1225098

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

14-AMRP-0186

MAY 27 2014

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

RECEIVED
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EDMC

Dear Ms. Hedges:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 100-H-46, 190-H POTENTIAL CONTAMINATION SOIL WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2014-003 and supporting, "Remaining Sites Verification Package for the 100-H-46, 190-H Potential Contamination Soil Waste Site," Rev. 0. If you have questions, please contact me or your staff may contact Ellwood Glossbrenner, of my staff, at (509) 376-5828.

Sincerely,

Mark S. French, Director
River Corridor Division

AMRC:ETG

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

0082806

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2014-003

Waste Site Code(s)/Subsite Code(s): 100-H-46

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-46, 190-H Potential Contaminated Soil 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) by the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2009), as a candidate site. Confirmatory sampling was conducted in November and December 2009 with samples collected at three test pits. The sampling results indicated a portion of the site required remediation.

Remedial action at the 100-H-46 waste site began on February 5, 2013, and continued through July 16, 2013. The original design included removal of material to a depth of 3 m (10 ft) below ground surface (bgs). Due to the discovery of hexavalent chromium-contaminated concrete at the remaining 190-H Building below ground structure and elevated hexavalent chromium in test pit samples, the original design was expanded to allow removal of additional hexavalent chromium-contaminated material underlying the western portion of the former 190-H Building. Excavation in the western area extended to the periodically rewetted zone (12.5 m [41 ft] bgs); thereby effectively removing the vadose zone in this portion of the site. Waste removed from the site included concrete and demolition debris, steel pipe, steel rebar, and chromium-contaminated soil. A total of approximately 62,000 bank cubic meters (BCM) (81,100 bank cubic yards [BCY]) of overburden was removed and stockpiled. Approximately 61,300 BCM (80,200 BCY) of contaminated soil and debris were removed and staged for disposal at the Environmental Restoration Disposal Facility (ERDF). Waste loadout operations began on June 17, 2013, and were completed March 5, 2014.

Verification sampling of the overburden stockpile was expedited due to remediation needs at the 100-H Area and was performed on August 19, 2013, with concurrence from the Washington State Department of Ecology. Verification samples from two decision units within the 100-H-46 excavation were collected on December 13, 2013, and January 6, 2014.

Remediation, verification sampling, and comparison of residual contaminant concentrations against cleanup levels have been performed in accordance with remedial action objectives and goals established by the 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) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at ERDF, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification to Interim Closed Out.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2014-003

Waste Site Code(s)/Subsite Code(s): 100-H-46

Basis for reclassification:

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009). The results of verification 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 from the 100-H-46 waste site that extended into the deep vadose zone (greater than 4.6 m [15 ft] bgs) has been removed through removal of the soil that comprised the vadose zone to a depth of 12.5 m (41 ft)] bgs. The excavation was terminated at the top of the water table on July 16, 2013. Therefore, 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-46, 190-H Potential Contaminated Soil Waste Site* (attached).

Regulator comments:

Waste Site Controls:

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

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

J. P. Neath	J P Neath	4/17/14
DOE Federal Project Director (printed)	Signature	Date
N. Menard KIM WELSCH FOR	Kim Welsch FOR	4/29/14
Ecology Project Manager (printed)	Signature	Date
N/A		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-46, 190-H POTENTIAL CONTAMINATED SOIL WASTE SITE

Attachment to Waste Site Reclassification Form 2014-003

May 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-46 POTENTIAL CONTAMINATED SOIL WASTE SITE

EXECUTIVE SUMMARY

The 100-H-46, 190-H Potential Contaminated Soil waste site, located within the 100-HR-1 Operable Unit, was part of the former 190-H Main Process Pump House. The site consisted of several locations along the northern and western sections of the former 190-H Building where sodium dichromate was handled, mixed, and injected into the 105-H Reactor process cooling water system.

Remedial action at the 100-H-46 waste site was conducted from February 5, 2013, and continued through July 16, 2013. The original remedial design included removal of material to a depth of 3 m (10 ft) below ground surface (bgs). Due to the discovery of hexavalent chromium-contaminated concrete in the remaining 190-H Building below ground structure and elevated hexavalent chromium in test pit samples, the original design was expanded to allow removal of additional hexavalent chromium-contaminated material underlying the western portion of the former 190-H Building. Excavation in the western area extended to the periodically rewetted zone (12.5 m [41 ft] bgs); thereby effectively removing the vadose zone in this portion of the site. Waste removed from the site included concrete and demolition debris, steel pipe, steel rebar, and chromium-contaminated soil. A total of approximately 62,000 bank cubic meters (BCM) (81,100 bank cubic yards [BCY]) of overburden was removed and stockpiled. Approximately 61,300 BCM (80,200 BCY) of contaminated soil and debris were removed and staged for disposal at the Environmental Restoration Disposal Facility. Waste loadout operations began on June 17, 2013, and were completed March 5, 2014.

Verification sampling of the overburden stockpile was expedited due to remediation needs at the 100-H Area and was sampled on August 19, 2013, with concurrence from the Washington State Department of Ecology. Verification samples from two decision units within the 100-H-46 excavation were collected on December 13, 2013, and January 6, 2014, per the *Work Instruction for Verification Sampling of the 100-H-46, 190-H Potential Contaminated Soil Waste Site* (WCH 2013d).

The verification sampling results indicate that the waste removal action 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 cleanup evaluation for the results from verification sampling against the applicable criteria is presented in Table ES-1. The results of verification sampling are used to make reclassification decisions for the 100-H-46 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-46 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of <15 mrem/yr above background for 1,000 years.	Radionuclides were not COPCs for the 100-H-46 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	All individual COPC concentrations in shallow zone decision units are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The hazard quotient determined from shallow zone decision units is <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient determined from shallow zone decision units (1.1×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for hexavalent chromium, the only carcinogen detected above background levels, 1.3×10^{-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, 1.3×10^{-7}, is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	Radionuclides were not COPCs for the 100-H-46 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 copper in Decision Unit 1 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), it is predicted that copper 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 copper in Decision Unit 1 are not predicted to migrate more than 2.6 m (8.5 ft) vertically within 1,000 years (based on the copper distribution coefficient of 22 mL/g). The distance to groundwater from the bottom of Decision Unit 1 is approximately 3.5 m (11.5 ft). Therefore, residual concentrations of copper are predicted to be protective of groundwater and the Columbia River.

Table ES-1. Summary of Remedial Action Goals for the 100-H-46 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?

COPC = contaminant of potential concern
DOE = U.S. Department of Energy
MCL = maximum contaminant level
NA = not applicable
RAG = remedial action goal
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)

In accordance with this evaluation, the verification sampling results support a reclassification of this waste site to Interim Closed Out. 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 zone soil (surface to 4.6 m [15 ft] bgs), and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Contamination from the 100-H-46 waste site that extended into the deep zone (greater than 4.6 m [15 ft] bgs) has been removed; 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-46 waste site contaminants of potential concern and other constituents (Appendix A). The higher of the maximum or statistical values were considered for comparison. Ecological screening levels from *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron and vanadium. The U.S. Environmental Protection Agency's ecological soil screening levels were exceeded for manganese and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of 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-46, 190-H POTENTIAL CONTAMINATED SOIL WASTE SITE

STATEMENT OF PROTECTIVENESS

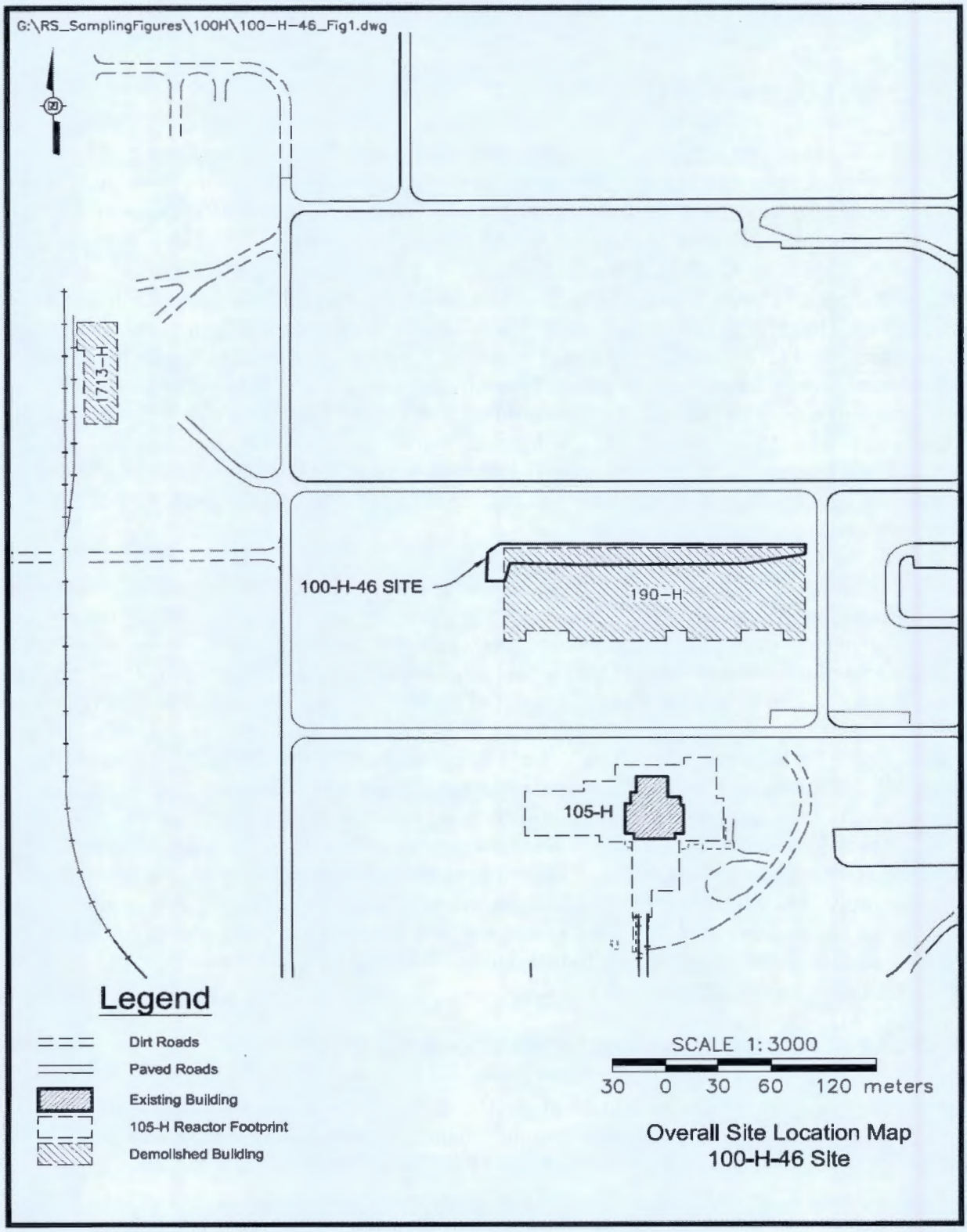
The 100-H-46 waste site verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of 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 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 from the 100-H-46 waste site that extended into the deep zone has been removed through removal of the vadose zone; 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-46 waste site contaminants of potential concern (COPCs) and other constituents (Appendix A). The higher of the maximum or statistical values were considered for comparison. Ecological screening levels from *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron and vanadium. The U.S. Environmental Protection Agency's (EPA's) ecological soil screening levels were exceeded for manganese and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of 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-46 waste site is located north of the 105-H Reactor at a location associated with the former 190-H Building where sodium dichromate handling, mixing, and injection occurred (Figure 1). The site is within the 100-HR-1 Operable Unit of the Hanford Site.

Figure 1. Overall Site Location of the 100-H-46 Waste Site.



History

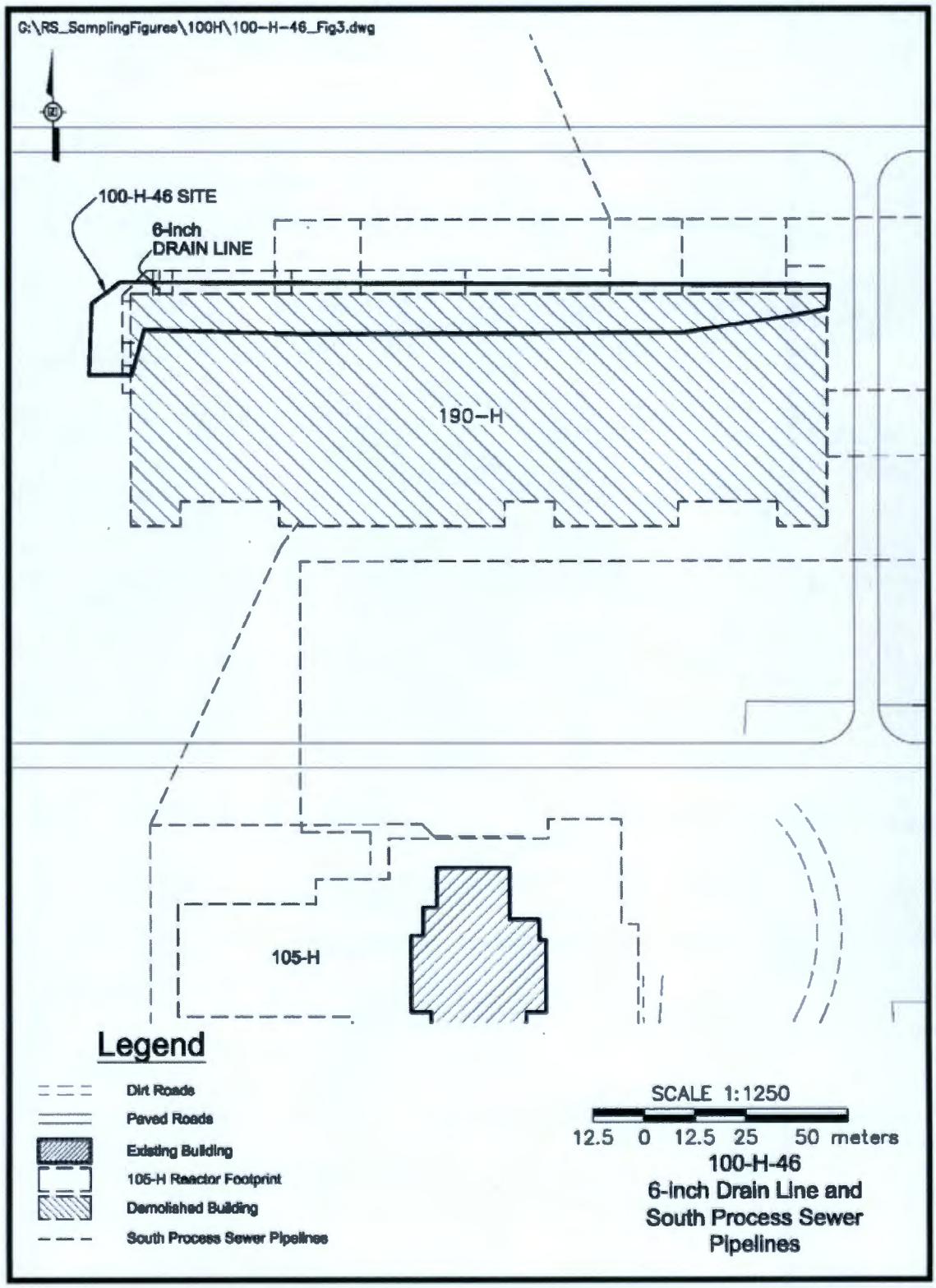
The 190-H complex was a process water pump house that supplied the 105-H Reactor with nonradioactive cooling water. A 15% sodium dichromate solution was prepared by adding dry crystalline sodium dichromate to filtered water. The solution was injected into reactor cooling water piping as an anticorrosive agent for the aluminum process tubes in the reactor. This piping fed to four process water storage tanks within the 190-H Facility. Figure 2 shows the tanks during construction of the 190-H Pump House.

Figure 2. 190-H Process Water Tanks During Construction (February 1949).

The sodium dichromate addition process consisted of a mixing tank, two feed tanks, four injection pumps, piping, valves, and associated electrical and instrument equipment. Packaged dry sodium dichromate was delivered to the 190-H Building via railcar. An unloading dock with an elevator was used to convey the material from the railcars to an upper level of the 190-H Building where it was added to the mixing tank and mixed with water.

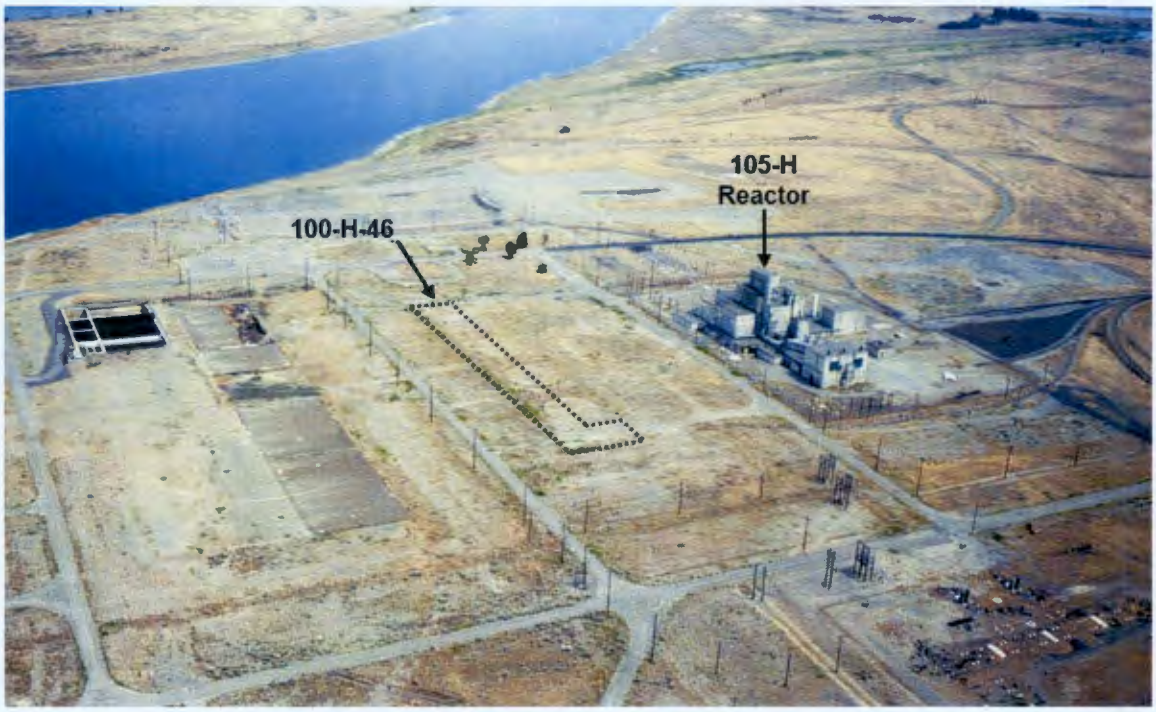
Piping from the mixing tank fed the liquid concentrate to the feed tanks and to four injection pumps. The sodium dichromate concentrate piping ran approximately the full length of the building servicing the four injection pump locations. The sodium dichromate liquid was added to the filtered water by injection pumps through chemical feed injection rings. The injection rings were located inline in the 76-cm (30-in.) and 107-cm (42-in.)-diameter pipes that entered the process water storage tanks through automatic control valves. Drain lines from the sodium dichromate mixing tank and the feed tanks entered a 15-cm (6-in.) drain pipe that fed to the process sewer system and exited towards the south process sewer (100-H-28:2, South Process Sewers subsite) (Figure 3). Spills and leaks of sodium dichromate from the mixing, injection, and drain line systems is believed to have caused accumulation of sodium dichromate contamination in the vadose zone of the 100-H-46 waste site.

Figure 3. Locations of 100-H-46 Waste Site, 190-H Building 6-in. Drain Line, and South Process Sewer Pipelines (100-H-28:2).



In 1977, the 190-H Building was demolished and the debris buried in the 183-H clearwells. In 1986, the pipe tunnels between the 190-H facility and the 105-H Reactor Building were uncovered and filled to grade with clean soil after removing the pipelines. Figure 4 shows the 100-H Area after decommissioning of the 190-H Pump House. The circular footprint of the base of each of the four process water tanks can be seen in the photograph.

Figure 4. Photograph of the 100-H-46 Waste Site Looking Southeast (1985).



CONFIRMATORY SAMPLING

Confirmatory sampling of the 100-H-46 waste site was performed in accordance with the *Work Instruction for Confirmatory Sampling of 100-H-46, 190-H Potential Contaminated Soil* (CWI) (WCH 2009c) at the end of November and beginning of December 2009, as described in the following section.

Contaminants of Potential Concern

The COPCs for the 100-H-46 waste site confirmatory sampling were identified as hexavalent chromium, total chromium, lead, and mercury. Although not considered COPCs, arsenic, antimony, barium, beryllium, boron, cadmium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc were also evaluated by performing analyses for the expanded inductively coupled plasma (ICP) metals list.

Asbestos was included as a contingency analysis as it may have been used in piping systems for outer insulation and gasket materials. Asbestos-containing material (ACM) was identified during confirmatory sampling and sample of suspected ACM was collected and analyzed for asbestos.

Contingencies for the discovery of oil-stained soil or evidence of burning were included in the CWI (WCH 2009c) with additional analysis for polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAH) specified. Because oil-stained soil or evidence of burning was not observed during field activities, PCBs, TPH, and PAH analysis was not required.

Field screening for volatile organic compounds (VOCs) 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 sampling. Because radiological activity was not detected in the field above background levels, samples were not analyzed for radionuclides.

The COPCs and analytical methods for 100-H-46 confirmatory sampling are presented in Table 1.

Table 1. Confirmatory Sampling Laboratory Analytical Methods.

Analytical Method	Contaminants of Potential Concern
Hexavalent chromium – EPA Method 7196	Hexavalent chromium
ICP metals [a] – EPA Method 6010	Lead, total chromium
Mercury – EPA Method 7471	Mercury
Bulk asbestos – NIOSH Method 7400	Asbestos

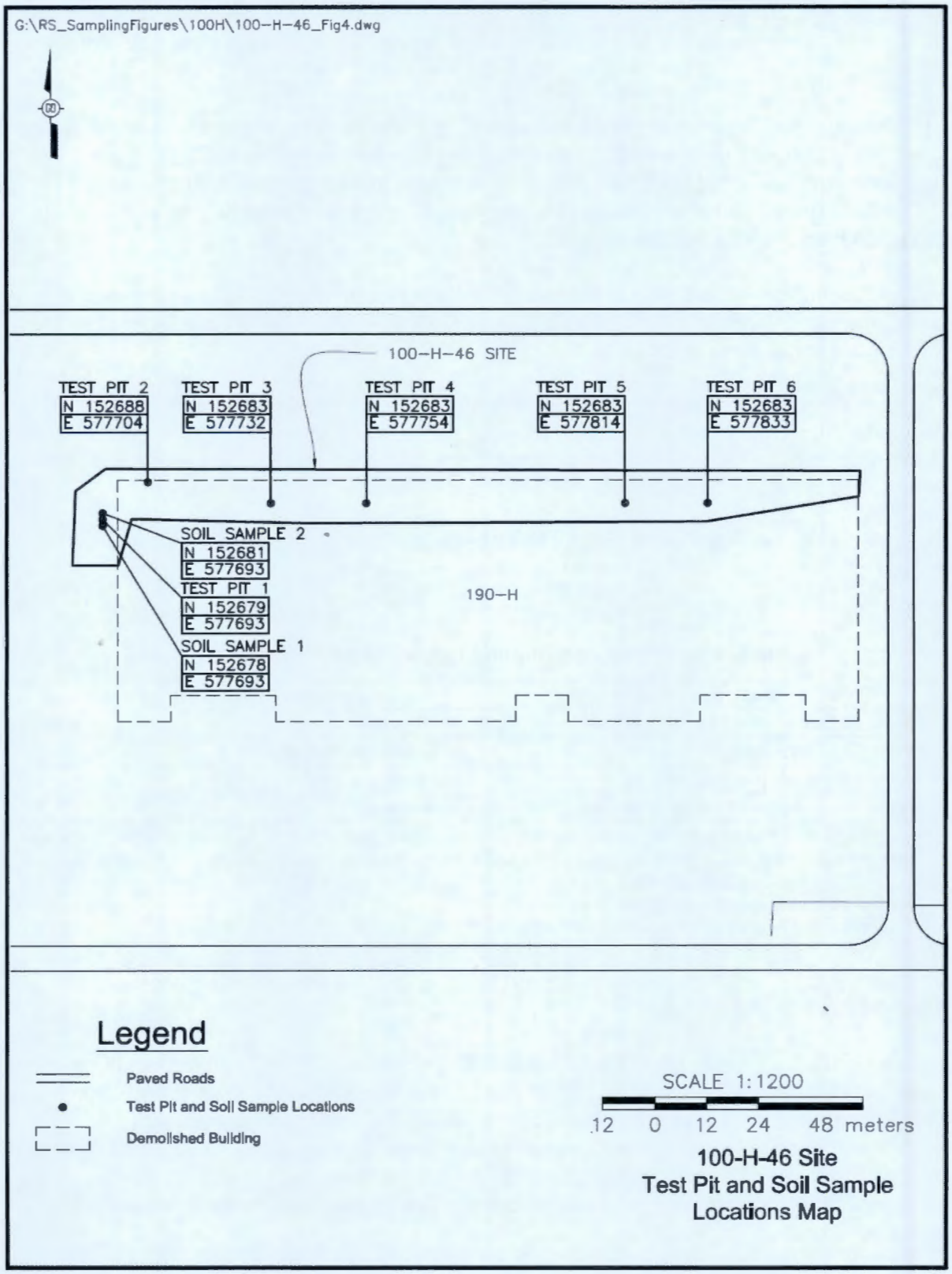
[a] Analyses for the expanded list of ICP metals including antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc were performed.

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
NIOSH = National Institute for Occupational Safety and Health

Confirmatory Sample Design

Because historical knowledge of the 190-H Building demolition in 1977 did not include the condition of the below-grade portion of the pumphouse, several locations were identified on and below the ground floor as possible worst-case locations for confirmatory sampling. The locations selected for sampling included the soil between the former loading dock and railroad tracks (test pit 1), the suspected drain connection for the sodium dichromate overflow pipe (test pit 2), and tank drain sumps (test pits 3 through 6). Test pit locations for the confirmatory sampling design are shown in Figure 5.

Figure 5. Confirmatory Sampling Design Locations for the 100-H-46 Waste Site.



Summary of Confirmatory Sampling Activities

Confirmatory sampling activities at the 100-H-46 waste site were performed in accordance with the CWI (WCH 2009c) at the end of November and beginning of December 2009, as described in the field logbooks (WCH 2009a, 2009b). A summary of confirmatory samples is provided in Table 2. A discussion of field activities follows.

Table 2. 100-H-46 Confirmatory Sample Summary Table.

Sample Location	Sample Description	HEIS Number	Sample Date	Depth (bgs)	Washington State Plane Coordinates (m)		Sample Analysis
					Northing	Easting	
Test pit 1	Surface soil 1	J19D67	12/2/2009	0 ft	152679	577693	Hexavalent chromium, ICP metals [a], mercury
Test pit 1	Surface soil 2	J19C43	12/9/2009	0 ft	152681	577693	
Test pit 1	Subsurface soil	J19D68	12/2/2009	1 ft	152679	577693	
Test pit 1	Concrete scabble	J19D69	12/9/2009	0 ft	152680	577693	ICP metals [a], mercury
		J19D72	12/9/2009	0 ft			Hexavalent chromium
Test pit 2	Sump contents 1	J19D64	12/2/2009	4.5 ft	152688	577703	Hexavalent chromium, ICP metals [a], mercury
Test pit 2	Sump contents 2	J19D65	12/2/2009	4.5 ft	152688	577703	
Test pit 2	Sump floor scrapings	J19D62	12/2/2009	4.5 ft	152688	577703	
Test pit 2	Duplicate of J19D62	J19D63	12/2/2009	4.5 ft	152688	577703	
Test pit 2	Suspect asbestos	J19C30	12/2/2009	4.5 ft	152688	577703	Asbestos
Test pit 3	Pipe scale	J19DP5	12/10/2009	7 ft	152683	577732	ICP metals [a], mercury
		J19DN8	12/10/2009	7 ft			Hexavalent chromium
NA	Equipment blank	J19D66	12/2/2009	NA	NA	NA	ICP metals [a], mercury
Test pits 4, 5, and 6	No sample material found	NA	NA	NA	NA	NA	NA

[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

On November 23, 2009, excavation was started on test pit 6. Approximately 0.3 m (1 ft) of fill material was removed to reach the concrete slab. The manhole appeared to be filled with dirt and gravel. No stained soil or concrete was found. On December 1, 2009, the excavation and sampling crew completed excavations at test pits 4, 5, and 6. No samples were taken at test pits 4, 5, and 6 due to a lack of appropriate available sample material. Figure 6 shows the excavation at test pit 5, and Figure 7 shows the building rubble material found in test pit 5.

Figure 6. 100-H-46 Excavation at Test Pit 5 (View to the Southeast).

Figure 7. 100-H-46 Test Pit 5 Building Rubble Material.

On December 2, 2009, test pit 2 was excavated and sampled. Sample J19D62 (Washington State Department of Ecology (Ecology) Ecology split J19D77) was collected from scrapings of the sump floor at a depth of approximately 1.4 m (4.5 ft) below ground surface (bgs). A duplicate of sample J19D62 (J19D63) was also collected. In addition, two samples of soil (J19D64 [Ecology split J19D78] and J19D65 [Ecology split J19D79]) in contact with the debris in the test pit 2 sump were collected. Suspect asbestos-containing material on a 0.3-m (1-ft) long pipe was collected for asbestos analysis (J19C30). Test pit 2 was backfilled.

Also on December 2, 2009, test pit 1 was excavated and sampled. Soil samples were collected at the surface (J19D67 [Ecology split J19D80]) and at approximately 0.3 m (1 ft) bgs (J19D68 [Ecology split J19D81]). An equipment blank was obtained (J19D66). On December 9, 2009, scabbling of stained concrete at test pit 1 provided material for two samples (J19D69 and J19D72). Also, a surface soil sample was collected (J19C43).

On December 10, 2009, pipe scale in test pit 3 was collected at approximately 2.1 m (7 ft) bgs, resulting in two samples (J19DP5 and J19DN8).

CONFIRMATORY SAMPLE RESULTS

All confirmatory samples were analyzed using analytical methods approved by the EPA (DOE-RL 2009). 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) was performed. This comparison indicated that portions of the 100-H-46 site at test pits 1 and 3 failed direct exposure remedial action goals (RAGs) for three analytes. Additionally, asbestos was detected in a sample from test pit 2. A summary table for these analytes is presented in Table 3. Based on these results, the associated portions of the 100-H-46 waste site were recommended for remediation (WCH 2010).

Table 3. Analytes Exceeding Direct Exposure Remedial Action Goals.

Contaminant of Potential Concern	Confirmatory Sample Location and Media	Maximum Result (mg/kg)	Direct Exposure RAG (mg/kg) [a]	Does the Maximum Result Exceed the RAG?
Arsenic	Test pit 3 - pipe scale	115	20 [b]	Yes
Hexavalent chromium	Test pit 1 - concrete	66.6	2.1	Yes
Manganese	Test pit 3 - pipe scale	3,940	3,760	Yes

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

RAG = remedial action goal
RDR/RAWP= Remedial Design Report/Remedial Action Work Plan

REMEDIAL ACTION SUMMARY

Remedial action at the 100-H-46 waste site began on February 5, 2013, and continued through July 16, 2013. A pre-remediation photograph is presented in Figure 8. Waste removed from the site included concrete and demolition debris, steel pipe, steel rebar, and chromium-contaminated soil. The original design included removal of material to a depth of approximately 3 m (10 ft) bgs. However, green-stained concrete (Figure 9) with concentrations of hexavalent chromium greater than RAGs was discovered in March 2013. The concrete originated from the western portion of the remediation. Several test pits were excavated with in-process samples collected as deep as 5.5 m (18 ft) below the original surface grade (Appendix C). Due to the discovery of green-stained concrete and the test pit results, the remedial design was changed to allow removal of additional hexavalent chromium-contaminated material in the western portion of the former 190-H Building. Based on the remediation necessary to remove hexavalent chromium-contaminated soil at the 100-D-30, 185-D Sodium Dichromate Trench in the 190-D Complex, and at the 100-F-57, 190-F Process Water Pump House Debris waste sites, the updated 100-H-46 design conservatively allowed for remediation to the depth of groundwater in the area with hexavalent chromium-contamination.

Figure 8. Aerial Photograph of the 100-H-46 Waste Site Area Before Remediation.

Figure 9. Green Stained Concrete from the Western Portion of the 100-H-46 Excavation (March 11, 2013).

Due to the increased remediation depth, additional overburden/layback material was removed and staged in a pile to the west of the remediation. The clean overburden pile contained approximately 62,000 bank cubic meters (BCM) (81,100 bank cubic yards [BCY]) of soil.

As remediation progressed, in-process samples were collected to measure hexavalent chromium and chromium (total) concentrations in 1.5 m (5 ft) depth intervals (Appendix C). A sample collected May 16, 2013, from the southwestern corner of the excavation (J1RMF0) indicated hexavalent chromium concentrations in excess of RAGs extended past the design boundary. The remedial design was then expanded to allow additional removal of material in the southwest area of the excavation.

Remediation in the western portion of the waste site extended to the periodically rewetted zone (PRZ) at an elevation of approximately 117.0 m (384 ft) above mean sea level (amsl) (a depth of 12.5 m [41 ft] bgs), effectively removing all of the vadose zone soil in this area. In-process

sampling of the sidewalls surrounding the excavation floor in the PRZ indicated that the concentration of hexavalent chromium in the remaining soil was less than RAGs.

During the course of remediation, the portion of the 190-H Building foundation within the 100-H-46 WIDS boundary was removed in its entirety. All 100-H-46 confirmatory sampling locations were removed in their entirety. The only remaining portion of the 190-H Building foundation that remains lies outside of the 100-H-46 waste site boundary, along the southeast edge of the former building.

In total, approximately 61,300 BCM (80,200 BCY) of contaminated soil and debris was removed and staged at multiple staging pile areas (SPAs) pending loadout and disposal. The SPAs received waste beginning February 5, 2013. Waste loadout of 100-H-46 material with disposal at the Environmental Restoration Disposal Facility began on June 17, 2013, and was completed March 5, 2014. The SPAs were also used to receive waste from other 100-H remediation areas and were not included in the verification sampling of the 100-H-46 excavation and overburden. Verification sampling of the SPAs will be conducted with sampling of the other waste sites.

During remediation, a previously unidentified french drain was discovered at Washington State Plane (WSP) coordinates N 152655, E 577686. The base of the french drain extended to approximately 4.6 m (15 ft) bgs. Red-stained soil and rock were present in the french drain and were sampled (Figure 10). The hexavalent chromium concentration in the sample (2.3 mg/kg), J1RKM3, slightly exceeded direct exposure and river protection RAGs. The french drain location was within the area of the site in which the vadose zone was removed during remedial action. No other anomalies were discovered.

Figure 10. Red-Stained Soil and Rock at Location of Unidentified French Drain in 100-H-46 Excavation (April 10, 2013).

In-process sample results and diagrams correlating sample locations to excavation depths are presented in Appendix C. Photographs of the remediated site are presented in Figures 11 and 12. The post-excavation civil survey of the 100-H-46 remediation is provided in Figure 13. The locations of the excavation, overburden stockpile, and staging pile areas are presented in Figure 14.

Figure 11. 100-H-46 Excavation at Final Remediation Depth (July 16, 2013).

Figure 12. Aerial Photograph of the Excavated 100-H-46 Waste Site (August 8, 2013).

Figure 13. Post-Excavation Civil Survey of the 100-H-46 Excavation Showing Original Waste Site Boundary and Footprint of the Former 190-H Building.

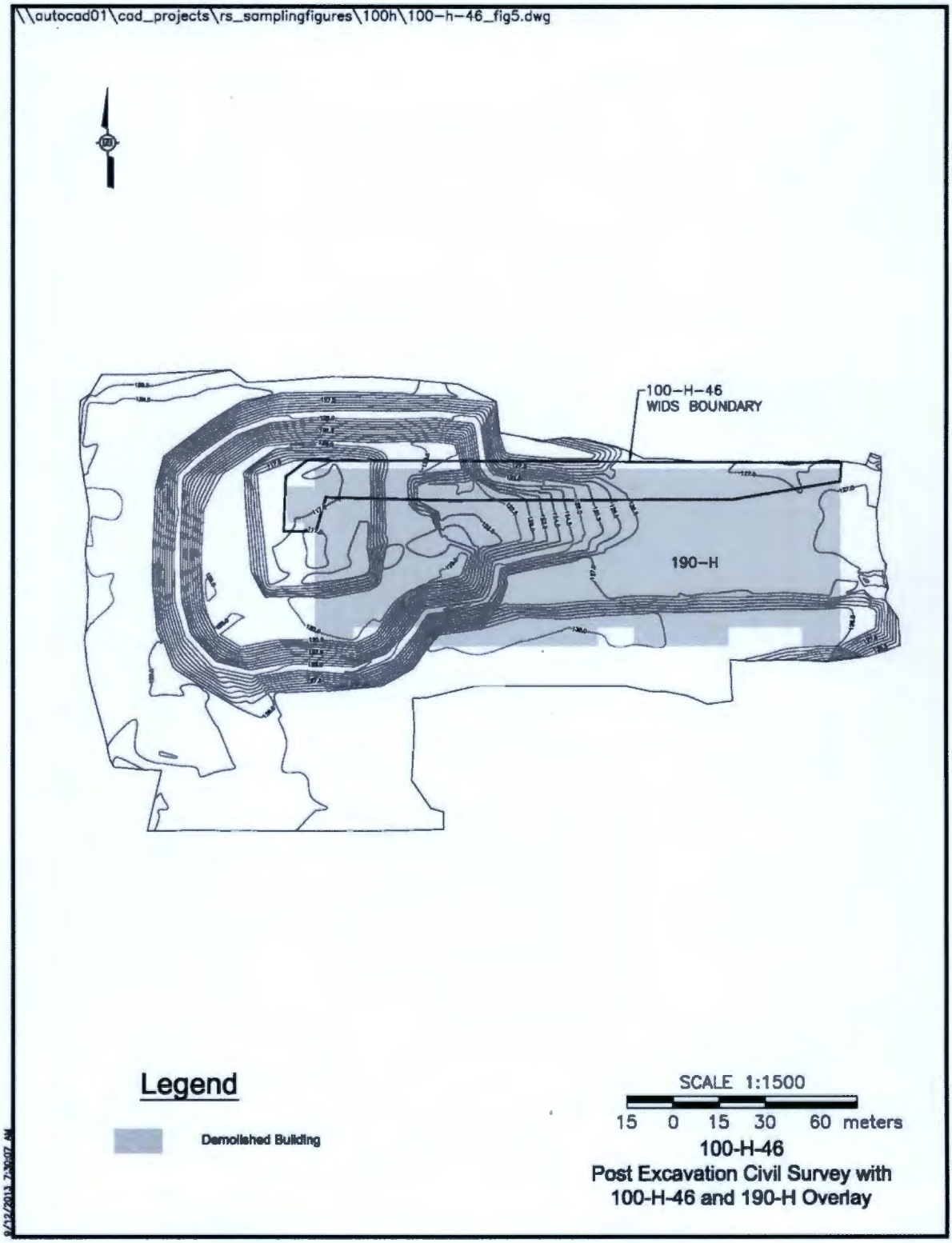
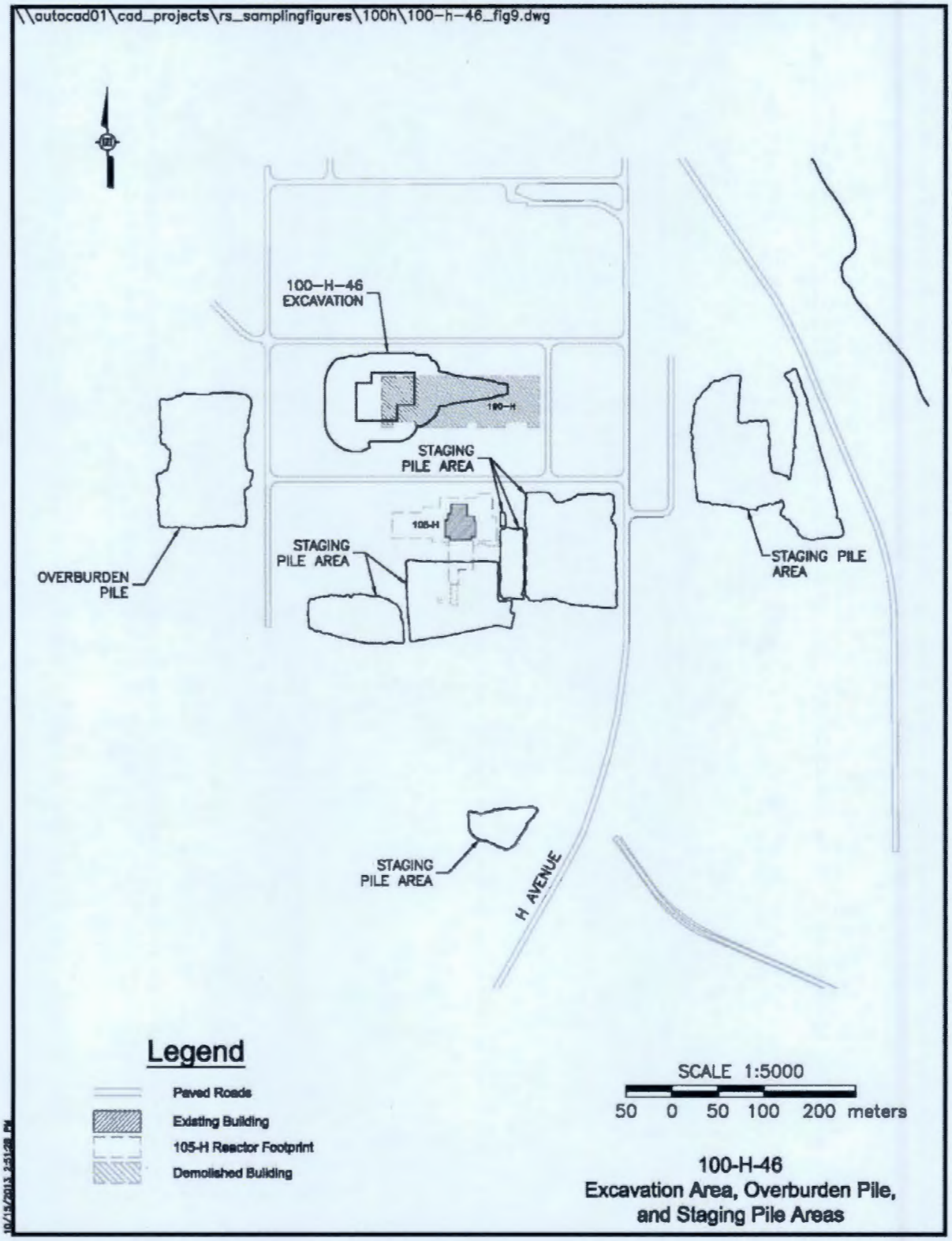


Figure 14. Locations of 100-H-46 Excavation Area, Overburden, and Staging Pile Areas.



VERIFICATION SAMPLING

This section describes the basis for selection of a verification sampling design for the 100-H-46 waste site excavation area and overburden pile.

Contaminants of Potential Concern for Verification Sampling

The COPCs for the 100-H-46 waste site were identified based on the process knowledge of the 190-H facility and similar waste sites associated with sodium dichromate use and the results of confirmatory and in-process sampling. Multiple metals were quantified above RAGs in confirmatory samples and were retained as COPCs for verification sampling. These metals included antimony, arsenic, cadmium, chromium (total), cobalt, copper, hexavalent chromium, lead, mercury, manganese, molybdenum, nickel, vanadium, and zinc. Although not considered COPCs, barium, beryllium, boron, selenium, and silver were evaluated by performing analysis for the expanded list of ICP metals. Radionuclides were not COPCs for the 100-H-46 waste site.

During confirmatory sampling, asbestos containing material was found on a pipe within Test Pit 2. The asbestos encountered during confirmatory sampling was found and removed during remediation. No additional asbestos was identified during the 100-H-46 excavation. Therefore, asbestos was excluded as a COPC.

The analytical methods performed to evaluate the 100-H-46 site COPCs are provided in Table 4.

Table 4. Laboratory Analytical Methods.

Analytical Method	Contaminant of Potential Concern
ICP metals [a] – EPA Method 6010	Antimony, arsenic, cadmium, chromium (total), cobalt, copper, lead, mercury, manganese, molybdenum, nickel, vanadium, and zinc
Mercury – EPA Method 7471	Mercury
Hexavalent chromium – EPA Method 7196	Hexavalent chromium

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

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

Verification Sampling Design

The statistical sampling designs for the 100-H-46 excavation area decision units and overburden pile were developed using Visual Sample Plan[1] (VSP). The areas identified for the purpose of statistical verification sampling were delineated in VSP and used as the basis for a random-start systematic grid for verification soil sample collection at the site. Twelve statistical soil samples

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

were collected on the grid within each of the three decision units. A triangular grid is used based on studies that indicate triangular grids are superior to square grids (Gilbert 1987).

A total of three decision units were identified for statistical verification sampling. The 100-H-46 excavation area was divided into two decision units (Decision units 1 and 2). Decision unit 3 was the overburden pile. Decision unit 1 included areas within the excavation boundary that are above the lower tier bench at an elevation of 120.0 m (393.7 ft) amsl and within the 100-H-46 Waste Information Data System site boundary and former 190-H Building footprint. Decision unit 1 extended from the ground surface to a depth of approximately 9.5 m (31.2 ft) bgs (elevation 120.0 m amsl). A cross section of the decision units in the western portion of the excavation area is presented in Figure 15. Areas within the former 190-H Building footprint that were not within the remediation footprint were not included in the sample design.

Decision unit 2 included the excavation area below 120.0 m (393.7 ft) amsl and above 118.0 m (387.1 ft) amsl. The decision unit extends from a depth of approximately 9.5 m (31.2 ft) bgs to 11.5 m (37.7 ft) bgs. The 118.0 m (387.1 ft) amsl elevation is just above the floor of the deepest excavated area (117.0 m amsl) and the groundwater rewetted zone. The floor of the excavation below 118.0 m (387.1 ft) amsl within the rewetted zone was not included for cleanup verification sampling. The decision units for the excavation area and the sample locations are presented in Figure 16. Sampling of decision units 1 and 2 was performed on December 13, 2013, and January 6, 2014.

The 100-H-46 verification sample location DU1-12 was located at WSP coordinates N 152644.6, E 577798.0 in the approved VWI (WCH 2013d). Upon locating the coordinates in the field, it was discovered that the location contained substantial concrete debris and rebar. The sample location was moved with concurrence from Ecology (WCH 2013c) so that the resulting verification sample data was not impacted by the debris at the original location. The new location was near the original location and outside of the debris area (Figure 17) at WSP coordinates N 152653.8, E 577798.6. The adjusted sample location is also shown in the context of the entire sampling design in Figure 16.

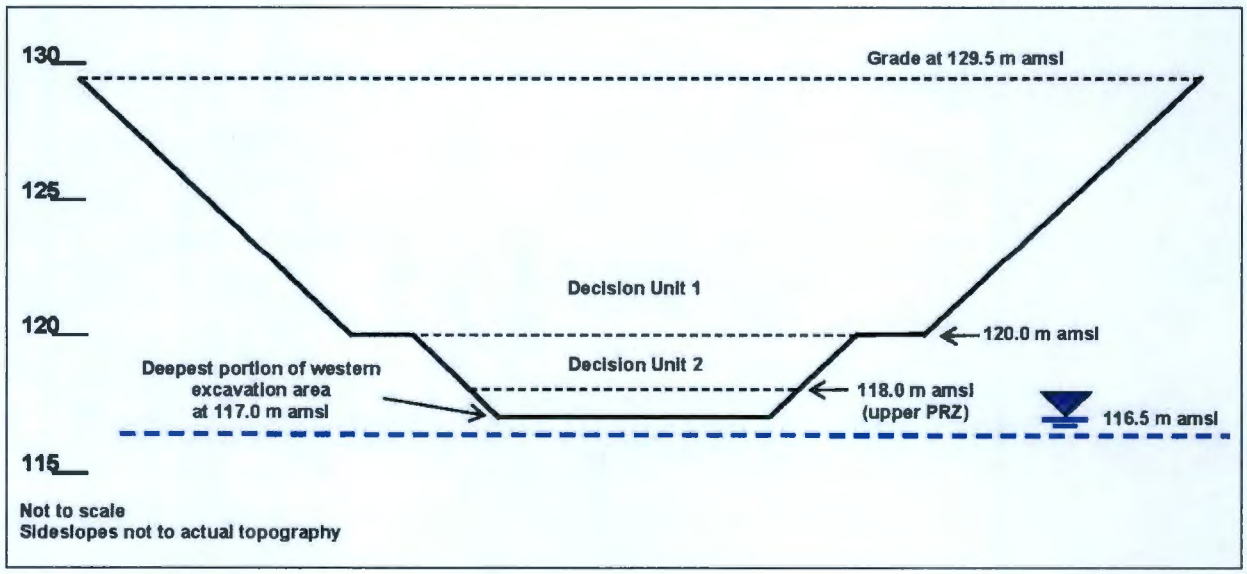
To support other remediation activities in the 100-H area, the statistical sampling design of the overburden pile was prepared prior to issuance of the VWI (WCH 2013d) with approval from Ecology. The verification sample locations are presented in Figure 18. Sampling of the overburden was conducted on August 19, 2013.

Waste loadout of 100-H-46 material from the SPAs was completed March 5, 2014. The SPAs were also used to receive waste from other 100-H remediation areas and were not included in the verification sampling of the 100-H-46 excavation and overburden. Verification sampling of the SPAs will be conducted with sampling of the other waste sites.

Verification sampling and analysis was performed to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). Discrete samples were collected as described in the VWI (WCH 2013d). All sampling was performed in

accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2009a).

Figure 15. Cross Section of Decision Units in the Western Excavation Area.



amsl = above mean sea level
PRZ = periodically rewetted zone

Figure 16. Verification Sample Locations for the 100-H-46 Waste Site Excavation Decision Units 1 and 2.

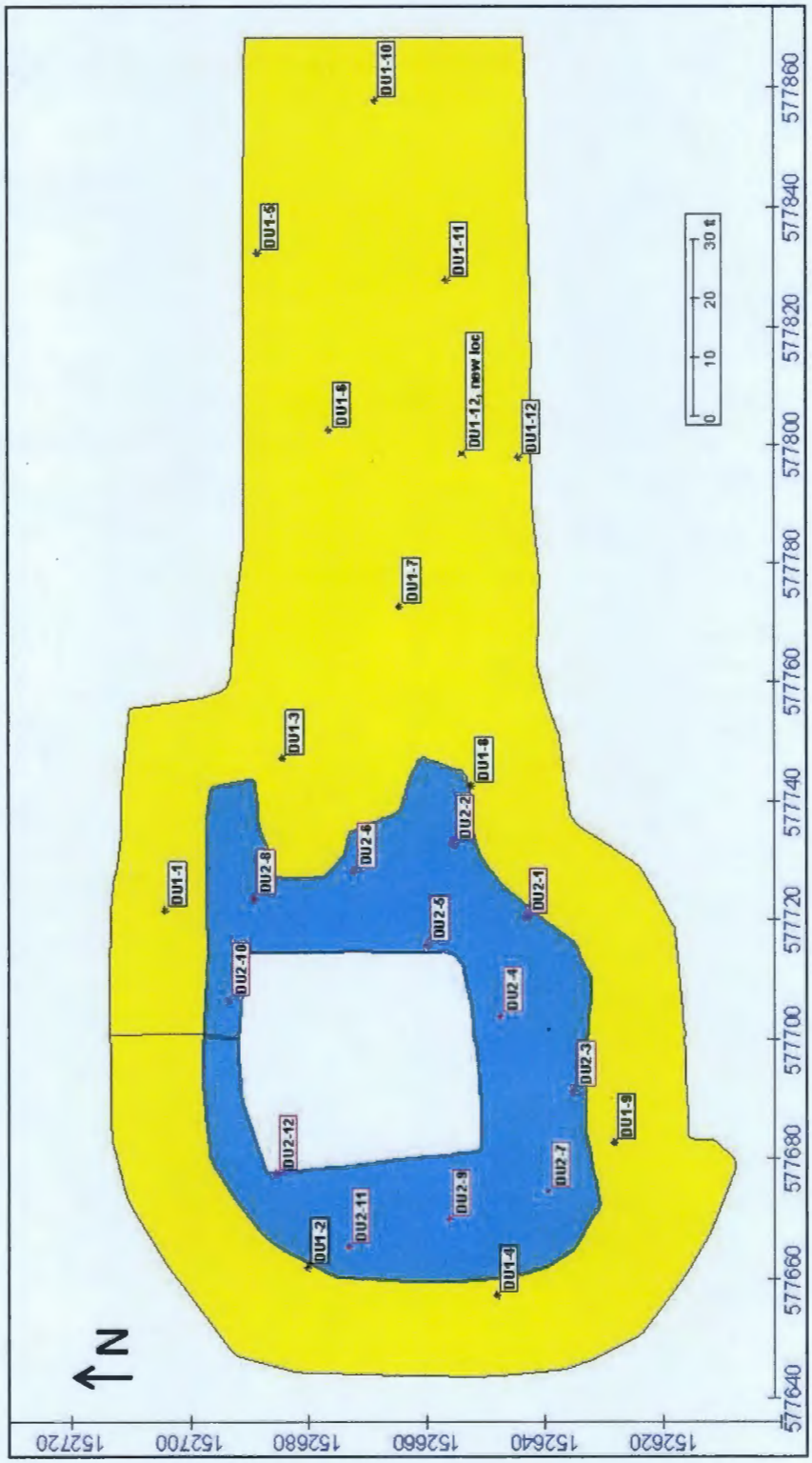
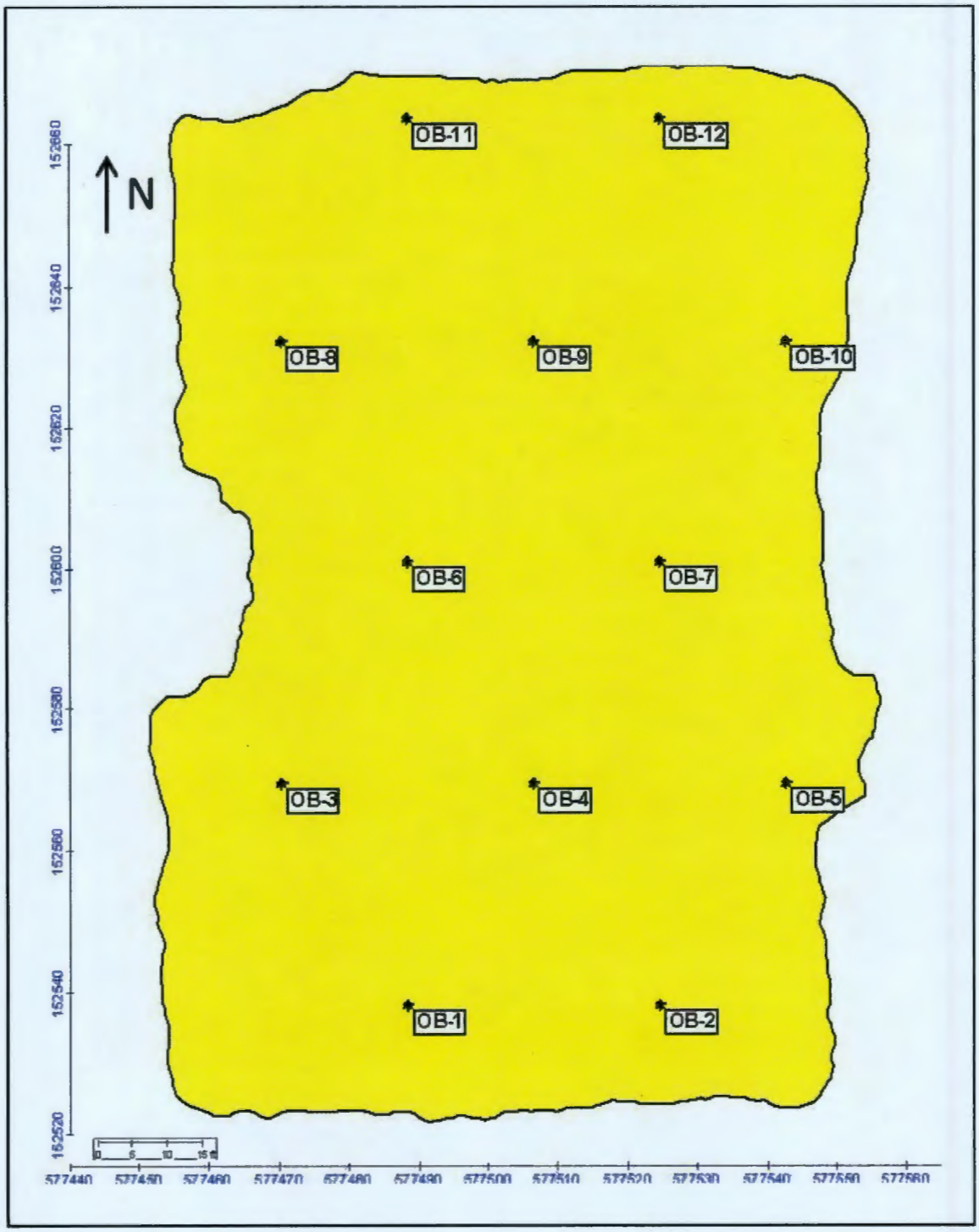


Figure 17. Original and Updated 100-H-46 DU1-12 Sample Locations.

Figure 18. Verification Sample Locations for the 100-H-46 Overburden Stockpile (Decision Unit 3).



A summary of the verification samples collected and laboratory analyses performed is provided in Table 5. Sample collection activities were documented in the field logbooks (WCH 2013a, 2013b).

Table 5. 100-H-46 Verification Sample Summary. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
DU1-1	J1T6L4	152704.3	577721.8	ICP metals [a], mercury, hexavalent chromium
DU1-2	J1T6L5	152680.3	577661.9	
DU1-3	J1T6L6	152684.4	577747.2	
DU1-4	J1T6L7	152648.3	577657.4	
DU1-5	J1T6L8	152688.5	577832.5	
DU1-6	J1T6L9	152676.5	577802.5	
DU1-7	J1T6M0	152664.5	577772.6	
DU1-8	J1T6M1	152652.5	577742.6	
DU1-9	J1T6M2	152628.4	577682.7	
DU1-10	J1T6M3	152668.6	577857.9	
DU1-11	J1T6M4	152656.6	577827.9	
DU1-12 [b]	J1T6M5	152653.8	577798.6	
Duplicate of J1T6L4	J1T6M6	152704.3	577721.8	
DU2-1	J1T6M8	152643.1	577720.6	ICP metals [a], mercury, hexavalent chromium
DU2-2	J1T6M9	152655.5	577732.9	
DU2-3	J1T6N0	152635.2	577691.5	
DU2-4	J1T6N1	152647.6	577703.7	
DU2-5	J1T6N2	152660.0	577716.0	
DU2-6	J1T6N3	152672.4	577728.3	
DU2-7	J1T6N4	152639.6	577674.6	
DU2-8	J1T6N5	152689.2	577723.7	
DU2-9	J1T6N6	152656.4	577670.0	
DU2-10	J1T6N7	152693.6	577706.8	
DU2-11	J1T6N8	152673.2	577665.4	
DU2-12	J1T6N9	152685.6	577677.6	
Duplicate of J1T6N8	J1T6P0	152673.2	577665.4	
OB-1	J1RX91	152538.2	577488.4	ICP metals [a], mercury, hexavalent chromium
OB-2	J1RX92	152538.2	577524.5	
OB-3	J1RX93	152569.6	577470.3	
OB-4	J1RX94	152569.6	577506.4	
OB-5	J1RX95	152569.6	577542.6	
OB-6	J1RX96	152600.9	577488.4	
OB-7	J1RX97	152600.9	577524.5	
OB-8	J1RX98	152632.3	577470.3	
OB-9	J1RX99	152632.3	577506.4	
OB-10	J1RXC0	152632.3	577542.6	
OB-11	J1RXC1	152663.6	577488.4	
OB-12	J1RXC2	152663.6	577524.5	
Duplicate of J1RX91	J1RXC3	152538.2	577488.4	

Table 5. 100-H-46 Verification Sample Summary. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
Equipment blank	J1T6M7	NA	NA	ICP metals [a], mercury

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

[b] Due to the presence of substantial concrete debris and rebar in the original DU1-12 sample location, the location was moved to a new location (N 152653.8, E 577798.6) outside of the debris area with concurrence from Washington State Department of Ecology (WCH 2013d).

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

Verification Sampling Results

All verification samples were analyzed using analytical methods approved by EPA (DOE-RL 2009b). Evaluation of the verification data from the 100-H-46 waste site was performed by direct comparison of the statistical or maximum sample results for each COPC against cleanup criteria.

The primary statistical calculation to evaluate compliance with cleanup standards is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each detected COPC are computed for each of the decision units as specified by the 100 Area RDR/RAWP (DOE-RL 2009b). The calculations are provided in Appendix D. When a nonradionuclide COPC was detected in fewer than 50% of the verification samples collected for a decision unit, the maximum detected value was used for comparison to RAGs. If no detections for a given COPC were reported in the data set, then no statistical calculation or evaluation was performed for that COPC.

Comparisons of the results for site COPCs with the RAGs for each of the decision units are listed in Tables 6, 7, and 8. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2014) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in these tables. The complete laboratory results are stored in the WCH project-specific database prior to submitting to the HEIS for archiving and are provided in Appendix D.

Table 6. Comparison of Contaminant Concentrations to Remedial Action Goals for the 100-H-46 Decision Unit 1 Statistical Verification Samples.

COPC	Statistical or 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		
Arsenic	5.5 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	52.1 (<BG)	5,600	200	400	No	--
Beryllium	0.23 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Boron [e]	1.9	7,200	320	-- [f]	No	--
Cadmium [g]	0.12 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	9.4 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	5.7 (<BG)	24	15.7 [c]	-- [f]	No	--
Copper	24.0	2,960	59.2	22.0 [c]	Yes	Yes [h]
Hexavalent chromium [e]	0.276	2.1	4.8	2	No	--
Lead	8.2 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	244 (<BG)	3,760	512 [c]	512 [c]	No	--
Mercury	0.012 (<BG)	24	0.33 [c]	0.33 [c]	No	--
Molybdenum [e]	0.77	400	8	-- [f]	No	--
Nickel	9.8 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	44.2 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	33.8 (<BG)	24,000	480	67.8 [c]	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 D.

[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] 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]).

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

[f] 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]).

[g] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

[h] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of copper are not expected to migrate more than 2.6 m (8.5 ft) vertically in 1,000 years based on the copper distribution coefficient of 22 mL/g. The vadose zone underlying the soil below Decision Unit 1 is approximately 3.5 m (11.5 ft) thick. Therefore, residual concentrations of copper are predicted to be protective of groundwater and the Columbia River.

-- = 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*

Table 7. Comparison of Contaminant Concentrations to Remedial Action Goals for the 100-H-46 Decision Unit 2 Statistical Verification Samples.

COPC	Statistical or 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		
Arsenic	3.3 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	43.0 (<BG)	5,600	200	400	No	--
Beryllium	0.16 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Boron [e]	1.2	7,200	320	-- [f]	No	--
Cadmium [g]	0.26 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	9.1 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	4.8 (<BG)	24	15.7 [c]	-- [f]	No	--
Copper	14.5 (<BG)	2,960	59.2	22.0 [c]	No	--
Hexavalent chromium [e]	0.226	2.1	4.8	2	No	--
Lead	9.0 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	213 (<BG)	3,760	512 [c]	512 [c]	No	--
Molybdenum [e]	0.33	400	8	-- [f]	No	--
Nickel	9.0 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	42.8 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	28.7 (<BG)	24,000	480	67.8 [c]	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 D.

[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] 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]).

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

[f] 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]).

[g] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

-- = 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*

Table 8. Comparison of Contaminant Concentrations to Remedial Action Goals for the 100-H-46 Overburden (Decision Unit 3) Statistical Verification Samples.

COPC	Statistical or 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		
Arsenic	2.4 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	42.5 (<BG)	5,600	200	400	No	--
Beryllium	0.14 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Cadmium [e]	0.15 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	10.2 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	5.2 (<BG)	24	15.7 [c]	-- [f]	No	--
Copper	12.6 (<BG)	2,960	59.2	22.0 [c]	No	--
Hexavalent chromium [e]	0.237	2.1	4.8	2	No	--
Lead	3.2 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	230 (<BG)	3,760	512 [c]	512 [c]	No	--
Molybdenum [e]	0.30	400	8	-- [f]	No	--
Nickel	9.9 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	40.8 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	29.4 (<BG)	24,000	480	67.8 [c]	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 D.
[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] 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]).
[e] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[f] 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*

CLEANUP VERIFICATION DATA EVALUATION

This section demonstrates that remedial action at the 100-H-46 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-46 waste site.

Attainment of Nonradionuclide RAGS

Direct Exposure RAG Evaluation

All COPCs from the 100-H-46 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 copper in Decision Unit 1. However, copper, with a distribution coefficient (K_d) of 22 mL/g, is not expected to migrate vertically more than 2.6 m (8.5 ft) in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). The vadose zone underlying the soil below Decision Unit 1 is approximately 3.5 m (11.5 ft) thick. Therefore, residual concentrations of copper are predicted to be protective of groundwater and the Columbia River.

Three-Part Test for Nonradionuclides

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

The application of the three-part test for the 100-H-46 waste site is included in the statistical calculations, where half or more of the data set was detected (Appendix D). The results of this evaluation indicate that residual COPC concentrations pass the three-part test in comparison against applicable RAGs with the exception of copper in Decision Unit 1 and lead in Decision Unit 2. As previously discussed, copper, with a K_d of 22 mL/g, is not expected to migrate vertically more than 2.6 m (8.5 ft) vertically in 1,000 years based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). Lead failed the three-part test due to a single sample at location DU2-10 at greater than twice the cleanup level. Lead, with a K_d of 30 mL/g, is not expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). However, the depth to groundwater underlying this sample location is approximately 2 m (6.6 ft). The sample was located at 11.0 m (36.1 ft) bgs. Therefore, residual concentrations of COPCs are predicted to be protective of groundwater and the Columbia River.

An additional application of the three-part test is included for the statistical data sets that default to the maximum because less than half of the data set was detected. The results of this evaluation indicate that all residual COPC concentrations defaulting to the maximum value pass the three-part test in comparison against applicable RAGs. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

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 1.1×10^{-2}. The carcinogenic risk value for hexavalent chromium, the only constituent subject to the excess cancer risk evaluation, was 1.3×10^{-7}, which is less than the individual and cumulative cancer risk values of 1×10^{-6} and 1×10^{-5}, respectively. The 100-H-46 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-46 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 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-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 K_d values for these contaminants are less than that necessary to show no migration to groundwater in 1,000 years based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). Based on this model and a vadose zone of approximately 3.5 m (11.5 ft) thickness, a K_d of 20 or greater is required to show no predicted migration to groundwater in 1,000 years from Decision Unit 1. All individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-H-46 waste site is 1.0×10^{-1}, which is less than 1.0. The 100-H-46 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.

BACKFILL

An agreement to backfill a portion of the 100-H-46 waste site excavation with clean concrete and steel debris was obtained from Ecology on January 29, 2014 (WCH 2014). The agreement specified that the bottom 3 m (10 ft) of the excavation would be soil. Clean concrete and debris could be placed over the soil to an elevation that would be no closer than 6.1 m (20 ft) from the backfilled surface grade.

To achieve a more natural appearing topography and preserve borrow resources, the 100-H-46 excavation may be backfilled with soil up to 3.6 m (12 ft) below the surrounding surface. With a generalized 100-H Area surface elevation of 130 m (426 ft) amsl, the finished backfilled topographic elevation at the 100-H-46 excavation would generally be no lower than 126.3 m (414 ft) amsl. To account for the requirements for placement of clean debris no closer than 6.1 m (20 ft) below the backfilled surface grade, the finished grade in areas where clean debris is placed will be higher than 126.3 m (414 ft) amsl. The finished backfilled surface contours will be at the discretion of WCH natural resource staff and will follow the general guidelines for closed borrow pits. Guidelines generally include slopes no steeper than 4 horizontal to 1 vertical with rolling and blending contours to approximate the surrounding natural landscape. The finished backfill contours and slopes will also limit tumbleweed accumulation. During backfill and contouring activities, walkdowns may be scheduled with Ecology and DOE to ensure a common understanding of the final grade and topography of backfill and contoured areas.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed on the verification data. The DQA compared the sampling approach, the field logbooks (WCH 2013a and 2013b), 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-46 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 cleanup verification 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 D. The detailed DQA is presented in Appendix E.

SUMMARY FOR INTERIM CLOSURE

The 100-H-46 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009b). Verification sampling was performed and the analytical results indicate that the residual concentrations of COPCs at this subsite meet the remedial action objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-H-46 waste site to Interim Closed Out. Contamination from the 100-H-46 waste site that extended into the deep zone (greater than 4.6 m [15 ft] bgs) has been removed through removal of the vadose zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-H-46 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								
Boron	--	0.5	--	--	--	--	--	--	1.9
Manganese	512	1,100 [d]	--	1,500	220	450	4,300	4,000	220 (<BG)
Vanadium	85.1	2	--	--	--	--	7.8	280	44.2 (<BG)

NOTE: Shaded cells indicate screening values that are exceeded.

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

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

[c] Wildlife.

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

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

APPENDIX B

CONFIRMATORY SAMPLES

Table B-1. 100-H-46 Confirmatory Sampling Results - Metals. (4 Pages)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1, Surface Soil 2	J19C43	12/9/2009	5320		4.35	1.93		0.52	10.1		0.87	65.8		0.44
Test Pit 2, Sump Floor Scrapings	J19D62	12/2/2009	8870		4.76	2.55		0.57	15.1		0.95	89.8		0.48
Test Pit 2, Duplicate of J19D62	J19D63	12/2/2009	12800		5.58	1.15		0.67	13.6		1.12	117		0.56
Test Pit 2, Sump Contents 1	J19D64	12/2/2009	7470		4.76	0.57	U	0.57	4.08		0.95	69.0		0.48
Test Pit 2, Sump Contents 2	J19D65	12/2/2009	6910		4.47	1.52		0.54	10.7		0.89	81.4		0.45
Equipment Blank	J19D66	12/2/2009	186		4.72	0.57	U	0.57	0.94	U	0.94	2.19		0.47
Test Pit 1, Surface Soil 1	J19D67	12/2/2009	6240		3.81	1.75		0.46	10.2		0.76	68.2		0.38
Test Pit 1, Subsurface Soil	J19D68	12/2/2009	8640		3.99	0.48	U	0.48	4.02		0.8	79.4		0.40
Test Pit 1, Concrete Scabble	J19D69	12/9/2009	8040		4.9	0.59	U	0.59	4.96		0.98	118		0.49
Test Pit 1, Concrete Scabble	J19D72	12/9/2009												
Test Pit 3, Pipe Scale	J19DN8	12/10/2009												
Test Pit 3, Pipe Scale	J19DP5	12/10/2009	962		13.9	12.5		1.67	115		2.78	42.8		1.39

Note below and definitions apply to all tables in this appendix.

Note: Data qualified with B are considered acceptable values. Cells are shaded if an analyte was not analysed for a specific sample.

B = Detected but below the Reporting Limit
CLP = Contract Laboratory Program
HEIS = Hanford Environmental Information System
J = estimate
PQL = practical quantitation limit
Q = qualifier
RDL = Required Detection Limit
U = undetected

Sample Location	HEIS Number	Sample Date	Beryllium			Boron			Cadmium			Calcium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1, Surface Soil 2	J19C43	12/9/2009	0.13	B	0.17	3.81		1.74	0.15	B	0.17	21400		87
Test Pit 2, Sump Floor Scrapings	J19D62	12/2/2009	0.58		0.19	27.3		1.91	1.81		0.19	25000		95.3
Test Pit 2, Duplicate of J19D62	J19D63	12/2/2009	0.93		0.22	41.3		2.23	2.84		0.22	31500		112
Test Pit 2, Sump Contents 1	J19D64	12/2/2009	0.24		0.19	1.51	B	1.91	0.08	B	0.19	6050		95.3
Test Pit 2, Sump Contents 2	J19D65	12/2/2009	0.24		0.18	2.70		1.79	0.20		0.18	9490		89.3
Equipment Blank	J19D66	12/2/2009	0.19	U	0.19	1.89	U	1.89	0.19	U	0.19	49.8	B	94.3
Test Pit 1, Surface Soil 1	J19D67	12/2/2009	0.16		0.15	1.73		1.53	0.18		0.15	19500		76.3
Test Pit 1, Subsurface Soil	J19D68	12/2/2009	0.28		0.16	1.07	B	1.59	0.12	B	0.16	9530		79.7
Test Pit 1, Concrete Scabble	J19D69	12/9/2009	0.16	B	0.20	2.59		1.96	0.80		0.2	62200		1180
Test Pit 1, Concrete Scabble	J19D72	12/9/2009												
Test Pit 3, Pipe Scale	J19DN8	12/10/2009												
Test Pit 3, Pipe Scale	J19DP5	12/10/2009	0.56	U	0.56	25.4		5.56	1.18		0.56	8140		278

Table B-1. 100-H-46 Confirmatory Sampling Results - Metals. (4 Pages)

Sample Location	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1, Surface Soil 2	J19C43	12/9/2009	174		0.17	4.81		1.74	20.6		0.87	0.13		0.21
Test Pit 2, Sump Floor Scrapings	J19D62	12/2/2009	1100		0.19	10.1		1.91	101		0.95	0.13	B	0.23
Test Pit 2, Duplicate of J19D62	J19D63	12/2/2009	1090		0.22	11.0		2.23	74.9		1.12	0.15	B	0.24
Test Pit 2, Sump Contents 1	J19D64	12/2/2009	27.7		0.19	6.49		1.91	19.1		0.95	0.16	B	0.21
Test Pit 2, Sump Contents 2	J19D65	12/2/2009	72		0.18	8.78		1.79	83.1		0.89	0.18	B	0.21
Equipment Blank	J19D66	12/2/2009	0.189	U	0.19	1.89	U	1.89	0.94	U	0.94			
Test Pit 1, Surface Soil 1	J19D67	12/2/2009	88.7		0.15	6.13		1.53	40.2		0.76	0.12	B	0.22
Test Pit 1, Subsurface Soil	J19D68	12/2/2009	32.2		0.16	5.73		1.59	14.5		0.8	0.15	B	0.23
Test Pit 1, Concrete Scabble	J19D69	12/9/2009	1630		0.2	6.99		1.96	28.7		0.98			
Test Pit 1, Concrete Scabble	J19D72	12/9/2009										66.6		0.155
Test Pit 3, Pipe Scale	J19DN8	12/10/2009										3.05		0.155
Test Pit 3, Pipe Scale	J19DP5	12/10/2009	933		4.44	19.1		5.56	209		2.78			

Sample Location	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1, Surface Soil 2	J19C43	12/9/2009	13400		17.4	7.85		0.44	2900		65.2	208		4.35
Test Pit 2, Sump Floor Scrapings	J19D62	12/2/2009	79500		114	105		0.48	3150		71.5	359		4.76
Test Pit 2, Duplicate of J19D62	J19D63	12/2/2009	47600		22.3	125		0.56	4490		83.7	345		5.58
Test Pit 2, Sump Contents 1	J19D64	12/2/2009	17500		19.1	11.7		0.48	4130		71.4	280		4.76
Test Pit 2, Sump Contents 2	J19D65	12/2/2009	22100		17.9	51.6		0.45	4130		67	298		4.47
Equipment Blank	J19D66	12/2/2009	260		18.9	0.587		0.47	30.4	B	70.8	4.49	B	4.72
Test Pit 1, Surface Soil 1	J19D67	12/2/2009	19100		15.3	13		0.38	3500		57.2	276		3.81
Test Pit 1, Subsurface Soil	J19D68	12/2/2009	16600		15.9	5.73		0.4	5180		59.8	261		3.99
Test Pit 1, Concrete Scabble	J19D69	12/9/2009	16500		19.6	4.25		0.49	3950		73.5	223		4.9
Test Pit 1, Concrete Scabble	J19D72	12/9/2009												
Test Pit 3, Pipe Scale	J19DN8	12/10/2009												
Test Pit 3, Pipe Scale	J19DP5	12/10/2009	484000		444	207		1.39	1050		208	3940		111

Table B-1. 100-H-46 Confirmatory Sampling Results - Metals. (4 Pages)

Sample Location	HEIS Number	Sample Date	Mercury			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1, Surface Soil 2	J19C43	12/9/2009	0.024	B	0.03	0.792	B	1.74	7.38		3.48	847		348
Test Pit 2, Sump Floor Scrapings	J19D62	12/2/2009	1.70		0.03	16		1.91	46.8		3.81	1460		381
Test Pit 2, Duplicate of J19D62	J19D63	12/2/2009	1.83		0.04	10.8		2.23	44.7		4.47	2170		447
Test Pit 2, Sump Contents 1	J19D64	12/2/2009	0.015	B	0.03	1.04	B	1.91	13.5		3.81	1230		381
Test Pit 2, Sump Contents 2	J19D65	12/2/2009	0.038		0.03	16.9		1.79	11.7		3.57	1150		357
Equipment Blank	J19D66	12/2/2009	0.028	U	0.03	1.89	U	1.89	3.77	U	3.77	86.7	B	377
Test Pit 1, Surface Soil 1	J19D67	12/2/2009	0.044		0.03	2.13		1.53	11.6		3.05	1000		305
Test Pit 1, Subsurface Soil	J19D68	12/2/2009	0.012	B	0.03	0.451	B	1.59	15.6		3.19	1370		319
Test Pit 1, Concrete Scabble	J19D69	12/9/2009	0.031		0.03	0.926	B	1.96	8.51		3.92	1290		392
Test Pit 1, Concrete Scabble	J19D72	12/9/2009												
Test Pit 3, Pipe Scale	J19DN8	12/10/2009												
Test Pit 3, Pipe Scale	J19DP5	12/10/2009	5.53		0.27	14.5		5.56	75.0		11.1	345	B	1110

Sample Location	HEIS Number	Sample Date	Selenium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1, Surface Soil 2	J19C43	12/9/2009	0.26	U	0.26	474		1.74	0.17	U	0.17	178		43.5
Test Pit 2, Sump Floor Scrapings	J19D62	12/2/2009	0.29	U	0.29	922		1.91	0.33		0.19	759		47.6
Test Pit 2, Duplicate of J19D62	J19D63	12/2/2009	0.34	U	0.34	1070		2.23	0.44		0.22	1080		55.8
Test Pit 2, Sump Contents 1	J19D64	12/2/2009	0.29	U	0.29	1260		1.91	0.19	U	0.19	176		47.6
Test Pit 2, Sump Contents 2	J19D65	12/2/2009	0.27	U	0.27	825		1.79	0.18	U	0.18	207		44.7
Equipment Blank	J19D66	12/2/2009	0.28	U	0.28	214		1.89	0.19	U	0.19	11.1	B	47.2
Test Pit 1, Surface Soil 1	J19D67	12/2/2009	0.23	U	0.23	719		1.53	0.15	U	0.15	229		38.1
Test Pit 1, Subsurface Soil	J19D68	12/2/2009	0.24	U	0.24	962		1.59	0.16	U	0.16	210		39.9
Test Pit 1, Concrete Scabble	J19D69	12/9/2009	0.29	U	0.29	571		1.96	0.34		0.20	1270		49.0
Test Pit 1, Concrete Scabble	J19D72	12/9/2009												
Test Pit 3, Pipe Scale	J19DN8	12/10/2009												
Test Pit 3, Pipe Scale	J19DP5	12/10/2009	0.83	U	0.83	1000		5.56	0.56	U	0.56	1680		139

Table B-1. 100-H-46 Confirmatory Sampling Results - Metals. (4 Pages)

Sample Location	HEIS Number	Sample Date	Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1, Surface Soil 2	J19C43	12/9/2009	34.2		2.17	70.4		8.7
Test Pit 2, Sump Floor Scrapings	J19D62	12/2/2009	110		2.38	269		9.53
Test Pit 2, Duplicate of J19D62	J19D63	12/2/2009	128		2.79	315		11.2
Test Pit 2, Sump Contents 1	J19D64	12/2/2009	43.4		2.38	54.6		9.53
Test Pit 2, Sump Contents 2	J19D65	12/2/2009	44		2.23	199		8.93
Equipment Blank	J19D66	12/2/2009	0.374	B	2.36	1.33	B	9.43
Test Pit 1, Surface Soil 1	J19D67	12/2/2009	43.3		1.91	90.8		7.63
Test Pit 1, Subsurface Soil	J19D68	12/2/2009	35.4		1.99	44.2		7.97
Test Pit 1, Concrete Scabble	J19D69	12/9/2009	50.2		2.45	74.1		9.8
Test Pit 1, Concrete Scabble	J19D72	12/9/2009						
Test Pit 3, Pipe Scale	J19DN8	12/10/2009						
Test Pit 3, Pipe Scale	J19DP5	12/10/2009	113		6.94	226		27.8

Table B-2. 100-H-46 Confirmatory Sampling Results - Asbestos.

Sample Location	HEIS Number	Sample Date	Chrysotile, %	RDL, %	Amosite, %	RDL, %	Crodidolite, %	RDL, %	Actinolite/ Tremolite,	RDL, %	Anthophyllite	RDL, %
Test Pit 2, Suspect Asbestos	J19C30	12/2/2009	5.0	1	20	1	U	1	U	1	U	1

APPENDIX C

IN-PROCESS SAMPLES

Table C-1. 100-H-46 In-Process/Waste Characterization Samples. (6 Pages)

Location	HEIS Number	Sample Date	Northing	Easting	Hexavalent Chromium METALSING			Arsenic QT METAL			Barium QT METAL			Beryllium QT METAL			Cadmium QT METAL			Chromium QT METAL			Lead QT METAL			Selenium QT METAL			Silver QT METAL		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-46 NW Test Pit	J1RF13	2/7/2013	152679	577695	0.73		0.155	3	U	10.1	38.6		2.01	0.169		0.101	0.0821	U	2.01	14.7		10.1	3.75	U	10.1	-0.279	U	10.1	-0.123	U	10.1
100-H-46 NW Test Pit	J1RF14	2/7/2013	152679	577695	1.78		0.155	2.27	U	9.85	39.4		1.97	0.182		0.0985	0.0765	U	1.97	26.5		9.85	2.29	U	9.85	-0.197	U	9.85	-0.0034	U	9.85
100-H-46 NW Test Pit	J1RF15	2/7/2013	152679	577695	2.33		0.155	1.34	U	9.77	35.2		1.95	0.162		0.0977	0.0821	U	1.95	33.8		9.77	2.41	U	9.77	-0.317	U	9.77	0.0193	U	9.77
100-H-46 NW Test Pit	J1RF16	2/7/2013	152679	577695	0.723		0.155	4.32	U	9.75	37.7		1.95	0.156		0.0975	0.0763	U	1.95	17		9.75	2.23	U	9.75	-0.233	U	9.75	-0.0969	U	9.75
100-H-46 NW Test Pit	J1RF17	2/7/2013	152679	577695	1.13		0.155	1.73	U	10	42.7		2.01	0.151		0.1	0.0727	U	2.01	13.8		10	2.05	U	10	-0.23	U	10	0.0341	U	10
100-H-46 NW Test Pit	J1RF18	2/7/2013	152679	577695	1.03		0.155	1.18	U	10.1	44.1		2.02	0.191		0.101	0.0706	U	2.02	13.8		10.1	2.02	U	10.1	-0.318	U	10.1	-0.0148	U	10.1
100-H-46 NW Test Pit	J1RF19	2/7/2013	152679	577695	0.981		0.155	1.86	U	9.93	42.8		1.99	0.166		0.0993	0.0832	U	1.99	14.1		9.93	2.41	U	9.93	-0.195	U	9.93	-0.0324	U	9.93
100-H-46 NW Test Pit 2	J1RF96	2/13/2013	152670	577705	0.155	U	0.155	1.45	U	10.1	29.9		2.02	0.146		0.101	0.138	U	2.02	6.11	U	10.1	2.23	U	10.1	0.03	U	10.1	-0.081	U	10.1
100-H-46 NW Test Pit 2	J1RF97	2/13/2013	152670	577705	0.155	U	0.155	1.32	U	10.1	32.8		2.01	0.153		0.101	0.115	U	2.01	11		10.1	2.21	U	10.1	0.0848	U	10.1	-0.193	U	10.1
100-H-46 NW Test Pit 2	J1RF98	2/13/2013	152670	577705	0.155	U	0.155	1.06	U	9.91	41.8		1.98	0.151		0.0991	0.126	U	1.98	7.88	U	9.91	2.07	U	9.91	-0.044	U	9.91	0.017	U	9.91
100-H-46 NW Test Pit 2	J1RF99	2/13/2013	152670	577705	0.155	U	0.155	0.923	U	10	43.4		2	0.15		0.1	0.133	U	2	9.27	U	10	2.38	U	10	0.00708	U	10	-0.108	U	10
100-H-46 NW Test Pit 2	J1RFC0	2/13/2013	152670	577705	0.155	U	0.155	1.22	U	10.1	48.7		2.01	0.15		0.101	0.0998	U	2.01	11.1		10.1	2.62	U	10.1	0.0831	U	10.1	-0.17	U	10.1
100-H-46 NW Test Pit 2	J1RFC1	2/13/2013	152670	577705	2.72		0.155	1.27	U	10.1	44.8		2.01	0.159		0.101	0.143	U	2.01	12.6		10.1	2.35	U	10.1	0.149	U	10.1	-0.0363	U	10.1
100-H-46 NW Test Pit 3	J1RFD1	2/13/2013	152683	577710	0.23		0.155	3.52	U	9.94	43.5		1.99	0.168		0.0994	0.185	U	1.99	8.5	U	9.94	7.43	U	9.94	-0.0774	U	9.94	-0.00686	U	9.94
100-H-46 NW Test Pit 3	J1RFD2	2/13/2013	152683	577710	0.155	U	0.155	1.13	U	10.1	31.1		2.01	0.128		0.101	0.0962	U	2.01	9.12	U	10.1	1.82	U	10.1	-0.0553	U	10.1	-0.0495	U	10.1
100-H-46 NW Test Pit 3	J1RFD3	2/13/2013	152683	577710	0.155	U	0.155	1.69	U	10	42.1		2	0.164		0.1	0.12	U	2	9.26	U	10	3.06	U	10	-0.107	U	10	-0.0973	U	10
100-H-46 NW Test Pit 3	J1RFD4	2/13/2013	152683	577710	0.364		0.155	1.68	U	9.94	34.3		1.99	0.166		0.0994	0.121	U	1.99	9.67	U	9.94	2.27	U	9.94	-0.196	U	9.94	-0.0766	U	9.94
100-H-46 NW Test Pit 3	J1RFD5	2/13/2013	152683	577710	0.688		0.155	0.892	U	9.95	40.6		1.99	0.21		0.0995	0.12	U	1.99	12.2		9.95	2.27	U	9.95	0.102	U	9.95	-0.0347	U	9.95
100-H-46 NW Test Pit 3	J1RFD6	2/13/2013	152683	577710	1.62		0.155	1.28	U	10.1	40.3		2.02	0.147		0.101	0.112	U	2.02	12.4		10.1	2.17	U	10.1	-0.415	U	10.1	-0.0665	U	10.1
100-H-46 NW Test Pit 4	J1RFD7	2/13/2013	152677	577705	0.313		0.155	1.81	U	9.94	43.9		1.99	0.149		0.0994	0.146	U	1.99	8.34	U	9.94	4.25	U	9.94	0.0639	U	9.94	-0.0337	U	9.94
100-H-46 NW Test Pit 4	J1RFD8	2/13/2013	152677	577705	0.155	U	0.155	4.06	U	9.94	40.2		1.99	0.175		0.0994	0.145	U	1.99	11.3		9.94	2.01	U	9.94	-0.107	U	9.94	-0.0667	U	9.94
100-H-46 NW Test Pit 4	J1RFD9	2/13/2013	152677	577705	0.155	U	0.155	1.29	U	9.94	37.5		1.99	0.181		0.0994	0.151	U	1.99	13.6		9.94	2.61	U	9.94	-0.169	U	9.94	-0.036	U	9.94
100-H-46 NW Test Pit 4	J1RFF0	2/13/2013	152677	577705	0.155	U	0.155	1.13	U	10.1	34.9		2.02	0.171		0.101	0.106	U	2.02	10.2		10.1	2.16	U	10.1	0.0843	U	10.1	-0.0783	U	10.1
100-H-46 NW Test Pit 4	J1RFF1	2/13/2013	152677	577705	0.155	U	0.155	1.28	U	9.98	38.2		2	0.167		0.0998	0.138	U	2	10.2		9.98	2.18	U	9.98	-0.282	U	9.98	-0.0503	U	9.98
100-H-46 NW Test Pit 4	J1RFF2	2/13/2013	152677	577705	0.278		0.155	0.843	U	9.9	41.9		1.98	0.154		0.099	0.128	U	1.98	9.02	U	9.9	2.1	U	9.9	-0.0885	U	9.9	-0.0936	U	9.9
100-H-46 ACL SPA EZ SOIL	J1RFK5	2/19/2013			10.7		0.155	6.34	U	10.1	59.5		2.01	0.242		0.101	0.161	U	2.01	73.3		10.1	20		10.1	-0.265	U	10.1	-0.366	U	10.1
100-H-46 Stained Concrete	J1RFM0	2/19/2013			3830		0.155	19.6	U	19.9	87.1		3.97	0.193	U	0.199	0.213	U	3.97	4080		19.9	4.54	U	19.9	-0.0545	U	19.9	0.0826	U	19.9
100-H-46 NW Test Pit 5	J1RFV9	2/25/2013	152681	577721	0.155	U	0.155	1.57	U	9.65	45.5		1.93	0.154		0.0965	0.103	U	1.93	9.53	U	9.65	2.4	U	9.65	0.316	U	9.65	0.0322	U	9.65
100-H-46 NW Test Pit 5	J1RFW0	2/25/2013	152681	577721	0.155	U	0.155	1.44	U	9.71	40		1.94	0.139		0.0971	0.114	U	1.94	9.25	U	9.71	2.13	U	9.71	-0.132	U	9.71	0.0655	U	9.71
100-H-46 NW Test Pit 5	J1RFW1	2/25/2013	152681	577721	0.155	U	0.155	0.943	U	9.66	48.1		1.93	0.159		0.0966	0.105	U	1.93	6.43	U	9.66	2.17	U	9.66	0.00589	U	9.66	0.0328	U	9.66
100-H-46 NW Test Pit 5	J1RFW2	2/25/2013	152681	577721	0.155	U	0.155	1.06	U	9.77	43.5		1.95	0.179		0.0977	0.126	U	1.95	13		9.77	2.17	U	9.77	-0.273	U	9.77	0.0294	U	9.77
100-H-46 NW Test Pit 5	J1RFW3	2/25/2013	152681	577721	0.155	U	0.155	1.14	U	9.69	38		1.94	0.165		0.0969	0.12	U	1.94	9.27	U	9.69	2.23	U	9.69	0.253	U	9.69	-0.0239	U	9.69
100-H-46 NW Test Pit 5	J1RFW4	2/25/2013	152681	577721	0.155	U	0.155	5.57	U	9.78	39.4		1.96	0.152		0.0978	0.119	U	1.96	8.98	U	9.78	2.05	U	9.78	0.142	U	9.78	0.0325	U	9.78
100-H-46 NW Test Pit 6	J1RFW5	2/25/2013	152679	577739	0.155	U	0.155	1.48	U	9.64	36.3		1.93	0.161		0.0964	0.102	U	1.93	9.97		9.64	2.52	U	9.64	-0.121	U	9.64	0.0894	U	9.64
100-H-46 NW Test Pit 6	J1RFW6	2/25/2013	152679	577739	0.189		0.155	1.99	U	9.7	43.5		1.94	0.151		0.097	0.125	U	1.94	8.81	U	9.7	6.85	U	9.7	-0.208	U	9.7	0.0688	U	9.7
100-H-46 NW Test Pit 6	J1RFW7	2/25/2013	152679	577739	0.229		0.155	1.78	U	9.98	30.8		2	0.133		0.0998	0.0889	U	2	10.2		9.98	2.56	U	9.98	-0.0993	U	9.98	0.0161	U	9.98
100-H-46 NW Test Pit 6	J1RFW8	2/25/2013	152679	577739	0.155	U	0.155	1.09	U	9.8	32.7		1.96	0.115		0.098	0.104	U	1.96	7.72	U	9.8	2.08	U	9.8	-0.089	U	9.8	0.0352	U	9.8
100-H-46 NW Test Pit 6	J1RFW9	2/25/2013	152679	577739	0.155	U	0.155	1.41	U	9.81	37.8		1.96	0.146		0.0981	0.112	U	1.96	8.71	U	9.81	2.48	U	9.81	-0.31	U	9.81	0.00081	U	9.81
100-H-46 NW Test Pit 6	J1RFX0	2/25/2013	152679	577739	0.155	U	0.155	0.858	U	9.8	42.2		1.96	0.124		0.098	0.077	U	1.96	9.41	U	9.8	1.73	U	9.8	-0.1	U	9.8	0.102	U	9.8
100-H-46 Test Pit 7	J1RJ07	3/13/2013	152688	577864	0.155	U	0.155	0.936	U	10	32.4		2	0.169		0.1	0.118	U	2	9.6	U	10	2.02	U	10	0.282	U	10	-0.362	U	10
100-H-46 Test Pit 7	J1RJ08	3/13/2013	152688	577864	0.155	U	0.155	2.24	U	9.97	26.4		1.99	0.148		0.0997	0.094	U	1.99	8.85	U	9.97	2.27	U	9.97	0.692	U	9.97	-0.333	U	9.97
100-H-46 Test Pit 7	J1RJ09	3/13/2013	152688	577864	0.155	U	0.155	1.23	U	10.1	33.1		2.01	0.155		0.101	0.0723	U	2.01	7.98	U	10.1	2.13	U	10.1	0.705	U	10.1	-0.393	U	10.1
100-H-46 Test Pit 7	J1RJ10	3/13/2013	152688	577864	0.155	U	0.155	0.828	U	10	29.3		2.01	0.15		0.1	0.0824	U	2.01	7.88	U	10	1.97	U	10	0.256	U	10	-0.359	U	10
100-H-46 Test Pit 7	J1RJ11	3/13/2013	152688	577864	0.155	U	0.155	1.09	U	9.97	31.3		1.99	0.174		0.0997	0.0752	U	1.99	7.58	U	9.97	2.23	U	9.97	0.528	U	9.97	-0.35	U	9.97
100-H-46 Test Pit 7	J1RJ12	3/13/2013	152688	577864	0.155	U	0.155	0.974	U	9.98	34.9		2	0.152		0.0998	0.0658	U	2	8.49	U	9.98	2.58	U	9.98	0.626	U	9.98	-0.352	U	9.98
100-H-46 Test Pit 8	J1RJ13	3/13/2013	152683	577754	0.155	U	0.155	2.09	U	9.9	47.3		1.98	0.208		0.099	0.112	U	1.98	15.3		9.9	3.59	U	9.9	0.755	U	9.9	-0.344	U	9.9
100-H-46 Test Pit 8	J1RJ14	3/13/2013	152683	577754	0.155	U	0.155	1.26	U	10	47.1		2.01	0.198		0.1	0.105	U	2.01	6.52	U	10	2.19	U	10	0.269	U	10	-0.416	U	10
100-H-46 Test Pit 8	J1RJ15	3/13/2013	152683	577754	0.155	U	0.155	1.43	U	10.1	47.7		2.02	0.175		0.101	0.108	U	2.02	6.78	U	10.1	2.67	U	10.1	0.576	U	10.1	-0.32	U	10.1
100-H-46 Test Pit 8	J1RJ16	3/13/2013	152683	577754	0.155	U	0.155	2.87	U	9.97	35.6		1.99	0.161		0.0997	0.0858	U	1.99	7.5	U	9.97	2.94	U	9.97	0.132	U	9.97	-0.331	U	9.97
100-H-46 Test Pit 8	J1RJ17	3/13/2013	152683	577754	0.155	U	0.155	1.16	U	9.99	34.2		2	0.15		0.0999	0.102	U	2	7.87	U	9.99	2.16	U	9.99	0.807	U	9.99	-0.34	U	9.99
100-H-46 Test Pit 8	J1RJ18	3/13/2013	152683	577754	0.155	U	0.155	1.31	U	10.1	38.3		2.02	0.184		0.101	0.0929	U	2.02	12.9		10.1	2.17	U	10.1	0.283	U	10.1	-0.217	U	10.1
100-H-46 Test Pit 9	J1RJ19	3/13/2013	152651	577737	0.161		0.155	1.51	U	9.96	51.5		1.99	0.182		0.0996	0.0528	U	1.99	8.57	U	9.96	3.3	U	9.96	0.842	U	9.96	-0.411	U	9.96

Table C-1. 100-H-46 In-Process/Waste Characterization Samples. (6 Pages)

Location	HEIS Number	Sample Date	Northing	Easting	Hexavalent Chromium METALSING			Arsenic QT METAL			Barium QT METAL			Beryllium QT METAL			Cadmium QT METAL			Chromium QT METAL			Lead QT METAL			Selenium QT METAL			Silver QT METAL		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-46 Test Pit 9	J1RJ20	3/13/2013	152651	577737	0.181		0.155	1.3	U	10.1	49.8		2.02	0.182		0.101	0.13	U	2.02	11.6		10.1	3.81	U	10.1	0.576	U	10.1	-0.319	U	10.1
100-H-46 Test Pit 9	J1RJ21	3/13/2013	152651	577737	0.155	U	0.155	1.09	U	10.1	45.8		2.01	0.177		0.101	0.124	U	2.01	8.55	U	10.1	2.98	U	10.1	0.881	U	10.1	-0.411	U	10.1
100-H-46 Test Pit 9	J1RJ22	3/13/2013	152651	577737	0.179		0.155	0.942	U	10	38.7		2	0.164		0.1	0.0642	U	2	9.44	U	10	2.26	U	10	0.859	U	10	-0.377	U	10
100-H-46 Test Pit 9	J1RJ23	3/13/2013	152651	577737	0.155	U	0.155	1.35	U	10	58.4		2	0.177		0.1	0.0803	U	2	10.7		10	2.14	U	10	0.407	U	10	-0.405	U	10
100-H-46 Test Pit 9	J1RJ24	3/13/2013	152651	577737	0.155	U	0.155	1.14	U	9.98	43.6		2	0.192		0.0998	0.0751	U	2	8.55	U	9.98	2.75	U	9.98	0.507	U	9.98	-0.282	U	9.98
100-H-46 (in-situ sampling)	J1RK92	4/8/2013			0.994		0.155	6.49	U	10	64.4		2	0.269		0.1	0.131	U	2	20.6		10	18.9		10	0.0615	U	10	-0.0146	U	10
100-H-46 (in-situ sampling)	J1RK93	4/8/2013			0.155	U	0.155	3.92	U	10	38.4		2	0.193		0.1	0.0904	U	2	10.9		10	12.9		10	0.363	U	10	-0.0849	U	10
100-H-46 (in-situ sampling)	J1RK94	4/8/2013			0.17		0.155	6.36	U	9.99	42.9		2	0.197		0.0999	0.0977	U	2	9.47	U	9.99	15.6		9.99	0.0604	U	9.99	-0.0964	U	9.99
100-H-46 (in-situ sampling)	J1RK95	4/8/2013			0.155	U	0.155	2.67	U	9.96	39.1		1.99	0.185		0.0996	0.0893	U	1.99	9.39	U	9.96	4.85	U	9.96	0.172	U	9.96	-0.0738	U	9.96
100-H-46 (in-situ sampling)	J1RK96	4/8/2013			0.155	U	0.155	2.44	U	9.94	46.9		1.99	0.196		0.0994	0.111	U	1.99	10.8		9.94	5.98	U	9.94	-0.548	U	9.94	-0.0838	U	9.94
100-H-46 (in-situ sampling)	J1RK97	4/8/2013			0.168		0.155	3.35	U	10	46.1		2.01	0.208		0.1	0.115	U	2.01	10.2		10	4.39	U	10	-0.229	U	10	-0.119	U	10
100-H-46 (in-situ sampling)	J1RK98	4/8/2013			0.155	U	0.155	2.57	U	9.97	53.6		1.99	0.225		0.0997	0.12	U	1.99	8.3	U	9.97	4.06	U	9.97	0.00492	U	9.97	-0.076	U	9.97
100-H-46 (in-situ sampling)	J1RK99	4/8/2013			0.155	U	0.155	2.35	U	10	45.8		2	0.219		0.1	0.127	U	2	8.21	U	10	3.23	U	10	-0.25	U	10	-0.197	U	10
100-H-46 (in-situ sampling)	J1RKC0	4/8/2013			0.155	U	0.155	9.65	U	9.98	77.8		2	0.249		0.0998	0.149	U	2	9.66	U	9.98	34.2		9.98	-0.0349	U	9.98	-0.145	U	9.98
100-H-46 (in-situ sampling)	J1RKC1	4/8/2013			0.851		0.155	9.67	U	9.97	66.2		1.99	0.207		0.0997	0.127	U	1.99	11.6		9.97	7.39	U	9.97	0.386	U	9.97	-0.0529	U	9.97
100-H-46 (in-situ sampling)	J1RKC2	4/8/2013			0.188		0.155	2.5	U	10	52.7		2	0.215		0.1	0.107	U	2	10.3		10	5.58	U	10	-0.0623	U	10	-0.108	U	10
100-H-46 (in-situ sampling)	J1RKC3	4/8/2013			0.188		0.155	4.72	U	10	58.3		2	0.293		0.1	0.125	U	2	9.9	U	10	6.32	U	10	-0.205	U	10	-0.117	U	10
100-H-46 (in-situ sampling)	J1RKC4	4/8/2013			0.155	U	0.155	2.21	U	10	49		2	0.217		0.1	0.0996	U	2	9.82	U	10	3.74	U	10	-0.0771	U	10	-0.0508	U	10
100-H-46 (in-situ sampling)	J1RKC5	4/15/2013			1.05		0.155	2.61	U	10	42.1		2.01	0.199		0.1	0.122	U	2.01	17.1		10	5.61	U	10	0.00985	U	10	0.112	U	10
100-H-46 (in-situ sampling)	J1RKC6	4/15/2013			0.594		0.155	2.9	U	9.96	42.6		1.99	0.201		0.0996	0.121	U	1.99	11.4		9.96	7.09	U	9.96	-0.405	U	9.96	0.172	U	9.96
100-H-46 (in-situ sampling)	J1RKC7	4/15/2013			0.439		0.155	2.36	U	10	72.1		2	0.203		0.1	0.144	U	2	11.3		10	8.41	U	10	-0.214	U	10	0.151	U	10
100-H-46 (in-situ sampling)	J1RKC8	4/16/2013			0.306		0.155																								
100-H-46 (in-situ sampling)	J1RKC9	4/16/2013			0.611		0.155																								
100-H-46 (in-situ sampling)	J1RKD0	4/16/2013			0.415		0.155																								
100-H-46 (in-situ sampling)	J1RKD1	4/23/2013			0.242		0.155	4.61	U	9.95	67.3		1.99	0.267		0.0995	0.123	U	1.99	11.9		9.95	15.1		9.95	-0.137	U	9.95	-0.0663	U	9.95
100-H-46 (in-situ sampling)	J1RKD2	4/23/2013			0.155	U	0.155	6.14	U	10.1	50.5		2.02	0.233		0.101	0.118	U	2.02	9.86	U	10.1	15.7		10.1	-0.142	U	10.1	0.00442	U	10.1
100-H-46 (in-situ sampling)	J1RKD3	4/23/2013			0.155	U	0.155	7.29	U	10	63.1		2	0.228		0.1	0.118	U	2	9.26	U	10	16.7		10	-0.224	U	10	-0.129	U	10
100-H-46 (in-situ sampling)	J1RKD4	4/23/2013			0.174		0.155	6.05	U	10.1	49.8		2.01	0.243		0.101	0.142	U	2.01	10.7		10.1	14.9		10.1	-0.061	U	10.1	-0.0691	U	10.1
100-H-46 (in-situ sampling)	J1RKD5	4/23/2013			0.232		0.155	3.99	U	9.91	50.6		1.98	0.231		0.0991	0.106	U	1.98	11.3		9.91	8.13	U	9.91	0.151	U	9.91	-0.13	U	9.91
100-H-46 Red colored soil	J1RKM3	4/15/2013			2.3		0.155	1.95	U	10.1	85.3		2.02	0.284		0.101	0.22	U	2.02	34		10.1	24		10.1	-0.433	U	10.1	0.00837	U	10.1
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL00	5/1/2013			0.155	U	0.155	1.5	U	10	40.9		2.01	0.15		0.1	0.169	U	2.01	8.25	U	10	2.92	U	10	-0.173	U	10	-0.00125	U	10
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL01	5/1/2013			0.552		0.155	2	U	9.94	36.4		1.99	0.153		0.0994	0.157	U	1.99	11.1		9.94	4.35	U	9.94	-0.166	U	9.94	-0.108	U	9.94
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL02	5/1/2013			0.241		0.155	1.39	U	10	42.1		2.01	0.155		0.1	0.16	U	2.01	10.5		10	3.33	U	10	0.0616	U	10	0.0561	U	10
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL03	5/1/2013			1.29		0.155	2.44	U	10	52.9		2.01	0.153		0.1	0.186	U	2.01	15.1		10	2.92	U	10	0.449	U	10	-0.0719	U	10
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL04	5/1/2013			0.436		0.155	3.87	U	10	49.8		2	0.177		0.1	0.168	U	2	10.3		10	9.02	U	10	0.382	U	10	-0.0131	U	10
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL05	5/1/2013			1.82		0.155	1.63	U	10	40.8		2	0.157		0.1	0.145	U	2	13.9		10	3.39	U	10	0.0863	U	10	-0.0807	U	10
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL06	5/1/2013			1.43		0.155	1.05	U	9.91	43.3		1.98	0.163		0.0991	0.145	U	1.98	12.4		9.91	2.41	U	9.91	-0.0126	U	9.91	-0.0569	U	9.91
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL07	5/1/2013			0.685		0.155	1.88	U	9.96	51.1		1.99	0.182		0.0996	0.138	U	1.99	13.1		9.96	4.59	U	9.96	0.189	U	9.96	0.00437	U	9.96
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL08	5/2/2013			0.176		0.155	1.9	U	10	44		2	0.224		0.1	0.127	U	2	9.95	U	10	3.26	U	10	0.143	U	10	0.00569	U	10
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL09	5/2/2013			0.184		0.155	2.28	U	10.1	57		2.01	0.243		0.101	0.108	U	2.01	10.9		10.1	4.17	U	10.1	0.074	U	10.1	-0.0857	U	10.1

Table C-1. 100-H-46 In-Process/Waste Characterization Samples. (6 Pages)

Location	HEIS Number	Sample Date	Northing	Easting	Hexavalent Chromium METALSING mg/kg	Q	PQL	Arsenic QT METAL mg/kg	Q	PQL	Barium QT METAL mg/kg	Q	PQL	Beryllium QT METAL mg/kg	Q	PQL	Cadmium QT METAL mg/kg	Q	PQL	Chromium QT METAL mg/kg	Q	PQL	Lead QT METAL mg/kg	Q	PQL	Selenium QT METAL mg/kg	Q	PQL	Silver QT METAL mg/kg	Q	PQL
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL10	5/2/2013			0.155	U	0.155	1.71	U	9.7	43.3		1.94	0.209		0.097	0.11	U	1.94	8.83	U	9.7	4.32	U	9.7	0.234	U	9.7	-0.0298	U	9.7
100-H-46 (in-situ 15-20 feet bgs ACL/BCL)	J1RL11	5/2/2013			0.155	U	0.155	1.76	U	9.97	60.1		1.99	0.219		0.0997	0.116	U	1.99	9.96	U	9.97	2.95	U	9.97	0.285	U	9.97	-0.0453	U	9.97
100-H-46 (in-situ 15-20 ft bgs ACL/BCL)	J1RL12	5/7/2013			0.204		0.155	2.14	U	10	44.6		2	0.21		0.1	0.143	U	2	8.35	U	10	5.01	U	10	-0.146	U	10	-0.0919	U	10
100-H-46 (in-situ 15-20 ft bgs ACL/BCL)	J1RL13	5/7/2013			0.168		0.155	2.37	U	10	61.1		2.01	0.221		0.1	0.161	U	2.01	8.94	U	10	2.93	U	10	0.074	U	10	-0.118	U	10
100-H-46 (in-situ 15-20 ft bgs ACL/BCL)	J1RL14	5/7/2013			0.155	U	0.155	1.87	U	10	63.2		2	0.208		0.1	0.141	U	2	9.33	U	10	2.42	U	10	-0.0241	U	10	-0.13	U	10
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLN4	5/8/2013			0.155	U	0.155	1.61	U	9.92	46.5		1.98	0.149		0.0992	0.118	U	1.98	8.2	U	9.92	2.26	U	9.92	0.0397	U	9.92	0.0571	U	9.92
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLN5	5/8/2013			0.307		0.155	1.25	U	9.95	35		1.99	0.147		0.0995	0.112	U	1.99	7.64	U	9.95	2.53	U	9.95	0.0475	U	9.95	0.0452	U	9.95
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLN6	5/8/2013			1.66		0.155	1.35	U	10	48.3		2	0.165		0.1	0.131	U	2	15.2		10	2.34	U	10	0.383	U	10	0.0183	U	10
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLN7	5/8/2013			2.22		0.155	1.45	U	10	44.4		2.01	0.148		0.1	0.143	U	2.01	14.4		10	2.71	U	10	0.0559	U	10	0.0809	U	10
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLN8	5/8/2013			0.155	U	0.155	1.22	U	10	33.6		2	0.15		0.1	0.106	U	2	6.85	U	10	2.31	U	10	0.384	U	10	0.0955	U	10
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLN9	5/8/2013			0.429		0.155	0.818	U	10	38.9		2	0.136		0.1	0.116	U	2	7.02	U	10	2.16	U	10	-0.143	U	10	0.032	U	10
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP0	5/8/2013			1.92		0.155	1.97	U	10.1	53.6		2.02	0.173		0.101	0.119	U	2.02	13.2		10.1	2.3	U	10.1	0.298	U	10.1	0.0166	U	10.1
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP1	5/8/2013			4.46		0.155	1.25	U	9.97	44.6		1.99	0.146		0.0997	0.136	U	1.99	18		9.97	3.54	U	9.97	0.0218	U	9.97	0.0621	U	9.97
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP2	5/13/2013			0.155	U	0.155	0.389	U	2.5	11.2		0.5	0.0409		0.025	0.0295	U	0.5	2.68		2.5	0.572	U	2.5	0.0916	U	2.5	0.0237	U	2.5
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP3	5/13/2013			0.155	U	0.155	0.713	U	2.5	10.8		0.5	0.0495		0.025	0.0286	U	0.5	2.27	U	2.5	0.702	U	2.5	-0.0143	U	2.5	-0.016	U	2.5
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP4	5/13/2013			0.155	U	0.155	0.348	U	2.5	13.4		0.5	0.0473		0.025	0.0229	U	0.5	2.33	U	2.5	0.541	U	2.5	0.0164	U	2.5	0.0247	U	2.5
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP5	5/13/2013			0.155	U	0.155	0.412	U	2.5	11.7		0.5	0.0465		0.025	0.0237	U	0.5	2.81		2.5	0.511	U	2.5	-0.0308	U	2.5	0.0373	U	2.5
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP6	5/13/2013			0.158		0.155	0.665	U	2.5	10.1		0.5	0.0501		0.025	0.0303	U	0.5	2.58		2.5	0.488	U	2.5	0.0329	U	2.5	0.0379	U	2.5
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP7	5/13/2013			1.09		0.155	0.535	U	2.5	11.3		0.5	0.0512		0.025	0.0292	U	0.5	3		2.5	0.577	U	2.5	-0.000782	U	2.5	0.0199	U	2.5
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP8	5/13/2013			2.09		0.155	0.411	U	2.5	11		0.5	0.0442		0.025	0.0235	U	0.5	3.03		2.5	0.575	U	2.5	-0.0122	U	2.5	0.019	U	2.5
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLP9	5/13/2013			3.33		0.155	0.438	U	2.5	10.7		0.5	0.043		0.025	0.0228	U	0.5	2.75		2.5	0.634	U	2.5	0.0138	U	2.5	0.0161	U	2.5
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLR0	5/14/2013			0.175		0.155	1.31	U	10	42.8		2	0.158		0.1	0.0912	U	2	8.07	U	10	3.06	U	10	0.195	U	10	-0.0041	U	10
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLR1	5/14/2013			0.155	U	0.155	1.91	U	10.1	41.8		2.01	0.168		0.101	0.105	U	2.01	8.69	U	10.1	2.92	U	10.1	0.285	U	10.1	-0.00359	U	10.1
100-H-46 (in-situ 20-25 ft bgs ACL/BCL)	J1RLR2	5/14/2013			0.155	U	0.155	1.71	U	10.1	42.7		2.02	0.143		0.101	0.106	U	2.02	9.22	U	10.1	3.05	U	10.1	0.144	U	10.1	0.0263	U	10.1
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMD8	5/16/2013			0.155	U	0.155	4.1	U	10.1	33.5		2.02	0.17		0.101	0.148	U	2.02	7.19	U	10.1	2.12	U	10.1	-0.163	U	10.1	-0.245	U	10.1

Table C-1. 100-H-46 In-Process/Waste Characterization Samples. (6 Pages)

Location	HEIS Number	Sample Date	Northing	Easting	Hexavalent Chromium METALSING			Arsenic QT METAL			Barium QT METAL			Beryllium QT METAL			Cadmium QT METAL			Chromium QT METAL			Lead QT METAL			Selenium QT METAL			Silver QT METAL		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMD9	5/16/2013			0.67		0.155	0.532	U	9.94	39.4		1.99	0.152		0.0994	0.115	U	1.99	9.63	U	9.94	1.92	U	9.94	-0.209	U	9.94	-0.0894	U	9.94
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF0	5/16/2013			3.17		0.155	0.592	U	9.95	45.6		1.99	0.15		0.0995	0.126	U	1.99	13.7		9.95	1.69	U	9.95	-0.485	U	9.95	-0.162	U	9.95
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF1	5/16/2013			1.85		0.155	0.667	U	10	41.7		2	0.133		0.1	0.115	U	2	10.5		10	1.65	U	10	-0.329	U	10	-0.177	U	10
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF2	5/16/2013			2.59		0.155	0.582	U	10.1	41.9		2.02	0.15		0.101	0.1	U	2.02	16.4		10.1	1.72	U	10.1	-0.473	U	10.1	-0.192	U	10.1
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF3	5/16/2013			4.53		0.155	0.413	U	10.1	47.1		2.02	0.143		0.101	0.0977	U	2.02	26.8		10.1	1.92	U	10.1	-0.532	U	10.1	-0.0271	U	10.1
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF4	5/16/2013			2.22		0.155	1.08	U	10.1	40.3		2.02	0.185		0.101	0.132	U	2.02	14.9		10.1	1.74	U	10.1	-0.479	U	10.1	-0.11	U	10.1
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF5	5/16/2013			0.416		0.155	0.832	U	10.1	35.9		2.02	0.15		0.101	0.121	U	2.02	9.83	U	10.1	1.72	U	10.1	-0.204	U	10.1	-0.167	U	10.1
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF6	5/21/2013			0.758		0.155	1.05	U	9.97	53.8		1.99	0.123		0.0997	0.0896	U	1.99	8.8	U	9.97	2.03	U	9.97	0.224	U	9.97	-0.0266	U	9.97
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF7	5/21/2013			3.09		0.155	1.13	U	9.94	41.5		1.99	0.119		0.0994	0.11	U	1.99	10.7		9.94	2.19	U	9.94	0.0511	U	9.94	-0.0183	U	9.94
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF8	5/21/2013			0.172		0.155	0.819	U	10.1	57.2		2.01	0.119		0.101	0.154	U	2.01	8.47	U	10.1	2.21	U	10.1	-0.166	U	10.1	-0.0343	U	10.1
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMF9	5/21/2013			0.155	U	0.155	0.97	U	10	36.7		2	0.118		0.1	0.111	U	2	9.42	U	10	1.91	U	10	-0.185	U	10	-0.233	U	10
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMH0	5/21/2013			0.155	U	0.155	0.699	U	10	37.7		2.01	0.112		0.1	0.104	U	2.01	7.07	U	10	1.82	U	10	0.0609	U	10	-0.0147	U	10
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMH1	5/21/2013			0.155	U	0.155	1.04	U	9.92	47.6		1.98	0.135		0.0992	0.0995	U	1.98	8.37	U	9.92	1.96	U	9.92	0.296	U	9.92	0.0508	U	9.92
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMH2	5/21/2013			0.155	U	0.155	0.888	U	10	45.5		2	0.142		0.1	0.0959	U	2	8.57	U	10	3.37	U	10	-0.037	U	10	-0.0975	U	10
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMH3	5/21/2013			0.155	U	0.155	0.972	U	9.94	34.5		1.99	0.125		0.0994	0.105	U	1.99	7.33	U	9.94	2.19	U	9.94	-0.0257	U	9.94	-0.0414	U	9.94
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMH4	5/21/2013			0.172		0.155	1.43	U	10	37.7		2	0.118		0.1	0.114	U	2	8.03	U	10	1.91	U	10	0.141	U	10	-0.0117	U	10
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMH5	5/21/2013			0.155	U	0.155	0.799	U	10	39.8		2	0.111		0.1	0.105	U	2	7.33	U	10	1.98	U	10	-0.0665	U	10	-0.062	U	10
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMH6	5/21/2013			0.155	U	0.155	1.04	U	9.9	39.2		1.98	0.136		0.099	0.104	U	1.98	8.83	U	9.9	2.04	U	9.9	0.166	U	9.9	0.0558	U	9.9
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMH7	5/21/2013			0.155	U	0.155	1.16	U	10	34.9		2.01	0.135		0.1	0.0927	U	2.01	8.87	U	10	2.44	U	10	0.152	U	10	-0.00816	U	10
100-H-46 In-Situ 25-30 ft bgs ACL/BCL	J1RMN3	5/21/2013			0.193		0.155	1.1	U	9.98	37.4		2	0.129		0.0998	0.104	U	2	9.11	U	9.98	2.31	U	9.98	-0.0812	U	9.98	-0.0978	U	9.98
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMR1	7/3/2013			0.166		0.155	1.09	U	10.1	32.2		2.01	0.149		0.101	0.0892	U	2.01	7.32	U	10.1	2.43	U	10.1	0.199	U	10.1	-0.000487	U	10.1
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMR2	7/3/2013			0.155	U	0.155	0.608	U	10	35.3		2	0.137		0.1	0.081	U	2	7.78	U	10	2.17	U	10	0.415	U	10	0.0626	U	10
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMR3	7/3/2013			0.155	U	0.155	0.608	U	9.95	56.2		1.99	0.125		0.0995	0.106	U	1.99	10.2		9.95	2	U	9.95	0.246	U	9.95	-0.064	U	9.95
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMR4	7/3/2013			0.155	U	0.155	0.784	U	9.89	34.3		1.98	0.133		0.0989	0.107	U	1.98	6.93	U	9.89	2.19	U	9.89	0.11	U	9.89	-0.0369	U	9.89
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMR5	7/3/2013			0.155	U	0.155	0.745	U	10.1	32.2		2.01	0.137		0.101	0.113	U	2.01	9.95	U	10.1	2.21	U	10.1	0.0594	U	10.1	-0.0162	U	10.1

Table C-1. 100-H-46 In-Process/Waste Characterization Samples. (6 Pages)

Location	HEIS Number	Sample Date	Northing	Easting	Hexavalent Chromium METALSING			Arsenic QT METAL			Barium QT METAL			Beryllium QT METAL			Cadmium QT METAL			Chromium QT METAL			Lead QT METAL			Selenium QT METAL			Silver QT METAL		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMR6	7/3/2013			0.155	U	0.155	0.691	U	9.97	32		1.99	0.131		0.0997	0.124	U	1.99	6.09	U	9.97	3.12	U	9.97	0.249	U	9.97	-0.0411	U	9.97
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMR7	7/3/2013			0.155	U	0.155	0.63	U	10.1	37.4		2.02	0.136		0.101	0.118	U	2.02	9.59	U	10.1	2.1	U	10.1	0.342	U	10.1	0.0126	U	10.1
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMR8	7/3/2013			0.166		0.155	1.08	U	10	50.4		2.01	0.147		0.1	0.107	U	2.01	8.89	U	10	2.03	U	10	0.131	U	10	0.0257	U	10
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMR9	7/3/2013			0.435		0.155	0.69	U	9.9	36.1		1.98	0.14		0.099	0.117	U	1.98	8.65	U	9.9	1.99	U	9.9	0.0278	U	9.9	-0.129	U	9.9
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMT1	7/9/2013			4.13		0.155	1.99	U	9.96	43.2		1.99	0.136		0.0996	0.1	U	1.99	16.7		9.96	6.7	U	9.96	0.116	U	9.96	0.0943	U	9.96
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMT2	7/9/2013			3.2		0.155	1.59	U	9.97	59.9		1.99	0.136		0.0997	0.128	U	1.99	15.6		9.97	4.48	U	9.97	-0.0663	U	9.97	-0.0257	U	9.97
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMT3	7/9/2013			1.01		0.155	1.49	U	10	35.9		2.01	0.128		0.1	0.115	U	2.01	7.86	U	10	2.3	U	10	-0.079	U	10	0.0502	U	10
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMT4	7/9/2013			0.477		0.155	3.74	U	10	37.5		2.01	0.136		0.1	0.0942	U	2.01	10.8		10	1.99	U	10	0.168	U	10	-0.0104	U	10
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMT5	7/9/2013			1.32		0.155	1.4	U	10	41.5		2	0.142		0.1	0.0759	U	2	10.8		10	2.46	U	10	0.223	U	10	0.0554	U	10
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMT6	7/10/2013			1.98		0.155	1.09	U	9.93	36.8		1.99	0.124		0.0993	0.105	U	1.99	13.3		9.93	3.14	U	9.93	0.0218	U	9.93	-0.0593	U	9.93
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMT7	7/10/2013			1.65		0.155	1.48	U	9.99	42		2	0.142		0.0999	0.0862	U	2	10.4		9.99	5.94	U	9.99	-0.337	U	9.99	-0.156	U	9.99
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMT8	7/10/2013			0.835		0.155	1.51	U	10.1	42.7		2.01	0.139		0.101	0.0796	U	2.01	12.3		10.1	4.3	U	10.1	-0.0336	U	10.1	0.00637	U	10.1
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMT9	7/10/2013			0.155	U	0.155	1.59	U	9.98	38.5		2	0.151		0.0998	0.084	U	2	7.3	U	9.98	4.43	U	9.98	-0.22	U	9.98	-0.00199	U	9.98
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RMV0	7/10/2013			0.155	U	0.155	0.487	U	10.1	38.3		2.02	0.132		0.101	0.0942	U	2.02	11.9		10.1	2.32	U	10.1	-0.278	U	10.1	-0.0408	U	10.1
100-H-46 - BCL Stockpile	J1RPD6	6/19/2013			0.155	U	0.155	4.82	U	9.92	167		1.98	0.273		0.0992	0.114	U	1.98	12.5		9.92	19.8		9.92	0.635	U	9.92	-0.173	U	9.92
100-H-46 - BCL Stockpile	J1RPD7	6/19/2013			0.273		0.155	3.93	U	9.96	54.9		1.99	0.225		0.0996	0.187	U	1.99	10.8		9.96	11.6		9.96	-0.0327	U	9.96	-0.128	U	9.96
100-H-46 - BCL Stockpile	J1RPD8	6/19/2013			0.196		0.155	3.86	U	10.1	48.3		2.02	0.223		0.101	0.0917	U	2.02	8.11	U	10.1	10.6		10.1	-0.127	U	10.1	-0.108	U	10.1
100-H-46 - BCL Stockpile	J1RPD9	6/19/2013			0.271		0.155	1.83	U	9.95	57.2		1.99	0.208		0.0995	0.131	U	1.99	10.5		9.95	6.12	U	9.95	-0.683	U	9.95	0.0633	U	9.95
100-H-46 - BCL Stockpile	J1RPF0	6/19/2013			0.254		0.155	2.74	U	10	47.7		2	0.194		0.1	0.0914	U	2	9.11	U	10	6.02	U	10	0.204	U	10	-0.0076	U	10
100-H-46 - BCL Stockpile	J1RPF1	6/19/2013			0.27		0.155	2.4	U	10	39.8		2.01	0.211		0.1	0.129	U	2.01	12.1		10	5.96	U	10	-0.139	U	10	-0.174	U	10
100-H-46 - BCL Stockpile	J1RPF2	6/19/2013			0.291		0.155	1.34	U	10	40.6		2	0.197		0.1	0.139	U	2	9.15	U	10	5.48	U	10	0.653	U	10	-0.0735	U	10
100-H-46 - BCL Stockpile	J1RPF3	6/19/2013			0.23		0.155	2.12	U	9.95	36.7		1.99	0.178		0.0995	0.09	U	1.99	8.08	U	9.95	4.11	U	9.95	0.726	U	9.95	0.00369	U	9.95
100-H-46 - BCL Stockpile	J1RPF4	6/25/2013			0.175		0.155	3.84	U	10.1	38.5		2.02	0.2		0.101	0.048	U	2.02	8.17	U	10.1	6.4	U	10.1	0.523	U	10.1	0.0597	U	10.1
100-H-46 - BCL Stockpile	J1RPF5	6/25/2013			0.155	U	0.155	2.64	U	9.91	38.2		1.98	0.177		0.0991	0.0645	U	1.98	9.95		9.91	4.35	U	9.91	0.35	U	9.91	-0.0279	U	9.91
100-H-46 - BCL Stockpile	J1RPF6	6/25/2013			0.155	U	0.155	3.7	U	10.1	42.2		2.01	0.178		0.101	0.0698	U	2.01	7.88	U	10.1	3.34	U	10.1	0.23	U	10.1	0.0627	U	10.1
100-H-46 - BCL Stockpile	J1RPF7	6/25/2013			0.155	U	0.155	1.96	U	9.98	49.7		2	0.179		0.0998	0.0647	U	2	8.17	U	9.98	3.98	U	9.98	0.156	U	9.98	0.0211	U	9.98
100-H-46 - BCL Stockpile	J1RPF8	6/25/2013			0.155	U	0.155	1.9	U	10.1	39.9		2.01	0.168		0.101	0.0646	U	2.01	8.79	U	10.1	3.07	U	10.1	0.53	U	10.1	-0.00531	U	10.1
100-H-46 - In Situ 20-25 ft bgs BCL	J1RPJ9	6/20/2013			0.155	U	0.155	1.59	U	9.9	41.9		1.98	0.173		0.099	0.0799	U	1.98	7.82	U	9.9	2.17	U	9.9	0.807	U	9.9	-0.0798	U	9.9
100-H-46 - In Situ 20-25 ft bgs BCL	J1RPK0	6/20/2013			0.155	U	0.155	1.57	U	9.96	43		1.99	0.162		0.0996	0.108	U	1.99	7.96	U	9.96	1.97	U	9.96	-0.0279	U	9.96	-0.0347	U	9.96
100-H-46 - In Situ 20-25 ft bgs BCL	J1RPK1	6/20/2013			0.18		0.155	1.98	U	10	35		2.01	0.175		0.1	0.112	U	2.01	7.66	U	10	1.89	U	10	0.275	U	10	-0.084	U	10
100-H-46 - In Situ 20-25 ft bgs BCL	J1RPK2	6/24/2013			0.348		0.155	1.56	U	9.95	51		1.99	0.174		0.0995	0.0986	U	1.99	11		9.95	3.2	U	9.95	1.34	U	9.95	-0.0346	U	9.95
100-H-46 - In Situ 20-25 ft bgs BCL	J1RPK3	6/24/2013			0.234		0.155	0.798	U	10.1	40.4		2.02	0.176		0.101	0.0882	U	2.02	9.43	U	10.1	2.72	U	10.1	0.488	U	10.1	-0.0219	U	10.1

Table C-1. 100-H-46 In-Process/Waste Characterization Samples. (6 Pages)

Location	HEIS Number	Sample Date	Northing	Easting	Hexavalent Chromium METALSING			Arsenic QT METAL			Barium QT METAL			Beryllium QT METAL			Cadmium QT METAL			Chromium QT METAL			Lead QT METAL			Selenium QT METAL			Silver QT METAL		
					mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-46 - In Situ 20-25 ft bgs BCL	J1RPK4	6/24/2013			0.155	U	0.155	0.555	U	9.93	45.4		1.99	0.17		0.0993	0.0978	U	1.99	7.54	U	9.93	2.44	U	9.93	0.956	U	9.93	0.00171	U	9.93
100-H-46 - In Situ 20-25 ft bgs BCL	J1RPK5	6/25/2013			0.155	U	0.155	1.71	U	9.97	57		1.99	0.173		0.0997	0.113	U	1.99	8.17	U	9.97	2.81	U	9.97	-0.182	U	9.97	-0.169	U	9.97
100-H-46 - In Situ 20-25 ft bgs BCL	J1RPK6	6/25/2013			0.155	U	0.155	2.04	U	10.1	36.4		2.01	0.165		0.101	0.0918	U	2.01	8.19	U	10.1	2.62	U	10.1	-0.214	U	10.1	-0.0287	U	10.1
100-H-46 - In Situ 20-25 ft bgs BCL	J1RPK7	6/25/2013			0.155	U	0.155	1.5	U	9.97	30.9		1.99	0.126		0.0997	0.0897	U	1.99	7.52	U	9.97	2.08	U	9.97	-0.132	U	9.97	0.006	U	9.97
100-H-46 In Situ 25-30 ft bgs BCL	J1RPK9	6/25/2013			0.155	U	0.155	1.31	U	10	37.3		2	0.167		0.1	0.0352	U	2	7.18	U	10	1.96	U	10	0.481	U	10	0.00614	U	10
100-H-46 In Situ 25-30 ft bgs BCL	J1RPL0	6/25/2013			0.24		0.155	1.17	U	10.1	43.8		2.02	0.166		0.101	0.0664	U	2.02	10.8		10.1	1.59	U	10.1	0.518	U	10.1	0.0247	U	10.1
100-H-46 In Situ 25-30 ft bgs BCL	J1RPL1	6/25/2013			0.155	U	0.155	1.47	U	10.1	31.9		2.02	0.149		0.101	0.0443	U	2.02	7.68	U	10.1	2.21	U	10.1	0.766	U	10.1	0.0382	U	10.1
100-H-46 In Situ 25-30 ft bgs BCL	J1RPL2	6/26/2013			0.233		0.155	0.925	U	9.98	39.1		2	0.142		0.0998	0.167	U	2	8.53	U	9.98	2.41	U	9.98	0.501	U	9.98	-0.123	U	9.98
100-H-46 In Situ 25-30 ft bgs BCL	J1RPL3	6/26/2013			0.155	U	0.155	0.816	U	9.68	59.3		1.94	0.156		0.0968	0.0809	U	1.94	8.64	U	9.68	2.32	U	9.68	0.7	U	9.68	-0.074	U	9.68
100-H-46 In Situ 25-30 ft bgs BCL	J1RPL4	6/26/2013			0.155	U	0.155	2.06	U	9.66	33.4		1.93	0.159		0.0966	0.055	U	1.93	9.38	U	9.66	2.11	U	9.66	0.457	U	9.66	-0.043	U	9.66
100-H-46 In Situ 25-30 ft bgs BCL	J1RPL5	6/27/2013			0.367		0.155	1.81	U	10	38.8		2.01	0.174		0.1	0.0248	U	2.01	9.13	U	10	2.12	U	10	0.824	U	10	-0.0364	U	10
100-H-46 In Situ 25-30 ft bgs BCL	J1RPL6	6/27/2013			0.348		0.155	0.882	U	9.62	47.9		1.92	0.16		0.0962	0.0365	U	1.92	8.59	U	9.62	1.5	U	9.62	0.664	U	9.62	-0.0139	U	9.62
100-H-46 In Situ 25-30 ft bgs BCL	J1RPL7	6/27/2013			0.247		0.155	2.04	U	9.91	41.3		1.98	0.161		0.0991	0.0431	U	1.98	10.3		9.91	2.04	U	9.91	0.855	U	9.91	-0.142	U	9.91
100-H-46 - In Situ 30-35 ft bgs ACL/BCL	J1RT00	7/10/2013			0.155	U	0.155	1.06	U	9.89	38		1.98	0.127		0.0989	0.0745	U	1.98	8.68	U	9.89	2.49	U	9.89	0.062	U	9.89	-0.0825	U	9.89
100-H-46 30 to 40 ft side walls	J1RV76	7/17/2013			0.24		0.155	1.21	U	9.97	52.8		1.99	0.121		0.0997	0.114	U	1.99	9.36	U	9.97	1.95	U	9.97	0.0715	U	9.97	-0.015	U	9.97
100-H-46 30 to 40 ft side walls	J1RV77	7/17/2013			0.297		0.155	0.992	U	10	31.8		2.01	0.135		0.1	0.0979	U	2.01	10.3		10	1.84	U	10	-0.137	U	10	-0.0603	U	10
100-H-46 30 to 40 ft side walls	J1RV78	7/17/2013			0.155	U	0.155	1.24	U	10.1	31.4		2.01	0.131		0.101	0.175	U	2.01	9.03	U	10.1	1.85	U	10.1	-0.00598	U	10.1	0.0133	U	10.1
100-H-46 30 to 40 ft side walls	J1RV79	7/17/2013			0.676		0.155	1.44	U	9.92	39.5		1.98	0.153		0.0992	0.118	U	1.98	10.4		9.92	1.82	U	9.92	0.0863	U	9.92	-0.139	U	9.92
100-H-46 30 to 40 ft side walls	J1RV80	7/17/2013			0.317		0.155	1.5	U	9.96	53.7		1.99	0.135		0.0996	0.121	U	1.99	8.32	U	9.96	2.01	U	9.96	-0.0477	U	9.96	0.0685	U	9.96
100-H-46 30 to 40 ft side walls	J1RV81	7/17/2013			0.155	U	0.155	0.914	U	9.98	34.8		2	0.148		0.0998	0.102	U	2	7.25	U	9.98	1.71	U	9.98	-0.132	U	9.98	-0.0181	U	9.98
100-H-46 30 to 40 ft side walls	J1RV82	7/17/2013			0.155	U	0.155	0.996	U	10	44.9		2	0.154		0.1	0.142	U	2	6.96	U	10	2.54	U	10	-0.182	U	10	-0.0232	U	10

QT = quick turn

Figure C-1. In-Process Pothole Sample Locations and Results.

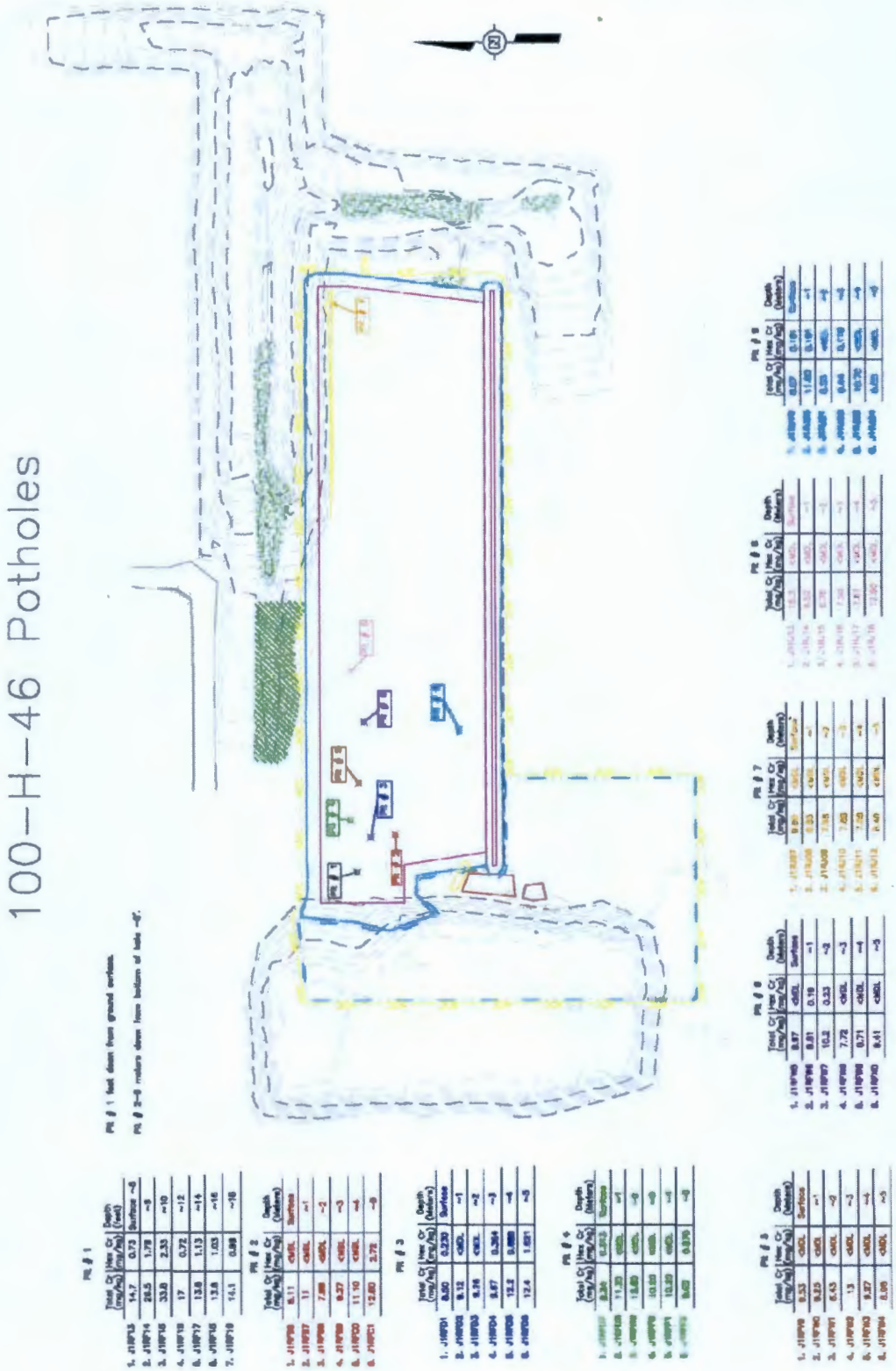


Figure C-2. In-Process Sample Locations and Results, 10 to 15 ft Lifts.

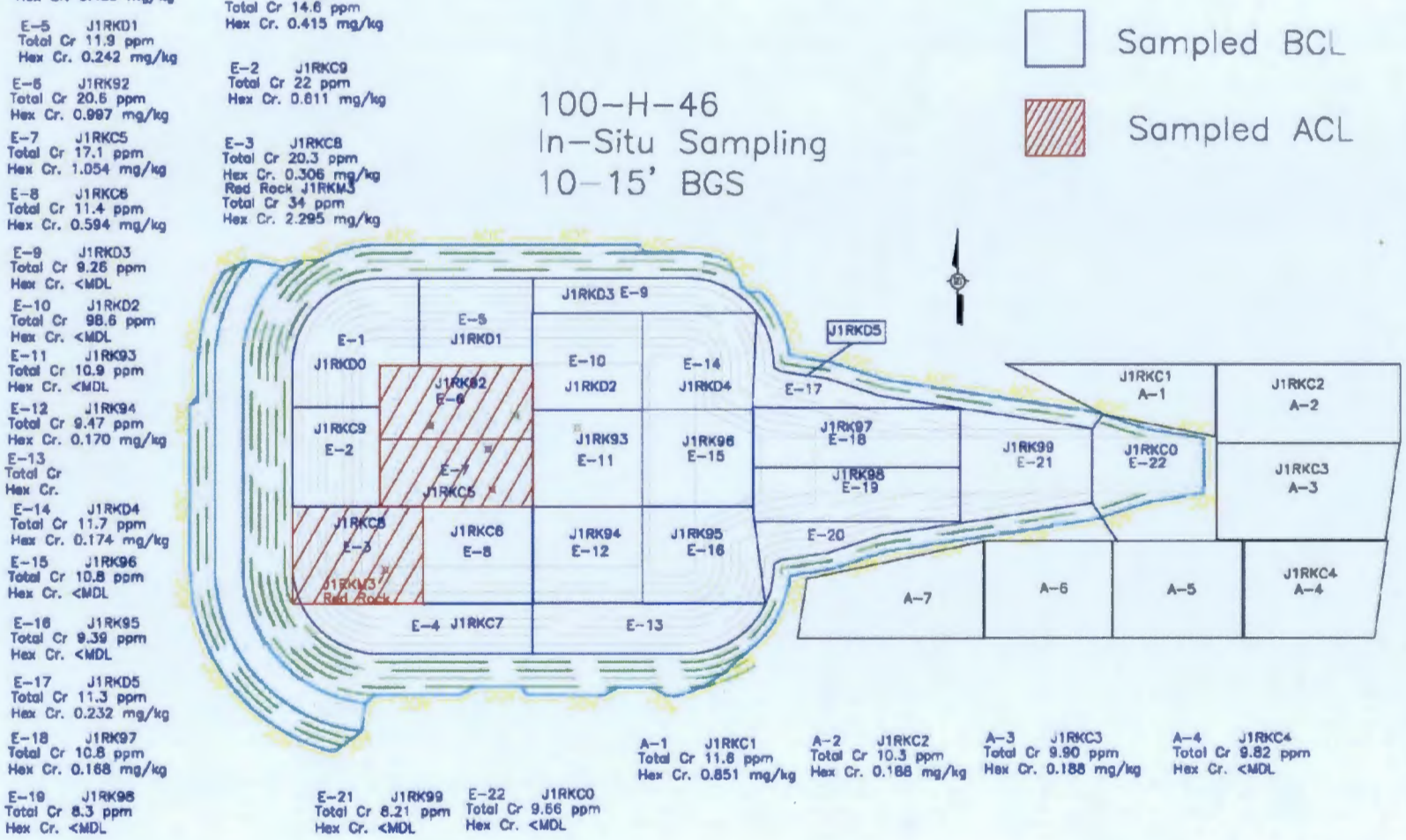


Figure C-3. In-Process Sample Locations and Results, 15 to 20 ft Lifts.

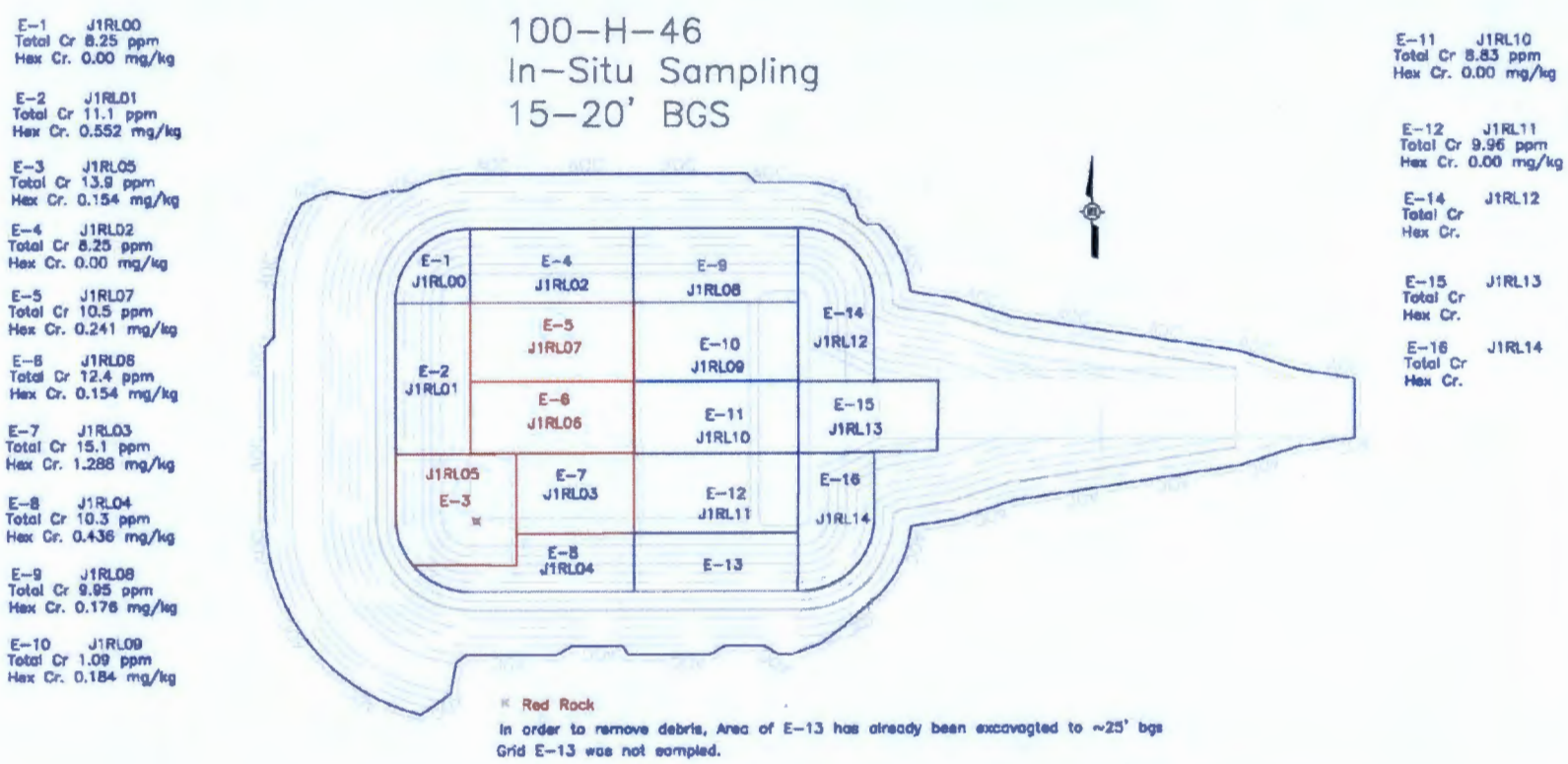


Figure C-4. In-Process Sample Locations and Results, 20 to 25 ft Lifts.

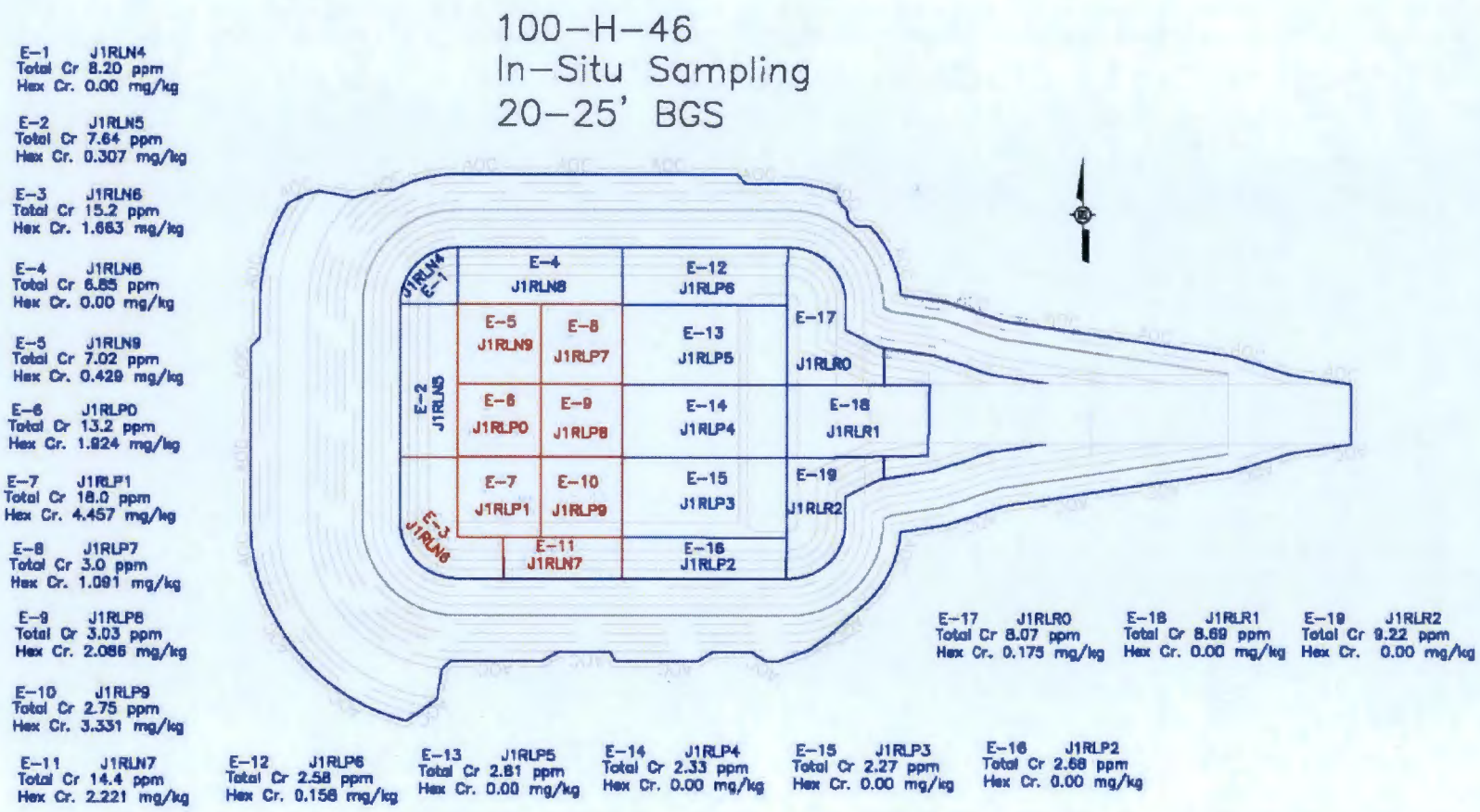


Figure C-5. In-Process Sample Locations and Results, 20 to 25 ft Lifts, Southwest Expansion.

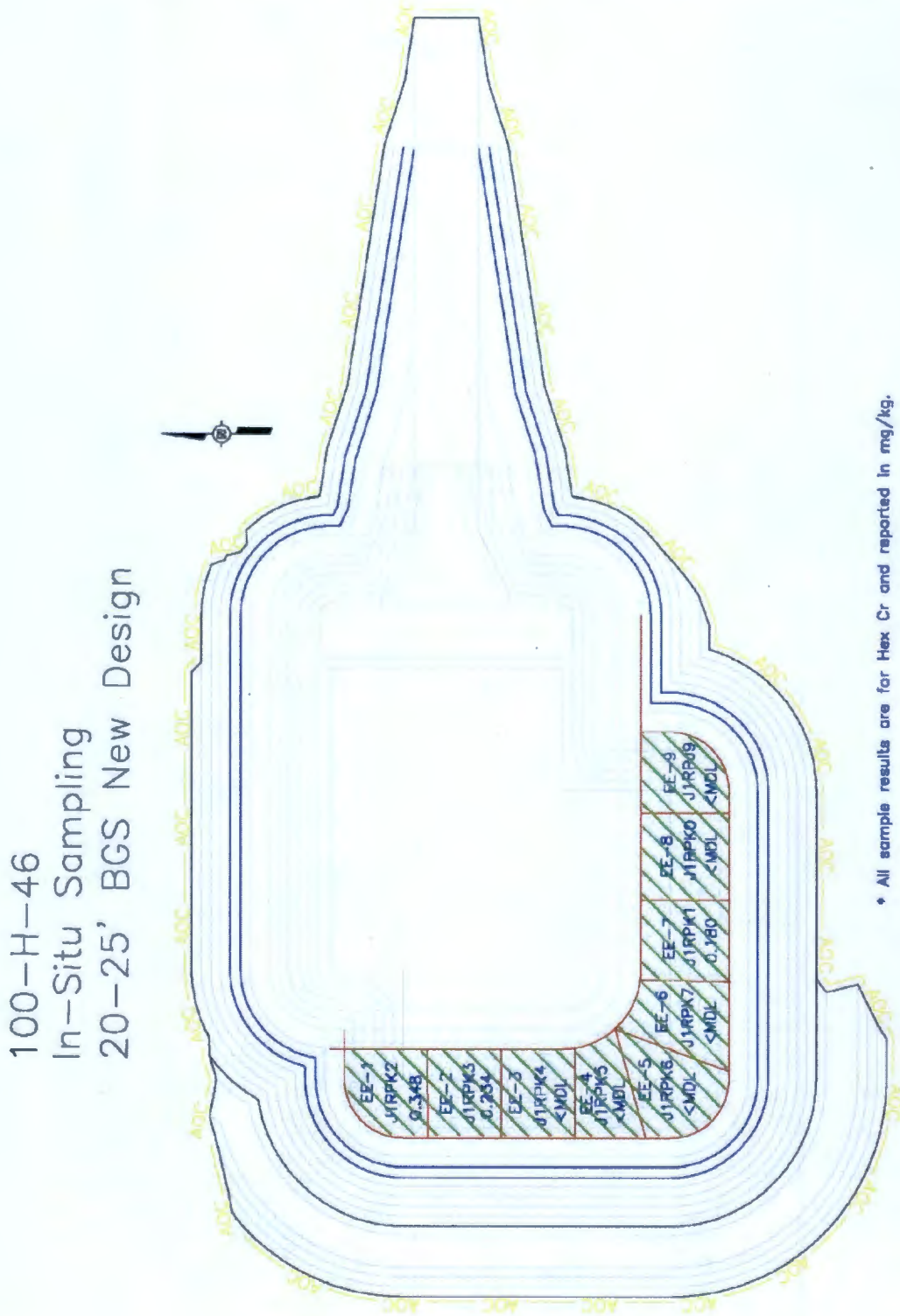


Figure C-6. In-Process Sample Locations and Results, 25 to 30 ft Lifts.

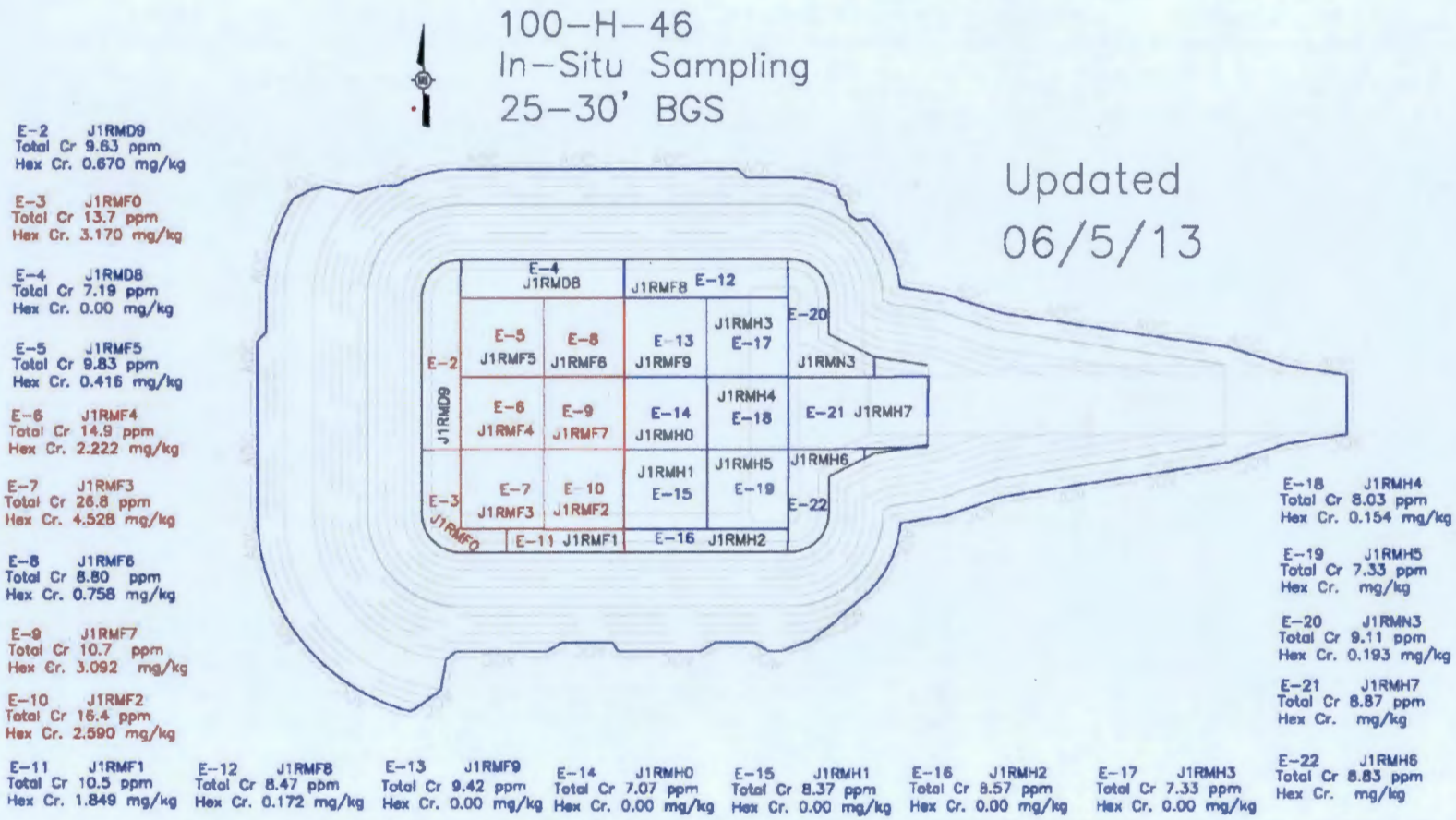


Figure C-7. In-Process Sample Locations and Results, 25 to 30 ft Lifts, Southwest Expansion.

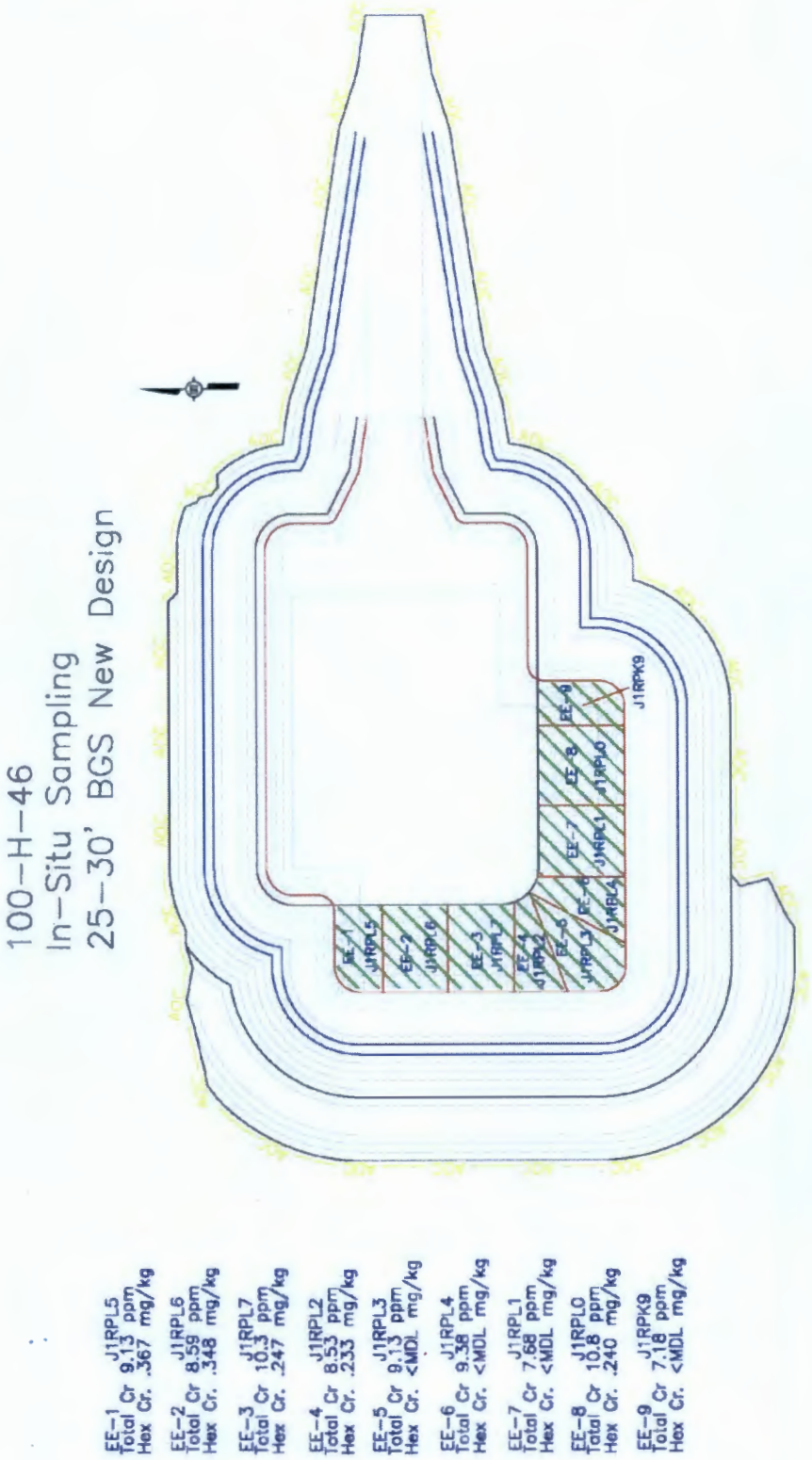
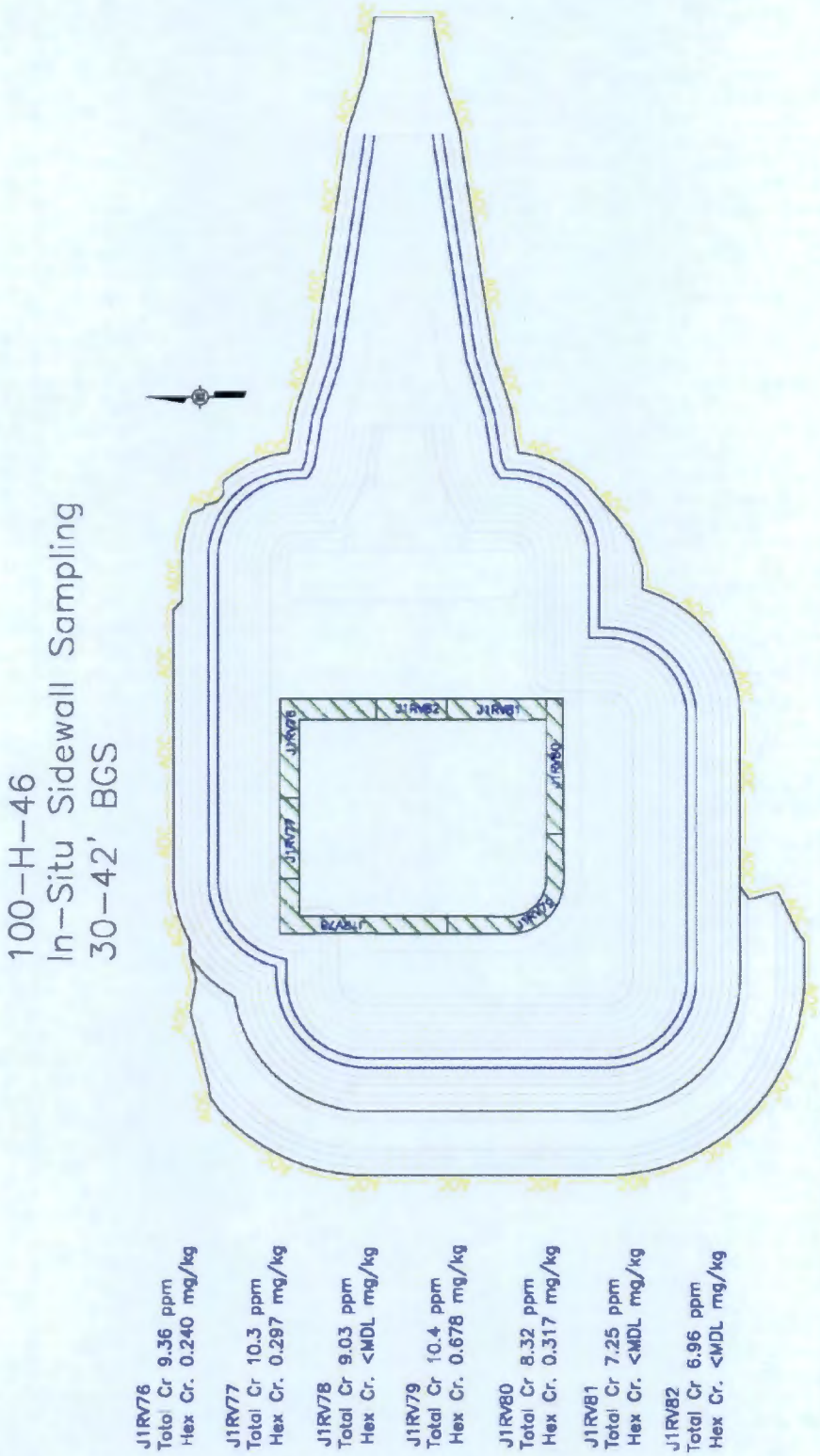


Figure C-8. In-Process Sample Locations and Results, Sidewall Samples at Final Depth.



APPENDIX D

CALCULATIONS

APPENDIX D

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-46 Waste Site Cleanup Verification 95% UCL Calculation, 0100H-CA-V0201, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-H-46 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0100H-CA-V0202, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-H-46 Waste Site Protection of Groundwater Hazard Quotient and Carcinogenic Risk Calculation, 0100H-CA-V0203, Rev. 1, 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-V0201

Subject: 100-H-46 Waste Site Cleanup Verification 95% UCL Calculation

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 22 Attm. 1 = 8 Total = 31	N. K. Schiffern N. K. Schiffern	J. D. Skoglie J. D. Skoglie	I. B. Berezovskiy I. B. Berezovskiy	D. F. Obenauer D. F. Obenauer	1/23/14

SUMMARY OF REVISION

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

Washington Closure Hanford **CALCULATION SHEET**

Originator N. K. Schiffern		**Date** 01/21/14	**Calc. No.** 0100H-CA-V0201	**Rev. No.** 0	
Project 100-H Field Remediation		**Job No.** 14655	**Checked** J. D. Skoglie	**Date** 01/21/14	
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations				**Sheet No.** 1 of 22	

Summary

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

Table of Contents:
Sheets 1 to 4 - Calculation Sheet Summary
Sheets 5 to 13 - Calculation Sheet Verification Data Results- Decision Unit 1, Decision Unit 2, and Overburden Stockpiles.
Sheets 14 to 19 - Ecology Software (MTCAStat) Results
Sheets 20 and 22 - Calculation Sheet - Duplicate Analysis
Attachment 1 - 100-H-46, Verification Sampling Results (8 pages)

Given/References:
1) Sample Results (Attachment 1).
2) DOE-RL, 2009a, *100 Area Remedial Action Sampling and Analysis Plan* (SAP), DOE/RL-96-22, Rev.5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
3) DOE-RL, 2009b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
5) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Suppiement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets),* Publication #92-54, Washington Department of Ecology, Olympia, Washington.
6) Ecology, 2011, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
7) EPA, 1989, *Risk Assessment Guidance for Superfund:* Volume 1, *Human Health Evaluation Manual, Part A; Interim Final,* EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D. C.
8) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," *Washington Administrative Code.*

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2009b). Use data from attached worksheets to perform the 95% UCL calculation for each analyte, the WAC 173-340-740(7)(e) 3-part test for nonradionuclides, and the RPD calculations for each COC/COPC. The hazard quotient and carcinogenic risk calculations are located in a separate calculation brief as an appendix to the Remaining Sites Verification Package (RSVP).

Calculation Description:
The subject calculations were performed on statistical data from soil verification samples (Attachment 1) from the 100-H-46 waste site. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2009b) is documented by this calculation. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

Methodology:
The 100-H-46 waste site underwent statistical sampling that consists of three decision units for verification sampling; Decision Unit 1, Decision Unit 2, and the Overburden Stockpile. Also provided in the attachment are results from samples collected in the periodically rewetted zone (PRZ) which were collected for informational purposes only.

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

Washington Closure Hanford **CALCULATION SHEET**

Originator N. K. Schiffern	**Date** 01/21/14	**Calc. No.** 0100H-CA-V0201	**Rev. No.** 0
Project 100-H Field Remediation	**Job No.** 14655	**Checked** J. D. Skoglie	**Date** 01/21/14
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations			**Sheet No.** 2 of 22

Summary (continued)

Methodology, continued:

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

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

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets (n<10), the calculations are performed assuming nonparametric distribution, so no tests for distribution are performed. For nonradionuclide data sets of ten or greater, as for the subject site, distributional testing is done using Ecology's MTCAStat software (Ecology 1993). Due to differences in addressing censored data between the RDR/RAWP (DOE-RL 2009b) and MTCAStat coding and due to a limitation in the MTCAStat coding (no direct capability to address variable quantitation limits within a data set), substitutions for censored data are performed before software input and the resulting data set treated as uncensored.

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

The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDLs are pre-determined values for analytical methods and constituents with cleanup levels as listed in Table 2-1 of the SAP (DOE-RL 2009a). Table 2-1 includes nominal TDLs for identified methods based organic analyses. The nominal TDLs are also used in support of the RPD calculation for the methods based analytes. TDLs not included in Table 2-1 are based on the laboratory and/or methods used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than 30% indicates the data compare favorably. If the RPD is greater than 30%, further investigation regarding the usability of the data is performed. To assist in the identification of anomalous sample pairs, when an analyte is detected in the primary or duplicate sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable RSVP.

Washington Closure Hanford **CALCULATION SHEET**

Originator	N. K. Schiffern	**Date**	01/21/14	**Calc. No.**	0100H-CA-V0201	**Rev. No.**	0
Project	100-H Field Remediation	**Job No.**	14655	**Checked**	J. D. Skoglie	**Date**	01/21/14
Subject	100-H-46 Waste Site Cleanup Verification 95% UCL Calculations					**Sheet No.**	3 of 22

Summary (continued)

QUALIFIER LIST

B = blank contamination
D = dilution
J = estimate
M = sample duplicate precision not met
N = MS/MSD or LCS recovery is outside control limits
U = undetected
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present.

ACRONYM LIST

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

Washington Closure Hanford

CALCULATION SHEET

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0
Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 4 of 22

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations and/or maximum for the decision unit 1, decision unit 2, overburden stockpiles, the WAC 173-340-740(7)(e) 3-part test evaluation, and the RPD calculations, and are for use in risk analysis and the RSVP for this site.

Results Summary [a]

Analyte	DU1		DU2		OB		Units
	95% UCL Result	Maximum Result	95% UCL Result	Maximum Result	95% UCL Result	Maximum Result	
Arsenic	5.5	--	3.3	--	2.4	--	mg/kg
Barium	52.1	--	43.0	--	42.5	--	mg/kg
Beryllium	0.23	--	0.16	--	0.14	--	mg/kg
Boron	--	1.9	--	1.2	--	--	mg/kg
Cadmium	0.12	--	0.26	--	0.15	--	mg/kg
Chromium	9.4	--	9.1	--	10.2	--	mg/kg
Cobalt	5.7	--	4.8	--	5.2	--	mg/kg
Copper	24.0	--	14.5	--	12.6	--	mg/kg
Hexavalent chromium	0.276	--	--	0.226	--	0.237	mg/kg
Lead	8.2	--	9.0	--	3.2	--	mg/kg
Manganese	244	--	213	--	230	--	mg/kg
Mercury	--	0.012	--	--	--	--	mg/kg
Molybdenum	--	0.77	0.33	--	--	0.30	mg/kg
Nickel	9.8	--	9.0	--	9.9	--	mg/kg
Vanadium	44.2	--	42.8	--	40.8	--	mg/kg
Zinc	33.8	--	28.7	--	29.4	--	mg/kg

WAC 173-340-740(7)(e) Evaluation:

WAC 173-340 3-Part Test for most stringent RAG:	DU1		DU2		OB	
95% UCL or maximum> Cleanup Limit?	YES	NO	NO	NO	NA	NO
> 10% above Cleanup Limit?	NO	NO	NO	NO	NA	NO
Any sample > 2x Cleanup Limit?	YES	NO	YES	NO	NA	NO

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

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

Analyte	Duplicate Analysis		
	DU1	DU2	OB
Aluminum	3.3%	11.5%	10.1%
Barium	2.5%	21.2%	6.4%
Calcium	1.5%	16.2%	9.1%
Chromium	17.5%	3.7%	21.1%
Copper	4.7%	9.4%	9.1%
Iron	5.3%	16.9%	4.1%
Magnesium	11.9%	13.7%	11.4%
Manganese	6.8%	21.0%	8.2%
Silicon	22.1%	22.0%	13.6%
Vanadium	5.3%	15.8%	1.9%
Zinc	5.9%	18.4%	4.8%

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

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-H Field Remediation
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations

Date 01/21/14
Job No. 14655

Calc. No. 0100H-CA-V0201
Checked J. D. Skoglie JS

Rev. No. 0
Date 01/21/14
Sheet No. 5 of 22

100-H-46 Statistical Calculations

Verification Data - Decision Unit (DU1)

1	Sample	Sample	Sample	Arsenic			Barium			Beryllium			Cadmium			Chromium			Cobalt			Copper			Hexavalent Chromium			Lead		
2	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
3	DU1-1	J1T6L4	1/6/2014	2.7		0.66	40.2		0.076	0.22		0.033	0.098	B	0.041	9.3		0.058	5.9	X	0.10	14.4		0.22	0.168		0.155	3.7		0.27
4	Duplicate of J1T6L4	J1T6M6	1/6/2014	2.5		0.63	39.2		0.073	0.22		0.032	0.10	B	0.039	7.8		0.056	5.2	X	0.096	15.1		0.21	0.155	U	0.155	4.3		0.26
5	DU1-2	J1T6L5	1/6/2014	1.8		0.59	38.7		0.068	0.19		0.029	0.090	B	0.037	8.8		0.052	4.8	X	0.089	13.9		0.19	0.476		0.155	2.7		0.24
6	DU1-3	J1T6L6	1/6/2014	2.0		0.64	35.1		0.074	0.19	B	0.032	0.081	B	0.040	9.1		0.057	5.2	X	0.098	14.4		0.21	0.155	U	0.155	2.0		0.26
7	DU1-4	J1T6L7	1/6/2014	1.8		0.67	47.6		0.077	0.17	B	0.033	0.074	B	0.042	7.8		0.059	5.1	X	0.10	12.0		0.22	0.155	U	0.155	2.2		0.27
8	DU1-5	J1T6L8	1/6/2014	3.9		0.64	41.3		0.074	0.24		0.032	0.12	B	0.040	8.6		0.056	5.7	X	0.097	17.2		0.21	0.167		0.155	9.5		0.26
9	DU1-6	J1T6L9	1/6/2014	2.6		0.58	44.3		0.067	0.21		0.029	0.11	B	0.036	9.9		0.051	5.8	X	0.088	14.7		0.19	0.210		0.155	3.6		0.24
10	DU1-7	J1T6M0	1/6/2014	13.8		0.68	59.6		0.078	0.22		0.034	0.13	B	0.042	9.7		0.060	6.2	X	0.10	57.0		0.22	0.171		0.155	5.2		0.28
11	DU1-8	J1T6M1	1/6/2014	2.2		0.63	37.4		0.072	0.19		0.031	0.098	B	0.039	8.1		0.055	5.2	X	0.095	13.9		0.21	0.155	U	0.155	2.3		0.26
12	DU1-9	J1T6M2	1/6/2014	2.0		0.61	40.4		0.071	0.17	B	0.031	0.090	B	0.038	7.3		0.054	5.2	X	0.093	12.7		0.20	0.155	U	0.155	2.1		0.25
13	DU1-10	J1T6M3	1/6/2014	3.7		0.67	55.3		0.078	0.24		0.034	0.13	B	0.042	9.9		0.059	5.6	X	0.10	15.9		0.22	0.271		0.155	5.6		0.28
14	DU1-11	J1T6M4	1/6/2014	6.0		0.65	46.6		0.075	0.24		0.032	0.11	B	0.040	9.3		0.057	5.5	X	0.098	15.3		0.21	0.169		0.155	17.2		0.27
15	DU1-12	J1T6M5	1/6/2014	4.6		0.63	70.4		0.072	0.25		0.031	0.12	B	0.039	9.8		0.055	5.6	X	0.095	15.9		0.21	0.272		0.155	5.7		0.26

16 **Statistical Computation Input Data**

17	Sample	Sample	Sample	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Hexavalent Chromium	Lead
18	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
19	DU1-1	J1T6L4/J1T6M6	1/6/2014	2.6	39.7	0.22	0.099	8.6	5.6	14.8	0.123	4.0
20	DU1-2	J1T6L5	1/6/2014	1.8	38.7	0.19	0.090	8.8	4.8	13.9	0.476	2.7
21	DU1-3	J1T6L6	1/6/2014	2.0	35.1	0.19	0.081	9.1	5.2	14.4	0.0775	2.0
22	DU1-4	J1T6L7	1/6/2014	1.8	47.6	0.17	0.074	7.8	5.1	12.0	0.0775	2.2
23	DU1-5	J1T6L8	1/6/2014	3.9	41.3	0.24	0.12	8.6	5.7	17.2	0.167	9.5
24	DU1-6	J1T6L9	1/6/2014	2.6	44.3	0.21	0.11	9.9	5.8	14.7	0.210	3.6
25	DU1-7	J1T6M0	1/6/2014	13.8	59.6	0.22	0.13	9.7	6.2	57.0	0.171	5.2
26	DU1-8	J1T6M1	1/6/2014	2.2	37.4	0.19	0.098	8.1	5.2	13.9	0.0775	2.3
27	DU1-9	J1T6M2	1/6/2014	2.0	40.4	0.17	0.090	7.3	5.2	12.7	0.0775	2.1
28	DU1-10	J1T6M3	1/6/2014	3.7	55.3	0.24	0.13	9.9	5.6	15.9	0.271	5.6
29	DU1-11	J1T6M4	1/6/2014	6.0	46.6	0.24	0.11	9.3	5.5	15.3	0.169	17.2
30	DU1-12	J1T6M5	1/6/2014	4.6	70.4	0.25	0.12	9.8	5.6	15.9	0.272	5.7

31 **Statistical Computations**

32		Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Hexavalent Chromium	Lead
33	95% UCL based on	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
34	N	12	12	12	12	12	12	12	12	12
35	% < Detection limit	0%	0%	0%	0%	0%	0%	0%	33%	0%
36	Mean	3.9	46.4	0.21	0.10	8.9	5.5	18.1	0.181	5.2
37	Standard deviation	3.4	10.5	0.028	0.019	0.87	0.37	12.3	0.117	4.4
38	95% UCL on mean	5.5	52.1	0.23	0.12	9.4	5.7	24.0	0.276	8.2
39	Maximum value	13.8	70.4	0.25	0.13	9.9	6.2	57.0	0.476	17.2
40	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	0.81 GW & River Protection	18.5 GW & River Protection	15.7 GW Protection	22.0 River Protection	2 River Protection	10.2 GW & River Protection
41	**WAC 173-340 3-PART TEST**									
42	95% UCL > Cleanup Limit?	NO	NA	NA	NA	NA	NA	YES	NO	NO
43	> 10% above Cleanup Limit?	NO	NA	NA	NA	NA	NA	NO	NO	NO
44	Any sample > 2X Cleanup Limit?	NO	NA	NA	NA	NA	NA	YES	NO	NO
45	**WAC 173-340 Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (1.51 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (0.81 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (18.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (15.7 mg/kg) the WAC 173-340 3-part test is not required.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

46 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-H Field Remediation
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations

Date 01/21/14
Job No. 14655

Calc. No. 0100H-CA-V0201
Checked J. D. Skoglie

Rev. No. 0
Date 01/21/14
Sheet No. 6 of 22

100-H-46 Statistical Calculations
Verification Data - Decision Unit (DU1)

1	Sample	Sample	Sample	Manganese			Nickel			Vanadium			Zinc		
2	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
3	DU1-1	J1T6L4	1/6/2014	242		0.10	10.5		0.12	40.6		0.094	33.4	X	0.40
4	Duplicate of J1T6L4	J1T6M6	1/6/2014	226		0.096	8.9		0.12	38.5		0.090	31.5	X	0.38
5	DU1-2	J1T6L5	1/6/2014	215		0.089	8.3		0.11	38.9		0.084	28.8	X	0.36
6	DU1-3	J1T6L6	1/6/2014	225		0.098	11.0		0.12	40.7		0.092	28.6	X	0.39
7	DU1-4	J1T6L7	1/6/2014	219		0.10	9.5		0.12	35.1		0.095	29.6	X	0.40
8	DU1-5	J1T6L8	1/6/2014	234		0.097	9.5		0.12	44.4		0.091	34.8	X	0.39
9	DU1-6	J1T6L9	1/6/2014	248		0.088	10.0		0.11	48.0		0.083	34.5	X	0.35
10	DU1-7	J1T6M0	1/6/2014	260		0.10	9.8		0.13	47.0		0.096	33.6	X	0.41
11	DU1-8	J1T6M1	1/6/2014	218		0.095	8.1		0.12	43.1		0.089	30.5	X	0.38
12	DU1-9	J1T6M2	1/6/2014	212		0.093	9.0		0.11	35.6		0.087	27.0	X	0.37
13	DU1-10	J1T6M3	1/6/2014	253		0.10	9.5		0.13	42.1		0.096	35.6	X	0.41
14	DU1-11	J1T6M4	1/6/2014	248		0.098	9.2		0.12	44.3		0.092	32.5	X	0.39
15	DU1-12	J1T6M5	1/6/2014	251		0.095	9.1		0.12	43.6		0.089	37.0	X	0.38

16 **Statistical Computation Input Data**

17	Sample	Sample	Sample	Manganese	Nickel	Vanadium	Zinc
18	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg
19	DU1-1	J1T6L4/J1T6M6	1/6/2014	234	9.7	39.6	32.5
20	DU1-2	J1T6L5	1/6/2014	215	8.3	38.9	28.8
21	DU1-3	J1T6L6	1/6/2014	225	11.0	40.7	28.6
22	DU1-4	J1T6L7	1/6/2014	219	9.5	35.1	29.6
23	DU1-5	J1T6L8	1/6/2014	234	9.5	44.4	34.8
24	DU1-6	J1T6L9	1/6/2014	248	10.0	48.0	34.5
25	DU1-7	J1T6M0	1/6/2014	260	9.8	47.0	33.6
26	DU1-8	J1T6M1	1/6/2014	218	8.1	43.1	30.5
27	DU1-9	J1T6M2	1/6/2014	212	9.0	35.6	27.0
28	DU1-10	J1T6M3	1/6/2014	253	9.5	42.1	35.6
29	DU1-11	J1T6M4	1/6/2014	248	9.2	44.3	32.5
30	DU1-12	J1T6M5	1/6/2014	251	9.1	43.6	37.0

31 **Statistical Computations**

32		Manganese	Nickel	Vanadium	Zinc
33	95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.
34	N	12	12	12	12
35	% < Detection limit	0%	0%	0%	0%
36	Mean	235	9.4	41.9	32.1
37	Standard deviation	16.8	0.76	4.1	3.2
38	95% UCL on mean	244	9.8	44.2	33.8
39	Maximum value	260	11.0	48.0	37.0
40	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	512 GW & River Protection	19.1 GW Protection	85.1 GW Protection	67.8 River Protection
41	**WAC 173-340 3-PART TEST**				
42	95% UCL > Cleanup Limit?	NA	NA	NA	NA
43	> 10% above Cleanup Limit?	NA	NA	NA	NA
44	Any sample > 2X Cleanup Limit?	NA	NA	NA	NA
45	**WAC 173-340 Compliance?**	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (19.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (85.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (67.8 mg/kg) the WAC 173-340 3-part test is not required.

46 **Acronyms and qualifiers are defined on sheet 3.**

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0
Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 7 of 22

1 **100-H-46 Maximum Calculations**

2 **Verification Data - Decision Unit 1 (DU1)**

3	Sample	Sample	Sample	Boron			Mercury			Molybdenum		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5	DU1-1	J1T6L4	1/6/2014	0.98	U	0.98	0.0058	U	0.0058	0.26	U	0.26
6	Duplicate of J1T6L4	J1T6M6	1/6/2014	0.94	U	0.94	0.0052	U	0.0052	0.25	U	0.25
7	DU1-2	J1T6L5	1/6/2014	0.92	B	0.88	0.0064	U	0.0064	0.23	B	0.23
8	DU1-3	J1T6L6	1/6/2014	0.96	U	0.96	0.0053	U	0.0053	0.25	U	0.25
9	DU1-4	J1T6L7	1/6/2014	0.99	U	0.99	0.0049	U	0.0049	0.26	U	0.26
10	DU1-5	J1T6L8	1/6/2014	0.95	U	0.95	0.0053	U	0.0053	0.25	U	0.25
11	DU1-6	J1T6L9	1/6/2014	0.86	U	0.86	0.0054	U	0.0054	0.24	B	0.23
12	DU1-7	J1T6M0	1/6/2014	1.0	U	1.0	0.0055	U	0.0055	0.66	B	0.27
13	DU1-8	J1T6M1	1/6/2014	0.93	U	0.93	0.0056	U	0.0056	0.25	U	0.25
14	DU1-9	J1T6M2	1/6/2014	0.91	U	0.91	0.0059	U	0.0059	0.24	U	0.24
15	DU1-10	J1T6M3	1/6/2014	1.1	B	1.0	0.0055	B	0.0052	0.77	B	0.27
16	DU1-11	J1T6M4	1/6/2014	1.1	B	0.96	0.0065	U	0.0065	0.26	U	0.26
17	DU1-12	J1T6M5	1/6/2014	1.9		0.93	0.012	B	0.0063	0.25	B	0.25

18 **Statistical Computations**

19		Boron			Mercury			Molybdenum		
20	% < Detection limit	67%			83%			58%		
21	Maximum value	1.9			0.012			0.77		
22	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	320	GW Protection		0.33	GW & River Protection		8	GW Protection	
23	**3-PART TEST**									
24	Maximum > Cleanup Limit?	NO			NA			NO		
25	> 10% above Cleanup Limit?	NO			NA			NO		
26	Any sample > 2X Cleanup Limit?	NO			NA			NO		
27	**3-Part Test Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.			Because all values are below background (0.33 mg/kg) the WAC 173-340 3-part test is not required.			The data set meets the 3-part test criteria when compared to the most stringent RAG.		

28 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NO
Project 100-H Field Remediation
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations

Date 01/21/14
Job No. 14655

Calc. No. 0100H-CA-V0201
Checked J. D. Skoglie JD

Rev. No. 0
Date 01/21/14
Sheet No. 8 of 22

100-H-46 Statistical Calculations
Verification Data - Decision Unit (DU2)

1	Sample	Sample	Sample	Arsenic			Barium			Beryllium			Cadmium			Chromium			Cobalt			Copper			Lead			Manganese		
2	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
3	DU2-11	J1T6N8	12/13/2013	2.1		0.61	30.0		0.071	0.15	B	0.031	0.25		0.038	7.9		0.054	4.8		0.093	13.4		0.20	2.1		0.25	216		0.093
4	Duplicate of J1T6N8	J1T6P0	12/13/2013	1.5		0.62	37.1		0.071	0.13	B	0.031	0.21		0.039	8.2		0.054	4.1		0.094	12.2		0.20	2.2		0.25	175		0.094
5	DU2-1	J1T6M8	12/13/2013	2.1		0.64	36.0		0.074	0.14	B	0.032	0.23		0.040	7.9		0.057	3.8	M	0.098	13.7		0.21	2.2		0.26	200		0.098
6	DU2-2	J1T6M9	12/13/2013	2.2		0.58	56.5		0.066	0.14	B	0.029	0.22		0.036	7.2		0.051	4.5		0.087	12.9		0.19	2.3		0.24	191		0.087
7	DU2-3	J1T6N0	12/13/2013	3.1		0.66	32.4		0.076	0.17	B	0.033	0.26		0.041	8.6		0.058	4.9		0.10	15.3		0.22	2.5		0.27	212		0.10
8	DU2-4	J1T6N1	12/13/2013	1.6		0.67	35.0		0.077	0.15	B	0.034	0.23		0.042	8.6		0.059	4.7		0.10	11.8		0.22	2.2		0.27	192		0.10
9	DU2-5	J1T6N2	12/13/2013	1.6		0.61	35.7		0.070	0.14	B	0.030	0.25		0.038	6.8		0.053	4.5		0.092	11.6		0.20	2.0		0.25	177		0.092
10	DU2-6	J1T6N3	12/13/2013	2.4		0.62	40.0		0.071	0.15	B	0.031	0.26		0.038	8.2		0.054	4.7		0.093	12.8		0.20	2.5		0.25	204		0.093
11	DU2-7	J1T6N4	12/13/2013	2.1		0.65	44.1		0.075	0.16	B	0.033	0.26		0.040	7.9		0.057	4.6		0.099	12.4		0.21	2.2		0.27	206		0.099
12	DU2-8	J1T6N5	12/13/2013	1.9		0.64	37.7		0.073	0.15	B	0.032	0.25		0.040	8.1		0.056	4.6		0.097	14.1		0.21	2.2		0.26	195		0.097
13	DU2-9	J1T6N6	12/13/2013	2.2		0.64	38.5		0.074	0.13	B	0.032	0.24		0.040	9.0		0.057	4.9		0.097	17.3		0.21	2.4		0.26	221		0.097
14	DU2-10	J1T6N7	12/13/2013	7.5		0.63	49.5		0.073	0.20		0.032	0.28		0.039	12.9		0.055	5.5		0.096	15.5		0.21	32.7		0.26	246		0.096
15	DU2-12	J1T6N9	12/13/2013	1.7		0.62	36.9		0.071	0.14	B	0.031	0.24		0.038	7.6		0.054	4.6		0.093	12.8		0.20	2.1		0.25	201		0.093

16 **Statistical Computation Input Data**

17	Sample	Sample	Sample	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
18	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
19	DU2-11	J1T6N8/J1T6P0	12/13/2013	1.8	33.6	0.14	0.23	8.1	4.5	12.8	2.2	196
20	DU2-1	J1T6M8	12/13/2013	2.1	36.0	0.14	0.23	7.9	3.8	13.7	2.2	200
21	DU2-2	J1T6M9	12/13/2013	2.2	56.5	0.14	0.22	7.2	4.5	12.9	2.3	191
22	DU2-3	J1T6N0	12/13/2013	3.1	32.4	0.17	0.26	8.6	4.9	15.3	2.5	212
23	DU2-4	J1T6N1	12/13/2013	1.6	35.0	0.15	0.23	8.6	4.7	11.8	2.2	192
24	DU2-5	J1T6N2	12/13/2013	1.6	35.7	0.14	0.25	6.8	4.5	11.6	2.0	177
25	DU2-6	J1T6N3	12/13/2013	2.4	40.0	0.15	0.26	8.2	4.7	12.8	2.5	204
26	DU2-7	J1T6N4	12/13/2013	2.1	44.1	0.16	0.26	7.9	4.6	12.4	2.2	206
27	DU2-8	J1T6N5	12/13/2013	1.9	37.7	0.15	0.25	8.1	4.6	14.1	2.2	195
28	DU2-9	J1T6N6	12/13/2013	2.2	38.5	0.13	0.24	9.0	4.9	17.3	2.4	221
29	DU2-10	J1T6N7	12/13/2013	7.5	49.5	0.20	0.28	12.9	5.5	15.5	32.7	246
30	DU2-12	J1T6N9	12/13/2013	1.7	36.9	0.14	0.24	7.6	4.6	12.8	2.1	201

31 **Statistical Computations**

32		Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
33	95% UCL based on	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.
34	N	12	12	12	12	12	12	12	12	12
35	% < Detection limit	0%	0%	0%	0%	0%	0%	0%	0%	0%
36	Mean	2.5	39.7	0.15	0.25	8.4	4.6	13.6	4.8	203
37	Standard deviation	1.6	7.1	0.019	0.017	1.5	0.39	1.7	8.8	17.4
38	95% UCL on mean	3.3	43.0	0.16	0.26	9.1	4.8	14.5	9.0	213
39	Maximum value	7.5	56.5	0.20	0.28	12.9	5.5	17.3	32.7	246
40	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	0.81 GW & River Protection	18.5 GW & River Protection	15.7 GW Protection	22.0 River Protection	10.2 GW & River Protection	512 GW & River Protection
41	**WAC 173-340 3-PART TEST**									
42	95% UCL > Cleanup Limit?	NO	NA	NA	NA	NA	NA	NA	NO	NA
43	> 10% above Cleanup Limit?	NO	NA	NA	NA	NA	NA	NA	NO	NA
44	Any sample > 2X Cleanup Limit?	NO	NA	NA	NA	NA	NA	NA	YES	NA
45	**WAC 173-340 Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (1.51 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (0.81 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (18.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (15.7 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (22.0 mg/kg) the WAC 173-340 3-part test is not required.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.

46 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0
Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 9 of 22

100-H-46 Statistical Calculations
Verification Data - Decision Unit (DU2)

1	Sample	Sample	Sample	Molybdenum			Nickel			Vanadium			Zinc		
2	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
3	DU2-11	J1T6N8	12/13/2013	0.24	B	0.24	8.1		0.11	44.5		0.087	28.5	X	0.37
4	Duplicate of J1T6N8	J1T6P0	12/13/2013	0.24	B	0.24	8.2		0.12	38.0		0.088	23.7	X	0.37
5	DU2-1	J1T6M8	12/13/2013	0.25	U	0.25	8.2		0.12	31.2		0.092	22.6	X	0.39
6	DU2-2	J1T6M9	12/13/2013	0.24	B	0.23	7.5		0.11	40.4		0.082	25.9	X	0.35
7	DU2-3	J1T6N0	12/13/2013	0.26	U	0.26	8.4		0.12	47.2		0.094	28.3	X	0.40
8	DU2-4	J1T6N1	12/13/2013	0.26	U	0.26	9.4		0.12	38.2		0.095	25.6	X	0.40
9	DU2-5	J1T6N2	12/13/2013	0.30	B	0.24	6.6		0.11	36.0		0.087	24.7	X	0.37
10	DU2-6	J1T6N3	12/13/2013	0.33	B	0.24	8.5		0.11	42.9		0.088	27.2	X	0.37
11	DU2-7	J1T6N4	12/13/2013	0.26	U	0.26	7.9		0.12	42.2		0.093	28.0	X	0.39
12	DU2-8	J1T6N5	12/13/2013	0.25	U	0.25	7.4		0.12	43.1		0.091	27.3	X	0.38
13	DU2-9	J1T6N6	12/13/2013	0.28	B	0.25	10.1		0.12	43.7		0.092	27.7	X	0.39
14	DU2-10	J1T6N7	12/13/2013	0.72	B	0.25	10.3		0.12	39.3		0.090	36.0	X	0.38
15	DU2-12	J1T6N9	12/13/2013	0.27	B	0.24	8.1		0.11	39.2		0.088	26.2	X	0.37

16 **Statistical Computation Input Data**

17	Sample	Sample	Sample	Molybdenum	Nickel	Vanadium	Zinc
18	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg
19	DU2-11	J1T6N8/J1T6P0	12/13/13	0.24	8.2	41.3	26.1
20	DU2-1	J1T6M8	12/13/2013	0.13	8.2	31.2	22.6
21	DU2-2	J1T6M9	12/13/2013	0.24	7.5	40.4	25.9
22	DU2-3	J1T6N0	12/13/2013	0.13	8.4	47.2	28.3
23	DU2-4	J1T6N1	12/13/2013	0.13	9.4	38.2	25.6
24	DU2-5	J1T6N2	12/13/2013	0.30	6.6	36.0	24.7
25	DU2-6	J1T6N3	12/13/2013	0.33	8.5	42.9	27.2
26	DU2-7	J1T6N4	12/13/2013	0.13	7.9	42.2	28.0
27	DU2-8	J1T6N5	12/13/2013	0.13	7.4	43.1	27.3
28	DU2-9	J1T6N6	12/13/2013	0.28	10.1	43.7	27.7
29	DU2-10	J1T6N7	12/13/2013	0.72	10.3	39.3	36.0
30	DU2-12	J1T6N9	12/13/2013	0.27	8.1	39.2	26.2

31 **Statistical Computations**

32		Molybdenum	Nickel	Vanadium	Zinc
33	95% UCL based on	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
34	N	12	12	12	12
35	% < Detection limit	42%	0%	0%	0%
36	Mean	0.25	8.4	40.4	27.1
37	Standard deviation	0.17	1.1	4.1	3.2
38	95% UCL on mean	0.33	9.0	42.8	28.7
39	Maximum value	0.72	10.3	47.2	36.0
40	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	8 GW Protection	19.1 GW Protection	85.1 GW Protection	67.8 River Protection
41	**WAC 173-340 3-PART TEST**				
42	95% UCL > Cleanup Limit?	NO	NA	NA	NO
43	> 10% above Cleanup Limit?	NO	NA	NA	NO
44	Any sample > 2X Cleanup Limit?	NO	NA	NA	NO
45	**WAC 173-340 Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (19.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (85.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (67.8 mg/kg) the WAC 173-340 3-part test is not required.

46 **Acronyms and qualifiers are defined on sheet 3.**

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0
Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 10 of 22

1 **100-H-46 Maximum Calculations**

2 **Verification Data - Decision Unit (DU2)**

	Sample Area	Sample Number	Sample Date	Boron mg/kg	Boron Q	Boron PQL	Hexavalent Chromium mg/kg	Hexavalent Chromium Q	Hexavalent Chromium PQL
5	DU2-11	J1T6N8	12/13/2013	0.91	U	0.91	0.155	U	0.155
6	Duplicate of J1T6N8	J1T6P0	12/13/2013	0.92	U	0.92	0.155	U	0.155
7	DU2-1	J1T6M8	12/13/2013	0.96	U	0.96	0.164		0.155
8	DU2-2	J1T6M9	12/13/2013	0.86	U	0.86	0.155	U	0.155
9	DU2-3	J1T6N0	12/13/2013	0.98	U	0.98	0.155	U	0.155
10	DU2-4	J1T6N1	12/13/2013	1.0	U	1.0	0.155	U	0.155
11	DU2-5	J1T6N2	12/13/2013	0.90	U	0.90	0.155	U	0.155
12	DU2-6	J1T6N3	12/13/2013	0.91	U	0.91	0.155	U	0.155
13	DU2-7	J1T6N4	12/13/2013	0.97	U	0.97	0.155	U	0.155
14	DU2-8	J1T6N5	12/13/2013	0.95	U	0.95	0.203		0.155
15	DU2-9	J1T6N6	12/13/2013	0.95	U	0.95	0.155	U	0.155
16	DU2-10	J1T6N7	12/13/2013	1.2	B	0.94	0.226		0.155
17	DU2-12	J1T6N9	12/13/2013	0.91	U	0.91	0.155	U	0.155

18 **Statistical Computations**

		Boron	Hexavalent Chromium
19		**Boron**	**Hexavalent Chromium**
20	% < Detection limit	92%	75%
21	Maximum value	1.2	0.226
22	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	320 GW Protection	2 River Protection
23	**3-PART TEST**		
24	Maximum > Cleanup Limit?	NO	NO
25	> 10% above Cleanup Limit?	NO	NO
26	Any sample > 2X Cleanup Limit?	NO	NO
27	**3-Part Test Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

28 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NO
Project 100-H Field Remediation
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations

Date 01/21/14
Job No. 14655

Calc. No. 0100H-CA-V0201
Checked J. D. Skoglie

Rev. No. 0
Date 01/21/14
Sheet No. 11 of 22

100-H-46 Statistical Calculations

Verification Data - Overburden Stockpile (OB)

1	Sample	Sample	Sample	Arsenic			Barium			Beryllium			Cadmium			Chromium			Cobalt			Copper			Lead			Manganese		
2	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	Q	mg/kg	Q	PQL	mg/kg	Q	PQL
3	OB-1	J1RX91	8/19/2013	3.5		0.64	39.5		0.074	0.17	B	0.032	0.14	B	0.040	11.0		0.057	5.5	X	0.098	13.8		0.21	5.7		0.26	242		0.098
4	Duplicate of J1RX91	J1RXC3	8/19/2013	2.7		0.59	42.1		0.068	0.14	B	0.030	0.16	B	0.037	8.9		0.052	5.1	X	0.090	12.6		0.20	4.7		0.24	223		0.090
5	OB-2	J1RX92	8/19/2013	2.5		0.59	34.2		0.068	0.15	B	0.029	0.13	B	0.036	8.7		0.052	4.5	X	0.089	10.9		0.19	3.5		0.24	206		0.089
6	OB-3	J1RX93	8/19/2013	1.9		0.63	39.8		0.072	0.14	B	0.031	0.14	B	0.039	10.5		0.055	5.5	X	0.095	13.1		0.21	2.8		0.26	243		0.095
7	OB-4	J1RX94	8/19/2013	1.8		0.60	40.1		0.069	0.13	B	0.030	0.13	B	0.037	10.3		0.052	5.0	X	0.090	11.7		0.20	2.2		0.24	243		0.090
8	OB-5	J1RX95	8/19/2013	1.8		0.60	43.2		0.069	0.12	B	0.030	0.14	B	0.037	10.4		0.053	5.5	X	0.091	13.3		0.20	2.1		0.25	225		0.091
9	OB-6	J1RX96	8/19/2013	1.6		0.62	49.8		0.071	0.13	B	0.031	0.15	B	0.038	9.9		0.054	4.9	X	0.094	11.7		0.20	2.4		0.25	221		0.094
10	OB-7	J1RX97	8/19/2013	2.2		0.64	38.0		0.074	0.13	B	0.032	0.15	B	0.040	9.6		0.056	5.3	X	0.097	12.8		0.21	2.3		0.26	224		0.097
11	OB-8	J1RX98	8/19/2013	2.1		0.62	36.5		0.072	0.12	B	0.031	0.14	B	0.039	8.5		0.055	4.9	X	0.095	10.7		0.21	2.3		0.26	220		0.095
12	OB-9	J1RX99	8/19/2013	2.1		0.63	36.0		0.072	0.14	B	0.031	0.12	B	0.039	10.1		0.055	4.7	X	0.095	12.0		0.21	2.5		0.26	212		0.095
13	OB-10	J1RXC0	8/19/2013	2.7		0.61	38.1		0.071	0.13	B	0.031	0.15	B	0.038	10.5		0.054	5.4	X	0.093	12.7		0.20	2.4		0.25	219		0.093
14	OB-11	J1RXC1	8/19/2013	2.2		0.65	37.1		0.075	0.14	B	0.032	0.14	B	0.040	10.5		0.057	4.4	X	0.098	11.0		0.21	2.6		0.27	214		0.098
15	OB-12	J1RXC2	8/19/2013	2.3		0.66	46.8		0.076	0.16	B	0.033	0.15	B	0.041	9.6		0.058	4.9	X	0.099	11.4		0.22	3.2		0.27	226		0.099

16 **Statistical Computation Input Data**

17	Sample	Sample	Sample	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
18	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
19	OB-1	J1RX91/J1RXC3	8/19/2013	3.1	40.8	0.16	0.15	10.0	5.3	13.2	5.2	233
20	OB-2	J1RX92	8/19/2013	2.5	34.2	0.15	0.13	8.7	4.5	10.9	3.5	206
21	OB-3	J1RX93	8/19/2013	1.9	39.8	0.14	0.14	10.5	5.5	13.1	2.8	243
22	OB-4	J1RX94	8/19/2013	1.8	40.1	0.13	0.13	10.3	5.0	11.7	2.2	243
23	OB-5	J1RX95	8/19/2013	1.8	43.2	0.12	0.14	10.4	5.5	13.3	2.1	225
24	OB-6	J1RX96	8/19/2013	1.6	49.8	0.13	0.15	9.9	4.9	11.7	2.4	221
25	OB-7	J1RX97	8/19/2013	2.2	38.0	0.13	0.15	9.6	5.3	12.8	2.3	224
26	OB-8	J1RX98	8/19/2013	2.1	36.5	0.12	0.14	8.5	4.9	10.7	2.3	220
27	OB-9	J1RX99	8/19/2013	2.1	36.0	0.14	0.12	10.1	4.7	12.0	2.5	212
28	OB-10	J1RXC0	8/19/2013	2.7	38.1	0.13	0.15	10.5	5.4	12.7	2.4	219
29	OB-11	J1RXC1	8/19/2013	2.2	37.1	0.14	0.14	10.5	4.4	11.0	2.6	214
30	OB-12	J1RXC2	8/19/2013	2.3	46.8	0.16	0.15	9.6	4.9	11.4	3.2	226

31 **Statistical Computations**

32		Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese
33	95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.
34	N	12	12	12	12	12	12	12	12	12
35	% < Detection limit	0%	0%	0%	0%	0%	0%	0%	0%	0%
36	Mean	2.2	40.0	0.14	0.14	9.9	5.0	12.0	2.8	224
37	Standard deviation	0.42	4.6	0.013	0.010	0.68	0.38	0.95	0.86	11.3
38	95% UCL on mean	2.4	42.5	0.14	0.15	10.2	5.2	12.6	3.2	230
39	Maximum value	3.5	49.8	0.17	0.16	11.0	5.5	13.8	5.7	243
40	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	0.81 GW & River Protection	18.5 GW & River Protection	15.7 GW Protection	22.0 River Protection	10.2 GW & River Protection	512 GW & River Protection
41	**WAC 173-340 3-PART TEST**									
42	95% UCL > Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NA	NA
43	> 10% above Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NA	NA
44	Any sample > 2X Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NA	NA
45	**WAC 173-340 Compliance?**	Because all values are below background (6.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (1.51mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (0.81 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (18.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (15.7 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (22.0 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (10.2 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.

46 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern
Project 100-H Field Remediation
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations

Date 01/21/14
Job No. 14655

Calc. No. 0100H-CA-V0201
Checked J. D. Skoglie

Rev. No. 0
Date 01/21/14
Sheet No. 12 of 22

100-H-46 Statistical Calculations

Verification Data - Overburden Stockpile (OB)

1	Sample	Sample	Sample	Nickel			Vanadium			Zinc		
2	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
3	OB-1	J1RX91	8/19/2013	11.2		0.12	41.0		0.092	31.7	X	0.39
4	Duplicate of J1RX91	J1RXC3	8/19/2013	9.4		0.11	41.8		0.085	30.2	X	0.36
5	OB-2	J1RX92	8/19/2013	8.6		0.11	33.4		0.084	27.1	X	0.35
6	OB-3	J1RX93	8/19/2013	9.2		0.12	44.8		0.089	30.8	X	0.38
7	OB-4	J1RX94	8/19/2013	9.5		0.11	41.6		0.085	28.8	X	0.36
8	OB-5	J1RX95	8/19/2013	9.6		0.11	42.5		0.086	28.7	X	0.36
9	OB-6	J1RX96	8/19/2013	9.2		0.12	37.0		0.088	28.3	X	0.37
10	OB-7	J1RX97	8/19/2013	9.9		0.12	43.2		0.092	30.3	X	0.39
11	OB-8	J1RX98	8/19/2013	8.6		0.12	35.1		0.089	27.2	X	0.38
12	OB-9	J1RX99	8/19/2013	10.2		0.12	35.6		0.089	27.0	X	0.38
13	OB-10	J1RXC0	8/19/2013	10.4		0.11	39.8		0.087	28.8	X	0.37
14	OB-11	J1RXC1	8/19/2013	10.2		0.12	33.1		0.093	26.0	X	0.39
15	OB-12	J1RXC2	8/19/2013	9.5		0.12	34.0		0.093	28.2	X	0.40

16 **Statistical Computation Input Data**

17	Sample	Sample	Sample	Nickel			Vanadium			Zinc		
18	Area	Number	Date	mg/kg			mg/kg			mg/kg		
19	OB-1	J1RX91/J1RXC3	8/19/2013	10.3			41.4			31.0		
20	OB-2	J1RX92	8/19/2013	8.6			33.4			27.1		
21	OB-3	J1RX93	8/19/2013	9.2			44.8			30.8		
22	OB-4	J1RX94	8/19/2013	9.5			41.6			28.8		
23	OB-5	J1RX95	8/19/2013	9.6			42.5			28.7		
24	OB-6	J1RX96	8/19/2013	9.2			37.0			28.3		
25	OB-7	J1RX97	8/19/2013	9.9			43.2			30.3		
26	OB-8	J1RX98	8/19/2013	8.6			35.1			27.2		
27	OB-9	J1RX99	8/19/2013	10.2			35.6			27.0		
28	OB-10	J1RXC0	8/19/2013	10.4			39.8			28.8		
29	OB-11	J1RXC1	8/19/2013	10.2			33.1			26.0		
30	OB-12	J1RXC2	8/19/2013	9.5			34.0			28.2		

31 **Statistical Computations**

32		Nickel			Vanadium			Zinc		
33	95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.			Large data set (n ≥ 10), use MTCAStat lognormal distribution.			Large data set (n ≥ 10), use MTCAStat lognormal distribution.		
34	N	12			12			12		
35	% < Detection limit	0%			0%			0%		
36	Mean	9.6			38.5			28.5		
37	Standard deviation	0.62			4.2			1.6		
38	95% UCL on mean	9.9			40.8			29.4		
39	Maximum value	11.2			44.8			31.7		
40	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	19.1	GW Protection		85.1	GW Protection		67.8	River Protection	
41	**WAC 173-340 3-PART TEST**									
42	95% UCL > Cleanup Limit?	NA			NA			NA		
43	> 10% above Cleanup Limit?	NA			NA			NA		
44	Any sample > 2X Cleanup Limit?	NA			NA			NA		
45	**WAC 173-340 Compliance?**	Because all values are below background (19.1 mg/kg) the WAC 173-340 3-part test is not required.			Because all values are below background (85.1 mg/kg) the WAC 173-340 3-part test is not required.			Because all values are below background (67.8 mg/kg) the WAC 173-340 3-part test is not required.		

46 **Acronyms and qualifiers are defined on sheet 3.**

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NS
Project 100-H Field Remediation
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations

Date 01/21/14
Job No. 14655

Calc. No. 0100H-CA-V0201
Checked J. D. Skoglie JS

Rev. No. 0
Date 01/21/14
Sheet No. 13 of 22

1 **100-H-46 Maximum Calculations**

2 **Verification Data - Overburden Stockpile (OB)**

3	Sample	Sample	Sample	Hexavalent Chromium			Molybdenum		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL
5	OB-1	J1RX91	8/19/2013	0.155	U	0.155	0.30	B	0.25
6	Duplicate of J1RX91	J1RXC3	8/19/2013	0.155	U	0.155	0.23	U	0.23
7	OB-2	J1RX92	8/19/2013	0.155	U	0.155	0.23	U	0.23
8	OB-3	J1RX93	8/19/2013	0.155	U	0.155	0.25	U	0.25
9	OB-4	J1RX94	8/19/2013	0.155	U	0.155	0.24	U	0.24
10	OB-5	J1RX95	8/19/2013	0.155	U	0.155	0.24	U	0.24
11	OB-6	J1RX96	8/19/2013	0.237		0.155	0.24	U	0.24
12	OB-7	J1RX97	8/19/2013	0.155	U	0.155	0.25	U	0.25
13	OB-8	J1RX98	8/19/2013	0.155	U	0.155	0.25	U	0.25
14	OB-9	J1RX99	8/19/2013	0.155	U	0.155	0.25	U	0.25
15	OB-10	J1RXC0	8/19/2013	0.155	U	0.155	0.24	U	0.24
16	OB-11	J1RXC1	8/19/2013	0.155	U	0.155	0.26	U	0.26
17	OB-12	J1RXC2	8/19/2013	0.155	U	0.155	0.26	U	0.26

18 **Statistical Computations**

19		Hexavalent Chromium	Molybdenum
20	% < Detection limit	92%	92%
21	Maximum value	0.237	0.30
22	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	2 River Protection	8 GW Protection
23	**3-PART TEST**		
24	Maximum > Cleanup Limit?	NO	NO
25	> 10% above Cleanup Limit?	NO	NO
26	Any sample > 2X Cleanup Limit?	NO	NO
27	**3-Part Test Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent RAG.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

28 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0

Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14

Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 14 of 22

Ecology Software (MTCAStat) Results, 100-H-46 Waste Site Decision Unit (DU1)

Arsenic 95% UCL Calculation

DATA	ID
2.6	J1T6L4/J1T6M6
1.8	J1T6L5
2.0	J1T6L6
1.8	J1T6L7
3.9	J1T6L8
2.6	J1T6L9
13.8	J1T6M0
2.2	J1T6M1
2.0	J1T6M2
3.7	J1T6M3
6.0	J1T6M4
4.6	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	3.9
Censored		Lognormal mean	3.8
Detection limit or PQL		Std. devn.	3.4
Method detection limit		Median	2.6
TOTAL	12	Min.	1.8
		Max.	13.8

Lognormal distribution? r-squared is: 0.856

Normal distribution? r-squared is: 0.627

Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 5.5

Barium 95% UCL Calculation

DATA	ID
39.7	J1T6L4/J1T6M6
38.7	J1T6L5
35.1	J1T6L6
47.6	J1T6L7
41.3	J1T6L8
44.3	J1T6L9
59.6	J1T6M0
37.4	J1T6M1
40.4	J1T6M2
55.3	J1T6M3
46.6	J1T6M4
70.4	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	46.4
Censored		Lognormal mean	46.4
Detection limit or PQL		Std. devn.	10.5
Method detection limit		Median	42.8
TOTAL	12	Min.	35.1
		Max.	70.4

Lognormal distribution? r-squared is: 0.923

Normal distribution? r-squared is: 0.872

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 52.1

Beryllium 95% UCL Calculation

DATA	ID
0.22	J1T6L4/J1T6M6
0.19	J1T6L5
0.19	J1T6L6
0.17	J1T6L7
0.24	J1T6L8
0.21	J1T6L9
0.22	J1T6M0
0.19	J1T6M1
0.17	J1T6M2
0.24	J1T6M3
0.24	J1T6M4
0.25	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	0.21
Censored		Lognormal mean	0.21
Detection limit or PQL		Std. devn.	0.028
Method detection limit		Median	0.22
TOTAL	12	Min.	0.17
		Max.	0.25

Lognormal distribution? r-squared is: 0.924

Normal distribution? r-squared is: 0.929

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.23

Cadmium 95% UCL Calculation

DATA	ID
0.099	J1T6L4/J1T6M6
0.090	J1T6L5
0.081	J1T6L6
0.074	J1T6L7
0.12	J1T6L8
0.11	J1T6L9
0.13	J1T6M0
0.098	J1T6M1
0.090	J1T6M2
0.13	J1T6M3
0.11	J1T6M4
0.12	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	0.10
Censored		Lognormal mean	0.10
Detection limit or PQL		Std. devn.	0.019
Method detection limit		Median	0.10
TOTAL	12	Min.	0.074
		Max.	0.13

Lognormal distribution? r-squared is: 0.962

Normal distribution? r-squared is: 0.967

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.12

Chromium 95% UCL Calculation

DATA	ID
8.6	J1T6L4/J1T6M6
8.8	J1T6L5
9.1	J1T6L6
7.8	J1T6L7
8.6	J1T6L8
9.9	J1T6L9
9.7	J1T6M0
8.1	J1T6M1
7.3	J1T6M2
9.9	J1T6M3
9.3	J1T6M4
9.8	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	8.9
Censored		Lognormal mean	8.9
Detection limit or PQL		Std. devn.	0.87
Method detection limit		Median	9.0
TOTAL	12	Min.	7.3
		Max.	9.9

Lognormal distribution? r-squared is: 0.939

Normal distribution? r-squared is: 0.947

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 9.4

Cobalt 95% UCL Calculation

DATA	ID
5.6	J1T6L4/J1T6M6
4.8	J1T6L5
5.2	J1T6L6
5.1	J1T6L7
5.7	J1T6L8
5.8	J1T6L9
6.2	J1T6M0
5.2	J1T6M1
5.2	J1T6M2
5.6	J1T6M3
5.5	J1T6M4
5.6	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	5.5
Censored		Lognormal mean	5.5
Detection limit or PQL		Std. devn.	0.37
Method detection limit		Median	5.5
TOTAL	12	Min.	4.8
		Max.	6.2

Lognormal distribution? r-squared is: 0.958

Normal distribution? r-squared is: 0.956

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 5.7

Copper 95% UCL Calculation

DATA	ID
14.8	J1T6L4/J1T6M6
13.9	J1T6L5
14.4	J1T6L6
12.0	J1T6L7
17.2	J1T6L8
14.7	J1T6L9
57.0	J1T6M0
13.9	J1T6M1
12.7	J1T6M2
15.9	J1T6M3
15.3	J1T6M4
15.9	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	18.1
Censored		Lognormal mean	17.7
Detection limit or PQL		Std. devn.	12.3
Method detection limit		Median	14.7
TOTAL	12	Min.	12.0
		Max.	57.0

Lognormal distribution? r-squared is: 0.530

Normal distribution? r-squared is: 0.403

Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 24.0

Hexavalent chromium 95% UCL Calculation

DATA	ID
0.123	J1T6L4/J1T6M6
0.476	J1T6L5
0.0775	J1T6L6
0.0775	J1T6L7
0.167	J1T6L8
0.210	J1T6L9
0.171	J1T6M0
0.0775	J1T6M1
0.0775	J1T6M2
0.271	J1T6M3
0.169	J1T6M4
0.272	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	0.181
Censored		Lognormal mean	0.183
Detection limit or PQL		Std. devn.	0.117
Method detection limit		Median	0.168
TOTAL	12	Min.	0.0775
		Max.	0.476

Lognormal distribution? r-squared is: 0.916

Normal distribution? r-squared is: 0.823

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.276

Lead 95% UCL Calculation

DATA	ID
4.0	J1T6L4/J1T6M6
2.7	J1T6L5
2.0	J1T6L6
2.2	J1T6L7
9.5	J1T6L8
3.6	J1T6L9
5.2	J1T6M0
2.3	J1T6M1
2.1	J1T6M2
5.6	J1T6M3
17.2	J1T6M4
5.7	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	5.2
Censored		Lognormal mean	5.1
Detection limit or PQL		Std. devn.	4.4
Method detection limit		Median	3.8
TOTAL	12	Min.	2.0
		Max.	17.2

Lognormal distribution? r-squared is: 0.913

Normal distribution? r-squared is: 0.712

Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 8.2

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0

Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14

Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 15 of 22

Ecology Software (MTCAStat) Results, 100-H-46 Waste Site Decision Unit (DU1)

Manganese 95% UCL Calculation

DATA	ID
234	J1T6L4/J1T6M6
215	J1T6L5
225	J1T6L6
219	J1T6L7
234	J1T6L8
248	J1T6L9
260	J1T6M0
218	J1T6M1
212	J1T6M2
253	J1T6M3
248	J1T6M4
251	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	235
Censored		Lognormal mean	235
Detection limit or PQL		Std. devn.	16.8
Method detection limit		Median	234
TOTAL	12	Min.	212
		Max.	260

Lognormal distribution? r-squared is: 0.935

Normal distribution? r-squared is: 0.935

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 244

Nickel 95% UCL Calculation

DATA	ID
9.7	J1T6L4/J1T6M6
8.3	J1T6L5
11.0	J1T6L6
9.5	J1T6L7
9.5	J1T6L8
10.0	J1T6L9
9.8	J1T6M0
8.1	J1T6M1
9.0	J1T6M2
9.5	J1T6M3
9.2	J1T6M4
9.1	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	9.4
Censored		Lognormal mean	9.4
Detection limit or PQL		Std. devn.	0.76
Method detection limit		Median	9.5
TOTAL	12	Min.	8.1
		Max.	11.0

Lognormal distribution? r-squared is: 0.939

Normal distribution? r-squared is: 0.936

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 9.8

Vanadium 95% UCL Calculation

DATA	ID
39.6	J1T6L4/J1T6M6
38.9	J1T6L5
40.7	J1T6L6
35.1	J1T6L7
44.4	J1T6L8
48.0	J1T6L9
47.0	J1T6M0
43.1	J1T6M1
35.6	J1T6M2
42.1	J1T6M3
44.3	J1T6M4
43.6	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	41.9
Censored		Lognormal mean	41.9
Detection limit or PQL		Std. devn.	4.1
Method detection limit		Median	42.6
TOTAL	12	Min.	35.1
		Max.	48.0

Lognormal distribution? r-squared is: 0.960

Normal distribution? r-squared is: 0.971

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 44.2

Zinc 95% UCL Calculation

DATA	ID
32.5	J1T6L4/J1T6M6
28.8	J1T6L5
28.6	J1T6L6
29.6	J1T6L7
34.8	J1T6L8
34.5	J1T6L9
33.6	J1T6M0
30.5	J1T6M1
27.0	J1T6M2
35.6	J1T6M3
32.5	J1T6M4
37.0	J1T6M5

Number of samples		Uncensored values	
Uncensored	12	Mean	32.1
Censored		Lognormal mean	32.1
Detection limit or PQL		Std. devn.	3.2
Method detection limit		Median	32.5
TOTAL	12	Min.	27.0
		Max.	37.0

Lognormal distribution? r-squared is: 0.971

Normal distribution? r-squared is: 0.974

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 33.8

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0

Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14

Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 16 of 22

Ecology Software (MTCAStat) Results, 100-H-46 Waste Site Decision Unit (DU2)

Arsenic 95% UCL Calculation

DATA	ID
1.8	J1T6N8/J1T6P0
2.1	J1T6M8
2.2	J1T6M9
3.1	J1T6N0
1.6	J1T6N1
1.6	J1T6N2
2.4	J1T6N3
2.1	J1T6N4
1.9	J1T6N5
2.2	J1T6N6
7.5	J1T6N7
1.7	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	2.5
Censored		Lognormal mean	2.5
Detection limit or PQL		Std. devn.	1.6
Method detection limit		Median	2.1
TOTAL	12	Min.	1.6
		Max.	7.5

Lognormal distribution? r-squared is: 0.705
Normal distribution? r-squared is: 0.519
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 3.3

Barium 95% UCL Calculation

DATA	ID
33.6	J1T6N8/J1T6P0
36.0	J1T6M8
56.5	J1T6M9
32.4	J1T6N0
35.0	J1T6N1
35.7	J1T6N2
40.0	J1T6N3
44.1	J1T6N4
37.7	J1T6N5
38.5	J1T6N6
49.5	J1T6N7
36.9	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	39.7
Censored		Lognormal mean	39.7
Detection limit or PQL		Std. devn.	7.1
Method detection limit		Median	37.3
TOTAL	12	Min.	32.4
		Max.	56.5

Lognormal distribution? r-squared is: 0.883
Normal distribution? r-squared is: 0.834
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 43.0

Beryllium 95% UCL Calculation

DATA	ID
0.14	J1T6N8/J1T6P0
0.14	J1T6M8
0.14	J1T6M9
0.17	J1T6N0
0.15	J1T6N1
0.14	J1T6N2
0.15	J1T6N3
0.16	J1T6N4
0.15	J1T6N5
0.13	J1T6N6
0.20	J1T6N7
0.14	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	0.15
Censored		Lognormal mean	0.15
Detection limit or PQL		Std. devn.	0.019
Method detection limit		Median	0.15
TOTAL	12	Min.	0.13
		Max.	0.20

Lognormal distribution? r-squared is: 0.822
Normal distribution? r-squared is: 0.781
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.16

Cadmium 95% UCL Calculation

DATA	ID
0.23	J1T6N8/J1T6P0
0.23	J1T6M8
0.22	J1T6M9
0.26	J1T6N0
0.23	J1T6N1
0.25	J1T6N2
0.26	J1T6N3
0.26	J1T6N4
0.25	J1T6N5
0.24	J1T6N6
0.28	J1T6N7
0.24	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	0.25
Censored		Lognormal mean	0.25
Detection limit or PQL		Std. devn.	0.017
Method detection limit		Median	0.25
TOTAL	12	Min.	0.22
		Max.	0.28

Lognormal distribution? r-squared is: 0.954
Normal distribution? r-squared is: 0.948
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.26

Chromium 95% UCL Calculation

DATA	ID
8.1	J1T6N8/J1T6P0
7.9	J1T6M8
7.2	J1T6M9
8.6	J1T6N0
8.6	J1T6N1
6.8	J1T6N2
8.2	J1T6N3
7.9	J1T6N4
8.1	J1T6N5
9.0	J1T6N6
12.9	J1T6N7
7.6	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	8.4
Censored		Lognormal mean	8.4
Detection limit or PQL		Std. devn.	1.5
Method detection limit		Median	8.1
TOTAL	12	Min.	6.8
		Max.	12.9

Lognormal distribution? r-squared is: 0.768
Normal distribution? r-squared is: 0.681
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 9.1

Cobalt 95% UCL Calculation

DATA	ID
4.5	J1T6N8/J1T6P0
3.8	J1T6M8
4.5	J1T6M9
4.9	J1T6N0
4.7	J1T6N1
4.5	J1T6N2
4.7	J1T6N3
4.6	J1T6N4
4.6	J1T6N5
4.9	J1T6N6
5.5	J1T6N7
4.6	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	4.6
Censored		Lognormal mean	4.6
Detection limit or PQL		Std. devn.	0.39
Method detection limit		Median	4.6
TOTAL	12	Min.	3.8
		Max.	5.5

Lognormal distribution? r-squared is: 0.841
Normal distribution? r-squared is: 0.848
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 4.8

Copper 95% UCL Calculation

DATA	ID
12.8	J1T6N8/J1T6P0
13.7	J1T6M8
12.9	J1T6M9
15.3	J1T6N0
11.8	J1T6N1
11.6	J1T6N2
12.8	J1T6N3
12.4	J1T6N4
14.1	J1T6N5
17.3	J1T6N6
15.5	J1T6N7
12.8	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	13.6
Censored		Lognormal mean	13.6
Detection limit or PQL		Std. devn.	1.7
Method detection limit		Median	12.9
TOTAL	12	Min.	11.6
		Max.	17.3

Lognormal distribution? r-squared is: 0.924
Normal distribution? r-squared is: 0.898
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 14.5

Lead 95% UCL Calculation

DATA	ID
2.2	J1T6N8/J1T6P0
2.2	J1T6M8
2.3	J1T6M9
2.5	J1T6N0
2.2	J1T6N1
2.0	J1T6N2
2.5	J1T6N3
2.2	J1T6N4
2.2	J1T6N5
2.4	J1T6N6
32.7	J1T6N7
2.1	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	4.8
Censored		Lognormal mean	3.8
Detection limit or PQL		Std. devn.	8.8
Method detection limit		Median	2.2
TOTAL	12	Min.	2.0
		Max.	32.7

Lognormal distribution? r-squared is: 0.373
Normal distribution? r-squared is: NA
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 9.0

Manganese 95% UCL Calculation

DATA	ID
196	J1T6N8/J1T6P0
200	J1T6M8
191	J1T6M9
212	J1T6N0
192	J1T6N1
177	J1T6N2
204	J1T6N3
206	J1T6N4
195	J1T6N5
221	J1T6N6
246	J1T6N7
201	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	203
Censored		Lognormal mean	203
Detection limit or PQL		Std. devn.	17.4
Method detection limit		Median	201
TOTAL	12	Min.	177
		Max.	246

Lognormal distribution? r-squared is: 0.911
Normal distribution? r-squared is: 0.885
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 213

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0
Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 17 of 22

Ecology Software (MTCAStat) Results, 100-H-46 Waste Site Decision Unit (DU2)

Molybdenum 95% UCL Calculation

DATA	ID
0.24	J1T6N8/J1T6P0
0.13	J1T6M8
0.24	J1T6M9
0.13	J1T6N0
0.13	J1T6N1
0.30	J1T6N2
0.33	J1T6N3
0.13	J1T6N4
0.13	J1T6N5
0.28	J1T6N6
0.72	J1T6N7
0.27	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	0.25
Censored		Lognormal mean	0.25
Detection limit or PQL		Std. devn.	0.17
Method detection limit		Median	0.24
TOTAL	12	Min.	0.13
		Max.	0.72

Lognormal distribution? r-squared is: 0.858
Normal distribution? r-squared is: 0.706
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.33

Nickel 95% UCL Calculation

DATA	ID
8.2	J1T6N8/J1T6P0
8.2	J1T6M8
7.5	J1T6M9
8.4	J1T6N0
9.4	J1T6N1
6.6	J1T6N2
8.5	J1T6N3
7.9	J1T6N4
7.4	J1T6N5
10.1	J1T6N6
10.3	J1T6N7
8.1	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	8.4
Censored		Lognormal mean	8.4
Detection limit or PQL		Std. devn.	1.1
Method detection limit		Median	8.2
TOTAL	12	Min.	6.6
		Max.	10.3

Lognormal distribution? r-squared is: 0.953
Normal distribution? r-squared is: 0.940
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 9.0

Vanadium 95% UCL Calculation

DATA	ID
41.3	J1T6N8/J1T6P0
31.2	J1T6M8
40.4	J1T6M9
47.2	J1T6N0
38.2	J1T6N1
36.0	J1T6N2
42.9	J1T6N3
42.2	J1T6N4
43.1	J1T6N5
43.7	J1T6N6
39.3	J1T6N7
39.2	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	40.4
Censored		Lognormal mean	40.4
Detection limit or PQL		Std. devn.	4.1
Method detection limit		Median	40.8
TOTAL	12	Min.	31.2
		Max.	47.2

Lognormal distribution? r-squared is: 0.912
Normal distribution? r-squared is: 0.941
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 42.8

Zinc 95% UCL Calculation

DATA	ID
26.1	J1T6N8/J1T6P0
22.6	J1T6M8
25.9	J1T6M9
28.3	J1T6N0
25.6	J1T6N1
24.7	J1T6N2
27.2	J1T6N3
28.0	J1T6N4
27.3	J1T6N5
27.7	J1T6N6
36.0	J1T6N7
26.2	J1T6N9

Number of samples		Uncensored values	
Uncensored	12	Mean	27.1
Censored		Lognormal mean	27.1
Detection limit or PQL		Std. devn.	3.2
Method detection limit		Median	26.7
TOTAL	12	Min.	22.6
		Max.	36.0

Lognormal distribution? r-squared is: 0.818
Normal distribution? r-squared is: 0.765
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 28.7

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern no
Project 100-H Field Remediation
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations

Date 01/21/14
Job No. 14655

Calc. No. 0100H-CA-V0201
Checked J. D. Skoglie

Rev. No. 0
Date 01/21/14
Sheet No. 18 of 22

Ecology Software (MTCAStat) Results, 100-H-46 Waste Site Overburden Stockpile (OB)

Arsenic 95% UCL Calculation

DATA	ID
3.1	J1RX91/J1RXC3
2.5	J1RX92
1.9	J1RX93
1.8	J1RX94
1.8	J1RX95
1.6	J1RX96
2.2	J1RX97
2.1	J1RX98
2.1	J1RX99
2.7	J1RXC0
2.2	J1RXC1
2.3	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	2.2
Censored		Lognormal mean	2.2
Detection limit or PQL		Std. devn.	0.42
Method detection limit		Median	2.2
TOTAL	12	Min.	1.6
		Max.	3.1

Lognormal distribution? r-squared is: 0.975
Normal distribution? r-squared is: 0.945
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 2.4

Barium 95% UCL Calculation

DATA	ID
40.8	J1RX91/J1RXC3
34.2	J1RX92
39.8	J1RX93
40.1	J1RX94
43.2	J1RX95
49.8	J1RX96
38.0	J1RX97
36.5	J1RX98
36.0	J1RX99
38.1	J1RXC0
37.1	J1RXC1
46.8	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	40.0
Censored		Lognormal mean	40.0
Detection limit or PQL		Std. devn.	4.6
Method detection limit		Median	39.0
TOTAL	12	Min.	34.2
		Max.	49.8

Lognormal distribution? r-squared is: 0.939
Normal distribution? r-squared is: 0.914
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 42.5

Beryllium 95% UCL Calculation

DATA	ID
0.16	J1RX91/J1RXC3
0.15	J1RX92
0.14	J1RX93
0.13	J1RX94
0.12	J1RX95
0.13	J1RX96
0.13	J1RX97
0.12	J1RX98
0.14	J1RX99
0.13	J1RXC0
0.14	J1RXC1
0.16	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	0.14
Censored		Lognormal mean	0.14
Detection limit or PQL		Std. devn.	0.013
Method detection limit		Median	0.14
TOTAL	12	Min.	0.12
		Max.	0.16

Lognormal distribution? r-squared is: 0.941
Normal distribution? r-squared is: 0.935
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.14

Cadmium 95% UCL Calculation

DATA	ID
0.15	J1RX91/J1RXC3
0.13	J1RX92
0.14	J1RX93
0.13	J1RX94
0.14	J1RX95
0.15	J1RX96
0.15	J1RX97
0.14	J1RX98
0.12	J1RX99
0.15	J1RXC0
0.14	J1RXC1
0.15	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	0.14
Censored		Lognormal mean	0.14
Detection limit or PQL		Std. devn.	0.010
Method detection limit		Median	0.14
TOTAL	12	Min.	0.12
		Max.	0.15

Lognormal distribution? r-squared is: 0.840
Normal distribution? r-squared is: 0.849
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.15

Chromium 95% UCL Calculation

DATA	ID
10.0	J1RX91/J1RXC3
8.7	J1RX92
10.5	J1RX93
10.3	J1RX94
10.4	J1RX95
9.9	J1RX96
9.6	J1RX97
8.5	J1RX98
10.1	J1RX99
10.5	J1RXC0
10.5	J1RXC1
9.6	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	9.9
Censored		Lognormal mean	9.9
Detection limit or PQL		Std. devn.	0.68
Method detection limit		Median	10.0
TOTAL	12	Min.	8.5
		Max.	10.5

Lognormal distribution? r-squared is: 0.837
Normal distribution? r-squared is: 0.853
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 10.2

Cobalt 95% UCL Calculation

DATA	ID
5.3	J1RX91/J1RXC3
4.5	J1RX92
5.5	J1RX93
5.0	J1RX94
5.5	J1RX95
4.9	J1RX96
5.3	J1RX97
4.9	J1RX98
4.7	J1RX99
5.4	J1RXC0
4.4	J1RXC1
4.9	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	5.0
Censored		Lognormal mean	5.0
Detection limit or PQL		Std. devn.	0.38
Method detection limit		Median	5.0
TOTAL	12	Min.	4.4
		Max.	5.5

Lognormal distribution? r-squared is: 0.941
Normal distribution? r-squared is: 0.944
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 5.2

Copper 95% UCL Calculation

DATA	ID
13.2	J1RX91/J1RXC3
10.9	J1RX92
13.1	J1RX93
11.7	J1RX94
13.3	J1RX95
11.7	J1RX96
12.8	J1RX97
10.7	J1RX98
12.0	J1RX99
12.7	J1RXC0
11.0	J1RXC1
11.4	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	12.0
Censored		Lognormal mean	12.0
Detection limit or PQL		Std. devn.	0.95
Method detection limit		Median	11.9
TOTAL	12	Min.	10.7
		Max.	13.3

Lognormal distribution? r-squared is: 0.939
Normal distribution? r-squared is: 0.938
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 12.6

Lead 95% UCL Calculation

DATA	ID
5.2	J1RX91/J1RXC3
3.5	J1RX92
2.8	J1RX93
2.2	J1RX94
2.1	J1RX95
2.4	J1RX96
2.3	J1RX97
2.3	J1RX98
2.5	J1RX99
2.4	J1RXC0
2.6	J1RXC1
3.2	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	2.8
Censored		Lognormal mean	2.8
Detection limit or PQL		Std. devn.	0.86
Method detection limit		Median	2.5
TOTAL	12	Min.	2.1
		Max.	5.2

Lognormal distribution? r-squared is: 0.809
Normal distribution? r-squared is: 0.707
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 3.2

Manganese 95% UCL Calculation

DATA	ID
233	J1RX91/J1RXC3
206	J1RX92
243	J1RX93
243	J1RX94
225	J1RX95
221	J1RX96
224	J1RX97
220	J1RX98
212	J1RX99
219	J1RXC0
214	J1RXC1
226	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	224
Censored		Lognormal mean	224
Detection limit or PQL		Std. devn.	11.3
Method detection limit		Median	223
TOTAL	12	Min.	206
		Max.	243

Lognormal distribution? r-squared is: 0.958
Normal distribution? r-squared is: 0.950
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 230

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern

Project 100-H Field Remediation

Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations

Date 01/21/14

Job No. 14655

Calc. No. 0100H-CA-V0201

Checked J. D. Skoglie

Rev. No. 0

Date 01/21/14

Sheet No. 19 of 22

Ecology Software (MTCAStat) Results, 100-H-46 Waste Site Overburden Stockpile (OB)

Nickel 95% UCL Calculation

DATA	ID
10.3	J1RX91/J1RXC3
8.6	J1RX92
9.2	J1RX93
9.5	J1RX94
9.6	J1RX95
9.2	J1RX96
9.9	J1RX97
8.6	J1RX98
10.2	J1RX99
10.4	J1RXC0
10.2	J1RXC1
9.5	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	9.6
Censored		Lognormal mean	9.6
Detection limit or PQL		Std. devn.	0.62
Method detection limit		Median	9.6
TOTAL	12	Min.	8.6
		Max.	10.4

Lognormal distribution? r-squared is: 0.933

Normal distribution? r-squared is: 0.939

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 9.9

Vanadium 95% UCL Calculation

DATA	ID
41.4	J1RX91/J1RXC3
33.4	J1RX92
44.8	J1RX93
41.6	J1RX94
42.5	J1RX95
37.0	J1RX96
43.2	J1RX97
35.1	J1RX98
35.6	J1RX99
39.8	J1RXC0
33.1	J1RXC1
34.0	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	38.5
Censored		Lognormal mean	38.5
Detection limit or PQL		Std. devn.	4.2
Method detection limit		Median	38.4
TOTAL	12	Min.	33.1
		Max.	44.8

Lognormal distribution? r-squared is: 0.931

Normal distribution? r-squared is: 0.931

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 40.8

Zinc 95% UCL Calculation

DATA	ID
31.0	J1RX91/J1RXC3
27.1	J1RX92
30.8	J1RX93
28.8	J1RX94
28.7	J1RX95
28.3	J1RX96
30.3	J1RX97
27.2	J1RX98
27.0	J1RX99
28.8	J1RXC0
26.0	J1RXC1
28.2	J1RXC2

Number of samples		Uncensored values	
Uncensored	12	Mean	28.5
Censored		Lognormal mean	28.5
Detection limit or PQL		Std. devn.	1.6
Method detection limit		Median	28.5
TOTAL	12	Min.	26.0
		Max.	31.0

Lognormal distribution? r-squared is: 0.956

Normal distribution? r-squared is: 0.953

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 29.4

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern NO **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0
Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 20 of 22

Duplicate Analysis - 100-H-46 Waste Site Decision unit (DU1)

Sampling Area	Sample Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU1-1	J1T6L4	1/6/2014	5620		1.6	2.7		0.66	40.2		0.076	0.22		0.033	0.098	B	0.041	4780		14.1	9.3		0.058	5.9	X	0.10
Duplicate of J1T6L4	J1T6M6	1/6/2014	5440		1.5	2.5		0.63	39.2		0.073	0.22		0.032	0.10	B	0.039	4850		13.6	7.8		0.056	5.2	X	0.096

Analysis:

TDL			5			10			2			0.2			0.2			100			1			2		
Duplicate Analysis	Both > PQL?		Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)		
	Both >5xTDL?		Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			No-Stop (acceptable)			No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)		
	RPD		3.3%						2.5%									1.5%			17.5%					
	Difference > 2 TDL?		Not applicable			No - acceptable			Not applicable			No - acceptable			No - acceptable			Not applicable			Not applicable			No - acceptable		

Duplicate Analysis - 100-H-46 Waste Site Decision unit (DU1)

Sampling Area	Sample Number	Sample Date	Copper			Iron			Lead			Magnesium			Manganese			Nickel			Potassium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU1-1	J1T6L4	1/6/2014	14.4		0.22	15600		3.8	3.7		0.27	4190		3.7	242		0.10	10.5		0.12	718		41.0	176	M	5.7
Duplicate of J1T6L4	J1T6M6	1/6/2014	15.1		0.21	14800		3.7	4.3		0.26	3720		3.6	226		0.096	8.9		0.12	663		39.4	141		5.4

Analysis:

TDL			1			5			5			75			5			4			400			2		
Duplicate Analysis	Both > PQL?		Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)			Yes (continue)		
	Both >5xTDL?		Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)			No-Stop (acceptable)			Yes (calc RPD)		
	RPD		4.7%			5.3%						11.9%			6.8%									22.1%		
	Difference > 2 TDL?		Not applicable			Not applicable			No - acceptable			Not applicable			Not applicable			No - acceptable			No - acceptable			Not applicable		

Duplicate Analysis - 100-H-46 Waste Site Decision unit (DU1)

Sampling Area	Sample Number	Sample Date	Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU1-1	J1T6L4	1/6/2014	194		59.0	40.6		0.094	33.4	X	0.40
Duplicate of J1T6L4	J1T6M6	1/6/2014	199		56.8	38.5		0.090	31.5	X	0.38

Analysis:

TDL			50			2.5			1																	
Duplicate Analysis	Both > PQL?		Yes (continue)			Yes (continue)			Yes (continue)																	
	Both >5xTDL?		No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)																	
	RPD					5.3%			5.9%																	
	Difference > 2 TDL?		No - acceptable			Not applicable			Not applicable																	

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0
Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 21 of 22

Duplicate Analysis - 100-H-46 Waste Site Decicion Unit 2 (DU2)

Sampling Area	Sample Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU2-11	J1T6N8	12/13/2013	5150		1.4	2.1		0.61	30.0		0.071	0.15	B	0.031	0.25		0.038	5400		13.1	7.9		0.054	4.8		0.093
Duplicate of J1T6N8	J1T6P0	12/13/2013	4590		1.5	1.5		0.62	37.1		0.071	0.13	B	0.031	0.21		0.039	4590		13.2	8.2		0.054	4.1		0.094

Analysis:

TDL		5	10	2	0.2	0.2	100	1	2
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)
	RPD	11.5%		21.2%			16.2%	3.7%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable

Duplicate Analysis - 100-H-46 Waste Site Decicion Unit 2 (DU2)

Sampling Area	Sample Number	Sample Date	Copper			Iron			Lead			Magnesium			Manganese			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU2-11	J1T6N8	12/13/2013	13.4		0.20	16000		3.5	2.1		0.25	3890		3.4	216		0.093	0.24	B	0.24	8.1		0.11	525		38.1
Duplicate of J1T6N8	J1T6P0	12/13/2013	12.2		0.20	13500		3.6	2.2		0.25	3390		3.5	175		0.094	0.24	B	0.24	8.2		0.12	475		38.5

Analysis:

TDL		1	5	5	75	5	2	4	400
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)	No-Stop (acceptable)
	RPD	9.4%	16.9%		13.7%	21.0%			
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable

Duplicate Analysis - 100-H-46 Waste Site Decicion Unit 2 (DU2)

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
DU2-11	J1T6N8	12/13/2013	85.6	NJ	5.3	146		54.9	44.5		0.087	28.5	X	0.37
Duplicate of J1T6N8	J1T6P0	12/13/2013	68.6	NJ	5.3	144		55.4	38.0		0.088	23.7	X	0.37

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	22.0%		15.8%	18.4%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

CALCULATION SHEET

Washington Closure Hanford

Originator N. K. Schiffern **Date** 01/21/14 **Calc. No.** 0100H-CA-V0201 **Rev. No.** 0
Project 100-H Field Remediation **Job No.** 14655 **Checked** J. D. Skoglie **Date** 01/21/14
Subject 100-H-46 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 22 of 22

Duplicate Analysis - 100-H-46 Waste Site Overburden Stockpile (OB)

Sampling Area	Sample Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
OB-1	J1RX91	8/19/2013	5910		1.5	3.5		0.64	39.5		0.074	0.17	B	0.032	0.14	B	0.040	7040		13.7	11.0		0.057	5.5	X	0.098
Duplicate of J1RX91	J1RXC3	8/19/2013	5340		1.4	2.7		0.59	42.1		0.068	0.14	B	0.030	0.16	B	0.037	6430		12.7	8.9		0.052	5.1	X	0.090

Analysis:

TDL		5	10	2	0.2	0.2	100	1	2
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)
	RPD	10.1%		6.4%			9.1%	21.1%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable

Duplicate Analysis - 100-H-46 Waste Site Overburden Stockpile (OB)

Sampling Area	Sample Number	Sample Date	Copper			Iron			Lead			Magnesium			Manganese			Nickel			Potassium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
OB-1	J1RX91	8/19/2013	13.8		0.21	15100		3.7	5.7		0.26	4170		3.6	242		0.098	11.2		0.12	736		40.0	307	N	5.5
Duplicate of J1RX91	J1RXC3	8/19/2013	12.6		0.20	14500		3.4	4.7		0.24	3720		3.3	223		0.090	9.4		0.11	639		36.9	268		5.1

Analysis:

TDL		1	5	5	75	5	4	400	2
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)	**Yes (calc RPD)**
	RPD	9.1%	4.1%		11.4%	8.2%			13.6%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable

Duplicate Analysis - 100-H-46 Waste Site Overburden Stockpile (OB)

Sampling Area	Sample Number	Sample Date	Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
OB-1	J1RX91	8/19/2013	196		57.5	41.0		0.092	31.7	X	0.39
Duplicate of J1RX91	J1RXC3	8/19/2013	185		53.1	41.8		0.085	30.2	X	0.36

Analysis:

TDL		50	2.5	1
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD		1.9%	4.8%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable

Attachment 1. 100-H-46 Waste Site Verification Sample Results (Metals).

LOCATION	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU1-1	J1T6L4	1/6/2014	5620		1.6	0.38	U	0.38	2.7		0.66	40.2		0.076
Duplicate of J1T6L4	J1T6M6	1/6/2014	5440		1.5	0.37	U	0.37	2.5		0.63	39.2		0.073
DU1-2	J1T6L5	1/6/2014	5160		1.4	0.34	U	0.34	1.8		0.59	38.7		0.068
DU1-3	J1T6L6	1/6/2014	4920		1.5	0.37	U	0.37	2.0		0.64	35.1		0.074
DU1-4	J1T6L7	1/6/2014	4580		1.6	0.39	U	0.39	1.8		0.67	47.6		0.077
DU1-5	J1T6L8	1/6/2014	5840		1.5	0.37	U	0.37	3.9		0.64	41.3		0.074
DU1-6	J1T6L9	1/6/2014	5620		1.4	0.33	U	0.33	2.6		0.58	44.3		0.067
DU1-7	J1T6M0	1/6/2014	5900		1.6	0.39	U	0.39	13.8		0.68	59.6		0.078
DU1-8	J1T6M1	1/6/2014	5160		1.5	0.36	U	0.36	2.2		0.63	37.4		0.072
DU1-9	J1T6M2	1/6/2014	4250		1.4	0.35	U	0.35	2.0		0.61	40.4		0.071
DU1-10	J1T6M3	1/6/2014	6270		1.6	0.39	U	0.39	3.7		0.67	55.3		0.078
DU1-11	J1T6M4	1/6/2014	5920		1.5	0.37	U	0.37	6.0		0.65	46.6		0.075
DU1-12	J1T6M5	1/6/2014	5930		1.5	0.36	U	0.36	4.6		0.63	70.4		0.072
DU2-11	J1T6N8	12/13/2013	5150		1.4	0.35	UJ	0.35	2.1		0.61	30.0		0.071
Duplicate of J1T6N8	J1T6P0	12/13/2013	4590		1.5	0.36	UJ	0.36	1.5		0.62	37.1		0.071
DU2-1	J1T6M8	12/13/2013	4410		1.5	0.37	UJ	0.37	2.1		0.64	36.0		0.074
DU2-2	J1T6M9	12/13/2013	4780		1.4	0.33	UJ	0.33	2.2		0.58	56.5		0.066
DU2-3	J1T6N0	12/13/2013	5260		1.5	0.38	UJ	0.38	3.1		0.66	32.4		0.076
DU2-4	J1T6N1	12/13/2013	4650		1.6	0.39	UJ	0.39	1.6		0.67	35.0		0.077
DU2-5	J1T6N2	12/13/2013	4070		1.4	0.35	UJ	0.35	1.6		0.61	35.7		0.070
DU2-6	J1T6N3	12/13/2013	5190		1.4	0.35	UJ	0.35	2.4		0.62	40.0		0.071
DU2-7	J1T6N4	12/13/2013	5510		1.5	0.38	UJ	0.38	2.1		0.65	44.1		0.075
DU2-8	J1T6N5	12/13/2013	4930		1.5	0.37	UJ	0.37	1.9		0.64	37.7		0.073
DU2-9	J1T6N6	12/13/2013	5110		1.5	0.37	UJ	0.37	2.2		0.64	38.5		0.074
DU2-10	J1T6N7	12/13/2013	6530		1.5	0.36	UJ	0.36	7.5		0.63	49.5		0.073
DU2-12	J1T6N9	12/13/2013	4890		1.4	0.35	UJ	0.35	1.7		0.62	36.9		0.071
OB-1	J1RX91	8/19/2013	5910		1.5	0.37	U	0.37	3.5		0.64	39.5		0.074
Duplicate of J1RX91	J1RXC3	8/19/2013	5340		1.4	0.34	U	0.34	2.7		0.59	42.1		0.068
OB-2	J1RX92	8/19/2013	4730		1.4	0.34	U	0.34	2.5		0.59	34.2		0.068
OB-3	J1RX93	8/19/2013	5330		1.5	0.36	U	0.36	1.9		0.63	39.8		0.072
OB-4	J1RX94	8/19/2013	5150		1.4	0.34	U	0.34	1.8		0.60	40.1		0.069
OB-5	J1RX95	8/19/2013	5020		1.4	0.35	U	0.35	1.8		0.60	43.2		0.069
OB-6	J1RX96	8/19/2013	5120		1.5	0.36	U	0.36	1.6		0.62	49.8		0.071
OB-7	J1RX97	8/19/2013	5270		1.5	0.37	U	0.37	2.2		0.64	38.0		0.074
OB-8	J1RX98	8/19/2013	4610		1.5	0.36	U	0.36	2.1		0.62	36.5		0.072
OB-9	J1RX99	8/19/2013	4990		1.5	0.36	U	0.36	2.1		0.63	36.0		0.072
OB-10	J1RXC0	8/19/2013	5000		1.4	0.35	U	0.35	2.7		0.61	38.1		0.071
OB-11	J1RXC1	8/19/2013	5100		1.5	0.37	U	0.37	2.2		0.65	37.1		0.075
OB-12	J1RXC2	8/19/2013	5190		1.5	0.38	U	0.38	2.3		0.66	46.8		0.076
Equipment Blank	J1T6M7	1/6/2014	188		1.3	0.32	U	0.32	0.55	U	0.55	2.2		0.064

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

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

[a] = Sample results from PRZ-1 through PRZ-5 are provided for informational purposes only.

B = blank contamination (inorganic constituents)

C = sample concentration was ≤5x blank concentration.

DU = decision unit

HEIS = Hanford Environmental Information System

J = estimate

M = sample duplicate precision not met

N = recovery is outside control limits

OB = overburden stockpile

Attachment	1	Sheet No.	1 of 8
Originator	N. K. Schiffern	Date	1/21/14
Checked	J. D. Skoglie	Date	1/21/14
Calc. No.	0100H-CA-V0201	Rev. No.	0

PQL = practical quantitation limit

PRZ = periodically rewetted zone

Q = qualifier

U = undetected

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

Attachment 1. 100-H-46 Waste Site Verification Sample Results (Metals).

LOCATION	HEIS Number	Sample Date	Beryllium			Boron			Cadmium			Calcium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU1-1	J1T6L4	1/6/2014	0.22		0.033	0.98	U	0.98	0.098	B	0.041	4780		14.1
Duplicate of J1T6L4	J1T6M6	1/6/2014	0.22		0.032	0.94	U	0.94	0.10	B	0.039	4850		13.6
DU1-2	J1T6L5	1/6/2014	0.19		0.029	0.92	B	0.88	0.090	B	0.037	4830		12.6
DU1-3	J1T6L6	1/6/2014	0.19	B	0.032	0.96	U	0.96	0.081	B	0.040	5250		13.8
DU1-4	J1T6L7	1/6/2014	0.17	B	0.033	0.99	U	0.99	0.074	B	0.042	5050		14.3
DU1-5	J1T6L8	1/6/2014	0.24		0.032	0.95	U	0.95	0.12	B	0.040	6680		13.6
DU1-6	J1T6L9	1/6/2014	0.21		0.029	0.86	U	0.86	0.11	B	0.036	5870		12.4
DU1-7	J1T6M0	1/6/2014	0.22		0.034	1.0	U	1.0	0.13	B	0.042	5600		14.5
DU1-8	J1T6M1	1/6/2014	0.19		0.031	0.93	U	0.93	0.098	B	0.039	4950		13.4
DU1-9	J1T6M2	1/6/2014	0.17	B	0.031	0.91	U	0.91	0.090	B	0.038	4820		13.1
DU1-10	J1T6M3	1/6/2014	0.24		0.034	1.1	B	1.0	0.13	B	0.042	6070		14.4
DU1-11	J1T6M4	1/6/2014	0.24		0.032	1.1	B	0.96	0.11	B	0.040	5470		13.8
DU1-12	J1T6M5	1/6/2014	0.25		0.031	1.9		0.93	0.12	B	0.039	7380		13.4
DU2-11	J1T6N8	12/13/2013	0.15	B	0.031	0.91	U	0.91	0.25		0.038	5400		13.1
Duplicate of J1T6N8	J1T6P0	12/13/2013	0.13	B	0.031	0.92	U	0.92	0.21		0.039	4590		13.2
DU2-1	J1T6M8	12/13/2013	0.14	B	0.032	0.96	U	0.96	0.23		0.040	6300		13.8
DU2-2	J1T6M9	12/13/2013	0.14	B	0.029	0.86	U	0.86	0.22		0.036	4720		12.3
DU2-3	J1T6N0	12/13/2013	0.17	B	0.033	0.98	U	0.98	0.26		0.041	5400		14.1
DU2-4	J1T6N1	12/13/2013	0.15	B	0.034	1.0	U	1.0	0.23		0.042	5040		14.3
DU2-5	J1T6N2	12/13/2013	0.14	B	0.030	0.90	U	0.90	0.25		0.038	4300		13.0
DU2-6	J1T6N3	12/13/2013	0.15	B	0.031	0.91	U	0.91	0.26		0.038	5450		13.2
DU2-7	J1T6N4	12/13/2013	0.16	B	0.033	0.97	U	0.97	0.26		0.040	5820		13.9
DU2-8	J1T6N5	12/13/2013	0.15	B	0.032	0.95	U	0.95	0.25		0.040	5210		13.6
DU2-9	J1T6N6	12/13/2013	0.13	B	0.032	0.95	U	0.95	0.24		0.040	5050		13.7
DU2-10	J1T6N7	12/13/2013	0.20		0.032	1.2	B	0.94	0.28		0.039	5380		13.5
DU2-12	J1T6N9	12/13/2013	0.14	B	0.031	0.91	U	0.91	0.24		0.038	4870		13.2
OB-1	J1RX91	8/19/2013	0.17	B	0.032	0.96	U	0.96	0.14	B	0.040	7040		13.7
Duplicate of J1RX91	J1RXC3	8/19/2013	0.14	B	0.030	0.88	U	0.88	0.16	B	0.037	6430		12.7
OB-2	J1RX92	8/19/2013	0.15	B	0.029	0.87	U	0.87	0.13	B	0.036	6140		12.5
OB-3	J1RX93	8/19/2013	0.14	B	0.031	0.93	U	0.93	0.14	B	0.039	5900		13.4
OB-4	J1RX94	8/19/2013	0.13	B	0.030	0.89	U	0.89	0.13	B	0.037	5510		12.8
OB-5	J1RX95	8/19/2013	0.12	B	0.030	0.89	U	0.89	0.14	B	0.037	5630		12.8
OB-6	J1RX96	8/19/2013	0.13	B	0.031	0.92	U	0.92	0.15	B	0.038	5740		13.2
OB-7	J1RX97	8/19/2013	0.13	B	0.032	0.95	U	0.95	0.15	B	0.040	5560		13.7
OB-8	J1RX98	8/19/2013	0.12	B	0.031	0.93	U	0.93	0.14	B	0.039	5240		13.3
OB-9	J1RX99	8/19/2013	0.14	B	0.031	0.93	U	0.93	0.12	B	0.039	5700		13.4
OB-10	J1RXC0	8/19/2013	0.13	B	0.031	0.91	U	0.91	0.15	B	0.038	5950		13.1
OB-11	J1RXC1	8/19/2013	0.14	B	0.032	0.96	U	0.96	0.14	B	0.040	6150		13.9
OB-12	J1RXC2	8/19/2013	0.16	B	0.033	0.97	U	0.97	0.15	B	0.041	6930		14.0
Equipment Blank	J1T6M7	1/6/2014	0.028	U	0.028	0.82	U	0.82	0.034	U	0.034	44.8		11.9

Attachment	1	Sheet No.	2 of 8
Originator	N. K. Schiffern	Date	1/20/14
Checked	J. D. Skoglie	Date	1/20/14
Calc. No.	0100H-CA-V0201	Rev. No.	0

Attachment 1. 100-H-46 Waste Site Verification Sample Results (Metals).

LOCATION	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU1-1	J1T6L4	1/6/2014	9.3		0.058	5.9	X	0.10	14.4		0.22	0.168		0.155
Duplicate of J1T6L4	J1T6M6	1/6/2014	7.8		0.056	5.2	X	0.096	15.1		0.21	0.155	U	0.155
DU1-2	J1T6L5	1/6/2014	8.8		0.052	4.8	X	0.089	13.9		0.19	0.476		0.155
DU1-3	J1T6L6	1/6/2014	9.1		0.057	5.2	X	0.098	14.4		0.21	0.155	U	0.155
DU1-4	J1T6L7	1/6/2014	7.8		0.059	5.1	X	0.10	12.0		0.22	0.155	U	0.155
DU1-5	J1T6L8	1/6/2014	8.6		0.056	5.7	X	0.097	17.2		0.21	0.167		0.155
DU1-6	J1T6L9	1/6/2014	9.9		0.051	5.8	X	0.088	14.7		0.19	0.210		0.155
DU1-7	J1T6M0	1/6/2014	9.7		0.060	6.2	X	0.10	57.0		0.22	0.171		0.155
DU1-8	J1T6M1	1/6/2014	8.1		0.055	5.2	X	0.095	13.9		0.21	0.155	U	0.155
DU1-9	J1T6M2	1/6/2014	7.3		0.054	5.2	X	0.093	12.7		0.20	0.155	U	0.155
DU1-10	J1T6M3	1/6/2014	9.9		0.059	5.6	X	0.10	15.9		0.22	0.271		0.155
DU1-11	J1T6M4	1/6/2014	9.3		0.057	5.5	X	0.098	15.3		0.21	0.169		0.155
DU1-12	J1T6M5	1/6/2014	9.8		0.055	5.6	X	0.095	15.9		0.21	0.272		0.155
DU2-11	J1T6N8	12/13/2013	7.9		0.054	4.8		0.093	13.4		0.20	0.155	U	0.155
Duplicate of J1T6N8	J1T6P0	12/13/2013	8.2		0.054	4.1		0.094	12.2		0.20	0.155	U	0.155
DU2-1	J1T6M8	12/13/2013	7.9		0.057	3.8	M	0.098	13.7		0.21	0.164		0.155
DU2-2	J1T6M9	12/13/2013	7.2		0.051	4.5		0.087	12.9		0.19	0.155	U	0.155
DU2-3	J1T6N0	12/13/2013	8.6		0.058	4.9		0.10	15.3		0.22	0.155	U	0.155
DU2-4	J1T6N1	12/13/2013	8.6		0.059	4.7		0.10	11.8		0.22	0.155	U	0.155
DU2-5	J1T6N2	12/13/2013	6.8		0.053	4.5		0.092	11.6		0.20	0.155	U	0.155
DU2-6	J1T6N3	12/13/2013	8.2		0.054	4.7		0.093	12.8		0.20	0.155	U	0.155
DU2-7	J1T6N4	12/13/2013	7.9		0.057	4.6		0.099	12.4		0.21	0.155	U	0.155
DU2-8	J1T6N5	12/13/2013	8.1		0.056	4.6		0.097	14.1		0.21	0.203		0.155
DU2-9	J1T6N6	12/13/2013	9.0		0.057	4.9		0.097	17.3		0.21	0.155	U	0.155
DU2-10	J1T6N7	12/13/2013	12.9		0.055	5.5		0.096	15.5		0.21	0.226		0.155
DU2-12	J1T6N9	12/13/2013	7.6		0.054	4.6		0.093	12.8		0.20	0.155	U	0.155
OB-1	J1RX91	8/19/2013	11.0		0.057	5.5	X	0.098	13.8		0.21	0.155	U	0.155
Duplicate of J1RX91	J1RXC3	8/19/2013	8.9		0.052	5.1	X	0.090	12.6		0.20	0.155	U	0.155
OB-2	J1RX92	8/19/2013	8.7		0.052	4.5	X	0.089	10.9		0.19	0.155	U	0.155
OB-3	J1RX93	8/19/2013	10.5		0.055	5.5	X	0.095	13.1		0.21	0.155	U	0.155
OB-4	J1RX94	8/19/2013	10.3		0.052	5.0	X	0.090	11.7		0.20	0.155	U	0.155
OB-5	J1RX95	8/19/2013	10.4		0.053	5.5	X	0.091	13.3		0.20	0.155	U	0.155
OB-6	J1RX96	8/19/2013	9.9		0.054	4.9	X	0.094	11.7		0.20	0.237		0.155
OB-7	J1RX97	8/19/2013	9.6		0.056	5.3	X	0.097	12.8		0.21	0.155	U	0.155
OB-8	J1RX98	8/19/2013	8.5		0.055	4.9	X	0.095	10.7		0.21	0.155	U	0.155
OB-9	J1RX99	8/19/2013	10.1		0.055	4.7	X	0.095	12.0		0.21	0.155	U	0.155
OB-10	J1RXC0	8/19/2013	10.5		0.054	5.4	X	0.093	12.7		0.20	0.155	U	0.155
OB-11	J1RXC1	8/19/2013	10.5		0.057	4.4	X	0.098	11.0		0.21	0.155	U	0.155
OB-12	J1RXC2	8/19/2013	9.6		0.058	4.9	X	0.099	11.4		0.22	0.155	U	0.155
Equipment Blank	J1T6M7	1/6/2014	0.11	B	0.049	0.12	BX	0.084	0.29	BC	0.18			

Attachment	1	Sheet No.	3 of 8
Originator	N. K. Schiffern	Date	1/20/14
Checked	J. D. Skoglie	Date	1/20/14
Calc. No.	0100H-CA-V0201	Rev. No.	0

Attachment 1. 100-H-46 Waste Site Verification Sample Results (Metals).

LOCATION	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU1-1	J1T6L4	1/6/2014	15600		3.8	3.7		0.27	4190		3.7	242		0.10
Duplicate of J1T6L4	J1T6M6	1/6/2014	14800		3.7	4.3		0.26	3720		3.6	226		0.096
DU1-2	J1T6L5	1/6/2014	14200		3.4	2.7		0.24	3780		3.3	215		0.089
DU1-3	J1T6L6	1/6/2014	14700		3.7	2.0		0.26	3860		3.6	225		0.098
DU1-4	J1T6L7	1/6/2014	14000		3.9	2.2		0.27	3710		3.8	219		0.10
DU1-5	J1T6L8	1/6/2014	15900		3.7	9.5		0.26	3950		3.6	234		0.097
DU1-6	J1T6L9	1/6/2014	16400		3.3	3.6		0.24	4340		3.2	248		0.088
DU1-7	J1T6M0	1/6/2014	18400		3.9	5.2		0.28	4370		3.8	260		0.10
DU1-8	J1T6M1	1/6/2014	14800		3.6	2.3		0.26	4000		3.5	218		0.095
DU1-9	J1T6M2	1/6/2014	13100		3.5	2.1		0.25	3530		3.4	212		0.093
DU1-10	J1T6M3	1/6/2014	15700		3.9	5.6		0.28	4110		3.8	253		0.10
DU1-11	J1T6M4	1/6/2014	15800		3.7	17.2		0.27	3910		3.6	248		0.098
DU1-12	J1T6M5	1/6/2014	16100		3.6	5.7		0.26	4040		3.5	251		0.095
DU2-11	J1T6N8	12/13/2013	16000		3.5	2.1		0.25	3890		3.4	216		0.093
Duplicate of J1T6N8	J1T6P0	12/13/2013	13500		3.6	2.2		0.25	3390		3.5	175		0.094
DU2-1	J1T6M8	12/13/2013	12500		3.7	2.2		0.26	3140		3.6	200		0.098
DU2-2	J1T6M9	12/13/2013	14500		3.3	2.3		0.24	3440		3.2	191		0.087
DU2-3	J1T6N0	12/13/2013	16300		3.8	2.5		0.27	3760		3.7	212		0.10
DU2-4	J1T6N1	12/13/2013	14200		3.9	2.2		0.27	3620		3.8	192		0.10
DU2-5	J1T6N2	12/13/2013	14000		3.5	2.0		0.25	3090		3.4	177		0.092
DU2-6	J1T6N3	12/13/2013	15500		3.5	2.5		0.25	3590		3.5	204		0.093
DU2-7	J1T6N4	12/13/2013	15200		3.8	2.2		0.27	3700		3.7	206		0.099
DU2-8	J1T6N5	12/13/2013	16100		3.7	2.2		0.26	3570		3.6	195		0.097
DU2-9	J1T6N6	12/13/2013	15400		3.7	2.4		0.26	3860		3.6	221		0.097
DU2-10	J1T6N7	12/13/2013	16100		3.6	32.7		0.26	4090		3.5	246		0.096
DU2-12	J1T6N9	12/13/2013	14700		3.5	2.1		0.25	3650		3.5	201		0.093
OB-1	J1RX91	8/19/2013	15100		3.7	5.7		0.26	4170		3.6	242		0.098
Duplicate of J1RX91	J1RXC3	8/19/2013	14500		3.4	4.7		0.24	3720		3.3	223		0.090
OB-2	J1RX92	8/19/2013	12600		3.4	3.5		0.24	3480		3.3	206		0.089
OB-3	J1RX93	8/19/2013	15400		3.6	2.8		0.26	4120		3.5	243		0.095
OB-4	J1RX94	8/19/2013	13900		3.4	2.2		0.24	3850		3.3	243		0.090
OB-5	J1RX95	8/19/2013	14700		3.5	2.1		0.25	3900		3.4	225		0.091
OB-6	J1RX96	8/19/2013	13600		3.6	2.4		0.25	3900		3.5	221		0.094
OB-7	J1RX97	8/19/2013	14900		3.7	2.3		0.26	4180		3.6	224		0.097
OB-8	J1RX98	8/19/2013	12600		3.6	2.3		0.26	3520		3.5	220		0.095
OB-9	J1RX99	8/19/2013	13000		3.6	2.5		0.26	3770		3.5	212		0.095
OB-10	J1RXC0	8/19/2013	14000		3.5	2.4		0.25	4000		3.4	219		0.093
OB-11	J1RXC1	8/19/2013	12200		3.7	2.6		0.27	3840		3.6	214		0.098
OB-12	J1RXC2	8/19/2013	12800		3.8	3.2		0.27	3730		3.7	226		0.099
Equipment Blank	J1T6M7	1/6/2014	264		3.2	0.48		0.23	24.5		3.1	6.0		0.084

Attachment	1	Sheet No.	4 of 8
Originator	N. K. Schiffern	Date	1/20/14
Checked	J. D. Skoglie	Date	1/20/14
Calc. No.	0100H-CA-V0201	Rev. No.	0

Attachment 1. 100-H-46 Waste Site Verification Sample Results (Metals).

LOCATION	HEIS Number	Sample Date	Mercury			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU1-1	J1T6L4	1/6/2014	0.0058	U	0.0058	0.26	U	0.26	10.5		0.12	718		41.0
Duplicate of J1T6L4	J1T6M6	1/6/2014	0.0052	U	0.0052	0.25	U	0.25	8.9		0.12	663		39.4
DU1-2	J1T6L5	1/6/2014	0.0064	U	0.0064	0.23	B	0.23	8.3		0.11	617		36.6
DU1-3	J1T6L6	1/6/2014	0.0053	U	0.0053	0.25	U	0.25	11.0		0.12	564		40.0
DU1-4	J1T6L7	1/6/2014	0.0049	U	0.0049	0.26	U	0.26	9.5		0.12	715		41.6
DU1-5	J1T6L8	1/6/2014	0.0053	U	0.0053	0.25	U	0.25	9.5		0.12	730		39.7
DU1-6	J1T6L9	1/6/2014	0.0054	U	0.0054	0.24	B	0.23	10.0		0.11	675		36.0
DU1-7	J1T6M0	1/6/2014	0.0055	U	0.0055	0.66	B	0.27	9.8		0.13	663		42.1
DU1-8	J1T6M1	1/6/2014	0.0056	U	0.0056	0.25	U	0.25	8.1		0.12	528		38.8
DU1-9	J1T6M2	1/6/2014	0.0059	U	0.0059	0.24	U	0.24	9.0		0.11	509		38.0
DU1-10	J1T6M3	1/6/2014	0.0055	B	0.0052	0.77	B	0.27	9.5		0.13	934		41.8
DU1-11	J1T6M4	1/6/2014	0.0065	U	0.0065	0.26	U	0.26	9.2		0.12	717		40.3
DU1-12	J1T6M5	1/6/2014	0.012	B	0.0063	0.25	B	0.25	9.1		0.12	806		38.9
DU2-11	J1T6N8	12/13/2013	0.0054	U	0.0054	0.24	B	0.24	8.1		0.11	525		38.1
Duplicate of J1T6N8	J1T6P0	12/13/2013	0.0067	U	0.0067	0.24	B	0.24	8.2		0.12	475		38.5
DU2-1	J1T6M8	12/13/2013	0.0061	U	0.0061	0.25	U	0.25	8.2		0.12	494		40.0
DU2-2	J1T6M9	12/13/2013	0.0065	U	0.0065	0.24	B	0.23	7.5		0.11	567		35.8
DU2-3	J1T6N0	12/13/2013	0.0057	U	0.0057	0.26	U	0.26	8.4		0.12	541		41.0
DU2-4	J1T6N1	12/13/2013	0.0070	U	0.0070	0.26	U	0.26	9.4		0.12	565		41.6
DU2-5	J1T6N2	12/13/2013	0.0060	U	0.0060	0.30	B	0.24	6.6		0.11	470		37.8
DU2-6	J1T6N3	12/13/2013	0.0054	U	0.0054	0.33	B	0.24	8.5		0.11	562		38.3
DU2-7	J1T6N4	12/13/2013	0.0052	U	0.0052	0.26	U	0.26	7.9		0.12	614		40.5
DU2-8	J1T6N5	12/13/2013	0.0052	U	0.0052	0.25	U	0.25	7.4		0.12	558		39.6
DU2-9	J1T6N6	12/13/2013	0.0055	U	0.0055	0.28	B	0.25	10.1		0.12	580		40.0
DU2-10	J1T6N7	12/13/2013	0.0058	U	0.0058	0.72	B	0.25	10.3		0.12	898		39.2
DU2-12	J1T6N9	12/13/2013	0.0064	U	0.0064	0.27	B	0.24	8.1		0.11	557		38.3
OB-1	J1RX91	8/19/2013	0.0055	U	0.0055	0.30	B	0.25	11.2		0.12	736		40.0
Duplicate of J1RX91	J1RXC3	8/19/2013	0.0063	U	0.0063	0.23	U	0.23	9.4		0.11	639		36.9
OB-2	J1RX92	8/19/2013	0.0049	U	0.0049	0.23	U	0.23	8.6		0.11	625		36.4
OB-3	J1RX93	8/19/2013	0.0051	U	0.0051	0.25	U	0.25	9.2		0.12	613		38.9
OB-4	J1RX94	8/19/2013	0.0049	U	0.0049	0.24	U	0.24	9.5		0.11	560		37.1
OB-5	J1RX95	8/19/2013	0.0049	U	0.0049	0.24	U	0.24	9.6		0.11	612		37.3
OB-6	J1RX96	8/19/2013	0.0048	U	0.0048	0.24	U	0.24	9.2		0.12	651		38.4
OB-7	J1RX97	8/19/2013	0.0053	U	0.0053	0.25	U	0.25	9.9		0.12	599		39.9
OB-8	J1RX98	8/19/2013	0.0057	U	0.0057	0.25	U	0.25	8.6		0.12	566		38.8
OB-9	J1RX99	8/19/2013	0.0055	U	0.0055	0.25	U	0.25	10.2		0.12	646		38.8
OB-10	J1RXC0	8/19/2013	0.0058	U	0.0058	0.24	U	0.24	10.4		0.11	593		38.1
OB-11	J1RXC1	8/19/2013	0.0059	U	0.0059	0.26	U	0.26	10.2		0.12	645		40.3
OB-12	J1RXC2	8/19/2013	0.0065	U	0.0065	0.26	U	0.26	9.5		0.12	721		40.8
Equipment Blank	J1T6M7	1/6/2014	0.0055	U	0.0055	0.22	U	0.22	0.11	B	0.10	57.0	B	34.5

Attachment	1	Sheet No.	5 of 8
Originator	N. K. Schiffern	Date	1/20/14
Checked	J. D. Skoglie	Date	1/20/14
Calc. No.	0100H-CA-V0201	Rev. No.	0

Attachment 1. 100-H-46 Waste Site Verification Sample Results (Metals).

LOCATION	HEIS Number	Sample Date	Selenium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
DU1-1	J1T6L4	1/6/2014	0.86	U	0.86	176	M	5.7	0.16	U	0.16	194		59.0
Duplicate of J1T6L4	J1T6M6	1/6/2014	0.83	U	0.83	141		5.4	0.15	U	0.15	199		56.8
DU1-2	J1T6L5	1/6/2014	0.77	U	0.77	129		5.1	0.14	U	0.14	164		52.7
DU1-3	J1T6L6	1/6/2014	0.84	U	0.84	112		5.5	0.16	U	0.16	167		57.6
DU1-4	J1T6L7	1/6/2014	0.87	U	0.87	87.0		5.7	0.16	U	0.16	162		59.8
DU1-5	J1T6L8	1/6/2014	0.83	U	0.83	243		5.5	0.15	U	0.15	240		57.1
DU1-6	J1T6L9	1/6/2014	0.75	U	0.75	197		5.0	0.14	U	0.14	254		51.8
DU1-7	J1T6M0	1/6/2014	0.88	U	0.88	308		5.8	0.16	U	0.16	229		60.5
DU1-8	J1T6M1	1/6/2014	0.81	U	0.81	104		5.4	0.15	U	0.15	201		55.9
DU1-9	J1T6M2	1/6/2014	0.80	U	0.80	131		5.3	0.15	U	0.15	158		54.7
DU1-10	J1T6M3	1/6/2014	0.88	U	0.88	279		5.8	0.16	U	0.16	250		60.2
DU1-11	J1T6M4	1/6/2014	0.84	U	0.84	194		5.6	0.16	U	0.16	234		57.9
DU1-12	J1T6M5	1/6/2014	0.82	U	0.82	236		5.4	0.15	U	0.15	293		56.0
DU2-11	J1T6N8	12/13/2013	0.80	U	0.80	85.6	NJ	5.3	0.15	U	0.15	146		54.9
Duplicate of J1T6N8	J1T6P0	12/13/2013	0.81	U	0.81	68.6	NJ	5.3	0.15	U	0.15	144		55.4
DU2-1	J1T6M8	12/13/2013	0.84	U	0.84	134	NJ	5.5	0.16	U	0.16	165		57.6
DU2-2	J1T6M9	12/13/2013	0.75	U	0.75	121	NJ	4.9	0.14	U	0.14	165		51.6
DU2-3	J1T6N0	12/13/2013	0.86	U	0.86	132	NJ	5.7	0.16	U	0.16	174		58.9
DU2-4	J1T6N1	12/13/2013	0.87	U	0.87	102	NJ	5.7	0.16	U	0.16	152		59.9
DU2-5	J1T6N2	12/13/2013	0.79	U	0.79	145	NJ	5.2	0.15	U	0.15	152		54.3
DU2-6	J1T6N3	12/13/2013	0.80	U	0.80	214	NJ	5.3	0.15	U	0.15	183		55.1
DU2-7	J1T6N4	12/13/2013	0.85	U	0.85	103	NJ	5.6	0.16	U	0.16	174		58.3
DU2-8	J1T6N5	12/13/2013	0.83	U	0.83	96.6	NJ	5.5	0.15	U	0.15	163		57.0
DU2-9	J1T6N6	12/13/2013	0.84	U	0.84	101	NJ	5.5	0.16	U	0.16	189		57.5
DU2-10	J1T6N7	12/13/2013	0.82	U	0.82	267	NJ	5.4	0.15	U	0.15	169		56.3
DU2-12	J1T6N9	12/13/2013	0.80	U	0.80	82.9	NJ	5.3	0.15	U	0.15	146		55.1
OB-1	J1RX91	8/19/2013	0.84	U	0.84	307	N	5.5	0.16	U	0.16	196		57.5
Duplicate of J1RX91	J1RXC3	8/19/2013	0.77	U	0.77	268		5.1	0.14	U	0.14	185		53.1
OB-2	J1RX92	8/19/2013	0.76	U	0.76	201		5.0	0.14	U	0.14	135		52.4
OB-3	J1RX93	8/19/2013	0.82	U	0.82	199		5.4	0.15	U	0.15	188		56.0
OB-4	J1RX94	8/19/2013	0.78	U	0.78	155		5.1	0.14	U	0.14	193		53.4
OB-5	J1RX95	8/19/2013	0.78	U	0.78	178		5.2	0.15	U	0.15	152		53.7
OB-6	J1RX96	8/19/2013	0.81	U	0.81	201		5.3	0.15	U	0.15	152		55.3
OB-7	J1RX97	8/19/2013	0.84	U	0.84	143		5.5	0.16	U	0.16	155		57.5
OB-8	J1RX98	8/19/2013	0.81	U	0.81	168		5.4	0.15	U	0.15	137		55.8
OB-9	J1RX99	8/19/2013	0.81	U	0.81	224		5.4	0.15	U	0.15	172		55.9
OB-10	J1RXC0	8/19/2013	0.80	U	0.80	164		5.3	0.15	U	0.15	153		54.8
OB-11	J1RXC1	8/19/2013	0.85	U	0.85	188		5.6	0.16	U	0.16	153		58.1
OB-12	J1RXC2	8/19/2013	0.86	U	0.86	194		5.6	0.16	U	0.16	163		58.7
Equipment Blank	J1T6M7	1/6/2014	0.72	U	0.72	96.7		4.8	0.13	U	0.13	49.6	U	49.6

Attachment	1	Sheet No.	6 of 8
Originator	N. K. Schiffern	Date	1/20/14
Checked	J. D. Skoglie	Date	1/20/14
Calc. No.	0100H-CA-V0201	Rev. No.	0

Attachment 1. 100-H-46 Waste Site Verification Sample Results (Metals and Physical).

LOCATION	HEIS Number	Sample Date	Vanadium			Zinc			Percent Moisture		
			mg/kg	Q	PQL	mg/kg	Q	PQL	%	Q	PQL
DU1-1	J1T6L4	1/6/2014	40.6		0.094	33.4	X	0.40	2.0		0.10
Duplicate of J1T6L4	J1T6M6	1/6/2014	38.5		0.090	31.5	X	0.38	1.9		0.10
DU1-2	J1T6L5	1/6/2014	38.9		0.084	28.8	X	0.36	1.8		0.10
DU1-3	J1T6L6	1/6/2014	40.7		0.092	28.6	X	0.39	1.5		0.10
DU1-4	J1T6L7	1/6/2014	35.1		0.095	29.6	X	0.40	1.4		0.10
DU1-5	J1T6L8	1/6/2014	44.4		0.091	34.8	X	0.39	1.6		0.10
DU1-6	J1T6L9	1/6/2014	48.0		0.083	34.5	X	0.35	1.8		0.10
DU1-7	J1T6M0	1/6/2014	47.0		0.096	33.6	X	0.41	3.5		0.10
DU1-8	J1T6M1	1/6/2014	43.1		0.089	30.5	X	0.38	3.2		0.10
DU1-9	J1T6M2	1/6/2014	35.6		0.087	27.0	X	0.37	2.9		0.10
DU1-10	J1T6M3	1/6/2014	42.1		0.096	35.6	X	0.41	2.0		0.10
DU1-11	J1T6M4	1/6/2014	44.3		0.092	32.5	X	0.39	2.1		0.10
DU1-12	J1T6M5	1/6/2014	43.6		0.089	37.0	X	0.38	2.4		0.10
DU2-11	J1T6N8	12/13/2013	44.5		0.087	28.5	X	0.37	1.4		0.10
Duplicate of J1T6N8	J1T6P0	12/13/2013	38.0		0.088	23.7	X	0.37	1.4		0.10
DU2-1	J1T6M8	12/13/2013	31.2		0.092	22.6	X	0.39	1.5		0.10
DU2-2	J1T6M9	12/13/2013	40.4		0.082	25.9	X	0.35	1.4		0.10
DU2-3	J1T6N0	12/13/2013	47.2		0.094	28.3	X	0.40	1.9		0.10
DU2-4	J1T6N1	12/13/2013	38.2		0.095	25.6	X	0.40	1.6		0.10
DU2-5	J1T6N2	12/13/2013	36.0		0.087	24.7	X	0.37	1.3		0.10
DU2-6	J1T6N3	12/13/2013	42.9		0.088	27.2	X	0.37	1.7		0.10
DU2-7	J1T6N4	12/13/2013	42.2		0.093	28.0	X	0.39	1.7		0.10
DU2-8	J1T6N5	12/13/2013	43.1		0.091	27.3	X	0.38	1.4		0.10
DU2-9	J1T6N6	12/13/2013	43.7		0.092	27.7	X	0.39	1.3		0.10
DU2-10	J1T6N7	12/13/2013	39.3		0.090	36.0	X	0.38	2.1		0.10
DU2-12	J1T6N9	12/13/2013	39.2		0.088	26.2	X	0.37	1.7		0.10
OB-1	J1RX91	8/19/2013	41.0		0.092	31.7	X	0.39	0.44		0.10
Duplicate of J1RX91	J1RXC3	8/19/2013	41.8		0.085	30.2	X	0.36	0.73	M	0.10
OB-2	J1RX92	8/19/2013	33.4		0.084	27.1	X	0.35	0.42		0.10
OB-3	J1RX93	8/19/2013	44.8		0.089	30.8	X	0.38	0.68		0.10
OB-4	J1RX94	8/19/2013	41.6		0.085	28.8	X	0.36	0.43		0.10
OB-5	J1RX95	8/19/2013	42.5		0.086	28.7	X	0.36	0.18		0.10
OB-6	J1RX96	8/19/2013	37.0		0.088	28.3	X	0.37	0.32		0.10
OB-7	J1RX97	8/19/2013	43.2		0.092	30.3	X	0.39	0.31		0.10
OB-8	J1RX98	8/19/2013	35.1		0.089	27.2	X	0.38	0.25		0.10
OB-9	J1RX99	8/19/2013	35.6		0.089	27.0	X	0.38	0.44		0.10
OB-10	J1RXC0	8/19/2013	39.8		0.087	28.8	X	0.37	0.24		0.10
OB-11	J1RXC1	8/19/2013	33.1		0.093	26.0	X	0.39	0.37		0.10
OB-12	J1RXC2	8/19/2013	34.0		0.093	28.2	X	0.40	0.45		0.10
Equipment Blank	J1T6M7	1/6/2014	0.28	B	0.079	2.0	XC	0.33	0.10	U	0.10

Attachment	1	Sheet No.	7 of 8
Originator	N. K. Schiffern	Date	1/20/14
Checked	J. D. Skoglie	Date	1/20/14
Calc. No.	0100H-CA-V0201	Rev. No.	0

Attachment 1. 100-H-46 Waste Site Verification Sample Results - Information Only[a]

LOCATION	HEIS Number	Sample Date	Hexavalent Chromium		
			mg/kg	Q	PQL
PRZ-1	J1T6P1	12/13/2013	3.20		0.155
PRZ-2	J1T6P2	12/13/2013	0.204		0.155
PRZ-3	J1T6P3	12/13/2013	0.446		0.155
PRZ-4	J1T6P4	12/13/2013	2.54		0.155
PRZ-5	J1T6P5	12/13/2013	0.155	U	0.155

Attachment	1	Sheet No.	8 of 8
Originator	N. K. Schiffern	Date	1/20/14
Checked	J. D. Skoglie	Date	1/20/14
Calc. No.	0100H-CA-V0201	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0202

Subject: 100-H-46 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 3 Total = 4	N. K. Schiffern N.K. Schiffern	J. D. Skoglie	J.B. Berezovsky J.B. Berezovsky	D. F. Obenauer D.F. Obenauer	1/23/14

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:	N. K. Schiffern NS	Date:	01/21/14	Calc. No.:	0100H-CA-V0202	Rev.:	0
Project:	100-H Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie JS	Date:	01/21/14
Subject:	100-H-46 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-H-46 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.

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

4) WCH, 2014, *100-H-46 Waste Site Cleanup Verification 95% UCL Calculation*, 0100H-CA-V0201, Rev. 0, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

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

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	01/21/14	Calc. No.:	0100H-CA-V0202	Rev.:	0
Project:	100-H Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	01/21/14
Subject:	100-H-46 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	2 of 3

METHODOLOGY:

The 100-H-46 waste site is comprised of three decision units for verification sampling; Decision Unit 1, Decision Unit 2, and overburden stockpile. In addition, five samples were collected from the periodically rewetted zone for informational purposes only. The direct contact hazard quotient and carcinogenic risk calculations for the 100-H-46 waste site were conservatively calculated for the entire waste site (with exception of Decision Unit 2, which is located in the deep zone) using the greater of the statistical or maximum value for each analyte from Decision Unit 1 and overburden stockpile from WCH (2014). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, molybdenum require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Copper requires HQ and risk calculations because this analyte was detected above a Washington State or Hanford Site background value. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.9 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 2.6×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation. The sum of the HQ values is 1.1×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, and then multiplied by 1.0×10^{-6}. For example, the statistical value for hexavalent chromium is 0.276 mg/kg, divided by 2.1 mg/kg, and multiplied as indicated, is 1.3×10^{-7}. Comparing this value and all other individual values, to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values is 1.3×10^{-7}. Comparing these values to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

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

Table 1 shows the results of the calculations.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	01/21/14	Calc. No.:	0100H-CA-V0202	Rev.:	0
Project:	100-H Area Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	01/21/14
Subject:	100-H-46 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	3 of 3

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-H-46 Waste Site.

Contaminants of Potential Concern	Maximum or Statistical Value [a] (mg/kg)	Noncarcinogen RAG [b] (mg/kg)	Hazard Quotient	Carcinogen RAG [b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.9	7,200	2.6E-04	--	--
Chromium, hexavalent [c]	0.276	240	1.2E-03	2.1	1.3E-07
Copper	24.0	2,960	8.1E-03	--	--
Molybdenum	0.77	400	1.9E-03	--	--
Totals					
Cumulative Hazard Quotient:			**1.1E-02**		
Cumulative Excess Cancer Risk:					**1.3E-07**

Notes:

[a] = From WCH (2014).

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

-- = not applicable

RAG = remedial action goal

CONCLUSION:

The calculations in Table 1 demonstrate that the 100-H-46 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk, 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.

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0202

Subject: 100-H-46 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 3 Total = 4	N.K. Schiffern	I.B. Berezovskiy	J.D. Skoglie	D.F. Obenauer (signed 1/23/14)	1/23/14
1	Cover = 1 Summary = 3 Total = 4	H.M. Sulloway	J.D. Skoglie	NA	D.F. Obenauer	4/14/14

SUMMARY OF REVISION

1	p. 2. Updated vadose zone depths for decision unit 1 and decision unit 2.

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	1/22/2014	Calc. No.:	0100H-CA-V0202	Rev.:	0
Project:	100-H Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	1/22/2014
Subject:	100-H-46 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-46 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-46 Waste Site Cleanup Verification 95% UCL Calculations*, 0100H-CA-V0201, Rev. 0, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

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

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

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

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	H. M. Sulloway	Date:	4/14/2014	Calc. No.:	0100H-CA-V0202	Rev.:	1
Project:	100-H Area Field Remediation	Job No:	14655	Checked:	J.D. Skoglie	Date:	4/14/2014
Subject:	100-H-46 Waste Site Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 100-H-46 waste site is comprised of three decision units for verification sampling; Decision Unit 1, Decision Unit 2, and overburden stockpile. In addition, five samples were collected from the periodically rewetted zone for informational purposes only. Hazard quotient and carcinogenic risk calculations for potential impact to groundwater at the 100-H-46 waste site were conservatively calculated for the entire waste site using the greater of the statistical or maximum value for each analyte in all decision units from the 95% UCL calculation (WCH 2014). Based on the generic site RESRAD model (BHI 2005) and a vadose zone of approximately 3.5 m (11.5 ft) thickness, a K_d of 20 or greater is required to show no predicted migration to groundwater in 1,000 years at Decision Unit 1. Decision Unit 2 has a vadose zone of approximately 1.5 m (4.9 ft) thickness, and a K_d of 40 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, hexavalent chromium, and molybdenum are included because no Washington State or Hanford background value has been established and the distribution coefficients are less than that necessary to show no migration to groundwater in 1,000 years using this model. All other site nonradionuclide COPCs were not detected, quantified below background levels, or have a K_d greater than or equal to 20 in decision unit 1 or 40 in decision unit 2. 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 is 1.9 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 5.9×10^{-3}. Comparing this value to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The cumulative HQ for the 100-H-46 waste site is 1.0×10^{-1}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, and then multiplied by 1×10^{-6}. There were not any constituents 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:	N. K. Schiffern	Date:	1/22/2014	Calc. No.:	0100H-CA-V0202	Rev.:	0
Project:	100-H Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	1/22/2014
Subject:	100-H-46 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-46 waste site.

Contaminants of Potential Concern[a]	Maximum or Statistical Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.9	320	5.9E-03	--	--
Chromium, hexavalent	0.276	4.8	5.8E-02	--	--
Molybdenum	0.33	8	4.1E-02	--	--
Totals					
Cumulative Hazard Quotient:			**1.0E-01**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:
[a] = From WCH (2014).
[b] = Value obtained from the Cleanup Levels and Risk Calculations (CLARC) database using Groundwater, Method B, results and the "100 times" model.
-- = not applicable
RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-H-46 waste site meets the requirements for the hazard quotients and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2009).

APPENDIX E

DATA QUALITY ASSESSMENT

APPENDIX E

DATA QUALITY ASSESSMENT

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

A review of the sample design (WCH 2013c), the field logbooks (WCH 2013a, WCH 2013b), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. To ensure quality data, the 100 Area SAP (DOE-RL 2009) data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Verification sample data collected at the 100-H-46 waste site were provided by the laboratory in three sample delivery groups (SDGs): JP0615, JP0677, and JP0684. SDG JP0677 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 100-H-46 and 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.

SDG JP0615

This SDG comprises 12 statistical soil samples (J1RX91 through J1RX99, J1RXC0 through J1RXC2) from the 100-H-46 waste site overburden area. This SDG includes one field duplicate pair (J1RX91/J1RXC3). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury and hexavalent chromium. Minor deficiencies are as follows.

In the ICP metals analysis, chromium and iron were detected in the method blank, at very low levels, less than 1/25th of the associated field sample result. Although not qualified for the method blank contamination, all chromium and iron results may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample (LCS) recovery for silicon was below the project recovery limit at 13%. Silicon is not a contaminant of potential concern (COPC) for the 100-H-46 waste site nor is it a regulated compound under the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act-Cleanup." Although not qualified for LCS recovery outside the quality control (QC) limits, all silicon results in SDG JP0615 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 four analytes (aluminum [516%], antimony [56%], iron [2,361%], and silicon [16%]). For aluminum and iron 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 concentrations rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. Although not qualified for MS results outside the QC limits, all antimony and silicon results for SDG JP0615 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG JP0677

This SDG comprises 12 statistical soil samples (J1T6M8, J1T6M9, and J1T6N0 through J1T6N9) from the 100-H-46 waste site, excavation area decision unit 2. This SDG includes one field duplicate pair (J1T6N8/J1T6P0). These samples were analyzed for ICP metals, mercury, and hexavalent chromium. Minor deficiencies are as follows.

In the ICP metals analysis, the matrix spike recoveries are out of project acceptance criteria for four analytes (aluminum [994%], antimony [69%], iron [3,549%], and silicon [29%]). For aluminum and iron 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 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 JP0677 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 laboratory control sample (LCS) recovery for silicon was below the project recovery limit, at 8%. Silicon is not a COPC for 100-H-46 waste sites nor is it a regulated compound under WAC 173-340. All silicon results in SDG JP0677 were qualified as estimated with "J" flags by third-party validation. Estimated data are usable for decision-making purposes.

SDG JP0684

This SDG comprises 12 statistical soil samples (J1T6L4 through J1T6L9, J1T6M0 through J1T6M5). This SDG includes one field duplicate pair (J1T6L4/J1T6M6) from the 100-H-46 waste site, excavation area decision unit 1. These samples were analyzed for ICP metals, mercury, and hexavalent chromium. In addition, a field equipment blank sample (J1T6M7) was collected and analyzed for ICP metals and mercury. Minor deficiencies are as follows.

In the ICP metals analysis, copper, iron, 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 copper, iron, and 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 10%. Silicon is not a COPC for the 100-H-46 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 JP0684 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 five analytes (aluminum [880%], antimony [63%], iron [1,752%], manganese [195%], and silicon [25%]). 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 and silicon did not have mismatched spike and native concentrations in the MS. Although not qualified for MS recoveries below QC limit, all antimony and silicon data in SDG JP0684 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 silicon is above the acceptance criteria of 30%, at 43%. 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 silicon data results in SDG JP0684 may be considered estimated. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbooks (WCH 2013a, 2013b), are shown in Table E-1. The main and QA/QC sample results are presented in Appendix D.

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

Sample Area	Main Sample	Duplicate Sample
Decision Unit 1	J1T6L4	J1T6M6
Decision Unit 2	J1T6N8	J1T6P0
Decision Unit 3 (Overburden pile)	J1RX91	J1RXC3

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. 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 D 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 target detection limit (TDL), including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix D) to indicate that a visual check of the data is required by the reviewer. None of the data 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-46 waste sites verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 100-H-46 waste sites concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes.

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

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