WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-DR-1 **Control No.:** 2012-074

Waste Site Code(s)/Subsite Code(s): 100-D-50:8, 117-DR Condensate Drain Pipelines

Reclassification Category: Interim ☒ Final ☐

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

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-D-50:8, 117-DR Condensate Drain Pipelines was a subsite of the 100-D-50 underground pipelines associated with pre-reactor process cooling water, process wastewater, and sanitary wastewater. The 100-D-50 Water Treatment Facilities Underground Pipelines waste site was identified as a candidate site that potentially required remediation in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision* (EPA 2004). The 100-D-50:8 waste subsite is 1 of the 10 subsites associated with the 100-D-50 underground pipelines.

The 100-D-50:8 waste subsite consisted of a 10-cm (4-in.)-diameter nonfriable asbestos cement distribution pipe that connected the 117-DR HEPA Filter Building to the 116-DR-8, 117-DR Seal Pit Crib. This distribution pipeline was a total length of 83 m (272 ft) and operated independently from all other pipelines. This pipeline received radioactive process effluent from the 117-DR HEPA Filter Building. The 117-DR Filter Building was later used for the 105-DR Large Sodium Fire Facility and was demolished in 2004. Remedial action at the 100-D-50:8 pipeline waste subsite was performed between on April 11 and 12, 2012. The site was excavated to a depth of approximately 3.0 m (9.9 ft) below grade, resulting in approximately 720.0 bank cubic meters (941.7 bank cubic yards) of material being removed for disposal at the Environmental Restoration Disposal Facility, including approximately 230 m (759 ft) of pipe. Excavation continued until all debris and contamination associated with the 100-D-50:8 waste subsite had been removed. Verification soil samples were collected on July 31, 2012, per 0100D-WI-G0120, *Work Instruction for Verification Sampling of the 100-D-50:8, 117-DR Condensate Drain Pipelines*, Washington Closure Hanford, Richland, Washington (WCH 2012b).

Remediation, verification sampling, and comparison of residual contaminant concentrations against cleanup levels have been performed in accordance with remedial action objectives and goals established by the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999). The selected remedy involved (1) excavating the subsite to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Area of the Hanford Site, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the subsite for reclassification as Interim Closed Out.

Basis for reclassification:

Cleanup verification sampling results were evaluated in comparison to the remedial action goals (RAGs). In accordance with this evaluation, the verification sampling results support a reclassification of this waste subsite to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding RAGs established in the Remaining Sites ROD (EPA 1999). The evaluation of all verification sample data collected from the waste site resulted in a determination 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. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-D-50:8, 117-DR Condensate Drain Pipelines* (attached). Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-DR-1 **Control No.:** 2012-074

Waste Site Code(s)/Subsite Code(s): 100-D-50:8, 117-DR Condensate Drain Pipelines

Regulator comments:

Approval of this WSRF documents regulator agreement that the "100-D-50:8" waste subsite qualifies for "Interim Closed Out" under this Interim Action ROD. In addition, Ecology has evaluated the data for this site against WAC 173-340 (2007) clean-up levels for direct contact, groundwater protection, and river protection. This evaluation is documented in the letter transmitting Ecology's approval of the site's interim reclassification to "Interim Closed Out."

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 DOE Federal Project Director (printed)	Signature	12/14/12 Date
N. Menard Ecology Project Manager (printed)	Nina M. Menard Signature	1/2/13 Date
N/A EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-50:8, 117-DR CONDENSATE DRAIN PIPELINES

Attachment to Waste Site Reclassification Form 2012-074

January 2013

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-50:8, 117-DR CONDENSATE DRAIN PIPELINES

EXECUTIVE SUMMARY

The 100-D-50:8, 117-DR Condensate Drain Pipelines waste subsite, part of the 100-DR-1 Operable Unit, consisted of a 10-cm (4-in.)-diameter nonfriable asbestos cement distribution pipe that connected the 117-DR Filter Building to the 116-DR-8, 117-DR Seal Pit Crib. This distribution pipeline was a total length of 83 m (272 ft) and operated independently from all other pipelines. This pipeline received radioactive process effluent from the 117-DR HEPA Filter Building and discharged it to the 116-DR-8 Seal Pit Crib. The 117-DR Filter Building was later used for the 105-DR Large Sodium Fire Facility (LSFF) and was demolished in 2004.

The 100-D-50 Water Treatment Facilities Underground Pipelines waste site was identified as a candidate site that potentially required remediation in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision* (Remaining Sites ESD) (EPA 2004). The 100-D-50:8 waste subsite is 1 of the 10 subsites associated with the 100-D-50 underground pipelines. Confirmatory sampling of this subsite was conducted on July 7, 2005, collecting samples from within the pipeline and from the soil directly beneath the pipeline. The confirmatory sample results were below the remedial action goals (RAGs) for all contaminants. However, the 116-DR-8 waste site, which received the discharge from the 100-D-50:8 pipeline, exceeded the RAGs for multiple metals, including direct exposure RAGs for arsenic and hexavalent chromium. Based on these results, the 100-D-50:8, 117-DR Condensate Drain Pipelines were recommended for remedial action.

Remediation of the 100-D-50:8 waste subsite was performed on April 11 and 12, 2012. The excavation extended to a depth of 3.0 m (9.9 ft) below ground surface (bgs). Approximately 720.0 bank cubic meters (941.7 bank cubic yards) of contaminated soil, concrete, and piping was excavated and direct loaded for disposal at the Environmental Restoration Disposal Facility (ERDF).

Following remediation, verification sampling was conducted on July 31, 2012. These results indicated that, following the remediation, residual contaminant concentrations met the remedial action objectives (RAOs) and RAGs for the 100-D-50:8 waste subsite.

A summary of the cleanup evaluation for the soil results compared to the applicable cleanup criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the 100-D-50:8 waste 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-D-50:8 Waste Subsite.

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of <15 mrem/yr dose rate above background over 1,000 years.	Radionuclide constituents were not quantified above background levels. As a consequence, the maximum predicted dose rate above background is 0.00 mrem/yr.	Yes
Direct Exposure – Nonradionuclides	Attain individual COPC 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.	All hazard quotients are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (2.6×10^{-3}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for hexavalent chromium, the only carcinogen quantified above background levels, is 1×10^{-7}, which is $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk for hexavalent chromium, the only carcinogen quantified above background levels, is 1.0×10^{-7}, which is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	No radionuclides were quantified above background levels.	Yes
	Attain national primary drinking water standards [a]. 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.	No radionuclides were quantified above background levels.	
	Meet drinking water standards for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5 [b].	No alpha-emitting radionuclides were quantified above background levels.	
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].	Uranium was not quantified above background levels for this site.	
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	No contaminants exceeded soil RAGs for groundwater and/or Columbia River protection.	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 Areas, 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).

COPC = contaminant of potential concern
MCL = maximum contaminant level
RAG = remedial action goal

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the RAOs and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) and the *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).

The verification sample results show 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. Site contamination did not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based 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-D-50:8 waste subsite contaminants of potential concern and other constituents. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, manganese, and vanadium. Ecological screening levels from *Washington Administrative Code* 173-340 were exceeded for boron and vanadium. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, and vanadium are below Hanford Site or Washington State background values (note that state background values are only used when Hanford Site background values are not available), 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-D-50:8, 117-DR CONDENSATE DRAIN PIPELINES

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 100-D-50:8, 117-DR Condensate Drain Pipelines waste subsite meets the objectives to support a reclassification of this site to Interim Closed Out as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). The verification sample results show 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. Site contamination did not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based 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-D-50:8 waste subsite contaminants of potential concern (COPCs) and other constituents (Appendix A). The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for antimony, manganese, and vanadium. Ecological screening levels from *Washington Administrative Code* (WAC) 173-340 were exceeded for boron and vanadium. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, and vanadium are below Hanford Site or Washington State background values (note that state background values are only used when Hanford Site background values are not available), 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-D-50 waste site encompasses those underground pipelines associated with pre-reactor process cooling water, process wastewater, and sanitary wastewater. This site has been administratively divided into 10 subsites based on process knowledge, COPCs, and possible remedial actions. The 10 subsites are as follows:

- 100-D-50:1 Emergency Discharge Pipeline
- 100-D-50:2 Reactor Cooling Water Pipelines
- 100-D-50:3 Reactor Cooling Water Pipelines

- 100-D-50:4 Gas Recirculation Pipelines
- 100-D-50:5 183-DR Sedimentation Basin Drain Pipelines
- 100-D-50:6 183-DR Clearwell Drain Pipelines
- 100-D-50:7 183-DR Head House Floor Drain and Catch Basins Pipelines
- 100-D-50:8 117-DR Condensate Drain Pipelines
- 100-D-50:9 1607-DR3 Sanitary Sewer Pipelines
- 100-D-50:10 Construction Camp Potable Water Supply Pipelines.

The 100-D-50 underground pipelines waste site encompasses those underground pipelines that transported nonradioactive treated and untreated wastewater from the 183-DR basins, 183-DR Clearwell Area, and 105-DR Reactor Buildings to discharge to the Columbia River via the outfall at the 100-D-8 site.

The 100-D-50:8, 117-DR Condensate Drain Pipelines subsite is located southeast of the 105-DR Reactor Building (Figure 1). The pipeline was the feed pipe from the 117-DR Filter Building to the 116-DR-8 Seal Pit Crib. The pipeline exited the middle of the 117-DR Building. The center coordinates are located at Washington State Plane coordinates N 151127.9, E 573820.8.

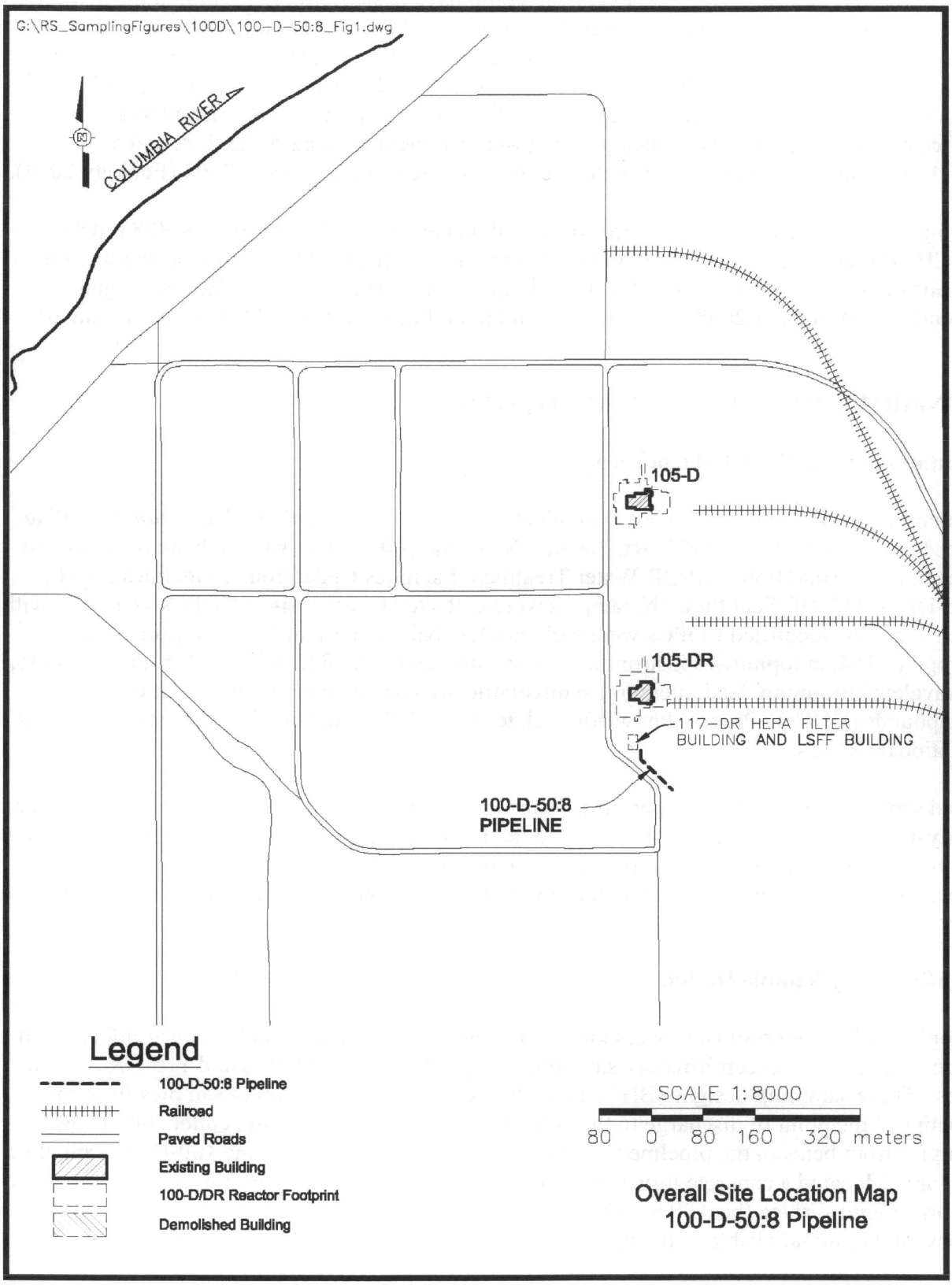
The 100-D-50:8 waste subsite was a 10-cm (4-in.)-diameter nonfriable asbestos cement distribution pipe that connected the 117-DR HEPA Filter Building to the 116-DR-8 Seal Pit Crib. The distribution pipe had a total length of 83 m (272 ft) and operated independently from all other pipelines. Although the 100-D-50 pipelines generally do not transport radioactive liquids, the distribution pipe received radioactive process effluent from the 117-DR HEPA Filter Building. The 117-DR HEPA Filter Building, which was later used for the 105-DR Large Sodium Fire Facility (LSFF), was demolished in 2004, and the 116-DR-8 Seal Pit Crib was filled with gravel and covered with clean soil. The 116-DR-8 waste site was remediated and interim closed out in 2009 (WCH 2009b).

The distribution pipe was used from 1960 to 1964 in support of reactor operations. It transferred water that collected in the seal pits as part of the exhaust filter system at the 117-DR HEPA Filter Building to the 116-DR-8 Crib. The distribution pipe was then used from 1972 through 1986 in support of the 105-DR LSFF (DOE-RL 1995).

The LSFF was initially used only for engineering-scale alkali metal reaction studies (DOE-RL 1995). However, the LSFF was also used by the Fusion Safety Support Studies program for intermediate-sized safety reaction tests with lithium and lithium lead compounds. Since the facility was used to store and treat alkali metal waste, the LSFF was subject to the regulatory requirements for the storage and treatment of dangerous waste (DOE-RL 1995) and was included in the *Hanford Facility Dangerous Waste Part A Permit Application* (DOE-RL 1998).

The LSFF was divided into seven areas according to use and deposition of reaction by-products for closure evaluation as described in the *105-DR Large Sodium Fire Facility Closure Plan* (DOE-RL 1995). Area 6 consisted of the 116-DR-8 Crib and the connecting distribution pipe.

Figure 1. 100-D-50:8 Pipeline Location Map.



The LSFF produced waste that consisted of sodium, lithium, sodium-potassium alloy, lithium-lead alloy, and other oxidation products that could have been transported through the distribution pipeline. In 1996, the Washington State Department of Ecology (Ecology) identified that Area 6 was believed not to have received dangerous waste and was considered closed for the purposes of WAC 173-303 (Ecology 1996b). Ecology also accepted closure of Areas 1, 3, and 7 at that time (Ecology 1996a). In June 2004, the U.S. Department of Energy, Richland Operations Office provided Ecology a certification of closure for the remaining Areas 2, 4, and 5 (DOE-RL2004). Ecology accepted closure of the entire LSFF on July 1, 2004 (Ecology 2004).

Two geophysical investigations were conducted that are relevant to the 100-D-50:8 pipeline (WCH 2009a). The first investigation was conducted in August 2008 to support the western expansion of the excavation for 118-D-5 (Figure 2). The August investigation was again extended in December 2008 to cover the southern half of the 100-D-50:8 pipeline (Figure 3).

CONFIRMATORY SAMPLING ACTIVITIES

Contaminants of Potential Concern

Contaminants of potential concern were identified in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009a). Since the 100-D-50:8 waste subsite is associated with both the 100-D-50, 100-DR Water Treatment Facilities Underground Pipelines and the 116-DR-8, 117-DR Seal Pit Crib, samples were collected for analysis of COPCs identified with each site. The identified COPCs were carbon-14, cobalt-60, cesium-137, europium-152, europium-154, europium-155, strontium-90, tritium, uranium-234, uranium-235, uranium-238, hexavalent chromium, lead, mercury, semivolatile organic compounds, and volatile organic compounds (VOCs). Process knowledge related to the LSFF identified lithium and sodium as additional COPCs.

Field screening for VOCs was performed during sampling to assess the need for volatile organic analysis. As no VOCs were detected in the field, volatile organic analyses were not included in the requested analyses for any samples. Similarly, because no suspect friable asbestos-containing material was identified during field sampling, no samples were submitted for asbestos analysis.

Confirmatory Sample Design

Geophysical survey results, process knowledge, historical drawings, and site visit information were used to develop confirmatory sampling designs for the 100-D-50:8 and 116-DR-8 waste sites. These sampling designs (BHI 2005b, 2005c) included collection of samples from the pipeline at the point of discharge to the crib and at an upstream bend and collection of soil samples from beneath the pipeline and crib. Excavation at the bend in the 100-D-50:8 pipeline (Figure 4) located a concrete thrust block and the intact pipeline at approximately 0.9 m (3.5 ft) below ground surface (bgs). The pipeline was breached at the downstream side of the thrust block, and minimal visible scale was noted in the lower third of the pipeline.

Figure 2. Geophysical Survey of Northern Portion of the 100-D-50:8 Waste Subsite.

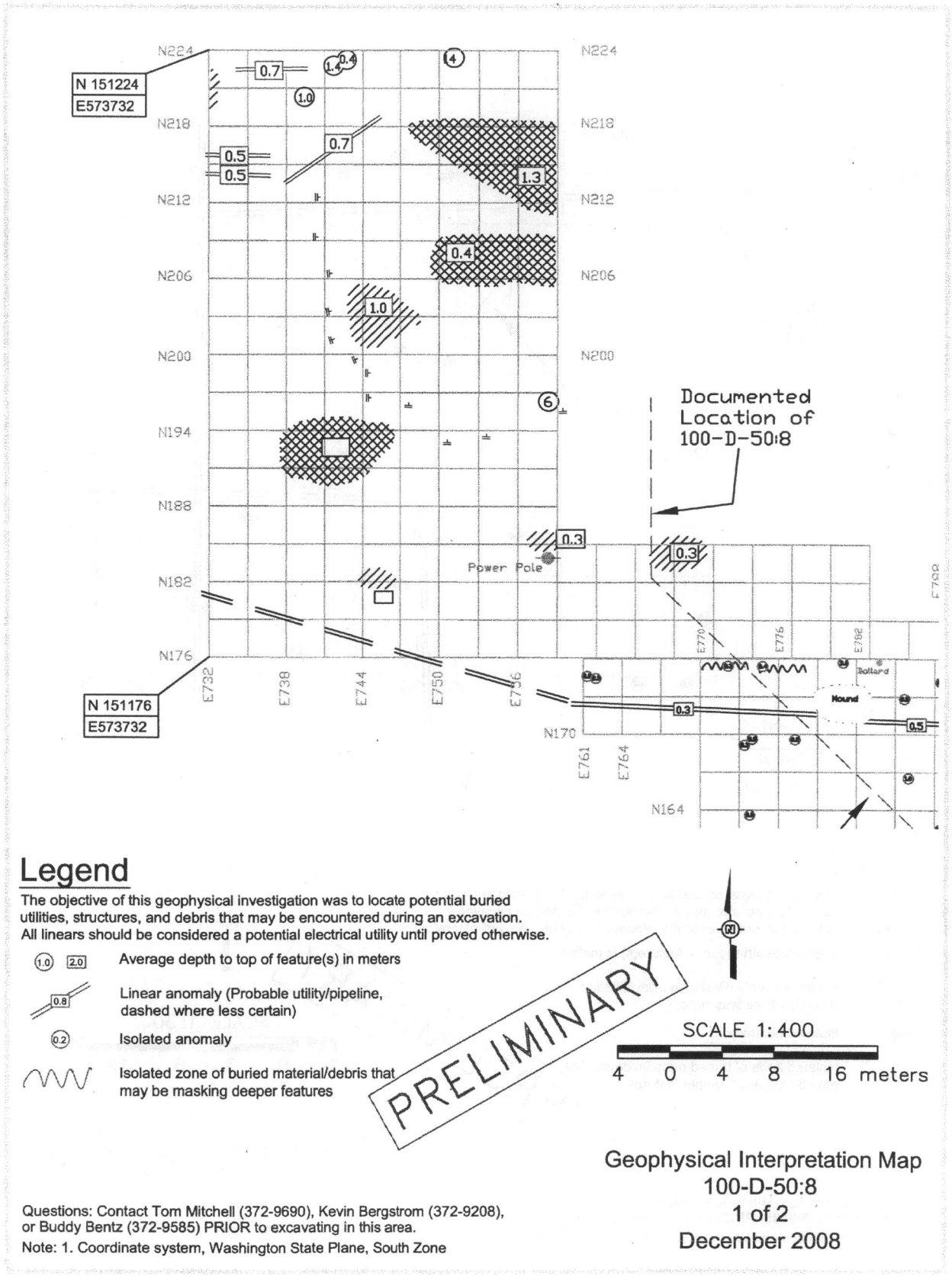
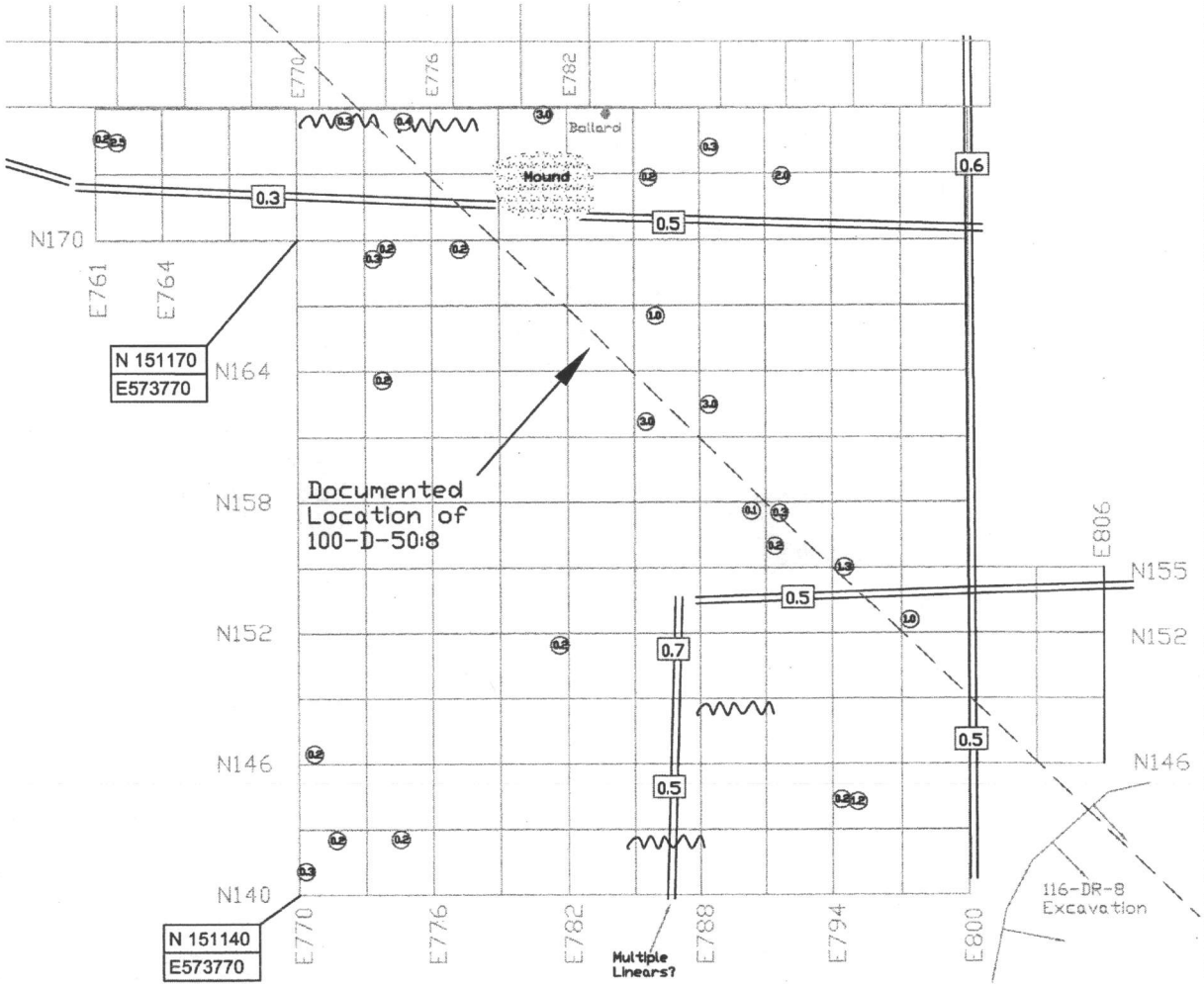


Figure 3. Geophysical Survey of Southern Portion of the 100-D-50:8 Waste Subsite.



Legend

The objective of this geophysical investigation was to locate potential buried utilities, structures, and debris that may be encountered during an excavation. All linears should be considered a potential electrical utility until proved otherwise.

- (1.0) [2.0] Average depth to top of feature(s) in meters
- [0.8] Linear anomaly (Probable utility/pipeline, dashed where less certain)
- (0.2) Isolated anomaly
- Isolated zone of buried material/debris that may be masking deeper features

PRELIMINARY

SCALE 1: 300

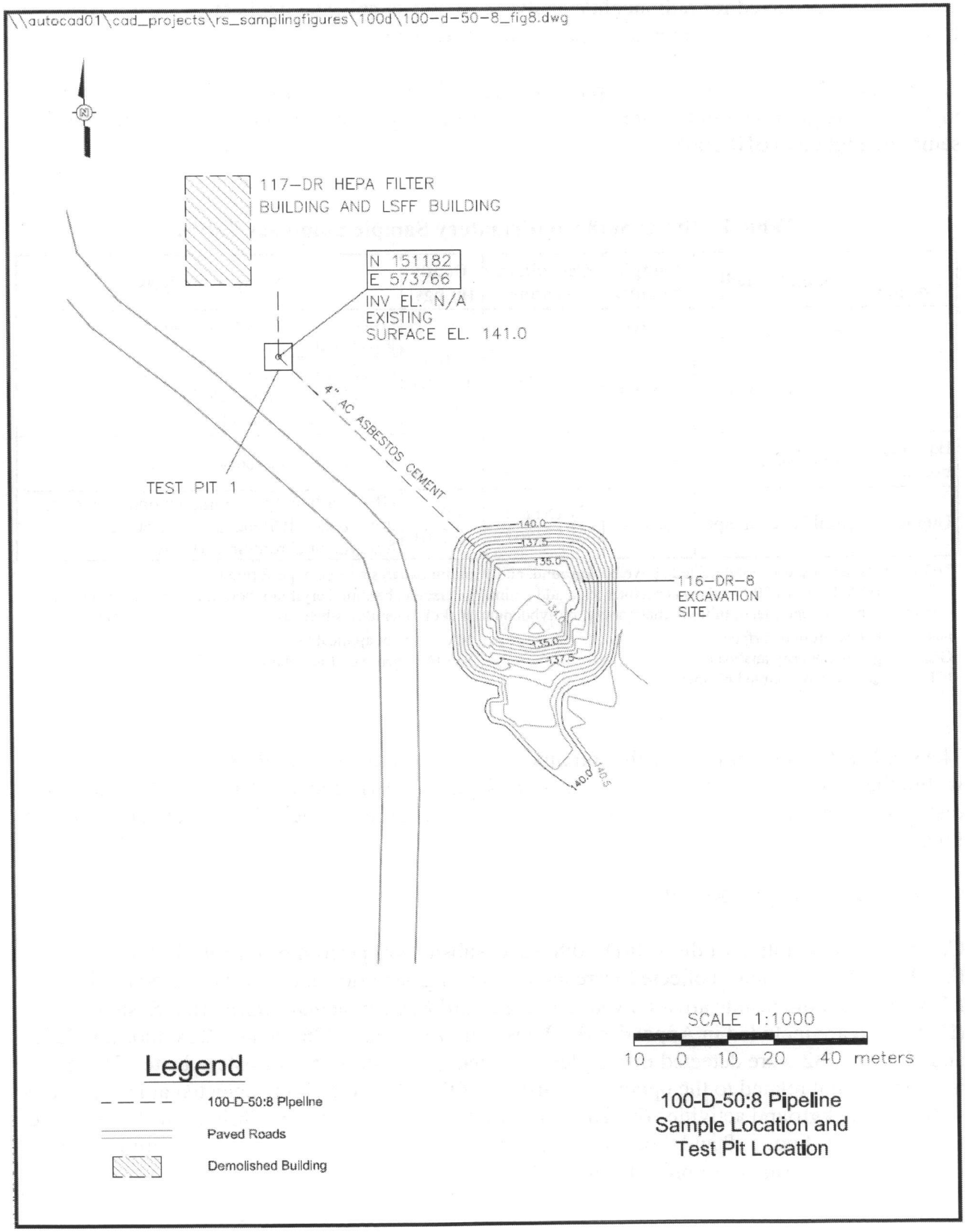
3 0 3 6 12 meters

Geophysical Interpretation Map
100-D-50:8
2 of 2
December 2008

Questions: Contact Tom Mitchell (372-9690), Kevin Bergstrom (372-9208), or Buddy Bentz (372-9585) PRIOR to excavating in this area.

Note: 1. Coordinate system, Washington State Plane, South Zone

Figure 4. 100-D-50:8 Waste Subsite Sample Location.



Insufficient material was present to collect the planned pipeline sample, but a smear sample of the scale was collected for radionuclide analysis. A soil sample and duplicate were collected from material beneath the pipeline at the location breached.

A summary of the confirmatory samples collected and laboratory analyses performed is provided in Table 1. Additional information related to confirmatory sampling can be found in the field sampling logbook (BHI 2005a).

Table 1. 100-D-50:8 Confirmatory Sample Summary Table.

Sample Location	Sample Media	Sample Number	Coordinate Locations	Depth (m bgs)	Sample Analysis
Test pit 1	Pipe scale smear	J037V9	N 151181 E 573767	1.0 m (3.3 ft)	GEA, carbon-14, tritium, isotopic uranium, gross beta [a]
	Soil beneath pipe	J037N5			GEA, carbon-14, tritium, isotopic uranium, gross beta [a], ICP metals [b], mercury, hexavalent chromium, SVOA
Equipment blank	Silica sand	J037N4	NA	NA	ICP metals [b], mercury, SVOA
Duplicate	Soil beneath pipe	J037N6	N 151181 E 573767	1.0 m (3.3 ft)	GEA, carbon-14, tritium, isotopic uranium, gross beta [a], ICP metals [b], mercury, hexavalent chromium, SVOA

[a] Gross beta activity was not detected above background, and strontium analysis was not performed.
[b] The expanded list of ICP metals was performed to add antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, lithium, manganese, molybdenum, nickel, selenium, silver, sodium, vanadium, and zinc.

bgs = below ground surface
GEA = gamma energy analysis
ICP = inductively coupled plasma
NA = not applicable
SVOA = semivolatile organic analysis

The southeastern end of the distribution pipe that connects to the 116-DR-8 Crib was sampled within the scope of the 116-DR-8 confirmatory sampling (BHI 2005c). The laboratory analysis results from that sample location were also used for evaluation of the 117-DR Condensate Drain Pipeline.

Confirmatory Sample Results

Confirmatory sampling of the 100-D-50:8 waste subsite was performed on July 7, 2005 (WCH 2005b). Samples collected were analyzed using analytical methods approved by the EPA. The sample results are archived in the Hanford Environmental Information System (HEIS) and are included in Appendix B. Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 were detected in samples collected at the 100-D-50:8 waste subsite. These isotopes are not related to the operational history of the site and all were detected at levels below statistical background activities (based on an assumption of secular equilibrium, the background activities for radium-228 and thorium-228 are equal to the statistical background activity of 1.32 pCi/g for thorium-232 provided in DOE-RL [1996]).

The confirmatory sample results were compared against the cleanup criteria specified in the RDR/RAWP (DOE-RL 2009b). No contaminants for the 100-D-50:8 waste subsite exceeded the direct exposure, groundwater, and river protection remedial action goals (RAGs). However, the 116-DR-8 waste site confirmatory sample results contained cadmium, hexavalent chromium, lead, lithium, and nickel at concentrations exceeding soil RAGs for direct exposure and protection of groundwater and the Columbia River. In addition, antimony, barium, chromium (total), manganese, mercury, molybdenum, silver, and zinc were also detected at concentrations exceeding the applicable soil RAGs for the protection of groundwater and/or the Columbia River. Based on evaluation of the 116-DR-8 confirmatory sample results (Appendix B), it was determined that remedial action of the 100-D-50:8 waste subsite was necessary (WCH 2005a).

REMEDIAL ACTION ACTIVITIES

Remediation of the 100-D-50:8 waste subsite was performed on April 11 and 12, 2012. The excavation extended to a depth of 3.3 m (10 ft) bgs (Figures 5 through 7). Approximately 720 bank cubic meters (BCM) (941.7 bank cubic yards [BCY]) of contaminated soil, concrete, and piping was excavated and staged in a stockpile area before disposal at the Environmental Restoration Disposal Facility (ERDF). Approximately 70 m (230 ft) of pipe was also removed during remediation and disposed at the ERDF. The remaining portion of the 100-D-50:8 pipeline (approximately 13 m [42 ft]) was removed during remediation activities of the 116-DR-8 waste site. During the 100-D-50:8 excavation, two additional pipeline segments from the 100-D-63, 100-D/DR Service Water Pipeline were discovered. One of the two segments was removed because it was impeding the 100-D-50:8 remediation campaign (Figure 5), and one segment was left undisturbed (Figure 6). A post-excavation civil survey was completed on April 24, 2012 (Figure 8). In June and July 2008, a portion of the 100-D-50:8 pipelines was removed during the 116-DR-8 excavation. This area underwent verification sampling as part of the 116-DR-8 waste site (WCH 2009b).

Global Positioning Environmental Radiological Surveyor (GPERS) surveys were conducted on May 2, 2012 (gamma) and May 16, 2012 (beta). No elevated gamma or beta radioactivity was detected within the excavation (Figures 9 and 10, respectively).

No in-process and waste characterization samples were conducted during the excavation of the 100-D-50:8 waste subsite. Also, no staining or anomalous material was noted during remediation.

Figure 5. 100-D-50:8 Excavation Looking Southeast (April 12, 2012).

Figure 6. 100-D-50:8 Excavation Looking Northwest (April 12, 2012).

Figure 7. 100-D-50:8 Excavation at Pipeline Bend Looking South (April 12, 2012).

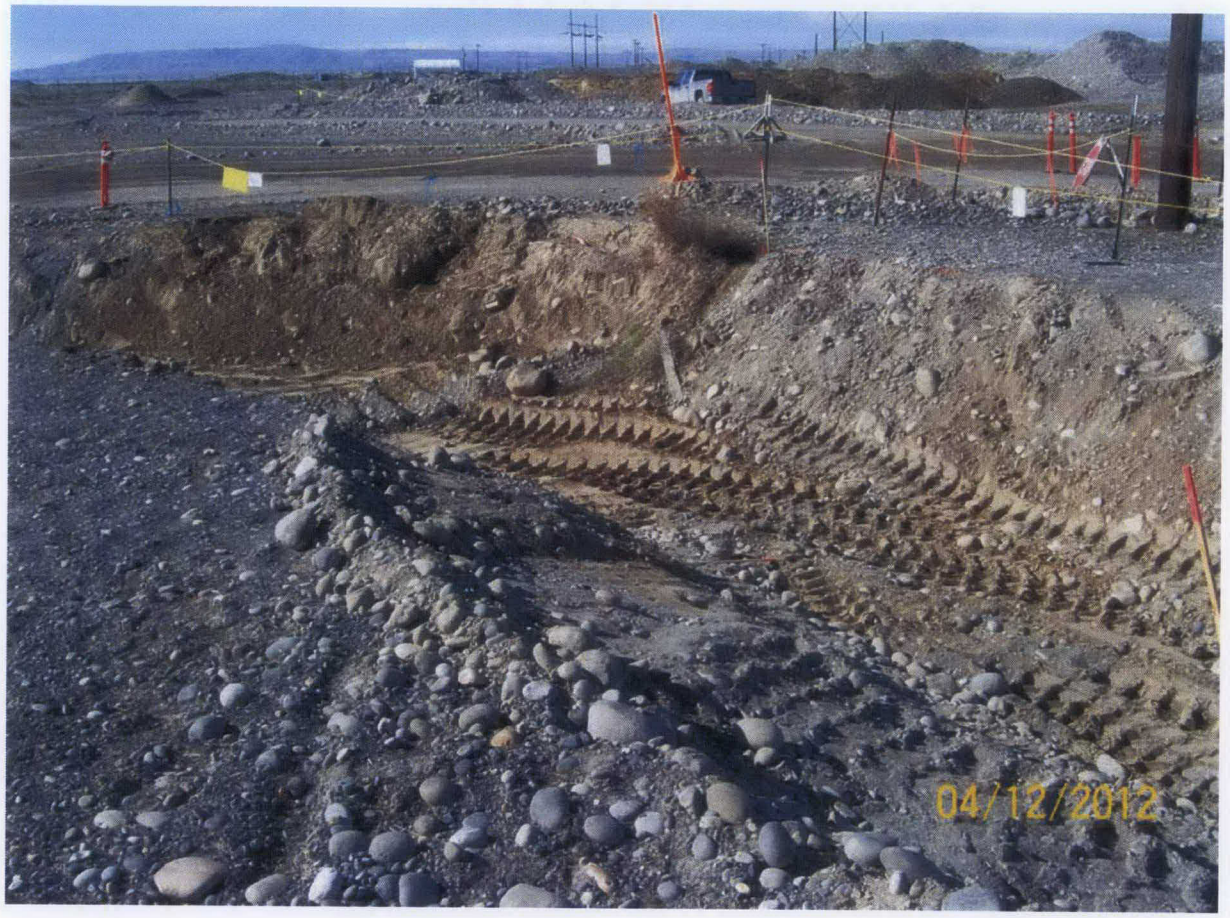


Figure 8. 100-D-50:8 Waste Subsite Civil Survey (April 24, 2012).

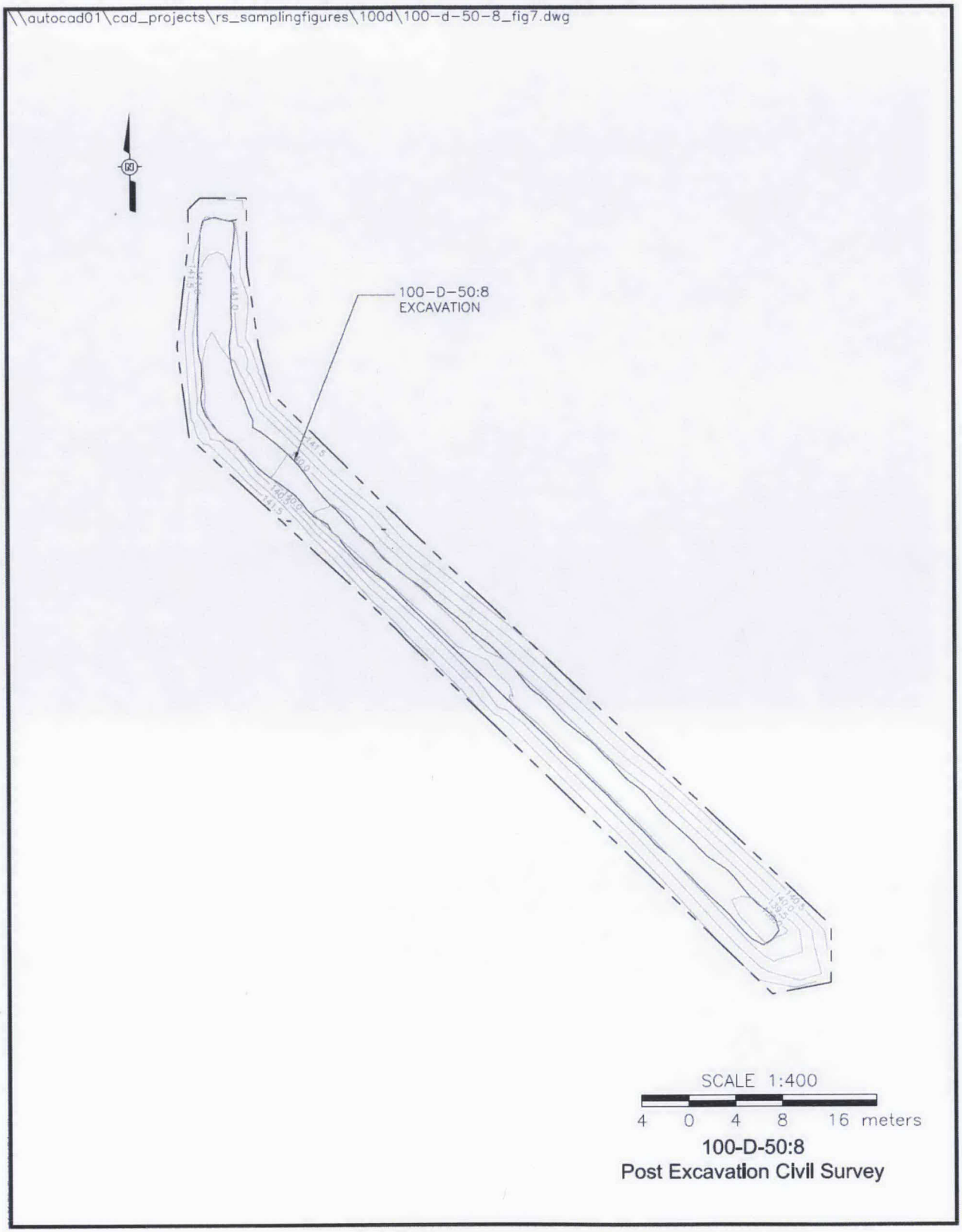


Figure 9. 100-D-50:8 Gamma Track Map (May 2, 2012).

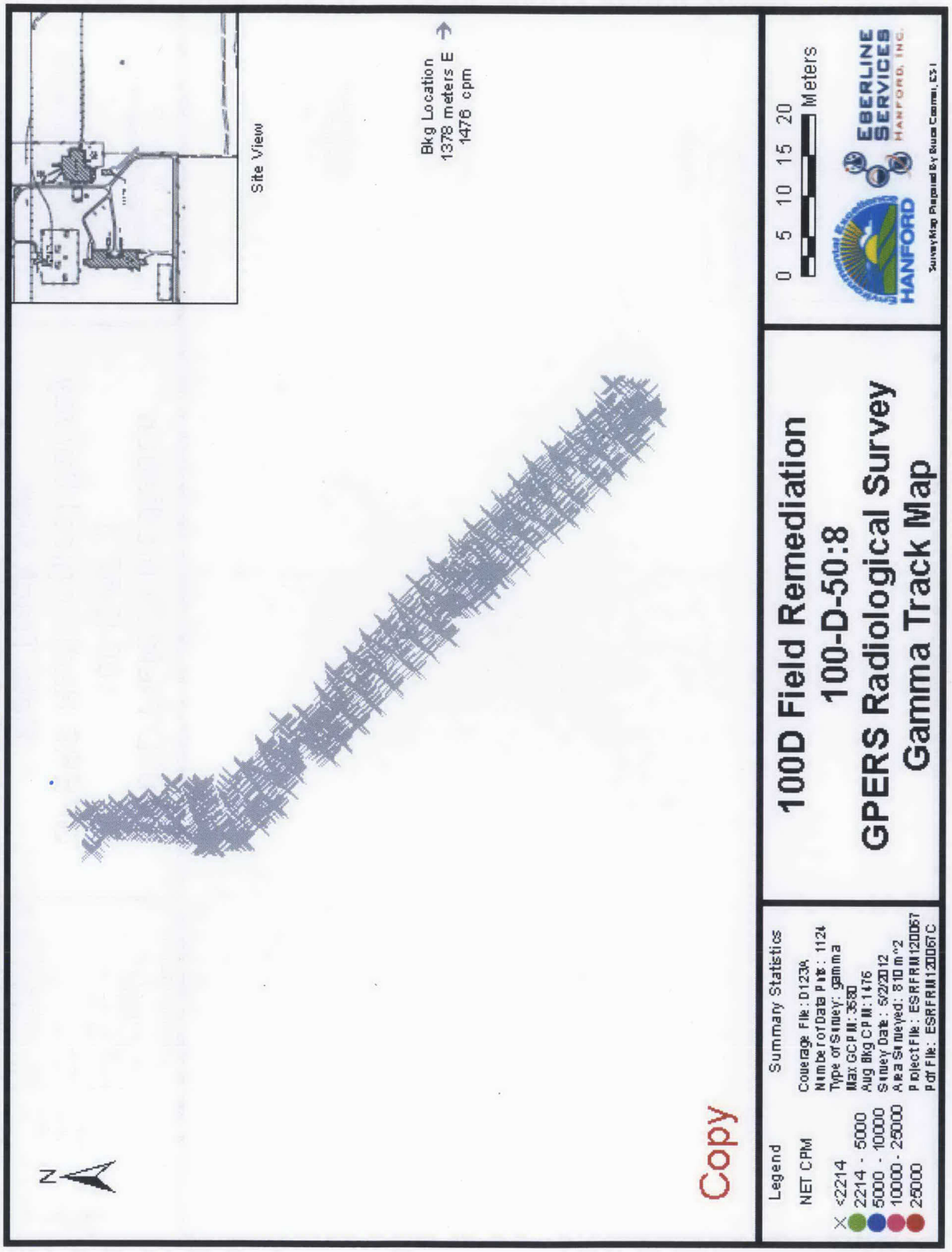
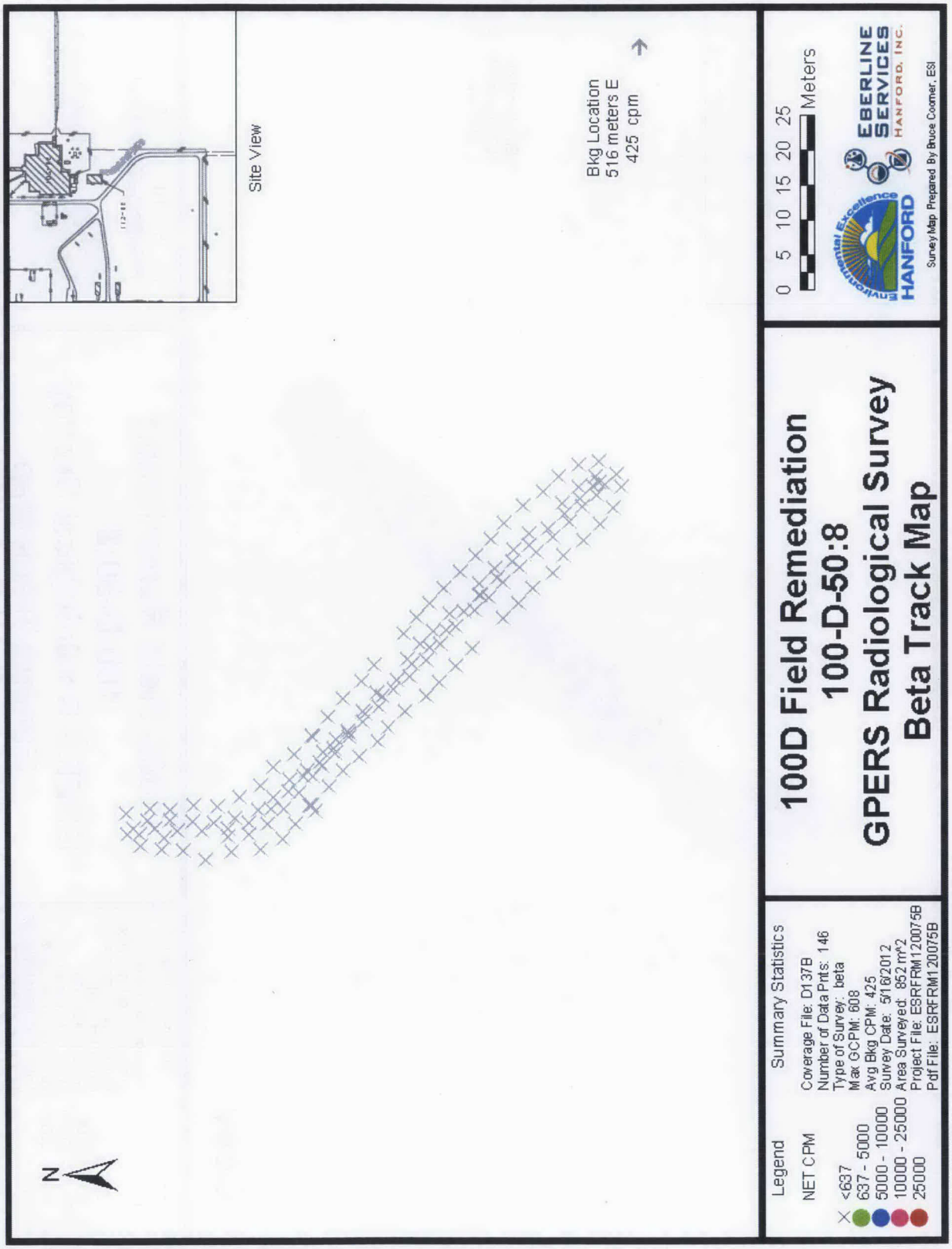


Figure 10. 100-D-50:8 Beta Track Map (May 16, 2012).



VERIFICATION SAMPLING ACTIVITIES

This section describes the basis for selection of a verification sampling design for the 100-D-50:8 waste subsite. Statistical sampling was the method chosen for selecting the sampling locations. The area identified for the purpose of statistical verification sampling for the 100-D-50:8 waste subsite consists of two decision units, the excavated area and the staging pile area (WCH 2012b).

Statistical verification sampling was conducted at the 100-D-50:8 waste subsite on July 31, 2012 (WCH 2012a), to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). A statistical sampling design was used to collect verification soil samples from the 100-D-50:8 excavation and the staging pile area to support closeout of the waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site.

Contaminants of Potential Concern

Contaminants of potential concern have been identified in the SAP (DOE-RL 2009a). Since the 100-D-50:8 subsite pipeline received condensate containing radionuclides from the 117-DR Filter Building and discharged the condensate to the 116-DR-8, Seal Pit Crib, samples were collected for analysis of COPCs identified with each site. The identified COPCs are carbon-14, cobalt-60, cesium-137, europium-152, europium-154, europium-155, stronium-90, tritium, uranium-234, uranium-235, uranium-238, hexavalent chromium, lead, mercury, semivolatile organic compounds, and VOCs. However, carbon-14, cesium-137, cobalt-60, europium-152, europium-154, europium-155, tritium, uranium-235, mercury, and semivolatile organic compounds have been excluded as COPCs, based on confirmatory sampling results that were either undetected or considerably below RAGs. Volatile organic compounds have been excluded as waste site COPCs because they were not detected using field instruments during confirmatory sampling. The 117-DR Filter Building was later used for the 105-DR LSFF. Process knowledge related to the LSFF has identified lithium and sodium as additional COPCs.

Although not considered COPCs, analyses were also included for the entire list of inductively coupled plasma (ICP) metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium [total], cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc).

Due to an oversight during sampling collection, mercury was inadvertently included in the sampling analysis even though it was removed as a COPC. Therefore, mercury was treated as a COPC and compared against the applicable RAGs for this waste subsite RSVP.

The laboratory analyses that were performed to evaluate samples for the COPCs are identified in Table 2.

Table 2. Laboratory Analytical Methods.

Analytical Method	Contaminants of Potential Concern
Isotopic uranium	Uranium-234, uranium-238
Sr-90 – Liquid Scintillation	Strontium-90
ICP metals – EPA Method 6010 [a]	Lead, lithium, sodium
Mercury – EPA Method 7471 [b]	Mercury
Hexavalent chromium – EPA Method 7196	Hexavalent chromium

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

[b] Originally mercury was not a COPC, but was inadvertently included in the sampling analysis due to an oversight during sampling collection.

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma

Verification Sample Design

The statistical sampling design for the 100-D-50:8 waste subsite was developed using Visual Sample Plan[1] (VSP). The areas identified for the purpose of statistical verification sampling for the 100-D-50:8 waste subsite were delineated in VSP and used as the basis for a random-start systematic grid for verification soil sample collection at the site. Twelve statistical soil samples were collected on the grid within each of the two decision units at the 100-D-50:8 waste subsite. A triangular grid is used based on studies that indicate triangular grids are superior to square grids (Gilbert 1987). Additional details concerning the use of VSP to develop the statistical sampling designs and derive the number of verification samples to collect are discussed in *Work Instruction for Verification Sampling of the 100-D-50:8, 117-DR Condensate Drain Pipelines* (WCH 2012b). The 100-D-50:8 waste subsite sample locations are shown in Figure 11.

A summary of the verification samples collected and laboratory analyses performed is provided in Table 3. Additional information related to verification sampling can be found in the field sampling logbooks (WCH 2012a).

Verification Sampling Results

All verification samples were analyzed using analytical methods approved by EPA (DOE-RL 2009b). Evaluation of the verification data from the 100-D-50:8 waste subsite was performed by direct comparison of the statistical or maximum sample results for each COPC against cleanup criteria.

[1] Visual Sample Plan is a site map-based user-interface program that may be downloaded at http://vsp.pnnl.gov.

Figure 11. Verification Sample Locations for the 100-D-50:8 Waste Subsite.

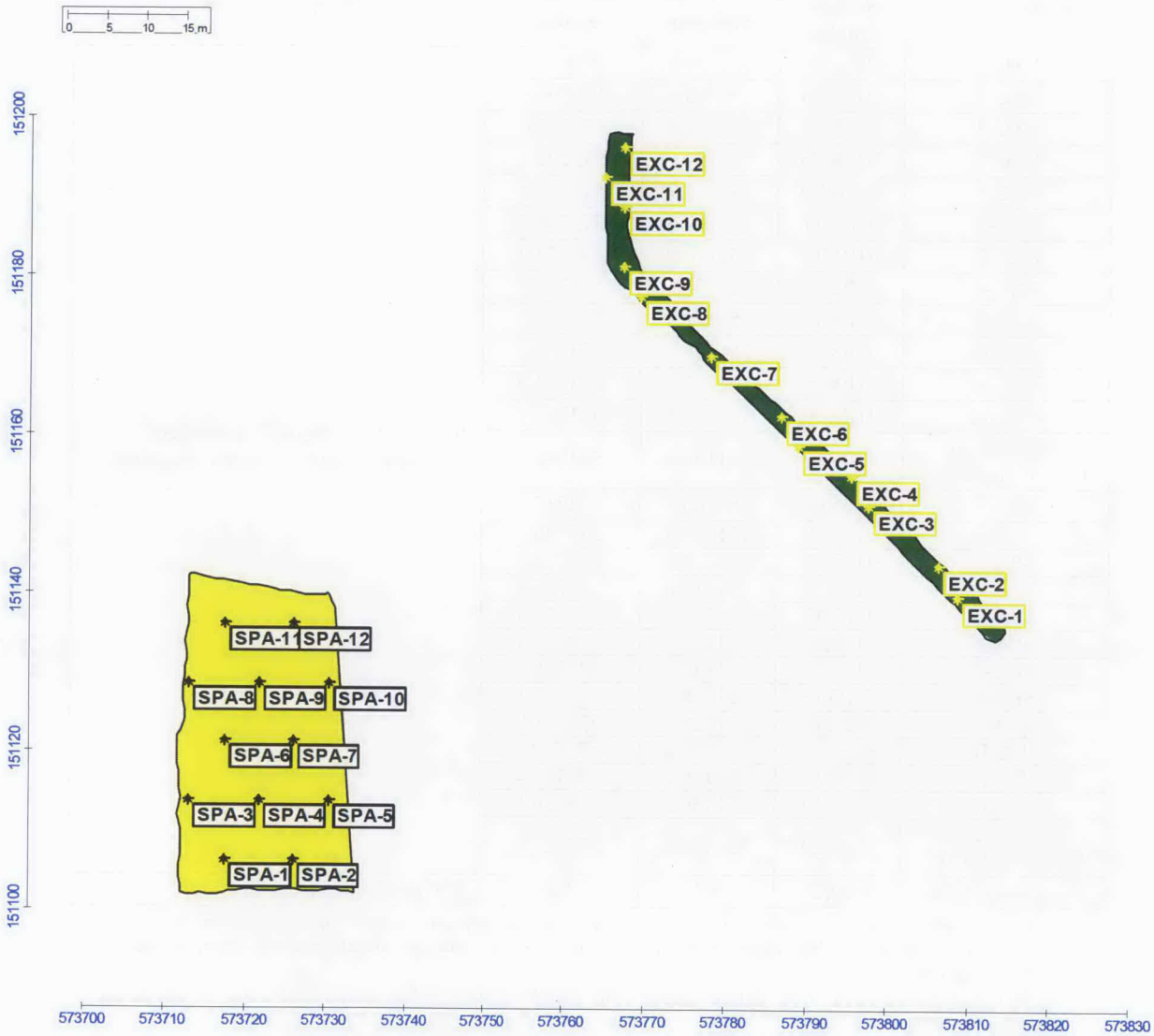


Table 3. 100-D-50:8 Waste Subsite Sample Summary.

Sample Location	HEIS Sample Number	WSP Coordinates (m)		Sample Analysis
		Northing	Easting	
EXC-1	J1PWX5	151139.8	573808.5	ICP metals [a], mercury [b], hexavalent chromium, isotopic uranium, strontium-90
EXC-2	J1PWX6	151143.6	573806.3	
EXC-3	J1PWX7	151151.2	573797.6	
EXC-4	J1PWX8	151154.9	573795.4	
EXC-5	J1PWX9	151158.7	573788.9	
EXC-6	J1PX00	151162.5	573786.7	
EXC-7	J1PX01	151170.0	573778.0	
EXC-8	J1PX02	151177.6	573769.3	
EXC-9	J1PX03	151181.4	573767.1	
EXC-10	J1PX04	151188.9	573767.1	
EXC-11	J1PX05	151192.7	573764.9	
EXC-12	J1PX06	151196.5	573767.1	
Duplicate of J1PX03 (EXC-9) [c]	J1PX07	151181.4	573767.1	
SPA-1	J1PX08	151106.4	573717.4	
SPA-2	J1PX09	151106.4	573726.1	
SPA-3	J1PX10	151113.8	573713.1	
SPA-4	J1PX11	151113.8	573721.8	
SPA-5	J1PX12	151113.8	573730.4	
SPA-6	J1PX13	151121.3	573717.4	
SPA-7	J1PX14	151121.3	573726.1	
SPA-8	J1PX15	151128.8	573713.1	
SPA-9	J1PX16	151128.8	573721.8	
SPA-10	J1PX17	151128.8	573730.4	
SPA-11	J1PX18	151136.2	573717.4	
SPA-12	J1PX19	151136.2	573726.1	
Duplicate of J1PX11 (SPA-4) [c]	J1PX20	151113.8	573721.8	
Equipment blank	J1PX21	NA	NA	ICP metals [a], mercury [b]

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

[b] Originally mercury was not a COPC, but was inadvertently included in the sampling analysis due to an oversight during sampling collection.

[c] One duplicate soil sample was collected from a location selected at the project analytical lead's discretion.

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
WSP = Washington State Plane

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 each of the 100-D-50:8 decision units as specified by the 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 a decision unit, the maximum detected value was used for comparison to 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 site COPCs with the RAGs for each of the 100-D-50:8 decision units are listed 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 2012) 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 COPCs and are also not included in these tables. The complete laboratory results are stored in the Environmental Restoration (ENRE) project-specific database prior to submitting to the HEIS for archiving and are provided in Appendix C.

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-D-50:8 waste 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 RDR/RAWP (DOE-RL 2009b). Tables 4 and 5 compare the verification sample values to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River.

Evaluation of the results listed in Tables 4 and 5 from verification sampling at the 100-D-50:8 waste subsite show that no contaminants exceed direct exposure, groundwater, or river protection RAGs for either decision unit.

Three-Part Test for Nonradionuclides

A RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. The WAC 173-340 three-part test consists of the following criteria: (1) the cleanup verification 95% UCL value must be less than the cleanup level, (2) no single detection can 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-D-50:8 pipeline waste subsite is included in the 95% UCL statistical calculations (Appendix C). The results of this evaluation indicate that all residual COPC concentrations pass the three-part test in comparison against applicable RAGs.

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

Table 4. Comparison of Contaminant Concentrations to Action Levels for the 100-D-50:8 Excavation Statistical Verification Samples.

COPC or Other Analyte	Statistical or Maximum Result [b] (pCi/kg)	Soil Lookup Values (pCi/g) [a]			Does the Statistical Result Exceed Lookup Values?	Does the Statistical Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Soil Lookup Value for Groundwater Protection	Soil Lookup Value for River Protection		
Uranium-233/234	0.190 (<BG)	1.1 [c]	1.1 [c]	1.1 [c]	No	--
Uranium-238	0.180 (<BG)	1.1 [c]	1.1 [c]	1.1 [c]	No	--
COPC	**Statistical or Maximum Result [b] (mg/kg)**	**Remedial Action Goals (mg/kg) [a]**			**Does the Statistical Result Exceed RAGs?**	**Does the Statistical Result Pass RESRAD Modeling?**
		Direct Exposure	**Soil Cleanup Level for Groundwater Protection**	**Soil Cleanup Level for River Protection**		
Antimony [d]	0.73 (<BG)	32	5 [c]	5 [c]	No	--
Arsenic	1.6 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	68.5 (<BG)	5,600	200	400	No	--
Beryllium	0.13 (<BG)	10.4 [e]	1.51 [c]	1.51 [c]	No	--
Boron [f]	1.2	7,200	320	-- [g]	No	--
Cadmium [d]	0.14 (<BG)	13.9 [e]	0.81 [c]	0.81 [c]	No	--
Chromium	9.6 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	8.3 (<BG)	24	15.7 [c]	-- [g]	No	--
Copper	16.7 (<BG)	2,960	59.2	22.0 [c]	No	--
Hexavalent chromium [f]	0.193	2.1 [e]	4.8	2	No	--
Lead	4.5 (<BG)	353 [h]	10.2 [c]	10.2 [c]	No	--
Manganese	301 (<BG)	3,760	512 [c]	512 [c]	No	--
Mercury	0.0059 (<BG)	24	0.33 [c]	0.33 [c]	No	--
Molybdenum [f]	0.38	400	8	-- [g]	No	--
Nickel	13.1 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	57.2 (<BG)	560	85.1 [c]	-- [g]	No	--
Zinc	41.1 (<BG)	24,000	480	67.8 [c]	No	--

[a] Lookup values and RAGs obtained from the RDR/RAWP (DOE-RL 2009b).
[b] Maximum or 95% UCL, depending on data censorship, as described in the *100-D-50:8 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 1996b). The arsenic cleanup level 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009b).
[d] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[e] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3]) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[f] No Hanford Site-specific or Washington State background value available.
[g] 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 (Ecology 2012) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], Ecology 1996 [Method B for surface waters]).
[h] Use EPA, 1994, *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.

-- = not applicable
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Table 5. Comparison of Contaminant Concentrations to Action Levels for the 100-D-50:8 Staging Pile Area Statistical Verification Samples.

COPC or Other Analyte	Statistical or Maximum Result [b] (pCi/kg)	Soil Lookup Values (pCi/g) [a]			Does the Statistical Result Exceed Lookup Values?	Does the Statistical Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Soil Lookup Value for Groundwater Protection	Soil Lookup Value for River Protection		
Uranium-233/234	0.193 (<BG)	1.1 [c]	1.1 [c]	1.1 [c]	No	--
Uranium-238	0.219 (<BG)	1.1 [c]	1.1 [c]	1.1 [c]	No	--
COPC	**Statistical or Maximum Result [b] (mg/kg)**	**Remedial Action Goals (mg/kg) [a]**			**Does the Statistical Result Exceed RAGs?**	**Does the Statistical Result Pass RESRAD Modeling?**
		Direct Exposure	**Soil Cleanup Level for Groundwater Protection**	**Soil Cleanup Level for River Protection**		
Antimony [d]	0.59 (<BG)	32	5 [c]	5 [c]	No	--
Arsenic	1.6 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	62.7 (<BG)	5,600	200	400	No	--
Beryllium	0.095 (<BG)	10.4 [e]	1.51 [c]	1.51 [c]	No	--
Boron [f]	1.6	7,200	320	-- [g]	No	--
Cadmium [d]	0.13 (<BG)	13.9 [e]	0.81 [c]	0.81 [c]	No	--
Chromium	9.1 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	8.2 (<BG)	24	15.7 [c]	-- [g]	No	--
Copper	17.5 (<BG)	2,960	59.2	22.0 [c]	No	--
Hexavalent chromium [f]	0.214	2.1 [e]	4.8	2	No	--
Lead	5.2 (<BG)	353 [h]	10.2 [c]	10.2 [c]	No	--
Manganese	302 (<BG)	3,760	512 [c]	512 [c]	No	--
Mercury	0.055 (<BG)	24	0.33 [c]	0.33 [c]	No	--
Molybdenum [f]	0.60	400	8	-- [g]	No	--
Nickel	10.7 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	57.6 (<BG)	560	85.1 [c]	-- [g]	No	--
Zinc	40.6 (<BG)	24,000	480	67.8 [c]	No	--

[a] Lookup values and RAGs obtained from the RDR/RAWP (DOE-RL 2009b).
[b] Maximum or 95% UCL, depending on data censorship, as described in the *100-D-50:8 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 1996b). The arsenic cleanup level 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009b).
[d] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[e] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3]) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[f] No Hanford Site-specific or Washington State background value available.
[g] 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 (Ecology 2012) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], Ecology 1996 [Method B for surface waters]).
[h] Use EPA, 1994, *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.

-- = not applicable
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Nonradionuclide risk requirements include a hazard quotient of less than 1.0 for all individual noncarcinogens, a cumulative hazard quotient of less than 1.0 for noncarcinogens, an excess cancer risk of less than 1×10^{-6} for individual carcinogens, and a cumulative excess cancer risk of less than 1×10^{-5} for carcinogens. These risk values were calculated for the entire pipeline waste subsite using the highest values from each of the decision units. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. All individual hazard quotients for noncarcinogenic constituents detected above background are less than 1.0. The cumulative hazard quotient of 2.6×10^{-3} is less than 1.0. The excess cancer risk for hexavalent chromium, the only carcinogenic constituent quantified above background levels, is 1.0×10^{-7}. The 100-D-50:8 pipeline waste subsite meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the RDR/RAWP (DOE-RL 2009b).

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-D-50:8 pipeline waste subsite included calculation of the hazard quotient and carcinogenic (excess cancer) risk values for groundwater protection for nonradionuclides. The requirements include a hazard quotient of less than 1.0 for all individual noncarcinogens, a cumulative hazard quotient of less than 1 for noncarcinogens, an excess cancer risk of less than 1×10^{-6} for individual carcinogens, and a cumulative excess cancer risk of less than 1×10^{-5} for carcinogens. These risk values were conservatively calculated for the entire pipeline waste subsite using the highest value for each COPC from each of the decision units. Risk values were not calculated for constituents that were not detected, were detected at concentrations below Hanford Site or Washington State background values, or had a distribution coefficient greater than that required to show no migration to groundwater in 1,000 years using the RESidual RADioactivity (RESRAD) model discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b). All individual hazard quotients for noncarcinogenic constituents detected above background are less than 1.0. The cumulative hazard quotient, 5.0×10^{-2}, is less than 1.0. No carcinogenic constituents met the criteria for evaluation at the 100-D-50:8 waste subsite. Therefore, the 100-D-50:8 pipeline waste subsite meets the requirements for the hazard quotient and carcinogenic risk for groundwater protection.

Attainment of Radionuclide Direct Exposure RAGs

No radionuclides were quantified above background levels. As a consequence, the maximum predicted cumulative dose rate for the waste subsite is 0.00 mrem/yr, and thus below the RAG of 15 mrem/yr above background.

CONFIRMATORY AND VERIFICATION DATA QUALITY ASSESSMENT

A data quality assessment (DQA) review was performed to compare the confirmatory sampling approach and analytical data with the sampling and data requirements specified by the project objectives. This review involves evaluation of the data to determine if it is of the right type,

quality, and quantity to support the intended use (i.e., closeout decisions [EPA 2000]). The assessment review completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data process.

A data quality assessment (DQA) was performed to compare the verification sampling approach, the field logbook (WCH 2012a), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA for the 100-D-50:8 waste subsite established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in the ENRE project-specific database for data evaluation prior to its archival in the HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 100-D-50:8 waste subsite has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009b). The site was remediated by removing approximately 720 BCM (942 BCY) of material for disposal at the ERDF. Verification sampling was performed and the analytical results indicate that the residual concentrations of COPCs at this site meet the remedial action objectives and corresponding RAGs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-D-50:8 waste subsite to Interim Closed Out. Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

REFERENCES

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

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

BHI, 2005a, *Remaining Sites Confirmation Sampling Logbook*, EL-1578-7, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2005b, *Work Instruction for 100-D-50:8, 117-DR Condensate Drain Pipeline*, 0100D-WI-G0012, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2005c, *Work Instruction for 116-DR-8 Seal Pit Crib*, 0100D-WI-G0003, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

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

DOE-RL, 1995, *105-DR Large Sodium Fire Facility Closure Plan*, DOE/RL-90-25, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1996, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, DOE/RL-96-12, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1998, *Hanford Facility Dangerous Waste Part A Permit Application*, DOE/RL-88-21, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2004, "Certification of Closure for Areas Two, Four and Five of the 105-DR Reactor's Large Sodium Fire Facility (LSFF)," letter to M. A. Wilson, Washington State Department of Ecology, from K. A. Klein, U.S. Department of Energy, Richland Operations Office, Richland, Washington, June 3.

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

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

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

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

Ecology, 1996a, "No Subject," CCN 065150, letter to J. E. Rasmussen, U.S. Department of Energy, Richland Operations Office, and E. F. Loika, Westinghouse Hanford Company, from M. A. Wilson, Washington State Department of Ecology, Richland, Washington, July 16.

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

Ecology, 2004, "Closure Certification for the 105-DR Large Sodium Fire Facility (Resource Conservation and Recovery Act Treatment, Storage, and Disposal Unit) in June 2004 and request for Part A Stamped 'Closed'," letter to K. A. Klein, U.S. Department of Energy, Richland Operations Office, and J. W. Golden, Bechtel Hanford, Inc., from R. Bond, Washington State Department of Ecology, Richland, Washington, July 1.

Ecology, 2012, *Cleanup Levels and Risk Calculations (CLARC) Database*, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc.CLARCHome.aspx>.

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

EPA, 1994, *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.

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

EPA, 2000, *Explanation of Significant Difference for the 100 Area Remaining Sites ROD*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2004, *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision,* April 2004, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

Gilbert, R. O., 1987, *Statistical Methods for Environmental Pollution Monitoring*, Wiley & Sons, Inc., New York, New York.

WAC 173-340, 2001, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, Washington State Department of Ecology, Olympia, Washington.

WCH, 2005a, *100-D-50:8 and 116-DR-8 Remaining Sites for Remedial Action*, Washington Closure Hanford, Richland, Washington.

WCH, 2005b, *Remaining Sites Field Sampling*, Logbook EL-1578-7, pp. 44-45, Washington Closure Hanford, Richland, Washington.

WCH, 2009a, *Geophysical Site Investigation Summary – 100-D-50:8 Condensate Drain Pipeline*, GI #0596704, Washington Closure Hanford, Richland, Washington.

WCH, 2009b, *Remaining Sites Verification Package for 116-DR-8 Seal Pit Crib*, Rev. 1, Attachment to Waste Site Reclassification Form Control Number 2009-037, CCN 153883, September 2010, Washington Closure Hanford, Richland, Washington.

WCH, 2012a, *100D Field Remediation Project Sampling and Field Notes*, Logbook EL-1607-14, pp. 43-46, Washington Closure Hanford, Richland, Washington.

WCH, 2012b, *Work Instruction for Verification Sampling of the 100-D-50:8, 117-DR Condensate Drain Pipelines*, 0100D-WI-G0120, Rev. 0, Washington Closure Hanford, Richland, Washington.

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

APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-D-50:8 Waste Subsite [a].

Hazardous Substance		2007 WAC 173-340, Table 749-3			EPA Ecological Soil Screening Levels [b]				Maximum of Focused or Statistical Result
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
	Background	Metals (mg/kg)							
Antimony	5	5	--	--	--	78	--	0.27	0.73 (<BG)
Boron	--	0.5	--	--	--	--	--	--	1.6
Manganese	512	1,100 [d]	--	1,500	220	450	4,300	4,000	302 (<BG)
Vanadium	85.1	2	--	--	--	--	7.8	280	57.6 (<BG)

NOTE: Shaded cells are exceeded by the maximum of the focused or statistical result.

[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.

-- = values not available
BG = Hanford Site background
EPA = U.S. Environmental Protection Agency
WAC = *Washington Administrative Code*

APPENDIX B

CONFIRMATORY SAMPLE RESULTS

Table B-1. 100-D-50:8 Confirmatory Sampling Results. (4 Pages)

Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Carbon-14			Cesium-137			Cobalt-60			Europium-152			Europium-154		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath pipe	J037N5	7/7/05	0.17	U	0.17	1.75	U	2.5	0.049	U	0.049	0.042	U	0.042	0.11	U	0.11	0.17	U	0.17
Soil beneath pipe (Duplicate)	J037N6	7/7/05	0.19	U	0.19	0.242	U	2.5	0.034	U	0.034	0.040	U	0.040	0.12	U	0.12	0.13	U	0.13
Smear of pipe scale	J037V9	7/7/05	3.4	U	3.4				1.2	U	1.2	1.2	U	1.2	2.7	U	2.7	3.9	U	3.9

Sample Location	HEIS Number	Sample Date	Europium-155			Gross beta			Nickel-63			Potassium-40			Radium-226			Radium-228		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath pipe	J037N5	7/7/05	0.12	U	0.12	18.2		5.6	-0.722	U	3.7	13.8		0.58	0.501		0.097	0.762		0.19
Soil beneath pipe (Duplicate)	J037N6	7/7/05	0.13	U	0.13	18.4		5.7	-1.01	U	3.8	8.23		0.28	0.397		0.059	0.568		0.13
Smear of pipe scale	J037V9	7/7/05	2.5	U	2.5				-0.410	U	3.6	20	U	20	1.9	U	1.9	4.2	U	4.2

Sample Location	HEIS Number	Sample Date	Technetium-99			Thorium-228 GEA			Thorium-232 GEA			Tritium			Uranium-233/234			Uranium-235		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath pipe	J037N5	7/7/05	-0.046	U	0.39	0.711		0.056	0.762		0.19	1.43	U	2.4	0.649		0.16	0.051	U	0.19
Soil beneath pipe (Duplicate)	J037N6	7/7/05	0.011	U	0.56	0.709		0.059	0.568		0.13	1.64	U	2.3	0.584		0.19	0	U	0.23
Smear of pipe scale	J037V9	7/7/05	-0.588	U	3.3	1.5	U	1.5	4.2	U	4.2				0.131	U	0.20	0	U	0.24

Sample Location	HEIS Number	Sample Date	Uranium-235 GEA			Uranium-238			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath pipe	J037N5	7/7/05	0.18	U	0.18	0.586		0.16	6.1	U	6.1
Soil beneath pipe (Duplicate)	J037N6	7/7/05	0.18	U	0.18	0.389		0.19	4.3	U	4.3
Smear of pipe scale	J037V9	7/7/05	3.6	U	3.6	0.210		0.20	130	U	130

Note: Data qualified with B, C, and/or J, are considered acceptable values.
B = blank contamination
C = blank contamination
GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
J = estimate
MDA = minimum detectable activity
PQL = practical quantitation limit
Q = qualifier
U = undetected

Table B-1. 100-D-50:8 Confirmatory Sampling Results. (4 Pages)

Sample Location	HEIS Number	Sample Date	Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment blank	J037N4	7/7/05	0.38	U	0.38	0.42	U	0.42	0.92	C	0.02	0.02		0.009	0.22	U	0.22	0.03	U	0.03
Soil beneath pipe	J037N5	7/7/05	0.40	U	0.40	2.3		0.44	59.8	C	0.02	0.80		0.01	1.5		0.23	0.03	U	0.03
Soil beneath pipe (Duplicate)	J037N6	7/7/05	0.40	U	0.40	2.4		0.45	61.1	C	0.02	0.77		0.01	1.0		0.23	0.03	U	0.03

Sample Location	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Hexavalent Chromium			Lead			Lithium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment blank	J037N4	7/7/05	0.25	C	0.07	0.08	U	0.08	0.08	U	0.08				0.24	U	0.25	0.1	C	0.02
Soil beneath pipe	J037N5	7/7/05	7.5	C	0.07	5.8		0.09	11.5		0.08	0.24		0.20	4.0		0.24	7.8	C	0.02
Soil beneath pipe (Duplicate)	J037N6	7/7/05	6.9	C	0.07	5.8		0.09	11.9		0.08	0.39		0.21	3.9		0.25	7.4	C	0.02

Sample Location	HEIS Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel			Selenium			Silver		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment blank	J037N4	7/7/05	3.7	C	0.02	0.02	U	0.02	0.20	C	0.15	0.21	U	0.21	0.46	U	0.46	0.08	UC	0.08
Soil beneath pipe	J037N5	7/7/05	282	C	0.02	0.02	U	0.02	0.56	C	0.16	8.9		0.22	0.48	U	0.48	0.09	UC	0.09
Soil beneath pipe (Duplicate)	J037N6	7/7/05	276	C	0.02	0.02	U	0.02	0.42	C	0.16	9.0		0.22	0.49	U	0.49	0.09	UC	0.09

Sample Location	HEIS Number	Sample Date	Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment blank	J037N4	7/7/05	7.4	C	0.14	0.12	C	0.06	8.1		0.05
Soil beneath pipe	J037N5	7/7/05	114	C	0.15	36.9	C	0.06	40.3		0.05
Soil beneath pipe (Duplicate)	J037N6	7/7/05	103	C	0.15	34.7	C	0.06	35.0		0.05

Table B-1. 100-D-50:8 Confirmatory Sampling Results. (4 Pages)

Constituent	J037N4 Equipment blank Sample Date 7/7/05			J037N5 Soil beneath pipe Sample Date 7/7/05			J037N6 Soil beneath pipe (duplicate) Sample Date 7/7/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organics									
1,2,4-Trichlorobenzene	330	U	330	350	U	350	350	U	350
1,2-Dichlorobenzene	330	U	330	350	U	350	350	U	350
1,3-Dichlorobenzene	330	U	330	350	U	350	350	U	350
1,4-Dichlorobenzene	330	U	330	350	U	350	350	U	350
2,4,5-Trichlorophenol	830	U	830	880	U	880	880	U	880
2,4,6-Trichlorophenol	330	U	330	350	U	350	350	U	350
2,4-Dichlorophenol	330	U	330	350	U	350	350	U	350
2,4-Dimethylphenol	330	U	330	350	U	350	350	U	350
2,4-Dinitrophenol	830	U	830	880	U	880	880	U	880
2,4-Dinitrotoluene	330	U	330	350	U	350	350	U	350
2,6-Dinitrotoluene	330	U	330	350	U	350	350	U	350
2-Chloronaphthalene	330	U	330	350	U	350	350	U	350
2-Chlorophenol	330	U	330	350	U	350	350	U	350
2-Methylnaphthalene	330	U	330	350	U	350	350	U	350
2-Methylphenol (cresol, o-)	330	U	330	350	U	350	350	U	350
2-Nitroaniline	830	U	830	880	U	880	880	U	880
2-Nitrophenol	330	U	330	350	U	350	350	U	350
3+4 Methylphenol (cresol, m+p)	330	U	330	350	U	350	350	U	350
3,3'-Dichlorobenzidine	330	U	330	350	U	350	350	U	350
3-Nitroaniline	830	U	830	880	U	880	880	U	880
4,6-Dinitro-2-methylphenol	830	U	830	880	U	880	880	U	880
4-Bromophenylphenyl ether	330	U	330	350	U	350	350	U	350
4-Chloro-3-methylphenol	330	U	330	350	U	350	350	U	350
4-Chloroaniline	330	U	330	350	U	350	350	U	350
4-Chlorophenylphenyl ether	330	U	330	350	U	350	350	U	350
4-Nitroaniline	830	U	830	880	U	880	880	U	880
4-Nitrophenol	830	U	830	880	U	880	880	U	880
Acenaphthene	330	U	330	350	U	350	350	U	350
Acenaphthylene	330	U	330	350	U	350	350	U	350
Anthracene	330	U	330	350	U	350	350	U	350
Benzo(a)anthracene	330	U	330	350	U	350	350	U	350
Benzo(a)pyrene	330	U	330	350	U	350	350	U	350
Benzo(b)fluoranthene	330	U	330	350	U	350	350	U	350
Benzo(ghi)perylene	330	U	330	350	U	350	350	U	350
Benzo(k)fluoranthene	330	U	330	350	U	350	350	U	350
Bis(2-chloro-1-methylethyl)ether	330	U	330	350	U	350	350	U	350
Bis(2-Chloroethoxy)methane	330	U	330	350	U	350	350	U	350
Bis(2-chloroethyl) ether	330	U	330	350	U	350	350	U	350
Bis(2-ethylhexyl) phthalate	72	JB	330	98	JB	350	85	JB	350
Butylbenzylphthalate	330	U	330	350	U	350	350	U	350
Carbazole	330	U	330	350	U	350	350	U	350
Chrysene	330	U	330	350	U	350	350	U	350
Di-n-butylphthalate	110	JB	330	33	JB	350	56	JB	350
Di-n-octylphthalate	330	U	330	350	U	350	350	U	350
Dibenz[a,h]anthracene	330	U	330	350	U	350	350	U	350
Dibenzofuran	330	U	330	350	U	350	350	U	350
Diethylphthalate	66	J	330	350	U	350	350	U	350
Dimethyl phthalate	330	U	330	350	U	350	350	U	350

Table B-1. 100-D-50:8 Confirmatory Sampling Results. (4 Pages)

Constituent	J037N4 Equipment blank Sample Date 7/7/05			J037N5 Soil beneath pipe Sample Date 7/7/05			J037N6 Soil beneath pipe (duplicate) Sample Date 7/7/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organics (continued)									
Fluoranthene	330	U	330	350	U	350	350	U	350
Fluorene	330	U	330	350	U	350	350	U	350
Hexachlorobenzene	330	U	330	350	U	350	350	U	350
Hexachlorobutadiene	330	U	330	350	U	350	350	U	350
Hexachlorocyclopentadiene	330	U	330	350	U	350	350	U	350
Hexachloroethane	330	U	330	350	U	350	350	U	350
Indeno(1,2,3-cd)pyrene	330	U	330	350	U	350	350	U	350
Isophorone	330	U	330	350	U	350	350	U	350
N-Nitroso-di-n-dipropylamine	330	U	330	350	U	350	350	U	350
N-Nitrosodiphenylamine	330	U	330	350	U	350	350	U	350
Naphthalene	330	U	330	350	U	350	350	U	350
Nitrobenzene	330	U	330	350	U	350	350	U	350
Pentachlorophenol	830	U	830	880	U	880	880	U	880
Phenanthrene	330	U	330	350	U	350	350	U	350
Phenol	25	JB	330	350	U	350	350	U	350
Pyrene	330	U	330	350	U	350	350	U	350

Table B-2. 116-DR-8 Confirmatory Sampling Results. (4 Pages)

Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Carbon-14			Cesium-137			Cobalt-60			Europium-152			Europium-154		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath crib	J03D25	7/8/05	0.23	U	0.23	-0.582	U	3.7	0.036	U	0.036	0.035	U	0.035	0.077	U	0.077	0.12	U	0.12
Soil beneath crib (duplicate)	J03D26	7/8/05	0.047	U	0.047	0.278	U	3.7	0.037	U	0.037	0.042	U	0.042	0.11	U	0.11	0.14	U	0.14
Pipe sediment	J03D36	7/11/05	0.22	U	0.22				1.30		0.23	0.28	U	0.28	0.65	U	0.65	0.75	U	0.75

Sample Location	HEIS Number	Sample Date	Europium-155			Gross alpha			Gross beta			Potassium-40			Radium-226			Radium-228		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath crib	J03D25	7/8/05	0.11	U	0.11	7.31		2.3	17.4		5.5	9.76		0.37	0.375		0.062	0.484		0.15
Soil beneath crib (duplicate)	J03D26	7/8/05	0.075	U	0.075	9.23		2.9	14.9		5.6	7.98		0.38	0.360		0.068	0.404		0.16
Pipe sediment	J03D36	7/11/05	0.37	U	0.37	3.62	U	4.6	9.19		6.1	3.0	U	3.0	0.515		0.37	1.1	U	1.1

Sample Location	HEIS Number	Sample Date	Thorium-228 GEA			Thorium-232 GEA			Tritium			Uranium-233/234			Uranium-235			Uranium-235 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath crib	J03D25	7/8/05	0.566		0.062	0.484		0.15	0.325	U	3.9	0.424		0.038	0.022	U	0.028	0.14	U	0.14
Soil beneath crib (duplicate)	J03D26	7/8/05	0.494		0.044	0.404		0.16	0.376	U	3.9	0.487		0.029	0.033		0.028	0.13	U	0.13
Pipe sediment	J03D36	7/11/05	0.616		0.24	1.1	U	1.1				0.260		0.028	0.013	U	0.034	0.61	U	0.61

Sample Location	HEIS Number	Sample Date	Uranium-238			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath crib	J03D25	7/8/05	0.498		0.024	4.4	U	4.4
Soil beneath crib (duplicate)	J03D26	7/8/05	0.523		0.029	4.9	U	4.9
Pipe sediment	J03D36	7/11/05	0.260		0.028	23	U	23

Note: Data qualified with B, C, and/or J, are considered acceptable values.
B = blank contamination
C = blank contamination
GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
J = estimate
MDA = minimum detectable activity
PQL = practical quantitation limit
PCB = polychlorinated biphenyl
Q = qualifier
U = undetected

Table B-2. 116-DR-8 Confirmatory Sampling Results. (4 Pages)

Sample Location	HEIS Number	Sample Date	Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil beneath crib	J03D25	7/8/05	0.43		0.37	1.2	C	0.42	50.1		0.02	1.0		0.009	1.1	C	0.22	0.1		3
Soil beneath crib (duplicate)	J03D26	7/8/05	0.44		0.39	1.7	C	0.44	56.8		0.02	1.1		0.01	1.2	C	0.22	0.17		0.03
Equipment blank	J03D27	7/8/05	0.32	U	0.32	0.36	UC	0.36	0.90		0.02	0.01		0.008	0.69	C	0.18	0.02	U	0.02
Pipe sediment	J03D36	7/11/05	11.8		2.3	2.6	U	2.6	194	C	0.12	0.63		0.06	4.4		1.3	29.8		0.18

Sample Location	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Hexavalent Chromium			Lead			Lithium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil beneath crib	J03D25	7/8/05	7.0	C	0.07	7.9		0.08	17.6		0.07	0.21	U	0.21	4.5		0.23	265		0.02
Soil beneath crib (duplicate)	J03D26	7/8/05	7.7	C	0.07	8.1		0.09	18.4		0.08	0.21	U	0.21	4.5		0.24	272		0.02
Equipment blank	J03D27	7/8/05	0.23	C	0.06	0.07	U	0.07	0.06	U	0.06				0.20	U	0.20	0.04		0.02
Pipe sediment	J03D30*	7/11/05										76.8		0.35						
Pipe sediment	J03D36	7/11/05	6880		0.41	123		0.53	622		0.47				970		1.5	1920	C	0.12

* Only analyte was hexavalent chromium.

Sample Location	HEIS Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel			Selenium			Silver		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil beneath crib	J03D25	7/8/05	314		0.02	0.01	U	0.01	0.74		0.15	8.4		0.21	0.46	U	0.46	0.08	U	0.08
Soil beneath crib (duplicate)	J03D26	7/8/05	326		0.02	0.01	U	0.01	0.75		0.16	9.8		0.21	0.48	U	0.48	0.23		0.09
Equipment blank	J03D27	7/8/05	2.2		0.02	0.02	U	0.02	0.13	U	0.13	0.18	U	0.18	0.39	U	0.39	0.07	U	0.07
Pipe sediment	J03D36	7/11/05	1680		0.12	0.74		0.02	23.6		0.94	5560		1.3	2.87	U	2.9	6.2		0.53

Sample Location	HEIS Number	Sample Date	Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil beneath crib	J03D25	7/8/05	1170	C	0.14	81.0		0.06	77.2		0.05
Soil beneath crib (duplicate)	J03D26	7/8/05	1170	C	0.15	81.7		0.06	77.8		0.05
Equipment blank	J03D27	7/8/05	3.8	C	0.12	0.05		0.05	0.43		0.04
Pipe sediment	J03D36	7/11/05	1410		0.88	23.0		0.35	1890		0.29

Table B-2. 116-DR-8 Confirmatory Sampling Results. (4 Pages)

Constituent	J03D25 Soil beneath crib Sample Date 7/8/05			J03D26 Soil beneath crib (duplicate) Sample Date 7/8/05			J03D27 Equipment blank Sample Date 7/8/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls (PCBs)									
Aroclor-1016	14	U	14	14	U	14			
Aroclor-1221	14	U	14	14	U	14			
Aroclor-1232	14	U	14	14	U	14			
Aroclor-1242	14	U	14	14	U	14			
Aroclor-1248	14	U	14	14	U	14			
Aroclor-1254	14	U	14	14	U	14			
Aroclor-1260	14	U	14	14	U	14			
Semivolatile Organics									
1,2,4-Trichlorobenzene	350	U	350	350	U	350	330	U	330
1,2-Dichlorobenzene	350	U	350	350	U	350	330	U	330
1,3-Dichlorobenzene	350	U	350	350	U	350	330	U	330
1,4-Dichlorobenzene	350	U	350	350	U	350	330	U	330
2,4,5-Trichlorophenol	870	U	870	870	U	870	830	U	830
2,4,6-Trichlorophenol	350	U	350	350	U	350	330	U	330
2,4-Dichlorophenol	350	U	350	350	U	350	330	U	330
2,4-Dimethylphenol	350	U	350	350	U	350	330	U	330
2,4-Dinitrophenol	870	U	870	870	U	870	830	U	830
2,4-Dinitrotoluene	350	U	350	350	U	350	330	U	330
2,6-Dinitrotoluene	350	U	350	350	U	350	330	U	330
2-Chloronaphthalene	350	U	350	350	U	350	330	U	330
2-Chlorophenol	350	U	350	350	U	350	330	U	330
2-Methylnaphthalene	350	U	350	350	U	350	330	U	330
2-Methylphenol (cresol, o-)	350	U	350	350	U	350	330	U	330
2-Nitroaniline	870	U	870	870	U	870	830	U	830
2-Nitrophenol	350	U	350	350	U	350	330	U	330
3+4 Methylphenol (cresol, m+p)	350	U	350	350	U	350	330	U	330
3,3'-Dichlorobenzidine	350	U	350	350	U	350	330	U	330
3-Nitroaniline	870	U	870	870	U	870	830	U	830
4,6-Dinitro-2-methylphenol	870	U	870	870	U	870	830	U	830
4-Bromophenylphenyl ether	350	U	350	350	U	350	330	U	330
4-Chloro-3-methylphenol	350	U	350	350	U	350	330	U	330
4-Chloroaniline	350	U	350	350	U	350	330	U	330
4-Chlorophenylphenyl ether	350	U	350	350	U	350	330	U	330
4-Nitroaniline	870	U	870	870	U	870	830	U	830
4-Nitrophenol	870	U	870	870	U	870	830	U	830
Acenaphthene	350	U	350	350	U	350	330	U	330
Acenaphthylene	350	U	350	350	U	350	330	U	330
Anthracene	350	U	350	350	U	350	330	U	330
Benzo(a)anthracene	350	U	350	350	U	350	330	U	330
Benzo(a)pyrene	350	U	350	350	U	350	330	U	330
Benzo(b)fluoranthene	350	U	350	350	U	350	330	U	330
Benzo(ghi)perylene	350	U	350	350	U	350	330	U	330
Benzo(k)fluoranthene	350	U	350	350	U	350	330	U	330
Bis(2-chloro-1-methylethyl)ether	350	U	350	350	U	350	330	U	330
Bis(2-Chloroethoxy)methane	350	U	350	350	U	350	330	U	330
Bis(2-chloroethyl) ether	350	U	350	350	U	350	330	U	330
Bis(2-ethylhexyl) phthalate	51	JB	350	130	JB	350	33	JB	330
Butylbenzylphthalate	350	U	350	350	U	350	330	U	330

Table B-2. 116-DR-8 Confirmatory Sampling Results. (4 Pages)

Constituent	J03D25 Soil beneath crib Sample Date 7/8/05			J03D26 Soil beneath crib (duplicate) Sample Date 7/8/05			J03D27 Equipment blank Sample Date 7/8/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organics (continued)									
Carbazole	350	U	350	350	U	350	330	U	330
Chrysene	350	U	350	350	U	350	330	U	330
Di-n-butylphthalate	25	J	350	350	U	350	72	JB	330
Di-n-octylphthalate	350	U	350	350	U	350	330	U	330
Dibenz[a,h]anthracene	350	U	350	350	U	350	330	U	330
Dibenzofuran	350	U	350	350	U	350	330	U	330
Diethylphthalate	350	U	350	350	U	350	37	JB	330
Dimethyl phthalate	350	U	350	350	U	350	330	U	330
Fluoranthene	350	U	350	350	U	350	330	U	330
Fluorene	350	U	350	350	U	350	330	U	330
Hexachlorobenzene	350	U	350	350	U	350	330	U	330
Hexachlorobutadiene	350	U	350	350	U	350	330	U	330
Hexachlorocyclopentadiene	350	U	350	350	U	350	330	U	330
Hexachloroethane	350	U	350	350	U	350	330	U	330
Indeno(1,2,3-cd)pyrene	350	U	350	350	U	350	330	U	330
Isophorone	350	U	350	350	U	350	330	U	330
N-Nitroso-di-n-dipropylamine	350	U	350	350	U	350	330	U	330
N-Nitrosodiphenylamine	350	U	350	350	U	350	330	U	330
Naphthalene	350	U	350	350	U	350	330	U	330
Nitrobenzene	350	U	350	350	U	350	330	U	330
Pentachlorophenol	870	U	870	870	U	870	830	U	830
Phenanthrene	350	U	350	350	U	350	330	U	330
Phenol	350	U	350	350	U	350	330	U	330
Pyrene	350	U	350	350	U	350	330	U	330

APPENDIX C

CALCULATION BRIEFS

APPENDIX C

CALCULATION BRIEFS

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

100-D-50:8 Waste Subsite Cleanup Verification, 95% UCL Calculation, 0100D-CA-V0470, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-D-50:8 Waste Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0100D-CA-V0471, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-D-50:8 Waste Sites Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100D-CA-V0476, 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-D Field Remediation **Job No. 14655**

Area: 100-D

Discipline: Environmental *Calculation No: 0100D-CA-V0470

Subject: 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculation

Computer Program: Excel Program No: Excel 2003

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 = 19 Attm. 1 = 6 Total = 26	N. K. Schiffern N K Schiffern	J. D. Skoglie	C. H. Dobie CH Dobie	D. F. Obenauer D. F. Obenauer	1/8/13

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	N. K. Schiffern	**Date**	09/04/12	**Calc. No.**	0100D-CA-V0470	**Rev. No.**	0
Project	100-D Field Remediation	**Job No.**	14655	**Checked**	J. D. Skoglie	**Date**	09/04/12
Subject	100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations					**Sheet No.**	1 of 19

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 13 - Calculation Sheet Verification Data - Excavation and Staging Pile Area
Sheets 14 to 17 - Ecology Software (MTCAStat) Results
Sheets 18 to 19 - Calculation Sheet - Duplicate Analysis
Attachment 1 - 100-D-50:8 Subsite, Verification Sampling Results (6 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-D-50:8 subsite. The data were entered into an EXCEL 2003 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-D-50:8 subsite underwent statistical sampling. The 100-D-50:8 subsite has two decision units for verification sampling, consisting of excavation and staging pile area.

Washington Closure Hanford **CALCULATION SHEET**

Originator	N. K. Schiffern NS	**Date**	09/04/12	**Calc. No.**	0100D-CA-V0470	**Rev. No.**	0
Project	100-D Field Remediation	**Job No.**	14655	**Checked**	J. D. Skoglie	**Date**	09/04/12
Subject	100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations					**Sheet No.**	2 of 19

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. The 95% UCL values were not calculated for potassium-40, radium-226, radium-228, thorium-228, and thorium-232 based on natural occurence at the Hanford Site.

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.

Washington Closure Hanford **CALCULATION SHEET**

Originator	N. K. Schiffern NS	**Date**	09/04/12	**Calc. No.**	0100D-CA-V0470	**Rev. No.**	0
Project	100-D Field Remediation	**Job No.**	14655	**Checked**	J. D. Skoglie	**Date**	09/04/12
Subject	100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations					**Sheet No.**	3 of 19

Summary (continued)

QUALIFIER LIST

B = estimate
C = Sample was </= 5X the blank concentration
J = estimate
M = sample duplicate precision not met
N = recovery is outside control limits
U = undetected
X = Serial dilution in the analytical batch indicates that physical and chemical interferences are present.

ACRONYM LIST

– = not applicable
DE = direct exposure
EXC = excavation
GW = groundwater
MDA = minimum detected activity
MTCA = *Model Toxics Control Act*
NA = not applicable
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
SPA = staging pile area
TDL = target detection limit
UCL = upper confidence limit
WAC = Washington Administrative Code

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS **Date** 09/04/12 **Calc. No.** 0100D-CA-V0470 **Rev. No.** 0
Project 100-D Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 09/04/12
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 4 of 19

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations for the excavation, staging pile 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 subsite.

Results Summary [a]

Analyte	Excavation		Staging Pile Area		Units
	95% UCL Result	Maximum Result	95% UCL Result	Maximum Result	
Uranium-234	0.190	--	0.193	--	pCi/g
Uranium-238	0.180	--	0.219	--	pCi/g
Antimony	--	0.73	--	0.59	mg/kg
Arsenic	1.6	--	1.6	--	mg/kg
Barium	68.5	--	62.7	--	mg/kg
Beryllium	0.13	--	0.095	--	mg/kg
Boron	1.2	--	--	1.6	mg/kg
Cadmium	0.14	--	0.13	--	mg/kg
Chromium	9.6	--	9.1	--	mg/kg
Cobalt	8.3	--	8.2	--	mg/kg
Copper	16.7	--	17.5	--	mg/kg
Hexavalent Chromium	--	0.193	--	0.214	mg/kg
Lead	4.5	--	5.2	--	mg/kg
Manganese	301	--	302	--	mg/kg
Mercury	0.0059	--	0.055	--	mg/kg
Molybdenum	--	0.38	--	0.60	mg/kg
Nickel	13.1	--	10.7	--	mg/kg
Vanadium	57.2	--	57.6	--	mg/kg
Zinc	41.1	--	40.6	--	mg/kg

3-Part Test Evaluation

	Excavation		Staging Pile Area	
95% UCL or Maximum > Cleanup Limit	NO	NO	NA	NO
> 10% above Cleanup Limit?	NO	NO	NA	NO
Any sample > 2x Cleanup Limit?	NO	NO	NA	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 N. K. Schiffern	**Date** 09/04/12	**Calc. No.** 0100D-CA-V0470	**Rev. No.** 0
Project 100-D Field Remediation	**Job No.** 14655	**Checked** J. D. Skoglie	**Date** 09/04/12
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations			**Sheet No.** 5 of 19

Summary (continued)

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations for the excavation, staging pile 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	Staging Pile Area
Aluminum	1.9%	7.2%
Barium	3.7%	2.6%
Calcium	2.9%	0.4%
Chromium	2.9%	14.9%
Copper	2.8%	3.8%
Iron	1.6%	2.0%
Magnesium	1.6%	6.6%
Manganese	2.0%	2.7%
Silicon	3.3%	6.8%
Sodium		0.7%
Vanadium	6.6%	3.9%
Zinc	3.1%	3.5%

Grey cells indicate not applicable

[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

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12
Job No. 14655

Calc. No. 0100D-CA-V0470
Checked J. D. Skoglie JS

Rev. No. 0
Date 09/04/12
Sheet No. 6 of 19

100-D-50:8 Subsite Statistical Calculations

Verification Data -Excavation

Sample Area	Sample Number	Sample Date	Uranium-234 pCi/g	Q	MDA	Uranium-238 pCi/g	Q	MDA
EXC-9	J1PX03	7/31/2012	0.151		0.0471	0.150		0.0560
Duplicate of J1PX03	J1PX07	7/31/2012	0.249		0.0603	0.263		0.0506
EXC-1	J1PWX5	7/31/2012	0.119		0.0483	0.248		0.0620
EXC-2	J1PWX6	7/31/2012	0.100		0.0583	0.152		0.0514
EXC-3	J1PWX7	7/31/2012	0.125		0.0508	0.0966		0.0562
EXC-4	J1PWX8	7/31/2012	0.134		0.0492	0.132		0.0610
EXC-5	J1PWX9	7/31/2012	0.178		0.0547	0.164		0.0640
EXC-6	J1PX00	7/31/2012	0.163		0.0581	0.152		0.0512
EXC-7	J1PX01	7/31/2012	0.218		0.0442	0.108		0.0525
EXC-8	J1PX02	7/31/2012	0.247		0.0691	0.159		0.0691
EXC-10	J1PX04	7/31/2012	0.158		0.0835	0.190		0.0924
EXC-11	J1PX05	7/31/2012	0.195		0.0856	0.166		0.0603
EXC-12	J1PX06	7/31/2012	0.196		0.0694	0.152		0.0650

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Uranium-234 pCi/g			Uranium-238 pCi/g		
EXC-9	J1PX03/J1PX07	7/31/2012	0.200			0.207		
EXC-1	J1PWX5	7/31/2012	0.119			0.248		
EXC-2	J1PWX6	7/31/2012	0.100			0.152		
EXC-3	J1PWX7	7/31/2012	0.125			0.0966		
EXC-4	J1PWX8	7/31/2012	0.134			0.132		
EXC-5	J1PWX9	7/31/2012	0.178			0.164		
EXC-6	J1PX00	7/31/2012	0.163			0.152		
EXC-7	J1PX01	7/31/2012	0.218			0.108		
EXC-8	J1PX02	7/31/2012	0.247			0.159		
EXC-10	J1PX04	7/31/2012	0.158			0.190		
EXC-11	J1PX05	7/31/2012	0.195			0.166		
EXC-12	J1PX06	7/31/2012	0.196			0.152		

Statistical Computations

	Uranium-234			Uranium-238		
95% UCL based on	Radionuclide data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.		
N	12			12		
% < Detection limit	0%			0%		
Mean	0.169			0.161		
Standard deviation	0.0442			0.0411		
Z-statistic	1.64			1.64		
95% UCL on mean	0.190			0.180		
Maximum value	0.249			0.263		

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 09/04/12 **Calc. No.** 0100D-CA-V0470 **Rev. No.** 0
Project 100-D Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 09/04/12
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 7 of 19

1 **100-D-50:8 Subsite Statistical Calculations**

2 **Verification Data - Excavation**

3	Sample	Sample	Sample	Arsenic			Barium			Beryllium			Boron			Cadmium			Chromium			Cobalt			Copper		
4	Area	Number	Date	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
5	EXC-9	J1PX03	7/31/2012	1.8		0.62	72.5	X	0.072	0.15	B	0.031	1.3	B	0.92	0.15	B	0.039	10.4	X	0.055	6.9	X	0.094	14.4	X	0.20
6	Duplicate of J1PX03	J1PX07	7/31/2012	2.0		0.64	69.9	X	0.073	0.15	B	0.032	1.3	B	0.95	0.13	B	0.040	10.1	X	0.056	6.9	X	0.096	14.0	X	0.21
7	EXC-1	J1PWX5	7/31/2012	0.88	B	0.62	53.8	X	0.072	0.035	B	0.031	0.93	U	0.93	0.12	B	0.039	9.8	X	0.055	9.0	X	0.095	17.5	X	0.21
8	EXC-2	J1PWX6	7/31/2012	2.2		0.63	76.2	X	0.073	0.18	B	0.032	1.5	B	0.94	0.13	B	0.039	10.5	X	0.056	7.6	X	0.096	16.9	X	0.21
9	EXC-3	J1PWX7	7/31/2012	1.9		0.64	65.6	X	0.073	0.12	B	0.032	1.2	B	0.95	0.13	B	0.040	9.2	X	0.056	7.5	X	0.097	15.8	X	0.21
10	EXC-4	J1PWX8	7/31/2012	1.4		0.57	65.6	X	0.065	0.11	B	0.028	0.98	B	0.84	0.14	B	0.035	8.7	X	0.050	6.8	X	0.086	13.9	X	0.19
11	EXC-5	J1PWX9	7/31/2012	1.3		0.59	56.6	X	0.068	0.090	B	0.030	0.94	B	0.88	0.12	B	0.037	8.0	X	0.052	6.8	X	0.090	13.9	X	0.20
12	EXC-6	J1PX00	7/31/2012	1.5		0.65	68.7	X	0.075	0.16	B	0.033	1.2	B	0.97	0.13	B	0.040	10.3	X	0.057	7.1	X	0.099	15.6	X	0.21
13	EXC-7	J1PX01	7/31/2012	1.6		0.56	69.7	X	0.064	0.11	B	0.028	1.3	B	0.83	0.17		0.035	8.7	X	0.049	7.5	X	0.085	15.5	X	0.18
14	EXC-8	J1PX02	7/31/2012	1.6		0.63	68.0	X	0.072	0.12	B	0.031	1.0	B	0.93	0.15	B	0.039	9.1	X	0.055	7.8	X	0.095	15.8	X	0.21
15	EXC-10	J1PX04	7/31/2012	1.1		0.62	65.1	X	0.071	0.087	B	0.031	1.0	B	0.92	0.13	B	0.038	9.9	X	0.054	8.2	X	0.093	16.1	X	0.20
16	EXC-11	J1PX05	7/31/2012	0.65	U	0.65	49.8	X	0.075	0.032	U	0.032	0.96	U	0.96	0.11	B	0.040	4.8	X	0.057	9.6	X	0.098	18.3	X	0.21
17	EXC-12	J1PX06	7/31/2012	0.61	U	0.61	50.1	X	0.070	0.031	U	0.031	0.91	U	0.91	0.12	B	0.038	6.0	X	0.054	8.8	X	0.093	17.0	X	0.20

18 **Statistical Computation Input Data**

19	Sample	Sample	Sample	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper
20	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
21	EXC-9	J1PX03/J1PX07	7/31/2012	1.9	71.2	0.15	1.3	0.14	10.3	6.9	14.2
22	EXC-1	J1PWX5	7/31/2012	0.88	53.8	0.035	0.47	0.12	9.8	9.0	17.5
23	EXC-2	J1PWX6	7/31/2012	2.2	76.2	0.18	1.5	0.13	10.5	7.6	16.9
24	EXC-3	J1PWX7	7/31/2012	1.9	65.6	0.12	1.2	0.13	9.2	7.5	15.8
25	EXC-4	J1PWX8	7/31/2012	1.4	65.6	0.11	0.98	0.14	8.7	6.8	13.9
26	EXC-5	J1PWX9	7/31/2012	1.3	56.6	0.090	0.94	0.12	8.0	6.8	13.9
27	EXC-6	J1PX00	7/31/2012	1.5	68.7	0.16	1.2	0.13	10.3	7.1	15.6
28	EXC-7	J1PX01	7/31/2012	1.6	69.7	0.11	1.3	0.17	8.7	7.5	15.5
29	EXC-8	J1PX02	7/31/2012	1.6	68.0	0.12	1.0	0.15	9.1	7.8	15.8
30	EXC-10	J1PX04	7/31/2012	1.1	65.1	0.087	1.0	0.13	9.9	8.2	16.1
31	EXC-11	J1PX05	7/31/2012	0.33	49.8	0.016	0.48	0.11	4.8	9.6	18.3
32	EXC-12	J1PX06	7/31/2012	0.31	50.1	0.016	0.46	0.12	6.0	8.8	17.0

33 **Statistical Computations**

34		Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper
35	95% UCL based on	Large data set (n ≥10), use MTCAStat normal distribution.	Large data set (n ≥10), use MTCAStat lognormal distribution.	Large data set (n ≥10), use MTCAStat normal distribution.	Large data set (n ≥10), use MTCAStat normal 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), use MTCAStat lognormal distribution.
36	N	12	12	12	12	12	12	12	12
37	% < Detection limit	17%	0%	17%	25%	0%	0%	0%	0%
38	Mean	1.3	63.4	0.099	0.99	0.13	8.8	7.8	15.9
39	Standard deviation	0.60	8.7	0.054	0.35	0.016	1.8	0.92	1.4
40	95% UCL on mean	1.6	68.5	0.13	1.2	0.14	9.6	8.3	16.7
41	Maximum value	2.2	76.2	0.18	1.5	0.17	10.5	9.6	18.3
42	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	320 GW Protection	0.81 GW & River Protection	18.5 GW & River Protection	15.7 GW Protection	22.0 River Protection
43	**WAC 173-340 3-PART TEST**								
44	95% UCL > Cleanup Limit?	NA	NA	NA	NO	NA	NA	NA	NA
45	> 10% above Cleanup Limit?	NA	NA	NA	NO	NA	NA	NA	NA
46	Any sample > 2X Cleanup Limit?	NA	NA	NA	NO	NA	NA	NA	NA
47	**WAC 173-340 Compliance?**	Because all values are below background (6.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (1.51 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 (0.81 mg/kg) the WAC 173-340 3-part test is not required.	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.

48 Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12
Job No. 14655

Calc. No. 0100D-CA-V0470
Checked J. D. Skoglie JS

Rev. No. 0
Date 09/04/12
Sheet No. 8 of 19

1 **100-D-50:8 Subsite Statistical Calculations**
2 **Verification Data - Excavation**

3	Sample	Sample	Sample	Lead			Manganese			Mercury			Nickel			Vanadium			Zinc		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5	EXC-9	J1PX03	7/31/2012	4.5		0.25	303	X	0.094	0.0061	B	0.0060	10.6	X	0.12	46.7		0.088	38.7	X	0.37
6	Duplicate of J1PX03	J1PX07	7/31/2012	4.1		0.26	297	X	0.096	0.0067	B	0.0058	10.3	X	0.12	43.7		0.091	37.5	X	0.38
7	EXC-1	J1PWX5	7/31/2012	4.0		0.26	304	X	0.095	0.0054	B	0.0048	19.3	XM	0.12	59.0		0.089	42.1	X	0.38
8	EXC-2	J1PWX6	7/31/2012	4.9		0.26	307	X	0.096	0.0087	B	0.0050	11.4	X	0.12	44.4		0.090	39.5	X	0.38
9	EXC-3	J1PWX7	7/31/2012	5.0		0.26	295	X	0.097	0.0066	B	0.0050	9.7	X	0.12	47.2		0.091	39.5	X	0.38
10	EXC-4	J1PWX8	7/31/2012	4.0		0.23	276	X	0.086	0.0049	U	0.0049	9.4	X	0.11	44.4		0.081	35.2	X	0.34
11	EXC-5	J1PWX9	7/31/2012	4.7		0.24	262	X	0.090	0.0048	U	0.0048	8.9	X	0.11	48.6		0.085	35.8	X	0.36
12	EXC-6	J1PX00	7/31/2012	4.2		0.27	289	X	0.099	0.0063	U	0.0063	13.5	X	0.12	45.5		0.093	36.0	X	0.39
13	EXC-7	J1PX01	7/31/2012	5.2		0.23	295	X	0.085	0.0057	B	0.0052	9.8	X	0.10	52.0		0.079	43.1	X	0.34
14	EXC-8	J1PX02	7/31/2012	4.3		0.26	307	X	0.095	0.0060	B	0.0048	11.1	X	0.12	54.1		0.089	41.8	X	0.38
15	EXC-10	J1PX04	7/31/2012	3.9		0.25	299	X	0.093	0.0059	B	0.0056	15.8	X	0.11	58.4		0.088	40.7	X	0.37
16	EXC-11	J1PX05	7/31/2012	2.5		0.26	308	X	0.098	0.0053	U	0.0053	9.6	X	0.12	69.6		0.092	43.3	X	0.39
17	EXC-12	J1PX06	7/31/2012	2.4		0.25	284	X	0.093	0.0058	U	0.0058	11.2	X	0.11	63.0		0.087	39.4	X	0.37

18 **Statistical Computation Input Data**

19	Sample	Sample	Sample	Lead	Manganese	Mercury	Nickel	Vanadium	Zinc
20	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
21	EXC-9	J1PX03/J1PX07	7/31/2012	4.3	300	0.0064	10.5	45.2	38.1
22	EXC-1	J1PWX5	7/31/2012	4.0	304	0.0054	19.3	59.0	42.1
23	EXC-2	J1PWX6	7/31/2012	4.9	307	0.0087	11.4	44.4	39.5
24	EXC-3	J1PWX7	7/31/2012	5.0	295	0.0066	9.7	47.2	39.5
25	EXC-4	J1PWX8	7/31/2012	4.0	276	0.0025	9.4	44.4	35.2
26	EXC-5	J1PWX9	7/31/2012	4.7	262	0.0024	8.9	48.6	35.8
27	EXC-6	J1PX00	7/31/2012	4.2	289	0.0032	13.5	45.5	36.0
28	EXC-7	J1PX01	7/31/2012	5.2	295	0.0057	9.8	52.0	43.1
29	EXC-8	J1PX02	7/31/2012	4.3	307	0.0060	11.1	54.1	41.8
30	EXC-10	J1PX04	7/31/2012	3.9	299	0.0059	15.8	58.4	40.7
31	EXC-11	J1PX05	7/31/2012	2.5	308	0.0027	9.6	69.6	43.3
32	EXC-12	J1PX06	7/31/2012	2.4	284	0.0029	11.2	63.0	39.4

33 **Statistical Computations**

34		Lead	Manganese	Mercury	Nickel	Vanadium	Zinc
35	95% UCL based on	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.	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.
36	N	12	12	12	12	12	12
37	% < Detection limit	0%	0%	42%	0%	0%	0%
38	Mean	4.1	294	0.0049	11.7	52.6	39.5
39	Standard deviation	0.89	14.0	0.0021	3.1	8.3	2.8
40	95% UCL on mean	4.5	301	0.0059	13.1	57.2	41.1
41	Maximum value	5.2	308	0.0087	19.3	69.6	43.3
42	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	10.2 GW & River Protection	512 GW & River Protection	0.33 GW & River Protection	19.1 GW Protection	85.1 GW Protection	67.8 River Protection
43	**WAC 173-340 3-PART TEST**						
44	95% UCL > Cleanup Limit?	NA	NA	NA	NO	NA	NA
45	> 10% above Cleanup Limit?	NA	NA	NA	NO	NA	NA
46	Any sample > 2X Cleanup Limit?	NA	NA	NA	NO	NA	NA
47	**WAC 173-340 Compliance?**	Because all values are below background (10.2 mg/kg) the WAC 173-340 3-part test is not required.	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 (0.33 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 (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.

48 Qualifiers are defined on page 3.

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12
Job No. 14655
Calc. No. 0100D-CA-V0470
Checked J. D. Skoglie

Rev. No. 0
Date 09/04/12
Sheet No. 9 of 19

1 **100-D-50:8 Subsite Maximum Calculations**
2 **Verification Data - Excavation**

3 Sample Area	Sample Number	Sample Date	Antimony mg/kg	Antimony Q	Antimony PQL	Hexavalent Chromium mg/kg	Hexavalent Chromium Q	Hexavalent Chromium PQL	Molybdenum mg/kg	Molybdenum Q	Molybdenum PQL
5 EXC-9	J1PX03	7/31/2012	0.36	U	0.36	0.155	U	0.155	0.24	U	0.24
6 Duplicate of J1PX03	J1PX07	7/31/2012	0.37	U	0.37	0.155	U	0.155	0.25	U	0.25
7 EXC-1	J1PWX5	7/31/2012	0.40	B	0.36	0.155	U	0.155	0.38	B	0.25
8 EXC-2	J1PWX6	7/31/2012	0.48	B	0.37	0.155	U	0.155	0.29	B	0.25
9 EXC-3	J1PWX7	7/31/2012	0.37	U	0.37	0.171		0.155	0.25	U	0.25
10 EXC-4	J1PWX8	7/31/2012	0.33	U	0.33	0.155	U	0.155	0.22	U	0.22
11 EXC-5	J1PWX9	7/31/2012	0.73		0.34	0.155	U	0.155	0.23	U	0.23
12 EXC-6	J1PX00	7/31/2012	0.37	U	0.37	0.155	U	0.155	0.26	U	0.26
13 EXC-7	J1PX01	7/31/2012	0.45	B	0.32	0.193		0.155	0.22	U	0.22
14 EXC-8	J1PX02	7/31/2012	0.43	B	0.36	0.155	U	0.155	0.25	U	0.25
15 EXC-10	J1PX04	7/31/2012	0.36	U	0.36	0.155	U	0.155	0.24	U	0.24
16 EXC-11	J1PX05	7/31/2012	0.37	U	0.37	0.155	U	0.155	0.26	U	0.26
17 EXC-12	J1PX06	7/31/2012	0.35	U	0.35	0.155	U	0.155	0.24	U	0.24

18
19 **Statistical Computations**

20	Antimony	Hexavalent Chromium	Molybdenum
21 % < Detection limit	58%	83%	83%
22 Maximum value	0.73	0.193	0.38
23 **Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	5 GW & River Protection	2 River Protection	8 GW Protection
24 **WAC 173-340 3-PART TEST**			
25 Maximum > Cleanup Limit?	NA	NO	NO
26 > 10% above Cleanup Limit?	NA	NO	NO
27 Any sample > 2X Cleanup Limit?	NA	NO	NO
28 **3-Part Test Compliance?**	Because all values are below background (5 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.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

29 Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12
Job No. 14655

Calc. No. 0100D-CA-V0470
Checked J. D. Skoglie

Rev. No. 0
Date 09/04/12
Sheet No. 10 of 19

100-D-50:8 Subsite Statistical Calculations

Verification Data -Staging pile Area

Sample Area	Sample Number	Sample Date	Uranium-234 pCi/g	Q	MDA	Uranium-238 pCi/g	Q	MDA
SPA-4	J1PX11	7/31/2012	0.180		0.0555	0.0812		0.0649
Duplicate of J1PX11	J1PX20	7/31/2012	0.234		0.0600	0.206		0.0702
SPA-1	J1PX08	7/31/2012	0.157		0.0526	0.155		0.0607
SPA-2	J1PX09	7/31/2012	0.204		0.0466	0.243		0.0466
SPA-3	J1PX10	7/31/2012	0.160		0.0464	0.227		0.0596
SPA-5	J1PX12	7/31/2012	0.176		0.0541	0.165		0.0476
SPA-6	J1PX13	7/31/2012	0.225		0.0457	0.250		0.0505
SPA-7	J1PX14	7/31/2012	0.176		0.0601	0.176		0.0619
SPA-8	J1PX15	7/31/2012	0.158		0.0950	0.148		0.0833
SPA-9	J1PX16	7/31/2012	0.238		0.0578	0.277		0.0460
SPA-10	J1PX17	7/31/2012	0.150		0.0667	0.205		0.0720
SPA-11	J1PX18	7/31/2012	0.138		0.0421	0.0920		0.0421
SPA-12	J1PX19	7/31/2012	0.116		0.0472	0.231		0.0606

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Uranium-234 pCi/g			Uranium-238 pCi/g		
SPA-4	J1PX11/J1PX20	7/31/2012	0.207			0.144		
SPA-1	J1PX08	7/31/2012	0.157			0.155		
SPA-2	J1PX09	7/31/2012	0.204			0.243		
SPA-3	J1PX10	7/31/2012	0.160			0.227		
SPA-5	J1PX12	7/31/2012	0.176			0.165		
SPA-6	J1PX13	7/31/2012	0.225			0.250		
SPA-7	J1PX14	7/31/2012	0.176			0.176		
SPA-8	J1PX15	7/31/2012	0.158			0.148		
SPA-9	J1PX16	7/31/2012	0.238			0.277		
SPA-10	J1PX17	7/31/2012	0.150			0.205		
SPA-11	J1PX18	7/31/2012	0.138			0.0920		
SPA-12	J1PX19	7/31/2012	0.116			0.231		

Statistical Computations

	Uranium-234			Uranium-238		
95% UCL based on	Radionuclide data set. Use nonparametric z-statistic.			Radionuclide data set. Use nonparametric z-statistic.		
N	12			12		
% < Detection limit	0%			0%		
Mean	0.175			0.193		
Standard deviation	0.0365			0.0545		
Z-statistic	1.64			1.64		
95% UCL on mean	0.193			0.219		
Maximum value	0.238			0.277		

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 09/04/12 **Calc. No.** 0100D-CA-V0470 **Rev. No.** 0
Project 100-D Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 09/04/12
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 11 of 19

100-D-50:8 Subsite Statistical Calculations

Verification Data - Staging Pile Area

Sample Area	Sample Number	Sample Date	Arsenic			Barium			Beryllium			Cadmium			Chromium			Cobalt			Copper			Lead		
			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
SPA-4	J1PX11	7/31/2012	1.7		0.63	64.1	X	0.073	0.11	B	0.032	0.14	B	0.039	8.7	X	0.055	7.4	X	0.096	15.3	X	0.21	4.2		0.26
Duplicate of J1PX11	J1PX20	7/31/2012	1.5		0.61	65.8	X	0.071	0.11	B	0.031	0.14	B	0.038	10.1	X	0.054	7.5	X	0.093	15.9	X	0.20	4.6		0.25
SPA-1	J1PX08	7/31/2012	1.7		0.61	66.2	X	0.070	0.13	B	0.030	0.14	B	0.038	9.6	X	0.053	7.7	X	0.092	16.4	X	0.20	4.6		0.25
SPA-2	J1PX09	7/31/2012	0.61	U	0.61	52.4	X	0.070	0.032	B	0.031	0.11	B	0.038	5.8	X	0.054	8.7	X	0.092	18.3	X	0.20	2.7		0.25
SPA-3	J1PX10	7/31/2012	1.3		0.62	55.1	X	0.072	0.069	B	0.031	0.14	B	0.039	8.1	X	0.055	7.7	X	0.094	17.0	X	0.20	4.3		0.25
SPA-5	J1PX12	7/31/2012	1.0		0.63	46.7	X	0.072	0.031	U	0.031	0.11	B	0.039	5.3	X	0.055	8.8	X	0.095	17.3	X	0.21	2.6		0.26
SPA-6	J1PX13	7/31/2012	2.1		0.66	67.2	X	0.076	0.12	B	0.033	0.14	B	0.041	9.6	X	0.058	7.5	X	0.10	16.1	X	0.22	5.0		0.27
SPA-7	J1PX14	7/31/2012	1.2		0.66	51.2	X	0.076	0.057	B	0.033	0.13	B	0.041	8.1	X	0.058	7.5	X	0.099	15.2	X	0.22	3.2		0.27
SPA-8	J1PX15	7/31/2012	1.3		0.61	62.7	X	0.070	0.030	U	0.030	0.13	B	0.038	7.3	X	0.053	8.5	X	0.092	18.5	X	0.20	9.6		0.25
SPA-9	J1PX16	7/31/2012	1.6		0.62	61.4	X	0.072	0.10	B	0.031	0.13	B	0.039	9.3	X	0.055	7.5	X	0.094	17.3	X	0.20	4.8		0.25
SPA-10	J1PX17	7/31/2012	1.5		0.59	52.1	X	0.068	0.029	B	0.029	0.11	B	0.037	8.1	X	0.052	8.2	X	0.089	17.2	X	0.19	3.4		0.24
SPA-11	J1PX18	7/31/2012	1.3		0.67	65.0	X	0.077	0.084	B	0.033	0.12	B	0.041	8.2	X	0.059	8.2	X	0.10	16.8	X	0.22	4.1		0.27
SPA-12	J1PX19	7/31/2012	1.7		0.65	59.5	X	0.075	0.11	B	0.033	0.13	B	0.040	10.6	X	0.057	7.1	X	0.099	17.4	X	0.21	3.4		0.27

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Arsenic mg/kg	Barium mg/kg	Beryllium mg/kg	Cadmium mg/kg	Chromium mg/kg	Cobalt mg/kg	Copper mg/kg	Lead mg/kg
SPA-4	J1PX11/J1PX20	7/31/2012	1.6	65.0	0.11	0.14	9.4	7.5	15.6	4.4
SPA-1	J1PX08	7/31/2012	1.7	66.2	0.13	0.14	9.6	7.7	16.4	4.6
SPA-2	J1PX09	7/31/2012	0.31	52.4	0.032	0.11	5.8	8.7	18.3	2.7
SPA-3	J1PX10	7/31/2012	1.3	55.1	0.069	0.14	8.1	7.7	17.0	4.3
SPA-5	J1PX12	7/31/2012	1.0	46.7	0.016	0.11	5.3	8.8	17.3	2.6
SPA-6	J1PX13	7/31/2012	2.1	67.2	0.12	0.14	9.6	7.5	16.1	5.0
SPA-7	J1PX14	7/31/2012	1.2	51.2	0.057	0.13	8.1	7.5	15.2	3.2
SPA-8	J1PX15	7/31/2012	1.3	62.7	0.015	0.13	7.3	8.5	18.5	9.6
SPA-9	J1PX16	7/31/2012	1.6	61.4	0.10	0.13	9.3	7.5	17.3	4.8
SPA-10	J1PX17	7/31/2012	1.5	52.1	0.029	0.11	8.1	8.2	17.2	3.4
SPA-11	J1PX18	7/31/2012	1.3	65.0	0.084	0.12	8.2	8.2	16.8	4.1
SPA-12	J1PX19	7/31/2012	1.7	59.5	0.11	0.13	10.6	7.1	17.4	3.4

Statistical Computations

	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead
95% UCL based on	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 normal distribution.	Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥10), use MTCAStat normal 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.
N	12	12	12	12	12	12	12	12
% < Detection limit	8%	0%	17%	0%	0%	0%	0%	0%
Mean	1.4	58.7	0.073	0.13	8.3	7.9	16.9	4.3
Standard deviation	0.45	6.9	0.042	0.012	1.6	0.56	0.98	1.8
95% UCL on mean	1.6	62.7	0.095	0.13	9.1	8.2	17.5	5.2
Maximum value	2.1	67.2	0.13	0.14	10.6	8.8	18.5	9.6
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	0.81 GW & River Protection	18.5 GW & River Protection	15.7 GW Protection	22.0 River Protection	10.2 GW & River Protection
WAC 173-340 3-PART TEST								
95% UCL > Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NA
> 10% above Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NA
Any sample > 2X Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NA
WAC 173-340 Compliance?	Because all values are below background (6.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (1.51 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.	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.	Because all values are below background (10.2 mg/kg) the WAC 173-340 3-part test is not required.

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12
Job No. 14655

Calc. No. 0100D-CA-V0470
Checked J. D. Skoglie

Rev. No. 0
Date 09/04/12
Sheet No. 12 of 19

1 **100-D-50:8 Subsite Statistical Calculations**

2 **Verification Data - Staging Pile Area**

Sample Area	Sample Number	Sample Date	Manganese mg/kg	Q	PQL	Mercury mg/kg	Q	PQL	Nickel mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL	Zinc mg/kg	Q	PQL
SPA-4	J1PX11	7/31/2012	295	X	0.096	0.012	B	0.0061	9.6	X	0.12	52.6		0.090	39.8	X	0.38
Duplicate of J1PX11	J1PX20	7/31/2012	303	X	0.093	0.0079	B	0.0048	10.6	X	0.11	50.6	X	0.088	41.2	X	0.37
SPA-1	J1PX08	7/31/2012	307	X	0.092	0.0072	B	0.0061	9.7	X	0.11	51.3		0.087	40.1	X	0.37
SPA-2	J1PX09	7/31/2012	291	X	0.092	0.013	B	0.0053	9.1	X	0.11	61.3		0.087	40.2	X	0.37
SPA-3	J1PX10	7/31/2012	286	X	0.094	0.042		0.0059	10.0	X	0.12	56.5		0.088	38.4	X	0.37
SPA-5	J1PX12	7/31/2012	287	X	0.095	0.0051	U	0.0051	9.2	X	0.12	64.3		0.090	40.5	X	0.38
SPA-6	J1PX13	7/31/2012	305	X	0.10	0.076		0.0062	10.3	X	0.12	52.7		0.094	40.5	X	0.40
SPA-7	J1PX14	7/31/2012	274	X	0.099	0.0067	B	0.0054	10.1	X	0.12	52.9		0.093	36.5	X	0.40
SPA-8	J1PX15	7/31/2012	306	X	0.092	0.030		0.0059	10.0	X	0.11	60.3	X	0.086	44.0	X	0.37
SPA-9	J1PX16	7/31/2012	291	X	0.094	0.012	B	0.0055	10.5	X	0.12	49.7	X	0.089	39.0	X	0.38
SPA-10	J1PX17	7/31/2012	286	X	0.089	0.032		0.0052	10.5	X	0.11	57.5	X	0.084	38.7	X	0.36
SPA-11	J1PX18	7/31/2012	324	X	0.10	0.011	B	0.0049	12.4	X	0.12	52.6	X	0.095	39.3	X	0.40
SPA-12	J1PX19	7/31/2012	269	X	0.099	0.031		0.0051	11.1	X	0.12	47.8	X	0.093	36.3	X	0.39

18 **Statistical Computation Input Data**

Sample Area	Sample Number	Sample Date	Manganese mg/kg	Mercury mg/kg	Nickel mg/kg	Vanadium mg/kg	Zinc mg/kg
SPA-4	J1PX11/J1PX20	7/31/2012	299	0.010	10.1	51.6	40.5
SPA-1	J1PX08	7/31/2012	307	0.0072	9.7	51.3	40.1
SPA-2	J1PX09	7/31/2012	291	0.013	9.1	61.3	40.2
SPA-3	J1PX10	7/31/2012	286	0.042	10.0	56.5	38.4
SPA-5	J1PX12	7/31/2012	287	0.0026	9.2	64.3	40.5
SPA-6	J1PX13	7/31/2012	305	0.076	10.3	52.7	40.5
SPA-7	J1PX14	7/31/2012	274	0.0067	10.1	52.9	36.5
SPA-8	J1PX15	7/31/2012	306	0.030	10.0	60.3	44.0
SPA-9	J1PX16	7/31/2012	291	0.012	10.5	49.7	39.0
SPA-10	J1PX17	7/31/2012	286	0.032	10.5	57.5	38.7
SPA-11	J1PX18	7/31/2012	324	0.011	12.4	52.6	39.3
SPA-12	J1PX19	7/31/2012	269	0.031	11.1	47.8	36.3

33 **Statistical Computations**

	Manganese	Mercury	Nickel	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), use MTCAStat lognormal distribution.	Large data set (n ≥10), use MTCAStat lognormal distribution.
N	12	12	12	12	12
% < Detection limit	0%	8%	0%	0%	0%
Mean	294	0.023	10.3	54.9	39.5
Standard deviation	15.3	0.021	0.87	5.1	2.0
95% UCL on mean	302	0.055	10.7	57.6	40.6
Maximum value	324	0.076	12.4	64.3	44.0
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	512 GW & River Protection	0.33 GW & River Protection	19.1 GW Protection	85.1 GW Protection	67.8 River Protection
WAC 173-340 3-PART TEST					
95% UCL > Cleanup Limit?	NA	NA	NA	NA	NA
> 10% above Cleanup Limit?	NA	NA	NA	NA	NA
Any sample > 2X Cleanup Limit?	NA	NA	NA	NA	NA
WAC 173-340 Compliance?	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 (0.33 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 (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.

48 Qualifiers are defined on page 3.

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12 **Calc. No.** 0100D-CA-V0470 **Rev. No.** 0
Job No. 14655 **Checked** J. D. Skoglie **Date** 09/04/12
Sheet No. 13 of 19

100-D-50:8 Subsite Maximum Calculations
Verification Data - Staging Pilea Area

Sample Area	Sample Number	Sample Date	Antimony			Boron			Hexavalent Chromium			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SPA-4	J1PX11	7/31/2012	0.36	U	0.36	1.2	B	0.94	0.155	U	0.155	0.25	U	0.25
Duplicate of J1PX11	J1PX20	7/31/2012	0.35	UJ	0.35	1.6	B	0.91	0.155	U	0.155	0.24	U	0.24
SPA-1	J1PX08	7/31/2012	0.35	U	0.35	1.2	B	0.90	0.155	U	0.155	0.24	U	0.24
SPA-2	J1PX09	7/31/2012	0.52	B	0.35	0.91	U	0.91	0.155	U	0.155	0.24	U	0.24
SPA-3	J1PX10	7/31/2012	0.36	U	0.36	0.92	U	0.92	0.155	U	0.155	0.24	U	0.24
SPA-5	J1PX12	7/31/2012	0.58		0.36	0.93	U	0.93	0.155	U	0.155	0.25	U	0.25
SPA-6	J1PX13	7/31/2012	0.38	U	0.38	1.3	B	0.98	0.214		0.155	0.26	U	0.26
SPA-7	J1PX14	7/31/2012	0.38	U	0.38	0.97	U	0.97	0.155	U	0.155	0.26	U	0.26
SPA-8	J1PX15	7/31/2012	0.59	J	0.35	1.2	B	0.90	0.155	U	0.155	0.40	BM	0.24
SPA-9	J1PX16	7/31/2012	0.36	UJ	0.36	1.3	B	0.92	0.155	U	0.155	0.60	B	0.25
SPA-10	J1PX17	7/31/2012	0.34	UJ	0.34	0.88	U	0.88	0.155	U	0.155	0.23	U	0.23
SPA-11	J1PX18	7/31/2012	0.38	UJ	0.38	0.99	U	0.99	0.155	U	0.155	0.43	B	0.26
SPA-12	J1PX19	7/31/2012	0.37	BJ	0.37	0.97	U	0.97	0.155	U	0.155	0.38	B	0.26

Statistical Computations

	Antimony	Boron	Hexavalent Chromium	Molybdenum
% < Detection limit	67%	58%	92%	67%
Maximum value	0.59	1.6	0.214	0.60
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	5 GW & River Protection	320 GW Protection	2 River Protection	8 GW Protection
WAC 173-340 3-PART TEST				
Maximum > Cleanup Limit?	NA	NO	NO	NO
> 10% above Cleanup Limit?	NA	NO	NO	NO
Any sample > 2X Cleanup Limit?	NA	NO	NO	NO
3-Part Test Compliance?	Because all values are below background (5 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.	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.

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12
Job No. 14655

Calc. No. 0100D-CA-V0470
Checked J. D. Skoglie

Rev. No. 0
Date 09/04/12
Sheet No. 14 of 19

Ecology Software (MTCAStat) Results, 100-D-50:8 Subsite Excavation

Arsenic 95% UCL Calculation

DATA	ID
1.9	J1PX03/J1PX07
0.88	J1PWX5
2.2	J1PWX6
1.9	J1PWX7
1.4	J1PWX8
1.3	J1PWX9
1.5	J1PX00
1.6	J1PX01
1.6	J1PX02
1.1	J1PX04
0.33	J1PX05
0.31	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	1.3
Censored		Lognormal mean	1.4
Detection limit or PQL		Std. devn.	0.60
Method detection limit		Median	1.5
TOTAL	12	Min.	0.31
		Max.	2.2

Lognormal distribution? r-squared is: 0.797
Normal distribution? r-squared is: 0.944
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 1.6

Barium 95% UCL Calculation

DATA	ID
71.2	J1PX03/J1PX07
53.8	J1PWX5
76.2	J1PWX6
65.6	J1PWX7
65.6	J1PWX8
56.6	J1PWX9
68.7	J1PX00
69.7	J1PX01
68.0	J1PX02
65.1	J1PX04
49.8	J1PX05
50.1	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	63.4
Censored		Lognormal mean	63.4
Detection limit or PQL		Std. devn.	8.7
Method detection limit		Median	65.6
TOTAL	12	Min.	49.8
		Max.	76.2

Lognormal distribution? r-squared is: 0.902
Normal distribution? r-squared is: 0.920
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 68.5

Beryllium 95% UCL Calculation

DATA	ID
0.15	J1PX03/J1PX07
0.035	J1PWX5
0.18	J1PWX6
0.12	J1PWX7
0.11	J1PWX8
0.090	J1PWX9
0.16	J1PX00
0.11	J1PX01
0.12	J1PX02
0.087	J1PX04
0.016	J1PX05
0.016	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	0.099
Censored		Lognormal mean	0.11
Detection limit or PQL		Std. devn.	0.054
Method detection limit		Median	0.11
TOTAL	12	Min.	0.016
		Max.	0.18

Lognormal distribution? r-squared is: 0.803
Normal distribution? r-squared is: 0.943
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.13

Boron 95% UCL Calculation

DATA	ID
1.3	J1PX03/J1PX07
0.47	J1PWX5
1.5	J1PWX6
1.2	J1PWX7
0.98	J1PWX8
0.94	J1PWX9
1.2	J1PX00
1.3	J1PX01
1.0	J1PX02
1.0	J1PX04
0.48	J1PX05
0.46	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	0.99
Censored		Lognormal mean	1.0
Detection limit or PQL		Std. devn.	0.35
Method detection limit		Median	1.0
TOTAL	12	Min.	0.46
		Max.	1.5

Lognormal distribution? r-squared is: 0.833
Normal distribution? r-squared is: 0.907
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 1.2

Cadmium 95% UCL Calculation

DATA	ID
0.14	J1PX03/J1PX07
0.12	J1PWX5
0.13	J1PWX6
0.13	J1PWX7
0.14	J1PWX8
0.12	J1PWX9
0.13	J1PX00
0.17	J1PX01
0.15	J1PX02
0.13	J1PX04
0.11	J1PX05
0.12	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	0.13
Censored		Lognormal mean	0.13
Detection limit or PQL		Std. devn.	0.016
Method detection limit		Median	0.13
TOTAL	12	Min.	0.11
		Max.	0.17

Lognormal distribution? r-squared is: 0.925
Normal distribution? r-squared is: 0.896
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.14

Chromium 95% UCL Calculation

DATA	ID
10.3	J1PX03/J1PX07
9.8	J1PWX5
10.5	J1PWX6
9.2	J1PWX7
8.7	J1PWX8
8.0	J1PWX9
10.3	J1PX00
8.7	J1PX01
9.1	J1PX02
9.9	J1PX04
4.8	J1PX05
6.0	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	8.8
Censored		Lognormal mean	8.8
Detection limit or PQL		Std. devn.	1.8
Method detection limit		Median	9.2
TOTAL	12	Min.	4.8
		Max.	10.5

Lognormal distribution? r-squared is: 0.777
Normal distribution? r-squared is: 0.845
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 9.6

Cobalt 95% UCL Calculation

DATA	ID
6.9	J1PX03/J1PX07
9.0	J1PWX5
7.6	J1PWX6
7.5	J1PWX7
6.8	J1PWX8
6.8	J1PWX9
7.1	J1PX00
7.5	J1PX01
7.8	J1PX02
8.2	J1PX04
9.6	J1PX05
8.8	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	7.8
Censored		Lognormal mean	7.8
Detection limit or PQL		Std. devn.	0.92
Method detection limit		Median	7.6
TOTAL	12	Min.	6.8
		Max.	9.6

Lognormal distribution? r-squared is: 0.936
Normal distribution? r-squared is: 0.921
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 8.3

Copper 95% UCL Calculation

DATA	ID
14.2	J1PX03/J1PX07
17.5	J1PWX5
16.9	J1PWX6
15.8	J1PWX7
13.9	J1PWX8
13.9	J1PWX9
15.6	J1PX00
15.5	J1PX01
15.8	J1PX02
16.1	J1PX04
18.3	J1PX05
17.0	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	15.9
Censored		Lognormal mean	15.9
Detection limit or PQL		Std. devn.	1.4
Method detection limit		Median	15.8
TOTAL	12	Min.	13.9
		Max.	18.3

Lognormal distribution? r-squared is: 0.953
Normal distribution? r-squared is: 0.957
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 16.7

Lead 95% UCL Calculation

DATA	ID
4.3	J1PX03/J1PX07
4.0	J1PWX5
4.9	J1PWX6
5.0	J1PWX7
4.0	J1PWX8
4.7	J1PWX9
4.2	J1PX00
5.2	J1PX01
4.3	J1PX02
3.9	J1PX04
2.5	J1PX05
2.4	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	4.1
Censored		Lognormal mean	4.1
Detection limit or PQL		Std. devn.	0.89
Method detection limit		Median	4.3
TOTAL	12	Min.	2.4
		Max.	5.2

Lognormal distribution? r-squared is: 0.806
Normal distribution? r-squared is: 0.876
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 4.5

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator	N. K. Schiffern	**Date**	09/04/12	**Calc. No.**	0100D-CA-V0470
Project	100-D Field Remediation	**Job No.**	14655	**Checked**	J. D. Skoglie
Subject	100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations				

Rev. No. 0
Date 09/04/12
Sheet No. 15 of 19

Ecology Software (MTCAStat) Results, 100-D-50:8 Subsite Excavation

Manganese 95% UCL Calculation

DATA	ID
300	J1PX03/J1PX07
304	J1PWX5
307	J1PWX6
295	J1PWX7
276	J1PWX8
262	J1PWX9
289	J1PX00
295	J1PX01
307	J1PX02
299	J1PX04
308	J1PX05
284	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	294
Censored		Lognormal mean	294
Detection limit or PQL		Std. devn.	14.0
Method detection limit		Median	297
TOTAL	12	Min.	262
		Max.	308

Lognormal distribution? r-squared is: 0.876
Normal distribution? r-squared is: 0.889
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 301

Mercury 95% UCL Calculation

DATA	ID
0.0064	J1PX03/J1PX07
0.0054	J1PWX5
0.0087	J1PWX6
0.0066	J1PWX7
0.0025	J1PWX8
0.0024	J1PWX9
0.0032	J1PX00
0.0057	J1PX01
0.0060	J1PX02
0.0059	J1PX04
0.0027	J1PX05
0.0029	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	0.0049
Censored		Lognormal mean	0.0049
Detection limit or PQL		Std. devn.	0.0021
Method detection limit		Median	0.0056
TOTAL	12	Min.	0.0024
		Max.	0.0087

Lognormal distribution? r-squared is: 0.886
Normal distribution? r-squared is: 0.900
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.0059

Nickel 95% UCL Calculation

DATA	ID
10.5	J1PX03/J1PX07
19.3	J1PWX5
11.4	J1PWX6
9.7	J1PWX7
9.4	J1PWX8
8.9	J1PWX9
13.5	J1PX00
9.8	J1PX01
11.1	J1PX02
15.8	J1PX04
9.6	J1PX05
11.2	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	11.7
Censored		Lognormal mean	11.7
Detection limit or PQL		Std. devn.	3.1
Method detection limit		Median	10.8
TOTAL	12	Min.	8.9
		Max.	19.3

Lognormal distribution? r-squared is: 0.857
Normal distribution? r-squared is: 0.789
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 13.1

Vanadium 95% UCL Calculation

DATA	ID
45.2	J1PX03/J1PX07
59.0	J1PWX5
44.4	J1PWX6
47.2	J1PWX7
44.4	J1PWX8
48.6	J1PWX9
45.5	J1PX00
52.0	J1PX01
54.1	J1PX02
58.4	J1PX04
69.6	J1PX05
63.0	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	52.6
Censored		Lognormal mean	52.7
Detection limit or PQL		Std. devn.	8.3
Method detection limit		Median	50.3
TOTAL	12	Min.	44.4
		Max.	69.6

Lognormal distribution? r-squared is: 0.920
Normal distribution? r-squared is: 0.903
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 57.2

Zinc 95% UCL Calculation

DATA	ID
38.1	J1PX03/J1PX07
42.1	J1PWX5
39.5	J1PWX6
39.5	J1PWX7
35.2	J1PWX8
35.8	J1PWX9
36.0	J1PX00
43.1	J1PX01
41.8	J1PX02
40.7	J1PX04
43.3	J1PX05
39.4	J1PX06

Number of samples		Uncensored values	
Uncensored	12	Mean	39.5
Censored		Lognormal mean	39.6
Detection limit or PQL		Std. devn.	2.8
Method detection limit		Median	39.5
TOTAL	12	Min.	35.2
		Max.	43.3

Lognormal distribution? r-squared is: 0.944
Normal distribution? r-squared is: 0.949
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 41.1

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator	N. K. Schiffern	**Date**	09/04/12	**Calc. No.**	0100D-CA-V0470
Project	100-D Field Remediation	**Job No.**	14655	**Checked**	J. D. Skoglie
Subject	100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations				

Rev. No. 0
Date 09/04/12
Sheet No. 16 of 19

Ecology Software (MTCAStat) Results, 100-D-50:8 Subsite Staging Pile Area

Arsenic 95% UCL Calculation

DATA	ID
1.6	J1PX11/J1PX20
1.7	J1PX08
0.31	J1PX09
1.3	J1PX10
1.0	J1PX12
2.1	J1PX13
1.2	J1PX14
1.3	J1PX15
1.6	J1PX16
1.5	J1PX17
1.3	J1PX18
1.7	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	1.4
Censored		Lognormal mean	1.4
Detection limit or PQL		Std. devn.	0.45
Method detection limit		Median	1.4
TOTAL	12	Min.	0.31
		Max.	2.1

Lognormal distribution? r-squared is: 0.677
Normal distribution? r-squared is: 0.891
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 1.6

Barium 95% UCL Calculation

DATA	ID
65.0	J1PX11/J1PX20
66.2	J1PX08
52.4	J1PX09
55.1	J1PX10
46.7	J1PX12
67.2	J1PX13
51.2	J1PX14
62.7	J1PX15
61.4	J1PX16
52.1	J1PX17
65.0	J1PX18
59.5	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	58.7
Censored		Lognormal mean	58.7
Detection limit or PQL		Std. devn.	6.9
Method detection limit		Median	60.5
TOTAL	12	Min.	46.7
		Max.	67.2

Lognormal distribution? r-squared is: 0.926
Normal distribution? r-squared is: 0.934
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 62.7

Beryllium 95% UCL Calculation

DATA	ID
0.11	J1PX11/J1PX20
0.13	J1PX08
0.032	J1PX09
0.069	J1PX10
0.016	J1PX12
0.12	J1PX13
0.057	J1PX14
0.015	J1PX15
0.10	J1PX16
0.029	J1PX17
0.084	J1PX18
0.11	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	0.073
Censored		Lognormal mean	0.079
Detection limit or PQL		Std. devn.	0.042
Method detection limit		Median	0.077
TOTAL	12	Min.	0.015
		Max.	0.13

Lognormal distribution? r-squared is: 0.880
Normal distribution? r-squared is: 0.935
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.095

Cadmium 95% UCL Calculation

DATA	ID
0.14	J1PX11/J1PX20
0.14	J1PX08
0.11	J1PX09
0.14	J1PX10
0.11	J1PX12
0.14	J1PX13
0.13	J1PX14
0.13	J1PX15
0.13	J1PX16
0.11	J1PX17
0.12	J1PX18
0.13	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	0.13
Censored		Lognormal mean	0.13
Detection limit or PQL		Std. devn.	0.012
Method detection limit		Median	0.13
TOTAL	12	Min.	0.11
		Max.	0.14

Lognormal distribution? r-squared is: 0.843
Normal distribution? r-squared is: 0.852
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.13

Chromium 95% UCL Calculation

DATA	ID
9.4	J1PX11/J1PX20
9.6	J1PX08
5.8	J1PX09
8.1	J1PX10
5.3	J1PX12
9.6	J1PX13
8.1	J1PX14
7.3	J1PX15
9.3	J1PX16
8.1	J1PX17
8.2	J1PX18
10.6	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	8.3
Censored		Lognormal mean	8.3
Detection limit or PQL		Std. devn.	1.6
Method detection limit		Median	8.2
TOTAL	12	Min.	5.3
		Max.	10.6

Lognormal distribution? r-squared is: 0.886
Normal distribution? r-squared is: 0.928
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 9.1

Cobalt 95% UCL Calculation

DATA	ID
7.5	J1PX11/J1PX20
7.7	J1PX08
8.7	J1PX09
7.7	J1PX10
8.8	J1PX12
7.5	J1PX13
7.5	J1PX14
8.5	J1PX15
7.5	J1PX16
8.2	J1PX17
8.2	J1PX18
7.1	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	7.9
Censored		Lognormal mean	7.9
Detection limit or PQL		Std. devn.	0.56
Method detection limit		Median	7.7
TOTAL	12	Min.	7.1
		Max.	8.8

Lognormal distribution? r-squared is: 0.927
Normal distribution? r-squared is: 0.922
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 8.2

Copper 95% UCL Calculation

DATA	ID
15.6	J1PX11/J1PX20
16.4	J1PX08
18.3	J1PX09
17.0	J1PX10
17.3	J1PX12
16.1	J1PX13
15.2	J1PX14
18.5	J1PX15
17.3	J1PX16
17.2	J1PX17
16.8	J1PX18
17.4	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	16.9
Censored		Lognormal mean	16.9
Detection limit or PQL		Std. devn.	0.98
Method detection limit		Median	17.1
TOTAL	12	Min.	15.2
		Max.	18.5

Lognormal distribution? r-squared is: 0.965
Normal distribution? r-squared is: 0.967
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 17.5

Lead 95% UCL Calculation

DATA	ID
4.4	J1PX11/J1PX20
4.6	J1PX08
2.7	J1PX09
4.3	J1PX10
2.6	J1PX12
5.0	J1PX13
3.2	J1PX14
9.6	J1PX15
4.8	J1PX16
3.4	J1PX17
4.1	J1PX18
3.4	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	4.3
Censored		Lognormal mean	4.3
Detection limit or PQL		Std. devn.	1.8
Method detection limit		Median	4.2
TOTAL	12	Min.	2.6
		Max.	9.6

Lognormal distribution? r-squared is: 0.881
Normal distribution? r-squared is: 0.718
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 5.2

Manganese 95% UCL Calculation

DATA	ID
299	J1PX11/J1PX20
307	J1PX08
291	J1PX09
286	J1PX10
287	J1PX12
305	J1PX13
274	J1PX14
306	J1PX15
291	J1PX16
286	J1PX17
324	J1PX18
269	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	294
Censored		Lognormal mean	294
Detection limit or PQL		Std. devn.	15.3
Method detection limit		Median	291
TOTAL	12	Min.	269
		Max.	324

Lognormal distribution? r-squared is: 0.965
Normal distribution? r-squared is: 0.962
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 302

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12
Job No. 14655

Calc. No. 0100D-CA-V0470
Checked J. D. Skoglie

Rev. No. 0
Date 09/04/12
Sheet No. 17 of 19

Ecology Software (MTCAStat) Results, 100-D-50:8 Subsite Staging Pile Area

Mercury 95% UCL Calculation

DATA	ID
0.010	J1PX11/J1PX20
0.0072	J1PX08
0.013	J1PX09
0.042	J1PX10
0.0026	J1PX12
0.076	J1PX13
0.0067	J1PX14
0.030	J1PX15
0.012	J1PX16
0.032	J1PX17
0.011	J1PX18
0.031	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	0.023
Censored		Lognormal mean	0.024
Detection limit or PQL		Std. devn.	0.021
Method detection limit		Median	0.013
TOTAL	12	Min.	0.0026
		Max.	0.076

Lognormal distribution? r-squared is: 0.962
Normal distribution? r-squared is: 0.808
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.055

Nickel 95% UCL Calculation

DATA	ID
10.1	J1PX11/J1PX20
9.7	J1PX08
9.1	J1PX09
10.0	J1PX10
9.2	J1PX12
10.3	J1PX13
10.1	J1PX14
10.0	J1PX15
10.5	J1PX16
10.5	J1PX17
12.4	J1PX18
11.1	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	10.3
Censored		Lognormal mean	10.3
Detection limit or PQL		Std. devn.	0.87
Method detection limit		Median	10.1
TOTAL	12	Min.	9.1
		Max.	12.4

Lognormal distribution? r-squared is: 0.903
Normal distribution? r-squared is: 0.876
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 10.7

Vanadium 95% UCL Calculation

DATA	ID
51.6	J1PX11/J1PX20
51.3	J1PX08
61.3	J1PX09
56.5	J1PX10
64.3	J1PX12
52.7	J1PX13
52.9	J1PX14
60.3	J1PX15
49.7	J1PX16
57.5	J1PX17
52.6	J1PX18
47.8	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	54.9
Censored		Lognormal mean	54.9
Detection limit or PQL		Std. devn.	5.1
Method detection limit		Median	52.8
TOTAL	12	Min.	47.8
		Max.	64.3

Lognormal distribution? r-squared is: 0.956
Normal distribution? r-squared is: 0.946
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 57.6

Zinc 95% UCL Calculation

DATA	ID
40.5	J1PX11/J1PX20
40.1	J1PX08
40.2	J1PX09
38.4	J1PX10
40.5	J1PX12
40.5	J1PX13
36.5	J1PX14
44.0	J1PX15
39.0	J1PX16
38.7	J1PX17
39.3	J1PX18
36.3	J1PX19

Number of samples		Uncensored values	
Uncensored	12	Mean	39.5
Censored		Lognormal mean	39.5
Detection limit or PQL		Std. devn.	2.0
Method detection limit		Median	39.7
TOTAL	12	Min.	36.3
		Max.	44.0

Lognormal distribution? r-squared is: 0.909
Normal distribution? r-squared is: 0.902
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 40.6

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12
Job No. 14655

Calc. No. 0100D-CA-V0470
Checked J. D. Skoglie

Rev. No. 0
Date 09/04/12
Sheet No. 18 of 19

Duplicate Analysis - 100-D-50:8 Subsite Excavation

Sampling Area	Sample Number	Sample Date	Uranium-234			Uranium-238			Aluminium			Arsenic			Barium			Beryllium			Boron			Cadmium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	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-9	J1PX03	7/31/2012	0.151		0.0471	0.150		0.0560	7840	X	1.5	1.8		0.62	72.5	X	0.072	0.15	B	0.031	1.3	B	0.92	0.15	B	0.039
Duplicate of J1PX03	J1PX07	7/31/2012	0.249		0.0603	0.263		0.0506	7690	X	1.5	2.0		0.64	69.9	X	0.073	0.15	B	0.032	1.3	B	0.95	0.13	B	0.040

Analysis:

TDL		1	1	5	10	2	0.2	2	0.2
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)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD			1.9%		3.7%			
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable

Duplicate Analysis - 100-D-50:8 Subsite Excavation

Sampling Area	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-9	J1PX03	7/31/2012	4240	X	13.3	10.4	X	0.055	6.9	X	0.094	14.4	X	0.20	19100	X	3.6	4.5		0.25	3810	X	3.5	303	X	0.094
Duplicate of J1PX03	J1PX07	7/31/2012	4120	X	13.6	10.1	X	0.056	6.9	X	0.096	14.0	X	0.21	18800	X	3.7	4.1		0.26	3870	X	3.6	297	X	0.096

Analysis:

TDL		100	1	2	1	5	5	75	5
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)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	2.9%	2.9%		2.8%	1.6%		1.6%	2.0%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

Duplicate Analysis - 100-D-50:8 Subsite Excavation

Sampling Area	HEIS Number	Sample Date	Mercury			Nickel			Potassium			Silicon			Sodium			Vanadium			Zinc		
			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-9	J1PX03	7/31/2012	0.0061	B	0.0060	10.6	X	0.12	1510		38.6	562		5.3	241		55.5	46.7		0.088	38.7	X	0.37
Duplicate of J1PX03	J1PX07	7/31/2012	0.0067	B	0.0058	10.3	X	0.12	1500		39.5	581		5.5	272		56.9	43.7		0.091	37.5	X	0.38

Analysis:

TDL		0.2	4	400	2	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD				3.3%		6.6%	3.1%
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable

Qualifiers are defined on page 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-D Field Remediation
Subject 100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations

Date 09/04/12
Job No. 14655

Calc. No. 0100D-CA-V0470
Checked J. D. Skoglie

Rev. No. 0
Date 09/04/12
Sheet No. 19 of 19

Duplicate Analysis - 100-D-50:8 Subsite Staging Pile Area

Sampling Area	Sample Number	Sample Date	Uranium-234			Uranium-238			Aluminium			Arsenic			Barium			Beryllium			Boron			Cadmium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SPA-4	J1PX11	7/31/2012	0.180		0.0555	0.0812		0.0649	6800	X	1.5	1.7		0.63	64.1	X	0.073	0.11	B	0.032	1.2	B	0.94	0.14	B	0.039
Duplicate of J1PX11	J1PX20	7/31/2012	0.234		0.0600	0.206		0.0702	7310	X	1.4	1.5		0.61	65.8	X	0.071	0.11	B	0.031	1.6	B	0.91	0.14	B	0.038

Analysis:

TDL		1	1	5	10	2	0.2	2	0.2
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)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD			7.2%		2.6%			
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable

Duplicate Analysis - 100-D-50:8 Subsite Staging Pile Area

Sampling Area	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SPA-4	J1PX11	7/31/2012	5360	X	13.5	8.7	X	0.055	7.4	X	0.096	15.3	X	0.21	20300	X	3.6	4.2		0.26	3950	X	3.5	295	X	0.096
Duplicate of J1PX11	J1PX20	7/31/2012	5340	X	13.1	10.1	X	0.054	7.5	X	0.093	15.9	X	0.20	20700	X	3.5	4.6		0.25	4220	X	3.4	303	X	0.093

Analysis:

TDL		100	1	2	1	5	5	75	5
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)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	0.4%	14.9%		3.8%	2.0%		6.6%	2.7%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

Duplicate Analysis - 100-D-50:8 Subsite Staging Pile Area

Sampling Area	HEIS Number	Sample Date	Mercury			Nickel			Potassium			Silicon			Sodium			Vanadium			Zinc		
			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
SPA-4	J1PX11	7/31/2012	0.012	B	0.0061	9.6	X	0.12	1250		39.2	597		5.4	281		56.4	52.6		0.090	39.8	X	0.38
Duplicate of J1PX11	J1PX20	7/31/2012	0.0079	B	0.0048	10.6	X	0.11	1340		38.2	639	XJ	5.3	279		54.9	50.6	X	0.088	41.2	X	0.37

Analysis:

TDL		0.2	4	400	2	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD				6.8%	0.7%	3.9%	3.5%
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	Not applicable	Not applicable

Qualifiers are defined on page 3.

Attachment 1. 100-D-50:8 Subsite Verification Sampling Results - Radionuclides

Sample Location	HEIS Number	Sample Date	Uranium-234			Uranium-235			Uranium-238			Total beta radiostrontium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
EXC-9	J1PX03	7/31/2012	0.151		0.0471	-0.00140	U	0.0505	0.150		0.0560	0.0384	U	0.176
Duplicate of J1PX03	J1PX07	7/31/2012	0.249		0.0603	-0.000504	U	0.0458	0.263		0.0506	0.134	U	0.167
EXC-1	J1PWX5	7/31/2012	0.119		0.0483	0.0106	U	0.0518	0.248		0.0620	0.114	U	0.182
EXC-2	J1PWX6	7/31/2012	0.100		0.0583	-0.00102	U	0.0514	0.152		0.0514	0.0794	U	0.179
EXC-3	J1PWX7	7/31/2012	0.125		0.0508	-0.00112	U	0.0562	0.0966		0.0562	0.0211	U	0.197
EXC-4	J1PWX8	7/31/2012	0.134		0.0492	0.0108	U	0.0529	0.132		0.0610	0.126	U	0.187
EXC-5	J1PWX9	7/31/2012	0.178		0.0547	0.0105	U	0.0517	0.164		0.0640	0.0119	U	0.195
EXC-6	J1PX00	7/31/2012	0.163		0.0581	0.0117	U	0.0512	0.152		0.0512	-0.00815	U	0.187
EXC-7	J1PX01	7/31/2012	0.218		0.0442	-0.000972	U	0.0489	0.108		0.0525	0.0414	U	0.165
EXC-8	J1PX02	7/31/2012	0.247		0.0691	-0.00302	U	0.0627	0.159		0.0691	0.0175	U	0.191
EXC-10	J1PX04	7/31/2012	0.158		0.0835	0.0191	U	0.0677	0.190		0.0924	0.0511	U	0.171
EXC-11	J1PX05	7/31/2012	0.195		0.0856	0.00919	U	0.0603	0.166		0.0603	-0.0109	U	0.167
EXC-12	J1PX06	7/31/2012	0.196		0.0694	0.00897	U	0.0537	0.152		0.0650	0.0624	U	0.161
SPA-4	J1PX11	7/31/2012	0.180		0.0555	-0.000973	U	0.0489	0.0812		0.0649	0.0329	U	0.181
Duplicate of J1PX11	J1PX20	7/31/2012	0.234		0.0600	0.0131	UJ	0.0478	0.206		0.0702	-0.0473	U	0.170
SPA-1	J1PX08	7/31/2012	0.157		0.0526	-0.000974	U	0.0490	0.155		0.0607	0.0751	U	0.162
SPA-2	J1PX09	7/31/2012	0.204		0.0466	-0.00103	U	0.0515	0.243		0.0466	0.0316	U	0.147
SPA-3	J1PX10	7/31/2012	0.160		0.0464	0.0101	U	0.0498	0.227		0.0596	-0.0426	U	0.152
SPA-5	J1PX12	7/31/2012	0.176		0.0541	-0.000947	U	0.0476	0.165		0.0476	0.0692	U	0.153
SPA-6	J1PX13	7/31/2012	0.225		0.0457	0.0241	U	0.0505	0.250		0.0505	0.0399	U	0.148
SPA-7	J1PX14	7/31/2012	0.176		0.0601	0.00855	U	0.0561	0.176		0.0619	-0.00341	U	0.150
SPA-8	J1PX15	7/31/2012	0.158		0.0950	0.0253	UJ	0.0673	0.148		0.0833	0.0642	U	0.165
SPA-9	J1PX16	7/31/2012	0.238		0.0578	0.0121	UJ	0.0460	0.277		0.0460	0.0547	U	0.162
SPA-10	J1PX17	7/31/2012	0.150		0.0667	-0.00112	UJ	0.0560	0.205		0.0720	0.0954	U	0.230
SPA-11	J1PX18	7/31/2012	0.138		0.0421	-0.000925	UJ	0.0465	0.0920		0.0421	-0.0200	U	0.173
SPA-12	J1PX19	7/31/2012	0.116		0.0472	0.0103	UJ	0.0506	0.231		0.0606	0.0720	U	0.169

Grey cells indicate not applicable or data will not be used.

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

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

B = blank contamination (inorganic constituents)

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

HEIS = Hanford Environmental Information System

J = estimate

M = sample duplicate precision not met.

MDA = minimum detected activity

N= recovery exceeds upper or lower control limits.

PQL = practical quantitation limit

Q = qualifier

RAG = remedial action goal

U = undetected

X = Serial dilution in the analytical batch indicates that physical and chemical interferences are present.

Attachment	1	Sheet No.	1 of 6
Originator	N. K. Schiffern	Date	09/04/12
Checked	J. D. Skoglie	Date	09/04/12
Calc. No.	0100D-CA-V0470	Rev. No.	0

Attachment 1. 100-D-50:8 Subsite Verification Sampling Results - Metals

Sample 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-9	J1PX03	7/31/2012	7840	X	1.5	0.36	U	0.36	1.8		0.62	72.5	X	0.072	0.15	B	0.031	1.3	B	0.92
Duplicate of J1PX03	J1PX07	7/31/2012	7690	X	1.5	0.37	U	0.37	2.0		0.64	69.9	X	0.073	0.15	B	0.032	1.3	B	0.95
EXC-1	J1PWX5	7/31/2012	5920	X	1.5	0.40	B	0.36	0.88	B	0.62	53.8	X	0.072	0.035	B	0.031	0.93	U	0.93
EXC-2	J1PWX6	7/31/2012	8100	X	1.5	0.48	B	0.37	2.2		0.63	76.2	X	0.073	0.18	B	0.032	1.5	B	0.94
EXC-3	J1PWX7	7/31/2012	6800	X	1.5	0.37	U	0.37	1.9		0.64	65.6	X	0.073	0.12	B	0.032	1.2	B	0.95
EXC-4	J1PWX8	7/31/2012	6500	X	1.3	0.33	U	0.33	1.4		0.57	65.6	X	0.065	0.11	B	0.028	0.98	B	0.84
EXC-5	J1PWX9	7/31/2012	5880	X	1.4	0.73		0.34	1.3		0.59	56.6	X	0.068	0.090	B	0.030	0.94	B	0.88
EXC-6	J1PX00	7/31/2012	7340	X	1.5	0.37	U	0.37	1.5		0.65	68.7	X	0.075	0.16	B	0.033	1.2	B	0.97
EXC-7	J1PX01	7/31/2012	6900	X	1.3	0.45	B	0.32	1.6		0.56	69.7	X	0.064	0.11	B	0.028	1.3	B	0.83
EXC-8	J1PX02	7/31/2012	7130	X	1.5	0.43	B	0.36	1.6		0.63	68.0	X	0.072	0.12	B	0.031	1.0	B	0.93
EXC-10	J1PX04	7/31/2012	6690	X	1.4	0.36	U	0.36	1.1		0.62	65.1	X	0.071	0.087	B	0.031	1.0	B	0.92
EXC-11	J1PX05	7/31/2012	4680	X	1.5	0.37	U	0.37	0.65	U	0.65	49.8	X	0.075	0.032	U	0.032	0.96	U	0.96
EXC-12	J1PX06	7/31/2012	4790	X	1.4	0.35	U	0.35	0.61	U	0.61	50.1	X	0.070	0.031	U	0.031	0.91	U	0.91
SPA-4	J1PX11	7/31/2012	6800	X	1.5	0.36	U	0.36	1.7		0.63	64.1	X	0.073	0.11	B	0.032	1.2	B	0.94
Duplicate of J1PX11	J1PX20	7/31/2012	7310	X	1.4	0.35	UJ	0.35	1.5		0.61	65.8	X	0.071	0.11	B	0.031	1.6	B	0.91
SPA-1	J1PX08	7/31/2012	7170	X	1.4	0.35	U	0.35	1.7		0.61	66.2	X	0.070	0.13	B	0.030	1.2	B	0.90
SPA-2	J1PX09	7/31/2012	5390	X	1.4	0.52	B	0.35	0.61	U	0.61	52.4	X	0.070	0.032	B	0.031	0.91	U	0.91
SPA-3	J1PX10	7/31/2012	6050	X	1.5	0.36	U	0.36	1.3		0.62	55.1	X	0.072	0.069	B	0.031	0.92	U	0.92
SPA-5	J1PX12	7/31/2012	5080	X	1.5	0.58		0.36	1.0		0.63	46.7	X	0.072	0.031	U	0.031	0.93	U	0.93
SPA-6	J1PX13	7/31/2012	7410	X	1.5	0.38	U	0.38	2.1		0.66	67.2	X	0.076	0.12	B	0.033	1.3	B	0.98
SPA-7	J1PX14	7/31/2012	5760	X	1.5	0.38	U	0.38	1.2		0.66	51.2	X	0.076	0.057	B	0.033	0.97	U	0.97
SPA-8	J1PX15	7/31/2012	6230	X	1.4	0.59	J	0.35	1.3		0.61	62.7	X	0.070	0.030	U	0.030	1.2	B	0.90
SPA-9	J1PX16	7/31/2012	6600	X	1.5	0.36	UJ	0.36	1.6		0.62	61.4	X	0.072	0.10	B	0.031	1.3	B	0.92
SPA-10	J1PX17	7/31/2012	5900	X	1.4	0.34	UJ	0.34	1.5		0.59	52.1	X	0.068	0.029	B	0.029	0.88	U	0.88
SPA-11	J1PX18	7/31/2012	6400	X	1.6	0.38	UJ	0.38	1.3		0.67	65.0	X	0.077	0.084	B	0.033	0.99	U	0.99
SPA-12	J1PX19	7/31/2012	6650	X	1.5	0.37	BJ	0.37	1.7		0.65	59.5	X	0.075	0.11	B	0.033	0.97	U	0.97
Equipment Blank	J1PX21	7/31/2012	216	X	1.4	0.35	UJ	0.35	0.61	U	0.61	2.2	X	0.070	0.042	B	0.031	0.91	U	0.91

Attachment	1	Sheet No.	2 of 6
Originator	N. K. Schiffern	Date	09/04/12
Checked	J. D. Skoglie	Date	09/04/12
Calc. No.	0100D-CA-V0470	Rev. No.	0

Attachment 1. 100-D-50:8 Subsite Verification Sampling Results - Metals

Sample 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-9	J1PX03	7/31/2012	0.15	B	0.039	4240	X	13.3	10.4	X	0.055	6.9	X	0.094	14.4	X	0.20	0.155	U	0.155
Duplicate of J1PX03	J1PX07	7/31/2012	0.13	B	0.040	4120	X	13.6	10.1	X	0.056	6.9	X	0.096	14.0	X	0.21	0.155	U	0.155
EXC-1	J1PWX5	7/31/2012	0.12	B	0.039	5940	X	13.3	9.8	X	0.055	9.0	X	0.095	17.5	X	0.21	0.155	U	0.155
EXC-2	J1PWX6	7/31/2012	0.13	B	0.039	5590	X	13.6	10.5	X	0.056	7.6	X	0.096	16.9	X	0.21	0.155	U	0.155
EXC-3	J1PWX7	7/31/2012	0.13	B	0.040	4990	X	13.6	9.2	X	0.056	7.5	X	0.097	15.8	X	0.21	0.171		0.155
EXC-4	J1PWX8	7/31/2012	0.14	B	0.035	4420	X	12.1	8.7	X	0.050	6.8	X	0.086	13.9	X	0.19	0.155	U	0.155
EXC-5	J1PWX9	7/31/2012	0.12	B	0.037	4740	X	12.7	8.0	X	0.052	6.8	X	0.090	13.9	X	0.20	0.155	U	0.155
EXC-6	J1PX00	7/31/2012	0.13	B	0.040	4570	X	13.9	10.3	X	0.057	7.1	X	0.099	15.6	X	0.21	0.155	U	0.155
EXC-7	J1PX01	7/31/2012	0.17		0.035	5360	X	11.9	8.7	X	0.049	7.5	X	0.085	15.5	X	0.18	0.193		0.155
EXC-8	J1PX02	7/31/2012	0.15	B	0.039	5090	X	13.4	9.1	X	0.055	7.8	X	0.095	15.8	X	0.21	0.155	U	0.155
EXC-10	J1PX04	7/31/2012	0.13	B	0.038	6190	X	13.2	9.9	X	0.054	8.2	X	0.093	16.1	X	0.20	0.155	U	0.155
EXC-11	J1PX05	7/31/2012	0.11	B	0.040	5950	X	13.8	4.8	X	0.057	9.6	X	0.098	18.3	X	0.21	0.155	U	0.155
EXC-12	J1PX06	7/31/2012	0.12	B	0.038	6170	X	13.1	6.0	X	0.054	8.8	X	0.093	17.0	X	0.20	0.155	U	0.155
SPA-4	J1PX11	7/31/2012	0.14	B	0.039	5360	X	13.5	8.7	X	0.055	7.4	X	0.096	15.3	X	0.21	0.155	U	0.155
Duplicate of J1PX11	J1PX20	7/31/2012	0.14	B	0.038	5340	X	13.1	10.1	X	0.054	7.5	X	0.093	15.9	X	0.20	0.155	U	0.155
SPA-1	J1PX08	7/31/2012	0.14	B	0.038	5350	X	13.0	9.6	X	0.053	7.7	X	0.092	16.4	X	0.20	0.155	U	0.155
SPA-2	J1PX09	7/31/2012	0.11	B	0.038	6530	X	13.0	5.8	X	0.054	8.7	X	0.092	18.3	X	0.20	0.155	U	0.155
SPA-3	J1PX10	7/31/2012	0.14	B	0.039	7670	X	13.3	8.1	X	0.055	7.7	X	0.094	17.0	X	0.20	0.155	U	0.155
SPA-5	J1PX12	7/31/2012	0.11	B	0.039	5930	X	13.4	5.3	X	0.055	8.8	X	0.095	17.3	X	0.21	0.155	U	0.155
SPA-6	J1PX13	7/31/2012	0.14	B	0.041	5920	X	14.0	9.6	X	0.058	7.5	X	0.10	16.1	X	0.22	0.214		0.155
SPA-7	J1PX14	7/31/2012	0.13	B	0.041	6180	X	14.0	8.1	X	0.058	7.5	X	0.099	15.2	X	0.22	0.155	U	0.155
SPA-8	J1PX15	7/31/2012	0.13	B	0.038	7820	X	12.9	7.3	X	0.053	8.5	X	0.092	18.5	X	0.20	0.155	U	0.155
SPA-9	J1PX16	7/31/2012	0.13	B	0.039	6480	X	13.3	9.3	X	0.055	7.5	X	0.094	17.3	X	0.20	0.155	U	0.155
SPA-10	J1PX17	7/31/2012	0.11	B	0.037	7270	X	12.6	8.1	X	0.052	8.2	X	0.089	17.2	X	0.19	0.155	U	0.155
SPA-11	J1PX18	7/31/2012	0.12	B	0.041	6280	X	14.3	8.2	X	0.059	8.2	X	0.10	16.8	X	0.22	0.155	U	0.155
SPA-12	J1PX19	7/31/2012	0.13	B	0.040	6930	X	13.9	10.6	X	0.057	7.1	X	0.099	17.4	X	0.21	0.155	U	0.155
Equipment Blank	J1PX21	7/31/2012	0.038	U	0.038	39.6	BX	13.1	0.12	BX	0.054	0.12	BX	0.093	0.20	UX	0.20			

Attachment	1	Sheet No.	3 of 6
Originator	N. K. Schiffern	Date	09/04/12
Checked	J. D. Skoglie	Date	09/04/12
Calc. No.	0100D-CA-V0470	Rev. No.	0

Attachment 1. 100-D-50:8 Subsite Verification Sampling Results - Metals

Sample 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-9	J1PX03	7/31/2012	19100	X	3.6	4.5		0.25	3810	X	3.5	303	X	0.094	0.0061	B	0.0060	0.24	U	0.24
Duplicate of J1PX03	J1PX07	7/31/2012	18800	X	3.7	4.1		0.26	3870	X	3.6	297	X	0.096	0.0067	B	0.0058	0.25	U	0.25
EXC-1	J1PWX5	7/31/2012	22300	X	3.6	4.0		0.26	5300	X	3.5	304	X	0.095	0.0054	B	0.0048	0.38	B	0.25
EXC-2	J1PWX6	7/31/2012	20100	X	3.7	4.9		0.26	4510	X	3.6	307	X	0.096	0.0087	B	0.0050	0.29	B	0.25
EXC-3	J1PWX7	7/31/2012	20200	X	3.7	5.0		0.26	4080	X	3.6	295	X	0.097	0.0066	B	0.0050	0.25	U	0.25
EXC-4	J1PWX8	7/31/2012	18000	X	3.3	4.0		0.23	3700	X	3.2	276	X	0.086	0.0049	U	0.0049	0.22	U	0.22
EXC-5	J1PWX9	7/31/2012	18100	X	3.4	4.7		0.24	3620	X	3.3	262	X	0.090	0.0048	U	0.0048	0.23	U	0.23
EXC-6	J1PX00	7/31/2012	18700	X	3.7	4.2		0.27	4330	X	3.7	289	X	0.099	0.0063	U	0.0063	0.26	U	0.26
EXC-7	J1PX01	7/31/2012	20200	X	3.2	5.2		0.23	3970	X	3.1	295	X	0.085	0.0057	B	0.0052	0.22	U	0.22
EXC-8	J1PX02	7/31/2012	21200	X	3.6	4.3		0.26	4230	X	3.5	307	X	0.095	0.0060	B	0.0048	0.25	U	0.25
EXC-10	J1PX04	7/31/2012	21800	X	3.6	3.9		0.25	4720	X	3.5	299	X	0.093	0.0059	B	0.0056	0.24	U	0.24
EXC-11	J1PX05	7/31/2012	24800	X	3.7	2.5		0.26	4090	X	3.6	308	X	0.098	0.0053	U	0.0053	0.26	U	0.26
EXC-12	J1PX06	7/31/2012	22800	X	3.5	2.4		0.25	4310	X	3.4	284	X	0.093	0.0058	U	0.0058	0.24	U	0.24
SPA-4	J1PX11	7/31/2012	20300	X	3.6	4.2		0.26	3950	X	3.5	295	X	0.096	0.012	B	0.0061	0.25	U	0.25
Duplicate of J1PX11	J1PX20	7/31/2012	20700	X	3.5	4.6		0.25	4220	X	3.4	303	X	0.093	0.0079	B	0.0048	0.24	U	0.24
SPA-1	J1PX08	7/31/2012	20400	X	3.5	4.6		0.25	4090	X	3.4	307	X	0.092	0.0072	B	0.0061	0.24	U	0.24
SPA-2	J1PX09	7/31/2012	22800	X	3.5	2.7		0.25	4070	X	3.4	291	X	0.092	0.013	B	0.0053	0.24	U	0.24
SPA-3	J1PX10	7/31/2012	20500	X	3.6	4.3		0.25	4070	X	3.5	286	X	0.094	0.042		0.0059	0.24	U	0.24
SPA-5	J1PX12	7/31/2012	23200	X	3.6	2.6		0.26	4040	X	3.5	287	X	0.095	0.0051	U	0.0051	0.25	U	0.25
SPA-6	J1PX13	7/31/2012	20500	X	3.8	5.0		0.27	4130	X	3.7	305	X	0.10	0.076		0.0062	0.26	U	0.26
SPA-7	J1PX14	7/31/2012	19700	X	3.8	3.2		0.27	4010	X	3.7	274	X	0.099	0.0067	B	0.0054	0.26	U	0.26
SPA-8	J1PX15	7/31/2012	22700	X	3.5	9.6		0.25	4320	X	3.4	306	X	0.092	0.030		0.0059	0.40	BM	0.24
SPA-9	J1PX16	7/31/2012	19500	X	3.6	4.8		0.25	4180	X	3.5	291	X	0.094	0.012	B	0.0055	0.60	B	0.25
SPA-10	J1PX17	7/31/2012	21300	X	3.4	3.4		0.24	4390	X	3.3	286	X	0.089	0.032		0.0052	0.23	U	0.23
SPA-11	J1PX18	7/31/2012	20900	X	3.8	4.1		0.27	4430	X	3.7	324	X	0.10	0.011	B	0.0049	0.43	B	0.26
SPA-12	J1PX19	7/31/2012	18300	X	3.7	3.4		0.27	4200	X	3.7	269	X	0.099	0.031		0.0051	0.38	B	0.26
Equipment Blank	J1PX21	7/31/2012	273	X	3.5	0.50		0.25	22.8	X	3.4	6.8	X	0.093	0.0057	U	0.0057	0.24	U	0.24

Attachment	1	Sheet No.	4 of 6
Originator	N. K. Schiffern	Date	09/04/12
Checked	J. D. Skoglie	Date	09/04/12
Calc. No.	0100D-CA-V0470	Rev. No.	0

Attachment 1. 100-D-50:8 Subsite Verification Sampling Results - Metals

Sample 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-9	J1PX03	7/31/2012	10.6	X	0.12	1510		38.6	0.81	U	0.81	562		5.3	0.15	U	0.15	241		55.5
Duplicate of J1PX03	J1PX07	7/31/2012	10.3	X	0.12	1500		39.5	0.83	U	0.83	581		5.5	0.15	U	0.15	272		56.9
EXC-1	J1PWX5	7/31/2012	19.3	XM	0.12	876		38.8	0.81	U	0.81	257		5.4	0.15	U	0.15	360		55.8
EXC-2	J1PWX6	7/31/2012	11.4	X	0.12	1360		39.4	0.83	U	0.83	628		5.4	0.15	U	0.15	252		56.7
EXC-3	J1PWX7	7/31/2012	9.7	X	0.12	1230		39.6	0.83	U	0.83	373		5.5	0.15	U	0.15	247		56.9
EXC-4	J1PWX8	7/31/2012	9.4	X	0.11	1170		35.2	0.74	U	0.74	479		4.9	0.14	U	0.14	208		50.7
EXC-5	J1PWX9	7/31/2012	8.9	X	0.11	952		36.9	0.77	U	0.77	453		5.1	0.14	U	0.14	226		53.1
EXC-6	J1PX00	7/31/2012	13.5	X	0.12	1280		40.5	0.85	U	0.85	492		5.6	0.16	U	0.16	224		58.2
EXC-7	J1PX01	7/31/2012	9.8	X	0.10	1140		34.7	0.73	U	0.73	519		4.8	0.14	U	0.14	254		49.9
EXC-8	J1PX02	7/31/2012	11.1	X	0.12	1330		39.0	0.82	U	0.82	467		5.4	0.15	U	0.15	255		56.2
EXC-10	J1PX04	7/31/2012	15.8	X	0.11	1180		38.3	0.80	U	0.80	464		5.3	0.15	U	0.15	330		55.1
EXC-11	J1PX05	7/31/2012	9.6	X	0.12	589		40.2	0.84	U	0.84	316		5.6	0.16	U	0.16	456		57.9
EXC-12	J1PX06	7/31/2012	11.2	X	0.11	673		38.0	0.80	U	0.80	366		5.2	0.15	U	0.15	361		54.6
SPA-4	J1PX11	7/31/2012	9.6	X	0.12	1250		39.2	0.82	U	0.82	597		5.4	0.15	U	0.15	281		56.4
Duplicate of J1PX11	J1PX20	7/31/2012	10.6	X	0.11	1340		38.2	0.80	U	0.80	639	XJ	5.3	0.15	U	0.15	279		54.9
SPA-1	J1PX08	7/31/2012	9.7	X	0.11	1360		37.8	0.79	U	0.79	451		5.2	0.15	U	0.15	273		54.3
SPA-2	J1PX09	7/31/2012	9.1	X	0.11	703		37.9	0.79	U	0.79	431		5.2	0.15	U	0.15	368		54.5
SPA-3	J1PX10	7/31/2012	10.0	X	0.12	903		38.6	0.81	U	0.81	434		5.3	0.15	U	0.15	313		55.5
SPA-5	J1PX12	7/31/2012	9.2	X	0.12	679		39.1	0.82	U	0.82	340		5.4	0.15	U	0.15	323		56.2
SPA-6	J1PX13	7/31/2012	10.3	X	0.12	1230		40.9	0.86	U	0.86	467		5.6	0.16	U	0.16	292		58.8
SPA-7	J1PX14	7/31/2012	10.1	X	0.12	838		40.7	0.85	U	0.85	335		5.6	0.16	U	0.16	287		58.6
SPA-8	J1PX15	7/31/2012	10.0	X	0.11	903		37.6	0.79	U	0.79	506	NXJ	5.2	0.15	U	0.15	345		54.2
SPA-9	J1PX16	7/31/2012	10.5	X	0.12	1120		38.7	0.81	U	0.81	501	XJ	5.3	0.15	U	0.15	265		55.7
SPA-10	J1PX17	7/31/2012	10.5	X	0.11	837		36.6	0.77	U	0.77	535	XJ	5.1	0.14	U	0.14	286		52.7
SPA-11	J1PX18	7/31/2012	12.4	X	0.12	1020		41.5	0.87	U	0.87	549	XJ	5.7	0.16	U	0.16	284		59.7
SPA-12	J1PX19	7/31/2012	11.1	X	0.12	943		40.5	0.85	U	0.85	419	XJ	5.6	0.16	U	0.16	266		58.2
Equipment Blank	J1PX21	7/31/2012	0.11	UX	0.11	47.6	B	38.0	0.80	U	0.80	176	XJ	5.2	0.15	U	0.15	54.6	U	54.6

Attachment	1	Sheet No.	5 of 6
Originator	N. K. Schiffern	Date	09/04/12
Checked	J. D. Skoglie	Date	09/04/12
Calc. No.	0100D-CA-V0470	Rev. No.	0

Attachment 1. 100-D-50:8 Subsite Verification Sampling Results - Metals and Physical

Sample Location	HEIS Number	Sample Date	Vanadium			Zinc			Percent moisture (wet sample)		
			mg/kg	Q	PQL	mg/kg	Q	PQL	pH unit	Q	PQL
EXC-9	J1PX03	7/31/2012	46.7		0.088	38.7	X	0.37	0.71		0.10
Duplicate of J1PX03	J1PX07	7/31/2012	43.7		0.091	37.5	X	0.38	0.30		0.10
EXC-1	J1PWX5	7/31/2012	59.0		0.089	42.1	X	0.38	1.2		0.10
EXC-2	J1PWX6	7/31/2012	44.4		0.090	39.5	X	0.38	0.91		0.10
EXC-3	J1PWX7	7/31/2012	47.2		0.091	39.5	X	0.38	0.38		0.10
EXC-4	J1PWX8	7/31/2012	44.4		0.081	35.2	X	0.34	0.54		0.10
EXC-5	J1PWX9	7/31/2012	48.6		0.085	35.8	X	0.36	0.75		0.10
EXC-6	J1PX00	7/31/2012	45.5		0.093	36.0	X	0.39	0.63		0.10
EXC-7	J1PX01	7/31/2012	52.0		0.079	43.1	X	0.34	0.58		0.10
EXC-8	J1PX02	7/31/2012	54.1		0.089	41.8	X	0.38	0.90		0.10
EXC-10	J1PX04	7/31/2012	58.4		0.088	40.7	X	0.37	0.90		0.10
EXC-11	J1PX05	7/31/2012	69.6		0.092	43.3	X	0.39	1.0		0.10
EXC-12	J1PX06	7/31/2012	63.0		0.087	39.4	X	0.37	0.92		0.10
SPA-4	J1PX11	7/31/2012	52.6		0.090	39.8	X	0.38	0.43		0.10
Duplicate of J1PX11	J1PX20	7/31/2012	50.6	X	0.088	41.2	X	0.37	0.54		0.10
SPA-1	J1PX08	7/31/2012	51.3		0.087	40.1	X	0.37	0.37		0.10
SPA-2	J1PX09	7/31/2012	61.3		0.087	40.2	X	0.37	0.76		0.10
SPA-3	J1PX10	7/31/2012	56.5		0.088	38.4	X	0.37	0.69		0.10
SPA-5	J1PX12	7/31/2012	64.3		0.090	40.5	X	0.38	0.98		0.10
SPA-6	J1PX13	7/31/2012	52.7		0.094	40.5	X	0.40	0.63		0.10
SPA-7	J1PX14	7/31/2012	52.9		0.093	36.5	X	0.40	0.38		0.10
SPA-8	J1PX15	7/31/2012	60.3	X	0.086	44.0	X	0.37	0.96		0.10
SPA-9	J1PX16	7/31/2012	49.7	X	0.089	39.0	X	0.38	1.9		0.10
SPA-10	J1PX17	7/31/2012	57.5	X	0.084	38.7	X	0.36	0.94		0.10
SPA-11	J1PX18	7/31/2012	52.6	X	0.095	39.3	X	0.40	1.2		0.10
SPA-12	J1PX19	7/31/2012	47.8	X	0.093	36.3	X	0.39	1.6		0.10
Equipment Blank	J1PX21	7/31/2012	0.17	BX	0.087	1.2	XCUJ	0.37	0.10	U	0.10

Attachment	1	Sheet No.	6 of 6
Originator	N. K. Schiffern	Date	09/04/12
Checked	J. D. Skoglie	Date	09/04/12
Calc. No.	0100D-CA-V0470	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-D Field Remediation **Job No. 14655**

Area: 100-D

Discipline: Environmental *Calculation No: 0100D-CA-V0471

Subject: 100-D-50:8 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculation

Computer Program: Excel Program No: Excel 2003

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	N. K. Schiffern N.K. Schiffern	J. D. Skoglie J. D. Skoglie	I. B. Berezovskiy I.B. Berezovskiy	D. F. Obenauer D.F. Obenauer	1/8/13

SUMMARY OF REVISION

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	09/25/12	Calc. No.:	0100D-CA-V0471	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	09/25/12
Subject:	100-D-50:8 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-D-50:8 subsite. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009a), 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, *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.

2) DOE-RL, 2009b, 100 Area Remedial Action Sampling and Analysis Plan, DOE/RL-96-22, Rev. 5, 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, 2012, *100-D-50:8 Subsite Cleanup Verification 95% UCL Calculation*, 0100D-CA-V0470, Rev. 0, Washington Closure Hanford, Inc., 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 2009a).

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 2009a).

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	09/06/12	Calc. No.:	0100D-CA-V0471	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	09/06/12
Subject:	100-D-50:8 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	2 of 3

METHODOLOGY:

The 100-D-50:8 subsite is comprised of two decision units for verification sampling. The direct contact hazard quotient and carcinogenic risk calculations for the 100-D-50:8 subsite were conservatively calculated for the entire subsite using the greater of the statistical or maximum value for each analyte in all decision units from WCH (2012). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, and molybdenum 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 maximum value for boron is 1.6 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 2.2×10^{-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 2.6×10^{-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, and then multiplied by 1.0×10^{-6}. For example, the maximum value for hexavalent chromium is 0.214 mg/kg, divided by 2.1 mg/kg, and multiplied as indicated, is 1.0×10^{-7}. Comparing the value for hexavalent chromium, the only carcinogenic RAG, the requirement of $<1 \times 10^{-6}$ is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. Since the 100-D-50:8 subsite has only one constituent detected for the carcinogen risk, the sum of the excess cancer risk values is equal to the excess cancer risk of hexavalent chromium in 3), or 1.0×10^{-7}. Comparing these values 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, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	09/04/12	Calc. No.:	0100D-CA-V0471	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	09/04/12
Subject:	100-D-50:8 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	3 of 3

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-D-50:8 Subsite.

Contaminant 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					
Boron	1.6	7,200	2.2E-04	--	--
Chromium, hexavalent[c]	0.214	240	8.9E-04	2.1	1.0E-07
Molybdenum	0.60	400	1.5E-03	--	--
Totals					
Cumulative Hazard Quotient:			**2.6E-03**		
Cumulative Excess Cancer Risk:					**1.0E-07**

Note:
[a] = From WCH (2012).
[b] = Value obtained from the RDR/RAWP (DOE-RL 2009a) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.
[c] = Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3), 1996.
-- = not applicable
RAG = remedial action goal

CONCLUSION:

The calculations in Table 1 demonstrate that the 100-D-50:8 subsite meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2009a) and SAP (DOE-RL 2009b). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-D Area Field Remediation **Job No. 14655**

Area: 100-D

Discipline: Environmental *Calculation No: 0100D-CA-V0476

Subject: 100-D-50:8 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2003

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	N. K. Schiffern N.K. Schiffern	I. B. Berezovskiy I.B. Berezovskiy	C. H. Dobie C.H. Dobie	D. F. Obenauer D.F. Obenauer	1/8/13

SUMMARY OF REVISION

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	9/10/2012	Calc. No.:	0100D-CA-V0476	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	9/10/2012
Subject:	100-D-50:8 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-D-50:8 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, 2012, *100-D-50:8 Subsite Cleanup Verification 95% UCL Calculations*, 0100D-CA-V0470, Rev. 0, Washington Closure Hanford, Inc., 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, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	9/10/2012	Calc. No.:	0100D-CA-V0476	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	9/10/2012
Subject:	100-D-50:8 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 100-D-50:8 subsite was divided into two decision units for the purpose of verification sampling; excavation and staging pile area. Hazard quotient and carcinogenic risk calculations for potential impact to groundwater at the 100-D-50:8 subsite were conservatively calculated for the entire subsite using the greater of the statistical or maximum value for each analyte in all decision units from the 95% UCL calculation (WCH 2012). Of the contaminants of potential concern (COPCs) for this site, boron and hexavalent chromium are included because no Washington State or Hanford background value has been established 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). Based on this model and a vadose zone of approximately 19.0 m (62.3 ft) thickness, a K_d of 3.9 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 3.9. 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 maximum value for boron of 1.6 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 5.0×10^{-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-D-50:8 subsite is 5.0×10^{-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-D-50:8 subsite doesn't have any constituents with carcinogen RAG, therefore, the criterion for excess cancer 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, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	9/10/2012	Calc. No.:	0100D-CA-V0476	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	9/10/2012
Subject:	100-D-50:8 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-D-50:8 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					
Boron	1.6	320	5.0E-03	--	--
Chromium, hexavalent	0.214	4.8	4.5E-02	--	--
Totals					
Cumulative Hazard Quotient:			**5.0E-02**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:
[a] = From WCH (2012).
[b] = Value obtained from the Cleanup Levels and Risk Calculations (CLARC) database using Groundwater, Method B, results and the "100 times" model.
-- = not applicable
RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-D-50:8 subsite meets the requirements for the hazard quotients 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

CONFIRMATORY SAMPLING

A data quality assessment (DQA) review was performed to compare the confirmatory sampling approach and analytical data with the sampling and data requirements specified by the project objectives. 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 [EPA 2006]). The assessment review completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data process.

This DQA review was performed in accordance with WCH-EE-01, *Environmental Investigations Procedures*. Specific data quality objectives for the site are found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009). All samples were collected per agreements with the lead regulatory agency. The data quality requirements in the SAP are used for assessing data from statistical sampling and do not specifically apply to the data sets resulting from the focused sampling performed for the remaining sites. However, to ensure quality data sets, the SAP data assurance requirements as well as the validation procedures for chemical and radiochemical analysis (BHI 2000a, 2000b) are followed where appropriate.

Two sample delivery groups (SDGs) were generated by confirmatory sampling of the 100-D-50:8 pipeline: SDG H3259 and SDG H3261.

SDG H3259 consists of three samples: J037N4, J037N5, and J037N6, which were analyzed for semivolatile organic compounds (SVOCs), inductively coupled plasma (ICP) metals, hexavalent chromium, gross beta, gamma energy analysis (GEA), tritium, isotopic uranium, and carbon-14. All of the data were found to be usable for decision-making purposes. Minor deficiencies were found in the SVOC and ICP metal analyses.

In the SVOC analysis for SDG H3259, the analyte 2,4-dinitrophenol had a low recovery in the matrix spike duplicate (MSD). Recoveries for 2,4-dinitrophenol in the matrix spike (MS) and the laboratory control standard (LCS) were within criteria. The analyst noted that the MSD result might be due to "losses during extraction." This result seems to be limited to a single analyte in the MSD. The common laboratory contaminants bis(2ethylhexyl)phthalate and di-n-butylphthalate were also seen in all samples and in the method blank (MB) at similar concentrations. The concentration levels involved are below the required detection limits and have not resulted in any significant impact on the sample data. The data are valid for decision-making purposes. The SVOC analysis for SDG H3259 also had five analytes with low recoveries (Isopherone 57%, 2,4-dimethylphenol 36%, 1,2,4-trichlorobenzene 52%, 4-chloro-3-methylphenol 53%, and 2-methyl naphthalene 52%) in the LCS. These analytes had good recoveries in the MS and MSD. The low result in the LCS should have no impact on the field samples, as demonstrated by the MS and MSD results. The data are valid for decision-making purposes.

The metals analysis for SDG H3259 had three analytes out of criteria with respect to the MB. In sample J037N4, the analytes chromium, lithium, and sodium had sample results that were less than 20 times the MB result. It is typical of the metals analysis to pick up low-level results in the MBs that can be attributed to trace contamination in the solvents used for extraction or other trace sources. These levels are typically well below any result found in actual field samples. However, sample J037N4 was an equipment blank. Because the sample was also a "blank," the result for some analytes were as low as those seen in the MB. The criteria were intended to catch MB contamination that was high enough to impact field sample data rather than point out samples that have concentrations low enough to be similar to the MB. The data are valid for decision-making purposes.

SDG 3261 consists of one sample, JO37V9, analyzed for GEA, nickel-63, and isotopic uranium. The sampling plan (BHI 2005b) called for additional analyses, but there was insufficient material present to collect more than a smear sample (BHI 2005a). Additional data were collected from piping downstream from this sample location.

The DQA review for the 100-D-50:8 waste subsite found the results to be accurate within the standard errors associated with the methods, including sampling and sample handling and concludes that the data are of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any analytical results should be rejected as a result of quality assurance and quality control deficiencies. All analytical data were found to be acceptable for decision-making purposes.

VERIFICATION SAMPLING

A DQA was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2012b). This DQA was performed in accordance with site-specific data quality objectives found in the SAP (DOE-RL 2009).

To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical analysis (BHI 2000a) 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).

A review of the sample design (WCH 2012b), the field logbook (WCH 2012a), and the applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design (WCH 2012b).

Verification sample data collected at the 100-D-50:8 waste subsite were provided by the laboratory in two SDGs: SDG JP0403 and SDG JP0404. SDG JP0404 was submitted for third-party validation. No major deficiencies were identified in the 100-D-50:8 analytical

data set. Minor deficiencies are discussed for the 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.

100-D-50:8 MINOR DEFICIENCIES

SDG JP0404

This SDG comprises six statistical soil samples (J1PX15 through J1PX20) collected from the 100-D-50:8 waste subsite staging pile area and an equipment blank (J1PX21). The duplicate sample (J1PX20) for a duplicate pair (J1PX11, J1PX20) is included in this SDG. The main sample (J1PX11) is included in SDG JP0403. These samples were analyzed for isotopic uranium, strontium-90, hexavalent chromium, ICP metals, and mercury, with the exception of the equipment blank (EB) (J1PX21), which was only analyzed for ICP metals. This SDG was submitted for third-party validation. Minor deficiencies are as follows:

In the ICP metals analysis, zinc was detected at a low concentration in the MB. A similar concentration of zinc was detected in the EB. Due to the MB contamination, third-party-validation qualified the EB zinc result as nondetected and estimated with "U" and "J" flags. Nondetected and estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for antimony (56%) and silicon (11%) are outside the quality control (QC) limits. In addition the LCS for silicon (26%) is also outside the QC limits. Third-party validation qualified all antimony and silicon results in SDG JP0404 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the relative percent difference (RPD) calculated on the laboratory duplicate analysis of sample J1PX15 for the analyte molybdenum is outside the QC limit. An acceptable LCS result for molybdenum indicates that the analytical system was working within proper control. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. The data are usable for decision-making purposes.

In the isotopic uranium analysis, no LCS analysis was performed for uranium-235. Third-party validation qualified all uranium-235 results as estimated with "J" flags. Estimated data are usable for decision-making purposes.

SDG JP0403

This SDG comprises 17 statistical samples (J1PWX5 through J1PWX9, J1PX00 through J1PX11) collected from the 100-D-50:8 waste subsite excavation and staging pile area. One duplicate pair form the excavation (J1PX03, J1PX07) is included in this SDG. Additionally the main sample (J1PX11) for a staging pile duplicate pair (J1PX11, J1PX20) is included in this SDG. The duplicate sample (J1PX20) is included in SDG JP0404. These samples were analyzed for isotopic uranium, strontium-90, hexavalent chromium, ICP metals, and mercury. Minor deficiencies are as follows:

In the hexavalent chromium analysis, the MS recovered below QC limits at 67%. The laboratory performed a post-digestive spike with acceptable recovery at 99%. This implies that the sample matrix has a reducing capacity that impacted the original MS recovery. The data are usable for decision-making purposes.

In the isotopic uranium analysis, no LCS analysis was performed for uranium-235. All uranium-235 results in SDG JP0403 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory performed a serial digestion and noted physical and chemical interferences for several analytes. The laboratory has qualified these analytes with "X" flags. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the RPD calculated for the laboratory duplicate analysis of sample J1PWX5 was above the control limit for nickel at 56%. An acceptable LCS result for nickel indicates that the analytical system was working within proper control. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. The data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2012a), are shown in Table D-1. The main and QA/QC sample results are presented in Appendix C.

Table D-1. Field Duplicates.

Sample Area	Main Sample	Duplicate Sample
Excavation	J1PX03	J1PX07
Staging pile area	J1PX11	J1PX20

Field duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the sample/duplicate pair(s) for each contaminant of potential concern (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. No sample results 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-D-50:8 waste 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-D-50:8 waste 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.

REFERENCES

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

BHI, 2000b, *Data Validation Procedure for Radiochemical Analysis*, BHI-01433, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2005a, *Remaining Sites Confirmation Sampling Logbook*, EL-1578-7, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2005b, *Work Instruction for 100-D-50:8, 117-DR Condensate Drain Pipeline*, 0100D-WI-G0012, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

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

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

WCH-EE-01, *Environmental Investigations Procedures*, Washington Closure Hanford, Richland, Washington.

WCH, 2012a, *100-D Field Remediation Project Sampling and Field Notes*, EL-1607-14, pp. 43- 46, Washington Closure Hanford, Richland, Washington.

WCH, 2012b, *Work Instruction for Verification Sampling of the 100-D-50:8, 117-DR Condensate Drain Pipelines*, 0100D-WI-G0120, Rev. 0, Washington Closure Hanford, Richland, Washington.