WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2014-115

Waste Site Code(s)/Subsite Code(s): 100-H-51:1

Reclassification Category: Interim ☒ Final ☐

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

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-H-51, Potentially Contaminated Pipeline Segments waste site, part of the 100-HR-1 Operable Unit, 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* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999), as a candidate site for confirmatory sampling via 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). Subsequently, the 100-H-51 waste site was divided into six subsites and the 100-H-51:1, 1703-H Sanitary Sewer Segment subsite was recommended for remedial action.

The 100-H-51:1 subsite consisted of a 15.2-cm (6-in.) vitrified clay sanitary sewer pipeline that ran from the 1703-H Building and tied into the 100-H-28 pipeline. The 1703-H Building was constructed in 1949 and contained offices for area administrative and technical personnel. The pipeline exited the west side of the 1703-H Building, turned north, and terminated at a manhole where it joined the 100-H-28:5 sanitary sewer pipeline.

Remedial action at the 100-H-51:1 subsite was performed on May 7, 2014. The remediation depth extended to approximately 1.5 m (5 ft) below ground surface resulting in approximately 200 bank cubic meters (262 bank cubic yards) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). The debris consisted of the vitrified clay pipe and concrete. Approximately 105 linear meters (345 linear feet) of pipeline was removed. The waste material was staged prior to loadout and will be addressed in the 100-H-28:2/100-H-42 closure document. No stained soil or anomalous materials were encountered during the remediation.

Verification sampling was conducted on May 13, August 26, and September 29, 2014. The sampling was performed to determine if the waste site met the remedial action objectives (RAOs) and remedial action goals (RAGs) established by the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP), DOE/RL-97-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009b), and the Remaining Sites ROD (EPA 1999). 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, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification to Interim Closed Out.

Basis for reclassification:

The verification sampling and modeling results for the 100-H-51:1 subsite demonstrate that the site meets the RAOs and corresponding RAGs established in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999) to support a reclassification to Interim Closed Out. These sampling and modeling results established that residual contaminant concentrations 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 results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, 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 100-H-51:1, 1703-H Sanitary Sewer Segment Subsite* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2014-115

Waste Site Code(s)/Subsite Code(s): 100-H-51:1

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		3/16/15
DOE Federal Project Director (printed)	Signature	Date
N. Menard		3/27/15
Ecology Project Manager (printed)	Signature	Date
NA		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-51:1, 1703-H SANITARY SEWER SEGMENT SUBSITE

Attachment to Waste Site Reclassification Form 2014-115

April 2015

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-51:1, 1703-H SANITARY SEWER SEGMENT SUBSITE

EXECUTIVE SUMMARY

The 100-H-51, Potentially Contaminated Pipeline Segments waste site, part of the 100-HR-1 Operable Unit, 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 via the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2009). Subsequently, the 100-H-51 waste site was divided into six subsites. The 100-H-51:1, 1703-H Sanitary Sewer Segment subsite was identified for remediation based on confirmatory sampling results (WCH 2011).

Remedial action at the 100-H-51:1 subsite was performed on May 7, 2014. The remediation depth extended to approximately 1.5 m (5 ft) below ground surface, resulting in approximately 200 bank cubic meters (BCM) (262 bank cubic yards [BCY]) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility. The debris consisted of the vitrified clay pipe and concrete. Approximately 105 linear meters (345 linear feet) of pipeline was removed. The waste material was staged prior to loadout and will be addressed in the 100-H-28:2/100-H-42 closure document. No stained soil or anomalous materials were encountered during the remediation.

One focused verification soil sample was collected on May 13, 2014. Verification sampling continued on August 26, 2014. Arsenic was detected above the direct exposure remedial action goals (RAGs); therefore, additional remediation was conducted on September 24, 2014. An additional 280 BCM (366 BCY) of soil was removed from the excavation and disposed at the Environmental Restoration Disposal Facility. Replacement sampling was conducted on September 29, 2014, per the *100-H-43 and 100-H-51:1 Additional Remediation and Resampling Agreements* (WCH 2014b).

The verification sampling results indicate that the waste removal action achieved compliance with the remedial action objectives and RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999).

A summary of the cleanup evaluation for the soil sampling results against the applicable RAGs is presented in Table ES-1. The results of the verification sampling were used to make reclassification decisions for the 100-H-51:1 subsite 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 100-H-51:1 Subsite. (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 100-H-51:1 subsite.	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 for the 100-H-51:1 subsite (2.5×10^{-3}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for individual carcinogens is $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The cumulative excess cancer risk (1.0×10^{-6}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 100-H-51:1 subsite.	NA
	Attain National Primary Drinking Water Regulations [a]: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ.		
	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 30 µg/L (21.2 pCi/L) [c].		

Table ES-1. Summary of Remedial Action Goals for the 100-H-51:1 Subsite. (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, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene exceeded soil RAGs for groundwater and/or river protection. However, based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), it is predicted that the residual concentrations of these contaminants 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 100 Area RDR/RAWP (DOE-RL 2009b), residual concentrations of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene are not predicted to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the lowest K_d of these contaminants [lead with a K_d of 30 mL/g]). The vadose zone underlying the soil beneath the excavation is approximately 12 m (39.4 ft) thick; therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and consequently are protective of the Columbia River.

COPC = contaminant of potential concern
DOE = U.S. Department of Energy
K_d = soil-partitioning coefficient
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 and modeling support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding RAGs established in the 100 Area RDR/RAWP (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 sampling and modeling results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft] deep), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil 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 100-H-51:1 subsite contaminants of potential concern and other constituents (Appendix A). Ecological screening

levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for arsenic, boron, lead, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, lead, manganese, and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the concentrations of antimony, manganese, and vanadium are below the Hanford Site or Washington State background values, 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 risk to ecological receptors as part of the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-51:1, 1703-H SANITARY SEWER SEGMENT SUBSITE

STATEMENT OF PROTECTIVENESS

The 100-H-51:1 subsite cleanup verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (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* (Remaining Sites ROD) (EPA 1999).

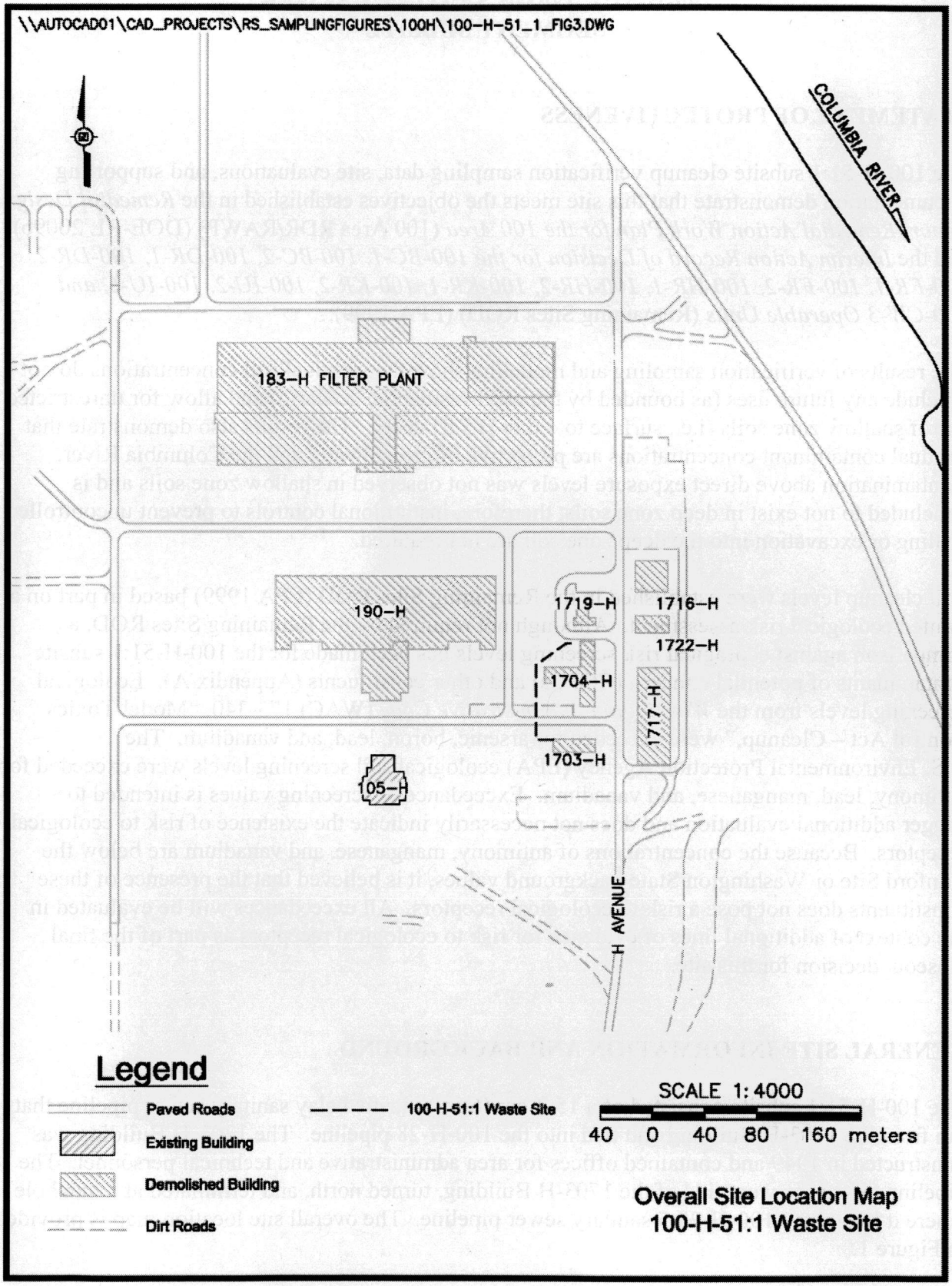
The results of verification sampling and modeling show that residual soil concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil 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 100-H-51:1 subsite contaminants of potential concern (COPCs) and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for arsenic, boron, lead, and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for antimony, lead, manganese, and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the concentrations of antimony, manganese, and vanadium are below the Hanford Site or Washington State background values, 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 risk to ecological receptors as part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-H-51:1 subsite consisted of a 15.2-cm (6-in.) vitrified clay sanitary sewer pipeline that ran from the 1703-H Building and tied into the 100-H-28 pipeline. The 1703-H Building was constructed in 1949 and contained offices for area administrative and technical personnel. The pipeline exited the west side of the 1703-H Building, turned north, and terminated at a manhole where it joined the 100-H-28:5 sanitary sewer pipeline. The overall site location map is provided in Figure 1.

Figure 1. 100-H-51:1 Overall Site Location Map.



CONFIRMATORY SAMPLING ACTIVITIES

The 100-H-51:1 subsite is one of four subsites associated with the 100-H-51, Potentially Contaminated Pipeline Segments waste site. The 100-H-51:1 subsite consisted of a segment of sanitary sewer that connected the 1703-H Building with the 100-H-28:5 subsite.

A focused sampling approach was used to evaluate the pipeline contents and underlying soil. Confirmatory sampling was performed at the 100-H-51:1 subsite on November 30, 2009, per the *Work Instruction for Confirmatory Sampling of the 100-H-51:1, 1703-H Sanitary Sewer Segment* (WCH 2009b) as described in the field logbook (WCH 2009a).

Test pit 1 was excavated at Washington State plane (WSP) coordinates N 152560, E 577899. The pipeline was uncovered at approximately 0.6 m (2 ft) below ground surface (bgs) (WCH 2009a). The inside of the pipeline was clear of debris, scale, and sediment; therefore, no sample of pipe content was collected. A soil sample was collected from below the pipeline at approximately 0.9 m (3 ft) bgs. Additionally, a sample of the pipe sealant was collected (WCH 2011).

Test pit 2 was excavated at WSP coordinates N 152619, E 577899. No pipeline was found at this location; therefore, no samples were collected. A third test pit location was identified as an alternative to the test pit 2 location. Test pit 3 was excavated at WSP coordinates N 152625, E 577908 and measured 4 m^2 (12 ft^2) and 2 m (6 ft) deep. No pipeline was observed; therefore, no sample was collected (WCH 2011).

A summary of the confirmatory samples collected is provided in Table 1. Figure 2 shows the test pit locations.

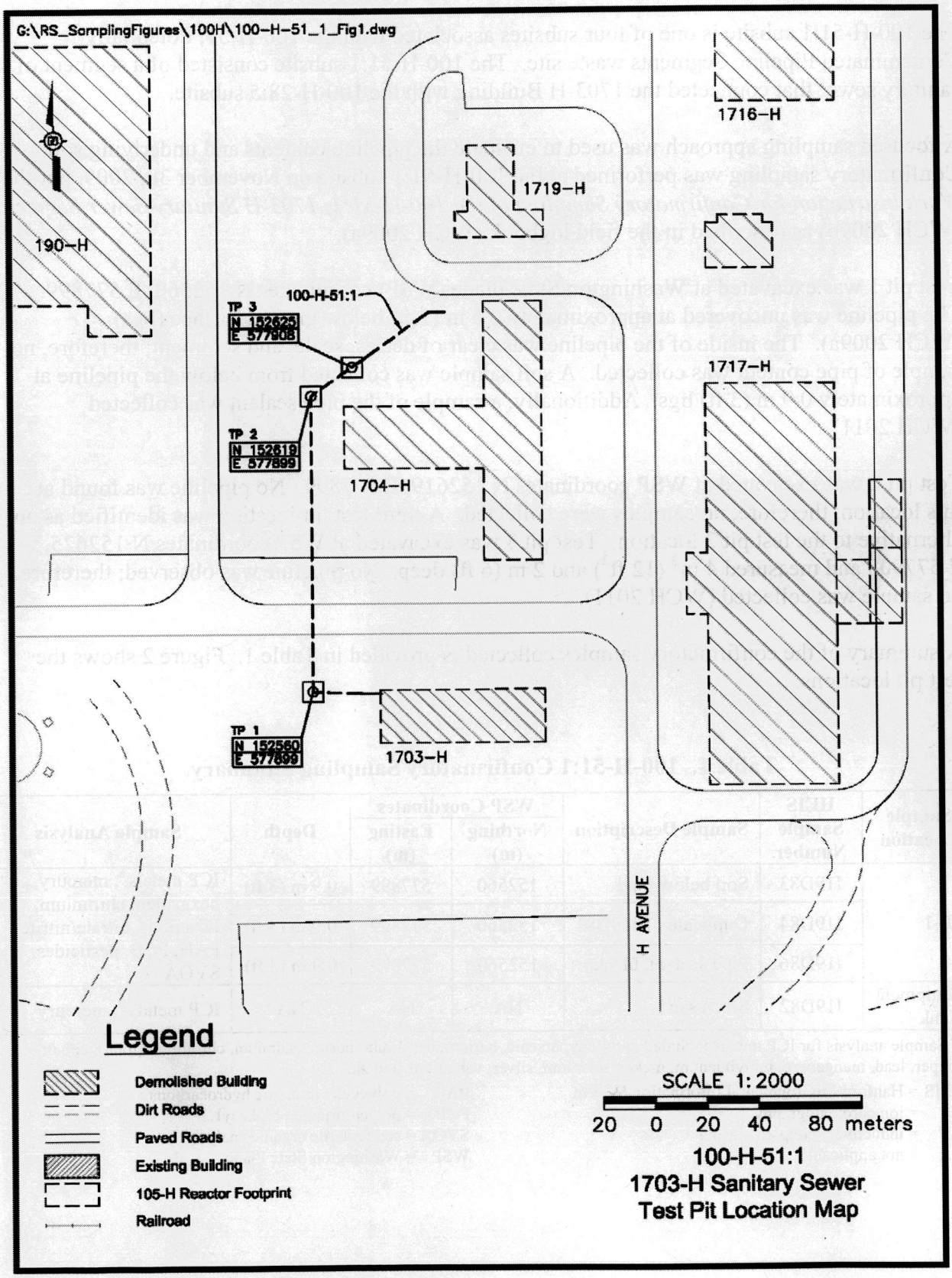
Table 1. 100-H-51:1 Confirmatory Sampling Summary.

Sample Location	HEIS Sample Number	Sample Description	WSP Coordinates		Depth	Sample Analysis
			Northing (m)	Easting (m)		
TP-1	J19D83	Soil below pipe	152560	577899	0.9 m (3 ft)	ICP metals [a], mercury, hexavalent chromium, IC anions, nitrate/nitrite, PAH, PCB, pesticides, SVOA
	J19D84	Duplicate of J19D83	152560	577899	0.9 m (3 ft)	
	J19D86	Pipe sealant, black	152560	577899	0.9 m (3 ft)	
Equipment blank	J19D82	Silica sand	NA	NA	NA	ICP metals [a], mercury

[a] Sample analysis for ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc

HEIS = Hanford Environmental Information System
IC = ion chromatography
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
WSP = Washington State Plane

Figure 2. 100-H-51:1 Waste Site Confirmatory Sampling Locations.



Contaminants of Potential Concern for Confirmatory Sampling

The COPCs for confirmatory sampling at the 100-H-51:1 subsite were developed using process knowledge and historical information (WCH 2009b). The COPCs included inductively coupled plasma metals, pesticides, and semivolatile organic compounds. Ion chromatography (IC) anions, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), and hexavalent chromium were included as COPCs for the associated 100-H-28 waste site; therefore, they were included as COPCs for confirmatory sampling at the 100-H-51:1. Radiological activity, volatile organic compounds (VOCs), stained soil, evidence of burning, and suspect asbestos were not detected or observed during the confirmatory sampling; therefore, radionuclides, VOCs, total petroleum hydrocarbons (TPH), and asbestos were not added as COPCs.

Confirmatory Sample Results

An evaluation of the sample results shows that the pipe sealant on the 100-H-51:1 pipeline subsite failed the direct exposure remedial action goal (RAG) for benzo(a)anthracene. Therefore, the 100-H-51:1 subsite was recommended for remediation (WCH 2011). The confirmatory sample results are provided in Appendix B.

REMEDIAL ACTION SUMMARY

Remedial action at the 100-H-51:1 pipeline subsite was performed on May 7, 2014. The remediation extended to approximately 1.5 m (5 ft) below ground surface, resulting in approximately 200 bank cubic meters (BCM) (262 bank cubic yards [BCY]) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility. The debris consisted of the vitrified clay pipe and concrete. Approximately 105 linear meters (345 linear feet) of pipeline was removed. Portions of the 100-H-51:1 pipeline were removed during the 100-H-28:3 and 100-H-28:5 pipeline remediation. An additional 280 BCM (366 BCY) of soil was removed from the excavation on September 24, 2014.

The waste material was staged in a waste staging pile area (SPA) prior to loadout to the Environmental Restoration Disposal Facility . The SPA was used for multiple waste sites and will be addressed in the 100-H-28:2/100-H-42 closure document. No overburden material was staged for use as backfill. No stained soil or anomalous materials were encountered during the remediation.

A post-remediation walkaround boundary survey was conducted following remedial action activities. Segments of the 100-H-51:1 overlap the 100-H-28:3 and 100-H-28:5 pipeline remediation and the removal of those segments are shown in the 100-H-28:3 and 100-H-28:5 post-excavation civil survey. The surveys were combined and are shown in Figure 3. A small section of the 100-H-51:1 pipeline was removed during the installation of the ramp into the 100-H-28:3 and 100-H-28:5 deep excavation. This portion of the pipeline is depicted on Figure 3. All segments of the 100-H-51:1 pipeline have been removed. Photographs of the remediated waste site are provided in Figures 4 and 5.

Figure 3. 100-H-51:1 Post-Remediation Boundary Survey.

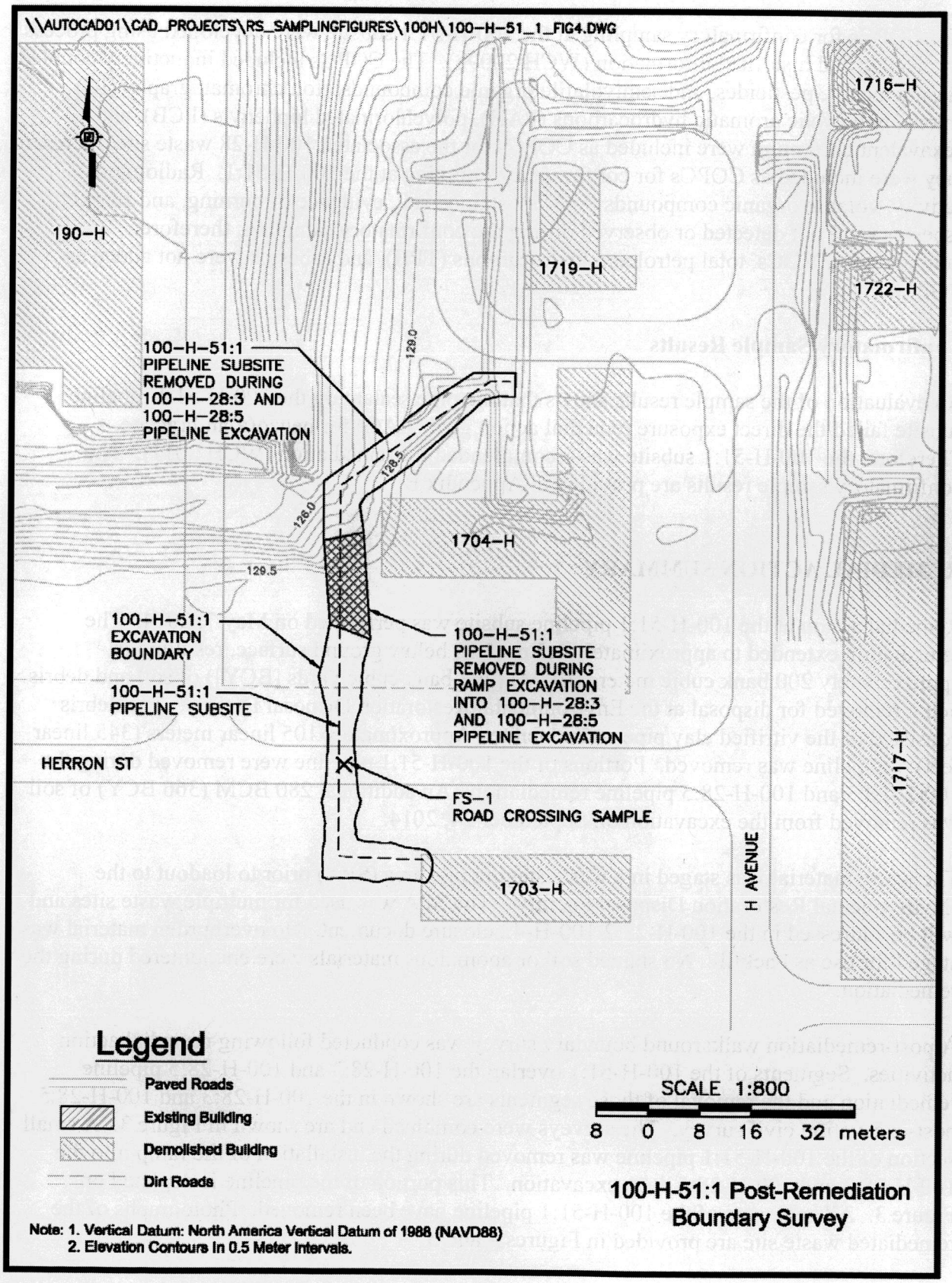


Figure 4. Photograph of the 100-H-51:1 Excavation Looking East.

Figure 5. Photograph of the 100-H-51:1 Excavation Looking North.

An aerial photograph of the 100-H Area is shown in Figure 6. The photograph is annotated and cropped to show the former location of the pipeline. No in-process soil samples were collected from the 100-H-51:1 subsite.

Figure 6. Aerial Photograph of the 100-H Area Identifying the 100-H-51:1 Excavation, Cropped, Dated May 2014.

VERIFICATION SAMPLING ACTIVITIES

One focused verification soil sample was collected on May 13, 2014. Verification sampling continued on August 26, 2014, per the *Work Instruction for Verification Sampling of the 100-H-51:1, 1703-H Sanitary Sewer Segment* (WCH 2014c). Sampling was conducted to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). Because arsenic was detected above the direct exposure RAG at two locations (EXC-3 and EXC-9), additional remediation was conducted at these two locations and replacement samples were collected and analyzed for metals only. The replacement sampling was conducted on September 29, 2014, per the *100-H-43 and 100-H-51:1 Additional Remediation and Resampling Agreements* (WCH 2014b).

The verification sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives and RAGs for the 100-H-51:1 subsite. The following subsections provide additional discussion of the information used to develop the verification sampling design. The statistical results of verification sampling are also summarized to support interim closure of the site.

Contaminants of Potential Concern

The COPCs for verification sampling at the 100-H-51:1 subsite were determined based on the confirmatory sampling results (Appendix B). Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, endrin ketone, copper, lead, and nickel were detected above a RAG in the confirmatory samples; therefore, they were retained as site COPCs. While not considered site COPCs, analysis for mercury and the expanded list of inductively coupled plasma metals (which also includes antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, manganese, molybdenum, selenium, silver, vanadium, and zinc) was requested. Although hexavalent chromium was detected below the RAG, it was retained as a COPC for site evaluation.

No radiological activity was detected during confirmatory sampling; therefore, radionuclides were not included as COPCs. Field screening did not detect VOCs, and oily soil or evidence of burning was not observed during field activities; therefore, VOC analysis and TPH were not requested and are not considered site COPCs. Suspect asbestos-containing material was not identified during field activities; therefore, asbestos analysis was not requested and asbestos is not a site COPC.

Chloride and sulfate were detected in the confirmatory samples well below the background values; therefore, they were not considered site COPCs. The reported result for nitrogen in nitrate and nitrite is assumed to exist entirely as nitrate based on the environmental fate of nitrite. Because the reported result is less than background for nitrate, it was not considered a COPC.

One focused sample was collected prior to determining the site COPCs. In addition to the COPCs identified for the 100-H-51:1 subsite, the focused sample was conservatively analyzed for IC anions, nitrate/nitrite, PCBs, and semivolatile organic compounds.

The analytical methods that were performed to evaluate the site COPCs and other constituents are provided in Table 2.

Verification Sample Design

One decision unit was identified for the 100-H-51:1 subsite and consists of the excavation only. A combination statistical and focused sampling design was used to evaluate the waste site excavation. Twelve statistical verification soil samples plus one duplicate were collected. Additionally, one focused sample was collected from the location where the pipeline crossed under an established roadway. The sample was collected from the approximate center of the roadway. All samples were grab samples. One equipment blank sample was also 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* (DOE-RL 2009a). Additional information related to verification sampling can be found in the field sampling logbook (WCH 2014a). The verification sample summary is provided in Table 3, and the sample locations are shown in Figure 7.

Table 2. Laboratory Analytical Methods for the 100-H-51:1 Subsite.

Analytical Method	Contaminants of Potential Concern
ICP metals [a] – EPA Method 6010	Copper, lead, nickel
Mercury – EPA Method 7471	Mercury
Hexavalent chromium – EPA Method 7196	Hexavalent chromium
IC anions [b] – EPA Method 300.0	Anions
PAH – EPA Method 8310	Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene,
PCB [b] – EPA Method 8082	Polychlorinated biphenyls
Pesticides – EPA Method 8081	Endrin ketone
SVOA [b, c] – EPA Method 8270	Semivolatile organic compounds

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

[b] Analysis was requested for the road crossing focused verification sample only. It is not a site COPC and was not requested for the remaining verification samples.

[c] Because Method 8310 is specifically meant to analyze for PAH, data from this method was used preferentially over the Method 8270 data for evaluation of PAH analyses for the road crossing focused verification sample.

COPC= contaminant of potential concern
EPA = U.S. Environmental Protection Agency
IC = ion chromatography
ICP = inductively coupled plasma
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyls
SVOA = semivolatile organic analysis

Table 3. 100-H-51:1 Subsite Verification Sample Summary Table.

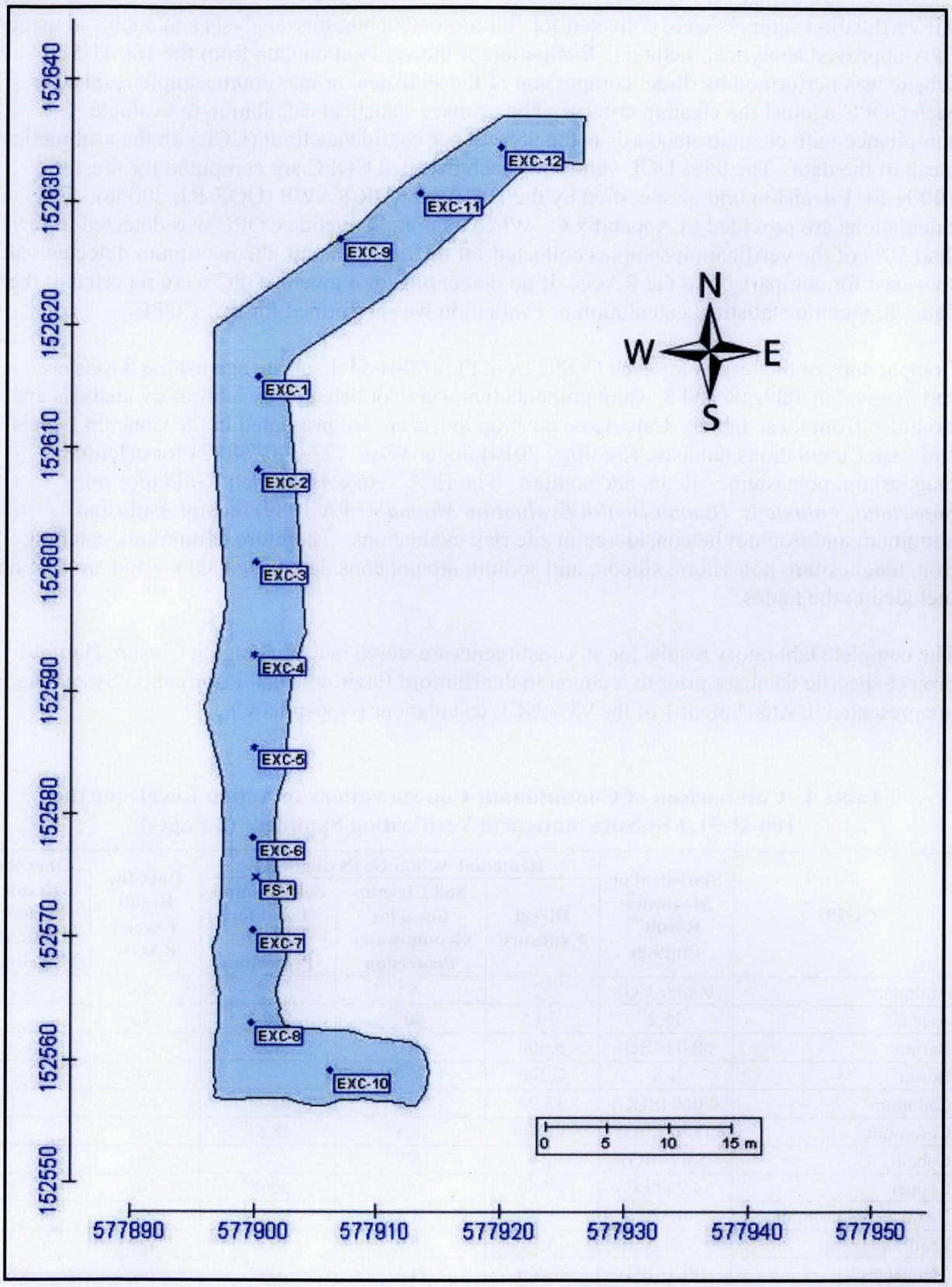
Sample Location	HEIS Sample Number	WSP Northing (m)	WSP Easting (m)	Sample Analysis
EXC-1	J1TXN3	152615.7	577900.3	ICP metals [a], mercury, hexavalent chromium, PAH, pesticides
EXC-2	J1TXN4	152608.2	577900.2	
EXC-3	J1TXN5/J1V0F3 [b]	152600.7	577900.1	
EXC-4	J1TXN6	152593.1	577900.1	
EXC-5	J1TXN7	152585.6	577899.3	
EXC-6	J1TXN8	152571.4	577899.5	
EXC-7	J1TXN9	152570.5	577899.8	
EXC-8	J1TXP0	152562.9	577899.7	
EXC-9	J1TXP1/J1V0F4 [b]	152627.0	577906.9	
EXC-10	J1TXP2	152559.1	577906.2	
EXC-11	J1TXP3	152630.7	577913.5	
EXC-12	J1TXP4	152634.4	577920.1	
Duplicate of EXC-7	J1TXP5	152570.5	577899.8	
FS-1	J1TPJ3	152574.8	577900.1	ICP metals [a], mercury, hexavalent chromium, IC anions, nitrate/nitrite, PAH, pesticides, SVOA
Equipment blank	J1TXP6	NA	NA	ICP metals [a], mercury

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

[b] Replacement samples were collected at EXC-3 (J1V0F3) and EXC-9 (J1V0F4) and analyzed for metals only. Because no other analyses were replaced; sample numbers J1TXN5 and J1TXP1 still apply to EXC-3 and EXC-9, respectively, for the remaining analyses.

HEIS = Hanford Environmental Information System
IC = ion chromatography
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
SVOA = semivolatile organic analysis
WSP = Washington State Plane

Figure 7. 100-H-51:1 Subsite Verification Sample Locations.



Verification Sample Results

All verification samples were collected for full protocol laboratory analysis and analyzed using EPA-approved analytical methods. Evaluation of the verification data from the 100-H-51:1 subsite was performed by direct comparison of the statistical or maximum sample results for each COPC against the cleanup criteria. The primary statistical calculation to evaluate compliance with cleanup standards is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each detected COPC are computed for the 100-H-51:1 decision unit as specified by the 100 Area RDR/RAWP (DOE-RL 2009b). The calculations are provided in Appendix C. When a nonradionuclide COPC was detected in fewer than 50% of the verification samples collected for the decision unit, the maximum detected value was used for comparison to the RAGs. If no detections for a given COPC were reported in the data set, then no statistical calculation or evaluation was performed for that COPC.

Comparisons of the results for each COPC from the 100-H-51:1 subsite against the RAGs are summarized in Tables 4 and 5. Contaminants that were not detected by laboratory analysis are excluded from these tables. 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* (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 the tables.

The complete laboratory results for all constituents are stored in a Washington Closure Hanford project-specific database prior to archival in the Hanford Environmental Information System and are presented in Attachment 1 of the 95% UCL calculations (Appendix C).

Table 4. Comparison of Contaminant Concentrations to Action Levels for the 100-H-51:1 Subsite Statistical Verification Samples. (2 Pages)

COPC	Statistical or Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony [c]	0.85 (<BG)	32	5 [d]	5 [d]	No	--
Arsenic	15.2	20 [d]	20 [d]	20 [d]	No	--
Barium	60.0 (<BG)	5,600	200	400	No	--
Boron [e]	1.8	7,200	320	-- [f]	No	--
Cadmium [c]	0.060 (<BG)	13.9 [g]	0.81 [d]	0.81 [d]	No	--
Chromium	11.9 (<BG)	80,000	18.5 [d]	18.5 [d]	No	--
Cobalt	5.6 (<BG)	24	15.7 [d]	-- [f]	No	--
Copper	14.2 (<BG)	2,960	59.2	22.0 [d]	No	--
Hexavalent chromium [e]	0.280	2.1 [g]	4.8	2	No	--
Lead	81.3	353	10.2 [d]	10.2 [d]	Yes	Yes [h]
Manganese	282 (<BG)	3,760	512 [d]	512 [d]	No	--
Mercury	0.018 (<BG)	24	0.33 [d]	0.33 [d]	No	--

Table 4. Comparison of Contaminant Concentrations to Action Levels for the 100-H-51:1 Subsite Statistical Verification Samples. (2 Pages)

COPC	Statistical or Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Molybdenum [e]	0.35	400	8	-- [f]	No	--
Nickel	11.9 (<BG)	1,600	19.1 [d]	27.4	No	--
Silver	0.15 (<BG)	400	8	0.73 [d]	No	--
Vanadium	39.8 (<BG)	560	85.1 [d]	-- [f]	No	--
Zinc	38.5 (<BG)	24,000	480	67.8 [d]	No	--
Acenaphthene	0.020	4,800	96	129	No	--
Benzo(a)anthracene	0.12	1.37	0.015 [i]	0.015 [i]	Yes	Yes [h]
Benzo(a)pyrene	0.093	0.137	0.015 [i]	0.015 [i]	Yes	Yes [h]
Benzo(b)fluoranthene	0.092	1.37	0.015 [i]	0.015 [i]	Yes	Yes [h]
Benzo(ghi)perylene [j]	0.063	2,400	48	192	No	--
Benzo(k)fluoranthene	0.014	1.37	0.015 [i]	0.015 [i]	No	--
Chrysene	0.12	13.7	0.12	0.1 [i]	Yes	Yes [h]
Fluoranthene	0.14	3,200	64	18.0	No	--
Fluorene	0.0087	3,200	64	260	No	--
Indeno(1,2,3-cd)pyrene	0.038	1.37	0.033 [i]	0.033 [i]	Yes	Yes [h]
Naphthalene	0.016	1,600	16.0	988	No	--
Phenanthrene [j]	0.035	24,000	240	1,920	No	--
Pyrene	0.14	2,400	48	192	No	--
4-4'-DDE	0.0018	2.94	0.0257	0.0033 [i]	No	--
4-4'-DDT	0.0023	2.94	0.0257	0.0033 [i]	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum or 95% upper confidence limit, depending on data censorship, as described in the *100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).
[c] Hanford Site-specific background value is not available. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[d] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 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 100 Area RDR/RAWP (DOE-RL 2009b).
[e] No Hanford Site-specific or Washington State background value available.
[f] No parameters (bioconcentration factors or ambient water quality criteria values) are available from the Washington State Department of Ecology Cleanup Levels and Risk Calculations database or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).
[g] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], Ecology 1996).
[h] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene are not predicted to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the lowest K_d of the contaminants [lead with a K_d of 30 mL/g]). The vadose zone beneath the 100-H-51:1 subsite is approximately 12 m (39.4 ft) thick. Therefore, the residual concentrations of the contaminants are predicted to be protective of groundwater and the Columbia River.
[i] Where cleanup levels are less than the RDLs, cleanup levels default to the RDLs per WAC 173-340-707(2) (Ecology 1996).
[j] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals: Contaminant: phenanthrene, surrogate is anthracene; benzo(ghi)perylene, surrogate is pyrene.

-- = not applicable
BG = background
COPC = contaminant of potential concern
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyl trichloroethane
K_d = soil-partitioning coefficient
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Table 5. Comparison of Contaminant Concentrations to Action Levels for the 100-H-51:1 Subsite Focused Verification Sample.

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	5.4 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	45.2 (<BG)	5,600	200	400	No	--
Boron [d]	1.0	7,200	320	-- [e]	No	--
Cadmium [f]	0.11 (<BG)	13.9 [g]	0.81 [c]	0.81 [c]	No	--
Chromium	9.0 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	6.5 (<BG)	24	15.7 [c]	-- [e]	No	--
Copper	14.5 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	14.7	353	10.2 [c]	10.2 [c]	Yes	Yes [h]
Manganese	229 (<BG)	3,760	512 [c]	512 [c]	No	--
Nickel	11.2 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	36.4 (<BG)	560	85.1 [c]	-- [e]	No	--
Zinc	33.0 (<BG)	24,000	480	67.8 [c]	No	--
Chloride	8.6 (<BG)	--	25,000	--	No	--
Fluoride	1.2 (<BG)	4,800	96	400	No	--
Nitrogen in nitrate	1.6 (<BG)	128,000	1,000	2,000	No	--
Sulfate	9.5 (<BG)	--	25,000	--	No	--
Benzo(a)pyrene	0.013	0.137	0.015 [i]	0.015 [i]	No	--
Benzo(b)fluoranthene	0.0059	1.37	0.015 [i]	0.015 [i]	No	--
Chrysene	0.0076	13.7	0.12	0.1 [i]	No	--
Fluoranthene	0.016	3,200	64	18.0	No	--
Phenanthrene [j]	0.015	24,000	240	1,920	No	--
Pyrene	0.019	2,400	48	192	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum value as described in the *100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).
[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 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 100 Area RDR/RAWP (DOE-RL 2009b).
[d] No Hanford Site-specific or Washington State background value available.
[e] No parameters (bioconcentration factors or ambient water quality criteria values) are available from the Washington State Department of Ecology Cleanup Levels and Risk Calculations database 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] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], Ecology 1996).
[h] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentration of lead is not predicted to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the K_d of 30 mL/g]). The vadose zone beneath the 100-H-51:1 subsite is approximately 12 m (39.4 ft) thick. Therefore, the residual concentration of lead is predicted to be protective of groundwater and the Columbia River.
[i] Where cleanup levels are less than the RDLs, cleanup levels default to the RDLs per WAC 173-340-707(2) (Ecology 1996).
[j] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals: Contaminant: phenanthrene, surrogate is anthracene.

-- = not applicable
BG = background
COPC = contaminant of potential concern
K_d = soil-partitioning coefficient
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-H-51:1 subsite 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 100 Area RDR/RAWP (DOE-RL 2009b).

Attainment of Nonradionuclide RAGs

Tables 4 and 5 compare the cleanup verification sample values for the 100-H-51:1 subsite excavation to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River. All COPCs were quantified below direct exposure RAGs. All COPCs were quantified below groundwater and/or river protection soil RAGs with the exception of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene. However, given the lowest soil-partitioning coefficient (K_d) of these contaminants (lead with a K_d of 30), none would be expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). The vadose zone beneath the 100-H-51:1 subsite is approximately 12 m (39.4 ft) thick. Therefore, residual concentrations of all contaminants are predicted to be protective of groundwater and the Columbia River.

Three-Part Test for Nonradionuclides

A RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test, which consists of the following criteria: (1) the cleanup verification 95% UCL value must be less than the cleanup level, (2) no single detection shall exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10% of the data set.

The application of the three-part test for the 100-H-51:1 subsite is included in the *100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations* in Appendix C of this remaining sites verification package, where half or more of the data set was detected. The results of this evaluation indicate that residual COPC concentrations pass the three-part test in comparison against applicable RAGs with the exception of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and 4-4'-dichlorodiphenyl trichloroethane (DDT), which fail one or more parts of the three-part test to be protective of groundwater and the Columbia River. However, based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of these constituents are not predicted to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the lowest K_d of the contaminants [lead with a K_d of 30 mL/g]). The vadose zone beneath the 100-H-51:1 subsite is approximately 12 m (39.4 ft) thick; therefore, the residual concentrations of lead are predicted to be protective of groundwater and the Columbia River.

An additional application of the three-part test is included for the statistical data sets that default to the maximum value because less than half of the data set was detected. The results of this evaluation indicate that residual COPC concentrations pass the three-part test in comparison against applicable RAGs.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Nonradionuclide risk 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 carcinogenic risk of less than 1×10^{-5}. For the 100-H-51:1 subsite, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background. All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detected levels is 2.5×10^{-3}, which is less than 1.0. The individual carcinogenic risk values for the carcinogenic constituents detected above background are less than 1×10^{-6}, and the cumulative carcinogenic risk value is 1.0×10^{-6}, which is less than 1×10^{-5}. The 100-H-51:1 subsite meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the 100 Area RDR/RAWP (DOE-RL 2009b).

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-H-51:1 subsite included a calculation of the hazard quotient and carcinogenic (excess cancer) risk values for groundwater protection for nonradionuclides. The requirements include an individual and cumulative hazard quotient of less than 1.0, an individual excess carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. Risk values were calculated for constituents that were detected at concentrations above Hanford Site or Washington State background values, or for which there is no background value. In addition, the K_d for these contaminants must be less than that necessary to show no migration to groundwater in 1,000 years based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). Based on this model and a vadose zone of approximately 12 m (39.4 ft) in thickness, a K_d of 6.1 mL/g or greater is required to show no predicted migration to groundwater in 1,000 years. All individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-H-51:1 subsite is 6.5×10^{-2}, which is less than 1.0. No carcinogenic constituents met the criteria for groundwater protection evaluation at the 100-H-51:1 subsite; therefore, no calculations of excess carcinogenic risk were performed. Therefore, nonradionuclide risk requirements related to groundwater are met.

DATA QUALITY ASSESSMENT

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

The DQA for the 100-H-51:1 subsite established that the data are of the right type, quality, and quantity to support site closeout 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 Washington Closure Hanford project-specific database for data evaluation prior to archival in Hanford Environmental

Information System and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 100-H-51:1 subsite have been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009b). Verification sampling was performed and the analytical results indicate that the residual concentrations of COPCs at the site meet the remedial action objectives for direct exposure, groundwater protection, and river protection.

In accordance with this evaluation, the verification sampling results support a reclassification of the 100-H-51:1 subsite to Interim Closed Out. Contamination above direct exposure levels was not observed in the shallow zone soils and is concluded to not exist in deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the sites are not required.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-H-51:1 Subsite [a].

Hazardous Substance		2001 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Maximum Result
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
	Background	Metals (mg/kg)							
Antimony	5	5	NA	NA	NA	78	NA	0.27	0.85 (<BG)
Arsenic III	6.5	NA	NA	7	18	NA	43	46	15.2
Arsenic V		10	60	132	NA	NA	NA	NA	
Boron	NA	0.5	NA	NA	NA	NA	NA	NA	1.8
Lead	10.2	50	500	118	120	1,700	11	56	81.3
Manganese	512	1,100 [d]	NA	1,500	220	450	4,300	4,000	282 (<BG)
Vanadium	85.1	2	NA	NA	NA	NA	7.8	280	39.8 (<BG)

NOTE: Shaded cells indicate screening values that are exceeded.

[a] Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. All exceedances must be evaluated in the context of additional lines of evidence for ecological effects following a baseline risk assessment for the river corridor portion of the Hanford Site, which will include a more complete quantitative ecological risk assessment.

[b] Available on the Internet at www.epa.gov/ecotox/ecossl.

[c] Wildlife.

[d] Benchmark replaced by Washington State natural background concentration from Ecology, 1994, *Natural Background Soil Metals Concentrations in Washington State*, Publication 94-115, Washington State Department of Ecology, Olympia, Washington.

BG = background
EPA = U.S. Environmental Protection Agency
NA = not available
WAC= *Washington Administrative Code*

APPENDIX B

CONFIRMATORY SAMPLE DATA

APPENDIX B

CONFIRMATORY SAMPLE DATA

Table B-1. 100-H-51:1 Confirmatory Sampling Results. (4 Pages)

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
Equipment Blank	J19D82	11/20/2009	75.9		4.47	0.536	U	0.54	0.894	U	0.89	1.06		0.45
Test pit 1 soil	J19D83	11/30/2009	5920		4.38	0.526	U	0.53	9.16		0.88	48.3		0.44
Test pit 1 soil	J19D84	11/30/2009	6030		3.44	0.412	U	0.41	8.72		0.69	50.8		0.34
Test pit 1 pipe junction sealant	J19D86	11/30/2009	7500		4.17	0.5	U	0.5	7.21		0.83	61.9		0.42

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
Equipment Blank	J19D82	11/20/2009	0.179	U	0.18	1.79	U	1.79	0.179	U	0.18	14.9	B	89.4
Test pit 1 soil	J19D83	11/30/2009	0.172	B	0.18	2.56		1.75	0.068	B	0.18	5070		87.7
Test pit 1 soil	J19D84	11/30/2009	0.178		0.14	2.61		1.37	0.073	B	0.14	5130		68.7
Test pit 1 pipe junction sealant	J19D86	11/30/2009	0.127	B	0.17	2.76		1.67	0.089	B	0.17	5320		83.3

Sample Location	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment Blank	J19D82	11/20/2009	0.179	U	0.18	1.79	U	1.79	0.894	U	0.89			
Test pit 1 soil	J19D83	11/30/2009	9.73		0.18	5.03		1.75	12.3		0.88	0.15	B	0.2
Test pit 1 soil	J19D84	11/30/2009	9.6		0.14	5.17		1.37	12.4		0.69	0.2	B	0.2
Test pit 1 pipe junction sealant	J19D86	11/30/2009	11.3		0.17	6.44		1.67	25		0.83	0.18	B	0.2

Sample Location	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment Blank	J19D82	11/20/2009	148		17.9	0.271	B	0.45	8.62	B	67	3.7	B	4.47
Test pit 1 soil	J19D83	11/30/2009	15100		17.5	29		0.44	3700		65.7	241		4.38
Test pit 1 soil	J19D84	11/30/2009	15200		13.7	22.5		0.34	3710		51.5	247		3.44
Test pit 1 pipe junction sealant	J19D86	11/30/2009	15000		16.7	18		0.42	4370		62.5	176		4.17

Sample Location	HEIS Number	Sample Date	Mercury			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment Blank	J19D82	11/20/2009	0.027	U	0.03	1.79	U	1.79	3.57	U	3.57	26.8	B	357
Test pit 1 soil	J19D83	11/30/2009	0.029		0.03	0.253	B	1.75	8.81		3.51	1070		351
Test pit 1 soil	J19D84	11/30/2009	0.024	B	0.02	0.248	B	1.37	9.52		2.75	1120		275
Test pit 1 pipe junction sealant	J19D86	11/30/2009	0.131		0.03	1.71		1.67	59.2		3.33	683		333

Sample Location	HEIS Number	Sample Date	Selenium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment Blank	J19D82	11/20/2009	0.268	U	0.27	74.1		1.79	0.179	U	0.18	44.7	U	44.7
Test pit 1 soil	J19D83	11/30/2009	0.263	U	0.26	331		1.75	0.175	U	0.18	141		43.8
Test pit 1 soil	J19D84	11/30/2009	0.206	U	0.21	306		1.37	0.137	U	0.14	151		34.4
Test pit 1 pipe junction sealant	J19D86	11/30/2009	0.682		0.25	499		1.67	0.167	U	0.17	89.3		41.7

Sample Location	HEIS Number	Sample Date	Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment Blank	J19D82	11/20/2009	2.23	U	2.23	8.94	U	8.94
Test pit 1 soil	J19D83	11/30/2009	36.6		2.19	34.3		8.77
Test pit 1 soil	J19D84	11/30/2009	36.7		1.72	35.5		6.87
Test pit 1 pipe junction sealant	J19D86	11/30/2009	66.8		2.08	62.3		8.33

Table B-1. 100-H-51:1 Confirmatory Sampling Results. (4 Pages)

CONSTITUENT	CLASS	J19D83 11/30/2009			J19D84 11/30/2009			J19D86 11/30/2009		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	34	U	34	34	U	34	2890		200
Acenaphthylene	PAH	34	U	34	34	U	34	68	J	200
Anthracene	PAH	3.4	U	3.4	3.4	U	3.4	89		20
Benzo(a)anthracene	PAH	3.4	U	3.4	3.4	U	3.4	1510		20
Benzo(a)pyrene	PAH	3.4	U	3.4	1.19	J	3.4	99		20
Benzo(b)fluoranthene	PAH	3.4	U	3.4	1.19	J	3.4	132		20
Benzo(ghi)perylene	PAH	3.4	U	3.4	1.36	J	3.4	20	U	20
Benzo(k)fluoranthene	PAH	3.4	U	3.4	3.4	U	3.4	33		20
Chrysene	PAH	3.4	U	3.4	3.4	U	3.4	2090		20
Dibenz[a,h]anthracene	PAH	3.4	U	3.4	4.75		3.4	20	U	20
Fluoranthene	PAH	3.4	U	3.4	3.4	U	3.4	1120		20
Fluorene	PAH	116		3.4	2.88	J	3.4	126		20
Indeno(1,2,3-cd)pyrene	PAH	3.4	U	3.4	3.4	U	3.4	20	U	20
Naphthalene	PAH	34	U	34	34	U	34	619		200
Phenanthrene	PAH	3.4	U	3.4	1.36	J	3.4	806		20
Pyrene	PAH	3.4	U	3.4	2.71	J	3.4	1840		20
Aroclor-1016	PCB	13.5	U	13.5	13.5	U	13.5	39.9	U	39.9
Aroclor-1221	PCB	13.5	U	13.5	13.5	U	13.5	39.9	U	39.9
Aroclor-1232	PCB	13.5	U	13.5	13.5	U	13.5	39.9	U	39.9
Aroclor-1242	PCB	13.5	U	13.5	13.5	U	13.5	39.9	U	39.9
Aroclor-1248	PCB	13.5	U	13.5	13.5	U	13.5	39.9	U	39.9
Aroclor-1254	PCB	13.5	U	13.5	13.5	U	13.5	39.9	U	39.9
Aroclor-1260	PCB	13.5	U	13.5	13.5	U	13.5	39.9	U	39.9
Aldrin	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Alpha-BHC	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
alpha-Chlordane	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
beta-1,2,3,4,5,6-Hexachlorocyclohexane	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Delta-BHC	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Dichlorodiphenyldichloroethane	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Dichlorodiphenyldichloroethylene	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Dichlorodiphenyltrichloroethane	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Dieldrin	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Endosulfan I	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Endosulfan II	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Endosulfan sulfate	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Endrin	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Endrin aldehyde	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Endrin ketone	Pesticides	1.35	UD	1.35	1.35	UD	1.35	6	D	4
Gamma-BHC (Lindane)	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
gamma-Chlordane	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Heptachlor	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Heptachlor epoxide	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Methoxychlor	Pesticides	1.35	UD	1.35	1.35	UD	1.35	4	UD	4
Toxaphene	Pesticides	20.3	UD	20.3	20.3	UD	20.3	60	UD	60

Table B-1. 100-H-51:1 Confirmatory Sampling Results. (4 Pages)

CONSTITUENT	CLASS	J19D83 11/30/2009			J19D84 11/30/2009			J19D86 11/30/2009		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
1,2-Dichlorobenzene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
1,3-Dichlorobenzene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
1,4-Dichlorobenzene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2,4,5-Trichlorophenol	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2,4,6-Trichlorophenol	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2,4-Dichlorophenol	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2,4-Dimethylphenol	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2,4-Dinitrophenol	SVOA	3360	U	3360	13400	UD	13400	492000	UD	492000
2,4-Dinitrotoluene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2,6-Dinitrotoluene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2-Chloronaphthalene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2-Chlorophenol	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2-Methylnaphthalene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2-Methylphenol (cresol, o-)	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
2-Nitroaniline	SVOA	3360	U	3360	13400	UD	13400	492000	UD	492000
2-Nitrophenol	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
3+4 Methylphenol (cresol, m+p)	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
3,3'-Dichlorobenzidine	SVOA	1340	U	1340	5370	UD	5370	197000	UD	197000
3-Nitroaniline	SVOA	3360	U	3360	13400	UD	13400	492000	UD	492000
4,6-Dinitro-2-methylphenol	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
4-Bromophenylphenyl ether	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
4-Chloro-3-methylphenol	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
4-Chloroaniline	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
4-Chlorophenylphenyl ether	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
4-Nitroaniline	SVOA	3360	U	3360	13400	UD	13400	492000	UD	492000
4-Nitrophenol	SVOA	3360	U	3360	13400	UD	13400	492000	UD	492000
Acenaphthene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Acenaphthylene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Anthracene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Benzo(a)anthracene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Benzo(a)pyrene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Benzo(b)fluoranthene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Benzo(ghi)perylene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Benzo(k)fluoranthene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Bis(2-chloro-1-methylethyl)ether	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Bis(2-Chloroethoxy)methane	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Bis(2-chloroethyl) ether	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Bis(2-ethylhexyl) phthalate	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Butylbenzylphthalate	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Carbazole	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Chrysene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Di-n-butylphthalate	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Di-n-octylphthalate	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Dibenz[a,h]anthracene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Dibenzofuran	SVOA	671	U	671	2690	UD	2690	98400	UD	98400

Table B-1. 100-H-51:1 Confirmatory Sampling Results. (4 Pages)

CONSTITUENT	CLASS	J19D83 11/30/2009			J19D84 11/30/2009			J19D86 11/30/2009		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Diethyl phthalate	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Dimethyl phthalate	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Fluoranthene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Fluorene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Hexachlorobenzene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Hexachlorobutadiene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Hexachlorocyclopentadiene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Hexachloroethane	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Indeno(1,2,3-cd)pyrene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Isophorone	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
N-Nitroso-di-n-dipropylamine	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
N-Nitrosodiphenylamine	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Naphthalene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Nitrobenzene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Pentachlorophenol	SVOA	3360	U	3360	13400	UD	13400	492000	UD	492000
Phenanthrene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Phenol	SVOA	671	U	671	2690	UD	2690	98400	UD	98400
Pyrene	SVOA	671	U	671	2690	UD	2690	98400	UD	98400

Sample Location	HEIS Number	Sample Date	Bromide			Chloride			Fluoride			Nitrate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test pit 1 soil	J19D83	11/30/2009	2.5	U	2.5	33.5		2.5	2.5	U	2.5	2.5	U	2.5
Test pit 1 soil	J19D84	11/30/2009	2.4	U	2.4	38.6		2.4	2.4	U	2.4	2.4	U	2.4
Test pit 1 pipe junction sealant	J19D86	11/30/2009	2.7	U	2.7	3.2		2.7	2.7	U	2.7	2.7	U	2.7

Sample Location	HEIS Number	Sample Date	Nitrite			Nitrogen in Nitrite and			Phosphate			Sulfate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test pit 1 soil	J19D83	11/30/2009	2.5	U	2.5	0.19	U	0.19	2.5	U	2.5	4.2		2.5
Test pit 1 soil	J19D84	11/30/2009	2.4	U	2.4	0.19	U	0.19	2.4	U	2.4	5.3		2.4
Test pit 1 pipe junction sealant	J19D86	11/30/2009	2.7	U	2.7	0.1	B	0.2	2.7	U	2.7	1.5	B	2.7

APPENDIX C

CALCULATIONS

APPENDIX C

CALCULATION BRIEFS

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

100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations, 0100H-CA-V0217, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-H-51:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0100H-CA-V0218, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-H-51:1 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater, 0100H-CA-V0219, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculations that are 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 in the administrative record.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-H Area Closure Operations **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100~~D~~H-CA-V0217 RJN 2/25/15

Subject: 100-H-51:1 Subsite Cleanup Verification 95% UCL 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 Sheets = 14 Attm. 1 = 9 Total = 24	R. J. Nielson	I. B. Berezovskiy	J. D. Skoglie	S. G. Wilkinson	2/23/15

SUMMARY OF REVISION

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

Washington Closure Hanford **CALCULATION SHEET**

Originator R. J. Nielson	**Date** 11/17/14	**Calc. No.** 0100H-CA-V0217		**Rev. No.** 0	
Project 100-H Area Closure Operations	**Job No.** 14655	**Checked** I. B. Berezovskiy		**Date** 11/17/14	
Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations				**Sheet No.** 1 of 14	

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) values to evaluate compliance with cleanup standards for the subject site. Also, perform the *Washington Administrative Code* (WAC) 173-340-740(7)(e) Model Toxics Control Act (MTCA) 3-part test for nonradionuclide analytes and calculate the relative percent difference (RPD) for primary-duplicate sample pairs for each contaminant of concern (COC) and contaminant of potential concern (COPC), as necessary.

Table of Contents:
Sheets 1 to 5 - Calculation Sheet Summary
Sheets 6 to 10 - Calculation Sheet Verification Data Results - Excavation Area
Sheets 11 to 13 - Ecology Software (MTCAStat) Results
Sheets 14 - Calculation Sheet Duplicate Analysis - Excavation Area
Attachment 1 - 100-H-51:1 Subsite Verification Sampling Results (9 pages)

Given/References:
1) Sample Results (Attachment 1).
2) DOE-RL, 2009a, *100 Area Remedial Action Sampling and Analysis Plan* (SAP), DOE/RL-96-22, Rev.5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
3) DOE-RL, 2009b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
5) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets),* Publication #92-54, Washington Department of Ecology, Olympia, Washington.
6) Ecology, 2011, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
7) 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.
8) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," *Washington Administrative Code.*

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2009b). Use data from attached worksheets to perform the 95% UCL calculation for each analyte, the WAC 173-340-740(7)(e) 3-part test for nonradionuclides, and the RPD calculations for each COC/COPC. The hazard quotient and carcinogenic risk calculations are located in a separate calculation brief as an appendix to the Remaining Sites Verification Package (RSVP).

Calculation Description:
The subject calculations were performed on statistical data from soil verification samples (Attachment 1) from the 100-H-51:1 subsite. The data were entered into an EXCEL 2010 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2009b) is documented by this calculation. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

Methodology:
The 100-H-51:1 subsite underwent statistical verification sampling at the excavation area decision unit. One focused sample was also collected. Two sample locations (EXC-3 and EXC-9) failed for arsenic. Additional remediation and resampling for metals only (excluding mercury) was conducted at those locations. The replacement metals data was used in the statistical evaluation. All data are provided in the attachment for information. Data not used are grayed out in the attachment.

Analytical results for all sampling locations are summarized in the tables provided on sheets 4 and 5 . Further information of the sample data quality is presented in the data quality assessment section of the associated RSVP.

Washington Closure Hanford **CALCULATION SHEET**

Originator R. J. Nielson	**Date** 11/17/14	**Calc. No.** 0100H-CA-V0217		**Rev. No.** 0	
Project 100-H Area Closure Operations	**Job No.** 14655	**Checked** I. B. Berezovskiy		**Date** 11/17/14	
Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations				**Sheet No.** 2 of 14	

Summary (continued)

Methodology, continued:

For nonradioactive analytes with ≤50% of the data below detection limits, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, as determined by direct inspection of the sample results (Attachment 1), the maximum detected value for the data set is used instead of the 95% UCL, and no further calculations are performed for those data sets. For convenience, these maximum detected values are included in the summary tables that follow. The 95% UCL was not calculated for data sets with no reported detections. Calculated cleanup levels are not available in Ecology (2011) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance* for Superfund (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 COCs/COPCs and are also not included in these calculations.

All nonradionuclide data reported as being undetected are set to ½ the detection limit value for calculation of the statistics (Ecology 1993). For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above. For radionuclide data, calculation of the statistics is done using the reported value. In cases where the laboratory does not report a value below the minimum detectable activity (MDA), half of the MDA is used in the calculation. For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets (n<10), the calculations are performed assuming nonparametric distribution, so no tests for distribution are performed. For nonradionuclide data sets of ten or greater, as for the subject site, distributional testing is done using Ecology's MTCAStat software (Ecology 1993). Due to differences in addressing censored data between the RDR/RAWP (DOE-RL 2009b) and MTCAStat coding and due to a limitation in the MTCAStat coding (no direct capability to address variable quantitation limits within a data set), substitutions for censored data are performed before software input and the resulting data set treated as uncensored.

The WAC 173-340-740(7)(e) 3-part test is performed for nonradionuclide analytes only and determines if:
1) the 95% UCL exceeds the most stringent cleanup limit for each COPC/COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each COPC/COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each COPC/COC.

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 TDLs are pre-determined values for analytical methods and constituents with cleanup levels as listed in Table 2-1 of the SAP (DOE-RL 2009a). Table 2-1 includes nominal TDLs for identified methods based organic analyses. The nominal TDLs are also used in support of the RPD calculation for the methods based analytes. TDLs not included in Table 2-1 are based on the laboratory and/or methods 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:

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

where, M = Main Sample Value S = Split (or duplicate) Sample Value

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than 30% indicates the data compare favorably. If the RPD is greater than 30%, further investigation regarding the usability of the data is performed. To assist in the identification of anomalous sample pairs, 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. Additional discussion as necessary is provided in the data quality assessment section of the applicable RSVP.

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Summary (continued)

QUALIFIER LIST

B = estimated result. Result is less than the RL, but greater than the MDL
C = the analyte was detected in both the sample and the associated QC blank, and the sample concentrations was </= 5X the blank concentration
J = Result is les than the RL but greater than or equal to the MDL and the concentration is an approximate value (organics)
M = sample duplicate precision not met
Q = qualifier
U = undetected
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals)
X = More than 40% difference between columns, lower result reported (organics)

ACRONYM LIST

-- = not applicable
DE = direct exposure
EXC = excavation
FS = focus sample
GW = groundwater
HEIS = Hanford Environmental Information System
MTCA = *Model Toxics Control Act*
PQL = practical quantitation limit
Q = qualifier
QA/QC = quality assurance/quality control
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
RPD = relative percent difference
RSVP = remaining sites verification package
SAP = sampling and analysis plan
TDL = target detection limit
UCL = upper confidence limit
WAC = Washington Administrative Code

Washington Closure Hanford **CALCULATION SHEET**

Originator R. J. Nielson RN **Date** 11/17/14 **Calc. No.** 0100H-CA-V0217 **Rev. No.** 0
Project 100-H Area Closure Operations **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 11/17/14
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Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations and/or maximum for the excavation area, the WAC 173-340-740(7)(e) 3-part test evaluation, and the RPD calculations, and are for use in risk analysis and the RSVP for this site.

Results Summary [a]

Analyte	Excavation		FS-1	Units
	95% UCL Result	Maximum Result	Maximum Result	
Antimony	--	0.85	--	mg/kg
Arsenic	15.2	--	5.4	mg/kg
Barium	60.0	--	45.2	mg/kg
Boron	1.8	--	1.0	mg/kg
Cadmium	--	0.060	0.11	mg/kg
Chromium	11.9	--	9.0	mg/kg
Cobalt	5.6	--	6.5	mg/kg
Copper	14.2	--	14.5	mg/kg
Hexavalent chromium	0.280	--	--	mg/kg
Lead	81.3	--	14.7	mg/kg
Manganese	282	--	229	mg/kg
Mercury	0.018	--	--	mg/kg
Molybdenum	--	0.35	--	mg/kg
Nickel	11.9	--	11.2	mg/kg
Silver	0.15	--	--	mg/kg
Vanadium	39.8	--	36.4	mg/kg
Zinc	38.5	--	33.0	mg/kg
Chloride	--	--	8.6	mg/kg
Fluoride	--	--	1.2	mg/kg
Nitrogen in nitrate	--	--	1.6	mg/kg
Sulfate	--	--	9.5	mg/kg
Acenaphthene	--	0.020	--	mg/kg
Benzo(a)anthracene (PAH)	0.12	--	--	mg/kg
Benzo(a)pyrene (PAH)	0.093	--	0.013	mg/kg
Benzo(b)fluoranthene (PAH)	0.092	--	0.0059	mg/kg
Benzo(ghi)perylene (PAH)	0.063	--	--	mg/kg
Benzo(k)fluoranthene (PAH)	0.014	--	--	mg/kg
Chrysene (PAH)	0.12	--	0.0076	mg/kg
Fluoranthene (PAH)	0.14	--	0.016	mg/kg
Fluorene	--	0.0087	--	mg/kg
Indeno(1,2,3-cd)pyrene (PAH)	--	0.038	--	mg/kg
Naphthalene	--	0.016	--	mg/kg
Phenanthrene (PAH)	0.035	--	0.015	mg/kg
Pyrene (PAH)	0.14	--	0.019	mg/kg
4-4'-DDE	0.0018	--	--	mg/kg
4-4'-DDT	0.0023	--	--	mg/kg

WAC 173-340-740(7)(e) Evaluation:

WAC 173-340 3-Part Test for most stringent RAG:	EXCAVATION	
95% UCL or maximum> Cleanup Limit?	YES	NO
> 10% above Cleanup Limit?	YES	NO
Any sample > 2x Cleanup Limit?	YES	NO

[a] The 95% UCL result or maximum value, depending on data censorship, as described in the methodology section.

Washington Closure Hanford **CALCULATION SHEET**

Originator R. J. Nielson RN **Date** 11/17/14 **Calc. No.** 0100H-CA-V0217 **Rev. No.** 0
Project 100-H Area Closure Operations **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 11/17/14
Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 5 of 14

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations and/or maximum for the excavation area, the WAC 173-340-740(7)(e) 3-part test evaluation, and the RPD calculations, and are for use in risk analysis and the RSVP for this site.

Relative Percent Difference Results and QA/QC Analysis[a]

Analyte	Duplicate Analysis
	Excavation
Aluminum	4.9%
Barium	7.5%
Calcium	8.3%
Chromium	1.8%
Copper	6.0%
Iron	12.0%
Lead	16.2%
Magnesium	8.6%
Manganese	13.5%
Silicon	6.4%
Vanadium	12.8%
Zinc	13.0%

[a] RPD listed where result produced, based on criteria. If RPD not required, no value is listed. The significance of the reported RPD values, including values greater than 30%, is addressed in the data quality assessment section of the RSVP.

CALCULATION SHEET

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Originator R. J. Nielson RN
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100-H-51:1 Statistical Calculations

Verification Data - Excavation

Sample Area	Sample Number	Sample Date	Arsenic mg/kg	Arsenic Q	Arsenic PQL	Barium mg/kg	Barium Q	Barium PQL	Boron mg/kg	Boron Q	Boron PQL	Chromium mg/kg	Chromium Q	Chromium PQL	Cobalt mg/kg	Cobalt Q	Cobalt PQL	Copper mg/kg	Copper Q	Copper PQL
EXC-7	J1TXN9	8/26/14	18.9		0.57	60.7	X	0.066	2.0		0.85	11.5	X	0.050	5.4	X	0.087	13.0	X	0.19
Duplicate of J1TXN9	J1TXP5	8/26/14	18.5		0.61	65.4	X	0.071	2.0		0.91	11.3	X	0.054	5.9	X	0.093	13.8	X	0.20
EXC-1	J1TXN3	8/26/14	8.3		0.57	53.2	X	0.066	1.8		0.85	10.5	X	0.050	5.0	X	0.087	13.2	X	0.19
EXC-2	J1TXN4	8/26/14	7.7		0.59	50.5	X	0.068	1.6	B	0.87	10.2	X	0.052	4.8	X	0.089	12.2	X	0.19
EXC-3	J1V0F3	9/29/14	4.6		0.58	33.7		0.067	0.94	B	0.87	9.1		0.051	4.9	X	0.088	10.7		0.19
EXC-4	J1TXN6	8/26/14	12.1		0.59	53.9	X	0.067	1.6	B	0.87	11.3	X	0.051	5.8	X	0.089	14.5	X	0.19
EXC-5	J1TXN7	8/26/14	4.4		0.65	45.6	X	0.074	1.2	B	0.96	8.3	X	0.057	4.5	X	0.098	10.8	X	0.21
EXC-6	J1TXN8	8/26/14	9.7		0.57	51.4	X	0.066	1.5	B	0.85	10.0	X	0.050	4.9	X	0.086	12.4	X	0.19
EXC-8	J1TXP0	8/26/14	17.9		0.66	53.5	X	0.076	1.8	B	0.98	10.4	X	0.058	5.2	X	0.10	12.5	X	0.22
EXC-9	J1V0F4	9/29/14	8.0		0.64	50.6		0.074	2.0		0.95	14.8		0.056	5.6		0.097	14.2	X	0.21
EXC-10	J1TXP2	8/26/14	5.2		0.63	53.2	X	0.072	1.1	B	0.93	9.0	X	0.055	4.6	X	0.095	11.8	X	0.21
EXC-11	J1TXP3	8/26/14	14.9		0.57	67.5	X	0.066	1.4	B	0.85	12.2	X	0.050	6.1	X	0.087	14.5	X	0.19
EXC-12	J1TXP4	8/26/14	16.3		0.64	79.4	X	0.073	1.8	B	0.94	13.0	X	0.056	6.3	X	0.096	17.6	X	0.21

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Arsenic mg/kg	Barium mg/kg	Boron mg/kg	Chromium mg/kg	Cobalt mg/kg	Copper mg/kg
EXC-7	J1TXN9/J1TXP5	8/26/14	18.7	63.1	2.0	11.4	5.7	13.4
EXC-1	J1TXN3	8/26/14	8.3	53.2	1.8	10.5	5.0	13.2
EXC-2	J1TXN4	8/26/14	7.7	50.5	1.6	10.2	4.8	12.2
EXC-3	J1V0F3	9/29/14	4.6	33.7	0.94	9.1	4.9	10.7
EXC-4	J1TXN6	8/26/14	12.1	53.9	1.6	11.3	5.8	14.5
EXC-5	J1TXN7	8/26/14	4.4	45.6	1.2	8.3	4.5	10.8
EXC-6	J1TXN8	8/26/14	9.7	51.4	1.5	10.0	4.9	12.4
EXC-8	J1TXP0	8/26/14	17.9	53.5	1.8	10.4	5.2	12.5
EXC-9	J1V0F4	9/29/14	8.0	50.6	2.0	14.8	5.6	14.2
EXC-10	J1TXP2	8/26/14	5.2	53.2	1.1	9.0	4.6	11.8
EXC-11	J1TXP3	8/26/14	14.9	67.5	1.4	12.2	6.1	14.5
EXC-12	J1TXP4	8/26/14	16.3	79.4	1.8	13.0	6.3	17.6

	Arsenic	Barium	Boron	Chromium	Cobalt	Copper
95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.
N	12	12	12	12	12	12
% < Detection limit	0%	0%	0%	0%	0%	0%
Mean	10.7	54.6	1.6	10.9	5.3	13.2
Standard deviation	5.2	11.4	0.35	1.8	0.60	1.9
95% UCL on mean	15.2	60.0	1.8	11.9	5.6	14.2
Maximum value	18.9	79.4	2.0	14.8	6.3	17.6
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	20 DE, GW & River Protection	200 GW Protection	320 GW Protection	18.5 GW & River Protection	15.7 GW Protection	22.0 River Protection
WAC 173-340 3-PART TEST						
95% UCL > Cleanup Limit?	NO	NA	NO	NA	NA	NA
> 10% above Cleanup Limit?	NO	NA	NO	NA	NA	NA
Any sample > 2X Cleanup Limit?	NO	NA	NO	NA	NA	NA
WAC 173-340 Compliance?	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (18.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (15.7 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (22.0 mg/kg) the WAC 173-340 3-part test is not required.

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson RN
Project 100-H Area Closure Operations
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Date 11/17/14
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100-H-51:1 Statistical Calculations

Verification Data - Excavation

Sample Area	Sample Number	Sample Date	Lead mg/kg	Lead Q	Lead PQL	Manganese mg/kg	Manganese Q	Manganese PQL	Nickel mg/kg	Nickel Q	Nickel PQL	Silver mg/kg	Silver Q	Silver PQL	Vanadium mg/kg	Vanadium Q	Vanadium PQL	Zinc mg/kg	Zinc Q	Zinc PQL
EXC-7	J1TXN9	8/26/14	120	X	0.23	256	X	0.087	11.4	X	0.11	0.14	U	0.14	35.0		0.082	35.2		0.35
Duplicate of J1TXN9	J1TXP5	8/26/14	102	X	0.25	293	X	0.093	11.6	X	0.11	0.21		0.15	39.8		0.087	40.1		0.37
EXC-1	J1TXN3	8/26/14	29.3	X	0.23	259	X	0.087	11.1	XM	0.11	0.14	U	0.14	39.1		0.082	35.4		0.35
EXC-2	J1TXN4	8/26/14	22.9	X	0.24	271	X	0.089	9.6	X	0.11	0.14	U	0.14	38.1		0.084	32.3		0.35
EXC-3	J1V0F3	9/29/14	10.0		0.24	235		0.088	9.7		0.11	0.14	U	0.14	34.9		0.083	28.5		0.35
EXC-4	J1TXN6	8/26/14	35.7	X	0.24	272	X	0.089	11.2	X	0.11	0.20		0.14	46.7		0.083	36.5		0.35
EXC-5	J1TXN7	8/26/14	6.1	X	0.26	220	X	0.098	8.7	X	0.12	0.16	B	0.16	31.3		0.092	28.9		0.39
EXC-6	J1TXN8	8/26/14	49.3	X	0.23	247	X	0.086	9.9	X	0.11	0.14	U	0.14	36.3		0.081	36.7		0.34
EXC-8	J1TXP0	8/26/14	95.1	X	0.27	246	X	0.10	10.0	X	0.12	0.16	U	0.16	36.2		0.094	35.7		0.40
EXC-9	J1V0F4	9/29/14	16.3		0.26	272		0.097	15.5		0.12	0.17	B	0.16	38.4		0.091	33.3		0.39
EXC-10	J1TXP2	8/26/14	18.4	X	0.26	205	X	0.095	8.6	X	0.12	0.15	U	0.15	34.2		0.089	32.0		0.38
EXC-11	J1TXP3	8/26/14	28.7	X	0.23	295	X	0.087	11.9	X	0.11	0.19		0.14	40.3		0.082	39.3		0.35
EXC-12	J1TXP4	8/26/14	47.7	X	0.26	342	X	0.096	12.7	X	0.12	0.21		0.15	39.6		0.091	51.3		0.38

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Lead mg/kg	Manganese mg/kg	Nickel mg/kg	Silver mg/kg	Vanadium mg/kg	Zinc mg/kg
EXC-7	J1TXN9/J1TXP5	8/26/14	111	275	11.5	0.14	37.4	37.7
EXC-1	J1TXN3	8/26/14	29.3	259	11.1	0.070	39.1	35.4
EXC-2	J1TXN4	8/26/14	22.9	271	9.6	0.070	38.1	32.3
EXC-3	J1V0F3	9/29/14	10.0	235	9.7	0.070	34.9	28.5
EXC-4	J1TXN6	8/26/14	35.7	272	11.2	0.20	46.7	36.5
EXC-5	J1TXN7	8/26/14	6.1	220	8.7	0.16	31.3	28.9
EXC-6	J1TXN8	8/26/14	49.3	247	9.9	0.070	36.3	36.7
EXC-8	J1TXP0	8/26/14	95.1	246	10.0	0.080	36.2	35.7
EXC-9	J1V0F4	9/29/14	16.3	272	15.5	0.17	38.4	33.3
EXC-10	J1TXP2	8/26/14	18.4	205	8.6	0.075	34.2	32.0
EXC-11	J1TXP3	8/26/14	28.7	295	11.9	0.19	40.3	39.3
EXC-12	J1TXP4	8/26/14	47.7	342	12.7	0.21	39.6	51.3

	Lead	Manganese	Nickel	Silver	Vanadium	Zinc
95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
N	12	12	12	12	12	12
% < Detection limit	0%	0%	0%	50%	0%	0%
Mean	39.2	262	10.9	0.13	37.7	35.6
Standard deviation	32.8	35.9	1.9	0.058	3.8	6.0
95% UCL on mean	81.3	282	11.9	0.15	39.8	38.5
Maximum value	120	342	15.5	0.21	46.7	51.3
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	10.2 GW & River Protection	512 GW & River Protection	19.1 GW Protection	0.73 River Protection	85.1 GW Protection	67.8 River Protection
WAC 173-340 3-PART TEST						
95% UCL > Cleanup Limit?	YES	NA	NA	NA	NA	NA
> 10% above Cleanup Limit?	YES	NA	NA	NA	NA	NA
Any sample > 2X Cleanup Limit?	YES	NA	NA	NA	NA	NA
WAC 173-340 Compliance?	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (19.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (0.73 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (85.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (67.8 mg/kg) the WAC 173-340 3-part test is not required.

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson RN
Project 100-H Area Closure Operations
Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations

Date 12/15/14
Job No. 14655

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Checked I. B. Berezovskiy

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1 **100-H-51:1 Statistical Calculations**
2 **Verification Data - Excavation**

3	Sample	Sample	Sample	Hexavalent Chromium			Mercury			Benzo(a)anthracene			Benzo(a)pyrene			Benzo(b)fluoranthene			Benzo(ghi)perylene			Benzo(k)fluoranthene		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
5	EXC-7	J1TXN9	8/26/14	0.358		0.155	0.019		0.0053	8.9	J	3.2	14	J	6.4	13	J	4.2	8.0	J	7.1	3.9	U	3.9
6	Duplicate of J1TXN9	J1TXP5	8/26/14	0.275		0.155	0.022		0.0050	3.2	U	3.2	11	J	6.4	14	J	4.2	7.6	JX	7.1	5.0	J	3.9
7	EXC-1	J1TXN3	8/26/14	0.361		0.155	0.0080	BM	0.0050	7.4	JX	3.1	10	J	6.3	18		4.1	8.7	JX	7.0	4.2	J	3.8
8	EXC-2	J1TXN4	8/26/14	0.295		0.155	0.0085	B	0.0054	5.7	JX	3.1	15	X	6.3	12	JX	4.1	18	J	7.0	4.0	J	3.9
9	EXC-3	J1TXN5	8/26/14	0.155	U	0.155	0.031		0.0052	130		3.0	83		6.1	70		4.0	63		6.9	30		3.8
10	EXC-4	J1TXN6	8/26/14	0.235		0.155	0.016		0.0051	4.4	JX	3.2	7.3	JX	6.4	6.9	J	4.2	8.2	JX	7.2	4.0	U	4.0
11	EXC-5	J1TXN7	8/26/14	0.196		0.155	0.0084	B	0.0051	3.1	U	3.1	6.3	U	6.3	4.1	U	4.1	7.0	U	7.0	3.9	U	3.9
12	EXC-6	J1TXN8	8/26/14	0.380		0.155	0.011	B	0.0052	16	X	3.1	80		6.3	65		4.1	80		7.1	24		3.9
13	EXC-8	J1TXP0	8/26/14	0.213		0.155	0.0092	B	0.0049	3.0	U	3.0	6.8	J	6.0	8.1	J	4.0	6.8	U	6.8	3.7	U	3.7
14	EXC-9	J1TXP1	8/26/14	0.155	U	0.155	0.0069	B	0.0049	3.1	U	3.1	6.3	U	6.3	4.8	JX	4.1	7.1	U	7.1	3.9	U	3.9
15	EXC-10	J1TXP2	8/26/14	0.213		0.155	0.010	B	0.0052	3.2	U	3.2	6.4	U	6.4	4.2	U	4.2	7.2	U	7.2	3.9	U	3.9
16	EXC-11	J1TXP3	8/26/14	0.254		0.155	0.010	B	0.0050	46		3.0	43		6.1	42		4.0	30		6.8	18		3.7
17	EXC-12	J1TXP4	8/26/14	0.155	U	0.155	0.029		0.0052	31		3.1	38		6.3	35		4.1	20	JX	7.1	15		3.9

18 **Statistical Computation Input Data**

19	Sample	Sample	Sample	Hexavalent Chromium	Mercury	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene
20	Area	Number	Date	mg/kg	mg/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
21	EXC-7	J1TXN9/J1TXP5	8/26/14	0.317	0.021	5.3	12.5	13.5	7.8	3.5
22	EXC-1	J1TXN3	8/26/14	0.361	0.0080	7.4	10	18	8.7	4.2
23	EXC-2	J1TXN4	8/26/14	0.295	0.0085	5.7	15	12	18	4.0
24	EXC-3	J1TXN5	8/26/14	0.078	0.031	130	83	70	63	30
25	EXC-4	J1TXN6	8/26/14	0.235	0.016	4.4	7.3	6.9	8.2	2.0
26	EXC-5	J1TXN7	8/26/14	0.196	0.0084	1.6	3.2	2.1	3.5	2.0
27	EXC-6	J1TXN8	8/26/14	0.380	0.011	16	80	65	80	24
28	EXC-8	J1TXP0	8/26/14	0.213	0.0092	1.5	6.8	8.1	3.4	1.9
29	EXC-9	J1TXP1	8/26/14	0.078	0.0069	1.6	3.2	4.8	3.6	2.0
30	EXC-10	J1TXP2	8/26/14	0.213	0.010	1.6	3.2	2.1	3.6	2.0
31	EXC-11	J1TXP3	8/26/14	0.254	0.010	46	43	42	30	18
32	EXC-12	J1TXP4	8/26/14	0.078	0.029	31	38	35	20	15

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34		Hexavalent Chromium	Mercury	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene
35	95% UCL based on	Large data set (n ≥ 10), use MTCAStat normal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
36	N	12	12	12	12	12	12	12
37	% < Detection limit	25%	0%	33%	25%	17%	33%	42%
38	Mean	0.225	0.014	21	25	23	21	9.0
39	Standard deviation	0.106	0.0084	37	29	24	25	10
40	95% UCL on mean	0.280	0.018	123	93	92	63	14
41	Maximum value	0.380	0.031	130	83	70	80	30
42	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg), unless otherwise noted**	2 River Protection	0.33 GW & River Protection	15 ug/kg GW & River Protection	15 ug/kg GW & River Protection	15 ug/kg GW & River Protection	48000 ug/kg GW Protection	15 ug/kg GW & River Protection
43	**WAC 173-340 3-PART TEST**							
44	95% UCL > Cleanup Limit?	NO	NA	YES	YES	YES	NO	NO
45	> 10% above Cleanup Limit?	NO	NA	YES	YES	YES	NO	YES
46	Any sample > 2X Cleanup Limit?	NO	NA	YES	YES	YES	NO	YES
47	**WAC 173-340 Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (0.33 mg/kg) the WAC 173-340 3-part test is not required.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.

48 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson RN
Project 100-H Area Closure Operations
Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations

Date 11/17/14
Job No. 14655

Calc. No. 0100H-CA-V0217
Checked I. B. Berezovskiy

Rev. No. 0
Date 11/17/14
Sheet No. 9 of 14

1 **100-H-51:1 Statistical Calculations**
2 **Verification Data - Excavation**

3	Sample	Sample	Sample	Chrysene			Fluoranthene			Phenanthrene			Pyrene			4-4'-DDE			4-4'-DDT		
4	Area	Number	Date	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
5	EXC-7	J1TXN9	8/26/14	15	J	4.8	20	J	13	12	U	12	24	J	12	0.23	U	0.23	0.57	U	0.57
6	Duplicate of J1TXN9	J1TXP5	8/26/14	17	J	4.8	16	J	13	12	U	12	17	J	12	0.23	U	0.23	0.56	U	0.56
7	EXC-1	J1TXN3	8/26/14	18	J	4.7	27	J	13	18	JX	12	26	J	12	1.2	J	0.24	5.0	X	0.58
8	EXC-2	J1TXN4	8/26/14	14	J	4.7	31	J	13	17	J	12	37	J	12	4.7		0.23	4.4		0.57
9	EXC-3	J1TXN5	8/26/14	85		4.6	160		12	81		11	190		11	3.1		0.23	3.1	X	0.58
10	EXC-4	J1TXN6	8/26/14	4.9	U	4.9	20	J	13	12	U	12	30	J	12	0.23	U	0.23	0.58	U	0.58
11	EXC-5	J1TXN7	8/26/14	4.7	U	4.7	13	U	13	12	U	12	12	U	12	0.23	U	0.23	0.57	U	0.57
12	EXC-6	J1TXN8	8/26/14	100		4.8	120		13	60		12	93	X	12	0.47	J	0.24	0.94	JX	0.60
13	EXC-8	J1TXP0	8/26/14	13	J	4.6	23	J	12	12	J	11	22	J	11	1.0	J	0.24	1.1	JX	0.59
14	EXC-9	J1TXP1	8/26/14	6.2	JX	4.7	13	U	13	12	U	12	15	J	12	0.23	U	0.23	0.57	U	0.57
15	EXC-10	J1TXP2	8/26/14	4.8	U	4.8	13	U	13	12	U	12	12	U	12	2.0		0.23	1.6	J	0.58
16	EXC-11	J1TXP3	8/26/14	35	JX	4.6	76		12	40		11	83		11	0.24	U	0.24	0.59	U	0.59
17	EXC-12	J1TXP4	8/26/14	29	JX	4.8	62		13	27	J	12	59		12	0.47	J	0.24	0.59	U	0.59

18 **Statistical Computation Input Data**

19	Sample	Sample	Sample	Chrysene	Fluoranthene	Phenanthrene	Pyrene	4-4'-DDE	4-4'-DDT
20	Area	Number	Date	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
21	EXC-7	J1TXN9/J1TXP5	8/26/14	16	18	6.0	21	0.12	0.28
22	EXC-1	J1TXN3	8/26/14	18	27	18	26	1.2	5.0
23	EXC-2	J1TXN4	8/26/14	14	31	17	37	4.7	4.4
24	EXC-3	J1TXN5	8/26/14	85	160	81	190	3.1	3.1
25	EXC-4	J1TXN6	8/26/14	2.5	20	6.0	30	0.12	0.29
26	EXC-5	J1TXN7	8/26/14	2.4	6.5	6.0	6.0	0.12	0.29
27	EXC-6	J1TXN8	8/26/14	100	120	60	93	0.47	0.94
28	EXC-8	J1TXP0	8/26/14	13	23	12	22	1.0	1.1
29	EXC-9	J1TXP1	8/26/14	6.2	6.5	6.0	15	0.12	0.29
30	EXC-10	J1TXP2	8/26/14	2.4	6.5	6.0	6.0	2.0	1.6
31	EXC-11	J1TXP3	8/26/14	35	76	40	83	0.12	0.30
32	EXC-12	J1TXP4	8/26/14	29	62	27	59	0.47	0.30

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34		Chrysene	Fluoranthene	Phenanthrene	Pyrene	4-4'-DDE	4-4'-DDT
35	95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
36	N	12	12	12	12	12	12
37	% < Detection limit	25%	25%	42%	17%	42%	50%
38	Mean	27	46	24	49	1.1	1.5
39	Standard deviation	32	49	25	53	1.5	1.7
40	95% UCL on mean	124	144	35	137	1.8	2.3
41	Maximum value	100	160	81	190	4.7	5.0
42	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (ug/kg)**	100 River Protection	18000 River Protection	240000 GW Protection	48000 GW Protection	3.3 River Protection	3.3 River Protection
43	**WAC 173-340 3-PART TEST**						
44	95% UCL > Cleanup Limit?	YES	NO	NO	NO	NO	NO
45	> 10% above Cleanup Limit?	NO	NO	NO	NO	NO	YES
46	Any sample > 2X Cleanup Limit?	NO	NO	NO	NO	NO	NO
47	**WAC 173-340 Compliance?**	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.

48 **Acronyms and qualifiers are defined on sheet 3.**

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson RN
Project 100-H Area Closure Operations
Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations

Date 11/17/14
Job No. 14655

Calc. No. 0100H-CA-V0217
Checked I. B. Berezovskiy

Rev. No. 0
Date 11/17/14
Sheet No. 10 of 14

1 **100-H-51:1 Subsite Maximum Calculations**
2 **Verification Data - Excavation**

3	Sample	Sample	Sample	Antimony			Cadmium			Molybdenum		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5	EXC-7	J1TXN9	8/26/14	0.58		0.33	0.075	BCUJ	0.036	0.23	U	0.23
6	Duplicate of J1TXN9	J1TXP5	8/26/14	0.35	B	0.35	0.073	BCUJ	0.038	0.24	U	0.24
7	EXC-1	J1TXN3	8/26/14	0.45	B	0.33	0.070	BCUJ	0.036	0.35	BM	0.23
8	EXC-2	J1TXN4	8/26/14	0.34	U	0.34	0.32	UJ	0.037	0.30	B	0.23
9	EXC-3	J1V0F3	9/29/14	0.34	U	0.34	0.036	U	0.036	0.23	B	0.23
10	EXC-4	J1TXN6	8/26/14	0.34	U	0.34	0.060	BCUJ	0.036	0.23	U	0.23
11	EXC-5	J1TXN7	8/26/14	0.37	U	0.37	0.086	BCUJ	0.040	0.25	U	0.25
12	EXC-6	J1TXN8	8/26/14	0.33	U	0.33	0.067	BCUJ	0.035	0.22	U	0.22
13	EXC-8	J1TXP0	8/26/14	0.38	U	0.38	0.041	U	0.041	0.26	U	0.26
14	EXC-9	J1V0F4	9/29/14	0.85		0.37	0.060	B	0.040	0.32	B	0.25
15	EXC-10	J1TXP2	8/26/14	0.36	U	0.36	0.062	BCUJ	0.039	0.25	U	0.25
16	EXC-11	J1TXP3	8/26/14	0.33	U	0.33	0.079	BCUJ	0.036	0.23	U	0.23
17	EXC-12	J1TXP4	8/26/14	0.37	U	0.37	0.12	BCUJ	0.039	0.25	U	0.25

18 **Statistical Computations**

19		Antimony			Cadmium			Molybdenum		
20	% < Detection limit	75%			92%			67%		
21	Maximum value	0.85			0.06			0.35		
22	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	5	GW & River Protection		0.81	GW & River Protection		8	GW Protection	
23	**3-PART TEST**									
24	Maximum > Cleanup Limit?	NA			NA			NO		
25	> 10% above Cleanup Limit?	NA			NA			NO		
26	Any sample > 2X Cleanup Limit?	NA			NA			NO		
27	**3-Part Test Compliance?**	Because all values are below background (5 mg/kg) the WAC 173-340 3-part test is not required.			Because all values are below background (0.81 mg/kg) the WAC 173-340 3-part test is not required.			The data set meets the 3-part test criteria when compared to the most stringent RAG.		

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29 **100-H-51:1 Subsite Maximum Calculations**
30 **Verification Data - Excavation**

31	Sample	Sample	Sample	Acenaphthene			Fluorene			Indeno(1,2,3-cd)pyrene			Naphthalene		
32	Area	Number	Date	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
33	EXC-7	J1TXN9	8/26/14	9.9	U	9.9	5.2	U	5.2	12	U	12	12	U	12
34	Duplicate of J1TXN9	J1TXP5	8/26/14	9.9	U	9.9	5.2	U	5.2	12	U	12	12	U	12
35	EXC-1	J1TXN3	8/26/14	9.8	U	9.8	5.1	U	5.1	12	U	12	12	U	12
36	EXC-2	J1TXN4	8/26/14	9.8	U	9.8	5.2	U	5.2	12	U	12	12	U	12
37	EXC-3	J1TXN5	8/26/14	20	JX	9.6	8.7	JX	5.0	38	X	11	16	JX	11
38	EXC-4	J1TXN6	8/26/14	10	U	10	5.3	U	5.3	12	U	12	12	U	12
39	EXC-5	J1TXN7	8/26/14	9.8	U	9.8	5.2	U	5.2	12	U	12	12	U	12
40	EXC-6	J1TXN8	8/26/14	9.8	U	9.8	6.6	J	5.2	38		12	12	U	12
41	EXC-8	J1TXP0	8/26/14	9.4	U	9.4	5.0	U	5.0	11	U	11	11	U	11
42	EXC-9	J1TXP1	8/26/14	9.8	U	9.8	5.2	U	5.2	12	U	12	12	U	12
43	EXC-10	J1TXP2	8/26/14	10	U	10	5.3	U	5.3	12	U	12	12	U	12
44	EXC-11	J1TXP3	8/26/14	14	J	9.5	8.3	JX	5.0	31		11	11	U	11
45	EXC-12	J1TXP4	8/26/14	9.9	J	9.9	5.2	U	5.2	27	J	12	12	U	12

46 **Statistical Computations**

47		Acenaphthene			Fluorene			Indeno(1,2,3-cd)pyrene			Naphthalene		
48	% < Detection limit	75%			75%			67%			92%		
49	Maximum value	20			8.7			38			16		
50	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (ug/kg)**	96000	GW Protection		64000	GW Protection		330	GW & River Protection		16000	GW Protection	
51	**3-PART TEST**												
52	Maximum > Cleanup Limit?	NO			NO			NO			NO		
53	> 10% above Cleanup Limit?	NO			NO			NO			NO		
54	Any sample > 2X Cleanup Limit?	NO			NO			NO			NO		
55	**3-Part Test Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.			The data set meets the 3-part test criteria when compared to the most stringent RAG.			The data set meets the 3-part test criteria when compared to the most stringent RAG.			The data set meets the 3-part test criteria when compared to the most stringent RAG.		

57 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson

Project 100-H Area Closure Operations

Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations

Date 11/17/14

Job No. 14655

Calc. No. 0100H-CA-V0217

Checked I. B. Berezovskiy

Rev. No. 0

Date 11/17/14

Sheet No. 11 of 14

Ecology Software (MTCAStat) Results, 100-H-51:1 Subsite Excavation

Arsenic 95% UCL Calculation

DATA	ID
18.7	J1TXN9/J1TXP5
8.3	J1TXN3
7.7	J1TXN4
4.6	J1V0F3
12.1	J1TXN6
4.4	J1TXN7
9.7	J1TXN8
17.9	J1TXP0
8.0	J1V0F4
5.2	J1TXP2
14.9	J1TXP3
16.3	J1TXP4

Number of samples		Uncensored values	
Uncensorec	12	Mean	10.7
Censored		Lognormal me	10.8
Detection limit or PQL		Std. devn.	5.2
Method detection limit		Median	9.0
TOTAL	12	Min.	4.4
		Max.	18.7

Lognormal distribution? r-squared is: 0.947

Normal distribution? r-squared is: 0.932

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 15.2

Barium 95% UCL Calculation

DATA	ID
63.1	J1TXN9/J1TXP5
53.2	J1TXN3
50.5	J1TXN4
33.7	J1V0F3
53.9	J1TXN6
45.6	J1TXN7
51.4	J1TXN8
53.5	J1TXP0
50.6	J1V0F4
53.2	J1TXP2
67.5	J1TXP3
79.4	J1TXP4

Number of samples		Uncensored values	
Uncensorec	12	Mean	54.6
Censored		Lognormal me	54.7
Detection limit or PQL		Std. devn.	11.4
Method detection limit		Median	53.2
TOTAL	12	Min.	33.7
		Max.	79.4

Lognormal distribution? r-squared is: 0.888

Normal distribution? r-squared is: 0.887

Recommendations:

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 60.0

Boron 95% UCL Calculation

DATA	ID
2.0	J1TXN9/J1TXP5
1.8	J1TXN3
1.6	J1TXN4
0.94	J1V0F3
1.6	J1TXN6
1.2	J1TXN7
1.5	J1TXN8
1.8	J1TXP0
2.0	J1V0F4
1.1	J1TXP2
1.4	J1TXP3
1.8	J1TXP4

Number of samples		Uncensored values	
Uncensorec	12	Mean	1.6
Censored		Lognormal me	1.6
Detection limit or PQL		Std. devn.	0.35
Method detection limit		Median	1.6
TOTAL	12	Min.	0.94
		Max.	2.0

Lognormal distribution? r-squared is: 0.922

Normal distribution? r-squared is: 0.855

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 1.8

Cadmium 95% UCL Calculation

DATA	ID
0.074	J1TXN9/J1TXP5
0.070	J1TXN3
0.32	J1TXN4
0.018	J1V0F3
0.060	J1TXN6
0.086	J1TXN7
0.067	J1TXN8
0.021	J1TXP0
0.060	J1V0F4
0.062	J1TXP2
0.079	J1TXP3
0.12	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	0.086
Censored		Lognormal mean	0.088
Detection limit or PQL		Std. devn.	0.078
Method detection limit		Median	0.069
TOTAL	12	Min.	0.018
		Max.	0.32

Lognormal distribution? r-squared is: 0.860

Normal distribution? r-squared is: 0.613

Recommendations:

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.12

Chromium 95% UCL Calculation

DATA	ID
11.4	J1TXN9/J1TXP5
10.5	J1TXN3
10.2	J1TXN4
9.1	J1V0F3
11.3	J1TXN6
8.3	J1TXN7
10.0	J1TXN8
10.4	J1TXP0
14.8	J1V0F4
9.0	J1TXP2
12.2	J1TXP3
13.0	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	10.9
Censored		Lognormal mean	10.9
Detection limit or PQL		Std. devn.	1.8
Method detection limit		Median	10.5
TOTAL	12	Min.	8.3
		Max.	14.8

Lognormal distribution? r-squared is: 0.978

Normal distribution? r-squared is: 0.951

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 11.9

Cobalt 95% UCL Calculation

DATA	ID
5.7	J1TXN9/J1TXP5
5.0	J1TXN3
4.8	J1TXN4
4.9	J1V0F3
5.8	J1TXN6
4.5	J1TXN7
4.9	J1TXN8
5.2	J1TXP0
5.6	J1V0F4
4.6	J1TXP2
6.1	J1TXP3
6.3	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	5.3
Censored		Lognormal mean	5.3
Detection limit or PQL		Std. devn.	0.60
Method detection limit		Median	5.1
TOTAL	12	Min.	4.5
		Max.	6.3

Lognormal distribution? r-squared is: 0.958

Normal distribution? r-squared is: 0.950

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 5.6

Copper 95% UCL Calculation

DATA	ID
13.4	J1TXN9/J1TXP5
13.2	J1TXN3
12.2	J1TXN4
10.7	J1V0F3
14.5	J1TXN6
10.8	J1TXN7
12.4	J1TXN8
12.5	J1TXP0
14.2	J1V0F4
11.8	J1TXP2
14.5	J1TXP3
17.6	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	13.2
Censored		Lognormal mean	13.2
Detection limit or PQL		Std. devn.	1.9
Method detection limit		Median	12.9
TOTAL	12	Min.	10.7
		Max.	17.6

Lognormal distribution? r-squared is: 0.949

Normal distribution? r-squared is: 0.917

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 14.2

Hexavalent Chromium 95% UCL Calculation

DATA	ID
0.317	J1TXN9/J1TXP5
0.361	J1TXN3
0.295	J1TXN4
0.0775	J1TXN5
0.235	J1TXN6
0.196	J1TXN7
0.380	J1TXN8
0.213	J1TXP0
0.0775	J1TXP1
0.213	J1TXP2
0.254	J1TXP3
0.0775	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	0.225
Censored		Lognormal mean	0.234
Detection limit or PQL		Std. devn.	0.106
Method detection limit		Median	0.224
TOTAL	12	Min.	0.0775
		Max.	0.380

Lognormal distribution? r-squared is: 0.846

Normal distribution? r-squared is: 0.938

Recommendations:

Use normal distribution.

UCL (based on t-statistic) is 0.280

Lead 95% UCL Calculation

DATA	ID
111	J1TXN9/J1TXP5
29.3	J1TXN3
22.9	J1TXN4
10.0	J1V0F3
35.7	J1TXN6
6.1	J1TXN7
49.3	J1TXN8
95.1	J1TXP0
16.3	J1V0F4
18.4	J1TXP2
28.7	J1TXP3
47.7	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	39.2
Censored		Lognormal mean	41.2
Detection limit or PQL		Std. devn.	32.8
Method detection limit		Median	29.0
TOTAL	12	Min.	6.1
		Max.	111

Lognormal distribution? r-squared is: 0.983

Normal distribution? r-squared is: 0.833

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 81.3

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson
Project 100-H Area Closure Operations
Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations

Date 11/17/14
Job No. 14655

Calc. No. 0100H-CA-V0217
Checked I. B. Berezovskiy

Rev. No. 0
Date 11/17/14
Sheet No. 12 of 14

Ecology Software (MTCAStat) Results, 100-H-51:1 Subsite Excavation

Manganese 95% UCL Calculation

DATA	ID
275	J1TXN9/J1TXP5
259	J1TXN3
271	J1TXN4
235	J1V0F3
272	J1TXN6
220	J1TXN7
247	J1TXN8
246	J1TXP0
272	J1V0F4
205	J1TXP2
295	J1TXP3
342	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	262
Censored		Lognormal mean	262
Detection limit or PQL		Std. devn.	35.9
Method detection limit		Median	265
TOTAL	12	Min.	205
		Max.	342

Lognormal distribution? r-squared is: 0.957
Normal distribution? r-squared is: 0.937
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 282

Mercury 95% UCL Calculation

DATA	ID
0.0205	J1TXN9/J1TXP5
0.0080	J1TXN3
0.0085	J1TXN4
0.031	J1TXN5
0.016	J1TXN6
0.0084	J1TXN7
0.011	J1TXN8
0.0092	J1TXP0
0.0069	J1TXP1
0.010	J1TXP2
0.010	J1TXP3
0.029	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	0.014
Censored		Lognormal mean	0.014
Detection limit or PQL		Std. devn.	0.0084
Method detection limit		Median	0.010
TOTAL	12	Min.	0.0069
		Max.	0.031

Lognormal distribution? r-squared is: 0.869
Normal distribution? r-squared is: 0.777
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.018

Nickel 95% UCL Calculation

DATA	ID
11.5	J1TXN9/J1TXP5
11.1	J1TXN3
9.6	J1TXN4
9.7	J1V0F3
11.2	J1TXN6
8.7	J1TXN7
9.9	J1TXN8
10.0	J1TXP0
15.5	J1V0F4
8.6	J1TXP2
11.9	J1TXP3
12.7	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	10.9
Censored		Lognormal mean	10.9
Detection limit or PQL		Std. devn.	1.9
Method detection limit		Median	10.6
TOTAL	12	Min.	8.6
		Max.	15.5

Lognormal distribution? r-squared is: 0.941
Normal distribution? r-squared is: 0.897
Recommendations:
Use lognormal distribution.

UCL (based on t-statistic) is 11.9

Silver 95% UCL Calculation

DATA	ID
0.14	J1TXN9/J1TXP5
0.070	J1TXN3
0.070	J1TXN4
0.070	J1V0F3
0.20	J1TXN6
0.16	J1TXN7
0.070	J1TXN8
0.080	J1TXP0
0.17	J1V0F4
0.075	J1TXP2
0.19	J1TXP3
0.21	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	0.13
Censored		Lognormal mean	0.13
Detection limit or PQL		Std. devn.	0.058
Method detection limit		Median	0.11
TOTAL	12	Min.	0.07
		Max.	0.21

Lognormal distribution? r-squared is: 0.824
Normal distribution? r-squared is: 0.839
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.15

Vanadium 95% UCL Calculation

DATA	ID
37.4	J1TXN9/J1TXP5
39.1	J1TXN3
38.1	J1TXN4
34.9	J1V0F3
46.7	J1TXN6
31.3	J1TXN7
36.3	J1TXN8
36.2	J1TXP0
38.4	J1V0F4
34.2	J1TXP2
40.3	J1TXP3
39.6	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	37.7
Censored		Lognormal mean	37.7
Detection limit or PQL		Std. devn.	3.8
Method detection limit		Median	37.8
TOTAL	12	Min.	31.3
		Max.	46.7

Lognormal distribution? r-squared is: 0.939
Normal distribution? r-squared is: 0.917
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 39.8

Zinc 95% UCL Calculation

DATA	ID
37.7	J1TXN9/J1TXP5
35.4	J1TXN3
32.3	J1TXN4
28.5	J1V0F3
36.5	J1TXN6
28.9	J1TXN7
36.7	J1TXN8
35.7	J1TXP0
33.3	J1V0F4
32.0	J1TXP2
39.3	J1TXP3
51.3	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	35.6
Censored		Lognormal mean	35.6
Detection limit or PQL		Std. devn.	6.0
Method detection limit		Median	35.6
TOTAL	12	Min.	28.5
		Max.	51.3

Lognormal distribution? r-squared is: 0.895
Normal distribution? r-squared is: 0.834
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 38.5

Benzo(a)anthracene 95% UCL Calculation

DATA	ID
5.3	J1TXN9/J1TXP5
7.4	J1TXN3
5.7	J1TXN4
130	J1TXN5
4.4	J1TXN6
1.6	J1TXN7
16	J1TXN8
1.5	J1TXP0
1.6	J1TXP1
1.6	J1TXP2
46	J1TXP3
31	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	21
Censored		Lognormal mean	22
Detection limit or PQL		Std. devn.	37
Method detection limit		Median	5.5
TOTAL	12	Min.	1.5
		Max.	130

Lognormal distribution? r-squared is: 0.915
Normal distribution? r-squared is: 0.571
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 123

Benzo(a)pyrene 95% UCL Calculation

DATA	ID
13	J1TXN9/J1TXP5
10	J1TXN3
15	J1TXN4
83	J1TXN5
7.3	J1TXN6
3.2	J1TXN7
80	J1TXN8
6.8	J1TXP0
3.2	J1TXP1
3.2	J1TXP2
43	J1TXP3
38	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	25
Censored		Lognormal mean	28
Detection limit or PQL		Std. devn.	29
Method detection limit		Median	11
TOTAL	12	Min.	3.2
		Max.	83

Lognormal distribution? r-squared is: 0.931
Normal distribution? r-squared is: 0.766
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 93

Benzo(b)fluoranthene 95% UCL Calculation

DATA	ID
14	J1TXN9/J1TXP5
18	J1TXN3
12	J1TXN4
70	J1TXN5
6.9	J1TXN6
2.1	J1TXN7
65	J1TXN8
8.1	J1TXP0
4.8	J1TXP1
2.1	J1TXP2
42	J1TXP3
35	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	23
Censored		Lognormal mean	27
Detection limit or PQL		Std. devn.	24
Method detection limit		Median	13
TOTAL	12	Min.	2.1
		Max.	70

Lognormal distribution? r-squared is: 0.966
Normal distribution? r-squared is: 0.829
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 92

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson

Project 100-H Area Closure Operations

Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations

Date 11/17/14

Job No. 14655

Calc. No. 0100H-CA-V0217

Checked I. B. Berezovskiy

Rev. No. 0

Date 11/17/14

Sheet No. 13 of 14

Ecology Software (MTCAStat) Results, 100-H-51:1 Subsite Excavation

Benzo(ghi)perylene 95% UCL Calculation

DATA	ID
7.8	J1TXN9/J1TXP5
8.7	J1TXN3
18	J1TXN4
63	J1TXN5
8.2	J1TXN6
3.5	J1TXN7
80	J1TXN8
3.4	J1TXP0
3.6	J1TXP1
3.6	J1TXP2
30	J1TXP3
20	J1TXP4

Number of samples		Uncensored values	
Uncensorec	12	Mean	21
Censored		Lognormal me	22
Detection limit or PQL		Std. devn.	25
Method detection limit		Median	8.5
TOTAL	12	Min.	3.4
		Max.	80

Lognormal distribution? r-squared is: 0.914

Normal distribution? r-squared is: 0.724

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 63

Benzo(k)fluoranthene 95% UCL Calculation

DATA	ID
3.5	J1TXN9/J1TXP5
4.2	J1TXN3
4.0	J1TXN4
30	J1TXN5
2.0	J1TXN6
2.0	J1TXN7
24	J1TXN8
1.9	J1TXP0
2.0	J1TXP1
2.0	J1TXP2
18	J1TXP3
15	J1TXP4

Number of samples		Uncensored values	
Uncensorec	12	Mean	9.0
Censored		Lognormal me	9.3
Detection limit or PQL		Std. devn.	10
Method detection limit		Median	3.7
TOTAL	12	Min.	1.9
		Max.	30

Lognormal distribution? r-squared is: 0.837

Normal distribution? r-squared is: 0.756

Recommendations:

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 14

Chrysene 95% UCL Calculation

DATA	ID
16	J1TXN9/J1TXP5
18	J1TXN3
14	J1TXN4
85	J1TXN5
2.5	J1TXN6
2.4	J1TXN7
100	J1TXN8
13	J1TXP0
6.2	J1TXP1
2.4	J1TXP2
35	J1TXP3
29	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	27
Censored		Lognormal mean	32
Detection limit or PQL		Std. devn.	32
Method detection limit		Median	15
TOTAL	12	Min.	2.4
		Max.	100

Lognormal distribution? r-squared is: 0.944

Normal distribution? r-squared is: 0.743

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 124

Fluoranthene 95% UCL Calculation

DATA	ID
18	J1TXN9/J1TXP5
27	J1TXN3
31	J1TXN4
160	J1TXN5
20	J1TXN6
6.5	J1TXN7
120	J1TXN8
23	J1TXP0
6.5	J1TXP1
6.5	J1TXP2
76	J1TXP3
62	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	46
Censored		Lognormal mean	51
Detection limit or PQL		Std. devn.	49
Method detection limit		Median	25
TOTAL	12	Min.	6.5
		Max.	160

Lognormal distribution? r-squared is: 0.947

Normal distribution? r-squared is: 0.797

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 144

Phenanthrene 95% UCL Calculation

DATA	ID
6.0	J1TXN9/J1TXP5
18	J1TXN3
17	J1TXN4
81	J1TXN5
6.0	J1TXN6
6.0	J1TXN7
60	J1TXN8
12	J1TXP0
6.0	J1TXP1
6.0	J1TXP2
40	J1TXP3
27	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	24
Censored		Lognormal mean	24
Detection limit or PQL		Std. devn.	25
Method detection limit		Median	15
TOTAL	12	Min.	6.0
		Max.	81

Lognormal distribution? r-squared is: 0.883

Normal distribution? r-squared is: 0.772

Recommendations:

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 35

Pyrene 95% UCL Calculation

DATA	ID
21	J1TXN9/J1TXP5
26	J1TXN3
37	J1TXN4
190	J1TXN5
30	J1TXN6
6.0	J1TXN7
93	J1TXN8
22	J1TXP0
15	J1TXP1
6.0	J1TXP2
83	J1TXP3
59	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	49
Censored		Lognormal mean	53
Detection limit or PQL		Std. devn.	53
Method detection limit		Median	28
TOTAL	12	Min.	6.0
		Max.	190

Lognormal distribution? r-squared is: 0.973

Normal distribution? r-squared is: 0.757

Recommendations:

Use lognormal distribution.

UCL (Land's method) is 137

4-4'-DDE 95% UCL Calculation

DATA	ID
0.12	J1TXN9/J1TXP5
1.2	J1TXN3
4.7	J1TXN4
3.1	J1TXN5
0.12	J1TXN6
0.12	J1TXN7
0.47	J1TXN8
1.0	J1TXP0
0.12	J1TXP1
2.0	J1TXP2
0.12	J1TXP3
0.47	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	1.1
Censored		Lognormal mean	1.3
Detection limit or PQL		Std. devn.	1.5
Method detection limit		Median	0.47
TOTAL	12	Min.	0.12
		Max.	4.7

Lognormal distribution? r-squared is: 0.884

Normal distribution? r-squared is: 0.750

Recommendations:

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 1.8

4-4'-DDT 95% UCL Calculation

DATA	ID
0.28	J1TXN9/J1TXP5
5.0	J1TXN3
4.4	J1TXN4
3.1	J1TXN5
0.29	J1TXN6
0.29	J1TXN7
0.94	J1TXN8
1.1	J1TXP0
0.29	J1TXP1
1.6	J1TXP2
0.30	J1TXP3
0.30	J1TXP4

Number of samples		Uncensored values	
Uncensored	12	Mean	1.5
Censored		Lognormal mean	1.6
Detection limit or PQL		Std. devn.	1.7
Method detection limit		Median	0.62
TOTAL	12	Min.	0.28
		Max.	5.0

Lognormal distribution? r-squared is: 0.832

Normal distribution? r-squared is: 0.753

Recommendations:

Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 2.3

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson RN
Project 100-H Area Closure Operations
Subject 100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations

Date 11/17/14
Job No. 14655

Calc. No. 0100H-CA-V0217
Checked I. B. Berezovskiy

Rev. No. 0
Date 11/17/14
Sheet No. 14 of 14

Duplicate Analysis - 100-H-51:1 Subsite - Excavation

Sampling Area	Sample Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-7	J1TXN9	8/26/14	8750		1.3	0.58		0.33	18.9		0.57	60.7	X	0.066	0.075	BC	0.036	4840	X	12.2	11.5	X	0.050	5.4	X	0.1
Duplicate of J1TXN9	J1TXP5	8/26/14	8330		1.4	0.35		0.35	18.5		0.61	65.4	X	0.071	0.073	BC	0.038	5260	X	13.1	11.3	X	0.054	5.9	X	0.1

Analysis:

TDL		5	0.6	10	2	0.2	100	1	2
Duplicate Analysis	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)
	RPD	4.9%			7.5%		8.3%	1.8%	
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

Duplicate Analysis - 100-H-51:1 Subsite - Excavation

Sampling Area	Sample Number	Sample Date	Copper			Hexavalent Chromium			Iron			Lead			Magnesium			Manganese			Mercury			Nickel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-7	J1TXN9	8/26/14	13.0	X	0.19	0.358		0.155	15600		3.3	120	X	0.23	4140		3.2	256	X	0.087	0.019		0.0053	11.4	X	0.11
Duplicate of J1TXN9	J1TXP5	8/26/14	13.8	X	0.20	0.275		0.155	17600		3.5	102	X	0.25	4510		3.4	293	X	0.093	0.022		0.0050	11.6	X	0.11

Analysis:

TDL		1	0.5	5	5	75	5	0.2	4
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	6.0%		12.0%	16.2%	8.6%	13.5%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	Not applicable	Not applicable	No - acceptable	No - acceptable

Duplicate Analysis - 100-H-51:1 Subsite - Excavation

Sampling Area	Sample Number	Sample Date	Potassium			Silicon			Sodium			Vanadium			Zinc			Benzo(a)pyrene			Benzo(b)fluoranthene			Benzo(ghi)perylene		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
EXC-7	J1TXN9	8/26/14	1220		35.6	151	NJ	4.9	216		51.2	35.0		0.082	35.2		0.35	14	J	6.4	13	J	4.2	8.0	J	7.1
Duplicate of J1TXN9	J1TXP5	8/26/14	1250		38.0	161	NJ	5.3	252		54.8	39.8		0.087	40.1		0.37	11	J	6.4	14	J	4.2	7.6	JX	7.1

Analysis:

TDL		400	2	50	2.5	1	15	15	15
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD		6.4%		12.8%	13.0%			
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable

Duplicate Analysis - 100-H-51:1 Subsite - Excavation

Sampling Area	Sample Number	Sample Date	Chrysene			Fluoranthene			Pyrene		
			ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
EXC-7	J1TXN9	8/26/14	15	J	4.8	20	J	13	24	J	12
Duplicate of J1TXN9	J1TXP5	8/26/14	17	J	4.8	16	J	13	17	J	12

Analysis:

TDL		15	15	15
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD			
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable

Acronyms and qualifiers are defined on sheet 3.

Attachment 1. 100-H-51:1 Subsite Verification Sample Results (Metals).

Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-7	J1TXN9	8/26/14	8750		1.3	0.58	J	0.33	18.9		0.57	60.7	X	0.066	0.029	U	0.029	2.0		0.85
Duplicate of J1TXN9	J1TXP5	8/26/14	8330		1.4	0.35	BJ	0.35	18.5		0.61	65.4	X	0.071	0.031	U	0.031	2.0		0.91
EXC-1	J1TXN3	8/26/14	6270		1.3	0.45	BJ	0.33	8.3		0.57	53.2	X	0.066	0.029	U	0.029	1.8		0.85
EXC-2	J1TXN4	8/26/14	6420		1.4	0.34	UJ	0.34	7.7		0.59	50.5	X	0.068	0.029	U	0.029	1.6	B	0.87
EXC-3	J1TXN5	8/26/14	7280		1.3	0.33	UJ	0.33	24.6		0.56	68.5	X	0.065	0.028	U	0.028	4.1		0.84
EXC-3	J1V0F3	9/29/14	5350		1.4	0.34	U	0.34	4.6		0.58	33.7		0.067	0.029	U	0.029	0.94	B	0.87
EXC-4	J1TXN6	8/26/14	6680		1.4	0.34	UJ	0.34	12.1		0.59	53.9	X	0.067	0.029	U	0.029	1.6	B	0.87
EXC-5	J1TXN7	8/26/14	6030		1.5	0.37	UJ	0.37	4.4		0.65	45.6	X	0.074	0.032	U	0.032	1.2	B	0.96
EXC-6	J1TXN8	8/26/14	6960		1.3	0.33	UJ	0.33	9.7		0.57	51.4	X	0.066	0.028	U	0.028	1.5	B	0.85
EXC-8	J1TXP0	8/26/14	7710		1.5	0.38	UJ	0.38	17.9		0.66	53.5	X	0.076	0.033	U	0.033	1.8	B	0.98
EXC-9	J1TXP1	8/26/14	7780		1.6	0.41	BJ	0.38	22.4		0.66	58.8	X	0.076	0.033	U	0.033	1.3	B	0.98
EXC-9	J1V0F4	9/29/14	6010		1.5	0.85		0.37	8.0		0.64	50.6		0.074	0.032	U	0.032	2.0		0.95
EXC-10	J1TXP2	8/26/14	6370		1.5	0.36	UJ	0.36	5.2		0.63	53.2	X	0.072	0.031	U	0.031	1.1	B	0.93
EXC-11	J1TXP3	8/26/14	8520		1.3	0.33	UJ	0.33	14.9		0.57	67.5	X	0.066	0.029	U	0.029	1.4	B	0.85
EXC-12	J1TXP4	8/26/14	9830		1.5	0.37	UJ	0.37	16.3		0.64	79.4	X	0.073	0.032	U	0.032	1.8	B	0.94
FS-1	J1TPJ3	5/13/14	5670		1.4	0.33	U	0.33	5.4		0.58	45.2		0.066	0.029	U	0.029	1.0	B	0.86
Equipment blank	J1TXP6	8/26/14	150		1.3	0.33	UJ	0.33	0.57	U	0.57	1.0	X	0.066	0.044	B	0.029	0.85	U	0.85

Gray cells indicate not applicable.

B = estimated result. Result is less than the RL, but greater than the MDL.

C = the analyte was detected in both the sample and the associated QC blank, and the sample concentrations was </= 5X the blank concentration

EXC = excavation

FS = focused sample

HEIS = Hanford Environmental Information System

J = Result is les than the RL but greater than or equal to the MDL and the concentration is an approximate value (organics)

M = sample duplicate precision not met

N = recovery exceeds upper or lower control limits (metals)

N = MS, MSD recovery exceeds upper or lower control limits (organics)

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyls

PEST = pesticides

PQL = practical quantitation limit

Q = qualifier

SVOA = semivolatile organic analysis

U = undetected

X = serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals)

X = More than 40% difference between columns, lower result reported (organics)

Attachment	1	Sheet No.	1 of 9
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0217	Rev. No.	0

Attachment 1. 100-H-51:1 Subsite Verification Sample Results (Metals and Hexavalent Chromium).

Location	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-7	J1TXN9	8/26/14	0.075	BCUJ	0.036	4840	X	12.2	11.5	X	0.050	5.4	X	0.087	13.0	X	0.19	0.358		0.155
Duplicate of J1TXN9	J1TXP5	8/26/14	0.073	BCUJ	0.038	5260	X	13.1	11.3	X	0.054	5.9	X	0.093	13.8	X	0.20	0.275		0.155
EXC-1	J1TXN3	8/26/14	0.070	BCUJ	0.036	5950	X	12.3	10.5	X	0.050	5.0	X	0.087	13.2	X	0.19	0.361		0.155
EXC-2	J1TXN4	8/26/14	0.32	UJ	0.037	5880	X	12.6	10.2	X	0.052	4.8	X	0.089	12.2	X	0.19	0.295		0.155
EXC-3	J1TXN5	8/26/14	0.083	BCUJ	0.035	3850	X	12.1	9.8	X	0.050	4.6	X	0.086	12.2	X	0.19	0.155	U	0.155
EXC-3	J1V0F3	9/29/14	0.036	U	0.036	5940		12.5	9.1		0.051	4.9	X	0.088	10.7		0.19			
EXC-4	J1TXN6	8/26/14	0.060	BCUJ	0.036	5680	X	12.5	11.3	X	0.051	5.8	X	0.089	14.5	X	0.19	0.235		0.155
EXC-5	J1TXN7	8/26/14	0.086	BCUJ	0.040	4410	X	13.8	8.3	X	0.057	4.5	X	0.098	10.8	X	0.21	0.196		0.155
EXC-6	J1TXN8	8/26/14	0.067	BCUJ	0.035	5320	X	12.2	10.0	X	0.050	4.9	X	0.086	12.4	X	0.19	0.380		0.155
EXC-8	J1TXP0	8/26/14	0.041	U	0.041	5320	X	14.1	10.4	X	0.058	5.2	X	0.10	12.5	X	0.22	0.213		0.155
EXC-9	J1TXP1	8/26/14	0.064	BCUJ	0.041	3220	X	14.1	8.8	X	0.058	4.7	X	0.10	10.2	X	0.22	0.155	U	0.155
EXC-9	J1V0F4	9/29/14	0.060	B	0.040	5680		13.7	14.8		0.056	5.6		0.097	14.2	X	0.21			
EXC-10	J1TXP2	8/26/14	0.062	BCUJ	0.039	5130	X	13.4	9.0	X	0.055	4.6	X	0.095	11.8	X	0.21	0.213		0.155
EXC-11	J1TXP3	8/26/14	0.079	BCUJ	0.036	4990	X	12.3	12.2	X	0.050	6.1	X	0.087	14.5	X	0.19	0.254		0.155
EXC-12	J1TXP4	8/26/14	0.12	BCUJ	0.039	4770	X	13.6	13.0	X	0.056	6.3	X	0.096	17.6	X	0.21	0.155	U	0.155
FS-1	J1TPJ3	5/13/14	0.11	B	0.036	5380		12.3	9.0		0.051	6.5		0.087	14.5		0.19	0.155	U	0.155
Equipment blank	J1TXP6	8/26/14	0.036	U	0.036	36.4	BX	12.3	0.38	XCUJ	0.050	0.18	BX	0.087	0.94	X	0.19			

Location	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-7	J1TXN9	8/26/14	15600		3.3	120	X	0.23	4140		3.2	256	X	0.087	0.019		0.0053	0.23	U	0.23
Duplicate of J1TXN9	J1TXP5	8/26/14	17600		3.5	102	X	0.25	4510		3.4	293	X	0.093	0.022		0.0050	0.24	U	0.24
EXC-1	J1TXN3	8/26/14	15400		3.3	29.3	X	0.23	4120		3.2	259	X	0.087	0.0080	BM	0.0050	0.35	BM	0.23
EXC-2	J1TXN4	8/26/14	15400		3.4	22.9	X	0.24	3930		3.3	271	X	0.089	0.0085	B	0.0054	0.3	B	0.23
EXC-3	J1TXN5	8/26/14	13400		3.3	123	X	0.23	3160		3.2	240	X	0.086	0.031		0.0052	0.29	B	0.22
EXC-3	J1V0F3	9/29/14	14400		3.4	10.0		0.24	4160		3.3	235		0.088				0.23	B	0.23
EXC-4	J1TXN6	8/26/14	18400		3.4	35.7	X	0.24	4190		3.3	272	X	0.089	0.016		0.0051	0.23	U	0.23
EXC-5	J1TXN7	8/26/14	13200		3.7	6.1	X	0.26	3380		3.6	220	X	0.098	0.0084	B	0.0051	0.25	U	0.25
EXC-6	J1TXN8	8/26/14	15300		3.3	49.3	X	0.23	3980		3.2	247	X	0.086	0.011	B	0.0052	0.22	U	0.22
EXC-8	J1TXP0	8/26/14	15700		3.8	95.1	X	0.27	3790		3.7	246	X	0.10	0.0092	B	0.0049	0.26	U	0.26
EXC-9	J1TXP1	8/26/14	13700		3.8	56.1	X	0.27	3310		3.7	234	X	0.10	0.0069	B	0.0049	0.26	U	0.26
EXC-9	J1V0F4	9/29/14	16300		3.7	16.3		0.26	4880		3.6	272		0.097				0.32	B	0.25
EXC-10	J1TXP2	8/26/14	13300		3.6	18.4	X	0.26	3310		3.5	205	X	0.095	0.010	B	0.0052	0.25	U	0.25
EXC-11	J1TXP3	8/26/14	18200		3.3	28.7	X	0.23	4840		3.2	295	X	0.087	0.010	B	0.0050	0.23	U	0.23
EXC-12	J1TXP4	8/26/14	18500		3.7	47.7	X	0.26	4770		3.6	342	X	0.096	0.029		0.0052	0.25	U	0.25
FS-1	J1TPJ3	5/13/14	15000		3.3	14.7		0.24	3910		3.2	229		0.087	0.0053	U	0.0053	0.23	U	0.23
Equipment blank	J1TXP6	8/26/14	298		3.3	0.23	UX	0.23	22.4		3.2	3.2	X	0.087	0.0054	U	0.0054	0.23	U	0.23

Attachment	1	Sheet No.	2 of 9
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0217	Rev. No.	0

Attachment 1. 100-H-51:1 Subsite Verification Sample Results (Metals and Physical).

Location	HEIS Number	Sample Date	Nickel			Potassium			Selenium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-7	J1TXN9	8/26/14	11.4	X	0.11	1220		35.6	0.75	U	0.75	151	NJ	4.9	0.14	U	0.14	216		51.2
Duplicate of J1TXN9	J1TXP5	8/26/14	11.6	X	0.11	1250		38.0	0.80	U	0.80	161	NJ	5.3	0.21		0.15	252		54.8
EXC-1	J1TXN3	8/26/14	11.1	XM	0.11	849		35.7	0.75	U	0.75	101	NJ	4.9	0.14	U	0.14	203		51.3
EXC-2	J1TXN4	8/26/14	9.6	X	0.11	840		36.5	0.77	U	0.77	123	NJ	5.0	0.14	U	0.14	263		52.6
EXC-3	J1TXN5	8/26/14	8.5	X	0.11	1170		35.1	0.74	U	0.74	136	NJ	4.8	0.14	U	0.14	226		50.5
EXC-3	J1V0F3	9/29/14	9.7		0.11	689		36.3	0.76	U	0.76	150	N	5.0	0.14	U	0.14	186		52.2
EXC-4	J1TXN6	8/26/14	11.2	X	0.11	902		36.4	0.76	U	0.76	132	NJ	5.0	0.20		0.14	240		52.3
EXC-5	J1TXN7	8/26/14	8.7	X	0.12	885		40.1	0.84	U	0.84	133	NJ	5.5	0.16	B	0.16	194		57.7
EXC-6	J1TXN8	8/26/14	9.9	X	0.11	1010		35.4	0.74	U	0.74	133	NJ	4.9	0.14	U	0.14	228		50.9
EXC-8	J1TXP0	8/26/14	10.0	X	0.12	1080		40.9	0.86	U	0.86	154	NJ	5.7	0.16	U	0.16	200		58.9
EXC-9	J1TXP1	8/26/14	8.8	X	0.12	1300		41.1	0.86	U	0.86	147	NJ	5.7	0.17	B	0.16	176		59.1
EXC-9	J1V0F4	9/29/14	15.5		0.12	853		39.8	0.84	U	0.84	314	N	5.5	0.17	B	0.16	205		57.3
EXC-10	J1TXP2	8/26/14	8.6	X	0.12	853		39.0	0.82	U	0.82	132	NJ	5.4	0.15	U	0.15	236		56.2
EXC-11	J1TXP3	8/26/14	11.9	X	0.11	1330		35.7	0.75	U	0.75	181	NJ	4.9	0.19		0.14	222		51.3
EXC-12	J1TXP4	8/26/14	12.7	X	0.12	1500		39.5	0.83	U	0.83	212	NJ	5.5	0.21		0.15	224		56.8
FS-1	J1TPJ3	5/13/14	11.2		0.11	769		35.8	0.75	U	0.75	150	N	4.9	0.14	U	0.14	198		51.5
Equipment blank	J1TXP6	8/26/14	0.30	BX	0.11	54.0	B	35.7	0.75	U	0.75	71.3	NJ	4.9	0.14	U	0.14	51.3	U	51.3

Location	HEIS Number	Sample Date	Vanadium			Zinc			Percent Moisture		
			mg/kg	Q	PQL	mg/kg	Q	PQL	%	Q	PQL
EXC-7	J1TXN9	8/26/14	35.0		0.082	35.2		0.35	1.5		0.10
Duplicate of J1TXN9	J1TXP5	8/26/14	39.8		0.087	40.1		0.37	1.1		0.10
EXC-1	J1TXN3	8/26/14	39.1		0.082	35.4		0.35	1.7		0.10
EXC-2	J1TXN4	8/26/14	38.1		0.084	32.3		0.35	0.71		0.10
EXC-3	J1TXN5	8/26/14	31.1		0.080	35.5		0.34	0.93		0.10
EXC-3	J1V0F3	9/29/14	34.9		0.083	28.5		0.35	5.0		0.10
EXC-4	J1TXN6	8/26/14	46.7		0.083	36.5		0.35	1.1		0.10
EXC-5	J1TXN7	8/26/14	31.3		0.092	28.9		0.39	2.6		0.10
EXC-6	J1TXN8	8/26/14	36.3		0.081	36.7		0.34	1.7		0.10
EXC-8	J1TXP0	8/26/14	36.2		0.094	35.7		0.40	0.85		0.10
EXC-9	J1TXP1	8/26/14	28.6		0.094	30.8		0.40	1.2		0.10
EXC-9	J1V0F4	9/29/14	38.4		0.091	33.3		0.39	1.9		0.10
EXC-10	J1TXP2	8/26/14	34.2		0.089	32.0		0.38	0.88		0.10
EXC-11	J1TXP3	8/26/14	40.3		0.082	39.3		0.35	0.93		0.10
EXC-12	J1TXP4	8/26/14	39.6		0.091	51.3		0.38	1.1		0.10
FS-1	J1TPJ3	5/13/14	36.4		0.082	33.0		0.35	2.9		0.10
Equipment blank	J1TXP6	8/26/14	0.34	B	0.082	0.50	B	0.35	0.10	U	0.10

Attachment	1	Sheet No.	3 of 9
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0217	Rev. No.	0

Attachment 1. 100-H-51:1 Subsite Verification Sample Results (Anions).

Location	HEIS Number	Sample Date	Bromide			Chloride			Fluoride			Nitrogen in Nitrate			Nitrogen in Nitrite			Phosphorous in Phosphate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	%	Q	PQL
FS-1	J1TPJ3	5/13/14	0.39	U	0.39	8.6		2.0	1.2	B	0.82	1.6	B	0.31	0.34	U	0.34	1.2	U	1.2

Location	HEIS Number	Sample Date	Sulfate		
			mg/kg	Q	PQL
FS-1	J1TPJ3	5/13/14	9.5		1.7

Attachment	1	Sheet No.	4 of 9
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0217	Rev. No.	0

Attachment 1. 100-H-51:1 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TXN9			J1TXP5			J1TXN3			J1TXN4			J1TXN5			J1TXN6		
		EXC-7			Duplicate of EXC-7			EXC-1			EXC-2			EXC-3			EXC-4		
		8/26/14			8/26/14			8/26/14			8/26/14			8/26/14			8/26/14		
		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	9.9	U	9.9	9.9	U	9.9	9.8	U	9.8	9.8	U	9.8	20	JX	9.6	10	U	10
Acenaphthylene	PAH	8.9	U	8.9	8.9	U	8.9	8.8	U	8.8	8.8	U	8.8	8.6	U	8.6	9.0	U	9.0
Anthracene	PAH	3.0	U	3.0	3.0	U	3.0	3.0	U	3.0	3.0	U	3.0	2.9	U	2.9	3.1	U	3.1
Benzo(a)anthracene	PAH	8.9	J	3.2	3.2	U	3.2	7.4	JX	3.1	5.7	JX	3.1	130		3.0	4.4	JX	3.2
Benzo(a)pyrene	PAH	14	J	6.4	11	J	6.4	10	J	6.3	15	X	6.3	83		6.1	7.3	JX	6.4
Benzo(b)fluoranthene	PAH	13	J	4.2	14	J	4.2	18		4.1	12	JX	4.1	70		4.0	6.9	J	4.2
Benzo(ghi)perylene	PAH	8	J	7.1	7.6	JX	7.1	8.7	JX	7	18	J	7	63		6.9	8.2	JX	7.2
Benzo(k)fluoranthene	PAH	3.9	U	3.9	5	J	3.9	4.2	J	3.8	4.0	J	3.9	30		3.8	4.0	U	4.0
Chrysene	PAH	15	J	4.8	17	J	4.8	18	J	4.7	14	J	4.7	85		4.6	4.9	U	4.9
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	11	U	11	11	U	11	11	U	11	11	U	11
Fluoranthene	PAH	20	J	13	16	J	13	27	J	13	31	J	13	160		12	20	J	13
Fluorene	PAH	5.2	U	5.2	5.2	U	5.2	5.1	U	5.1	5.2	U	5.2	8.7	JX	5.0	5.3	U	5.3
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	12	U	12	12	U	12	12	U	12	38	X	11	12	U	12
Naphthalene	PAH	12	U	12	12	U	12	12	U	12	12	U	12	16	JX	11	12	U	12
Phenanthrene	PAH	12	U	12	12	U	12	18	JX	12	17	J	12	81		11	12	U	12
Pyrene	PAH	24	J	12	17	J	12	26	J	12	37	J	12	190		11	30	J	12
Aldrin	PEST	0.24	U	0.24	0.24	U	0.24	0.25	U	0.25	0.24	U	0.24	0.25	U	0.25	0.25	U	0.25
Alpha-BHC	PEST	0.21	U	0.21	0.20	U	0.20	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21
alpha-Chlordane	PEST	0.31	U	0.31	0.31	U	0.31	0.32	U	0.32	0.31	U	0.31	0.32	U	0.32	0.32	U	0.32
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	0.64	U	0.64	0.63	U	0.63	0.66	U	0.66	0.64	U	0.64	0.65	U	0.65	0.65	U	0.65
Delta-BHC	PEST	0.39	U	0.39	0.38	U	0.38	0.40	U	0.40	0.38	U	0.38	0.39	U	0.39	0.39	U	0.39
Dichlorodiphenyldichloroethane	PEST	0.52	U	0.52	0.52	U	0.52	0.54	U	0.54	0.52	U	0.52	0.54	UN	0.54	0.54	U	0.54
Dichlorodiphenyldichloroethylene	PEST	0.23	U	0.23	0.23	U	0.23	1.2	J	0.24	4.7		0.23	3.1		0.23	0.23	U	0.23
Dichlorodiphenyltrichloroethane	PEST	0.57	U	0.57	0.56	U	0.56	5.00	X	0.58	4.4		0.57	3.1	X	0.58	0.58	U	0.58
Dieldrin	PEST	0.20	U	0.2	0.20	U	0.20	0.21	U	0.21	0.20	U	0.20	0.21	U	0.21	0.21	U	0.21
Endosulfan I	PEST	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17
Endosulfan II	PEST	0.28	U	0.28	0.27	U	0.27	0.28	U	0.28	0.28	U	0.28	0.28	U	0.28	0.28	U	0.28
Endosulfan sulfate	PEST	0.27	U	0.27	0.26	U	0.26	0.27	U	0.27	0.26	U	0.26	0.27	U	0.27	0.27	U	0.27
Endrin	PEST	0.29	U	0.29	0.29	U	0.29	0.30	U	0.30	0.29	U	0.29	0.30	U	0.30	0.30	U	0.30
Endrin aldehyde	PEST	0.16	U	0.16	0.16	U	0.16	0.17	U	0.17	0.16	U	0.16	0.17	U	0.17	0.17	U	0.17
Endrin ketone	PEST	0.47	U	0.47	0.47	U	0.47	0.48	U	0.48	0.47	U	0.47	0.48	U	0.48	0.48	U	0.48
Gamma-BHC (Lindane)	PEST	0.45	U	0.45	0.44	U	0.44	0.46	U	0.46	0.45	U	0.45	0.46	U	0.46	0.46	U	0.46
gamma-Chlordane	PEST	0.26	U	0.26	0.25	U	0.25	0.26	U	0.26	0.26	U	0.26	0.26	U	0.26	0.26	U	0.26
Heptachlor	PEST	0.21	U	0.21	0.20	U	0.20	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21
Heptachlor epoxide	PEST	0.41	U	0.41	0.41	U	0.41	0.42	U	0.42	0.41	U	0.41	0.42	U	0.42	0.42	U	0.42
Methoxychlor	PEST	0.43	U	0.43	0.43	U	0.43	0.45	U	0.45	0.43	U	0.43	0.44	U	0.44	0.44	U	0.44
Toxaphene	PEST	15	UJ	15	15	UJ	15	16	UJ	16	15	UJ	15	16	UJ	16	16	UJ	16

Attachment	1	Sheet No.	5 of 9
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0217	Rev. No.	0

Attachment 1. 100-H-51:1 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TXN7			J1TXN8			J1TXP0			J1TXP1			J1TXP2			J1TXP3		
		EXC-5			EXC-6			EXC-8			EXC-9			EXC-10			EXC-11		
		8/26/14			8/26/14			8/26/14			8/26/14			8/26/14			8/26/14		
		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	9.8	U	9.8	9.8	U	9.8	9.4	U	9.4	9.8	U	9.8	10	U	10	14	J	9.5
Acenaphthylene	PAH	8.8	U	8.8	8.9	U	8.9	8.5	U	8.5	8.8	U	8.8	9.0	U	9.0	8.5	U	8.5
Anthracene	PAH	3.0	U	3.0	3.0	U	3.0	2.9	U	2.9	3.0	U	3.0	3.0	U	3.0	2.9	U	2.9
Benzo(a)anthracene	PAH	3.1	U	3.1	16	X	3.1	3.0	U	3.0	3.1	U	3.1	3.2	U	3.2	46		3.0
Benzo(a)pyrene	PAH	6.3	U	6.3	80		6.3	6.8	J	6.0	6.3	U	6.3	6.4	U	6.4	43		6.1
Benzo(b)fluoranthene	PAH	4.1	U	4.1	65		4.1	8.1	J	4.0	4.8	JX	4.1	4.2	U	4.2	42		4.0
Benzo(ghi)perylene	PAH	7.0	U	7.0	80		7.1	6.8	U	6.8	7.1	U	7.1	7.2	U	7.2	30		6.8
Benzo(k)fluoranthene	PAH	3.9	U	3.9	24		3.9	3.7	U	3.7	3.9	U	3.9	3.9	U	3.9	18		3.7
Chrysene	PAH	4.7	U	4.7	100		4.8	13	J	4.6	6.2	JX	4.7	4.8	U	4.8	35	JX	4.6
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	10	U	10	11	U	11	11	U	11	10	U	10
Fluoranthene	PAH	13	U	13	120		13	23	J	12	13	U	13	13	U	13	76		12
Fluorene	PAH	5.2	U	5.2	6.6	J	5.2	5.0	U	5.0	5.2	U	5.2	5.3	U	5.3	8.3	JX	5.0
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	38		12	11	U	11	12	U	12	12	U	12	31		11
Naphthalene	PAH	12	U	12	12	U	12	11	U	11	12	U	12	12	U	12	11	U	11
Phenanthrene	PAH	12	U	12	60		12	12	J	11	12	U	12	12	U	12	40		11
Pyrene	PAH	12	U	12	93	X	12	22	J	11	15	J	12	12	U	12	83		11
Aldrin	PEST	0.24	U	0.24	0.25	U	0.25	0.25	U	0.25	0.24	U	0.24	0.25	U	0.25	0.25	U	0.25
Alpha-BHC	PEST	0.21	U	0.21	0.22	U	0.22	0.22	U	0.22	0.21	U	0.21	0.21	U	0.21	0.22	U	0.22
alpha-Chlordane	PEST	0.31	U	0.31	0.33	U	0.33	0.32	U	0.32	0.31	U	0.31	0.32	U	0.32	0.32	U	0.32
Beta-BHC	PEST	0.64	U	0.64	0.67	U	0.67	0.67	U	0.67	0.64	U	0.64	0.65	U	0.65	0.67	U	0.67
Delta-BHC	PEST	0.39	U	0.39	0.41	U	0.41	0.40	U	0.40	0.39	U	0.39	0.39	U	0.39	0.40	U	0.40
4-4'-DDD	PEST	0.53	U	0.53	0.55	U	0.55	0.55	U	0.55	0.53	U	0.53	0.54	U	0.54	0.55	U	0.55
4-4'-DDE	PEST	0.23	U	0.23	0.47	J	0.24	1.0	J	0.24	0.23	U	0.23	2.0		0.23	0.24	U	0.24
4-4'-DDT	PEST	0.57	U	0.57	0.94	JX	0.6	1.1	JX	0.59	0.57	U	0.57	1.6	J	0.58	0.59	U	0.59
Dieldrin	PEST	0.20	U	0.20	0.21	U	0.21	0.21	U	0.21	0.20	U	0.20	0.21	U	0.21	0.21	U	0.21
Endosulfan I	PEST	0.17	U	0.17	0.18	U	0.18	0.18	U	0.18	0.17	U	0.17	0.17	U	0.17	0.18	U	0.18
Endosulfan II	PEST	0.28	U	0.28	0.29	U	0.29	0.29	U	0.29	0.28	U	0.28	0.28	U	0.28	0.29	U	0.29
Endosulfan sulfate	PEST	0.27	U	0.27	0.28	U	0.28	0.28	U	0.28	0.27	U	0.27	0.27	U	0.27	0.28	U	0.28
Endrin	PEST	0.30	U	0.30	0.31	U	0.31	0.31	U	0.31	0.29	U	0.29	0.30	U	0.30	0.31	U	0.31
Endrin aldehyde	PEST	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.16	U	0.16	0.17	U	0.17	0.17	U	0.17
Endrin ketone	PEST	0.47	U	0.47	0.49	U	0.49	0.49	U	0.49	0.47	U	0.47	0.48	U	0.48	0.49	U	0.49
Gamma-BHC (Lindane)	PEST	0.45	U	0.45	0.47	U	0.47	0.47	U	0.47	0.45	U	0.45	0.46	U	0.46	0.47	U	0.47
gamma-Chlordane	PEST	0.26	U	0.26	0.27	U	0.27	0.27	U	0.27	0.26	U	0.26	0.26	U	0.26	0.27	U	0.27
Heptachlor	PEST	0.21	U	0.21	0.22	U	0.22	0.22	U	0.22	0.21	U	0.21	0.21	U	0.21	0.22	U	0.22
Heptachlor epoxide	PEST	0.41	U	0.41	0.43	U	0.43	0.43	U	0.43	0.41	U	0.41	0.42	U	0.42	0.43	U	0.43
Methoxychlor	PEST	0.44	U	0.44	0.45	U	0.45	0.45	U	0.45	0.43	U	0.43	0.44	U	0.44	0.45	U	0.45
Toxaphene	PEST	15	UJ	15	16	UJ	16	16	UJ	16	15	UJ	15	16	UJ	16	16	UJ	16

Attachment	1	Sheet No.	6 of 9
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0217	Rev. No.	0

Attachment 1. 100-H-51:1 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TXP4			J1TPJ3		
		EXC-12			FS-1		
		8/26/14			5/13/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	9.9	J	9.9	10	U	10
Acenaphthylene	PAH	8.9	U	8.9	9.1	U	9.1
Anthracene	PAH	3.0	U	3.0	3.1	U	3.1
Benzo(a)anthracene	PAH	31		3.1	3.2	U	3.2
Benzo(a)pyrene	PAH	38		6.3	13	J	6.4
Benzo(b)fluoranthene	PAH	35		4.1	5.9	JN	4.2
Benzo(ghi)perylene	PAH	20	JX	7.1	7.2	U	7.2
Benzo(k)fluoranthene	PAH	15		3.9	4.0	UN	4.0
Chrysene	PAH	29	JX	4.8	7.6	J	4.9
Dibenz[a,h]anthracene	PAH	11	U	11	11	UN	11
Fluoranthene	PAH	62		13	16	J	13
Fluorene	PAH	5.2	U	5.2	5.3	U	5.3
Indeno(1,2,3-cd)pyrene	PAH	27	J	12	12	U	12
Naphthalene	PAH	12	U	12	12	U	12
Phenanthrene	PAH	27	J	12	15	JX	12
Pyrene	PAH	59		12	19	J	12
Aroclor-1016	PCB				2.8	U	2.8
Aroclor-1221	PCB				8.0	U	8.0
Aroclor-1232	PCB				2.0	U	2.0
Aroclor-1242	PCB				4.6	U	4.6
Aroclor-1248	PCB				4.6	U	4.6
Aroclor-1254	PCB				2.6	U	2.6
Aroclor-1260	PCB				2.6	U	2.6
Aldrin	PEST	0.25	U	0.25	0.26	U	0.26
Alpha-BHC	PEST	0.21	U	0.21	0.22	U	0.22
alpha-Chlordane	PEST	0.32	U	0.32	0.33	U	0.33
Beta-BHC	PEST	0.66	U	0.66	0.67	U	0.67
Delta-BHC	PEST	0.40	U	0.40	0.41	U	0.41
4-4'-DDD	PEST	0.54	U	0.54	0.55	U	0.55
4-4'-DDE	PEST	0.47	J	0.24	0.24	U	0.24
4-4'-DDT	PEST	0.59	U	0.59	0.60	U	0.60
Dieldrin	PEST	0.21	U	0.21	0.21	U	0.21
Endosulfan I	PEST	0.18	U	0.18	0.18	U	0.18
Endosulfan II	PEST	0.29	U	0.29	0.29	U	0.29
Endosulfan sulfate	PEST	0.28	U	0.28	0.28	U	0.28
Endrin	PEST	0.31	U	0.31	0.31	U	0.31
Endrin aldehyde	PEST	0.17	U	0.17	0.17	U	0.17
Endrin ketone	PEST	0.49	U	0.49	0.50	U	0.50
Gamma-BHC (Lindane)	PEST	0.46	U	0.46	0.47	U	0.47
gamma-Chlordane	PEST	0.27	U	0.27	0.27	U	0.27
Heptachlor	PEST	0.21	U	0.21	0.22	U	0.22
Heptachlor epoxide	PEST	0.43	U	0.43	0.43	U	0.43
Methoxychlor	PEST	0.45	U	0.45	0.46	U	0.46
Toxaphene	PEST	16	UJ	16	16	U	16

Attachment	1	Sheet No.	7 of 9
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0217	Rev. No.	0

Attachment 1. 100-H-51:1 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TPJ3		
		FS-1		
		5/13/14		
		ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	110	UD	110
1,2-Dichlorobenzene	SVOA	87	UD	87
1,3-Dichlorobenzene	SVOA	47	UD	47
1,4-Dichlorobenzene	SVOA	54	UD	54
2,4,5-Trichlorophenol	SVOA	39	UD	39
2,4,6-Trichlorophenol	SVOA	39	UD	39
2,4-Dichlorophenol	SVOA	39	UD	39
2,4-Dimethylphenol	SVOA	260	UD	260
2,4-Dinitrophenol	SVOA	1300	UD	1300
2,4-Dinitrotoluene	SVOA	260	UD	260
2,6-Dinitrotoluene	SVOA	110	UD	110
2-Chloronaphthalene	SVOA	39	UD	39
2-Chlorophenol	SVOA	83	UD	83
2-Methylnaphthalene	SVOA	75	UD	75
2-Methylphenol (cresol, o-)	SVOA	51	UD	51
2-Nitroaniline	SVOA	200	UD	200
2-Nitrophenol	SVOA	39	UD	39
3,3'-Dichlorobenzidine	SVOA	360	UD	360
3+4 Methylphenol (cresol, m+p)	SVOA	130	UD	130
3-Nitroaniline	SVOA	290	UD	290
4,6-Dinitro-2-methylphenol	SVOA	1300	UD	1300
4-Bromophenylphenyl ether	SVOA	75	UD	75
4-Chloro-3-methylphenol	SVOA	260	UD	260
4-Chloroaniline	SVOA	320	UD	320
4-Chlorophenylphenyl ether	SVOA	83	UD	83
4-Nitroaniline	SVOA	290	UD	290
4-Nitrophenol	SVOA	380	UD	380
Acenaphthene	SVOA	41	UD	41
Acenaphthylene	SVOA	67	UD	67
Anthracene	SVOA	67	UD	67
Benzo(a)anthracene	SVOA	79	UD	79
Benzo(a)pyrene	SVOA	79	UD	79

Attachment	1	Sheet No.	8 of 9
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0217	Rev. No.	0

Attachment 1. 100-H-51:1 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TPJ3		
		FS-1		
		5/13/14		
		ug/kg	Q	PQL
Benzo(b)fluoranthene	SVOA	100	UD	100
Benzo(ghi)perylene	SVOA	63	UD	63
Benzo(k)fluoranthene	SVOA	160	UD	160
Bis(2-chloro-1-methylethyl)ether	SVOA	91	UD	91
Bis(2-Chloroethoxy)methane	SVOA	91	UD	91
Bis(2-chloroethyl) ether	SVOA	66	UD	66
Bis(2-ethylhexyl) phthalate	SVOA	180	UD	180
Butylbenzylphthalate	SVOA	170	UD	170
Carbazole	SVOA	140	UD	140
Chrysene	SVOA	110	UD	110
Dibenz[a,h]anthracene	SVOA	75	UD	75
Dibenzofuran	SVOA	79	UD	79
Diethyl phthalate	SVOA	100	UD	100
Dimethyl phthalate	SVOA	91	UD	91
Di-n-butylphthalate	SVOA	110	UD	110
Di-n-octylphthalate	SVOA	57	UD	57
Fluoranthene	SVOA	140	UD	140
Fluorene	SVOA	71	UD	71
Hexachlorobenzene	SVOA	110	UD	110
Hexachlorobutadiene	SVOA	39	UD	39
Hexachlorocyclopentadiene	SVOA	200	UD	200
Hexachloroethane	SVOA	84	UD	84
Indeno(1,2,3-cd)pyrene	SVOA	87	UD	87
Isophorone	SVOA	67	UD	67
Naphthalene	SVOA	120	UD	120
Nitrobenzene	SVOA	87	UD	87
N-Nitroso-di-n-dipropylamine	SVOA	120	UD	120
N-Nitrosodiphenylamine	SVOA	83	UD	83
Pentachlorophenol	SVOA	1300	UD	1300
Phenanthrene	SVOA	67	UD	67
Phenol	SVOA	71	UD	71
Pyrene	SVOA	48	UD	48

Attachment	1	Sheet No.	9 of 9
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0217	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-H Area Closure Operations **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0218

Subject: 100-H-51:1 Subsite 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 = 4 Total = 5	R. J. Nielson	I. B. Berezovskiy	J. D. Skoglie	S. G. Wilkinson	2/23/15

SUMMARY OF REVISION

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

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson RJN	Date:	11/17/14	Calc. No.:	0100H-CA-V0218	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy IBB	Date:	11/17/14
Subject:	100-H-51:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	1 of 4

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-H-51:1 subsite. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009), 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.

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

4) WCH, 2014, *100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations*, 0100H-CA-V0217 Rev. 0, 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 $<1 \times 10^{-5}$.

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson RJN	Date:	11/17/14	Calc. No.:	0100H-CA-V0218	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/17/14
Subject:	100-H-51:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	2 of 4

METHODOLOGY:

The 100-H-51:1 subsite is comprised of one decision unit for verification sampling, consisting of the excavation area. Additionally, one focused sample was collected. The direct contact hazard quotient and carcinogenic risk calculations for the 100-H-51:1 subsite were conservatively calculated for the entire subsite using the greater of the statistical or maximum value for each analyte in the excavation decision unit and focused sample from WCH (2014). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, molybdenum, detected polycyclic aromatic hydrocarbons, and detected pesticides require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. 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 statistical value for boron is 1.8 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 2.5×10^{-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 is 2.5×10^{-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 1.0×10^{-6}. For example, the statistical value for hexavalent chromium is 0.280 mg/kg; divided by 2.1 mg/kg, and multiplied as indicated, is 1.3×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk is obtained by summing the individual values. The excess cancer risk for the carcinogenic constituents detected is 1.0×10^{-6}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

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 $>1 \times 10^{-6}$: None
4) List the cumulative excess cancer risk for carcinogens $>1 \times 10^{-5}$: None

Table 1 shows the results of the calculations.

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson	Date:	11/17/14	Calc. No.:	0100H-CA-V0218	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/17/14
Subject:	100-H-51:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	3 of 4

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-H-51:1 Subsite.

Contaminants of Potential Concern	Statistical or Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Arsenic[c]	15.2	20	--	--	--
Boron	1.8	7,200	2.5E-04	--	--
Chromium, hexavalent[d]	0.280	240	1.2E-03	2.1	1.3E-07
Lead[e]	81.3	353	--	--	--
Molybdenum	0.35	400	8.8E-04	--	--
Polycyclic Aromatic Hydrocarbons					
Acenapthene	0.020	4,800	4.2E-06	--	--
Benzo(a)anthracene	0.12	--	--	1.37	8.8E-08
Benzo(a)pyrene	0.093	--	--	0.137	6.8E-07
Benzo(b)fluoranthene	0.092	--	--	1.37	6.7E-08
Benzo(ghi)perylene[f]	0.063	2,400	2.6E-05	--	--
Benzo(k)fluoranthene	0.014	--	--	1.37	1.0E-08
Chrysene	0.012	--	--	13.7	8.8E-10
Fluoranthene	0.14	3,200	4.4E-05	--	--
Fluorene	0.0087	3,200	2.7E-06	--	--
Indeno(1,2,3-cd)pyrene	0.038	--	--	1.37	2.8E-08
Naphthalene	0.016	1,600	1.0E-05	--	--
Phenanthrene[f]	0.035	24,000	1.5E-06	--	--
Pyrene	0.14	2,400	5.8E-05	--	--
Pesticides					
DDE, 4,4'-	0.0018	--	--	2.94	6.1E-10
DDT, 4,4'-	0.0023	40	5.8E-05	2.94	7.8E-10
Totals					
Cumulative Hazard Quotient:			**2.5E-03**		
Cumulative Excess Cancer Risk:					**1.0E-06**

Notes:

[a] = From WCH (2014).

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

[c] = 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 2009a).

[d] = Value for the carcinogen RAG calculated based on the inhalation exposure pathway (WAC) 173-340-750(3), 1996.

[e] = 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.

[f] = Toxicity data for these chemicals are not available. The cleanup levels are based on use of surrogate chemicals.
benzo(g,h,i)perylene surrogate: pyrene
phenanthrene surrogate: anthracene

-- = not applicable

RAG = remedial action goal

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson	Date:	11/17/14	Calc. No.:	0100H-CA-V0218	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/17/14
Subject:	100-H-51:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	4 of 4

CONCLUSION:

The calculations in Table 1 demonstrate that the 100-H-51:1 subsite meets the requirements for the direct contact hazard quotient and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2009b) and SAP (DOE-RL 2009a). The direct contact hazard quotient and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this subsite.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-H Area Closure Operations **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0219

Subject: 100-H-51:1 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

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 Sheets = 3 Total = 4	R. J. Nielson	J. B. Berezovsky	J. D. Skoglie	S. G. Wilkinson	2/23/15

SUMMARY OF REVISION

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

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson	Date:	11/17/2014	Calc. No.:	0100H-CA-V0219	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/17/2014
Subject:	100-H-51:1 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-H-51:1 subsite. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009), 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.

GIVEN/REFERENCES:

1) BHI, 2005, *100 Area Analogous Sites RESRAD Evaluation*, Calculation No. 0100X-CA-V0050 Rev 0, Bechtel Hanford, Inc., Richland, Washington.

2) DOE-RL, 2009, *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) WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996.

4) WCH, 2014, *100-H-51:1 Subsite Cleanup Verification 95% UCL Calculations*, 0100H-CA-V0217, Rev. 0, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Generate a HQ for each noncarcinogenic constituent detected above background in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (BHI 2005).

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 in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (BHI 2005).

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

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson	Date:	11/17/2014	Calc. No.:	0100H-CA-V0219	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/17/2014
Subject:	100-H-51:1 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 100-H-51:1 subsite consists of one decision unit for the purpose of verification sampling; specifically, the excavation area. Additionally, one focused sample was collected. The hazard quotient and carcinogenic risk calculations for potential impact to groundwater at the 100-H-51:1 subsite were conservatively calculated for the entire subsite using the greater of the statistical or maximum value for each analyte in the excavation area decision unit and focused sample from the 95% UCL calculation (WCH 2014). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, acenaphthene, and naphthalene are included because no Washington State or Hanford background value has been established or the detected value is greater than the background value and the distribution coefficients are less than that necessary to show no migration to groundwater in 1,000 years using the generic site RESRAD model (BHI 2005). Arsenic was detected above background; however, the arsenic standard is not toxicity based. Based on this model and a vadose zone of approximately 12 m (39 ft) thickness, a K_d of 6.1 or greater is required to show no predicted migration to groundwater in 1,000 years. All other site nonradionuclide COPCs were not detected, quantified below background levels, or have a K_d greater than or equal to 6.1. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum or statistical value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (mg/L) (calculated with, and related to the hazard quotient through, WAC 173-340-720(3)(a)(ii)(A), 1996) x 100 x 1 mg/1000 mg (conversion factor). This is based on the "100 times rule" of WAC 173-340-740(3)(a)(ii)(A) (1996). For example, the statistical value for boron of 1.8 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 5.6×10^{-3}. Comparing this value 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 cumulative HQ for the 100-H-51:1 subsite is 6.5×10^{-2}. 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, and then multiplied by 1×10^{-6}. The 100-H-51:1 subsite does not have any constituents with carcinogenic RAGs; therefore, the criterion for excess risk is met. Consequently, the criterion for cumulative excess cancer risk for carcinogens is also met.

4) The soil cleanup RAGs for protection of groundwater are based on the "100 times" provision in WAC 173-340-740(3)(a)(ii)(A). WAC 173-340-740(3)(a)(ii)(A) (1996) provides the "100 times rule" but also states "unless it can be demonstrated that a higher soil concentration is protective of ground water at the site." When the "100 times rule" values are exceeded, RESRAD was used to demonstrate that higher soil concentrations may be protective of groundwater.

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson	Date:	11/17/2014	Calc. No.:	0100H-CA-V0219	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/17/2014
Subject:	100-H-51:1 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 3 of 3	

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 calculations.

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-H-51:1 Subsite.

Contaminants of Potential Concern[a]	Maximum or Statistical Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Arsenic	15.2	20[c]	--	--	--
Boron	1.8	320	5.6E-03	--	--
Chromium, hexavalent	0.280	4.8	5.8E-02	--	--
Semivolatiles					
Acenaphthene	0.020	96	2.1E-04	--	--
Naphthalene	0.016	16	1.0E-03	--	
Totals					
Cumulative Hazard Quotient:			**6.5E-02**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:

[a] = From WCH (2014).

[b] = Value obtained from the Cleanup Levels and Risk Calculations (CLARC) database using Groundwater, Method B, results and the "100 times" model.

[c] = 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 2009). The arsenic standard is not toxicity based, therefore, will not have a hazard quotient calculated.

-- = not applicable

RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-H-51:1 subsite meets the requirements for the hazard quotient and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2009).

APPENDIX D

DATA QUALITY ASSESSMENT

APPENDIX D

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 and the resampling agreement (WCH 2014b, 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), resampling agreement (WCH 2014b), the field logbook (WCH 2014a), and applicable analytical data packages has been performed as part of this DQA. To ensure quality data, the 100 Area SAP (DOE-RL 2009) 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 100-H-51:1 subsite were provided by the laboratories in three sample delivery groups (SDGs): SDG JP0792, SDG JP0853, and SDG JP0867. The SDG JP0853 was submitted for third-party validation. Major and minor deficiencies are discussed for the 100-H-51:1 subsite 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.

MAJOR DEFICIENCIES

Due to the holding time exceedances of greater than twice the limit of 48 hours for the method 9056M ion chromatography (IC) anions analysis, nitrate, nitrite, and orthophosphate results, all undetected nitrite and orthophosphate results in SDG JP0792 are qualified as rejected with a "UR" flags. All detected nitrate results are qualified as estimated with "J" flags. Phosphate is not a regulated chemical under *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup." Nitrate and nitrite are excluded from the list of 100-H-51:1 subsite contaminants of potential concern (COPCs) and were evaluated in SDG JP0792 for conservative purposes while the sampling design was in preparation. The rejection of the undetected nitrite and orthophosphate data does not hinder the evaluation of the 100-H-51:1 subsite. The resulting data set is acceptable for decision-making purposes.

SDG JP0792

This SDG comprises one focused soil sample (J1TPJ3) from the road crossing area. This sample was analyzed for inductively coupled plasma (ICP) metals, mercury, IC anions, hexavalent chromium, semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs), and pesticides. Minor deficiencies are as follows.

In the SVOC analysis, the matrix spike (MS) and matrix spike duplicate (MSD) recoveries are outside the quality control (QC) limits for 2,4-dinitrophenol at 39% and 36%, respectively. The LCS recovery for 2,4-dinitrophenol is within the acceptable project QC limits. Results for 2,4-dinitrophenol in SDG JP0792 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, iron was detected in the method blank at very low levels, less than 1/20th of the associated field sample result. Although not qualified for the method blank contamination, all iron results may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample (LCS) recovery for silicon was below the project recovery limit at 8%. Silicon is not a COPC for the 100-H-51:1 subsite nor is it a regulated compound under WAC 173-340. Although not qualified for LCS recovery below the QC limit, all silicon results in SDG JP0792 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for five analytes (aluminum [1,105%], antimony [57%], iron [2,889%], manganese [298%], and silicon [21%]). For aluminum, iron, and manganese analytes the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. Although not qualified for MS recoveries below the QC limit, all antimony and silicon data in SDG JP0792 may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 9056M IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range on all samples. All detected nitrate results in SDG JP0792 are considered estimated. Estimated data are usable for decision-making purposes. The nondetected nitrite and orthophosphate results are discussed in the "Major Deficiencies" section above.

SDG JP0853

This SDG comprises 12 statistical soil samples (J1TXN3 through J1TXN9, J1TXP0 through J1TXP4) from the 100-H-51:1 subsite excavation area. This SDG includes one field duplicate pair (J1TXN9/J1TXP5). These samples were analyzed for ICP metals, mercury, IC anions, nitrate/nitrite and hexavalent chromium. In addition, one field equipment blank (J1TXP6) was

collected and analyzed for ICP metals and mercury. SDG JP0853 was submitted for third-party validation. Minor deficiencies are as follows.

In the ICP metals analysis, cadmium was detected in the method blank. Third-party validation qualified all detected cadmium results in SDG JP0853 as undetected with "UJ' flags. Data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon was below the project recovery limit at 7%. All silicon results in SDG JP0853 were qualified as estimated with "J" flags by third-party validation. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for five analytes (aluminum [1,014%], antimony [49%], iron [1,939%], manganese [142%], and silicon [20%]). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. 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. Antimony and silicon did not have mismatched spike and native concentrations in the MS. All antimony and silicon results for SDG JP0853 were qualified as estimated with "J" flags by third-party validation. Estimated data are usable for decision-making purposes.

In the SVOC analysis, due to lack of MS, MSD, and LCS for toxaphene, third-party validation qualified all toxaphene results in SDG JP0853 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

SDG JP0867

This SDG comprises two statistical soil samples (J1V0F3 and J1V0F4) from sampling locations EXC-3 and EXC-9. These two samples were collected following additional remediation at these locations. These samples were analyzed for ICP metals only. Minor deficiencies are as follows.

In the ICP metals analysis, barium, iron, and zinc were detected in the method blank at very low levels, less than 1/20th of the associated field sample results. Although not qualified for the method blank contamination, all barium, iron, and zinc results may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon was below the project recovery limit at 7%. Silicon is not a COPC for the 100-H-51:1 subsite nor is it a regulated compound under WAC 173-340. Although not qualified for LCS below QC limits, all silicon data in SDG JP0867 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for five analytes (aluminum [686%], antimony [58%], iron [1,687%], manganese [148%], and silicon [23%]). For aluminum, iron, and manganese the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. 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. Antimony and silicon did not have mismatched spike and native concentrations in the original MS. Although not qualified for MS outside QC limits, all antimony and silicon data in SDG JP0867 may be considered estimated. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

Relative percent difference (RPD) 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 2014), are shown in Table D-1. The main and QA/QC sample results are presented in Appendix C.

Table D-1. Field Quality Assurance/Quality Control Sample.

Sample Area	Main Sample	Duplicate Sample
Excavation Area	J1TXN9	J1TXP5

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 COPC. 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.

None of the RPDs calculated for the field duplicate sample are above the acceptance criteria (30%). 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. None of the duplicate evaluations 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 100-H-51:1

subsite 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 100-H-51:1 subsite 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 Environmental Restoration 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.

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