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

11-AMRC-0125

APR 14 2011

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

Dear Mr. Faulk:

TRANSMITTAL OF THE APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 100-K-78, FENCED CONTAMINATION AREA, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2011-004 and supporting "Remaining Sites Verification Package for the 100-K-78, Fenced Contamination Area," Revision 0. If you have questions, please contact me or your staff may contact Jamie Zeisloft, of my staff, at (509) 372-0188.

Sincerely,

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

AMRC:JHZ

Attachment

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

cc w/o attach:
S. L. Feaster, WCH
T. A. Foster, WCH
M. L. Proctor, WCH

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| Date Submitted: 02/02/2011<br>Originator: M. L Proctor<br>Phone: 372-9227 | **WASTE SITE RECLASSIFICATION FORM**<br>Operable Unit(s): 100-KR-1<br>Waste Site Code: 100-K-78<br>Type of Reclassification Action:<br>Closed Out ☐ Interim Closed Out ☐ No Action ☒<br>RCRA Postclosure ☐ Rejected ☐ Consolidated ☐ | Control Number: 2011-004 |
|---|---|---|

This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed Out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.

Description of current waste site condition:

The 100-K-78, Fenced Contamination Area is an area approximately 0.03 ha (0.07 ac) in size that is enclosed with chain and posted as a Radiological Contamination Area. Confirmatory sampling and evaluation of this site have been performed in accordance with remedial action objectives (RAOs) and remedial action goals (RAGs) 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 100-K-78 waste site was a candidate site for confirmatory sampling in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision,* U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2004). Confirmatory sampling was performed in accordance with the *Work Instruction for Confirmatory Sampling of the 100-K-78, Fenced Contamination Area,* Washington Closure Hanford, Richland, Washington (WCH 2010d). The selected action involved (1) evaluating the site using available process information, (2) demonstrating through confirmatory sampling that cleanup goals have been achieved, and (3) proposing the site for reclassification to No Action.

Basis for reclassification:

In accordance with this evaluation, the confirmatory sampling results support a reclassification of this site to No Action. The 100-K-78, Fenced Contamination Area achieves the RAOs and the corresponding RAGs established in the Remaining Sites ROD. The results of confirmatory sampling 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 show that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. 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. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-K-78, Fenced Contamination Area* (attached).

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.

| | | |
|---|---|---|
| 93 M. French<br>DOE Federal Project Director (printed) | M. French<br>Signature | 3/31/11<br>Date |
| N/A<br>Ecology Project Manager (printed) | Signature | Date |
| Chris Guzzetti<br>EPA Project Manager (printed) | Signature | 4/6/11<br>Date |

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-K-78, FENCED CONTAMINATION AREA

**Attachment to Waste Site Reclassification Form 2011-004**

**April 2011**

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-K-78, FENCED CONTAMINATION AREA

## EXECUTIVE SUMMARY

The 100-K-78, Fenced Contamination Area is an area enclosed with chain and posted as a radiological contamination area. The site is approximately 0.03 ha (0.07 ac) in size and centered at Washington State Plane coordinates N 147389, E 569252. The site is located in the 100-KR-1 Operable Unit of the Hanford Site.

No information was located to indicate why the 100-K-78 waste site was posted as a Radiological Contamination Area. It is possible the posting is related to contamination spread of reactor cooling water resulting from failure of earthen dikes around the 116-K-1 Crib and/or the 116-K-2 Trench, which were located nearby.

Confirmatory sampling was performed at 100-K-78 in April and November 2010. Four samples were collected of soil on or just below the surface. Another four samples were collected in approximate 0.8-m (2.5-ft) increments to depth of 3 m (10 ft).

The analytical results indicated no residual concentrations exceeding cleanup criteria except for total chromium, which exceeded the soil remedial action goals (RAGs) for the protection of groundwater and/or the Columbia River (hexavalent chromium was undetected in all samples). However, based on Residual Radioactivity (RESRAD) modeling discussed in Appendix C of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2009b) this constituent is not predicted to migrate to groundwater or to the Columbia River within 1,000 years, and its residual concentrations is, therefore, protective of groundwater and the Columbia River. A summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table ES-1.

**Table ES-1. Summary of Remedial Action Goals for the 100-K-78 Waste Site. (2 Pages)**

| Regulatory Requirement | Remedial Action Goals | Results | Remedial Action Objectives Attained? |
|---|---|---|---|
| Direct Exposure Radionuclides | Attain a dose rate of less than 15 mrem/yr above background over 1,000 years. | The maximum predicted cumulative dose for this waste site is 5.69 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 individual hazard quotients are <1. | Yes |
| | Attain a cumulative hazard quotient of <1 for noncarcinogens. | The cumulative hazard quotient ($1.7 \times 10^{-3}$) is <1. | |
| | Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens. | No carcinogenic constituents met the criteria for evaluation. | |

**Table ES-1. Summary of Remedial Action Goals for the 100-K-78 Waste Site. (2 Pages)**

| Regulatory Requirement | Remedial Action Goals | Results | Remedial Action Objectives Attained? |
|---|---|---|---|
| Risk Requirements – Nonradionuclides | Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens. | No carcinogenic constituents met the criteria for evaluation. | Yes |
| Groundwater/River Protection – Radionuclides | Attain single COPC groundwater and river protection RAGs. | All radionuclides COPCs were quantified below groundwater and river protection RAGs. | Yes |
| | Attain national primary drinking water regulations [a]: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs. | All organ-specific doses are below the 4-mrem/yr dose standard. | |
| | Meet drinking water standards for nonuranium alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide from DOE Order 5400.5 [b]. | No nonuranium alpha-emitting radionuclide COCs/COPCs were quantified above groundwater/river protection lookup values. | |
| | Meet total uranium standard of 21.2 pCi/L [c]. | All uranium isotopes were quantified below Hanford Site background values. | |
| Groundwater/River Protection – Nonradionuclides | Attain individual nonradionuclide groundwater and river cleanup requirements. | Total chromium is present at a concentration above soil RAGs for groundwater and/or river protection. However, vertical migration modeling predicts that this constituent will not reach groundwater (and, therefore, the Columbia River) within 1,000 years [d]. Therefore, the residual concentration achieves the remedial action objectives for groundwater and 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 Area, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001).
[d] Based on the RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), total chromium, with a distribution coefficient of 200 mL/g, is not predicted to migrate through the 5 m (16 ft) thick vadose zone to the groundwater in 1,000 years.

COC = contaminant of concern
COPC = contaminant of potential concern
MCL = maximum contaminant level
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose model)
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*

The results of confirmatory sampling are used to make reclassification decisions for the 100-K-78 site in accordance with the TPA-MP-14 (DOE-RL 2007) procedure. In accordance with this evaluation, the confirmatory sampling results support a reclassification of this site to No Action. The current site conditions achieve the remedial action objectives and the corresponding RAGs established in the (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 results of

confirmatory sampling 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 soils; 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 in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern and other constituents. *Washington Administrative Code* 173-340 (1996) ecological screening levels were exceeded for boron and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, chromium, manganese, vanadium, and zinc. Exceedance of 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, vanadium, and zinc values are below Hanford site background levels it is believed that the presence of these constituents does not pose a risk to environmental receptors. All exceedances will be evaluated in the context of additional lines of evidence for ecological effects as a part of the final closeout decision for the Columbia River corridor portion of the Hanford Site. A table showing contaminant concentrations from the 100-K-78 waste site that exceed ecological screening levels is provided in Appendix A.

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-78, FENCED CONTAMINATION AREA

## STATEMENT OF PROTECTIVENESS

This report demonstrates that the 100-K-78, Fenced Contamination Area waste site meets the objectives for No Action 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 results of confirmatory sampling 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 soils; 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 in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern and other constituents. *Washington Administrative Code* (WAC) 173-340 (1996) ecological screening levels were exceeded for boron and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, chromium, manganese, vanadium, and zinc. Exceedance of 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, vanadium, and zinc are below Hanford site background levels, it is believed that the presence of these constituents does not pose a risk to environmental receptors. All exceedances will be evaluated in the context of additional lines of evidence for ecological effects as a part of the final closeout decision for the Columbia River corridor portion of the Hanford Site. A table showing contaminant concentrations from the 100-K-78 waste site that exceed ecological screening levels is provided in Appendix A.

## GENERAL SITE INFORMATION AND BACKGROUND

The 100-K-78, Fenced Contamination Area is an approximately 19.4-m (63.7-ft)-long by 16.4-m (53.8-ft)-wide area, enclosed with chain, and posted as a radiological contamination area (CA). The center of the waste site is estimated to be located at Washington State Plane coordinates N 147389, E 569252.

The radiological posting at 100-K-78 was observed April 26, 2000, during a Radiation Area Remedial Action site inspection walkdown (BHI 2000). No historical radiological survey

information could be located to determine the date of the posting or the radiological activity associated with the CA.

A surface radiological survey performed in February 2010 did not detect removable contamination inside the 100-K-78 site boundary (WCH 2010a). Results of this survey were sufficient at the time to downpost the site from a CA; however, this was not done and the site remains posted. Due to the time lapse, a new survey will be required to downpost the site in the future.

Although no historical documentation regarding this site has been found, it is possible the site was posted as a CA due to historical releases of radioactive reactor cooling water effluent as a result of sidewall failures from the nearby 116-K-1 Crib and 116-K-2 Effluent Trench (Carpenter and Cote' 1994, Dorian and Richards 1978) (Figure 1). Both the crib and trench received cooling water effluent from the 105-KE and 105-KW Reactors, as well as mixed liquid waste from fuel storage basin overflow and from contaminated reactor floor drains.

A radiological characterization of the surface soil near the 116-K-2 Trench was performed in 1988 to determine the size and location of areas of elevated radiological concentrations in a 37-ha (92-ac) study area between the trench and the Columbia River (Gilbert and Klover 1988). The study identified an area of elevated radiological contamination that may correlate to the location of the 100-K-78 waste site and may be the basis for the radiological contamination posting of the waste site.

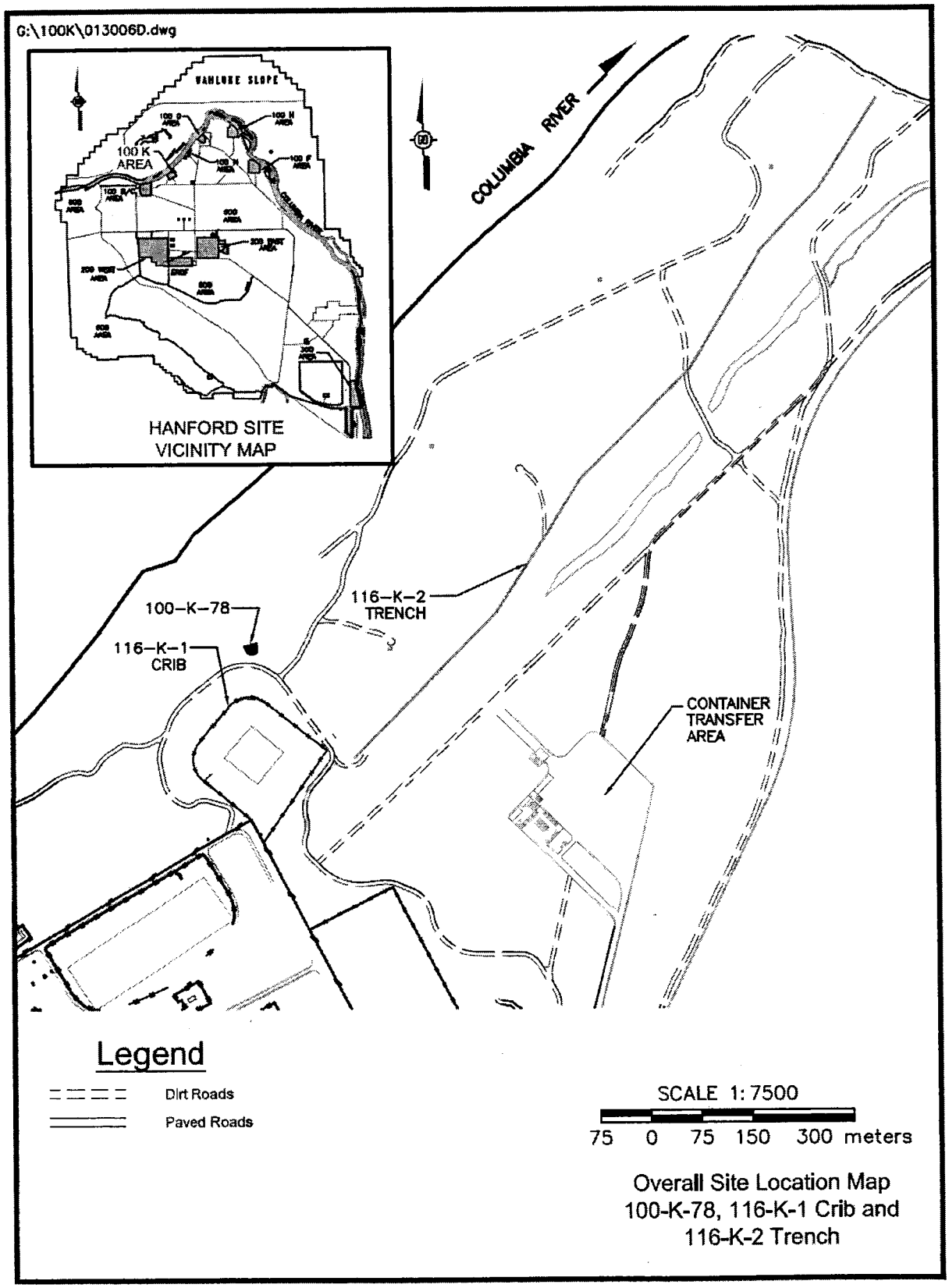
## CONFIRMATORY SAMPLING

Historical information for the 116-K-1 Crib and 116-K-2 Trench, including historical borehole characterization activities and field observations, was used to develop a site-specific confirmatory sample design (WCH 2010d). Confirmatory sampling was performed to collect information to support evaluation of the site against the remedial action goals (RAGs) identified in the Remaining Sites ROD (EPA 1999). The analytical sample results were evaluated against the cleanup criteria specified in the RDR/RAWP (DOE-RL 2009b) to support a no action or remedial action decision.

### Confirmatory Sample Design

A focused soil sampling design was used to evaluate the 100-K-78 waste site for potential contamination (WCH 2010d). A radiological scoping survey of the surface soil at the site was performed to determine the nature of the CA posting. Based on the results of that survey, a test pit was excavated to evaluate the potential for subsurface contamination. The confirmatory sampling activities were performed to determine if the site meets the cleanup criteria as specified in the RDR/RAWP (DOE-RL 2009b) or if the site requires remediation (i.e., remove, treat, and dispose). All sampling was performed in accordance with applicable ENV-1, *Environmental Monitoring & Management* procedures and the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2009a).

**Figure 1. Location of the 100-K-78, Fenced Contamination Area Waste Site.**



## Confirmatory Sampling Activities

A surface radiological survey was performed at the 100-K-78 waste site on February 25, 2010 (WCH 2010a). A sodium-iodide probe was used to collect information on potential contamination. Although the survey record notes direct beta/gamma readings up to 3.5 times background, no removable contamination above radiological control limits was present at the site.

Confirmatory sampling was performed at 100-K-78 on April 19 and November 5, 2010 (WCH 2010b). During the first sampling event, two samples plus one duplicate were collected of surface soil. One sample was collected at a location previously identified as having the highest radiological readings at the site. The second sample and duplicate were collected from material composited from five locations within the waste site. Field instruments did not detect elevated radiological or organic vapor readings in the sample material.

During the second sampling event, a test pit was excavated near the center of the site. Soil samples were taken in approximate 0.8-m (2.5-ft) intervals from the surface to 3 m (10 ft) below ground surface (bgs). Excavated material from 2.1 m (7 ft) bgs exhibited slightly elevated radiological readings. Background was noted as ~400 cpm; the material was reading ~550 cpm (WCH 2010c). This material was collected for the 1.5- to 2.3-m (5.0- to 7.5-ft) bgs sample. No other elevated radiological or organic vapor readings were detected.

No debris, anomalous material, or stained soil was observed during sampling activities.

Table 2 summarizes the samples collected and requested analyses from the two sampling events at 100-K-78.

**Table 2. 100-K-78 Sample Summary Table.**

| Sample Location | Sample Media | HEIS Number | Depth (bgs) | Sample Analysis |
|---|---|---|---|---|
| Surface (focused) | Soil | J19WF7 | 0 - 0.5 ft | GEA, C-14, Ni-63, isotopic Pu, isotopic U, Sr-90, tritium, ICP metals, mercury, hexavalent chromium |
| Surface (composite) | Soil | J19WF8 | 0 - 0.5 ft | |
| | | J19WF9 | | |
| Test pit | Soil | J1CN20 | 0 - 2.5 ft | |
| | | J1CN21 | 2.5 - 5 ft | |
| | | J1CDR4 | 5 - 7.5 ft | |
| | | J1CDR5 | 7.5 - 10 ft | |
| | | J1CDR6 | | |

**Table 2. 100-K-78 Sample Summary Table.**

| Sample Location | Sample Media | HEIS Number | Depth (bgs) | Sample Analysis |
|---|---|---|---|---|
| Equipment blank | Silica sand | J19WF6 | NA | ICP metals, mercury |
| | | J1CN19 | | ICP metals, mercury, hexavalent chromium |

bgs = below ground surface
GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable

## Confirmatory Sample Results

All confirmatory samples were analyzed using analytical methods approved by the U.S. Environmental Protection Agency (DOE-RL 2009b). Evaluation of the confirmatory data from the test pits was performed by direct comparison of the maximum sample results for each contaminant of potential concern (COPC) against cleanup criteria.

Comparisons of the results for each COPC against site RAGs are summarized in Table 3. Contaminants that were not detected by laboratory analysis are excluded from these tables (this included hexavalent chromium, which was undetected in all samples). Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2009) under WAC 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not included in these tables. The complete laboratory results are stored in the Environmental Restoration (ENRE) project-specific database prior to submitting to the Hanford Environmental Information System (HEIS) for archiving and are provided in Appendix B.

## DATA EVALUATION

Evaluation of the results listed in Table 3 from confirmatory sampling at the 100-K-78 waste site indicates that residual concentrations of all site COPCs are below soil RAGs except for total chromium. Elevated levels of total chromium were found in three separate surface samples; the maximum result of 30.0 mg/kg exceeds groundwater and river protection RAGs. However, RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b) predicts that compounds with a soil-partitioning coefficient ($K_d$) greater than 14 mL/g will not migrate through the 5-m-thick vadose zone between the surface and groundwater at this site. The $K_d$ for total chromium is 200 mL/g. The only pathway for contamination to reach the Columbia River is via groundwater migration, so the contaminant concentration is also protective of the Columbia River.

**Table 3. Comparison of the Maximum Contaminant Concentrations to the Remedial Action Goals for the 100-K-78 Confirmatory Sampling Data. (2 Pages)**

| COPC | Maximum Result (pCi/g) | Soil Lookup Values (pCi/g) [a] | | | Does the Statistical Result Exceed Lookup Values? | Do the Results Pass RESRAD Modeling? |
|---|---|---|---|---|---|---|
| | | Shallow Zone Lookup Value | Soil Lookup Value for Groundwater Protection | Soil Lookup Value for River Protection | | |
| Carbon-14 | 1.66 | 8.69 | -- [b] | -- [b] | No | -- |
| Cesium-137 | 0.320 | 6.2 | 1,465 | 2,930 | No | -- |
| Cobalt-60 | 0.073 | 1.4 | 13,900 | 27,800 | No | -- |
| Europium-152 | 0.270 | 3.3 | -- [b] | -- [b] | No | -- |
| Nickel-63 | 7.24 | 4013 | 83 | 166 | No | -- |
| Uranium-233/234 | 0.843 (<BG) | 1.1 [c] | 1.1 [c] | 1.1 [c] | No | -- |
| Uranium-235 | 0.048 (<BG) | 0.61 | 0.5 [d] | 0.5 [d] | No | -- |
| Uranium-238 | 0.932 (<BG) | 1.1 [c] | 1.1 [c] | 1.1 [c] | No | -- |
| **COPC** | **Maximum Result (mg/kg)** | **Remedial Action Goals [a] (mg/kg)** | | | **Does the Maximum Result Exceed RAGs?** | **Does the Maximum Result Pass RESRAD Modeling?** |
| | | **Direct Exposure** | **Soil Cleanup Level for Groundwater Protection** | **Soil Cleanup Level for River Protection** | | |
| Antimony | 0.391 (<BG) | 32 | 5 [e] | 5 [e] | No | -- |
| Arsenic | 4.33 (<BG) | 20 [e] | 20 [e] | 20 [e] | No | -- |
| Barium | 85.3 (<BG) | 5,600 | 200 | 400 | No | -- |
| Beryllium | 0.357 (<BG) | 10.4 [f] | 1.51 [e] | 1.51 [e] | No | -- |
| Boron [g] | 1.57 | 7,200 | 320 | -- [h] | No | -- |
| Cadmium | 0.136 (<BG) | 13.9 [f] | 0.81 [e] | 0.81 [e] | No | -- |
| Chromium (total) | 30.0 | 80,000 | 18.5 [e] | 18.5 [e] | Yes | Yes [i] |
| Cobalt | 6.11 (<BG) | 24 | 15.7 [e] | -- [h] | No | -- |
| Copper | 19.5 (<BG) | 2,960 | 59.2 | 22.0 [e] | No | -- |
| Lead | 6.38 (<BG) | 353 | 10.2 [e] | 10.2 [e] | No | -- |
| Manganese | 288 (<BG) | 3,760 | 512 [e] | 512 [e] | No | -- |
| Molybdenum [g] | 0.452 | 400 | 8 | -- [h] | No | -- |
| Nickel | 14.8 (<BG) | 1,600 | 19.1 [e] | 27.4 | No | -- |
| Vanadium | 42.9 (<BG) | 560 | 85.1 [e] | -- [h] | No | -- |

**Table 3. Comparison of the Maximum Contaminant Concentrations to the Remedial Action Goals for the 100-K-78 Confirmatory Sampling Data. (2 Pages)**

| COPC | Maximum Result (mg/kg) | Remedial Action Goals [a] (mg/kg) | | | Does the Maximum Result Exceed RAGs? | Does the Maximum Result Pass RESRAD Modeling? |
|---|---|---|---|---|---|---|
| | | Direct Exposure | Soil Cleanup Level for Groundwater Protection | Soil Cleanup Level for River Protection | | |
| Zinc | 47.0 (<BG) | 24,000 | 480 | 67.8 [e] | No | -- |

[a] Lookup values and RAGs obtained from the RDR/RAWP (DOE-RL 2009b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.
[b] No value; because the Kd value for this contaminant is greater than 80 mL/g, RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b) predicts that the contaminant will show no migration within the 100 Area vadose zone, and no impact on groundwater or the Columbia River.
[c] The remedial action goal is below the Hanford Site-specific soil background concentration. The value presented is the Hanford Site-specific soil background concentration.
[d] When the remedial action goal is below the minimum detectable activity (MDA) the cleanup level defaults to the MDA
[e] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009b).
[f] Carcinogenic cleanup level calculated based on the inhalation exposure pathway per WAC 173-340-750[3], 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m$^3$ (WDOH 1997).
[g] No Hanford Site-specific or Washington State background value available.
[h] No parameters (bioconcentration factors or ambient water quality criteria values) are available from the Washington State Department of Ecology Cleanup Levels and Risk Calculations database or other databases to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).
[i] Based on the RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b), total chromium is not predicted to migrate through the 5-m-thick vadose zone to the groundwater in 1,000 years (based on the total chrome soil-partitioning distribution coefficient of 200 mL/g).

-- = not applicable
BG = background (obtained from DOE [2001], unless otherwise stated)
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)
WAC = *Washington Administrative Code*

Assessment of the risk requirements for the 100-K-78 waste site is determined by calculation of the hazard quotient and excess cancer risk values for nonradionuclides. These calculations are located in Appendix C. The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than $1 \times 10^{-6}$, and a cumulative carcinogenic risk of less than $1 \times 10^{-5}$. These risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The results (Appendix C) indicate that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the noncarcinogenic constituents is $1.7 \times 10^{-3}$. No carcinogenic constituents met the criteria for evaluation at the 100-K-78 waste site and the excess carcinogenic risk is thus zero. Therefore, the individual and total excess cancer risk limits of $1 \times 10^{-6}$ and $1 \times 10^{-5}$, respectively, are met.

Cumulative radionuclide activities in soil samples were evaluated and determined to be less than the 15 mrem/yr dose rate. Table 4 provides a conservative comparison of the radionuclide results of confirmatory samples collected to the direct exposure single radionuclide 15 mrem/yr dose-equivalent values. The second column of the table provides the maximum radionuclide activity detected in soil at the site. The third column presents the single radionuclide 15 mrem/yr dose-equivalent activity, and the fourth column presents the radionuclide activity divided by the dose-equivalent activity. As demonstrated by the sum of the fractions, the cumulative dose contributed by residual radionuclide contamination is conservatively estimated to be 5.69 mrem/yr, less than the 15 mrem/yr RAG.

**Table 4. Attainment of Radionuclide Direct Exposure RAGs**

| COC/COPC | Maximum, (pCi/g) [a] Focused Samples | Activity Equivalent to 15 mrem/yr Dose [b] (pCi/g) | Fraction |
|---|---|---|---|
| Carbon-14 | 1.66 | 8.69 | 0.191 |
| Cesium-137 | 0.320 | 6.2 | 0.052 |
| Cobalt-60 | 0.073 | 1.4 | 0.052 |
| Europium-152 | 0.270 | 3.3 | 0.082 |
| Nickel-63 | 7.24 | 4013 | 0.002 |
| Uranium-233/234 | 0 (<BG) | 0.58 | 0 |
| Uranium-235 | 0 (<BG) | 0.61 | 0 |
| Uranium-238 | 0 (<BG) | 0.61 | 0 |
| | | **Total** | 0.379 |
| | | **Equivalent Dose (mrem/yr)** | 5.69 |

[a] Hanford Site background values for uranium-233/234 (1.1 pCi/g), uranium-235 (0.11 pCi/g), and uranium-238 (1.1 pCi/g) (DOE-RL 1996) have been subtracted from focused sample values.

[b] Single radionuclide 15 mrem/yr dose-equivalence values and derivation methodology are presented in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b).

BG = background
COC = contaminant of concern
COPC = contaminant of potential concern
RAG = remedial action goal

## DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the confirmatory sampling approach (WCH 2010d), the field logbook (WCH 2010b, 2010c), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 100-K-78 waste site established that the data are of the right type, quality, and quantity to support site confirmatory decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site confirmation. The cleanup confirmatory 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 B. The detailed DQA is presented in Appendix D.

## SUMMARY FOR NO ACTION

The 100-K-78 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009b). Confirmatory sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at this site meet the remedial action objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the confirmatory sampling results support a reclassification of the 100-K-78 waste site to No Action. 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.

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# APPENDIX A

# ECOLOGICAL RISK COMPARISON TABLE

**Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Level for the 100-K-78 Waste Site [a].**

| Hazardous Substance | | 2007 WAC 173-340 Table 749-3 | | | EPA Ecological Soil Screening Levels [b] | | | | Waste Site Analyses |
|---|---|---|---|---|---|---|---|---|---|
| | | Plants | Soil Biota | Wildlife | Plants | Soil Biota | Avian [c] | Mammalian [c] | |
| METALS (mg/kg) | | | | | | | | | |
| | Max Result | | | | | | | | |
| Antimony | 5 | 5 | -- | -- | -- | 78 | -- | 0.27 | 0.391 |
| Boron | -- | 0.5 | -- | -- | -- | -- | -- | -- | 1.57 |
| Chromium (total) | 18.5 | 42 [d] | 42 [d] | 67 | -- | -- | 26 | 34 | 30.0 |
| Manganese | 512 | 1,100 [d] | -- | 1,500 | 220 | 450 | 4,300 | 4,000 | 288 (<BG) |
| Vanadium | 85.1 | 2 | -- | -- | -- | -- | 7.8 | 280 | 42.9 (<BG) |
| Zinc | 67.8 | 86 [d] | 200 | 360 | 160 | 120 | 46 | 79 | 47.0 (<BG) |

Highlighted values are the lowest ecological screening levels for individual hazardous substances.

[a] Per WAC 173-340-7490(4)(b) (Ecology 2007), soil concentrations deeper than the standard point of compliance of 4.6 m (15 ft) are not considered in evaluation of risk to ecological receptors because this represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities, resulting in exposure by ecological receptors. 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.

-- = no value exists

BG = background

EPA = U. S. Environmental Protection Agency

WAC = *Washington Administrative Code*

# APPENDIX B

# CONFIRMATORY SAMPLING DATA

# Table B-1 Confirmatory Sample Data – Metals.

| sample location | HEIS Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | | Boron | | | Cadmium | | | Calcium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL |
| equipment blank | J19WF6 | 4/19/2010 | 196 | | 4.1 | 0.492 | U | 0.49 | 0.82 | U | 0.82 | 5.13 | | 0.41 | 0.164 | U | 0.16 | 1.64 | U | 1.64 | 0.164 | U | 0.16 | 54.4 | B | 82 |
| surface (focused) | J19WF7 | 4/19/2010 | 7600 | | 3.62 | 0.434 | U | 0.43 | 3.59 | | 0.72 | 75.2 | | 0.36 | 0.243 | | 0.15 | 1.53 | | 1.45 | 0.126 | B | 0.15 | 5480 | | 72.4 |
| surface (composite) | J19WF8 | 4/19/2010 | 7970 | | 3.19 | 0.383 | U | 0.38 | 4.05 | | 0.64 | 71 | | 0.32 | 0.256 | | 0.13 | 1.5 | | 1.28 | 0.132 | | 0.13 | 4670 | | 63.9 |
| duplicate J19WF8 | J19WF9 | 4/19/2010 | 8410 | | 3.56 | 0.427 | U | 0.43 | 4.31 | | 0.71 | 72.9 | | 0.36 | 0.272 | | 0.14 | 1.57 | | 1.42 | 0.136 | B | 0.14 | 4800 | | 71.2 |
| test pit 7 ft bgs | J1CDR4 | 11/5/2010 | 7020 | | 4.31 | 0.518 | U | 0.52 | 2.17 | | 0.86 | 67.1 | | 0.43 | 0.234 | | 0.17 | 0.484 | B | 1.73 | 0.049 | B | 0.17 | 2620 | | 86.3 |
| test pit 10 ft bgs | J1CDR5 | 11/5/2010 | 5760 | | 3.19 | 0.262 | B | 0.38 | 1.46 | | 0.64 | 46.4 | | 0.32 | 0.197 | | 0.13 | 0.379 | B | 1.28 | 0.045 | B | 0.13 | 2320 | | 63.8 |
| duplicate J1CDR5 | J1CDR6 | 11/5/2010 | 5750 | | 3.7 | 0.388 | B | 0.44 | 1.53 | | 0.74 | 51.7 | | 0.37 | 0.178 | | 0.15 | 0.409 | B | 1.48 | 0.046 | B | 0.15 | 2360 | | 74.1 |
| equipment blank | J1CN19 | 11/5/2010 | 168 | | 3.57 | 0.429 | U | 0.43 | 0.254 | B | 0.72 | 1.56 | | 0.36 | 0.041 | B | 0.14 | 1.43 | U | 1.43 | 0.143 | U | 0.14 | 34.7 | B | 71.5 |
| test pit 2 ft bgs | J1CN20 | 11/5/2010 | 10800 | | 4.2 | 0.334 | B | 0.5 | 4.33 | | 0.84 | 85.3 | | 0.42 | 0.357 | | 0.17 | 0.683 | B | 1.68 | 0.092 | B | 0.17 | 3370 | | 84.1 |
| test pit 5 ft bgs | J1CN21 | 11/5/2010 | 7330 | | 3.9 | 0.391 | B | 0.47 | 2.15 | | 0.78 | 63.7 | | 0.39 | 0.213 | | 0.16 | 0.54 | B | 1.56 | 0.058 | B | 0.16 | 2860 | | 78 |

| | | | Chromium | | | Cobalt | | | Copper | | | Hexavalent Chromium | | | Iron | | | Lead | | | Magnesium | | | Manganese | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL |
| equipment blank | J19WF6 | 4/19/2010 | 0.239 | | 0.16 | 1.64 | U | 1.64 | 0.82 | U | 0.82 | | | | 228 | | 16.4 | 0.447 | | 0.41 | 30.3 | B | 61.5 | 4.99 | | 4.1 |
| surface (focused) | J19WF7 | 4/19/2010 | 15.8 | | 0.15 | 4.98 | | 1.45 | 11.6 | | 0.72 | 0.2 | U | 0.2 | 15100 | | 14.5 | 6.38 | | 0.36 | 5250 | | 54.3 | 242 | | 3.62 |
| surface (composite) | J19WF8 | 4/19/2010 | 28.3 | | 0.13 | 6.11 | | 1.28 | 13.4 | | 0.64 | 0.2 | U | 0.2 | 17600 | | 12.8 | 6.11 | | 0.32 | 5270 | | 47.9 | 278 | | 3.19 |
| duplicate J19WF8 | J19WF9 | 4/19/2010 | 30 | | 0.14 | 6.06 | | 1.42 | 13.6 | | 0.71 | 0.2 | U | 0.2 | 18000 | | 14.2 | 6.26 | | 0.36 | 5510 | | 53.4 | 288 | | 3.56 |
| test pit 7 ft bgs | J1CDR4 | 11/5/2010 | 14.6 | | 0.17 | 3.44 | | 1.73 | 13.2 | | 0.86 | 0.51 | U | 0.51 | 13300 | | 17.3 | 3.63 | | 0.43 | 4190 | | 64.7 | 182 | | 4.31 |
| test pit 10 ft bgs | J1CDR5 | 11/5/2010 | 11 | | 0.13 | 3.09 | | 1.28 | 12.3 | | 0.64 | 0.51 | U | 0.51 | 11100 | | 12.8 | 2.7 | | 0.32 | 3490 | | 47.8 | 162 | | 3.19 |
| duplicate J1CDR5 | J1CDR6 | 11/5/2010 | 10.5 | | 0.15 | 3.06 | | 1.48 | 10.7 | | 0.74 | 0.51 | U | 0.51 | 11400 | | 14.8 | 2.5 | | 0.37 | 3620 | | 55.5 | 149 | | 3.7 |
| equipment blank | J1CN19 | 11/5/2010 | 0.143 | U | 0.14 | 1.43 | U | 1.43 | 0.715 | U | 0.72 | 0.5 | U | 0.5 | 225 | | 14.3 | 0.458 | | 0.36 | 19.1 | B | 53.6 | 4.89 | | 3.57 |
| test pit 2 ft bgs | J1CN20 | 11/5/2010 | 27.2 | | 0.17 | 4.91 | | 1.68 | 19.5 | | 0.84 | 0.51 | U | 0.51 | 19600 | | 16.8 | 4.68 | | 0.42 | 5080 | | 63.1 | 208 | | 4.2 |
| test pit 5 ft bgs | J1CN21 | 11/5/2010 | 13.9 | | 0.16 | 2.99 | | 1.56 | 12.1 | | 0.78 | 0.51 | U | 0.51 | 13400 | | 15.6 | 2.7 | | 0.39 | 3970 | | 58.5 | 184 | | 3.9 |

| | | | Mercury | | | Molybdenum | | | Nickel | | | Potassium | | | Selenium | | | Silicon | | | Silver | | | Sodium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL |
| equipment blank | J19WF6 | 4/19/2010 | 0.026 | U | 0.03 | 1.64 | U | 1.64 | 3.28 | U | 3.28 | 45 | B | 328 | 0.246 | U | 0.25 | 200 | | 1.64 | 0.164 | U | 0.16 | 41 | U | 41 |
| surface (focused) | J19WF7 | 4/19/2010 | 0.025 | U | 0.02 | 0.306 | B | 1.45 | 13.9 | | 2.9 | 1140 | | 290 | 0.217 | U | 0.22 | 565 | | 1.45 | 0.145 | U | 0.15 | 335 | | 36.2 |
| surface (composite) | J19WF8 | 4/19/2010 | 0.025 | U | 0.03 | 0.415 | B | 1.28 | 14.1 | | 2.56 | 1470 | | 256 | 0.192 | U | 0.19 | 510 | | 1.28 | 0.128 | U | 0.13 | 707 | | 31.9 |
| duplicate J19WF8 | J19WF9 | 4/19/2010 | 0.027 | U | 0.03 | 0.452 | B | 1.42 | 14.8 | | 2.85 | 1520 | | 285 | 0.214 | U | 0.21 | 545 | | 1.42 | 0.142 | U | 0.14 | 654 | | 35.6 |
| test pit 7 ft bgs | J1CDR4 | 11/5/2010 | 0.03 | U | 0.03 | 1.73 | U | 1.73 | 9.65 | | 3.45 | 996 | | 345 | 0.259 | U | 0.26 | 393 | | 1.73 | 0.173 | U | 0.17 | 125 | | 43.1 |
| test pit 10 ft bgs | J1CDR5 | 11/5/2010 | 0.03 | U | 0.03 | 1.28 | U | 1.28 | 8.37 | | 2.55 | 895 | | 255 | 0.191 | U | 0.19 | 328 | | 1.28 | 0.128 | U | 0.13 | 113 | | 31.9 |
| duplicate J1CDR5 | J1CDR6 | 11/5/2010 | 0.023 | U | 0.02 | 1.48 | U | 1.48 | 8.23 | | 2.96 | 827 | | 296 | 0.222 | U | 0.22 | 718 | | 1.48 | 0.148 | U | 0.15 | 110 | | 37 |
| equipment blank | J1CN19 | 11/5/2010 | 0.027 | U | 0.03 | 1.43 | U | 1.43 | 2.86 | U | 2.86 | 59.3 | B | 286 | 0.214 | U | 0.21 | 132 | | 1.43 | 0.143 | U | 0.14 | 9.96 | B | 35.7 |
| test pit 2 ft bgs | J1CN20 | 11/5/2010 | 0.029 | U | 0.03 | 0.252 | B | 1.68 | 14.1 | | 3.36 | 904 | | 336 | 0.252 | U | 0.25 | 833 | | 1.68 | 0.168 | U | 0.17 | 178 | | 42 |
| test pit 5 ft bgs | J1CN21 | 11/5/2010 | 0.028 | U | 0.03 | 0.162 | B | 1.56 | 7.77 | | 3.12 | 1140 | | 312 | 0.234 | U | 0.23 | 844 | | 1.56 | 0.156 | U | 0.16 | 160 | | 39 |

| | | | Vanadium | | | Zinc | | |
|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | QUAL | PQL | mg/kg | QUAL | PQL |
| equipment blank | J19WF6 | 4/19/2010 | 0.294 | B | 2.05 | 0.896 | B | 8.2 |
| surface (focused) | J19WF7 | 4/19/2010 | 31.6 | | 1.81 | 43.3 | | 7.24 |
| surface (composite) | J19WF8 | 4/19/2010 | 42.1 | | 1.6 | 45.9 | | 6.39 |
| duplicate J19WF8 | J19WF9 | 4/19/2010 | 42.5 | | 1.78 | 47 | | 7.12 |
| test pit 7 ft bgs | J1CDR4 | 11/5/2010 | 28.2 | | 2.16 | 31 | | 8.63 |
| test pit 10 ft bgs | J1CDR5 | 11/5/2010 | 22.9 | | 1.59 | 29.2 | | 6.38 |
| duplicate J1CDR5 | J1CDR6 | 11/5/2010 | 23.4 | | 1.85 | 25.1 | | 7.41 |
| equipment blank | J1CN19 | 11/5/2010 | 0.316 | B | 1.79 | 0.81 | B | 7.15 |
| test pit 2 ft bgs | J1CN20 | 11/5/2010 | 42.9 | | 2.1 | 36.9 | | 8.41 |
| test pit 5 ft bgs | J1CN21 | 11/5/2010 | 29.8 | | 1.95 | 32.8 | | 7.8 |

D = dilution
J = estimated result
PQL = practical quantitation limit
Q = qualifier
U = undetected

# Table B-2 Confirmatory Sampling Data – Radiological.

| | | | Americium-241 GEA | | | Carbon-14 | | | Cesium-137 | | | Cobalt-60 | | | Europium-152 | | | Europium-154 | | | Europium-155 | | | Gross alpha | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Location | HEIS Number | Sample Date | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA |
| surface (focused) | J19WF7 | 4/19/2010 | 0.037 | U | 0.037 | -2.35 | U | 6.13 | 0.024 | U | 0.024 | 0.023 | U | 0.023 | 0.063 | U | 0.063 | 0.074 | U | 0.074 | 0.069 | U | 0.069 | 8.9 | | 2.75 |
| surface (composite) | J19WF8 | 4/19/2010 | 0.197 | U | 0.197 | -0.252 | U | 6.09 | 0.315 | | 0.034 | 0.073 | | 0.03 | 0.27 | | 0.075 | 0.093 | U | 0.093 | 0.102 | U | 0.102 | 8.92 | | 6.31 |
| duplicate J19WF8 | J19WF9 | 4/19/2010 | 0.052 | U | 0.052 | -2.66 | U | 5.58 | 0.32 | | 0.015 | 0.059 | | 0.013 | 0.213 | | 0.03 | 0.034 | U | 0.034 | 0.055 | U | 0.055 | 10.7 | | 3.29 |
| test pit 7 ft bgs | J1CDR4 | 11/5/2010 | 0.102 | U | 0.102 | 1.66 | | 0.728 | 0.024 | U | 0.024 | 0.032 | U | 0.032 | 0.068 | U | 0.068 | 0.104 | U | 0.104 | 0.079 | U | 0.079 | | | |
| test pit 10 ft bgs | J1CDR5 | 11/5/2010 | 0.272 | U | 0.272 | 1.25 | | 0.668 | 0.063 | U | 0.063 | 0.053 | U | 0.053 | 0.164 | U | 0.164 | 0.181 | U | 0.181 | 0.187 | U | 0.187 | | | |
| duplicate J1CDR5 | J1CDR6 | 11/5/2010 | 0.341 | U | 0.341 | 1.45 | | 0.671 | 0.075 | U | 0.075 | 0.092 | U | 0.092 | 0.193 | U | 0.193 | 0.271 | U | 0.271 | 0.174 | U | 0.174 | | | |
| test pit 2 ft bgs | J1CN20 | 11/5/2010 | 0.216 | U | 0.216 | 1.48 | | 0.765 | 0.026 | U | 0.026 | 0.03 | U | 0.03 | 0.072 | U | 0.072 | 0.093 | U | 0.093 | 0.098 | U | 0.098 | | | |
| test pit 2 ft bgs | J1CN21 | 11/5/2010 | 0.037 | U | 0.037 | 1.32 | | 0.646 | 0.024 | U | 0.024 | 0.026 | U | 0.026 | 0.056 | U | 0.056 | 0.081 | U | 0.081 | 0.063 | U | 0.063 | | | |
| | | | Gross beta | | | Nickel-63 | | | Plutonium-238 | | | Plutonium-239/240 | | | Potassium-40 | | | Radium-226 | | | Radium-228 | | | Thorium-228 GEA | | |
| | | | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA |
| surface (focused) | J19WF7 | 4/19/2010 | 20.2 | | 5.03 | 0.117 | U | 3.02 | 0.044 | U | 0.243 | -0.02 | U | 0.168 | 15.9 | | 0.228 | 0.743 | | 0.045 | 1.1 | | 0.103 | 1.12 | | 0.03 |
| surface (composite) | J19WF8 | 4/19/2010 | 21.5 | | 5.42 | 7.24 | | 3.12 | 0 | U | 0.232 | 0.024 | U | 0.185 | 16.9 | | 0.278 | 0.722 | | 0.054 | 1.15 | | 0.116 | 1.08 | | 0.04 |
| duplicate J19WF8 | J19WF9 | 4/19/2010 | 19.7 | | 5.16 | -1.25 | U | 3.13 | 0.015 | U | 0.075 | 0.004 | U | 0.042 | 12.5 | | 0.072 | 0.759 | | 0.023 | 1.11 | | 0.051 | 1.1 | | 0.02 |
| test pit 7 ft bgs | J1CDR4 | 11/5/2010 | | | | -0.833 | U | 3.39 | -0.03 | U | 0.257 | 0 | U | 0.257 | 14 | | 0.256 | 0.452 | | 0.056 | 0.689 | | 0.134 | 0.61 | | 0.03 |
| test pit 10 ft bgs | J1CDR5 | 11/5/2010 | | | | 0.453 | U | 2.76 | 0.048 | U | 0.37 | 0 | U | 0.37 | 12.5 | | 0.429 | 0.379 | | 0.119 | 0.64 | | 0.256 | 0.42 | | 0.09 |
| duplicate J1CDR5 | J1CDR6 | 11/5/2010 | | | | 1.47 | U | 2.92 | 0.15 | U | 0.383 | 0.2 | U | 0.383 | 11.8 | | 0.845 | 0.38 | | 0.172 | 0.626 | | 0.388 | 0.57 | | 0.09 |
| test pit 2 ft bgs | J1CN20 | 11/5/2010 | | | | 1.56 | U | 4.08 | 0 | U | 0.297 | 0.039 | U | 0.297 | 14.6 | | 0.262 | 0.582 | | 0.055 | 0.905 | | 0.122 | 0.92 | | 0.03 |
| test pit 2 ft bgs | J1CN21 | 11/5/2010 | | | | 0.566 | U | 2.59 | 0 | U | 0.384 | 0 | U | 0.384 | 13.4 | | 0.24 | 0.369 | | 0.04 | 0.692 | | 0.107 | 0.57 | | 0.03 |
| | | | Thorium-232 GEA | | | Total radiostrontium | | | Tritium | | | Uranium-233/234 | | | Uranium-235 | | | Uranium-235 GEA | | | Uranium-238 | | | Uranium-238 GEA | | |
| | | | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA | pCi/g | QUAL | MDA |
| surface (focused) | J19WF7 | 4/19/2010 | 1.1 | | 0.103 | -0.032 | U | 0.304 | -0.14 | U | 9.01 | 0.726 | | 0.061 | 0.048 | | 0.037 | 0.146 | U | 0.146 | 0.671 | | 0.044 | 2.79 | U | 2.79 |
| surface (composite) | J19WF8 | 4/19/2010 | 1.15 | | 0.116 | -0.044 | U | 0.248 | 1.98 | U | 8.54 | 0.817 | | 0.074 | 0.041 | U | 0.062 | 0.181 | U | 0.181 | 0.687 | | 0.06 | 3.25 | U | 3.25 |
| duplicate J19WF8 | J19WF9 | 4/19/2010 | 1.11 | | 0.051 | 0.044 | U | 0.265 | -3.56 | U | 7.95 | 0.747 | | 0.058 | 0.03 | U | 0.041 | 0.132 | U | 0.132 | 0.747 | | 0.04 | 1.24 | U | 1.24 |
| test pit 7 ft bgs | J1CDR4 | 11/5/2010 | 0.689 | | 0.134 | -0.023 | U | 0.467 | -1.46 | U | 4.25 | 0.656 | | 0.209 | 0.066 | U | 0.253 | 0.16 | U | 0.16 | 0.684 | | 0.209 | 3.85 | U | 3.85 |
| test pit 10 ft bgs | J1CDR5 | 11/5/2010 | 0.64 | | 0.256 | 0.007 | U | 0.246 | -1.37 | U | 4.14 | 0.38 | | 0.207 | 0.033 | U | 0.251 | 0.524 | U | 0.524 | 0.271 | | 0.207 | 7.29 | U | 7.29 |
| duplicate J1CDR5 | J1CDR6 | 11/5/2010 | 0.626 | | 0.388 | 0.011 | U | 0.441 | -1.15 | U | 3.98 | 0.424 | | 0.25 | 0 | U | 0.302 | 0.351 | U | 0.351 | 0.555 | | 0.25 | 12 | U | 12 |
| test pit 2 ft bgs | J1CN20 | 11/5/2010 | 0.905 | | 0.122 | 0.118 | U | 0.397 | -1.53 | U | 3.96 | 0.819 | | 0.216 | 0.239 | U | 0.262 | 0.148 | U | 0.148 | 0.932 | | 0.216 | 3.36 | U | 3.36 |
| test pit 2 ft bgs | J1CN21 | 11/5/2010 | 0.692 | | 0.107 | -0.086 | U | 0.322 | -1.44 | U | 4.2 | 0.843 | | 0.201 | 0.032 | U | 0.244 | 0.144 | U | 0.144 | 0.632 | | 0.201 | 2.94 | U | 2.94 |

D = dilution
J = estimated result
PQL = practical quantitation limit
Q = qualifier
U = undetected

# APPENDIX C

# CALCULATIONS

# APPENDIX C

# CALCULATIONS

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

*100-K-78 Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation,* 0100K-CA-V0076, Rev. 0.

**DISCLAIMER FOR CALCULATIONS**

The calculation provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents.

Acrobat 8.0

# CALCULATION COVER SHEET

Project Title: 100-K Area Remedial Action **Job No. 14655**

Area: 100-K

Discipline: Environmental Calculation No: 0100K-CA-V0076

Subject: 100-K-78 RPD and 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<br>Summary = 7<br>Attachment 1 = 4<br>Total = 12 | D. I. Rollosson | J. D. Skoglie | I. B. Berezovskiy | D. F. Obenauer | 2/22/11 |

## SUMMARY OF REVISION

| | |
|---|---|
| | |

WCH-DE-018 (05/08/2007)

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | D. I. Rollosson | Date: | 1/13/2011 | Calc. No.: | 0100K-CA-V0076 | Rev.: | 0 |
| Project: | 100-K Area Remedial Action | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 1/13/2011 |
| Subject: | 100-K-78 RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. | 1 of 7 |

## PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-K-78 waste site. 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.

Also, calculate the relative percent difference (RPD) for primary-duplicate sample pairs from 100-K-78 confirmatory sampling, as necessary.

## GIVEN/REFERENCES:


1) DOE-RL, 2009a, *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.

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

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

5) WCH, 2011, *Remaining Sites Verification Package for the 100-K-78, Fenced Contamination Area*, Attachment to Waste Site Reclassification Form 2011-004, 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).

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | D. I. Rollosson | Date: | 1/12/2011 | Calc. No.: | 0100K-CA-V0076 | Rev.: | 0 |
| Project: | 100-K Area Remedial Action | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 1/12/2011 |
| Subject: | 100-K-78 RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 2 of 7 | |

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

5) Use data from WCH (2011) to perform the RPD calculations for primary-duplicate sample pairs, as required.

## METHODOLOGY:

The 100-K-78 data set is comprised of three test pit samples, one surface composite sample, and one surface focused sample. The direct contact hazard quotient and carcinogenic risk calculations for the 100-K-78 waste site were conservatively calculated for the entire waste site using the greatest of the maximum soil sample and duplicate results from surface soil and the test pit soil (WCH 2011). Of the contaminants of potential concern (COPCs) for this site, total chromium requires an HQ and risk calculation because the analyte was detected above the background value. Boron 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 1.57 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 $2.2 \times 10^{-4}$. 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 $1.7 \times 10^{-3}$. Comparing this value to the requirement of <1.0, this criterion is met.

3) No carcinogenic constituents met the criteria for evaluation at the 100-K-78 waste site: therefore, no calculations of excess carcinogenic risk were performed.

4) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed for certain analytes in Table II-1 of the SAP (DOE-RL 2009b). Other analytes will have their own pre-determined constituents and will have their own TDLs based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

When an analyte is detected in the primary or duplicate sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | D. I. Rollosson | Date: | 1/20/2011 | Calc. No.: | 0100K-CA-V0076 | Rev.: | 0 |
| Project: | 100-K Area Remedial Action | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 1/20/2011 |
| Subject: | 100-K-78 RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 3 of 7 | |

between the primary and duplicate results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. This assessment is provided in the data quality assessment section of the RSVP.

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. No split samples were collected for cleanup verification of the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2011), as necessary.

**RESULTS:**

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

Table 1 shows the results of the hazard quotient and excess cancer risk calculations.

Table 2 shows the results of the RPD calculations for the 100-K-78 waste site. The evaluation of the QA/QC duplicate RPD calculations is performed within the data quality assessment section of the RSVP.

**Table 1. Direct Contact HQ and Excess Cancer Risk Results for the 100-K-78 Waste Site.**

| Contaminants of Potential Concern | Maximum Value[a] (mg/kg) | Noncarcinogen RAG[b] (mg/kg) | Hazard Quotient | Carcinogen RAG[b] (mg/kg) | Carcinogen Risk |
|---|---|---|---|---|---|
| ***Metals*** | | | | | |
| Boron | 1.57 | 7,200 | 2.2E-04 | -- | -- |
| Chromium, total | 30.0 | 80,000 | 3.8E-04 | -- | -- |
| Molybdenum | 0.452 | 400 | 1.1E-03 | -- | -- |
| ***Totals*** | | | | | |
| **Cumulative Hazard Quotient:** | | | **1.7E-03** | | |
| **Cumulative Excess Cancer Risk:** | | | | | **0.0E+00** |

Notes:
a = From WCH (2010).
b = Value obtained from the RDR/RAWP (DOE-RL 2009a) or Washington Administrative Code (WAC) 173-340-740(3), Method B, 1996.
-- = not applicable
RAG = remedial action goal

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | D. I. Rollosson | Date: | 1/12/2011 | Calc. No.: | 0100K-CA-V0076 | Rev.: | 0 |
| Project: | 100-K Area Remedial Action | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 1/12/2011 |
| Subject: | 100-K-78 RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 4 of 7 | |

## Table 2. Relative Percent Difference Calculations for the 100-K-78 Waste Site. (4 Pages)

**100-K-78 Surface Sample Duplicate Analysis**

| Sampling Area | HEIS Number | Sample Date | Cesium-137 | | | Cobalt-60 | | | Europium-152 | | | Gross Alpha | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Surface Composite | J19WF8 | 4/19/2010 | 0.315 | | 0.034 | 0.073 | | 0.030 | 0.270 | | 0.075 | 8.92 | | 6.31 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 0.320 | | 0.015 | 0.059 | | 0.013 | 0.213 | | 0.030 | 10.7 | | 3.29 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 0.05 | 0.05 | 0.1 | 10 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) | No-Stop (acceptable) | No-Stop (acceptable) | No-Stop (acceptable) |
| | RPD | 1.6% | | | |
| | Difference > 2 TDL? | Not applicable | No - acceptable | No - acceptable | No - acceptable |

| Sampling Area | HEIS Number | Sample Date | Gross Beta | | | Potassium-40 | | | Radium-226 | | | Radium-228 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Surface Composite | J19WF8 | 4/19/2010 | 21.5 | | 5.42 | 16.9 | | 0.278 | 0.722 | | 0.054 | 1.15 | | 0.116 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 19.7 | | 5.16 | 12.5 | | 0.072 | 0.759 | | 0.023 | 1.11 | | 0.051 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 15 | 0.05 | 0.1 | 0.2 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) | Yes (calc RPD) |
| | RPD | | 29.9% | 5.0% | 3.5% |
| | Difference > 2 TDL? | No - acceptable | Not applicable | Not applicable | Not applicable |

| Sampling Area | HEIS Number | Sample Date | Thorium-228 GEA | | | Thorium-232 GEA | | | Uranium-233/234 | | | Uranium-238 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Surface Composite | J19WF8 | 4/19/2010 | 1.08 | | 0.039 | 1.15 | | 0.116 | 0.817 | | 0.074 | 0.687 | | 0.060 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 1.10 | | 0.017 | 1.11 | | 0.051 | 0.747 | | 0.058 | 0.747 | | 0.040 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 1 | 1 | 1 | 1 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | No-Stop (acceptable) | No-Stop (acceptable) | No-Stop (acceptable) |
| | RPD | | | | |
| | Difference > 2 TDL? | No - acceptable | No - acceptable | No - acceptable | No - acceptable |

| Sampling Area | HEIS Number | Sample Date | Aluminum | | | Arsenic | | | Barium | | | Beryllium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite | J19WF8 | 4/19/2010 | 7970 | | 3.19 | 4.05 | | 0.639 | 71.0 | | 0.319 | 0.256 | | 0.128 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 8410 | | 3.56 | 4.31 | | 0.712 | 72.9 | | 0.356 | 0.272 | | 0.142 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 5 | 10 | 2 | 0.2 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) | No-Stop (acceptable) | Yes (calc RPD) | No-Stop (acceptable) |
| | RPD | 5.4% | | 2.6% | |
| | Difference > 2 TDL? | Not applicable | No - acceptable | Not applicable | No - acceptable |

| Sampling Area | HEIS Number | Sample Date | Boron | | | Cadmium | | | Calcium | | | Chromium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite | J19WF8 | 4/19/2010 | 1.50 | | 1.28 | 0.132 | | 0.128 | 4670 | | 63.9 | 28.3 | | 0.128 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 1.57 | | 1.42 | 0.136 | B | 0.142 | 4800 | | 71.2 | 30.0 | | 0.142 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 2 | 0.2 | 100 | 1 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | No-Stop (acceptable) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | | Yes (calc RPD) | Yes (calc RPD) |
| | RPD | | | 2.7% | 5.8% |
| | Difference > 2 TDL? | No - acceptable | No - acceptable | Not applicable | Not applicable |

**Note: Gray cells indicate not applicable.**

B = estimated result. Result is less than the RL but greater than the MDL.
D = analyte reported from a dilution
J = estimated result.
HEIS = Hanford Environmental Information System
MDA = minimum detectable activity
PQL = practical quantitation limit.
Q = qualifier
RPD = relative percent difference.
TDL = target detection limit

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | D. I. Rollosson | Date: | 1/12/2011 | Calc. No.: | 0100K-CA-V0076 | Rev.: | 0 |
| Project: | 100-K Area Remedial Action | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 1/12/2011 |
| Subject: | 100-K-78 RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. | 5 of 7 |

## Table 2. Relative Percent Difference Calculations for the 100-K-78 Waste Site. (4 Pages)

**100-K-78 Surface Sample Duplicate Analysis**

| Sampling Area | HEIS Number | Sample Date | Cobalt | | | Copper | | | Iron | | | Lead | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite | J19WF8 | 4/19/2010 | 6.11 | | 1.28 | 13.4 | | 0.639 | 17600 | | 12.8 | 6.11 | | 0.319 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 6.06 | | 1.42 | 13.6 | | 0.712 | 18000 | | 14.2 | 6.26 | | 0.356 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 2 | 1 | 5 | 5 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) | No-Stop (acceptable) |
| | RPD | | 1.5% | 2.2% | |
| | Difference > 2 TDL? | No - acceptable | Not applicable | Not applicable | No - acceptable |

| Sampling Area | HEIS Number | Sample Date | Magnesium | | | Manganese | | | Molybdenum | | | Nickel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite | J19WF8 | 4/19/2010 | 5270 | | 47.9 | 278 | | 3.19 | 0.415 | B | 1.28 | 14.1 | | 2.56 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 5510 | | 53.4 | 288 | | 3.56 | 0.452 | B | 1.42 | 14.8 | | 2.85 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 75 | 5 | 2 | 4 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | No-Stop (acceptable) | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) | Yes (calc RPD) | | No-Stop (acceptable) |
| | RPD | 4.5% | 3.5% | | |
| | Difference > 2 TDL? | Not applicable | Not applicable | No - acceptable | No - acceptable |

| Sampling Area | HEIS Number | Sample Date | Potassium | | | Silicon | | | Sodium | | | Vanadium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite | J19WF8 | 4/19/2010 | 1470 | | 256 | 510 | | 1.28 | 707 | | 31.9 | 42.1 | | 1.60 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 1520 | | 285 | 545 | | 1.42 | 654 | | 35.6 | 42.5 | | 1.78 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 400 | 2 | 50 | 2.5 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) | Yes (calc RPD) |
| | RPD | | 6.6% | 7.8% | 0.9% |
| | Difference > 2 TDL? | No - acceptable | Not applicable | Not applicable | Not applicable |

| Sampling Area | HEIS Number | Sample Date | Zinc | | |
|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL |
| Surface Composite | J19WF8 | 4/19/2010 | 45.9 | | 6.39 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 47.0 | | 7.12 |

**Analysis:**

| | | |
|---|---|---|
| TDL | | 1 |
| Duplicate Analysis | Both > PQL? | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) |
| | RPD | 2.4% |
| | Difference > 2 TDL? | Not applicable |

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | D. I. Rollosson | Date: | 1/12/2011 | Calc. No.: | 0100K-CA-V0076 | Rev.: | 0 |
| Project: | 100-K Area Remedial Action | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 1/12/2011 |
| Subject: | 100-K-78 RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 6 of 7 | |

## Table 2. Relative Percent Difference Calculations for the 100-K-78 Waste Site. (4 Pages)

**100-K-78 Test Pit Duplicate Analysis**

| Sampling Area | HEIS Number | Sample Date | Carbon-14 | | | Potassium-40 | | | Radium-226 | | | Radium-228 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 1.25 | J | 0.668 | 12.5 | | 0.429 | 0.379 | | 0.119 | 0.640 | | 0.256 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 1.45 | J | 0.671 | 11.8 | | 0.845 | 0.380 | | 0.172 | 0.626 | | 0.388 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 1 | 0.05 | 0.1 | 0.2 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | Yes (calc RPD) | No-Stop (acceptable) | No-Stop (acceptable) |
| | RPD | | 5.8% | | |
| | Difference > 2 TDL? | No - acceptable | Not applicable | No - acceptable | No - acceptable |

| Sampling Area | HEIS Number | Sample Date | Thorium-228 GEA | | | Thorium-232 GEA | | | Uranium-233/234 | | | Uranium-238 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 0.421 | | 0.087 | 0.640 | | 0.256 | 0.380 | | 0.207 | 0.271 | | 0.207 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 0.573 | | 0.091 | 0.626 | | 0.388 | 0.424 | | 0.250 | 0.555 | | 0.250 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 1 | 1 | 1 | 1 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | No-Stop (acceptable) | No-Stop (acceptable) | No-Stop (acceptable) |
| | RPD | | | | |
| | Difference > 2 TDL? | No - acceptable | No - acceptable | No - acceptable | No - acceptable |

| Sampling Area | HEIS Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 5760 | | 3.19 | 0.262 | BJ | 0.383 | 1.46 | | 0.638 | 46.4 | | 0.319 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 5750 | | 3.70 | 0.388 | BJ | 0.444 | 1.53 | | 0.741 | 51.7 | | 0.370 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 5 | 0.6 | 10 | 2 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | No-Stop (acceptable) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) | | No-Stop (acceptable) | Yes (calc RPD) |
| | RPD | 0.2% | | | 10.8% |
| | Difference > 2 TDL? | Not applicable | No - acceptable | No - acceptable | Not applicable |

| Sampling Area | HEIS Number | Sample Date | Beryllium | | | Boron | | | Cadmium | | | Calcium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 0.197 | | 0.128 | 0.379 | B | 1.28 | 0.0452 | B | 0.128 | 2320 | | 63.8 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 0.178 | | 0.148 | 0.409 | B | 1.48 | 0.0458 | B | 0.148 | 2360 | | 74.1 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 0.2 | 2 | 0.2 | 100 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | No-Stop (acceptable) | No-Stop (acceptable) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | | | Yes (calc RPD) |
| | RPD | | | | 1.7% |
| | Difference > 2 TDL? | No - acceptable | No - acceptable | No - acceptable | Not applicable |

| Sampling Area | HEIS Number | Sample Date | Chromium | | | Cobalt | | | Copper | | | Iron | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 11.0 | | 0.128 | 3.09 | | 1.28 | 12.3 | | 0.638 | 11100 | | 12.8 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 10.5 | | 0.148 | 3.06 | | 1.48 | 10.7 | | 0.741 | 11400 | | 14.8 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 1 | 2 | 1 | 5 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) |
| | RPD | 4.7% | | 13.9% | 2.7% |
| | Difference > 2 TDL? | Not applicable | No - acceptable | Not applicable | Not applicable |

**Note: Gray cells indicate not applicable.**

B = estimated result. Result is less than the RL but greater than the MDL.
D = analyte reported from a dilution
J = estimated result.
HEIS = Hanford Environmental Information System
PQL = practical quantitation limit.
Q = qualifier
RPD = relative percent difference.
TDL = target detection limit

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | D. I. Rollosson | Date: | 1/12/2011 | Calc. No.: | 0100K-CA-V0076 | Rev.: | 0 |
| Project: | 100-K Area Remedial Action | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 1/12/2011 |
| Subject: | 100-K-78 RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 7 of 7 | |

## Table 2. Relative Percent Difference Calculations for the 100-K-78 Waste Site. (4 Pages)

**100-K-78 Test Pit Duplicate Analysis**

| Sampling Area | HEIS Number | Sample Date | Lead | | | Magnesium | | | Manganese | | | Nickel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 2.70 | | 0.319 | 3490 | | 47.8 | 162 | | 3.19 | 8.37 | | 2.55 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 2.50 | | 0.370 | 3620 | | 55.5 | 149 | | 3.70 | 8.23 | | 2.96 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 5 | 75 | 5 | 4 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) | No-Stop (acceptable) |
| | RPD | | 3.7% | 8.4% | |
| | Difference > 2 TDL? | No - acceptable | Not applicable | Not applicable | No - acceptable |

| Sampling Area | HEIS Number | Sample Date | Potassium | | | Silicon | | | Sodium | | | Vanadium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 895 | J | 255 | 328 | J | 1.28 | 113 | | 31.9 | 22.9 | | 1.59 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 827 | J | 296 | 718 | J | 1.48 | 110 | | 37.0 | 23.4 | | 1.85 |

**Analysis:**

| | | | | | |
|---|---|---|---|---|---|
| TDL | | 400 | 2 | 50 | 2.5 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | Yes (calc RPD) | No-Stop (acceptable) | Yes (calc RPD) |
| | RPD | | 74.6% | | 2.2% |
| | Difference > 2 TDL? | No - acceptable | Not applicable | No - acceptable | Not applicable |

| Sampling Area | HEIS Number | Sample Date | Zinc | | |
|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 29.2 | | 6.38 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 25.1 | | 7.41 |

**Analysis:**

| | | |
|---|---|---|
| TDL | | 1 |
| Duplicate Analysis | Both > PQL? | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) |
| | RPD | 15.1% |
| | Difference > 2 TDL? | Not applicable |

## CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 100-K-78 waste site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2009a) and SAP (DOE-RL 2009b). The hazard quotients and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

**Attachment 1. 100-K-78 Confirmatory Sample Results (Radionuclides).**

| 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 |
| Surface Composite Sample | J19WF8 | 4/19/2010 | 0.197 | U | 0.197 | -0.252 | U | 6.09 | 0.315 | | 0.034 | 0.073 | | 0.030 | 0.270 | | 0.075 | 0.093 | U | 0.093 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 0.052 | U | 0.052 | -2.66 | U | 5.58 | 0.320 | | 0.015 | 0.059 | | 0.013 | 0.213 | | 0.030 | 0.034 | U | 0.034 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | 0.037 | U | 0.037 | -2.35 | U | 6.13 | 0.024 | U | 0.024 | 0.023 | U | 0.023 | 0.063 | U | 0.063 | 0.074 | U | 0.074 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 0.272 | U | 0.272 | 1.25 | J | 0.668 | 0.063 | U | 0.063 | 0.053 | U | 0.053 | 0.164 | U | 0.164 | 0.181 | U | 0.181 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 0.341 | U | 0.341 | 1.45 | J | 0.671 | 0.075 | U | 0.075 | 0.092 | U | 0.092 | 0.193 | U | 0.193 | 0.271 | U | 0.271 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | 0.102 | U | 0.102 | 1.66 | J | 0.728 | 0.024 | U | 0.024 | 0.032 | U | 0.032 | 0.068 | U | 0.068 | 0.104 | U | 0.104 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | 0.216 | U | 0.216 | 1.48 | J | 0.765 | 0.026 | U | 0.026 | 0.030 | U | 0.030 | 0.072 | U | 0.072 | 0.093 | U | 0.093 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | 0.037 | U | 0.037 | 1.32 | J | 0.646 | 0.024 | U | 0.024 | 0.026 | U | 0.026 | 0.056 | U | 0.056 | 0.081 | U | 0.081 |

| Sample Location | HEIS Number | Sample Date | Europium-155 | | | Gross Alpha | | | Gross Beta | | | Nickel-63 | | | Plutonium-238 | | | Plutonium-239/240 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Surface Composite Sample | J19WF8 | 4/19/2010 | 0.102 | U | 0.102 | 8.92 | | 6.31 | 21.5 | | 5.42 | 7.24 | | 3.12 | 0 | U | 0.232 | 0.024 | U | 0.185 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 0.055 | U | 0.055 | 10.7 | | 3.29 | 19.7 | | 5.16 | -1.25 | U | 3.13 | 0.015 | U | 0.075 | 0.004 | U | 0.042 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | 0.069 | U | 0.069 | 8.90 | | 2.75 | 20.2 | | 5.03 | 0.117 | U | 3.02 | 0.044 | U | 0.243 | -0.022 | U | 0.168 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 0.187 | U | 0.187 | | | | | | | 0.453 | U | 2.76 | 0.048 | U | 0.37 | 0 | U | 0.370 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 0.174 | U | 0.174 | | | | | | | 1.47 | U | 2.92 | 0.150 | U | 0.383 | 0.200 | U | 0.383 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | 0.079 | U | 0.079 | | | | | | | -0.833 | U | 3.39 | -0.034 | U | 0.257 | 0 | U | 0.257 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | 0.098 | U | 0.098 | | | | | | | 1.56 | U | 4.08 | 0 | U | 0.297 | 0.039 | U | 0.297 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | 0.063 | U | 0.063 | | | | | | | 0.566 | U | 2.59 | 0 | U | 0.384 | 0 | U | 0.384 |

| Sample Location | HEIS Number | Sample Date | Potassium-40 | | | Radium-226 | | | Radium-228 | | | Thorium-228 GEA | | | Thorium-232 GEA | | | Total beta radiostrontium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| Surface Composite Sample | J19WF8 | 4/19/2010 | 16.9 | | 0.278 | 0.722 | | 0.054 | 1.15 | | 0.116 | 1.08 | | 0.039 | 1.15 | | 0.116 | -0.044 | U | 0.248 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 12.5 | | 0.072 | 0.759 | | 0.023 | 1.11 | | 0.051 | 1.10 | | 0.017 | 1.11 | | 0.051 | 0.044 | U | 0.265 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | 15.9 | | 0.228 | 0.743 | | 0.045 | 1.10 | | 0.103 | 1.12 | | 0.029 | 1.10 | | 0.103 | -0.032 | U | 0.304 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 12.5 | | 0.429 | 0.379 | | 0.119 | 0.640 | | 0.256 | 0.421 | | 0.087 | 0.640 | | 0.256 | 0.007 | U | 0.246 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 11.8 | | 0.845 | 0.380 | | 0.172 | 0.626 | | 0.388 | 0.573 | | 0.091 | 0.626 | | 0.388 | 0.011 | U | 0.441 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | 14.0 | | 0.256 | 0.452 | | 0.056 | 0.689 | | 0.134 | 0.609 | | 0.031 | 0.689 | | 0.134 | -0.023 | U | 0.467 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | 14.6 | | 0.262 | 0.582 | | 0.055 | 0.905 | | 0.122 | 0.922 | | 0.033 | 0.905 | | 0.122 | 0.118 | U | 0.397 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | 13.4 | | 0.240 | 0.369 | | 0.040 | 0.692 | | 0.107 | 0.569 | | 0.028 | 0.692 | | 0.107 | -0.086 | U | 0.322 |

**Gray cells indicate not applicable.**

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

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

B = blank contamination (inorganic constituents)

HEIS = Hanford Environmental Information System

J = estimate

MDA = minimum detectable activity

PQL = practical quantitation limit

Q = qualifier

U = undetected

ft = feet

bgs = below ground surface

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 1 of 4 |
| Originator | D. I. Rollosson | Date | 1/11/11 |
| Checked | J. D. Skoglie | Date | 1/11/11 |
| Calc. No. | 0100K-CA-V0076 | Rev. No. | 0 |

Attachment 1. 100-K-78 Confirmatory Sample Results (Radionuclides).

| Sample Location | HEIS Number | Sample Date | Tritium | | | Uranium-233/234 | | | Uranium-235 | | | Uranium-235 GEA | | | Uranium-238 | | | Uranium-238 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 |
| Surface Composite Sample | J19WF8 | 1/1/1900 | 1.98 | U | 8.54 | 0.817 | | 0.074 | 0.041 | U | 0.062 | 0.181 | U | 0.181 | 0.687 | | 0.060 | 3.25 | U | 3.25 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | -3.56 | U | 7.95 | 0.747 | | 0.058 | 0.030 | U | 0.041 | 0.132 | U | 0.132 | 0.747 | | 0.040 | 1.24 | U | 1.24 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | -0.139 | U | 9.01 | 0.726 | | 0.061 | 0.048 | | 0.037 | 0.146 | U | 0.146 | 0.671 | | 0.044 | 2.79 | U | 2.79 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | -1.37 | UJ | 4.14 | 0.380 | | 0.207 | 0.033 | U | 0.251 | 0.524 | U | 0.524 | 0.271 | | 0.207 | 7.29 | U | 7.29 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | -1.15 | UJ | 3.98 | 0.424 | | 0.250 | 0 | U | 0.302 | 0.351 | U | 0.351 | 0.555 | | 0.250 | 12.0 | U | 12.0 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | -1.46 | UJ | 4.25 | 0.656 | | 0.209 | 0.066 | U | 0.253 | 0.160 | U | 0.160 | 0.684 | | 0.209 | 3.85 | U | 3.85 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | -1.53 | UJ | 3.96 | 0.819 | | 0.216 | 0.239 | U | 0.262 | 0.148 | U | 0.148 | 0.932 | | 0.216 | 3.36 | U | 3.36 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | -1.44 | UJ | 4.20 | 0.843 | | 0.201 | 0.032 | U | 0.244 | 0.144 | U | 0.144 | 0.632 | | 0.201 | 2.94 | U | 2.94 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 2 of 4 |
| Originator | D. I. Rollosson | Date | 1/11/11 |
| Checked | J. D. Skoglie | Date | 1/11/11 |
| Calc. No. | 0100K-CA-V0076 | Rev. No. | 0 |

## Attachment 1. 100-K-78 Confirmatory Sampling Results (Metals).

| Sample Location | HEIS Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite Sample | J19WF8 | 4/19/2010 | 7970 | | 3.19 | 0.383 | U | 0.383 | 4.05 | | 0.639 | 71.0 | | 0.319 | 0.256 | | 0.128 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 8410 | | 3.56 | 0.427 | U | 0.427 | 4.31 | | 0.712 | 72.9 | | 0.356 | 0.272 | | 0.142 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | 7600 | | 3.62 | 0.434 | U | 0.434 | 3.59 | | 0.724 | 75.2 | | 0.362 | 0.243 | | 0.145 |
| Surface Equipment Blank | J19WF6 | 4/19/2010 | 196 | | 4.10 | 0.492 | U | 0.492 | 0.820 | U | 0.820 | 5.13 | | 0.410 | 0.164 | U | 0.164 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 5760 | | 3.19 | 0.262 | BJ | 0.383 | 1.46 | | 0.638 | 46.4 | | 0.319 | 0.197 | | 0.128 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 5750 | | 3.70 | 0.388 | BJ | 0.444 | 1.53 | | 0.741 | 51.7 | | 0.370 | 0.178 | | 0.148 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | 7020 | | 4.31 | 0.518 | UJ | 0.518 | 2.17 | | 0.863 | 67.1 | | 0.431 | 0.234 | | 0.173 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | 10800 | | 4.20 | 0.334 | BJ | 0.504 | 4.33 | | 0.841 | 85.3 | | 0.420 | 0.357 | | 0.168 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | 7330 | | 3.90 | 0.391 | BJ | 0.468 | 2.15 | | 0.780 | 63.7 | | 0.390 | 0.213 | | 0.156 |
| Test Pit Equipment Blank | J1CN19 | 11/5/2010 | 168 | | 3.57 | 0.429 | UJ | 0.429 | 0.254 | B | 0.715 | 1.56 | | 0.357 | 0.0405 | B | 0.143 |

| Sample Location | HEIS Number | Sample Date | Boron | | | Cadmium | | | Calcium | | | Chromium | | | Cobalt | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite Sample | J19WF8 | 4/19/2010 | 1.50 | | 1.28 | 0.132 | | 0.128 | 4670 | | 63.9 | 28.3 | | 0.128 | 6.11 | | 1.28 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 1.57 | | 1.42 | 0.136 | B | 0.142 | 4800 | | 71.2 | 30.0 | | 0.142 | 6.06 | | 1.42 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | 1.53 | | 1.45 | 0.126 | B | 0.145 | 5480 | | 72.4 | 15.8 | | 0.145 | 4.98 | | 1.45 |
| Surface Equipment Blank | J19WF6 | 4/19/2010 | 1.64 | U | 1.64 | 0.164 | U | 0.164 | 54.4 | B | 82.0 | 0.239 | | 0.164 | 1.64 | U | 1.64 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 0.379 | B | 1.28 | 0.0452 | B | 0.128 | 2320 | | 63.8 | 11.0 | | 0.128 | 3.09 | | 1.28 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 0.409 | B | 1.48 | 0.0458 | B | 0.148 | 2360 | | 74.1 | 10.5 | | 0.148 | 3.06 | | 1.48 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | 0.484 | B | 1.73 | 0.0492 | B | 0.173 | 2620 | | 86.3 | 14.6 | | 0.173 | 3.44 | | 1.73 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | 0.683 | B | 1.68 | 0.0921 | B | 0.168 | 3370 | | 84.1 | 27.2 | | 0.168 | 4.91 | | 1.68 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | 0.540 | B | 1.56 | 0.0577 | B | 0.156 | 2860 | | 78.0 | 13.9 | | 0.156 | 2.99 | | 1.56 |
| Test Pit Equipment Blank | J1CN19 | 11/5/2010 | 1.43 | U | 1.43 | 0.143 | U | 0.143 | 34.7 | BJ | 71.5 | 0.143 | U | 0.143 | 1.43 | U | 1.43 |

| Sample Location | HEIS Number | Sample Date | Copper | | | Hexavalent Chromium | | | Iron | | | Lead | | | Magnesium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite Sample | J19WF8 | 4/19/2010 | 13.4 | | 0.639 | 0.20 | U | 0.20 | 17600 | | 12.8 | 6.11 | | 0.319 | 5270 | | 47.9 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 13.6 | | 0.712 | 0.20 | U | 0.20 | 18000 | | 14.2 | 6.26 | | 0.356 | 5510 | | 53.4 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | 11.6 | | 0.724 | 0.20 | U | 0.20 | 15100 | | 14.5 | 6.38 | | 0.362 | 5250 | | 54.3 |
| Surface Equipment Blank | J19WF6 | 4/19/2010 | 0.820 | U | 0.820 | | | | 228 | | 16.4 | 0.447 | | 0.410 | 30.3 | B | 61.5 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 12.3 | | 0.638 | 0.51 | U | 0.51 | 11100 | | 12.8 | 2.70 | | 0.319 | 3490 | | 47.8 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 10.7 | | 0.741 | 0.51 | U | 0.51 | 11400 | | 14.8 | 2.50 | | 0.370 | 3620 | | 55.5 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | 13.2 | | 0.863 | 0.51 | U | 0.51 | 13300 | | 17.3 | 3.63 | | 0.431 | 4190 | | 64.7 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | 19.5 | | 0.841 | 0.51 | U | 0.51 | 19600 | | 16.8 | 4.68 | | 0.420 | 5080 | | 63.1 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | 12.1 | | 0.780 | 0.51 | U | 0.51 | 13400 | | 15.6 | 2.70 | | 0.390 | 3970 | | 58.5 |
| Test Pit Equipment Blank | J1CN19 | 11/5/2010 | 0.715 | U | 0.715 | 0.50 | U | 0.50 | 225 | | 14.3 | 0.458 | | 0.357 | 19.1 | B | 53.6 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 3 of 4 |
| Originator | D. I. Rollosson | Date | 1/12/11 |
| Checked | J. D. Skoglie | Date | 1/12/11 |
| Calc. No. | 0100K-CA-V0076 | Rev. No. | 0 |

## Attachment 1. 100-K-78 Confirmatory Sampling Results (Metals).

| Sample Location | HEIS Number | Sample Date | Manganese | | | Mercury | | | Molybdenum | | | Nickel | | | Potassium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite Sample | J19WF8 | 4/19/2010 | 278 | | 3.19 | 0.0252 | U | 0.0252 | 0.415 | B | 1.28 | 14.1 | | 2.56 | 1470 | | 256 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 288 | | 3.56 | 0.0268 | U | 0.0268 | 0.452 | B | 1.42 | 14.8 | | 2.85 | 1520 | | 285 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | 242 | | 3.62 | 0.0247 | U | 0.0247 | 0.306 | B | 1.45 | 13.9 | | 2.90 | 1140 | | 290 |
| Surface Equipment Blank | J19WF6 | 4/19/2010 | 4.99 | | 4.10 | 0.0257 | U | 0.0257 | 1.64 | U | 1.64 | 3.28 | U | 3.28 | 45.0 | B | 328 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 162 | | 3.19 | 0.0296 | U | 0.0296 | 1.28 | U | 1.28 | 8.37 | | 2.55 | 895 | J | 255 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 149 | | 3.70 | 0.0230 | U | 0.0230 | 1.48 | U | 1.48 | 8.23 | | 2.96 | 827 | J | 296 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | 182 | | 4.31 | 0.0296 | U | 0.0296 | 1.73 | U | 1.73 | 9.65 | | 3.45 | 996 | J | 345 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | 208 | | 4.20 | 0.0288 | U | 0.0288 | 0.252 | B | 1.68 | 14.1 | | 3.36 | 904 | J | 336 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | 184 | | 3.90 | 0.0277 | U | 0.0277 | 0.162 | B | 1.56 | 7.77 | | 3.12 | 1140 | J | 312 |
| Test Pit Equipment Blank | J1CN19 | 11/5/2010 | 4.89 | | 3.57 | 0.0265 | U | 0.0265 | 1.43 | U | 1.43 | 2.86 | U | 2.86 | 59.3 | BJ | 286 |

| Sample Location | HEIS Number | Sample Date | Selenium | | | Silicon | | | Silver | | | Sodium | | | Vanadium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Surface Composite Sample | J19WF8 | 4/19/2010 | 0.192 | U | 0.192 | 510 | | 1.28 | 0.128 | U | 0.128 | 707 | | 31.9 | 42.1 | | 1.60 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 0.214 | U | 0.214 | 545 | | 1.42 | 0.142 | U | 0.142 | 654 | | 35.6 | 42.5 | | 1.78 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | 0.217 | U | 0.217 | 565 | | 1.45 | 0.145 | U | 0.145 | 335 | | 36.2 | 31.6 | | 1.81 |
| Surface Equipment Blank | J19WF6 | 4/19/2010 | 0.246 | U | 0.246 | 200 | | 1.64 | 0.164 | U | 0.164 | 41.0 | U | 41.0 | 0.294 | B | 2.05 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 0.191 | U | 0.191 | 328 | J | 1.28 | 0.128 | U | 0.128 | 113 | | 31.9 | 22.9 | | 1.59 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 0.222 | U | 0.222 | 718 | J | 1.48 | 0.148 | U | 0.148 | 110 | | 37.0 | 23.4 | | 1.85 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | 0.259 | U | 0.259 | 393 | J | 1.73 | 0.173 | U | 0.173 | 125 | | 43.1 | 28.2 | | 2.16 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | 0.252 | U | 0.252 | 833 | J | 1.68 | 0.168 | U | 0.168 | 178 | | 42.0 | 42.9 | | 2.10 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | 0.234 | U | 0.234 | 844 | J | 1.56 | 0.156 | U | 0.156 | 160 | | 39.0 | 29.8 | | 1.95 |
| Test Pit Equipment Blank | J1CN19 | 11/5/2010 | 0.214 | U | 0.214 | 132 | J | 1.43 | 0.143 | U | 0.143 | 9.96 | BJ | 35.7 | 0.316 | B | 1.79 |

| Sample Location | HEIS Number | Sample Date | Zinc | | |
|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL |
| Surface Composite Sample | J19WF8 | 4/19/2010 | 45.9 | | 6.39 |
| Duplicate of J19WF8 | J19WF9 | 4/19/2010 | 47.0 | | 7.12 |
| Surface Focused Sample | J19WF7 | 4/19/2010 | 43.3 | | 7.24 |
| Surface Equipment Blank | J19WF6 | 4/19/2010 | 0.896 | B | 8.20 |
| Test Pit 10 ft bgs | J1CDR5 | 11/5/2010 | 29.2 | | 6.38 |
| Duplicate of J1CDR5 | J1CDR6 | 11/5/2010 | 25.1 | | 7.41 |
| Test Pit 7 ft bgs | J1CDR4 | 11/5/2010 | 31.0 | | 8.63 |
| Test Pit 2 ft bgs | J1CN20 | 11/5/2010 | 36.9 | | 8.41 |
| Test Pit 5 ft bgs | J1CN21 | 11/5/2010 | 32.8 | | 7.80 |
| Test Pit Equipment Blank | J1CN19 | 11/5/2010 | 0.810 | B | 7.15 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 4 of 4 |
| Originator | D. I. Rollosson | Date | 1/12/11 |
| Checked | J. D. Skoglie | Date | 1/12/11 |
| Calc. No. | 0100K-CA-V0076 | Rev. No. | 0 |

# APPENDIX D

# DATA QUALITY ASSESSMENT

# APPENDIX D

# DATA QUALITY ASSESSMENT

## CONFIRMATORY SAMPLING

A data quality assessment (DQA) was performed to compare the confirmatory sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2010c). This DQA was performed in accordance with site specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009).

A review of the sample design (WCH 2010c), the field logbooks (WCH 2010a, 2010b), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. To ensure quality data, the SAP data assurance requirements and the data validation procedure for chemical and radiochemical analysis (BHI 2000a, 2000b) 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).

Sample data collected at the 100-K-78 waste site were provided by the laboratories in two sample delivery groups (SDGs): SDG K2489 and K2027. SDG K2489 was submitted for third-party validation. Samples in the 100-K-78 data set were analyzed using U.S. Environmental Protection Agency (EPA) method 6010 (inductively coupled plasma [ICP] metals), EPA method 7471 (cold vapor atomic absorption [mercury]), EPA method 7196 (hexavalent chromium), alpha energy analysis (AEA) (isotopic plutonium, uranium, and americium), gamma energy analysis (GEA) (gamma-emitting radionuclides), total strontium, and liquid scintillation (carbon-14 and tritium). The ICP metals include antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

No major deficiencies were found in any of the SDGs. Minor deficiencies are discussed by SDG as follows below. If no comments are made about a specific analysis it should be assumed that no deficiencies in the quality of the data were found. Unless otherwise noted, deficiencies listed below are specific to the individual SDG but apply to all samples within that SDG.

### Minor Deficiencies

### SDG K2489

SDG K2489 comprises six soil samples (J1CDR4 through J1CDR6 and J1CN19 through J1CN21) from the test pit at the 100-K-78 waste site. Sample J1CDR6 is the field duplicate of sample J1CDR5. Sample J1CN19 is the equipment blank. SDG K2489 was submitted for formal third-party validation. Minor deficiencies are as follows:

In the liquid scintillation analyses, matrix spikes were not performed for carbon-14 or tritium. Third-party validation has qualified all carbon-14 and tritium results in SDG K2489 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, calcium and sodium were detected in the method blank. Third-party validation has qualified the calcium and sodium results in SDG K2489 as estimated with "UJ" flags. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries for four analytes were out of project acceptance criteria (70% to 130%). For all of the analytes with MS recoveries outside the acceptance criteria, except antimony, the initial matrix spike concentrations were not significantly large when compared to the native concentration in the sample. Therefore, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. The original MS recoveries for antimony (39%) cannot be attributed to insufficient spike amounts. Third-party validation has qualified the antimony results in SDG K2489 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the laboratory control standard (LCS) recovery was below project control limits (70% to 130%) for silicon (68%). Third-party validation qualified all silicon results in SDG K2489 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the relative percent difference (RPD) calculated using the laboratory duplicate, for potassium and silicon, were above the acceptable range (0% to 30%) at 33% and 32%, respectively. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix rather than to analytical variability in the sample extraction or analysis process. Third-party validation qualified all potassium and silicon results in SDG K2489 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

**SDG K2027**

This SDG comprises three surface soil samples (J19WF7 through J19WF9) from the 100-K-78 waste site. Sample J19WF9 is the field duplicate of sample J19WF8. Minor deficiencies are as follows:

In the liquid scintillation analyses, matrix spikes were not performed for carbon-14 or tritium. The carbon-14 and tritium results in SDG K2027 may be considered estimated. Estimated data are useable for decision-making purposes.

In the anion analysis, the LCS for insoluble hexavalent chromium (124%) was above the laboratory established control limits (80% to 120%). The hexavalent chromium results in SDG K2027 may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for three analytes were out of project acceptance criteria (70-130%). For all of the analytes with MS recoveries outside the acceptance criteria, except antimony, the initial matrix spike concentrations were not significantly large when compared to the native concentration in the sample. Therefore, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. The original MS recoveries for antimony (40%) cannot be attributed to insufficient spike amounts. The antimony results in SDG K2027 may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the LCS recovery was below project control limits (70% to 130%) for silicon (68%). All silicon results in SDG K2027 may be considered estimated. Estimated data are useable 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/quality control (QA/QC) measures are used to assess potential sources of error and cross contamination of samples that could bias results. Two sets of field QA/QC samples (main sample and duplicate) were collected, as documented in the field logbook (WCH 2010a, 2010b). Sample J19WF8 is the main sample, and J19WF9 is the field duplicate for the surface composite sample. Sample J1CDR5 is the main sample, and J1CDR6 is the field duplicate for the test pit sample.

The RPDs for the main and field duplicate samples have been calculated and are presented in Appendix C. The entire sample data set including the duplicate sample data are presented as an attachment to the RPD calculation.

Field duplicate samples 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 concern. No major deficiencies in the RPD calculations were found for the duplicate samples.

The only minor deficiency was in the field duplicate evaluation for the test pit. The RPD calculated for silicon (74.6%) is above the field duplicate acceptance criteria (less than 30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The data are useable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the target detection limit (TDL), including undetected analytes. In these cases, a control limit of $\pm$ 2 times the TDL is used (Appendix B) to indicate that a visual check of the data is required by the review. This case did not apply to any

of the sample results. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are useable 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-K-78 confirmatory 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 the 100-K-78 waste site concludes that the reviewed 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 QA and QC deficiencies. The analytical data were found acceptable for decision-making purposes. The confirmatory 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 confirmatory sample analytical data are also summarized in Appendix B.

## REFERENCES

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