WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2014-065

Waste Site Code(s)/Subsite Code(s): 100-N-97

Reclassification Category: Interim ☒ Final ☐

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

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-N-97, 100-N Oil Filters #2 waste site, part of the 100-NR-1 Operable Unit, was added to the *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (100-N Area ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999), as a remove, treat, and dispose (RTD) site by the *Explanation of Significant Differences for the 100-NR-1 and 100-NR-2 Operable Units Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2011).

The 100-N-97 waste site was a dumping area that consisted of three oil filters and the underlying soil. The waste site was located approximately 56 m (184 ft) west of the southwest corner of the 100-D perimeter road.

Remedial action at the 100-N-97 waste site began on November 12, 2013, and continued through January 8, 2014. The remediation extended approximately 0.61 m (2 ft) below ground surface resulting in approximately 1.3 bank cubic meters (1.7 bank cubic yards) of soil and debris being removed and disposed at the Environmental Restoration Disposal Facility (ERDF). No overburden pile or waste staging pile area was created. No anomalous material was encountered during the waste site remediation. Verification soil sampling was performed on March 27, 2014.

Cleanup verification sampling was conducted to determine if the waste site met the remedial action objectives (RAOs) and remedial action goals (RAGs) established by the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (100-N Area RDR/RAWP), DOE/RL-2005-93, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2013), and the 100-N Area ROD (EPA 1999). The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at ERDF, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification of Interim Closed Out.

Basis for reclassification:

The verification sampling results for the 100-N-97 waste site demonstrate that the site meets the RAOs and corresponding RAGs established in the 100-N Area RDR/RAWP (DOE-RL 2013) and the 100-N Area ROD (EPA 1999) and support a reclassification to Interim Closed Out. These sampling results established that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Residual contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-N-97, 100-N Oil Filters #2* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2014-065

Waste Site Code(s)/Subsite Code(s): 100-N-97

Regulator comments:

Waste Site Controls:

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

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

Name (printed)	Signature	Date
J. P. Neath DOE Federal Project Director (printed)	[signature] Signature	7/21/14 Date
N. Menard KIM WELSCH FOR Ecology Project Manager (printed)	[signature] Signature	7/23/14 Date
N/A EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-97, 100-N OIL FILTERS #2

Attachment to Waste Site Reclassification Form 2014-065

August 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-97, 100-N OIL FILTERS #2

EXECUTIVE SUMMARY

The 100-N-97, 100-N Oil Filters #2 waste site, part of the 100-NR-1 Operable Unit, was a dumping area consisting of used oil filters and the underlying soil. The 100-N-97 waste site was added to the *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (100-N Area ROD) (EPA 1999) as a remove, treat, and dispose (RTD) site by the *Explanation of Significant Differences for the 100-NR-1 and 100-NR-2 Operable Units Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2011).

Remedial action at the 100-N-97 waste site began on November 12, 2013, and continued through January 8, 2014. The excavation extended to approximately 0.61 m (2 ft) below ground surface resulting in approximately 1.3 bank cubic meters (1.7 bank cubic yards) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). Because the waste site was located in a culturally sensitive area, it was remediated by hand digging and placing the material into plastic bags for disposal. The plastic bags were hand carried to the nearest access road to be disposed in an ERDF container. The debris consisted of oil filters. All material was direct loaded from the waste site; therefore, no waste staging pile area was created. Additionally, there is no overburden soil pile associated with the waste site. No anomalous material was observed during remediation, and all visibly stained soil was removed.

Following remediation, verification soil sampling was conducted on March 27, 2014. A summary of the cleanup evaluation for the soil sampling results against the applicable remedial action goals (RAGs) is presented in Table ES-1. The results of the verification sampling were used to make reclassification decisions for the 100-N-97 waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (DOE-RL 2013) and the 100-N Area ROD (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The sampling results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft] deep), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Residual contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required.

Table ES-1. Summary of Remedial Action Goals for the 100-N-97 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain a dose rate of <15 mrem/yr above background over 1,000 years.	Radionuclides were not COPCs for the 100-N-97 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual direct exposure COPC RAGs.	All individual COPC concentrations are below the direct exposure RAGs.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The hazard quotient for individual nonradionuclide COPCs is <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for the 100-N-97 waste site (1.3×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk value for benzo(a)pyrene, the only contaminant subject to the excess cancer risk evaluation, is 1.9×10^{-7}, which is $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The excess cancer risk value for benzo(a)pyrene, the only contaminant subject to the excess cancer risk evaluation, is 1.9×10^{-7},which is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 100-N-97 waste site.	NA
	Attain National Primary Drinking Water Regulations [a]: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ.		
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [b].		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].		

Table ES-1. Summary of Remedial Action Goals for the 100-N-97 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	With the exception of benzo(a)pyrene, all individual COPC concentrations are below the groundwater and Columbia River cleanup requirements. Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), it is predicted that the residual concentration of benzo(a)pyrene will not migrate through the soil and reach groundwater (and thus the Columbia River) within 1,000 years based on the soil-partitioning coefficient of benzo(a)pyrene of 969 mL/g.	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).

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

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the 100-N Area ROD, a comparison against ecological risk screening levels has been made for the 100-N-97 waste site contaminants of potential concern and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* 173-340 were exceeded for barium, boron, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for manganese and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the concentrations of manganese and vanadium are below the Hanford Site background values, it is believed that the presence of these constituents do not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-97, 100-N OIL FILTERS #2

STATEMENT OF PROTECTIVENESS

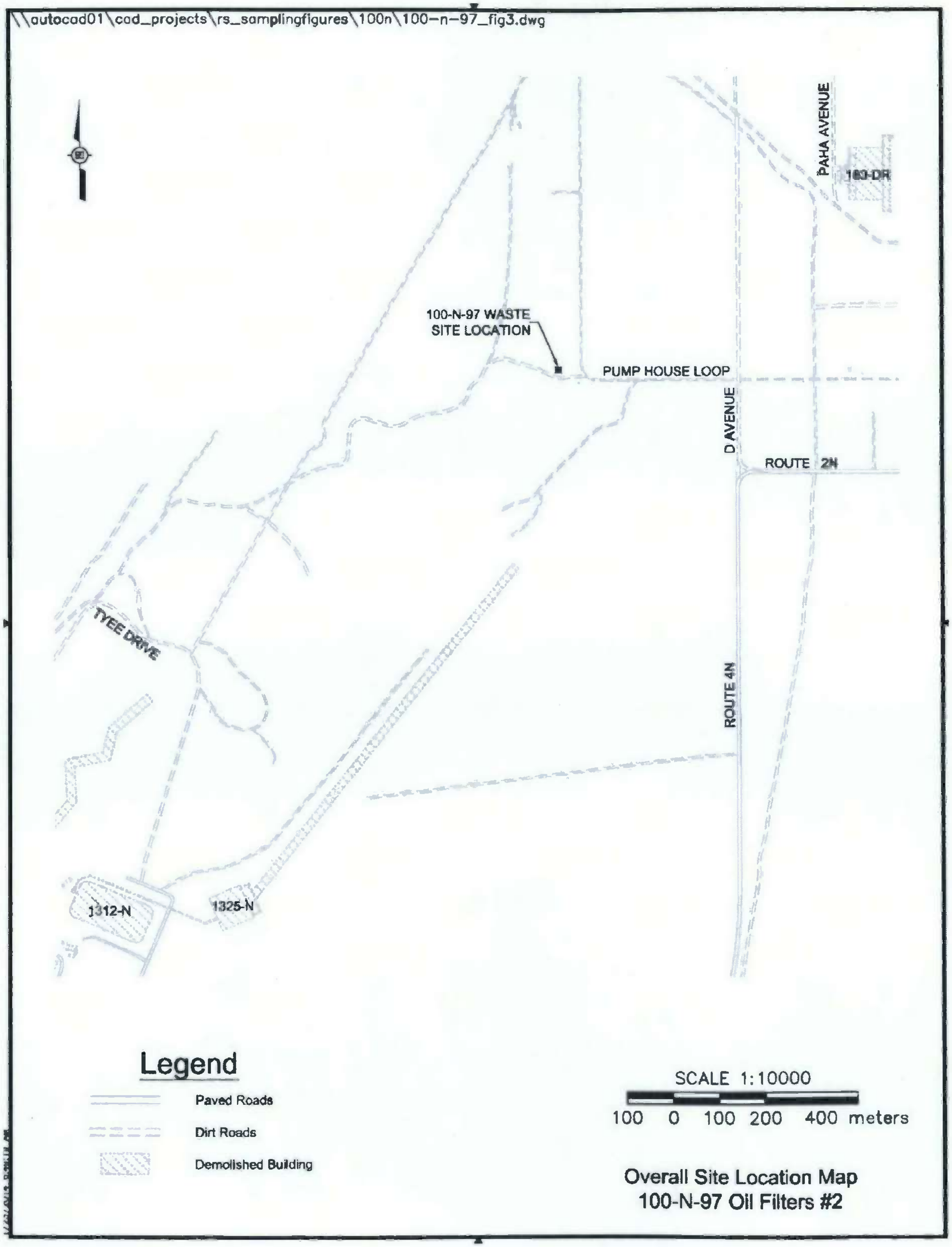
The 100-N-97 waste site cleanup verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (100-N Area RDR/RAWP) (DOE-RL 2013) and the *Interim Action Record of Decision for the 100-NR-1 and 100-NR-2 Operable Units, Hanford Site, Benton County, Washington* (100-N Area ROD) (EPA 1999). The results of verification sampling show that residual soil concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Residual contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required.

Soil cleanup levels were established in the 100-N Area ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the 100-N Area ROD, a comparison against ecological risk screening levels has been made for the 100-N-97 waste site contaminants of potential concern (COPCs) and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340 were exceeded for barium, boron, and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for manganese and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the concentrations of manganese and vanadium are below the Hanford Site background values, it is believed that the presence of these constituents do not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-N-97 waste site, part of the 100-NR-1 Operable Unit, was a dumping area consisting of oil filters and the underlying soil. The waste site was located approximately 56 m (184 ft) west of the southwest corner of the 100-D perimeter road (Figure 1).

Figure 1. 100-N-97 Waste Site Location Map.



CONFIRMATORY SAMPLING

Based on the area being devoid of vegetation and the presence of oil filters and stained soil (Figures 2 and 3), the site was believed to contain hazardous constituents at levels exceeding the remedial action goals (RAGs). Therefore, the 100-N-97 waste site was recommended for remedial action without confirmatory sampling (WCH 2010).

Figure 2. Photograph 1 of the 100-N-97 Waste Site (May 19, 2010).

Figure 3. Photograph 2 of the 100-N-97 Waste Site (May 19, 2010).

REMEDIAL ACTION SUMMARY

A waste characterization sample was collected on April 22, 2013, prior to the start of remediation. The sample summary and data are presented in Appendix B.

Waste site remediation began on November 12, 2013, and continued through January 8, 2014. Because the waste site was located in a culturally sensitive area, it was remediated by hand digging and placing the material into plastic bags for disposal. The plastic bags were hand carried to the nearest access road to be disposed in an Environmental Restoration Disposal Facility (ERDF) container.

Two in-process soil samples were collected on November 13, 2013, and analyzed for the site COPCs to determine if remedial action activities were complete and if the site was ready for verification sampling. Total petroleum hydrocarbons (TPH) exceeded the RAG in both samples collected; therefore, remediation continued to remove the residual contaminated soil. On January 8, 2014, two additional in-process soil samples were collected from the same locations as the previous in-process samples to determine if the residual contaminated soil had been removed. The samples were analyzed for TPH only. The results, provided in Appendix B, indicated that the contaminated soil had been removed; therefore, remediation was determined to be complete on January 8, 2014. The remediation extended approximately 0.61 m (2 ft) below ground surface, resulting in approximately 1.3 bank cubic meters (1.7 bank cubic yards) of soil and debris being removed and disposed at ERDF. No anomalous material was encountered during the remediation of the site. All visibly stained soil was removed. Photographs of the waste site following site remediation are provided in Figures 4 and 5.

Figure 4. Photograph of the Hand-Dug Remediated 100-N-97 Waste Site (November 12, 2013).

Figure 5. Photograph of the 100-N-97 Waste Site After Remediation (November 12, 2013).

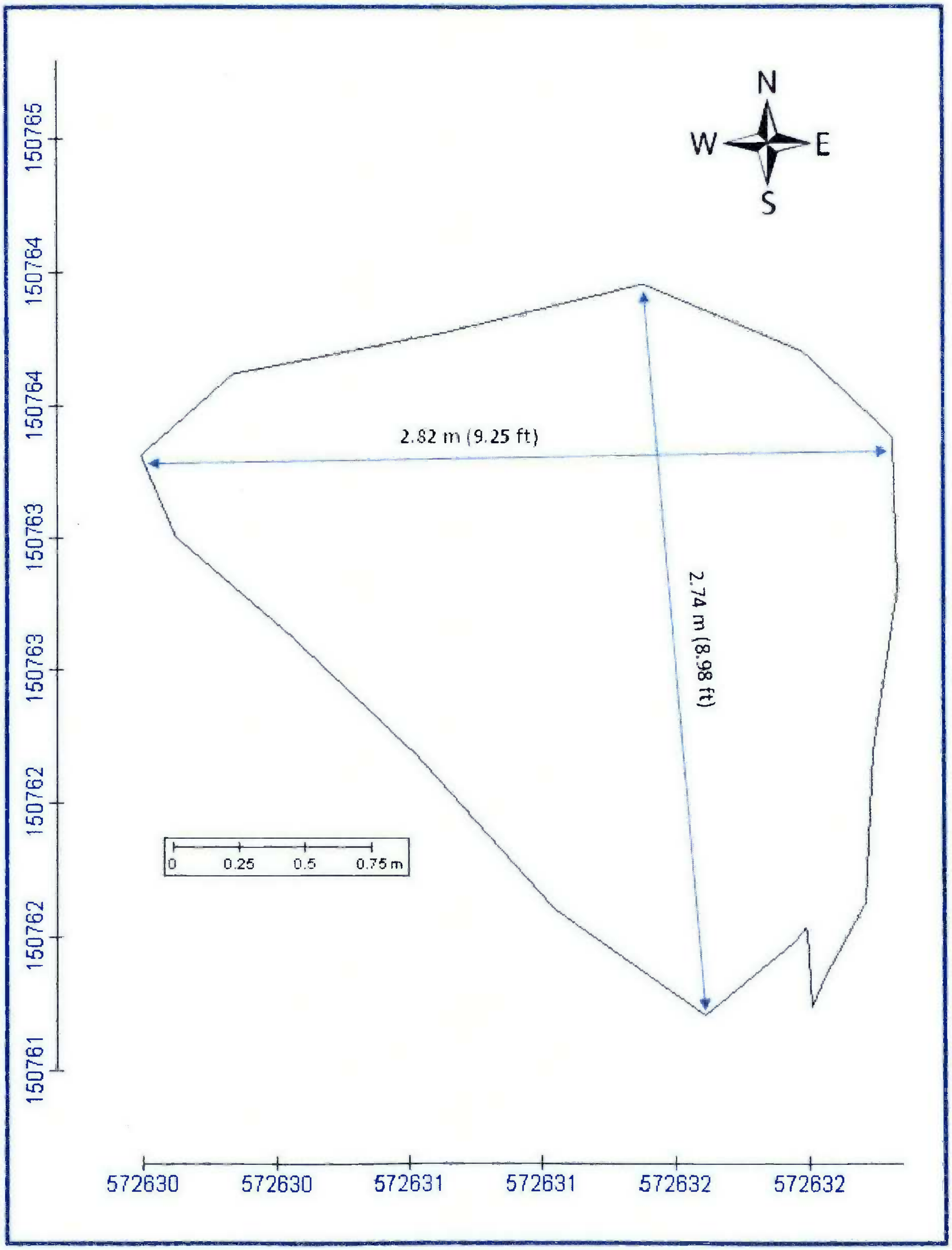
A post-remediation walkaround boundary survey was conducted following remedial action activities. The post-remediation survey is provided in Figure 6.

VERIFICATION SAMPLING ACTIVITIES

Verification soil sampling was conducted on March 27, 2014, per the *Work Instruction for Verification Sampling of the 100-N-97, 100-N Oil Filters #2* (WCH 2014b). Sampling was conducted to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the 100-N Area RDR/RAWP (DOE-RL 2013) and 100-N Area ROD (EPA 1999).

The verification sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) and RAGs for the 100-N-97 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site.

Figure 6. 100-N-97 Post-Remediation Walkaround Boundary Survey.



Contaminants of Potential Concern

The 100-N-97 waste site is not listed in the *100-N Area Sampling and Analysis Plan for CERCLA Waste Sites* (DOE-RL 2006); therefore, the COPCs were identified based on the visual observations of debris at the waste site.

The expanded inductively coupled plasma (ICP) metals list (including antimony, arsenic, barium, beryllium, boron, total chromium, cobalt, copper, manganese, magnesium, molybdenum, nickel, selenium, silver, vanadium, and zinc), mercury, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs), and TPH were identified as site COPCs.

The analytical methods that were performed to evaluate the site COPCs are provided in Table 1.

Table 1. Laboratory Analytical Methods for the 100-N-97 Waste Site.

Analytical Method	Contaminants of Potential Concern
ICP metals [a] – EPA Method 6010	Metals
Mercury – EPA Method 7471	Mercury
PAH – EPA Method 8310	Polycyclic aromatic hydrocarbons
PCBs – EPA Method 8082	Polychlorinated biphenyls
TPH – NWTPH-Dx	Total petroleum hydrocarbons

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

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

Verification Sample Design

A focused sample design was used for verification sampling at the 100-N-97 waste site. The waste site was divided in half, and one discrete grab soil sample was collected from the approximate center of each half. Additionally, one duplicate and one split sample were collected.

All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100-N Area Sampling and Analysis Plan for CERCLA Waste Sites* (DOE-RL 2006). Additional information related to verification sampling can be found in the field sampling logbook (WCH 2014a). The verification sample summary is provided in Table 2. Figure 7 shows the overall waste site footprint and the sampling locations.

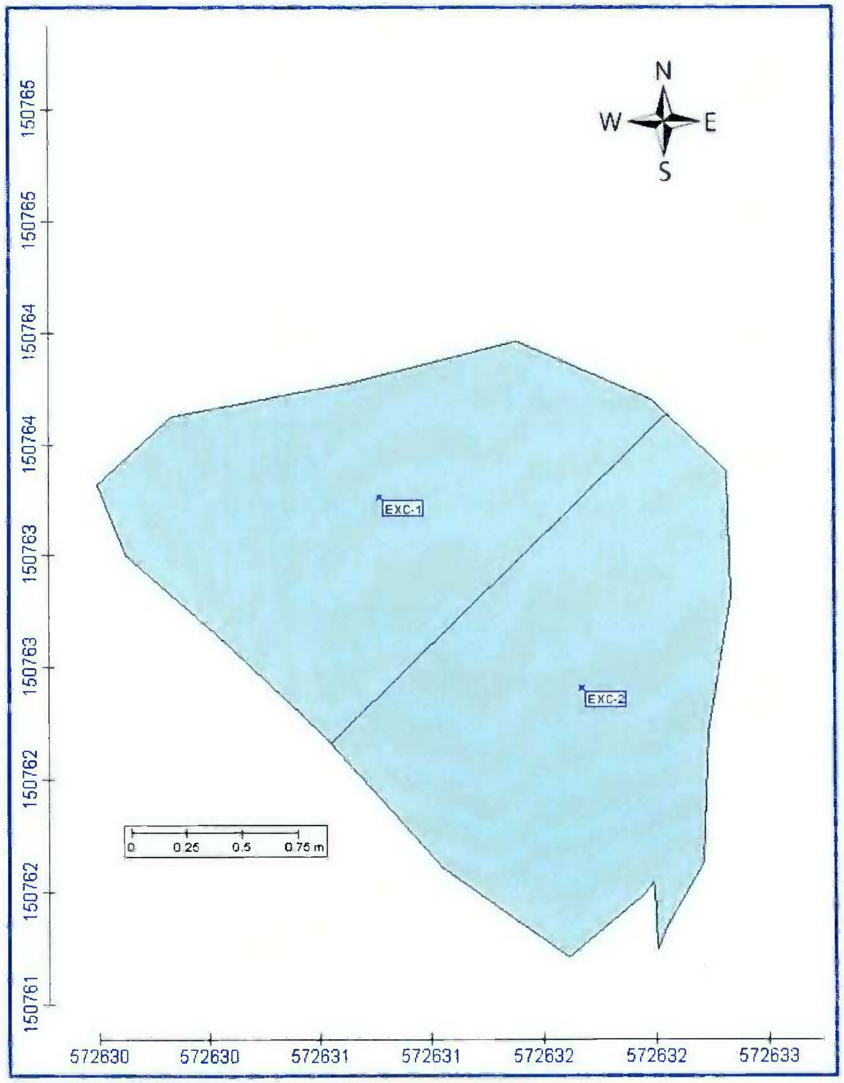
Table 2. 100-N-97 Waste Site Verification Sample Summary Table.

Sample Location	HEIS Sample Number	Washington State Plane		Sample Analysis
		Northing (m)	Easting (m)	
EXC-1	J1THF0	150763.3	572630.8	ICP metals[a], mercury, PAH, PCB, TPH
EXC-2	J1THF1	150762.4	572631.7	
Duplicate of EXC-1	J1THF2	150763.3	572630.8	
Split of EXC-1	J1THF4	150763.3	572630.8	
Equipment blank	J1THF3	NA	NA	ICP metals[a], mercury

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

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

Figure 7. 100-N-97 Waste Site Verification Sample Locations.



Verification Sample Results

All verification samples were analyzed using EPA-approved analytical methods. Evaluation of the verification data from the 100-N-97 waste site was performed by direct comparison of the maximum sample results for each COPC against the cleanup criteria.

Comparisons of the results for each COPC from the 100-N-97 waste site against the RAGs are summarized in Table 3. Contaminants that were not detected by laboratory analysis are excluded from the table. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2014) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in the table. The complete laboratory results for all constituents are stored in a Washington Closure Hanford (WCH) project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are presented in Attachment 1 of the *100-N-97 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation* (Appendix C).

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-N-97 waste site achieve the applicable RAGs developed to support unrestricted land use at the 100 Area as established in the 100-N Area ROD (EPA 1999) and documented in the 100-N Area RDR/RAWP (DOE-RL 2013).

Attainment of Nonradionuclide RAGS

Table 3 compares the cleanup verification sample values for the 100-N-97 waste site excavation to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River. All COPCs were quantified below direct exposure, groundwater, and river protection soil RAGs.

Table 3. Comparison of Contaminant Concentrations to Action Levels for the 100-N-97 Verification Samples. (2 Pages)

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	3.0 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	198	16,000 [d]	200	400	No	--
Beryllium	0.44 (<BG)	10.4 [e]	1.51 [c]	1.51 [c]	No	--
Boron [f]	1.3	16,000 [d]	320	-- [g]	No	--

Table 3. Comparison of Contaminant Concentrations to Action Levels for the 100-N-97 Verification Samples. (2 Pages)

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Cadmium [h]	0.080 (<BG)	13.9 [e]	0.81 [c]	0.81 [c]	No	--
Chromium	7.7 (<BG)	120,000 [d]	18.5 [c]	18.5 [c]	No	--
Cobalt	8.2 (<BG)	1,600 [d]	32	-- [g]	No	--
Copper	17.6 (<BG)	2,960 [d]	59.2	22.0 [c]	No	--
Lead	3.8 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	287 (<BG)	11,200 [d]	512 [c]	-- [g]	No	--
Molybdenum [f]	0.24	400 [d]	8	-- [g]	No	--
Nickel	9.5 (<BG)	1,600 [d]	19.1 [c]	27.4	No	--
Vanadium	51.1 (<BG)	560 [d]	85.1 [c]	-- [g]	No	--
Zinc	42.2 (<BG)	24,000 [d]	480	67.8 [c]	No	--
Benzo(a)pyrene [i]	0.026	0.137	0.015 [j]	0.015 [j]	Yes	Yes [k]
TPH – diesel	79	--	200	200	No	--
TPH – diesel extended	130	--	200	200	No	--

[a] RAGs obtained from the 100-N Area RDR/RAWP (DOE-RL 2013), or the 100 Area RDR/RAWP (DOE-RL 2009) where indicated.

[b] Maximum results as described in the *100-N-97 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation*.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the 100-N Area RDR/RAWP (DOE-RL 2013).

[d] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B (Ecology 1996).

[e] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], Ecology 1996).

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

[g] No parameters (bioconcentration factors or ambient water quality criteria values) are available from the Washington State Department of Ecology Cleanup Levels and Risk Calculations database or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).

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

[i] Remedial action goals obtained from the 100 Area RDR/RAWP (DOE-RL 2009).

[j] Where cleanup levels are less than the RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996). The cited RDLs are based on EPA-approved analytical methods that may not be available for rapid turnaround analyses.

[k] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), the residual concentration of benzo(a)pyrene is not predicted to migrate vertically within 1,000 years (based on the soil-partitioning coefficient of benzo(a)pyrene of 969 mL/g). A contaminant with a soil-partitioning coefficient of 80 mL/g or greater is not predicted to migrate vertically through the soil. Therefore, the residual concentration of benzo(a)pyrene is predicted to be protective of groundwater and the Columbia River.

-- = not applicable
BG = background
COPC = contaminant of potential concern
EPA = U.S. Environmental Protection Agency
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Three-Part Test for Nonradionuclides

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. Because there were no statistical verification samples for the 100-N-97 waste site, this test is not applicable.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1 x 10^{-6}, and a cumulative carcinogenic risk of less than 1 x 10^{-5}. For the 100-N-97 waste site, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background. All individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detected levels is 1.3 x 10^{-2}, which is less than 1.0. The carcinogenic risk value for benzo(a)pyrene, the only contaminant subject to the excess cancer risk evaluation, is 1.9 x 10^{-7}, which is less than 1 x 10^{-5}. The 100-N-97 waste site meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the 100-N Area RDR/RAWP (DOE-RL 2013).

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-N-97 waste site included a calculation of the hazard quotient and carcinogenic (excess cancer) risk values for groundwater protection for nonradionuclides. The requirements include an individual and cumulative hazard quotient of less than 1.0, an individual excess carcinogenic risk of less than 1 x 10^{-6}, and a cumulative excess carcinogenic risk of less than 1 x 10^{-5}. Risk values were calculated for constituents that were detected at concentrations above Hanford Site or Washington State background values or for which there is no background value. In addition, the soil-partitioning coefficients for these contaminants must be less than that necessary to show no migration to groundwater in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013). Based on this model and a vadose zone of approximately 24 m (78 ft) in thickness, a distribution coefficient of 3.1 or greater is required to show no predicted migration to groundwater in 1,000 years. The noncarcinogenic hazard quotient for boron, the only constituent subject to the noncarcinogenic calculation, is 4.1 x 10^{-3}, which is less than 1.0. No carcinogenic constituents met the criteria for evaluation; therefore, no carcinogenic risk calculations were performed.

DATA QUALITY ASSESSMENT

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

The DQA for the 100-N-97 waste site established that the data are of the right type, quality, and quantity to support site closeout decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in a WCH project-specific database for data evaluation prior to archival in the HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 100-N-97 waste site has been evaluated in accordance with the 100-N Area ROD (EPA 1999) and the 100-N Area RDR/RAWP (DOE-RL 2013). Verification sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at the site meet the RAOs for direct exposure, groundwater protection, and river protection.

In accordance with this evaluation, the verification sampling results support a reclassification of the 100-N-97 waste site to Interim Closed Out. Residual contamination above direct exposure levels was not observed in the shallow zone soils and is concluded to not exist in deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-N-97 Waste Site [a].

Hazardous Substance		2001 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Maximum Result
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
	Background	Metals (mg/kg)							
Barium	132	500	NA	102	NA	330	NA	2,000	198
Boron	NA	0.5	NA	NA	NA	NA	NA	NA	1.3
Manganese	512	1,100 [d]	NA	1,500	220	450	4,300	4,000	287 (<BG)
Vanadium	85.1	2	NA	NA	NA	NA	7.8	280	51.1 (<BG)

NOTE: Shaded cells indicate screening values that are exceeded.

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

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

[c] Wildlife.

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

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

APPENDIX B

WASTE CHARACTERIZATION AND IN-PROCESS SAMPLING RESULTS

APPENDIX B

WASTE CHARACTERIZATION AND IN-PROCESS SAMPLING RESULTS

A waste characterization sample was collected on April 22, 2013, prior to the start of remediation. Additionally, four in-process soil samples were collected after the oil filters and underlying soil were removed. The waste characterization and in-process soil samples are summarized in Table B-1. The data are provided in Table B-2.

Table B-1. Waste Characterization and In-Process Sampling Summary for the 100-N-97 Waste Site.

HEIS Sample Number	Sample Description	WSP Coordinates		Sample Analysis
		Northing (m)	Easting (m)	
J1RKR7	Waste characterization	150767.9	572630.6	ICP metals [a], mercury, SVOA
J1T5R7	In-process soil sample, collected from east side of excavation. Silt, sand, and gravel.	150762.4	572631.8	ICP metals [a], mercury, PAH, PCB, TPH
J1T5R8	Collected from west side of excavation. Silt, sand, and gravel.	150763.4	572630.4	ICP metals [a], mercury, PAH, PCB, TPH
J1T759	In-pròcess soil sample, collected from east side of excavation. Silt, sand, and gravel.	150762.4	572631.8	TPH
J1T760	Collected from west side of excavation. Silt, sand, and gravel.	150763.4	572630.4	TPH

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

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons
WSP = Washington State Plane

Table B-2. 100-N-97 Waste Characterization and In-Process Sample Data. (3 Pages)

Sample Number	Sample Date/Time	Sample Type	Northing	Easting	Aluminum			Antimony			Arsenic			Barium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1RKR7	4/22/2013 12:47	Waste characterization	150762.9	572630.6	9200		1.5	0.36	U	0.36	2.8		0.62	80.8		0.072
J1T5R7	11/13/2013 11:50	In-process	150762.4	572631.8	8440		1.5	0.37	U	0.37	3.3		0.65	89.4		0.074
J1T5R8	11/13/2013 11:55	In-process	150763.4	572630.4	9530		1.8	0.43	U	0.43	3.4		0.75	87.5		0.086
J1T759	1/8/2014 12:50	In-process	150762.4	572631.8												
J1T760	1/8/2014 12:55	In-process	150763.4	572630.4												

Sample Number	Sample Date/Time	Sample Type	Northing	Easting	Beryllium			Boron			Cadmium			Calcium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1RKR7	4/22/2013 12:47	Waste characterization	150762.9	572630.6	0.42		0.03	1.4	B	0.93	0.16	B	0.04	2690		13.3
J1T5R7	11/13/2013 11:50	In-process	150762.4	572631.8	0.27		0.03	0.96	U	0.96	0.17	B	0.04	3120		13.8
J1T5R8	11/13/2013 11:55	In-process	150763.4	572630.4	0.29		0.04	1.1	U	1.1	0.12	B	0.05	3680		16
J1T759	1/8/2014 12:50	In-process	150762.4	572631.8												
J1T760	1/8/2014 12:55	In-process	150763.4	572630.4												

Sample Number	Sample Date/Time	Sample Type	Northing	Easting	Chromium			Cobalt			Copper			Iron		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1RKR7	4/22/2013 12:47	Waste characterization	150762.9	572630.6	12.4		0.06	6.7	X	0.1	14.4		0.21	18700	X	3.6
J1T5R7	11/13/2013 11:50	In-process	150762.4	572631.8	10.1		0.06	7.5	X	0.1	12.8		0.21	18600		3.7
J1T5R8	11/13/2013 11:55	In-process	150763.4	572630.4	11.4		0.07	7.8	X	0.11	15.7		0.25	20400		4.3
J1T759	1/8/2014 12:50	In-process	150762.4	572631.8												
J1T760	1/8/2014 12:55	In-process	150763.4	572630.4												

Sample Number	Sample Date/Time	Sample Type	Northing	Easting	Lead			Magnesium			Manganese			Mercury		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1RKR7	4/22/2013 12:47	Waste characterization	150762.9	572630.6	7.2	X	0.26	4030		3.5	329		0.1	0.0057	B	0.006
J1T5R7	11/13/2013 11:50	In-process	150762.4	572631.8	5.5		0.26	4200		3.6	373		0.1	0.0067	U	0.007
J1T5R8	11/13/2013 11:55	In-process	150763.4	572630.4	5.4		0.31	4640		4.2	372		0.11	0.0066	U	0.007
J1T759	1/8/2014 12:50	In-process	150762.4	572631.8												
J1T760	1/8/2014 12:55	In-process	150763.4	572630.4												

Sample Number	Sample Date/Time	Sample Type	Northing	Easting	Molybdenum			Nickel			Potassium			Selenium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1RKR7	4/22/2013 12:47	Waste characterization	150762.9	572630.6	0.29	B	0.25	11.6	X	0.12	2010		38.8	0.81	U	0.81
J1T5R7	11/13/2013 11:50	In-process	150762.4	572631.8	0.25	U	0.25	11		0.12	2100		40.2	0.84	U	0.84
J1T5R8	11/13/2013 11:55	In-process	150763.4	572630.4	0.29	U	0.29	12.5		0.14	2090		46.5	0.98	U	0.98
J1T759	1/8/2014 12:50	In-process	150762.4	572631.8												
J1T760	1/8/2014 12:55	In-process	150763.4	572630.4												

Sample Number	Sample Date/Time	Sample Type	Northing	Easting	Silicon			Silver			Sodium			Vanadium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1RKR7	4/22/2013 12:47	Waste characterization	150762.9	572630.6	185		5.4	0.15	U	0.15	155		55.8	45		0.089
J1T5R7	11/13/2013 11:50	In-process	150762.4	572631.8	287	N	5.5	0.16	U	0.16	146		57.8	40.7		0.092
J1T5R8	11/13/2013 11:55	In-process	150763.4	572630.4	282	N	6.4	0.18	U	0.18	192		66.9	44.5		0.11
J1T759	1/8/2014 12:50	In-process	150762.4	572631.8												
J1T760	1/8/2014 12:55	In-process	150763.4	572630.4												

Sample Number	Sample Date/Time	Sample Type	Northing	Easting	Zinc		
					mg/kg	Q	PQL
J1RKR7	4/22/2013 12:47	Waste characterization	150762.9	572630.6	47.7		0.38
J1T5R7	11/13/2013 11:50	In-process	150762.4	572631.8	40.5	X	0.39
J1T5R8	11/13/2013 11:55	In-process	150763.4	572630.4	42.6	X	0.45
J1T759	1/8/2014 12:50	In-process	150762.4	572631.8			
J1T760	1/8/2014 12:55	In-process	150763.4	572630.4			

Table B-2. 100-N-97 Waste Characterization and In-Process Sample Data. (3 Pages)

SAMPLE NUMBER		J1RKR7 Waste characterization			J1T5R7 In-process			J1T5R8 In-process		
LOCATION		N150762.87, E572630.57			N150762.4, E572631.8			N150763.4, E572630.4		
CONSTITUENT	CLASS	04/22/13 12:47 PM			11/13/13 11:50 AM			11/13/13 11:55 AM		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH				11	U	11	11	U	11
Acenaphthylene	PAH				9.9	U	9.9	9.9	U	9.9
Anthracene	PAH				3.4	U	3.4	3.4	U	3.4
Benzo(a)anthracene	PAH				3.5	U	3.5	3.5	UN	3.5
Benzo(a)pyrene	PAH				7.1	U	7.1	7.1	U	7.1
Benzo(b)fluoranthene	PAH				4.6	U	4.6	4.6	UN	4.6
Benzo(ghi)perylene	PAH				7.9	U	7.9	8	UN	8
Benzo(k)fluoranthene	PAH				4.3	U	4.3	4.4	UN	4.4
Chrysene	PAH				5.3	U	5.3	5.3	UN	5.3
Dibenz[a,h]anthracene	PAH				12	U	12	12	UN	12
Fluoranthene	PAH				14	U	14	14	U	14
Fluorene	PAH				5.8	U	5.8	5.8	U	5.8
Indeno(1,2,3-cd)pyrene	PAH				13	U	13	13	U	13
Naphthalene	PAH				13	U	13	13	U	13
Phenanthrene	PAH				13	U	13	13	U	13
Pyrene	PAH				13	U	13	13	U	13
Aroclor-1016	PCB				3	U	3	3.1	U	3.1
Aroclor-1221	PCB				8.8	U	8.8	8.9	U	8.9
Aroclor-1232	PCB				2.2	U	2.2	2.2	U	2.2
Aroclor-1242	PCB				5.1	U	5.1	5.2	U	5.2
Aroclor-1248	PCB				5.1	U	5.1	5.2	U	5.2
Aroclor-1254	PCB				2.9	U	2.9	2.9	U	2.9
Aroclor-1260	PCB				2.9	U	2.9	2.9	UN	2.9
1,2,4-Trichlorobenzene	SVOA	280	UD	280						
1,2-Dichlorobenzene	SVOA	220	UD	220						
1,3-Dichlorobenzene	SVOA	120	UD	120						
1,4-Dichlorobenzene	SVOA	140	UD	140						
2,4,5-Trichlorophenol	SVOA	100	UD	100						
2,4,6-Trichlorophenol	SVOA	100	UD	100						
2,4-Dichlorophenol	SVOA	100	UD	100						
2,4-Dimethylphenol	SVOA	660	UD	660						
2,4-Dinitrophenol	SVOA	3300	UD	3300						
2,4-Dinitrotoluene	SVOA	660	UD	660						
2,6-Dinitrotoluene	SVOA	280	UD	280						
2-Chloronaphthalene	SVOA	100	UD	100						
2-Chlorophenol	SVOA	210	UD	210						
2-Methylnaphthalene	SVOA	190	UD	190						
2-Methylphenol (cresol, o-)	SVOA	130	UD	130						
2-Nitroaniline	SVOA	500	UD	500						
2-Nitrophenol	SVOA	100	UD	100						
3,3'-Dichlorobenzidine	SVOA	910	UD	910						
3+4 Methylphenol (cresol, m+p)	SVOA	330	UD	330						
3-Nitroaniline	SVOA	730	UD	730						
4,6-Dinitro-2-methylphenol	SVOA	3300	UD	3300						
4-Bromophenylphenyl ether	SVOA	190	UD	190						
4-Chloro-3-methylphenol	SVOA	660	UD	660						
4-Chloroaniline	SVOA	820	UD	820						
4-Chlorophenylphenyl ether	SVOA	210	UD	210						
4-Nitroaniline	SVOA	730	UD	730						
4-Nitrophenol	SVOA	980	UD	980						

Table B-2. Waste Characterization and In-Process Sample Data. (3 Pages)

SAMPLE NUMBER		J1RKR7 Waste characterization			J1T5R7 In-process			J1T5R8 In-process		
LOCATION		N150762.87, E572630.57			N150762.4, E572631.8			N150763.4, E572630.4		
CONSTITUENT	CLASS	04/22/13 12:47 PM			11/13/13 11:50 AM			11/13/13 11:55 AM		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	SVOA	100	UD	100						
Acenaphthylene	SVOA	170	UD	170						
Anthracene	SVOA	170	UD	170						
Benzo(a)anthracene	SVOA	200	UD	200						
Benzo(a)pyrene	SVOA	200	UD	200						
Benzo(b)fluoranthene	SVOA	260	UD	260						
Benzo(ghi)perylene	SVOA	160	UD	160						
Benzo(k)fluoranthene	SVOA	400	UD	400						
Bis(2-chloro-1-methylethyl)ether	SVOA	230	UD	230						
Bis(2-Chloroethoxy)methane	SVOA	230	UD	230						
Bis(2-chloroethyl) ether	SVOA	170	UD	170						
Bis(2-ethylhexyl) phthalate	SVOA	460	UD	460						
Butylbenzylphthalate	SVOA	430	UD	430						
Carbazole	SVOA	360	UD	360						
Chrysene	SVOA	270	UD	270						
Dibenz[a,h]anthracene	SVOA	190	UD	190						
Dibenzofuran	SVOA	200	UD	200						
Diethyl phthalate	SVOA	260	UD	260						
Dimethyl phthalate	SVOA	230	UD	230						
Di-n-butylphthalate	SVOA	290	UD	290						
Di-n-octylphthalate	SVOA	140	UD	140						
Fluoranthene	SVOA	360	UD	360						
Fluorene	SVOA	180	UD	180						
Hexachlorobenzene	SVOA	290	UD	290						
Hexachlorobutadiene	SVOA	100	UD	100						
Hexachlorocyclopentadiene	SVOA	500	UD	500						
Hexachloroethane	SVOA	210	UD	210						
Indeno(1,2,3-cd)pyrene	SVOA	220	UD	220						
Isophorone	SVOA	170	UD	170						
Naphthalene	SVOA	310	UD	310						
Nitrobenzene	SVOA	220	UD	220						
N-Nitroso-di-n-dipropylamine	SVOA	310	UD	310						
N-Nitrosodiphenylamine	SVOA	210	UD	210						
Pentachlorophenol	SVOA	3300	UD	3300						
Phenanthrene	SVOA	170	UD	170						
Phenol	SVOA	180	UD	180						
Pyrene	SVOA	120	UD	120						

Sample Number	Sample Date/Time	Sample Type	Northing	Easting	TPHs - Diesel Extended			TPH - Diesel		
					ug/kg	Q	PQL	ug/kg	Q	PQL
J1RKR7	4/22/2013 12:47	Waste characterization	150762.9	572630.6						
J1T5R7	11/13/2013 11:50	In-process	150762.4	572631.8	250000		1100	150000		770
J1T5R8	11/13/2013 11:55	In-process	150763.4	572630.4	200000		1100	120000		770
J1T759	1/8/2014 12:50	In-process	150762.4	572631.8	35000		1000	21000		690
J1T760	1/8/2014 12:55	In-process	150763.4	572630.4	25000		1000	15000		690

APPENDIX C

CALCULATIONS

APPENDIX C

CALCULATIONS

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

100-N-97 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0100N-CA-V0263, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-N-97 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100N-CA-V0264, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

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

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-N

Discipline: Environmental *Calculation No: 0100N-CA-V0263

Subject: 100-N-97 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 6 Attachment = 2 Total = 9	I. B. Berezovskiy	J. D. Skoglie	H. M. Sulloway	S.G. Wilkinson ~~D. F. Obenauer~~	5/20/14

SUMMARY OF REVISION

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

Washington Closure Hanford, LLC CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	5/8/2014	Calc. No.:	0100N-CA-V0263	Rev.:	0
Project:	100-N Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	5/8/2014
Subject:	100-N-97 Waste Site Relative Percent Difference and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 6	

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-N-97 waste site. In accordance with the remedial action goals (RAGs) in the 100-N remedial design report/remedial action work plan (100-N RDR/RAWP) (DOE-RL 2013), 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 x 10^{-6} for individual carcinogens
4) A cumulative excess cancer risk of <1 x 10^{-5} for carcinogens.

Also, calculate the relative percent difference (RPD) for the primary-duplicate and split sample pairs from the 100-N-97 waste site verification sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2006, *100-N Area Sampling and Analysis Plan for CERCLA Waste Sites*, DOE/RL-2005-92, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) DOE-RL, 2013, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, DOE/RL-2005-93, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

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

5) WCH, 2014, *Remaining Sites Verification Package for the 100-N-97, 100-N Oil Filters #2*, Attachment to Waste Site Reclassification Form 2014-065, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2013).

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 x 10^{-6} (DOE-RL 2013).

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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 Attachment 1 to perform the RPD calculations for primary-split sample pairs, as required.

METHODOLOGY:

The 100-N-97 waste site underwent discrete focused sampling at two locations for the purpose of verification sampling. One duplicate and one split sample were also collected. The direct contact hazard quotient and carcinogenic risk calculations for the 100-N-97 waste site were conservatively calculated for the entire waste site using the greatest of the maximum soil sample results from Attachment 1. Of the contaminants of potential concern (COPCs) for this site boron, molybdenum and benzo(a)pyrene require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Barium requires HQ and risk calculations because this analyte was detected above a Washington State or Hanford Site background value. Although total petroleum hydrocarbons (diesel range extended) were detected and no background value is available, the risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.3 mg/kg, divided by the noncarcinogenic RAG value of 16,000 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), produces a HQ value of 8.1×10^{-5}. 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 1.3×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, then multiplied by 1.0×10^{-6}. For example, the maximum value for benzo(a)pyrene is 0.026 mg/kg, divided by 0.137 mg/kg, and multiplied as indicated, is 1.9×10^{-7}. Comparing this value, and all other individual values, to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) The cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values is 1.9×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

5) The RPD is calculated when both the primary value and the duplicate/split value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDLs are pre-determined values for analytical methods and constituents with cleanup levels as listed in Table 2-1 of the SAP (DOE-RL 2006). Table 2-1 includes nominal TDLs for identified methods based organic analyses. The nominal TDLs are also used in support of the RPD calculation for the

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methods based analytes. TDLs not included in Table 2-1 are based on the laboratory and/or methods used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate/split 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 or split sample value

When an analyte is detected in the primary or duplicate/split sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate/split 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. One duplicate and one split sample was collected for the verification sampling of the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2014), as necessary.

RESULTS:

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

Table 1 shows the results of the direct contact hazard quotient calculations.

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

Table 2 shows the results of the RPD calculations for the 100-N-97 waste site.

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Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-N-97 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					
Barium	198	16,000	1.2E-02	--	--
Boron	1.3	16,000	8.1E-05	--	--
Molybdenum	0.24	400	6.0E-04	--	--
Semivolatiles					
Benzo(a)pyrene	0.026	--	--	0.137	1.9E-07
Total Petroleum Hydrocarbons					
Diesel range EXT [c]	130	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**1.3E-02**		
Cumulative Excess Cancer Risk:					**1.9E-07**

Notes:

[a] = From Attachment 1.

[b] = Value obtained from the 100-N RDR/RAWP (DOE-RL 2013) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

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

-- = not applicable

RAG = remedial action goal

Table 2. Relative Percent Difference Calculations for the 100-N-97 Waste Site. (3 Pages)

Duplicate/Split Analysis - 100-N-97 Waste Site Excavation (EXC)

Sampling Location	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	5920		1.4	2.6		0.61	198	NXMJ	0.071	0.43		0.031
Duplicate of J1THF0	J1THF2	3/27/2014	6740		1.5	3.0		0.62	53.1	XJ	0.071	0.44		0.031
Split of J1THF0	J1THF4	3/27/2014	5300		7.06	3.72		0.519	56.4		0.104	0.393	B	0.104

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	13.0%		*115.4%*	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable
Split 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	11.1%		*111.3%*	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable

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Table 2. Relative Percent Difference Calculations for the 100-N-97 Waste Site. (3 Pages)

Duplicate/Split Analysis - 100-N-97 Waste Site Excavation (EXC)

Sampling Location	HEIS Number	Sample Date	Boron			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	0.91	B	0.91	7190	X	13.1	5.5	X	0.054	8.2	X	0.093
Duplicate of J1THF0	J1THF2	3/27/2014	0.93	B	0.92	8280	X	13.3	6.9	X	0.055	8.1	X	0.094
Split of J1THF0	J1THF4	3/27/2014	3.05	B	1.04	7470		8.30	7.16		0.156	11.3	D	0.778

Analysis:

TDL		2	100	1	2
Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		14.1%	22.6%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable
Split Analysis	Both > PQL?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		3.8%	26.2%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

Duplicate/Split Analysis - 100-N-97 Waste Site Excavation (EXC)

Sampling Location	HEIS Number	Sample Date	Copper			Iron			Lead			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	17.6	X	0.20	21300	X	3.5	3.2		0.25	3900	X	3.4
Duplicate of J1THF0	J1THF2	3/27/2014	15.9	X	0.20	21500	X	3.6	3.1		0.25	4470	X	3.5
Split of J1THF0	J1THF4	3/27/2014	20.5		0.311	22100		8.30	4.32	BD	1.71	4200		8.82

Analysis:

TDL		1	5	5	75
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	10.1%	0.9%		13.6%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	15.2%	3.7%		7.4%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable

Duplicate/Split Analysis - 100-N-97 Waste Site Excavation (EXC)

Sampling Location	HEIS Number	Sample Date	Manganese			Nickel			Potassium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	244	X	0.093	7.8	XM	0.11	872		38.1	203	MJ	5.3
Duplicate of J1THF0	J1THF2	3/27/2014	271	X	0.094	9.5	X	0.12	920		38.6	175	J	5.3
Split of J1THF0	J1THF4	3/27/2014	279		0.208	9.91		0.156	872		6.64	592	N	1.56

Analysis:

TDL		5	4	400	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	10.5%			14.8%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	13.4%			97.9%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable

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Table 2. Relative Percent Difference Calculations for the 100-N-97 Waste Site. (3 Pages)

Duplicate/Split Analysis - 100-N-97 Waste Site Excavation (EXC)

Sampling Location	HEIS Number	Sample Date	Sodium			Vanadium			Zinc			TPH - Diesel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	248		54.9	51.1	X	0.087	41.2	X	0.37	10000		670
Duplicate of J1THF0	J1THF2	3/27/2014	244		55.5	50.8	X	0.088	42.2	X	0.37	18000		680
Split of J1THF0	J1THF4	3/27/2014	136		7.26	70.7	D	0.519	49.1	D	2.08	2260	U	2260

Analysis:

TDL		50	2.5	1	5000
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		0.6%	2.4%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	
	RPD		32.2%	17.5%	
	Difference > 2 TDL?	Yes - assess further	Not applicable	Not applicable	Not applicable

Duplicate/Split Analysis - 100-N-97 Waste Site Excavation (EXC)

Sampling Location	HEIS Number	Sample Date	TPH - Diesel EXT		
			ug/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	19000		990
Duplicate of J1THF0	J1THF2	3/27/2014	32000		990
Split of J1THF0	J1THF4	3/27/2014			

Analysis:

TDL		5000
Duplicate Analysis	Both > PQL?	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)
	RPD	
	Difference > 2 TDL?	Yes - assess further
Split Analysis	Both > PQL?	
	Both >5xTDL?	
	RPD	
	Difference > 2 TDL?	

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 100-N-97 waste site meets the requirements for the direct contact hazard quotient and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the 100-N RDR/RAWP (DOE-RL 2013) and SAP (DOE-RL 2006). The hazard quotient and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

Attachment 1. 100-N-97 Waste Site Verification Sample Results (Metals and Physical).

Sample 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
EXC-1	J1THF0	3/27/2014	5920		1.4	0.35	UJ	0.35	2.6		0.61	198	NXMJ	0.071
Duplicate of J1THF0	J1THF2	3/27/2014	6740		1.5	0.36	UJ	0.36	3.0		0.62	53.1	XJ	0.071
EXC-2	J1THF1	3/27/2014	7380		1.5	0.36	UJ	0.36	2.5		0.63	62.5	XJ	0.073
Split of J1THF0	J1THF4	3/27/2014	5300		7.06	1.71	DU	1.71	3.72		0.519	56.4		0.104
Equipment Blank	J1THF3	3/27/2014	176		1.6	0.38	UJ	0.38	0.66	U	0.66	1.8	XJ	0.076

Sample 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
EXC-1	J1THF0	3/27/2014	0.43		0.031	0.91	B	0.91	0.067	BCMUJ	0.038	7190	X	13.1
Duplicate of J1THF0	J1THF2	3/27/2014	0.44		0.031	0.93	B	0.92	0.080	BCUJ	0.039	8280	X	13.3
EXC-2	J1THF1	3/27/2014	0.41		0.032	1.3	B	0.94	0.053	BCUJ	0.039	5990	X	13.5
Split of J1THF0	J1THF4	3/27/2014	0.393	B	0.104	3.05	B	1.04	0.387	B	0.104	7470		8.30
Equipment Blank	J1THF3	3/27/2014	0.071	B	0.033	0.98	U	0.98	0.057	BCUJ	0.041	33.6	BX	14.1

Sample 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
EXC-1	J1THF0	3/27/2014	5.5	X	0.054	8.2	X	0.093	17.6	X	0.20	21300	X	3.5
Duplicate of J1THF0	J1THF2	3/27/2014	6.9	X	0.055	8.1	X	0.094	15.9	X	0.20	21500	X	3.6
EXC-2	J1THF1	3/27/2014	7.7	X	0.055	7.7	X	0.096	16.5	X	0.21	20500	X	3.6
Split of J1THF0	J1THF4	3/27/2014	7.16		0.156	11.3	D	0.778	20.5		0.311	22100		8.30
Equipment Blank	J1THF3	3/27/2014	0.059	BX	0.058	0.19	BX	0.1	0.22	UX	0.22	1420	X	3.8

Sample Area	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	3.2		0.25	3900	X	3.4	244	X	0.093			
Duplicate of J1THF0	J1THF2	3/27/2014	3.1		0.25	4470	X	3.5	271	X	0.094			
EXC-2	J1THF1	3/27/2014	3.8		0.26	4140	X	3.5	287	X	0.096			
Split of J1THF0	J1THF4	3/27/2014	4.32	BD	1.71	4200		8.82	279		0.208	0.0117	B	0.00411
Equipment Blank	J1THF3	3/27/2014	0.27	U	0.27	18	BX	3.7	18.7	X	0.10			

Sample Area	HEIS Number	Sample Date	Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	0.24	B	0.24	7.8	XM	0.11	872		38.1	0.80	U	0.80
Duplicate of J1THF0	J1THF2	3/27/2014	0.24	U	0.24	9.5	X	0.12	920		38.6	0.81	U	0.81
EXC-2	J1THF1	3/27/2014	0.25	U	0.25	9.5	X	0.12	1350		39.2	0.82	U	0.82
Split of J1THF0	J1THF4	3/27/2014	0.208	U	0.208	9.91		0.156	872		6.64	0.336	DU	0.336
Equipment Blank	J1THF3	3/27/2014	0.26	U	0.26	0.26	BX	0.12	43.4	B	41.0	0.86	U	0.86

Sample Area	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	203	MJ	5.3	0.15	UNJ	0.15	248		54.9	51.1	X	0.087
Duplicate of J1THF0	J1THF2	3/27/2014	175	J	5.3	0.15	UJ	0.15	244		55.5	50.8	X	0.088
EXC-2	J1THF1	3/27/2014	192	J	5.4	0.15	UJ	0.15	178		56.4	42.2	X	0.090
Split of J1THF0	J1THF4	3/27/2014	592	N	1.56	0.104	U	0.104	136		7.26	70.7	D	0.519
Equipment Blank	J1THF3	3/27/2014	99.4	J	5.7	0.16	UJ	0.16	59.0	U	59.0	0.27	BX	0.094

Sample Area	HEIS Number	Sample Date	Zinc			TPH - Diesel			TPH - Diesel Ext			TPH - motor oil (high boiling)		
			mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
EXC-1	J1THF0	3/27/2014	41.2	X	0.37	10000		670	19000		990			
Duplicate of J1THF0	J1THF2	3/27/2014	42.2	X	0.37	18000		680	32000		990			
EXC-2	J1THF1	3/27/2014	38.7	X	0.38	79000		640	130000		940			
Split of J1THF0	J1THF4	3/27/2014	49.1	D	2.08	2260	UT	2260				12900	T	2260
Equipment Blank	J1THF3	3/27/2014	2.1	XCUJ	0.40									

Sample Area	HEIS Number	Sample Date	Percent moisture (wet sample)		
			%	Q	PQL
EXC-1	J1THF0	3/27/2014	3.2		0.10
Duplicate of J1THF0	J1THF2	3/27/2014	3.3		0.10
EXC-2	J1THF1	3/27/2014	3.2		0.10
Split of J1THF0	J1THF4	3/27/2014			
Equipment Blank	J1THF3	3/27/2014	0.10	U	0.10

Note: Data qualified with B, J, M, and X are acceptable values.
B = analyte was found in associated method blank as well as the sample.
D = results are reported from a diluted aliquot of sample.
EXC = excavation
HEIS = Hanford Environmental Information system
J = Results less than RL but greater than or equal to the MDL and the concentration is an approximate value.
M = sample duplicate precision not met
N = spike sample recovery is outside control limits.
PAH = polycyclic aromatic hydrocarbons
PQL = practical quantitation limit
Q = qualifier
T = spike and/or duplicate sample recovery is outside control limits.
U = undetected
X = Serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals)

Attachment	1	Sheet No.	1 of 2
Originator	I. B. Berezovskiy	Date	5/8/2014
Checked	J. D. Skoglie	Date	5/8/2014
Calc. No.	0100N-CA-V0263	Rev. No.	0

Attachment 1. 100-N-97 Waste Site Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1THF0, EXC-1			J1THF2, Duplicate of J1THF0			J1THF1, EXC-2			J1THF4, Split of J1THF0		
		3/27/2014			3/27/2014			3/27/2014			3/27/2014		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	10	U	10	10	U	10	10	U	10	5.22	U	5.22
Acenaphthylene	PAH	9.2	U	9.2	9.2	U	9.2	9.1	U	9.1	5.22	U	5.22
Anthracene	PAH	3.1	U	3.1	3.1	U	3.1	3.1	U	3.1	1.74	U	1.74
Benzo(a)anthracene	PAH	3.3	U	3.3	3.3	U	3.3	3.2	U	3.2	0.557	U	0.557
Benzo(a)pyrene	PAH	6.6	U	6.6	6.6	U	6.6	26		6.4	0.557	U	0.557
Benzo(b)fluoranthene	PAH	4.3	U	4.3	4.3	U	4.3	4.2	U	4.2	0.557	U	0.557
Benzo(ghi)perylene	PAH	7.4	U	7.4	7.4	U	7.4	7.2	U	7.2	0.557	U	0.557
Benzo(k)fluoranthene	PAH	4.0	U	4.0	4.0	U	4.0	4.0	U	4.0	0.279	U	0.279
Chrysene	PAH	4.9	U	4.9	5.0	U	5.0	4.9	U	4.9	0.557	U	0.557
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	11	U	11	0.557	U	0.557
Fluoranthene	PAH	13	U	13	13	U	13	13	U	13	0.557	U	0.557
Fluorene	PAH	5.4	U	5.4	5.4	U	5.4	5.3	U	5.3	5.22	U	5.22
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	12	U	12	12	U	12	0.557	U	0.557
Naphthalene	PAH	12	U	12	12	U	12	12	U	12	5.22	U	5.22
Phenanthrene	PAH	12	U	12	12	U	12	12	U	12	5.22	U	5.22
Pyrene	PAH	12	U	12	12	U	12	12	U	12	0.557	U	0.557

Attachment	1	Sheet No.	2 of 2
Originator	I. B. Berezovskiy	Date	5/8/2014
Checked	J. D. Skoglie	Date	5/8/2014
Calc. No.	0100N-CA-V0263	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-N

Discipline: Environmental *Calculation No: 0100N-CA-V0264

Subject: 100-N-97 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 3 Total = 4	I. B. Berezovskiy *I. B. Berezovskiy*	J.D. Skoglie *[signature]*	H. M. Sulloway *H. M. Sulloway*	~~D.F. Obenauer~~ S.G. Wilkinson *[signature]*	5/20/14

SUMMARY OF REVISION

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

Washington Closure Hanford, LLC CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	05/08/14	Calc. No.:	0100N-CA-V0264	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	05/08/14
Subject:	100-N-97 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-N-97 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) for the 100-N Area (DOE-RL 2013), the following criteria must be met:

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

GIVEN/REFERENCES:

1) DOE-RL, 2013, *Remedial Design Report/Remedial Action Work Plan for the 100-N Area*, DOE/RL-2005-93, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

3) WCH, 2014, *Remaining Sites Verification Package for the 100-N-97, 100-N Oil Filters #2 Waste Site*, Attachment to Waste Site Reclassification Form 2014-065, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Generate a HQ for each noncarcinogenic constituent detected above background in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (DOE-RL 2013).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (DOE-RL 2013).

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

Washington Closure Hanford, LLC CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	05/08/14	Calc. No.:	0100N-CA-V0264	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	05/08/14
Subject:	100-N-97 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 100-N-97 waste site is comprised of one decision unit for verification sampling, consisting of the excavation area. Two focused samples, one duplicate, and one split sample were collected from this excavation. The protection of groundwater hazard quotient and carcinogenic risk calculations for the 100-N-97 waste site were conservatively calculated for the entire waste site using the maximum value for each analyte (WCH 2014). Based on the generic site RESRAD model (DOE-RL 2013) and a vadose zone of approximately 24 m (79 ft) thickness, a K_d of 3.1 or greater is required to show no predicted migration to groundwater in 1,000 years. Boron is the only constituent included because it has a K_d of less than 3.1 and no Hanford background value has been established. All other site nonradionuclide COPCs were undetected, quantified below background levels, or have a K_d greater than or equal to 3.1. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (μg/L) (calculated with, and related to the hazard quotient through, WAC 173-340-720 (3)(a)(ii)(A), (1996) x 100 x 1 mg/1000 μg (conversion factor). This is based on the "100 times rule" of WAC 173-340-740(3)(a)(ii) (A) (1996). For example, the maximum value for boron of 1.3 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 4.1×10^{-3}. Comparing this value to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The cumulative HQ for the 100-N-97 waste site is 4.1×10^{-3}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, and then multiplied by 1×10^{-6}. There were not any constituents in this calculation that had a carcinogenic RAG associated with it. Therefore, the requirement of $<1 \times 10^{-6}$ is met. Furthermore, the criterion for cumulative excess cancer risk for carcinogens is also met.

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

Washington Closure Hanford, LLC CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	05/08/14	Calc. No.:	0100N-CA-V0264	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	05/08/14
Subject:	100-N-97 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 3 of 3	

RESULTS:

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

Table 1 shows the results of the calculations.

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-N-97 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	1.3	320	4.1E-03	--	--
Totals					
Cumulative Hazard Quotient:			**4.1E-03**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:

[a] = From WCH (2014).

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

-- = not applicable

RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-N-97 waste site meets the requirements for the hazard quotient and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2013).

APPENDIX D

DATA QUALITY ASSESSMENT

APPENDIX D

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2014b). This DQA was performed in accordance with site-specific data quality objectives found in the *100-N Area Sampling and Analysis Plan for CERCLA Waste Sites* (100-N Area SAP) (DOE-RL 2006).

A review of the sample design (WCH 2014b), the field logbook (WCH 2014a), 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 analysis (BHI 2000) is used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Verification data from samples collected at the 100-N-97 waste site were provided by the laboratories in two sample delivery groups (SDGs): SDG JP0768 and SDG XP0064. SDG JP0768 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 100-N-97 data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

MINOR DEFICIENCIES

SDG JP0768

This SDG comprises two focused soil samples (J1THF0, J1THF1) collected from the 100-N-97 excavation area. This SDG includes one field duplicate pair (J1THF0/J1THF2). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAH). In addition, one equipment blank (J1THF3) was collected and analyzed for ICP metals and mercury. SDG JP0768 was submitted for third-party validation. Minor deficiencies are as follows:

In the ICP metals analysis, cadmium and zinc were detected in the method blank. Zinc result in sample J1THF3 was qualified as undetected, with "U" flag, by third-party validation. All cadmium results were qualified as undetected by third-party validation, with "U" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries are outside the project acceptance criteria for seven analytes (aluminum [548%], antimony [61%], barium [17%], iron [-539%], manganese [138%], silver [69%], and silicon [22%]). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony, barium, silver, and silicon did not have mismatched spike and native concentrations in the MS. All antimony, barium, silver, and silicon data were qualified by third-party validation as estimated, with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample recovery is outside the quality control (QC) limit for silicon (18%). Third-party validation qualified all silicon data in SDG JP0768 as estimated, with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate relative percent difference (RPD) for barium (107%) and silicon (55%) are above the acceptance criteria of 30%. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for the RPD above the QC limits, all barium and silicon data results in SDG JP0768 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG XP0064

This SDG comprises one focused soil sample (J1THF4) collected from the 100-N-97 excavation area. Field sample J1THF4 is a split sample associated with sample J1THF0. This sample was analyzed for ICP metals, mercury, TPH, and PAH. Minor deficiencies are as follows:

In the ICP metals analysis, arsenic and zinc were detected in the method blank at very low levels, less than 1/20th of the most restrictive cleanup level. Method blank contamination of this magnitude has no significant impact on the field sample results. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recovery is outside the project acceptance criteria for silicon (61.3%). The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. A post-spike was also prepared for silicon and was above the acceptance criteria at 142%. Silicon did not have mismatched spike and native concentrations in the MS. Although not qualified for MS deficiency, all silicon data in SDG XP0064 may be considered estimated. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2014a), are shown in Table D-1. The main and QA/QC sample results are presented in Appendix C.

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

Sample Area	Main Sample	Duplicate Sample	Split Sample
100-N-97 Excavation	J1THF0	J1THF2	J1THF4

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

Field split samples are used to determine systematic differences (bias) between laboratories. A statistical determination of systematic differences would require larger data sets than are presented here. Such a determination is complicated by variability introduced by the natural heterogeneities inherent in field soil samples, and the analytical variability that each individual laboratory experiences. Therefore, when evaluating limited field split data relatively large RPDs are expected. No major deficiencies in the RPD calculations were found for the split sample. Minor deficiencies for the field duplicate and split samples are as follows:

In the field duplicate sample evaluation, the RPD calculated for barium (115.4%) is above the field duplicate acceptance criteria of 30%. In the split evaluation, the RPDs calculated for barium (111.3%) and silicon (97.9%) were above the field split acceptance criteria (less than 35%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The data are usable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and split) is less than five times the TDL, including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. Sodium split evaluation required this check.

A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are usable for decision-making purposes.

SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-N-97 waste site verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for the 100-N-97 waste site data set concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes.

The verification sample analytical data are stored in the Washington Closure Hanford project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix C.

REFERENCES

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

DOE-RL, 2006, *100-N Area Sampling and Analysis Plan for CERCLA Waste Sites,* DOE/RL-2005-92, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

WCH, 2014a, *100-N Field Remediation and Sampling*, Logbook EL-1652-11, pp. 78-81, Washington Closure Hanford, Richland, Washington.

WCH, 2014b, *Work Instruction for Verification Sampling of the 100-N-97, 100-N Oil Filters #2,* 0100N-WI-G0084, Rev. 0, Washington Closure Hanford, Richland, Washington.