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

14-AMRP-0291

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-H-56; H-AREA MISCELLANEOUS PIPELINES WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2014-063 and supporting, "Remaining Sites Verification Package for the 100-H-56; H-Area Miscellaneous Pipelines Waste Site," 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-HR-1 **Control No.:** 2014-063

Waste Site Code(s)/Subsite Code(s): 100-H-56

Reclassification Category: Interim ☒ Final ☐

Reclassification Status: Closed Out ☐ No Action ☒ Rejected ☐

RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-H-56; H-Area Miscellaneous Pipelines waste site was added to the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999), as a candidate site for confirmatory sampling in the Tri-Party Agreement Administrative Record Fact Sheet *100 Area "Plug-In" and Candidate Waste Sites for Calendar Year 2011,* U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2012). Confirmatory sampling was conducted in June and July 2013 and March 2014 with samples collected at eight test pits and two test trenches.

Confirmatory sampling and comparison of residual contaminant concentrations against cleanup levels have been performed in accordance with remedial action objectives and goals established by the Remaining Sites ROD (EPA 1999) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Areas* (100 Area RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009). The selected action involved: (1) demonstrating through confirmatory sampling that cleanup goals have been achieved, and (2) proposing the site for reclassification to Interim No Action.

Basis for reclassification:

In accordance with this evaluation, the confirmatory sampling results support a reclassification of this site to Interim No Action. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009b). The results of the confirmatory sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep vadose zone of the site are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-H-56; H-Area Miscellaneous Pipelines Waste Site* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2014-063

Waste Site Code(s)/Subsite Code(s): 100-H-56

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	8/13/14
DOE Federal Project Director (printed)	Signature	Date
N. Menard KIM WELSCH FOR	KIM WELSCH FOR	8/20/14
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-56; H-AREA MISCELLANEOUS PIPELINES WASTE SITE

Attachment to Waste Site Reclassification Form 2014-063

September 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-56; H-AREA MISCELLANEOUS PIPELINES WASTE SITE

EXECUTIVE SUMMARY

The 100-H-56; H-Area Miscellaneous Pipelines waste site is located within the 100-HR-1 Operable Unit. These pipelines were not associated with an existing waste site; they were discovered during a spatial analysis of the pipeline geographic information system. Additional pipelines were also discovered during field remediation activities. In total there are 17 pipelines associated with this site.

Confirmatory sampling occurred in June and July 2013, and in March 2014. These samples included eight test pits and two test trenches per the *Work Instruction for Confirmatory Sampling of the 100-H-56; H-Area Miscellaneous Pipelines* (WCH 2013b).

The confirmatory sampling results indicate that the soil within these test pits and test trenches achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999).

A summary of the confirmatory sampling against the applicable criteria is presented in Table ES-1. The results of confirmatory sampling are used to make reclassification decisions for the 100-H-56 waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

Table ES-1. Summary of Remedial Action Goals for the 100-H-56 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain a dose rate of <15 mrem/yr above background for 1,000 years.	Radionuclides were not COPCs for the 100-H-56 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC direct exposure RAGs.	All individual COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The individual hazard quotient was determined to be <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient was determined to be 7.6×10^{-1}, which is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for hexavalent chromium, the only carcinogen detected above background levels, 1.5×10^{-7}, is $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk for hexavalent chromium, the only carcinogen detected above background levels, 1.5×10^{-7}, is $<1 \times 10^{-5}$.	

Table ES-1. Summary of Remedial Action Goals for the 100-H-56 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	Radionuclides were not COPCs for the 100-H-56 waste site.	NA
	Attain national primary drinking water standards [a]: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.		
	Meet drinking water standards for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5 [b].		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Residual concentrations of barium, copper, lead, mercury, selenium, and zinc exceed soil RAGs for groundwater and/or river protection. However, based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b) and evaluation of the contaminant matrix, it is predicted that these constituents 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 the Environment* (DOE Order 5400.5).

[c] Based on the isotopic distribution of uranium in the 100 Area, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001).

[d] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of barium, copper, lead, mercury, and zinc are not predicted to migrate more than 2.6 m (8.5 ft) vertically within 1,000 years based on the lowest distribution coefficient of the contaminants exceeding the RAGs, copper, with a distribution coefficient of 22 mL/g). The vadose zone underlying the soil below the waste site is approximately 12 m (40 ft) thick. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and consequently are protective of the Columbia River. Confirmatory sampling at the 100-H-56 waste site detected selenium at 1.55 mg/kg at test trench 5 at 4.6 m (15 ft) below ground surface, which is above the river protection lookup value of 1.0 mg/kg. This consisted of one focused sample taken within a test trench where a pipeline was not encountered. Selenium is not a product of any known processes related to reactor operations. Examination of the 100-H-56 data has concluded that the selenium concentration reported is due to the natural mineralogy found in the sample matrix and not to any type of waste disposal or man-made contamination. Therefore, it is concluded the selenium concentrations at the 100-H-56 site meet the remedial action objectives established in the RDR/RAWP.

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

In accordance with this evaluation, the confirmatory sampling results support a reclassification of this waste site to Interim No Action. The current site conditions achieve the RAOs and the corresponding RAGs of the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow and deep zone soil (surface to 4.6 m [15 ft] below ground surface) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the 100-H-56 waste site contaminants of potential concern and other constituents (Appendix A). The higher of the confirmatory sampling analyses maximum values were considered for comparison. Ecological screening levels from *Washington Administrative Code* 173-340, "Model Toxics Control Act – Cleanup," were exceeded for arsenic, barium, boron, lead, mercury, selenium, and vanadium. The U.S. Environmental Protection Agency's ecological soil screening levels were exceeded for antimony, barium, 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 concentrations of antimony, cadmium, manganese and vanadium are below Hanford Site or Washington State background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents do not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-56; H-AREA MISCELLANEOUS PIPELINES WASTE SITE

STATEMENT OF PROTECTIVENESS

The 100-H-56 waste site confirmatory sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow and deep zone soil (i.e., surface to 4.6 m [15 ft]) and that 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 of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the 100-H-56 waste site contaminants of potential concern (COPCs) and other constituents (Appendix A). The higher of the confirmatory sampling analyses maximum values were considered for comparison. Ecological screening levels from *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for arsenic, barium, boron, lead, mercury, selenium, and vanadium. The U.S. Environmental Protection Agency's (EPA's) ecological soil screening levels were exceeded for antimony, barium, 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 concentrations of antimony, cadmium, manganese, and vanadium are below Hanford Site or Washington State background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents do not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-H-56 waste site lies within the 100-HR-1 Operable Unit throughout the 100-H Area, shown in Figures 1 and 2.

Figure 1. Overall Site Location of the 100-H-56 Waste Site.

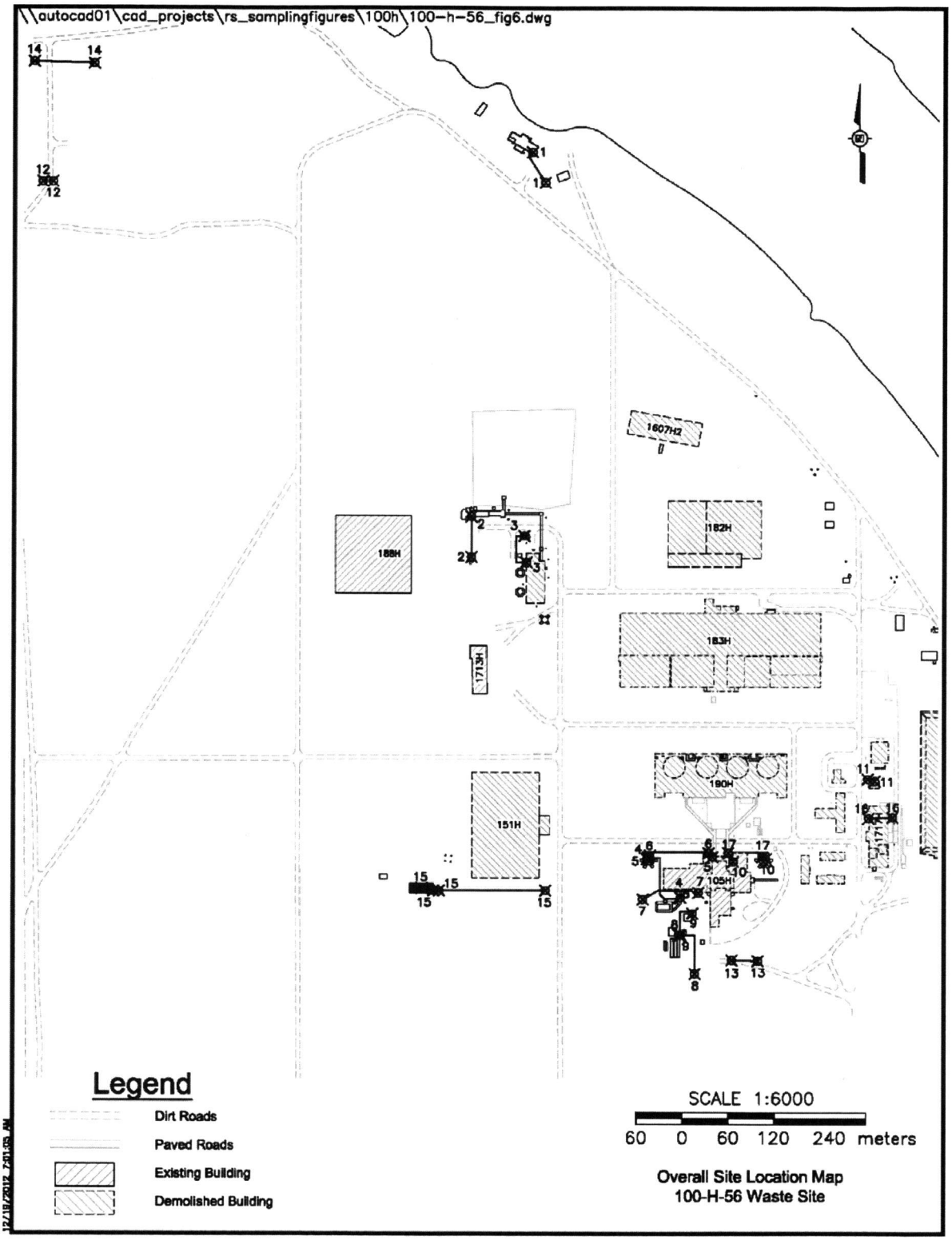
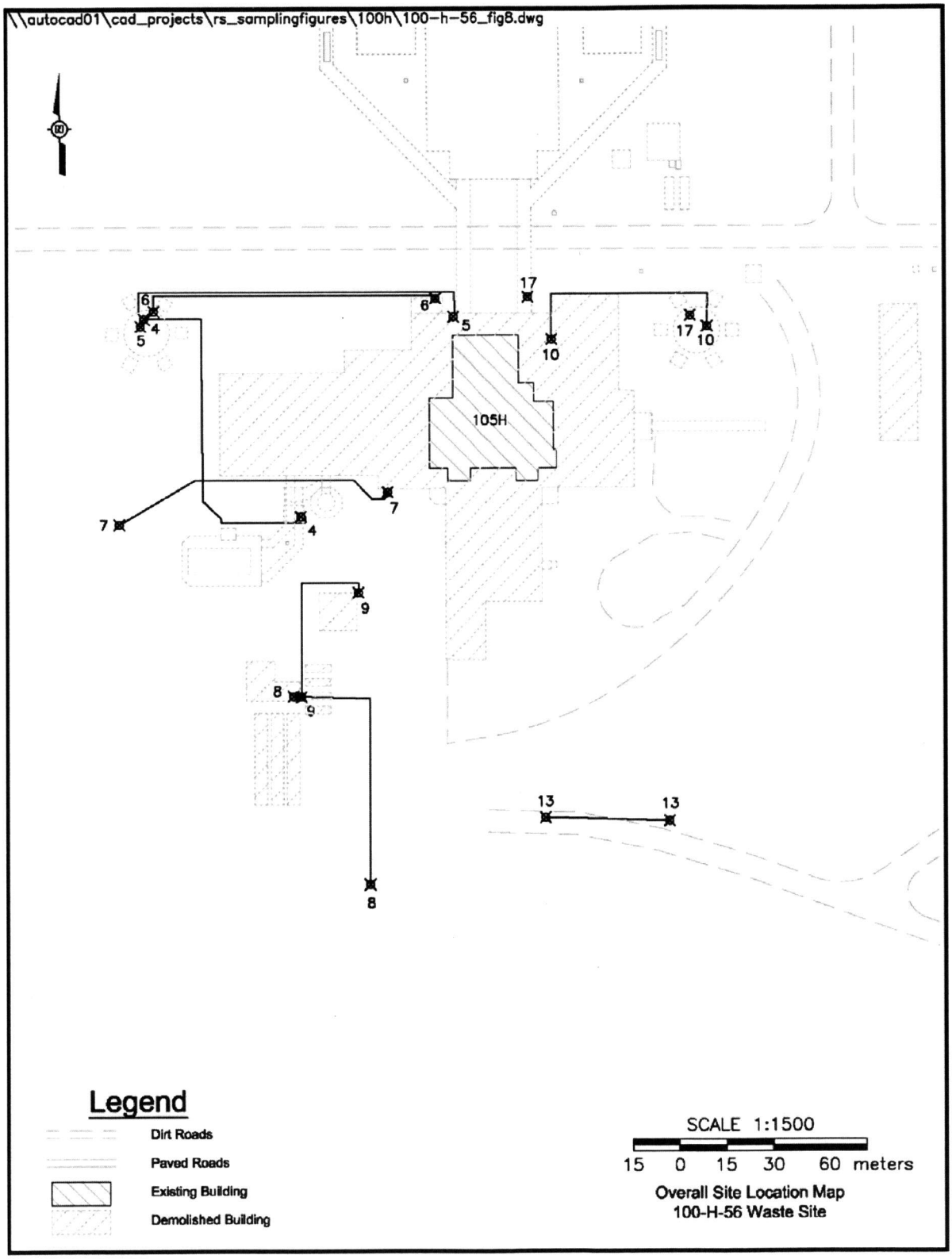


Figure 2. Overall Site Location of the 100-H-56 Waste Site.



The 100-H-56 waste site consisted of all the 100-H Area miscellaneous pipelines (1 through 17 below) not associated with an existing waste site. These consisted of 4 sewer lines (1, 8, 11, and 15) that will be included in a remove, treat, and dispose (RTD) report; 2 pipelines (7 and 9) that have been taken out with the 132-H-3 waste site; and 11 pipelines (2 through 6, 10, 12 through 14, 16, and 17) that were sampled within the confirmatory work instruction (WCH 2013b). Pipeline 3 is within the 100-H-28:3 subsite excavation. Therefore, a sample from the native soil at the bottom of the 100-H-28:3 subsite excavation will be taken.

History

These pipeline segments were discovered during a spatial analysis of the pipeline geographic information system assignments with those contained in regulator-approved work instructions and closure documents. Some of these pipeline segments were either not assigned to waste sites or incorrectly assigned to a waste site when compared to the documents. Additional pipeline segments were discovered in the field during field remediation activities.

The following are descriptions and Washington State Plane coordinates for each of the 17 pipelines. Each of the locations is numbered 1 through 17 and is shown in Figures 1 and 2.

1. End coordinates N 153474.45, E 577535.22 and N 153434.55, E 577551.95. The 15-cm (6-in.) cast iron pipeline carried sanitary waste to the 1607-H4 septic tank.

2. End coordinates N 152944.97, E 577455.58 and N 152998.08, E 577455.58. The 5-cm (2-in.) steel pipeline carried water from the brine pump house to the coal conveyor. The water supply originated from the 184-H Power House and traveled to the brine pump house through the 100-H-53:3 subsite.

3. End coordinates N 152937.94, E 577527.96 and N 152972.67, E 577525.05. The 2.5-cm (1-in.) steel soft water line runs from the elevated water tower to the 184-H Power House.

4. End coordinates N 152553.08, E 577687.81 and N 152500.00, E 577730.23. The 10-cm (4-in.) and 1.9-cm (0.75-in.) steel pipeline carried filtered water from elevated water tank 187-H1 to the 119-H Sample Building.

5. End coordinates N 152551.11, E 577686.91 and N 152553.57, E 577771.68. The 30-cm (12-in.) pipeline carried filtered water from elevated water tank 187-H1 to the 105-H Sample Building.

6. End coordinates N 152555.06, E 577690.42 and N 152558.53, E 577766.78. The 40.6-cm (16-in.) pipeline carried filtered water from elevated water tank 187-H1 to the 105-H Sample Building.

7. End coordinates N 152497.87, E 577681.05 and N 152506.51, E 577753.69. The 15-cm (6-in.) vitrified clay pipeline was within the boundary and taken out with the 132-H-3 waste site.

8. End coordinates N 152451.66, E 577728.13 and N 152401.09, E 577748.81. The 15-cm (6-in.) vitrified clay pipe connects the 110-H Building with the sanitary sewer trench (100-H-30 waste site).

9. End coordinates N 152479.46, E 577745.75 and N 152451.59, E 577730.33. The 3.8-cm (1.5-in.) steel sanitary water pipe connected the 110-H Building with the sanitary water supply leading into the east side of the 1608-H Building. This pipe was within the boundary of the 132-H-3 waste site and was taken out with that excavation.

10. End coordinates N 152547.47, E 577798.95 and N 152550.90, E 577841.31. The 40.6-cm. (16-in.) steel pipeline carried filtered water from elevated water tank 187-H2 to the 105-H Building. Allegedly 500 parts per million dichromate solution was added to the water left in the pipeline during descaling of the 105 high tank piping in 1960. After chemically descaling the tanks and the lines in 1960 and 1961, a sodium silicate injection system was added for the high tanks (GE 1964b). A sodium silicate tank was installed in the 190-H Building, and silicate was added directly into the fill lines for the 187-H High Tanks (GE 1964a).

11. End coordinates N 152655.44, E 577974.51 and N 152652.88, E 577983.39. The 10-cm (4-in.) vitrified clay sanitary sewer line connects the 1722-H Building with the 100-H-28:2 subsite.

12. End coordinates N 153434.19, E 576892.43 and N 153434.18, E 576905.77. The 2.5-cm (1-in.) cast iron service water line is located near the 100-H-55 waste site.

13. End coordinates N 152419.00, E 577797.00 and N 152418.00, E 577831.00. The concrete-encased pipe was found during remediation of the 105-H Decontamination Pads in July 2009.

14. End coordinates N 153591.57, E 576881.05 and N 153589.19, E 576958.70. The 10-cm (4-in.) aluminum resembles an irrigation pipe running east/west near the 600-152 waste site. Thin-walled with concrete set around it.

15. End coordinates N 152509.32, E 577553.38 and N 152509.34, E 577405.98. Temporary construction sewer line, septic tank, and drain field west of the 151-H Building. Sewer line from the 100-H-28:4 subsite.

16. End coordinates N 152604.50, E 577975.70 and N 152605.50, E 578007.30. The 15-cm (6-in.) cast iron pipe was discovered during excavation of the 100-H-4 waste site in January 2010.

17. End coordinates N 152558.86, E 577792.40 and N 152553.82, E 577836.80. The 1.9-cm (0.75-in.) sodium silicate pipe runs from a storage tank in the 190-H Building to the 187-H2 elevated water tower.

CONFIRMATORY SAMPLING

Confirmatory sampling of the 100-H-56 waste site was performed in accordance with the *Work Instruction for Confirmatory Sampling of 100-H-56, H-Area Miscellaneous Pipelines* (WCH 2013b) in June and July 2013 and March 2014, as described in the following section and shown in Figure 3.

Contaminants of Potential Concern

The COPCs for the 100-H-56 waste site confirmatory sampling included total chromium, hexavalent chromium, lead, mercury, and anions. Although not considered COPCs, analysis for the expanded list of inductively coupled plasma metals (antimony, arsenic, barium, beryllium, boron, cadmium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc) was also included.

Field screening for volatile organic compounds was performed during soil sampling using an organic vapor monitor. Volatile organic analysis of soils was not required because VOCs were not detected in the field.

The possible presence of radiological contaminants was evaluated using field radiological survey instrumentation (capable of detecting alpha, beta, and gamma radiation) during confirmatory sampling. Because radiological activity was not detected in the field above background levels, samples were not analyzed for radionuclides.

There were no suspect hazardous debris or stained soils unrelated to the 100-H-56 waste site discovered during sampling activities.

Asbestos-containing material was identified within TP-4 (Pipeline 3) excavation activities. It was found to be a steam line wrapped in thermal system insulation. Because steam lines are not hazardous and not considered a waste site, sampling was not needed.

The COPCs and analytical methods for 100-H-56 waste site confirmatory sampling are presented in Table 1.

Summary of Confirmatory Sampling Activities

Eight test pits and two test trenches were excavated on the downgradient end of the miscellaneous pipelines, which would be the area most likely to contain contamination. The 11 pipelines selected for sampling included those that were not being sent to a RTD report (sewer pipelines) and pipelines that were not taken out with another site.

Confirmatory sampling activities at the 100-H-56 waste site were performed in accordance with the confirmatory work instruction (WCH 2013b) in June and July 2013 and March 2014, as described in the field logbooks (WCH 2013a, 2014). A summary of confirmatory samples is provided in Table 2. A discussion of field activities follows.

Figure 3. Confirmatory Sampling Design Locations for the 100-H-56 Waste Site.

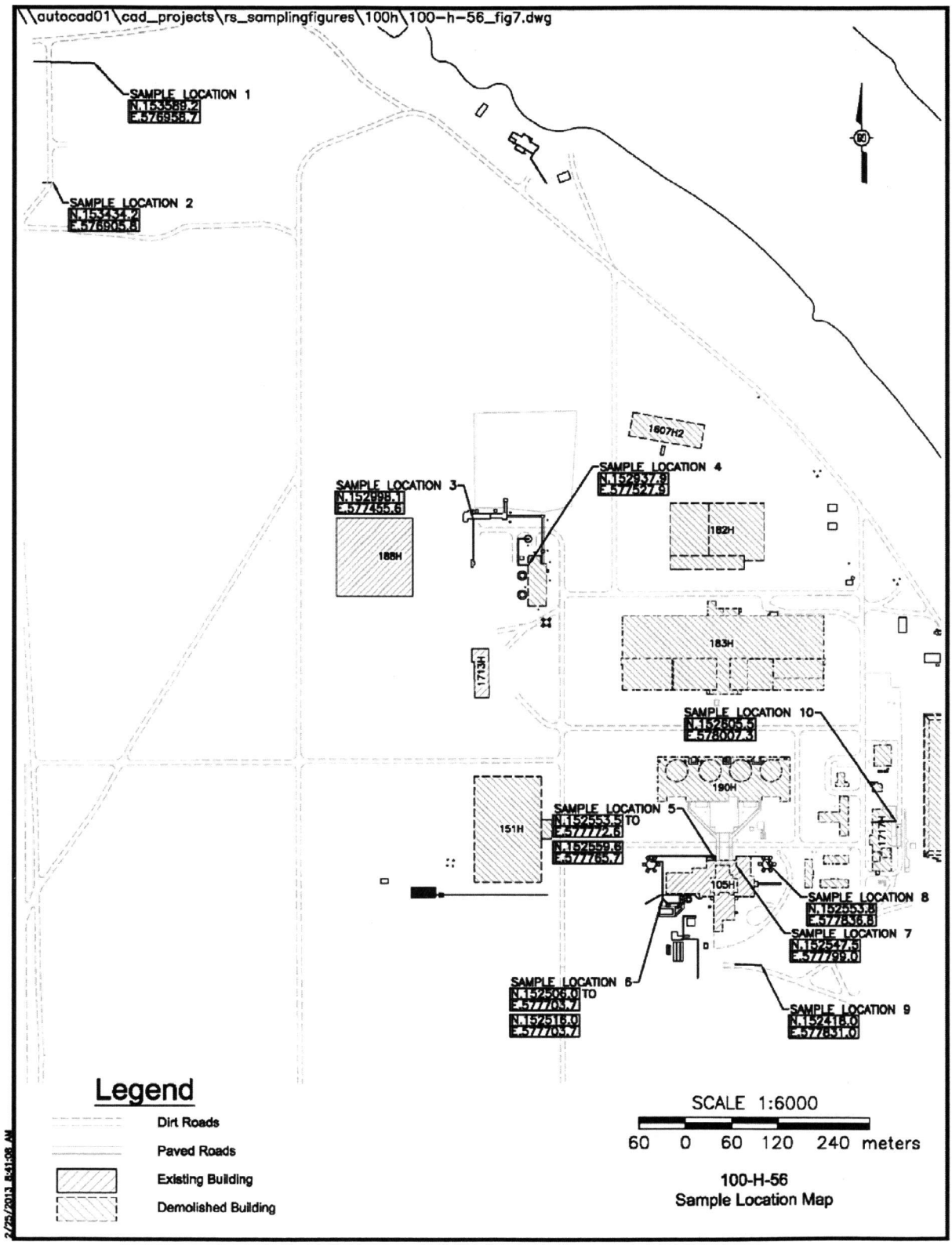


Table 1. 100-H-56 Confirmatory Sampling Analytical Methods.

Analytical Method	Contaminants of Potential Concern
ICP metals [a] – EPA Method 6010	Chromium (total)
Mercury – EPA Method 7471	Mercury
Hexavalent chromium – EPA Method 7196	Hexavalent chromium
IC anions – EPA Method 300.0	Anions
Nitrite/nitrate – EPA Method 353.2	Nitrogen in nitrate and nitrite

[a] The expanded ICP metals analysis will 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
IC = ion chromatography
ICP = inductively coupled plasma

Table 2. 100-H-56 Confirmatory Sample Summary Table.

Sample Location	Associated Pipeline	Sample Description	HEIS Number	Sample Date	Depth (bgs)	Washington State Plane Coordinates (m)		Sample Analysis
						Northing	Easting	
TP-1	Pipeline 14	Soil	J1RPY0	6/28/13	10 ft	153589.2	576958.7	ICP metals, Hg, CrVI, anions, pH
Duplicate of TP-1	Pipeline 14	Soil	J1RPY5	6/28/13	10 ft	153589.2	576958.7	
TP-2	Pipeline 12	Soil	J1RR68	7/1/13	15 ft	153434.2	576905.8	
TP-3	Pipeline 2	Soil	J1TF98	3/5/14	5 ft	152998.1	577455.6	ICP metals, Hg, CrVI, anions
TP-4	Pipeline 3	Soil	J1THH0	3/31/14	10 ft	152937.9	577527.9	
TT-5	Pipelines 5 and 6	Soil	J1RR73	7/16/13	15 ft	152555.0	577770.5	ICP metals, Hg, CrVI, anions, pH
TT-6	Pipeline 4	Soil	J1RR71	7/8/13	15 ft	152516.0	577703.7	
TP-7	Pipeline 10	Soil	J1RR70	7/2/13	15 ft	152547.5	577799.0	
TP-8	Pipeline 17	Soil	J1RPJ0	6/21/13	13 ft	152553.8	577836.8	
TP-8	Pipeline 17	Soil	J1RPH9	6/21/13	15 ft	152553.8	577836.8	
TP-9	Pipeline 13	Soil	J1RR72	7/8/13	6 ft	152418.0	577831.0	
TP-10	Pipeline 16	Soil	J1RR69	7/2/13	3.5 ft	152606.0	578007.0	
Equipment blank	NA	Silica sand	J1RPY6	6/28/13	NA	NA	NA	ICP metals and Hg

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

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

Below are descriptions of the test pits or test trenches and the samples taken chronologically by date. Photographs are included when available.

On June 21, 2013, excavation was started at test pit 8 with one sample taken at 4 m (13 ft) below ground surface (bgs) and one sample taken at 4.6 m (15 ft) bgs, no pipe was found at this excavation. On June 28, 2013, test pit 1 was excavated to native soil where primary and duplicate samples were taken at a depth of 3 m (10 ft) bgs. No pipe was found.

Figure 4, test pit 2 was excavated on July 1, 2013, at a depth of 4.6 m (15 ft) bgs, and no pipe was visible. A sample was taken at the base of the excavation.

Figure 4. 100-H-56 Test Pit 2 (July 1, 2013).

Test pit 10 (Figure 5) was excavated on July 2, 2013, and a pipe was encountered at 1.1 m (3.5 ft) bgs. A sample was taken below the pipe. However, a sample was not taken from inside the pipe due to the pipe being crimped as seen in the photograph. Along with the crimped pipe found in the side wall, a 0.76-m (2.5-ft) section of pipe was found in the excavation; however, according to the logbook, there were no contents to be sampled (WCH 2013a). No staining was encountered.

Figure 5. 100-H-56 Test Pit 10 (July 2, 2013).

Test pit 7 (Figure 6) was excavated to a depth of 4.6 m (15 ft) bgs and sampled. No pipe was encountered.

Figure 6. 100-H-56 Test Pit 7 Looking South (July 2, 2013).

Test trench 6 (Figure 7) was excavated and sampled at a depth of 4.6 m (15 ft) bgs on July 8, 2013. No pipe was encountered.

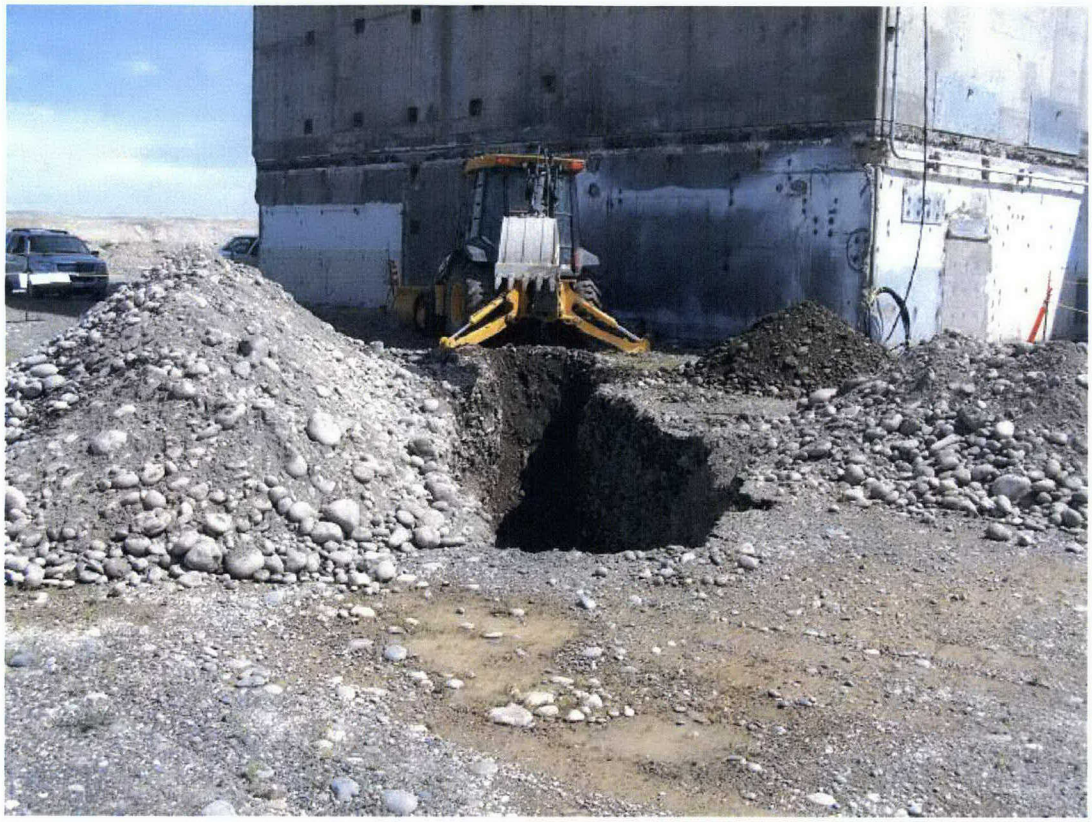
Figure 7. 100-H-56 Test Trench 6 (July 8, 2013).

On July 8, 2013, test pit 9 was excavated to a depth of 1.8 m (6 ft) bgs. At that location a duct bank was encountered as seen in Figure 8. The duct bank runs east/west and is approximately 0.3 m (1 ft) thick and 0.9 m (3 ft) wide. The crew and engineer were confident that this resembles previous electrical duct banks encountered at the 100-D, 100-F, and 300 Areas. The amount of concrete used makes it unlikely that there is just a pipe inside. One sample was taken from underneath the electrical duct bank.

Figure 8. 100-H-56 Test Pit 9 (July 8, 2013).

Figure 9 shows test trench 5 that was excavated to a depth of 4.6 m (15 ft) bgs on July 16, 2013. No pipe was discovered and one soil sample was taken at the bottom of the excavation.

Figure 9. 100-H-56 Test Trench 5 (July 16, 2013).



On March 5, 2014, two pipes were encountered during excavation of test pit 3: a 2.5-cm (1-in.)-diameter pipe running east-west about 0.6 m (2 ft) bgs and a 5-cm (2-in.) pipe running north-south about 1.2 or 1.5 m (4 or 5 ft) bgs. Both pipes were open and empty. A sample from underneath the pipes at about 1.5 m (5 ft) bgs was taken. A picture was not found for this test pit.

Figure 10 shows the test pit 4 excavation that was initiated on March 5, 2014, when a 5-cm (2-in.)-diameter pipe at 1.2 m (4 ft) bgs was encountered. This pipe was wrapped in thermal system insulation asbestos material and had been disturbed by the excavator during the excavation. The area was stabilized, properly posted, and the excavator was properly decontaminated. It was determined that the 5-cm (2-in.)-diameter pipe was a steam line and therefore nonhazardous. The steam line was left in place and on March 31, 2014, in a continuing effort to find the pipe and/or collect a soil sample from the pipes location a sample was taken approximately 3 m (10 ft) bgs at the 100-H-28:3 excavation. This sample took the place of the original TP-4 sample and is located where pipeline 3 would have entered the 100-H-28:3 pipeline. The soft water pipeline was never found.

Figure 10. 100-H-56 Test Pit 4. Pipe Wrapped in Thermal System Insulation (March 5, 2014).

CONFIRMATORY SAMPLE RESULTS

All confirmatory samples were analyzed using analytical methods approved by the EPA (DOE-RL 2009a). The laboratory-reported data results for all constituents are stored in the Washington Closure Hanford (WCH) project-specific database prior to submission for archival in the Hanford Environmental Information System (HEIS) site-wide database and are summarized in Appendix B.

A comparison of the maximum results against soil cleanup levels identified in the 100 Area RDR/RAWP (DOE-RL 2009b) is shown in Table 3.

Table 3. Comparison of Contaminant Concentrations to Remedial Action Goals for the 100-H-56 Confirmatory Samples. (2 Pages)

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals [a]			Do the Results Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony	0.85 (<BG)	32	5	5	No	--
Arsenic	11.5	20 [c]	20 [c]	20 [c]	No	--
Barium	392	5,600	200	400	Yes	Yes [d]
Beryllium	0.628 (<BG)	10.4 [e]	1.51 [c]	1.51 [c]	No	--
Boron [f]	69.0	7,200	320	-- [g]	No	--

Table 3. Comparison of Contaminant Concentrations to Remedial Action Goals for the 100-H-56 Confirmatory Samples. (2 Pages)

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals [a]			Do the Results Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Cadmium [f]	0.564 (<BG)	13.9 [e]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	15.9 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	10.1 (<BG)	24	15.7 [c]	-- [g]	No	--
Copper	29.8	2,960	59.2	22.0 [c]	Yes	Yes [d]
Hexavalent chromium [f]	0.308	2.1	4.8	2	No	--
Lead	84.0	353	10.2 [c]	10.2 [c]	Yes	Yes [d]
Manganese	326 (<BG)	3,760	512 [c]	512 [c]	No	--
Mercury	15.9	24	0.33	0.33	Yes	Yes [d]
Molybdenum [f]	0.48	400	8	-- [g]	No	--
Nickel	13.5 (<BG)	1,600	19.1 [c]	27.4	No	--
Selenium	1.55	400	5	1	Yes	Yes [d]
Silver	0.599 (<BG)	400	8	0.73	No	--
Vanadium	75.5 (<BG)	560	85.1 [c]	-- [g]	No	--
Zinc	70.9	24,000	480	67.8 [c]	Yes	Yes [d]
Chloride	11.0 (<BG)	-- [g]	25,000	-- [g]	No	--
Fluoride	1.2 (<BG)	4,800	96	400	No	--
Nitrogen in nitrate	6.6 (<BG)	128,000	1,000	2,000	No	--
Nitrogen in nitrate an nitrite	6.4 (<BG)	128,000	1,000	2,000	No	--
Sulfate	235 (<BG)	-- [g]	25,000	-- [g]	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b) unless otherwise noted.

[b] 95% upper confidence limit or maximum value, depending on data censorship, as described in Appendix C.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the 100 Area RDR/RAWP (DOE-RL 2009b).

[d] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of barium, copper, lead, mercury, and zinc are not predicted to migrate more than 2.6 m (8.5 ft) vertically within 1,000 years, based on the lowest distribution coefficient of the contaminants exceeding the RAGs, copper, with a distribution coefficient of 22 mL/g). The vadose zone underlying the soil below the waste site is approximately 12 m (40 ft) thick. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and consequently are protective of the Columbia River. Confirmatory sampling at the 100-H-56 waste site detected selenium at 1.55 mg/kg at test trench 5 at 4.6 m (15 ft) bgs, which is above the river protection lookup value of 1.0 mg/kg. This consisted of one focused sample taken within a test trench where a pipeline was not encountered. Selenium is not a product of any known processes related to reactor operations. Examination of the 100-H-56 data has concluded that the selenium concentration reported is due to the natural mineralogy found in the sample matrix and not to any type of waste disposal or man-made contamination. Therefore, it is concluded the selenium concentrations at the 100-H-56 site meet the remedial action objectives established in the RDR/RAWP.

[e] Carcinogenic cleanup level calculated based on the inhalation exposure pathway per WAC 173-340-750(3) (1996) (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[g] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2014) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii] [1996], [Method B for surface waters]).

-- = not applicable
AWQC = ambient water quality criteria
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*

CONFIRMATORY SAMPLING DATA EVALUATION

This section demonstrates that confirmatory sampling at the 100-H-56 waste site achieves the applicable RAGs developed to support unrestricted land use at the 100 Area as established in the Remaining Sites ROD (EPA 1999) and documented in the 100 Area RDR/RAWP (DOE-RL 2009b).

Attainment of Radionuclide RAGS

Radionuclides were not COPCs for the 100-H-56 waste site.

Attainment of Nonradionuclide RAGS

Direct Exposure RAG Evaluation

All COPCs from the 100-H-56 waste site were quantified below direct exposure RAGs.

Nonradionuclide Soil RAGs for Groundwater and River Protection Evaluation

All COPCs were quantified below groundwater and/or river protection soil RAGs with the exception of barium, copper, lead, mercury, selenium, and zinc. Of these, barium, copper, lead, mercury, and zinc are not predicted to migrate vertically more than 2.6 m (8.5 ft) within 1,000 years, based on the contaminant with the lowest distribution (22 mL/g for copper). Given that the vadose zone underlying the soil below the waste site is approximately 12 m (40 ft) thick, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River. Confirmatory sampling at the 100-H-56 waste site detected selenium at 1.55 mg/kg at test trench 5 at 4.6 m (15 ft) bgs, which is above the river protection lookup value of 1.0 mg/kg. This consisted of one focused sample taken within a test trench where a pipeline was not encountered. Selenium is not a product of any known processes related to reactor operations. Examination of the 100-H-56 data has concluded that the selenium concentration reported is due to the natural mineralogy found in the sample matrix and not to any type of waste disposal or man-made contamination. Therefore, it is concluded the selenium concentrations at the 100-H-56 site meet the remedial action objectives (RAOs) established in the RDR/RAWP.

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}. The 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 7.6×10^{-1}. The carcinogenic risk value for hexavalent chromium, the only constituent subject to the excess

cancer risk evaluation, was 1.5 x 10^{-7}, which is less than the individual and cumulative cancer risk values of 1 x 10^{-6} and 1 x 10^{-5}, respectively. The 100-H-56 waste site meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the 100 Area RDR/RAWP (DOE-RL 2009b).

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-H-56 waste site included calculation of the hazard quotient and carcinogenic (excess cancer) risk values for groundwater protection for nonradionuclides. The requirements include an individual and cumulative hazard quotient of less than 1.0, an individual excess carcinogenic risk of less than 1 x 10^{-6}, and a cumulative excess carcinogenic risk of less than 1 x 10^{-5}. These risk values were conservatively calculated for the entire subsite using the highest value for each COPC from each of the decision units. 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 distribution coefficient (K_d) values for these contaminants are less than that necessary to show no migration to groundwater in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). Based on this model and a vadose zone of approximately 12 m (40 ft) thickness, a K_d of 6.1 or greater is required to show no predicted migration to groundwater in 1,000 years. All individual groundwater protection hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-H-56 waste site is 1.0 x 10^{-1}, which is less than 1.0. The 100-H-56 waste site does not have any carcinogenic constituents subject to the groundwater cancer risk calculation; therefore, the criterion for excess cancer risk is met. Therefore, nonradionuclide risk requirements related to groundwater are met.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed on the confirmatory sampling data. The DQA compared the sampling approach, the field logbooks (WCH 2013a, 2014), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA for the 100-H-56 waste site established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The confirmatory sample analytical data are stored in the WCH project-specific database for data evaluation prior to its archival in the HEIS and are summarized in Appendix B. The detailed DQA is presented in Appendix C.

SUMMARY FOR INTERIM CLOSURE

The 100-H-56 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009b). Confirmatory sampling was performed and the analytical results indicate that the residual concentrations of COPCs at this

site meet the RAOs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the confirmatory sampling results support a reclassification of the 100-H-56 waste site to Interim No Action. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation at the 100-H-56 waste site are not required.

REFERENCES

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

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

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WCH, 2013a, *IU-2/6 and Segment 4 Miscellaneous Restoration Sites*, Logbook EL-1667, pp. 42-45, 47-60, 63-66, 71-72, Washington Closure Hanford, Richland, Washington.

WCH, 2013b, *Work Instruction for Confirmatory Sampling of the 100-H-56; H-Area Miscellaneous Pipelines,* 0100H-WI-G0056, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2014, *IU-2/6 and Segment 4 Miscellaneous Restoration Sites*, Logbook EL-1627-08, pp. 16-19, 35-36, Washington Closure Hanford, Richland, Washington.

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

APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-H-56 Waste Site [a].

Hazardous Substance		2007 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Waste Site Analyses
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
Metals (mg/kg)									
	Background								
Antimony	5	5	--	--	--	78	--	0.27	0.85 (<BG)
Arsenic	6.5	10	60	132	18	--	43	46	11.5
Barium	132	500	--	102	--	330	--	2,000	392
Boron	--	0.5	--	--	--	--	--	--	69.0
Cadmium	0.81	4	20	14	32	140	0.77	0.36	0.564 (<BG)
Copper	22.0	100	50	217	70	80	28	49	29.8
Lead	10.2	50	500	118	120	1,700	11	56	84.0
Manganese	512	1,100 [d]	--	1,500	220	450	4,300	4,000	326 (<BG)
Mercury	0.33	0.3	0.1	5.5	--	--	--	--	15.9
Selenium	0.78	1	70	0.3	0.52	4.1	1.2	0.63	1.55
Vanadium	85.1	2	--	--	--	--	7.8	280	75.5 (<BG)
Zinc	67.8	86 [d]	200	360	160	120	46	79	70.9

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.

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

APPENDIX B

CALCULATIONS

APPENDIX B

CALCULATION BRIEFS

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

100-H-56 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0100H-CA-V0204, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-H-56 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100H-CA-V0205, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

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

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0204

Subject: 100-H-56 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 6 Attachment = 3 Total = 10	J. D. Skoglie	I. B. Berezovskiy	H. M. Sulloway	S.G. Wilkins ~~D. F. Obenauer~~	9/2/14

SUMMARY OF REVISION

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

*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/24/2014	Calc. No.:	0100H-CA-V0204	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/24/2014
Subject:	100-H-56 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 6	

PURPOSE:

Using sample data from Attachment 1 provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-H-56 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009b), the following criteria must be met:

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

Also, calculate the relative percent difference (RPD) for primary-duplicate sample pairs from 100-H-56 waste site confirmatory sampling, as necessary.

GIVEN/REFERENCES:

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

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

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

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

5) WCH, 2014, *Remaining Sites Verification Package for the 100-H-56; H-Area Miscellaneous Pipelines*, Attachment to Waste Site Reclassification Form 2014-063, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2009b).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2009b).

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/23/2014	Calc. No.:	0100H-CA-V0204	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/23/2014
Subject:	100-H-56 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 6	

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

5) Use data from Attachment 1 to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

The 100-H-56 waste site underwent confirmatory focused sampling at ten locations including a duplicate sample. The direct contact hazard quotient and carcinogenic risk calculations for the 100-H-56 waste site were conservatively calculated using the maximum results from Attachment 1. Of the contaminants of potential concern (COPCs) and other analytes for this site, boron, hexavalent chromium, and molybdenum require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Barium, copper, mercury, selenium, and zinc require HQ and risk calculations because these analytes were detected above Washington State or Hanford Site background value. 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. Additionally, arsenic was detected above background; however, the arsenic standard is not toxicity based. 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 69.0 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 9.6×10^{-3}. 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 for COPCs is 7.6×10^{-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, then multiplied by 1.0×10^{-6}. For example, the maximum value for hexavalent chromium is 0.308 mg/kg, divided by 2.1 mg/kg, and multiplied as indicated, is 1.5×10^{-7}. Comparing this value, the requirement of $<1 \times 10^{-6}$ is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values for COPCs is 1.5×10^{-7}. Comparing these values to the requirement of $<1 \times 10^{-5}$, this criterion is met.

5) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed for certain analytes in Table II-1 of the SAP (DOE-RL 2009a). Other analytes will have their own pre-determined

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/23/2014	Calc. No.:	0100H-CA-V0204	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/23/2014
Subject:	100-H-56 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 6	

constituents and will have their own TDLs based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

When an analyte is detected in the primary or duplicate sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. This assessment is provided in the data quality assessment section of the RSVP.

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. No split samples were collected for the confirmatory sampling at the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2014), as necessary.

RESULTS:

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

Table 1 shows the results of the hazard quotient and excess cancer risk calculations for the 100-H-56 waste site.

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

Table 2 shows the results of the RPD calculations for the 100-H-56 waste site.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/23/2014	Calc. No.:	0100H-CA-V0204	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/23/2014
Subject:	100-H-56 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 6	

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-H-56 Waste Site.

Contaminants of Potential Concern	Maximum Value [a] (mg/kg)	Noncarcinogen RAG [b] (mg/kg)	Hazard Quotient	Carcinogen RAG [b] (mg/kg)	Carcinogen Risk
Metals					
Arsenic [c]	11.5	20	--	--	--
Barium	392	5,600	7.0E-02	--	--
Boron	69.0	7,200	9.6E-03	--	--
Chromium, hexavalent [d]	0.308	240	1.3E-03	2.1	1.5E-07
Copper	29.8	2,960	1.0E-02	--	--
Lead [e]	84.0	353	--	--	--
Mercury	15.9	24	6.6E-01	--	--
Molybdenum	0.48	400	1.2E-03	--	--
Selenium	1.55	400	3.9E-03	--	--
Zinc	70.9	24,000	3.0E-03	--	--
Totals					
Cumulative Hazard Quotient:			**7.6E-01**		
Cumulative Excess Cancer Risk:					**1.5E-07**

Notes:

[a] = From Attachment 1.

[b] = Value obtained from the 100 Area RDR/RAWP (DOE-RL 2009b) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

[c] = The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009a).

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

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

-- = not applicable

RAG = remedial action goal

Table 2. Relative Percent Difference Calculations for the 100-H-56 Waste Site (2 pages).

Duplicate Analysis - 100-H-56 Waste Site

Sampling Area	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	5910		1.4	0.76	JM	0.34	2.1		0.60	35.7		0.069
Duplicate of J1RPY0	J1RPY5	6/28/13	6080		1.5	0.49	JB	0.37	1.9		0.64	38.9		0.073

Analysis:

TDL		5	0.6	10	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	2.8%			8.6%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/23/2014	Calc. No.:	0100H-CA-V0204	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/23/2014
Subject:	100-H-56 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 5 of 6	

Table 2. Relative Percent Difference Calculations for the 100-H-56 Waste Site (2 pages).

Duplicate Analysis - 100-H-56 Waste Site

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	0.23		0.037	3290		12.7	10.2		0.052	5.3	X	0.090
Duplicate of J1RPY0	J1RPY5	6/28/13	0.23		0.040	3410		13.6	10.3		0.056	5.3	X	0.096

Analysis:

TDL		0.2	100	1	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		3.6%	1.0%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

Duplicate Analysis - 100-H-56 Waste Site

Sampling Area	Sample Number	Sample Date	Copper			Hexavalent Chromium			Iron			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	13.5		0.20	0.196		0.155	13300		3.4	3.0		0.24
Duplicate of J1RPY0	J1RPY5	6/28/13	14.0		0.21	0.176		0.155	13500		3.7	3.3		0.26

Analysis:

TDL		1	0.5	5	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	3.6%		1.5%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable

Duplicate Analysis - 100-H-56 Waste Site

Sampling Area	Sample Number	Sample Date	Magnesium			Manganese			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	4230		3.3	252		0.090	10.4		0.110	732		37.0
Duplicate of J1RPY0	J1RPY5	6/28/13	4240		3.6	254		0.096	10.2		0.120	731		39.5

Analysis:

TDL		75	5	4	400
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	0.2%	0.8%		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

Duplicate Analysis - 100-H-56 Waste Site

Sampling Area	Sample Number	Sample Date	Silicon			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	199	J	5.1	159		53.3	32.7		0.085	29.8		0.36
Duplicate of J1RPY0	J1RPY5	6/28/13	184	J	5.5	178		56.9	34.0		0.091	29.0		0.38

Analysis:

TDL		2	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	7.8%		3.9%	2.7%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

Duplicate Analysis - 100-H-56 Waste Site

Sampling Area	Sample Number	Sample Date	Chloride			Nitrogen in Nitrate			Nitrogen in Nitrate and Nitrite			Sulfate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	4.4	B	1.9	2.9	J	0.31	2.4		0.32	4.2	B	1.7
Duplicate of J1RPY0	J1RPY5	6/28/13	5.9		1.9	1.5	JB	0.31	0.94		0.30	4.0	B	1.7

Analysis:

TDL		2	0.75	0.75	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD				
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/23/2014	Calc. No.:	0100H-CA-V0204	Rev.:	0
Project:	100-H Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/23/2014
Subject:	100-H-56 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 6 of 6	

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 100-H-56 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2009b) and SAP (DOE-RL 2009a). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

Attachment 1. 100-H-56 Waste Site Confirmatory Sampling Results (Metals).

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	5910		1.4	0.76	JM	0.34	2.1		0.60	35.7		0.069	0.030	U	0.030
Duplicate of J1RPY0	J1RPY5	6/28/13	6080		1.5	0.49	JB	0.37	1.9		0.64	38.9		0.073	0.032	U	0.032
TP-2, 15 ft bgs	J1RR68	7/1/13	7100		7.13	1.73	U	1.73	3.61		0.524	59.5		0.105	0.628		0.105
TP-3, 5 ft bgs	J1TF98	3/5/14	6660	X	1.5	0.37	U	0.37	5.4	N	0.64	106	MNX	0.074	0.032	UN	0.032
100-H-28:3 South of TP-4	J1THH0	3/31/14	7040		1.5	0.37	U	0.37	11.5		0.64	105		0.073	0.35		0.032
TT 5, 15 ft bgs	J1RR73	7/16/13	4080		7.13	1.73	DU	1.73	2.92	B	0.524	48.4	N	0.105	0.31	B	0.105
TT 6, 15 ft bgs	J1RR71	7/8/13	7170		7.56	1.83	U	1.83	7.65		0.556	72.0	*	0.111	0.578		0.111
TP-7, 15 ft bgs	J1RR70	7/2/13	6480		7.22	1.75	U	1.75	8.83		0.531	126		0.106	0.628		0.106
TP-8, 15 ft bgs	J1RPH9	6/21/13	10100	MX	1.6	0.77		0.40	4.8		0.70	392	MN	0.080	0.26	M	0.035
TP-8, 13 ft bgs	J1RPJ0	6/21/13	7160	X	1.5	0.85		0.37	7.2		0.64	116		0.073	0.095	B	0.032
TP-9, 6 ft bgs	J1RR72	7/8/13	5170		6.34	0.308	U	0.308	5.21		0.466	49.8	*	0.0932	0.342	B	0.0932
TP-10, 3.5 ft bgs	J1RR69	7/2/13	6610		6.82	1.66	U	1.66	10.1		0.502	78.1		0.100	0.624		0.100
Equipment Blank	J1RPY6	6/28/13	147		1.5	0.36	UJ	0.36	0.62	U	0.62	1.7		0.072	0.035	B	0.031

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
TP1, 10 ft bgs	J1RPY0	6/28/13	0.89	U	0.89	0.23		0.037	3290		12.7	10.2		0.052	5.3	X	0.090
Duplicate of J1RPY0	J1RPY5	6/28/13	0.94	U	0.94	0.23		0.040	3410		13.6	10.3		0.056	5.3	X	0.096
TP-2, 15 ft bgs	J1RR68	7/1/13	1.70	B	1.05	0.522	B	0.105	4730		8.39	15.9		0.157	6.72		0.786
TP-3, 5 ft bgs	J1TF98	3/5/14	7.9	N	0.95	0.17	BN	0.040	6970	NX	13.7	11.4	NX	0.056	5.2	NX	0.097
100-H-28:3 South of TP-4	J1THH0	3/31/14	11.5		0.94	0.16	B	0.039	10000		13.6	12.6		0.056	6.2		0.096
TT 5, 15 ft bgs	J1RR73	7/16/13	9.89		1.05	0.285	B	0.105	5000		8.39	4.62		0.157	10.1	D	0.786
TT 6, 15 ft bgs	J1RR71	7/8/13	1.23	B	1.11	0.405	B	0.111	4300		8.89	11.9		0.167	7.61		0.834
TP-7, 15 ft bgs	J1RR70	7/2/13	10.4		1.06	0.564		0.106	9690		8.50	11.4		0.159	7.33		0.796
TP-8, 15 ft bgs	J1RPH9	6/21/13	69.0	MN	1.0	0.20	B	0.043	13200	MNX	14.9	10.3		0.061	6.4	X	0.11
TP-8, 13 ft bgs	J1RPJ0	6/21/13	12.4		0.95	0.20		0.040	6810	X	13.6	9.6		0.056	6.6	X	0.097
TP-9, 6 ft bgs	J1RR72	7/8/13	1.30	B	0.932	0.440	B	0.0932	3290		7.46	9.42		0.140	5.02		0.140
TP-10, 3.5 ft bgs	J1RR69	7/2/13	2.82	B	1.00	0.496	B	0.100	7820		8.03	12.4		0.151	7.09		0.753
Equipment Blank	J1RPY6	6/28/13	0.93	U	0.93	0.039	U	0.039	33.2	B	13.3	0.12	B	0.055	0.094	UX	0.094

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

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

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

* = duplicate analysis not within control limits

B = blank contamination (inorganic constituents)

bgs = below ground surface

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

D = reported from a dilution

ft = foot

HEIS = Hanford Environmental Information System

J = estimate

M = sample duplicate precision not met.

N = recovery exceeds upper or lower control limit.

PQL = practical quantitation limit

Q = qualifier

RAG = remedial action goal

TP = test pit

TT = test trench

U = not detected.

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

Attachment	1	Sheet No.	1 of 3
Originator	J. D. Skoglie	Date	4/23/2014
Checked	I. B. Berezovskiy	Date	4/23/2014
Calc. No.	0100H-CA-V0204	Rev. No.	0

Attachment 1. 100-H-56 Waste Site Confirmatory Sampling Results (Metals).

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
TP1, 10 ft bgs	J1RPY0	6/28/13	13.5		0.20	0.196		0.155	13300		3.4	3.0		0.24	4230		3.3
Duplicate of J1RPY0	J1RPY5	6/28/13	14.0		0.21	0.176		0.155	13500		3.7	3.3		0.26	4240		3.6
TP-2, 15 ft bgs	J1RR68	7/1/13	18.0		0.314	0.168	U	0.168	21000		8.39	5.06	B	1.73	4510		8.91
TP-3, 5 ft bgs	J1TF98	3/5/14	14.4	NX	0.21	0.155	U	0.155	13900	X	3.7	15.4	XN	0.26	4270	NX	3.6
100-H-28:3 South of TP-4	J1THH0	3/31/14	29.8		0.21	0.308		0.155	16300		3.7	34.3		0.26	4730		3.6
TT 5, 15 ft bgs	J1RR73	7/16/13	14.1		0.315	0.167	U	0.167	20700		8.39	3.47	BD	1.73	3750		8.91
TT 6, 15 ft bgs	J1RR71	7/8/13	17.8		0.333	0.176	U	0.176	21300		8.89	15.6		1.83	4880		9.45
TP-7, 15 ft bgs	J1RR70	7/2/13	22.3		0.319	0.174	U	0.174	20800		8.50	84.0		1.75	4620		9.03
TP-8, 15 ft bgs	J1RPH9	6/21/13	17.9		0.23	0.155	U	0.155	15800	X	4.0	34.6	X	0.29	5060		3.9
TP-8, 13 ft bgs	J1RPJ0	6/21/13	15.8		0.21	0.155	U	0.155	16100	X	3.7	38.1	X	0.26	4260		3.6
TP-9, 6 ft bgs	J1RR72	7/8/13	8.84		0.280	0.169	U	0.169	14500		7.46	4.07		0.308	3300		7.92
TP-10, 3.5 ft bgs	J1RR69	7/2/13	23.0		0.301	0.156	U	0.156	21900		8.03	26.2		1.66	4800		8.53
Equipment Blank	J1RPY6	6/28/13	0.21	B	0.20				526		3.6	0.34	B	0.25	16.3	B	3.5

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
TP1, 10 ft bgs	J1RPY0	6/28/13	252		0.090	0.0062	U	0.0062	0.23	B	0.23	10.4		0.110	732		37.0
Duplicate of J1RPY0	J1RPY5	6/28/13	254		0.096	0.0051	U	0.0051	0.25	U	0.25	10.2		0.120	731		39.5
TP-2, 15 ft bgs	J1RR68	7/1/13	323		0.210	0.00522	B	0.00421	0.210	U	0.210	13.5		0.157	1400		6.71
TP-3, 5 ft bgs	J1TF98	3/5/14	225	X	0.097	0.016	B	0.0062	0.29	BN	0.25	12.3	NX	0.12	956	N	39.9
100-H-28:3 South of TP-4	J1THH0	3/31/14	261		0.096	15.9		0.64	0.32	BM	0.25	13.2		0.12	1190		39.5
TT 5, 15 ft bgs	J1RR73	7/16/13	255		0.210	0.00421	U	0.00421	0.210	U	0.210	7.38		0.157	667	N	6.71
TT 6, 15 ft bgs	J1RR71	7/8/13	326		0.222	0.00452	U	0.00452	0.222	U	0.222	13.2	*	0.167	1290	N	7.11
TP-7, 15 ft bgs	J1RR70	7/2/13	277		0.212	0.994		0.0439	0.212	U	0.212	11.0		0.159	971		6.80
TP-8, 15 ft bgs	J1RPH9	6/21/13	252		0.11	0.16	MN	0.0060	0.48	BM	0.28	9.6	X	0.130	1020		43.4
TP-8, 13 ft bgs	J1RPJ0	6/21/13	254		0.097	0.059		0.0063	0.25	U	0.25	11.0	X	0.120	924		39.6
TP-9, 6 ft bgs	J1RR72	7/8/13	200		0.186	0.00389	U	0.00389	0.186	U	0.186	7.68	*	0.140	1060	N	5.97
TP-10, 3.5 ft bgs	J1RR69	7/2/13	314		0.201	0.00582	B	0.00398	0.201	U	0.201	12.9		0.151	1110		6.42
Equipment Blank	J1RPY6	6/28/13	5.9		0.094	0.0048	U	0.0048	0.25	U	0.25	0.13	B	0.120	40.5	B	38.7

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
TP1, 10 ft bgs	J1RPY0	6/28/13	0.78	U	0.78	199	J	5.1	0.14	U	0.14	159		53.3	32.7		0.085
Duplicate of J1RPY0	J1RPY5	6/28/13	0.83	U	0.83	184	J	5.5	0.15	U	0.15	178		56.9	34.0		0.091
TP-2, 15 ft bgs	J1RR68	7/1/13	0.524	U	0.524	2010	N	1.57	0.599	C	0.105	198	N	7.34	55.1	*	0.524
TP-3, 5 ft bgs	J1TF98	3/5/14	0.84	UN	0.84	136	N	5.5	0.16	UN	0.16	263	MN	57.4	31.1	NX	0.091
100-H-28:3 South of TP-4	J1THH0	3/31/14	0.83	U	0.83	219	N	5.4	0.15	U	0.15	295		56.8	35.1		0.090
TT 5, 15 ft bgs	J1RR73	7/16/13	1.55	B	0.524	527	N	1.57	0.105	U	0.105	186		7.34	75.5	DN	0.524
TT 6, 15 ft bgs	J1RR71	7/8/13	0.556	U	0.556	2940	*	1.67	0.462	B	0.111	140		7.78	57.3		0.556
TP-7, 15 ft bgs	J1RR70	7/2/13	0.531	U	0.531	1700	N	1.59	0.470	BC	0.106	447	N	7.43	54.5	*	0.531
TP-8, 15 ft bgs	J1RPH9	6/21/13	0.91	U	0.91	231		6.0	0.17	U	0.17	721	M	62.5	43.1		0.10
TP-8, 13 ft bgs	J1RPJ0	6/21/13	0.83	U	0.83	330		5.5	0.15	U	0.15	267		57.0	39.0		0.091
TP-9, 6 ft bgs	J1RR72	7/8/13	0.666	B	0.466	2340	*	1.40	0.366	B	0.0932	109		6.52	38.0		0.0932
TP-10, 3.5 ft bgs	J1RR69	7/2/13	0.502	U	0.502	1960	N	1.51	0.480	BC	0.100	248	N	7.02	55.1	*	0.502
Equipment Blank	J1RPY6	6/28/13	0.81	U	0.81	112	J	5.3	0.15	U	0.15	55.7	U	55.7	0.48	B	0.089

Attachment	1	Sheet No.	2 of 3
Originator	J. D. Skoglie	Date	4/23/2014
Checked	I. B. Berezovskiy	Date	4/23/2014
Calc. No.	0100H-CA-V0204	Rev. No.	0

Attachment 1. 100-H-56 Waste Site Confirmatory Sampling Results (Metals, anions, and Physical).

Sample Location	HEIS Number	Sample Date	Zinc			% moisture (wet sample)			pH Measurement			Bromide			Chloride		
			mg/kg	Q	PQL	%	Q	PQL	pH	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	29.8		0.36	2.1		0.10	8.96	J	0.100	0.38	U	0.38	4.4	B	1.9
Duplicate of J1RPY0	J1RPY5	6/28/13	29.0		0.38	2.1		0.10	9.10	J	0.100	0.38	U	0.38	5.9		1.9
TP-2, 15 ft bgs	J1RR68	7/1/13	39.4		2.10				8.35	X	0.010	0.715	U	0.715	0.890	B	0.715
TP-3, 5 ft bgs	J1TF98	3/5/14	70.9	NX	0.39	3.9		0.10				0.40	U	0.40	6.3	C	2.0
100-H-28:3 South of TP-4	J1THH0	3/31/14	68.5	X	0.38	3.8		0.10				0.40	U	0.40	11.0	C	2.0
TT 5, 15 ft bgs	J1RR73	7/16/13	48.1	D	2.10				9.16	X	0.010	0.702	U	0.702	0.995	B	0.702
TT 6, 15 ft bgs	J1RR71	7/8/13	45.5		2.22				8.63	X	0.010	0.754	U	0.754	1.24	B	0.754
TP-7, 15 ft bgs	J1RR70	7/2/13	70.8		2.12				10.0	X	0.010	0.731	U	0.731	2.00	B	0.731
TP-8, 15 ft bgs	J1RPH9	6/21/13	38.7		0.42	8.3		0.10	7.28		0.100	0.42	U	0.42	5.1	B	2.1
TP-8, 13 ft bgs	J1RPJ0	6/21/13	46.6		0.38	7.6		0.10	8.35		0.100	0.41	U	0.41	5.4		2.1
TP-9, 6 ft bgs	J1RR72	7/8/13	29.8		0.373				9.00	X	0.010	0.711	U	0.711	1.10	B	0.711
TP-10, 3.5 ft bgs	J1RR69	7/2/13	45.3		2.01				8.93	X	0.010	0.698	U	0.698	1.48	B	0.698
Equipment Blank	J1RPY6	6/28/13	1.5		0.38	0.10	U	0.10									

Sample Location	HEIS Number	Sample Date	Fluoride			Nitrogen in Nitrate			Nitrogen in Nitrate and Nitrite			Nitrogen in Nitrite			Phosphorous in phosphate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	0.97	B	0.80	2.9		0.31	2.4		0.32	0.33	UR	0.33	1.2	UNR	1.2
Duplicate of J1RPY0	J1RPY5	6/28/13	0.80	U	0.80	1.5	B	0.31	0.94		0.30	0.33	UR	0.33	1.2	UR	1.2
TP-2, 15 ft bgs	J1RR68	7/1/13	0.352	U	0.352	2.48	J	0.352	3.98		0.179	0.352	UR	0.352	0.715	UR	0.715
TP-3, 5 ft bgs	J1TF98	3/5/14	1.2	BN	0.83	0.87	JB	0.32	0.37	U	0.37	0.34	UR	0.34	1.3	UR	1.3
100-H-28:3 South of TP-4	J1THH0	3/31/14	0.83	UN	0.83	4.8	J	0.32	5.2		0.37	0.34	UR	0.34	1.3	UNR	1.3
TT 5, 15 ft bgs	J1RR73	7/16/13	0.510	B	0.346	0.826	JB	0.346	1.17		0.178	0.346	UR	0.346	0.702	UR	0.702
TT 6, 15 ft bgs	J1RR71	7/8/13	0.900	B	0.371	1.39	J	0.371	1.29		0.189	0.371	UR	0.371	0.754	UR	0.754
TP-7, 15 ft bgs	J1RR70	7/2/13	0.360	U	0.360	5.75	J	0.36	4.61		0.181	0.360	UR	0.360	0.731	UR	0.731
TP-8, 15 ft bgs	J1RPH9	6/21/13	0.90	UN	0.90	2.5	JB	0.34	2.0	NM	0.34	0.37	UR	0.37	1.4	UR	1.4
TP-8, 13 ft bgs	J1RPJ0	6/21/13	0.87	U	0.87	6.6	J	0.33	6.4		0.32	0.36	UR	0.36	1.3	UR	1.3
TP-9, 6 ft bgs	J1RR72	7/8/13	1.11		0.350	1.34	J	0.350	1.10		0.175	0.350	UR	0.350	0.711	UR	0.711
TP-10, 3.5 ft bgs	J1RR69	7/2/13	0.808	B	0.344	2.89	J	0.344	2.05		0.174	0.344	UR	0.344	0.698	UR	0.698

Sample Location	HEIS Number	Sample Date	Sulfate		
			mg/kg	Q	PQL
TP1, 10 ft bgs	J1RPY0	6/28/13	4.2	B	1.7
Duplicate of J1RPY0	J1RPY5	6/28/13	4.0	B	1.7
TP-2, 15 ft bgs	J1RR68	7/1/13	32.5		1.42
TP-3, 5 ft bgs	J1TF98	3/5/14	30.1		1.7
100-H-28:3 South of TP-4	J1THH0	3/31/14	235		1.7
TT 5, 15 ft bgs	J1RR73	7/16/13	3.26	B	1.39
TT 6, 15 ft bgs	J1RR71	7/8/13	138		1.50
TP-7, 15 ft bgs	J1RR70	7/2/13	47.7		1.45
TP-8, 15 ft bgs	J1RPH9	6/21/13	24.7		1.9
TP-8, 13 ft bgs	J1RPJ0	6/21/13	45.2		1.8
TP-9, 6 ft bgs	J1RR72	7/8/13	5.27		1.41
TP-10, 3.5 ft bgs	J1RR69	7/2/13	13.3		1.39

Attachment	1	Sheet No.	3 of 3
Originator	J. D. Skoglie	Date	5/13/2014
Checked	I. B. Berezovskiy	Date	5/13/2014
Calc. No.	0100H-CA-V0204	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0205

Subject: 100-H-56 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 3 Total = 4	J. D. Skoglie	I. B. Berezovskiy	H. M. Sulloway	S.G. Wilkinson ~~B. F. Obenauer~~	9/2/14

SUMMARY OF REVISION

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/24/2014	Calc. No.:	0100H-CA-V0205	Rev.:	0
Project:	100-H Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/24/2014
Subject:	100-H-56 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 1 of 3	

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-H-56 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009), the following criteria must be met:

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

GIVEN/REFERENCES:

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

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

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

4) WCH, 2014, *100-H-56 Waste Site Relative Percent Difference (RPD) and Direct Hazard Quotient and Carcinogenic Risk Calculations*, 0100H-CA-V0204, Rev. 0, Washington Closure Hanford, Richland, Washington.

SOLUTION:

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

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

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

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/24/2014	Calc. No.:	0100H-CA-V0205	Rev.:	0
Project:	100-H Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/24/2014
Subject:	100-H-56 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	2 of 3

METHODOLOGY:

The 100-H-56 waste site underwent confirmatory focused sampling at ten locations including a duplicate sample. Hazard quotient and carcinogenic risk calculations for potential impact to groundwater at the 100-H-56 waste site was conservatively calculated for the entire waste sites using the greater of the maximum values for each analyte in each sample from the RPD calculation (WCH 2014). Based on the generic site RESRAD model (BHI 2005) and a vadose zone of approximately 12 m (40 ft) thickness, a K_d of 6.1 or greater is required to show no predicted migration to groundwater in 1,000 years. Of the contaminants of potential concern (COPCs) for this site, boron and hexavalent chromium are included because no Washington State or Hanford background value has been established and the distribution coefficients are less than that necessary to show no migration to groundwater in 1,000 years. Selenium was detected above a Washington State or Hanford background value and has a distribution coefficient less than that necessary to show no migration to groundwater in 1,000 years. Arsenic was detected above background and the distribution coefficients are less than that necessary; however, the arsenic cleanup level is not toxicity based, and therefore HQ and risk calculations for arsenic are not performed. All other site nonradionuclide COPCs were not detected, quantified below background levels, or have a K_d greater than or equal to 6.1. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum or statistical value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (mg/L) (calculated with, and related to the hazard quotient through, WAC 173-340-720(3)(a)(ii)(A), 1996) x 100 x 1 mg/1000 mg (conversion factor). This is based on the "100 times rule" of WAC 173-340-740(3)(a)(ii)(A) (1996). For example, the maximum value for boron of 69.0 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 2.2×10^{-1}. Comparing this value to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation). The cumulative HQ for the 100-H-56 waste site is 5.9×10^{-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 with a carcinogenic RAG, therefore, comparing zero to the requirement of $<1 \times 10^{-6}$, this criterion is met. 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 groundwater at the site." When the "100 times rule" values are exceeded, RESRAD was used to demonstrate that higher soil concentrations may be protective of groundwater.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	4/24/2014	Calc. No.:	0100H-CA-V0205	Rev.:	0
Project:	100-H Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	4/24/2014
Subject:	100-H-56 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 3 of 3	

RESULTS:

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

Table 1 shows the results of the calculations.

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-H-56 waste site.

Contaminants of Potential Concern[a]	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Arsenic[c]	11.5	20	--	0.667	--
Boron	69.0	320	2.2E-01	--	--
Chromium, hexavalent	0.308	4.8	6.4E-02	--	--
Selenium	1.55	5	3.1E-01	--	--
Totals					
Cumulative Hazard Quotient:			**5.9E-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.
[c] = The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009b).
-- = not applicable
RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-H-56 waste site meets the requirements for the hazard quotient and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2009).

APPENDIX C

DATA QUALITY ASSESSMENT

APPENDIX C

DATA QUALITY ASSESSMENT

CONFIRMATORY SAMPLING

A data quality assessment (DQA) was performed to compare the confirmatory sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2013b). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009).

A review of the sample design (WCH 2013b), the field logbooks (WCH 2013a, 2014), and applicable analytical data packages has been performed as part of this DQA. To ensure quality data, the SAP 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).

Confirmatory sample data collected at the 100-H-56 waste site were provided by the laboratory in seven sample delivery groups (SDGs): SDG J01839, SDG J01847, SDG J02102, SDG J02126, SDG X0004, SDG X0005, and SDG X0007. SDG J01847 was submitted for third-party validation. Major and minor deficiencies are discussed for the 100-H-56 waste site data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

MAJOR DEFICIENCIES

Due to the holding time exceedances of greater than twice the limit of 48 hours for the method 300.0 ion chromatography (IC) anions analysis, nitrate, nitrite, and orthophosphate results, all undetected nitrite and orthophosphate results in SDG J01839, SDG J02102, SDG J02126, SDG X0004, SDG X0005, and SDG X0007 are qualified as rejected, with "UR" flags. All detected nitrate results are qualified as estimated, with "J" flags. This result was anticipated, and EPA analytical method 353.2 was also requested to provide usable nitrate/nitrite data for decision-making purposes. Phosphate is not a regulated chemical under *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup." The rejection of the undetected nitrite and orthophosphate data does not hinder the evaluation of the 100-H-56 waste site. The resulting data set is acceptable for decision-making purposes.

Due to the holding time exceedances of greater than twice the limit for the IC anions, method 300.0, third-party validation qualified all undetected nitrate and orthophosphate results in SDG J01847 as rejected with "UR" flags. This result was anticipated, and EPA analytical

method 353.2 was also requested to provide usable nitrate/nitrite data for decision-making purposes. The resulting data set is acceptable for decision-making purposes.

SDG J01839

This SDG comprises two focused soil samples (J1RPH9 and J1RPJ0) from the 100-H-56 waste site confirmatory sampling test pit 8 location. These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, IC anions, nitrate/nitrite (method 353.2), and hexavalent chromium. Minor deficiencies are as follows:

In the ICP metals analysis, the laboratory control sample (LCS) recovery for silicon was below the project recovery limit, at 8%. Silicon is not a contaminant of potential concern (COPC) for the 100-H-56 waste site nor is it a regulated compound under WAC 173-340, "Model Toxics Control Act – Cleanup." Although not qualified for LCS recovery below the quality control (QC) limit, all silicon results in SDG J01839 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries are out of project acceptance criteria for eight analytes (aluminum [-769%], antimony [60%], barium [-49%], boron [31%], calcium [-4%], iron [2,302%], manganese [169%], and silicon [32%]). For aluminum, iron, and manganese analytes, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of recovery from the sample. Antimony, barium, boron, calcium, and silicon did not have mismatched spike and native concentrations in the MS. Although not qualified for MS recoveries below the QC limit, all antimony, barium, boron, calcium, and silicon data in SDG J01839 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate relative percent difference (RPD) for aluminum (42%), barium (120%), beryllium (136%), boron (166%), calcium (57%), molybdenum (49%), and sodium (89%) are above the acceptance criteria of 30%. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for the RPD above the QC limits, all aluminum, barium, beryllium, boron, calcium, molybdenum, and sodium data results in SDG J01839 may be considered estimated. Estimated data are usable for decision-making purposes.

In the mercury analysis, the laboratory duplicate (RPD) for mercury is above the acceptance criteria of 30%, at 34%. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for the RPD above the QC limit, at mercury results in SDG J01839 may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range on all samples. All detected nitrate results in SDG J01839 are considered estimated. Estimated data are usable for decision-making

purposes. The nondetected nitrite and orthophosphate results are discussed in the "Major Deficiencies" section above.

SDG J01847

This SDG comprises one focused soil sample (J1RPY0) from the 100-H-56 waste site test pit 1 confirmatory sampling location. This SDG includes one field duplicate pair (J1RPY0/J1RPY5). These samples were analyzed for ICP metals, mercury, IC anions, nitrate/nitrite, and hexavalent chromium. In addition, one field equipment blank (J1RPY6) was collected and analyzed for ICP metals and mercury. SDG J01847 was submitted for third-party validation. Minor deficiencies are as follows.

In the IC anions analysis, the samples were analyzed by both EPA method 300.0 and EPA method 352.3. Due to holding time exceedances of greater than twice the limit of (48 hours), all detected nitrate, and pH results have all been qualified by third-party validation as estimated, with "J" flags. To mitigate this result the project also requested that the samples be analyzed by method 352.3 which has a longer holding time. Because the method 353.2 data for nitrate and nitrite are of higher quality than the method 300.0 data, they will be used to evaluate the 100-H-56 waste site. The resulting data set is usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for five analytes (aluminum [845%], antimony [57%], iron [1,224%], manganese [157%], and silicon [31%]). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. All antimony and silicon results for SDG J01847 were qualified as estimated with "J" flags by third-party validation. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon was below the project recovery limit, at 8%. All silicon results in SDG J01847 were qualified as estimated, with "J" flags, by third-party validation. Estimated data are usable for decision-making purposes.

SDG J02102

This SDG comprises one focused soil sample (J1TF98) from the 100-H-56 waste site confirmatory sampling location test pit 3. This sample was analyzed for ICP metals, mercury, IC anions, nitrate/nitrite, and hexavalent chromium. Minor deficiencies are as follows.

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

In the ICP metals analysis, the LCS recovery for silicon was below the project recovery limit, at 17%. Silicon is not a COPC for the 100-H-56 waste site nor is it a regulated compound under WAC 173-340. Although not qualified for LCS below QC limits, all silicon data in SDG J02102 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are below project acceptance criteria for all metal analytes. There is no indication that the analytical system was operating out of control, and method accuracy has been vilified by the acceptable LCS analysis data. Although not qualified for MS recoveries below QC limit, all metals data in sample J1TF98 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate RPDs for barium and sodium are above the acceptance criteria of 30%, at 33% and 73%, respectively. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for the RPD above the QC limits, all barium and sodium data results in SDG J02102 may be considered estimated. Estimated data are usable for decision-making purposes.

In the IC anions analysis, chloride was detected in the method blank. Although not qualified for the method blank contamination, all chloride results may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range on all samples. All detected nitrate results in SDG J02102 may be considered estimated. Estimated data are usable for decision-making purposes. The nondetected nitrite and orthophosphate results are discussed in the "Major Deficiencies" section above.

SDG J02126

This SDG comprises one focused soil sample (J1THH0) from the 100-H-56 waste site confirmatory sampling location test pit 4. This sample was analyzed for ICP metals, mercury, IC anions, nitrate/nitrite, and hexavalent chromium. Minor deficiencies are as follows.

In the ICP metals analysis, zinc was detected in the method blank, at very low levels, less than 1/20th of the associated field sample result. Although not qualified for the method blank contamination, zinc data in sample J1THH0 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon was below the project recovery limit, at 17%. Silicon is not a COPC for the 100-H-56 waste site nor is it a regulated compound under WAC 173-340. Although not qualified for LCS below QC limits, all silicon data in SDG J02126 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were out of project acceptance criteria for six analytes (aluminum [1,360%], antimony [61%], calcium [155%], iron [2,145%], manganese [164%], and silicon [18%]). For aluminum, iron, and manganese, the spiking concentration was

insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony, calcium, and silicon did not have mismatched spike and native concentrations in the original MS. Although not qualified for MS outside QC limits, all antimony, calcium, and silicon data in SDG J02126 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate RPD for molybdenum is above the acceptance criteria of 30%, at 103%. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for the RPD above the QC limit, all molybdenum data results in SDG J02126 may be considered estimated. Estimated data are usable for decision-making purposes.

In the mercury analysis, the MS was above QC limit, at 3,062%. The spiking concentration for mercury was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Data are usable for decision-making purposes.

In the IC anions analysis, chloride was detected in the method blank. Although not qualified for the method blank contamination, all chloride results may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range on all samples. All detected nitrate results in SDG J02126 may be considered estimated. Estimated data are usable for decision-making purposes. The nondetected nitrite and orthophosphate results are discussed in the "Major Deficiencies" section above.

SDG X0004

This SDG comprises three focused soil samples (J1RR68, J1RR69, and J1RR70) from the 100-H-56 waste site confirmatory test pits 2, 10, and 7. These samples were analyzed for ICP metals, mercury, IC anions, nitrate/nitrite, and hexavalent chromium. Minor deficiencies are as follows.

In the ICP metals analysis, the laboratory duplicate RPD for cadmium is above the acceptance criteria of 30%, at 53.1%. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for the RPD above the QC limit, all molybdenum data results in SDG X0004 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, antimony, arsenic, copper, molybdenum, potassium, and silver were detected in the method blank at very low levels, less than 1/20th of the associated field sample result. Although not qualified for the method blank contamination, all antimony, arsenic, copper,

molybdenum, potassium, and silver results for sample J1RR68 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for two analytes (silicon [2.11%], sodium [133%]). The deficiency in the MS is a reflection of the variability of the native concentrations rather than a measure of the recovery from the sample. Silicon and sodium did not have mismatched spike and native concentrations in the MS. Although not qualified for MS results outside the QC limits, all silicon and sodium results for SDG X0004 may be considered estimated. Estimated data are usable for decision-making purposes.

In the IC anions analysis, the MS was above QC limit for sulfate (160%). The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Although not qualified for the MS above QC limit, all sulfate results in SDG X0004 may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range on all samples. All detected nitrate results in SDG X0004 may be considered estimated. Estimated data are usable for decision-making purposes. The nondetected nitrite and orthophosphate results are discussed in the "Major Deficiencies" section above.

SDG X0005

This SDG comprises two focused soil samples (J1RR71 and J1RR72) from the 100-H-56 waste site confirmatory sampling test pits 6 and 9. These samples were analyzed for ICP metals, mercury, IC anions, nitrate/nitrite, and hexavalent chromium. Minor deficiencies are as follows.

In the ICP metals analysis, arsenic, molybdenum, and zinc were detected in the method blank at very low levels, less than $1/20^{th}$ of the associated field sample result. Although not qualified for the method blank contamination, all arsenic, molybdenum, and zinc results for sample J1RR71 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS was above QC limit for potassium (52.3%). The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Potassium is not a regulated constituent under WAC 173-340. Data are usable for decision-making purposes.

In the IC anions analysis, the MS was above QC limit for sulfate (160%). The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Although not qualified for the MS above QC limit, all sulfate results in SDG X0005 may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range on all samples. All detected nitrate results in SDG X0005 may be considered estimated. Estimated data are usable for decision-making purposes. The nondetected nitrite and orthophosphate results are discussed in the "Major Deficiencies" section above.

SDG X0007

This SDG comprises one focused soil sample (J1RR73) from the 100-H-56 waste site test trench 5. This sample was analyzed for ICP metals, mercury, IC anions, nitrate/nitrite, and hexavalent chromium. Minor deficiencies are as follows.

In the ICP metals analysis, potassium was detected in the method blank, at very low levels, less than 1/20th of the associated field sample result. Potassium is not a regulated constituent under WAC 173-340. Data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for four analytes (barium [46.9%], potassium [32.1%], silicon [48.9%], and vanadium [74.1%]). The deficiency in the MS is a reflection of the variability of the native concentrations rather than a measure of the recovery from the sample. A post-digestion spike was performed for all four analytes, yielding acceptable recoveries. Although not qualified for MS results outside the QC limits, all barium, potassium, silicon, and vanadium results for SDG X0007 may be considered estimated. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anions analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range on all samples. All detected nitrate results in SDG X0007 may be considered estimated. Estimated data are usable for decision-making purposes. The nondetected nitrite and orthophosphate results are discussed in the "Major Deficiencies" section above.

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 logbooks (WCH 2013a, 2014), are shown in Table C-1. The main and QA/QC sample results are presented in Appendix B.

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

Sample Area	Main Sample	Duplicate Sample
Test pit - 1	J1RPY0	J1RPY5

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

None of the RPDs calculated for the field duplicate sample are above the acceptance criteria (30%). A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the TDL, including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix B) to indicate that a visual check of the data is required by the reviewer. None of the duplicate evaluations required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are usable for decision-making purposes.

SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-H-56 waste site confirmatory sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 100-H-56 waste site 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 confirmatory sample analytical data are stored in the Environmental Restoration project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The confirmatory sample analytical data are also summarized in Appendix B.

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