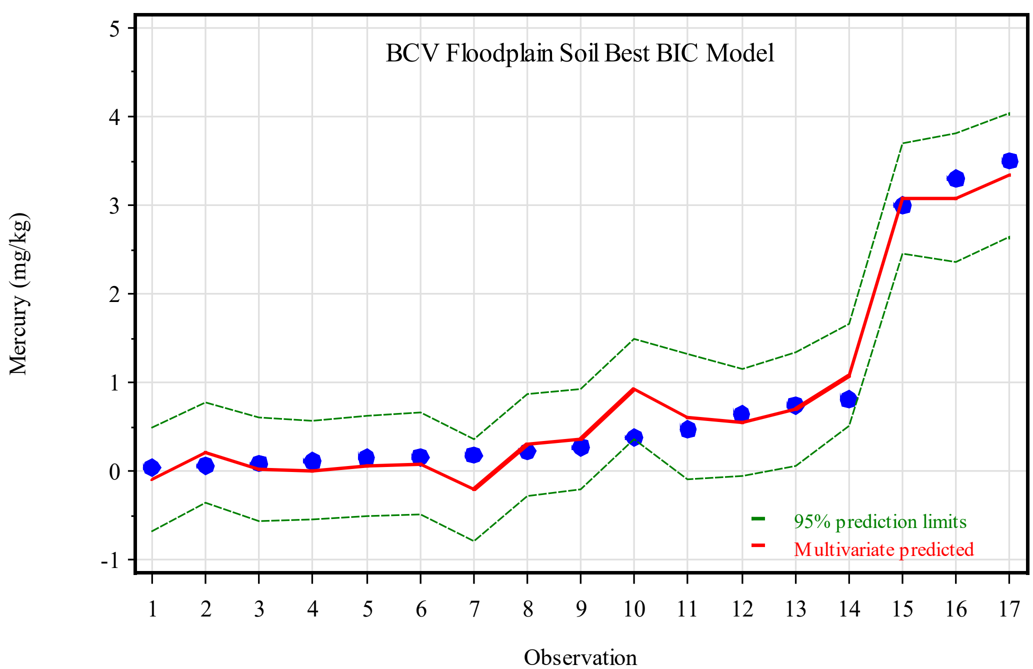
The best model with the lowest AICc, BIC, and SBC scores using all floodplain soil data has an AICc = -40.4186, a BIC = -29.6802, an SBC = -39.5859, an adjusted R^2 = 0.9576, an RMSE = 0.2449, an F = 91.27, an F *p*-value = < 0.0001, and *k* = 4 variables (not counting the intercept). Table E.8 shows the parameter estimates, standard errors, student's t-statistics, and two-sided *p*-values for the best AICc, BIC, and SBC model for floodplain soil.

Table E.8. Model statistics for floodplain soil for AICc, BIC, and SBC

Independent variable	Parameter estimate (mg/kg)	Standard error (mg/kg)	Student's t-statistic	Two-sided *p*-value
Intercept	-0.76039	0.2266	-3.36	0.0057
Fluoride	0.23247	0.02512	9.25	<0.0001
Lead	0.06446	0.01847	3.49	0.0045
Selenium	-0.46983	0.20547	-2.29	0.0412
Uranium	0.0115	0.00482	2.39	0.0344

AICc = Akaike's Information Criterion corrected
BIC = Bayesian Information Criterion
SBC = Schwarz Bayesian Criterion

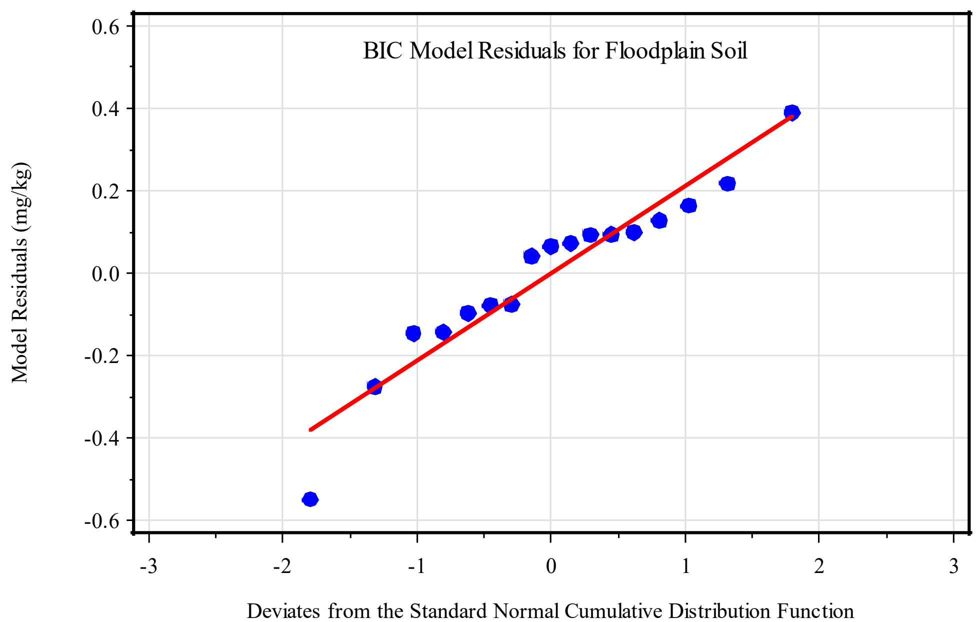
Table E.8 shows all variables significantly contribute to the model at the 0.05 significance level. Copper, phosphorous, and TOC have been removed from the AICc, BIC, and SBC model compared to the AIC model in Table E.7. Figure E.7 is a plot that shows the multivariate-predicted concentrations and 95% prediction limits compared with the actual mercury concentrations. Figure E.7 shows all concentrations are within the 95% prediction limits.



AICc = Akaike's Information Criterion corrected
BCV = Bear Creek Valley
BIC = Bayesian Information Criterion
SBC = Schwarz Bayesian Criterion

Figure E.7. Best AICc, BIC, and SBC model for floodplain soil.

Figure E.8 shows a normal probability plot of the best AICc, BIC, and SBC model residuals. Model residuals were tested for normality using the SW test, which showed the residuals are approximately normally distributed at the 0.05 significance level, with an SW *p*-value = 0.298. All residuals, except the smallest residual of -0.5485 from BCT9-FP (observation 10 in Figure E.7.), plot approximately linearly along the regression line.



AICc = Akaike's Information Criterion corrected
BIC = Bayesian Information Criterion
SBC = Schwarz Bayesian Criterion

Figure E.8. AICc, BIC, and SBC model residuals for floodplain soil.

A comparison of the best AIC model (Table E.7) with the best model determined by AICc, BIC, and SBC (Table E.8) shows the preferred model to be the AICc, BIC, and SBC model because it is more parsimonious ($k = 4$ variables instead of $k = 7$ for AIC). AIC tends to overfit the data by selecting more variables compared to other information criteria. The AIC model also selected copper, phosphorous, and TOC, which did not significantly contribute to the model. Because AICc, BIC, and SBC agree on the same model and it is more parsimonious than the AIC model, the model shown in Table E.8 was selected as the best overall model for predictING MERCURY FOR FLOODPLAIN SOIL DATA.

E.3.3 CREEK BANK SOIL

There are $n = 31$ samples from creek bank soil. Pearson correlations were calculated between all 27 analytes detected in all 31 samples. The following analytes were significantly correlated with mercury at the 0.05 significance level and had all detected concentrations: fluoride, arsenic, cadmium, calcium, copper, lead, lithium, phosphorous, selenium, strontium, zinc, and TOC. The sequential extraction analytes were excluded from consideration because there were only 9 samples, compared to 31 samples for the other analytes. Including even one sequential extraction analyte would reduce the dataset to nine records, which would further limit the number of regressors that could be considered in the model because the number of regressors could exceed the number of observations.

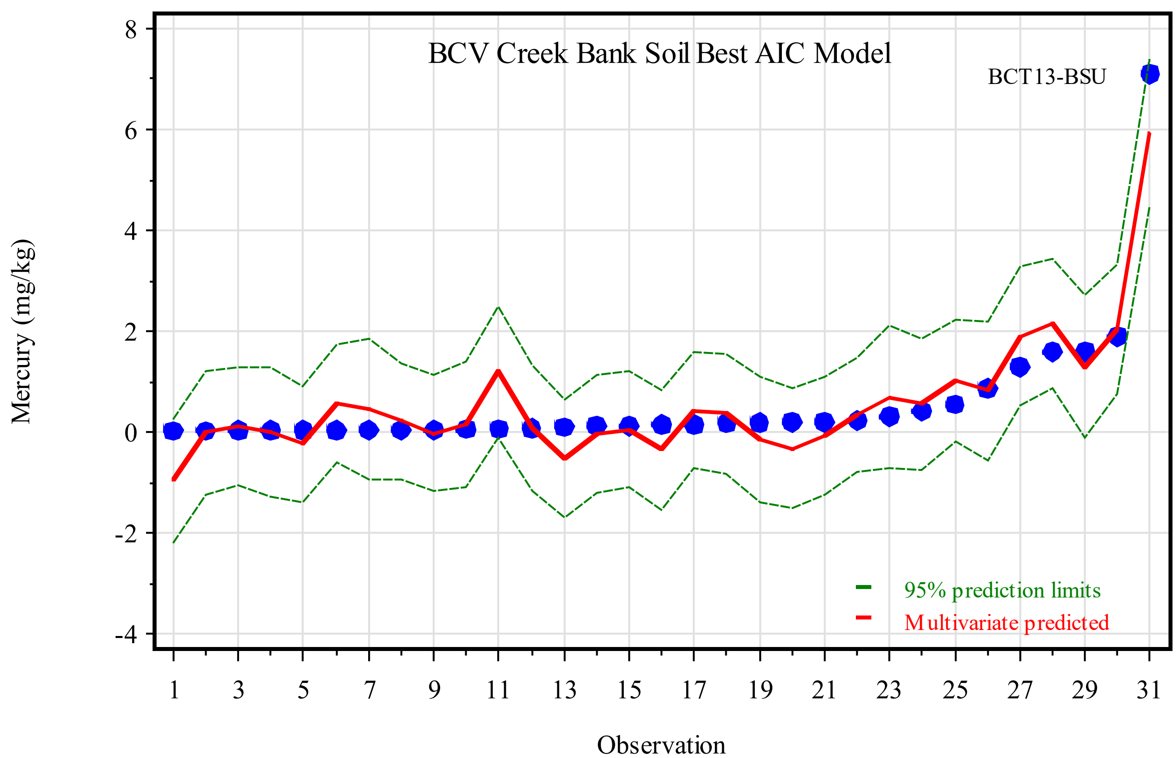
The best model with the lowest AIC score using all creek bank soil data has an AIC = -31.6709, an adjusted $R^2 = 0.8337$, an RMSE = 0.5381, an F = 22.49, an F *p*-value = < 0.0001, and $k = 7$ variables (not counting the intercept). Table E.9 shows the parameter estimates, standard errors, student's t-statistics, and two-sided *p*-values for the best AIC model for creek bank soil.

Table E.9. Model statistics for creek bank soil for AIC model

Independent variable	Parameter estimate (mg/kg)	Standard error (mg/kg)	Student's t-statistic	Two-sided *p*-value
Intercept	-1.7876	0.4639	-3.85	0.0008
Fluoride	-0.10065	0.0426	-2.36	0.027
Cadmium	0.13534	0.06649	2.04	0.0535
Calcium	3.93E-04	1.17E-04	3.36	0.0027
Copper	0.33347	0.05754	5.80	<0.0001
Lead	0.09004	0.04748	1.90	0.0705
Selenium	-0.13023	0.04575	-2.85	0.0091
Zinc	-0.07549	0.01944	-3.88	0.0008

AIC = Akaike's Information Criterion

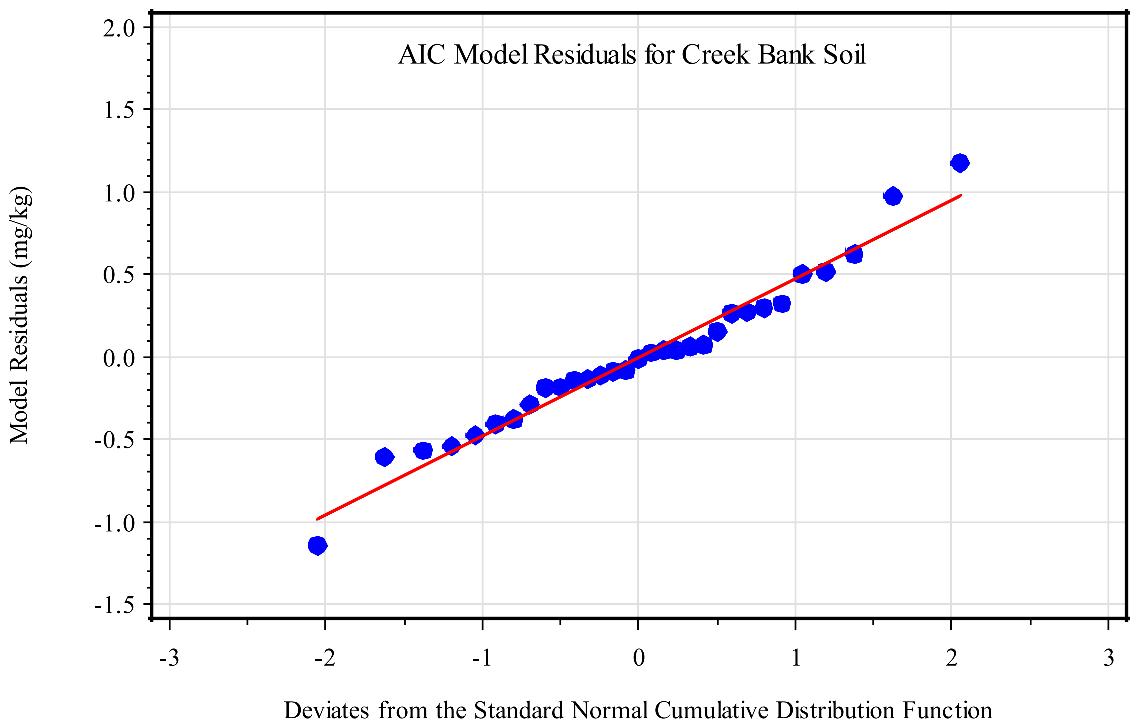
Table E.9 shows cadmium and lead do not significantly contribute to the model at the 0.05 significance level. Figure E.9 is a plot that shows the multivariate-predicted concentrations and 95% prediction limits compared with the actual mercury concentrations. Figure E.9 shows all concentrations are within the 95% prediction limits.



AIC = Akaike's Information Criterion
BCV = Bear Creek Valley
BSU = upper creek bank soil

Figure E.9. Best AIC model for creek bank soil.

Figure E.10 shows a normal probability plot of the best AIC model residuals. Model residuals were tested for normality using the SW test, which showed the residuals are approximately normally distributed at the 0.05 significance level, with an SW p-value = 0.653. All residuals plot approximately linearly along the regression line.



AIC = Alaike Information Criterion

Figure E.10. AIC model residuals for creek bank soil.

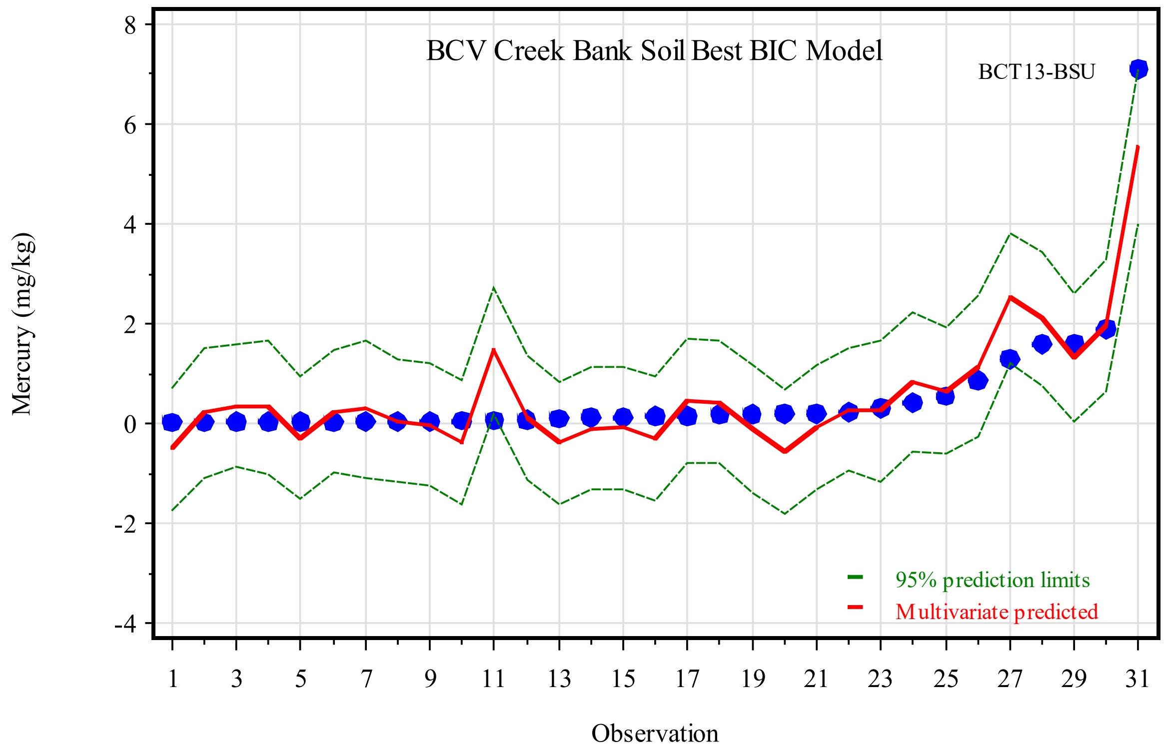
The best model with the lowest AICc, BIC, and SBC scores using all creek bank soil data has an AICc = -29.2201, a BIC = -25.808, an SBC = -22.0501, an adjusted R^2 = 0.8068, an RMSE = 0.58005, an F = 32.33, an F p-value = < 0.0001, and k = 4 variables (not counting the intercept). Table E.10 shows the parameter estimates, standard errors, student's t-statistics, and two-sided p-values for the best AICc, BIC, and SBC model for creek bank soil.

Table E.10. Model statistics for creek bank soil for AICc, BIC, and SBC

Independent variable	Parameter estimate (mg/kg)	Standard error (mg/kg)	Student's t-statistic	Two-sided *p*-value
Intercept	-1.37462	0.23	-5.98	<0.0001
Calcium	3.42E-04	1.17E-04	2.93	0.007
Copper	0.31536	0.04581	6.88	<0.0001
Strontium	-0.09753	0.04185	-2.33	0.0278
Zinc	-0.04884	0.0169	-2.89	0.0077

AICc = Akaike's Information Criterion corrected
BIC = Bayesian Information Criterion
SBC = Schwarz Bayesian Criterion

Table E.10 shows all variables significantly contribute to the model at the 0.05 significance level. Cadmium and lead were eliminated from the AIC model in Table E.9 because they did not significantly contribute to the model at the 0.05 significance level. In addition, compared to the AIC model, fluoride and selenium were eliminated and replaced with strontium. Figure E.11 is a plot that shows the multivariate-predicted concentrations and 95% prediction limits compared with the actual mercury concentrations. Figure E.11 shows all concentrations, except BCT13-BSU, are within the 95% prediction limits.

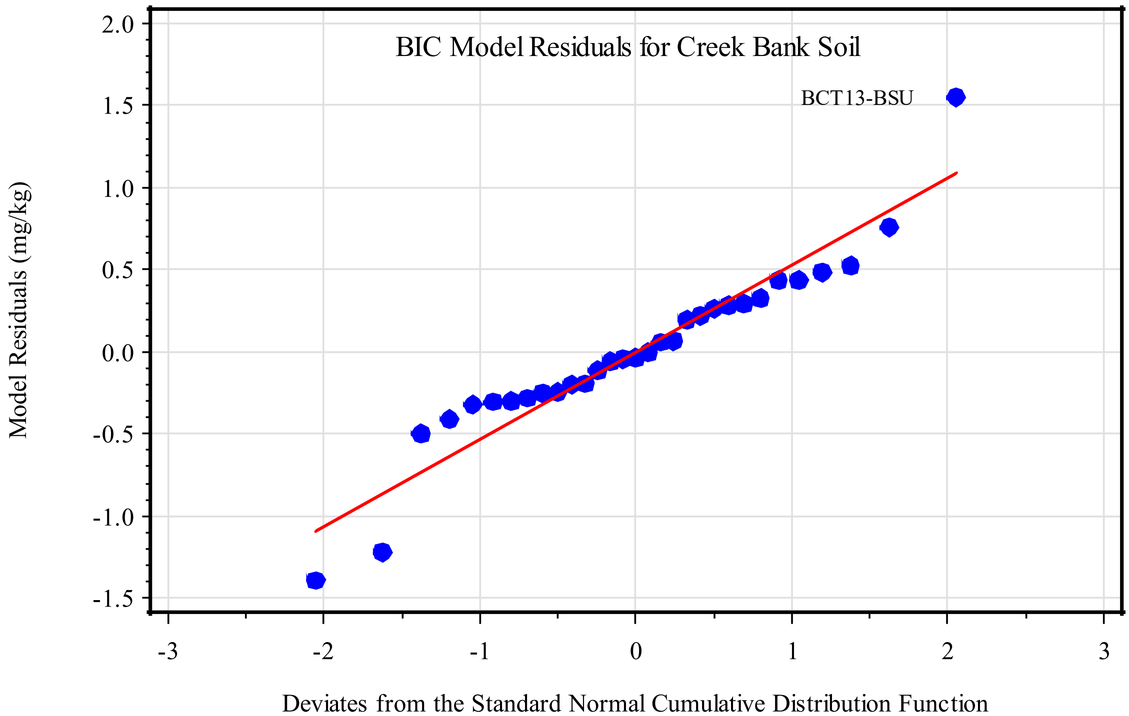


AICc = Akaike's Information Criterion corrected
BCV = Bear Creek Valley
BIC = Bayesian Information Criterion
BSU = upper creek bank soil
SBC = Schwarz Bayesian Criterion

Figure E.11. Best AICc, BIC, and SBC model for creek bank soil.

Figure E.12 shows a normal probability plot of the best AICc, BIC, and SBC model residuals. Model residuals were tested for normality using the SW test, which showed the residuals are approximately normally distributed at the 0.04 significance level, with an SW p-value = 0.0457. The two smallest residuals (BCT4-BSL and BCT12B-BSL) and the largest residual (BCT13-BSU) cause the SW p-value to be slightly below 0.05. All other residuals plot approximately linearly along the regression line.

A comparison of the best AIC model (Table E.9) with the best model determined by AICc, BIC, and SBC (Table E.10) shows the preferred model to be the AICc, BIC, and SBC model because it is more parsimonious (k = 4 variables instead of k = 7 for AIC). AIC tends to overfit the data by selecting more variables compared to other information criteria. The AIC model also selected lead and cadmium, which did not significantly contribute to the model. The AICc, BIC, and SBC scores are more than 1 lower than the AICc, BIC, and SBC scores of the model with the next lowest scores. This indicates the model is considerably better than the model with the next lowest AICc, BIC, and SBC scores. Because AICc, BIC, and SBC agree on the same model and it is more parsimonious than the AIC model, the model shown in Table E.10 was selected as the best overall model for predicting mercury for creek bank soil data.



AICc = Akaike's Information Criterion corrected
BIC = Bayesian Information Criterion
BSU = upper creek bank soil
SBC = Schwarz Bayesian Criterion

Figure E.12. AICc, BIC, and SBC model residuals for creek bank soil.

A comparison of the overall best models for floodplain soil with creek bank soil shows fluoride, lead, selenium, and uranium best predict mercury concentrations in floodplain soil, while calcium, copper, strontium, and zinc best predict mercury concentrations in creek bank soil. This may indicate differences in mercury characteristics in the floodplain and creek bank soils.

E.3.4 FLOODPLAIN AND CREEK BANK SOIL BY PARTICLE SIZE

The particle sizes of the floodplain and creek bank soil data were also a part of the database. Pearson correlations were calculated for all pairs of variables with all detected concentrations for particle size #10 using data from locations BCT14-BSL, BCT14-BSU, BCT14-FP, BCT3-BSL, BCT4-BSU, and BCT4-FP. Kendall's tau correlations were calculated for pairs of variables with at least one non-detect, and at least one-half of the six samples were detected. There were only two sequential extraction samples collected with particle size #10, so these were excluded. Table E.2 summarizes the correlations of soil for particle size #10. Correlations that test the null hypothesis of zero correlation and are significant at the 0.05 significance level are highlighted by significance. Correlations that are not highlighted are not significant at the 0.05 significance level.

For particle size #10 soil, arsenic, copper, lithium, manganese, phosphorous, zinc, and TOC were significantly positively correlated with mercury at the 0.05 significance level. All these analytes, except manganese, are also significantly correlated with mercury in all soil (Table E.1).

E.4. SEDIMENT RESULTS

As with soil, the modeling for sediment began as a descriptive process because the dataset is too small (n = 12) to establish definitive predictive models. For exploratory purposes, four different selection criteria were used for model evaluation to see which models were the best for each of the four information criteria using mercury as the dependent variable. The scores from these four criteria cannot be compared with each other because they score the models differently.

From Table E.3, the following analytes were selected that were significantly correlated with mercury and had all detected concentrations: chloride, calcium, selenium, and TOC. The sequential extraction analytes were excluded from consideration because there were only 6 samples, compared to 12 samples for the other analytes. Including even one sequential extraction analyte would reduce the dataset to six observations, which would further limit the number of regressors that could be considered in the model. The best model with the lowest AIC, AICc, BIC, and SBC scores using all sediment data has an AIC = -51.3739, an AICc = -50.0405, a BIC = -46.3792, an SBC = -49.9191, an adjusted R^2 = 0.6557, an RMSE = 0.10574, an F = 11.47, an F p-value = 0.0033, and k = 2 variables (not counting the intercept). Table E.11 shows the parameter estimates, standard errors, student's t-statistics, and two-sided p-values for the best AIC, AICc, BIC, and SBC model.

Table E.11. Model statistics for all sediment

Independent variable	Parameter estimate (mg/kg)	Standard error (mg/kg)	Student's t-statistic	Two-sided p-value
Intercept	-0.11258	0.07631	-1.48	0.1742
Chloride	0.01064	0.00332	3.20	0.0108
TOC	2.21E-05	6.47E-06	3.42	0.0076

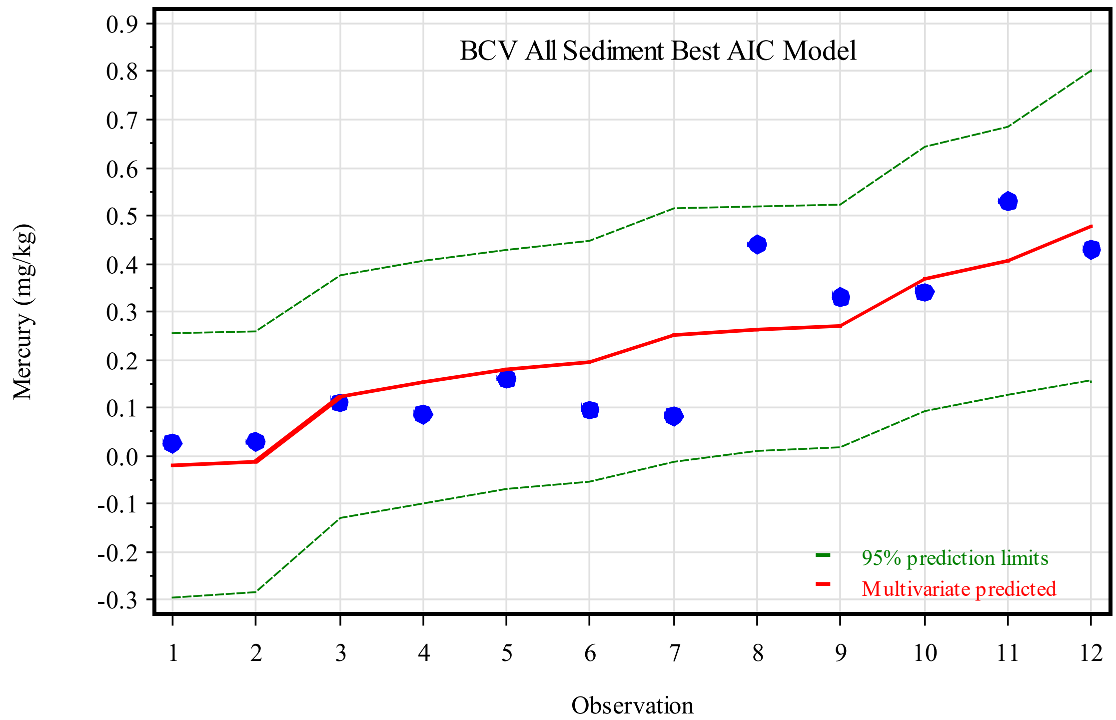
TOC = total organic carbon

Table E.11 shows chloride and TOC significantly contribute to the model at the 0.05 significance level, while the intercept does not. Figure E.13 is a plot that shows the multivariate-predicted concentrations and 95% prediction limits compared with the actual mercury concentrations. Figure E.13 shows all concentrations are within the 95% prediction limits.

Figure E.14 shows a normal probability plot of the best AIC, AICc, BIC, and SBC model residuals. Model residuals were tested for normality using the SW test, which showed the residuals are approximately normally distributed at the 0.05 significance level, with an SW p-value = 0.9965.

E.4.1 SEDIMENT BY PARTICLE SIZE

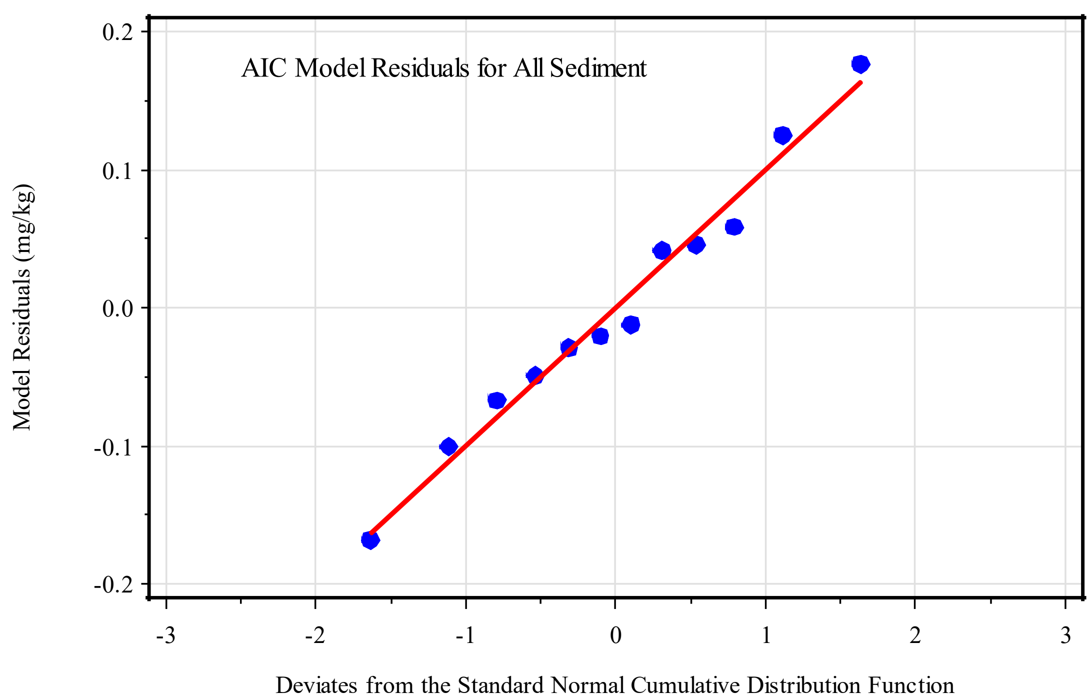
The particle sizes of the sediment data were used for a correlation analysis. Of the 12 sediment locations, 7 had particle size #10, 1 had particle size #20, 1 had particle size #4, 1 had particle size 3/4 in., and 2 had particle size 3/8 in. Therefore, only particle size #10 had enough samples to perform a correlation analysis. Table E.4 summarizes the correlations of sediment for particle size #10. Combinations that result in correlations that are significant at the 0.05 significance level are highlighted by significance. Correlations that are not highlighted are not significant at the 0.05 significance level.



AIC = Akaike's Information Criterion
AICc = Akaike's Information Criterion corrected
BCV = Bear Creek Valley

BIC = Bayesian Information Criterion
SBC = Schwarz Bayesian Criterion

Figure E.13. Best AIC, AICc, BIC, and SBC model for all sediment.



AIC Akaike's Information Criterion
AICc = Akaike's Information Criterion corrected

BIC = Bayesian Information Criterion
SBC = Schwarz Bayesian Criterion

Figure E.14. AIC, AICc, BIC, and SBC model residuals for all sediment.

For particle size #10 sediment, barium, cadmium, calcium, cobalt, copper, manganese, nickel, selenium, strontium, zinc, and TOC were significantly positively correlated with mercury at the 0.05 significance level, while antimony was significantly negatively correlated with mercury at the 0.05 significance level. Table E.3 shows chloride, calcium, selenium, sodium, mercury (F1), mercury (FS), and TOC were all significantly positively correlated with mercury for all sediment.

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E.5. CONCLUSIONS

Correlation analysis was performed for all pairs of analytes for soil and sediment where at least one-half of the samples were detected and $n \geq 3$. Those analytes with significant correlation with mercury were used in multivariate regression models. Four information criteria methods were used to determine the best multivariate models to predict mercury in soil, sediment, creek bank soil, and floodplain soil.

Correlations for particle size #10 show different analytes significantly correlate with mercury compared to all soil and all sediment.

Fluoride, copper, lead, lithium, zinc, calcium, uranium, and vanadium are significant predictors of mercury for all soil combined. Fluoride, lead, selenium, and uranium are significant predictors of mercury in floodplain soil. Calcium, copper, strontium, and zinc are significant predictors of mercury in creek bank soil. Chloride and TOC are significant predictors of mercury in sediment.

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E.6. REFERENCES

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APPENDIX F.
WATER RESOURCES RESTORATION PROGRAM SURFACE WATER TOTAL MERCURY AND METHYLMERCURY LOGITUDINAL DATA PLOTS FOR BEAR CREEK

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WATER RESOURCES RESTORATION PROGRAM SURFACE WATER TOTAL MERCURY LONGITUDINAL DATA PLOTS FOR BEAR CREEK

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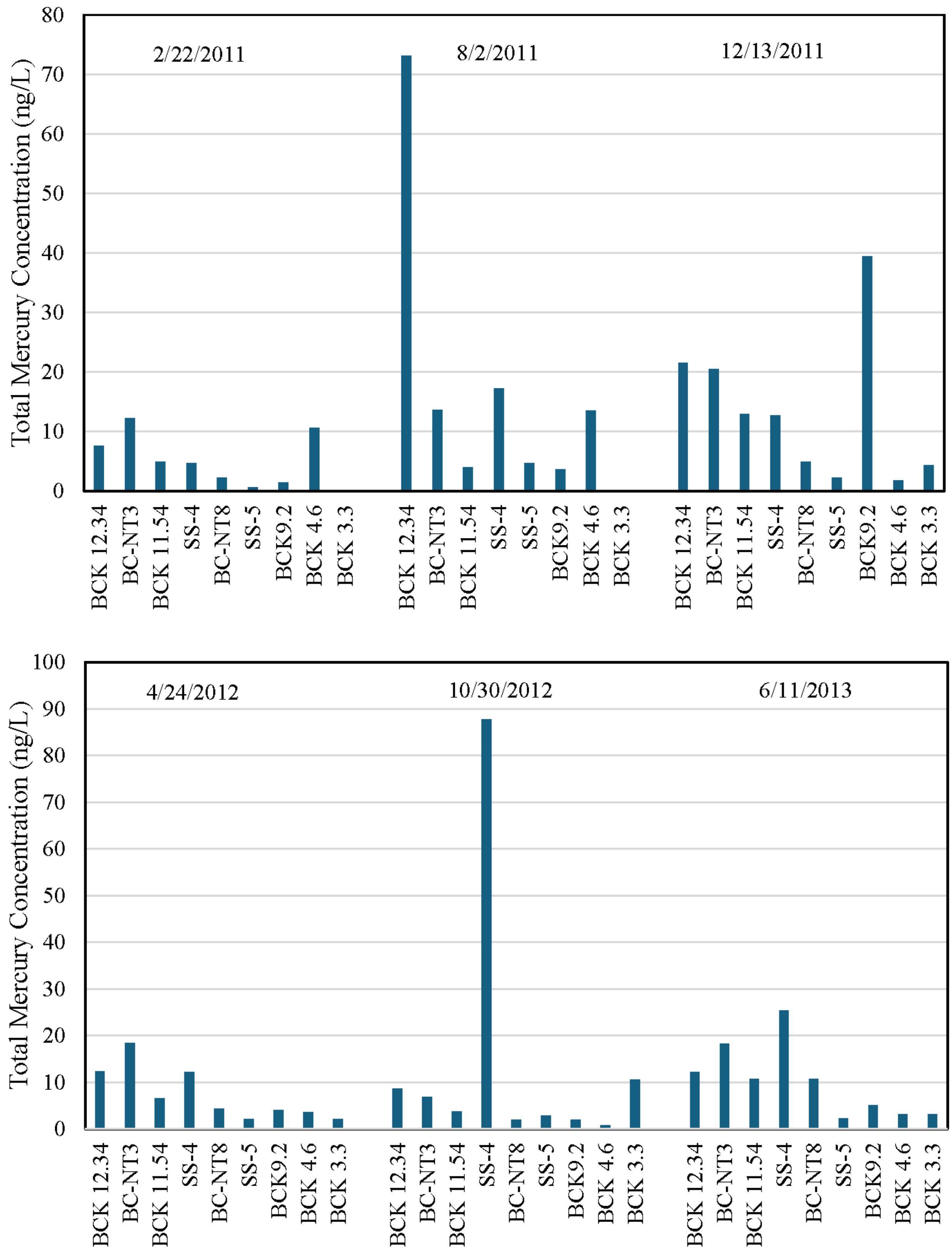

Figure F.1. Total mercury in surface water between February 2011 and June 2013.

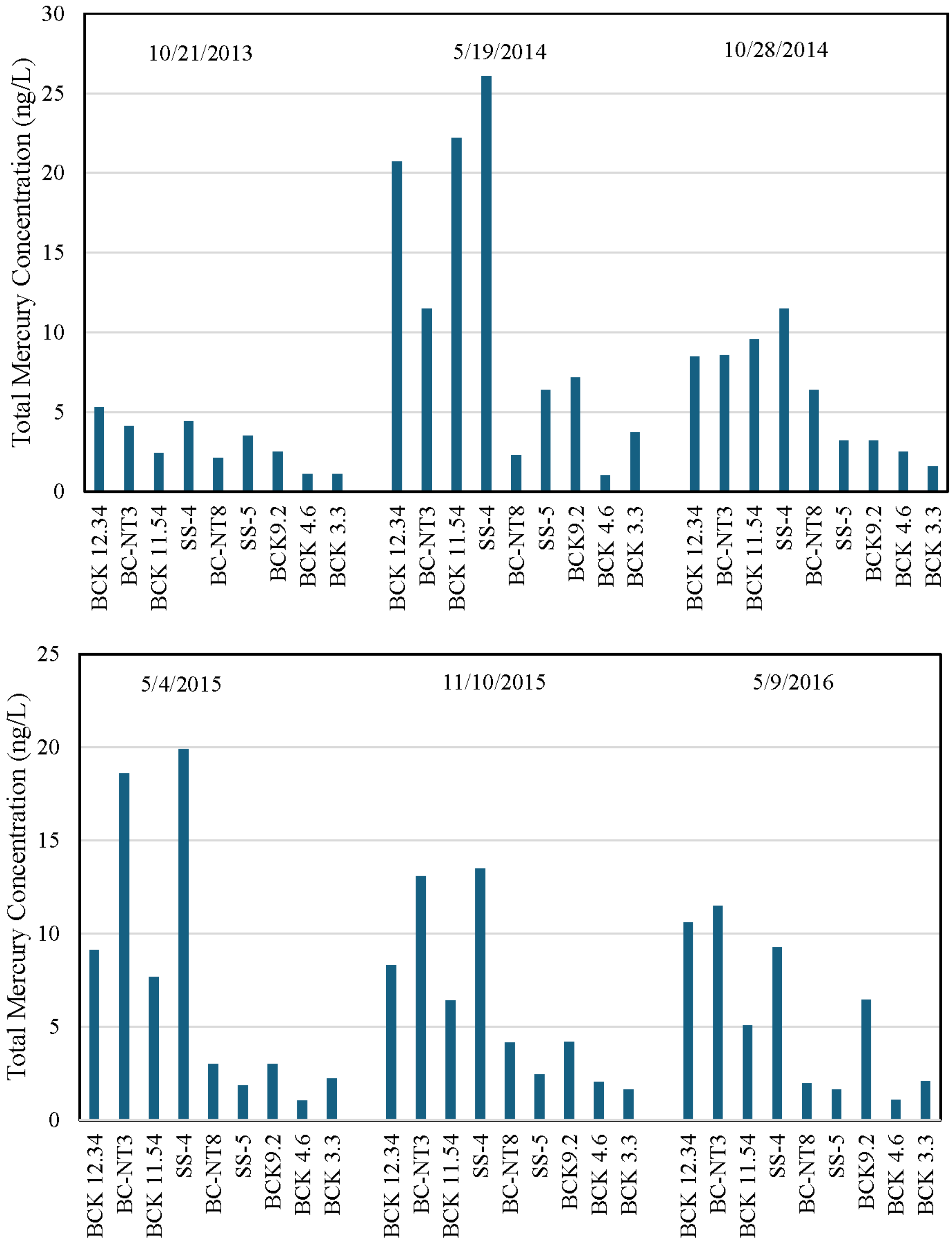

Figure F.2. Total mercury in surface water between October 2013 and May 2016.

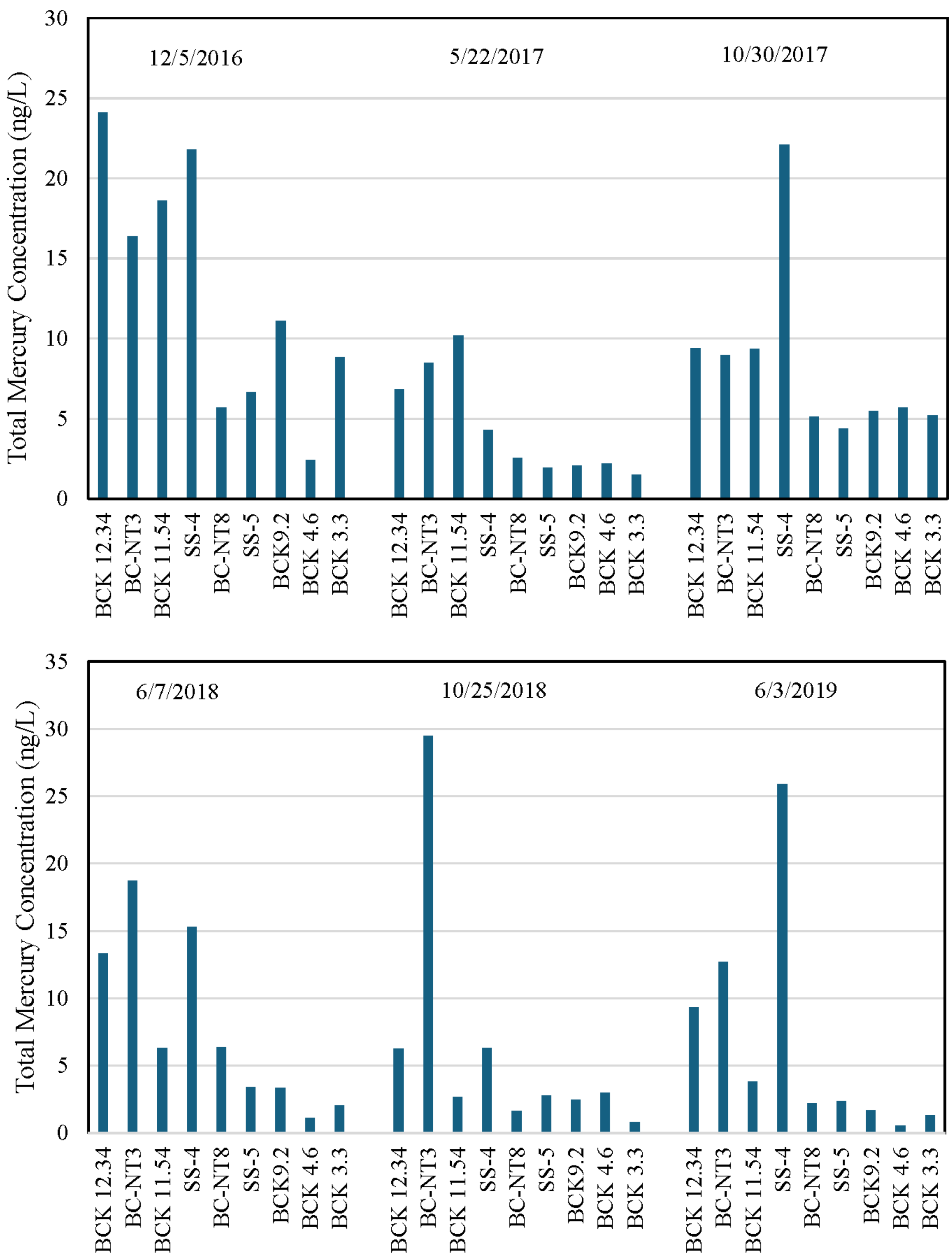

Figure F.3. Total mercury in surface water between December 2016 and June 2019.

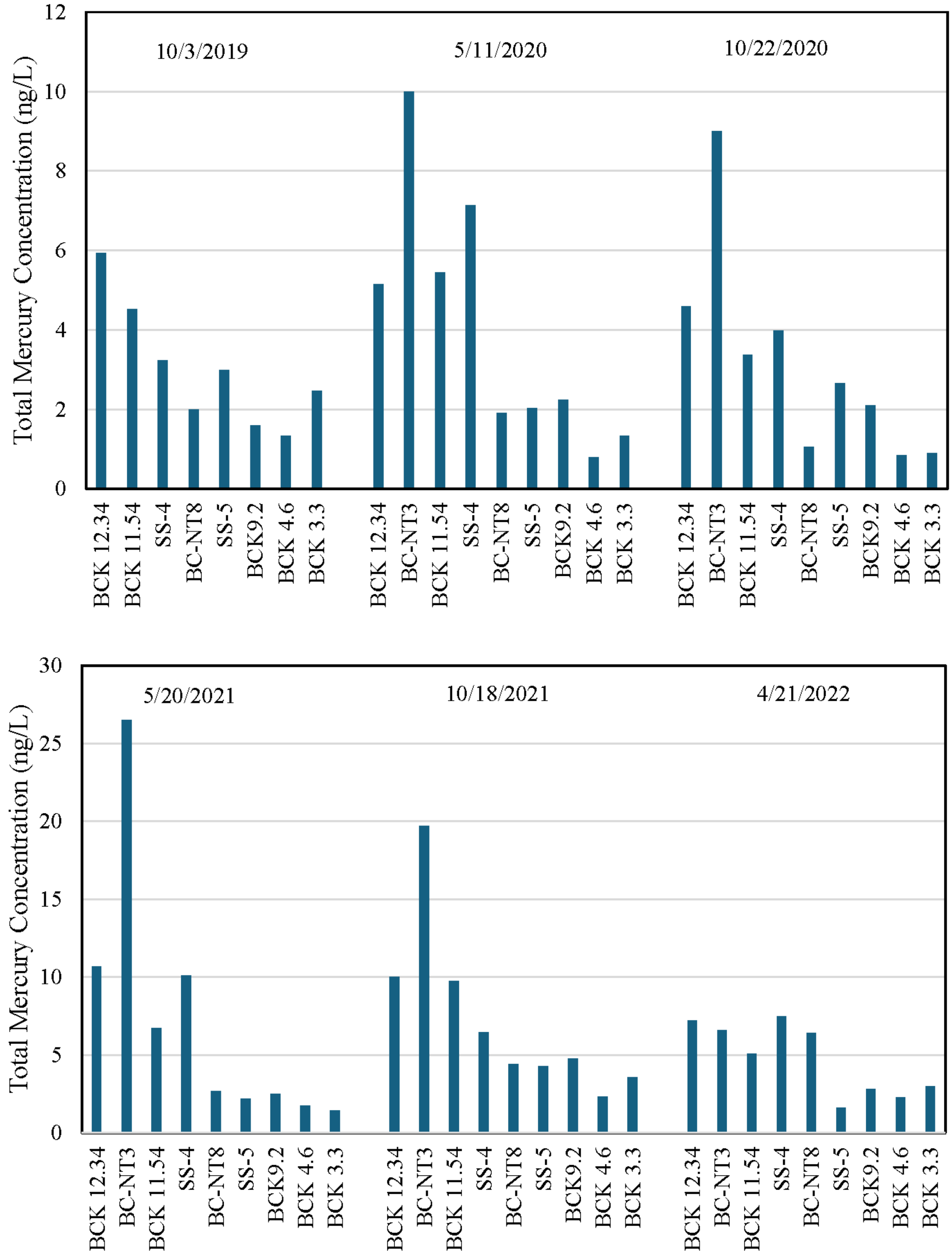

Figure F.4. Total mercury in surface water between October 2019 and April 2022.

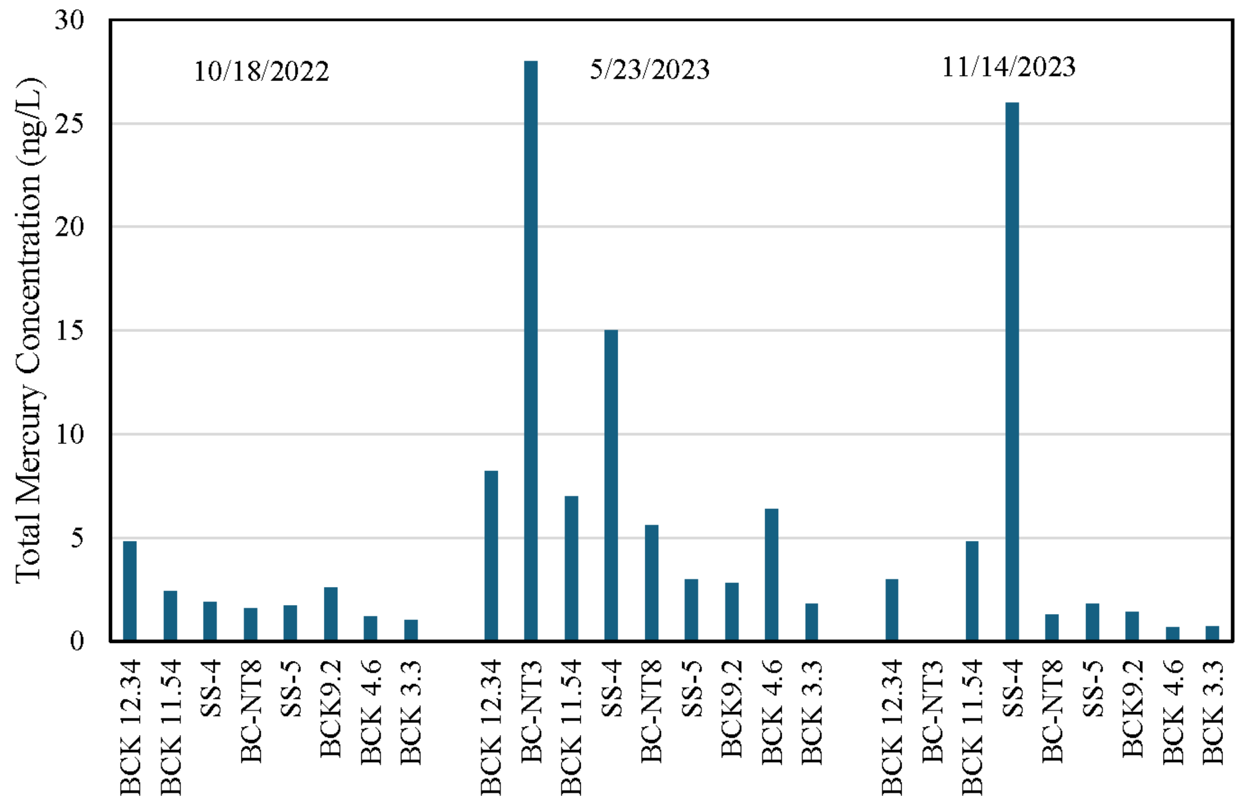

Figure F.5. Total mercury in surface water between October 2022 and November 2023.

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WATER RESOURCES RESTORATION PROGRAM SURFACE WATER TOTAL METHYLMERCURY LONGITUDINAL DATA PLOTS FOR BEAR CREEK

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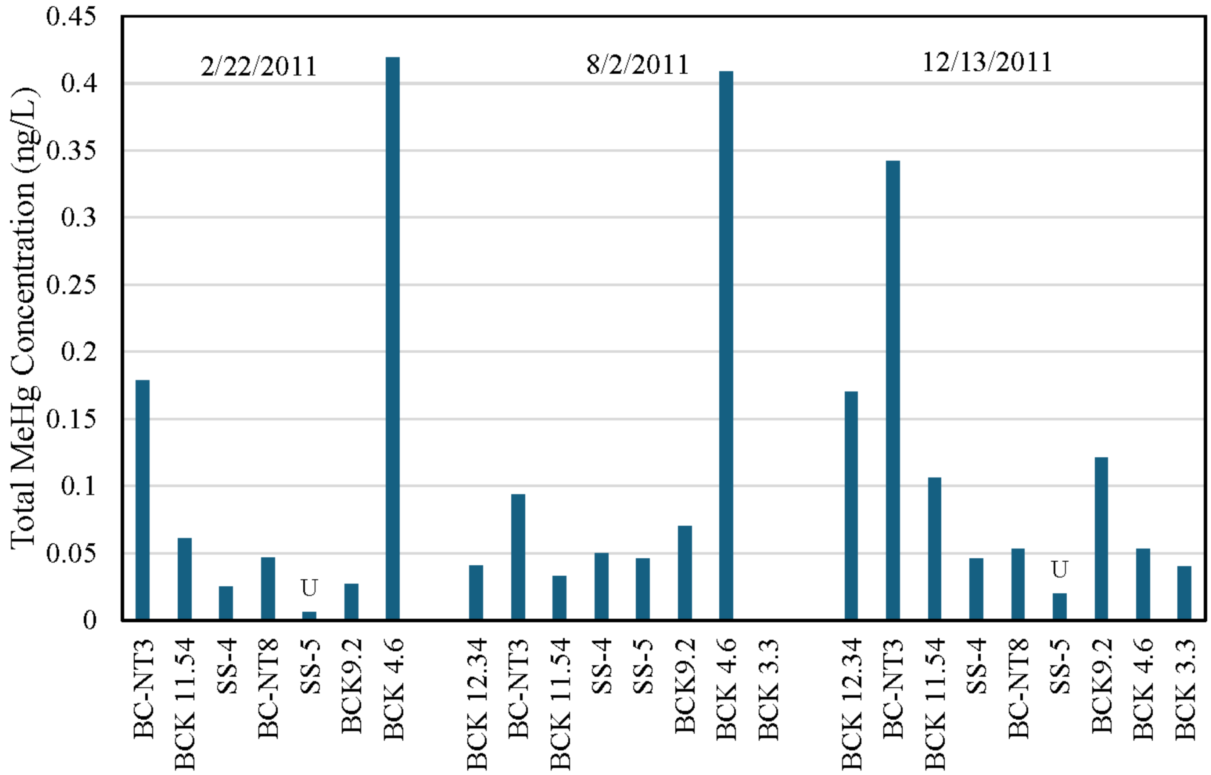


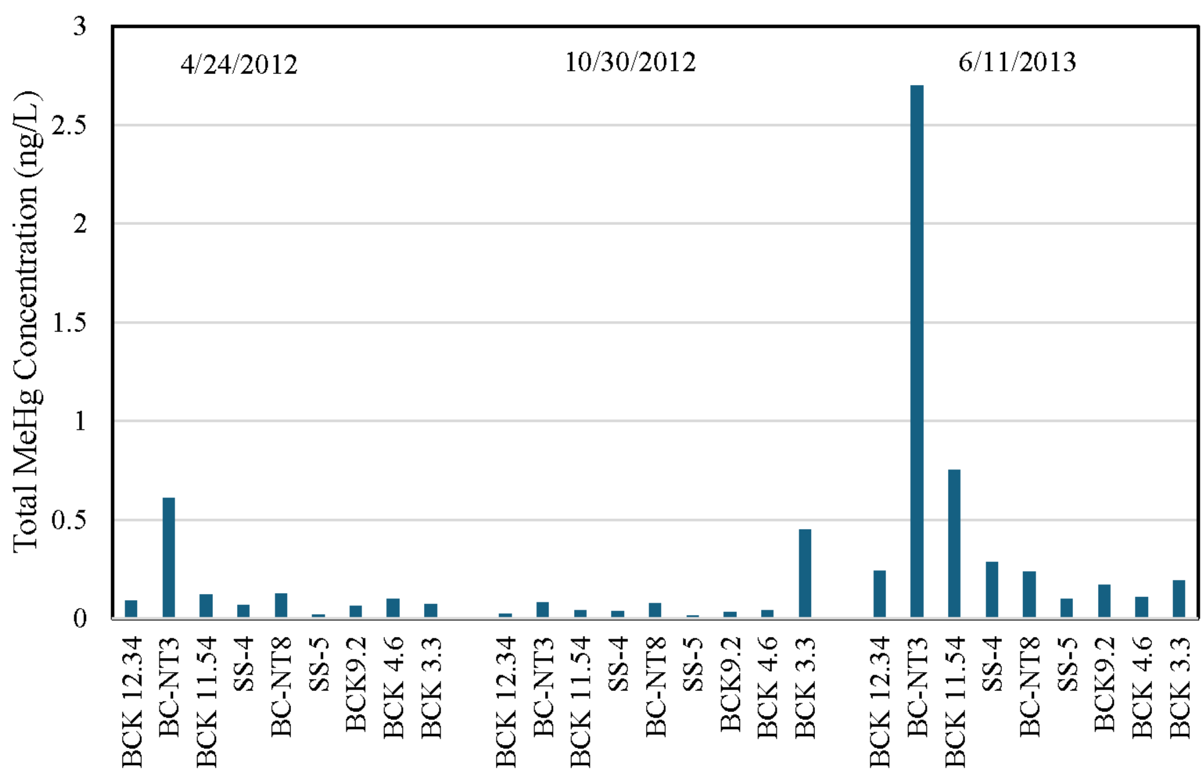


Figure F.6. Total methylmercury in surface water between February 2011 and June 2013.

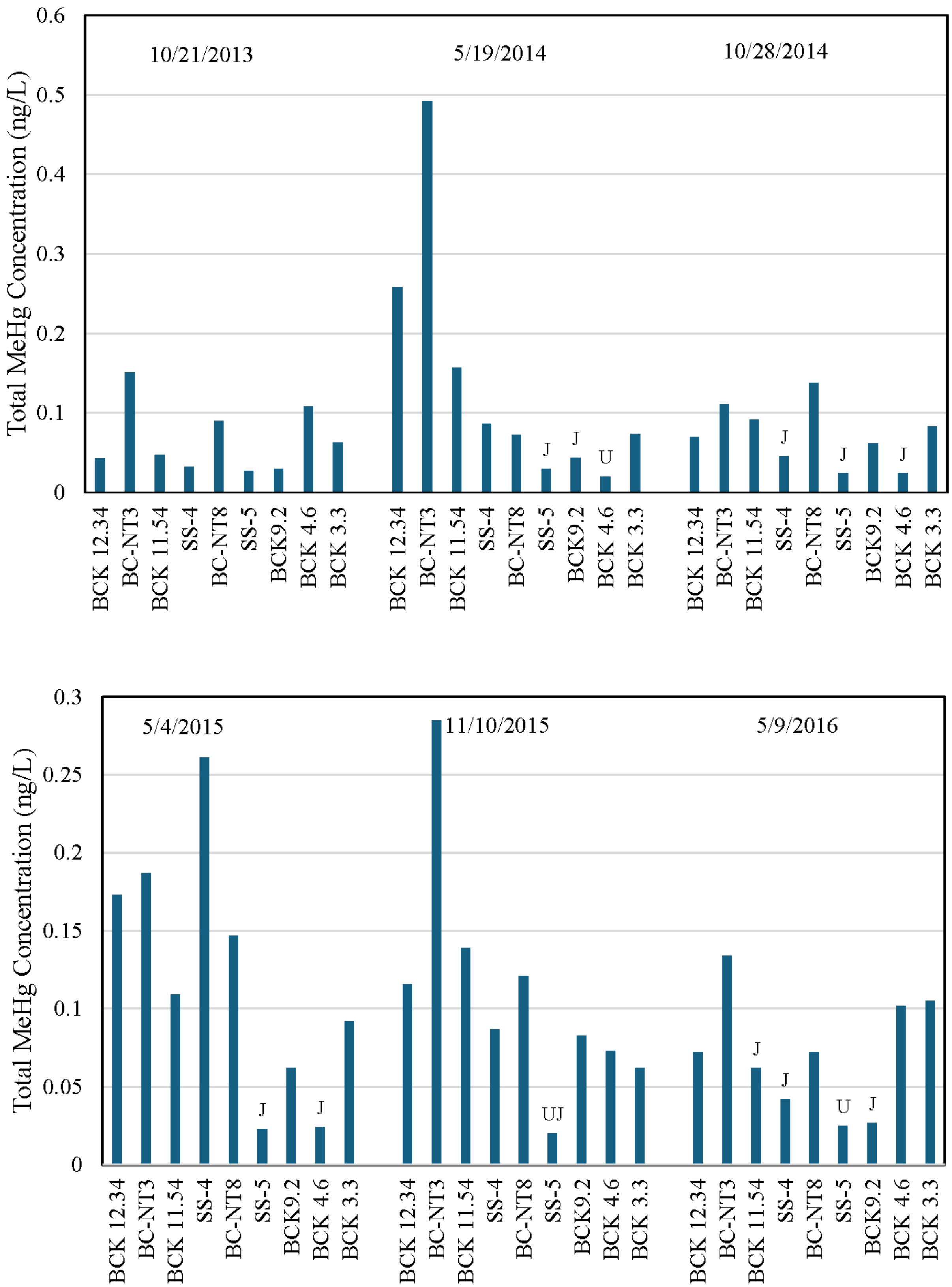


Figure F.7. Total methylmercury in surface water between October 2013 and May 2016.

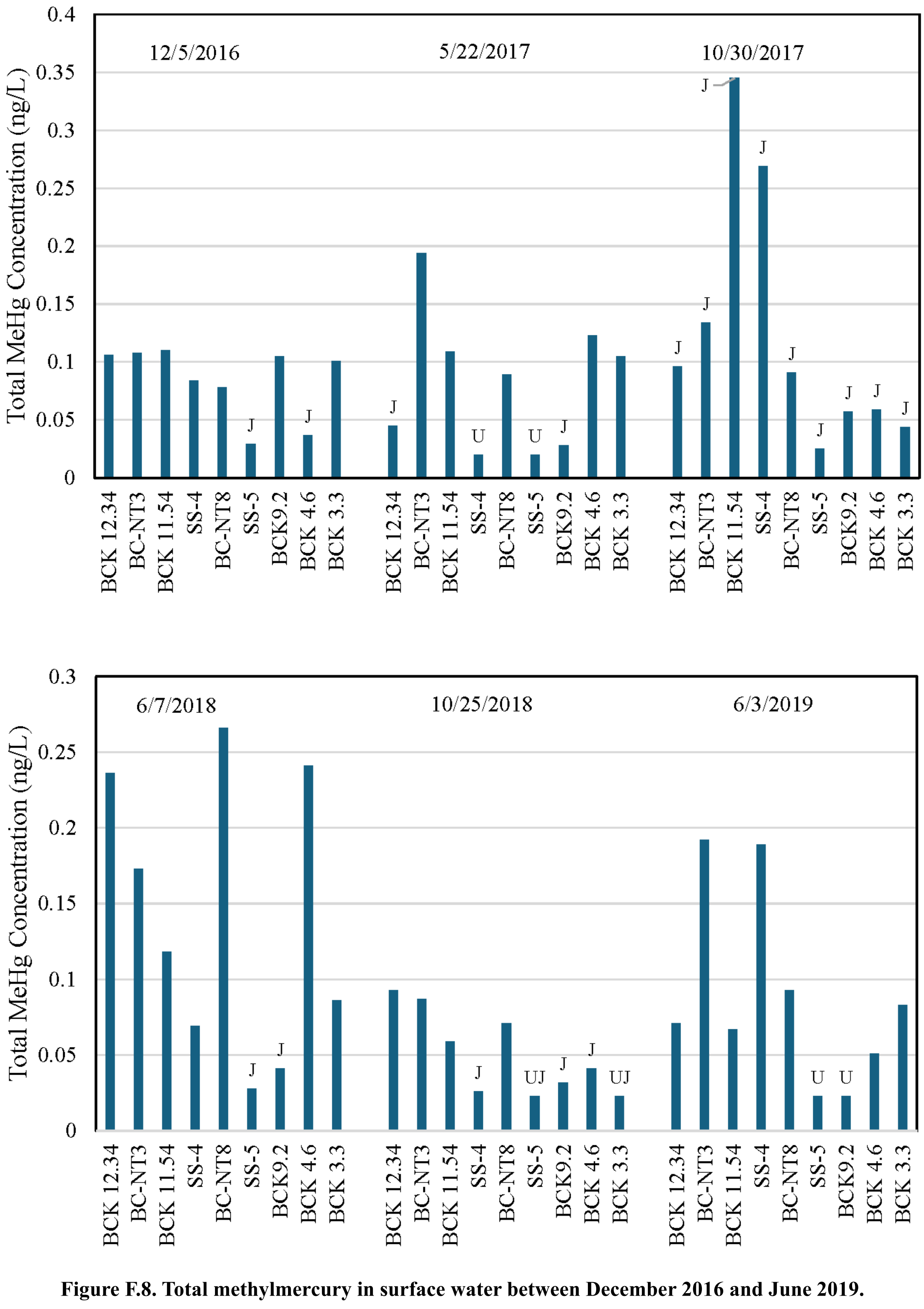
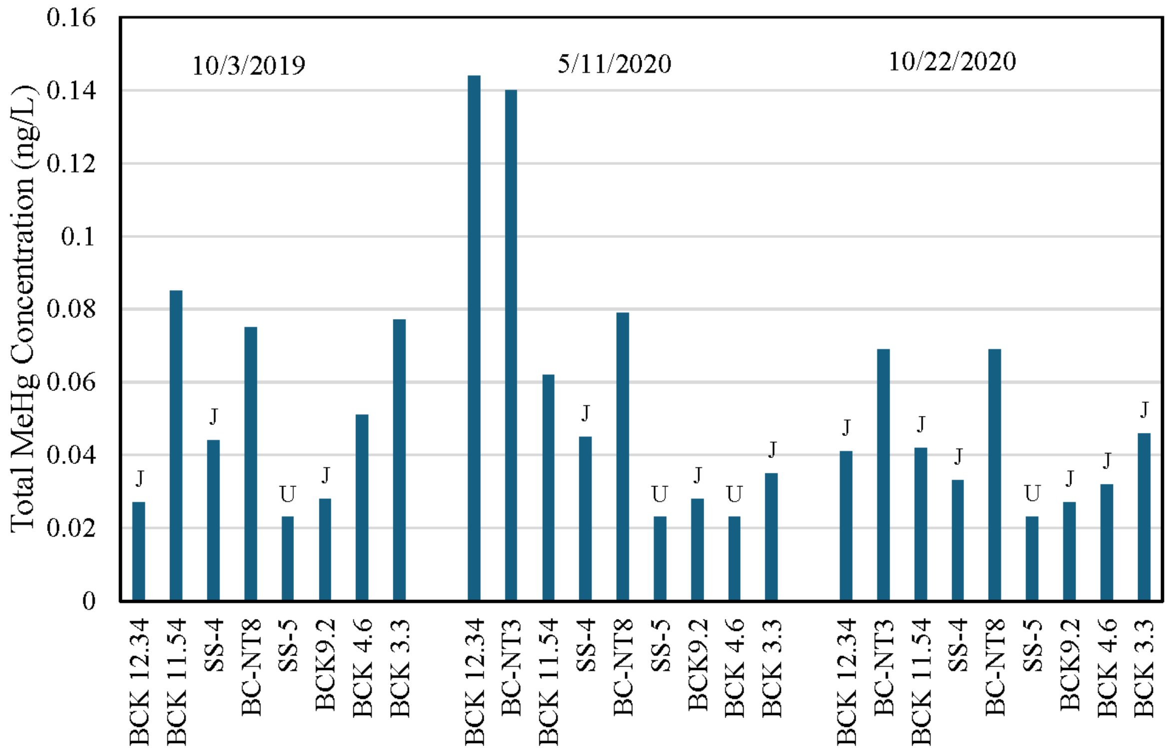


Figure F.8. Total methylmercury in surface water between December 2016 and June 2019.



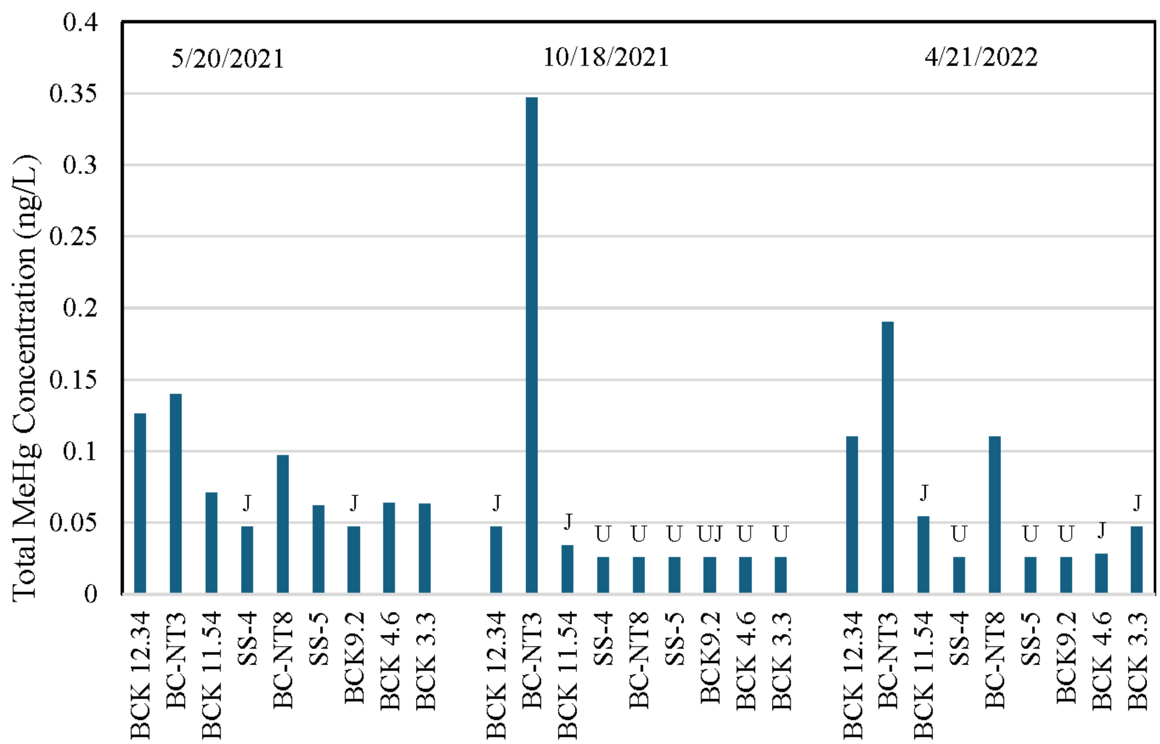


Figure F.9. Total methylmercury in surface water between October 2019 and April 2022.

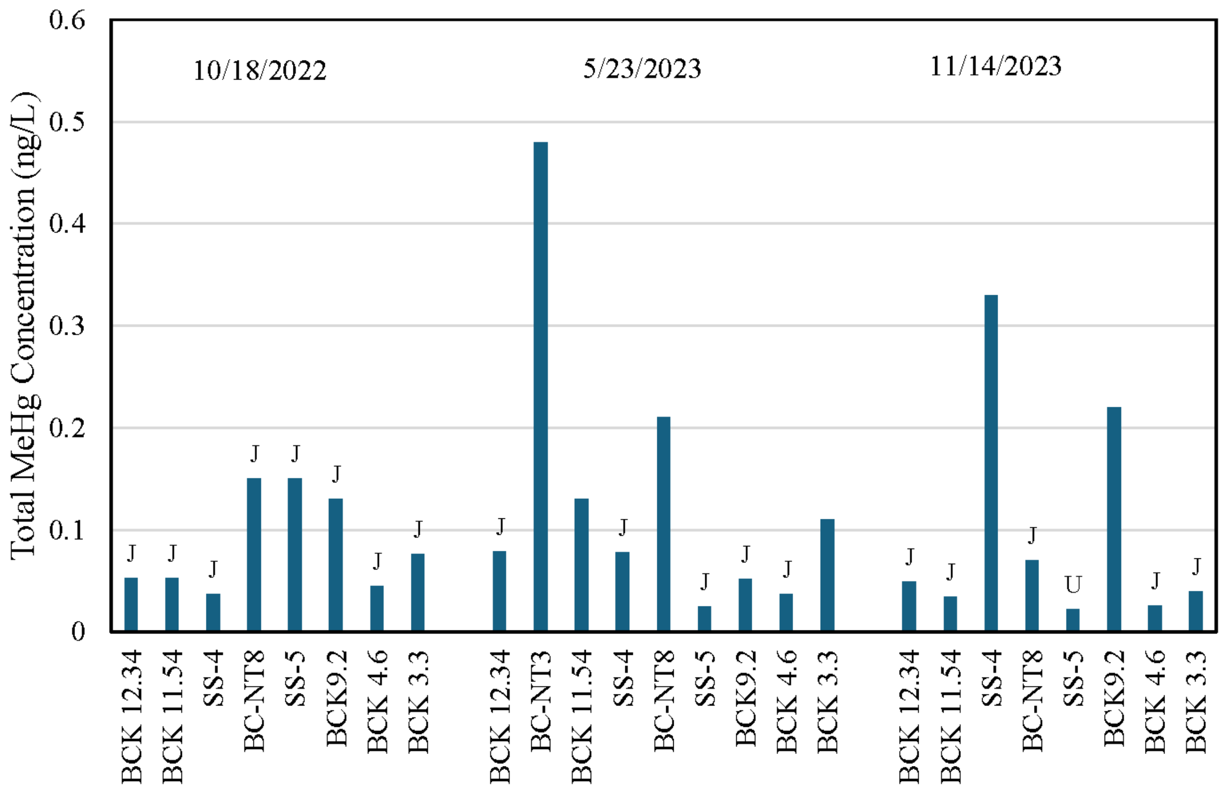


Figure F.10. Total methylmercury in surface water between October 2022 and November 2023.

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