1226605

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

14-AMRP-0254

AUG 04 2014

Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

RECEIVED
AUG 07 2014
EDMC

Dear Mr. Faulk:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 600-378, 506 TELEPHONE EXCHANGE EMERGENCY GENERATOR BUILDING UNDERGROUND FUEL STORAGE TANK WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2014-051 and supporting documentation for the, "Remaining Sites Verification Package for the 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank Waste Site," Rev. 0. If you have questions, please contact me or your staff may contact Ellwood Glossbrenner, of my staff, at (509) 376-5828.

Sincerely,

Catherine S. Louie for
Mark S. French, Federal Project Director
for the River Corridor Closure Project

AMRC:ETG

Attachment

cc w/attach:
C. J. Guzzetti, EPA
Administrative Record, H6-08

cc w/o attach:
R. D. Cantwell, WCH
S. L. Feaster, WCH
T. Q. Howell, WCH
D. L. Plung, WCH
J. P. Shearer, CHPRC
C. P. Strand, WCH

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-6 **Control No.:** 2014-051

Waste Site Code(s)/Subsite Code(s):

600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank

Reclassification Category: Interim ☒ Final ☐

Reclassification Status: Closed Out ☒ No Action ☐ Rejected ☐ RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☐ EPA ☒

Description of current waste site condition:

The 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank waste site, located in the 100-IU-6 Operable Unit of the Hanford Site, consisted of a 379-L (100-gal) underground storage tank used to store fuel for the 506 telephone exchange emergency generator building. The 506 Building was located on the south side of the Hanford – Cold Creek Road (Route 11A). The 600-378 waste site was added to the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999), as a candidate site for confirmatory sampling in the Fact Sheet *100 Area "Plug-In" and Candidate Waste Sites for Calendar Year 2011*, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2012). This waste site was subsequently recommended for remove, treat, and dispose (RTD) without confirmatory sampling and is being dispositioned as a "plug-in" site in accordance with the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2009).

Remediation of the 600-378 waste site was performed on December 18, 2013, and January 8 and April 30, 2014. The remediation resulted in a total of 43.5 bank cubic meters (56.8 bank cubic yards) of material being removed and disposed at the Environmental Restoration Disposal Facility (ERDF). Cleanup verification sampling was performed on February 25 and April 30, 2014, to determine if the waste site meets remedial action objectives (RAOs) and remedial action goals (RAGs) established by the Remaining Sites ROD (EPA 1999) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Areas* (RDR/RAWP), DOE/RL-97-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009). The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at ERDF at the 200 Area of the Hanford Site, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

In accordance with the *Washington Administrative Code* (WAC) Chapter 173-360-110(2)(d), the 600-378 waste site Underground Storage Tank is exempt from the requirements of WAC 173-360, "Underground Storage Tank Regulations," based on its capacity of less than 416 L (110 gal).

Basis for reclassification:

Cleanup verification sampling results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-378 waste site to Interim Closed Out. The current site conditions achieve the RAOs and RAGs established by the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009). The results of verification sampling do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The analytical results and rationale presented in the attached remaining sites verification package also demonstrate that residual contaminant concentrations meet direct exposure cleanup criteria and are protective of groundwater and the Columbia River. The waste site contamination does not extend into the deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-6 **Control No.:** 2014-051

Waste Site Code(s)/Subsite Code(s):

600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank

Regulator comments:

Waste Site Controls:

Engineered Controls: ☐ Yes ☒ No Institutional Controls: ☐ Yes ☒ No O&M Requirements: ☐ Yes ☒ No

If any of the Waste Site Controls are checked Yes, specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents:

J. P. Neath	[signature]	7/21/14
DOE Federal Project Director (printed)	Signature	Date
NA		
Ecology Project Manager (printed)	Signature	Date
C. Guzzetti	[signature]	7/28/14
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-378, 506 TELEPHONE EXCHANGE EMERGENCY GENERATOR BUILDING UNDERGROUND FUEL STORAGE TANK WASTE SITE

Attachment to Waste Site Reclassification Form 2014-051

July 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-378, 506 TELEPHONE EXCHANGE EMERGENCY GENERATOR BUILDING UNDERGROUND FUEL STORAGE TANK WASTE SITE

EXECUTIVE SUMMARY

The 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank waste site is part of the 100-IU-6 Operable Unit and consisted of the historical location of a 379-L (100-gal) underground storage tank used to store fuel for the 506 telephone exchange emergency generator building. This waste site was added to the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999) as a candidate site for confirmatory sampling in the Fact Sheet *100 Area "Plug-In" and Candidate Waste Sites for Calendar Year 2011* (DOE-RL 2012). This waste site was subsequently recommended for remove, treat, and dispose (RTD) without confirmatory sampling based on the geophysical investigation results (WCH 2013) and is being dispositioned as a "plug-in" site in accordance with the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2009).

Remediation of the 600-378 waste site occurred on December 18, 2013, and January 8 and April 30, 2014, and resulted in 43.5 bank cubic meters (56.8 bank cubic yards) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility. No overburden soil was stockpiled to be used as backfill. Following remediation, verification sampling was performed for the 600-378 waste site on February 25, and April 30, 2014. These results indicated that residual contaminant concentrations met the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 600-378 waste site.

In accordance with the Washington Administrative Code (WAC) chapter 173-360-110(2)(d), the 600-378 waste site Underground Storage Tank is exempt from the requirements of WAC 173-360, Underground Storage Tank Regulations, based on its capacity of less than 416 L (110 gal).

A summary of the cleanup evaluation for the soil results compared to the applicable cleanup criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

Table ES-1. Summary of Remedial Action Goals for the 600-378 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain a dose rate of <15 mrem/yr above background over 1,000 years.	Radionuclides were not COPCs for the 600-378 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC direct exposure RAGs.	All individual COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The hazard quotients for individual nonradionuclide COPCs are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient is (4.2×10^{3}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	All individual carcinogens have an excess risk below 1×10^{-6}.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The cumulative excess cancer risk (8.5×10^{7}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 600-378 waste site.	NA
	Attain National Primary Drinking Water Regulations: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ [a].		
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [b].		
	Meet total uranium standard of 21.2 pCi/L [c].		

Table ES-1. Summary of Remedial Action Goals for the 600-378 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	Lead, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene., and benzo(k)fluoranthene are present at concentrations above soil RAGs for groundwater and/or Columbia River protection. However, based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), it is predicted that these constituents will not reach groundwater (and thus the Columbia River) within 1,000 years [d].	Yes

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).

[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).

[c] Based on the isotopic distribution of uranium in the 100 Area, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001).

[d] Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), residual concentrations of lead, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene are predicted not to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the lowest distribution coefficient of the contaminants exceeding RAGs, lead and zinc, with distribution coefficients of 30 mL/g). The vadose zone underlying the soil below the waste site is approximately 43 m (141 ft) thick. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and consequently are protective of the Columbia River.

COPC = contaminant of potential concern
MCL = maximum contaminant level
NA = not applicable
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)

In accordance with this evaluation, the verification sampling results support a reclassification of the 600-378 waste site to Interim Closed Out. The current site conditions achieve the RAOs and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The 600-378 waste site contamination does not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern, and other constituents. Those constituents exceeding ecological screening levels in WAC 173-340 were barium, boron, and vanadium.

The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, cadmium, lead, manganese, vanadium, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of antimony, barium, cadmium, manganese, and vanadium are below Hanford Site background levels, it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for ecological effects as a part of the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-378, 506 TELEPHONE EXCHANGE EMERGENCY GENERATOR BUILDING UNDERGROUND FUEL STORAGE TANK WASTE SITE

STATEMENT OF PROTECTIVENESS

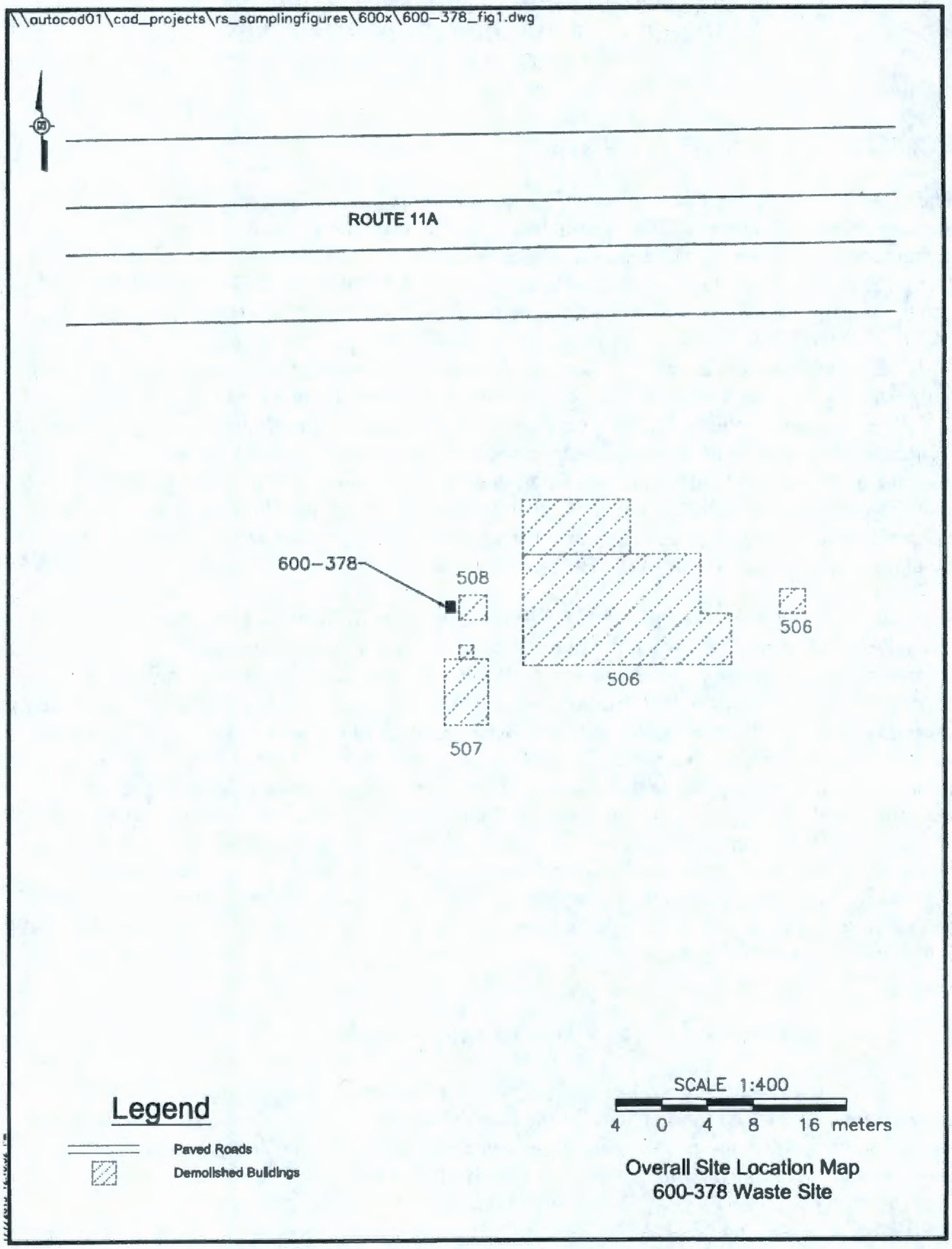
The 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank waste site verification sampling data, site evaluations, and supporting documentation demonstrate that the waste site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Contamination from the 600-378 waste site does not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern (COPCs), and other constituents. Those constituents exceeding ecological screening levels in the *Washington Administrative Code* (WAC) 173-340 were barium, boron, and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for antimony, cadmium, lead, manganese, vanadium, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of antimony, barium, cadmium, manganese and vanadium, are below Hanford Site background levels, it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for ecological effects as a part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 600-378 waste site consisted of the historical location of a 379-L (100-gal) underground storage tank (UST) used to store fuel for the 506 Telephone Exchange Generator Building, also known as the 508 Building. The 600-378 waste site is reported in the *100-F/IU-2/IU-6 Area – Segment 4 Orphan Sites Evaluation Report* (WCH 2011a) under orphan site evaluation identification number SG4-580. The 600-378 waste site is located in the 600 Area in the 100-IU-6 Operable Unit (Figure 1).

Figure 1. The 600-378 Waste Site Location Map.



The Washington State Plane (WSP) coordinates are N 138768.8 E 581237.9 at the center of the location determined by the geophysical investigation to be where the UST was most likely to be found.

The 506 B-Y Telephone Exchange, constructed in 1945, handled essentially all of the telephone switching between the inner and outer areas of the Hanford Site. It also housed the 50-line Hanford exchange and served as the primary base of operations for telephone maintenance personnel in support of the 100 and 200 Areas. The 508 Building, a 2.4- by 2.4-m (8- by 8-ft) concrete block structure, housed an emergency generator that provided emergency power to support the 506 B-Y Telephone Exchange Building in the event of a power outage. The 507 Building, a 3.6- by 6.1-m (12- by 20-ft) structure adjacent to the 506 Building, provided storage space and was used for minor repair and maintenance tasks (GE 1964). The 600-378 UST appears to be located immediately east of the 508 Building, where it stored fuel for the emergency generator use.

Ecological and Cultural

An ecological and cultural resources review was performed for the 600-378 waste site on January 3, 2013, that included waste characterization sampling scope for the 600-378 waste site (WCH 2013). Previously, on November 29, 2012, the U.S. Department of Energy, Richland Operations Office had concurred with the finding of "No Adverse Effect" in HCRC#2011-600-042, suggesting that work at this waste site location would not impact cultural or historic properties. However, because the waste site is located within the Gable Mountain buffer, a culturally sensitive area, some work restrictions applied. The cultural resources review indicated that depth of the excavation would be no greater than 4.6 m (15 ft) below grade surface. Cultural resources awareness training was required for all project personnel involved in sampling or remediation of this waste site. Full-time cultural resources monitoring was also required, with a 7-days' notice to schedule a cultural resources monitor for the project (WCH 2013b).

Although no cultural resources were anticipated within the project area, all workers were directed to watch for cultural materials (e.g., bones, stone tools, mussel shell) during all work activities. If any cultural materials were encountered, work in the vicinity of the discovery had to stop until a cultural resources specialist was notified, the significance of the find assessed, the appropriate Tribes notified, and, if necessary, arrangements made for mitigation of the find (WCH 2013b).

Geophysical Survey

A geophysical survey was performed in November 2010 for the historical area of the potential UST (WCH 2011b). An anomaly representative of a UST was found approximately 2 m (6.6 ft) west of the suggested historical location. Much of the area was surveyed with ground-penetrating radar and EM-31 and EM-61 electromagnetic induction that detected areas of scattered debris, often metallic in nature, which is representative of a facility that has been demolished in place.

Figure 2 shows a geophysical interpretation map with the suggested historical location and the location determined by the geophysical investigation to be where the UST was likely to be found (at WSP coordinates N 138768.8, E 581237.9). The top of the UST was anticipated to be approximately 0.9 m (3 ft) below ground surface (bgs).

Waste Characterization Sampling

Waste characterization sampling was performed for waste disposal purposes. The resulting data were used to support the determination of the COPCs for waste at the 600-378 site and to guide remedial efforts. The waste characterization sampling data are included in Appendix A.

A waste characterization sample (J1T771) of dark black stained soil was collected and submitted for analysis. This sample was analyzed for inductively coupled plasma (ICP) metals, mercury, total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAH). Analytical sampling results indicated that metal constituents were below background levels and/or the most stringent soil cleanup levels (Appendix A). Several PAH constituents (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene) were above groundwater and/or river protection criteria. The diesel range organics and motor oil data results were 4.64 mg/kg and 4.56 mg/kg, respectively, which are significantly below the 200 mg/kg soil cleanup criteria for TPH.

REMEDIAL ACTION SUMMARY

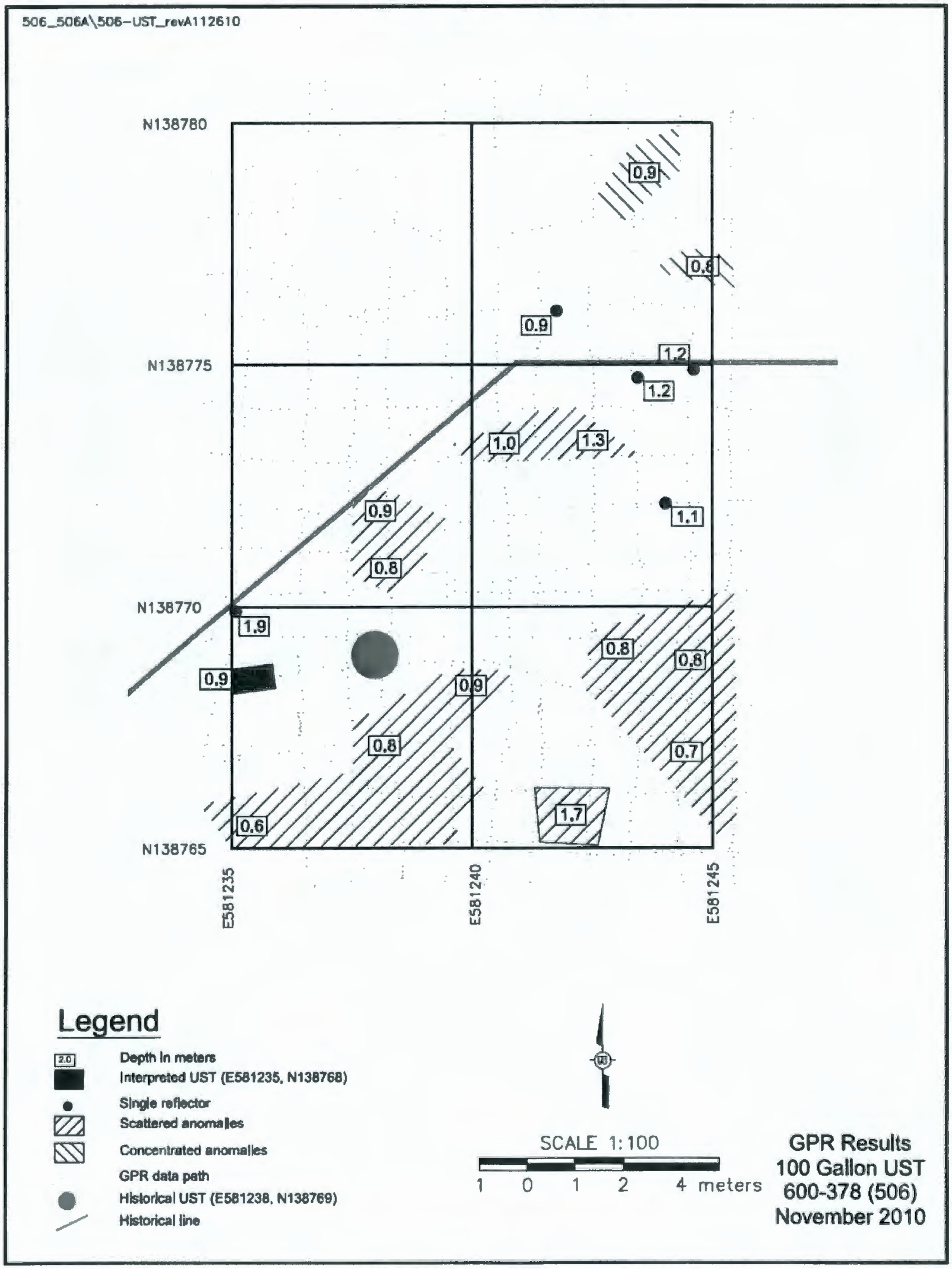
The 600-378 waste site was recommended for remediation without confirmatory sampling based on the geophysical investigation findings at this site (WCH 2013a).

Remedial Action

Remediation of the 600-378 waste site began on December 18, 2013. A 379 L (100 gal) underground fuel tank was discovered 0.46 m (1.5 ft) bgs. The tank was found to be completely empty of contents and positioned sideways as shown on drawing H-5-548 (Appendix B). Remediation of the 600-378 waste site continued on January 8, 2014, to remove and dispose the underground fuel tank and underlying soil. While removing the fuel tank, it was noted that the valve attached to the tank was broken off. After removing the tank from the excavation and loading it for disposal, dark black staining was observed below the tank. However, after excavating through the stained soils it was noted that the black staining under the fuel tank was the result of the dust-suppression water applied to the inside of the tank.

The two pipeline segments that connected to the fuel tank (Appendix B) were found and removed for disposal. A 0.6-m (2-ft)-long, 2-in.-diameter galvanized steel (Schedule 40) pipeline was observed buried beside the fuel tank. As shown in Appendix B, Figure B-2, this pipe was a fill pipe that connected to the top of the fuel tank. A copper 3/8-in.- diameter pipeline that trended east and connected to the generator structure was also found within the excavation. Concrete debris was uncovered on the east side of the excavation, consistent with the location of the 508 Emergency Generator Building.

Figure 2. Geophysical Interpretation Map for the 600-378 Waste Site.



As the excavation continued, some burned debris including burned wood debris was found at 0.9 m (3 ft) bgs on the northwest side of the excavation. This burned material was only partially removed because it is not associated with the 600-378 waste site fuel tank. Approximately 7.5 bank cubic meters (BCM) (9.8 bank cubic yards [BCY]) of soil and debris was removed and direct loaded for disposal at the Environmental Restoration Disposal Facility (ERDF). No overburden soil was stockpiled to be used as backfill. A post-remediation photograph is shown in Figure 3.

Figure 3. Photograph of the 600-378 Waste Site Excavation Looking Northeast (January 9, 2014).

Verification sampling performed on February 25, 2014, indicated that benzo(a)pyrene was above the direct exposure cleanup criteria at sample location FS-3. Additional remediation was performed on April 30, 2014, to remove contaminated material from the excavation. The entire 600-378 excavation was re-excavated (Figure 4). Approximately 36 BCM (47 BCY) of soil was removed and direct loaded for disposal at ERDF. The final excavation depth is approximately 2.2 m (7.2 ft) bgs.

Remediation of the 600-378 waste site resulted in a total excavation of approximately 43.5 BCM (56.8 BCY) of contaminated soil and debris that was direct loaded for disposal at ERDF. No stained soils were visible within the excavation during and after remediation.

Figure 4. Photograph of the 600-378 Waste Site Excavation, Following Additional Remediation – Looking East (May 15, 2014).

VERIFICATION SAMPLING ACTIVITIES

Verification sampling was performed at the 600-378 waste site on February 25 and April 30, 2014. Sampling was conducted to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999).

The verification sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 600-378 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. The maximum results of verification sampling are summarized to support interim closure of the site.

A more detailed discussion of the verification sampling can be found in the *Work Instruction for Verification Sampling of the 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank Waste Site* (WCH 2014c).

Contaminants of Potential Concern

The COPCs for the 600-378 waste site are associated with the storage of fuel during operation of the UST. The COPCs include ICP metals, mercury, TPH, and PAH. Radionuclides are not identified as COPCs for the 600-378 waste site. No volatile organic compounds were detected in the field; therefore, volatile organic analysis was not performed. The COPCs for verification sampling and the laboratory analytical methods are identified in Table 1.

Table 1. 600-378 Laboratory Analytical Methods and Contaminants of Potential Concern.

Analysis	Analytical Method	Contaminant of Potential Concern
ICP metals [a]	EPA Method 6010	Lead
Mercury	EPA Method 7471	Mercury
PAH	EPA Method 8310	Polycyclic aromatic hydrocarbons
TPH	EPA Method NWTPH-Dx	Total petroleum hydrocarbons

[a] Analysis was performed for the expanded list of ICP metals including antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

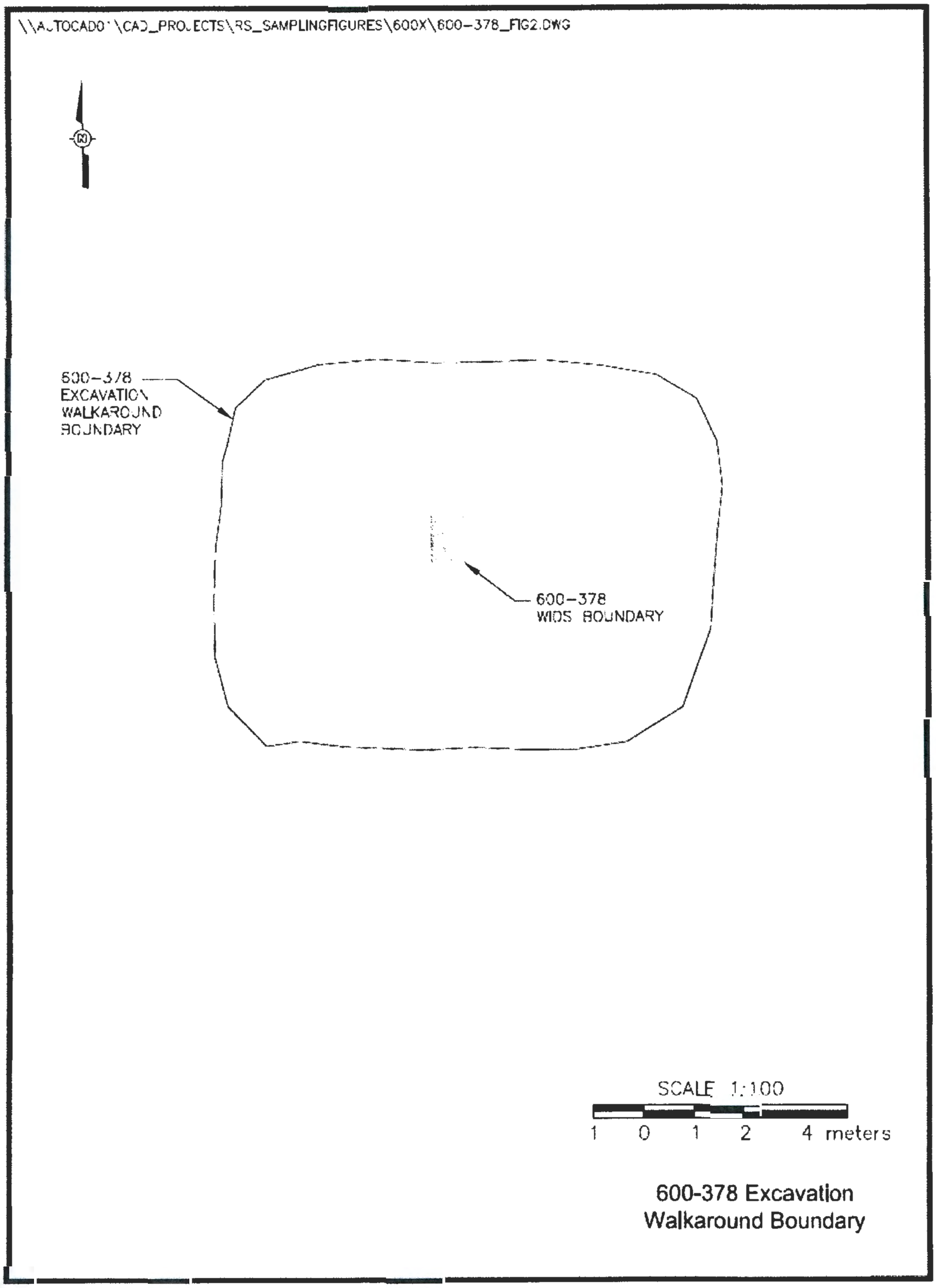
EPA = U.S. Environmental Protection Agency
NWTPH-Dx = Northwest total petroleum hydrocarbons-diesel range organics
ICP = inductively coupled plasma
PAH = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons

Verification Sample Design

This section describes the basis for selection of an appropriate sample design and determination of the number of verification samples that were collected. All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2009a).

Following remediation, a boundary walkaround survey of the 600-378 waste site excavation was performed and is shown in Figure 5. Due to the small size of the excavation (approximately 4 m by 6 m [13 ft by 20 ft]) a focused sampling plan was developed. The FS-1 sample location was the approximate area where the fuel tank was found. Sample location FS-2 was the approximate location of the 3/8-in.- diameter copper fuel pipeline that connected the fuel tank to the generator. The FS-3 sample is the location of the northern section of the excavation, where some burned material was observed. According to the available historical drawings and photographs of the 600-378 waste site, it is likely that the tank was filled at the north side of the tank through a fill pipe that connected to the top of the tank. Therefore, FS-3 also accounted for this location. Verification sampling performed on February 25, 2014, indicated that benzo(a)pyrene was above the direct exposure cleanup criteria at sample location FS-3. Additional remediation was performed at this location, as discussed in the Remedial Action Summary section of this remaining sites verification package. Sample location FS-4 was focused to sample the southwest section of the excavation.

Figure 5. The 600-378 Waste Site Post-Excavation Boundary, Following Additional Remediation.



The 600-378 waste site verification sampling locations map is shown in Figure 6. Additional information related to verification sampling can be found in the field sampling logbooks (WCH 2014a, 2014b). A summary of the verification samples collected and laboratory analyses performed is provided in Table 2.

Figure 6. 600-378 Waste Site Verification Sample Locations.

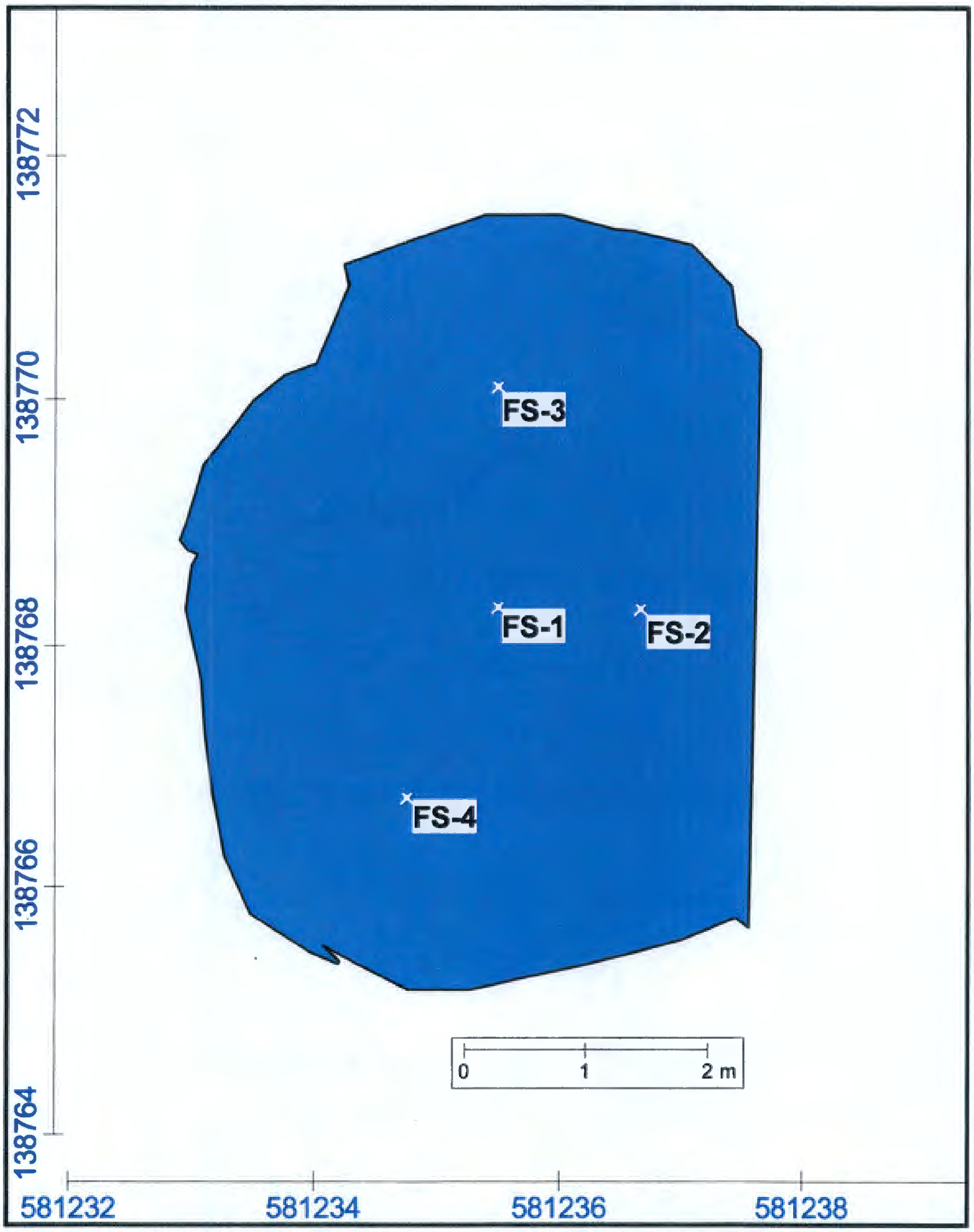


Table 2. 600-378 Sample Summary.

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
FS-1	J1TDP6	138768.3	581235.5	ICP metals [a], mercury, PAH, and TPH
FS-2	J1TDP7	138768.3	581236.7	
FS-3	J!TDP8	138770.1	581235.5	
FS-4	J1TDP9	138766.7	581234.8	
Duplicate [b]	J1TDR0	138768.3	581235.5	
Equipment blank	J1TDR1	NA	NA	ICP metals [a], mercury

[a] The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium(total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc in the analytical results package.
[b] One duplicate soil sample was collected at a location selected at the project analytical lead's discretion.

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
TPH = total petroleum hydrocarbons

Verification Sample Results

All verification samples were analyzed using analytical methods approved by EPA (DOE-RL 2009b). Evaluation of the verification data from the 600-378 waste site was performed by direct comparison of the maximum sample results for each COPC against cleanup criteria. The complete data set is provided in the *600-378 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation* in Appendix C.

Comparisons of the results for site COPCs with the RAGs for the 600-378 waste site are provided in Table 3.

Table 3. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 600-378 Excavation Verification Sampling Data. (2 Pages)

COPC	Maximum Result (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Maximum Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony	3.18 (<BG)	32	5 [b]	5 [b]	No	--
Arsenic	4.86 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	120 (<BG)	5,600	200	400	No	--
Beryllium	0.497 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	5.63	7,200	320	-- [e]	No	--
Cadmium [f]	0.778 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	6.46 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	10.7 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	16.0 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	11.9	353	10.2 [b]	10.2 [b]	Yes	Yes [g]
Manganese	395 (<BG)	3,760	512 [b]	512 [b]	No	--

Table 3. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 600-378 Excavation Verification Sampling Data. (2 Pages)

COPC	Maximum Result (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Maximum Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Mercury	0.00441 (<BG)	24	0.33 [b]	0.33 [b]	No	--
Nickel	8.49 (<BG)	1,600	19.1 [b]	27.4	No	--
Silver	0.638 (<BG)	400	8	0.73 [b]	No	--
Vanadium	83.0 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	77.7	24,000	480	67.8 [b]	Yes	Yes [g]
TPH – motor oil	31.2	200	200	200	No	--
Anthracene	0.0217	24,000	240	1,920	No	--
Benzo(a)anthracene	0.114	1.37	0.015 [h]	0.015 [h]	Yes	Yes [g]
Benzo(a)pyrene	0.089	0.137	0.015 [h]	0.015 [h]	Yes	Yes [g]
Benzo(b)fluoranthene	0.101	1.37	0.015 [h]	0.015 [h]	Yes	Yes [g]
Benzo(ghi)perylene [i]	0.053	2,400	48	192	No	--
Benzo(k)fluoranthene	0.0503	1.37	0.015 [h]	0.015 [h]	Yes	Yes [g]
Chrysene	0.095	13.7	0.12	0.1 [h]	No	--
Dibenz(a,h)anthracene	0.00251	1.37	0.03 [h]	0.03 [h]	No	--
Fluoranthene	0.179	3,200	64	18.0	No	--
Phenanthrene [i]	0.107	24,000	240	1,920	No	--
Pyrene	0.184	2,400	48	192	No	--

[a] RAGs obtained from the RDR/RAWP (DOE-RL 2009b).

[b] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009b).

[c] Carcinogenic cleanup level calculated based on the inhalation exposure pathway per WAC 173-340-750(3), 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

[d] No Hanford Site-specific or Washington State background value available.

[e] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2014) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).

[f] Hanford Site-specific background value is not available. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

[g] Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), the residual concentrations of lead, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene are not expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the contaminants with the lowest distribution coefficients, lead and zinc, with a value of 30 mL/g). The vadose zone underlying the soil below the site is approximately 43 m (141 ft). Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

[h] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996).

[i] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals:
benzo(ghi)perylene; surrogate: pyrene
phenanthrene; surrogate: anthracene

--	= not applicable	RDL	= required detection limit
AWQC	= ambient water quality criteria	RDR/RAWP	= remedial design report/remedial action work plan
BG	= background	RESRAD	= RESidual RADioactivity
COPC	= contaminant of potential concern	TPH	= total petroleum hydrocarbons
RAG	= remedial action goal	WAC	= *Washington Administrative Code*

Contaminants that were not detected by laboratory analysis are excluded from this table. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2014) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in this table. The laboratory-reported data results for all constituents are stored in a Washington Closure Hanford (WCH) project-specific database prior to archival in the Hanford Environmental Information System and are presented in an attachment to the relative percent difference calculation in Appendix C.

VERIFICATION SAMPLE DATA EVALUATION

This section demonstrates that contaminant concentrations at the 600-378 waste site achieve the applicable RAGs developed to support unrestricted land use at the 100 Area as established in the Remaining Sites ROD (EPA 1999) and documented in the RDR/RAWP (DOE-RL 2009b).

Nonradionuclide Soil RAGs for Direct Exposure and Groundwater and River Protection Attained

Table 3 compares the maximum detected verification sample results to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River. All COPCs for all sampling areas were quantified below their respective direct exposure soil RAGs.

Lead, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene are present at maximum concentrations above soil RAGs for groundwater and/or Columbia River protection. However, based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), it is predicted that these constituents will not migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the contaminants with the lowest distribution coefficients, lead and zinc, with distribution coefficients of 30 mL/g). The vadose zone underlying the soil below the site is approximately 43 m (141 ft). Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 600-378 waste site was determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix C). The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. Hazard quotient and excess carcinogenic risk calculations for direct contact were conservatively performed for the 600-378 waste site in Appendix C using the maximum concentrations of the waste site contaminants from the focused samples. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. All individual hazard quotients are below 1.0, and all individual excess carcinogenic risk values are below 1×10^{-6}. The direct contact cumulative hazard quotient for the 600-378 waste site is 4.2×10^{-3}, and the cumulative excess carcinogenic risk value is 8.5×10^{-7}, satisfying the criteria to be less than 1.0 and less than 1×10^{-5}, respectively. Therefore, the nonradionuclide risk requirements are met.

Three-Part Test for Nonradionuclides

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. However, no statistical samples were used in the 600-378 waste site sampling design (WCH 2014c). The verification samples were all focused samples; therefore, the three-part test is not applicable to the data evaluation for the 600-378 waste site.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2014c), the field logbooks (WCH 2014a, 2014b), and the resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 600-378 waste site established that the data are of the right type, quality, and quantity to support site cleanup verification decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in a WCH project-specific database for data evaluation prior to archival in the Hanford Environmental Information System and are summarized in an attachment to the relative percent difference calculation in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 600-378 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009b). Verification sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at this site met the RAGs and associated RAOs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-378 waste site to Interim Closed Out. In accordance with WAC 173-360-110(2)(d), the 600-378 waste site UST is exempt from the requirements of WAC 173-360, "Underground Storage Tank Regulations," based on its capacity of less than 416 L (110 gal). The 600-378 waste site contamination did not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

REFERENCES

40 CFR 141, "National Primary Drinking Water Regulations," *Code of Federal Regulations*, as amended.

BHI, 2001, *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* as amended, U. S. Department of Energy, Washington, D.C.

DOE-RL, 2009a, *100 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2009b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area,* DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2011, *Tri-Party Agreement Handbook Management Procedures,* RL-TPA-90-0001, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2012, *100 Area "Plug-In" and Candidate Waste Sites for Calendar Year 2011*, AR/PIR Accession Number 1202240339, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, 1994, *Natural Background Soil Metals Concentrations in Washington State*, Publication No. 94-115, Washington State Department of Ecology, Olympia, Washington.

Ecology, 1996, "Model Toxics Control Act – Cleanup," *Washington Administrative Code* (WAC) 173-340, Washington State Department of Ecology, Olympia, Washington.

Ecology, 2014, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

ENV-1, *Environmental Monitoring & Management*, Washington Closure Hanford, Richland, Washington.

EPA, 1989, *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, Part A; Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1999, *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2009, *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

GE, 1964, *Catalog of Hanford Buildings and Facilities Miscellaneous,* April 1, 1964, General Electric Company, Richland, Washington.

WAC 173-340, 1996, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, as amended.

WAC 173-360, 2003, "Underground Storage Tank Regulations," *Washington Administrative Code*, as amended.

WCH, 2011a, *100-F/IU-2/IU-6 Area – Segment 4 Orphan Sites Evaluation Report*, OSR-2011-0001, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2011b, *Geophysical Site Investigation Summary, 506, B-Y Telephone Exchange Building (features SG4-578, SG4-580, and SG4-591)*, GI #0614558, Washington Closure Hanford, Richland, Washington.

WCH, 2013a, "600-378, Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank for Remedial Action," CCN 169635, Interoffice Memorandum to T. M. Blakely from T. Q. Howell, Washington Closure Hanford, Richland, Washington, January, 28.

WCH, 2013b, *Supersedes CCN 169110: Ecological and Cultural Resources Review for Hand Sampling at Numerous WIDS Sites in IU2/IU6 and Segment 4 for Waste Characterization Purposes (12-ER-051a and HCRC#2011-600-022, HCRC# 2011-600-042, HCRC#2011-600-045, HCRC#2011-600-059, HCRC#2011-600-079 and HCRC#2011-100-084),* CCN 169163, to K. A. Anselm from J. E. Thomson, Washington Closure Hanford, Richland, Washington, January 3, 2013.

WCH, 2014a, *100-K and IU-2/6 Miscellaneous Restoration and Failed Remaining Sites Sampling*, Logbook EL-1666-01, pp. 88-90, Washington Closure Hanford, Richland, Washington.

WCH, 2014b, *100-K and IU-2/6 Miscellaneous Restoration and Failed Remaining Sites Sampling*, Logbook EL-1667-01, pp. 74-77, Washington Closure Hanford, Richland, Washington.

WCH, 2014c, *Work Instruction for Verification Sampling of the 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank Waste Site*, 0600X-WI-G0083, Rev. 0, Washington Closure Hanford, Richland, Washington.

WDOH, 1997, *Hanford Guidance for Radiological Cleanup*, WDOH/320-015, Rev. 1, Washington State Department of Health, Olympia, Washington.

APPENDIX A

WASTE CHARACTERIZATION SAMPLING RESULTS

Table A-1. 600-378 Waste Site Characterization Data - Metals and TPH. (1 Page)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-378	J1T771	1/8/14	5840		6.83	3.61	BD	1.66	5.21		0.502	86.4		0.1

Sample Location	HEIS Number	Sample Date	Beryllium			Boron			Cadmium			Calcium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-378	J1T771	1/8/14	0.541		0.1	4.62	BC	1	0.45	B	0.1	14200	*	8.03

Sample Location	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Iron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-378	J1T771	1/8/14	7.47	*	0.151	9.15	D	0.753	13.8		0.301	25500		8.03

Sample Location	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-378	J1T771	1/8/14	5.9	D	1.66	5280		8.54	345		0.201	0.0394		0.00439

Sample Location	HEIS Number	Sample Date	Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-378	J1T771	1/8/14	0.201	U	0.201	8.86	*M	0.151	1270	*N	6.43	0.343	DU	0.343

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-378	J1T771	1/8/14	486	N	1.51	0.1	U	0.1	258		7.03	70.7	D	0.502

Sample Location	HEIS Number	Sample Date	Zinc			TPH - Diesel range			TPH - Motor oil		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-378	J1T771	1/8/14	64.9	D	2.01	4640	J	2370	4560	J	2370

Acronyms and notes apply to all of the tables in this attachment.

Gray cells indicate not applicable.

* = duplicate analysis not within control limits.

Note: Data qualified with B, C, D, J, M, N, P, and/or X are considered acceptable values.

B = blank contamination (organic constituents) = estimated (inorganic)

C = Sample was </= 5X the blank concentration

D = results are reported from a diluted aliquot of sample.

HEIS = Hanford Environmental Information System

J = estimated

M = sample duplicate precision not met.

N = recovery is outside the control limits.

PQL = practical quantitation limit

Q = qualifier

U = undetected

Table A-1. 600-378 Waste Site Characterization Data - Organics. (1 Page)

CONSTITUENT	CLASS	J1T771		
		1/8/2014		
		ug/kg	Q	PQL
Acenaphthene	PAH	5.47	U	5.47
Acenaphthylene	PAH	5.47	U	5.47
Anthracene	PAH	24.5		1.82
Benzo(a)anthracene	PAH	67.9		0.584
Benzo(a)pyrene	PAH	47.2		0.584
Benzo(b)fluoranthene	PAH	53.3		0.584
Benzo(ghi)perylene	PAH	27.1		0.584
Benzo(k)fluoranthene	PAH	27.3		0.292
Chrysene	PAH	56.9		0.584
Dibenz[a,h]anthracene	PAH	4.47		0.584
Fluoranthene	PAH	123		0.584
Fluorene	PAH	12.2	J	5.47
Indeno(1,2,3-cd)pyrene	PAH	0.584	U	0.584
Naphthalene	PAH	5.47	U	5.47
Phenanthrene	PAH	113		5.47
Pyrene	PAH	121		0.584

APPENDIX B

DRAWINGS, PLAN VIEW OF 600-378 WASTE SITE

Figure B-1. Drawing H-5-548 – Plan View of the 600-378 Fuel Tank and Emergency Generator Building.

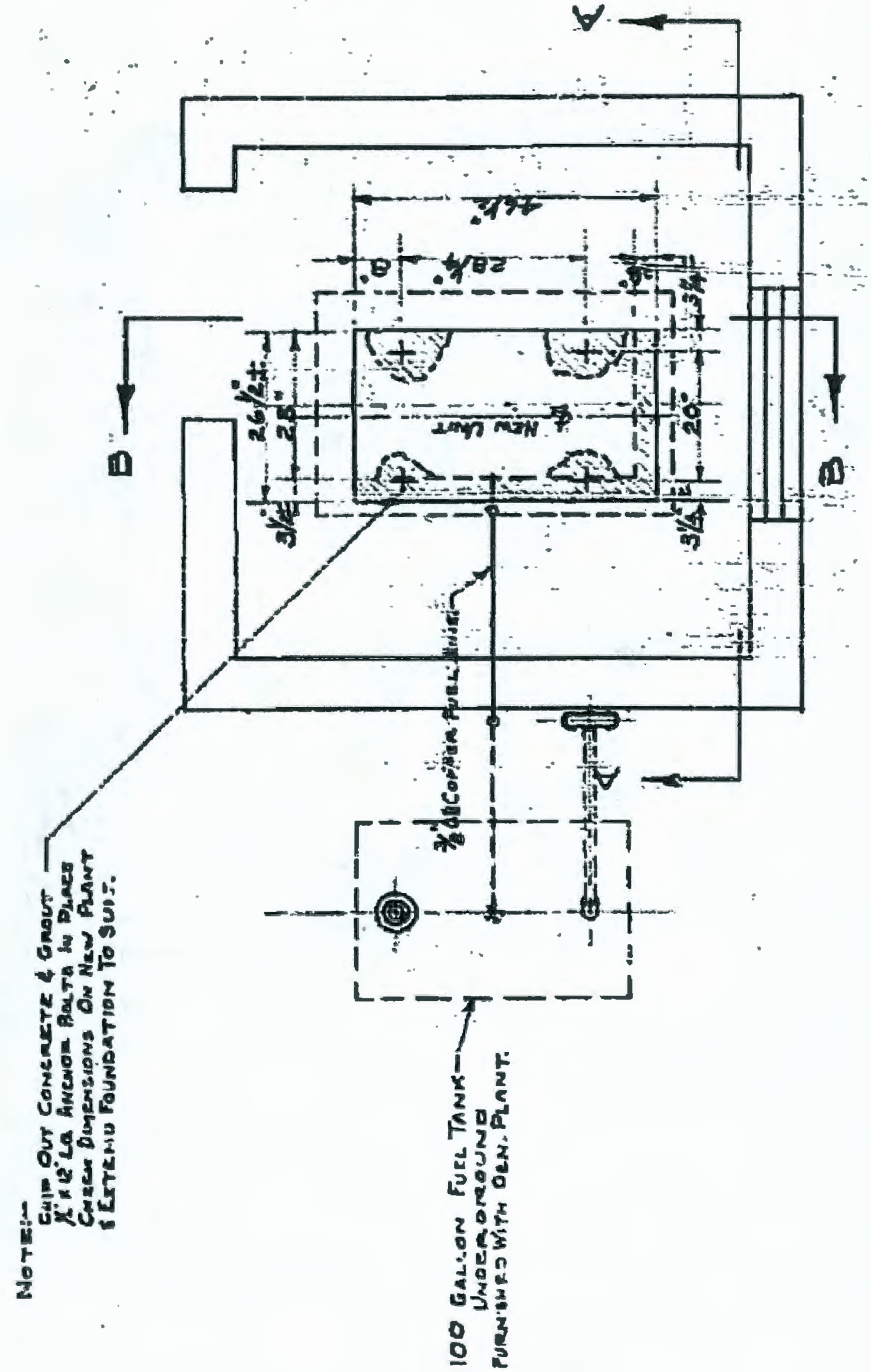
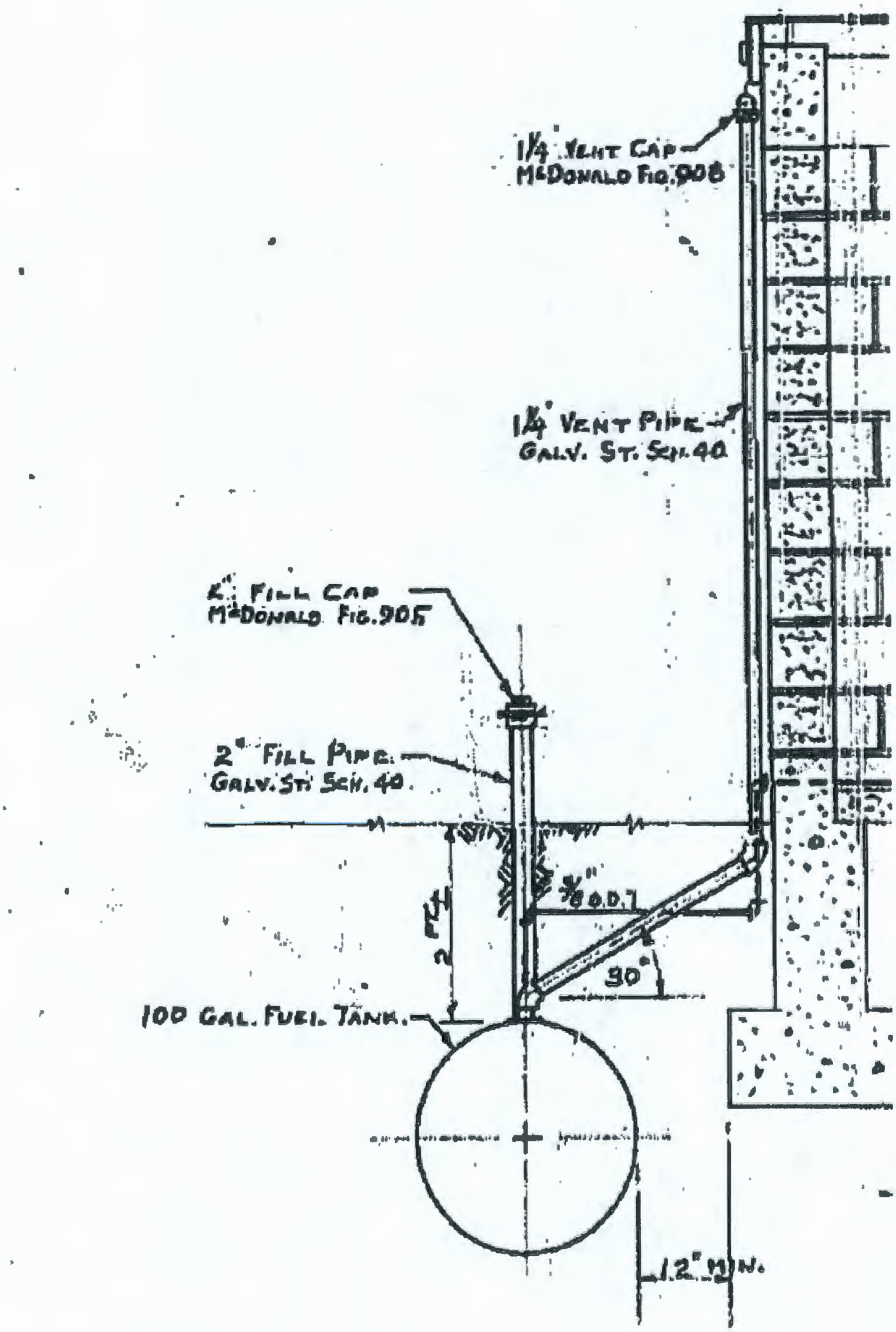


Figure B-2. Drawing H-5-548 Partial – Plan View of 600-378 with Connection to the Emergency Generator Building.



APPENDIX C

CALCULATIONS

APPENDIX C

CALCULATIONS

The calculations in this appendix are kept in the active Washington Closure Hanford project files and are available upon request. When the project is completed, the files will be stored in a U.S. Department of Energy, Richland Operations Office, repository. The calculations have been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculations," Washington Closure Hanford, Richland, Washington. The following calculations are provided in this appendix:

600-378 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0600X-CA-V0177, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculations provided in this appendix have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents.

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CALCULATION COVER SHEET

Project Title: 600 Field Remediation **Job No. 14655**

Area: 600

Discipline: Environmental *Calculation No: 0600X-CA-V0177

Subject: 600-378 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2010

The attached calculations have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 6 Attachment = 3 Total = 10	I. B. Berezovskiy	J. D. Skoglie	H. M. Sulloway	S.G. Wilkinson ~~D. F. Obenauer~~	7/15/14

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007) *Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford, LLC CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/13/2014	Calc. No.:	0600X-CA-V0177	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	5/13/2014
Subject:	600-378 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 6	

PURPOSE:

Using sample data from Attachment 1 provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 600-378 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009b), the following criteria must be met:

1) An HQ of <1.0 for all individual noncarcinogens
2) A cumulative HQ of <1.0 for noncarcinogens
3) An excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

Also, calculate the relative percent difference (RPD) for primary-duplicate sample pairs from 600-378 waste site verification sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2009a, *100 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) DOE-RL, 2009b, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas,* DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

3) EPA, 1994, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.

4) WAC 173-340, "Model Toxics Control Act – Cleanup," Washington Administrative Code, 1996.

5) WCH, 2014, *Remaining Sites Verification Package for the 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank,* Attachment to Waste Site Reclassification Form 2013-051, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2009b).

2) Sum the HQs and compare this value to the cumulative HQ of <1.0.

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2009b).

4) Sum the excess cancer risk value(s) and compare it to the cumulative cancer risk of <1 x 10^{-5}.

5) Use data from Attachment 1 to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

The 600-378 waste site underwent verification focused sampling at four locations including a duplicate sample. The direct contact hazard quotient and carcinogenic risk calculations for the 600-378 waste site were conservatively calculated using the maximum results from Attachment 1 as discussed in the RSVP (WCH 2014). Of the contaminants of potential concern (COPCs) and other analytes for this site, boron and the detected polycyclic aromatic hydrocarbons (PAH) require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Zinc requires HQ and risk calculations because this analyte was detected above Washington State or Hanford Site background value. Lead was detected above background; however, lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. Although total petroleum hydrocarbons (motor oil) were detected and no background value is available, the risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 5.63 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 7.8 x 10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation. The sum of the HQ values for COPCs is 4.2 x 10^{-3}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, then multiplied by 1.0 x 10^{-6}. For example, the maximum value for benzo(a)anthracene is 0.144 mg/kg, divided by 1.37 mg/kg, and multiplied as indicated, is 8.3 x 10^{-8}. Comparing this value, and all other individual values, to the requirement of <1 x 10^{-6}, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values for COPCs is 8.5 x 10^{-7}. Comparing these values to the requirement of <1 x 10^{-5}, this criterion is met.

5) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed for certain analytes

Washington Closure Hanford, LLC CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/13/2014	Calc. No.:	0600X-CA-V0173	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	5/13/2014
Subject:	600-378 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 6	

in Table II-1 of the SAP (DOE-RL 2009a). Other analytes will have their own pre-determined constituents and will have their own TDLs based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

$$RPD = [\,|M-D|/((M+D)/2)]*100$$

where, M = main sample value D = duplicate sample value

When an analyte is detected in the primary or duplicate sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. This assessment is provided in the data quality assessment section of the RSVP (WCH 2014).

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. No split samples were collected for the verification sampling at the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2014), as necessary.

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None
2) List the cumulative noncarcinogenic HQ >1.0: None
3) List individual carcinogens and corresponding excess cancer risk >1 x 10^{-6}: None
4) List the cumulative excess cancer risk for carcinogens >1 x 10^{-5}: None

Table 1 shows the results of the hazard quotient and excess cancer risk calculations for the 600-378 waste site.

5) The evaluation of the QA/QC duplicate RPD calculations are performed within the data quality assessment section of the RSVP.

Table 2 shows the results of the RPD calculations for the 600-378 waste site.

Washington Closure Hanford, LLC. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/22/2014	Calc. No.:	0600X-CA-V0177	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	5/22/2014
Subject:	600-378 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 6	

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 600-378 Waste Site.

Contaminants of Potential Concern	Maximum Value [a] (mg/kg)	Noncarcinogen RAG [b] (mg/kg)	Hazard Quotient	Carcinogen RAG [b] (mg/kg)	Carcinogen Risk
Metals					
Boron	5.63	7,200	7.8E-04	--	--
Lead [c]	11.9	353	--	--	--
Zinc	77.7	24,000	3.2E-03	--	--
Polycyclic Aromatic Hydrocarbons					
Anthracene	0.0217	24,000	9.0E-07	--	--
Benzo(a)anthracene	0.114	--	--	1.37	8.3E-08
Benzo(a)pyrene	0.0892	--	--	0.137	6.5E-07
Benzo(b)fluoranthene	0.101	--	--	1.37	7.4E-08
Benzo(ghi)perylene [d]	0.0532	2,400	2.2E-05	--	--
Benzo(k)fluoranthene	0.0503	--	--	1.37	3.7E-08
Chrysene	0.0951	--	--	13.7	6.9E-09
Dibenz(a,h)anthracene	0.00251	--	--	1.37	1.8E-09
Fluoranthene	0.179	3,200	5.6E-05	--	--
Phenanthrene [d]	0.107	24,000	4.5E-06	--	--
Pyrene	0.184	2,400	7.7E-05	--	--
Total Petroleum Hydrocarbons					
TPH - Motor oil [e]	31.2	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**4.2E-03**		
Cumulative Excess Cancer Risk:					**8.5E-07**

Notes:

[a] = From Attachment 1.

[b] = Value obtained from the 100 Area RDR/RAWP (DOE-RL 2009b) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

[c] = Value for the noncarcinogenic RAG calculated using Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children, EPA/540/R 93/081, Publication No. 9285.7, U.S. Environmental Protection Agency, Washington, D.C.

[d] = Toxicity data is not available. The cleanup levels are based on use of surrogate chemicals.

benzo(g,h,i)perylene surrogate: pyrene

phenanthrene surrogate: anthracene

[e] = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

-- = not applicable

RAG = remedial action goal

Washington Closure Hanford, LLC CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/13/2014	Calc. No.:	0600X-CA-V0177	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	5/13/2014
Subject:	600-378 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 5 of 6	

Table 2. Relative Percent Difference Calculations for the 600-378 Waste Site (2 pages).

Duplicate Analysis - 600-378 Waste Site

Sampling Area	HEIS Number	Sample Date	Aluminum mg/kg	Q	PQL	Antimony mg/kg	Q	PQL	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	5540		6.96	2.09	BD	1.69	4.32		0.512	120	*NJ	0.102
Duplicate of J1TDP6	J1TDR0	2/25/2014	5350		6.67	1.83	BD	1.62	4.86		0.490	75.4	*NJ	0.098

Analysis:

		Aluminum	Antimony	Arsenic	Barium
TDL		5	0.6	10	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	3.5%			45.6%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable

Duplicate Analysis - 600-378 Waste Site

Sampling Area	HEIS Number	Sample Date	Beryllium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Cadmium mg/kg	Q	PQL	Calcium mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	0.497	B	0.102	5.63		1.02	0.673		0.102	8420		8.19
Duplicate of J1TDP6	J1TDR0	2/25/2014	0.422	B	0.098	2.90	B	0.980	0.719		0.098	34600		7.84

Analysis:

		Beryllium	Boron	Cadmium	Calcium
TDL		0.2	2	0.2	100
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD				121.7%
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	Not applicable

Duplicate Analysis - 600-378 Waste Site

Sampling Area	Sample Number	Sample Date	Chromium mg/kg	Q	PQL	Cobalt mg/kg	Q	PQL	Copper mg/kg	Q	PQL	Iron mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	6.34		0.153	10.7	D	0.767	16.0		0.307	27000		8.19
Duplicate of J1TDP6	J1TDR0	2/25/2014	6.08		0.147	9.85	D	0.735	14.4		0.294	25300		7.84

Analysis:

		Chromium	Cobalt	Copper	Iron
TDL		1	2	1	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	4.2%		10.5%	6.5%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

Duplicate Analysis - 600-378 Waste Site

Sampling Area	Sample Number	Sample Date	Lead mg/kg	Q	PQL	Magnesium mg/kg	Q	PQL	Manganese mg/kg	Q	PQL	Nickel mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	5.92		1.69	4680		8.70	395		0.205	7.63		0.153
Duplicate of J1TDP6	J1TDR0	2/25/2014	5.33		1.62	5140		8.33	326		0.196	8.48		0.147

Analysis:

		Lead	Magnesium	Manganese	Nickel
TDL		5	75	5	4
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		9.4%	19.1%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

Duplicate Analysis - 600-378 Waste Site

Sampling Area	Sample Number	Sample Date	Potassium mg/kg	Q	PQL	Silicon mg/kg	Q	PQL	Silver mg/kg	Q	PQL	Sodium mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	1070		6.55	1080	NJ	1.53	0.636		0.102	200		7.16
Duplicate of J1TDP6	J1TDR0	2/25/2014	1060		6.27	991	NJ	1.47	0.334	B	0.098	192		6.86

Analysis:

		Potassium	Silicon	Silver	Sodium
TDL		400	2	0.2	50
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD		8.6%		
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	No - acceptable

Duplicate Analysis - 600-378 Waste Site

Sampling Area	Sample Number	Sample Date	Vanadium mg/kg	Q	PQL	Zinc mg/kg	Q	PQL	TPH - motor oil (high boiling) ug/kg	Q	PQL	Anthracene ug/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	83.0	D	0.512	59.2	D	2.05	8860	T	2300	15.7	J	1.77
Duplicate of J1TDP6	J1TDR0	2/25/2014	74.9	D	0.490	53.0	D	1.96	5760	TJ	2310	21.7		1.77

Analysis:

		Vanadium	Zinc	TPH - motor oil (high boiling)	Anthracene
TDL		2.5	1	5000	15
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	10.3%	11.1%		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

Washington Closure Hanford, LLC — CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/13/2014	Calc. No.:	0600X-CA-V0177	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	5/13/2014
Subject:	600-378 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 6 of 6	

Table 2. Relative Percent Difference Calculations for the 600-378 Waste Site (2 pages).

Duplicate Analysis - 600-378 Waste Site

Sampling Area	Sample Number	Sample Date	Benzo(a)anthracene ug/kg	Q	PQL	Benzo(a)pyrene ug/kg	Q	PQL	Benzo(b)fluoranthene ug/kg	Q	PQL	Benzo(ghi)perylene ug/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	80.5		0.565	64.3		0.565	65.9		0.565	39.4		0.565
Duplicate of J1TDP6	J1TDR0	2/25/2014	114		0.568	89.2		0.568	101		0.568	53.2		0.568

Analysis:

		Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene
TDL		15	15	15	15
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	34.4%			
	Difference > 2 TDL?	Not applicable	No - acceptable	Yes - assess further	No - acceptable

Duplicate Analysis - 600-378 Waste Site

Sampling Area	Sample Number	Sample Date	Benzo(k)fluoranthene ug/kg	Q	PQL	Chrysene ug/kg	Q	PQL	Dibenz(a,h)anthracene ug/kg	Q	PQL	Fluoranthene ug/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	39.3		0.283	67.6		0.565	1.78		0.565	124		0.565
Duplicate of J1TDP6	J1TDR0	2/25/2014	50.3		0.284	95.1		0.568	2.51		0.568	179		0.568

Analysis:

		Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene
TDL		15	15	15	660
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD				
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Duplicate Analysis - 600-378 Waste Site

Sampling Area	Sample Number	Sample Date	Phenenthrene ug/kg	Q	PQL	Pyrene ug/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	75.3		5.30	129		0.565
Duplicate of J1TDP6	J1TDR0	2/25/2014	107		5.32	184		0.568

Analysis:

		Phenenthrene	Pyrene
TDL		15	15
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)
	RPD	34.8%	35.1%
	Difference > 2 TDL?	Not applicable	Not applicable

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 600-378 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2009b) and SAP (DOE-RL 2009a). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

Attachment 1. 600-378 Waste Site Verification Sample Results (Metals)

LOCATION	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	5540		6.96	2.09	BD	1.69	4.32		0.512	120	*NJ	0.102	0.497	B	0.102
Duplicate of J1TDP6	J1TDR0	2/25/2014	5350		6.67	1.83	BD	1.62	4.86		0.490	75.4	*NJ	0.098	0.422	B	0.098
FS-2	J1TDP7	2/25/2014	5370		7.03	3.18	BD	1.71	2.29	B	0.517	75.5	*NJ	0.103	0.442	B	0.103
FS-3	J1TDP8	2/25/2014	5590		7.01	1.70	DU	1.70	3.22		0.515	75.0	*NJ	0.103	0.451	B	0.103
FS-4	J1TDP9	2/25/2014	5330		6.66	1.62	DU	1.62	2.21	B	0.490	75.4	*NJ	0.098	0.417	B	0.098
Equipment Blank	J1TDR1	2/25/2014	88.5		6.15	0.298	U	0.298	0.452	U	0.452	1.55	*NJ	0.0905	0.0905	U	0.0905

LOCATION	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	5.63		1.02	0.673		0.102	8420		8.19	6.34		0.153	10.7	D	0.767
Duplicate of J1TDP6	J1TDR0	2/25/2014	2.90	B	0.980	0.719		0.098	34600		7.84	6.08		0.147	9.85	D	0.735
FS-2	J1TDP7	2/25/2014	5.52		1.03	0.778		0.103	6890		8.27	6.33		0.155	10.3	D	0.776
FS-3	J1TDP8	2/25/2014	2.99	B	1.03	0.447	B	0.103	8910		8.24	6.16		0.155	9.79	D	0.773
FS-4	J1TDP9	2/25/2014	4.10	B	0.980	0.676		0.098	6460		7.84	6.46		0.147	10.1	D	0.735
Equipment Blank	J1TDR1	2/25/2014	0.905	U	0.905	0.0905	U	0.0905	33.4		7.24	0.136	U	0.136	0.136	U	0.136

LOCATION	HEIS Number	Sample Date	Copper			Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	16.0		0.307	27000		8.19	5.92	D	1.69	4680		8.70	395		0.205
Duplicate of J1TDP6	J1TDR0	2/25/2014	14.4		0.294	25300		7.84	5.33	D	1.62	5140		8.33	326		0.196
FS-2	J1TDP7	2/25/2014	15.0		0.310	25700		8.27	6.71	D	1.71	4800		8.79	361		0.207
FS-3	J1TDP8	2/25/2014	14.1		0.309	26200		8.24	6.60	D	1.70	4900		8.76	355		0.206
FS-4	J1TDP9	2/25/2014	15.2		0.294	24200		7.84	11.9	D	1.62	4460		8.33	359		0.196
Equipment Blank	J1TDR1	2/25/2014	0.271	U	0.271	190		7.24	0.298	U	0.298	15.1	B	7.69	3.75		0.181

Acronyms and notes apply to all of the tables in this attachment.

Note: Data qualified with *, B, C, D, J, N, and/or T are considered acceptable values.

Gray cells indicate not applicable

* = Duplicate analysis not within control limit.

B = blank contamination (inorganic constituents)

C = detected in both sample and associated QC blank, sample concentration </=5X blank concentration.

D = results are reported from a diluted aliquot of sample.

FS = focused sample

HEIS = Hanford Environmental Information System

J = estimate

N = recovery exceeds upper or lower control limit.

PAH = polycyclic aromatic hydrocarbons

PQL = practical quantitation limit

Q = qualifier

RAG = remedial action goal

TPH = total petroleum hydrocarbons

T = spike and/or spike duplicate sample recovery is outside control limits.

U = not detected.

Attachment	1	Sheet No.	1 of 3
Originator	I. B. Berezovskiy	Date	5/13/2014
Checked	J. D. Skoglie	Date	5/13/2014
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Attachment 1. 600-378 Waste Site Verification Sample Results (Metals and TPH)

LOCATION	HEIS Number	Sample Date	Mercury			Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	0.00416	U	0.00416	0.205	U	0.205	7.63		0.153	1070		6.55	0.348	DU	0.348
Duplicate of J1TDP6	J1TDR0	2/25/2014	0.00423	U	0.00423	0.196	U	0.196	8.48		0.147	1060		6.27	0.325	DU	0.325
FS-2	J1TDP7	2/25/2014	0.00424	U	0.00424	0.207	U	0.207	8.49		0.155	1180		6.62	0.349	DU	0.349
FS-3	J1TDP8	2/25/2014	0.00380	U	0.00380	0.206	U	0.206	7.62		0.155	1150		6.59	0.333	DU	0.333
FS-4	J1TDP9	2/25/2014	0.00441	B	0.00399	0.196	U	0.196	8.23		0.147	1270		6.27	0.332	DU	0.332
Equipment Blank	J1TDR1	2/25/2014	0.00363	U	0.00363	0.181	U	0.181	0.136	U	0.136	30.4		5.79	0.297	DU	0.297

LOCATION	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	1080	NJ	1.53	0.638		0.102	200		7.16	83.0	D	0.512	59.2	D	2.05
Duplicate of J1TDP6	J1TDR0	2/25/2014	991	NJ	1.47	0.334	B	0.098	192		6.86	74.9	D	0.490	53.0	D	1.96
FS-2	J1TDP7	2/25/2014	1090	NJ	1.55	0.589		0.103	160		7.24	74.2	D	0.517	76.0	D	2.07
FS-3	J1TDP8	2/25/2014	1080	NJ	1.55	0.608		0.103	177		7.21	72.2	D	0.515	54.6	D	2.06
FS-4	J1TDP9	2/25/2014	795	NJ	1.47	0.608		0.098	172		6.86	66.0	D	0.490	77.7	D	1.96
Equipment Blank	J1TDR1	2/25/2014	130	NJ	1.36	0.0905	U	0.0905	6.33	U	6.33	0.191	B	0.0905	1.85	CUJ	0.362

LOCATION	HEIS Number	Sample Date	TPH - diesel range			TPH - motor oil (high boiling)		
			ug/kg	Q	PQL	ug/kg	Q	PQL
FS-1	J1TDP6	2/25/2014	2300	TU	2300	8860	T	2300
Duplicate of J1TDP6	J1TDR0	2/25/2014	2310	TU	2310	5760	TJ	2310
FS-2	J1TDP7	2/25/2014	2310	TU	2310	9650	T	2310
FS-3	J1TDP8	2/25/2014	2310	TU	2310	11000	T	2310
FS-4	J1TDP9	2/25/2014	2310	TU	2310	31200	T	2310

Attachment	1	Sheet No.	2 of 3
Originator	I. B. Berezovskiy	Date	5/13/2014
Checked	J. D. Skoglie	Date	5/13/2014
Calc. No.	0600X-CA-V0177	Rev. No.	0

Attachment 1. 600-378 Waste Site Verification Sample Results (Organics)

CONSTITUENT	CLASS	J1TDP6, FS-1			J1TDR0, Duplicate of J1TDP6			J1TDP7, FS-2			J1TL54, FS-3 Re-sample			J1TDP9, FS-4			J1TDP8, FS-3		
		2/25/2014			2/25/2014			2/25/2014			4/30/2014			2/25/2014			2/25/2014		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	5.30	U	5.30	5.32	U	5.32	5.32	U	5.32	5.29	U	17.6	5.31	U	5.31	5.33	U	5.33
Acenaphthylene	PAH	5.30	U	5.30	5.32	U	5.32	5.32	U	5.32	5.29	U	17.6	5.31	U	5.31	5.33	U	5.33
Anthracene	PAH	15.7	J	1.77	21.7		1.77	19.3		1.77	6.52	J	17.6	7.50	J	1.77	37.8		1.78
Benzo(a)anthracene	PAH	80.5		0.565	114		0.568	104		0.567	38.8		1.76	54.0		0.566	173		0.569
Benzo(a)pyrene	PAH	64.3		0.565	89.2		0.568	78.0		0.567	29.1		1.76	45.3		0.566	168		0.569
Benzo(b)fluoranthene	PAH	65.9		0.565	101		0.568	81.1		0.567	33.5		1.76	52.4		0.566	175		0.569
Benzo(ghi)perylene	PAH	39.4		0.565	53.2		0.568	43.9		0.567	17.5		1.76	29.0		0.566	106		0.569
Benzo(k)fluoranthene	PAH	39.3		0.283	50.3		0.284	49.2		0.284	19.5		0.881	27.0		0.283	89.9		0.284
Chrysene	PAH	67.6		0.565	95.1		0.568	83.8		0.567	32.5		1.76	47.8		0.566	154		0.569
Dibenz[a,h]anthracene	PAH	1.78		0.565	2.51		0.568	2.01		0.567	0.564	U	1.76	1.21	J	0.566	4.90		0.569
Fluoranthene	PAH	124		0.565	179		0.568	161		0.567	65.4		1.76	83.4		0.566	261		0.569
Fluorene	PAH	5.30	U	5.30	5.32	U	5.32	5.32	U	5.32	5.29	U	17.6	5.31	U	5.31	5.33	U	5.33
Indeno(1,2,3-cd)pyrene	PAH	0.565	U	0.565	0.568	U	0.568	0.567	U	0.567	0.564	U	1.76	0.566	U	0.566	0.569	U	0.569
Naphthalene	PAH	5.30	U	5.30	5.32	U	5.32	5.32	U	5.32	5.29	U	17.6	5.31	U	5.31	5.33	U	5.33
Phenanthrene	PAH	75.3		5.30	107		5.32	80.2		5.32	42.0		17.6	39.9		5.31	178		5.33
Pyrene	PAH	129		0.565	184		0.568	163		0.567	65.1		1.76	86.2		0.566	255		0.569

Attachment	1	Sheet No.	3 of 3
Originator	I. B. Berezovskiy	Date	05/13/14
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APPENDIX D

DATA QUALITY ASSESSMENT

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DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2014c). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2009).

A review of the sample design (WCH 2014c), the field logbooks (WCH 2014a, 2014b), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. To ensure quality data, the 100 Area SAP data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Verification sample data collected at the 600-378 waste site were provided by the laboratories in one sample delivery group (SDG): SDG XP0053. SDG XP0053 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 600-378 data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

SDG XP0053

This SDG comprises four focused soil samples (J1TDP6 through J1TDP9) collected from the 600-378 waste site excavation. This SDG includes one field duplicate pair (J1TDP6/J1TDR0). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, polycyclic aromatic hydrocarbons (PAH), and total petroleum hydrocarbons (TPH). In addition, a field equipment blank sample (J1TDR1) was collected and analyzed for ICP metals and mercury. SDG XP0053 was submitted for third-party validation. Minor deficiencies are as follows.

In the ICP analysis, zinc was detected in the method blank (MB) at very low levels, less than $1/25^{th}$ of the detected field sample result. Third-party validation qualified zinc result in sample J1TDR1 as undetected, with "UJ" flags. The data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries are out of project acceptance criteria for two analytes (barium [0%] and silicon [26.4%]). Post-spike (PS) was performed for both analytes. Barium (61.2%) and silicon (143%) analyte PS recovery was outside the project acceptance criteria. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Barium and silicon did not have mismatched spike and native concentrations in the MS. Third-party validation qualified all barium and silicon results for SDG XP0053 as estimates, with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate relative percent difference (RPD) for barium is above the acceptance criteria of 30%, at 55.7%. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. All barium results for SDG XP0053 were qualified as estimates by third-party validation, with "J" flags. Estimated data are usable for decision-making purposes.

SDG XP0085

This SDG comprises one focused soil resample (J1TL54) collected from the 600-378 waste site sample location FS-3. This sample was analyzed for PAH. Minor deficiencies are as follows.

In the PAH analysis, the MS and matrix spike duplicate (MSD) pair RPD is above the acceptance criteria of 30% for benzo(a)anthracene (57.5%), benzo(a)pyrene (45.7%), benzo(b)fluoranthene (51.5%), benzo(k)fluoranthene (60.6%), chrysene (49.5%), fluoranthene (75.6%), and pyrene (71.9%). Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. Data are usable for decision-making purposes.

In the PAH analysis, the MSD recovery is above the quality control (QC) limit for benzo(a)anthracene (177%), benzo(a)pyrene (137%), benzo(b)fluoranthene (160%), benzo(k)fluoranthene (211%), chrysene (157%), fluoranthene (253%), and pyrene (253%). These recoveries also suggest that there are natural heterogeneities present in the sample matrix. The laboratory control sample recoveries and the MS recoveries are within the project control limits; therefore, there is no significant impact to the field sample data. Data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

Relative percent difference evaluations of main sample(s) versus the laboratory duplicate(s) are routinely performed and reported by the laboratory. Any deficiencies in those calculations are reported by SDG in the previous sections.

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2014a, 2014b), include 600-378 primary and duplicate sample pair (J1TDP6/J1TDR0). The main and QA/QC sample results are presented in Appendix C.

Field duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the sample/duplicate pair(s) for each contaminant of potential concern. Relative percent differences are not calculated for analytes that are not detected in both the main and duplicate sample at more than five times the target detection limit (TDL). Relative percent differences of analytes detected at low concentrations (less than five times the detection limit) are not considered to be indicative of the analytical system performance. The calculation brief in Appendix C provides details on duplicate pair evaluation and RPD calculation.

The calculated barium (45.6%), calcium (121.7%), benzo(a)anthracene (34.4%), phenanthrene (34.8%), and pyrene (35.1%) RPDs for the duplicate analysis are above the acceptance criteria of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. There is no indication that the analytical system was operating out of control. The data are usable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the TDL, including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. The benzo(b)fluoranthene data required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are usable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues, such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 600-378 waste site verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 600-378 waste site concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes. The verification sample analytical data are stored in the Washington Closure Hanford project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix C.

REFERENCES

BHI, 2000, *Data Validation Procedure for Chemical Analysis*, BHI-01435, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 2009, *100 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

WCH, 2014a, *100-K and IU-2/6 Miscellaneous Restoration and Failed Remaining Sites Sampling*, Logbook EL-1666-01, pp. 88-90, Washington Closure Hanford, Richland, Washington.

WCH, 2014b, *100-K and IU-2/6 Miscellaneous Restoration and Failed Remaining Sites Sampling*, Logbook EL-1667-01, pp. 74-77, Washington Closure Hanford, Richland, Washington.

WCH, 2014c, *Work Instruction for Verification Sampling of the 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank Waste Site,* 0600X-WI-G0083, Rev. 0, Washington Closure Hanford, Richland, Washington.