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

14-AMRP-0298

SEP 19 2014

Ms. J. A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Blvd.
Richland, Washington 99354

Dear Ms. Hedges:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 100-N-84:4, 100-N AREA STEAM AND CONDENSATE PIPELINES, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2011-118 and supporting, "Remaining Sites Verification Package for the 100-N-84:4, 100-N Area Steam and Condensate Pipelines," Rev. 0. If you have questions, please contact me or your staff may contact Joanne Chance, of my staff, at (509) 376-0811.

Sincerely,

Mark S. French, Director
River Corridor Division

AMRP:JCC

Attachment

cc w/attach:
N. M. Menard, Ecology
Administrative Record, H6-08

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

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2011-118

Waste Site Code(s)/Subsite Code(s): 100-N-84:4

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-84:4, 100-N Steam and Condensate Pipelines subsite is one of 10 subsites associated with the 100-N-84, 100-N Miscellaneous Pipelines waste site. The 100-N-84 waste site, part of the 100-NR-1 Operable Unit, was added to the *Interim Remedial 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 candidate site for confirmatory sampling via 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). Subsequently, the 100-N-84:4 pipelines were recommended for remedial action. The 100-N-84:4 subsite consisted of steam and condensate pipelines concentrated around the 105-N Reactor.

Three french drains (formerly part of the 100-N-103:1, 100-N Steam Condensate French Drains waste site) were added to the 100-N-84:4 subsite because they were within the planned layback of the 100-N-84:4 pipeline remediation. French drain 9 was removed during demolition activities performed in 2009. French drains 10 and 11 were removed and disposed with the remediation of the 100-N-84:4 pipeline subsite.

Several segments of the 100-N-84:4 pipelines subsite were removed with previous waste site remediations and were not included in the 100-N-84:4 sample design for verification sampling.

Remedial actions at the 100-N-84:4 pipelines subsite were conducted from December 2, 2013, through February 24, 2014. The excavation depth ranged from 1.5 to 5 m (4.9 to 16.4 ft) below ground surface resulting in approximately 4,100 bank cubic meters (5,363 bank cubic yards) of soil and pipeline debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). All waste material was loaded directly from the excavation into ERDF containers for disposal; therefore, no waste staging pile area was generated. Additionally, there is no overburden soil stockpile associated with the 100-N-84:4 pipeline subsite. No anomalous material was observed during the remediation.

Cleanup verification sampling was conducted on February 6 and 26, 2014, to support backfilling of established roadways. Cleanup verification sampling continued on May 5, 2014. The sampling was performed to determine if the waste site met the remedial action objectives (RAOs) and remedial action goals (RAGs) established by the *Remedial Design Report/Remedial Action Work Plan for the 100-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 to Interim Closed Out.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-NR-1 **Control No.:** 2011-118

Waste Site Code(s)/Subsite Code(s): 100-N-84:4

Basis for reclassification:

The verification sampling and modeling results for the 100-N-84:4 subsite 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) to support a reclassification to Interim Closed Out. These sampling and modeling results established that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-N-84:4, 100-N Area Steam and Condensate Pipelines* (attached).

Regulator comments:

Waste Site Controls:

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

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

J. P. Neath	J P Neath	9/11/14
DOE Federal Project Director (printed)	Signature	Date
N. Menard	Nina M. Menard	9/9/14
Ecology Project Manager (printed)	Signature	Date
NA		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-84:4, 100-N AREA STEAM AND CONDENSATE PIPELINES

Attachment to Waste Site Reclassification Form 2011-118

September 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-84:4, 100-N AREA STEAM AND CONDENSATE PIPELINES

EXECUTIVE SUMMARY

The 100-N-84:4, 100-N Area Steam and Condensate Pipelines subsite, part of the 100-NR-1 Operable Unit, is 1 of 10 subsites associated with the 100-N-84, 100-N Miscellaneous Pipelines waste site. The 100-N-84:4 subsite consisted of steam and condensate pipelines concentrated around the 105-N Reactor and its support facilities, and three french drains that were formerly part of the 100-N-103:1 waste site. The 100-N-84 waste site was added to the *Interim Remedial 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 candidate site for confirmatory sampling via 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). Subsequently, the 100-N-84:4 subsite was recommended for remedial action (WCH 2012).

Three french drains (formerly part of the 100-N-103:1, 100-N Steam Condensate French Drains waste site) were added to the 100-N-84:4 subsite because they were within the planned layback of the 100-N-84:4 pipeline remediation. French drain 9 was removed during demolition activities performed in 2009. French drains 10 and 11 were removed and disposed with the remediation of the 100-N-84:4 pipeline subsite.

Several segments of the 100-N-84:4 pipelines subsite were removed with previous waste site remediations and were not included in the 100-N-84:4 sample design for verification sampling (WCH 2014b).

Remedial actions were conducted from December 2, 2013, through February 24, 2014. The excavation depth ranged from 1.5 to 5 m (4.9 to 16.4 ft) below ground surface resulting in approximately 4,100 bank cubic meters (5,363 bank cubic yards) of soil and pipeline debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). All waste material was loaded directly from the excavation into ERDF containers for disposal; therefore, no waste staging pile area was generated. Additionally, there is no overburden soil stockpile associated with the 100-N-84:4 pipeline subsite. No anomalous material was observed during the remediation.

Focused verification soil samples were collected on February 6 and 26, 2014, to support backfill of established roadways. Verification soil sampling continued on May 5, 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.

Table ES-1. Summary of Remedial Action Goals for the 100-N-84:4 Subsite. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of <15 mrem/yr above background over 1,000 years.	Radionuclides were not COPCs for the 100-N-84:4 subsite.	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 quotients for individual nonradionuclide COPCs are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for the 100-N-84:4 subsite (5.1×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for hexavalent chromium, the only contaminant subject to the excess cancer risk calculation, is 2.2×10^{-7}, which is $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The excess cancer risk for hexavalent chromium, the only contaminant subject to the excess cancer risk calculation, is 2.2×10^{-7}, which is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the the100-N-84:4 waste subsite.	NA
	Attain National Primary Drinking Water Regulations [a]: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ.		
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [b].		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].		

Table ES-1. Summary of Remedial Action Goals for the 100-N-84:4 Subsite. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	Chromium (total), copper, lead, nickel, and zinc exceeded soil RAGs for groundwater and/or river protection. However, based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), it is predicted that the residual concentrations of these contaminants will not reach groundwater (and thus the Columbia River) within 1,000 years [d].	Yes

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).
[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).
[c] Based on the isotopic distribution of uranium in the 100 Area, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001).
[d] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), residual concentrations of total chromium, copper, lead, nickel, and zinc are predicted to migrate less than 2.6 m (8.5 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient of these contaminants [copper] of 22 mL/g. The vadose zone underlying the soil beneath the excavation is approximately 8 m (26.2 ft) thick. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and consequently are protective of the Columbia River.

COPC = contaminant of potential concern
DOE = U.S. Department of Energy
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)

The results of the verification sampling were used to make reclassification decisions for the 100-N-84:4 subsite 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 and modeling support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding RAGs established in the *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 and modeling results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft] deep) and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required.

Soil cleanup levels were established in the 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-84:4 subsite contaminants of potential concern and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron, copper, selenium, vanadium, and zinc. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for cadmium, copper, lead, manganese, selenium, 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 the concentrations of cadmium, manganese, and vanadium, are below the Hanford Site or Washington State background values, it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-N-84:4, 100-N AREA STEAM AND CONDENSATE PIPELINES

STATEMENT OF PROTECTIVENESS

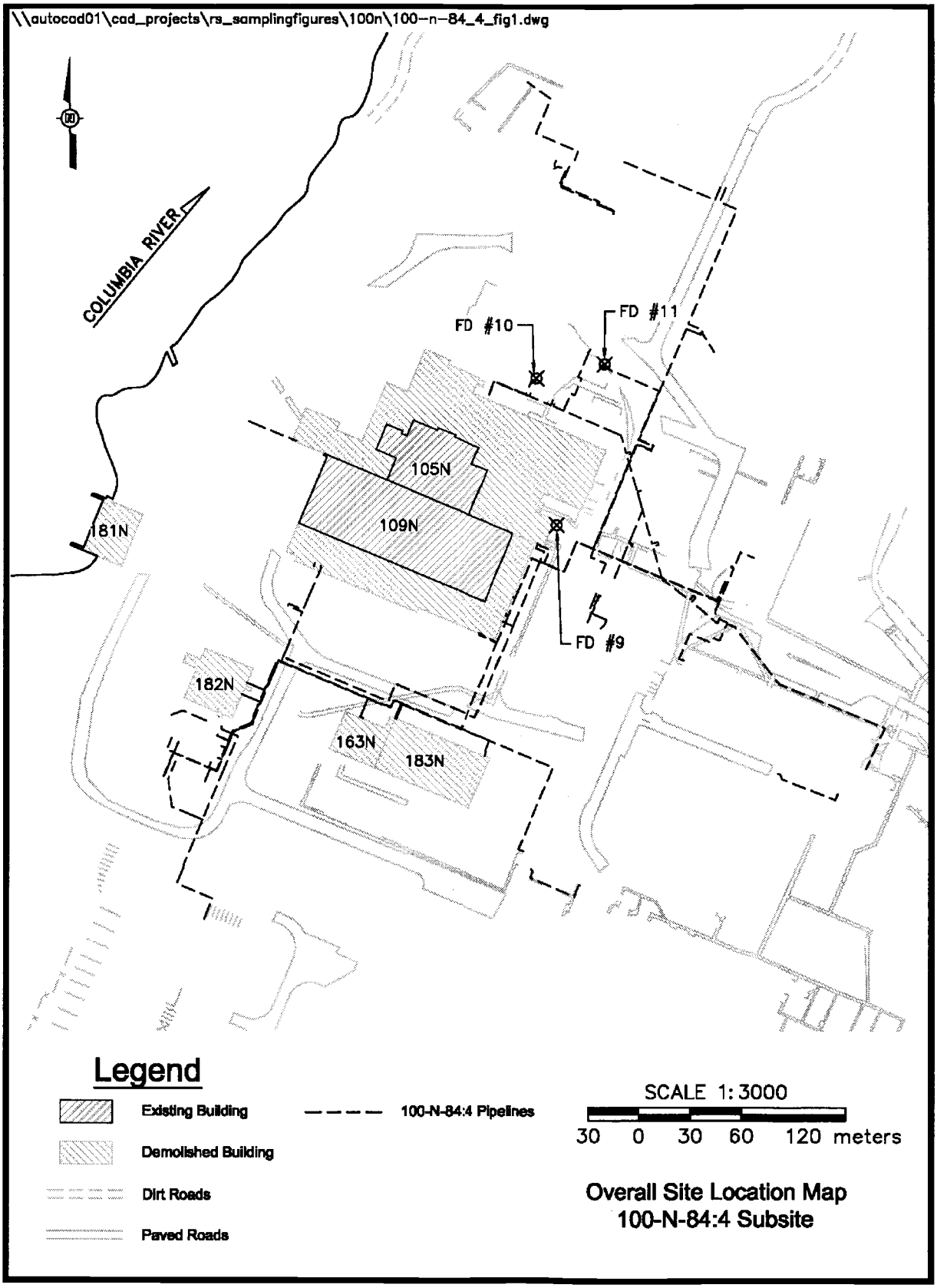
The 100-N-84:4, 100-N Area Steam and Condensate Pipelines subsite cleanup verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* (100-N Area RDR/RAWP) (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 and modeling show that residual soil concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required.

Soil cleanup levels were established in the 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-84:4 subsite contaminants of potential concern (COPCs) and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron, copper, selenium, vanadium, and zinc. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for cadmium, copper, lead, manganese, selenium, 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 the concentrations of cadmium, manganese, and vanadium, are below the Hanford Site or Washington State background values, it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-N-84:4, 100-N Area Steam and Condensate Pipelines subsite is one of ten subsites associated with the 100-N-84, 100-N Miscellaneous Pipelines waste site. The 100-N-84:4 subsite consisted of steam and condensate pipelines that were concentrated around the 105-N Reactor Building and its support facilities (Figure 1). The 100-N-84:4 subsite also included three french drains that were originally part of the 100-N-103:1 waste site. The french drains were deferred for disposition with the 100-N-84:4 subsite because they were within the planned pipeline remediation footprint or were removed during previous demolition and removal of the 105-N control room structure.

Figure 1. 100-N-84:4 Subsite Location Map.



CONFIRMATORY SAMPLING ACTIVITIES

Contaminants of Potential Concern

The COPCs for confirmatory sampling identified in the *Work Instruction for Confirmatory Sampling of the 100-N-84:4, 100-N Area Steam and Condensate Pipelines* (WCH 2010) included inductively coupled plasma (ICP) metals, mercury, and hexavalent chromium. Radionuclides, volatile organic compounds, total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAH) were listed in the work instruction as potential COPCs depending on field conditions.

Confirmatory Sample Design and Sample Results

A stratified sampling design with focused sampling of pipelines and underlying soil was used to evaluate the 100-N-84:4 subsite (WCH 2010). The 100-N-84:4 subsite included four types of process pipelines: high-pressure steam, medium-pressure steam, low-pressure steam, and vacuum pump condensate. To ensure representative sampling, at least one test pit was specified to be selected from each of the four pipeline types. Samples were specified to be collected of the pipeline contents (if present) and the underlying soil.

The intent of the confirmatory sampling design was to evaluate the potential presence of contamination in the steam and condensate pipelines or the soils where water may have leaked. Samples were to be collected from the material within the pipeline as a worst-case estimate of residual contamination associated with the pipelines themselves. Soil was to be collected from beneath the pipeline to determine if a leak associated with the pipeline may have resulted in contamination that would pose a risk to human health and the environment.

Confirmatory sampling was conducted in June and July 2011. No elevated radionuclides or industrial hygiene readings were detected at any of the test pits (WCH 2011); therefore, volatile organic analysis, gamma energy analysis, and gross alpha and gross beta analyses were not performed for any of the confirmatory samples. Table 1 is a summary of confirmatory samples collected and the requested analyses. The test pit locations are shown in Figure 2.

Based on the confirmatory sampling results, the 100-N-84:4 subsite was identified for remediation (WCH 2012). The confirmatory sampling data are provided in Appendix B.

Table 1. 100-N-84:4 Subsite Confirmatory Sample Summary Table.

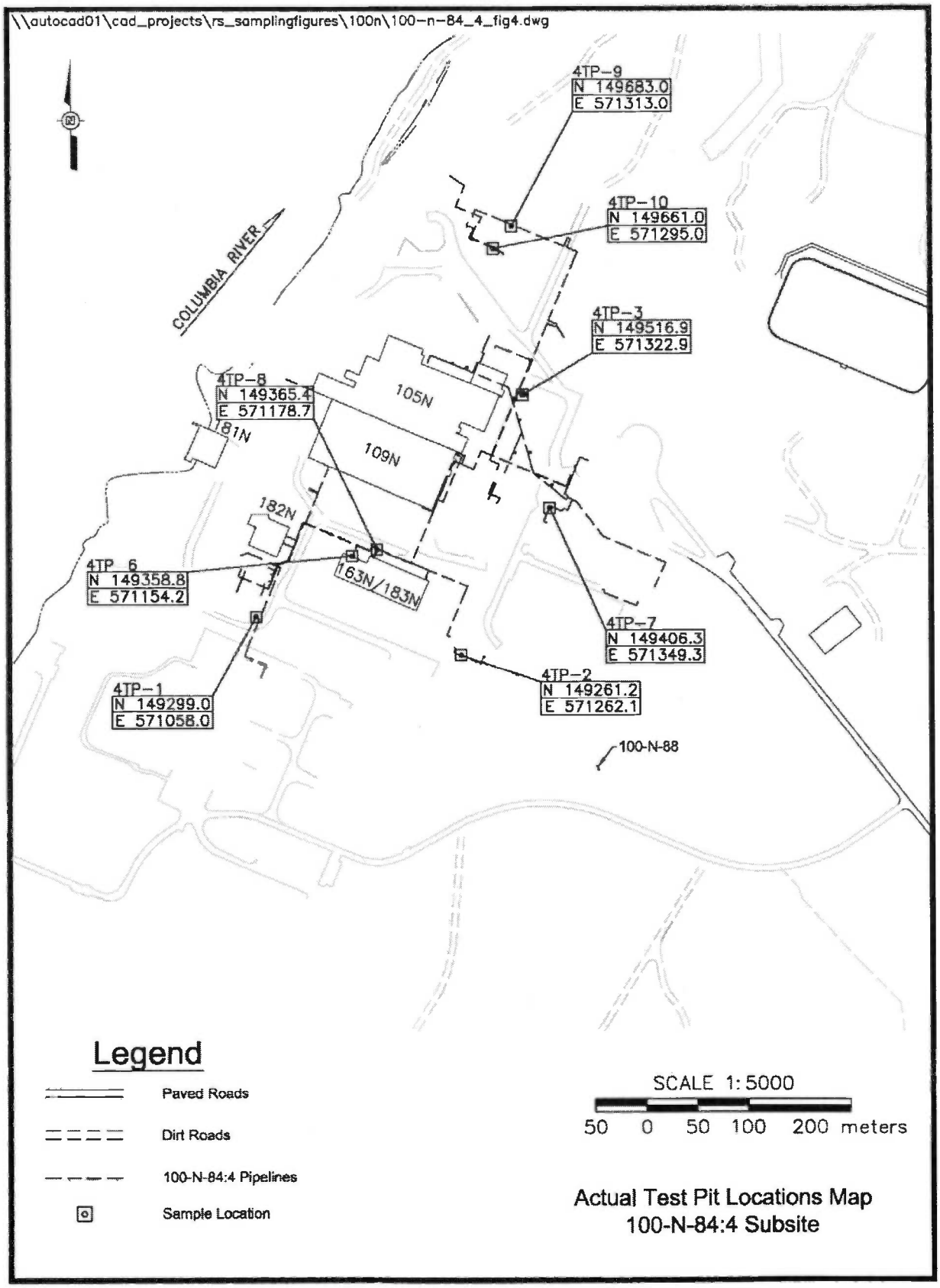
Sample Location	Sample Media	HEIS Sample Number	Sample Depth	WSP Coordinates (m)	Sample Analysis
4TP-1	Pipe contents	J1JDM8	1.5 m (5 ft)	N 149299 E 571058	ICP metals[a], mercury
		J1JDR7			Hexavalent chromium
	Soil below pipe	J1JDC8			ICP metals[a], mercury, hexavalent chromium
4TP-2	Soil, bottom of excavation, 2.4 m (8 ft) bgs, no pipe found	J1JDD0	2.4 m (8 ft)	N 149261 E 571262	ICP metals[a], mercury, hexavalent chromium
	Stained soil, no pipe found	J1JDD1			ICP metals[a], mercury, hexavalent chromium, anions, NO_2/NO_3, pH
	Duplicate of J1JDD0	J1JDD2			ICP metals[a], mercury, hexavalent chromium
4TP-3	Water inside pipe	J1JF19	1.8 m (6 ft)	N 149516 E 571322	ICP metals[a], mercury
	Water inside pipe	J1JF29			Hexavalent chromium
	Soil below pipe	J1JDF5			ICP metals[a], mercury, hexavalent chromium
4TP-6	Burnt material	J1JDR6	2.4 m (8 ft)	N 149358 E 571154	Hexavalent chromium
	Burnt material	J1JDM6			ICP metals[a], mercury, PAH, TPH
4TP-7	Water inside pipe	J1K3W6	0.9 m (3 ft)	N 149406 E 571349	ICP metals[a], mercury
	Water inside pipe	J1JF31			Hexavalent chromium
	Soil below pipe	J1JDF7			ICP metals[a], mercury, hexavalent chromium
4TP-8	Pipe contents	J1JDM7	0.9 m (3 ft)	N 149365 E 571178	ICP metals[a], mercury, PAH
	Soil below pipe	J1JDC7			ICP metals[a], mercury, hexavalent chromium
4TP-9	Water inside pipe	J1JF21	1.5 m (5 ft)	N 149683 E 571313	ICP metals[a], mercury
	Duplicate of J1JF21	J1JF22			
	Water inside pipe	J1JF35			Hexavalent chromium
	Soil below pipe	J1JDF2			ICP metals[a], mercury, hexavalent chromium
4TP-10	Pipe contents	J1JDM9	1.8 m (6 ft)	N 149661 E 571295	ICP metals[a], mercury
	Soil below pipe	J1JDF4			ICP metals[a], mercury, PAH, TPH, hexavalent chromium
Equipment blanks	Silica sand	J1JDC9	NA		ICP metals[a], mercury, hexavalent chromium
	Tape material	J1JDN0			ICP metals[a], SVOA, PAH

Source: Field logbook EL-1601-05 (WCH 2011).

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

bgs = below ground surface
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons
WSP = Washington State Plane

Figure 2. The 100-N-84:4 Confirmatory Sample Test Pit Locations.



REMEDIAL ACTION SUMMARY

Three french drains (formerly part of the 100-N-103:1, 100-N Steam Condensate French Drains waste site) were added to the 100-N-84:4 subsite because they were within the planned layback of the 100-N-84:4 pipeline remediation. French drain 9 was removed during demolition activities performed in 2009 and french drains 10 and 11 were removed and disposed with the remediation of the 100-N-84:4 pipeline subsite. The french drains are included in this closure document as interim closed out.

Several segments of the 100-N-84:4 pipeline subsite were removed with previous waste site remediations and, therefore, were not included in the 100-N-84:4 sample design for verification sampling (WCH 2014b). Figure 3 shows the segments of pipeline that were removed with previous remediations. These segments are included in this closure document as interim closed out.

The Field Remediation Closure Project continued with the remediation of the 100-N-84:4 subsite from December 2, 2013, through February 24, 2014. The depth of the remediation ranged from approximately 1.5 to 5 m (4.9 to 16.4 ft) below ground surface resulting in approximately 4,100 bank cubic meters (5,363 bank cubic yards) of soil and pipeline debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). All waste material was loaded directly from the excavation into ERDF containers for disposal; therefore, no waste staging pile area was generated for the 100-N-84:4 subsite. Additionally, there is no overburden soil stockpile associated with the 100-N-84:4 pipeline subsite. A post-remediation civil survey was conducted following remedial action activities and is provided in Figure 4. Photographs of the 100-N-84:4 remediation are provided in Figures 5 through 12.

Several in-process soil samples were collected from the 100-N-84:4 pipeline subsite during and at the completion of site remediation. The data are provided in Appendix B.

Two verification soil samples were collected at road crossing areas as described in the "Request to Verification Sample and Backfill Immediately Portions of 100-N-84 Pipeline Subsites that Cross Under Established Roadways" (WCH 2014c) agreement. The verification samples are further discussed in the "Verification Sampling Activities" section of this remaining sites verification package.

Figure 3. 100-N-84:4 Pipeline Segments Removed with Other Waste Sites.

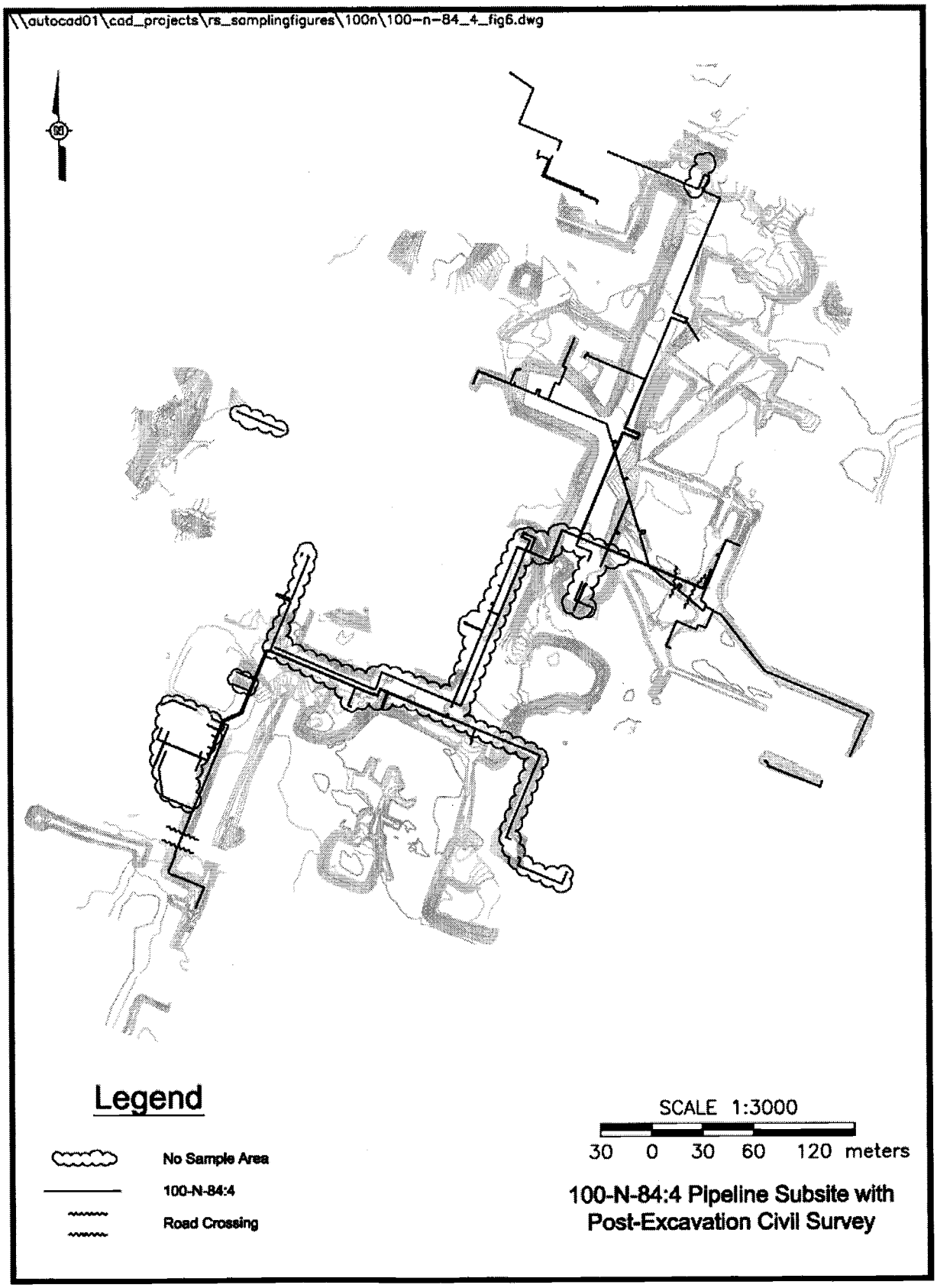


Figure 4. 100-N-84:4 Post-Excavation Civil Survey.

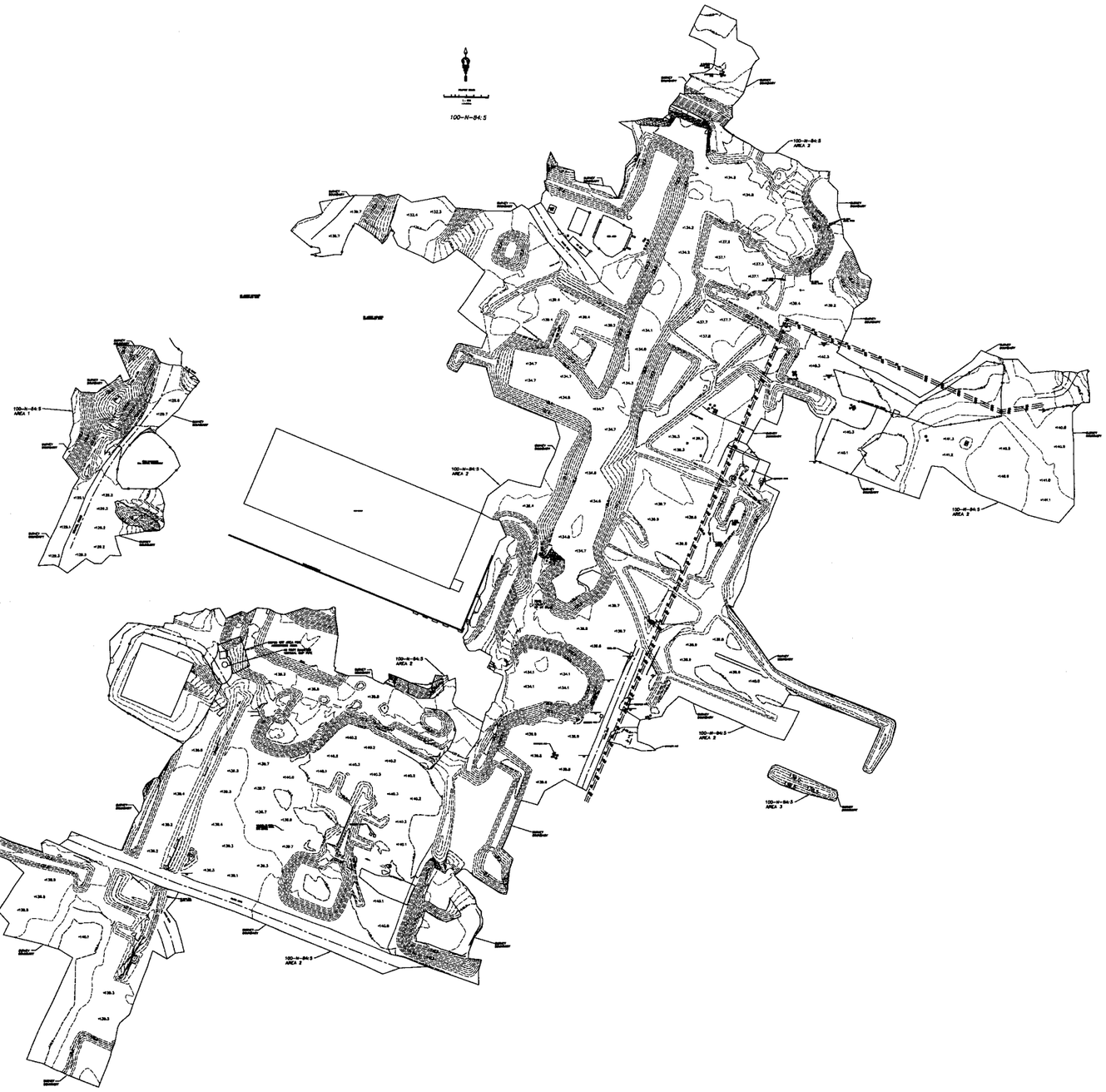


Figure 5. 100-N-84:4 Excavation, South of 105-N Reactor (December 3, 2013).

Figure 6. 100-N-84:4 Excavation and Loadout (December 4, 2013).

Figure 7. 100-N-84:4 Excavation, North of 105-N Reactor (December 12, 2013).

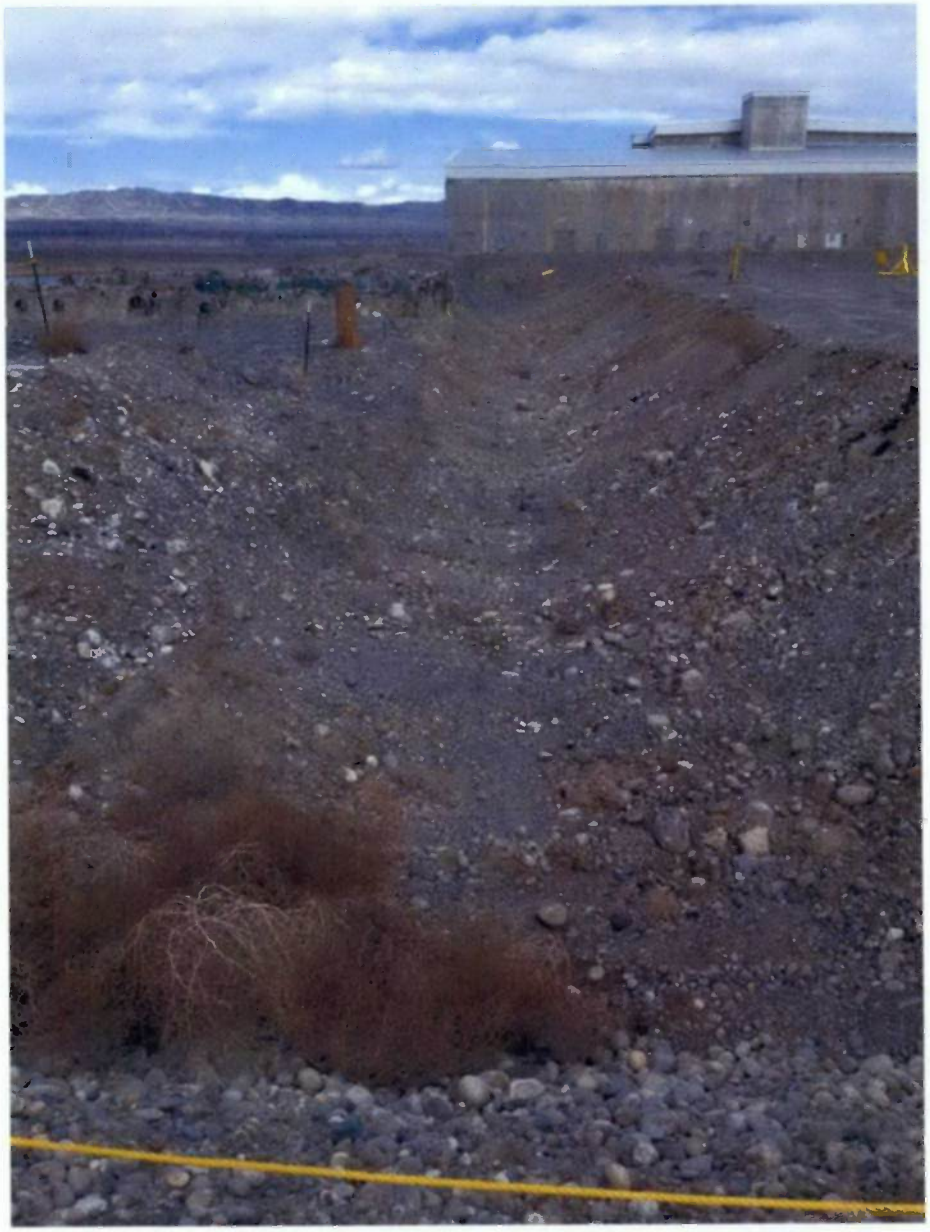
Figure 8. 100-N-84:4 Excavation Complete East of 105-N Reactor (February 3, 2014).

Figure 9. 100-N-84:4 Excavation Complete East of 105-N Reactor (February 3, 2014).

Figure 10. 100-N-84:4 Excavation North of 105-N Reactor (March 10, 2014).

Figure 11. 100-N-84:4 Excavation South of 105-N Reactor, Looking South of Road Crossing (March 10, 2014).

Figure 12. 100-N-84:4 Excavation South of 105-N Reactor, Looking North of Road Crossing (March 10, 2014).



VERIFICATION SAMPLING ACTIVITIES

Focused verification soil samples were collected on February 6 and 26, 2014, at two road crossing areas as described in the "Request to Verification Sample and Backfill Immediately Portions of 100-N-84 Pipeline Subsites that Cross Under Established Roadways" (WCH 2014c) agreement. The samples were collected to allow the area to be backfilled ahead of the normal verification sampling/closeout process. These road crossing areas were excluded from the verification sample design. The verification sample results are provided in Appendix C.

Verification soil sampling continued on May 5, 2014, per the *Work Instruction for Verification Sampling of the 100-N-84:4, 100-N Area Steam and Condensate Pipelines* (WCH 2014d). 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 remedial action goals (RAGs) for the 100-N-84:4 subsite. The following subsections provide additional discussion of the information used to develop the verification sampling design. The statistical results of verification sampling are also summarized to support interim closure of the site.

Contaminants of Potential Concern

The COPCs identified in the *Work Instruction for Confirmatory Sampling of the 100-N-84:4, 100-N Area Steam and Condensate Pipelines* (CWI) (WCH 2010) included ICP metals, mercury, and hexavalent chromium. Total petroleum hydrocarbons and PAH were identified as COPCs if oil or burnt soils/material were encountered. Although not identified in the CWI, ion chromatograph anions, and nitrate/nitrite were added as COPCs for a sample of burnt material. Radiological activity and volatile organic compounds (VOCs) were not detected in the field during confirmatory sampling; therefore, radionuclides and VOCs were not added as COPCs for this site.

Because antimony, arsenic, barium, cadmium, total chromium, copper, lead, manganese, molybdenum, nickel, selenium, zinc, and hexavalent chromium were detected above a RAG in the confirmatory samples (Appendix B), they were retained as site COPCs for verification sampling. Although not detected above a RAG, analysis for mercury was also retained. Additionally, beryllium, boron, cobalt, silver, and vanadium were included in the expanded list of ICP metals. Anions were not detected above RAGs in the sample of burnt material and were not considered COPCs for verification sampling. Total petroleum hydrocarbons and PAH were also detected above a RAG; however, asphaltic material related to former construction (roadways, parking lots, mastic, and gilsulate applications around subsurface pipelines) intersected or coincided with the pipeline remediations. In these instances, TPH and PAH associated with asphaltic materials were likely to be present above soil RAGs. Therefore, TPH and PAH were not considered site COPCs unless soil staining was observed (WCH 2014d). Soil staining was not observed during the verification sampling; therefore, TPH and PAH were not added to the list of analyses for verification sampling.

The final list of analyses for verification sampling of the 100-N-84:4 subsite included ICP metals, mercury, and hexavalent chromium.

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

Table 2. 100-N-84:4 Pipeline Subsite Laboratory Analytical Methods.

Analytical Method	Contaminants of Potential Concern
ICP metals [a] – EPA Method 6010	Antimony, arsenic, barium, cadmium, chromium, copper, lead, manganese, molybdenum, nickel, selenium, and zinc
Mercury – EPA Method 7471	Mercury
Hexavalent chromium – EPA Method 7196	Hexavalent chromium

[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.

EPA= U.S. Environmental Protection Agency

ICP = inductively coupled plasma

Verification Sample Design

The 100-N-84:4 pipeline subsite was divided into three areas for evaluation. The areas were determined based on geographical location of pipeline segments and the location of the colocated 100-N-84:2 pipeline subsite, and the pipeline segments removed with other waste sites. Figure 13 shows the three areas. The area shown in green (Area 2) consists of the 100-N-84:4 pipeline segments that were colocated with the 100-N-84:2 pipelines, the area shown in blue (Area 3) consists of the 100-N-84:4 pipeline segments that were removed and dispositioned with other waste sites, and the area shown in red (Area 1) consists of the verification sampling area for the remaining 100-N-84:4 pipeline segments.

One decision unit was identified for Area 1. Twelve statistical samples plus one duplicate and one split sample were collected from the decision unit. The sample area was restricted to a narrow segment of the excavation floor directly below and approximately 1 m (3.3 ft) on either side of the pipeline location. Two focused verification samples were collected from Area 1 at the former location of french drains 10 and 11. The french drains were formerly part of the 100-N-103:1 waste site; however, they were added to the 100-N-84:4 subsite because they were within the planned layback of the 100-N-84:4 pipeline remediation. Additionally, two focused verification samples were collected at road crossing areas. The verification sample summary is provided in Table 3.

No verification soil samples were collected from Area 2. The 100-N-84:4 pipeline segments within Area 2 were steam piping that ran parallel with the 100-N-84:2 diesel and Bunker C pipelines. The excavation to remove the 100-N-84:2 pipelines and petroleum contaminated soil extended to a minimum depth of 4.6 m (15 ft) below ground surface. Because the 100-N-84:4 pipeline was fairly shallow, sufficient soil has been removed from below the pipeline to have removed any potentially contaminated soil that may have come from the steam pipeline. Soil samples collected from the bottom of the excavated area would not be representative of the 100-N-84:4 steam pipeline segments.

No additional verification soil samples were collected from Area 3. The pipeline segments have been removed with other waste sites (WCH 2014b).

Figure 13. 100-N-84:4 Sample Areas.

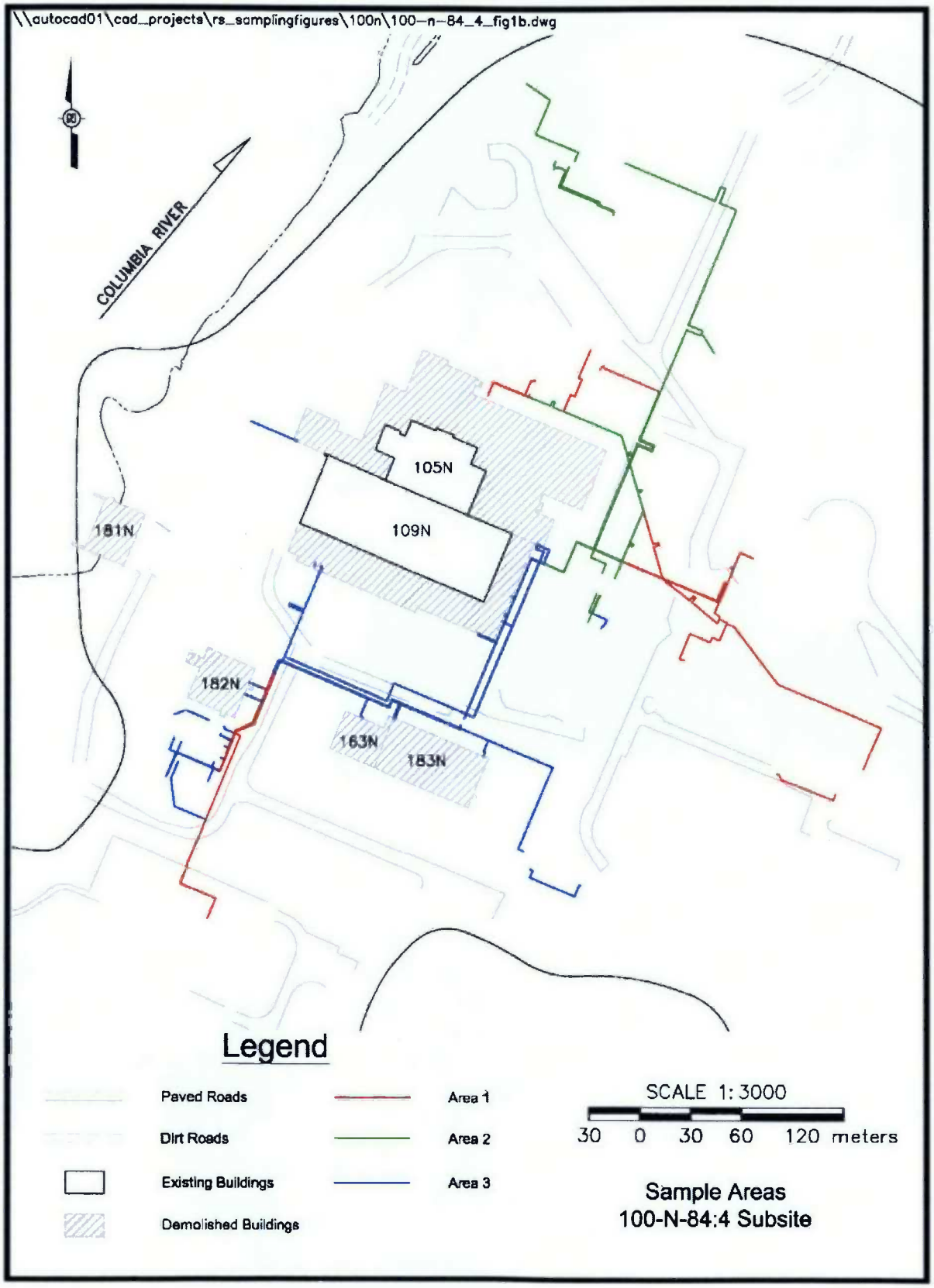


Table 3. 100-N-84:4 Waste Site Verification Sample Summary Table.

Sample Location	HEIS Sample Number	Washington State Plane Coordinates		Sample Analysis
		Northing (m)	Easting (m)	
100-N-84:4 Road Crossing Focused Verification Samples				
N-84-4a	J1T9D7	149278.5	571053.6	ICP metals [a], mercury, hexavalent chromium
N-84-4b	J1T9D8	149423.55	571354.17	
100-N-84:4 Excavation Verification Samples				
EXC-1	J1TL72	149257.6	571050.3	ICP metals [a], mercury, hexavalent chromium.
EXC-2	J1TL73	149300.1	571062.5	
EXC-3	J1TL74	149321.3	571405.7	
EXC-4	J1TL75	149353.1	571460.9	
EXC-5	J1TL76	149374.4	571411.8	
EXC-6	J1TL77	149395.6	571387.3	
EXC-7	J1TL78	149416.8	571362.8	
EXC-8	J1TL79	149438.1	571338.3	
EXC-9	J1TL80	149448.7	571332.2	
EXC-10	J1TL81	149544.2	571277.0	
EXC-11	J1TL82	149554.8	571234.1	
EXC-12	J1TL83	149554.8	571319.9	
Duplicate of EXC-3	J1TL84	149321.3	571405.7	
Split of EXC-3	J1TL88	149321.3	571405.7	
FS-1 [b]	J1TL85	149558.1	571258.8	ICP metals [a], mercury, hexavalent chromium
FS-2 [b]	J1TL86	149566.4	571299.5	
Equipment blank	J1TL87	NA	NA	ICP metals [a], mercury

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

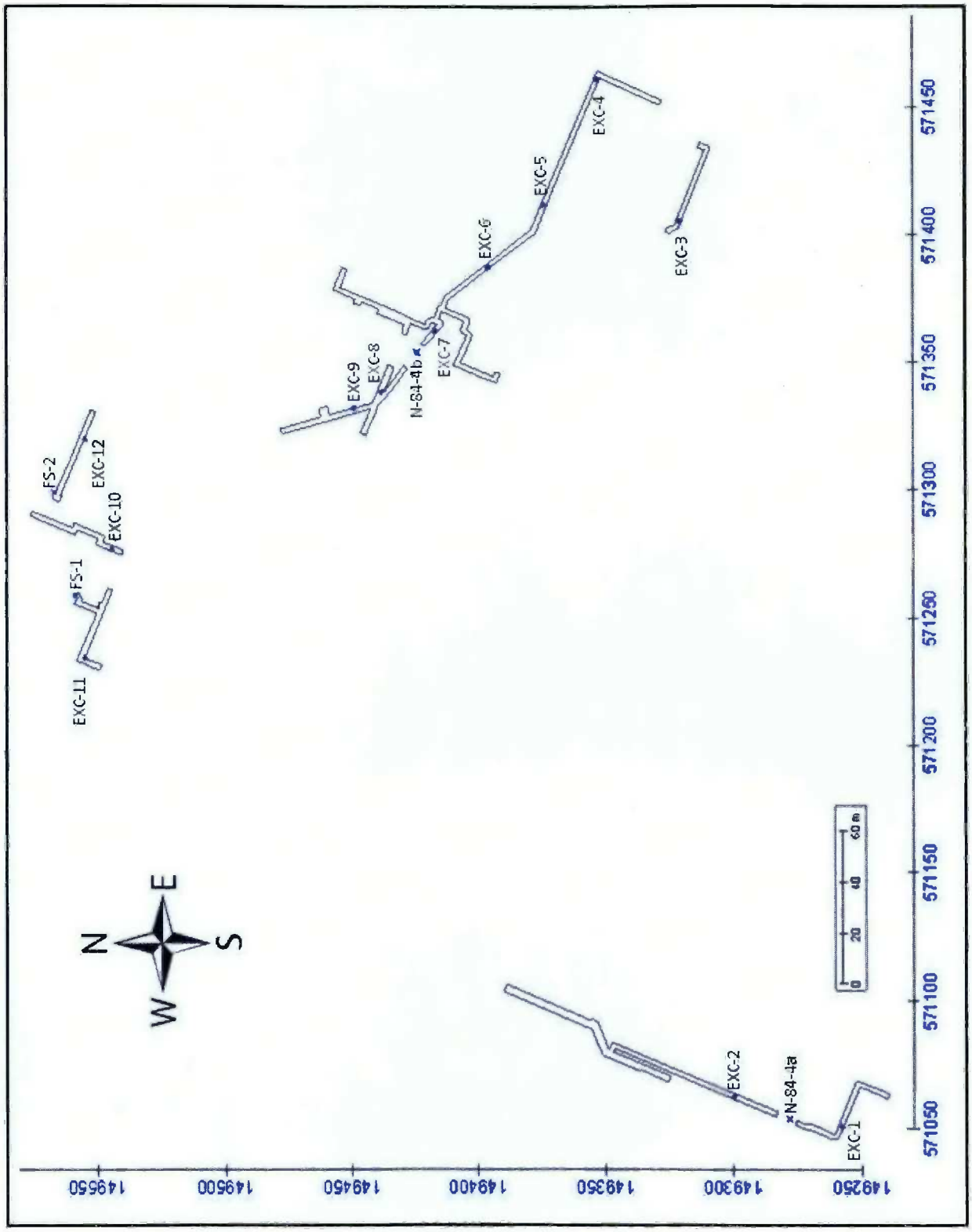
[b] Focused samples FS-1 and FS-2 are the former locations of french drains number 10 and 11, respectively.

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable

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). All samples were grab samples collected at the predetermined coordinates.

Additional information related to verification sampling can be found in the field sampling logbook (WCH 2014a). The verification sample locations are shown in Figure 14.

Figure 14. 100-N-84:4 Verification Sample Locations.



Verification Sample Results

All verification samples were collected for full protocol laboratory analysis and analyzed using EPA-approved analytical methods. Evaluation of the verification data from the 100-N-84:4 subsite was performed by direct comparison of the statistical or maximum sample results for each COPC against the cleanup criteria.

The primary statistical calculation to evaluate compliance with cleanup standards is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each detected COPC are computed for the 100-N-84:4 subsite decision unit as specified by the 100-N Area RDR/RAWP (DOE-RL 2013). The calculations are provided in Appendix C. When a nonradionuclide COPC was detected in fewer than 50% of the verification samples collected for the decision unit, the maximum detected value was used for comparison to the RAGs. If no detections for a given COPC were reported in the data set, then no statistical calculation or evaluation was performed for that COPC.

Comparisons of the results for each COPC from the 100-N-84:4 subsite against the RAGs are summarized in Tables 4 and 5. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2014) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in the 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 95% UCL calculations (Appendix C).

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-N-84:4 subsite 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

Tables 4 and 5 compare the cleanup verification sample results for the 100-N-84:4 subsite excavation to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River.

Table 4. Comparison of Contaminant Concentrations to Action Levels for the 100-N-84:4 Excavation Verification Samples.

COPC	Statistical or Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	4.3 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	69.8 (<BG)	16,000 [d]	200	400	No	--
Beryllium	0.35 (<BG)	10.4 [e]	1.51 [c]	1.51 [c]	No	--
Boron [f]	1.1	16,000 [d]	320	-- [g]	No	--
Cadmium [h]	0.15 (<BG)	13.9 [e]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	19.5	120,000 [d]	18.5 [c]	18.5 [c]	Yes	Yes [i]
Cobalt	9.2 (<BG)	1,600 [d]	32	-- [g]	No	--
Copper	16.7 (<BG)	2,960 [d]	59.2	22.0 [c]	No	--
Hexavalent chromium [f]	0.423	2.1 [e]	4.8	2	No	--
Lead	7.6 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	336 (<BG)	11,200 [d]	512 [c]	-- [g]	No	--
Mercury	0.030 (<BG)	24 [d]	0.33 [c]	0.33 [c]	No	--
Molybdenum [f]	0.60	400 [d]	8	-- [g]	No	--
Nickel	17.0 (<BG)	1,600 [d]	19.1 [c]	27.4	No	--
Selenium	0.88	400 [d]	5	1	No	--
Vanadium	52.9 (<BG)	560 [d]	85.1 [c]	-- [g]	No	--
Zinc	57.5 (<BG)	24,000 [d]	480	67.8 [c]	No	--

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

[b] Maximum or 95% UCL, depending on data censorship, as described in the *100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the 100-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] 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 total chromium 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 total chromium of 200 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 total chromium is predicted to be protective of groundwater and the Columbia River.

-- = not applicable
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Table 5. Comparison of Contaminant Concentrations to Action Levels for the 100-N-84:4 Focused Verification Samples.

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	3.8 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	95.8 (<BG)	16,000 [d]	200	400	No	--
Beryllium	0.21 (<BG)	10.4 [e]	1.51 [c]	1.51 [c]	No	--
Boron [f]	3.2	16,000 [d]	320	-- [g]	No	--
Cadmium [h]	0.39 (<BG)	13.9 [e]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	11.6 (<BG)	120,000 [d]	18.5 [c]	18.5 [c]	No	--
Cobalt	10.8 (<BG)	1,600 [d]	32	-- [g]	No	--
Copper	74.3	2,960 [d]	59.2	22.0 [c]	Yes	Yes [i]
Hexavalent chromium [f]	0.455	2.1 [e]	4.8	2	No	--
Lead	12.3	353	10.2 [c]	10.2 [c]	Yes	Yes [i]
Manganese	405 (<BG)	11,200 [d]	512 [c]	-- [g]	No	--
Mercury	0.018 (<BG)	24 [d]	0.33 [c]	0.33 [c]	No	--
Molybdenum [f]	0.31	400 [d]	8	-- [g]	No	--
Nickel	23.8	1,600 [d]	19.1 [c]	27.4	Yes	Yes [i]
Selenium	1.0	400 [d]	5	1	No	--
Vanadium	71.3 (<BG)	560 [d]	85.1 [c]	-- [g]	No	--
Zinc	104	24,000 [d]	480	67.8 [c]	Yes	Yes [i]

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

[b] Maximum results of the road crossing and french drain focused samples as described in the *100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the 100-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] Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), the residual concentrations of copper, lead, nickel, and zinc are not predicted to migrate more than 2.6 m (8.5 ft) vertically within 1,000 years (based on the contaminant with the lowest soil-partitioning coefficient [22 mL/g for copper]). The vadose zone beneath the 100-N-84:4 subsite is approximately 8 m (26.2 ft) thick. Therefore, the residual concentrations of copper, lead, nickel, and zinc are predicted to be protective of groundwater and the Columbia River.

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

All COPCs were quantified below direct exposure RAGs. All COPCs were quantified below groundwater and/or river protection soil RAGs with the exception of total chromium, copper, lead, nickel, and zinc. However, given the lowest soil-partitioning coefficient (K_d) of these contaminants (copper) of 22 mL/g, none would be expected to migrate more than 2.6 m (8.5 ft) vertically in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013). The vadose zone beneath the 100-N-84:4 subsite is approximately 8 m (26.2 ft) thick. Therefore, residual concentrations of total chromium, copper, lead, nickel, and zinc are predicted to be protective of groundwater, and thus the Columbia River.

Three-Part Test for Nonradionuclides

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

The application of the three-part test for the 100-N-84:4 subsite is included in the *100-N-84:4 Subsite Cleanup Verification 95% UCL* in Appendix C of this remaining sites verification package, where half or more of the data set was detected. The results of this evaluation indicate that residual COPC concentrations pass the three-part test in comparison against applicable RAGs with the exception of total chromium, nickel, and selenium, which fail one or more parts of the three-part test to be protective of groundwater and the Columbia River. Based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013), the residual concentrations of total chromium, nickel, and selenium are predicted to migrate less than 15 m (49.2 ft) vertically within 1,000 years (based on the contaminant with the lowest soil-partitioning coefficient [selenium] of 5 mL/g). Because the 100-N-84:4 pipelines subsite is located throughout the 100-N Area at differing elevations, a conservative approach to determining the vadose thickness was taken. A starting elevation of 131.5 m (431 ft) (pipeline segment closest to the river) was used for the entire 100-N-84:4 pipelines subsite and a maximum remediation depth of 5 m (16.4 ft) was assumed for the entire site. With the groundwater at approximately 118.5 m (389 ft), the vadose was determined to be 8 m (26.2 ft) thick, which is insufficient to show groundwater/river protection for selenium. Therefore, the vadose thickness was reevaluated in the areas surrounding the locations where selenium exceeded a groundwater/river RAG to determine if sufficient vadose zone thickness was available to show groundwater/river protection. Two locations were evaluated. The area around sample location EXC-2 had a starting elevation of 140 m (459 ft), the remediation depth was approximately 2 m (6.6 ft), and the groundwater is at 118.5 m (389 ft); therefore, the vadose thickness is 19.5 m (64 ft). The area around sample location EXC-9 had a starting elevation of 139 m (456 ft), the remediation depth was approximately 2 m (6.6 ft), and the groundwater is at 119 m (390 ft); therefore, the vadose thickness is 18 m (59 ft). Based on RESRAD modeling and a vadose thickness of 18 m (59 ft), the residual concentrations of total chromium, nickel, and selenium are predicted to be protective of groundwater and the Columbia River.

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

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative carcinogenic risk of less than 1×10^{-5}. For the 100-N-84:4 subsite, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background. All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detected levels is 5.1×10^{-2}, which is less than 1.0. The excess cancer risk for hexavalent chromium, the only contaminant subject to the excess cancer risk calculation, is 2.2×10^{-7}, which is less than the individual carcinogenic risk of less than 1×10^{-6} and the cumulative carcinogenic risk of less than 1×10^{-5}. The 100-N-84:4 subsite 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-84:4 subsite included a calculation of the hazard quotient and carcinogenic (excess cancer) risk values for groundwater protection for nonradionuclides. The requirements include an individual and cumulative hazard quotient of less than 1.0, an individual excess carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. Risk values were calculated for constituents that were detected at concentrations above Hanford Site or Washington State background values or for which there is no background value. In addition, the soil-partitioning coefficients for these contaminants must be less than that necessary to show no migration to groundwater in 1,000 years based on RESRAD modeling discussed in Appendix C of the 100-N Area RDR/RAWP (DOE-RL 2013). Based on this model and a vadose zone of approximately 8 m (26.2 ft) in thickness, a K_d of 8.8 or greater is required to show no predicted migration to groundwater in 1,000 years. All individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-N-84:4 subsite is 3.0×10^{-1}, which is less than 1.0. No carcinogenic constituents met the criteria for groundwater protection . evaluation at the 100-N-84:4 subsite; therefore, no calculations of excess carcinogenic risk were performed. Therefore, nonradionuclide risk requirements related to groundwater are met.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2014d), 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-84:4 subsite established that the data are of the right type, quality, and quantity to support site closeout decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in a WCH project-specific database for data evaluation prior to archival in HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 100-N-84:4 subsite 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-84:4 subsite to Interim Closed Out. Contamination above direct exposure levels was not observed in the shallow zone soils and is concluded to not exist in deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the sites are not required.

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WCH, 2014b, "Request to Backfill 100-N-84 Pipeline Segments," CCN 174313 to W. Elliot, Washington State Department of Ecology, and J. Chance, U.S. Department of Energy, Richland Operations Office, from D. G. Saueressig, Washington Closure Hanford, Richland, Washington, January 13.

WCH, 2014c, "Request to Verification Sample and Backfill Immediately Portions of 100-N-84 Pipeline Subsites that Cross Under Established Roadways," CCN 174966 to W. Elliott, Washington State Department of Ecology and J. Chance, U.S. Department of Energy, Richland Operations Office, from T. Q. Howell, Washington Closure Hanford, Richland, Washington, February 24.

WCH, 2014d, *Work Instruction for Verification Sampling of the 100-N-84:4, 100-N- Area Steam and Condensate Pipelines,* 0100N-WI-G0089, Rev. 0, Washington Closure Hanford, Richland, Washington.

APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-N-84:4 Subsite [a].

Hazardous Substance		2001 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Maximum Result
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
	Background	Metals (mg/kg)							
Boron	NA	0.5	NA	NA	NA	NA	NA	NA	3.2
Cadmium	0.81	4	20	14	32	140	0.77	0.36	0.39 (<BG)
Copper	22	100	50	217	70	80	28	49	74.3
Lead	10.2	50	500	118	120	1,700	11	56	12.3
Manganese	512	1,100 [d]	NA	1,500	220	450	4,300	4,000	405 (<BG)
Selenium	0.78	1	70	0.3	0.52	4.1	1.2	0.63	1.0
Vanadium	85.1	2	NA	NA	NA	NA	7.8	280	71.3 (<BG)
Zinc	67.8	86 [d]	200	360	160	120	46	79	104

NOTE: Shaded cells indicate screening values that are exceeded.

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

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

[c] Wildlife.

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

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

APPENDIX B

CONFIRMATORY AND IN-PROCESS SAMPLE DATA

APPENDIX B

CONFIRMATORY AND IN-PROCESS SAMPLE DATA

Table B-1. Confirmatory Sample Data. (7 Pages)

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Aluminum			Antimony			Arsenic			Barium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1JDC7	6/20/2011 12:05	4TP-8, soil below pipe	149365	571178	19200		7.56	0.834	B	0.91	2.31		1.51	1090		0.76
J1JDC8	6/22/2011 13:30	4TP-1, soil below pipe	149299	571058	11600		5.43	1.51		0.65	6.22		1.09	603		0.54
J1JDC9	6/28/2011 12:15	Equipment blank	NA	NA	277		5	0.6	U	0.6	1	U	1	2.45		0.5
J1JDD0	6/28/2011 12:15	4TP-2, soil below pipe	149261	571262	4840		3.39	0.406	U	0.41	2.14		0.68	44.3		0.34
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	1830		4.9	0.588	U	0.59	1.97		0.98	111		0.49
J1JDD2	6/28/2011 12:22	Duplicate J1JDD0	149261	571262	6090		4.38	0.525	U	0.53	2.25		0.88	49.5		0.44
J1JDF2	6/29/2011 8:50	4TP-9, soil below pipe	149683	571313	7780		4.96	0.596	U	0.6	3.19		0.99	57.5		0.5
J1JDF4	6/29/2011 11:00	4TP-10, soil below pipe	149661	571295	3950		3.91	0.469	U	0.47	1.75		0.78	33.4		0.39
J1JDF5	7/11/2011 14:30	4TP-3, soil below pipe	149516	571322	9910		6.09	0.73	U	0.73	3.81		1.22	433		0.61
J1JDF7	7/13/2011 12:00	4TP-7, soil below pipe	149406	571349	4030		5.83	0.7	U	0.7	1.56		1.17	31.2		0.58
J1JDM6	6/20/2011 8:10	4TP-6, burnt material	149358	571154	1060		10	1.2	U	1.2	2	U	2	17.6		1
J1JDM7	6/20/2011 11:55	4TP-8, pipe contents	149365	571178	6120		25.9	3.1	U	3.1	23.9		5.17	450		2.59
J1JDM8	6/22/2011 13:20	4TP-1, pipe contents	149299	571058	1540		53.6	6.43	U	6.43	36		10.7	26		5.36
J1JDM9	6/29/2011 10:45	4TP-10, pipe contents	149661	571295	51.7	U	51.7	6.21	U	6.21	11		10.3	5.17	U	5.17
J1JDN0	7/13/2011 11:30	Equipment blank, tape	NA	NA	203		4.39	136		0.53	0.452	B	0.88	1.96		0.44
J1JDR6	6/20/2011 8:10	4TP-6, burnt material	149358	571154												
J1JDR7	6/22/2011 13:20	4TP-1, pipe contents	149299	571058												

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Beryllium			Boron			Cadmium			Calcium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1JDC7	6/20/2011 12:05	4TP-8, soil below pipe	149365	571178	0.134	B	0.3	5.58		3.03	0.326		0.3	206000		2270
J1JDC8	6/22/2011 13:30	4TP-1, soil below pipe	149299	571058	0.094	B	0.22	7.19		2.17	0.926		0.22	143000		1630
J1JDC9	6/28/2011 12:15	Equipment blank	NA	NA	0.067	B	0.2	2	U	2	0.2	U	0.2	52.3	B	100
J1JDD0	6/28/2011 12:15	4TP-2, soil below pipe	149261	571262	0.262		0.14	0.645	B	1.35	0.092	B	0.14	5830		67.7
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	0.098	B	0.2	1.44	B	1.96	0.09	B	0.2	2410		97.9
J1JDD2	6/28/2011 12:22	Duplicate J1JDD0	149261	571262	0.292		0.18	1.31	B	1.75	0.118	B	0.18	6310		87.5
J1JDF2	6/29/2011 8:50	4TP-9, soil below pipe	149683	571313	0.271		0.2	1.45	B	1.99	0.117	B	0.2	3530		99.3
J1JDF4	6/29/2011 11:00	4TP-10, soil below pipe	149661	571295	0.191		0.16	0.716	B	1.56	0.08	B	0.16	3240		78.2
J1JDF5	7/11/2011 14:30	4TP-3, soil below pipe	149516	571322	0.173	B	0.24	5		2.43	0.383		0.24	90900		609
J1JDF7	7/13/2011 12:00	4TP-7, soil below pipe	149406	571349	0.233	U	0.23	0.716	B	2.33	0.117	B	0.23	163000		583
J1JDM6	6/20/2011 8:10	4TP-6, burnt material	149358	571154	0.268	B	0.4	25.9		4	0.135	B	0.4	1430		200
J1JDM7	6/20/2011 11:55	4TP-8, pipe contents	149365	571178	1.03	U	1.03	10.3	U	10.3	1.03	U	1.03	3980		517
J1JDM8	6/22/2011 13:20	4TP-1, pipe contents	149299	571058	2.14	U	2.14	10.2	B	21.4	2.14	U	2.14	1850		1070
J1JDM9	6/29/2011 10:45	4TP-10, pipe contents	149661	571295	2.07	U	2.07	20.7	U	20.7	2.07	U	2.07	1030	U	1030
J1JDN0	7/13/2011 11:30	Equipment blank, tape	NA	NA	0.175	U	0.18	6.31		1.75	0.071	B	0.18	55900		2110
J1JDR6	6/20/2011 8:10	4TP-6, burnt material	149358	571154												
J1JDR7	6/22/2011 13:20	4TP-1, pipe contents	149299	571058												

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Chromium			Cobalt			Copper			Hexavalent Chromium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1JDC7	6/20/2011 12:05	4TP-8, soil below pipe	149365	571178	225		0.3	14.2		3.03	22.4		1.51	3.56		0.91
J1JDC8	6/22/2011 13:30	4TP-1, soil below pipe	149299	571058	159		0.22	10.7		2.17	23.3		1.09	13.2	D	1.33
J1JDC9	6/28/2011 12:15	Equipment blank	NA	NA	0.396		0.2	2	U	2	1	U	1	0.5	U	0.5
J1JDD0	6/28/2011 12:15	4TP-2, soil below pipe	149261	571262	12.8		0.14	9.12		1.35	14.1		0.68	0.53	U	0.53
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	3.88		0.2	1.96	U	1.96	4.25		0.98	0.27	B	0.59
J1JDD2	6/28/2011 12:22	Duplicate J1JDD0	149261	571262	5.85		0.18	8.25		1.75	15.5		0.88	0.53	U	0.53
J1JDF2	6/29/2011 8:50	4TP-9, soil below pipe	149683	571313	15.7		0.2	4.98		1.99	8.37		0.99	0.52	U	0.52
J1JDF4	6/29/2011 11:00	4TP-10, soil below pipe	149661	571295	3.89		0.16	6.81		1.56	8.11		0.78	2.09	U	2.09
J1JDF5	7/11/2011 14:30	4TP-3, soil below pipe	149516	571322	84.7		0.24	9.72		2.43	21.2		1.22	0.48	B	0.65
J1JDF7	7/13/2011 12:00	4TP-7, soil below pipe	149406	571349	5.11		0.23	3.61		2.33	8.25		1.17	0.62	U	0.62
J1JDM6	6/20/2011 8:10	4TP-6, burnt material	149358	571154	3.11		0.4	4	U	4	3.99		2			
J1JDM7	6/20/2011 11:55	4TP-8, pipe contents	149365	571178	81.9		1.03	12		10.3	61.4		5.17			
J1JDM8	6/22/2011 13:20	4TP-1, pipe contents	149299	571058	148		2.14	15.7	B	21.4	152		10.7			
J1JDM9	6/29/2011 10:45	4TP-10, pipe contents	149661	571295	12.9		2.07	20.7	U	20.7	20.6		10.3			
J1JDN0	7/13/2011 11:30	Equipment blank, tape	NA	NA	0.415		0.18	1.75	U	1.75	2.7		0.88			
J1JDR6	6/20/2011 8:10	4TP-6, burnt material	149358	571154										0.154	U	0.15
J1JDR7	6/22/2011 13:20	4TP-1, pipe contents	149299	571058										0.815		0.16

Table B-1. Confirmatory Sample Data. (7 Pages)

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Iron			Lead			Magnesium			Manganese		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1JDC7	6/20/2011 12:05	4TP-8, soil below pipe	149365	571178	18300		30.3	3.06		0.76	22700		113	259		7.56
J1JDC8	6/22/2011 13:30	4TP-1, soil below pipe	149299	571058	19100		21.7	5.47		0.54	13400		81.5	213		5.43
J1JDC9	6/28/2011 12:15	Equipment blank	NA	NA	852		20	0.566		0.5	43.3	B	75	6.08		5
J1JDD0	6/28/2011 12:15	4TP-2, soil below pipe	149261	571262	23300		13.5	4.89		0.34	4310		50.8	315		3.39
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	28400		19.6	4.5		0.49	457		73.4	50		4.9
J1JDD2	6/28/2011 12:22	Duplicate J1JDD0	149261	571262	24500		17.5	4.88		0.44	4490		65.6	319		4.38
J1JDF2	6/29/2011 8:50	4TP-9, soil below pipe	149683	571313	16200		19.9	4.1		0.5	4510		74.5	223		4.96
J1JDF4	6/29/2011 11:00	4TP-10, soil below pipe	149661	571295	17200		15.6	3.02		0.39	3680		58.6	216		3.91
J1JDF5	7/11/2011 14:30	4TP-3, soil below pipe	149516	571322	27000		122	3.5		0.61	9280		91.3	306		6.09
J1JDF7	7/13/2011 12:00	4TP-7, soil below pipe	149406	571349	10700		23.3	2.66		0.58	2580		87.5	177		5.83
J1JDM6	6/20/2011 8:10	4TP-6, burnt material	149358	571154	7420		40	3.25		1	469		150	75.2		10
J1JDM7	6/20/2011 11:55	4TP-8, pipe contents	149365	571178	215000		414	14.8		2.59	4330		388	1450		25.9
J1JDM8	6/22/2011 13:20	4TP-1, pipe contents	149299	571058	580000		429	59.7		5.36	547	B	804	908		53.6
J1JDM9	6/29/2011 10:45	4TP-10, pipe contents	149661	571295	309000		207	8.91		5.17	776	U	776	977		51.7
J1JDN0	7/13/2011 11:30	Equipment blank, tape	NA	NA	128		17.5	0.385	B	0.44	1210		65.8	18.8		4.39
J1JDR6	6/20/2011 8:10	4TP-6, burnt material	149358	571154												
J1JDR7	6/22/2011 13:20	4TP-1, pipe contents	149299	571058												

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Mercury			Molybdenum			Nickel			Potassium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1JDC7	6/20/2011 12:05	4TP-8, soil below pipe	149365	571178	0.048	U	0.05	0.63	B	3.03	47.7		6.05	7110		605
J1JDC8	6/22/2011 13:30	4TP-1, soil below pipe	149299	571058	0.031	U	0.03	1.06	B	2.17	31.5		4.35	6340		435
J1JDC9	6/28/2011 12:15	Equipment blank	NA	NA	0.024	U	0.02	2	U	2	4	U	4	79.1	B	400
J1JDD0	6/28/2011 12:15	4TP-2, soil below pipe	149261	571262	0.026	U	0.03	0.382	B	1.35	25.5		2.71	741		271
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	0.029	U	0.03	0.672	B	1.96	3.92	U	3.92	1640		392
J1JDD2	6/28/2011 12:22	Duplicate J1JDD0	149261	571262	0.025	U	0.02	0.351	B	1.75	9.11		3.5	840		350
J1JDF2	6/29/2011 8:50	4TP-9, soil below pipe	149683	571313	0.026	U	0.03	0.313	B	1.99	13.5		3.97	1270		397
J1JDF4	6/29/2011 11:00	4TP-10, soil below pipe	149661	571295	0.025	U	0.02	0.485	B	1.56	15.4		3.13	609		313
J1JDF5	7/11/2011 14:30	4TP-3, soil below pipe	149516	571322	0.034	U	0.03	0.601	B	2.43	26.4		4.87	3840		487
J1JDF7	7/13/2011 12:00	4TP-7, soil below pipe	149406	571349	0.035	U	0.03	0.265	B	2.33	7.24		4.67	728		467
J1JDM6	6/20/2011 8:10	4TP-6, burnt material	149358	571154	0.047		0.03	0.563	B	4	2.48	B	8	181	B	800
J1JDM7	6/20/2011 11:55	4TP-8, pipe contents	149365	571178	0.027	U	0.03	4.94	B	10.3	28.2		20.7	1760	B	2070
J1JDM8	6/22/2011 13:20	4TP-1, pipe contents	149299	571058	0.07		0.03	20.6	B	21.4	50.4		42.9	528	B	4290
J1JDM9	6/29/2011 10:45	4TP-10, pipe contents	149661	571295	0.025	U	0.03	3.23	B	20.7	11.1	B	41.4	4140	U	4140
J1JDN0	7/13/2011 11:30	Equipment blank, tape	NA	NA				0.913	B	1.75	3.51	U	3.51	364		351
J1JDR6	6/20/2011 8:10	4TP-6, burnt material	149358	571154												
J1JDR7	6/22/2011 13:20	4TP-1, pipe contents	149299	571058												

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Selenium			Silicon			Silver			Sodium		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1JDC7	6/20/2011 12:05	4TP-8, soil below pipe	149365	571178	0.454	U	0.45	576		3.03	0.303	U	0.3	572		75.6
J1JDC8	6/22/2011 13:30	4TP-1, soil below pipe	149299	571058	0.358		0.33	269		2.17	0.217	U	0.22	558		54.3
J1JDC9	6/28/2011 12:15	Equipment blank	NA	NA	0.3	U	0.3	181		2	0.2	U	0.2	11.8	B	50
J1JDD0	6/28/2011 12:15	4TP-2, soil below pipe	149261	571262	0.203	U	0.2	266		1.35	0.135	U	0.14	376		33.9
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	0.294	U	0.29	313		1.96	0.196	U	0.2	2510		49
J1JDD2	6/28/2011 12:22	Duplicate J1JDD0	149261	571262	0.263	U	0.26	378		1.75	0.175	U	0.18	500		43.8
J1JDF2	6/29/2011 8:50	4TP-9, soil below pipe	149683	571313	0.298	U	0.3	432		1.99	0.199	U	0.2	165		49.6
J1JDF4	6/29/2011 11:00	4TP-10, soil below pipe	149661	571295	0.234	U	0.23	240		1.56	0.156	U	0.16	155		39.1
J1JDF5	7/11/2011 14:30	4TP-3, soil below pipe	149516	571322	0.365	U	0.37	818		2.43	0.243	U	0.24	1140		60.9
J1JDF7	7/13/2011 12:00	4TP-7, soil below pipe	149406	571349	0.35	U	0.35	878		2.33	0.233	U	0.23	809		58.3
J1JDM6	6/20/2011 8:10	4TP-6, burnt material	149358	571154	1.25		0.6	253		4	0.4	U	0.4	1250		100
J1JDM7	6/20/2011 11:55	4TP-8, pipe contents	149365	571178	1.55	U	1.55	228		10.3	1.03	U	1.03	571		259
J1JDM8	6/22/2011 13:20	4TP-1, pipe contents	149299	571058	3.21	U	3.21	611		21.4	2.14	U	2.14	111	B	536
J1JDM9	6/29/2011 10:45	4TP-10, pipe contents	149661	571295	3.1	U	3.1	137		20.7	2.07	U	2.07	517	U	517
J1JDN0	7/13/2011 11:30	Equipment blank, tape	NA	NA	0.486		0.26	102		1.75	0.175	U	0.18	76.9		43.9
J1JDR6	6/20/2011 8:10	4TP-6, burnt material	149358	571154												
J1JDR7	6/22/2011 13:20	4TP-1, pipe contents	149299	571058												

Table B-1. Confirmatory Sample Data. (7 Pages)

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Vanadium			Zinc		
					mg/kg	Q	PQL	mg/kg	Q	PQL
J1JDC7	6/20/2011 12:05	4TP-8, soil below pipe	149365	571178	68		3.78	55.3		15.1
J1JDC8	6/22/2011 13:30	4TP-1, soil below pipe	149299	571058	57.3		2.72	58.9		10.9
J1JDC9	6/28/2011 12:15	Equipment blank	NA	NA	0.833	B	2.5	2.81	B	10
J1JDD0	6/28/2011 12:15	4TP-2, soil below pipe	149261	571262	66.6		1.69	52		6.77
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	58.4		2.45	12.7		9.79
J1JDD2	6/28/2011 12:22	Duplicate J1JDD0	149261	571262	72.7		2.19	63.3		8.75
J1JDF2	6/29/2011 8:50	4TP-9, soil below pipe	149683	571313	35.1		2.48	34.6		9.93
J1JDF4	6/29/2011 11:00	4TP-10, soil below pipe	149661	571295	31.9		1.95	33.1		7.82
J1JDF5	7/11/2011 14:30	4TP-3, soil below pipe	149516	571322	67.2		3.04	78.4		12.2
J1JDF7	7/13/2011 12:00	4TP-7, soil below pipe	149406	571349	33.5		2.92	29.3		11.7
J1JDM6	6/20/2011 8:10	4TP-6, burnt material	149358	571154	7.53		5	11	B	20
J1JDM7	6/20/2011 11:55	4TP-8, pipe contents	149365	571178	28.8		12.9	109		51.7
J1JDM8	6/22/2011 13:20	4TP-1, pipe contents	149299	571058	12.9	B	26.8	261		107
J1JDM9	6/29/2011 10:45	4TP-10, pipe contents	149661	571295	2.95	B	25.9	103	U	103
J1JDN0	7/13/2011 11:30	Equipment blank, tape	NA	NA	0.764	B	2.19	7310		211
J1JDR6	6/20/2011 8:10	4TP-6, burnt material	149358	571154						
J1JDR7	6/22/2011 13:20	4TP-1, pipe contents	149299	571058						

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Bromide			Chloride			Fluoride		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	5.8	U	5.8	4.6	B	5.8	1.6	B	5.8

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Nitrate			Nitrite			Nitrogen in Nitrite and Nitrate		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	4.9	B	5.8	5.8	U	5.8	0.93		0.58

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Phosphate			Sulfate			pH Measurement		
					mg/kg	Q	PQL	mg/kg	Q	PQL	pH	Q	PQL
J1JDD1	6/28/2011 12:20	4TP-2, stained soil	149261	571262	11.7	U	11.7	51.7		5.8	6.92		0.1

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	TPH - diesel range			TPH - motor oil			Percent Solids		
					ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL
J1JDF4	6/29/2011 11:00	4TP-10, soil below pipe	149661	571295	295000	D	69300	618000	D	208000	95.5		0.1
J1JDM6	6/20/2011 8:10	4TP-6, burnt material	149358	571154	3740000		132000	8610000		395000			

Table B-1. Confirmatory Sample Data. (7 Pages)

Sample Number		J1JDN0			J1JDF4			J1JDM6		
Location		Special EB			100-N-84:4			100-N-84:4		
Constituent	Class	07/13/11 11:30 AM			06/29/11 11:00 AM			06/20/11 08:10 AM		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	2570000	D	19400	156	JD	170	23100	D	332
Acenaphthylene	PAH	45700	D	19400	278	D	170	332	U	332
Anthracene	PAH	19400	UD	19400	84.6	JD	170	332	U	332
Benzo(a)anthracene	PAH	19400	UD	19400	130	JD	170	604	D	332
Benzo(a)pyrene	PAH	19400	UD	19400	72	JD	170	1580	D	332
Benzo(b)fluoranthene	PAH	19400	UD	19400	170	UD	170	1280	D	332
Benzo(ghi)perylene	PAH	5450	JD	19400	170	UD	170	2230	D	332
Benzo(k)fluoranthene	PAH	19400	UD	19400	170	UD	170	349	D	332
Chrysene	PAH	19400	UD	19400	178	D	170	1220	D	332
Dibenz[a,h]anthracene	PAH	19400	UD	19400	94.8	JD	170	673	D	332
Fluoranthene	PAH	23700	D	19400	636	D	170	332	U	332
Fluorene	PAH	26800	D	19400	110	JD	170	332	U	332
Indeno(1,2,3-cd)pyrene	PAH	19400	UD	19400	170	U	170	28300	D	332
Naphthalene	PAH	6890	JD	19400	249	D	170	8860	D	332
Phenanthrene	PAH	146000	D	19400	361	D	170	2010	D	332
Pyrene	PAH	13000	JD	19400	446	D	170	1420	D	332
1,2,4-Trichlorobenzene	SVOA	30900	UD	30900						
1,2-Dichlorobenzene	SVOA	30900	UD	30900						
1,3-Dichlorobenzene	SVOA	30900	UD	30900						
1,4-Dichlorobenzene	SVOA	30900	UD	30900						
2,4,5-Trichlorophenol	SVOA	30900	UD	30900						
2,4,6-Trichlorophenol	SVOA	30900	UD	30900						
2,4-Dichlorophenol	SVOA	30900	UD	30900						
2,4-Dimethylphenol	SVOA	30900	UD	30900						
2,4-Dinitrophenol	SVOA	155000	UD	155000						
2,4-Dinitrotoluene	SVOA	30900	UD	30900						
2,6-Dinitrotoluene	SVOA	30900	UD	30900						
2-Chloronaphthalene	SVOA	30900	UD	30900						
2-Chlorophenol	SVOA	30900	UD	30900						
2-Methylnaphthalene	SVOA	30900	UD	30900						
2-Methylphenol (cresol, o-)	SVOA	30900	UD	30900						
2-Nitroaniline	SVOA	155000	UD	155000						
2-Nitrophenol	SVOA	30900	UD	30900						
3,3'-Dichlorobenzidine	SVOA	61900	UD	61900						
3+4 Methylphenol (cresol, m+p)	SVOA	30900	UD	30900						
3-Nitroaniline	SVOA	155000	UD	155000						
4,6-Dinitro-2-methylphenol	SVOA	30900	UD	30900						
4-Bromophenylphenyl ether	SVOA	30900	UD	30900						
4-Chloro-3-methylphenol	SVOA	30900	UD	30900						
4-Chloroaniline	SVOA	30900	UD	30900						
4-Chlorophenylphenyl ether	SVOA	30900	UD	30900						
4-Nitroaniline	SVOA	155000	UD	155000						
4-Nitrophenol	SVOA	155000	UD	155000						
Acenaphthene	SVOA	30900	UD	30900						
Acenaphthylene	SVOA	30900	UD	30900						
Anthracene	SVOA	30900	UD	30900						

Table B-1. Confirmatory Sample Data. (7 Pages)

Sample Number		J1JDN0			J1JDF4			J1JDM6		
Location		Special EB			100-N-84:4			100-N-84:4		
Constituent	Class	07/13/11 11:30 AM			06/29/11 11:00 AM			06/20/11 08:10 AM		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Benzo(a)anthracene	SVOA	30900	UD	30900						
Benzo(a)pyrene	SVOA	30900	UD	30900						
Benzo(b)fluoranthene	SVOA	30900	UD	30900						
Benzo(ghi)perylene	SVOA	30900	UD	30900						
Benzo(k)fluoranthene	SVOA	30900	UD	30900						
Bis(2-chloro-1-methylethyl)ether	SVOA	30900	UD	30900						
Bis(2-Chloroethoxy)methane	SVOA	30900	UD	30900						
Bis(2-chloroethyl) ether	SVOA	30900	UD	30900						
Bis(2-ethylhexyl) phthalate	SVOA	30900	UD	30900						
Butylbenzylphthalate	SVOA	30900	UD	30900						
Carbazole	SVOA	30900	UD	30900						
Chrysene	SVOA	30900	UD	30900						
Dibenz[a,h]anthracene	SVOA	30900	UD	30900						
Dibenzofuran	SVOA	30900	UD	30900						
Diethyl phthalate	SVOA	30900	UD	30900						
Dimethyl phthalate	SVOA	30900	UD	30900						
Di-n-butylphthalate	SVOA	30900	UD	30900						
Di-n-octylphthalate	SVOA	30900	UD	30900						
Fluoranthene	SVOA	30900	UD	30900						
Fluorene	SVOA	30900	UD	30900						
Hexachlorobenzene	SVOA	30900	UD	30900						
Hexachlorobutadiene	SVOA	30900	UD	30900						
Hexachlorocyclopentadiene	SVOA	30900	UD	30900						
Hexachloroethane	SVOA	30900	UD	30900						
Indeno(1,2,3-cd)pyrene	SVOA	30900	UD	30900						
Isophorone	SVOA	30900	UD	30900						
Naphthalene	SVOA	30900	UD	30900						
Nitrobenzene	SVOA	30900	UD	30900						
N-Nitroso-di-n-dipropylamine	SVOA	30900	UD	30900						
N-Nitrosodiphenylamine	SVOA	30900	UD	30900						
Pentachlorophenol	SVOA	155000	UD	155000						
Phenanthrene	SVOA	30900	UD	30900						
Phenol	SVOA	30900	UD	30900						
Pyrene	SVOA	30900	UD	30900						

Table B-1. Confirmatory Sample Data. (7 Pages)

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Aluminum			Antimony			Arsenic		
					ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
J1JF19	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322	20.4	B	50	6	U	6	10	U	10
J1JF21	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313	552		50	6	U	6	2.05	B	10
J1JF22	6/29/2011 8:47	Duplicate of 4TP-9, water inside pipe	149683	571313	213		50	6	U	6	10	U	10
J1JF29	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322									
J1JF31	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349									
J1JF35	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313									
J1K3W6	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349	74.8		50	6	U	6	10	U	10

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Barium			Beryllium			Boron		
					ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
J1JF19	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322	42.3		5	2	U	2	25.8		10
J1JF21	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313	20		5	2	U	2	118		10
J1JF22	6/29/2011 8:47	Duplicate of 4TP-9, water inside pipe	149683	571313	14.8		5	2	U	2	112		10
J1JF29	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322									
J1JF31	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349									
J1JF35	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313									
J1K3W6	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349	1.5	B	5	2	U	2	20.9		10

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Cadmium			Calcium			Chromium		
					ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
J1JF19	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322	1	U	1	8830		100	2	U	2
J1JF21	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313	1	U	1	5440		100	11		2
J1JF22	6/29/2011 8:47	Duplicate of 4TP-9, water inside pipe	149683	571313	1	U	1	5110		100	1.06	B	2
J1JF29	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322									
J1JF31	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349									
J1JF35	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313									
J1K3W6	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349	1	U	1	4480		100	7.37		2

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Cobalt			Copper			Hexavalent Chromium		
					ug/L	Q	PQL	ug/L	Q	PQL	mg/L	Q	PQL
J1JF19	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322	2	U	2	10	U	10			
J1JF21	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313	1.5	B	2	16.8		10			
J1JF22	6/29/2011 8:47	Duplicate of 4TP-9, water inside pipe	149683	571313	2	U	2	10	U	10			
J1JF29	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322							0.0037	U	0.0037
J1JF31	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349							0.0037	U	0.0037
J1JF35	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313							0.0037	U	0.0037
J1K3W6	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349	2	U	2	137		10			

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Iron			Lead			Magnesium		
					ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
J1JF19	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322	398		50	5	U	5	50.9	B	100
J1JF21	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313	31300		50	4.91	B	5	417		100
J1JF22	6/29/2011 8:47	Duplicate of 4TP-9, water inside pipe	149683	571313	4230		50	5	U	5	319		100
J1JF29	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322									
J1JF31	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349									
J1JF35	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313									
J1K3W6	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349	16500		50	45.3		5	20.7	B	100

Table B-1. Confirmatory Sample Data. (7 Pages)

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Manganese			Mercury			Molybdenum		
					ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
J1JF19	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322	93.8		2	0.2	U	0.2	23		2
J1JF21	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313	340		2	0.2	U	0.2	3.47		2
J1JF22	6/29/2011 8:47	Duplicate of 4TP-9, water inside pipe	149683	571313	80.6		2	0.2	U	0.2	2.42		2
J1JF29	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322									
J1JF31	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349									
J1JF35	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313									
J1K3W6	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349	157		2	0.2	U	0.2	2.83		2

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Nickel			Potassium			Selenium		
					ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
J1JF19	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322	5	U	5	6700		500	10	U	10
J1JF21	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313	4.06	B	5	1320		500	10	U	10
J1JF22	6/29/2011 8:47	Duplicate of 4TP-9, water inside pipe	149683	571313	0.703	B	5	1270		500	10	U	10
J1JF29	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322									
J1JF31	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349									
J1JF35	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313									
J1K3W6	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349	3.52	B	5	7170		500	10	U	10

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Silicon			Silver			Sodium		
					ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
J1JF19	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322	440		50	2	U	2	26600		100
J1JF21	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313	1040		50	2	U	2	7220		100
J1JF22	6/29/2011 8:47	Duplicate of 4TP-9, water inside pipe	149683	571313	507		50	2	U	2	7140		100
J1JF29	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322									
J1JF31	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349									
J1JF35	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313									
J1K3W6	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349	400		50	2	U	2	4880		100

Sample Number	Sample Date/Time	Sample Location	Northing	Easting	Uranium			Vanadium			Zinc		
					ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
J1JF19	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322	100	U	100	5	U	5	10	U	10
J1JF21	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313	100	U	100	2.26	B	5	12.1		10
J1JF22	6/29/2011 8:47	Duplicate of 4TP-9, water inside pipe	149683	571313	100	U	100	5	U	5	10.1		10
J1JF29	7/11/2011 14:10	4TP-3, water inside pipe	149516	571322									
J1JF31	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349									
J1JF35	6/29/2011 8:45	4TP-9, water inside pipe	149683	571313									
J1K3W6	7/13/2011 11:45	4TP-7, water inside pipe	149406	571349	100	U	100	5	U	5	25.5		10

Table B-2. In-Process Sample Data. (2 Pages)

Sample Number	Sample Date/Time	Northing	Easting	Aluminum			Antimony			Arsenic			Barium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1FHX0	3/22/2011 14:00	149651	571372	7580		1.6	0.4	U	0.4	2.8		0.69	66.6		0.08
J1T736	1/6/2014 14:25	149556.2	571233.4	5100		1.5	0.37	U	0.37	2.4		0.64	50.4		0.074
J1T737	1/6/2014 14:30	149547.6	571254.5	6450		1.7	0.41	U	0.41	3.5		0.72	50.9		0.083
J1T738	1/6/2014 14:45	149575.4	571290.8	7660		1.4	0.35	U	0.35	2.9		0.61	67.1		0.071
J1T739	1/6/2014 14:50	149550.8	571331.8	6430		1.6	0.4	U	0.4	2.8		0.69	43.1		0.079

Sample Number	Sample Date/Time	Northing	Easting	Beryllium			Boron			Cadmium			Calcium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1FHX0	3/22/2011 14:00	149651	571372	0.14	B	0.035	1.1	B	1	0.085	B	0.043	7520		14.8
J1T736	1/6/2014 14:25	149556.2	571233.4	0.29		0.032	0.95	U	0.95	0.11	B	0.04	6110		13.7
J1T737	1/6/2014 14:30	149547.6	571254.5	0.35		0.036	1.1	U	1.1	0.13	B	0.045	7320		15.3
J1T738	1/6/2014 14:45	149575.4	571290.8	0.34		0.031	1.1	B	0.91	0.16	B	0.038	7310		13.1
J1T739	1/6/2014 14:50	149550.8	571331.8	0.27		0.035	1	U	1	0.12	B	0.043	5750		14.7

Sample Number	Sample Date/Time	Northing	Easting	Chromium			Cobalt			Copper			Hexavalent Chromium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1FHX0	3/22/2011 14:00	149651	571372	13.9		0.061	7		0.1	16.3		0.23	0.146	U	0.146
J1T736	1/6/2014 14:25	149556.2	571233.4	9.7	X	0.056	7.5	X	0.097	19.3	M	0.21	0.155	U	0.155
J1T737	1/6/2014 14:30	149547.6	571254.5	16.2	X	0.063	7.6	X	0.11	16.8		0.24	0.155	U	0.155
J1T738	1/6/2014 14:45	149575.4	571290.8	11.1	X	0.054	7.5	X	0.093	16.9		0.2	0.155	U	0.155
J1T739	1/6/2014 14:50	149550.8	571331.8	6	X	0.061	6.9	X	0.1	17		0.23	0.155	U	0.155

Sample Number	Sample Date/Time	Northing	Easting	Iron			Lead			Magnesium			Manganese		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1FHX0	3/22/2011 14:00	149651	571372	17500		4	6.3		0.28	4320		3.9	300		0.1
J1T736	1/6/2014 14:25	149556.2	571233.4	17900	X	3.6	3.7		0.26	4080	X	3.6	264	X	0.097
J1T737	1/6/2014 14:30	149547.6	571254.5	18300	X	3.8	6.2		0.29	4930	X	4	279	X	0.11
J1T738	1/6/2014 14:45	149575.4	571290.8	19400	X	3.9	5		0.25	4640	X	3.4	294	X	0.093
J1T739	1/6/2014 14:50	149550.8	571331.8	17800	X	4	3.7		0.28	4040	X	3.9	254	X	0.1

Sample Number	Sample Date/Time	Northing	Easting	Mercury			Molybdenum			Nickel			Potassium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1FHX0	3/22/2011 14:00	149651	571372	0.006	U	0.006	0.29	B	0.27	11.3		0.13	1380		43
J1T736	1/6/2014 14:25	149556.2	571233.4	0.0054	U	0.0054	0.32	B	0.25	9.2	X	0.12	748		39.8
J1T737	1/6/2014 14:30	149547.6	571254.5	0.0081	B	0.0063	0.37	B	0.28	10.3	X	0.13	1090		44.6
J1T738	1/6/2014 14:45	149575.4	571290.8	0.0071	U	0.0071	0.25	B	0.24	11	X	0.11	1310		38.1
J1T739	1/6/2014 14:50	149550.8	571331.8	0.0068	B	0.0061	0.27	U	0.27	8.6	X	0.13	749		42.9

Sample Number	Sample Date/Time	Northing	Easting	Selenium			Silicon			Silver			Sodium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1FHX0	3/22/2011 14:00	149651	571372	0.9	U	0.9	240	N	5.9	0.17	U	0.17	279		61.9
J1T736	1/6/2014 14:25	149556.2	571233.4	0.83	U	0.83	207	N	5.5	0.16	U	0.16	303		57.2
J1T737	1/6/2014 14:30	149547.6	571254.5	0.94	U	0.94	362	N	6.2	0.17	U	0.17	281		64.2
J1T738	1/6/2014 14:45	149575.4	571290.8	0.8	U	0.8	517	N	5.3	0.15	U	0.15	332		54.9
J1T739	1/6/2014 14:50	149550.8	571331.8	0.9	U	0.9	385	N	5.9	0.17	U	0.17	323		61.7

Sample Number	Sample Date/Time	Northing	Easting	Vanadium			Zinc		
				mg/kg	Q	PQL	mg/kg	Q	PQL
J1FHX0	3/22/2011 14:00	149651	571372	43.5		0.099	42.9		0.42
J1T736	1/6/2014 14:25	149556.2	571233.4	56.1		0.091	50.7	NX	0.39
J1T737	1/6/2014 14:30	149547.6	571254.5	46.4		0.1	41.9	X	0.43
J1T738	1/6/2014 14:45	149575.4	571290.8	43.8		0.087	56.8	X	0.37
J1T739	1/6/2014 14:50	149550.8	571331.8	48		0.098	48	X	0.42

Table B-2. In-Process Sample Data. (2 Pages)

Sample Number		J1T736			J1T737			J1T738			J1T739			J1T7X1		
Location		100-N-84:4			100-N-84:4			100-N-84:4			100-N-84:4			100-N-84:4		
		01/06/14 02:25 PM			01/06/14 02:30 PM			01/06/14 02:45 PM			01/06/14 02:50 PM			01/21/14 07:45 AM		
Constituent	Class	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	31	JX	10	11	U	11	10	U	10	230	X	10	250	UD	250
Acenaphthylene	PAH	9.2	UN	9.2	9.7	U	9.7	9.4	U	9.4	9.3	U	9.3	230	UD	230
Anthracene	PAH	29	X	3.1	3.3	U	3.3	3.2	U	3.2	330		3.1	77	UD	77
Benzo(a)anthracene	PAH	84	N	3.3	15	J	3.4	21		3.3	690		3.3	80	UD	80
Benzo(a)pyrene	PAH	59		6.5	7.9	JX	6.9	9.6	JX	6.7	520		6.6	420	D	160
Benzo(b)fluoranthene	PAH	46	NX	4.3	13	JX	4.5	4.4	U	4.4	530		4.3	110	UD	110
Benzo(ghi)perylene	PAH	30	JNX	7.3	7.7	U	7.7	18	JX	7.5	340		7.4	180	UD	180
Benzo(k)fluoranthene	PAH	23		4	4.2	U	4.2	4.1	JX	4.1	220		4.1	99	UD	99
Chrysene	PAH	53	X	4.9	19	J	5.2	17	J	5.1	630		5	120	UD	120
Dibenz[a,h]anthracene	PAH	11	U	11	12	U	12	12	U	12	79	X	11	280	UD	280
Fluoranthene	PAH	140		13	40	J	14	49		14	1500		13	330	UD	330
Fluorene	PAH	18	JN	5.4	5.7	U	5.7	5.5	U	5.5	170		5.4	130	UD	130
Indeno(1,2,3-cd)pyrene	PAH	57	X	12	13	U	13	13	U	13	320		12	300	UD	300
Naphthalene	PAH	12	U	12	13	U	13	13	U	13	12	U	12	300	UD	300
Phenanthrene	PAH	94		12	20	J	13	55		13	990		12	300	UD	300
Pyrene	PAH	150		12	42	J	13	43		13	1400		12	300	UD	300
Aroclor-1016	PCB													2.7	U	2.7
Aroclor-1221	PCB													7.7	U	7.7
Aroclor-1232	PCB													1.9	U	1.9
Aroclor-1242	PCB													4.5	U	4.5
Aroclor-1248	PCB													4.5	U	4.5
Aroclor-1254	PCB													2.5	U	2.5
Aroclor-1260	PCB													2.5	U	2.5

Sample Number	Sample Date/Time	Northing	Easting	TPH - Diesel Range Extended to C36			TPH - Diesel Range			Percent Moisture (wet sample)		
				ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL
J1FHX0	3/22/2011 14:00	149651	571372							14.1		0
J1T736	1/6/2014 14:25	149556.2	571233.4	62000		1000	35000		710	5.4		0
J1T737	1/6/2014 14:30	149547.6	571254.5	39000		1100	21000		720	9		0
J1T738	1/6/2014 14:45	149575.4	571290.8	29000		1100	16000		720	8.1		0
J1T739	1/6/2014 14:50	149550.8	571331.8	12000		1000	8100		700	5.3		0
J1T7X1	1/21/2014 7:45			240000		2000	160000		1300	2.3		0

Sample Number	Sample Date/Time	Northing	Easting	Gross Alpha			Gross Beta			Total Beta Radiostrontium		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
J1FHX0	3/22/2011 14:00	149651	571372	13.7		6.15	30.1		4.9	0.0207	U	0.172

Sample Number	Sample Date/Time	Northing	Easting	Americium-241			Cesium-137			Cobalt-60		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
J1FHX0	3/22/2011 14:00	149651	571372	-0.0498	U	0.0701	0.00173	U	0.0398	0.00964	U	0.045

Sample Number	Sample Date/Time	Northing	Easting	Europium-152			Europium-154			Europium-155		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
J1FHX0	3/22/2011 14:00	149651	571372	-0.0322	U	0.104	-0.0193	U	0.129	0.0301	U	0.101

Sample Number	Sample Date/Time	Northing	Easting	Radium-226		
				pCi/g	Q	MDA
J1FHX0	3/22/2011 14:00	149651	571372	0.555		0.0673

APPENDIX C

CALCULATIONS

APPENDIX C

CALCULATION BRIEF

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

100-N-84:4 Subsite Cleanup Verification 95% UCL Calculation, 0100N-CA-V0270, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-N-84:4 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0100N-CA-V0271, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-N-84:4 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater, 0100N-CA-V0272, 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.

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CALCULATION COVER SHEET

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

Area: 100-N

Discipline: Environmental *Calculation No: 0100N-CA-V0270

Subject: 100-N-84:4 Subsite Cleanup Verification 95% UCL Calculation

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 = 10 Attm. 1 = 3 Total = 14	J. D. Skoglie	I. B. Berezovskiy	H. M. Sulloway	S.G. Wilkinson ~~D. F. Obenauer~~	6/10/14

SUMMARY OF REVISION

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

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie	**Date** 06/05/14	**Calc. No.** 0100N-CA-V0270	**Rev. No.** 0
Project 100-N Field Remediation	**Job No.** 14655	**Checked** I. B. Berezovskiy	**Date** 06/05/14
Subject 100-N-84:4 Subsite Cleanup Verification 95% UCL			**Sheet No.** 1 of 10

Summary

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

Table of Contents:
Sheets 1 to 4 - Calculation Sheet Summary
Sheets 5 to 7 - Calculation Sheet Verification Data - Excavation Statistical and Maximum Calculations
Sheets 8 and 9 - Ecology Software (MTCAStat) Results
Sheet 10 - Calculation Sheet Duplicate-Split Analysis
Attachment 1 - 100-N-84:4, Verification Sampling Results (3 sheets)

Given/References:
1) Sample Results (Attachment 1).
2) DOE-RL, 2006a, 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.
3) 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.
4) Ecology, 1992, Statistical Guidance for Ecology Site Managers, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
5) Ecology, 1993, Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets), Publication #92-54, Washington Department of Ecology, Olympia, Washington.
6) Ecology, 2011, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
7) EPA, 1989, Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, Part A; Interim Final, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D. C.
8) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," Washington Administrative Code.

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2013). Use data from attached worksheets to perform the 95% UCL calculation for each analyte, the WAC 173-340-740(7)(e) 3-part test for nonradionuclides, and the RPD calculations for each COC/COPC. The hazard quotient and carcinogenic risk calculations are located in a separate calculation brief as an appendix to the Remaining Sites Verification Package (RSVP).

Calculation Description:
The subject calculations were performed on statistical and focused data from soil verification samples (Attachment 1) from the 100-N-84:4 subsite. The data were entered into an EXCEL 2010 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2013) is documented by this calculation. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

Methodology:
The 100-N-84:4 subsite underwent statistical and focused sampling. The 100-N-84:4 is comprised of one decision unit; excavation (EXC), with associated focused samples FS-1, FS-2, N-84-4a, and N-84-4b.

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

Summary (continued)

Methodology, continued:

For nonradioactive analytes with ≤50% of the data below detection limits, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, as determined by direct inspection of the sample results (Attachment 1), the maximum detected value for the data set (which includes primary and duplicate samples) is used instead of the 95% UCL, and no further calculations are performed for those data sets. For convenience, these maximum detected values are included in the summary tables that follow. The 95% UCL was not calculated for data sets with no reported detections. Calculated cleanup levels are not available in (Ecology 2011) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COCs/COPCs and are also not included in these calculations.

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

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets (n < 10), the calculations are performed assuming nonparametric distribution, so no tests for distribution are performed. For nonradionuclide data sets of ten or greater, as for the subject site, distributional testing is done using Ecology's MTCAStat software (Ecology 1993). Due to differences in addressing censored data between the RDR/RAWP (DOE-RL 2013) and MTCAStat coding and due to a limitation in the MTCAStat coding (no direct capability to address variable quantitation limits within a data set), substitutions for censored data are performed before software input and the resulting data set treated as uncensored.

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

The RPD is calculated when both the primary value and either the duplicate or split 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 in Table 2-1 of the SAP (DOE-RL 2013) for certain constituents. All other constituents will have their own pre-determined TDL's 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:

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

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

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. If the RPD is greater than 30%, further investigation regarding the usability of the data is performed. To assist in the identification of anomalous sample pairs, when an analyte is detected in the primary or duplicate/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 result exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable RSVP.

Washington Closure Hanford CALCULATION SHEET

Originator J. D. Skoglie Date 06/05/14 Calc. No. 0100N-CA-V0270 Rev. No. 0
Project 100-N Field Remediation Job No. 14655 Checked I. B. Berezovskiy Date 06/05/14
Subject 100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations Sheet No. 3 of 10

Summary (continued)

QUALIFIER LIST

B = estimated result. Result is less than the RL, but greater than MDL.
C = the analyte was detected in both the sample and associated QC blank, and the sample concentration was ≤ 5X the blank concentration.
D = reported from a dilution.
J = estimate
M = sample duplicate precision not met
N = recovery exceeds upper or lower control limits.
U = undetected
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals).

ACRONYM LIST

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

Washington Closure Hanford **CALCULATION SHEET**

Originator J. D. Skoglie **Date** 06/05/14 **Calc. No.** 0100N-CA-V0270 **Rev. No.** 0
Project 100-N Field Remediation **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 06/05/14
Subject 100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 4 of 10

Summary (continued)

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

Results Summary - Excavation and Focused Samples [a]

Analyte	Excavation		Focused Samples [b]	Units
	95% UCL Result	Maximum Result	Maximum Result	
Arsenic	4.3	--	3.8	mg/kg
Barium	69.8	--	95.8	mg/kg
Beryllium	--	0.35	0.21	mg/kg
Boron	1.1		3.2	mg/kg
Cadmium	0.15	--	0.39	mg/kg
Chromium	19.5	--	11.6	mg/kg
Cobalt	9.2	--	10.8	mg/kg
Copper	16.7	--	74.3	mg/kg
Hexavalent chromium	0.423	--	0.455	mg/kg
Lead	7.6	--	12.3	mg/kg
Manganese	336	--	405	mg/kg
Mercury	--	0.030	0.018	mg/kg
Molybdenum	--	0.60	0.31	mg/kg
Nickel	17.0	--	23.8	mg/kg
Selenium	0.88	--	1.0	mg/kg
Vanadium	52.9	--	71.3	mg/kg
Zinc	57.5	--	104	mg/kg

3-Part Test Evaluation:

	EXC
95% UCL or maximum [a] > Cleanup Limit?	YES NO
> 10% above Cleanup Limit?	YES NO
Any sample > 2x Cleanup Limit?	YES NO

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

[b] Focused samples include FS-1, FS-2, and the road crossing samples N-84-4a and N-84-4b.

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

Analyte	EXC	
	Duplicate	Split
Aluminum	4.8%	14.8%
Barium	11.4%	17.7%
Calcium	10.2%	16.4%
Chromium	4.3%	16.3%
Copper	0.0%	4.5%
Iron	1.9%	0.6%
Magnesium	1.0%	8.1%
Manganese	1.5%	7.8%
Nickel	27.5%	
Silicon	9.3%	***137.9%***
Sodium	6.0%	32.8%
Vanadium	3.3%	17.7%
Zinc	0.3%	22.0%

[a]RPD listed where result produced, based on criteria. If RPD not required, no value is listed. The significance of the reported RPD values, including values greater than 30%, and greater than 35% for splits, is addressed in the data quality assessment section of the RSVP.

CALCULATION SHEET

Washington Closure Hanford
Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations

Date 06/05/14
Job No. 14655

Calc. No. 0100N-CA-V0270
Checked I. B. Berezovskiy

Rev. No. 0
Date 06/05/14
Sheet No. 5 of 10

1 **100-N-84:4 Subsite Statistical Calculations**
2 **Verification Data - Excavation (EXC)**

3	Sample	Sample	Sample	Arsenic			Barium			Boron			Cadmium			Chromium			Cobalt			Copper			Hexavalent Chromium		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5	EXC-3	J1TL74	5/5/14	2.9		0.63	56.5	JX	0.073	1.1	B	0.94	0.12	B	0.039	9.0	X	0.055	7.6	X	0.096	13.1	X	0.21	0.307		0.155
6	Duplicate of J1TL74	J1TL84	5/5/14	3.6		0.62	50.4	JX	0.071	0.97	B	0.92	0.12	B	0.039	9.4	X	0.054	8.1	X	0.094	13.1	X	0.20	0.307		0.155
7	EXC-1	J1TL72	5/5/14	2.7		0.61	124	JXM	0.071	1.7	B	0.91	0.13	B	0.038	8.1	X	0.054	7.9	X	0.093	15.5	X	0.20	0.455		0.155
8	EXC-2	J1TL73	5/5/14	9.6		0.59	61.6	JX	0.068	1.3	B	0.88	0.15	B	0.037	12.1	X	0.052	8.4	X	0.089	18.6	X	0.19	0.413		0.155
9	EXC-4	J1TL75	5/5/14	2.7		0.56	50.2	JX	0.065	0.83	U	0.83	0.10	B	0.035	7.4	X	0.049	8.2	X	0.085	12.9	X	0.18	0.508		0.155
10	EXC-5	J1TL76	5/5/14	2.1		0.58	39.3	JX	0.066	0.86	U	0.86	0.092	B	0.036	6.9	X	0.051	6.5	X	0.087	8.8	X	0.19	0.155	U	0.155
11	EXC-6	J1TL77	5/5/14	2.1		0.58	46.1	JX	0.067	0.87	U	0.87	0.092	B	0.036	4.6	X	0.051	8.9	X	0.088	13.0	X	0.19	0.321		0.155
12	EXC-7	J1TL78	5/5/14	2.5		0.59	49.6	JX	0.068	0.87	U	0.87	0.12	B	0.037	6.6	X	0.052	9.2	X	0.089	14.9	X	0.19	0.534		0.155
13	EXC-8	J1TL79	5/5/14	3.0		0.57	69.5	JX	0.065	1.3	B	0.84	0.18		0.035	11.9	X	0.050	8.6	X	0.086	15.3	X	0.19	0.280		0.155
14	EXC-9	J1TL80	5/5/14	2.5		0.59	55.2	JX	0.068	0.88	U	0.88	0.11	B	0.037	4.4	X	0.052	9.5	X	0.090	14.3	X	0.20	0.449		0.155
15	EXC-10	J1TL81	5/5/14	2.3		0.61	42.5	JX	0.070	0.91	U	0.91	0.10	B	0.038	4.0	X	0.054	9.8	X	0.092	12.0	X	0.20	0.177		0.155
16	EXC-11	J1TL82	5/5/14	3.1		0.58	66.2	JX	0.067	1.6	B	0.86	0.20		0.036	60.7	X	0.051	9.1	X	0.088	21.9	X	0.19	0.349		0.155
17	EXC-12	J1TL83	5/5/14	3.7		0.59	52.2	JX	0.068	0.99	B	0.87	0.13	B	0.036	9.8	X	0.052	9.9	X	0.089	15.6	X	0.19	0.375		0.155

18
19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Arsenic	Barium	Boron	Cadmium	Chromium	Cobalt	Copper	Hexavalent Chromium
21	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
22	EXC-3	J1TL74/ J1TL84	5/5/14	3.3	53.5	1.0	0.12	9.2	7.9	13.1	0.307
23	EXC-1	J1TL72	5/5/14	2.7	124	1.7	0.13	8.1	7.9	15.5	0.455
24	EXC-2	J1TL73	5/5/14	9.6	61.6	1.3	0.15	12.1	8.4	18.6	0.413
25	EXC-4	J1TL75	5/5/14	2.7	50.2	0.42	0.10	7.4	8.2	12.9	0.508
26	EXC-5	J1TL76	5/5/14	2.1	39.3	0.43	0.092	6.9	6.5	8.8	0.0775
27	EXC-6	J1TL77	5/5/14	2.1	46.1	0.44	0.092	4.6	8.9	13.0	0.321
28	EXC-7	J1TL78	5/5/14	2.5	49.6	0.44	0.12	6.6	9.2	14.9	0.534
29	EXC-8	J1TL79	5/5/14	3.0	69.5	1.3	0.18	11.9	8.6	15.3	0.280
30	EXC-9	J1TL80	5/5/14	2.5	55.2	0.44	0.11	4.4	9.5	14.3	0.449
31	EXC-10	J1TL81	5/5/14	2.3	42.5	0.46	0.10	4.0	9.8	12.0	0.177
32	EXC-11	J1TL82	5/5/14	3.1	66.2	1.6	0.20	60.7	9.1	21.9	0.349
33	EXC-12	J1TL83	5/5/14	3.7	52.2	0.99	0.13	9.8	9.9	15.6	0.375

34
35 **Statistical Computations**

36		Arsenic	Barium	Boron	Cadmium	Chromium	Cobalt	Copper	Hexavalent Chromium
37	95% UCL based on	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat normal distribution.
38	N	12	12	12	12	12	12	12	12
39	% < Detection limit	0%	0%	50%	0%	0%	0%	0%	8%
40	mean	3.3	59.2	0.88	0.13	12.1	8.7	14.7	0.354
41	st. dev.	2.0	22.3	0.50	0.034	15.5	0.97	3.3	0.133
42	95% UCL on mean	4.3	69.8	1.1	0.15	19.5	9.2	16.7	0.423
43	max value	9.6	124	1.7	0.20	60.7	9.9	21.9	0.534
44	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	20 DE, GW & River Protection	200 GW Protection	320 GW Protection	0.81 GW & River Protection	18.5 GW & River Protection	32 GW Protection	22.0 River Protection	2 River Protection
45	**WAC 173-340 3-PART TEST**								
46	95% UCL > Cleanup Limit?	NO	NA	NO	NA	YES	NA	NA	NO
47	> 10% above Cleanup Limit?	NO	NA	NO	NA	NO	NA	NA	NO
48	Any sample > 2X Cleanup Limit?	NO	NA	NO	NA	YES	NA	NA	NO
49	**WAC 173-340 Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (0.81 mg/kg) the WAC 173-340 3-part test is not required.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	Because all values are below background (15.7 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (22.0 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

CALCULATION SHEET

Washington Closure Hanford
Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations

Date 06/05/14
Job No. 14655

Calc. No. 0100N-CA-V0270
Checked I. B. Berezovskiy

Rev. No. 0
Date 06/05/14
Sheet No. 6 of 10

1 100-N-84:4 Subsite Statistical Calculations
2 Verification Data - Excavation (EXC)

3	Sample	Sample	Sample	Lead			Manganese			Nickel			Selenium			Vanadium			Zinc		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5	EXC-3	J1TL74	5/5/14	3.8		0.26	268	X	0.096	21.0	X	0.12	0.82	U	0.82	38.7	X	0.09	34.8	X	0.38
6	Duplicate of J1TL74	J1TL84	5/5/14	3.9		0.25	264	X	0.094	27.7	X	0.12	0.81	U	0.81	40.0	X	0.088	34.9	X	0.37
7	EXC-1	J1TL72	5/5/14	10.0	M	0.25	275	X	0.093	10.6	X	0.11	0.97		0.80	43.3	X	0.087	41.6	X	0.37
8	EXC-2	J1TL73	5/5/14	9.7		0.24	397	X	0.089	13.4	X	0.11	1.1		0.77	34.1	X	0.084	58.1	X	0.36
9	EXC-4	J1TL75	5/5/14	7.7		0.23	297	X	0.085	10.5	X	0.10	0.85		0.73	43.7	X	0.080	41.0	X	0.34
10	EXC-5	J1TL76	5/5/14	3.8		0.24	204	X	0.087	23.2	X	0.11	0.75	U	0.75	30.5	X	0.082	27.7	X	0.35
11	EXC-6	J1TL77	5/5/14	4.2		0.24	283	X	0.088	8.5	X	0.11	0.83	B	0.76	51.2	X	0.083	39.3	X	0.35
12	EXC-7	J1TL78	5/5/14	3.9		0.24	307	X	0.089	10.5	X	0.11	0.77	U	0.77	54.9	X	0.084	42.2	X	0.36
13	EXC-8	J1TL79	5/5/14	6.8		0.23	329	X	0.086	13.5	X	0.11	0.92		0.74	48.4	X	0.081	106	X	0.34
14	EXC-9	J1TL80	5/5/14	4.2		0.24	297	X	0.090	9.2	X	0.11	1.3		0.77	56.3	X	0.085	46.9	X	0.36
15	EXC-10	J1TL81	5/5/14	3.0		0.25	292	X	0.092	8.0	X	0.11	0.80	U	0.80	58.4	X	0.087	42.2	X	0.37
16	EXC-11	J1TL82	5/5/14	8.2		0.24	356	X	0.088	15.8	X	0.11	0.76	U	0.76	49.2	X	0.083	51.8	X	0.35
17	EXC-12	J1TL83	5/5/14	4.8		0.24	358	X	0.089	15.6	X	0.11	0.79	B	0.76	55.2	X	0.084	45.3	X	0.35

18
19 Statistical Computation Input Data

20	Sample	Sample	Sample	Lead	Manganese	Nickel	Selenium	Vanadium	Zinc
21	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
22	EXC-3	J1TL74/ J1TL84	5/5/14	3.9	266	24.4	0.41	39.4	34.9
23	EXC-1	J1TL72	5/5/14	10.0	275	10.6	0.97	43.3	41.6
24	EXC-2	J1TL73	5/5/14	9.7	397	13.4	1.1	34.1	58.1
25	EXC-4	J1TL75	5/5/14	7.7	297	10.5	0.85	43.7	41.0
26	EXC-5	J1TL76	5/5/14	3.8	204	23.2	0.38	30.5	27.7
27	EXC-6	J1TL77	5/5/14	4.2	283	8.5	0.83	51.2	39.3
28	EXC-7	J1TL78	5/5/14	3.9	307	10.5	0.39	54.9	42.2
29	EXC-8	J1TL79	5/5/14	6.8	329	13.5	0.92	48.4	106
30	EXC-9	J1TL80	5/5/14	4.2	297	9.2	1.3	56.3	46.9
31	EXC-10	J1TL81	5/5/14	3.0	292	8.0	0.40	58.4	42.2
32	EXC-11	J1TL82	5/5/14	8.2	356	15.8	0.38	49.2	51.8
33	EXC-12	J1TL83	5/5/14	4.8	358	15.6	0.79	55.2	45.3

34
35 Statistical Computations

36		Lead	Manganese	Nickel	Selenium	Vanadium	Zinc
37	95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
38	N	12	12	12	12	12	12
39	% < Detection limit	0%	0%	0%	42%	0%	0%
40	mean	5.8	305	13.6	0.73	47.0	48.1
41	st. dev.	2.5	50.3	5.4	0.33	9.0	19.8
42	95% UCL on mean	7.6	336	17.0	0.88	52.9	57.5
43	max value	10.0	397	27.7	1.3	58.4	106
44	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	10.2 GW & River Protection	512 GW Protection	19.1 GW Protection	1 River Protection	85.1 GW Protection	67.8 River Protection
45	**WAC 173-340 3-PART TEST**						
46	95% UCL > Cleanup Limit?	NA	NA	NO	NO	NA	NO
47	> 10% above Cleanup Limit?	NA	NA	YES	YES	NA	NO
48	Any sample > 2X Cleanup Limit?	NA	NA	NO	NO	NA	NO
49	**WAC 173-340 Compliance?**	Because all values are below background (10.2 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	Because all values are below background (85.1 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

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MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations

Date 06/05/14
Job No. 14655

Calc. No. 0100N-CA-V0270
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Rev. No. 0
Date 06/05/14
Sheet No. 7 of 10

100-N-84:4 Subsite Statistical Calculations
Verification Data - Excavation (EXC)

Sample Area	Sample Number	Sample Date	Beryllium mg/kg	Beryllium Q	Beryllium PQL	Mercury mg/kg	Mercury Q	Mercury PQL	Molybdenum mg/kg	Molybdenum Q	Molybdenum PQL
EXC-3	J1TL74	5/5/14	0.032	U	0.032	0.0057	U	0.0057	0.51	B	0.25
Duplicate of J1TL74	J1TL84	5/5/14	0.063	B	0.031	0.0050	U	0.0050	0.60	B	0.24
EXC-1	J1TL72	5/5/14	0.031	U	0.031	0.0053	U	0.0053	0.26	B	0.24
EXC-2	J1TL73	5/5/14	0.35		0.030	0.0074	B	0.0057	0.23	U	0.23
EXC-4	J1TL75	5/5/14	0.028	U	0.028	0.0061	U	0.0061	0.22	U	0.22
EXC-5	J1TL76	5/5/14	0.029	U	0.029	0.0056	U	0.0056	0.52	B	0.23
EXC-6	J1TL77	5/5/14	0.029	U	0.029	0.0060	U	0.0060	0.23	U	0.23
EXC-7	J1TL78	5/5/14	0.029	U	0.029	0.0049	U	0.0049	0.23	U	0.23
EXC-8	J1TL79	5/5/14	0.054	B	0.028	0.030		0.0057	0.22	U	0.22
EXC-9	J1TL80	5/5/14	0.030	U	0.030	0.0058	U	0.0058	0.23	U	0.23
EXC-10	J1TL81	5/5/14	0.031	U	0.031	0.0052	U	0.0052	0.24	U	0.24
EXC-11	J1TL82	5/5/14	0.067	B	0.029	0.0078	B	0.0053	0.29	B	0.23
EXC-12	J1TL83	5/5/14	0.052	B	0.029	0.0061	U	0.0061	0.23	U	0.23

Statistical Computations

	Beryllium	Mercury	Molybdenum
% < Detection limit	58%	75%	67%
Maximum value	0.35	0.030	0.60
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	1.51 GW & River Protection	0.33 GW & River Protection	8 GW Protection
3-PART TEST			
Maximum > Cleanup Limit?	NA	NA	NO
> 10% above Cleanup Limit?	NA	NA	NO
Any sample > 2X Cleanup Limit?	NA	NA	NO
3-Part Test Compliance?	Because all values are below background (1.51 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (0.33 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

CALCULATION SHEET

Washington Closure Hanford
Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations

Date 06/05/14
Job No. 14655

Calc. No. 0100N-CA-V0270
Checked I. B. Berezovskiy

Rev. No. 0
Date 06/05/14
Sheet No. 8 of 10

Ecology Software (MTCAStat) Results, 100-N-84:4 Subsite Excavation (EXC)

Arsenic 95% UCL Calculation

DATA	ID
3.3	J1TL74/ J1TL84
2.7	J1TL72
9.6	J1TL73
2.7	J1TL75
2.1	J1TL76
2.1	J1TL77
2.5	J1TL78
3.0	J1TL79
2.5	J1TL80
2.3	J1TL81
3.1	J1TL82
3.7	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	3.3
Censored		Lognormal mean	3.2
Detection limit or PQL		Std. devn.	2.0
Method detection limit		Median	2.7
TOTAL	12	Min.	2.1
		Max.	9.6

Lognormal distribution? r-squared is: 0.707
Normal distribution? r-squared is: 0.515
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 4.3

Barium 95% UCL Calculation

DATA	ID
53.5	J1TL74/ J1TL84
124	J1TL72
61.6	J1TL73
50.2	J1TL75
39.3	J1TL76
46.1	J1TL77
49.6	J1TL78
69.5	J1TL79
55.2	J1TL80
42.5	J1TL81
66.2	J1TL82
52.2	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	59.2
Censored		Lognormal mean	59.0
Detection limit or PQL		Std. devn.	22.3
Method detection limit		Median	52.8
TOTAL	12	Min.	39.3
		Max.	124

Lognormal distribution? r-squared is: 0.839
Normal distribution? r-squared is: 0.686
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 69.8

Boron 95% UCL Calculation

DATA	ID
1.0	J1TL74/ J1TL84
1.7	J1TL72
1.3	J1TL73
0.42	J1TL75
0.43	J1TL76
0.44	J1TL77
0.44	J1TL78
1.3	J1TL79
0.44	J1TL80
0.46	J1TL81
1.6	J1TL82
0.99	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	0.88
Censored		Lognormal mean	0.89
Detection limit or PQL		Std. devn.	0.50
Method detection limit		Median	0.72
TOTAL	12	Min.	0.42
		Max.	1.7

Lognormal distribution? r-squared is: 0.823
Normal distribution? r-squared is: 0.841
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 1.1

Cadmium 95% UCL Calculation

DATA	ID
0.12	J1TL74/ J1TL84
0.13	J1TL72
0.15	J1TL73
0.10	J1TL75
0.092	J1TL76
0.092	J1TL77
0.12	J1TL78
0.18	J1TL79
0.11	J1TL80
0.10	J1TL81
0.20	J1TL82
0.13	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	0.13
Censored		Lognormal mean	0.13
Detection limit or PQL		Std. devn.	0.034
Method detection limit		Median	0.12
TOTAL	12	Min.	0.092
		Max.	0.20

Lognormal distribution? r-squared is: 0.934
Normal distribution? r-squared is: 0.884
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.15

Chromium 95% UCL Calculation

DATA	ID
9.2	J1TL74/ J1TL84
8.1	J1TL72
12.1	J1TL73
7.4	J1TL75
6.9	J1TL76
4.6	J1TL77
6.6	J1TL78
11.9	J1TL79
4.4	J1TL80
4.0	J1TL81
60.7	J1TL82
9.8	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	12.1
Censored		Lognormal mean	11.2
Detection limit or PQL		Std. devn.	15.5
Method detection limit		Median	7.8
TOTAL	12	Min.	4.0
		Max.	60.7

Lognormal distribution? r-squared is: 0.792
Normal distribution? r-squared is: 0.458
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 19.5

Cobalt 95% UCL Calculation

DATA	ID
7.9	J1TL74/ J1TL84
7.9	J1TL72
8.4	J1TL73
8.2	J1TL75
6.5	J1TL76
8.9	J1TL77
9.2	J1TL78
8.6	J1TL79
9.5	J1TL80
9.8	J1TL81
9.1	J1TL82
9.9	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	8.7
Censored		Lognormal mean	8.7
Detection limit or PQL		Std. devn.	0.97
Method detection limit		Median	8.8
TOTAL	12	Min.	6.5
		Max.	9.9

Lognormal distribution? r-squared is: 0.912
Normal distribution? r-squared is: 0.944
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 9.2

Copper 95% UCL Calculation

DATA	ID
13.1	J1TL74/ J1TL84
15.5	J1TL72
18.6	J1TL73
12.9	J1TL75
8.8	J1TL76
13.0	J1TL77
14.9	J1TL78
15.3	J1TL79
14.3	J1TL80
12.0	J1TL81
21.9	J1TL82
15.6	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	14.7
Censored		Lognormal mean	14.7
Detection limit or PQL		Std. devn.	3.3
Method detection limit		Median	14.6
TOTAL	12	Min.	8.8
		Max.	21.9

Lognormal distribution? r-squared is: 0.929
Normal distribution? r-squared is: 0.920
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 16.7

Hexavalent Chromium 95% UCL Calculation

DATA	ID
0.307	J1TL74/ J1TL84
0.455	J1TL72
0.413	J1TL73
0.508	J1TL75
0.0775	J1TL76
0.321	J1TL77
0.534	J1TL78
0.280	J1TL79
0.449	J1TL80
0.177	J1TL81
0.349	J1TL82
0.375	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	0.354
Censored		Lognormal mean	0.369
Detection limit or PQL		Std. devn.	0.133
Method detection limit		Median	0.362
TOTAL	12	Min.	0.0775
		Max.	0.534

Lognormal distribution? r-squared is: 0.794
Normal distribution? r-squared is: 0.958
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.423

Lead 95% UCL Calculation

DATA	ID
3.9	J1TL74/ J1TL84
10.0	J1TL72
9.7	J1TL73
7.7	J1TL75
3.8	J1TL76
4.2	J1TL77
3.9	J1TL78
6.8	J1TL79
4.2	J1TL80
3.0	J1TL81
8.2	J1TL82
4.8	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	5.8
Censored		Lognormal mean	5.9
Detection limit or PQL		Std. devn.	2.5
Method detection limit		Median	4.5
TOTAL	12	Min.	3.0
		Max.	10.0

Lognormal distribution? r-squared is: 0.911
Normal distribution? r-squared is: 0.877
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 7.6

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations

Date 06/05/14
Job No. 14655

Calc. No. 0100N-CA-V0270
Checked I. B. Berezovskiy

Rev. No. 0
Date 06/05/14
Sheet No. 9 of 10

Ecology Software (MTCAStat) Results, 100-N-84:4 Subsite Excavation (EXC)

Manganese 95% UCL Calculation

DATA	ID
266	J1TL74/ J1TL84
275	J1TL72
397	J1TL73
297	J1TL75
204	J1TL76
283	J1TL77
307	J1TL78
329	J1TL79
297	J1TL80
292	J1TL81
356	J1TL82
358	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	305
Censored		Lognormal mean	306
Detection limit or PQL		Std. devn.	50.3
Method detection limit		Median	297
TOTAL	12	Min.	204
		Max.	397

Lognormal distribution? r-squared is: 0.928
Normal distribution? r-squared is: 0.951
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 336

Nickel 95% UCL Calculation

DATA	ID
24.4	J1TL74/ J1TL84
10.6	J1TL72
13.4	J1TL73
10.5	J1TL75
23.2	J1TL76
8.5	J1TL77
10.5	J1TL78
13.5	J1TL79
9.2	J1TL80
8.0	J1TL81
15.8	J1TL82
15.6	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	13.6
Censored		Lognormal mean	13.6
Detection limit or PQL		Std. devn.	5.4
Method detection limit		Median	12.0
TOTAL	12	Min.	8.0
		Max.	24.4

Lognormal distribution? r-squared is: 0.936
Normal distribution? r-squared is: 0.861
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 17.0

Selenium 95% UCL Calculation

DATA	ID
0.41	J1TL74/ J1TL84
0.97	J1TL72
1.1	J1TL73
0.85	J1TL75
0.38	J1TL76
0.83	J1TL77
0.39	J1TL78
0.92	J1TL79
1.3	J1TL80
0.40	J1TL81
0.38	J1TL82
0.79	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	0.73
Censored		Lognormal mean	0.74
Detection limit or PQL		Std. devn.	0.33
Method detection limit		Median	0.81
TOTAL	12	Min.	0.38
		Max.	1.3

Lognormal distribution? r-squared is: 0.859
Normal distribution? r-squared is: 0.890
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 0.88

Vanadium 95% UCL Calculation

DATA	ID
39.4	J1TL74/ J1TL84
43.3	J1TL72
34.1	J1TL73
43.7	J1TL75
30.5	J1TL76
51.2	J1TL77
54.9	J1TL78
48.4	J1TL79
56.3	J1TL80
58.4	J1TL81
49.2	J1TL82
55.2	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	47.0
Censored		Lognormal mean	47.2
Detection limit or PQL		Std. devn.	9.01
Method detection limit		Median	48.8
TOTAL	12	Min.	30.5
		Max.	58.4

Lognormal distribution? r-squared is: 0.921
Normal distribution? r-squared is: 0.951
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 52.9

Zinc 95% UCL Calculation

DATA	ID
34.9	J1TL74/ J1TL84
41.6	J1TL72
58.1	J1TL73
41.0	J1TL75
27.7	J1TL76
39.3	J1TL77
42.2	J1TL78
106	J1TL79
46.9	J1TL80
42.2	J1TL81
51.8	J1TL82
45.3	J1TL83

Number of samples		Uncensored values	
Uncensored	12	Mean	48.1
Censored		Lognormal mean	47.9
Detection limit or PQL		Std. devn.	19.8
Method detection limit		Median	42.2
TOTAL	12	Min.	27.7
		Max.	106

Lognormal distribution? r-squared is: 0.828
Normal distribution? r-squared is: 0.665
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 57.5

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie
Project 100-N Field Remediation
Subject 100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations

Date 06/05/14
Job No. 14655

Calc. No. 0100N-CA-V0270
Checked I. B. Berezovskiy

Rev. No. 0
Date 06/05/14
Sheet No. 10 of 10

Duplicate/Split Analysis - 100-N-84:4 Subsite Excavation (EXC)

Sampling Area	Sample Number	Sample Date	Aluminum			Arsenic			Barium			Boron			Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-3	J1TL74	5/5/14	6530		1.5	2.9		0.63	56.5	JX	0.073	1.1	B	0.94	0.12	B	0.039	7640	X	13.5	9.0	X	0.055	7.6	X	0.096	13.1	X	0.21
Duplicate of J1TL74	J1TL84	5/5/14	6850		1.5	3.6		0.62	50.4	JX	0.071	0.97	B	0.92	0.12	B	0.039	6900	X	13.2	9.4	X	0.054	8.1	X	0.094	13.1	X	0.20
Split of J1TL74	J1TL88	5/5/14	5630		6.75	3.32		0.496	47.3		0.0993	2.55	B	0.993	0.328	B	0.0993	6480		7.94	10.6		0.149	6.73	D	0.744	13.7		0.298

Analysis:

	TDL	5	10	2	2	0.2	100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	4.8%		11.4%			10.2%	4.3%		0.0%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	14.8%		17.7%			16.4%	16.3%		4.5%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

Duplicate/Split Analysis - 100-N-84:4 Subsite Excavation (EXC)

Sampling Area	Sample Number	Sample Date	Hexavalent Chromium			Iron			Lead			Magnesium			Manganese			Molybdenum			Nickel			Potassium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-3	J1TL74	5/5/14	0.307		0.155	16100	X	3.6	3.8		0.26	4090	X	3.5	268	X	0.096	0.51	B	0.25	21.0	X	0.12	1130		39.2	213	J	5.4
Duplicate of J1TL74	J1TL84	5/5/14	0.307		0.155	15800	X	3.6	3.9		0.25	4130	X	3.5	264	X	0.094	0.60	B	0.24	27.7	X	0.12	1190		38.5	194	J	5.3
Split of J1TL74	J1TL88	5/5/14	0.119	U	0.119	16200		7.94	4.20	BD	1.64	3770		8.44	248		0.199	0.199	U	0.199	10.0		0.149	1120		6.35	1160	N	1.49

Analysis:

	TDL	0.5	5	5	75	5	2	4	400	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		1.9%		1.0%	1.5%		27.5%		9.3%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable
Split Analysis	Both > PQL?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?		Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		0.6%		8.1%	7.8%				*137.9%*
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	Yes - assess further	No - acceptable	Not applicable

Duplicate/Split Analysis - 100-N-84:4 Subsite Excavation (EXC)

Sampling Area	Sample Number	Sample Date	Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-3	J1TL74	5/5/14	940		56.4	38.7	X	0.090	34.8	X	0.38
Duplicate of J1TL74	J1TL84	5/5/14	998		55.4	40.0	X	0.088	34.9	X	0.37
Split of J1TL74	J1TL88	5/5/14	675		6.95	46.2	D	0.496	43.4	D	1.99

Analysis:

	TDL	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD	6.0%	3.3%	0.3%
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD	*32.8%*	17.7%	22.0%
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable

Attachment 1. 100-N-84:4 Subsite Verification Sample Results (Metals and Physical).

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
EXC-3	J1TL74	5/5/14	6530		1.5	0.36	UJ	0.36	2.9		0.63	56.5	JX	0.073	0.032	U	0.032
Duplicate of J1TL74	J1TL84	5/5/14	6850		1.5	0.36	UJ	0.36	3.6		0.62	50.4	JX	0.071	0.063	B	0.031
EXC-1	J1TL72	5/5/14	6650		1.4	0.35	UJ	0.35	2.7		0.61	124	JXM	0.071	0.031	U	0.031
EXC-2	J1TL73	5/5/14	10700		1.4	0.34	UJ	0.34	9.6		0.59	61.6	JX	0.068	0.35		0.030
EXC-4	J1TL75	5/5/14	6470		1.3	0.32	UJ	0.32	2.7		0.56	50.2	JX	0.065	0.028	U	0.028
EXC-5	J1TL76	5/5/14	4720		1.4	0.33	UJ	0.33	2.1		0.58	39.3	JX	0.066	0.029	U	0.029
EXC-6	J1TL77	5/5/14	4860		1.4	0.34	UJ	0.34	2.1		0.58	46.1	JX	0.067	0.029	U	0.029
EXC-7	J1TL78	5/5/14	5420		1.4	0.34	UJ	0.34	2.5		0.59	49.6	JX	0.068	0.029	U	0.029
EXC-8	J1TL79	5/5/14	7510		1.3	0.33	UJ	0.33	3.0		0.57	69.5	JX	0.065	0.054	B	0.028
EXC-9	J1TL80	5/5/14	5610		1.4	0.34	UJ	0.34	2.5		0.59	55.2	JX	0.068	0.030	U	0.030
EXC-10	J1TL81	5/5/14	4320		1.4	0.35	UJ	0.35	2.3		0.61	42.5	JX	0.070	0.031	U	0.031
EXC-11	J1TL82	5/5/14	7810		1.4	0.33	UJ	0.33	3.1		0.58	66.2	JX	0.067	0.067	B	0.029
EXC-12	J1TL83	5/5/14	8020		1.4	0.34	UJ	0.34	3.7		0.59	52.2	JX	0.068	0.052	B	0.029
Split of J1TL74	J1TL88	5/5/14	5630		6.75	1.64	DU	1.64	3.32		0.496	47.3		0.0993	0.294	B	0.0993
N-84-4a	J1T9D7	2/6/14	5730		7.3	0.36	U	0.36	2.8		0.62	56.9		0.36	0.074	B	0.031
N-84-4b	J1T9D8	2/26/14	7860		1.5	0.37	U	0.37	2.9		0.64	69.6		0.074	0.18	B	0.032
FS-1	J1TL85	5/5/14	11200		1.4	0.35	UJ	0.35	3.8		0.61	95.8	JX	0.070	0.21		0.030
FS-2	J1TL86	5/5/14	7610		1.5	0.36	UJ	0.36	3.4		0.63	84.0	JX	0.072	0.054	B	0.031
Equipment Blank	J1TL87	5/5/14	234		1.3	0.33	UJ	0.33	0.57	U	0.57	2.3	JX	0.066	0.063	B	0.029

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
EXC-3	J1TL74	5/5/14	1.1	B	0.94	0.12	B	0.039	7640	X	13.5	9.0	X	0.055	7.6	X	0.096
Duplicate of J1TL74	J1TL84	5/5/14	0.97	B	0.92	0.12	B	0.039	6900	X	13.2	9.4	X	0.054	8.1	X	0.094
EXC-1	J1TL72	5/5/14	1.7	B	0.91	0.13	B	0.038	6760	X	13.1	8.1	X	0.054	7.9	X	0.093
EXC-2	J1TL73	5/5/14	1.3	B	0.88	0.15	B	0.037	17900	X	12.6	12.1	X	0.052	8.4	X	0.089
EXC-4	J1TL75	5/5/14	0.83	U	0.83	0.10	B	0.035	4760	X	12.0	7.4	X	0.049	8.2	X	0.085
EXC-5	J1TL76	5/5/14	0.86	U	0.86	0.092	B	0.036	3930	X	12.3	6.9	X	0.051	6.5	X	0.087
EXC-6	J1TL77	5/5/14	0.87	U	0.87	0.092	B	0.036	5110	X	12.5	4.6	X	0.051	8.9	X	0.088
EXC-7	J1TL78	5/5/14	0.87	U	0.87	0.12	B	0.037	8100	X	12.6	6.6	X	0.052	9.2	X	0.089
EXC-8	J1TL79	5/5/14	1.3	B	0.84	0.18		0.035	5780	X	12.1	11.9	X	0.050	8.6	X	0.086
EXC-9	J1TL80	5/5/14	0.88	U	0.88	0.11	B	0.037	5110	X	12.7	4.4	X	0.052	9.5	X	0.090
EXC-10	J1TL81	5/5/14	0.91	U	0.91	0.10	B	0.038	5020	X	13.0	4.0	X	0.054	9.8	X	0.092
EXC-11	J1TL82	5/5/14	1.6	B	0.86	0.20		0.036	7720	X	12.4	60.7	X	0.051	9.1	X	0.088
EXC-12	J1TL83	5/5/14	0.99	B	0.87	0.13	B	0.036	8150	X	12.5	9.8	X	0.052	9.9	X	0.089
Split of J1TL74	J1TL88	5/5/14	2.55	B	0.993	0.328	B	0.0993	6480		7.94	10.6		0.149	6.73	D	0.744
N-84-4a	J1T9D7	2/6/14	0.92	U	0.92	0.13	B	0.038	5910	X	13.2	5.6		0.27	10.8		0.47
N-84-4b	J1T9D8	2/26/14	1.0	B	0.95	0.16	B	0.040	5710	X	13.7	10.7		0.056	8.2	X	0.097
FS-1	J1TL85	5/5/14	1.2	B	0.90	0.30		0.038	9650	X	13.0	11.1	X	0.053	10.1	X	0.092
FS-2	J1TL86	5/5/14	3.2		0.93	0.39		0.039	7650	X	13.4	11.6	X	0.055	8.1	X	0.095
Equipment Blank	J1TL87	5/5/14	0.85	U	0.85	0.036	U	0.036	44.5	X	12.3	0.22	X	0.050	0.11	BX	0.087

Attachment	1	Sheet No.	1 of 3
Originator	J. D. Skoglie	Date	6/5/14
Checked	I. B. Berezovskiy	Date	6/5/14
Calc. No.	0100N-CA-V0270	Rev. No.	0

B = blank contamination (inorganic constituents)
C = </= 5x blank concentration
D = reported from a dilution.
EXC = excavation
FS = focused sample
HEIS = Hanford Environmental Information System
J = estimate
M = duplicate precision not met.
N = recovery outside control limits
PQL = practical quantitation limit
Q = qualifier
U = undetected
X = >40% difference between primary and confirmation dector results.

Attachment 1. 100-N-84:4 Subsite Verification Sample Results (Metals and Physical).

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
EXC-3	J1TL74	5/5/14	13.1	JX	0.21	0.307		0.155	16100	X	3.6	3.8		0.26	4090	X	3.5
Duplicate of J1TL74	J1TL84	5/5/14	13.1	JX	0.20	0.307		0.155	15800	X	3.6	3.9		0.25	4130	X	3.5
EXC-1	J1TL72	5/5/14	15.5	JX	0.20	0.455		0.155	18700	X	3.5	10.0	M	0.25	4260	X	3.4
EXC-2	J1TL73	5/5/14	18.6	JX	0.19	0.413		0.155	20100	X	3.4	9.7		0.24	7280	X	3.3
EXC-4	J1TL75	5/5/14	12.9	JX	0.18	0.508		0.155	20000	X	3.2	7.7		0.23	4690	X	3.2
EXC-5	J1TL76	5/5/14	8.8	JX	0.19	0.155	U	0.155	12300	X	3.3	3.8		0.24	2670	X	3.2
EXC-6	J1TL77	5/5/14	13.0	JX	0.19	0.321		0.155	21400	X	3.4	4.2		0.24	4040	X	3.3
EXC-7	J1TL78	5/5/14	14.9	JX	0.19	0.534		0.155	22500	X	3.4	3.9		0.24	4990	X	3.3
EXC-8	J1TL79	5/5/14	15.3	JX	0.19	0.280		0.155	21300	X	3.3	6.8		0.23	4540	X	3.2
EXC-9	J1TL80	5/5/14	14.3	JX	0.20	0.449		0.155	24300	X	3.4	4.2		0.24	4190	X	3.3
EXC-10	J1TL81	5/5/14	12.0	JX	0.20	0.177		0.155	24700	X	3.5	3.0		0.25	4400	X	3.4
EXC-11	J1TL82	5/5/14	21.9	JX	0.19	0.349		0.155	23000	X	3.3	8.2		0.24	5020	X	3.2
EXC-12	J1TL83	5/5/14	15.6	JX	0.19	0.375		0.155	22900	X	3.4	4.8		0.24	6210	X	3.3
Split of J1TL74	J1TL88	5/5/14	13.7		0.298	0.119	U	0.119	16200		7.94	4.20	BD	1.64	3770		8.44
N-84-4a	J1T9D7	2/6/14	16.2		1.0				28800		17.8	3.8		1.3	4870		17.4
N-84-4b	J1T9D8	2/26/14	18.5		0.21	0.293		0.155	20600	X	3.7	6.3		0.26	4540		3.6
FS-1	J1TL85	5/5/14	74.3	JX	0.20	0.455		0.155	24600	X	3.5	12.3		0.25	6490	X	3.4
FS-2	J1TL86	5/5/14	19.0	JX	0.21	0.178		0.155	20300	X	3.6	7.3		0.26	4230	X	3.5
Equipment Blank	J1TL87	5/5/14	0.56	UJBXC	0.19				572	X	3.3	0.42	B	0.23	51.8	X	3.2

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
EXC-3	J1TL74	5/5/14	268	X	0.096	0.0057	U	0.0057	0.51	B	0.25	21.0	X	0.12	1130		39.2
Duplicate of J1TL74	J1TL84	5/5/14	264	X	0.094	0.0050	U	0.0050	0.60	B	0.24	27.7	X	0.12	1190		38.5
EXC-1	J1TL72	5/5/14	275	X	0.093	0.0053	U	0.0053	0.26	B	0.24	10.6	X	0.11	1050		38.1
EXC-2	J1TL73	5/5/14	397	X	0.089	0.0074	B	0.0057	0.23	U	0.23	13.4	X	0.11	1950		36.7
EXC-4	J1TL75	5/5/14	297	X	0.085	0.0061	U	0.0061	0.22	U	0.22	10.5	X	0.10	1200		34.9
EXC-5	J1TL76	5/5/14	204	X	0.087	0.0056	U	0.0056	0.52	B	0.23	23.2	X	0.11	819		35.9
EXC-6	J1TL77	5/5/14	283	X	0.088	0.0060	U	0.0060	0.23	U	0.23	8.5	X	0.11	787		36.3
EXC-7	J1TL78	5/5/14	307	X	0.089	0.0049	U	0.0049	0.23	U	0.23	10.5	X	0.11	723		36.6
EXC-8	J1TL79	5/5/14	329	X	0.086	0.030		0.0057	0.22	U	0.22	13.5	X	0.11	1470		35.3
EXC-9	J1TL80	5/5/14	297	X	0.090	0.0058	U	0.0058	0.23	U	0.23	9.2	X	0.11	781		36.9
EXC-10	J1TL81	5/5/14	292	X	0.092	0.0052	U	0.0052	0.24	U	0.24	8.0	X	0.11	676		37.9
EXC-11	J1TL82	5/5/14	356	X	0.088	0.0078	B	0.0053	0.29	B	0.23	15.8	X	0.11	1420		36.0
EXC-12	J1TL83	5/5/14	358	X	0.089	0.0061	U	0.0061	0.23	U	0.23	15.6	X	0.11	1270		36.5
Split of J1TL74	J1TL88	5/5/14	248		0.199	0.00414	U	0.00414	0.199	U	0.199	10.0		0.149	1120		6.35
N-84-4a	J1T9D7	2/6/14	344		0.47	0.0056	U	0.0056	0.24	B	0.24	7.8	X	0.12	768		38.5
N-84-4b	J1T9D8	2/26/14	316	X	0.097	0.018	M	0.0060	0.31	B	0.25	14.6	X	0.12	1450		39.7
FS-1	J1TL85	5/5/14	405	X	0.092	0.0093	B	0.0055	0.24	U	0.24	23.8	X	0.11	1750		37.8
FS-2	J1TL86	5/5/14	326	X	0.095	0.0060	U	0.0060	0.25	U	0.25	12.5	X	0.12	1410		38.9
Equipment Blank	J1TL87	5/5/14	6.5	X	0.087	0.0054	U	0.0054	0.23	U	0.23	0.47	BX	0.11	48.4	B	35.7

Attachment	1	Sheet No.	2 of 3
Originator	J. D. Skoglie	Date	6/5/14
Checked	I. B. Berezovskiy	Date	6/5/14
Calc. No.	0100N-CA-V0270	Rev. No.	0

Attachment 1. 100-N-84:4 Subsite Verification Sample Results (Metals and Physical).

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
EXC-3	J1TL74	5/5/14	0.82	U	0.82	213	J	5.4	0.15	U	0.15	940		56.4	38.7	X	0.090
Duplicate of J1TL74	J1TL84	5/5/14	0.81	U	0.81	194	J	5.3	0.15	U	0.15	998		55.4	40.0	X	0.088
EXC-1	J1TL72	5/5/14	0.97		0.80	144	J	5.3	0.15	U	0.15	373		54.8	43.3	X	0.087
EXC-2	J1TL73	5/5/14	1.1		0.77	217	J	5.1	0.14	U	0.14	284		52.8	34.1	X	0.084
EXC-4	J1TL75	5/5/14	0.85		0.73	148	J	4.8	0.14	U	0.14	1220		50.3	43.7	X	0.080
EXC-5	J1TL76	5/5/14	0.75	U	0.75	107	J	4.9	0.14	U	0.14	558		51.6	30.5	X	0.082
EXC-6	J1TL77	5/5/14	0.83	B	0.76	93.5	J	5.0	0.14	U	0.14	465		52.2	51.2	X	0.083
EXC-7	J1TL78	5/5/14	0.77	U	0.77	108	J	5.1	0.14	U	0.14	332		52.6	54.9	X	0.084
EXC-8	J1TL79	5/5/14	0.92		0.74	154	J	4.9	0.14	U	0.14	328		50.8	48.4	X	0.081
EXC-9	J1TL80	5/5/14	1.3		0.77	102	J	5.1	0.14	U	0.14	344		53.1	56.3	X	0.085
EXC-10	J1TL81	5/5/14	0.80	U	0.80	102	J	5.2	0.15	U	0.15	292		54.6	58.4	X	0.087
EXC-11	J1TL82	5/5/14	0.76	U	0.76	162	J	5.0	0.14	U	0.14	339		51.8	49.2	X	0.083
EXC-12	J1TL83	5/5/14	0.79	B	0.76	154	J	5.0	0.14	U	0.14	582		52.5	55.2	X	0.084
Split of J1TL74	J1TL88	5/5/14	0.334	DU	0.334	1160	N	1.49	0.0993	U	0.0993	675		6.95	46.2	D	0.496
N-84-4a	J1T9D7	2/6/14	0.81	U	0.81	248		26.6	0.15	U	0.15	277		55.4	71.3		0.44
N-84-4b	J1T9D8	2/26/14	0.83	U	0.83	297	NX	5.5	0.15	U	0.15	505	M	57.1	53.7		0.091
FS-1	J1TL85	5/5/14	1.0		0.79	200	J	5.2	0.15	U	0.15	384		54.4	48.4	X	0.087
FS-2	J1TL86	5/5/14	0.82	U	0.82	173	J	5.4	0.15	U	0.15	440		56.0	46.2	X	0.089
Equipment Blank	J1TL87	5/5/14	0.75	U	0.75	108	J	4.9	0.14	U	0.14	51.3	U	51.3	0.90	BX	0.082

Sample Location	HEIS Number	Sample Date	Zinc			Percent moisture (wet sample)		
			mg/kg	Q	PQL	%	Q	PQL
EXC-3	J1TL74	5/5/14	34.8	X	0.38	3.1		0.10
Duplicate of J1TL74	J1TL84	5/5/14	34.9	X	0.37	3.3		0.10
EXC-1	J1TL72	5/5/14	41.6	X	0.37	1.3		0.10
EXC-2	J1TL73	5/5/14	58.1	X	0.36	2.8		0.10
EXC-4	J1TL75	5/5/14	41.0	X	0.34	1.3		0.10
EXC-5	J1TL76	5/5/14	27.7	X	0.35	1.4		0.10
EXC-6	J1TL77	5/5/14	39.3	X	0.35	1.7		0.10
EXC-7	J1TL78	5/5/14	42.2	X	0.36	2.5		0.10
EXC-8	J1TL79	5/5/14	106	X	0.34	1.6		0.10
EXC-9	J1TL80	5/5/14	46.9	X	0.36	2.5		0.10
EXC-10	J1TL81	5/5/14	42.2	X	0.37	1.7		0.10
EXC-11	J1TL82	5/5/14	51.8	X	0.35	3.5		0.10
EXC-12	J1TL83	5/5/14	45.3	X	0.35	3.9		0.10
Split of J1TL74	J1TL88	5/5/14	43.4	D	1.99			
N-84-4a	J1T9D7	2/6/14	51.2		1.9	6.5		0.10
N-84-4b	J1T9D8	2/26/14	43.4	X	0.39	6.1		0.10
FS-1	J1TL85	5/5/14	104	X	0.37	4.0		0.10
FS-2	J1TL86	5/5/14	65.9	X	0.38	2.4		0.10
Equipment Blank	J1TL87	5/5/14	1.8	X	0.35	0.10	U	0.10

Attachment	1	Sheet No.	3 of 3
Originator	J. D. Skoglie	Date	6/5/14
Checked	I. B. Berezovskiy	Date	6/5/14
Calc. No.	0100N-CA-V0270	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-V0271

Subject: 100-N-84:4 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 3 Total = 4	J. D. Skoglie	L. B. Berezovskiy	H. M. Sulloway	S.G. Wilkinson ~~D. F. Obenauer~~	6/10/14

SUMMARY OF REVISION

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

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	6/4/2014	Calc. No.:	0100N-CA-V0271	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	6/4/2014
Subject:	100-N-84:4 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-N-84:4 subsite. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (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 $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

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

4) WCH, 2014, *100-N-84:4 Subsite Cleanup Verification 95% UCL Calculations,* 0100N-CA-V0270, 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 $<1 \times 10^{-6}$ (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 CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	6/5/2014	Calc. No.:	0100N-CA-V0271	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	6/5/2014
Subject:	100-N-84:4 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 3	

METHODOLOGY:

The 100-N-84:4 subsite is comprised of one decision unit for verification sampling consisting of the excavation area. In addition, four focused samples were collected: FS-1, FS-2, N-84-4a, and N-84-4b. The direct contact hazard quotient and carcinogenic risk calculations for the 100-N-84:4 subsite were conservatively calculated for the entire subsite using the greater of the maximum or statistical verification soil sample results (WCH 2014). Of the contaminants of potential concern (COPCs) for this subsite, boron, hexavalent chromium, and molybdenum require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Chromium, copper, nickel, selenium, and zinc are included because they were quantitated at a concentration above Hanford Site background. Lead was detected above background; however, lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. 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 3.2 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]), is 2.0×10^{-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 5.1×10^{-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 hexavalent chromium is 0.455 mg/kg, divided by 2.1 mg/kg, and multiplied as indicated, is 2.2×10^{-7}. Comparing this value, and all other individual values, to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk 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 2.2×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

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

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

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

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	6/4/2014	Calc. No.:	0100N-CA-V0271	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	6/4/2014
Subject:	100-N-84:4 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 3	

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-N-84:4 Subsite.

Contaminants of Potential Concern	Maximum or Statistical Value [a] (mg/kg)	Noncarcinogen RAG [b] (mg/kg)	Hazard Quotient	Carcinogen RAG [b] (mg/kg)	Carcinogen Risk
Metals					
Boron	3.2	16,000	2.0E-04	--	--
Chromium, total	19.5	120,000	1.6E-04	--	--
Chromium, hexavalent [c]	0.455	240	1.9E-03	2.1	2.2E-07
Copper	74.3	2,960	2.5E-02	--	--
Lead [d]	12.3	353	--	--	--
Molybdenum	0.60	400	1.5E-03	--	--
Nickel	23.8	1,600	1.5E-02	--	--
Selenium	1.0	400	2.5E-03	--	--
Zinc	104	24,000	4.3E-03	--	--
Totals					
Cumulative Hazard Quotient:			**5.1E-02**		
Cumulative Excess Cancer Risk:					**2.2E-07**

Notes:

[a] = From WCH (2014).

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

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

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

-- = not applicable

RAG = remedial action goal

CONCLUSION:

The calculations in Table 1 demonstrate that the 100-N-84:4 subsite meets the requirements for the direct contact hazard quotient and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2013) and SAP (DOE-RL 2006). The direct contact hazard quotient and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this subsite.

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-N

Discipline: Environmental *Calculation No: 0100N-CA-V0272

Subject: 100-N-84:4 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 3 Total = 4	J. D. Skoglie	I. B. Berezovskiy	H. M. Sulloway	S.G. Wilkinson ~~B. F. Obenauer~~	6/10/14

SUMMARY OF REVISION

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

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	06/04/14	Calc. No.:	0100N-CA-V0272	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	06/04/14
Subject:	100-N-84:4 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 1 of 3	

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-N-84:4 subsite. 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, *100-N-84:4 Waste Sites Cleanup Verification 95% UCL Calculations*, 0100N-CA-V0270, 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 CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	06/05/14	Calc. No.:	0100N-CA-V0272	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	06/05/14
Subject:	100-N-84:4 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 100-N-84:4 subsite is comprised of one decision unit for verification sampling, consisting of the excavation. In addition, four focused samples were collected; FS-1, FS-2, N-84-4a, and N-84-4b. The protection of groundwater hazard quotient and carcinogenic risk calculations for the 100-N-84:4 subsite were conservatively calculated for the entire subsite using the statistical or maximum value for each analyte (WCH 2014). Based on the generic site RESRAD model (DOE-RL 2013) and a vadose zone of approximately 8.0 m (26.2 ft) thickness, a K_d of 8.8 or greater is required to show no predicted migration to groundwater in 1,000 years. Boron and hexavalent chromium are included because they have a K_d of less than 8.8, and no Hanford Site background value has been established. Selenium was included because it has a K_d of less than 8.8 and a value greater than the Hanford Site background. All other site nonradionuclide COPCs were undetected, quantified below background levels, or have a K_d greater than or equal to 8.8. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum or statistical value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (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 3.2 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 1.0×10^{-2}. 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-84:4 subsite is 3.0×10^{-1}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, and then multiplied by 1×10^{-6}. 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 CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	06/04/14	Calc. No.:	0100N-CA-V0272	Rev.:	0
Project:	100-N Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	06/04/14
Subject:	100-N-84:4 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	3 of 3

RESULTS:

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

Table 1 shows the results of the calculations.

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-N-84:4 Subsite.

Contaminants of Potential Concern	Maximum or Statistical Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	3.2	320	1.0E-02	--	--
Chromium, hexavalent	0.455	4.8	9.5E-02	--	--
Selenium	1.0	5	2.0E-01	--	--
Totals					
Cumulative Hazard Quotient:			**3.0E-01**		
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-84:4 subsite 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 100-N Area SAP (DOE-RL 2006) data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Verification sample data collected at the 100-N-84:4 waste site were provided by the laboratories in sample delivery groups (SDGs) JP0733, JP0742, JP0786, and XP0087. SDG JP0786 was submitted for third-party validation. No major deficiencies were identified for the subject data sets. The minor deficiencies identified in the 100-N-84:4 analytical data sets are discussed as follows. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

MAJOR DEFICIENCIES

None.

MINOR DEFICIENCIES

SDG JP0786

This SDG is comprised of 13 statistical verification soil samples (J1TL72 through J1TL84) and 2 focused verification samples (J1TL85 and J1TL86) from the 100-N-84:4 excavation collected on May 5, 2014. Samples J1TL84 and J1TL74 comprise a field duplicate pair. All samples were analyzed for inductively coupled plasma (ICP) metals, mercury, and hexavalent chromium. In addition, one equipment blank (J1TL87) was analyzed for ICP metals and mercury.
SDG JP0786 was submitted for third-party validation. Minor deficiencies are as follows:

In the ICP metals analysis, the matrix spike (MS) recoveries were outside of quality control (QC) limits for antimony (58%) and silicon (22%). All antimony and silicon results were qualified as estimated and flagged "J" by third-party validation due to the MS recoveries outside the QC limits. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, all silicon results were considered qualified as estimated and flagged "J" by third-party validation due to a laboratory control sample (LCS) recovery below QC limits at 19%. Estimated data are usable for decision-making purposes.

SDG JP0733

This SDG is comprised of one soil sample (J1T9D7) from the 100-N-84:4 road crossing collected on February 6, 2014. The sample was analyzed for ICP metals, mercury, and hexavalent chromium. Minor deficiencies are as follows:

In the ICP metals analysis, the MS recovery was outside of QC limits for antimony (55%) and silicon (40%). Although not qualified for the MS recovery outside of QC limits, the antimony and silicon results may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery was outside of QC limits for silicon (22%). Although not qualified for the LCS recovery outside of QC limits, the silicon result may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, barium, copper, nickel, silicon, and zinc were detected at less than the contract required detection limit (CRDL) in the method blank (MB). 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, laboratory duplicate relative percent difference (RPD) calculation was above the QC limits for chromium (34%). Although not qualified for the laboratory duplicate results outside of QC limits, the chromium result may be considered estimated. Estimated data are usable for decision-making purposes.

SDG JP0742

This SDG is comprised of one soil sample (J1T9D8) from the 100-N-84:4 road crossing collected on February 26, 2014. The sample was analyzed for ICP metals, mercury, and hexavalent chromium. Minor deficiencies are as follows:

In the ICP metals analysis, the LCS recovery was outside of QC limits for silicon (13%). Although not qualified for the LCS recovery outside of QC limits, the silicon result may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, zinc was detected at less than the CRDL in the MB. 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 was outside of QC limits for antimony (49%) and silicon (18%). Although not qualified for the MS recovery outside of QC limits, the antimony and silicon results may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate RPD calculation was above QC limits for sodium (51%). Although not qualified for the laboratory duplicate result outside of QC limits, the sodium result may be considered estimated. Estimated data are usable for decision-making purposes.

SDG XP0087

This SDG is comprised of one soil sample (J1TL88) from the 100-N-84:4 excavation collected on May 5, 2014. Sample J1TLD8 is a split of sample J1TL74 collected on May 5, 2013. The sample was analyzed for ICP metals, mercury, and hexavalent chromium. Minor deficiencies are as follows:

In the ICP metals analysis, the LCS recovery was outside of QC limits for silicon (52.3%). Although not qualified for the LCS recovery outside of QC limits, the silicon result may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, antimony was detected at less than the CRDL in the MB. 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, laboratory duplicate RPD calculations were above QC limits for arsenic (50.0%), copper (32.3%), and nickel (34.7%). Although not qualified for the laboratory duplicate results outside of QC limits, the arsenic, copper, and nickel results may be considered estimated. Estimated data are usable for decision-making purposes.

In the hexavalent chromium analysis, the MS/matrix spike duplicate (MSD) recoveries were outside of QC limits at 55.9% and 50.2%, respectively. The laboratory attributed the low recoveries to sample matrix interference due to the similar recoveries. Although not qualified for the MS/MSD recoveries outside of QC limits, the hexavalent chromium result 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 2013a) 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
EXC-3	J1TL74	J1TL84	J1TL88

Field duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the sample/duplicate pair(s) for each contaminant of potential concern (COPC). Relative percent differences are not calculated for analytes that are not detected in both the main and duplicate sample at more than five times the target detection limit. 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.

Split samples are collected to provide a relative measure of the variability in the sampling, sample handling, and analytical techniques used by commercial laboratories. The field main and split samples are evaluated by computing the RPD of the split samples for each COPC to determine the usability of the verification data. The U.S. Environmental Protection Agency Contract Laboratory Program duplicate sample comparison methodology, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 2004), is used as an initial test of the data from the splits. Only analytes that had values above five times the CRDL for both the main and split sample were compared. The calculation brief in Appendix B provides details on split pair RPD calculation. The RPD acceptance criteria for project-split samples is ≤35% (less than or equal to 35%).

The RPD calculations for the field duplicate samples are all below the acceptance criteria (30%). The RPD calculations for the field split samples are below the acceptance criteria (35%), except for silicon (137.6%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneities 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 duplicate/split) is less than five times the target detection limit (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. This check was not required for the any of the duplicate samples. For the field split, this check was required for nickel. This result is attributed to heterogeneity in the sample matrix from which the samples were collected. A visual inspection of all of the data is also performed. 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-84:4 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-84:4 waste site Overburden 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.

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