1213485

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

12-AMRP-0011

APR 25 2012

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

Dear Ms. Hedges:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM NO. 2008-044 AND SUPPORTING DOCUMENTATION FOR THE 100-D-56:1, NORTH PORTION OF THE 100-D-56 SODIUM DICHROMATE UNDERGROUND SUPPLY LINES WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2008-044 and supporting "Remaining Sites Verification Package for the 100-D-56:1, North Portion of the 100-D-56 Sodium Dichromate Underground Supply Lines Waste Site," Rev. 0. If you have questions, please contact me or your staff may contact Tom Post, of my staff, at (509) 376-3232.

Sincerely,

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

AMRC:TCP

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
M. L. Proctor, WCH
J. P. Shearer, CHPRC

100-D2-1

Date Submitted: 06/30/11 Originator: M. L. Proctor Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 100-DR-1 Waste Site Code: 100-D-56:1 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2008-044

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

Description of current waste site condition:

The 100-D-56:1 North Portion of the Sodium Dichromate Underground Supply Lines waste site consisted of two abandoned 7.6-cm (3-in.)-diameter underground supply lines that transported sodium silicate and sodium dichromate liquids from the 108-D facility to the 190 D Complex. Originally, from about 1944 until 1950, the receiving, mixing, and transfer of sodium dichromate and other water treatment chemicals occurred in the 108-D Building. The chemicals were unloaded from railcars in either bags or barrels. Research indicates that the mixing of sodium dichromate into solution in the 108-D Building and use of the associated underground supply lines (100-D-56:1) was discontinued in 1950 when the mixing operations were transferred to the 185-D Building and the use of dry material handling was replaced with use of concentrated liquid sodium dichromate that was delivered by railcar and truck to an unloading facility/pumping station (100-D-12). Remediation and verification sampling of the 100-D-56:1 waste site has been performed in accordance with remedial action objectives and goals established by the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The selected remedial action involved: (1) draining and collection of the pipeline contents; removal and size reduction of the pipelines; and removal of contaminated soil, (2) demonstrating through verification sampling that cleanup goals have been achieved, and (3) proposing the site for reclassification to Interim Closed Out.

Basis for reclassification:

In accordance with this evaluation, the verification sampling results support a reclassification of the 100-D-56:1 waste 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. 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). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-D-56:1 North Portion of the 100-D-56 Sodium Dichromate Underground Supply Lines Waste Site* (attached).

Regulator Comment:
Approval of this WSRF documents regulator agreement that the "100-D-56:1" waste site qualifies for "Interim Closed Out" under this Interim Action ROD. In addition, The Washington State Department of Ecology (Ecology) has evaluated the data for this site against *Washington Administrative Code* 173-340 clean-up levels for direct contact, groundwater protection, and river protection. This evaluation is documented in the letter transmitting Ecology's approval of the site's interim reclassification to "Interim Closed Out."

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.

M. S. French DOE Federal Project Director (printed)	MS French Signature	4/2/12 Date
N. Menard Ecology Project Manager (printed)	Nina M. Menard Signature	4/5/12 Date
N/A EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR 100-D-56:1, NORTH PORTION OF THE 100-D-56 SODIUM DICHROMATE UNDERGROUND SUPPLY LINES WASTE SITE

Attachment to Waste Site Reclassification Form 2008-044

February 2012

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-56:1, NORTH PORTION OF THE SODIUM DICHROMATE UNDERGROUND SUPPLY LINES WASTE SITE

EXECUTIVE SUMMARY

The 100-D-56 waste site, located in the 100-DR-1 Operable Unit, includes two abandoned 7.6-cm (3-in.)-diameter underground supply lines that transported sodium silicate and sodium dichromate liquids between the 108-D, 190-D, 185-D, and 189-D facilities; the 100-D-12 Sodium Dichromate Pumping Station; and the 183-DR Building as reported in the Waste Information Data System (WIDS). Sodium silicate and sodium dichromate were stored, mixed, and used in the water treatment process.

The 100-D-56 sodium dichromate and sodium silicate supply lines exited the 185-D/190-D Building complex running parallel to each other. One set traveled north and east to the 108-D Building (100-D-56:1), and one set traveled south and west to the vicinity of the 100-D-12 Sodium Dichromate Pumping Station (100-D-56:2). The sodium dichromate line continued west from the vicinity of the 100-D-12 Sodium Dichromate Pumping Station and then turned south to the 183-DR Building.

In 2005, an evaluation of the 100-D-56 waste site was performed to determine a No Action or Remedial Action decision for this site. Based on a review of the historical process information, the results of the geophysical survey, and previous sampling events (Lerch 1998), it was determined that additional confirmatory sampling was not needed and remedial action at the site was necessary (Dittmer 2005).

Historical research of the sodium dichromate mixing operations and field observations of the pipeline contents during remedial action provided the rationale to perform the verification sampling of the 100-D-56 site as a north portion (100-D-56:1) and a south portion (100-D-56:2). Originally, from about 1944 until 1950, the receiving, mixing, and transfer of sodium dichromate and other water treatment chemicals occurred in the 108-D Building. The chemicals were unloaded from railcars in either bags or barrels. Research indicates that the mixing of sodium dichromate into the solution in the 108-D Building and associated pipelines was discontinued in 1950 when the mixing operations were transferred to the 185-D Building as part of Project C-396 (Sharpe 2006). With the transfer of the sodium dichromate system from the 108-D Building to the 185-D Building, the use of dry material handling was replaced with use of concentrated liquid sodium dichromate that was delivered by railcar and truck to an unloading facility/pumping station (100-D-12). The sodium dichromate pumping station was located south of the 183-D Building, next to the railroad tracks. The north portion of the 100-D-56 waste site (100-D-56:1) consists of the set of pipelines exiting the north side of the 185-D Building that were used during the initial dry material handling operations. The south portion (100-D-56:2) consists of the pipelines that exited the south side of the 185-D Building and continued to be used after the transition to use of concentrated liquid sodium dichromate.

Remediation of the 100-D-56 waste site was initiated on June 13, 2006. Remediation activities consisted of removal and stockpiling of overburden soil to expose the pipelines; tapping, draining, and collection of the pipeline contents; and removal and size reduction of the pipelines, including stained soil and contaminated soil identified during remediation. Remediation of the north portion of the 100-D-56 pipelines (100-D-56:1) began on December 18, 2006, and was completed on January 10, 2007. Approximately 1,885 bank cubic meters of stained soil and pipelines were excavated and disposed to the Environmental Restoration Disposal Facility (ERDF). Approximately 1,500 L (400 gal) of liquid were drained and collected from the northern pipelines for disposition at the Effluent Treatment Facility.

Following site remediation, verification sampling of the overburden soil stockpiles and soil within the excavation footprint was conducted on March 25 and 26, 2008. The results indicated that the waste removal action achieved compliance with the remedial action objectives for the 100-D-56 waste site. A summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the 100-D-56 waste site in accordance with the *Tri-Party Agreement Handbook Management Procedures,* TPA-MP-14 (DOE-RL 2007) procedure.

In accordance with this evaluation, the verification sampling results support a reclassification of the north portion of the 100-D-56 waste site (100-D-56:1) to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). The results of 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). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. The site does not have a deep zone or residual contaminant concentrations that would require any institutional controls.

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

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain 15-mrem/yr dose rate above background over 1,000 years.	Radionuclides are not COCs/COPCs for this waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual COC/COPC RAGs.	All individual COCs/COPCs were quantified below the direct exposure criteria.	Yes

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

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	All individual hazard quotients are less than 1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (1.2×10^{-2}) is less than 1.	Yes
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The individual excess cancer risk (1.5×10^{-7}) for hexavalent chromium, the only carcinogenic contaminant present at this site is less than 1×10^{-6}.	Yes
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk (1.5×10^{-7}) is less than 1×10^{-5}.	Yes
Groundwater/River Protection – Radionuclides	Attain single-COC/COPC groundwater and river protection RAGs.	Radionuclides are not COCs/COPCs for this waste site.	NA
	Attain national primary drinking water standards:[a] 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.		NA
	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]		NA
	Meet total uranium standard of 30 µg/L (21.2 pCi/L).[c]		NA
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Residual concentrations of selenium are above the soil RAG for river protection. However, RESRAD modeling predicts this constituent will not reach groundwater (and, therefore, 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] RESRAD modeling predicts that residual concentrations of selenium will not migrate more than 15 m (49 ft) vertically in 1,000 years based on the soil-partitioning distribution coefficient for selenium of 5 mL/g. The vadose zone underlying the site at the base of the excavation is approximately 24 m (79 ft) thick Therefore, residual concentrations of selenium are predicted to be protective of groundwater and the Columbia River.

COC = contaminant of concern
COPC = contaminant of potential concern
DOE = U.S. Department of Energy
MCL = maximum contaminant level (drinking water standard)
NA = not available
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose model)

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern, and other constituents (Appendix A). Those constituents exceeding the ecological screening levels in the *Washington Administrative Code* Chapter 173-340, Table 749-3, were boron, mercury, selenium, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, manganese, selenium, vanadium, and zinc. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the maximum detected levels of antimony, manganese, vanadium, and zinc are below Hanford Site background levels (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 does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for ecological effects as a part of the final closeout decision for the Columbia River corridor portion of the Hanford Site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-56:1, NORTH PORTION OF THE SODIUM DICHROMATE UNDERGROUND SUPPLY LINES WASTE SITE

STATEMENT OF PROTECTIVENESS

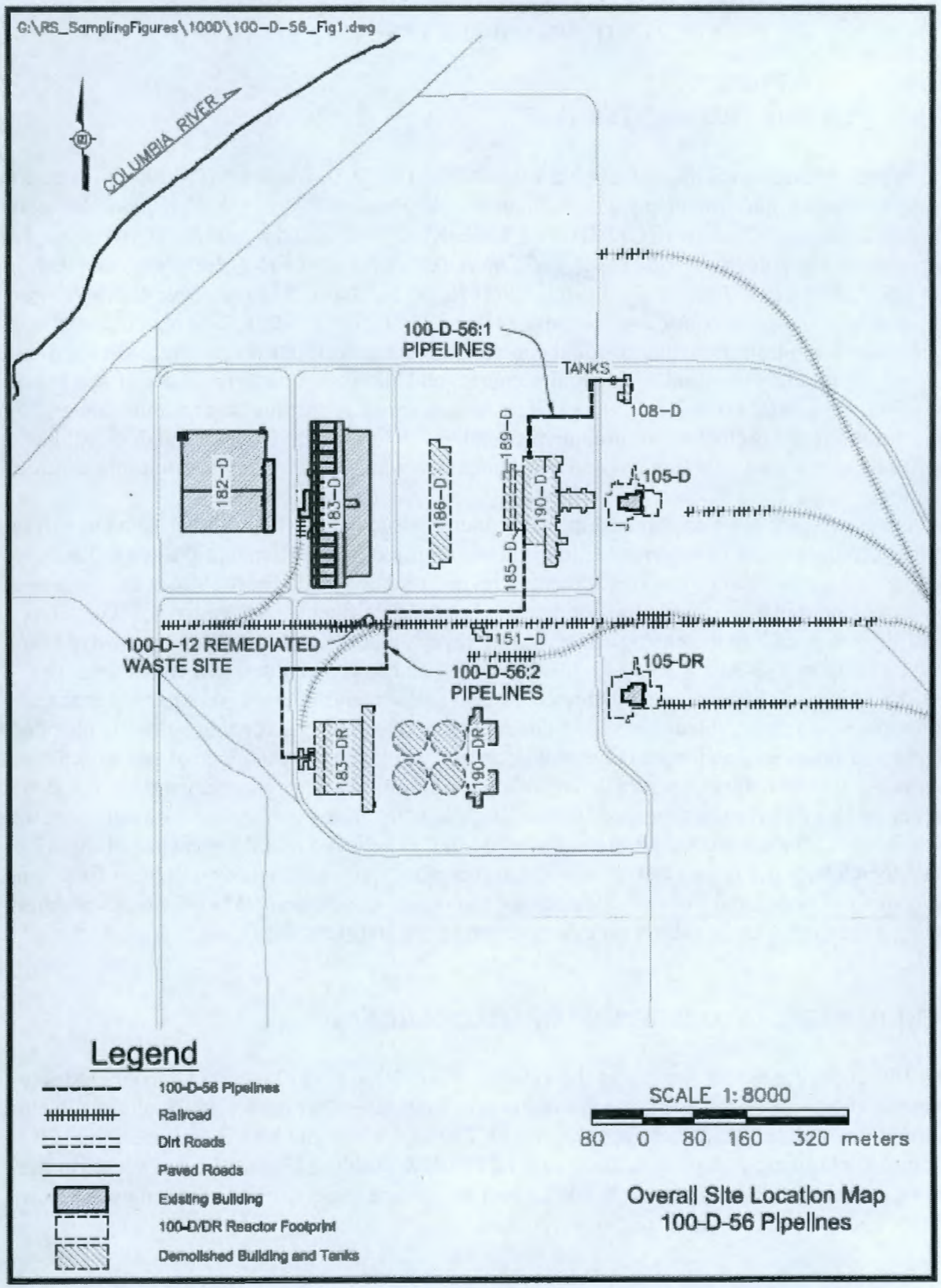
This report demonstrates that the north portion of the 100-D-56 waste site (100-D-56:1) meets the objectives for interim closure as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). The results of the 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). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. The site does not have a deep zone or residual contaminant concentrations that would require any institutional controls.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern, and other constituents (Appendix A). Those constituents exceeding the ecological screening levels in the *Washington Administrative Code* (WAC) Chapter 173-340, Table 749-3, were boron, mercury, selenium, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, manganese, selenium, vanadium, and zinc. Exceeding screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the maximum detected levels of antimony, manganese, vanadium, and zinc are below Hanford Site background levels (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 does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for ecological effects as a part of the final closeout decision for the Columbia River corridor portion of the Hanford Site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-D-56 waste site, located in the 100-DR-1 and 100-DR-2 Operable Units, includes two abandoned 7.6-cm (3-in.)-diameter underground supply lines that transported sodium silicate and sodium dichromate liquids between the 108-D, 190-D, 185-D, and 189-D facilities; the 100-D-12 Sodium Dichromate Pumping Station; and the 183-DR Building (Figure 1) as reported in the Waste Information Data System (WIDS). Sodium silicate and sodium dichromate were stored, mixed, and used in the water treatment process.

Figure 1. 100-D-56 Waste Site Location Map.



The sodium dichromate and sodium silicate supply lines exit the 185-D/190-D Building complex running parallel to each other. One set (100-D-56:1) travels north and east to the108-D Building, and one set (100-D-56:2) travels south and west to the vicinity of the 100-D-12 Sodium Dichromate Pumping Station. The 100-D-56:2 chemical supply lines continue west from the vicinity of the 100-D-12 Sodium Dichromate Pumping Station and then turn south to the 183-DR Building. The length of each pipe section is as follows:

North portion (100-D-56:1):

- 190-D to 108-D: 272 m (892 ft)

South portion (100-D-56:2):

- 185-D to 100-D-12: 352 m (1,155 ft)
- 100-D-12 to 183-DR: 436 m (1,430 ft).

Operational History

The heat generated during reactor operation was removed by pumping cooling water continuously through the reactors. Cooling water was pumped from the Columbia River at the 181-D River Pump House. The water was purified and treated in the 182-D Reservoir and Pump House and in the 183-D Filter Building, deaerated in the 185-D Plant, and then cooled in the 189-D Refrigeration Building (Figure 1). Water then flowed into the 190-D Process Pump House and was delivered to the front risers of the reactor building. Water treatment chemicals were added to prevent (a) excessive corrosion of the slugs or process tubes, (b) excessive film formation on the slugs and tubes, and (c) excessive effluent water radioactivity. Aluminum sulfate, ferric sulfate, sodium silicate, sulfuric acid, chlorine, lime, sodium dichromate, and diatomaceous earth were stored, mixed, and used in the water treatment process (GE 1953).

The 100-D-56 supply lines transported sodium silicate and sodium dichromate solutions. Sodium silicate was used as a coagulation aid to increase the rate of flocculent formulation and to produce a flocculent with stronger filtering characteristics. Sodium silicate was also used to minimize the radionuclides reaching the Columbia River in the reactor effluent water. Sodium dichromate was commonly used as a corrosion inhibitor in reactor coolant solutions.

Historical research indicates that several buildings and waste sites were associated with sodium dichromate use. Originally, from about 1944 until 1950, the receiving, mixing and transfer of sodium dichromate and other water treatment chemicals occurred in the 108-D Building. The chemicals were unloaded from railcars in either bags or barrels. Sodium dichromate was received in crystalline form, dissolved in water, and diluted to a 10% to 15% dichromate solution then transferred to feed tanks in the 105-D and 185-D Buildings (Sharpe 2006). Sufficient sodium dichromate was added to reactor cooling water so that the instantaneous concentration was 2.0 ppm as required by the reactor cooling water specifications (GE 1953).

Initially, mixed sodium dichromate was pumped from the 108-D Building through two different pipelines. One 7.6-cm (3-in.)-diameter overhead pipeline connected to the 105-D Reactor (HEW 1944a, 1944b). The other sodium dichromate pipeline was a below grade 7.6-cm (3-in.)-

diameter pipeline that exited the 108-D Building on the west side in combination with a parallel 7.6-cm (3-in.)-diameter pipeline that transferred sodium silicate to the north side of the 185-D Building. These mixed solutions were injected into the process water systems at the 105-D Reactor and 185-D Building.

A 7.6-cm (3-in.)-diameter sodium dichromate line and a 7.6-cm (3-in.)-diameter sodium silicate line then exited the south side of the 185-D Building and traveled west and then south to the 183-DR Building. These supply lines are associated with the south portion of the 100-D-56 supply lines. Research indicates that the mixing of sodium dichromate into the solution in the 108-D Building and associated pipelines was discontinued in 1950 when the mixing operations were transferred to the 185-D Building as part of Project C-396 (Sharpe 2006).

When the transfer of the sodium dichromate system from the 108-D Building to the 185-D Building was completed, the use of dry material handling was replaced with use of concentrated liquid sodium dichromate that was delivered by railcar and truck to an unloading facility/pumping station (100-D-12). The sodium dichromate pumping station was located south of the 183-D Building, next to the railroad tracks. A 7.6-cm (3-in.)-diameter underground line provided the means to pump stock solution to storage tanks in the 185-D Building (Lerch 1998). This pipeline is identified with the 100-D-56 pipelines in the south portion. The 100-D-12 site was remediated in April 2000 and closed out through a cleanup verification package (BHI 2000).

Historical research of the sodium dichromate mixing operations and field observations during remedial action provided the rationale to perform the verification sampling of the 100-D-56 site after remediation of these chemical supply lines as a north portion (100-D-56:1) and a south portion (100-D-56:2). The north portion of the 100-D-56 waste site (100-D-56:1) consists of the set of pipelines exiting the north side of the 185-D Building that were used during the initial dry material handling operations (Figure 1). The south portion (100-D-56:2) consists of the pipelines that exited the south side of the 185-D Building and continued to be used after the transition to use of concentrated liquid sodium dichromate.

REMEDIAL ACTION SUMMARY

Remediation of the 100-D-56 waste site was initiated in June 2006. Remediation activities consisted of removal and stockpiling of overburden soil to expose the pipelines; tapping, draining, and collection of the pipeline contents; removal and size reduction of the pipelines; and excavation and removal of approximately 0.3 m (1 ft) of soil directly below the pipelines, including stained and contaminated soil that was identified during remediation. Field portable x-ray fluorescence (XRF) instrumentation was used to evaluate residual soil contamination and guide the excavation (Figure 2). Areas of discolored soil were sampled as necessary to support waste characterization, supplement field XRF measurements, and assist in guiding the excavation. The laboratory results for these samples are provided in Appendix B. Stained soil and suspect contaminated soil was staged on plastic until transported to the Environmental Restoration Disposal Facility (ERDF) for disposal. In addition, an approximate 0.3 m (1-ft) layer of soil below the pipeline was removed for disposal. Figure 3 is a photograph taken during remediation showing the exposed pipelines and preparations made to support tapping into the pipelines.

Figure 2. Field Screening Using Field Portable XRF.

Figure 3. 100-D-56 Pipelines Exposed Within the Excavation.

Remedial Action – South Portion (100-D-56:2)

On June 15, 2006, during excavation at the southernmost section of the south portion of the 100-D-56 pipelines, approximately 60 m (197 ft) west of the 183-DR Headhouse, the pipelines were breached, releasing about 110 L (30 gallons) of a reddish-brown liquid from one pipe and a pale green liquid from the other. Upon further investigation it was presumed that the entire section of the 100-D-56 pipelines south of Paddock Street (east-west road between 190-D and 151-D [Figure 1]) contained liquids. These pipelines were later tapped and drained, with a sample of each pipeline collected for laboratory analysis to support waste disposition. The results of these waste characterization samples are provided in Appendix B, Table B-1. Figure 4 provides a December 2006 photograph showing the excavation of the south portion of the 100-D-56 pipelines, including the excavation associated with removal of chromium contaminated debris and soil at the 100-D-30 waste site.

Figure 5 shows the pipelines being tapped for draining and sampling. Figure 6 is a photograph showing the collection of liquids from each pipeline: one pipeline containing sodium silicate and the other sodium dichromate. Additional information concerning the cleanup activities for the south portion of the 100-D-56 pipelines (100-D-56:2) will be provided in the applicable remaining sites verification package (RSVP) after completion of the remediation.

Remedial Action - North Portion (100-D-56:1)

Excavation of the north portion of the 100-D-56 pipelines was initiated on December 18, 2006 and completed on January 10, 2007. Approximately 1,885 bank cubic meters (BCM) of soil and pipeline debris was excavated and disposed of at ERDF. Approximately 1,500 L (400 gal) of liquid were drained and collected from the northern pipelines for disposition at the Effluent Treatment Facility. A final post-excavation civil survey topographic figure of the waste site is presented in Figure 7. Figure 8 is a photograph of the north pipelines exposed during the excavation after removal of overburden. Stained soil and suspect contaminated soil was placed on plastic until it could be shipped to ERDF. In addition, an approximate 0.3 m (1-ft) layer of soil below the pipeline was removed for disposal. Overburden soil removed from above the pipelines was placed in stockpiles and was sampled to verify its acceptance for use as clean backfill. An approximate 20 m (66-ft) length of concrete pipe trench exposed in the 100-D-56:1 pipeline excavation at the northeast end near the decommissioned 108-D Building was removed during the excavation of the 100-D-31:3 pipelines as indicated in Figure 9.

The north 100-D-56 pipeline excavation was performed the same as the south portion. Specifically, the low points of the pipes were tapped; the high points were raised to allow draining and collection of pipe contents; and then this process was repeated with drained pipeline segments cut and removed until the low points in the pipelines were reached. Figure 10 shows the north pipelines tapped for draining.

The north 100-D-56 pipelines did not contain sodium dichromate as was found for the south pipelines. However, sodium silicate liquids were present and the pipes were observed to have significant buildup of interior scale and the exterior was highly corroded in some locations (Figure 11). The differences observed between the south pipelines and the north pipelines likely

Figure 4. Photograph of 100-D-56 (South Portion) and 100-D-30 Excavation (Dated December 6, 2006).

Figure 5. Tapping the Pipelines for Draining.

Figure 6. Draining the Sodium Dichromate and Sodium Silicate Pipelines.

Figure 7. Post-Excavation Civil Survey of 100-D-56:1.

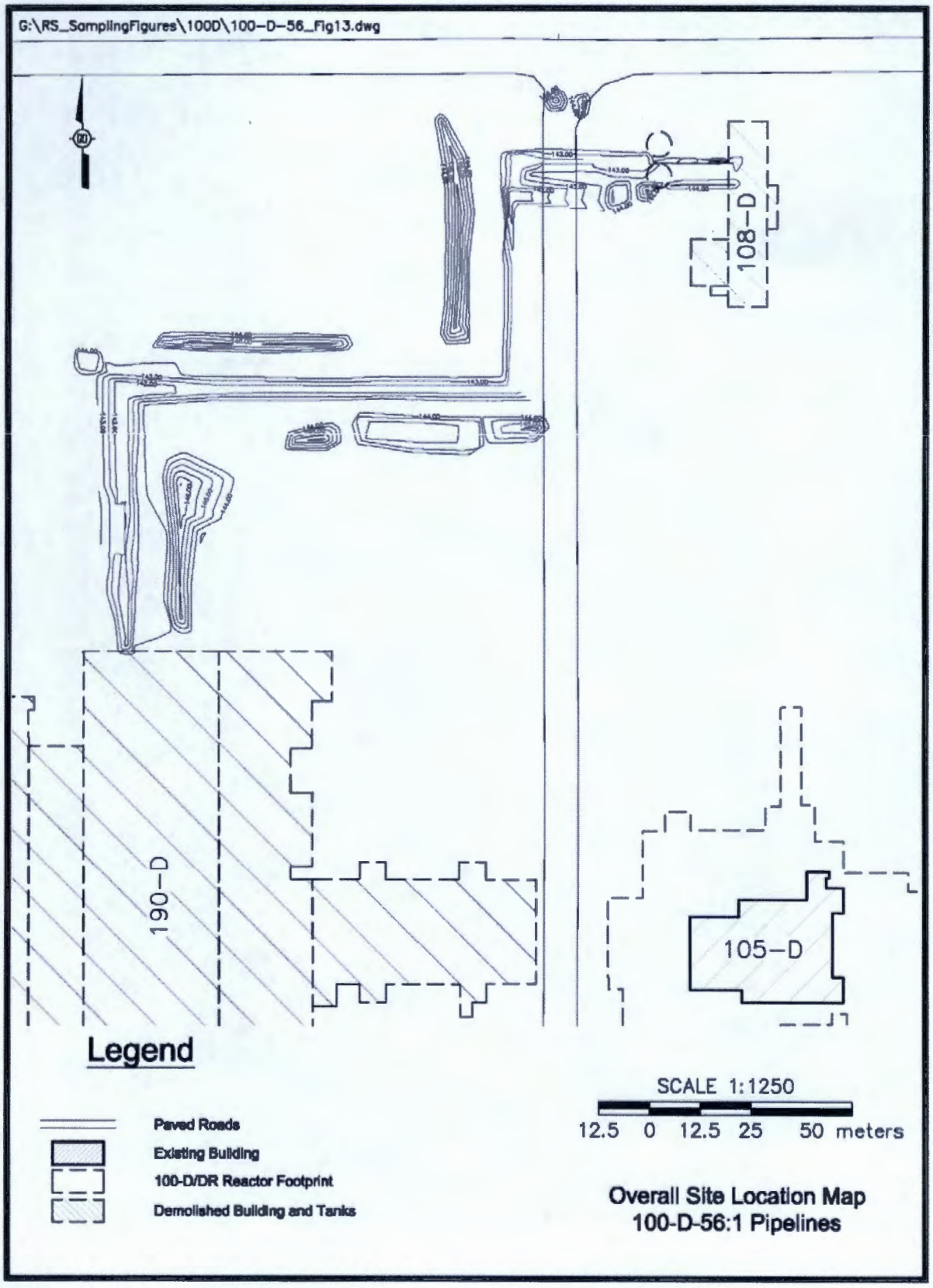


Figure 8. Excavation Exposing Pipelines in the North Portion of 100-D-56.

Figure 9. North Portion of the 100-D-56 Pipeline Excavation.

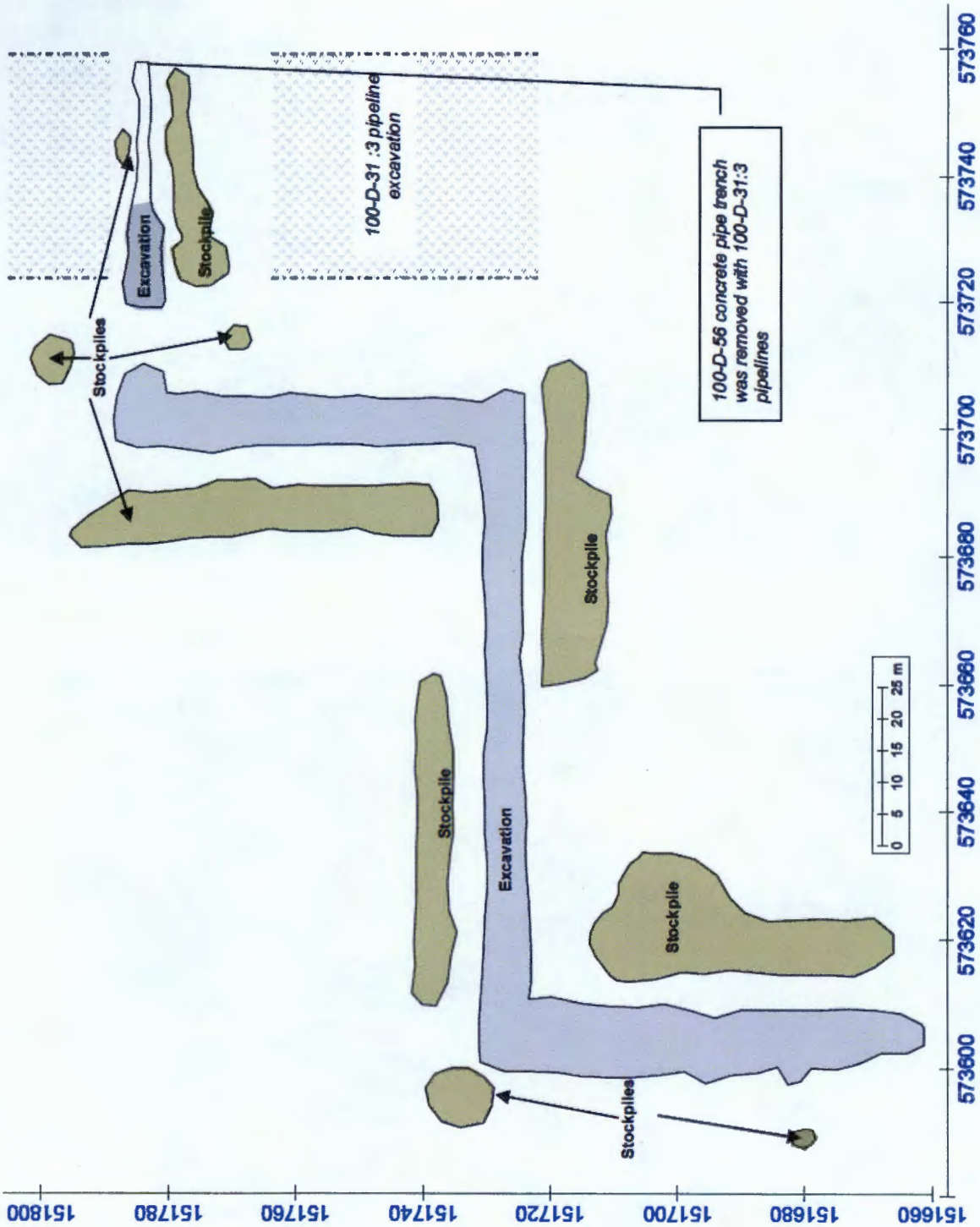
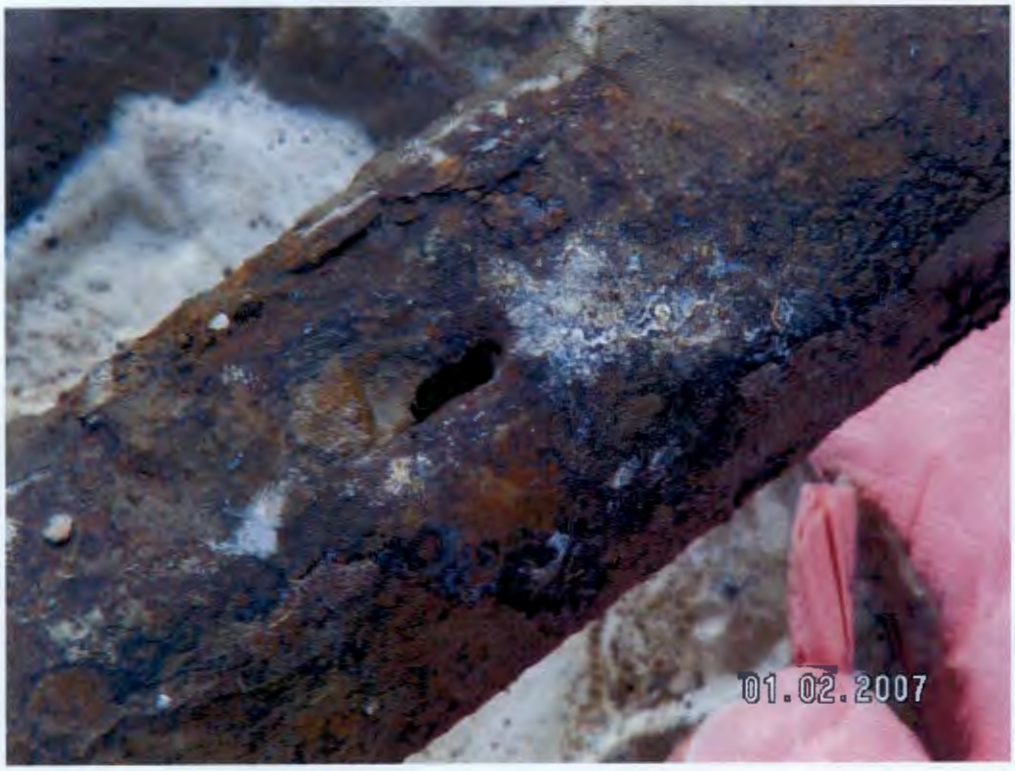


Figure 10. Draining the North Portion Pipelines.

Figure 11. Corroded Pipelines from North Portion.



relate to activities associated with the transfer of the sodium dichromate system from the 108-D Building to the 185-D Building when the use of dry sodium dichromate was replaced with the use of liquid sodium dichromate. It is also probable that the northern lines were completely flushed and not used after the aforementioned change in the sodium dichromate mixing process.

During the pipeline tapping and draining process, water used for dust suppression during the excavation activities entered the pipelines and some of the pipes burst following freezing weather conditions (Figure 12, 13). This resulted in either a frozen, plastic-like material that emerged from some of the pipe breaches (Figure 14) or, in some instances, the material was similar to ice (Figure 13). Samples of the plastic-like material and the ice-like material were collected to support waste characterization. The results (Appendix B, Table B-3) indicated neither material to be a chemical product such as the green liquid in the southern pipeline that was sodium silicate. It is likely that the plastic-like material is a result of using an acrylic polymer absorbent for dust suppression water during remediation activities. However, the manufacturer of the adsorbent indicated that barium is not a constituent used in the adsorbent. Therefore, it is unclear why the barium results were higher for this sample.

A "sump" collection area was excavated and lined with heavy plastic to collect the liquids in anticipation of the pipes thawing. Once the pipes thawed and the fluids collected in the sump, the fluids were transferred to drums and sampled to support waste disposition (Figure 15). The results of this sampling are provided in Appendix B, Table B-3. The pipes were then size reduced for transport to ERDF. During the pipe size-reduction activity, the plastic liner of the sump was compromised and some residual fluids escaped. Additional soil removal was performed at the location of the release.

Figure 12. Frozen Pipe Breach.

Figure 13. Frozen Dust Suppressant Water.

Figure 14. Frozen "Plastic-Like" Material Released from Pipes (J14BL9).

Figure 15. Sampling of Drums Containing Liquid Collected from Pipe Segment Staging Area.

VERIFICATION SAMPLING ACTIVITIES

Verification sampling for the 100-D-56:1 waste site was performed on March 25 and 26, 2008 (WCH 2008a). Verification sampling was performed to support a determination that residual contaminant concentrations at this site meet the cleanup criteria specified in the RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). The verification sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives for the 100-D-56 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of the verification sampling are also summarized to support interim closure of the north portion of the 100-D-56 waste site (100-D-56:1).

Contaminants of Concern and Contaminants of Potential Concern

The COPCs for verification sampling were determined in consideration of process knowledge, field observations, waste sampling information, and in consultation with the Washington State Department of Ecology (Ecology), and are described in the verification sampling work instruction (WCH 2008b). The COPCs included hexavalent chromium, mercury, inductively coupled plasma (ICP) metals, and anions.

Verification Sample Design

A pilot study, or preliminary sampling study, was performed to evaluate residual hexavalent chromium concentrations in the soil after remediation of the 100-D-56 site and support development of the verification soil sample design. A total of 17 statistical soil samples and 2 bias samples were collected from the combined north and south portions of the remediated pipeline areas (Figure 16). Only one sample result (7.5 mg/kg) in the south portion exceeded the cleanup criteria of 2.0 mg/kg hexavalent chromium. Additional soil removal was performed at this location. The results of the pilot study sampling are provided in Appendix B and shown in Figure 16.

A global positioning survey was used to delineate the boundaries of three areas for verification sampling: (1) the footprint of the pipeline excavation, (2) the overburden soil stockpiles, and (3) the pipeline storage (sump) area. Figure 17 shows the excavated area, the location of the soil stockpiles, and the pipeline storage (sump) area.

Statistical sampling of the pipeline excavation and the overburden soil stockpiles was performed because the spatial distribution of potential residual soil contamination over the area was uncertain. The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean of COCs/COPCs, as estimated by the 95% upper confidence limit (UCL) on the sample mean, with the cleanup level. The Washington State Department of Ecology publication *Guidance on Sampling and Data Analysis Methods* (Ecology 1995) recommends that systematic sampling with sample locations distributed over the entire study area be used. Therefore, sampling locations were distributed over the entire footprint of each sampling area using a random-start systematic grid in an effort to determine the potential residual presence of contamination.

Visual Sample Plan[1] (VSP) was used as a tool to develop the statistical sampling design for the north portion of the 100-D-56 waste site. The footprints of the pipeline excavation and the overburden soil stockpiles were delineated in VSP and used as the basis for location of a systematic grid for verification soil sample collection. Twelve verification soil sample locations were identified for the pipeline excavation area and eighteen verification soil samples for the overburden soil stockpiles. Additional details concerning the use of VSP to develop the statistical sampling design is provided in the verification sampling work instruction (WCH 2008b).

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

Figure 16. Pilot Study Hexavalent Chromium Sample Locations and Concentrations (mg/kg).

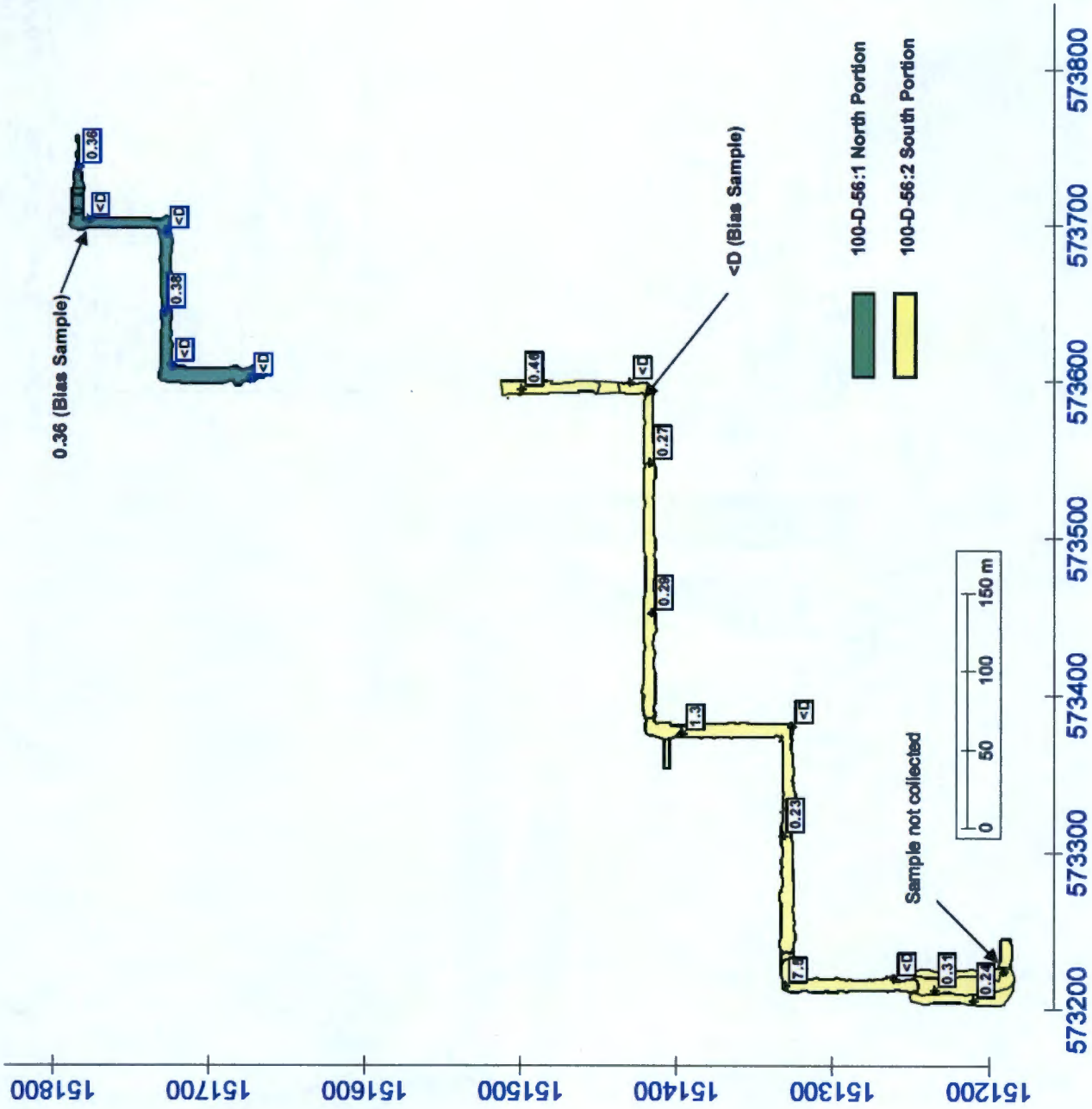
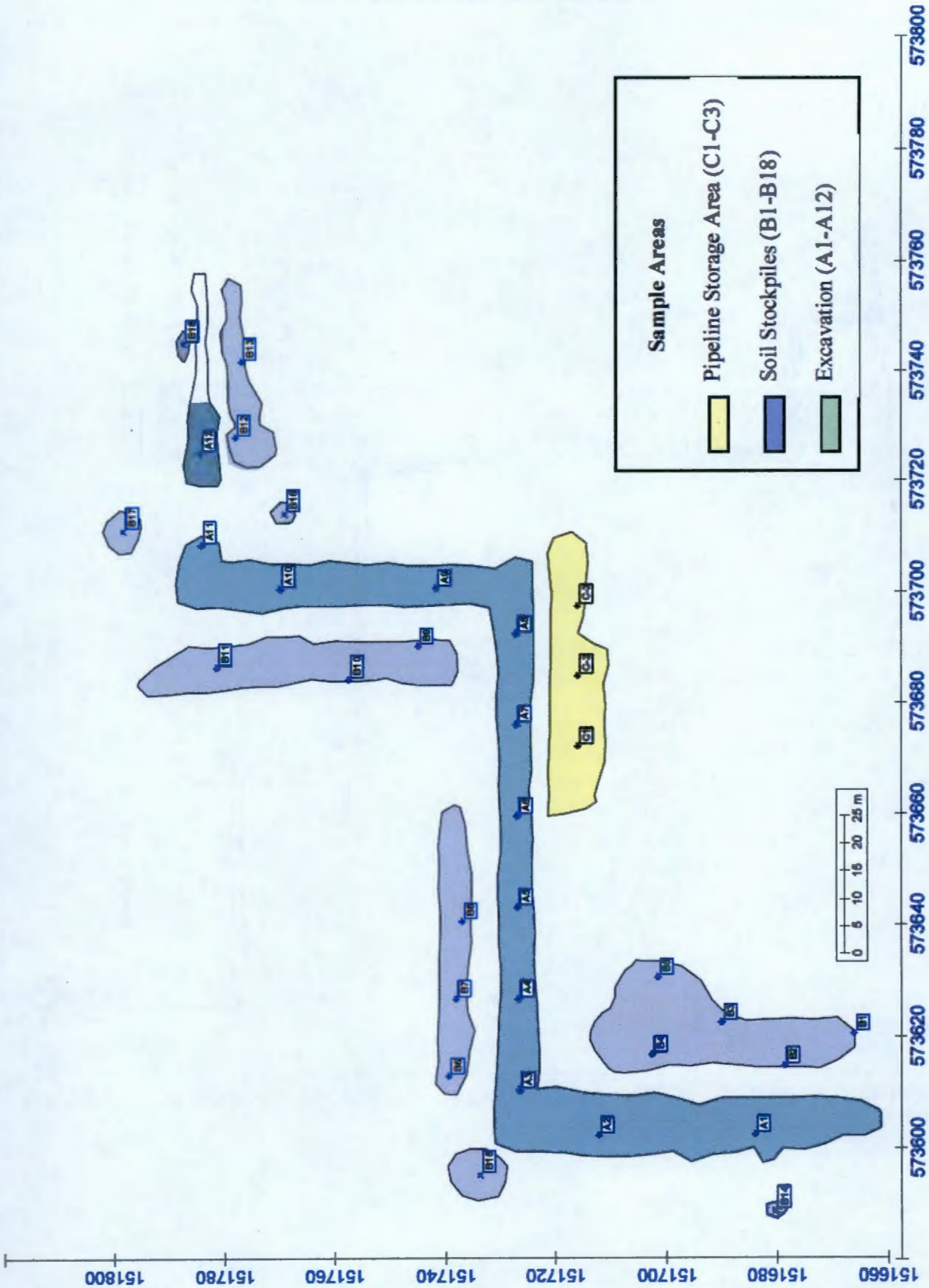


Figure 17. Verification Sample Design for the North Portion of the 100-D-56 Pipelines.



In addition to performing statistical sampling of the pipeline excavation footprint and the overburden soil stockpiles, three focused verification soil samples distributed across the base of the pipeline storage area (sump) were collected. The sample location at C2 is the base of the sump in a low area where liquids collected on the plastic liner. Figure 18 is a photograph of the sump area after the pipes and plastic liner were removed. The focused sample results were compared directly to the cleanup criteria, to verify that residual soil contamination exceeding the cleanup criteria is not present at these locations.

At the request of Ecology, an area within the north portion of the pipeline excavation where the corroded pipelines (see Figure 11) were observed was investigated for potential releases by collecting five judgmental samples at locations below the removed pipelines. Figure 19 provides a map of the judgmental sample locations. The samples were analyzed for hexavalent chromium.

The soil sample locations were surveyed and staked prior to sample collection (WCH 2008a, 2008b), and one discrete soil sample was collected at each location. 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 18. Sump Area After Removal of Pipe Segments.

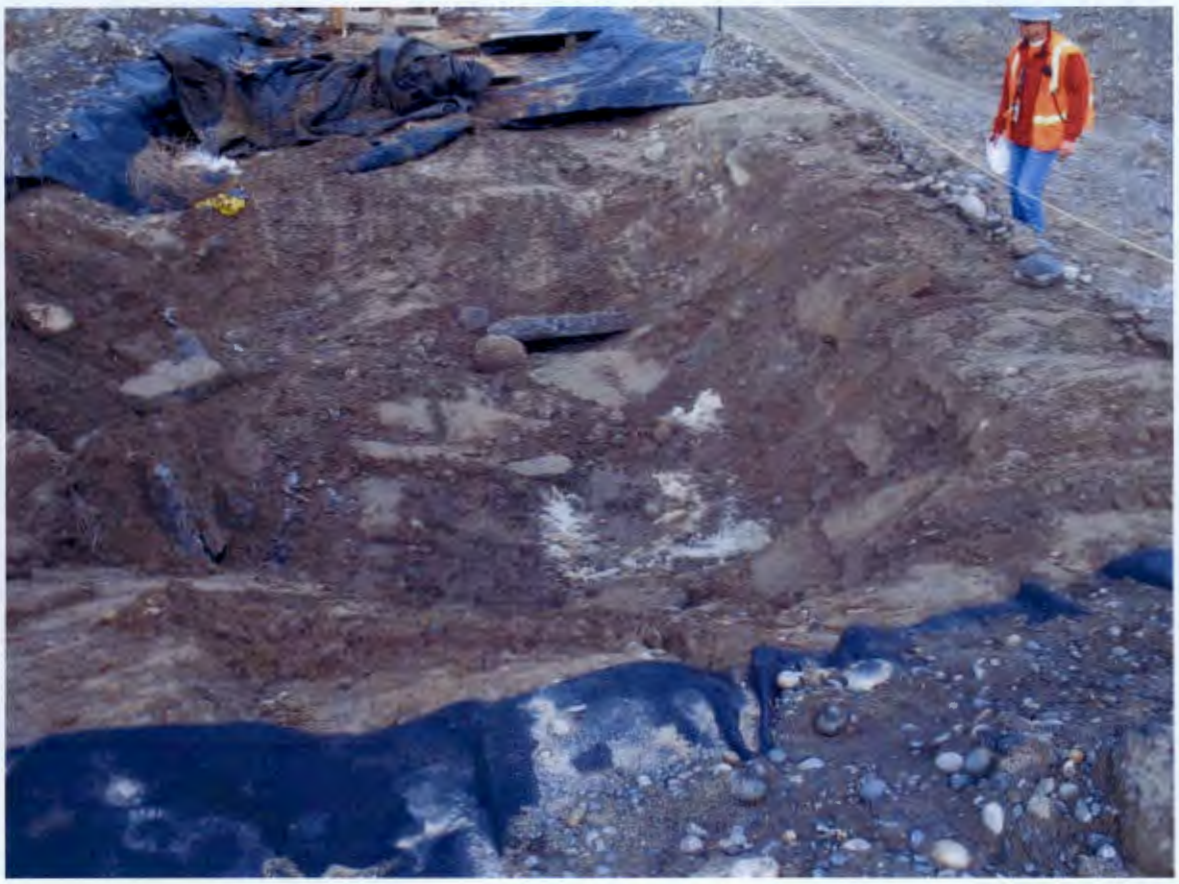
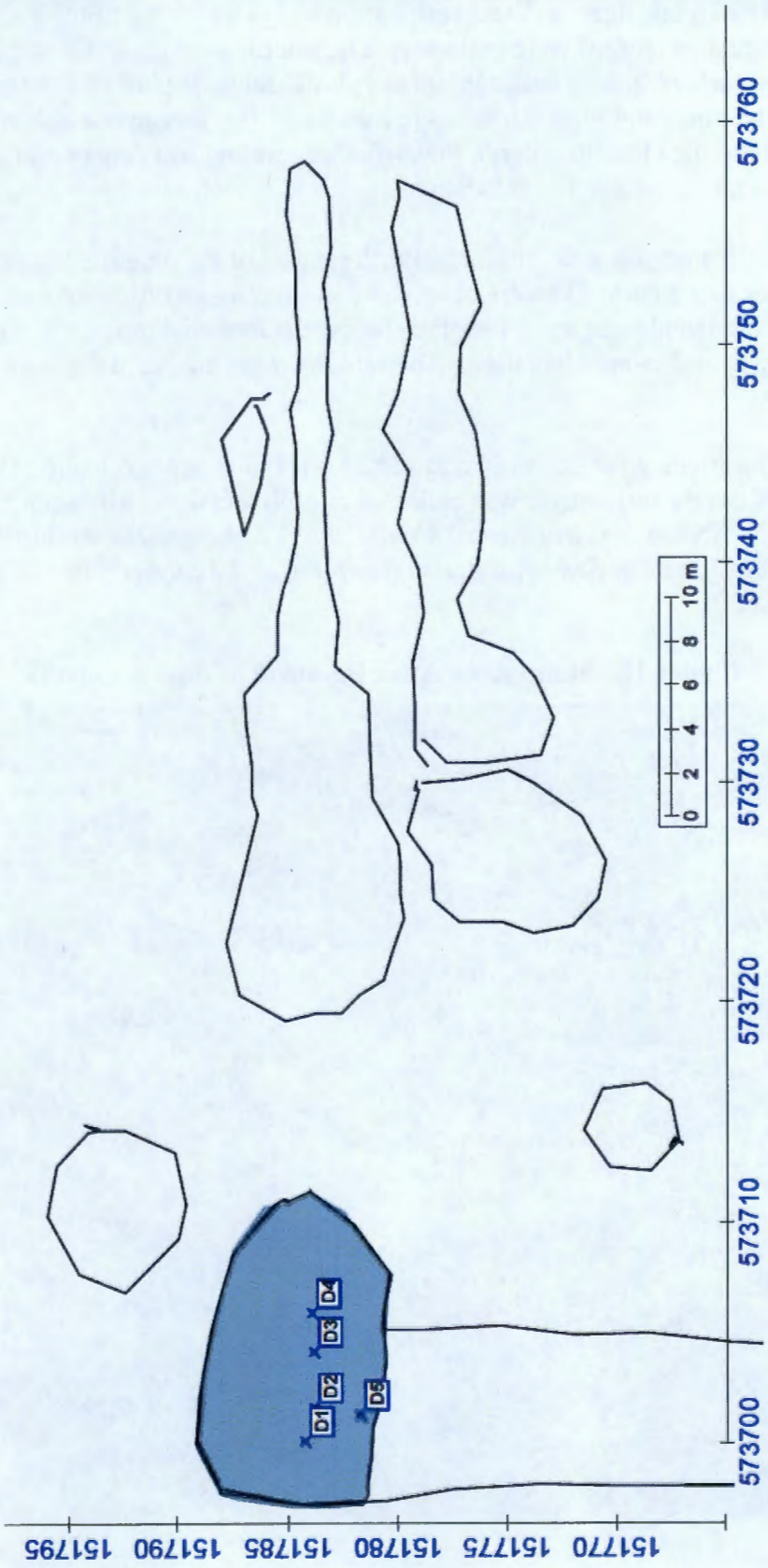


Figure 19. Map of Sample Locations for Evaluation of Corroded Pipeline Area.



Field quality control samples consisted of one equipment blank sample and two field duplicate samples. All samples were submitted for full protocol laboratory analysis. Four split samples were collected for Ecology from sample locations A5 (excavation area), B13 (soil stockpiles), C2 (pipeline storage/sump area), and D2 (corroded pipeline area).

A summary of the verification samples that were collected and the analysis performed is provided in Table 1.

Table 1. Verification Sample Summary for the North Portion of the 100-D-56 Waste Site. (3 Pages)

Sample Location	Sample Media	Sample Coordinates		HEIS Number	Sample Analysis
		Northing	Easting		
Excavation Footprint					
A1	Soil	151684.0	573602.4	J16DM2	ICP metals, mercury, hexavalent chromium, and IC anions
A2	Soil	151712.4	573602.2	J16DM3	ICP metals, mercury, hexavalent chromium, and IC anions
A3	Soil	151726.7	573610.3	J16DM4	ICP metals, mercury, hexavalent chromium, and IC anions
A4	Soil	151726.8	573626.8	J16DM5	ICP metals, mercury, hexavalent chromium, and IC anions
A5	Soil	151726.9	573643.2	J16DM6	ICP metals, mercury, hexavalent chromium, and IC anions
A6	Soil	151727.0	573659.6	J16DM8	ICP metals, mercury, hexavalent chromium, and IC anions
A7	Soil	151727.1	573676.0	J16DM9	ICP metals, mercury, hexavalent chromium, and IC anions
A8	Soil	151727.2	573692.4	J16DN0	ICP metals, mercury, hexavalent chromium, and IC anions
A9	Soil	151741.5	573700.5	J16DN1	ICP metals, mercury, hexavalent chromium, and IC anions
A10	Soil	151769.9	573700.3	J16DN2	ICP metals, mercury, hexavalent chromium, and IC anions
A11	Soil	151784.2	573708.4	J16DN3	ICP metals, mercury, hexavalent chromium, and IC anions
A12	Soil	151784.3	573724.8	J16DN4	ICP metals, mercury, hexavalent chromium, and IC anions
Soil Stockpiles					
B1	Soil	151666.2	573620.6	J16DN6	ICP metals, mercury, hexavalent chromium, and IC anions
B2	Soil	151678.7	573614.7	J16DN7	ICP metals, mercury, hexavalent chromium, and IC anions
B3	Soil	151690.2	573622.6	J16DN8	ICP metals, mercury, hexavalent chromium, and IC anions
B4	Soil	151702.8	573616.7	J16DN9	ICP metals, mercury, hexavalent chromium, and IC anions
B5	Soil	151701.6	573630.6	J16DP0	ICP metals, mercury, hexavalent chromium, and IC anions

Table 1. Verification Sample Summary for the North Portion of the 100-D-56 Waste Site. (3 Pages)

Sample Location	Sample Media	Sample Coordinates		HEIS Number	Sample Analysis
		Northing	Easting		
B6	Soil	151739.4	573612.8	J16DP1	ICP metals, mercury, hexavalent chromium, and IC anions
B7	Soil	151738.2	573626.7	J16DP2	ICP metals, mercury, hexavalent chromium, and IC anions
B8	Soil	151737.0	573640.6	J16DP3	ICP metals, mercury, hexavalent chromium, and IC anions
B9	Soil	151744.9	573690.1	J16DP4	ICP metals, mercury, hexavalent chromium, and IC anions
B10	Soil	151757.5	573684.2	J16DP5	ICP metals, mercury, hexavalent chromium, and IC anions
B11	Soil	151781.5	573686.2	J16DP6	ICP metals, mercury, hexavalent chromium, and IC anions
B12	Soil	151778.0	573727.8	J16DP7	ICP metals, mercury, hexavalent chromium, and IC anions
B13	Soil	151776.8	573741.7	J16DP8	ICP metals, mercury, hexavalent chromium, and IC anions
B14	Soil	151733.8	573595.3	J16DR0	ICP metals, mercury, hexavalent chromium, and IC anions
B15	Soil	151680.3	573588.9	J16DR1	ICP metals, mercury, hexavalent chromium, and IC anions
B16	Soil	151769.1	573714.1	J16DR2	ICP metals, mercury, hexavalent chromium, and IC anions
B17	Soil	151787.4	573744.8	J16DR3	ICP metals, mercury, hexavalent chromium, and IC anions
B18	Soil	151798.1	573710.9	J16DR4	ICP metals, mercury, hexavalent chromium, and IC anions
Pipeline Storage/Sump Area					
C1	Soil	151716.0	573672.2	J16DR6	ICP metals, mercury, hexavalent chromium, and IC anions
C2	Soil	151716.0	573684.9	J16DR7	ICP metals, mercury, hexavalent chromium, and IC anions
C3	Soil	151716.0	573697.5	J16DR8	ICP metals, mercury, hexavalent chromium, and IC anions
Corroded Pipe Investigation Area					
D1	Soil	573700.1	151784.2	J16DT0	Hexavalent chromium
D2	Soil	573701.6	151783.8	J16DT1	Hexavalent chromium
D3	Soil	573704.1	151783.8	J16DT2	Hexavalent chromium
D4	Soil	573705.9	151783.9	J16DT3	Hexavalent chromium
D5	Soil	573701.3	151781.7	J16DT4	Hexavalent chromium
Field Quality Control Samples					
Duplicate of J16DM6	Soil	151726.9	573643.2	J16DM7	ICP metals, mercury, hexavalent chromium, and IC anions
Duplicate of J16DP8	Soil	151776.8	573741.7	J16DP9	ICP metals, mercury, hexavalent chromium, and IC anions

Table 1. Verification Sample Summary for the North Portion of the 100-D-56 Waste Site. (3 Pages)

Sample Location	Sample Media	Sample Coordinates		HEIS Number	Sample Analysis
		Northing	Easting		
Equipment blank	Silica sand	NA	NA	J16DM1	ICP metals, mercury, hexavalent chromium, and IC anions
Ecology Split Samples					
Split of J16DM6	Soil	151726.9	573643.2	J16DN5	ICP metals, mercury, hexavalent chromium, and IC anions
Split of J16DP8	Soil	151776.8	573741.7	J16DR5	ICP metals, mercury, hexavalent chromium, and IC anions
Split of J16DR7	Soil	151716.0	573684.9	J16DR9	ICP metals, mercury, hexavalent chromium, and IC anions
Split of J16DT1	Soil	573701.6	151783.8	J16DT5	ICP metals, mercury, hexavalent chromium, and IC anions

HEIS = Hanford Environmental Information System
IC = Ion Chromatography
ICP = Inductively Coupled Plasma
NA = not available

Verification Sampling Results

Verification samples were analyzed using U.S. Environmental Protection Agency-approved analytical methods (DOE-RL 2009a). Evaluation of the verification data from the 100-D-56:1 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 is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each detected COC or COPC are computed for each of the 100-D-56:1 decision units as specified by the RDR/RAWP (DOE-RL 2009b), with calculations provided in Appendix C. When a nonradionuclide COC or COPC was detected in fewer than 50% of the verification samples collected for the area, the maximum detected value was used for comparison to remedial action goals (RAGs). If no detections for a given COC/COPC were reported in the data set, then no statistical evaluation or calculations were performed for that COC/COPC.

Evaluation of the focused verification sample data from the pipeline storage (sump) area and the corroded pipeline investigation area was performed by direct comparison of the maximum sample results for each COC/COPC against cleanup criteria. Hexavalent chromium was not detected in any of the focused soil samples collected from the corroded pipeline investigation area.

Comparisons of the statistical and maximum results for COCs and COPCs against the site RAGs for each area are summarized in Tables 2a through 2c. Contaminants that were not detected by laboratory analysis are excluded from these tables. Phosphate was detected in the samples, but is present as an essential nutrient and therefore not included in the tables (EPA 1989). Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database

Table 2a. Comparison of Maximum or Statistical Contaminant Concentrations to Action Levels for the North Portion of the 100-D-56 Excavation Verification Sampling Event.

COPC	Statistical or Maximum Result (mg/kg) [a]	Soil Cleanup Levels, (mg/kg) [b]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Antimony	1.1 (<BG)	32	5 [c]	5 [c]	No	--
Arsenic	2.5 (<BG)	20	20	20	No	--
Barium	59.4 (<BG)	5,600	132 [c]	224	No	--
Beryllium	0.50 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Boron [e]	1.6	16,000	320	NA	No	--
Cadmium	0.26 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium, total	10.5 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	7.3 (<BG)	1,600	32	NA	No	--
Copper	14.1 (<BG)	2,960	59.2	22.0 [c]	No	--
Hexavalent chromium	0.28	2.1 [d]	4.8	2	No	--
Lead	4.2 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	289 (<BG)	11,200	512 [c]	512 [c]	No	--
Mercury	0.02 (<BG)	24	0.33 [c]	0.33 [c]	No	--
Nickel	10.8 (<BG)	1,600	19.1 [c]	27.4	No	--
Selenium	1.5	400	5	1	Yes	Yes [f]
Vanadium	49.3 (<BG)	560	85.1 [c]	NA	No	--
Zinc	51.3 (<BG)	24,000	480	67.8 [c]	No	--
Nitrate (as Nitrogen)	6.6 [g]	128,000	1,000	2,000	No	--
Sulfate	19.3 (<BG)	NA	25,000	NA	No	--

[a] The statistical or maximum values for each COPC is determined in the 95% UCL calculation, which can be located in Appendix C, page C-5.

[b] RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d].

[d] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3]) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (WDOH 1997).

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

[f] Based on RESRAD modeling as discussed in Appendix C of the RDR/RAWP (DOE/RL 2009b), the residual concentration of selenium is not expected to migrate more than 15 m (49 ft) vertically in 1,000 years based on the soil-partitioning distribution coefficient for selenium of 5 mL/g. The vadose zone underlying the site at the base of the excavation is approximately 24 m (79 ft) thick Therefore, residual concentrations of selenium are predicted to be protective of groundwater and the Columbia River.

[g] EPA Method 300.0 result for nitrate of 29.4 mg/kg as nitrate converted to nitrogen-mass concentration basis by multiplying by a factor of 0.2259.

-- = not applicable
BG = background
COPC = contaminant of potential concern
EPA = U.S. Environmental Protection Agency
NA = not available
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose assessment model)
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Table 2b. Comparison of Maximum or Statistical Contaminant Concentrations to Action Levels for the North Portion of the 100-D-56 Soil Stockpiles Verification Sampling Event.

COPC	Statistical or Maximum Result (mg/kg)a	Soil Cleanup Levels, (mg/kg)[b]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Antimony	2.5 (<BG)	32	5[c]	5[c]	No	--
Arsenic	3.5 (<BG)	20	20	20	No	--
Barium	70.4 (<BG)	5,600	132[c]	224	No	--
Beryllium	0.57 (<BG)	10.4[d]	1.51[c]	1.51[c]	No	--
Boron[e]	24.2	16,000	320	NA	No	--
Cadmium	0.16 (<BG)	13.9	0.81[c]	0.81[c]	No	--
Chromium, total	10.2 (<BG)	80,000	18.5[c]	18.5[c]	No	--
Cobalt	8.3 (<BG)	1,600	32	NA	No	--
Copper	16.2 (<BG)	2,960	59.2	22.0[c]	No	--
Hexavalent chromium	0.31	2.1[d]	4.8	2	No	--
Lead	10.2 (<BG)	353	10.2[c]	10.2[c]	No	--
Manganese	327 (<BG)	11,200	512[c]	512[c]	No	--
Mercury	0.33	24	0.33[c]	0.33[c]	No	--
Molybdenum[e]	0.95	400	8	NA	No	--
Nickel	11.1 (<BG)	1,600	19.1[c]	27.4	No	--
Selenium	2.1	400	5	1	Yes	Yes[f]
Vanadium	58.9 (<BG)	560	85.1[c]	NA	No	--
Zinc	65.8 (<BG)	24,000	480	67.8[c]	No	--
Chloride	8.5 (<BG)	NA	25,000	NA	No	--
Fluoride	3.3	4,800	96	400	No	--
Nitrate (as Nitrogen)	16.2[g]	128,000	1,000	2,000	No	--
Nitrite (as Nitrogen)	1.2[h]	8,000	100	200	No	--
Sulfate	95.5 (<BG)	NA	25,000	NA	No	--

[a] The statistical or maximum values for each COPC is determined in the 95% UCL calculation which can be located in Appendix C, page B-6.

[b] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d].

[d] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3]) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (WDOH 1997).

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

[f] Based on RESRAD modeling as discussed in Appendix C of the RDR/RAWP (DOE/RL 2009b), the residual concentration of selenium is not expected to migrate more than 15 m (49 ft) vertically in 1,000 years based on the soil-partitioning distribution coefficient for selenium of 5 mL/g. The vadose zone underlying the site at the base of the excavation is approximately 24 m (79 ft) thick Therefore, residual concentrations of selenium are predicted to be protective of groundwater and the Columbia River.

[g] EPA Method 300.0 result for nitrate of 71.7 mg/kg as nitrate converted to nitrogen-mass concentration basis by multiplying by a factor of 0.2259.

[h] EPA Method 300.0 result for nitrite of 4.08 mg/kg as nitrate converted to nitrogen-mass concentration basis by multiplying by a factor of 0.3045.

-- = not applicable
BG = background
COPC = contaminant of potential concern
EPA = U.S. Environmental Protection Agency
NA = not available
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose assessment model)
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Table 2c. Comparison of Maximum Contaminant Concentrations to Action Levels for the North Portion of the 100-D-56 Pump Sump/Storage Area Verification Sampling Event.

COPC	Maximum Result (mg/kg)	Soil Cleanup Levels, (mg/kg)[a]			Does the Maximum Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Protective of Groundwater	Protective of the River		
Antimony	1.0 (<BG)	32	5[b]	5[b]	No	--
Arsenic	3.2 (<BG)	20	20	20	No	--
Barium	60.9 (<BG)	5,600	132[b]	224	No	--
Beryllium	0.55 (<BG)	10.4[c]	1.51[b]	1.51[b]	No	--
Boron[d]	1.8	16,000	320	NA	No	--
Chromium, total	11.8 (<BG)	80,000	18.5[b]	18.5[b]	No	--
Cobalt	7.6 (<BG)	1,600	32	NA	No	--
Copper	14.6 (<BG)	2,960	59.2	22.0[b]	No	--
Hexavalent chromium	0.28	2.1[c]	4.8	2	No	--
Lead	5.0 (<BG)	353	10.2[b]	10.2[b]	No	--
Manganese	339 (<BG)	11,200	512[b]	512[b]	No	--
Mercury	0.01 (<BG)	24	0.33[b]	0.33[b]	No	--
Nickel	13.1 (<BG)	1,600	19.1[b]	27.4	No	--
Silver	0.24 (<BG)	400	8	0.73[b]	No	--
Vanadium	51.5 (<BG)	560	85.1[b]	NA	No	--
Zinc	45.9 (<BG)	24,000	480	67.8[b]	No	--
Chloride	4.4 (<BG)	NA	25,000	NA	No	--
Nitrate (as Nitrogen)[e]	1.99 (<BG)	128,000	1,000	2,000	No	--
Sulfate	11.7 (<BG)	NA	25,000	NA	No	--

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

[b] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700[4][d].

[c] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3]) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (WDOH 1997).

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

[e] EPA Method 300.0 result for nitrate of 8.83 mg/kg as nitrate converted to nitrogen-mass concentration basis by multiplying by a factor of 0.2259.

-- = not applicable
BG = background
COPC = contaminant of potential concern
NA = not available
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

(Ecology 2011) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site COPCs and are also not included in these tables. 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 laboratory-reported data results for all constituents are stored in the Environmental Restoration (ENRE) project-specific database prior to submitting to the Hanford

Environmental Information System (HEIS) and are presented as an attachment to the statistical calculations in Appendix C.

VADOSE BOREHOLE INFORMATION

At the request of Ecology, a vadose characterization borehole, completed as a temporary groundwater monitoring well, was drilled May 2011 to evaluate the subsurface soil below the base of the corroded pipes. This borehole, 199-D5-143 (C8375) was drilled and sampled as specified in the *Integrated 100 Area Remediation Investigation/Feasibility Study Work Plan* (DOE/RL 2010). The borehole was located at N151784.26 and E573701.53. Groundwater was encountered at a depth of 25.1 m (82.5 ft). The borehole log and a summary of the laboratory results for the soil samples that were collected are provided in Appendix D. Strontium-90 was detected in a single sample, with an activity of 1.06 pCi/g and at a depth of (22 m) 72 ft. Tritium was detected in several samples with a maximum activity of 3.6 pCi/g, at a depth of 17.5 m (57.5 ft). Boron, molybdenum, and tin were detected at concentrations less than the laboratory practical quantification limit, with the exception of one sample detecting molybdenum at 5.9 mg/kg; these results were all below the soil cleanup criteria. Strontium was detected throughout the vadose zone with concentrations ranging from 12.2 mg/kg to 57 mg/kg and all detections were well below soil cleanup criteria.

Hexavalent chromium was not detected in any interval in borehole C8375. However, total chromium was detected above background in five samples collected below a depth of 15.8 m (52 ft) with a maximum concentration of 39.5 mg/kg. Elevated total chromium has also been detected at depth in multiple RI/FS borings, including several that were not proximal to any known waste site. These Remedial Investigation/Feasibility Study (RI/FS) samples, with elevated total chromium, also frequently had elevated nickel and molybdenum concentrations. These observations concerning total chromium and possible contributing factors are addressed and considered further within the context of the RI for 100-D Area. Additionally, RESRAD modeling predicts that this total chromium, having a K_d value of 200 mL/g, will not contribute to the existing chromium groundwater plume at 100-D within a 1,000 year period. The results of this evaluation of the subsurface vadose zone below the pipeline excavation did not identify any residual contamination due to potential releases from the corroded pipelines.

DATA EVALUATION

This section demonstrates that remedial actions at the 100-D-56:1 waste site have achieved 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 RDR/RAWP (DOE-RL 2009b).

Attainment of Nonradionuclide RAGS

Evaluation of the verification sampling results in Tables 2a through 2c show that all direct exposure and groundwater protection cleanup levels are met for the north portion of the

100-D-56 waste site (100-D-56:1). Selenium was the only contaminant detected exceeding the Columbia River protection RAG in a single sample collected from each of the excavation footprint and soil stockpile sample areas. However, given the soil-partitioning coefficient (K_d) for selenium of 5 ml/g, the residual concentration of selenium is not expected to migrate more than 15 m (49 ft) vertically in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in the RDR/RAWP (DOE/RL 2009b). The vadose zone between the base of the excavation and groundwater at the site is 24 m (79 ft) thick. Therefore, the remediation of the 100-D-56:1 waste site is protective of groundwater and the Columbia River.

All other COPCs for the north portion of the 100-D-56 waste site were not detected or were quantified below RAGs, with the exception of mercury; mercury was detected at the soil cleanup level for groundwater and river protection in a single sample. Given the K_d for mercury of 30 mL/g, RESRAD predicts the residual concentration of mercury will not migrate more than 2 m (6.6 ft) in 1,000 years and is 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 can 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-D-56:1 waste site is included in the statistical calculations (Appendix C). The results of this evaluation indicate that all residual COC/COPC concentrations pass the three-part test in comparison against applicable RAGs, with the exception of lead and zinc in the soil stockpile sample area. Five of the eighteen statistical sample results for lead (with values ranging from 10.4 mg/kg through 17.7 mg/kg) exceed the soil RAG for protection of groundwater and the river (10.2 mg/kg), failing the third criterion of the three-part test. Three of the eighteen statistical sample results for zinc (with values of 75.1 mg/kg, 85.8 mg/kg, and 132 mg/kg) exceed the protection of the river (67.8 mg/kg), also failing the third criterion of the three-part test. However, RESRAD modeling predicts that compounds having a K_d greater than 4 mL/g will not migrate through the 24 m (79-ft-) thick vadose zone between the base of the excavation and groundwater at the site (BHI 2005). The K_d for lead and zinc is 30 mL/g, and therefore these constituents are not predicted to migrate through the vadose zone within 1,000 years and residual concentrations are protective of groundwater and the Columbia River.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the north portion of the 100-D-56 waste site (100-D-56:1) is determined by calculation of the hazard quotient and carcinogenic (excess cancer) risk values for nonradionuclides. These calculations are located in Appendix C. The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. These risk values were conservatively calculated for the entire waste site using the highest values from each of the sampling areas.

Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The calculations indicated that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-D-56:1 waste site is 1.2×10^{-2}. All individual cumulative carcinogenic risk values are less than 1×10^{-6}. The cumulative carcinogenic risk value is 1.5×10^{-7}. Therefore, nonradionuclide risk requirements are met.

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-D-56:1 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 waste site using the highest value for each COPC from each of the decision units. Risk values were calculated for constituents that were detected at concentrations above Hanford Site or Washington State background values or for which there is no background value. In addition, the distribution coefficients for these contaminants are less than that necessary to show no migration to groundwater in 1,000 based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b). Based on this model and a vadose zone of approximately 24 m (74 ft), a distribution coefficient of 4.0 or greater is required to show no predicted migration to groundwater in 1,000 years. All individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-D-56:1 waste site is 1.9×10^{-1}, which is less than 1.0. No carcinogenic constituents met the criteria for calculation of a protection of groundwater carcinogen risk; therefore, no calculations of excess cancer risk were performed. Nonradionuclide risk requirements related to groundwater are met.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) is performed to compare the verification sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA for the 100-D-56:1 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 ENRE project-specific database for data evaluation prior to their archival in the HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix E.

SUMMARY FOR INTERIM CLOSURE

The north portion of the 100-D-56 waste site (100-D-56:1) has been evaluated and remediated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009b). Statistical sampling to verify the completeness of remediation was performed, and analytical results were shown to meet the applicable cleanup objectives for direct exposure, groundwater

protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the north portion of the 100-D-56 (100-D-56:1) waste site to Interim Closed Out. The site does not have a deep zone or residual contaminant concentrations that would require any institutional controls.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Contaminants Exceeding Ecological Screening Levels for the 100-D-56:1 Waste Site [a].

Hazardous Substance		2007 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Waste Site Analyses
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
Metals (mg/kg):									
	Background								
Antimony	5	5				78		0.27	2.5 (<BG)
Boron [d]		0.5							24.2
Manganese	512	1,100 [e]		1,500	220	450	4,300	4,000	339 (<BG)
Mercury, inorganic	0.33	0.3	0.1	5.5					0.33
Selenium	0.78	1	70	0.3	0.52	4.1	1.2	0.63	2.1
Vanadium	85.1	2					7.8	280	51.5 (<BG)
Zinc	67.8	86 [f]	200	360	160	120	46	79	65.8 (<BG)

Note: Shaded cells are exceeded by the maximum or the statistical result.
Blank cells = Values not available.

[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] No Hanford Site-specific or Washington State background available.
[f] Benchmark replaced by Washington State natural background concentration from *Natural Background Soil Metals Concentrations in Washington State*, Publication 94-115, Washington State Department of Ecology, Olympia, Washington (Ecology 1994).

BG = background
EPA = U.S. Environmental Protection Agency
WAC = *Washington Administrative Code*

APPENDIX B

WASTE CHARACTERIZATION AND IN-PROCESS SAMPLING RESULTS SUMMARY

Table B-1. Radiological Waste Characterization Data for Pipeline Contents.

Sample Location	HEIS Number	Sample Date	Americium-241 GEA			Cesium-137			Cobalt-60			Curium-243			Curium-245			Europium-152		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
West pipe; clear light green liquid	J13547	8/16/06																		
East pipe; red liquid	J13548	8/15/06																		
Soil	J13HY2	10/5/06	0.0124			0.0288	U	0.23	0.0256	U	0.287							0.0124	U	0.184
Drummed Liquid	J14HX0	3/7/07	-0.406			0.0492	U	0.1	0.0467	U	0.11	0.0084	U	0.169	0.0057	U	0.115	0.0181	U	0.136

Sample Location	HEIS Number	Sample Date	Europium-154			Europium-155			Gross alpha			Gross beta			Lead-212			Niobium-94		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
West pipe; clear light green liquid	J13547	8/16/06							0.009	U	0.017	0.006	U	0.011						
East pipe; red liquid	J13548	8/15/06							-0.486	U	2	-0.959	U	2.3						
Soil	J13HY2	10/5/06	0.00863	U	0.13	0.169	U	0.178												
Drummed Liquid	J14HX0	3/7/07	0.00187	U	0.0972	-0.0629	U	0.114	-0.723	U	1.5	0.638	U	1.1	0.407	U	0.246	-0.0507	U	0.0955

Sample Location	HEIS Number	Sample Date	Postassium-40			Radium-226			Radium-228			Silver-108 metastable			Thorium-228 GEA			Thorium-232 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
West pipe; clear light green liquid	J13547	8/16/06																		
East pipe; red liquid	J13548	8/15/06																		
Soil	J13HY2	10/5/06	13.6		2.13	0.947	U	2.28				0.0605	U	0.13						
Drummed Liquid	J14HX0	3/7/07	3.78	U	2.03				0.855	U	0.188	-0.0107	U	0.0841				0.0785	U	0.142

Sample Location	HEIS Number	Sample Date	Thorium-234 GEA			Uranium-235			Uranium-238-		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
West pipe; clear light green liquid	J13547	8/16/06									
East pipe; red liquid	J13548	8/15/06									
Soil	J13HY2	10/5/06	0.419	U	0.993	0.0636	U	0.142			
Drummed Liquid	J14HX0	3/7/07				-0.151	U	0.103	1.38	U	0.842

GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
MDA = minimum detectable activity
PQL = practical quantitation limit
Q = qualifier
U = undetected

Table B-2. Inorganic Waste Characterization Data for Pipeline Contents.

Sample Description	HEIS Number	Sample Date	Arsenic			Barium			Bromide			Cadmium			Chloride			Chromium		
			ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
West pipe; clear light green liquid	J13547	08/16/06	30.5	U		28.7	C		500	UD		3.5	U		1800	D		6110		
East pipe; red liquid	J13548	08/15/06	2930	U	2930	528		96	10,000	UD	10,000	336	U	336	196,000	D	10,000	40,800,000		624

Sample Description	HEIS Number	Sample Date	Flouride			Lead			Mercury			Nitrate			Nitrite			pH		
			ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	pH Units	Q	PQL
West pipe; clear light green liquid	J13547	08/16/06	500	UD		15.5	U		55			500	UD		500	UD		9.9		0.01
East pipe; red liquid	J13548	08/15/06	10,000	UD	10,000	1490	U	1490	0.5	U	0.5	10,000	UD	10,000	10,000	UD	10,000	5		

Sample Description	HEIS Number	Sample Date	Phosphate			Selenium			Silver			Sulfate			Total Dissolved Solids		
			ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
West pipe; clear light green liquid	J13547	08/16/06	1500	D		23.5	U		5.1			204,000	D		3,300,000		
East pipe; red liquid	J13548	08/15/06	10,000	UD	10,000	2260	U	2260	336	U	336	299,000	D	10,000	112,000,000		10,000,000

Sample Location	HEIS Number	Sample Date	Hexavalent Chromium		
			ug/L	Q	PQL
West pipe; clear light green liquid	J13550	08/16/06	6,880		2.0
East pipe; red liquid	J13551	08/15/06	47,100,000		2.0

D = diluted
HEIS = Hanford Environmental Information System
PQL = practical quantitation limit
Q = qualifier
U = undetected

Table B-3. 100-D-56 North Portion Waste Characterization Samples. (2 pages)

Sample Description	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Bismuth		
			ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
"Ice" material	J14BL8	01/16/07	23,000	C	106	12.5	U	12.5	15.5	U	15.5	697	C	0.5	0.9		0.5	40.2		20
Plastic-like material	J14BL9	01/16/07	836,000	C	422	50	U	50	1,340		62	7,680	C		39.2		2	279		80
Drummed Liquid	J14HW4	03/08/07	163,000	C	900	160	U	160	410		200	900		10	10		5	260	U	260

Sample Location	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt			Copper		
			ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
"Ice" material	J14BL8	01/16/07	3930		9.5	1.8	C	1.5	40,900		62.5	100		6	19.1	C	2.5	83.9		3.5
Plastic-like material	J14BL9	01/16/07	381,000		38	13.8	C	6	611,000		250	12,700		24	423	C		1,380		14
Drummed Liquid	J14HW4	03/08/07	210,000		2,300	20	U	20	17,800	C	380	2,700	C	2,700	40	U	40	130	U	130

Sample Location	HEIS Number	Sample Date	Iron			Lead			Lithium			Magnesium			Manganese			Mercury		
			ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
"Ice" material	J14BL8	01/16/07	203,000		122	57.6		8	192		1	14,500	C	23	1,730		2			
Plastic-like material	J14BL9	01/16/07	2,250,000		488	1,250		32	4,300		4	344,000	C	92	23,900		8			
Drummed Liquid	J14HW4	03/08/07	33,800	C	33,800	310		140	1300	C	20	2,200		2,200	230	C	10	10	U	10

Sample Location	HEIS Number	Sample Date	Molybednum			Nickel			pH			Phosphorous			Potassium			Selenium		
			ug/L	Q	PQL	ug/L	Q	PQL	pH Units	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
"Ice" material	J14BL8	01/16/07	30.4		8	62.8		11	10.2		0.01	2,030		62.5	11,600		2,650	21.5	U	21.5
Plastic-like material	J14BL9	01/16/07	277		32	1010		44	12.1		0.01	86,100		250	550,000		10,600	86	U	86
Drummed Liquid	J14HW4	03/08/07	120		60	100	U	100	11.8		0.01	12,300		880	330,000	C	2,400	180	U	180

C = analyte was detected in both the samples and associated QC blank, and the sample concentration was <=5x the blank concentration
HEIS = Hanford Environmental Information System
PQL = practical quantification limit
Q = qualifier
U = undetected

Table B-3. 100-D-56 North Portion Waste Characterization Samples. (2 pages)

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Strontium			Thallium			Tin		
			ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL
"Ice" material	J14BL8	01/16/07	68,600	C	32	2.5	UC	2.5	185,000		94.5	256	C	0.5	30.9	C	28	18	U	18
Plastic-like material	J14BL9	01/16/07	1,570,000	C	128	10	UC	10	50,500,000		9,070	3,850	C	2	112	UC	112	165		72
Drummed Liquid	J14HW4	03/08/07	418,000	C	210	40	U	40	28,400,000		8,900	410		5	280	U	280	340	C	170

Sample Location	HEIS Number	Sample Date	Uranium			Vanadium			Zinc			Hexavalent			Total Suspended Solids		
			ug/L	Q	PQL	ug/L	Q	PQL	ug/L	Q	PQL	mg/kg	Q	PQL	mg/L	Q	PQL
"Ice" material	J14BL8	01/16/07	68	U	68	76.9		3	162		2	Not analyzed			Not analyzed		
Plastic-like material	J14BL9	01/16/07	272	U	272	3,620		12	4,680		8	Not analyzed			Not analyzed		
Drummed Liquid	J14HW4	03/08/07	1,300	U	1,300	660		50	1,800		20				253		5

Table B-4. 100-D-56 North Portion Waste Characterization Samples.

Sample Description	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Bismuth		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J14226	1/3/07	5300		7.9	0.94	UC	0.94	4.5		1.2	69.3	C	0.04	0.43		0.04	1.5	U	1.5

Sample Location	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J14226	1/3/07	29.5	C	0.71	0.17		0.11	6870	C	4.7	9.9	C	0.45	6.9		0.19	17.3		0.26

Sample Location	HEIS Number	Sample Date	Iron			Lead			Lithium			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J14226	1/3/07	27,600		9.2	9.7		0.6	7.2	C	0.08	3730	C	1.7	348	C	0.15	Not analyzed		

Sample Location	HEIS Number	Sample Date	Molybednum			Nickel			pH			Phosphorous			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	pH Units	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J14226	1/3/07	0.83		0.6	13.2	C	0.83	Not analyzed			674		4.7	1120		8	1.6	U	1.6

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Strontium			Thallium			Tin		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soil	J14226	1/3/07	698		2.4	0.19	U	0.19	3,660		0.94	31.2	C	0.04	2.1	U	2.1	1.4	U	1.4

Sample Location	HEIS Number	Sample Date	Uranium			Vanadium			Zinc			Hexavalent Chromium			Total Dissolved Solids		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/L	Q	PQL
Soil	J14226	1/3/07	5.1	U	5.1	30.8		0.23	51.7	C	0.26	0.26	U	0.26	Not analyzed		

C = analyte was detected in both the samples and associated QC blank, and the sample concentration was <=5x the blank concentration
HEIS = Hanford Environmental Information System
PQL = practical quantification limit
U = undetected
Q = qualifier

Table B-5. Pilot Study Sample Results.

HEIS Number	Location	Sample Date	Hexavalent Chromium		
			mg/kg	Q	PQL
J14KK2	South	3/5/07	0.24		0.21
J14KK3	South	3/5/07	0.31		0.2
J14KL1	South	3/5/07	0.24	U	0.24
J14KL3	North	3/5/07	0.21	U	0.21
J14KL4	North	3/5/07	0.21	U	0.21
J14KL5	North	3/5/07	0.21	U	0.21
J14KK9	South	3/5/07	0.29		0.23
J14KL0	South	3/5/07	0.27		0.23
J14KL6	North	3/5/07	0.38		0.24
J14KM9	South	3/5/07	0.22	U	0.22
J14KK4	South	3/20/07	0.21	U	0.21
J14KK6	South	3/20/07	7.5		0.22
J14KL8	North	3/20/07	0.36		0.21
J14KL2	South	4/11/07	0.46		0.21
J14KK5	South	4/11/07	0.22	U	0.22
J14KK7	South	4/11/07	0.23		0.21
J14KK8	South	4/11/07	1.3		0.25

HEIS = Hanford Environmental Information System
PQL = practical quantification limit
U = undetected
Q = qualifier

APPENDIX C

CALCULATION BRIEFS

APPENDIX C

CALCULATIONS

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

North Portion of the 100-D-56 Sodium Dichromate Supply Lines Waste Site Cleanup Verification 95% UCL Calculation, 0100D-CA-V0284, Rev. 0 ..... C-2

North Portion of the 100-D-56 Sodium Dichromate Underground Supply Lines Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation, 0100D-CA-V0285, Rev. 0 ..... C-27

100-D-56:1 Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100D-CA-V0423, Rev. 0 ..... C-31

DISCLAIMER FOR CALCULATIONS

The calculations 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-D Field Remediation **Job No. 14655**

Area: 100-D; 100-DR-1 Operable Unit

Discipline: Environmental *Calculation No: 0100D-CA-V0284

Subject: North Portion of 100-D-56 Sodium Dichromate Supply Lines 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 = 16 Attm. 1 = 5 Total = 22	6/16/08 W. S. Thompson WSThompson	H. M. Sulloway HMSulloway	NA	J. E. Laurenz JELaurenz	6/19/08

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 W. S. Thompson	**Date** 06/16/08	**Calc. No.** 0100D-CA-V0284		**Rev. No.** 0
Project 100-D Area Field Remediation	**Job No.** 14655	**Checked** H. M. Sulloway		**Date** 06/16/08
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification 95% UCL Calculation				**Sheet No.** 1 of 16

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
Sheet 5 to 8 - Calculation Sheet Verification Data
Sheet 9 to 11 - Calculation Sheet Duplicate Analysis
Sheet 12 to 16 - Ecology Software (MTCAStat) Results
Attachment 1 - 100-D-56 North Portion Verification Sampling Results (5 sheets)

Given/References:
1) Sample Results (Attachment 1).
2) Background values and remedial action goals (RAGs) are taken from DOE-RL (2005b), DOE-RL (2001), and Ecology (1996).
3) DOE-RL, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, DOE/RL-92-24, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2005a, *100 Area Remedial Action Sampling and Analysis Plan* (SAP), DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) DOE-RL, 2005b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
6) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
7) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets),* Publication #92-54, Washington Department of Ecology, Olympia, Washington.
8) Ecology, 1996, *Model Toxic Control Act Cleanup Levels and Risk Calculations (CLARC II),* Publication #94-145, Washington State Department of Ecology, Olympia, Washington.
9) Ecology, 2005, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
10) EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-4/013. U.S. Environmental Protection Agency, Washington, D.C.
11) 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 2005b). 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 data from soil verification samples (Attachment 1) associated with the northern portion of the 100-D-56 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 2005b) is documented by this calculation. Duplicate and split RPD results are used in evaluation of data quality within the RSVP for this site.

Washington Closure Hanford **CALCULATION SHEET**

Originator W. S. Thompson	**Date** 06/16/08	**Calc. No.** 0100D-CA-V0284	**Rev. No.** 0
Project 100-D Area Field Remediation	**Job No.** 14655	**Checked** H. M. Sulloway	**Date** 06/16/08
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification 95% UCL Calculation			**Sheet No.** 2 of 16

Summary (continued)

Methodology:

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.

All nonradionuclide data reported as being undetected are set to ½ the detection limit value for calculation of the statistics (Ecology 1993). In cases where the laboratory does not report a value below the minimal 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 2005b) 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 TDL is a laboratory detection limit pre-determined for each analytical method and is listed in Table II-1 of the SAP (DOE-RL 2005a). 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. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable RSVP.

Washington Closure Hanford **CALCULATION SHEET**

Originator W. S. Thompson **Date** 06/16/08 **Calc. No.** 0100D-CA-V0284 **Rev. No.** 0
Project 100-D Area Field Remediation **Job No.** 14655 **Checked** H. M. Sulloway **Date** 06/16/08
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification **Sheet No.** 3 of 16
95% UCL Calculation

Summary (continued)

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations for excavation, 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 - Excavation

Analyte	95% UCL Result[a]	Maximum Value[a]	Units
Arsenic	2.5		mg/kg
Barium	59.4		mg/kg
Beryllium	0.50		mg/kg
Chromium	10.5		mg/kg
Cobalt	7.3		mg/kg
Copper	14.1		mg/kg
Lead	4.2		mg/kg
Manganese	289		mg/kg
Nickel	10.8		mg/kg
Vanadium	49.3		mg/kg
Zinc	51.3		mg/kg
Antimony		1.1	mg/kg
Boron		1.6	mg/kg
Cadmium		0.26	mg/kg
Mercury		0.02	mg/kg
Selenium		1.5	mg/kg
Hexavalent chromium		0.28	mg/kg
Nitrate		29.4	mg/kg
Sulfate		19.3	mg/kg

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

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

WAC 173-340 3-Part Test for most stringent RAG:

95% UCL > Cleanup Limit?	NO
> 10% above Cleanup Limit?	NO
Any sample > 2x Cleanup Limit?	NO

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

Analyte	Duplicate Analysis[b]	Split Analysis[b]
Barium	0.5%	10.9%
Chromium	1.0%	9.5%
Copper	5.5%	0.8%
Lead	6.9%	73.7%
Manganese	9.0%	19.1%
Vanadium	6.7%	24.4%
Zinc	4.1%	15.3%

[a]Relative percent difference evaluation was not required for analytes not included in this table.
[b]These values are discussed in the RSVP.

Abbreviations/Acronyms:

BG = background
C = blank contamination (inorganics)
COC = contaminant of concern
COPC = contaminant of potential concern
D = analyte was identified in an analysis at a secondary dilution factor
DE = direct exposure
GW = groundwater
J = estimate
MDA = minimal detectable activity
MTCA = *Model Toxics Control Act*
PQL = practical quantitation limit
Q = qualifier
QA/QC = quality assurance/quality control
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
RPD = relative percent difference
RSVP = remaining sites verification package
SAP = sampling and analysis plan
TDL = target detection limit
U = undetected
UCL = upper confidence limit
WAC = *Washington Administrative Code*

Washington Closure Hanford **CALCULATION SHEET**

Originator W. S. Thompson **Date** 06/16/08 **Calc. No.** 0100D-CA-V0284 **Rev. No.** 0
Project 100-D Area Field Remediation **Job No.** 14655 **Checked** H. M. Sulloway **Date** 06/16/08
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification 95% UCL Calculation **Sheet No.** 4 of 16

Summary (continued)

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations and the WAC 173-340-740(7)(e) 3-part test evaluation for the soil stockpiles, the summary of the results for the focused sampling of the pipe storage/sump area and the RPD calculations, and are for use in risk analysis and the RSVP for this site. The RPD calculations for the focused samples collected from the sump/pipe storage area are also presented.

Soil Stockpiles Summary

Results Summary - Soil Stockpiles

Analyte	95% UCL Result[a]	Maximum Value[a]	Units
Arsenic	3.5		mg/kg
Barium	70.4		mg/kg
Beryllium	0.57		mg/kg
Cadmium	0.16		mg/kg
Chromium	10.2		mg/kg
Cobalt	8.3		mg/kg
Copper	16.2		mg/kg
Lead	10.2		mg/kg
Manganese	327		mg/kg
Nickel	11.1		mg/kg
Vanadium	58.9		mg/kg
Zinc	65.8		mg/kg
Phosphate	4.6		mg/kg
Sulfate	95.5		mg/kg
Antimony		2.5	mg/kg
Boron		24.2	mg/kg
Mercury		0.33	mg/kg
Molybdenum		0.95	mg/kg
Selenium		2.1	mg/kg
Hexavalent chromium		0.31	mg/kg
Chloride		8.5	mg/kg
Fluoride		3.3	mg/kg
Nitrate		71.7	mg/kg
Nitrite		4.08	mg/kg

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

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

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

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

Analyte	Duplicate Analysis[b]	Split Analysis[b]
Barium	4.4%	5.8%
Chromium	4.3%	16.5%
Copper	1.2%	47.7%
Lead	11.8%	56.4%
Manganese	2.9%	12.4%
Vanadium	3.7%	10.2%
Zinc	11.0%	22.2%

[a]Relative percent difference evaluation was not required for analytes not included in this table.
[b]These values are discussed in the RSVP.

Pipe Storage/Sump Area Summary

Results Summary - Pipe Storage/Sump Area

Analyte	Maximum Value	Units
Antimony	1.0	mg/kg
Arsenic	3.2	mg/kg
Barium	60.9	mg/kg
Beryllium	0.55	mg/kg
Boron	1.8	mg/kg
Chromium	11.8	mg/kg
Cobalt	7.6	mg/kg
Copper	14.6	mg/kg
Hexavalent chromium	0.28	mg/kg
Lead	5.0	mg/kg
Manganese	339	mg/kg
Mercury	0.01	mg/kg
Nickel	13.1	mg/kg
Silver	0.24	mg/kg
Vanadium	51.5	mg/kg
Zinc	45.9	mg/kg
Chloride	4.4	mg/kg
Nitrate	8.83	mg/kg
Sulfate	11.7	mg/kg

Pipe Storage/Sump Area - Focused Samples

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

Analyte	Split Analysis[b]
Barium	5.0%
Chromium	16.1%
Copper	11.6%
Lead	119.3%
Manganese	22.2%
Vanadium	7.9%
Zinc	21.4%

[a]Relative percent difference evaluation was not required for analytes not included in this table.
[b]These values are discussed in the RSVP.

CALCULATION SHEET

Washington Closure Hanford

Originator W. S. Thompson **Date** 06/16/08 **Calc. No.** 0100D-CA-V0284 **Rev. No.** 0
Project 100-D Area Field Remediation **Job No.** 14655 **Checked** H. M. Sulloway **Date** 06/16/08
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification 95% UCL Calculation **Sheet No.** 5 of 16

1 **100-D-56 Northern Portion Excavation Statistical Calculations**

2 **Verification Data**

3	Sample	Sample	Sample	Arsenic			Barium			Beryllium			Chromium			Cobalt			Copper			Lead		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5	A1	J16DM2	3/25/08	2.6		1.3	58.6	C	0.26	0.41		0.13	11.2		0.52	5.9		0.52	12.2		0.52	5.5		0.79
6	A2	J16DM3	3/25/08	2.7		1.4	53.4	C	0.27	0.44		0.14	10.2		0.54	6.2		0.54	12.4		0.54	2.9		0.81
7	A3	J16DM4	3/25/08	1.8		1.3	57.2	C	0.27	0.52		0.13	7.3		0.53	7.6		0.53	12.4		0.53	2.6		0.80
8	A4	J16DM5	3/25/08	2.7		1.3	55.4	C	0.27	0.39		0.13	10.3		0.54	6.4		0.54	13.6		0.54	2.7		0.81
9	A5	J16DM6	3/26/08	2.8		1.5	58.3	C	0.29	0.45		0.15	9.9		0.58	7.3		0.58	13.1		0.58	3.0		0.88
10	Duplicate of J16DM6	J16DM7	3/26/08	2.8		1.4	58.6	C	0.27	0.44		0.14	10.0		0.55	6.9		0.55	12.4		0.55	2.8		0.82
11	A6	J16DM8	3/25/08	1.4		1.4	62.1	C	0.27	0.48		0.14	9.0		0.54	7.2		0.54	13.4		0.54	5.1		0.81
12	A7	J16DM9	3/25/08	1.7		1.3	49.0	C	0.26	0.43		0.13	8.8		0.51	6.5		0.51	13.6		0.51	3.3		0.77
13	A8	J16DN0	3/25/08	1.6		1.4	53.5	C	0.28	0.55		0.14	7.9		0.56	8.0		0.56	13.7		0.56	2.4		0.84
14	A9	J16DN1	3/25/08	2.6		1.3	59.6	C	0.25	0.53		0.13	8.4		0.51	7.4		0.51	14.0		0.51	3.7		0.76
15	A10	J16DN2	3/25/08	2.8		1.3	62.8	C	0.26	0.51		0.13	8.8		0.52	7.2		0.52	16.5		0.52	4.5		0.78
16	A11	J16DN3	3/25/08	2.5		1.4	63.4	C	0.28	0.50		0.14	9.8		0.56	7.5		0.56	14.8		0.56	4.0		0.83
17	A12	J16DN4	3/25/08	2.3		1.3	56.6	C	0.25	0.42		0.13	13.5		0.50	6.2		0.50	13.2		0.50	2.9		0.75

18

19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Arsenic	Barium	Beryllium	Chromium	Cobalt	Copper	Lead
21	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
22	A1	J16DM2	3/25/08	2.6	58.6	0.41	11.2	5.9	12.2	5.5
23	A2	J16DM3	3/25/08	2.7	53.4	0.44	10.2	6.2	12.4	2.9
24	A3	J16DM4	3/25/08	1.8	57.2	0.52	7.3	7.6	12.4	2.6
25	A4	J16DM5	3/25/08	2.7	55.4	0.39	10.3	6.4	13.6	2.7
26	A5	J16DM6/ J16DM7	3/26/08	2.8	58.5	0.45	10.0	7.1	12.8	2.9
27	A6	J16DM8	3/25/08	1.4	58.6	0.48	9.0	7.2	13.4	5.1
28	A7	J16DM9	3/25/08	1.7	49.0	0.43	8.8	6.5	13.6	3.3
29	A8	J16DN0	3/25/08	1.6	53.5	0.55	7.9	8.0	13.7	2.4
30	A9	J16DN1	3/25/08	2.6	59.6	0.53	8.4	7.4	14.0	3.7
31	A10	J16DN2	3/25/08	2.8	62.8	0.51	8.8	7.2	16.5	4.5
32	A11	J16DN3	3/25/08	2.5	63.4	0.50	9.8	7.5	14.8	4.0
33	A12	J16DN4	3/25/08	2.3	56.6	0.42	13.5	6.2	13.2	2.9

34 **Statistical Computations**

35		Arsenic	Barium	Beryllium	Chromium	Cobalt	Copper	Lead
36	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), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.
37	N	12	12	12	12	12	12	12
38	% < Detection limit	0%	0%	0%	0%	0%	0%	0%
39	Mean	2.3	57.2	0.47	9.6	6.9	13.5	3.5
40	Standard deviation	0.52	4.0	0.05	1.7	0.7	1.2	1.0
41	95% UCL on mean	2.5	59.4	0.50	10.5	7.3	14.1	4.2
42	Maximum value	2.8	63.4	0.55	13.5	8.0	16.5	5.5
43	Final Statistical Value	2.5	59.4	0.50	10.5	7.3	14.1	4.2
44	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	20 DE/GW & River Protection	132 BG/GW Protection	1.51 BG/GW & River Protection	18.5 BG/GW & River Protection	32 GW Protection	22.0 BG/River Protection	10.2 BG/GW & River Protection
45	**WAC 173-340 3-PART TEST**							
46	95% UCL > Cleanup Limit?	NO	NA	NA	NA	NA	NO	NA
47	> 10% above Cleanup Limit?	NO	NA	NA	NA	NA	NO	NA
48	Any sample > 2X Cleanup Limit?	NO	NA	NA	NA	NA	NO	NA
49	**WAC 173-340 Compliance?**	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	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 (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 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.

CALCULATION SHEET

Washington Closure Hanford

Originator W. S. Thompson **Date** 06/16/08
Project 100-D Area Field Remediation **Job No.** 14655
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification 95% UCL Calculation

Calc. No. 0100D-CA-V0284 **Rev. No.** 0
Checked H. M. Sulloway **Date** 06/16/08
Sheet No. 6 of 16

100-D-56 Northern Portion Excavation Statistical Calculations

Verification Data

Sample Area	Sample Number	Sample Date	Manganese mg/kg	Q	PQL	Nickel mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL	Zinc mg/kg	Q	PQL
A1	J16DM2	3/25/08	258	C	0.10	11.4		0.52	37.1		0.37	36.0		1.6
A2	J16DM3	3/25/08	287	C	0.11	10.6		0.54	41.4		0.38	34.7		1.6
A3	J16DM4	3/25/08	291	C	0.11	9.3		0.53	51.9		0.37	36.4		1.6
A4	J16DM5	3/25/08	267	C	0.11	11.8		0.54	39.1		0.38	32.9		1.6
A5	J16DM6	3/26/08	315	C	0.12	10.8		0.58	51.1		0.41	37.3		1.8
Duplicate of J16DM6	J16DM7	3/26/08	288	C	0.11	10.0		0.55	47.8		0.38	35.8		1.6
A6	J16DM8	3/25/08	284	C	0.11	10.0		0.54	47.0		0.38	41.2		1.6
A7	J16DM9	3/25/08	256	C	0.10	9.5		0.51	40.6		0.36	37.2		1.5
A8	J16DN0	3/25/08	283	C	0.11	9.3		0.56	56.8		0.39	40.2		1.7
A9	J16DN1	3/25/08	278	C	0.10	9.5		0.51	50.6		0.36	43.1		1.5
A10	J16DN2	3/25/08	282	C	0.10	10.8		0.52	45.3		0.36	44.2		1.6
A11	J16DN3	3/25/08	307	C	0.11	10.0		0.56	49.6		0.39	85.7		1.7
A12	J16DN4	3/25/08	266	C	0.10	11.2		0.50	41.4		0.35	61.6		1.5

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Manganese mg/kg	Nickel mg/kg	Vanadium mg/kg	Zinc mg/kg
A1	J16DM2	3/25/08	258	11.4	37.1	36.0
A2	J16DM3	3/25/08	287	10.6	41.4	34.7
A3	J16DM4	3/25/08	291	9.3	51.9	36.4
A4	J16DM5	3/25/08	267	11.8	39.1	32.9
A5	J16DM6/ J16DM7	3/26/08	302	10.4	49.5	36.6
A6	J16DM8	3/25/08	284	10.0	47.0	41.2
A7	J16DM9	3/25/08	256	9.5	40.6	37.2
A8	J16DN0	3/25/08	283	9.3	56.8	40.2
A9	J16DN1	3/25/08	278	9.5	50.6	43.1
A10	J16DN2	3/25/08	282	10.8	45.3	44.2
A11	J16DN3	3/25/08	307	10.0	49.6	85.7
A12	J16DN4	3/25/08	266	11.2	41.4	61.6

Statistical Computations

	Manganese	Nickel	Vanadium	Zinc
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.
N	12	12	12	12
% < Detection limit	0%	0%	0%	0%
Mean	280	10.3	45.9	44.2
Standard deviation	16	0.9	6.0	15.1
95% UCL on mean	289	10.8	49.3	51.3
Maximum value	315	11.8	56.8	85.7
Final Statistical Value	289	10.8	49.3	51.3
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	512 BG/GW & River Protection	19.1 BG/GW Protection	85.1 BG/GW Protection	67.8 BG/River Protection
WAC 173-340 3-PART TEST				
95% UCL > Cleanup Limit?	NA	NA	NA	NA
> 10% above Cleanup Limit?	NA	NA	NA	NA
Any sample > 2X Cleanup Limit?	NA	NA	NA	NA
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.

CALCULATION SHEET

Washington Closure Hanford

Originator W. S. Thompson
Project 100-D Area Field Remediation
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification 95% UCL Calculation

Date 06/16/08
Job No. 14655

Calc. No. 0100D-CA-V0284
Checked H. M. Sulloway

Rev. No. 0
Date 06/16/08
Sheet No. 7 of 16

100-D-56 Northern Portion Soil Stockpiles Statistical Calculations

Verification Data

Sample Area	Sample Number	Sample Date	Arsenic mg/kg	Arsenic Q	Arsenic PQL	Barium mg/kg	Barium Q	Barium PQL	Beryllium mg/kg	Beryllium Q	Beryllium PQL	Cadmium mg/kg	Cadmium Q	Cadmium PQL	Chromium mg/kg	Chromium Q	Chromium PQL	Cobalt mg/kg	Cobalt Q	Cobalt PQL	Copper mg/kg	Copper Q	Copper PQL
B1	J16DN6	3/26/08	1.6		1.3	71.1	C	0.26	0.57		0.13	0.13	U	0.13	9.2		0.53	8.4		0.53	15.5		0.53
B2	J16DN7	3/26/08	3.0		1.3	59.6	C	0.27	0.54		0.13	0.18		0.13	9.5		0.53	8.1		0.53	13.7		0.53
B3	J16DN8	3/26/08	2.4		1.3	70.3	C	0.26	0.52		0.13	0.17		0.13	8.9		0.51	8.2		0.51	14.3		0.51
B4	J16DN9	3/26/08	2.6		1.3	70.9	C	0.25	0.51		0.13	0.13	U	0.13	11.2		0.50	8.1		0.50	14.6		0.50
B5	J16DP0	3/26/08	2.5		1.2	60.6	C	0.24	0.52		0.12	0.20		0.12	10.0		0.49	7.8		0.49	15.1		0.49
B6	J16DP1	3/26/08	2.6		1.3	65.3	C	0.27	0.61		0.13	0.13	U	0.13	10.6		0.53	9.0		0.53	15.0		0.53
B7	J16DP2	3/26/08	2.8		1.3	63.2	C	0.27	0.59		0.13	0.13	U	0.13	10.0		0.53	8.4		0.53	15.5		0.53
B8	J16DP3	3/26/08	3.4		1.3	59.6	C	0.27	0.56		0.13	0.13	U	0.13	9.9		0.54	8.2		0.54	14.0		0.54
B9	J16DP4	3/25/08	3.4		1.3	67.0	C	0.26	0.52		0.13	0.14		0.13	8.7		0.52	7.0		0.52	15.2		0.52
B10	J16DP5	3/26/08	5.6		1.2	81.9	C	0.24	0.52		0.12	0.12	U	0.12	10.9		0.48	7.5		0.48	17.6		0.48
B11	J16DP6	3/25/08	4.6		1.2	64.9	C	0.25	0.55		0.12	0.18		0.12	8.8		0.50	7.8		0.50	15.3		0.50
B12	J16DP7	3/26/08	2.8		1.2	53.7	C	0.24	0.60		0.12	0.14		0.12	8.7		0.48	8.9		0.48	18.2		0.48
B13	J16DP8	3/26/08	3.0		1.4	76.3	C	0.27	0.55		0.14	0.14	U	0.14	11.8		0.55	7.8		0.55	16.6		0.55
Duplicate of B13	J16DP9	3/26/08	3.0		1.3	73.0	C	0.26	0.54		0.13	0.16		0.13	11.3		0.52	7.7		0.52	16.8		0.52
B14	J16DR0	3/26/08	2.7		1.3	68.6	C	0.26	0.66		0.13	0.13	U	0.13	9.0		0.52	9.0		0.52	14.3		0.52
B15	J16DR1	3/26/08	3.2		1.1	71.0	C	0.22	0.60		0.11	0.16		0.11	10.9		0.45	8.7		0.45	17.4		0.45
B16	J16DR2	3/25/08	3.9		1.3	58.3	C	0.26	0.50		0.13	0.18		0.13	7.6		0.52	7.6		0.52	14.4		0.52
B17	J16DR3	3/25/08	2.9		1.4	69.9	C	0.28	0.52		0.14	0.33		0.14	9.5		0.57	7.8		0.57	18.3		0.57
B18	J16DR4	3/25/08	3.5		1.4	78.7	C	0.27	0.48		0.14	0.16		0.14	10.5		0.55	7.0		0.55	15.0		0.55

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Arsenic mg/kg	Barium mg/kg	Beryllium mg/kg	Cadmium mg/kg	Chromium mg/kg	Cobalt mg/kg	Copper mg/kg
B1	J16DN6	3/26/08	1.6	71.1	0.57	0.07	9.2	8.4	15.5
B2	J16DN7	3/26/08	3.0	59.6	0.54	0.18	9.5	8.1	13.7
B3	J16DN8	3/26/08	2.4	70.3	0.52	0.17	8.9	8.2	14.3
B4	J16DN9	3/26/08	2.6	70.9	0.51	0.07	11.2	8.1	14.6
B5	J16DP0	3/26/08	2.5	60.6	0.52	0.20	10.0	7.8	15.1
B6	J16DP1	3/26/08	2.6	65.3	0.61	0.07	10.6	9.0	15.0
B7	J16DP2	3/26/08	2.8	63.2	0.59	0.07	10.0	8.4	15.5
B8	J16DP3	3/26/08	3.4	59.6	0.56	0.07	9.9	8.2	14.0
B9	J16DP4	3/25/08	3.4	67.0	0.52	0.14	8.7	7.0	15.2
B10	J16DP5	3/26/08	5.6	81.9	0.52	0.06	10.9	7.5	17.6
B11	J16DP6	3/25/08	4.6	64.9	0.55	0.18	8.8	7.8	15.3
B12	J16DP7	3/26/08	2.8	53.7	0.60	0.14	8.7	8.9	18.2
B13	J16DP8/ J16DP9	3/26/08	3.0	74.7	0.55	0.12	11.6	7.8	16.7
B14	J16DM8	3/26/08	3.0	68.6	0.66	0.07	9.0	9.0	14.3
B15	J16DM9	3/26/08	2.7	71.0	0.60	0.16	10.9	8.7	17.4
B16	J16DN0	3/25/08	3.2	58.3	0.50	0.18	7.6	7.6	14.4
B17	J16DN1	3/25/08	3.9	69.9	0.52	0.33	9.5	7.8	18.3
B18	J16DN2	3/25/08	2.9	78.7	0.48	0.16	10.5	7.0	15.0

Statistical Computations

	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper
95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.
N	18	18	18	18	18	18	18
% < Detection limit	0%	0%	0%	39%	0%	0%	0%
Mean	3.1	67.2	0.55	0.13	9.7	8.1	15.6
Standard deviation	0.89	7.3	0.05	0.07	1.1	0.6	1.4
95% UCL on mean	3.5	70.4	0.57	0.16	10.2	8.3	16.2
Maximum value	5.6	81.9	0.66	0.33	11.8	9.0	18.3
Final Statistical Value	3.5	70.4	0.57	0.16	10.2	8.3	16.2
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	20 DE/GW & River Protection	132 BG/GW Protection	1.51 BG/GW & River Protection	0.81 BG/GW & River Protection	18.5 BG/GW & River Protection	32 GW Protection	22.0 BG/River Protection
WAC 173-340 3-PART TEST							
95% UCL > Cleanup Limit?	NO	NA	NA	NA	NA	NA	NA
> 10% above Cleanup Limit?	NO	NA	NA	NA	NA	NA	NA
Any sample > 2X Cleanup Limit?	NO	NA	NA	NA	NA	NA	NA
WAC 173-340 Compliance?	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.	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 mg/kg), the WAC 173-340 3-part test is not required.

CALCULATION SHEET

Washington Closure Hanford

Originator W. S. Thompson
Project 100-D Area Field Remediation
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification 95% UCL Calculation

Date 06/16/08
Job No. 14655

Calc. No. 0100D-CA-V0284
Checked H. M. Sulloway

Rev. No. 0
Date 06/16/08
Sheet No. 8 of 16

1 **100-D-56 Northern Portion Soil Stockpiles Statistical Calculations**

2 **Verification Data**

3	Sample	Sample	Sample	Lead			Manganese			Nickel			Vanadium			Zinc			Phosphate			Sulfate		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5	B1	J16DN6	3/26/08	8.0		0.79	323	C	0.11	10.0		0.53	62.4		0.37	58.4		1.6	2.5	U	2.5	4.5		2.5
6	B2	J16DN7	3/26/08	6.9		0.80	317	C	0.10	10.3		0.53	60.7		0.37	62.8		1.6	2.5	U	2.5	2.5	U	2.5
7	B3	J16DN8	3/26/08	9.6		0.77	323	C	0.10	11.1		0.51	54.4		0.36	47.5		1.5	2.5		2.4	2.4	U	2.4
8	B4	J16DN9	3/26/08	4.6		0.76	322	C	0.10	11.8		0.50	54.3		0.35	41.0		1.5	2.4	U	2.4	2.4	U	2.4
9	B5	J16DP0	3/26/08	13.0		0.73	325	C	0.10	12.4		0.49	53.5		0.34	53.7		1.5	2.5	U	2.5	2.5	U	2.5
10	B6	J16DP1	3/26/08	6.0		0.80	345	C	0.11	12.2		0.53	66.4		0.37	48.1		1.6	2.5	U	2.5	2.5	U	2.5
11	B7	J16DP2	3/26/08	6.7		0.80	329	C	0.11	11.8		0.53	60.7		0.37	45.1		1.6	4.9		2.6	2.6	U	2.6
12	B8	J16DP3	3/26/08	3.6		0.80	328	C	0.11	10.5		0.54	56.6		0.38	40.2		1.6	2.5	U	2.5	2.5	U	2.5
13	B9	J16DP4	3/25/08	5.2		0.79	270	C	0.10	9.3		0.52	46.4		0.37	57.1		1.6	2.4	U	2.4	131	D	4.9
14	B10	J16DP5	3/26/08	11.3		0.72	312	C	0.10	10.9		0.48	53.9		0.33	85.8		1.4	5.6		5.6	576	D	44.9
15	B11	J16DP6	3/25/08	8.2		0.75	296	C	0.10	9.7		0.50	49.9		0.35	45.7		1.5	9.0		2.4	9.7		2.4
16	B12	J16DP7	3/26/08	10.9		0.72	328	C	0.10	10.3		0.48	64.1		0.34	46.7		1.4	3.8		2.3	2.3	U	2.3
17	B13	J16DP8	3/26/08	5.6		0.82	351	C	0.11	11.4		0.55	55.4		0.38	50.0		1.6	2.7		2.4	4.1		2.4
18	Duplicate of B13	J16DP9	3/26/08	6.3		0.78	341	C	0.10	11.7		0.52	53.4		0.36	44.8		1.6	3.2		2.5	4.4		2.5
19	B14	J16DR0	3/26/08	10.4		0.78	348	C	0.10	10.1		0.52	64.5		0.36	56.3		1.6	6.6		2.4	2.8		2.4
20	B15	J16DR1	3/26/08	8.0		0.67	340	C	0.09	11.1		0.45	61.2		0.31	48.8		1.3	2.5	U	2.5	10.3		2.5
21	B16	J16DR2	3/25/08	3.1		0.78	273	C	0.10	8.7		0.52	46.1		0.36	37.5		1.6	2.4	U	2.4	3.6		2.4
22	B17	J16DR3	3/25/08	7.7		0.85	315	C	0.11	9.8		0.57	51.0		0.40	132		1.7	7.9		2.7	3.0		2.7
23	B18	J16DR4	3/25/08	17.7		0.82	257	C	0.11	9.3		0.55	40.5		0.38	75.1		1.6	8.1		2.4	12.3		2.4

24 **Statistical Computation Input Data**

25	Sample	Sample	Sample	Lead	Manganese	Nickel	Vanadium	Zinc	Phosphate	Sulfate
26	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
27	B1	J16DN6	3/26/08	8.0	323	10.0	62.4	58.4	1.3	4.5
28	B2	J16DN7	3/26/08	6.9	317	10.3	60.7	62.8	1.3	1.3
29	B3	J16DN8	3/26/08	9.6	323	11.1	54.4	47.5	2.5	1.2
30	B4	J16DN9	3/26/08	4.6	322	11.8	54.3	41.0	1.2	1.2
31	B5	J16DP0	3/26/08	13.0	325	12.4	53.5	53.7	1.3	1.3
32	B6	J16DP1	3/26/08	6.0	345	12.2	66.4	48.1	1.3	1.3
33	B7	J16DP2	3/26/08	6.7	329	11.8	60.7	45.1	4.9	1.3
34	B8	J16DP3	3/26/08	3.6	328	10.5	56.6	40.2	1.3	1.3
35	B9	J16DP4	3/25/08	5.2	270	9.3	46.4	57.1	1.2	131
36	B10	J16DP5	3/26/08	11.3	312	10.9	53.9	85.8	5.6	576
37	B11	J16DP6	3/25/08	8.2	296	9.7	49.9	45.7	9.0	9.7
38	B12	J16DP7	3/26/08	10.9	328	10.3	64.1	46.7	3.8	1.2
39	B13	J16DP8/ J16DP9	3/26/08	6.0	346	11.6	54.4	47.4	3.0	4.3
40	B14	J16DM8	3/26/08	10.4	348	10.1	64.5	56.3	6.6	2.8
41	B15	J16DM9	3/26/08	8.0	340	11.1	61.2	48.8	1.3	10.3
42	B16	J16DN0	3/25/08	3.1	273	8.7	46.1	37.5	1.2	3.6
43	B17	J16DN1	3/25/08	7.7	315	9.8	51.0	132	7.9	3.0
44	B18	J16DN2	3/25/08	17.7	257	9.3	40.5	75.1	8.1	12.3

45 **Statistical Computations**

46		Lead	Manganese	Nickel	Vanadium	Zinc	Phosphate	Sulfate
47	95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), 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.
48	N	18	18	18	18	18	18	18
49	% < Detection limit	0%	0%	0%	0%	0%	44%	39%
50	Mean	8.2	317	10.6	55.6	57.2	3.5	42.6
51	Standard deviation	3.6	26.4	1.1	7.1	22.3	2.8	136.5
52	95% UCL on mean	10.2	327	11.1	58.9	65.8	4.6	95.5
53	Maximum value	17.7	351	12.4	66.4	132	9.0	576
54	Final Statistical Value	10.2	327	11.1	58.9	65.8	4.6	95.5
55	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)**	10.2 BG/GW & River Protection	512 BG/GW & River Protection	19.1 BG/GW Protection	85.1 BG/GW Protection	67.8 BG/River Protection	NA BG/River Protection	25,000 GW Protection
56	**WAC 173-340 3-PART TEST**							
57	95% UCL > Cleanup Limit?	NO	NA	NA	NA	NO	NA	NO
58	> 10% above Cleanup Limit?	YES	NA	NA	NA	YES	NA	NO
59	Any sample > 2X Cleanup Limit?	NO	NA	NA	NA	NO	NA	NO
59	**WAC 173-340 Compliance?**	A detailed RESRAD assessment will be performed. The data set meets the 3-part test criteria when compared to direct exposure criteria.	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.	A detailed RESRAD assessment will be performed. The data set meets the 3-part test criteria when compared to direct exposure criteria.	Phosphate is an essential nutrient and has no cleanup level.	The data set meets the 3-part test criteria when compared to the most stringent cleanup limit.

CALCULATION SHEET

Washington No - evaluate difference

Originator W. S. Thompson

Project 100-D Area Field Remediation

Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Waste Site Cleanup Verification

Date 06/16/08

Job No. 14655

Calc. No. 0100D-CA-V0284

Checked H. M. Sulloway

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Sheet No. 9 of 16

1 **Duplicate/Split Analysis - Excavation**

2				Antimony			Arsenic			Barium			Beryllium			Boron			Chromium			Cobalt			Copper		
3	Sampling Area	Sample Number	Sample 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
4	A5	J16DM6	3/26/08	0.88	U	0.88	2.8		1.5	58.3	C	0.29	0.45		0.15	1.5		1.5	9.9		0.58	7.3		0.58	13.1		0.58
5	Duplicate of J16DM6	J16DM7	3/26/08	1.1	C	0.82	2.8		1.4	58.6	C	0.27	0.44		0.14	1.4	U	1.4	10		0.55	6.9		0.55	12.4		0.55
6	Split of J16DM6	J16DN5	3/26/08	2.2	U	2.2	2.1		1.1	65		11	0.54	U	0.54	--		--	9		1.1	6.1		2.2	13		1.10

7

8 **Analysis:**

9									
	TDL		0.6	1	0.5	0.2	2	0.2	2	1
10	Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
11		Both >5xTDL?		No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)		**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**
12		RPD			0.5%			1.0%		5.5%
13		Difference > 2 x TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable
14	Split Analysis	Both > PQL?	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)		**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
15		Both >5xTDL?		No-Stop (acceptable)	**Yes (calc RPD)**			**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**
16		RPD			10.9%			9.5%		0.8%
17		Difference >2xTDL?	Yes - assess further	No - acceptable	Not applicable	No - acceptable		Not applicable	No - acceptable	Not applicable

18 **Duplicate/Split Analysis - Excavation**

19				Lead			Manganese			Nickel			Vanadium			Zinc		
20	Sampling Area	HEIS Number	Sample Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
21	A5	J16DM6	3/26/08	3.0		0.88	315	C	0.12	10.8		0.58	51.1		0.41	37.3		1.8
22	Duplicate of J16DM6	J16DM7	3/26/08	2.8		0.82	288	C	0.11	10		0.55	47.8		0.38	35.8		1.6
23	Split of J16DM6	J16DN5	3/26/08	6.5		0.65	260		1.1	11		2.2	40		1.1	32		2.2

24

25 **Analysis:**

26							
	TDL		0.5	5	4	2.5	1
27	Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
28		Both >5xTDL?	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
29		RPD	6.9%	9.0%		6.7%	4.1%
30		Difference > 2 x TDL?	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable
31	Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
32		Both >5xTDL?	**Yes (calc RPD)**	**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
33		RPD	73.7%	19.1%		24.4%	15.3%
34		Difference >2xTDL?	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

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Washington Closure Hanford

Originator W. S. Thompson
Project 100-D Area Field Remediation
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Waste Site Cleanup Verification

Date 06/16/08
Job No. 14655

Calc. No. 0100D-CA-V0284
Checked H. M. Sullowav

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Date 06/16/08
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1 **Duplicate/Split Analysis - Stockpile**

2 Sampling Area	Sample Number	Sample Date	Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium			Chromium			Cobalt		
3			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
4 B13	J16DP8	3/26/08	0.94	C	0.82	3.0		1.4	76.3	C	0.27	0.55		0.14	1.7		1.4	0.14	U	0.14	11.8		0.55	7.8		0.55
5 Duplicate of J16DP8	J16DP9	3/26/08	0.78	U	0.78	3.0		1.3	73.0	C	0.26	0.54		0.13	1.4		1.3	0.16		0.13	11.3		0.52	7.7		0.52
6 Split of J16DP8	J16DR5	3/26/08	2	U	2	1.4		1.0	72		10	0.51	U	0.51	--		--	0.51	U	0.51	10		1	6.9		2

7 **Analysis:**

8									
	TDL		0.6	1	0.5	0.2	2	0.2	0.2	2
9	Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**
10		Both >5xTDL?		No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**	No-Stop (acceptable)
11		RPD			4.4%				4.3%	
12		Difference > 2xTDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable
13	Split Analysis	Both > PQL?	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)		No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**
14		Both >5xTDL?		No-Stop (acceptable)	**Yes (calc RPD)**				**Yes (calc RPD)**	No-Stop (acceptable)
15		RPD			5.8%				16.5%	
16		Difference >2xTDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable		No - acceptable	Not applicable	No - acceptable

17

18 **Duplicate/Split Analysis - Stockpile**

19 Sampling Area	HEIS Number	Sample Date	Copper			Lead			Manganese			Mercury			Nickel			Vanadium			Zinc			Hexavalent Chromium		
20			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
21 B13	J16DP8	3/26/08	16.6		0.55	5.6		0.82	351	C	0.11	0.009	U	0.009	11.4		0.55	55.4		0.38	50.0		1.6	0.31		0.21
22 Duplicate of J16DP8	J16DP9	3/26/08	16.8		0.52	6.3		0.78	341	C	0.10	0.02		0.008	11.7		0.52	53.4		0.36	44.8		1.6	0.21	U	0.21
23 Split of J16DP8	J16DR5	3/26/08	27		1	10		0.61	310		1	0.034	U	0.034	11		2	50		2	40		2	2.1	U	2.1

24

25 **Analysis:**

26										
	TDL		1	0.5	5	0.2	4	2.5	1	0.5
27	Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)
28		Both >5xTDL?	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	
29		RPD	1.2%	11.8%	2.9%			3.7%	11.0%	
30		Difference > 2xTDL?	Not applicable	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable
31	Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)
32		Both >5xTDL?	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	
33		RPD	*47.7%*	*56.4%*	12.4%			10.2%	22.2%	
34		Difference >2xTDL?	Not applicable	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	Yes - assess further

35

36 **Duplicate/Split Analysis - Stockpile**

37 Sampling Area	HEIS Number	Sample Date	Phosphate			Sulfate		
38			mg/kg	Q	PQL	mg/kg	Q	PQL
39 B13	J16DP8	3/26/08	2.7		2.4	4.1		2.4
40 Duplicate of J16DP8	J16DP9	3/26/08	3.2		2.5	4.4		2.5
41 Split of J16DP8	J16DR5	3/26/08	5.2	U	5.2	10	U	10

42

43 **Analysis:**

44				
	TDL		5	5
45	Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**
46		Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)
47		RPD		
48		Difference > 2xTDL?	No - acceptable	No - acceptable
49	Split Analysis	Both > PQL?	No-Stop (acceptable)	No-Stop (acceptable)
50		Both >5xTDL?		
51		RPD		
52		Difference >2xTDL?	No - acceptable	No - acceptable

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Originator W. S. Thompson
Project 100-D Area Field Remediation
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1 **Split Analysis - Sump/Pipe Storage Area**

2 Sampling Area	Sample Number	Sample Date	Arsenic			Barium			Beryllium			Chromium			Cobalt			Copper			Lead			Manganese		
3			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
4 C2	J16DR7	3/26/08	2.1		1.1	60.9	C	0.23	0.50		0.11	7.4		0.46	6.9		0.46	14.6		0.46	4.8		0.68	248	C	0.09
5 Split of J16DR7	J16DR9	3/26/08	1.7		1	64		10	0.52	U	0.52	8.7		1	8.3		2.1	13		1	19		0.62	310		1

6 **Analysis:**

7 TDL		1	0.5	0.2	0.2	2	1	0.5	5
8 Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
9	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**		**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	**Yes (calc RPD)**
10	RPD		5.0%		16.1%		11.6%	*119.3%*	22.2%
11	Difference >2xTDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	Not applicable

12

13 **Split Analysis - Sump/Pipe Storage Area**

14 Sampling Area	HEIS Number	Sample Date	Nickel			Vanadium			Zinc		
15			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
16 C2	J16DR7	3/26/08	7.9		0.46	46.2		0.32	37.1		1.4
17 Split of J16DR7	J16DR9	3/26/08	11		2.1	50		2.1	46		2.1

18

19 **Analysis:**

20 TDL		4	2.5	1
21 Split Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**
22	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**
23	RPD		7.9%	21.4%
24	Difference >2xTDL?	No - acceptable	Not applicable	Not applicable

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Washington Closure Hanford

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Ecology Software (MTCAStat) Results - Excavation

	DATA	ID	Arsenic 95% UCL Calculation			
1	DATA	ID	Arsenic 95% UCL Calculation			
2	2.6	J16DM2				
3	2.7	J16DM3				
4	1.8	J16DM4	Number of samples		Uncensored values	
5	2.7	J16DM5	Uncensored	12	Mean	2.3
6	2.8	J16DM6/ J16DM7	Censored		Lognormal mean	2.3
7	1.4	J16DM8	Detection limit or PQL		Std. devn.	0.52
8	1.7	J16DM9	Method detection limit		Median	2.6
9	1.6	J16DN0	TOTAL	12	Min.	1.4
10	2.6	J16DN1			Max.	2.8
11	2.8	J16DN2				
12	2.5	J16DN3	Lognormal distribution?		Normal distribution?	
13	2.3	J16DN4	r-squared is: 0.84		r-squared is: 0.86	
14			Recommendations:			
15			Reject BOTH lognormal and normal distributions.			
16						
17			UCL (based on Z-statistic) is		2.5	
18						

	DATA	ID	Barium 95% UCL Calculation			
	DATA	ID	Barium 95% UCL Calculation			
2	58.6	J16DM2				
3	53.4	J16DM3				
4	57.2	J16DM4	Number of samples		Uncensored values	
5	55.4	J16DM5	Uncensored	12	Mean	57.2
6	58.5	J16DM6/ J16DM7	Censored		Lognormal mean	57.2
7	58.6	J16DM8	Detection limit or PQL		Std. devn.	4.0
8	49.0	J16DM9	Method detection limit		Median	57.8
9	53.5	J16DN0	TOTAL	12	Min.	49.0
10	59.6	J16DN1			Max.	63.4
11	62.8	J16DN2				
12	63.4	J16DN3	Lognormal distribution?		Normal distribution?	
13	56.6	J16DN4	r-squared is: 0.95		r-squared is: 0.96	
14			Recommendations:			
15			Use lognormal distribution.			
16						
17			UCL (Land's method) is		59.4	
18						

	DATA	ID	Beryllium 95% UCL Calculation			
	DATA	ID	Beryllium 95% UCL Calculation			
2	0.41	J16DM2				
3	0.44	J16DM3				
4	0.52	J16DM4	Number of samples		Uncensored values	
5	0.39	J16DM5	Uncensored	12	Mean	0.47
6	0.45	J16DM6/ J16DM7	Censored		Lognormal mean	0.47
7	0.48	J16DM8	Detection limit or PQL		Std. devn.	0.05
8	0.43	J16DM9	Method detection limit		Median	0.46
9	0.55	J16DN0	TOTAL	12	Min.	0.39
10	0.53	J16DN1			Max.	0.55
11	0.51	J16DN2				
12	0.50	J16DN3	Lognormal distribution?		Normal distribution?	
13	0.42	J16DN4	r-squared is: 0.96		r-squared is: 0.96	
14			Recommendations:			
15			Use lognormal distribution.			
16						
17			UCL (Land's method) is		0.50	
18						

	DATA	ID	Chromium 95% UCL Calculation			
19	DATA	ID	Chromium 95% UCL Calculation			
20	11.2	J16DM2				
21	10.2	J16DM3				
22	7.3	J16DM4	Number of samples		Uncensored values	
23	10.3	J16DM5	Uncensored	12	Mean	9.6
24	10.0	J16DM6/ J16DM7	Censored		Lognormal mean	9.6
25	9.0	J16DM8	Detection limit or PQL		Std. devn.	1.7
26	8.8	J16DM9	Method detection limit		Median	9.4
27	7.9	J16DN0	TOTAL	12	Min.	7.3
28	8.4	J16DN1			Max.	13.5
29	8.8	J16DN2				
30	9.8	J16DN3				
31	13.5	J16DN4	Lognormal distribution?		Normal distribution?	
32			r-squared is: 0.96		r-squared is:	0.92
33			Recommendations:			
34			Use lognormal distribution.			
35						
36			UCL (Land's method) is		10.5	
37						

	DATA	ID	Cobalt 95% UCL Calculation			
	DATA	ID	Cobalt 95% UCL Calculation			
20	5.9	J16DM2				
21	6.2	J16DM3				
22	7.6	J16DM4	Number of samples		Uncensored values	
23	6.4	J16DM5	Uncensored	12	Mean	6.9
24	7.1	J16DM6/ J16DM7	Censored		Lognormal mean	6.9
25	7.2	J16DM8	Detection limit or PQL		Std. devn.	0.7
26	6.5	J16DM9	Method detection limit		Median	7.2
27	8.0	J16DN0	TOTAL	12	Min.	5.9
28	7.4	J16DN1			Max.	8.0
29	7.2	J16DN2				
30	7.5	J16DN3				
31	6.2	J16DN4	Lognormal distribution?		Normal distribution?	
32			r-squared is: 0.91		r-squared is: 0.89	
33			Recommendations:			
34			Use lognormal distribution.			
35						
36			UCL (Land's method) is		7.3	
37						

	DATA	ID	Copper 95% UCL Calculation			
	DATA	ID	Copper 95% UCL Calculation			
20	12.2	J16DM2				
21	12.4	J16DM3				
22	12.4	J16DM4	Number of samples		Uncensored values	
23	13.6	J16DM5	Uncensored	12	Mean	13.5
24	12.8	J16DM6/ J16DM7	Censored		Lognormal mean	13.6
25	13.4	J16DM8	Detection limit or PQL		Std. devn.	1.2
26	13.6	J16DM9	Method detection limit		Median	13.5
27	13.7	J16DN0	TOTAL	12	Min.	12.2
28	14.0	J16DN1			Max.	16.5
29	16.5	J16DN2				
30	14.8	J16DN3				
31	13.2	J16DN4	Lognormal distribution?		Normal distribution?	
32			r-squared is: 0.90		r-squared is: 0.87	
33			Recommendations:			
34			Reject BOTH lognormal and normal distributions.			
35						
36			UCL (based on Z-statistic) is		14.1	
37						

CALCULATION SHEET

Washington Closure Hanford

Originator W. S. Thompson
Project 100-D Area Field Remediation
Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Waste Site Cleanup Verification

Date 06/16/08
Job No. 14655

Calc. No. 0100D-CA-V0284
Checked H. M. Sulloway

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Date 06/16/08
Sheet No. 13 of 16

Ecology Software (MTCAStat) Results - Excavation

Lead 95% UCL Calculation

DATA	ID
5.5	J16DM2
2.9	J16DM3
2.6	J16DM4
2.7	J16DM5
	J16DM6/
2.9	J16DM7
5.1	J16DM8
3.3	J16DM9
2.4	J16DN0
3.7	J16DN1
4.5	J16DN2
4.0	J16DN3
2.9	J16DN4

Number of samples		Uncensored values	
Uncensored	12	Mean	3.5
Censored		Lognormal mean	3.5
Detection limit or PQL		Std. devn.	1.0
Method detection limit		Median	3.1
TOTAL	12	Min.	2.4
		Max.	5.5

Lognormal distribution? r-squared is: 0.94
Normal distribution? r-squared is: 0.90
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 4.2

Manganese 95% UCL Calculation

DATA	ID
258	J16DM2
287	J16DM3
291	J16DM4
267	J16DM5
	J16DM6/
302	J16DM7
284	J16DM8
256	J16DM9
283	J16DN0
278	J16DN1
282	J16DN2
307	J16DN3
266	J16DN4

Number of samples		Uncensored values	
Uncensored	12	Mean	280
Censored		Lognormal mean	280
Detection limit or PQL		Std. devn.	16
Method detection limit		Median	283
TOTAL	12	Min.	256
		Max.	307

Lognormal distribution? r-squared is: 0.97
Normal distribution? r-squared is: 0.97
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 289

Nickel 95% UCL Calculation

DATA	ID
11.4	J16DM2
10.6	J16DM3
9.3	J16DM4
11.8	J16DM5
	J16DM6/
10.4	J16DM7
10.0	J16DM8
9.5	J16DM9
9.3	J16DN0
9.5	J16DN1
10.8	J16DN2
10.0	J16DN3
11.2	J16DN4

Number of samples		Uncensored values	
Uncensored	12	Mean	10.3
Censored		Lognormal mean	10.3
Detection limit or PQL		Std. devn.	0.9
Method detection limit		Median	10.2
TOTAL	12	Min.	9.3
		Max.	11.8

Lognormal distribution? r-squared is: 0.95
Normal distribution? r-squared is: 0.95
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 10.8

Vanadium 95% UCL Calculation

DATA	ID
37.1	J16DM2
41.4	J16DM3
51.9	J16DM4
39.1	J16DM5
	J16DM6/
49.5	J16DM7
47.0	J16DM8
40.6	J16DM9
56.8	J16DN0
50.6	J16DN1
45.3	J16DN2
49.6	J16DN3
41.4	J16DN4

Number of samples		Uncensored values	
Uncensored	12	Mean	45.9
Censored		Lognormal mean	45.9
Detection limit or PQL		Std. devn.	6.0
Method detection limit		Median	46.2
TOTAL	12	Min.	37.1
		Max.	56.8

Lognormal distribution? r-squared is: 0.97
Normal distribution? r-squared is: 0.96
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 49.3

Zinc 95% UCL Calculation

DATA	ID
36.0	J16DM2
34.7	J16DM3
36.4	J16DM4
32.9	J16DM5
	J16DM6/
36.6	J16DM7
41.2	J16DM8
37.2	J16DM9
40.2	J16DN0
43.1	J16DN1
44.2	J16DN2
85.7	J16DN3
61.6	J16DN4

Number of samples		Uncensored values	
Uncensored	12	Mean	44.2
Censored		Lognormal mean	44.1
Detection limit or PQL		Std. devn.	15.1
Method detection limit		Median	38.7
TOTAL	12	Min.	32.9
		Max.	85.7

Lognormal distribution? r-squared is: 0.76
Normal distribution? r-squared is: 0.66
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 51.3

CALCULATION SHEET

Washington Closure Hanford

Originator W. S. Thompson

Project 100-D Area Field Remediation

Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Waste Site Cleanup Verification

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Job No. 14655

Calc. No. 0100D-CA-V0284

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Ecology Software (MTCAStat) Results - Soil Stockpiles

	DATA	ID	Arsenic 95% UCL Calculation			
1	DATA	ID				
2	1.6	J16DN6				
3	3.0	J16DN7				
4	2.4	J16DN8	Number of samples		Uncensored values	
5	2.6	J16DN9	Uncensored	18	Mean	3.1
6	2.5	J16DP0	Censored		Lognormal mean	3.1
7	2.6	J16DP1	Detection limit or PQL		Std. devn.	0.89
8	2.8	J16DP2	Method detection limit		Median	3.0
9	3.4	J16DP3	TOTAL	18	Min.	1.6
10	3.4	J16DP4			Max.	5.6
11	5.6	J16DP5				
12	4.6	J16DP6				
13	2.8	J16DP7				
		J16DP8/				
14	3.0	J16DP9	Lognormal distribution?		Normal distribution?	
15	3.0	J16DM8	r-squared is: 0.91		r-squared is: 0.85	
16	2.7	J16DM9	Recommendations:			
17	3.2	J16DN0	Use lognormal distribution.			
18	3.9	J16DN1				
19	2.9	J16DN2	UCL (Land's method) is		3.5	
20						

	DATA	ID	Barium 95% UCL Calculation			
	DATA	ID				
	71.1	J16DN6				
	59.6	J16DN7				
	70.3	J16DN8	Number of samples		Uncensored values	
	70.9	J16DN9	Uncensored	18	Mean	67.2
	60.6	J16DP0	Censored		Lognormal mean	67.2
	65.3	J16DP1	Detection limit or PQL		Std. devn.	7.3
	63.2	J16DP2	Method detection limit		Median	67.8
	59.6	J16DP3	TOTAL	18	Min.	53.7
	67.0	J16DP4			Max.	81.9
	81.9	J16DP5				
	64.9	J16DP6				
	53.7	J16DP7				
		J16DP8/				
	74.7	J16DP9	Lognormal distribution?		Normal distribution?	
	68.6	J16DM8	r-squared is: 0.98		r-squared is: 0.98	
	71.0	J16DM9	Recommendations:			
	58.3	J16DN0	Use lognormal distribution.			
	69.9	J16DN1				
	78.7	J16DN2	UCL (Land's method) is		70.4	

	DATA	ID	Beryllium 95% UCL Calculation			
	DATA	ID				
	0.57	J16DN6				
	0.54	J16DN7				
	0.52	J16DN8	Number of samples		Uncensored values	
	0.51	J16DN9	Uncensored	18	Mean	0.55
	0.52	J16DP0	Censored		Lognormal mean	0.55
	0.61	J16DP1	Detection limit or PQL		Std. devn.	0.05
	0.59	J16DP2	Method detection limit		Median	0.54
	0.56	J16DP3	TOTAL	18	Min.	0.48
	0.52	J16DP4			Max.	0.66
	0.52	J16DP5				
	0.55	J16DP6				
	0.60	J16DP7				
		J16DP8/				
	0.55	J16DP9	Lognormal distribution?		Normal distribution?	
	0.66	J16DM8	r-squared is: 0.95		r-squared is: 0.94	
	0.60	J16DM9	Recommendations:			
	0.50	J16DN0	Use lognormal distribution.			
	0.52	J16DN1				
	0.48	J16DN2	UCL (Land's method) is		0.57	

	DATA	ID	Cadmium 95% UCL Calculation			
21	DATA	ID				
22	0.07	J16DN6				
23	0.18	J16DN7				
24	0.17	J16DN8	Number of samples		Uncensored values	
25	0.07	J16DN9	Uncensored	18	Mean	0.13
26	0.20	J16DP0	Censored		Lognormal mean	0.13
27	0.07	J16DP1	Detection limit or PQL		Std. devn.	0.07
28	0.07	J16DP2	Method detection limit		Median	0.14
29	0.07	J16DP3	TOTAL	18	Min.	0.06
30	0.14	J16DP4			Max.	0.33
31	0.06	J16DP5				
32	0.18	J16DP6				
33	0.14	J16DP7				
		J16DP8/				
34	0.12	J16DP9				
35	0.07	J16DM8	Lognormal distribution?		Normal distribution?	
36	0.16	J16DM9	r-squared is: 0.87		r-squared is: 0.84	
37	0.18	J16DN0	Recommendations:			
38	0.33	J16DN1	Reject BOTH lognormal and normal distributions.			
39	0.16	J16DN2				
40			UCL (based on Z-statistic) is		0.16	
41						

	DATA	ID	Chromium 95% UCL Calculation			
	DATA	ID				
	9.2	J16DN6				
	9.5	J16DN7				
	8.9	J16DN8	Number of samples		Uncensored values	
	11.2	J16DN9	Uncensored	18	Mean	9.8
	10.0	J16DP0	Censored		Lognormal mean	9.8
	10.6	J16DP1	Detection limit or PQL		Std. devn.	1.1
	10.0	J16DP2	Method detection limit		Median	9.7
	9.9	J16DP3	TOTAL	18	Min.	7.6
	8.7	J16DP4			Max.	11.6
	10.9	J16DP5				
	8.8	J16DP6				
	8.7	J16DP7				
		J16DP8/				
	11.6	J16DP9				
	9.0	J16DM8	Lognormal distribution?		Normal distribution?	
	10.9	J16DM9	r-squared is: 0.97		r-squared is: 0.97	
	7.6	J16DN0	Recommendations:			
	9.5	J16DN1	Use lognormal distribution.			
	10.5	J16DN2				
			UCL (Land's method) is		10.2	

	DATA	ID	Cobalt 95% UCL Calculation			
	DATA	ID				
	8.4	J16DN6				
	8.1	J16DN7				
	8.2	J16DN8	Number of samples		Uncensored values	
	8.1	J16DN9	Uncensored	18	Mean	8.1
	7.8	J16DP0	Censored		Lognormal mean	8.1
	9.0	J16DP1	Detection limit or PQL		Std. devn.	0.61
	8.4	J16DP2	Method detection limit		Median	8.1
	8.2	J16DP3	TOTAL	18	Min.	7.0
	7.0	J16DP4			Max.	9.0
	7.5	J16DP5				
	7.8	J16DP6				
	8.9	J16DP7				
		J16DP8/				
	7.8	J16DP9				
	9.0	J16DM8	Lognormal distribution?		Normal distribution?	
	8.7	J16DM9	r-squared is: 0.96		r-squared is: 0.97	
	7.6	J16DN0	Recommendations:			
	7.8	J16DN1	Use lognormal distribution.			
	7.0	J16DN2				
			UCL (Land's method) is		8.3	

CALCULATION SHEET

Washington Closure Hanford

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Calc. No. 0100D-CA-V0284
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Ecology Software (MTCAStat) Results - Soil Stockpiles

	DATA	ID	Copper 95% UCL Calculation				DATA	ID	Lead 95% UCL Calculation				DATA	ID	Manganese 95% UCL Calculation			
1																		
2	15.5	J16DN6					8.0	J16DN6					323	J16DN6				
3	13.7	J16DN7					6.9	J16DN7					317	J16DN7				
4	14.3	J16DN8	Number of samples		Uncensored values		9.6	J16DN8	Number of samples		Uncensored values		323	J16DN8	Number of samples		Uncensored values	
5	14.6	J16DN9	Uncensored	18	Mean	15.6	4.6	J16DN9	Uncensored	18	Mean	8.2	322	J16DN9	Uncensored	18	Mean	317
6	15.1	J16DP0	Censored		Lognormal mean	15.6	13.0	J16DP0	Censored		Lognormal mean	8.2	325	J16DP0	Censored		Lognormal mean	317
7	15.0	J16DP1	Detection limit or PQL		Std. devn.	1.4	6.0	J16DP1	Detection limit or PQL		Std. devn.	3.6	345	J16DP1	Detection limit or PQL		Std. devn.	26
8	15.5	J16DP2	Method detection limit		Median	15.2	6.7	J16DP2	Method detection limit		Median	7.9	329	J16DP2	Method detection limit		Median	323
9	14.0	J16DP3	TOTAL	18	Min.	13.7	3.6	J16DP3	TOTAL	18	Min.	3.1	328	J16DP3	TOTAL	18	Min.	257
10	15.2	J16DP4			Max.	18.3	5.2	J16DP4			Max.	17.7	270	J16DP4			Max.	348
11	17.6	J16DP5					11.3	J16DP5					312	J16DP5				
12	15.3	J16DP6					8.2	J16DP6					296	J16DP6				
13	18.2	J16DP7					10.9	J16DP7					328	J16DP7				
		J16DP8/						J16DP8/						J16DP8/				
14	16.7	J16DP9	Lognormal distribution?		Normal distribution?		6.0	J16DP9	Lognormal distribution?		Normal distribution?		346	J16DP9	Lognormal distribution?		Normal distribution?	
15	14.3	J16DM8	r-squared is: 0.91		r-squared is: 0.90		10.4	J16DM8	r-squared is: 0.99		r-squared is: 0.93		348	J16DM8	r-squared is: 0.86		r-squared is:	0.88
16	17.4	J16DM9	Recommendations:				8.0	J16DM9	Recommendations:				340	J16DM9	Recommendations:			
17	14.4	J16DN0	Use lognormal distribution.				3.1	J16DN0	Use lognormal distribution.				273	J16DN0	Reject BOTH lognormal and normal distributions.			
18	18.3	J16DN1					7.7	J16DN1					315	J16DN1				
19	15.0	J16DN2	UCL (Land's method) is		16.2		17.7	J16DN2	UCL (Land's method) is		10.2		257	J16DN2	UCL (based on Z-statistic) is		327	
20																		

	DATA	ID	Nickel 95% UCL Calculation				DATA	ID	Vanadium 95% UCL Calculation				DATA	ID	Zinc 95% UCL Calculation			
21																		
22	10.0	J16DN6					62.4	J16DN6					58.4	J16DN6				
23	10.3	J16DN7					60.7	J16DN7					62.8	J16DN7				
24	11.1	J16DN8	Number of samples		Uncensored values		54.4	J16DN8	Number of samples		Uncensored values		47.5	J16DN8	Number of samples		Uncensored values	
25	11.8	J16DN9	Uncensored	18	Mean	10.6	54.3	J16DN9	Uncensored	18	Mean	55.6	41.0	J16DN9	Uncensored	18	Mean	57.2
26	12.4	J16DP0	Censored		Lognormal mean	10.6	53.5	J16DP0	Censored		Lognormal mean	55.7	53.7	J16DP0	Censored		Lognormal mean	56.9
27	12.2	J16DP1	Detection limit or PQL		Std. devn.	1.1	66.4	J16DP1	Detection limit or PQL		Std. devn.	7.1	48.1	J16DP1	Detection limit or PQL		Std. devn.	22.3
28	11.8	J16DP2	Method detection limit		Median	10.4	60.7	J16DP2	Method detection limit		Median	54.4	45.1	J16DP2	Method detection limit		Median	48.5
29	10.5	J16DP3	TOTAL	18	Min.	8.7	56.6	J16DP3	TOTAL	18	Min.	40.5	40.2	J16DP3	TOTAL	18	Min.	37.5
30	9.3	J16DP4			Max.	12.4	46.4	J16DP4			Max.	66.4	57.1	J16DP4			Max.	132
31	10.9	J16DP5					53.9	J16DP5					85.8	J16DP5				
30	9.7	J16DP6					49.9	J16DP6					45.7	J16DP6				
31	10.3	J16DP7					64.1	J16DP7					46.7	J16DP7				
		J16DP8/						J16DP8/						J16DP8/				
32	11.6	J16DP9					54.4	J16DP9					47.4	J16DP9				
33	10.1	J16DM8	Lognormal distribution?		Normal distribution?		64.5	J16DM8	Lognormal distribution?		Normal distribution?		56.3	J16DM8	Lognormal distribution?		Normal distribution?	
34	11.1	J16DM9	r-squared is: 0.98		r-squared is: 0.98		61.2	J16DM9	r-squared is: 0.95		r-squared is: 0.97		48.8	J16DM9	r-squared is: 0.84		r-squared is: 0.69	
35	8.7	J16DN0	Recommendations:				46.1	J16DN0	Recommendations:				37.5	J16DN0	Recommendations:			
36	9.8	J16DN1	Use lognormal distribution.				51.0	J16DN1	Use lognormal distribution.				132	J16DN1	Reject BOTH lognormal and normal distributions.			
37	9.3	J16DN2					40.5	J16DN2					75.1	J16DN2				
38			UCL (Land's method) is		11.1				UCL (Land's method) is		58.9				UCL (based on Z-statistic) is		65.8	
39																		

CALCULATION SHEET

Washington Closure Hanford

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Subject North Portion of 100-D-56 Sodium Dichromate Supply Lines Waste Site Cleanup Verification

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Ecology Software (MTCAStat) Results - Soil Stockpiles

	DATA	ID	Phospate 95% UCL Calculation			
1	DATA	ID	Phospate 95% UCL Calculation			
2	1.3	J16DN6				
3	1.3	J16DN7				
4	2.5	J16DN8	Number of samples		Uncensored values	
5	1.2	J16DN9	Uncensored	18	Mean	3.5
6	1.3	J16DP0	Censored		Lognormal mean	3.5
7	1.3	J16DP1	Detection limit or PQL		Std. devn.	2.8
8	4.9	J16DP2	Method detection limit		Median	1.9
9	1.3	J16DP3	TOTAL	18	Min.	1.2
10	1.2	J16DP4			Max.	9.0
11	5.6	J16DP5				
12	9.0	J16DP6				
13	3.8	J16DP7				
		J16DP8/				
14	3.0	J16DP9	Lognormal distribution?		Normal distribution?	
15	6.6	J16DM8	r-squared is: 0.82		r-squared is: 0.81	
16	1.3	J16DM9	Recommendations:			
17	1.2	J16DN0	Reject BOTH lognormal and normal distributions.			
18	7.9	J16DN1				
19	8.1	J16DN2	UCL (based on Z-statistic) is		4.6	
20						

	DATA	ID	Sulfate 95% UCL Calculation			
	DATA	ID	Sulfate 95% UCL Calculation			
	4.5	J16DN6				
	1.3	J16DN7				
	1.2	J16DN8	Number of samples		Uncensored values	
	1.2	J16DN9	Uncensored	18	Mean	42.6
	1.3	J16DP0	Censored		Lognormal mean	19.4
	1.3	J16DP1	Detection limit or PQL		Std. devn.	136.5
	1.3	J16DP2	Method detection limit		Median	2.9
	1.3	J16DP3	TOTAL	18	Min.	1.2
	131	J16DP4			Max.	576
	576	J16DP5				
	9.7	J16DP6				
	1.2	J16DP7				
		J16DP8/				
	4.3	J16DP9	Lognormal distribution?		Normal distribution?	
	2.8	J16DM8	r-squared is: 0.75		r-squared is: 0.32	
	10.3	J16DM9	Recommendations:			
	3.6	J16DN0	Reject BOTH lognormal and normal distributions.			
	3.0	J16DN1				
	12.3	J16DN2	UCL (based on Z-statistic) is		95.5	

Attachment 1. 100-D-56 North Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium			Chromium		
			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
A1	J16DM2	3/25/08	0.79	U	0.79	2.6		1.3	58.6	C	0.26	0.41		0.13	1.3	U	1.3	0.13	U	0.13	11.2		0.52
A2	J16DM3	3/25/08	0.81	U	0.81	2.7		1.4	53.4	C	0.27	0.44		0.14	1.4	U	1.4	0.14	U	0.14	10.2		0.54
A3	J16DM4	3/25/08	0.80	U	0.80	1.8		1.3	57.2	C	0.27	0.52		0.13	1.3	U	1.3	0.13	U	0.13	7.3		0.53
A4	J16DM5	3/25/08	0.81	U	0.81	2.7		1.3	55.4	C	0.27	0.39		0.13	1.3	U	1.3	0.14		0.13	10.3		0.54
A5	J16DM6	3/26/08	0.88	U	0.88	2.8		1.5	58.3	C	0.29	0.45		0.15	1.5		1.5	0.15	U	0.15	9.9		0.58
Duplicate of J16DM6	J16DM7	3/26/08	1.1	C	0.82	2.8		1.4	58.6	C	0.27	0.44		0.14	1.4	U	1.4	0.14	U	0.14	10.0		0.55
A6	J16DM8	3/25/08	0.81	U	0.81	1.4		1.4	62.1	C	0.27	0.48		0.14	1.4	U	1.4	0.14	U	0.14	9.0		0.54
A7	J16DM9	3/25/08	0.77	U	0.77	1.7		1.3	49.0	C	0.26	0.43		0.13	1.3	U	1.3	0.13	U	0.13	8.8		0.51
A8	J16DN0	3/25/08	0.84	U	0.84	1.6		1.4	53.5	C	0.28	0.55		0.14	1.4	U	1.4	0.17		0.14	7.9		0.56
A9	J16DN1	3/25/08	0.76	U	0.76	2.6		1.3	59.6	C	0.25	0.53		0.13	1.5		1.3	0.20		0.13	8.4		0.51
A10	J16DN2	3/25/08	0.78	U	0.78	2.8		1.3	62.8	C	0.26	0.51		0.13	1.6		1.3	0.18		0.13	8.8		0.52
A11	J16DN3	3/25/08	0.83	U	0.836	2.5		1.4	63.4	C	0.28	0.50		0.14	1.4	U	1.4	0.26		0.14	9.8		0.56
A12	J16DN4	3/25/08	0.75	U	0.75	2.3		1.3	56.6	C	0.25	0.42		0.13	1.3	U	1.3	0.18		0.13	13.5		0.5
Equipment Blank	J16DM1	3/25/08	0.26	U	0.26	0.43	U	0.43	1.1	C	0.09	0.11		0.04	0.43	U	0.43	0.04	U	0.04	0.18		0.17
B1	J16DN6	3/26/08	1.4	C	0.79	1.6		1.3	71.1	C	0.26	0.57		0.13	1.3	U	1.3	0.13	U	0.13	9.2		0.53
B2	J16DN7	3/26/08	0.80	U	0.80	3.0		1.3	59.6	C	0.27	0.54		0.13	1.3	U	1.3	0.18		0.13	9.5		0.53
B3	J16DN8	3/26/08	0.77	U	0.77	2.4		1.3	70.3	C	0.26	0.52		0.13	1.5		1.3	0.17		0.13	8.9		0.51
B4	J16DN9	3/26/08	0.76	U	0.76	2.6		1.3	70.9	C	0.25	0.51		0.13	1.3	U	1.3	0.13	U	0.13	11.2		0.50
B5	J16DP0	3/26/08	0.76	C	0.73	2.5		1.2	60.6	C	0.24	0.52		0.12	1.2	U	1.2	0.20		0.12	10.0		0.49
B6	J16DP1	3/26/08	0.80	U	0.80	2.6		1.3	65.3	C	0.27	0.61		0.13	1.5		1.3	0.13	U	0.13	10.6		0.53
B7	J16DP2	3/26/08	0.80	U	0.80	2.8		1.3	63.2	C	0.27	0.59		0.13	1.3	U	1.3	0.13	U	0.13	10.0		0.53
B8	J16DP3	3/26/08	0.80	U	0.80	3.4		1.3	59.6	C	0.27	0.56		0.13	1.3	U	1.3	0.13	U	0.13	9.9		0.54
B9	J16DP4	3/25/08	0.79	U	0.79	3.4		1.3	67.0	C	0.26	0.52		0.13	5.1		1.3	0.14		0.13	8.7		0.52
B10	J16DP5	3/26/08	2.5	C	0.72	5.6		1.2	81.9	C	0.24	0.52		0.12	24.2		1.2	0.12	U	0.12	10.9		0.48
B11	J16DP6	3/25/08	0.75	U	0.75	4.6		1.2	64.9	C	0.25	0.55		0.12	1.2	U	1.2	0.18		0.12	8.8		0.50
B12	J16DP7	3/26/08	0.72	U	0.72	2.8		1.2	53.7	C	0.24	0.60		0.12	1.8		1.2	0.14		0.12	8.7		0.48
B13	J16DP8	3/26/08	0.94	C	0.82	3.0		1.4	76.3	C	0.27	0.55		0.14	1.7		1.4	0.14	U	0.14	11.8		0.55
Duplicate of J16DP9	J16DP9	3/26/08	0.78	U	0.78	3.0		1.3	73.0	C	0.26	0.54		0.13	1.4		1.3	0.16		0.13	11.3		0.52
B14	J16DR0	3/26/08	0.78	U	0.78	2.7		1.3	68.6	C	0.26	0.66		0.13	1.3	U	1.3	0.13	U	0.13	9.0		0.52
B15	J16DR1	3/26/08	0.77	C	0.67	3.2		1.1	71.0	C	0.22	0.60		0.11	1.9		1.1	0.16		0.11	10.9		0.45
B16	J16DR2	3/25/08	0.78	U	0.78	3.9		1.3	58.3	C	0.26	0.50		0.13	1.3	U	1.3	0.18		0.13	7.6		0.52
B17	J16DR3	3/25/08	0.85	U	0.85	2.9		1.4	69.9	C	0.28	0.52		0.14	1.4	U	1.4	0.33		0.14	9.5		0.57
B18	J16DR4	3/25/08	0.82	U	0.82	3.5		1.4	78.7	C	0.27	0.48		0.14	3.6		1.4	0.16		0.14	10.5		0.55
C1	J16DR6	3/26/08	0.77	C	0.75	2.9		1.2	59.7	C	0.25	0.55		0.12	1.8		1.2	0.12	U	0.12	11.8		0.5
C2	J16DR7	3/26/08	0.68	U	0.68	2.1		1.1	60.9	C	0.23	0.50		0.11	1.1	U	1.1	0.11	U	0.11	7.4		0.46
C3	J16DR8	3/26/08	1.0	C	0.73	3.2		1.2	52.5	C	0.24	0.54		0.12	1.4		1.2	0.12	U	0.12	9.1		0.48

Attachment	1	Sheet No.	1 of 5
Originator	W. S. Thompson	Date	06/16/08
Checked	H. M. Sulloway	Date	06/16/08
Calc. No.	0100D-CA-V0284	Rev. No.	0

Attachment 1. 100-D-56 North Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Cobalt			Copper			Lead			Manganese			Mercury			Molybdenum			Nickel		
			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
A1	J16DM2	3/25/08	5.9		0.52	12.2		0.52	5.5		0.79	258	C	0.10	0.02		0.01	0.79	U	0.79	11.4		0.52
A2	J16DM3	3/25/08	6.2		0.54	12.4		0.54	2.9		0.81	287	C	0.11	0.009	U	0.009	0.81	U	0.81	10.6		0.54
A3	J16DM4	3/25/08	7.6		0.53	12.4		0.53	2.6		0.80	291	C	0.11	0.009	U	0.099	0.80	U	0.80	9.3		0.53
A4	J16DM5	3/25/08	6.4		0.54	13.6		0.54	2.7		0.81	267	C	0.11	0.009	U	0.009	0.81	U	0.81	11.8		0.54
A5	J16DM6	3/26/08	7.3		0.58	13.1		0.58	3.0		0.88	315	C	0.12	0.009	U	0.009	0.88	U	0.88	10.8		0.58
Duplicate of J16DM6	J16DM7	3/26/08	6.9		0.55	12.4		0.55	2.8		0.82	288	C	0.11	0.01	U	0.01	0.82	U	0.872	10.0		0.55
A6	J16DM8	3/25/08	7.2		0.54	13.4		0.54	5.1		0.81	284	C	0.11	0.01	U	0.01	0.81	U	0.81	10.0		0.54
A7	J16DM9	3/25/08	6.5		0.51	13.6		0.51	3.3		0.77	256	C	0.10	0.01	U	0.01	0.77	U	0.77	9.5		0.51
A8	J16DN0	3/25/08	8.0		0.56	13.7		0.56	2.4		0.84	283	C	0.11	0.008	U	0.008	0.84	U	0.84	9.3		0.56
A9	J16DN1	3/25/08	7.4		0.51	14.0		0.51	3.7		0.76	278	C	0.10	0.009	U	0.009	0.76	U	0.76	9.5		0.51
A10	J16DN2	3/25/08	7.2		0.52	16.5		0.52	4.5		0.78	282	C	0.10	0.01		0.009	0.78	U	0.78	10.8		0.52
A11	J16DN3	3/25/08	7.5		0.56	14.8		0.56	4.0		0.83	307	C	0.11	0.01	U	0.01	0.83	U	0.83	10.0		0.56
A12	J16DN4	3/25/08	6.2		0.50	13.2		0.50	2.9		0.75	266	C	0.10	0.01	U	0.01	0.75	U	0.75	11.2		0.50
Equipment Blank	J16DM1	3/25/08	0.17	U	0.17	0.17	U	0.17	0.50		0.26	3.8	C	0.03	0.009	U	0.009	0.26	U	0.26	0.23		0.17
B1	J16DN6	3/26/08	8.4		0.53	15.5		0.53	8.0		0.79	323	C	0.11	0.06		0.009	0.79	U	0.79	10.0		0.53
B2	J16DN7	3/26/08	8.1		0.53	13.7		0.53	6.9		0.80	317	C	0.11	0.04		0.009	0.80	U	0.80	10.3		0.53
B3	J16DN8	3/26/08	8.2		0.51	14.3		0.51	9.6		0.77	323	C	0.10	0.008	U	0.008	0.77	U	0.77	11.1		0.51
B4	J16DN9	3/26/08	8.1		0.50	14.6		0.50	4.6		0.76	322	C	0.10	0.008	U	0.008	0.76	U	0.79	11.8		0.50
B5	J16DP0	3/26/08	7.8		0.49	15.1		0.49	13.0		0.73	325	C	0.10	0.01	U	0.01	0.78		0.73	12.4		0.49
B6	J16DP1	3/26/08	9.0		0.53	15.0		0.53	6.0		0.80	345	C	0.11	0.009	U	0.009	0.80	U	0.80	12.2		0.53
B7	J16DP2	3/26/08	8.4		0.53	15.5		0.53	6.7		0.80	329	C	0.11	0.009	U	0.009	0.80	U	0.80	11.8		0.53
B8	J16DP3	3/26/08	8.2		0.54	14.0		0.54	3.6		0.80	328	C	0.11	0.009	U	0.009	0.80	U	0.80	10.5		0.54
B9	J16DP4	3/25/08	7.0		0.52	15.2		0.52	5.2		0.79	270	C	0.10	0.009	U	0.009	0.79	U	0.79	9.3		0.52
B10	J16DP5	3/26/08	7.5		0.48	17.6		0.48	11.3		0.72	312	C	0.10	0.01	U	0.01	0.72	U	0.72	10.9		0.48
B11	J16DP6	3/25/08	7.8		0.50	15.3		0.50	8.2		0.75	296	C	0.10	0.01		0.01	0.75	U	0.75	9.7		0.50
B12	J16DP7	3/26/08	8.9		0.48	18.2		0.48	10.9		0.72	328	C	0.10	0.01		0.01	0.72	U	0.72	10.3		0.48
B13	J16DP8	3/26/08	7.8		0.55	16.6		0.55	5.6		0.82	351	C	0.11	0.009	U	0.009	0.82	U	0.82	11.4		0.55
Duplicate of J16DP9	J16DP9	3/26/08	7.7		0.52	16.8		0.52	6.3		0.78	341	C	0.10	0.02		0.008	0.78	U	0.78	11.7		0.52
B14	J16DR0	3/26/08	9.0		0.52	14.3		0.52	10.4		0.78	348	C	0.10	0.009	U	0.009	0.78	U	0.78	10.1		0.52
B15	J16DR1	3/26/08	8.7		0.45	17.4		0.45	8.0		0.67	340	C	0.09	0.33		0.01	0.67	U	0.67	11.1		0.45
B16	J16DR2	3/25/08	7.6		0.52	14.4		0.52	3.1		0.78	273	C	0.10	0.01		0.01	0.82		0.78	8.7		0.52
B17	J16DR3	3/25/08	7.8		0.57	18.3		0.57	7.7		0.85	315	C	0.11	0.04		0.009	0.95		0.85	9.8		0.57
B18	J16DR4	3/25/08	7.0		0.55	15.0		0.55	17.7		0.82	257	C	0.11	0.14		0.01	0.82	U	0.82	9.3		0.55
C1	J16DR6	3/26/08	7.6		0.50	13.7		0.50	5.0		0.75	339	C	0.10	0.01		0.01	0.75	U	0.75	13.1		0.50
C2	J16DR7	3/26/08	6.9		0.46	14.6		0.46	4.8		0.68	248	C	0.09	0.009	U	0.009	0.68	U	0.68	7.9		0.46
C3	J16DR8	3/26/08	7.5		0.48	13.1		0.48	4.7		0.73	295	C	0.10	0.009	U	0.009	0.73	U	0.73	10.2		0.48

Attachment	1	Sheet No.	2 of 5
Originator	W. S. Thompson	Date	06/16/08
Checked	H. M. Sulloway	Date	06/16/08
Calc. No.	0100D-CA-V0284	Rev. No.	0

Attachment 1. 100-D-56 North Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Selenium			Silver			Vanadium			Zinc			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A1	J16DM2	3/25/08	1.6	U	1.6	0.26	U	0.26	37.1		0.37	36.0		1.6	0.21	U	0.21
A2	J16DM3	3/25/08	1.6	U	1.6	0.27	U	0.27	41.4		0.38	34.7		1.6	0.21	U	0.21
A3	J16DM4	3/25/08	1.6	U	1.6	0.27	U	0.27	51.9		0.37	36.4		1.6	0.21	U	0.21
A4	J16DM5	3/25/08	1.6	U	1.6	0.27	U	0.27	39.1		0.38	32.9		1.6	0.20	U	0.20
A5	J16DM6	3/26/08	1.8	U	1.8	0.29	U	0.29	51.1		51.10	37.3		1.8	0.22	U	0.22
Duplicate of J16DM6	J16DM7	3/26/08	1.6	U	1.6	0.27	U	0.27	47.8		0.38	35.8		1.6	0.22	U	0.22
A6	J16DM8	3/25/08	1.6	U	1.6	0.27	U	0.27	47.0		0.38	41.2		1.6	0.28		0.22
A7	J16DM9	3/25/08	1.5	U	1.5	0.26	U	0.26	40.6		0.36	37.2		1.5	0.22	U	0.22
A8	J16DN0	3/25/08	1.7	U	1.7	0.28	U	0.28	56.8		0.39	40.2		1.7	0.21	U	0.21
A9	J16DN1	3/25/08	1.5		1.5	0.25	U	0.25	50.6		0.36	43.1		1.5	0.21	U	0.21
A10	J16DN2	3/25/08	1.6	U	1.6	0.26	U	0.26	45.3		0.36	44.2		1.6	0.20	U	0.20
A11	J16DN3	3/25/08	1.7	U	1.7	0.28	U	0.28	49.6		0.39	85.7		1.7	0.23		0.22
A12	J16DN4	3/25/08	1.5	U	1.5	0.25	U	0.25	41.4		0.35	61.6		1.5	0.21	U	0.21
Equipment Blank	J16DM1	3/25/08	0.51	U	0.51	0.09	U	0.09	0.12	U	0.12	0.51	U	0.51	0.20	U	0.20
B1	J16DN6	3/26/08	1.6	U	1.6	0.26	U	0.26	62.4		0.37	58.4		1.6	0.20	U	0.20
B2	J16DN7	3/26/08	1.6	U	1.6	0.27	U	0.27	60.7		0.37	62.8		1.6	0.21	U	0.21
B3	J16DN8	3/26/08	1.5	U	1.5	0.26	U	0.26	54.4		0.36	47.5		1.5	0.21	U	0.21
B4	J16DN9	3/26/08	1.5	U	1.5	0.25	U	0.25	54.3		0.35	41.0		1.5	0.20	U	0.20
B5	J16DP0	3/26/08	1.5	U	1.5	0.24	U	0.24	53.5		0.34	53.7		1.5	0.20	U	0.20
B6	J16DP1	3/26/08	1.6	U	1.6	0.27	U	0.27	66.4		0.37	48.1		1.6	0.22		0.20
B7	J16DP2	3/26/08	1.6	U	1.6	0.27	U	0.27	60.7		0.37	45.1		1.6	0.20	U	0.20
B8	J16DP3	3/26/08	1.6	U	1.6	0.27	U	0.27	56.6		0.38	40.2		1.6	0.20	U	0.20
B9	J16DP4	3/25/08	1.6	U	1.6	0.26	U	0.26	46.4		0.37	57.1		1.6	0.20	U	0.20
B10	J16DP5	3/26/08	1.4	U	1.4	0.24	U	0.24	53.9		0.33	85.8		1.4	0.21		0.20
B11	J16DP6	3/25/08	1.5	U	1.5	0.25	U	0.25	49.9		0.35	45.7		1.5	0.20	U	0.20
B12	J16DP7	3/26/08	1.4	U	1.4	0.24	U	0.24	64.1		0.34	46.7		1.4	0.20	U	0.20
B13	J16DP8	3/26/08	1.6	U	1.6	0.27	U	0.27	55.4		0.38	50.0		1.6	0.31		0.21
Duplicate of J16DP8	J16DP9	3/26/08	1.6	U	1.6	0.26	U	0.26	53.4		0.36	44.8		1.6	0.21	U	0.21
B14	J16DR0	3/26/08	1.6	U	1.6	0.26	U	0.26	64.5		0.36	56.3		1.6	0.20	U	0.20
B15	J16DR1	3/26/08	1.3	U	1.3	0.22	U	0.22	61.2		0.31	48.8		1.3	0.21	U	0.21
B16	J16DR2	3/25/08	2.1		1.6	0.26	U	0.26	46.1		0.36	37.5		1.6	0.26		0.20
B17	J16DR3	3/25/08	1.7	U	1.7	0.28	U	0.28	51.0		0.40	132		1.7	0.31		0.21
B18	J16DR4	3/25/08	1.6	U	1.6	0.27	U	0.27	40.5		0.38	75.1		1.6	0.20	U	0.20
C1	J16DR6	3/26/08	1.5	U	1.5	0.25	U	0.25	50.8		0.35	42.3		1.5	0.21	U	0.21
C2	J16DR7	3/26/08	1.4	U	1.4	0.23	U	0.23	46.2		0.32	37.1		1.4	0.20	U	0.20
C3	J16DR8	3/26/08	1.5	U	1.5	0.24		0.24	51.1		0.34	45.9		1.5	0.28		0.20
D1	J16DT0	3/26/08													0.20	U	0.20
D2	J16DT1	3/26/08													0.20	U	0.20
D3	J16DT2	3/26/08													0.21	U	0.21
D4	J16DT3	3/26/08													0.24	U	0.24
D5	J16DT4	3/26/08													0.21	U	0.21

Attachment	1	Sheet No.	3 of 5
Originator	W. S. Thompson	Date	06/16/08
Checked	H. M. Sulloway	Date	06/16/08
Calc. No.	0100D-CA-V0284	Rev. No.	0

Attachment 1. 100-D-56 North Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Bromide			Cloride			Fluoride			Nitrate			Nitrite			Phosphate			Sulfate		
			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
A1	J16DM2	3/25/08	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6	2.56	U	2.56	2.56	U	2.56	2.6	U	2.6	2.6	U	2.6
A2	J16DM3	3/25/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	2.51	U	2.51	2.51	U	2.51	2.5	U	2.5	2.5	U	2.5
A3	J16DM4	3/25/08	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4	2.38	U	2.38	2.38	U	2.38	2.4	U	2.4	2.4	U	2.4
A4	J16DM5	3/25/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	2.53	U	2.53	2.53	U	2.53	2.5	U	2.5	2.5	U	2.5
A5	J16DM6	3/26/08	2.8	U	2.8	2.8	U	2.8	2.8	U	2.8	2.78	U	2.78	2.78	U	2.78	2.8	U	2.8	2.8	U	2.8
Duplicate of J16DM6	J16DM7	3/26/08	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6	2.60	U	2.60	2.60	U	2.60	2.6	U	2.6	2.6	U	2.6
A6	J16DM8	3/25/08	2.7	U	2.7	2.7	U	2.7	2.7	U	2.7	3.17		2.72	2.72	U	2.72	2.7	U	2.7	2.7	U	2.7
A7	J16DM9	3/25/08	2.8	U	2.8	2.8	U	2.8	2.8	U	2.8	2.75	U	2.75	2.75	U	2.75	2.8	U	2.8	3.2		2.8
A8	J16DN0	3/25/08	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4	2.37	U	2.37	2.37	U	2.37	2.4	U	2.4	4.0		2.4
A9	J16DN1	3/25/08	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6	2.59	U	2.59	2.59	U	2.59	2.6	U	2.6	7.9		2.6
A10	J16DN2	3/25/08	2.1	U	2.1	2.1	U	2.1	2.1	U	2.1	6.96		2.07	2.07	U	2.07	2.1	U	2.1	19.3		2.1
A11	J16DN3	3/25/08	2.7	U	2.7	2.7	U	2.7	2.7	U	2.7	29.4		2.70	2.70	U	2.70	2.7	U	2.7	7.1		2.7
A12	J16DN4	3/25/08	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4	2.42	U	2.42	2.42	U	2.42	2.4	U	2.4	2.4	U	2.4
Equipment Blank	J16DM1	3/25/08	2.3	U	2.3	2.3	U	2.3	2.3	U	2.3	2.34	U	2.34	2.34	U	2.34	2.3	U	2.3	2.3	U	2.3
B1	J16DN6	3/26/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	2.53	U	2.53	2.53	U	2.53	2.5	U	2.5	4.5		2.5
B2	J16DN7	3/26/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	2.53	U	2.53	2.53	U	2.53	2.5	U	2.5	2.5	U	2.5
B3	J16DN8	3/26/08	2.4	U	2.4	2.4	U	2.4	3.3		2.4	2.39	U	2.39	2.39	U	2.39	2.5		2.4	2.4	U	2.4
B4	J16DN9	3/26/08	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4	2.42	U	2.42	2.42	U	2.42	2.4	U	2.4	2.4	U	2.4
B5	J16DP0	3/26/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	2.53	U	2.53	2.53	U	2.53	2.5	U	2.5	2.5	U	2.5
B6	J16DP1	3/26/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	2.54	U	2.54	2.54	U	2.54	2.5	U	2.5	2.5	U	2.5
B7	J16DP2	3/26/08	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6	2.58	U	2.58	2.58	U	2.58	4.9		2.6	2.6	U	2.6
B8	J16DP3	3/26/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	2.48	U	2.48	2.48	U	2.48	2.5	U	2.5	2.5	U	2.5
B9	J16DP4	3/25/08	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4	7.06		2.43	2.43	U	2.43	2.4	U	2.4	131	D	4.9
B10	J16DP5	3/26/08	2.2	U	2.2	2.2	U	2.2	2.2	U	2.2	71.7		2.24	4.08		2.24	5.6		2.2	576	D	44.9
B11	J16DP6	3/25/08	2.4	U	2.4	3.2		2.4	2.4	U	2.4	28.6		2.42	2.42	U	2.42	9.0		2.4	9.7		2.4
B12	J16DP7	3/26/08	2.3	U	2.3	2.3	U	2.3	2.3	U	2.3	2.27	U	2.27	2.27	U	2.27	3.8		2.3	2.3	U	2.3
B13	J16DP8	3/26/08	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4	2.35	U	2.35	2.35	U	2.35	2.7		2.4	4.1		2.4
Duplicate of J16DP9	J16DP9	3/26/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	2.51	U	2.51	2.51	U	2.51	3.2		2.5	4.4		2.5
B14	J16DR0	3/26/08	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4	19.7		2.45	2.45	U	2.45	6.6		2.4	2.8		2.4
B15	J16DR1	3/26/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	4.81		2.50	2.50	U	2.50	2.5	U	2.5	10.3		2.5
B16	J16DR2	3/25/08	2.4	U	2.4	8.5		2.4	2.4	U	2.4	3.36		2.44	2.44	U	2.44	2.4	U	2.4	3.6		2.4
B17	J16DR3	3/25/08	2.7	U	2.7	2.7	U	2.7	2.7	U	2.7	2.68	U	2.68	2.68	U	2.68	7.9		2.7	3.0		2.7
B18	J16DR4	3/25/08	2.4	U	2.4	7.6		2.4	2.4	U	2.4	46.1		2.40	2.40	U	2.40	8.1		2.4	12.3		2.4
C1	J16DR6	3/26/08	2.3	U	2.3	4.4		2.3	2.3	U	2.3	8.83		2.32	2.32	U	2.32	9.5		2.3	5.9		2.3
C2	J16DR7	3/26/08	2.4	U	2.4	2.4	U	2.4	2.4	U	2.4	6.35		2.40	2.40	U	2.40	10.4		2.4	3.0		2.4
C3	J16DR8	3/26/08	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	5.70		2.48	2.48	U	2.48	2.5	U	2.5	11.7		2.5

Attachment	1	Sheet No.	4 of 5
Originator	W. S. Thompson	Date	06/16/08
Checked	H. M. Sulloway	Date	06/16/08
Calc. No.	0100D-CA-V0284	Rev. No.	0

Attachment 1. 100-D-56 North Verification Sampling Results - Ecology Split Samples.

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Cadmium			Calcium		
			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
A5	J16DN5	3/26/08	5200		22	2.2	U	2.2	2.1		1.1	65		11	0.54	U	0.54	0.54	U	0.54	6600		110
B13	J16DR5	3/26/08	5900		20	2	U	2	1.4		1	72		10	0.51	U	0.51	0.51	U	0.51	6400		100
C2	J16DR9	3/26/08	5900		21	2.1	U	2.1	1.7		1	64		10	0.52	U	0.52	0.52	U	0.52	6300		100
D2	J16DT5	3/26/08	5500		20	2	U	2	1.8		1	65		10	0.5	U	0.5	0.5	U	0.5	6600		100

Sample Location	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Iron			Lead			Magnesium			Manganese		
			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
A5	J16DN5	3/26/08	9		1.1	6.1		2.2	13		1.1	19000		11	6.5		0.65	4100		110	260		1.1
B13	J16DR5	3/26/08	10		1	6.9		2	27		1	22000		20	10		0.61	4300		100	310		1
C2	J16DR9	3/26/08	8.7		1	8.3		2.1	13		1	22000		21	19		0.62	4200		100	310		1
D2	J16DT5	3/26/08	8.7		1	6.6		2	14		1	21000		20	10		0.61	4200		100	280		1

Sample Location	HEIS Number	Sample Date	Nickel			Potassium			Selenium			Silver			Sodium			Thallium			Vanadium		
			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
A5	J16DN5	3/26/08	11		2.2	920		110	0.54	U	0.54	1.1	U	1.1	160		110	2.2	U	2.2	40		1.1
B13	J16DR5	3/26/08	11		2	1100		100	1	U	1	1	U	1	230		100	2	U	2	50		2
C2	J16DR9	3/26/08	11		2.1	960		100	1	U	1	1	U	1	230		100	2.1	U	2.1	50		2.1
D2	J16DT5	3/26/08	11		2	1100		100	1	U	1	1	U	1	250		100	2	U	2	45		2

Sample Location	HEIS Number	Sample Date	Zinc			Mercury			Hexavalent Chromium			Bromide			Chloride			Flouride			Nitrate as Nitrogen		
			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
A5	J16DN5	3/26/08	32		2.2	0.036	U	0.036	2.2	U	2.2	2.2	U	2.2	2.2	U	2.2	1.3		1.1	2.2	U	2.2
B13	J16DR5	3/26/08	40		2	0.034	U	0.034	2.1	U	2.1	2.1	U	2.1	2.1	U	2.1	1.1		1	2.1	U	2.1
C2	J16DR9	3/26/08	46		2.1	0.035	U	0.035	2.1	U	2.1	2.1	U	2.1	2.1	U	2.1	1	U	1	2.1	U	2.1
D2	J16DT5	3/26/08	41		2	0.034	U	0.034	2.1	U	2.1	2.1	U	2.1	200		2.1	1	U	1	16		2.1

Sample Location	HEIS Number	Sample Date	Nitrite as Nitrogen			Orthophosphate as Phosphate			Sulfate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A5	J16DN5	3/26/08	1.1	U	1.1	5.4	U	5.4	11	U	11
B13	J16DR5	3/26/08	1	U	1	5.2	U	5.2	10	U	10
C2	J16DR9	3/26/08	1	U	1	5.2	U	5.2	10	U	10
D2	J16DT5	3/26/08	1	U	1	5.1	U	5.1	79		10

Attachment	1	Sheet No.	5 of 5
Originator	W. S. Thompson	Date	06/16/08
Checked	H. M. Sulloway	Date	06/16/08
Calc. No.	0100D-CA-V0284	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-D Area

Discipline: Environmental *Calculation No: 0100D-CA-V0285

Subject: North Portion of 100-D-56 Cleanup Verification 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	6/16/03 W. S. Thompson W. S. Thompson	H. M. Sullaway H. M. Sullaway	NA	J. E. Laurenz J. E. Laurenz	6/19/03

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:	W. S. Thompson	Date:	06/16/08	Calc. No.:	0100D-CA-V0285	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	6/16/2008
Subject:	North Portion of the 100-D-56 Sodium Dichromate Underground Supply Lines Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No. 1 of 3	

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess cancer) risk for the north portion of the 100-D-56 Sodium Dichromate Underground Supply Lines. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2005), 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, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas,* DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

3) WCH, 2008, *North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification 95% UCL Calculation*, Calc. No. 0100D-CA-V0284, 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 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 or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 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:	W. S. Thompson	Date:	06/16/08	Calc. No.:	0100D-CA-V0285	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	6/16/2008
Subject:	North Portion of the 100-D-56 Sodium Dichromate Underground Supply Lines Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No. 2 of 3	

METHODOLOGY:

The hazard quotient and carcinogenic risk calculations for the north portion of the 100-D-56 Sodium Dichromate Underground Supply Lines was calculated using the larger value of the excavation and soil stockpile verification sampling results for each analyte (WCH 2008). Boron, hexavalent chromium, molybdenum, nitrite, and flouride require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Selenium and nitrate were detected above background and included in the HQ and risk calculation. All other site nonradionuclide COCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the statistical value for boron is 24.2 mg/kg, divided by the noncarcinogenic RAG value of 16,000 mg/kg (boron is identified as a noncarcinogen in WAC 173-340-740[3]), is 1.5×10^{-3}. Comparing this value, and all other individual values, to the requirement of <1.0, this criteria is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. The sum of the HQ values is 1.2×10^{-2}. Comparing this value to the requirement of <1.0, this criteria is met.

3) To calculate the excess cancer risk, the statistical value is divided by the carcinogenic RAG value, then multiplied by 1×10^{-6}. For example, the statistical value for hexavalent chromium is 0.31 mg/kg, divided by 2.1 mg/kg, and multiplied as indicated, is 1.5×10^{-7}. Comparing this value and all other individual values to the requirement of $<1 \times 10^{-6}$, this criteria 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. The sum of the excess cancer risk values is 1.5×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None
2) List the cumulative noncarcinogenic HQ >1.0: None
3) List individual carcinogens and corresponding excess cancer risk $>1 \times 10^{-6}$: None
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:	W. S. Thompson	Date:	06/16/08	Calc. No.:	0100D-CA-V0285	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	6/16/2008
Subject:	North Portion of the 100-D-56 Sodium Dichromate Underground Supply Lines Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	3 of 3

Table 1. Hazard Quotient and Excess Cancer Risk Results for the North Portion of the 100-D-56 Sodium Dichromate Underground Supply Lines.

Contaminants of Concern[a]	Statistical or Maximum Result[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	24.2	16,000	1.5E-03	--	--
Chromium, hexavalent[c]	0.31	240	1.3E-03	2.1	1.5E-07
Molybdenum	0.95	400	2.4E-03	--	--
Selenium	2.1	400	5.3E-03	--	--
Anions					
Fluoride	3.3	4,800	6.9E-04	--	--
Nitrite	4.08	8,000	5.1E-04	--	--
Nitrate	71.7	128,000	5.6E-04	--	--
Totals					
Cumulative Hazard Quotient:			**1.2E-02**		
Cumulative Excess Cancer Risk:					**1.5E-07**

Notes:

[a] = From WCH (2008).

[b] = Value obtained from the RDR/RAWP (DOE-RL 2005) 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:

This calculation demonstrates that the north portion of the 100-D-56 Sodium Dichromate Underground Supply Lines meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2005).

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CALCULATION COVER SHEET

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

Area: 100-D

Discipline: Environmental *Calculation No: 0100D-CA-V0423

Subject: 100-D-56:1 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 Sheets = 3 Total = 4	W. S. Thompson W S Thompson	T. E. Queen T E Queen	B. L. Vedder B L Vedder	D. F. Obenauer D. F. Obenauer	6/15/11

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:	W. S. Thompson	Date:	06/14/11	Calc. No.:	0100D-CA-V0423	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	06/14/11
Subject:	100-D-56:1 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 contaminant levels within concrete compared to soil cleanup levels for protection of groundwater for the 100-D-56:1 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, 2008, *North Portion of 100-D-56 Sodium Dichromate Supply Lines Cleanup Verification 95% UCL Calculation*, 0100D-CA-V0284, 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:	W. S. Thompson WST	Date:	06/14/11	Calc. No.:	0100D-CA-V0423	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	T. E. Queen TEQ	Date:	06/14/11
Subject:	100-D-56:1 Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No.	2 of 3

METHODOLOGY:

The 100-D-56:1 site consisted of the excavation area, overburden/layback soil stockpiles, and the pipeline storage area for verification sampling. Soil samples were collected and submitted for laboratory analysis of the contaminants of potential concern (COPCs) for this site.

Hazard quotient and carcinogenic risk calculations for potential impact to groundwater at the 100-D-56:1 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 (WCH 2008). Of the COPCs for this site, boron, hexavalent chromium, nitrate, and nitrite are included because no 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 the generic site RESRAD model (BHI 2005). Based on this model and a vadose zone of approximately 24 m (79 ft) thickness, a K_d of 3.1 or greater is required to show no predicted migration to groundwater in 1,000 years. All other site nonradionuclide COPCs were not detected, quantified below background levels, or have a K_d greater than or equal to 3.1. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum or statistical value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (µg/L) (calculated with, and related to the hazard quotient through, WAC 173-340-720 (3)(a)(ii)(A), (1996) x 100 x 1 mg/1000 µg (conversion factor). This is based on the "100 times rule" of WAC 173-340-740(3)(a)(ii) (A) (1996). For example, the maximum value for boron of 24.2 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 7.6×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The cumulative HQ for the 100-D-56:1 waste site is 1.9×10^{-1}. Comparing this value to the requirement of <1.0, this criterion is met.

3) No carcinogenic constituents met the criteria for evaluation of groundwater at the 100-D-56:1 site; therefore, no calculations of excess cancer risk were performed.

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	W. S. Thompson	Date:	06/14/11	Calc. No.:	0100D-CA-V0423	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	T. E. Queen	Date:	06/14/11
Subject:	100-D-56:1 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.

CONCLUSION:

This calculation demonstrates that the 100-D-56:1 site meets the requirements for the hazard quotients and excess carcinogenic risk as identified in the RDR/RAWP (DOE-RL 2009).

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-D-56:1 Waste Site.

Contaminants of Potential Concern	Statistical or Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	24.2	320	7.6E-02	--	--
Chromium, hexavalent [c]	0.31	4.8	6.5E-02	--	--
Inorganics and TPH					
Nitrate (as nitrogen)	71.7	2,560	2.8E-02	--	--
Nitrite (as nitrogen)	4.08	160	2.6E-02	--	--
Totals					
Cumulative Hazard Quotient:			**1.9E-01**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:
[a] = From WCH (2008).
[b] = Value obtained from the Cleanup Levels and Risk Calculations (CLARC) database using Groundwater, Method B, results and "100 times" model 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

APPENDIX D

BOREHOLE C8375 BOREHOLE LOG AND SAMPLE RESULTS

BOREHOLE LOG

Page 1 of 3
Date: 4/7/11

Well ID: C8375 | Well Name: 199-D5-143 | Location: 100-D Area
Project: 100-HR-3 RI/FS | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description (Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level)
				0'-17.5' bgs: Silty Sandy Gravel (ms6)	Beckerthimner
0				70% Gravel - sm pebbles - lg cobbles sub-round to round	Splitspoon, 4" diameter
				80% mafic/20% felsic → (60% sm. pebbles - med pebbles	
				40% lg pebbles - lg cobbles) 20% silt - 70% sand	→ Added water to keep dust
				v. fn to medium grain 70% mafic/30% felsic	down.
5	G.S.			wet from added water, no rxn to HCl	Archive @ 5' bgs
				overall color: 10YR 3/2 v. dk. grayish Brown	
				(~0-10' is all recent backfill)	
				@ ~10' properties change to:	
				60% Gravel (60% lg pebbles - lg cobbles/40% sm pebbles)	
10	G.S.			20% Sand (90% mafic) black sand	Archive @ 10' bgs
				20% Silt - over all color 10YR 2/1 black	
15	G.S.			→ Sand starts to increase greatly	Archive @ 15' 4.7.11
	I-001 S.S.	50%			NCO S.S. 15.3'-16.5' bgs
					• I-001 HEISH'S: B2C5R1
				17.5'-35.0' bgs Gravely Sand	B2C5T3, B2C5V5, B2C5W7
				70% sand: v. fn - coarse, 80% mafic/20% felsic	B2C5N9
20	G.S.			(black sand) slightly damp	Archive @ 20'
	I-002 S.S.	50%		25% Gravel: sm pebbles - lg cobbles sub-ang	NCO S.S. 20.0'-21.2' 4.7.11
				to sub-rounded, 80% mafic/20% felsic •	I-002 HEISH B2C620
				<5% silt. Slightly damp, no rxn to HCl	B2C5Y8, B2C682, B2C64
				over all color: 10YR 2/1: black	
25	G.S.				Archive @ 25'
	I-003 S.S.	100%		→ Sandy lense ~25-28'	NCO S.S. 25.5' - 28.0' 4/7
				•	I-003 HEISH 4.7.11
				→ ~28' gravels re-appear	B2C5R2 B2C5T4
					B2C5V4 B2C5W8 B2C5P0
30	G.S.				Archive @ 30'
	I-004	100%		→ 31' sandy lense (~31-32.5') •	I-004 32.7-32.2' 4.7.11
				4.7.11	HEISH B2C621 B2C603
					B2C5Y4 B2C612 4.7.11
35	G.S.			35.0'-56.0' bgs Silty Sandy Gravel	
	I-005 S.S.	50%		80% Gravel: sm pebbles - lg cobbles 4.7.11	Archive @ 35'
				sub-rnd-angular I-006 37.5-39.7' •	I-005 35.2-36.2' bgs 4.7.11
	I-006 S.S.			30% Sand: v. fn - med B2C637	B2C5R3, B2C5W9, B2C5P1
				70% mafic/30% felsic	

Reported By: J. Fleming		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: J. Fleming	Date: 4.7.11	Signature: L.D. Walker	Date: 5/12/11

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 3
Date: 4.7.11/4.13.11

Well ID: C8376 | Well Name: 199-D5-143 | Location: N of D Reactors

Project: 100-HR-3 RI/FS | Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40	G.S. I-007	70%		35.0'-66.0' bgs Silty Sandy Gravel (mod)	Archive @ 40' bgs
				60% Gravel: sm pebbles-lg cobbles subrnd-angular	I-007 40-41.9' 4/7
				70% Mafic/30% felsic 1 30% Sand: v fn-med/coarse	B2C592 B2C5T6 B2C5V8
	I-008	50%		80% mafic/20% felsic (black sand) 10% Silt	B2C5X0 B2C5R4
				Wet from added water, no rxn to HCl,	I-008 42.4'-43.6' B2C638
45	G.S. I-009	100%		over all color: 10YR2/1: black	Archive @ 45' bgs
					I-009 45.0'-47.5' bgs 4.12.11
					B2C5P3 B2C5T7 B2C5V9
					B2C5X1 B2C5R5 @0845
	I-010	50%			I-010 47.5'-49.7' bgs B2C639
50	G.S. I-011	75%		@~47' bgs sand color changes from	Archive @ 50' bgs
				black to brown (10YR 4/3)	I-011 50.0'-51.2' bgs 4.12.11
					B2C5P4 B2C5T8 B2C5W0
	I-012	80%			B2C5X2 B2C5R6 @1005 4.12.11
					I-012 54.4'-54.9' bgs @1040
55	G.S. I-013	Ringold 80%		↗ Ringold/Hanford contact? Possible	B2C5X3 B2C5T0 B2C5Y1 B2C5R7
				@~56' bgs gravel composition changes	Archive @ 56' bgs
				to 70% felsic/30% Mafic w/ micaceous lm sand	Archive @ I-013 55-57.6' 4.12.11
					B2C5T1 B2C5T9 B2C5Y3 B2C5R3
	I-013A	20%		56.0-115.5' bgs, Silty Sandy Gravel (mod)	B2C5T2 @ 1115
60	G.S. I-014	80%		65% gravel sm pebbles to lg cobbles, rounded	I-013A 57.8'-58.3' bgs 4.12.11
				to sub rounded; 70% felsic/30% mafic	B2C642
				25% Sand: v fine-medium brown in color	Archive @ 60' bgs
				60% felsic/40% mafic, small mica flakes in sand	I-014 60.0'-62.5' bgs 4.12.11
				goldin color, sand is unconsolidated	B2C622 B2C5Y5 B2C604
65	G.S. I-015	50%		10% Silt → slight rxn to HCl on some rocks, damp	B2C613
				over all color 10YR 4/3 BROWN	Archive @ 65' bgs
					I-015 65-66.2' bgs 4.12.11
					B2C5P6 B2C5V0 B2C5W2
					B2C5X4 B2C5R8
70	G.S. I-016	100%		→ Sandy (consolidated) lense ~69'	Archive @ 70' bgs
					I-016 69.5'-72.0' bgs 4.12.11
					B2C5Y6 B2C605 B2C614
					B2C623 B2C636 B2C632 B2C624
					I-017 75.0'-75.6' 4.13
75	G.S. I-017	25%			B2C5P7 B2C5X5 B2C5R9
					Archive @ 75' bgs
	I-018	50%			I-018 77.4'-78.6' 4.13
					B2C6C0 B2C615 B2C625

Reported By: J. Fleming | Reviewed By: L.D. Walker

Title: Geologist | Title: Geologist

Signature: J. Fleming | Date: 4.13.11 | Signature: [signature] | Date: 5/12/11

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 3

Date: 4.12 / 4.18.11

Well ID: C8375	Well Name: 199-D5-143	Location: N of D Reactor
Project: 100-HR-3 RI/FS		Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	G.S. 1-019 1-020	20% NO RECOVERY		MSG continued from 56.0' bgs (56.0-105.5 MSG)	- Archive @ 80 bgs
					• 1-019 80.0-80.6' 4.13.11
					B2C588 B2C596 B2C570
				Water table: 82.5' bgs	• 1-020 - NO RECOVERY
					NOT COLLECTED
85	G.S. 1-025	50%			- Archive @ 85' bgs
					• 1-025 85.0-86.0' 4.13.11
					B2C610 B2C619 B2C628
90	G.S. 1-026 WATER	25%			- Archive @ 90' bgs
				1-026: water sample has yellowish tinge	• 1-026 90.0-91.0'
					B2C640 B2C641 4.13
					• 1-026 WATER 91.0 - B2C649
					B2C659 B2C695 B2C644 B2C669
95	G.S. WATER 1-027 DUP				- Archive @ 95' bgs
					• 1-027 95.0' 4.14.11
					B2C650 B2C660 B2C670
					B2C651 B2C661 4.14.11
100	G.S. 1-028 1-028A	WATER 25%			- Archive @ 100' bgs
				1-028A: 100% full, but mostly rock. 25% usable.	1-028A 100.1-102.4' 4.14.11
					B2C675
				→ Silt increase @ ~104' bgs	• 1-028 100.0': B2C662 B2C662
					WATER 4.14.11
105	G.S. WATER 1-034	95%			- Archive @ 105' bgs
				105.5'-118.0' bgs: Gravelly ~~Sandy~~ Silt	• 1-034 105.2'-107.7' 4.18.11
				70% silt - some consolidated - some semi-consolidated	B2C676 B2C677
				25% Gravel - sub-angular - lg cobbles, rod-sized 70% mafic	• 1-034 WATER: 104.0' 4.18.11
	1-035 G.S.	95%		5% sand - v. fn to med - 50% mafic / 50% felsic	B2C658 B2C668 B2C677
110				no rxn to HCl, damp, overall color 10YR 6/4	- Archive @ 110' bgs
				Pale yellowish brown	• 1-035 109.0'-109.8' 4.18.11
					B2C698 4.18.11
115	G.S.				- Archive @ 115' bgs
				TD: 118.0' bgs	

Reported By: J. Fleming		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature: J. Fleming	Date: 4.18.11	Signature: L.D. Walker	Date: 5/12/11

A-6003-642 (03/03)

Table D-1. Metal Sample Results for Borehole C8375. (6 pages)

HEIS Number	Sample Date	Depth Top Ft	Depth Bottom Ft	Aluminum			Antimony			Arsenic			Barium			Beryllium			Bismuth		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
B2C5W7	04/07/11	15.3	16.5	3930		3.25	0.39	U	0.39	1.24		0.65	47.5		0.33	0.181		0.13	1.12	B	6.5
B2C611	04/07/11	20	21.2	3880		3.93	0.472	U	0.47	1.13		0.79	66.7		0.39	0.201		0.16	1.74	B	7.86
B2C631	04/07/11	NA	NA	44.1		4.24	0.508	U	0.51	0.847	U	0.85	0.268	B	0.42	0.169	U	0.17	8.47	U	8.47
B2C5W8	04/07/11	25.8	28	3970		3.83	0.46	U	0.46	1.18		0.77	55.5		0.38	0.201		0.15	1.03	B	7.66
B2C612	04/07/11	29.7	32.2	3710		3.44	0.413	U	0.41	1.31		0.69	58.2		0.34	0.177		0.14	1.07	B	6.89
B2C5W9	04/07/11	35.2	36.2	3760		4.12	0.494	U	0.49	1.06		0.82	62.2		0.41	0.174		0.17	0.907	B	8.24
B2C5X0	04/07/11	40	41.9	3680		4.4	0.528	U	0.53	2.03		0.88	68.6		0.44	0.173	B	0.18	0.875	B	8.8
B2C5X1	04/12/11	45	47.5	5180		3.92	0.47	U	0.47	1.52		0.78	70.9		0.39	0.197		0.16	7.84	U	7.84
B2C5X2	04/12/11	50	51.2	4040		3.45	0.414	U	0.41	1.28		0.69	76.6		0.35	0.176		0.14	6.9	U	6.9
B2C5Y1	04/12/11	52.4	54.9	5670		4.49	0.538	U	0.54	1.86		0.9	76.2		0.45	0.195		0.18	8.97	U	8.97
B2C5X3	04/12/11	55	57.5	3400		4.24	0.509	U	0.51	0.805	B	0.85	39.8		0.42	0.121	B	0.17	8.49	U	8.49
B2C613	04/12/11	60	62.5	4560		4.86	0.583	U	0.58	1.06		0.97	61.7		0.49	0.164	B	0.19	9.72	U	9.72
B2C5X4	04/12/11	65	66.2	4890		3.5	0.42	U	0.42	1.66		0.7	46.7		0.35	0.213		0.14	7	U	7
B2C614	04/13/11	69.9	72	7810		4.46	0.535	U	0.54	2.25		0.89	53.5		0.45	0.292		0.18	8.92	U	8.92
B2C632	04/13/11	69.9	72	8200		4.34	0.52	U	0.52	2.42		0.87	52.3		0.43	0.315		0.17	8.67	U	8.67
B2C5X5	04/13/11	75	75.6	3900		3.52	0.423	U	0.42	1.34		0.71	42.3		0.35	0.124	B	0.14	7.05	U	7.05
B2C615	04/13/11	77.4	78.6	4170		3.68	0.441	U	0.44	1.31		0.74	42.6		0.37	0.135	B	0.15	7.35	U	7.35
B2C5X6	04/13/11	80	80.6	4720		4.07	0.488	U	0.49	2.05		0.81	54.4		0.41	0.139	B	0.16	8.14	U	8.14
B2C619	04/13/11	85	86	4580		4.34	0.521	U	0.52	1.12		0.87	99.7		0.43	0.113	B	0.17	8.69	U	8.69
B2C641	04/13/11	90	91	3010		3.54	0.425	U	0.43	1.03		0.71	50.1		0.35	0.121	B	0.14	7.08	U	7.08

B = detected below PQL
HEIS = Hanford Environmental Information System
J = estimate
P = practical quantification limit
Q = qualifier
U = undetected

Table D-1. Metal Sample Results for Borehole C8375. (6 pages)

HEIS Number	Sample Date	Depth Top Ft	Depth Bottom Ft	Boron			Cadmium			Calcium			Chromium			Cobalt			Copper		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
B2C5W7	04/07/11	15.3	16.5	0.429	B	1.3	0.104	B	0.13	5120		65	4.06		0.13	8.21		1.3	13.3		0.65
B2C611	04/07/11	20	21.2	1.57	U	1.57	0.112	B	0.16	5440		78.6	4.44		0.16	8.32		1.57	13		0.79
B2C631	04/07/11	NA	NA	1.69	U	1.69	0.169	U	0.17	7.19	B	84.7	0.273		0.17	1.69	U	1.69	0.847	U	0.85
B2C5W8	04/07/11	25.8	28	1.53	U	1.53	0.108	B	0.15	5730		76.6	5.55		0.15	7.57		1.53	12.2		0.77
B2C612	04/07/11	29.7	32.2	1.38	U	1.38	0.104	B	0.14	5520		68.9	4.09		0.14	7.29		1.38	12.2		0.69
B2C5W9	04/07/11	35.2	36.2	1.65	U	1.65	0.113	B	0.17	5230		82.4	6.65		0.17	8.44		1.65	12.9		0.82
B2C5X0	04/07/11	40	41.9	1.76	U	1.76	0.112	B	0.18	4970		88	5.77		0.18	7.25		1.76	12		0.88
B2C5X1	04/12/11	45	47.5	0.554	B	1.57	0.082	B	0.16	4900		78.4	11		0.16	4.02		1.57	8.2		0.78
B2C5X2	04/12/11	50	51.2	0.407	B	1.38	0.059	B	0.14	2730		69	8.51		0.14	3.29		1.38	8.45		0.69
B2C5Y1	04/12/11	52.4	54.9	0.649	B	1.79	0.076	B	0.18	3940		89.7	24.4		0.18	4		1.79	9.68		0.9
B2C5X3	04/12/11	55	57.5	1.7	U	1.7	0.043	B	0.17	1910		84.9	10.5		0.17	2.23		1.7	5.77		0.85
B2C613	04/12/11	60	62.5	1.94	U	1.94	0.065	B	0.19	2500		97.2	10.9		0.19	3.8		1.94	8.41		0.97
B2C5X4	04/12/11	65	66.2	0.551	B	1.4	0.077	B	0.14	10100		70	12.5		0.14	3.73		1.4	8.02		0.7
B2C614	04/13/11	69.9	72	1.12	B	1.78	0.144	B	0.18	27000		89.2	20.2		0.18	6.11		1.78	14.2		0.89
B2C632	04/13/11	69.9	72	1.07	B	1.73	0.156	B	0.17	27900		86.7	20.3		0.17	6.25		1.73	15.5		0.87
B2C5X5	04/13/11	75	75.6	0.424	B	1.41	0.248		0.14	24200		70.5	39.5		0.14	3.76		1.41	10.9		0.71
B2C615	04/13/11	77.4	78.6	0.457	B	1.47	0.046	B	0.15	2700		73.5	18.1		0.15	3.43		1.47	8.34		0.74
B2C5X6	04/13/11	80	80.6	0.436	B	1.63	0.167		0.16	24600		81.4	21.7		0.16	3.88		1.63	10.2		0.81
B2C619	04/13/11	85	86	1.74	U	1.74	0.066	B	0.17	2350		86.9	5.9		0.17	4.7		1.74	9.84		0.87
B2C641	04/13/11	90	91	0.366	B	1.42	0.06	B	0.14	1800		70.8	6.13		0.14	3.39		1.42	6.71		0.71

Table D-1. Metal Sample Results for Borehole C8375. (6 pages)

HEIS		Depth	Depth	Hexavalent Chromium			Iron			Lead			Lithium			Magnesium		
Number	Sample Date	Top Ft	Bottom Ft	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
B2C5W7	04/07/11	15.3	16.5	0.52	U	0.52	25500		13	1.51		0.33	3		1.62	3760		48.7
B2C611	04/07/11	20	21.2	0.52	U	0.52	27300		15.7	1.53		0.39	2.97		1.96	4180		58.9
B2C631	04/07/11	NA	NA	0.5	U	0.5	215		16.9	0.424	U	0.42	2.12	U	2.12	2.13	B	63.6
B2C5W8	04/07/11	25.8	28	0.52	U	0.52	24800		15.3	1.56		0.38	3.09		1.92	3970		57.5
B2C612	04/07/11	29.7	32.2	0.52	U	0.52	24200		13.8	1.49		0.34	3.05		1.72	3910		51.7
B2C5W9	04/07/11	35.2	36.2	0.51	U	0.51	24900		16.5	1.5		0.41	2.99		2.06	3780		61.8
B2C5X0	04/07/11	40	41.9	0.55	U	0.55	22800		17.6	1.8		0.44	3.5		2.2	3520		66
B2C5X1	04/12/11	45	47.5	0.52	U	0.52	11600		15.7	2.6		0.39	7.39		1.96	3030		58.8
B2C5X2	04/12/11	50	51.2	0.52	U	0.52	9940		13.8	2.65		0.35	6.33		1.72	2270		51.7
B2C5Y1	04/12/11	52.4	54.9	0.51	U	0.51	11300		17.9	2.71		0.45	9.23		2.24	3560		67.3
B2C5X3	04/12/11	55	57.5	0.55	U	0.55	6940		17	1.81		0.42	7.16		2.12	2630		63.7
B2C613	04/12/11	60	62.5	0.53	U	0.53	12600		19.4	3.16		0.49	7.84		2.43	2830		72.9
B2C5X4	04/12/11	65	66.2	0.54	U	0.54	10300		14	2.91		0.35	8.89		1.75	3870		52.5
B2C614	04/13/11	69.9	72	0.58	U	0.58	15400		17.8	5.7		0.45	15		2.23	9270		66.9
B2C632	04/13/11	69.9	72	0.58	U	0.58	15300		17.3	5.57		0.43	15.9		2.17	9520		65
B2C5X5	04/13/11	75	75.6	0.51	U	0.51	11600		14.1	1.87		0.35	7.55		1.76	3810		52.9
B2C615	04/13/11	77.4	78.6	0.51	U	0.51	9070		14.7	2.18		0.37	5.92		1.84	3380		55.2
B2C5X6	04/13/11	80	80.6	0.51	U	0.51	10400		16.3	2.71		0.41	6.98		2.03	3510		61
B2C619	04/13/11	85	86	0.54	U	0.54	15400		17.4	1.14		0.43	12.1		2.17	2550		65.1
B2C641	04/13/11	90	91	0.56	U	0.56	10400		14.2	1.57		0.35	3.09		1.77	1740		53.1

Table D-1. Metal Sample Results for Borehole C8375. (6 pages)

HEIS Number	Sample Date	Depth Top Ft	Depth Bottom Ft	Manganese			Mercury			Molybdenum			Nickel			Phosphorus			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
B2C5W7	04/07/11	15.3	16.5	313		3.25	0.025	U	0.02	0.59	B	1.3	5.5		2.6	1160		32.5	456		260
B2C611	04/07/11	20	21.2	308		3.93	0.025	U	0.03	0.437	B	1.57	6.6		3.14	1210		39.3	520		314
B2C631	04/07/11	NA	NA	0.246	B	4.24	0.024	U	0.02	1.69	U	1.69	3.39	U	3.39	5.37	B	42.4	34.5	B	339
B2C5W8	04/07/11	25.8	28	274		3.83	0.025	U	0.03	0.371	B	1.53	6.55		3.07	1120		38.3	418		307
B2C612	04/07/11	29.7	32.2	284		3.44	0.025	U	0.02	0.38	B	1.38	6.44		2.76	1110		34.4	418		276
B2C5W9	04/07/11	35.2	36.2	290		4.12	0.024	U	0.02	0.518	B	1.65	6.57		3.3	1180		41.2	430		330
B2C5X0	04/07/11	40	41.9	268		4.4	0.03	U	0.03	0.662	B	1.76	5.43		3.52	1020		44	513		352
B2C5X1	04/12/11	45	47.5	176		3.92	0.027	U	0.03	0.401	B	1.57	9.46		3.13	367		39.2	883		313
B2C5X2	04/12/11	50	51.2	139		3.45	0.026	U	0.03	0.396	B	1.38	7.19		2.76	311		34.5	636		276
B2C5Y1	04/12/11	52.4	54.9	188		4.49	0.027	U	0.03	0.461	B	1.79	17.9		3.59	318		44.9	1140		359
B2C5X3	04/12/11	55	57.5	140		4.24	0.027	U	0.03	0.245	B	1.7	9.37		3.4	231		42.4	679		340
B2C613	04/12/11	60	62.5	206		4.86	0.029	U	0.03	0.406	B	1.94	8.41		3.89	427		48.6	951		389
B2C5X4	04/12/11	65	66.2	204		3.5	0.029	U	0.03	0.47	B	1.4	11		2.8	383		35	773		280
B2C614	04/13/11	69.9	72	226		4.46	0.031	U	0.03	0.236	B	1.78	18.9		3.57	572		44.6	1360		357
B2C632	04/13/11	69.9	72	226		4.34	0.031	U	0.03	0.191	B	1.73	18.8		3.47	548		43.4	1390		347
B2C5X5	04/13/11	75	75.6	185		3.52	0.024	U	0.02	5.9		1.41	17.3		2.82	322		35.2	606		282
B2C615	04/13/11	77.4	78.6	137		3.68	0.024	U	0.02	0.389	B	1.47	17.4		2.94	299		36.8	638		294
B2C5X6	04/13/11	80	80.6	162		4.07	0.025	U	0.02	1.29	B	1.63	13.4		3.26	362		40.7	673		326
B2C619	04/13/11	85	86	212		4.34	0.027	U	0.03	0.588	B	1.74	6.07		3.47	407		43.4	1530		347
B2C641	04/13/11	90	91	136		3.54				0.394	B	1.42	6.72		2.83	312		35.4	334		283

Table D-1. Metal Sample Results for Borehole C8375. (6 pages)

HEIS Number	Sample Date	Depth Top Ft	Depth Bottom Ft	Selenium			Silicon			Silver			Sodium			Strontium			Thallium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
B2C5W7	04/07/11	15.3	16.5	0.195	U	0.2	408		1.3	0.13	U	0.13	422		32.5	16.8		0.65	0.325	U	0.33
B2C611	04/07/11	20	21.2	0.236	U	0.24	489		1.57	0.157	U	0.16	316		39.3	15.5		0.79	0.393	U	0.39
B2C631	04/07/11	NA	NA	0.254	U	0.25	32		1.69	0.169	U	0.17	42.4	U	42.4	0.154	B	0.85	0.424	U	0.42
B2C5W8	04/07/11	25.8	28	0.23	U	0.23	476		1.53	0.153	U	0.15	318		38.3	18.2		0.77	0.383	U	0.38
B2C612	04/07/11	29.7	32.2	0.207	U	0.21	438		1.38	0.138	U	0.14	293		34.4	17.4		0.69	0.344	U	0.34
B2C5W9	04/07/11	35.2	36.2	0.247	U	0.25	518		1.65	0.165	U	0.17	442		41.2	18.4		0.82	0.412	U	0.41
B2C5X0	04/07/11	40	41.9	0.264	U	0.26	679		1.76	0.176	U	0.18	376		44	17.8		0.88	0.44	U	0.44
B2C5X1	04/12/11	45	47.5	0.235	U	0.24	774		1.57	0.157	U	0.16	308		39.2	20.7		0.78	0.392	U	0.39
B2C5X2	04/12/11	50	51.2	0.207	U	0.21	613		1.38	0.138	U	0.14	232		34.5	18.4		0.69	0.345	U	0.35
B2C5Y1	04/12/11	52.4	54.9	0.269	U	0.27	863		1.79	0.179	U	0.18	343		44.9	19		0.9	0.449	U	0.45
B2C5X3	04/12/11	55	57.5	0.255	U	0.26	556		1.7	0.17	U	0.17	170		42.4	12.2		0.85	0.424	U	0.42
B2C613	04/12/11	60	62.5	0.291	U	0.29	689		1.94	0.194	U	0.19	264		48.6	15.9		0.97	0.486	U	0.49
B2C5X4	04/12/11	65	66.2	0.21	U	0.21	667		1.4	0.14	U	0.14	385		35	24.6		0.7	0.35	U	0.35
B2C614	04/13/11	69.9	72	0.268	U	0.27	915		1.78	0.178	U	0.18	161		44.6	56.5		0.89	0.446	U	0.45
B2C632	04/13/11	69.9	72	0.26	U	0.26	917		1.73	0.173	U	0.17	153		43.4	57		0.87	0.434	U	0.43
B2C5X5	04/13/11	75	75.6	0.211	U	0.21	539		1.41	0.141	U	0.14	166		35.2	20.3		0.71	0.352	U	0.35
B2C615	04/13/11	77.4	78.6	0.221	U	0.22	505		1.47	0.147	U	0.15	225		36.8	17.5		0.74	0.368	U	0.37
B2C5X6	04/13/11	80	80.6	0.258		0.24	619		1.63	0.163	U	0.16	262		40.7	29.1		0.81	0.407	U	0.41
B2C619	04/13/11	85	86	0.261	U	0.26	389		1.74	0.174	U	0.17	319		43.4	15.7		0.87	0.434	U	0.43
B2C641	04/13/11	90	91	0.212	U	0.21	352		1.42	0.142	U	0.14	176		35.4	15.6		0.71	0.354	U	0.35

Table D-1. Metal Sample Results for Borehole C8375. (6 pages)

HEIS Number	Sample Date	Depth Top Ft	Depth Bottom Ft	Tin			Vanadium			Zinc		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
B2C5W7	04/07/11	15.3	16.5	0.955	B	6.5	82.1		1.62	44.9		6.5
B2C611	04/07/11	20	21.2	0.978	B	7.86	81.7		1.96	47.2		7.86
B2C631	04/07/11	NA	NA	1.08	B	8.47	2.12	U	2.12	8.47	U	8.47
B2C5W8	04/07/11	25.8	28	1.11	B	7.66	77.7		1.92	43.6		7.66
B2C612	04/07/11	29.7	32.2	0.938	B	6.89	77.2		1.72	42.4		6.89
B2C5W9	04/07/11	35.2	36.2	1.26	B	8.24	82.3		2.06	45.2		8.24
B2C5X0	04/07/11	40	41.9	1.12	B	8.8	69.9		2.2	40.3		8.8
B2C5X1	04/12/11	45	47.5	0.923	B	7.84	27.7		1.96	24.3		7.84
B2C5X2	04/12/11	50	51.2	0.805	B	6.9	24.4		1.72	21.5		6.9
B2C5Y1	04/12/11	52.4	54.9	1.06	B	8.97	27		2.24	27.3		8.97
B2C5X3	04/12/11	55	57.5	0.963	B	8.49	15.8		2.12	21		8.49
B2C613	04/12/11	60	62.5	1.32	B	9.72	29.8		2.43	28.2		9.72
B2C5X4	04/12/11	65	66.2	0.923	B	7	19.5		1.75	25.7		7
B2C614	04/13/11	69.9	72	1.05	B	8.92	31.4		2.23	41.1		8.92
B2C632	04/13/11	69.9	72	1.12	B	8.67	32.7		2.17	42.2		8.67
B2C5X5	04/13/11	75	75.6	1.2	B	7.05	22.6		1.76	21.2		7.05
B2C615	04/13/11	77.4	78.6	0.932	B	7.35	21.7		1.84	19.3		7.35
B2C5X6	04/13/11	80	80.6	1.02	B	8.14	22.7		2.03	19.8		8.14
B2C619	04/13/11	85	86	1.12	B	8.69	38		2.17	30.9		8.69
B2C641	04/13/11	90	91	1.1	B	7.08	28.5		1.77	17.3		7.08

Table D-2. Anion Sample Results for Borehole C8375. (2 pages)

HEIS Number	Sample Date	Depth Top Ft	Depth Bottom Ft	Bromide			Chloride			Fluoride			Nitrate			Nitrite		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
B2C5W7	04/07/11	15.3	16.5	5.2	U	5.2	3.1	B	5.2	5.2	U	5.2	1.4	B	5.2	5.2	U	5.2
B2C611	04/07/11	20	21.2	5.1	U	5.1	19.2		5.1	5.1	U	5.1	3.4	B	5.1	5.1	U	5.1
B2C5W8	04/07/11	25.8	28	5.2	U	5.2	3.4	B	5.2	5.2	U	5.2	3.8	B	5.2	5.2	U	5.2
B2C612	04/07/11	29.7	32.2	5	U	5	2.6	B	5	5	U	5	3.6	B	5	5	U	5
B2C5W9	04/07/11	35.2	36.2	5	U	5	2.5	B	5	5	U	5	3.8	B	5	5	U	5
B2C5X0	04/07/11	40	41.9	5.4	U	5.4	2	B	5.4	5.4	U	5.4	2.1	B	5.4	5.4	U	5.4
B2C5X1	04/12/11	45	47.5	5	U	5	3.3	B	5	5	U	5	5	U	5	5	U	5
B2C5X2	04/12/11	50	51.2	5.2	U	5.2	2.3	B	5.2	5.2	U	5.2	2.3	B	5.2	5.2	U	5.2
B2C5Y1	04/12/11	52.4	54.9	5.1	U	5.1	3.2	B	5.1	5.1	U	5.1	1.7	B	5.1	5.1	U	5.1
B2C5X3	04/12/11	55	57.5	5.4	U	5.4	1.4	B	5.4	5.4	U	5.4	5.4	U	5.4	5.4	U	5.4
B2C613	04/12/11	60	62.5	5.3	U	5.3	1.7	B	5.3	5.3	U	5.3	1.2	B	5.3	5.3	U	5.3
B2C5X4	04/12/11	65	66.2	5.3	U	5.3	2	B	5.3	5.3	U	5.3	3.2	B	5.3	5.3	U	5.3
B2C614	04/13/11	69.9	72	5.8	U	5.8	3.5	B	5.8	5.8	U	5.8	12.9		5.8	5.8	U	5.8
B2C632	04/13/11	69.9	72	5.6	U	5.6	3	B	5.6	5.6	U	5.6	10.4		5.6	5.6	U	5.6
B2C5X5	04/13/11	75	75.6	4.9	U	4.9	1.1	B	4.9	4.9	U	4.9	4.9	U	4.9	4.9	U	4.9
B2C615	04/13/11	77.4	78.6	5	U	5	1.3	B	5	5	U	5	5	U	5	5	U	5
B2C5X6	04/13/11	80	80.6	5.1	U	5.1	1.7	B	5.1	5.1	U	5.1	1	B	5.1	5.1	U	5.1
B2C619	04/13/11	85	86	5.4	U	5.4	1.9	B	5.4	5.4	U	5.4	4.7	B	5.4	5.4	U	5.4

Table D-2. Anion Sample Results for Borehole C8375. (2 pages)

HEIS Number	Sample Date	Depth Top Ft	Depth Bottom Ft	Nitrogen in Nitrite and Nitrate			Phosphate			Sulfate		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
B2C5W7	04/07/11	15.3	16.5	0.12	B	0.52	10.3	U	10.3	31.5		5.2
B2C611	04/07/11	20	21.2	0.64		0.51	10.2	U	10.2	21.4		5.1
B2C5W8	04/07/11	25.8	28	0.77		0.52	10.3	U	10.3	13.8		5.2
B2C612	04/07/11	29.7	32.2	0.77		0.5	10	U	10	8.5		5
B2C5W9	04/07/11	35.2	36.2	0.81		0.5	10.1	U	10.1	12.7		5
B2C5X0	04/07/11	40	41.9	0.28	B	0.54	10.7	U	10.7	12.6		5.4
B2C5X1	04/12/11	45	47.5	0.5	U	0.5	10	U	10	10.2		5
B2C5X2	04/12/11	50	51.2	0.35	B	0.52	10.4	U	10.4	13.3		5.2
B2C5Y1	04/12/11	52.4	54.9	0.25	B	0.51	10.2	U	10.2	16		5.1
B2C5X3	04/12/11	55	57.5	0.54	U	0.54	10.8	U	10.8	11.2		5.4
B2C613	04/12/11	60	62.5	0.53	U	0.53	10.5	U	10.5	11.5		5.3
B2C5X4	04/12/11	65	66.2	0.53		0.53	10.6	U	10.6	36.6		5.3
B2C614	04/13/11	69.9	72	2.82		0.58	11.5	U	11.5	42.7		5.8
B2C632	04/13/11	69.9	72	2.3		0.56	11.3	U	11.3	35.2		5.6
B2C5X5	04/13/11	75	75.6	0.49	U	0.49	9.9	U	9.9	5.6		4.9
B2C615	04/13/11	77.4	78.6	0.5	U	0.5	10.1	U	10.1	3.7	B	5
B2C5X6	04/13/11	80	80.6	0.51	U	0.51	10.1	U	10.1	10.1		5.1
B2C619	04/13/11	85	86	1.25		0.54	10.7	U	10.7	19.5		5.4

Table D-3. Radionuclide Sample Results for Borehole C8375. (3 pages)

HEIS Number	Sample Date	Depth Top Ft.	Depth Bottom Ft.	Americium-241			Antimony-125			Barium-133			Beryllium-7			Cesium-134			Cesium-137		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
B2C5R1	04/07/11	15.3	16.5	0.311	U	0.311	0.136	U	0.136	0.072	U	0.072	0.503	U	0.503	0.081	U	0.081	0.057	U	0.057
B2C620	04/07/11	20	21.2	0.039	U	0.039	0.044	U	0.044	0.024	U	0.024	0.15	U	0.15	0.03	U	0.03	0.019	U	0.019
B2C5R2	04/07/11	25.8	28	0.094	U	0.094	0.049	U	0.049	0.032	U	0.032	0.158	U	0.158	0.032	U	0.032	0.022	U	0.022
B2C621	04/07/11	29.7	32.2	0.257	U	0.257	0.069	U	0.069	0.034	U	0.034	0.212	U	0.212	0.039	U	0.039	0.032	U	0.032
B2C5R3	04/07/11	35.2	36.2	0.173	U	0.173	0.128	U	0.128	0.061	U	0.061	0.408	U	0.408	0.073	U	0.073	0.056	U	0.056
B2C5R4	04/07/11	40	41.9	0.29	U	0.29	0.144	U	0.144	0.071	U	0.071	0.465	U	0.465	0.083	U	0.083	0.05	U	0.05
B2C5R5	04/12/11	45	47.5	0.127	U	0.127	0.069	U	0.069	0.045	U	0.045	0.227	U	0.227	0.047	U	0.047	0.032	U	0.032
B2C5R6	04/12/11	50	51.2	0.331	U	0.331	0.157	U	0.157	0.08	U	0.08	0.537	U	0.537	0.085	U	0.085	0.057	U	0.057
B2C5Y2	04/12/11	52.4	54.9	0.357	U	0.357	0.168	U	0.168	0.083	U	0.083	0.633	U	0.633	0.096	U	0.096	0.081	U	0.081
B2C5R7	04/12/11	55	57.5	0.374	U	0.374	0.188	U	0.188	0.101	U	0.101	0.649	U	0.649	0.102	U	0.102	0.094	U	0.094
B2C622	04/12/11	60	62.5	0.124	U	0.124	0.066	U	0.066	0.041	U	0.041	0.232	U	0.232	0.044	U	0.044	0.03	U	0.03
B2C5R8	04/12/11	65	66.2	0.136	U	0.136	0.063	U	0.063	0.033	U	0.033	0.204	U	0.204	0.037	U	0.037	0.024	U	0.024
B2C623	04/13/11	69.9	72	0.234	U	0.234	0.166	U	0.166	0.095	U	0.095	0.597	U	0.597	0.093	U	0.093	0.074	U	0.074
B2C634	04/13/11	69.9	72	0.134	U	0.134	0.059	U	0.059	0.031	U	0.031	0.201	U	0.201	0.037	U	0.037	0.022	U	0.022
B2C5R9	04/13/11	75	75.6	0.17	U	0.17	0.148	U	0.148	0.087	U	0.087	0.473	U	0.473	0.076	U	0.076	0.061	U	0.061
B2C624	04/13/11	77.4	78.6	0.085	U	0.085	0.027	U	0.027	0.014	U	0.014	0.088	U	0.088	0.017	U	0.017	0.011	U	0.011
B2C5T0	04/13/11	80	80.6	0.403	U	0.403	0.186	U	0.186	0.096	U	0.096	0.612	U	0.612	0.096	U	0.096	0.072	U	0.072
B2C628	04/13/11	85	86	0.095	U	0.095	0.189	U	0.189	0.098	U	0.098	0.706	U	0.706	0.107	U	0.107	0.081	U	0.081

Table D-3. Radionuclide Sample Results for Borehole C8375. (3 pages)

HEIS Number	Sample Date	Depth Top Ft.	Depth Bottom Ft.	Cobalt-60			Europium-152			Europium-154			Europium-155			Potassium-40			Radium-226		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
B2C5R1	04/07/11	15.3	16.5	0.053	U	0.053	0.171	U	0.171	0.19	U	0.19	0.181	U	0.181	8.58		0.591	0.353		0.115
B2C620	04/07/11	20	21.2	0.025	U	0.025	0.051	U	0.051	0.072	U	0.072	0.056	U	0.056	11		0.233	0.365		0.037
B2C5R2	04/07/11	25.8	28	0.021	U	0.021	0.061	U	0.061	0.08	U	0.08	0.068	U	0.068	8.74		0.194	0.269		0.042
B2C621	04/07/11	29.7	32.2	0.03	U	0.03	0.082	U	0.082	0.109	U	0.109	0.099	U	0.099	9.23		0.324	0.297		0.06
B2C5R3	04/07/11	35.2	36.2	0.045	U	0.045	0.153	U	0.153	0.168	U	0.168	0.176	U	0.176	9.17		0.594	0.284		0.095
B2C5R4	04/07/11	40	41.9	0.055	U	0.055	0.163	U	0.163	0.205	U	0.205	0.183	U	0.183	11.4		0.664	0.481		0.09
B2C5R5	04/12/11	45	47.5	0.032	U	0.032	0.077	U	0.077	0.112	U	0.112	0.098	U	0.098	14.4		0.338	0.428		0.06
B2C5R6	04/12/11	50	51.2	0.063	U	0.063	0.188	U	0.188	0.184	U	0.184	0.204	U	0.204	13.2		0.71	0.301		0.112
B2C5Y2	04/12/11	52.4	54.9	0.077	U	0.077	0.185	U	0.185	0.273	U	0.273	0.245	U	0.245	10.2		0.771	0.174	U	0.185
B2C5R7	04/12/11	55	57.5	0.106	U	0.106	0.174	U	0.174	0.272	U	0.272	0.198	U	0.198	11.7		0.969	0.437		0.161
B2C622	04/12/11	60	62.5	0.029	U	0.029	0.073	U	0.073	0.111	U	0.111	0.094	U	0.094	14.3		0.289	0.424		0.061
B2C5R8	04/12/11	65	66.2	0.026	U	0.026	0.068	U	0.068	0.087	U	0.087	0.097	U	0.097	15.9		0.237	0.518		0.053
B2C623	04/13/11	69.9	72	0.079	U	0.079	0.205	U	0.205	0.248	U	0.248	0.198	U	0.198	15.5		0.631	0.439		0.154
B2C634	04/13/11	69.9	72	0.026	U	0.026	0.067	U	0.067	0.082	U	0.082	0.093	U	0.093	16.1		0.224	0.572		0.052
B2C5R9	04/13/11	75	75.6	0.059	U	0.059	0.159	U	0.159	0.218	U	0.218	0.166	U	0.166	12		0.664	0.363		0.126
B2C624	04/13/11	77.4	78.6	0.012	U	0.012	0.029	U	0.029	0.04	U	0.04	0.054	U	0.054	14		0.115	0.376		0.024
B2C5T0	04/13/11	80	80.6	0.064	U	0.064	0.209	U	0.209	0.252	U	0.252	0.243	U	0.243	13.4		0.766	0.506		0.14
B2C628	04/13/11	85	86	0.1	U	0.1	0.223	U	0.223	0.29	U	0.29	0.169	U	0.169	13.7		0.413	0.39		0.184

Table D-3. Radionuclide Sample Results for Borehole C8375. (3 pages)

HEIS Number	Sample Date	Depth Top Ft.	Depth Bottom Ft.	Radium-228			Ruthenium-106			Silver-108m			Technetium-99			Total beta radiostrontium			Tritium		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
B2C5R1	04/07/11	15.3	16.5	0.374		0.213	0.439	U	0.439	0.047	U	0.047	-0.01	U	0.091	-0.01	U	0.311	0.253	U	3.15
B2C620	04/07/11	20	21.2	0.604		0.099	0.172	U	0.172	0.015	U	0.015	-0.02	U	0.093	-0.03	U	0.309	-0.54	U	3.05
B2C5R2	04/07/11	25.8	28	0.404		0.1	0.175	U	0.175	0.017	U	0.017	-0.03	U	0.102	0.028	U	0.373	-2.03	U	3.15
B2C621	04/07/11	29.7	32.2	0.364		0.161	0.232	U	0.232	0.023	U	0.023	-0.03	U	0.106	-0.08	U	0.236	3.15		3.11
B2C5R3	04/07/11	35.2	36.2	0.566		0.194	0.458	U	0.458	0.044	U	0.044	-0.03	U	0.089	-0.04	U	0.368	-0.6	U	3.11
B2C5R4	04/07/11	40	41.9	0.73		0.243	0.456	U	0.456	0.046	U	0.046	-0.03	U	0.092	-0.04	U	0.317	0.848	U	3.1
B2C5R5	04/12/11	45	47.5	0.806		0.159	0.246	U	0.246	0.023	U	0.023	-0.04	U	0.099	-0.06	U	0.279	3.58		2.64
B2C5R6	04/12/11	50	51.2	0.543		0.244	0.504	U	0.504	0.048	U	0.048	-0.01	U	0.093	0.054	U	0.28	3		2.44
B2C5Y2	04/12/11	52.4	54.9	0.467		0.41	0.595	U	0.595	0.06	U	0.06	-0.01	U	0.088	-0.09	U	0.264	0.256	U	2.87
B2C5R7	04/12/11	55	57.5	0.58		0.412	0.699	U	0.699	0.061	U	0.061	-0.02	U	0.085	-0.15	U	0.367	3.6		2.62
B2C622	04/12/11	60	62.5	0.67		0.151	0.241	U	0.241	0.022	U	0.022	-0.03	U	0.095	0.069	U	0.284	1.31	U	2.62
B2C5R8	04/12/11	65	66.2	0.914		0.091	0.22	U	0.22	0.018	U	0.018	-0.03	U	0.098	0.053	U	0.338	1.84	U	2.64
B2C623	04/13/11	69.9	72	0.9		0.337	0.617	U	0.617	0.056	U	0.056	0.021	U	0.129	1.06		0.303	2.3	U	2.52
B2C634	04/13/11	69.9	72	1.03		0.108	0.201	U	0.201	0.018	U	0.018	-0.05	U	0.093	0.019	U	0.298	2.42	U	2.66
B2C5R9	04/13/11	75	75.6	0.594		0.284	0.57	U	0.57	0.051	U	0.051	-0.03	U	0.092	0.01	U	0.308	2.7		2.56
B2C624	04/13/11	77.4	78.6	0.666		0.05	0.087	U	0.087	0.009	U	0.009	-0.01	U	0.105	0.003	U	0.314	2.21	U	2.63
B2C5T0	04/13/11	80	80.6	0.786		0.294	0.622	U	0.622	0.062	U	0.062	-0.01	U	0.097	-0.03	U	0.3	1.9	U	2.66
B2C628	04/13/11	85	86	0.625	U	0.625	0.693	U	0.693	0.062	U	0.062	-0.02	U	0.091	-0.06	U	0.249	1.46	U	2.47

Table D-4. Organic Sample Results for Borehole C8375. (2 pages)

LOCATION	CLASS	B2C5T3-15.3 Ft			B2C5Y3-20 Ft			B2C5T4-25.8 Ft			B2C5Y4-29.7 Ft			B2C5T6-40 Ft			B2C5T7-45 Ft		
CONSTITUENT		4/7/11 9:38			4/7/11 10:09			4/7/11 10:50			4/7/11 11:15			4/7/11 13:55			4/12/11 8:45		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,1,1-Trichloroethane	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
1,1,2,2-Tetrachloroethane	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
1,1,2-Trichloroethane	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
1,1-Dichloroethane	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
1,1-Dichloroethene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
1,2-Dichloroethane	VOA	5.07	U	5.07	6.44	U	6.44	7.19	U	7.19	4.51	U	4.51	5.85	U	5.85	5.65	U	5.65
1,2-Dichloroethene(Total)	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
1,2-Dichloropropane	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
2-Butanone	VOA	10.1	U	10.1	12.9	U	12.9	14.4	U	14.4	9.02	U	9.02	11.7	U	11.7	11.3	U	11.3
2-Hexanone	VOA	10.1	U	10.1	12.9	U	12.9	14.4	U	14.4	9.02	U	9.02	11.7	U	11.7	11.3	U	11.3
4-Methyl-2-Pentanone	VOA	10.1	U	10.1	12.9	U	12.9	14.4	U	14.4	9.02	U	9.02	11.7	U	11.7	11.3	U	11.3
Acetone	VOA	5.54	BJ	10.1	5.55	BJ	12.9	7.45	BJ	14.4	8.52	BJ	9.02	5.86	BJ	11.7	16	B	11.3
Benzene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Bromodichloromethane	VOA	5.07	U	5.07	6.44	U	6.44	7.19	U	7.19	4.51	U	4.51	5.85	U	5.85	5.65	U	5.65
Bromoform	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Bromomethane	VOA	8.45	U	8.45	10.7	U	10.7	12	U	12	7.52	U	7.52	9.74	U	9.74	9.41	U	9.41
Carbon disulfide	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Carbon tetrachloride	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Chlorobenzene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Chloroethane	VOA	8.45	U	8.45	10.7	U	10.7	12	U	12	7.52	U	7.52	9.74	U	9.74	9.41	U	9.41
Chloroform	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Chloromethane	VOA	8.45	U	8.45	10.7	U	10.7	12	U	12	7.52	U	7.52	9.74	U	9.74	9.41	U	9.41
cis-1,2-Dichloroethylene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
cis-1,3-Dichloropropene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Dibromochloromethane	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Ethylbenzene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Methylenechloride	VOA	5.07	U	5.07	6.44	U	6.44	7.19	U	7.19	4.51	U	4.51	5.85	U	5.85	5.65	U	5.65
Styrene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Tetrachloroethene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Toluene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
trans-1,2-Dichloroethylene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
trans-1,3-Dichloropropene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Trichloroethene	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71
Vinyl chloride	VOA	8.45	U	8.45	10.7	U	10.7	12	U	12	7.52	U	7.52	9.74	U	9.74	9.41	U	9.41
Xylenes (total)	VOA	4.23	U	4.23	5.36	U	5.36	5.99	U	5.99	3.76	U	3.76	4.87	U	4.87	4.71	U	4.71

Table D-4. Organic Sample Results for Borehole C8375. (2 pages)

LOCATION	CLASS	B2C5T8-50 Ft			B2C5T9-55 Ft			B2C5Y5-60 Ft			B2C5V0-65 Ft			B2C5Y6-69.9 Ft			B2C630-69.9 Ft		
CONSTITUENT		4/12/11 10:05			4/12/11 11:25			4/12/11 13:40			4/12/11 14:25			4/13/11 8:20			4/13/11 8:20		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,1,1-Trichloroethane	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
1,1,2,2-Tetrachloroethane	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
1,1,2-Trichloroethane	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
1,1-Dichloroethane	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
1,1-Dichloroethene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
1,2-Dichloroethane	VOA	6.16	U	6.16	5.04	U	5.04	5.42	U	5.42	5.74	U	5.74	6.08	U	6.08	5.74	U	5.74
1,2-Dichloroethene(Total)	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
1,2-Dichloropropane	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
2-Butanone	VOA	12.3	U	12.3	10.1	U	10.1	10.8	U	10.8	11.5	U	11.5	12.2	U	12.2	11.5	U	11.5
2-Hexanone	VOA	12.3	U	12.3	10.1	U	10.1	10.8	U	10.8	11.5	U	11.5	12.2	U	12.2	11.5	U	11.5
4-Methyl-2-Pentanone	VOA	12.3	U	12.3	10.1	U	10.1	10.8	U	10.8	11.5	U	11.5	12.2	U	12.2	11.5	U	11.5
Acetone	VOA	13.7	B	12.3	9.88	BJ	10.1	10.8	U	10.8	19.7	B	11.5	12.2	U	12.2	11.5	U	11.5
Benzene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Bromodichloromethane	VOA	6.16	U	6.16	5.04	U	5.04	5.42	U	5.42	5.74	U	5.74	6.08	U	6.08	5.74	U	5.74
Bromoform	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Bromomethane	VOA	10.3	U	10.3	8.41	U	8.41	9.04	U	9.04	9.56	U	9.56	10.1	U	10.1	9.57	U	9.57
Carbon disulfide	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Carbon tetrachloride	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Chlorobenzene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Chloroethane	VOA	10.3	U	10.3	8.41	U	8.41	9.04	U	9.04	9.56	U	9.56	10.1	U	10.1	9.57	U	9.57
Chloroform	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Chloromethane	VOA	10.3	U	10.3	8.41	U	8.41	9.04	U	9.04	9.56	U	9.56	10.1	U	10.1	9.57	U	9.57
cis-1,2-Dichloroethylene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
cis-1,3-Dichloropropene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Dibromochloromethane	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Ethylbenzene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Methylenechloride	VOA	6.16	U	6.16	5.04	U	5.04	5.42	U	5.42	5.74	U	5.74	6.08	U	6.08	5.74	U	5.74
Styrene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Tetrachloroethene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Toluene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
trans-1,2-Dichloroethylene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
trans-1,3-Dichloropropene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Trichloroethene	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79
Vinyl chloride	VOA	10.3	U	10.3	8.41	U	8.41	9.04	U	9.04	9.56	U	9.56	10.1	U	10.1	9.57	U	9.57
Xylenes (total)	VOA	5.13	U	5.13	4.2	U	4.2	4.52	U	4.52	4.78	U	4.78	5.07	U	5.07	4.79	U	4.79

APPENDIX E

VERIFICATION SAMPLING DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample designs (DOE-RL 2009, WCH 2008b). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009).

A review of the sample design (WCH 2008b), the field logbook (WCH 2008a), and applicable analytical data packages has been performed as part of this DQA. All samples were collected per the sample design. To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical and radiochemical analysis (BHI 2000a, 2000b) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., decision-making purposes). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2000).

Verification sample data collected at the 100-D-56 (North) waste site were provided by the laboratories in two sample delivery groups (SDGs): SDG K1168 and SDG K1170. These SDGs, including the field samples and the field quality control (QC) samples, were analyzed for anions by ion chromatography (IC anions), hexavalent chromium, and inductively coupled plasma (ICP). The IC anions include bromide, chloride, fluoride, nitrate, nitrite, phosphate, and sulphate. The ICP metals include antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc. SDG K1168 was submitted for third-party validation. No major deficiencies were found in the SDGs. The practical quantitation limit (PQL) for selenium was slightly elevated above the cleanup criteria of 1.0 mg/kg. However, RESRAD modeling predicts that residual concentrations of selenium, if present below the PQL, will not migrate more than 15 m (49 ft) vertically in 1,000 years based on the soil-partitioning distribution coefficient for selenium of 5 mL/g. The vadose zone underlying the site at the base of the excavation is approximately 24 m (79 ft) thick Therefore, residual concentrations of selenium that might present below the PQL are predicted to be protective of groundwater and the Columbia River. Minor deficiencies are discussed by SDG as follows below. Unless otherwise noted, deficiencies listed below are specific to the individual SDG, but apply to all samples within that SDG.

SDG K1168

This SDG comprises 18 field samples (J16DM1-J16DM9, J16DN0-J16DN4, J16DP4, and J16DR2-J16DR4), where sample J16DM1 is an equipment blank (EB) and the remainder are field soil samples. SDG KK1168 was submitted for formal third-party validation. Minor deficiencies found in SDG K1168 are as follows:

In the ICP metals analysis, barium and manganese were detected in the method blank (MB). With the exception of sample J16DM1, the EB, the MB results are insignificant (less than 1/20th) compared to the concentrations detected in the field samples. Third-party validation did not qualify any data due to these detections. The data are useable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries for manganese and antimony were outside the acceptance criteria (70% to 130%) at 138% and 59%, respectively. For manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, post-digestion spikes (PDSs) and serial dilutions were prepared for each analyte with results ranging from 104.8% to 106.7%. These results are within the acceptance criteria. However, antimony did not have mismatched spike and native concentrations in the original MS. Because the original MS recovery for antimony was 59%, third-party validation qualified all of the antimony data in SDG K1168 as estimated with "J" flags. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the relative percent difference (RPD) calculated in the laboratory duplicate for mercury is outside the acceptance criteria (70% to 130%) at 56.7%. Elevated RPDs in environmental soil samples are generally attributed to heterogeneities in the sample matrix and not to deficiencies in the laboratory procedures. Third-party validation did not qualify any data due to these detections. The data are useable for decision-making purposes.

SDG K1170

The RPDs for phosphate (200%) and sulfate (42.5%) for the laboratory duplicate samples were outside the acceptance criteria of 30%. The primary sample results for both analytes were detected just above the detection limit, and the duplicate results are both nondetected. When one of the two samples is nondetected or when the duplicate pair is near the detection limit, analysis of RPDs is not considered to be useful in the precision determination. The data are useable for decision- making purposes.

In the ICP metals analysis, the MS recovery for antimony is 46.7%, below the acceptance criteria. To confirm quantitation, a PDS and serial dilution were prepared for antimony with acceptable results. The antimony results for all samples in SDG K1170 may be considered estimated. Estimated data are useable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

RPD 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. Two field duplicate samples, listed in the field logbook (WCH 2008a), were collected. The main samples are J16DM6 and J16DP8; the duplicate samples are J16DM7 and J16DP9, respectively.

Field duplicate samples provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the duplicate samples for each contaminant of concern. None of the RPDs calculated for field duplicates are above the acceptance criteria (30%). The data are useable for decision-making purposes.

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

SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-D-56 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-D-56 waste site concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any analytical results should be rejected as a result of QA and QC deficiencies. The analytical data were found acceptable for decision-making purposes. The verification sample analytical data are stored in the Environmental Restoration project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix C.

Washington State Department of Ecology Split Samples

For the 100-D-56 (North) waste site, four split samples were collected at the direction of the Washington State Department of Ecology (Ecology). These samples were submitted to an independent laboratory and analyzed for IC anions, hexavalent chromium, and ICP metals. This data includes the same analyte list as presented for the verification data with the following exceptions:

- In the IC anions analysis, nitrate and nitrite are reported as nitrogen, and (ortho)phosphate is reported as phosphorus.
- In the ICP metals analysis, the analytes aluminum, calcium, iron, magnesium, nickel, and sodium are also reported. The analytes boron and molybdenum are not reported.

No field QC samples were sent to the split laboratory. No laboratory QC samples were reported along with the split sample data.

Field split samples are used to determine systematic differences (bias) between laboratories. A statistical determination of systematic differences would require larger data sets than are presented here.

Such a determination is complicated by variability introduced by the natural heterogeneities inherent in field soil samples, and the analytical variability that each individual laboratory experiences. Therefore, when evaluating limited field split data relatively large RPDs are expected.

The split sample data are presented in the 95% upper confidence limit (UCL) calculation in Appendix C. RPDs for the four split samples relative to the verification samples have been calculated where appropriate and are also presented in the UCL calculation. The RPDs calculated are generally less than expected, with only three values above 35%, and each of those from a different sample set. The 95% UCL calculation provides more details.

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