1213487

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

12-AMRP-0014

APR 25 2012

Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

Dear Mr. Faulk:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM NO. 2012-010 AND SUPPORTING DOCUMENTATION FOR THE 100-F-57:1, EASTERN 190-F PROCESS WATER PUMP HOUSE DEBRIS AND OVERBURDEN STOCKPILE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2012-010 and supporting, "Remaining Sites Verification Package for the 100-F-57:1, Eastern 190-F Process Water Pump House Debris and Overburden Stockpile," 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:
C. J. Guzzetti, EPA
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-FR-1

# WASTE SITE RECLASSIFICATION FORM

**Operable Unit:** 100-FR-1 **Control No.:** 2012-010

**Waste Site Code(s)/Subsite Code(s):**

100-F-57:1

**Reclassification Category:** Interim ☒ Final ☐

**Reclassification Status:** Closed Out ☒ No Action ☐ Rejected ☐

RCRA Postclosure ☐ Consolidated ☐ None ☐

**Approvals Needed:** DOE ☒ Ecology ☐ EPA ☒

**Description of Current Waste Site Condition:**

The 100-F-57:1, Eastern 190-F Process Water Pump House Debris waste subsite is located in the 100-FR-1 Operable Unit of the Hanford Site. It is located approximately 100 m (330 ft) north of the 105-F Reactor Building foundation and adjacent to the 185-F Building foundation. The overburden stockpile is located directly north of the 100-F-57:1 waste subsite. The 100-F-57:1 waste site is a subsite of the 100-F-57, 190-F Process Water Pump House Debris waste site, which was identified as a remaining site for remediation in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2009). Remediation of the 100-F-57:1 waste subsite and the overburden stockpile occurred between December 2010 and January 2012. The remediation resulted in approximately 3,002 bank cubic meters (3,926 bank cubic yards) of material being removed and disposed at the Environmental Restoration Disposal Facility (ERDF).

Cleanup verification sampling was performed in January and February 2012 to determine if the waste site meets remedial action objectives (RAOs) and remedial action goals (RAGs) 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*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (Remaining Sites ROD) (EPA 1999). The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at ERDF at the 200 Area of the Hanford Site, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

**Basis for Reclassification:**

Cleanup verification sampling results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-F-57:1 waste subsite and overburden stockpile to Interim Closed Out. The current site conditions achieve the RAOs and RAGs established by the Remaining Sites ROD (EPA 1999). The results of verification sampling 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 analytical results and rationale presented in the attached remaining sites verification package also demonstrate that residual contaminant concentrations meet direct-exposure cleanup criteria and are protective of groundwater and the Columbia River. The waste site contamination does not extend into the deep-zone soils. Therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep-zone soils are not required. The basis for reclassification is described in detail in the Remaining Sites Verification Package for the 100-F-57:1, Eastern 190-F Water Pump House Debris and Overburden Stockpile (attached).

# WASTE SITE RECLASSIFICATION FORM

**Operable Unit:** 100-FR-1 **Control No.:** 2012-010

**Waste Site Code(s)/Subsite Code(s):**

100-F-57:1

**Project Manager Comments:**

Approval of this Waste Site Reclassification Form documents the regulators' agreement that the 100-F-57:1 waste subsite and overburden stockpile qualify for Interim Closed Out under this Interim Action ROD. In addition, the lead regulatory agency has evaluated the data for this site against WAC 173-340 (2007) cleanup levels for direct-contact, groundwater protection, and river protection. This evaluation is documented in the letter transmitting the lead regulatory agency'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 | M S French | 4/6/12 |
| DOE Federal Project Director (printed) | Signature | Date |
| N/A | | |
| Ecology Project Manager (printed) | Signature | Date |
| C. Guzzetti | | 4/10/12 |
| EPA Project Manager (printed) | Signature | Date |

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-57:1, EASTERN 190-F PROCESS WATER PUMP HOUSE DEBRIS AND OVERBURDEN STOCKPILE

**Attachment to Waste Site Reclassification Form 2012-010**

**March 2012**

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-57:1, EASTERN 190-F PROCESS WATER PUMP HOUSE DEBRIS AND OVERBURDEN STOCKPILE

## EXECUTIVE SUMMARY

The 100-F-57 waste site is located in the 100-FR-1 Operable Unit of the Hanford Site approximately 100 m (330 ft) directly north of the 105-F Reactor. The overburden stockpile is located directly north of the 100-F-57 waste site and adjacent to the 185-F Building foundation. The 100-F-57 waste site was included in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision* (EPA 2009) as an additional site for remediation under 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 100-F-57 waste site is comprised of the 190-F Process Water Pump House remaining below-grade pump room facilities and foundations. The waste site was divided into two subsites in 2011. The 100-F-57:1 subsite comprises the eastern portion of the site. The western portion of the site is 100-F-57:2. The material in the overburden stockpile came from the 100-F-57:2 subsite, but underwent cleanup verification sampling in conjunction with the 100-F-57:1 waste subsite.

Confirmatory sampling of the 100-F-57 waste site was conducted in 2007. Results from the confirmatory samples failed to meet the direct-exposure remedial action goal (RAG) for benzo(a)pyrene. The subsequent design and remediation plan called for removal of the pipe cradles at the waste site.

Remediation of the 100-F-57 waste site pipe cradles began December 6, 2010.
On December 9, 2010, during exploration for the 100-F-57 northern pipe cradles, discolored (i.e., green-stained) concrete was discovered. High concentrations of hexavalent chromium were noted in the concrete. The discovery of the hexavalent chromium contamination resulted in a design change from the original plan to remediate only the pipe cradles. Remediation of the 100-F-57:1 waste subsite was completed September 7, 2011 and resulted in 2,969 bank cubic meters (BCM) (3,883 bank cubic yards [BCY]) of soil and debris being removed and disposed at the Environmental Restoration Disposal Facility. No overburden material was stockpiled from the 100-F-57:1 waste subsite.

During remediation of the 100-F-57:2 waste subsite, the project stockpiled approximately 10,062 BCM (13,161 BCY) of below contamination limit soil to be used as overburden soil. The overburden stockpile is located near the northern boundary of the 100-F-57:1 waste site and was sampled and evaluated in conjunction with the 100-F-57:1 waste subsite, though the material came from the 100-F-57:2 waste subsite.

Verification sampling of the 100-F-57:1 waste subsite and the overburden stockpile was conducted January 16, 2012. These results indicated four sample locations in the 100-F-57:1 waste subsite excavation footprint failed to pass RAGs. Additional remediation of the four locations resulted in the removal of an additional 33 BCM (43 BCY) of soil and concrete, which was completed January 31, 2012, resulting in a total 3,002 BCM (3,926 BCY) removed from the 100-F-57:1 waste subsite. Additional verification sampling was conducted at the 100-F-57:1 waste subsite on February 1, 2012.

These results indicated that, following the additional remediation, residual contaminant concentrations met the remedial action objectives (RAOs) and RAGs for the 100-F-57:1 waste subsite and overburden stockpile.

A summary of the cleanup evaluation for the soil results compared to the applicable cleanup criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the waste sites in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

**Table ES-1. Summary of Remedial Action Goals for the 100-F-57:1 Waste Site. (2 Pages)**

| Regulatory Requirement | Remedial Action Goals | Results | Remedial Action Objectives Attained? |
|---|---|---|---|
| Direct Exposure – Radionuclides | Attain dose rate of <15-mrem/yr above background over 1,000 years. | Radionuclides were not COPCs for the 100-F-57:1 waste site. | NA |
| Direct Exposure – Nonradionuclides | Attain individual COPC RAGs. | All individual COPC concentrations are below the direct-exposure criteria. | Yes |
| Risk Requirements – Nonradionuclides | Attain a hazard quotient of <1 for all individual noncarcinogens. | The hazard quotients for individual nonradionuclide COPCs are <1. | Yes |
| | Attain a cumulative hazard quotient of <1 for noncarcinogens. | The cumulative hazard quotient for all sampling areas ($4.1 \times 10^{-3}$) is <1. | |
| | Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens. | The 100-F-57:1 waste subsite has no constituents with a carcinogenic RAG value; therefore, the criterion of $<1 \times 10^{-6}$ is met. | |
| | Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens. | The 100-F-57:1 waste subsite has no constituents with a carcinogenic RAG value; therefore, the criterion of $<1 \times 10^{-5}$ is met. | |
| Groundwater/River Protection – Radionuclides | Attain single COPC groundwater and river RAGs. | Radionuclides were not COPCs for the 100-F-57:1 waste site. | NA |
| | Attain National Primary Drinking Water Regulations: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ [a]. | | |
| | Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [b]. | | |
| | Meet total uranium standard of 21.2 pCi/L [c]. | | |

**Table ES-1. Summary of Remedial Action Goals for the 100-F-57:1 Waste Site. (2 Pages)**

| Regulatory Requirement | Remedial Action Goals | Results | Remedial Action Objectives Attained? |
|---|---|---|---|
| Groundwater/River Protection – Nonradionuclides | Attain individual nonradionuclide groundwater and Columbia River cleanup requirements. | Chromium (total) and lead are present at concentrations slightly above soil RAGs for groundwater and/or Columbia River protection. However, an evaluation based upon RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b) shows that residual concentrations of these constituents are predicted to be protective of groundwater and the river [d]. | Yes |

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).

[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).

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

[d] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of chromium (total) and lead are not expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the contaminant with the lowest distribution coefficient, lead, with a $K_d$ value of 30 mL/g). The vadose zone underlying the soil below the site is approximately 12.8 m (42 ft) thick at the deepest portion of the excavation. Therefore, residual concentrations of total chromium and lead are not predicted to migrate to groundwater and, hence, the Columbia River within 1,000 years.

COPC = contaminant of potential concern
DOE = U.S. Department of Energy
MCL = maximum contaminant level
NA = not applicable
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the RAOs and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) and in the Remaining Sites ROD (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow-zone soil (i.e., surface to 4.6 m [15 ft]), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The 100-F-57:1 waste subsite and overburden stockpile contamination does not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based, in part, on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern, and other constituents. Those constituents exceeding the ecological screening levels in the *Washington Administrative Code* 173-340 were boron, mercury, selenium, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, lead, manganese, selenium, and vanadium. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of antimony, manganese, mercury, and vanadium are below Hanford Site background levels, 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-F-57:1, EASTERN 190-F PROCESS WATER PUMP HOUSE DEBRIS AND OVERBURDEN STOCKPILE

## STATEMENT OF PROTECTIVENESS

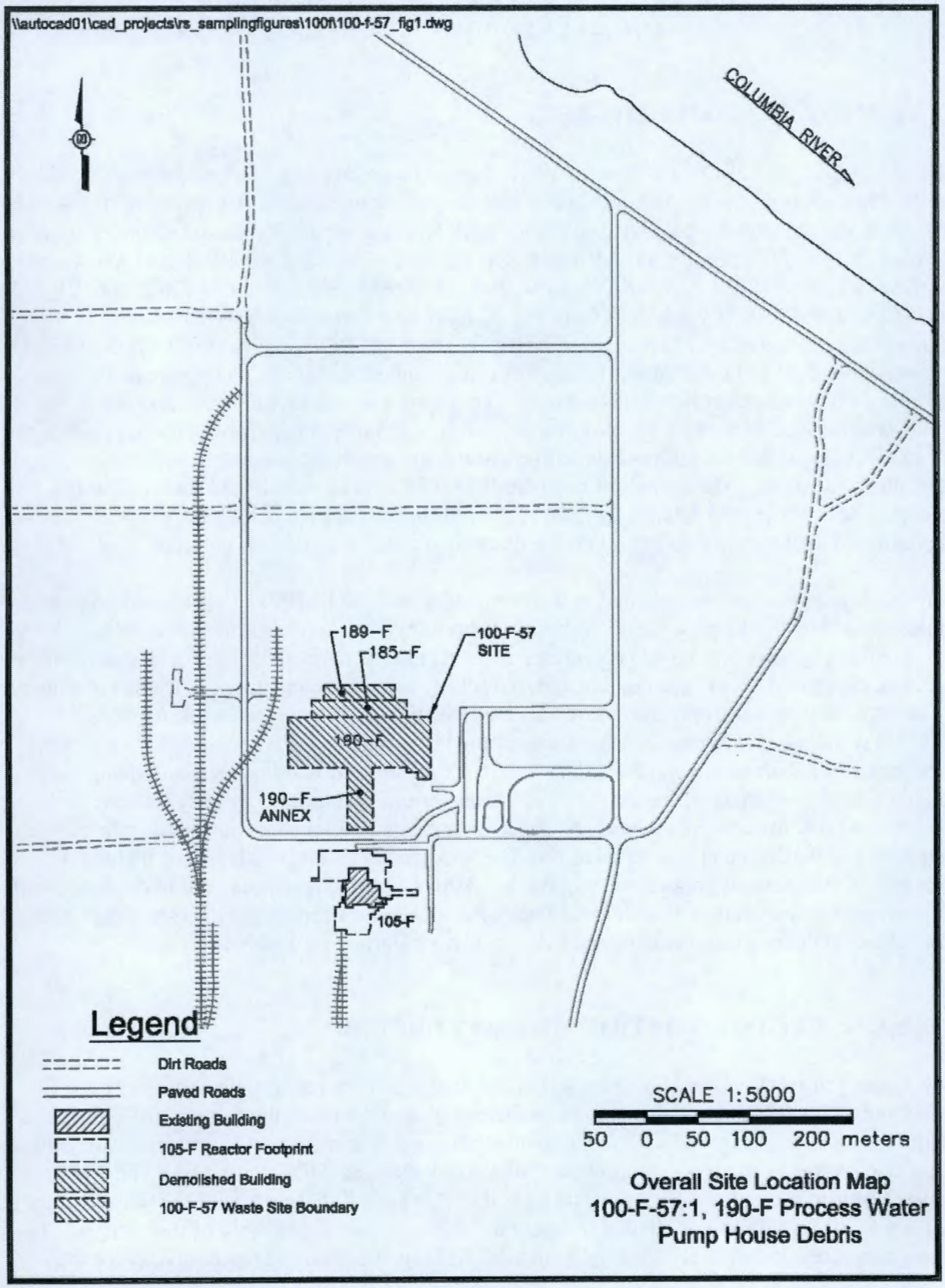
The 100-F-57:1, Eastern 190-F Process Water Pump House Debris and overburden stockpile verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow-zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Contamination from the 100-F-57:1 waste subsite and the overburden stockpile does not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based, in part, on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern (COPCs), and other constituents. Those constituents exceeding the ecological screening levels in the *Washington Administrative Code* (WAC) 173-340 were boron, mercury, selenium, and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for antimony, lead, manganese, selenium, and vanadium. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of antimony, manganese, mercury, and vanadium are below Hanford Site background levels, 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 Waste Information Data System (WIDS) general summary report describes the 100-F-57 waste site as the remaining below-grade facilities and foundation of the former 190-F Process Water Pump House (Figure 1). The pump house contained four large steel process water storage tanks and pumps to supply cooling water to the 105-F Reactor (DOE-RL 1992). The main pump house footprint measured 140 m (460 ft) wide by 50 m (165 ft) long. An annex was added to the south side of the building in 1956 to increase the cooling water throughput of the system. The annex measured 25 m (82 ft) wide by 60 m (197 ft) long and included replacements for the

**Figure 1. The 100-F-57 Waste Site Location Map.**



primary pumps in the 190-F Building. Figure A-1 (Appendix A) is an aerial photograph of the pump house and annex. Figure 1 shows the location of the 100-F-57 waste site, which includes both the 190-F Building and the annex.

The 100-F-57 waste site is comprised of the 190-F Process Water Pump House remaining below-grade pump room facilities and foundations. The 100-F-57:1 subsite comprises the eastern portion of the site. The western portion of the site is the 100-F-57:2 subsite. Figure 2 indicates the demarcation of the two subsites. It also shows the overburden stockpile. The material in the overburden stockpile came from the 100-F-57:2 waste subsite, but was sampled for cleanup verification in conjunction with the 100-F-57:1 waste subsite.

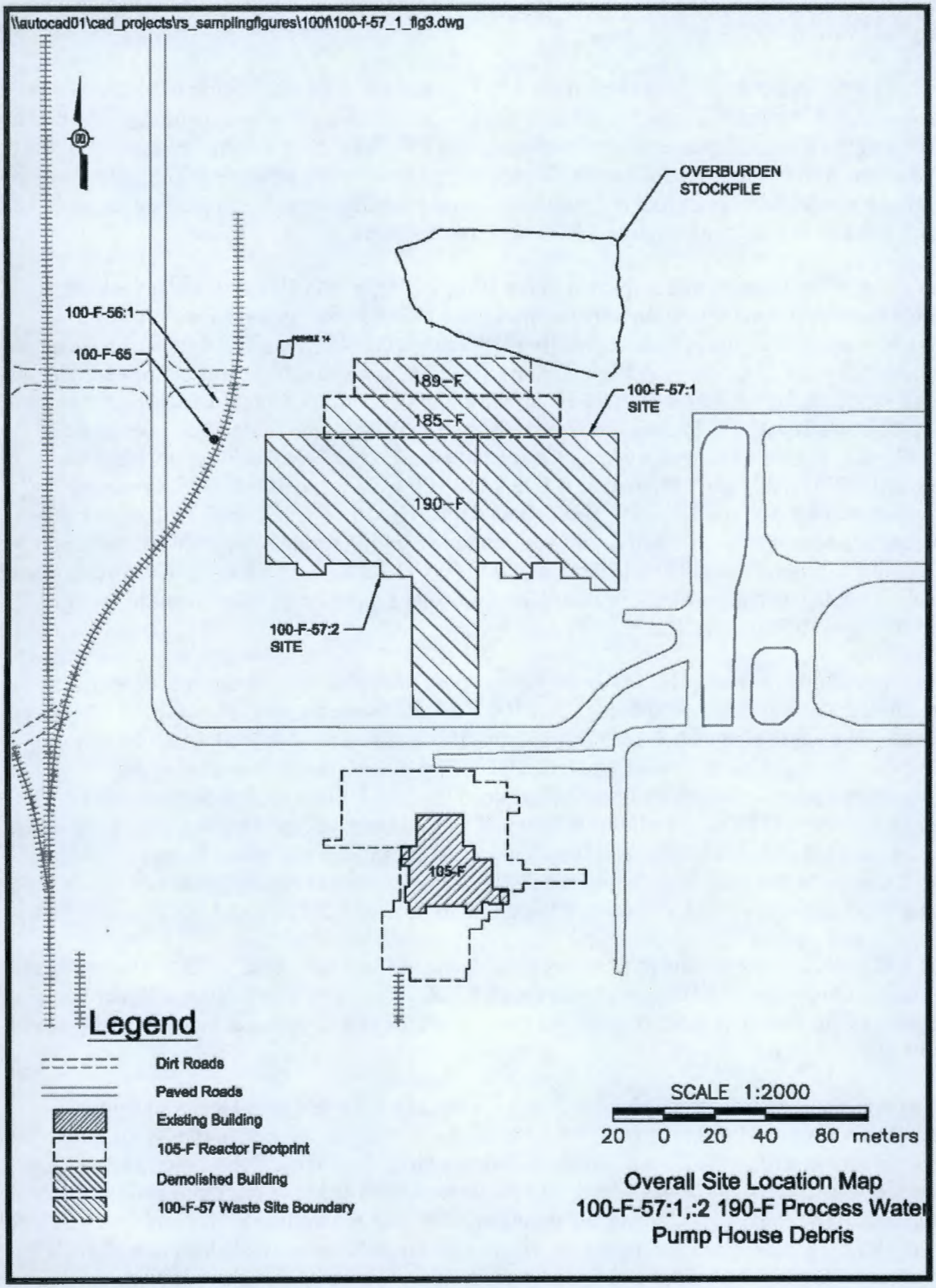
The 100-F-57:1 waste subsite is located in the 100-FR-1 Operable Unit of the Hanford Site approximately 100 m (330 ft) directly north of the 105-F Reactor (Figures 1 and 2). The overburden stockpile is located directly north of the 100-F-57:1 waste subsite and adjacent to the 185-F Building foundation. Originally, the 100-F-57:1 waste subsite was collocated with one of the locations for the 100-F-58, 100-F Surface Debris Potentially Containing Asbestos waste site. This specific 100-F-58 asbestos debris, located at Washington State Plane coordinates N 147742.1, E 580488.0, was previously remediated and reclassified as Interim Closed Out in June 2011 (WCH 2011d). Two other WIDS sites, 100-F-26:9 and 100-F-44:5, consisted of pipelines that crossed the 100-F-57 WIDS boundary. The 100-F-26:9, 1607-F2 Sanitary Sewer Pipeline waste site was remediated, and verification sampling results supported reclassification of the site to Interim Closed Out in October 2008 (WCH 2008c). The 100-F-44:5 Process Sewer Pipeline waste site had confirmatory sample results that supported a reclassification to "No Action" in April 2009 (WCH 2009).

A number of other active WIDS sites are located near the 100-F-57:1 waste subsite and are being remediated; the waste sites 100-F-56:1 and 100-F-65 are located west of the 100-F-57:2 waste subsite. The waste sites 100-F-26:5 and 100-F-26:7 are pipelines that are located outside the 100-F-57:1 waste subsite's boundary. The 100-F-26:5 waste subsite consisted of the underground process sewer pipelines that serviced the 190-F Building and other nearby buildings. The 100-F-26:7, Sodium Dichromate and Sodium Silicate Pipelines waste site was a pair of steel pipes that conveyed sodium dichromate and sodium silicate from the 108-F Chemical Pumping Building to the 190-F Water Treatment Building, both of which were remediated and reclassified as Interim Closed Out in February 2012 (WCH 2012b).

The 100-F Area water treatment facilities were operated from 1945 until 1965 to provide large volumes of high-quality cooling water to the 105-F Reactor. The 190-F Process Water Pump House was the final in a series of facilities that treated the raw river water before it was pumped to the 105-F Reactor.

Water was pumped from the Columbia River via the 181-F River Pump House and stored temporarily at the 182-F Reservoir. From 182-F, the water was pumped to the 183-F Filter Plant where chlorine, sulfuric acid, and coagulants were added. Following flocculation and settling, the water was filtered, lime was added, and the water was stored temporarily in underground clearwells. The clarified water was then transferred to four 6.6 million L (1.75 million gal) tanks in the 190-F Process Water Pump House, where sodium dichromate was added to inhibit corrosion of the 105-F Reactor aluminum process tubes. The treated water was temporarily

**Figure 2. Location of the 100-F-57:1 Waste Subsite and Overburden Stockpile.**



stored in the 190-F Process Water Pump House and pumped to the 105-F Reactor as needed (DOE-RL 1992).

The sodium dichromate storage tank was located near the northwest corner of the 190-F Building, but was associated primarily with the 185-F Building. Adjacent and north of the 185-F Building were the 189-F refrigeration units. These units were used for only two years (1945-1946). In 1949, the 189-F facility was converted into a chemical storage and makeup facility. Chemicals stored within the facility included sodium dichromate and sodium silicate.

The 105-F Reactor and its ancillary facilities, including the 190-F Process Water Pump House, were shut down in 1965. In 1977, the 190-F Process Water Pump House was demolished, salvageable materials sold, and the remaining rubble sent to the 182-F Reservoir as fill (WHC 1991). Following demolition of the 190-F facility, it was filled with soil to grade.

During its 20-year operating history, millions of liters of concentrated sodium dichromate solution passed through the pump rooms in the 190-F Building. The pump rooms supplying treated water to all of the 100 Area reactors were known to have a high potential for leaking and spilling water and chemicals. Sodium dichromate contamination has been documented at analogous pump house facilities at several of the 100 Area reactor facilities. At these analogous sites, it was determined basement sumps were low points capable of accumulating the most contamination (BHI 2005). This process history provided the basis for evaluating the concrete foundations and liquid collection trenches and sumps at the 100-F-57 waste site for sodium dichromate contamination.

### Site Visit and Geophysical Survey

During a field walkdown performed in 2005, the concrete foundation of the 190-F Building was observed (Appendix A, Figure A-2). A geophysical survey was not performed at the 100-F-57 waste site because the subsurface conditions at the location were well documented.

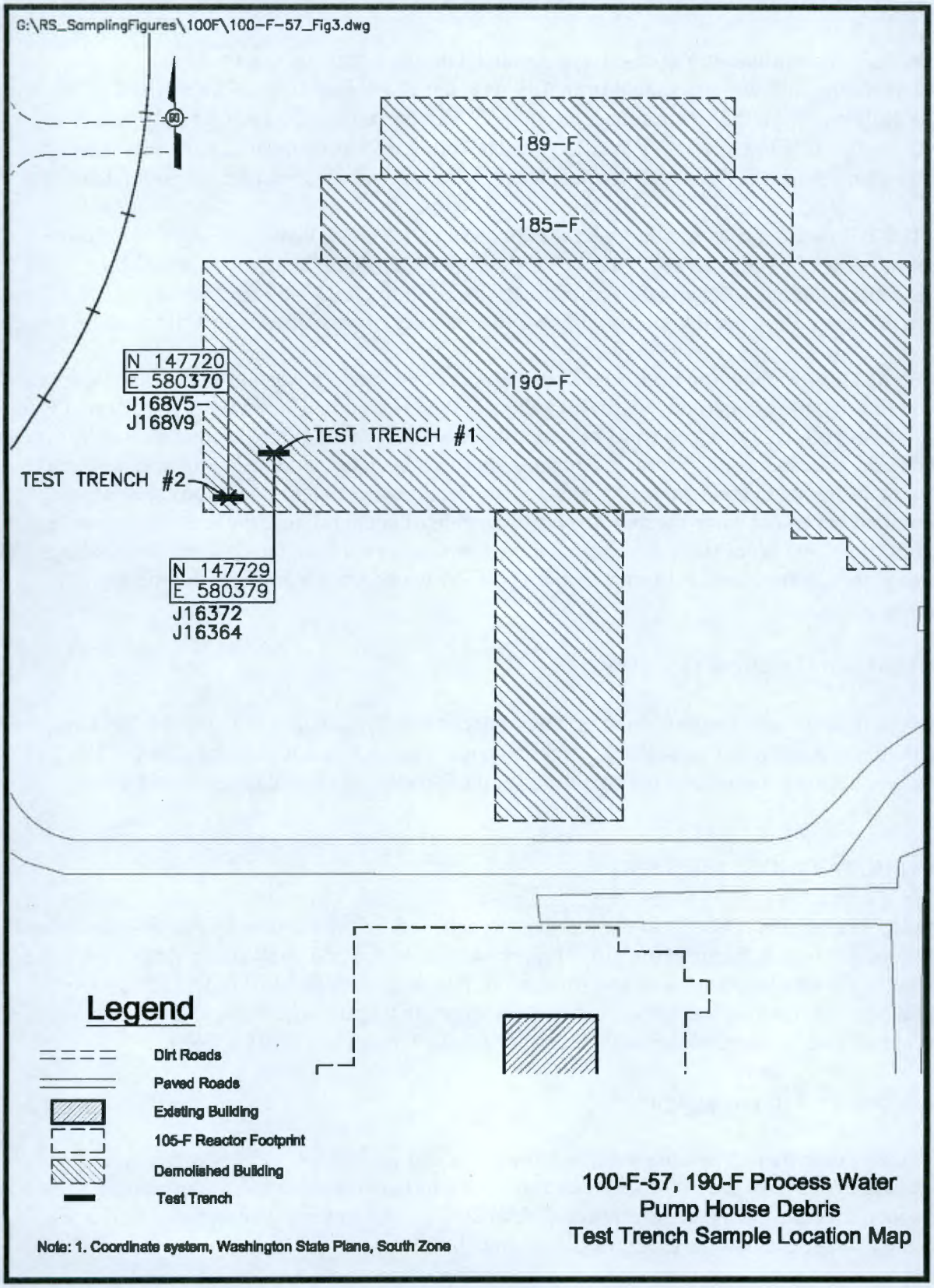
## CONFIRMATORY SAMPLING

Samples of scabbled concrete in the drainage trench, soil below the trench, and tar-like material and suspect asbestos found in the pipe cradles were collected and analyzed to determine if the site meets the cleanup criteria as specified in the 100 Area RDR/RAWP (DOE-RL 2009b). Confirmatory sampling was conducted in December 2007 and January 2008, and it was determined that remedial action was necessary for the waste site (WCH 2008b).

### Confirmatory Sample Design

A focused confirmatory sampling approach was chosen for the 100-F-57 waste site. Historical process knowledge of the 100-F-57 waste site and similar sites was used to develop a site-specific confirmatory sample design (WCH 2007). The sampling design included a test trench excavation as shown in Figure 3 (test trench #1).

**Figure 3. Confirmatory Sampling Locations at the 100-F-57 Waste Site.**



**Summary of Confirmatory Sampling Activities**

Excavation of the test trench (test trench #1) was performed on December 6, 2007 (WCH 2008b). The excavation exposed concrete slab walls approximately 1 m (3 ft) apart, with the area between the walls filled with debris. The debris was removed to reveal a trench approximately 1.2 m (4 ft) deep, with pipe cradles along the length of the trench. Tar-like and suspected asbestos materials were observed on the pipe cradles (Appendix A, Figure A-3). Samples were collected from the suspect hazardous materials and were identified, as summarized in Table 1. Further excavation at the test trench revealed additional bays, but no gutter trough as described in the sample design. The discrepancy between the expected trench and the excavation findings was evaluated by comparing the historical drawings and the photographs taken during the excavation. A higher quality copy of the 190-F design drawing (HEW 1944) was obtained to support a revised trench location approximately 9 m (30 ft) south of the original coordinates.

The excavation was moved to the revised test trench location (test trench #2) on January 17, 2008. The excavation removed rubble containing concrete chunks, rebar, and segments of pipe, exposing the south wall of the pump room and a 0.6-m (24-in.) pipe in the wall (WCH 2008b). The floor of the pump room was cleared of debris, exposing the pump pads and a grate covering the trench along the north wall. The pump room was examined for the potential location of a sump, and it was concluded that no sump was present. The excavator hammer was used to break out a piece of the trench floor. No elevated field screening reading or obvious staining of the concrete was observed to bias sample locations, and sample material was scabbled from each of the four pieces of concrete brought up from the trench. Soil samples were also collected from below the trench. Table 1 identifies samples and the analyses requested for each sample.

**Confirmatory Sample Results**

Confirmatory sampling of the 100-F-57 waste site was performed on December 6, 2007, and January 21, 2008. Samples were analyzed using analytical methods approved by the EPA. The laboratory-reported confirmatory sampling results for all constituents are stored in the Environmental Restoration (ENRE) project-specific database prior to archiving in the Hanford Environmental Information System (HEIS) and are included in Appendix B.

**Table 1. 100-F-57 Confirmatory Sample Summary. (2 Pages)**

| Sample Location | Sample Media | Sample Number | Coordinate Locations | Depth | Sample Analysis |
|---|---|---|---|---|---|
| Pipe cradles | Suspect asbestos | J16372 | N147729 E580379 | 1 m | Asbestos |
| | Tar-like material | J16364 | | 1 m | ICP metals, mercury, SVOA, PCBs |
| Drainage trench | Concrete scabble | J168V7 | N 147720 E 580370 | 4 m | ICP metals [a], mercury, PCBs |
| | | J168V8 | | | Hexavalent chromium |
| | | J168V9 | | | Hexavalent chromium |

**Table 1. 100-F-57 Confirmatory Sample Summary. (2 Pages)**

| Sample Location | Sample Media | Sample Number | Coordinate Locations | Depth | Sample Analysis |
|---|---|---|---|---|---|
| Below trench | Soil | J168V5 | N 147720<br>E 580370 | 4.2 m | ICP metals [a], mercury, hexavalent chromium, PCBs |
| | | J168V6 | | | ICP metals [a], mercury, hexavalent chromium, PCBs |
| Equipment blank | Silica sand | J168V4 | NA | NA | ICP metals [a], mercury |

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

ICP = inductively coupled plasma
NA = not applicable
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis

The COPCs for the confirmatory sampling of the 100-F-57 waste site were based on process knowledge of similar waste sites and sites associated with sodium dichromate contamination. The combined COPC list included hexavalent chromium, polychlorinated biphenyls (PCBs), total chromium, lead, and mercury. Although not COPCs, antimony, arsenic, barium, beryllium, boron, cadmium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc concentrations were evaluated by performing analyses for the constituents of the expanded inductively coupled plasma (ICP) metals list. Based on past practice knowledge, this site was expected to contain no radiologically contaminated materials. This determination was supported by field screening, which did not detect radioactivity above background levels; therefore, further radionuclide analysis was not requested.

Benzo(a)pyrene was detected in the tar-like material sampled from the pipe cradles at concentrations exceeding soil remedial action goals (RAGs) for direct exposure. Chrysene and lead were detected in the tar-like material sampled from the pipe cradles at concentrations exceeding soil RAGs for the protection of groundwater and the Columbia River. Also, sample results confirmed the presence of friable asbestos materials found in pipe cradles discovered at the site (Appendix B). For these reasons, the pipe cradles located in the trenches within the south-central location of the 190-F Process Water Pump House required remediation (WCH 2008a).

## REMEDIAL ACTION SUMMARY

Based on the confirmatory sampling results, the 100-F-57 waste site was recommended for remediation (WCH 2008a).

**Remedial Action**

Confirmatory sampling analysis performed in 2007 found only benzo(a)pyrene contamination, in the 100-F-57 waste site's pipe cradles, was above direct-exposure RAGs. The subsequent design and remediation plan for removal of the pipe cradles was based on the confirmatory sampling data. The maximum concentration of hexavalent chromium detected in confirmatory samples was 1.97 mg/kg and did not exceed the RAGs.

Excavation of the 100-F-57 waste site pipe cradle began October 15, 2010, to collect waste profile samples. Remediation of the 100-F-57 waste site began December 6, 2010.
On December 9, 2010, during exploration for the 100-F-57 northern pipe cradles, discolored (i.e., green-stained) concrete was discovered (Appendix A, Figure A-4). The discolored concrete was surveyed using x-ray fluorescence, and high concentrations of hexavalent chromium (>900 ppm) were noted in the concrete. A pipe removed from the pipe trench also had high x-ray fluorescence hexavalent chromium readings (WCH 2011c).

Upon discovery of the hexavalent chromium contamination at the 100-F-57 waste site, the project collected 21 in-process samples. The samples, collected December 14 and 15, 2010, included 2 "other solid" samples: 1 sample of the green-stained concrete and 1 composite sample of the scale material inside 12 steel process pipes (WCH 2011a). The "other solid" sample results indicated high concentrations of ICP metals, mercury, and semivolatile organic compounds (SVOCs): benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and dibenz(a,h)anthracene. The remaining in-process samples were soil samples collected from under the green-stained concrete and from the four stockpile areas, original overburden piles, and miscellaneous site perimeter locations. The in-process data results are provided in Appendix B.

The discovery of the high hexavalent chromium concentrations in the in-process soil samples resulted in a design change from the original plan to remediate only the pipe cradles at the 100-F-57 waste site (WCH 2011c). As remediation of the soil progressed to clean up the hexavalent chromium-contaminated soil at the 100-F-57 waste site, areas with hexavalent chromium sample results that exceeded RAGs were further remediated and sampled only for hexavalent chromium. The hexavalent chromium contamination was noted to be predominantly greater in the western portion of the waste site. The west end of the excavation required a deeper excavation to chase the hexavalent chromium plume.

Of the initial 21 in-process samples, 5 were collected from the eastern portion of the 100-F-57 waste site (later denoted as the 100-F-57:1 subsite). Four of these five samples (J1CYC0 through J1CYC3) were analyzed for hexavalent chromium, and all four results were nondetects. One sample (J1CYB7) was analyzed for ICP metals, hexavalent chromium, and mercury; the total chromium result was less than the applicable RAGs, and the hexavalent chromium result was nondetected. The eastern end of the excavation required only shallow remediation to remove the contaminated soil and debris.

In October 2011, the project split the site into two subsites to allow continued remediation of the western portion of the site and to facilitate closure of the eastern portion of the site and the overburden stockpile. The 100-F-57:1 subsite comprises the eastern portion of the site. The

western portion of the site is the 100-F-57:2 subsite. Figure 2 indicates the demarcation of the two subsites. It also shows the overburden stockpile.

Remediation of the 100-F-57:1 waste subsite was completed September 7, 2011. The soil within the 100-F-57:1 waste subsite footprint was excavated to a depth ranging from 1.0 to 2.0 m (3.3 to 6.6 ft) below ground surface, and the resulting 2,969 bank cubic meters (BCM) (3,883 bank cubic yards [BCY]) of soil and debris removed were disposed at the Environmental Restoration Disposal Facility (ERDF). The debris included concrete, rebar, steel pipe, miscellaneous steel, wire, steel cable, and nonfriable asbestos mastic, unlike the friable asbestos discovered during confirmatory sampling. On May 10, 2011, an underground injection control well was discovered at Washington State Plane coordinates N 147770.3, E 580494.9, near the northeastern WIDS boundary of the site. It was removed and disposed at ERDF. No overburden material was stockpiled from the 100-F-57:1 waste subsite.

The original overburden piles, which were sampled in December 2010, were eventually disposed as above contamination limit material. During remediation of the 100-F-57:2 waste subsite, the project stockpiled approximately 10,062 BCM (13,161 BCY) of below contamination limit (BCL) soil to be used as overburden soil (Appendix A, Figure A-5). The overburden stockpile is located near the northern boundary of the 100-F-57:1 waste site. This overburden stockpile will be verification sampled and evaluated in conjunction with the 100-F-57:1 waste subsite, even though the material came from the 100-F-57:2 waste subsite.

**In-Process Soil Samples**

In total, 63 in-process soil samples were collected at the 100-F-57:1 waste subsite (WCH 2011a, 2011b). The samples are identified in Table 2. Figure 4 shows the locations of the samples. Table 2 also includes six samples from pothole-14 (shown in Figure 2), which was located in the layback of the 100-F-57:2 waste subsite, approximately 34 m (112 ft) north of the northwest corner of the 100-F-57:2 waste subsite. The pothole-14 sample results indicated the layback material was BCL. This BCL material was added to the overburden stockpile, along with other BCL material from the excavation layback. The in-process data from pothole-14 are representative of the overburden stockpile material. The in-process sample data for the 100-F-57:1 waste subsite and pothole-14 are provided in Appendix B.

An intermediate civil survey was performed on October 13, 2011, for the 100-F-57:1 waste subsite excavation. The boundaries of this survey were overlaid on the WIDS boundary, along with a global positioning survey walkaround boundary of the overburden stockpile, as shown in Figure 5. Post-excavation photographs are provided in Appendix A, Figures A-6 and A-7.

**Table 2. 100-F-57:1 and Overburden Stockpile In-Process Samples. (2 Pages)**

| Sample Location [a] | Sample Depth [b] | HEIS Number | Sample Date |
|---|---|---|---|
| Stockpile 4 | NA | J1CYB7 | 12/15/2010 |
| Perimeter - 3 | NA | J1CYC0 | 12/15/2010 |
| Perimeter - 4 | NA | J1CYC1 | 12/15/2010 |
| Perimeter - 5 | NA | J1CYC2 | 12/15/2010 |
| Perimeter - 6 | NA | J1CYC3 | 12/15/2010 |
| Pothole 6A | 0-1 ft | J1F155 | 2/10/2011 |
| Pothole 6B | 3-4 ft | J1F156 | 2/10/2011 |
| Pothole 6C | 6-7 ft | J1F157 | 2/10/2011 |
| Pothole 6D | 9-10 ft | J1F158 | 2/10/2011 |
| Pothole 6E | 12-13 ft | J1F159 | 2/10/2011 |
| Pothole 6F | Bottom | J1F160 | 2/10/2011 |
| Pothole 7A | 0-1 ft | J1F175 | 2/10/2011 |
| Pothole 7B | 3-4 ft | J1F176 | 2/10/2011 |
| Pothole 7C | 6-7 ft | J1F177 | 2/10/2011 |
| Pothole 7D | 9-10 ft | J1F178 | 2/10/2011 |
| Pothole 7E | 12-13 ft | J1F179 | 2/10/2011 |
| Pothole 7F | Bottom | J1F180 | 2/10/2011 |
| Pothole 6 - concrete sample | NA | J1F1P2 | 2/17/2011 |
| Pothole 12 - east side | 6-7 ft | J1FKV5 | 3/16/2011 |
| Pothole 12 | 9-10 ft | J1FKV6 | 3/16/2011 |
| Pothole 12 | 12-13 ft | J1FKV7 | 3/16/2011 |
| Pothole 12 | 15-16 ft | J1FKV8 | 3/16/2011 |
| Pothole 12 - concrete sample | NA | J1FXF0 | 3/22/2011 |
| Pothole 14 | 0-1 ft | J1FKJ1 | 3/17/2011 |
| Pothole 14 | 3-4 ft | J1FKJ2 | 3/17/2011 |
| Pothole 14 | 6-7 ft | J1FKJ3 | 3/17/2011 |
| Pothole 14 | 9-10 ft | J1FKJ4 | 3/17/2011 |
| Pothole 14 | 12-13 ft | J1FKJ5 | 3/17/2011 |
| Pothole 14 | 15-16 ft | J1FKH7 | 3/17/2011 |
| Location - 1 | 2 ft under slab | J1HHR6 | 4/19/2011 |
| Location - 2 | 2 ft under slab | J1HHR7 | 4/19/2011 |
| Location - 3 | 2 ft under slab | J1HHR8 | 4/19/2011 |
| Location - 4 | 2 ft under slab | J1HHR9 | 4/19/2011 |
| Location - 5 | 2 ft under slab | J1HHT0 | 4/19/2011 |
| Location - 6 | 2 ft under slab | J1HHT1 | 4/19/2011 |
| Location - 7 | 2 ft under slab | J1HHT2 | 4/19/2011 |
| Location - 8 | 2 ft under slab | J1HHT3 | 4/19/2011 |
| Location - 9 | 2 ft under slab | J1HHT4 | 4/19/2011 |
| Location - 10 | 2 ft under slab | J1HHT5 | 4/19/2011 |
| Location - 11 | 2 ft under slab | J1HK70 | 4/25/2011 |
| Location - 12 | 2 ft under slab | J1HK71 | 4/25/2011 |
| Location - 23 | 2 ft under slab | J1HKR7 | 5/19/2011 |
| Location - 24 | 2 ft under slab | J1HKR8 | 5/19/2011 |

**Table 2. 100-F-57:1 and Overburden Stockpile In-Process Samples. (2 Pages)**

| Sample Location [a] | Sample Depth [b] | HEIS Number | Sample Date |
|---|---|---|---|
| Location - 25 | 2 ft under slab | J1HKR9 | 5/19/2011 |
| Location - 26 | 2 ft under slab | J1HKT0 | 5/19/2011 |
| Location - 27 | 2 ft under slab | J1HKT1 | 5/19/2011 |
| Location - 28 | 2 ft under slab | J1HKT2 | 5/19/2011 |
| Location - 39 | 2 ft under slab | J1JC77 | 5/19/2011 |
| Location - 40 | 2 ft under slab | J1JC78 | 5/19/2011 |
| Location - 41 | 2 ft under slab | J1JC79 | 5/19/2011 |
| Location - 42 | 2 ft under slab | J1JC80 | 5/19/2011 |
| Location - 43 | 2 ft under slab | J1JC81 | 5/19/2011 |
| Location - 44 | 2 ft under slab | J1JC82 | 5/19/2011 |
| Resample Location 1 (42) | 3 ft | J1K4N1 | 7/12/2011 |
| Resample Location 2 (42/43) | 3 ft | J1K4V6 | 7/12/2011 |
| Resample Location 3 (43) | 3 ft | J1K4V7 | 7/12/2011 |
| T6 | NA | J1KRW5 | 8/22/2011 |
| T5 | NA | J1KRW6 | 8/22/2011 |
| T4 | NA | J1KRW7 | 8/22/2011 |
| T3 | NA | J1KRW8 | 8/22/2011 |
| T2 | NA | J1KRW9 | 8/22/2011 |
| T1 | NA | J1KRX0 | 8/22/2011 |
| Location - 57 | NA | J1KTR6 | 8/25/2011 |
| Location - 58 | NA | J1KTR7 | 8/25/2011 |
| Location - 59 | NA | J1KTR8 | 8/25/2011 |
| Location - 60 | NA | J1KTR9 | 8/25/2011 |
| Location - 61 | NA | J1KTT0 | 8/25/2011 |
| Location - 62 | NA | J1KTT1 | 8/25/2011 |
| Location - 63 | NA | J1KTT2 | 8/25/2011 |

[a] All samples are soil, unless otherwise noted.
[b] Sample depth is feet below ground surface unless otherwise noted
HEIS = Hanford Environmental Information System.
NA = not applicable

**Figure 4. In-Process Sampling Locations at the 100-F-57:1 Waste Subsite.**

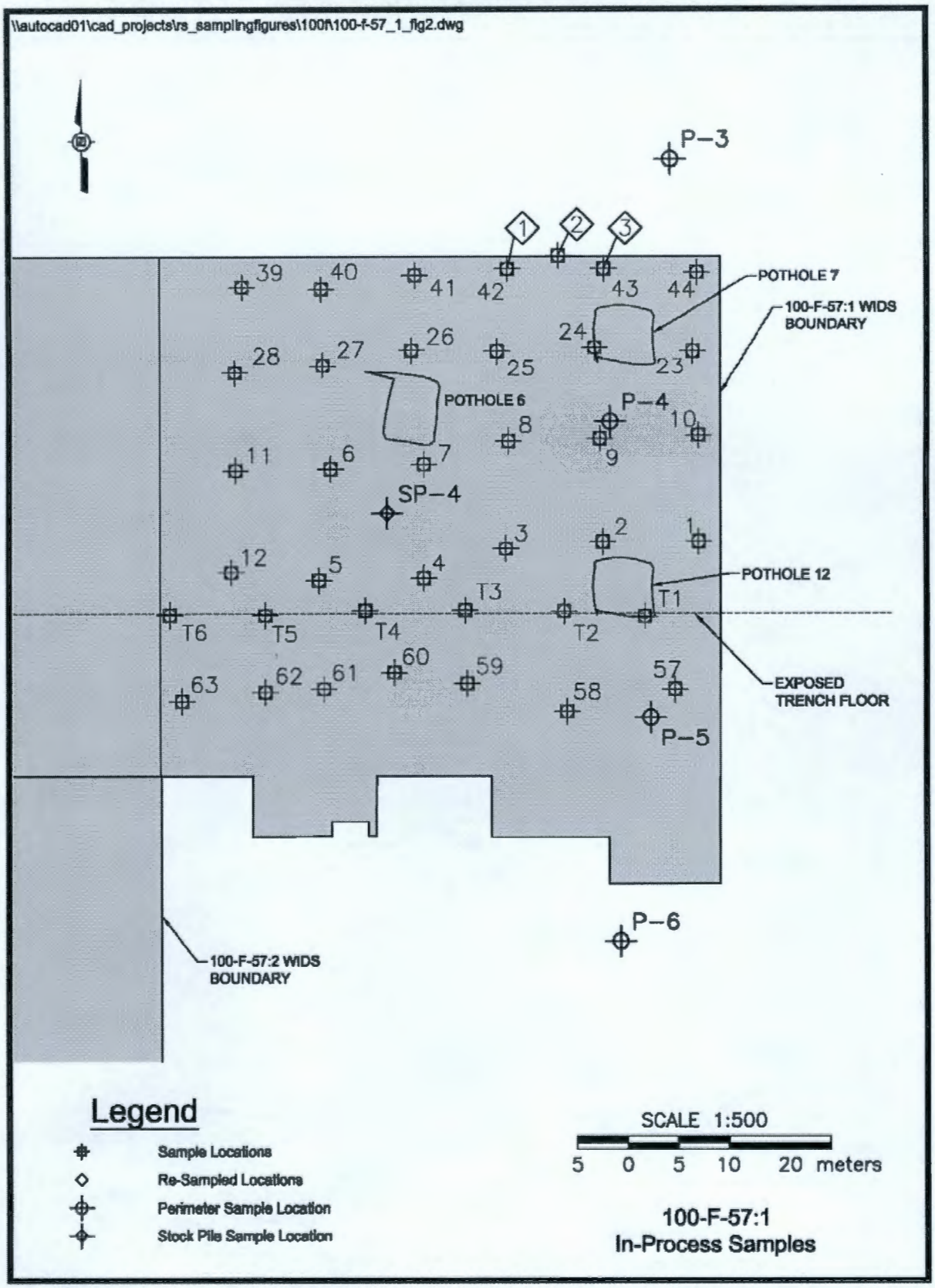
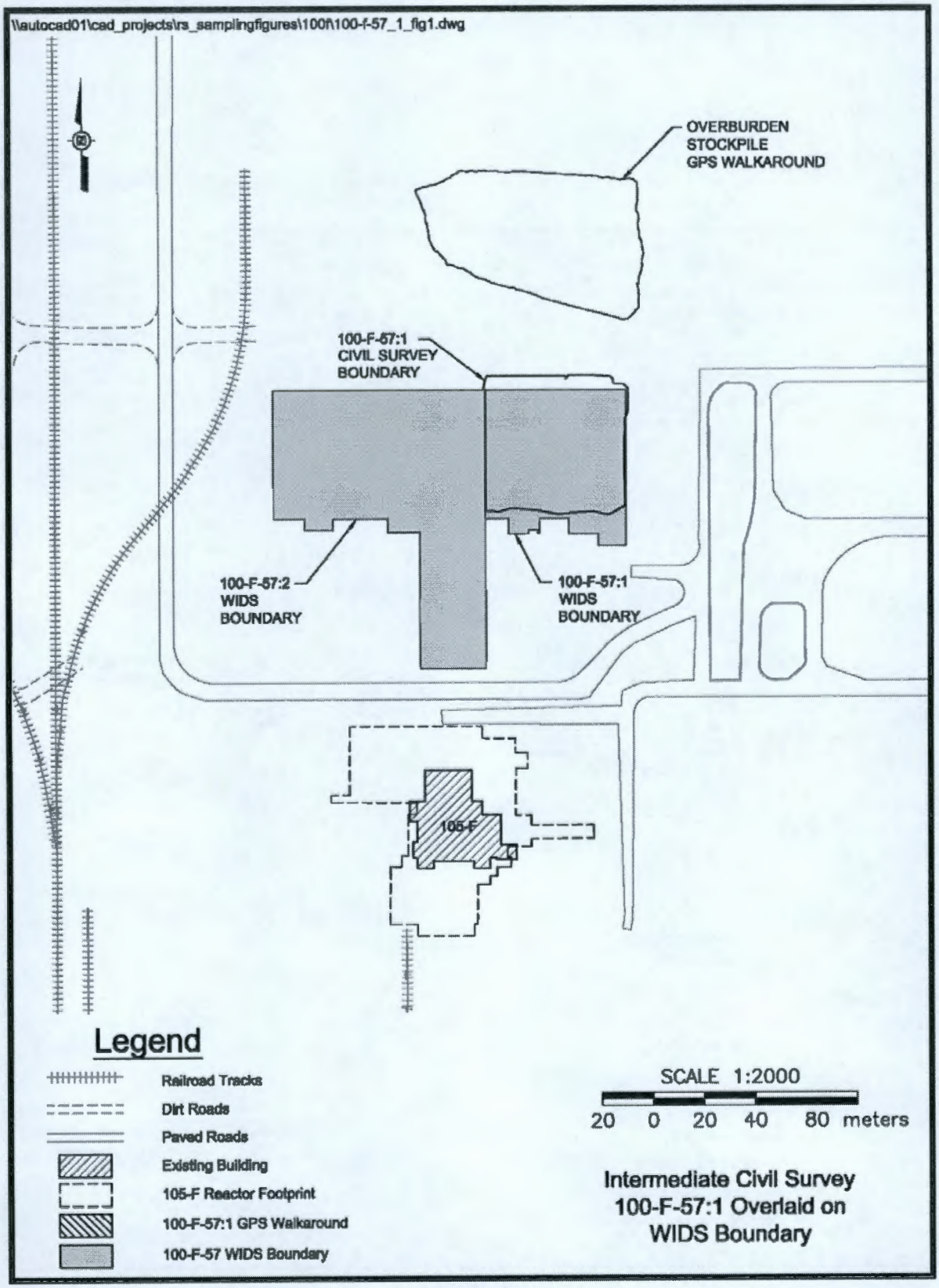


**Figure 5. Post-Excavation GPS Walkaround of Overburden Stockpile and Intermediate Civil Survey of 100-F-57:1 Overlaid on WIDS Boundary.**



## VERIFICATION SAMPLING ACTIVITIES

Verification sampling was conducted at the 100-F-57:1 waste subsite and the overburden stockpile on January 16, 2012. Sampling was conducted to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). The verification sampling results indicated four sample locations in the 100-F-57:1 waste subsite excavation footprint failed to pass RAGs.

Additional remediation of the four locations resulted in the removal of an additional 33 BCM (43 BCY) of soil and concrete, which was completed January 31, 2012. Additional verification sampling was conducted at the 100-F-57:1 waste subsite on February 1, 2012 (WCH 2012a). These results indicated that, following the additional remediation, residual contaminant concentrations met the remedial action objectives (RAOs) and RAGs for the 100-F-57:1 waste subsite and overburden stockpile.

The following subsections provide additional discussion of the information used to develop the verification sampling design. The statistical results of verification sampling are also summarized to support interim closure of the site. A more detailed discussion of the verification sampling can be found in the *Work Instruction for Verification Sampling of the 100-F-57:1, Eastern 190-F Process Water Pump House Debris and Overburden Stockpile* (WCH 2011e).

### Contaminants of Potential Concern

The COPCs for the verification sampling of the 100-F-57:1 waste subsite and overburden stockpile were identified based on process knowledge of similar waste sites and sites associated with sodium dichromate contamination, along with confirmatory and in-process sampling results.

The COPCs identified for verification sampling of the 100-F-57:1 waste subsite excavation and overburden stockpile are ICP metals, hexavalent chromium, mercury, and asbestos. PCBs were a COPC for the 100-F-57 waste site during confirmatory sampling; however, PCBs were not detected in any confirmatory samples and were detected in only one in-process soil sample, at a concentration below RAGs. The tar-like material confirmatory-sampled from the pipe cradles in the 100-F-57:2 waste subsite had high concentrations of the SVOCs benzo(a)pyrene and chrysene. During in-process sampling, analysis of two "other solid" samples indicated high concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and dibenz(a,h)anthracene. However, these high concentrations were only noted in the concrete and pipe samples. The SVOCs were not detected above RAGs in the soil samples. Therefore, PCBs and SVOCs are not considered COPCs for the 100-F-57:1 waste subsite or the overburden stockpile. Radionuclides were not COPCs at this waste site. Analysis was performed for the expanded list of ICP metals including antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

The COPCs for verification sampling and the laboratory analytical methods are identified in Table 3.

**Table 3. Laboratory Analytical Methods for the 100-F-57:1 Waste Site.**

| Analytical Method | Contaminants of Potential Concern |
|---|---|
| ICP metals – EPA Method 6010 | Barium, chromium (total), copper, lead [a], zinc |
| Mercury – EPA Method 7471 | Mercury |
| Hexavalent chromium – EPA Method 7196 | Hexavalent chromium |
| PCB – EPA Method 8082 | Polychlorinated biphenyls |
| PAH – EPA Method 8310 | Benzo(a)pyrene, chrysene |
| Bulk asbestos – NIOSH Method 7400 | Asbestos |

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

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
NIOSH = National Institute for Occupational Safety and Health
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl

## Verification Sample Design

This section describes the basis for selection of an appropriate sample design to determine if residual contaminant concentrations exceed soil cleanup levels for the protection of human health and the environment, as identified in the Remaining Sites ROD (EPA 1999). Professional judgment and field observations were used to develop the verification sampling design.

The sample design consists of two decision units for verification sampling: the 100-F-57:1 waste subsite excavation footprint (Decision Unit 1) and the overburden stockpile (Decision Unit 2). Twelve statistical samples were collected from Decision Unit 1. Decision Unit 2 was divided into approximate quadrants. Within each quadrant, a single composite sample was collected, consisting of 25 aliquots of soil distributed across the surface of the stockpile. A duplicate sample was collected from each decision unit. The HEIS numbers for each sample are provided in Table 4. Figure 6 shows the waste site excavation footprint and the overburden stockpile sampling locations.

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). Additional information related to verification sampling can be found in the field sampling logbooks (WCH 2011b, 2012a).

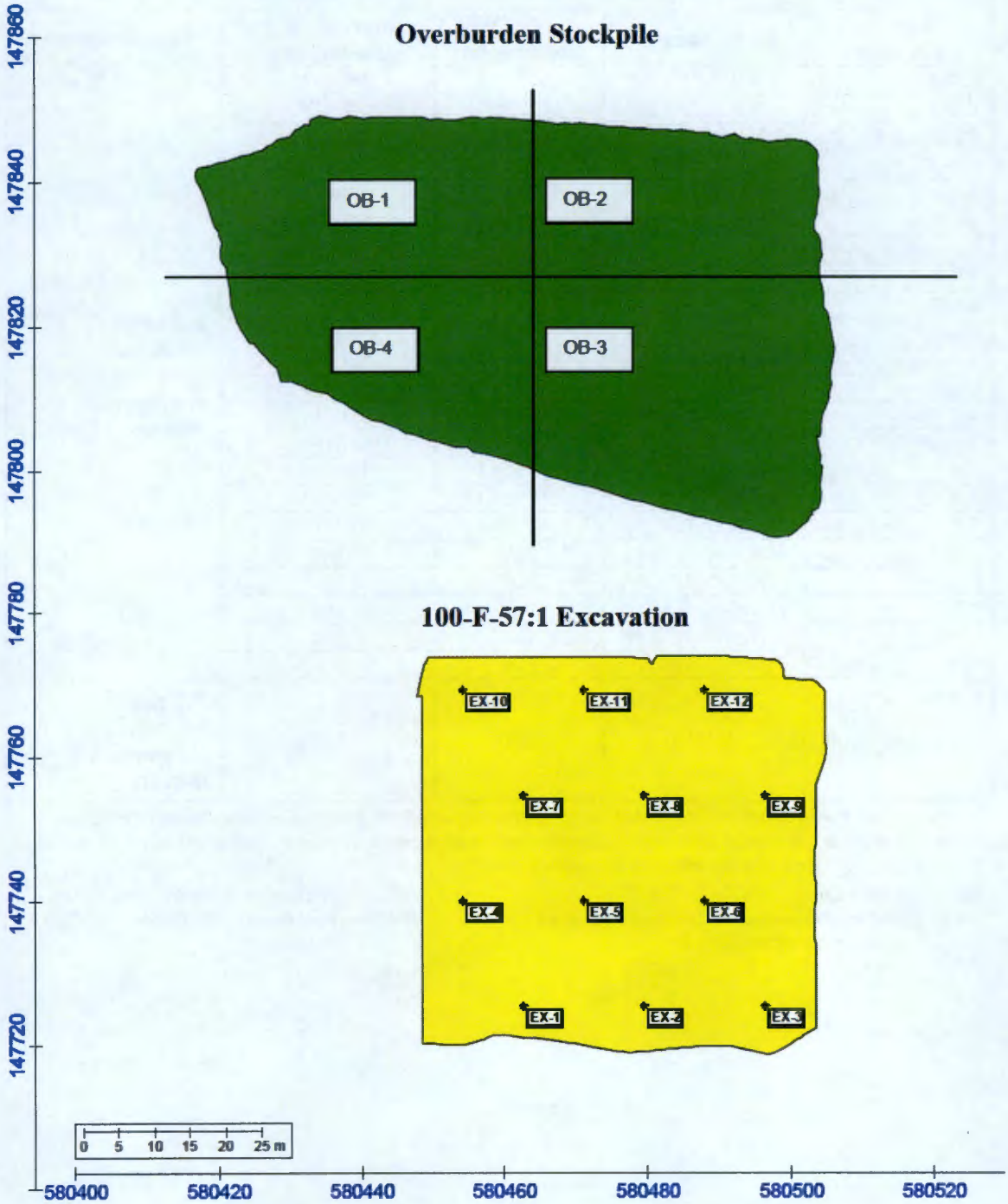
**Table 4. Sample Summary Table for 100-F-57:1 Waste Site Excavation and Overburden Stockpile.**

| Sample Location | HEIS Number | WSP Coordinates | | Sample Analysis |
|---|---|---|---|---|
| | | Northing (m) | Easting (m) | |
| EX-1 | J1N2L1, J1N2N0 | 147725.5 | 580462.5 | ICP metals [a], hexavalent chromium, mercury, and asbestos |
| EX-2 | J1N2L2, J1N2N1 | 147725.5 | 580479.3 | |
| Resample EX-2 | J1N3V0, J1N3T6 | 147725.5 | 580479.3 | |
| EX-3 | J1N2L3, J1N2N2 | 147725.5 | 580496.2 | |
| EX-4 | J1N2L4, J1N2N3 | 147740.1 | 580454.1 | |
| EX-5 | J1N2L5, J1N2N4 | 147740.1 | 580470.9 | |
| Resample EX-5 | J1N3V1, J1N3T7 | 147740.1 | 580470.9 | |
| EX-6 | J1N2L6, J1N2N5 | 147740.1 | 580487.8 | |
| EX-7 | J1N2L7, J1N2N6 | 147754.7 | 580462.5 | |
| EX-8 | J1N2L8, J1N2N7 | 147754.7 | 580479.3 | |
| Resample EX-8 | J1N3V2, J1N3T8 | 147754.7 | 580479.3 | |
| EX-9 | J1N2L9, J1N2N8 | 147754.7 | 580496.2 | |
| EX-10 | J1N2M0, J1N2N9 | 147769.3 | 580454.1 | |
| Resample EX-10 | J1N3V3, J1N3T9 | 147769.3 | 580454.1 | |
| EX-11 | J1N2M1, J1N2P0 | 147769.3 | 580470.9 | |
| EX-12 | J1N2M2, J1N2P1 | 147769.3 | 580487.8 | |
| EX-12 duplicate | J1N2M3, J1N2P2 | 147769.3 | 580487.8 | |
| OB-1 | J1N2M4, J1N2P3 | NA | NA | |
| OB-2 | J1N2M5, J1N2P4 | NA | NA | |
| OB-3 | J1N2M6, J1N2P5 | NA | NA | |
| OB-4 | J1N2M7, J1N2P6 | NA | NA | |
| OB-4 duplicate | J1N2M8, J1N2P7 | NA | NA | |
| Equipment blank | J1N2M9 | NA | NA | ICP metals [a], hexavalent chromium, and mercury |

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

EX = excavation
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
OB = overburden stockpile
WSP = Washington State Plane

**Figure 6. Verification Sample Locations for the 100-F-57:1 Waste Site Excavation and Overburden Stockpile.**



### Verification Sample Results

Verification samples were analyzed using EPA-approved analytical methods. The 95% upper confidence limit (UCL) on the true population mean for residual concentrations of COPCs was calculated for each decision unit (the combined excavation area and the overburden pile area footprints) as specified by the 100 Area RDR/RAWP (DOE-RL 2009b), with calculations provided in Appendix C. When a nonradionuclide COPC was detected in fewer than 50% of the verification samples collected for the area, the maximum detected value was used for comparison to the RAGs. If no detections for a given COPC were reported in the data set, then no statistical evaluation or calculations were performed for that COPC. Evaluation of the verification data from the composite samples was performed by direct comparison of the maximum sample results against cleanup criteria.

Comparisons of the results for each COPC from the 100-F-57:1 waste subsite and the overburden stockpile areas against site RAGs are summarized in Tables 5 and 6, respectively. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2011) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site-risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in these tables. The laboratory-reported data results for all constituents are stored in the ENRE project-specific database prior to archival in the HEIS and are presented in Attachment 1 of the 95% UCL calculations (Appendix C).

## VERIFICATION SAMPLE DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-F-57:1 waste subsite and the overburden stockpile achieve the applicable RAGs developed to support unrestricted land use at the 100 Area as established in the Remaining Sites ROD (EPA 1999) and documented in the 100 Area RDR/RAWP (DOE-RL 2009b).

### Nonradionuclides

Tables 5 and 6 compare the cleanup verification sample values to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River.
No contaminants exceed direct-exposure RAGs. All cleanup verification data values pass in direct comparison to the applicable RAGs, with the exception of total chromium and lead, which were quantified at concentrations exceeding soil cleanup RAGs for groundwater and/or river protection within the 100-F-57:1 waste subsite excavation.

## Table 5. Comparison of Statistical Contaminant Concentrations to Remedial Action Goals for the 100-F-57:1 Excavation Verification Sampling Data.

| COPC | Statistical or Maximum Result [b] | Remedial Action Goals [a] | | | Do the Statistical Results Exceed RAGs? | Do the Results Pass RESRAD Modeling? |
|---|---|---|---|---|---|---|
| | | Direct Exposure | Soil Cleanup Level for Groundwater Protection | Soil Cleanup Level for River Protection | | |
| **Metals (mg/kg)** | | | | | | |
| Antimony [c] | 0.84 (<BG) | 32 | 5 [d] | 5 [d] | No | -- |
| Arsenic | 3.5 (<BG) | 20 [d] | 20 [d] | 20 [d] | No | -- |
| Barium | 63.9 (<BG) | 5,600 | 200 | 400 | No | -- |
| Beryllium | 0.46 (<BG) | 10.4 [e] | 1.51 [d] | 1.51 [d] | No | -- |
| Boron [f] | 2.4 | 7,200 | 320 | -- [g] | No | -- |
| Cadmium [c] | 0.11 (<BG) | 13.9 [e] | 0.81 [d] | 0.81 [d] | No | -- |
| Chromium (total) | 19.8 | 80,000 | 18.5 [d] | 18.5 [d] | Yes | Yes [h] |
| Cobalt | 5.5 (<BG) | 24 | 15.7 [d] | -- [g] | No | -- |
| Copper | 17.2 (<BG) | 2,960 | 59.2 | 22.0 [d] | No | -- |
| Lead | 27.7 | 353 | 10.2 [d] | 10.2 [d] | Yes | Yes [h] |
| Manganese | 265 (<BG) | 3,760 | 512 [d] | -- [g] | No | -- |
| Mercury | 0.29 (<BG) | 24 | 0.33 [d] | 0.33 [d] | No | -- |
| Molybdenum [f] | 0.41 | 400 | 8 | -- [g] | No | -- |
| Nickel | 13.3 (<BG) | 1,600 | 19.1 [d] | 27.4 | No | -- |
| Selenium [c] | 1.0 | 400 | 5 | 1.0 | No | -- |
| Silver | 0.17 (<BG) | 400 | 8 | 0.73 | No | -- |
| Vanadium | 41.9 (<BG) | 560 | 85.1 [d] | -- [g] | No | -- |
| Zinc | 40.4 (<BG) | 24,000 | 480 | 67.8 [d] | No | -- |

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b) unless otherwise noted.
[b] 95% upper confidence limit or maximum value, depending on data censorship, as described in Appendix C.
[c] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[d] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project managers as discussed in Section 2.1.2.1 of the 100 Area RDR/RAWP (DOE-RL 2009b).
[e] Carcinogenic cleanup level calculated based on the inhalation exposure pathway per WAC 173-340-750(3) (1996), (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[f] No Hanford Site-specific or Washington State background value available.
[g] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2011) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii] [1996], [Method B for surface waters]).
[h] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of chromium (total) and lead are not expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the constituent with the lowest $K_d$ value, lead, with a $K_d$ value of 30 mL/g). The vadose zone soil underlying the waste site excavation is approximately 12.8 m (42 ft) thick. Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

**Table 6. Comparison of Maximum Contaminant Concentrations to Remedial Action Goals for the 100-F-57 Overburden Stockpile Verification Data.**

| COPC | Maximum Result | Remedial Action Goals [a] | | | Does the Maximum Result Exceed RAGs? | Do the Results Pass RESRAD Modeling? |
|---|---|---|---|---|---|---|
| | | Direct Exposure | Soil Cleanup Level for Groundwater Protection | Soil Cleanup Level for River Protection | | |
| **Metals (mg/kg)** | | | | | | |
| Antimony [b] | 0.71 (<BG) | 32 | 5 [c] | 5 [c] | No | |
| Arsenic | 2.8 (<BG) | 20 [c] | 20 [c] | 20 [c] | No | -- |
| Barium | 54.8 (<BG) | 5,600 | 200 | 400 | No | -- |
| Beryllium | 0.59 (<BG) | 10.4 [d] | 1.51 [c] | 1.51 [c] | No | -- |
| Cadmium [b] | 0.057 (<BG) | 13.9 [d] | 0.81 [c] | 0.81 [c] | No | -- |
| Chromium (total) | 11.4 (<BG) | 80,000 | 18.5 [c] | 18.5 [c] | No | -- |
| Cobalt | 5.3 (<BG) | 24 | 15.7 [c] | -- [e] | No | -- |
| Copper | 12.9 (<BG) | 2,960 | 59.2 | 22.0 [c] | No | -- |
| Lead | 10.2 | 353 | 10.2 [c] | 10.2 [c] | No | -- |
| Manganese | 260 (<BG) | 3,760 | 512 [c] | -- [e] | No | -- |
| Mercury | 0.032 (<BG) | 24 | 0.33 [c] | 0.33 [c] | No | -- |
| Nickel | 10.5 (<BG) | 1,600 | 19.1 [c] | 27.4 | No | -- |
| Vanadium | 48.8 (<BG) | 560 | 85.1 [c] | -- [e] | No | -- |
| Zinc | 36.8 (<BG) | 24,000 | 480 | 67.8 [c] | No | -- |

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b) unless otherwise noted.
[b] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project managers as discussed in Section 2.1.2.1 of the 100 Area RDR/RAWP (DOE-RL 2009b).
[d] Carcinogenic cleanup level calculated based on the inhalation exposure pathway per WAC 173-340-750(3) (1996) (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m$^3$ (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[e] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2011) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Data were not collected on the vertical extent of total chromium and lead, but an evaluation based upon RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b) shows that residual concentrations of these constituents are not expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years given the soil-partitioning coefficient ($K_d$) of 30 mL/g for lead, the contaminant with the lowest $K_d$ value. The vadose zone underlying the deepest part of the excavation is approximately 12.8 m (42 ft) thick; therefore, residual concentrations of these constituents are predicted to be protective of groundwater. The only pathway for contaminant migration to the Columbia River is via groundwater; therefore, residual concentrations of these contaminants are also predicted to be protective of the Columbia River. All other cleanup verification data values pass in direct comparison to the applicable RAGs.

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. The WAC 173-340 three-part test 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 WAC 173-340 three-part test for the 100-F-57:1 waste subsite and the overburden stockpile statistical data are included in the 95% UCL calculation (Appendix C). The results of this evaluation indicate that all residual COPC concentrations pass the three-part test in comparison to applicable RAGs, with the exception of lead and total chromium, which fail all three parts, and mercury, where a single value exceeded cleanup criteria in comparison to the soil RAGs for groundwater and river protection. However, RESRAD modeling predicts that lead and mercury, the contaminants with the lowest $K_d$ values (30 mL/g), are not predicted to migrate to groundwater, and hence, the Columbia River within 1,000 years. Therefore, the requirements of the three-part test are met.

Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than $1 \times 10^{-6}$, and a cumulative carcinogenic risk of less than $1 \times 10^{-5}$. For the 100-F-57:1 waste subsite and the overburden stockpile, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background levels. All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detected levels is $4.1 \times 10^{-3}$. The 100-F-57:1 waste subsite does not have any constituents with a carcinogenic RAG value; therefore, the criterion of a cumulative carcinogenic risk of $<1 \times 10^{-5}$ is met. The 100-F-57:1 waste subsite and the overburden stockpile meet the requirements for the direct-contact hazard quotient and excess carcinogenic risk as identified in the 100 Area RDR/RAWP (DOE-RL 2009b). Calculation of the 100-F-57:1 waste subsite and the overburden stockpile direct-contact hazard quotient and carcinogenic risk is presented in Appendix C.

## DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2011e), the field logbooks (WCH 2012a), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 100-F-57:1 waste subsite and the overburden stockpile 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 archival in the HEIS and are summarized in an attachment to the UCL calculation in Appendix C. The detailed DQA is presented in Appendix D.

## SUMMARY FOR INTERIM CLOSURE

The 100-F-57:1 waste subsite and the overburden stockpile have been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009b). Remedial action was performed between December 2010 and January 2012, removing contaminated soil and debris from the site. Verification sampling was performed January 16 and February 1, 2012, and the analytical results indicate that the residual concentrations of COPCs meet the RAGs and associated RAOs for direct exposure, groundwater protection, and river protection.

In accordance with this evaluation, the verification sampling results support a reclassification of the 100-F-57:1 waste subsite and the overburden stockpile to Interim Closed Out. The waste site contamination does not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site are not required.

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# APPENDIX A

# PHOTOGRAPHS

**Figure A-1. Aerial Photograph of the 190-F Pump House and 190-F Annex (dated circa 1956).**

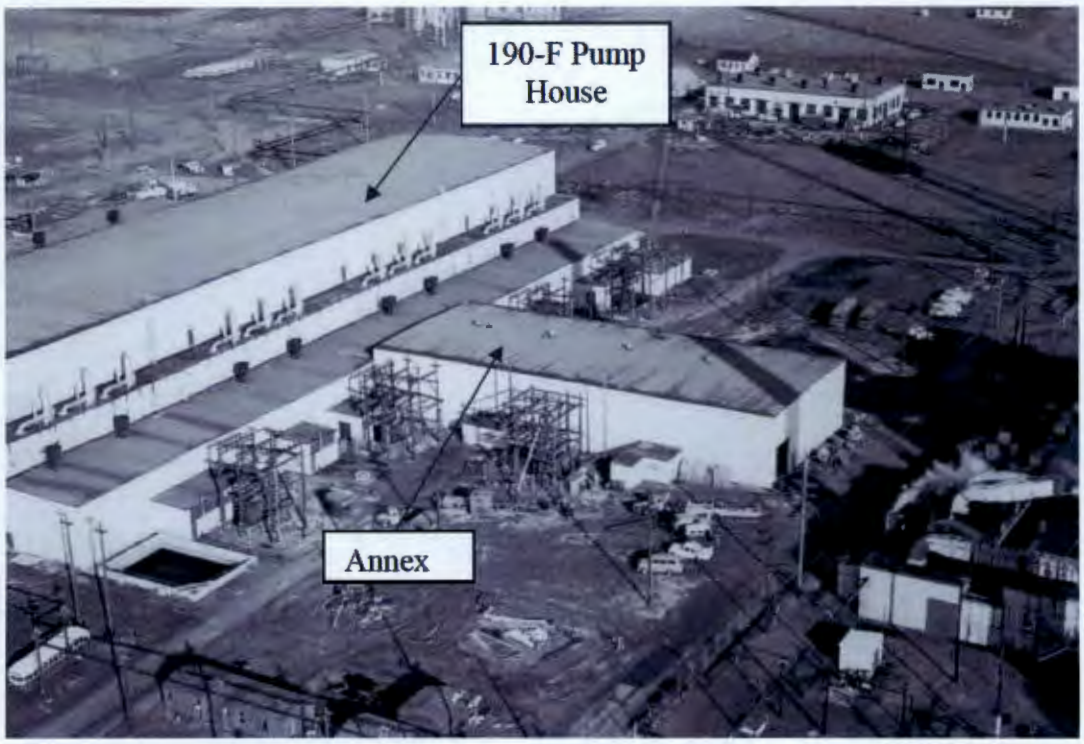


**Figure A-2. The 190-F- Building Concrete Foundation (April 27, 2005).**

**Figure A-3. 100-F-57 Pipe Cradle and Suspect Asbestos Material (December 2007).**

**Figure A-4. Green-Stained Concrete at 100-F-57 (December 9, 2010).**

**Figure A-5. The 100-F-57 Overburden Stockpile (September 2011).**

**Figure A-6. Post-Remediation Photograph of 100-F-57:1, Looking East (October 6, 2011).**

**Figure A-7. Post-Remediation Photograph of 100-F-57:1, Looking South (October 6, 2011).**

# APPENDIX B

# CONFIRMATORY AND IN-PROCESS SAMPLING RESULTS

# Table B-1. 100-F-57 Confirmatory Data Results. (4 Pages)

| Sample Location | Sample Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | | Boron | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| pipe cradle | J16364 | 12/06/07 | 134 | | 1.6 | 1.6 | U | 1.6 | 2.8 | U | 2.8 | 7.7 | | 0.27 | 0.02 | U | 0.02 | 0.49 | | 0.25 |
| equipment blank | J168V4 | 01/21/08 | 46.4 | | 3.6 | 0.27 | U | 0.27 | 0.45 | U | 0.45 | 1.3 | | 0.09 | 0.05 | U | 0.05 | 0.45 | U | 0.45 |
| soil below drainage trench | J168V5 | 01/21/08 | 3420 | | 10.7 | 0.8 | U | 0.8 | 1.3 | U | 1.3 | 27.8 | | 0.27 | 0.21 | | 0.13 | 1.3 | U | 1.3 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 2300 | | 9.9 | 0.74 | U | 0.74 | 1.2 | U | 1.2 | 32.8 | | 0.25 | 0.13 | | 0.12 | 1.2 | U | 1.2 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 10200 | | 11.5 | 1 | | 0.86 | 4.6 | | 1.4 | 140 | C | 0.29 | 0.56 | | 0.14 | 12 | | 1.4 |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | | | | | | | | | | | | | |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | | | | | | | | | | | | | |

| Sample Location | Sample Number | Sample Date | Cadmium | | | Calcium | | | Chromium | | | Cobalt | | | Copper | | | Hexavalent 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 |
| pipe cradle | J16364 | 12/06/07 | 0.49 | U | 0.49 | 722 | C | 1.8 | 3.2 | | 0.4 | 0.35 | U | 0.35 | 1.9 | | 0.2 | | | |
| equipment blank | J168V4 | 01/21/08 | 0.05 | U | 0.05 | 21.3 | C | 3.6 | 0.18 | U | 0.18 | 0.18 | U | 0.18 | 0.18 | U | 0.18 | | | |
| soil below drainage trench | J168V5 | 01/21/08 | 0.13 | U | 0.13 | 5930 | C | 10.7 | 5.4 | | 0.54 | 4.3 | | 0.54 | 9.7 | | 0.54 | 0.2 | U | 0.2 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 0.12 | U | 0.12 | 3700 | C | 9.9 | 3.2 | | 0.49 | 2.4 | | 0.49 | 5 | | 0.49 | 0.32 | | 0.2 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 0.26 | | 0.14 | 90500 | C | 11.5 | 15.7 | | 0.58 | 7 | | 0.58 | 22.6 | | 58 | | | |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | | | | | | | | | | | 1.29 | | 0.35 |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | | | | | | | | | | | 1.97 | | 0.35 |

| Sample Location | Sample Number | Sample Date | Iron | | | Lead | | | Magnesium | | | Manganese | | | Mercury | | | Molybdenum | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Iron | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| pipe cradle | J16364 | 12/06/07 | 287 | C | 0.3 | 17 | | 3.1 | 75.6 | C | 3.2 | 4.6 | | 0.08 | 0.07 | | 0.02 | 0.57 | U | 0.57 |
| equipment blank | J168V4 | 01/21/08 | 97.5 | C | 4.1 | 0.27 | U | 0.27 | 6.4 | | 2.3 | 4.6 | C | 0.04 | 0.01 | U | 0.01 | 0.27 | U | 0.27 |
| soil below drainage trench | J168V5 | 01/21/08 | 8050 | C | 12 | 1.9 | | 0.8 | 2560 | | 6.7 | 180 | C | 0.11 | 0.008 | U | 0.008 | 0.8 | U | 0.8 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 4870 | C | 11.1 | 1.5 | | 0.74 | 1520 | | 6.2 | 105 | C | 0.1 | 0.01 | U | 0.01 | 0.74 | U | 0.74 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 15700 | | 13 | 14 | | 0.86 | 5480 | | 7.2 | 192 | C | 0.12 | 4.68 | | 0.06 | 0.99 | | 0.86 |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | | | | | | | | | | | | | |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | | | | | | | | | | | | | |

Notes:

C = method blank contamination
J = estimate
PQL = practical quantitation limit
Q = qualifier
TDL = target detection limit
U = undetected

## Table B-1. 100-F-57 Confirmatory Data Results. (4 Pages)

| Sample Location | Sample Number | Sample Date | Nickel | | | Potassium | | | Selenium | | | Silicon | | | Silver | | | Sodium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| pipe cradle | J16364 | 12/06/07 | 1.1 | U | 1.1 | 43.2 | U | 43.2 | 3.6 | U | 3.6 | 158 | | 5.8 | 0.39 | U | 0.39 | 60.2 | C | 1.4 |
| equipment blank | J168V4 | 01/21/08 | 0.18 | U | 0.18 | 30.2 | C | 3.6 | 0.54 | U | 0.54 | 68.3 | | 3.6 | 0.09 | U | 0.09 | 12.1 | C | 1.8 |
| soil below drainage trench | J168V5 | 01/21/08 | 7.4 | | 0.54 | 571 | C | 10.7 | 1.6 | U | 1.6 | 2160 | | 10.7 | 0.27 | U | 0.27 | 134 | C | 5.4 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 4.1 | | 0.49 | 437 | C | 9.9 | 1.5 | U | 1.5 | 1390 | | 9.9 | 0.25 | U | 0.25 | 148 | C | 4.9 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 13.6 | | 0.58 | 1320 | | 11.5 | 1.7 | U | 1.7 | 22300 | | 11.5 | 0.29 | U | 0.29 | 1050 | C | 5.8 |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | | | | | | | | | | | | | |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | | | | | | | | | | | | | |

| Sample Location | Sample Number | Sample Date | Vanadium | | | Zinc | | |
|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL |
| pipe cradle | J16364 | 12/06/07 | 0.94 | | 0.3 | 15.3 | C | 0.15 |
| equipment blank | J168V4 | 01/21/08 | 0.15 | | 0.13 | 0.57 | C | 0.54 |
| soil below drainage trench | J168V5 | 01/21/08 | 16.8 | | 0.37 | 20.5 | C | 1.6 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 10.1 | | 0.34 | 12.9 | C | 1.5 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 42.2 | | 0.4 | 101 | | 1.7 |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | |

Notes:

C = method blank contamination
J = estimate
PQL = practical quantitation limit
Q = qualifier
TDL = target detection limit
U = undetected

## Table B-1. 100-F-57 Confirmatory Data Results. (4 Pages)

| CONSTITUENT | J16364 Pipe Cradle | | | J168V5 Soil Below Drainage Trench | | | J168V6 Duplicate of J168V5 | | | J168V7 Drainage Trench Scabbled Concrete | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL |
| **PCBs** | | | | | | | | | | | | |
| Aroclor-1016 | 2000 | U | 2000 | 14 | U | 14 | 14 | U | 14 | 13 | U | 13 |
| Aroclor-1221 | 2000 | U | 2000 | 14 | U | 14 | 14 | U | 14 | 13 | U | 13 |
| Aroclor-1232 | 2000 | U | 2000 | 14 | U | 14 | 14 | U | 14 | 13 | U | 13 |
| Aroclor-1242 | 2000 | U | 2000 | 14 | U | 14 | 14 | U | 14 | 13 | U | 13 |
| Aroclor-1248 | 2000 | U | 2000 | 14 | U | 14 | 14 | U | 14 | 13 | U | 13 |
| Aroclor-1254 | 2000 | U | 2000 | 14 | U | 14 | 14 | U | 14 | 13 | U | 13 |
| Aroclor-1260 | 2000 | U | 2000 | 14 | U | 14 | 14 | U | 14 | 13 | U | 13 |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | 250000 | U | 250000 | | | | | | | | | |
| 1,2-Dichlorobenzene | 250000 | U | 250000 | | | | | | | | | |
| 1,3-Dichlorobenzene | 250000 | U | 250000 | | | | | | | | | |
| 1,4-Dichlorobenzene | 250000 | U | 250000 | | | | | | | | | |
| 2,4,5-Trichlorophenol | 620000 | U | 620000 | | | | | | | | | |
| 2,4,6-Trichlorophenol | 250000 | U | 250000 | | | | | | | | | |
| 2,4-Dichlorophenol | 250000 | U | 250000 | | | | | | | | | |
| 2,4-Dimethylphenol | 250000 | U | 250000 | | | | | | | | | |
| 2,4-Dinitrophenol | 620000 | U | 620000 | | | | | | | | | |
| 2,4-Dinitrotoluene | 250000 | U | 250000 | | | | | | | | | |
| 2,6-Dinitrotoluene | 250000 | U | 250000 | | | | | | | | | |
| 2-Chloronaphthalene | 250000 | U | 250000 | | | | | | | | | |
| 2-Chlorophenol | 250000 | U | 250000 | | | | | | | | | |
| 2-Methylnaphthalene | 250000 | U | 250000 | | | | | | | | | |
| 2-Methylphenol (cresol, o-) | 250000 | U | 250000 | | | | | | | | | |
| 2-Nitroaniline | 620000 | U | 620000 | | | | | | | | | |
| 2-Nitrophenol | 250000 | U | 250000 | | | | | | | | | |
| 3+4 Methylphenol (cresol, m+p) | 250000 | U | 250000 | | | | | | | | | |
| 3,3'-Dichlorobenzidine | 250000 | U | 250000 | | | | | | | | | |
| 3-Nitroaniline | 620000 | U | 620000 | | | | | | | | | |
| 4,6-Dinitro-2-methylphenol | 620000 | U | 620000 | | | | | | | | | |
| 4-Bromophenylphenyl ether | 250000 | U | 250000 | | | | | | | | | |
| 4-Chloro-3-methylphenol | 250000 | U | 250000 | | | | | | | | | |
| 4-Chloroaniline | 250000 | U | 250000 | | | | | | | | | |
| 4-Chlorophenylphenyl ether | 250000 | U | 250000 | | | | | | | | | |
| 4-Nitroaniline | 620000 | U | 620000 | | | | | | | | | |
| 4-Nitrophenol | 620000 | U | 620000 | | | | | | | | | |
| Acenaphthene | 250000 | U | 250000 | | | | | | | | | |
| Acenaphthylene | 250000 | U | 250000 | | | | | | | | | |
| Anthracene | 250000 | U | 250000 | | | | | | | | | |
| Benzo(a)anthracene | 250000 | U | 250000 | | | | | | | | | |
| Benzo(a)pyrene | 22000 | J | 250000 | | | | | | | | | |
| Benzo(b)fluoranthene | 250000 | U | 250000 | | | | | | | | | |
| Benzo(ghi)perylene | 21000 | J | 250000 | | | | | | | | | |
| Benzo(k)fluoranthene | 250000 | U | 250000 | | | | | | | | | |
| Bis(2-chloro-1-methylethyl)ether | 250000 | U | 250000 | | | | | | | | | |
| Bis(2-Chloroethoxy)methane | 250000 | U | 250000 | | | | | | | | | |
| Bis(2-chloroethyl) ether | 250000 | U | 250000 | | | | | | | | | |
| Bis(2-ethylhexyl) phthalate | 250000 | U | 250000 | | | | | | | | | |
| Butylbenzylphthalate | 250000 | U | 250000 | | | | | | | | | |

Notes:

J = estimate

PQL = practical quantitation limit

Q = qualifier

U = undetected

## Table B-1. 100-F-57 Confirmatory Data Results. (4 Pages)

| CONSTITUENT | J16364 Pipe Cradle | | | J168V5 Soil Below Drainage | | | J168V6 Duplicate of J168V5 | | | J168V7 Drainage Trench | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL | µg/kg | Q | PQL |
| **Semivolatile Organic Compounds** | | | | | | | | | | | | |
| Carbazole | 250000 | U | 250000 | | | | | | | | | |
| Chrysene | 23000 | J | 250000 | | | | | | | | | |
| Di-n-butylphthalate | 250000 | U | 250000 | | | | | | | | | |
| Di-n-octylphthalate | 250000 | U | 250000 | | | | | | | | | |
| Dibenz[a,h]anthracene | 250000 | U | 250000 | | | | | | | | | |
| Dibenzofuran | 250000 | U | 250000 | | | | | | | | | |
| Diethylphthalate | 250000 | U | 250000 | | | | | | | | | |
| Dimethyl phthalate | 250000 | U | 250000 | | | | | | | | | |
| Fluoranthene | 250000 | U | 250000 | | | | | | | | | |
| Fluorene | 250000 | U | 250000 | | | | | | | | | |
| Hexachlorobenzene | 250000 | U | 250000 | | | | | | | | | |
| Hexachlorobutadiene | 250000 | U | 250000 | | | | | | | | | |
| Hexachlorocyclopentadiene | 250000 | U | 250000 | | | | | | | | | |
| Hexachloroethane | 250000 | U | 250000 | | | | | | | | | |
| Indeno(1,2,3-cd)pyrene | 250000 | U | 250000 | | | | | | | | | |
| Isophorone | 250000 | U | 250000 | | | | | | | | | |
| N-Nitroso-di-n-dipropylamine | 250000 | U | 250000 | | | | | | | | | |
| N-Nitrosodiphenylamine | 250000 | U | 250000 | | | | | | | | | |
| Naphthalene | 250000 | U | 250000 | | | | | | | | | |
| Nitrobenzene | 250000 | U | 250000 | | | | | | | | | |
| Pentachlorophenol | 620000 | U | 620000 | | | | | | | | | |
| Phenanthrene | 250000 | U | 250000 | | | | | | | | | |
| Phenol | 250000 | U | 250000 | | | | | | | | | |
| Pyrene | 18000 | J | 250000 | | | | | | | | | |

Notes:

J = estimate

Q = qualifier

## Table B-2. 100-F-57:1 In-Process Sampling - Metals and Physical Data. (6 Pages)

| Sample Location[a] | HEIS Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | | Boron | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Stockpile-4 | J1CYB7 | 12/15/2010 | 4550 | X | 1.5 | 0.38 | U | 0.38 | 3.2 | | 0.66 | 48.3 | | 0.076 | 0.19 | B | 0.033 | 0.98 | U | 0.98 |
| Pothole 6A | J1F155 | 2/10/2011 | 6810 | | 1.5 | 0.6 | | 0.37 | 2.5 | | 0.64 | 42.6 | | 0.073 | 0.032 | U | 0.032 | 1.2 | B | 0.95 |
| Pothole 6B | J1F156 | 2/10/2011 | 5950 | | 1.3 | 0.33 | U | 0.33 | 1.9 | | 0.57 | 32.7 | | 0.066 | 0.029 | U | 0.029 | 0.89 | B | 0.85 |
| Pothole 6C | J1F157 | 2/10/2011 | 5920 | | 1.4 | 0.35 | U | 0.35 | 2.1 | | 0.61 | 33.2 | | 0.07 | 0.03 | U | 0.03 | 0.9 | U | 0.90 |
| Pothole 6D | J1F158 | 2/10/2011 | 5680 | | 1.4 | 0.34 | U | 0.34 | 2 | | 0.58 | 37.2 | | 0.067 | 0.029 | U | 0.029 | 0.87 | U | 0.87 |
| Pothole 6E | J1F159 | 2/10/2011 | 5720 | | 1.6 | 0.45 | B | 0.39 | 1.5 | | 0.68 | 34.3 | | 0.078 | 0.034 | U | 0.034 | 1.0 | U | 1.0 |
| Pothole 6F | J1F160 | 2/10/2011 | 5950 | | 1.5 | 0.38 | B | 0.36 | 1.8 | | 0.63 | 30.7 | | 0.072 | 0.031 | U | 0.031 | 0.93 | U | 0.93 |
| Pothole 7A | J1F175 | 2/10/2011 | 8500 | | 1.6 | 0.39 | U | 0.39 | 2.7 | | 0.68 | 67.2 | | 0.079 | 0.054 | B | 0.034 | 2.2 | | 1.0 |
| Pothole 7B | J1F176 | 2/10/2011 | 7770 | | 1.5 | 0.36 | U | 0.36 | 2.7 | | 0.63 | 59.6 | | 0.072 | 0.049 | B | 0.031 | 1.8 | B | 0.93 |
| Pothole 7C | J1F177 | 2/10/2011 | 7480 | | 1.5 | 0.38 | U | 0.38 | 2.3 | | 0.66 | 50.9 | | 0.076 | 0.033 | U | 0.033 | 1.3 | B | 0.98 |
| Pothole 7D | J1F178 | 2/10/2011 | 6080 | | 1.5 | 0.37 | U | 0.37 | 2 | | 0.64 | 36.7 | | 0.073 | 0.032 | U | 0.032 | 0.95 | U | 0.95 |
| Pothole 7E | J1F179 | 2/10/2011 | 5840 | | 1.5 | 0.37 | B | 0.37 | 1.5 | | 0.64 | 40.2 | | 0.073 | 0.032 | U | 0.032 | 0.94 | U | 0.94 |
| Pothole 7F | J1F180 | 2/10/2011 | 6330 | | 1.4 | 0.35 | U | 0.35 | 1.9 | | 0.6 | 37.9 | | 0.069 | 0.033 | B | 0.03 | 1.7 | B | 0.89 |
| Pothole 6 - concrete pad | J1F1P2 | 2/17/2011 | 8610 | | 1.5 | 0.85 | | 0.36 | 5.6 | | 0.62 | 107 | X | 0.072 | 0.031 | U | 0.031 | 4.5 | | 0.92 |
| Pothole 12 - east side | J1FKV5 | 3/16/2011 | 9960 | | 1.5 | 0.37 | U | 0.37 | 4 | | 0.64 | 88.1 | | 0.074 | 0.12 | B | 0.032 | 3.3 | M | 0.95 |
| Pothole 12 | J1FKV6 | 3/16/2011 | 4870 | | 1.3 | 0.33 | U | 0.33 | 2 | | 0.57 | 34.3 | | 0.066 | 0.029 | U | 0.029 | 0.85 | U | 0.85 |
| Pothole 12 | J1FKV7 | 3/16/2011 | 5490 | | 1.5 | 0.36 | U | 0.36 | 2 | | 0.62 | 33.3 | | 0.071 | 0.049 | B | 0.031 | 0.92 | U | 0.92 |
| Pothole 12 | J1FKV8 | 3/16/2011 | 5480 | | 1.5 | 0.36 | U | 0.36 | 1.9 | | 0.63 | 34.4 | | 0.072 | 0.046 | B | 0.031 | 0.93 | U | 0.93 |
| Pothole 12 -concrete | J1FXF0 | 3/22/2011 | 7520 | | 1.6 | 0.49 | B | 0.39 | 4 | | 0.68 | 121 | | 0.079 | 0.034 | U | 0.034 | 4.6 | M | 1.0 |

Footnotes apply to all Appendix B in-process data tables.

Note: Gray cells indicate not applicable.

[a] In-process samples are soil unless stated otherwise

B = estimated result. Result is less than the RL but greater than the MDL.

D = diluted sample.

HEIS = Hanford Environmental Information System.

J = estimated result.

M = precision out of control limits.

N = recovery exceeds upper or lower control limits.

PCB = polychlorinate biphenyls

PQL = practical quantitation limit.

Q = qualifier.

SVOA = semivolatile organic analysis

TCLP = toxicity characteristic leachate procedure.

U = undetected.

X = serial dilution indicates physical/chemical interferences present.

## Table B-2. 100-F-57:1 In-Process Sampling - Metals and Physical Data. (6 Pages)

| Sample Location | HEIS Number | Sample Date | Cadmium | | | Calcium | | | Chromium | | | Cobalt | | | Copper | | | Iron | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Stockpile-4 | J1CYB7 | 12/15/2010 | 0.18 | B | 0.041 | 9420 | X | 14.1 | 13.9 | | 0.058 | 4.5 | | 0.1 | 13.1 | | 0.22 | 11000 | X | 3.8 |
| Pothole 6A | J1F155 | 2/10/2011 | 0.052 | B | 0.04 | 5320 | | 13.6 | 14.6 | | 0.056 | 5.1 | | 0.096 | 15.9 | | 0.21 | 14400 | | 3.7 |
| Pothole 6B | J1F156 | 2/10/2011 | 0.056 | B | 0.036 | 6370 | | 12.2 | 11.3 | | 0.05 | 5.0 | | 0.087 | 13.3 | | 0.19 | 14000 | | 3.3 |
| Pothole 6C | J1F157 | 2/10/2011 | 0.055 | B | 0.038 | 6550 | | 13 | 10 | | 0.053 | 4.4 | | 0.092 | 13 | | 0.20 | 12700 | | 3.5 |
| Pothole 6D | J1F158 | 2/10/2011 | 0.064 | B | 0.036 | 6010 | | 12.5 | 9.4 | | 0.051 | 4.4 | | 0.088 | 11.6 | | 0.19 | 12500 | | 3.4 |
| Pothole 6E | J1F159 | 2/10/2011 | 0.065 | B | 0.042 | 6640 | | 14.5 | 10.9 | | 0.059 | 4.2 | | 0.10 | 11.3 | | 0.22 | 11900 | | 3.9 |
| Pothole 6F | J1F160 | 2/10/2011 | 0.074 | B | 0.039 | 6770 | | 13.4 | 10 | | 0.055 | 4.4 | | 0.095 | 12.2 | | 0.21 | 12500 | | 3.6 |
| Pothole 7A | J1F175 | 2/10/2011 | 0.074 | B | 0.043 | 7740 | | 14.6 | 25.4 | | 0.06 | 5.7 | | 0.10 | 15.3 | | 0.22 | 16700 | | 3.9 |
| Pothole 7B | J1F176 | 2/10/2011 | 0.057 | B | 0.039 | 8260 | | 13.4 | 14.8 | | 0.055 | 7.3 | | 0.095 | 14.9 | | 0.21 | 15500 | | 3.6 |
| Pothole 7C | J1F177 | 2/10/2011 | 0.072 | B | 0.041 | 7370 | | 14.1 | 16.6 | | 0.058 | 5.3 | | 0.10 | 14.2 | | 0.22 | 15100 | | 3.8 |
| Pothole 7D | J1F178 | 2/10/2011 | 0.064 | B | 0.04 | 6850 | | 13.6 | 10.6 | | 0.056 | 4.6 | | 0.097 | 11.9 | | 0.21 | 13000 | | 3.7 |
| Pothole 7E | J1F179 | 2/10/2011 | 0.062 | B | 0.039 | 6430 | | 13.6 | 10.2 | | 0.056 | 4.4 | | 0.096 | 12.6 | | 0.21 | 13000 | | 3.7 |
| Pothole 7F | J1F180 | 2/10/2011 | 0.07 | B | 0.037 | 7080 | | 12.8 | 11.4 | | 0.053 | 4.4 | | 0.091 | 11.9 | | 0.20 | 12600 | | 3.5 |
| Pothole 6 - concrete pad | J1F1P2 | 2/17/2011 | 0.039 | U | 0.039 | 59900 | X | 13.3 | 12.2 | X | 0.055 | 4.3 | X | 0.094 | 16.1 | X | 0.20 | 15100 | X | 3.6 |
| Pothole 12 - east side | J1FKV5 | 3/16/2011 | 0.29 | | 0.04 | 6980 | N | 13.7 | 13.5 | | 0.056 | 6.6 | X | 0.097 | 16.6 | | 0.21 | 17400 | X | 3.7 |
| Pothole 12 | J1FKV6 | 3/16/2011 | 0.036 | U | 0.036 | 4690 | | 12.2 | 9.4 | | 0.05 | 4.1 | X | 0.087 | 11.5 | | 0.19 | 11400 | X | 3.3 |
| Pothole 12 | J1FKV7 | 3/16/2011 | 0.038 | U | 0.038 | 6160 | | 13.2 | 8.9 | | 0.054 | 4.0 | X | 0.094 | 11.3 | | 0.20 | 11200 | X | 3.6 |
| Pothole 12 | J1FKV8 | 3/16/2011 | 0.088 | B | 0.039 | 5520 | | 13.4 | 10.6 | | 0.055 | 4.1 | X | 0.095 | 11.3 | | 0.21 | 11200 | X | 3.6 |
| Pothole 12 -concrete | J1FXF0 | 3/22/2011 | 0.042 | U | 0.042 | 64400 | XM | 14.6 | 12.4 | M | 0.06 | 5.1 | | 0.10 | 17.7 | | 0.22 | 15700 | X | 3.9 |

| Sample Location | HEIS Number | Sample Date | Lead | | | Magnesium | | | 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 |
| Stockpile-4 | J1CYB7 | 12/15/2010 | 61.9 | | 0.27 | 3540 | X | 3.7 | 227 | | 0.1 | 0.064 | | 0.0053 | 0.26 | U | 0.26 | 8.7 | X | 0.12 |
| Pothole 6A | J1F155 | 2/10/2011 | 5.6 | | 0.26 | 3960 | X | 3.6 | 247 | | 0.096 | 0.012 | B | 0.0055 | 0.32 | B | 0.25 | 10.2 | | 0.12 |
| Pothole 6B | J1F156 | 2/10/2011 | 2.9 | | 0.23 | 4050 | X | 3.2 | 227 | | 0.087 | 0.0089 | B | 0.0052 | 0.23 | B | 0.23 | 11.8 | | 0.11 |
| Pothole 6C | J1F157 | 2/10/2011 | 3.3 | | 0.25 | 3690 | X | 3.4 | 223 | | 0.092 | 0.0071 | B | 0.0052 | 0.24 | U | 0.24 | 9.1 | | 0.11 |
| Pothole 6D | J1F158 | 2/10/2011 | 2.7 | | 0.24 | 3680 | X | 3.3 | 221 | | 0.088 | 0.011 | B | 0.0049 | 0.23 | U | 0.23 | 9.2 | | 0.11 |
| Pothole 6E | J1F159 | 2/10/2011 | 2.7 | | 0.28 | 3850 | X | 3.8 | 223 | | 0.10 | 0.0062 | B | 0.0049 | 0.27 | U | 0.27 | 9.9 | | 0.13 |
| Pothole 6F | J1F160 | 2/10/2011 | 2.5 | | 0.26 | 3980 | X | 3.5 | 237 | | 0.095 | 0.0066 | B | 0.0055 | 0.25 | U | 0.25 | 9.7 | | 0.12 |
| Pothole 7A | J1F175 | 2/10/2011 | 6.9 | | 0.28 | 4270 | | 3.8 | 279 | | 0.10 | 0.13 | | 0.0058 | 0.27 | U | 0.27 | 11.8 | | 0.13 |
| Pothole 7B | J1F176 | 2/10/2011 | 6.4 | | 0.26 | 4090 | | 3.5 | 298 | | 0.095 | 0.049 | | 0.0057 | 0.25 | U | 0.25 | 11.6 | | 0.12 |
| Pothole 7C | J1F177 | 2/10/2011 | 5.6 | | 0.27 | 4240 | | 3.7 | 260 | | 0.10 | 0.049 | | 0.0053 | 0.26 | U | 0.26 | 11.2 | | 0.12 |
| Pothole 7D | J1F178 | 2/10/2011 | 2.8 | | 0.26 | 4010 | | 3.6 | 251 | | 0.097 | 0.011 | B | 0.0054 | 0.25 | U | 0.25 | 12.2 | | 0.12 |
| Pothole 7E | J1F179 | 2/10/2011 | 2.5 | | 0.26 | 3770 | | 3.6 | 222 | | 0.096 | 0.011 | B | 0.0056 | 0.25 | U | 0.25 | 9.4 | | 0.12 |
| Pothole 7F | J1F180 | 2/10/2011 | 3.3 | | 0.25 | 3830 | | 3.4 | 242 | | 0.091 | 0.026 | | 0.0056 | 0.24 | U | 0.24 | 9.4 | | 0.11 |
| Pothole 6 - concrete pad | J1F1P2 | 2/17/2011 | 4.3 | | 0.25 | 4010 | X | 3.5 | 232 | X | 0.094 | 0.079 | | 0.0057 | 0.38 | B | 0.25 | 7.7 | X | 0.12 |
| Pothole 12 - east side | J1FKV5 | 3/16/2011 | 8.9 | | 0.26 | 5950 | N | 3.6 | 306 | X | 0.097 | 0.0065 | B | 0.006 | 0.34 | B | 0.25 | 12.7 | X | 0.12 |
| Pothole 12 | J1FKV6 | 3/16/2011 | 2.7 | | 0.23 | 3450 | | 3.2 | 211 | X | 0.087 | 0.0055 | U | 0.0055 | 0.36 | B | 0.23 | 8.9 | X | 0.11 |
| Pothole 12 | J1FKV7 | 3/16/2011 | 2.9 | | 0.25 | 3950 | | 3.5 | 225 | X | 0.094 | 0.0053 | UN | 0.0053 | 0.24 | U | 0.24 | 9.7 | X | 0.12 |
| Pothole 12 | J1FKV8 | 3/16/2011 | 3.1 | | 0.26 | 4100 | | 3.5 | 219 | X | 0.095 | 0.0051 | U | 0.0051 | 0.25 | U | 0.25 | 10.2 | X | 0.12 |
| Pothole 12 -concrete | J1FXF0 | 3/22/2011 | 9.2 | M | 0.28 | 3880 | X | 3.8 | 211 | | 0.10 | 0.14 | M | 0.0052 | 0.58 | B | 0.27 | 7.2 | X | 0.13 |

## Table B-2. 100-F-57:1 In-Process Sampling - Metals and Physical Data. (6 Pages)

| Sample Location | HEIS Number | Sample Date | Potassium | | | Selenium | | | Silicon | | | Silver | | | Sodium | | | Vanadium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| Stockpile-4 | J1CYB7 | 12/15/2010 | 833 | | 40.9 | 0.86 | U | 0.86 | 207 | | 2.1 | 0.16 | U | 0.16 | 179 | | 58.9 | 21.9 | | 0.094 |
| Pothole 6A | J1F155 | 2/10/2011 | 842 | | 39.6 | 0.83 | U | 0.83 | 128 | | 2.0 | 0.15 | U | 0.15 | 318 | | 56.9 | 33.3 | | 0.091 |
| Pothole 6B | J1F156 | 2/10/2011 | 666 | | 35.6 | 0.75 | U | 0.75 | 141 | | 1.8 | 0.14 | U | 0.14 | 186 | | 51.3 | 33.4 | | 0.082 |
| Pothole 6C | J1F157 | 2/10/2011 | 721 | | 37.7 | 0.79 | U | 0.79 | 133 | | 1.9 | 0.15 | U | 0.15 | 194 | | 54.3 | 31.3 | | 0.086 |
| Pothole 6D | J1F158 | 2/10/2011 | 644 | | 36.2 | 0.76 | U | 0.76 | 134 | | 1.9 | 0.14 | U | 0.14 | 220 | | 52.1 | 30.2 | | 0.083 |
| Pothole 6E | J1F159 | 2/10/2011 | 653 | | 42 | 0.88 | U | 0.88 | 125 | | 2.2 | 0.16 | U | 0.16 | 175 | | 60.5 | 28.1 | | 0.096 |
| Pothole 6F | J1F160 | 2/10/2011 | 661 | | 39 | 0.82 | U | 0.82 | 127 | | 2.0 | 0.15 | U | 0.15 | 180 | | 56.1 | 29.8 | | 0.089 |
| Pothole 7A | J1F175 | 2/10/2011 | 1430 | | 42.5 | 0.89 | U | 0.89 | 203 | | 2.2 | 0.17 | U | 0.17 | 268 | | 61.2 | 35.3 | | 0.097 |
| Pothole 7B | J1F176 | 2/10/2011 | 1150 | | 39 | 0.82 | U | 0.82 | 203 | | 2.0 | 0.15 | U | 0.15 | 313 | | 56.1 | 35.2 | | 0.089 |
| Pothole 7C | J1F177 | 2/10/2011 | 1070 | | 40.9 | 0.86 | U | 0.86 | 195 | | 2.1 | 0.16 | U | 0.16 | 283 | | 58.8 | 34.5 | | 0.094 |
| Pothole 7D | J1F178 | 2/10/2011 | 752 | | 39.6 | 0.83 | U | 0.83 | 158 | | 2.0 | 0.15 | U | 0.15 | 222 | | 57 | 30.4 | | 0.091 |
| Pothole 7E | J1F179 | 2/10/2011 | 616 | | 39.5 | 0.83 | U | 0.83 | 147 | | 2.0 | 0.15 | U | 0.15 | 221 | | 56.8 | 30.6 | | 0.09 |
| Pothole 7F | J1F180 | 2/10/2011 | 738 | | 37.3 | 0.78 | U | 0.78 | 150 | | 1.9 | 0.15 | U | 0.15 | 233 | | 53.6 | 28.4 | | 0.085 |
| Pothole 6 - concrete pad | J1F1P2 | 2/17/2011 | 1290 | | 38.7 | 0.81 | U | 0.81 | 127 | X | 2.0 | 0.15 | U | 0.15 | 795 | | 55.6 | 42.8 | | 0.089 |
| Pothole 12 - east side | J1FKV5 | 3/16/2011 | 1990 | | 39.8 | 1.5 | | 0.84 | 221 | N | 5.5 | 0.16 | U | 0.16 | 634 | | 57.3 | 39.8 | X | 0.091 |
| Pothole 12 | J1FKV6 | 3/16/2011 | 515 | | 35.6 | 1.8 | | 0.75 | 142 | | 4.9 | 0.14 | U | 0.14 | 204 | | 51.2 | 31.7 | X | 0.082 |
| Pothole 12 | J1FKV7 | 3/16/2011 | 567 | | 38.5 | 0.81 | U | 0.81 | 158 | | 5.3 | 0.15 | U | 0.15 | 177 | | 55.4 | 29.9 | X | 0.088 |
| Pothole 12 | J1FKV8 | 3/16/2011 | 579 | | 39.1 | 0.82 | U | 0.82 | 149 | | 5.4 | 0.15 | U | 0.15 | 195 | | 56.3 | 30.1 | X | 0.09 |
| Pothole 12 -concrete | J1FXF0 | 3/22/2011 | 1680 | | 42.4 | 0.89 | U | 0.89 | 151 | N | 5.9 | 0.17 | U | 0.17 | 725 | | 61 | 41.9 | | 0.097 |

| Sample Location | HEIS Number | Sample Date | Zinc | | | Percent moisture (wet sample) | | |
|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | % | Q | PQL |
| Stockpile-4 | J1CYB7 | 12/15/2010 | 54.1 | X | 0.4 | 9.7 | | 0 |
| Pothole 6A | J1F155 | 2/10/2011 | 36.3 | X | 0.38 | 0.34 | | 0 |
| Pothole 6B | J1F156 | 2/10/2011 | 28.7 | X | 0.35 | 2.5 | | 0 |
| Pothole 6C | J1F157 | 2/10/2011 | 29.1 | X | 0.37 | 1.2 | | 0 |
| Pothole 6D | J1F158 | 2/10/2011 | 27.3 | X | 0.35 | 2.4 | | 0 |
| Pothole 6E | J1F159 | 2/10/2011 | 27.2 | X | 0.41 | 2.5 | | 0 |
| Pothole 6F | J1F160 | 2/10/2011 | 28 | X | 0.38 | 1.7 | | 0 |
| Pothole 7A | J1F175 | 2/10/2011 | 41 | | 0.41 | 7.3 | | 0 |
| Pothole 7B | J1F176 | 2/10/2011 | 39 | | 0.38 | 6.2 | | 0 |
| Pothole 7C | J1F177 | 2/10/2011 | 37.4 | | 0.4 | 4.5 | | 0 |
| Pothole 7D | J1F178 | 2/10/2011 | 28.8 | | 0.38 | 2.4 | | 0 |
| Pothole 7E | J1F179 | 2/10/2011 | 27.9 | | 0.38 | 2.9 | | 0 |
| Pothole 7F | J1F180 | 2/10/2011 | 30.7 | | 0.36 | 2.6 | | 0 |
| Pothole 6 - concrete pad | J1F1P2 | 2/17/2011 | 33.9 | X | 0.38 | 5.3 | | 0 |
| Pothole 12 - east side | J1FKV5 | 3/16/2011 | 64.6 | X | 0.39 | 11.3 | | 0 |
| Pothole 12 | J1FKV6 | 3/16/2011 | 26.9 | X | 0.35 | 4.0 | | 0 |
| Pothole 12 | J1FKV7 | 3/16/2011 | 26 | X | 0.37 | 4.0 | | 0 |
| Pothole 12 | J1FKV8 | 3/16/2011 | 29.4 | X | 0.38 | 3.8 | | 0 |
| Pothole 12 -concrete | J1FXF0 | 3/22/2011 | 73 | XN | 0.41 | 7.9 | M | 0 |

## Table B-2. 100-F-57:1 In-Process Sampling – Metals and Physical Data. (6 Pages)

| Sample Location | HEIS Number | Sample Date | TCLP-Arsenic | | | TCLP-Barium | | | TCLP-Cadmium | | | TCLP-Chromium | | | TCLP-Lead | | | TCLP-Mercury | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/L | Q | PQL | mg/L | Q | PQL | mg/L | Q | PQL | mg/L | Q | PQL | mg/L | Q | PQL | mg/L | Q | PQL |
| Stockpile-4 | J1CYB7 | 12/15/2010 | 0.022 | U | 0.022 | 0.45 | B | 0.002 | 0.002 | U | 0.002 | 0.0062 | B | 0.003 | 0.073 | B | 0.013 | 0.00003 | U | 3E-05 |
| Pothole 12 - east side | J1FKV5 | 3/16/2011 | 0.022 | U | 0.022 | 0.083 | B | 0.002 | 0.002 | U | 0.002 | 0.0032 | B | 0.003 | 0.013 | U | 0.013 | 0.00003 | UN | 3E-05 |
| Pothole 12 | J1FKV6 | 3/16/2011 | 0.022 | U | 0.022 | 0.35 | B | 0.002 | 0.002 | U | 0.002 | 0.003 | U | 0.003 | 0.08 | B | 0.013 | 0.00003 | UN | 3E-05 |
| Pothole 12 | J1FKV7 | 3/16/2011 | 0.022 | U | 0.022 | 0.28 | B | 0.002 | 0.002 | U | 0.002 | 0.003 | U | 0.003 | 0.013 | U | 0.013 | 0.00003 | UN | 3E-05 |
| Pothole 12 | J1FKV8 | 3/16/2011 | 0.022 | U | 0.022 | 0.4 | B | 0.002 | 0.002 | U | 0.002 | 0.003 | U | 0.003 | 0.013 | U | 0.013 | 0.00003 | UN | 3E-05 |
| Pothole 12-concrete | J1FXF0 | 3/22/2011 | 0.022 | U | 0.022 | 1.0 | | 0.002 | 0.002 | U | 0.002 | 0.003 | U | 0.003 | 0.013 | U | 0.013 | 0.00003 | U | 3E-05 |

| Sample Location | HEIS Number | Sample Date | TCLP-Selenium | | | TCLP-Silver | | |
|---|---|---|---|---|---|---|---|---|
| | | | mg/L | Q | PQL | mg/kg | Q | PQL |
| Stockpile-4 | J1CYB7 | 12/15/2010 | 0.024 | U | 0.024 | 0.0059 | B | 0.004 |
| Pothole 12 - east side | J1FKV5 | 3/16/2011 | 0.024 | U | 0.024 | 0.004 | U | 0.004 |
| Pothole 12 | J1FKV6 | 3/16/2011 | 0.024 | U | 0.024 | 0.004 | U | 0.004 |
| Pothole 12 | J1FKV7 | 3/16/2011 | 0.024 | U | 0.024 | 0.004 | U | 0.004 |
| Pothole 12 | J1FKV8 | 3/16/2011 | 0.024 | U | 0.024 | 0.004 | U | 0.004 |
| Pothole 12 -concrete | J1FXF0 | 3/22/2011 | 0.027 | U | 0.024 | 0.004 | U | 0.004 |

**Table B-2. 100-F-57:1 In-Process Sampling – Metals and Physical Data. (6 Pages)**

| Sample Location | HEIS Number | Sample Date | Hexavalent Chromium | | |
|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL |
| Stockpile-4 | J1CYB7 | 12/15/2010 | 0.148 | U | 0.148 |
| Perimeter-3 | J1CYC0 | 12/15/2010 | 0.148 | U | 0.148 |
| Perimeter-4 | J1CYC1 | 12/15/2010 | 0.148 | U | 0.148 |
| Perimeter-5 | J1CYC2 | 12/15/2010 | 0.153 | U | 0.153 |
| Perimeter-6 | J1CYC3 | 12/15/2010 | 0.153 | U | 0.153 |
| Pothole 6A | J1F155 | 2/10/2011 | 0.197 | | 0.154 |
| Pothole 6B | J1F156 | 2/10/2011 | 0.153 | U | 0.153 |
| Pothole 6C | J1F157 | 2/10/2011 | 0.152 | U | 0.152 |
| Pothole 6D | J1F158 | 2/10/2011 | 1.93 | | 0.154 |
| Pothole 6E | J1F159 | 2/10/2011 | 0.154 | U | 0.154 |
| Pothole 6F | J1F160 | 2/10/2011 | 0.153 | U | 0.153 |
| Pothole 7A | J1F175 | 2/10/2011 | 0.155 | U | 0.155 |
| Pothole 7B | J1F176 | 2/10/2011 | 0.155 | U | 0.155 |
| Pothole 7C | J1F177 | 2/10/2011 | 0.154 | U | 0.154 |
| Pothole 7D | J1F178 | 2/10/2011 | 0.154 | U | 0.154 |
| Pothole 7E | J1F179 | 2/10/2011 | 0.155 | U | 0.155 |
| Pothole 7F | J1F180 | 2/10/2011 | 0.155 | U | 0.155 |
| Pothole 6 concrete | J1F1P2 | 2/17/2011 | 2.28 | | 0.149 |
| Pothole 12 - east side | J1FKV5 | 3/16/2011 | 0.155 | U | 0.155 |
| Pothole 12 | J1FKV6 | 3/16/2011 | 0.154 | U | 0.154 |
| Pothole 12 | J1FKV7 | 3/16/2011 | 0.154 | U | 0.154 |
| Pothole 12 | J1FKV8 | 3/16/2011 | 0.155 | U | 0.155 |
| Pothole 12 | J1FXF0 | 3/22/2011 | 1.75 | | 0.153 |
| Location- 1 | J1HHR6 | 4/19/2011 | 0.154 | U | 0.154 |
| Location- 2 | J1HHR7 | 4/19/2011 | 0.153 | U | 0.153 |
| Location- 3 | J1HHR8 | 4/19/2011 | 0.154 | U | 0.154 |
| Location- 4 | J1HHR9 | 4/19/2011 | 0.178 | | 0.154 |
| Location- 5 | J1HHT0 | 4/19/2011 | 0.153 | | 0.153 |
| Location- 6 | J1HHT1 | 4/19/2011 | 0.154 | U | 0.154 |
| Location- 7 | J1HHT2 | 4/19/2011 | 0.155 | U | 0.155 |
| Location- 8 | J1HHT3 | 4/19/2011 | 0.155 | U | 0.155 |
| Location- 9 | J1HHT4 | 4/19/2011 | 0.154 | U | 0.154 |
| Location- 10 | J1HHT5 | 4/19/2011 | 0.154 | U | 0.154 |
| Location- 11 | J1HK70 | 4/25/2011 | 0.986 | | 0.154 |
| Location- 12 | J1HK71 | 4/25/2011 | 1.28 | | 0.155 |

**Table B-2. 100-F-57:1 In-Process Sampling – Metals and Physical Data. (6 Pages)**

| Sample Location | HEIS Number | Sample Date | Hexavalent Chromium | | |
|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL |
| Location- 23 | J1HKR7 | 5/19/2011 | 0.154 | U | 0.154 |
| Location- 24 | J1HKR8 | 5/19/2011 | 0.178 | | 0.154 |
| Location- 25 | J1HKR9 | 5/19/2011 | 0.154 | U | 0.154 |
| Location- 26 | J1HKT0 | 5/19/2011 | 0.155 | U | 0.155 |
| Location- 27 | J1HKT1 | 5/19/2011 | 0.155 | U | 0.155 |
| Location- 28 | J1HKT2 | 5/19/2011 | 0.154 | U | 0.154 |
| Location- 39 | J1JC77 | 5/19/2011 | 0.154 | U | 0.154 |
| Location- 40 | J1JC78 | 5/19/2011 | 0.245 | | 0.155 |
| Location- 41 | J1JC79 | 5/19/2011 | 0.155 | U | 0.155 |
| Location- 42 | J1JC80 | 5/19/2011 | 4.48 | | 0.155 |
| Location- 43 | J1JC81 | 5/19/2011 | 0.276 | | 0.155 |
| Location- 44 | J1JC82 | 5/19/2011 | 0.154 | U | 0.154 |
| Resample Location 1 (42) | J1K4N1 | 7/12/2011 | 0.155 | U | 0.155 |
| Resample Location 2 (42/43) | J1K4V6 | 7/12/2011 | 0.155 | U | 0.155 |
| Resample Location 3 (43) | J1K4V7 | 7/12/2011 | 0.155 | U | 0.155 |
| T6 | J1KRW5 | 8/22/2011 | 0.834 | | 0.155 |
| T5 | J1KRW6 | 8/22/2011 | 1.51 | | 0.155 |
| T4 | J1KRW7 | 8/22/2011 | 0.155 | U | 0.155 |
| T3 | J1KRW8 | 8/22/2011 | 0.435 | | 0.155 |
| T2 | J1KRW9 | 8/22/2011 | 0.155 | U | 0.155 |
| T1 | J1KRX0 | 8/22/2011 | 0.374 | | 0.155 |
| Location 57 | J1KTR6 | 8/25/2011 | 0.155 | U | 0.155 |
| Location 58 | J1KTR7 | 8/25/2011 | 0.492 | | 0.155 |
| Location 59 | J1KTR8 | 8/25/2011 | 0.207 | | 0.155 |
| Location 60 | J1KTR9 | 8/25/2011 | 0.155 | U | 0.155 |
| Location 61 | J1KTT0 | 8/25/2011 | 0.155 | U | 0.155 |
| Location 62 | J1KTT1 | 8/25/2011 | 0.155 | U | 0.155 |
| Location 63 | J1KTT2 | 8/25/2011 | 0.155 | U | 0.155 |

## Table B-3. 100-F-57:1 In-Process Sampling – Organic Data. (2 Pages)

| LOCATION: Stockpile-4 | CLASS | J1CYB7 | | |
|---|---|---|---|---|
| 100-F-57:1 | | 12/15/2010 | | |
| CONSTITUENT | | ug/kg | Q | PQL |
| Aroclor-1016 | PCB | 3 | U | 3 |
| Aroclor-1221 | PCB | 8.7 | U | 8.7 |
| Aroclor-1232 | PCB | 2.2 | U | 2.2 |
| Aroclor-1242 | PCB | 5 | U | 5 |
| Aroclor-1248 | PCB | 5 | U | 5 |
| Aroclor-1254 | PCB | 2.8 | U | 2.8 |
| Aroclor-1260 | PCB | 2.8 | U | 2.8 |
| 1,2,4-Trichlorobenzene | SVOA | 310 | UD | 310 |
| 1,2-Dichlorobenzene | SVOA | 240 | UD | 240 |
| 1,3-Dichlorobenzene | SVOA | 130 | UD | 130 |
| 1,4-Dichlorobenzene | SVOA | 150 | UD | 150 |
| 2,4,5-Trichlorophenol | SVOA | 110 | UD | 110 |
| 2,4,6-Trichlorophenol | SVOA | 110 | UD | 110 |
| 2,4-Dichlorophenol | SVOA | 110 | UD | 110 |
| 2,4-Dimethylphenol | SVOA | 720 | UD | 720 |
| 2,4-Dinitrophenol | SVOA | 3600 | UD | 3600 |
| 2,4-Dinitrotoluene | SVOA | 720 | UD | 720 |
| 2,6-Dinitrotoluene | SVOA | 310 | UD | 310 |
| 2-Chloronaphthalene | SVOA | 110 | UD | 110 |
| 2-Chlorophenol | SVOA | 230 | UD | 230 |
| 2-Methylnaphthalene | SVOA | 210 | UD | 210 |
| 2-Methylphenol (cresol, o-) | SVOA | 140 | UD | 140 |
| 2-Nitroaniline | SVOA | 550 | UD | 550 |
| 2-Nitrophenol | SVOA | 110 | UD | 110 |
| 3+4 Methylphenol (cresol, m+p) | SVOA | 360 | UD | 360 |
| 3,3'-Dichlorobenzidine | SVOA | 980 | UD | 980 |
| 3-Nitroaniline | SVOA | 800 | UD | 800 |
| 4,6-Dinitro-2-methylphenol | SVOA | 3600 | UD | 3600 |
| 4-Bromophenylphenyl ether | SVOA | 210 | UD | 210 |
| 4-Chloro-3-methylphenol | SVOA | 720 | UD | 720 |
| 4-Chloroaniline | SVOA | 900 | UD | 900 |
| 4-Chlorophenylphenyl ether | SVOA | 230 | UD | 230 |
| 4-Nitroaniline | SVOA | 790 | UD | 790 |
| 4-Nitrophenol | SVOA | 1100 | UD | 1100 |
| Acenaphthene | SVOA | 110 | UD | 110 |

## Table B-3. 100-F-57:1 In-Process Sampling – Organic Data. (2 Pages)

| LOCATION: Stockpile-4 | CLASS | J1CYB7 | | |
|---|---|---|---|---|
| 100-F-57:1 | | 12/15/2010 | | |
| CONSTITUENT | | ug/kg | Q | PQL |
| Bis(2-chloro-1-methylethyl)ether | SVOA | 250 | UD | 250 |
| Bis(2-Chloroethoxy)methane | SVOA | 250 | UD | 250 |
| Bis(2-chloroethyl) ether | SVOA | 180 | UD | 180 |
| Bis(2-ethylhexyl) phthalate | SVOA | 500 | UD | 500 |
| Butylbenzylphthalate | SVOA | 470 | UD | 470 |
| Carbazole | SVOA | 390 | UD | 390 |
| Chrysene | SVOA | 300 | UD | 300 |
| Di-n-butylphthalate | SVOA | 320 | UD | 320 |
| Di-n-octylphthalate | SVOA | 160 | UD | 160 |
| Dibenz[a,h]anthracene | SVOA | 210 | UD | 210 |
| Dibenzofuran | SVOA | 220 | UD | 220 |
| Diethyl phthalate | SVOA | 280 | UD | 280 |
| Dimethyl phthalate | SVOA | 250 | UD | 250. |
| Fluoranthene | SVOA | 390 | UD | 390 |
| Fluorene | SVOA | 200 | UD | 200 |
| Hexachlorobenzene | SVOA | 320 | UD | 320 |
| Hexachlorobutadiene | SVOA | 110 | UD | 110 |
| Hexachlorocyclopentadiene | SVOA | 550 | UD | 550 |
| Hexachloroethane | SVOA | 230 | UD | 230 |
| Indeno(1,2,3-cd)pyrene | SVOA | 240 | UD | 240 |
| Isophorone | SVOA | 190 | UD | 190 |
| N-Nitroso-di-n-dipropylamine | SVOA | 340 | UD | 340 |
| N-Nitrosodiphenylamine | SVOA | 230 | UD | 230 |
| Naphthalene | SVOA | 340 | UD | 340 |
| Nitrobenzene | SVOA | 240 | UD | 240 |
| Pentachlorophenol | SVOA | 3600 | UD | 3600 |
| Phenanthrene | SVOA | 190 | UD | 190 |
| Phenol | SVOA | 200 | UD | 200 |
| Pyrene | SVOA | 130 | UD | 130 |

## Table B-4. Pothole 14 In-Process Sampling – Metals and Physical Data - Representative of Overburden Stockpile. (2 Pages)

| Sample Location | Sample Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | | Boron | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| pipe cradle | J16364 | 12/06/07 | 134 | | 1.6 | 1.6 | U | 1.6 | 2.8 | U | 2.8 | 7.7 | | 0.27 | 0.02 | U | 0.02 | 0.49 | | 0.25 |
| equipment blank | J168V4 | 01/21/08 | 46.4 | | 3.6 | 0.27 | U | 0.27 | 0.45 | U | 0.45 | 1.3 | | 0.09 | 0.05 | U | 0.05 | 0.45 | U | 0.45 |
| soil below drainage trench | J168V5 | 01/21/08 | 3420 | | 10.7 | 0.8 | U | 0.8 | 1.3 | U | 1.3 | 27.8 | | 0.27 | 0.21 | | 0.13 | 1.3 | U | 1.3 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 2300 | | 9.9 | 0.74 | U | 0.74 | 1.2 | U | 1.2 | 32.8 | | 0.25 | 0.13 | | 0.12 | 1.2 | U | 1.2 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 10200 | | 11.5 | 1 | | 0.86 | 4.6 | | 1.4 | 140 | C | 0.29 | 0.56 | | 0.14 | 12 | | 1.4 |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | | | | | | | | | | | | | |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | | | | | | | | | | | | | |

| Sample Location | Sample Number | Sample Date | Cadmium | | | Calcium | | | Chromium | | | Cobalt | | | Copper | | | Hexavalent 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 |
| pipe cradle | J16364 | 12/06/07 | 0.49 | U | 0.49 | 722 | C | 1.8 | 3.2 | | 0.4 | 0.35 | U | 0.35 | 1.9 | | 0.2 | | | |
| equipment blank | J168V4 | 01/21/08 | 0.05 | U | 0.05 | 21.3 | C | 3.6 | 0.18 | U | 0.18 | 0.18 | U | 0.18 | 0.18 | U | 0.18 | | | |
| soil below drainage trench | J168V5 | 01/21/08 | 0.13 | U | 0.13 | 5930 | C | 10.7 | 5.4 | | 0.54 | 4.3 | | 0.54 | 9.7 | | 0.54 | 0.2 | U | 0.2 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 0.12 | U | 0.12 | 3700 | C | 9.9 | 3.2 | | 0.49 | 2.4 | | 0.49 | 5 | | 0.49 | 0.32 | | 0.2 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 0.26 | | 0.14 | 90500 | C | 11.5 | 15.7 | | 0.58 | 7 | | 0.58 | 22.6 | | 58 | | | |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | | | | | | | | | | | 1.29 | | 0.35 |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | | | | | | | | | | | 1.97 | | 0.35 |

| Sample Location | Sample Number | Sample Date | Iron | | | Lead | | | Magnesium | | | Manganese | | | Mercury | | | Molybdenum | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Iron | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| pipe cradle | J16364 | 12/06/07 | 287 | C | 0.3 | 17 | | 3.1 | 75.6 | C | 3.2 | 4.6 | | 0.08 | 0.07 | | 0.02 | 0.57 | U | 0.57 |
| equipment blank | J168V4 | 01/21/08 | 97.5 | C | 4.1 | 0.27 | U | 0.27 | 6.4 | | 2.3 | 4.6 | C | 0.04 | 0.01 | U | 0.01 | 0.27 | U | 0.27 |
| soil below drainage trench | J168V5 | 01/21/08 | 8050 | C | 12 | 1.9 | | 0.8 | 2560 | | 6.7 | 180 | C | 0.11 | 0.008 | U | 0.008 | 0.8 | U | 0.8 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 4870 | C | 11.1 | 1.5 | | 0.74 | 1520 | | 6.2 | 105 | C | 0.1 | 0.01 | U | 0.01 | 0.74 | U | 0.74 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 15700 | | 13 | 14 | | 0.86 | 5480 | | 7.2 | 192 | C | 0.12 | 4.68 | | 0.06 | 0.99 | | 0.86 |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | | | | | | | | | | | | | |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | | | | | | | | | | | | | |

Notes:

C = method blank contamination
J = estimate
PQL = practical quantitation limit
Q = qualifier
TDL = target detection limit
U = undetected

## Table B-4. Pothole 14 In-Process Sampling – Metals and Physical Data - Representative of Overburden Stockpile. (2 Pages)

| Sample Location | Sample Number | Sample Date | Nickel | | | Potassium | | | Selenium | | | Silicon | | | Silver | | | Sodium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| pipe cradle | J16364 | 12/06/07 | 1.1 | U | 1.1 | 43.2 | U | 43.2 | 3.6 | U | 3.6 | 158 | | 5.8 | 0.39 | U | 0.39 | 60.2 | C | 1.4 |
| equipment blank | J168V4 | 01/21/08 | 0.18 | U | 0.18 | 30.2 | C | 3.6 | 0.54 | U | 0.54 | 68.3 | | 3.6 | 0.09 | U | 0.09 | 12.1 | C | 1.8 |
| soil below drainage trench | J168V5 | 01/21/08 | 7.4 | | 0.54 | 571 | C | 10.7 | 1.6 | U | 1.6 | 2160 | | 10.7 | 0.27 | U | 0.27 | 134 | C | 5.4 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 4.1 | | 0.49 | 437 | C | 9.9 | 1.5 | U | 1.5 | 1390 | | 9.9 | 0.25 | U | 0.25 | 148 | C | 4.9 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 13.6 | | 0.58 | 1320 | | 11.5 | 1.7 | U | 1.7 | 22300 | | 11.5 | 0.29 | U | 0.29 | 1050 | C | 5.8 |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | | | | | | | | | | | | | |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | | | | | | | | | | | | | |

| Sample Location | Sample Number | Sample Date | Vanadium | | | Zinc | | |
|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL |
| pipe cradle | J16364 | 12/06/07 | 0.94 | | 0.3 | 15.3 | C | 0.15 |
| equipment blank | J168V4 | 01/21/08 | 0.15 | | 0.13 | 0.57 | C | 0.54 |
| soil below drainage trench | J168V5 | 01/21/08 | 16.8 | | 0.37 | 20.5 | C | 1.6 |
| duplicate of J168V5 | J168V6 | 01/21/08 | 10.1 | | 0.34 | 12.9 | C | 1.5 |
| drainage trench scabbled concrete | J168V7 | 01/21/08 | 42.2 | | 0.4 | 101 | | 1.7 |
| drainage trench scabbled concrete | J168V8 | 01/21/08 | | | | | | |
| duplicate of J168V9 | J168V9 | 01/21/08 | | | | | | |

Notes:

C = method blank contamination
J = estimate
PQL = practical quantitation limit
Q = qualifier
TDL = target detection limit
U = undetected

# APPENDIX C

# CALCULATIONS

# 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 files will be stored in a U.S. Department of Energy, Richland Operations Office, repository. The calculations have 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:

*100-F-57:1 Waste Subsite Cleanup Verification 95% UCL Calculation,* 0100F-CA-V0404, Rev. 0, Washington Closure Hanford, Richland, Washington.

*100-F-57:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculation,* 0100F-CA-V0405, Rev. 0, Washington Closure Hanford, Richland, Washington.

**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.

Acrobat 8.0

# CALCULATION COVER SHEET

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

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0404

Subject: 100-F-57:1 Subsite 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<br>Sheets = 10<br>Attm. 1 = 6<br>Total = 17 | N. K. Schiffern<br>N.K. Schiffern | I. B. Berezovskiy<br>IB Berezovskiy | J. D. Skoglie<br>J. D. Skoglie | S. W. Callison<br>SW Callison | 9-12-12 |
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## SUMMARY OF REVISION

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

***Washington Closure Hanford*** **CALCULATION SHEET**

| | | | | | |
|---|---|---|---|---|---|
| **Originator** | N. K. Schiffern | **Date** | 02/27/12 | **Calc. No.** 0100F-CA-V0404 | **Rev. No.** 0 |
| **Project** | 100-F Field Remediation | **Job No.** | 14655 | **Checked** I. B. Berezovskiy | **Date** 02/27/12 |
| **Subject** | 100-F-57:1 Subsite Cleanup Verification 95% UCL Calculations | | | | **Sheet No.** 1 of 10 |

**Summary**

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

**Table of Contents:**
Sheets 1 to 4 - Calculation Sheet Summary
Sheet 5 to 6 - Calculation Sheet Verification Data - Excavation
Sheet 7 to 8 - Ecology Software (MTCAStat) Results
Sheet 9 to 10 - Calculation Sheet Duplicate Analysis
Attachment 1 - 100-F-57:1, Verification Sampling Results (6 sheets)

**Given/References:**
1) Sample Results (Attachment 1).
2) Background values and remedial action goals (RAGs) are taken from DOE-RL (2009b), 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, 2009a, *100 Area Remedial Action Sampling and Analysis Plan* (SAP), DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) DOE-RL, 2009b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
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, 2011, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
10) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," *Washington Administrative Code.*

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

**Calculation Description:**
The subject calculations were performed on statistical data from soil verification samples (Attachment 1) from the 100-F-57:1 subsite. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2009b) is documented by this calculation. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

**Methodology:**
The 100-F-57:1 subsite underwent statistical and focused sampling and has two decision units for verification sampling, consisting of excavation and overburden areas. Twelve statistical samples were collected from the excavation area and 4 composite samples were collected from the overburden area.

Analytical results for all sampling locations are summarized in the tables provided on sheet 3. Further information of the sample data quality is presented in the data quality assessment section of the associated RSVP.

*Washington Closure Hanford* **CALCULATION SHEET**

| | | | | | |
|---|---|---|---|---|---|
| **Originator** | N. K. Schiffern | **Date** | 02/27/12 | **Calc. No.** | 0100F-CA-V0404 **Rev. No.** 0 |
| **Project** | 100-F Field Remediation | **Job No.** | 14655 | **Checked** | I. B. Berezovskiy **Date** 02/27/12 |
| **Subject** | 100-F-57:1 Subsite Cleanup Verification 95% UCL Calculations | | | | **Sheet No.** 2 of 10 |

**Summary (continued)**

**Methodology, continued:**

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

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

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

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

The WAC 173-340-740(7)(e) 3-part test is not performed for COPCs where the statistical value defaults to the maximum value in the data set. Instead, direct comparison of the maximum value against site remedial action goals (RAGs) (within the RSVP) is used as the compliance basis.

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 2-1 of the SAP (DOE-RL 2009a) for certain constituents with cleanup levels. All other constituents will have their own pre-determined TDL's based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

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

***Washington Closure Hanford*** **CALCULATION SHEET**

| | | | | | |
|---|---|---|---|---|---|
| **Originator** N. K. Schiffern | **Date** 02/27/12 | **Calc. No.** 0100F-CA-V0404 | | **Rev. No.** 0 | |
| **Project** 100-F Field Remediation | **Job No.** 14655 | **Checked** I. B. Berezovskiy | | **Date** 02/27/12 | |
| **Subject** 100-F-57:1 Subsite Cleanup Verification 95% UCL Calculations | | | | **Sheet No.** 3 of 10 | |

**Summary (continued)**

**Results:**
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations for the excavation, the overburden, 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 | Maximum Result | Units |
|---|---|---|---|
| Antimony | 0.84 | – | mg/kg |
| Arsenic | 3.5 | – | mg/kg |
| Barium | 63.9 | – | mg/kg |
| Beryllium | 0.46 | – | mg/kg |
| Boron | – | 2.4 | mg/kg |
| Cadmium | 0.11 | – | mg/kg |
| Chromium | 19.8 | – | mg/kg |
| Cobalt | 5.5 | – | mg/kg |
| Copper | 17.2 | – | mg/kg |
| Lead | 27.7 | – | mg/kg |
| Manganese | 265 | – | mg/kg |
| Mercury | 0.29 | – | mg/kg |
| Molybdenum | – | 0.41 | mg/kg |
| Nickel | 13.3 | – | mg/kg |
| Selenium | – | 1.0 | mg/kg |
| Silver | – | 0.17 | mg/kg |
| Vanadium | 41.9 | – | mg/kg |
| Zinc | 40.4 | – | mg/kg |

**WAC 173-340-740(7)(e) Evaluation:**
WAC 173-340 3-Part Test for most stringent RAG:

| | |
|---|---|
| 95% UCL > Cleanup Limit? | YES |
| > 10% above Cleanup Limit? | YES |
| Any sample > 2x Cleanup Limit? | YES |

**Results Summary - Overburden**

| Analyte | Maximum Result | Units |
|---|---|---|
| Antimony | 0.71 | mg/kg |
| Arsenic | 2.8 | mg/kg |
| Barium | 54.8 | mg/kg |
| Beryllium | 0.59 | mg/kg |
| Cadmium | 0.057 | mg/kg |
| Chromium | 11.4 | mg/kg |
| Cobalt | 5.3 | mg/kg |
| Copper | 12.9 | mg/kg |
| Lead | 10.2 | mg/kg |
| Manganese | 260 | mg/kg |
| Mercury | 0.032 | mg/kg |
| Nickel | 10.5 | mg/kg |
| Vanadium | 48.8 | mg/kg |
| Zinc | 36.8 | mg/kg |

– = not applicable
B = blank contamination (inorganic constituents)
DE = direct exposure
GW = groundwater
J = estimate
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
X = > 40% difference between primary and confirmation detector results.

***Washington Closure Hanford*** **CALCULATION SHEET**

| | | | | | |
|---|---|---|---|---|---|
| **Originator** N. K. Schiffern | **Date** 02/27/12 | **Calc. No.** 0100F-CA-V0404 | **Rev. No.** 0 |
| **Project** 100-F Field Remediation | **Job No.** 14655 | **Checked** I. B. Berezovskiy | **Date** 02/27/12 |
| **Subject** 100-F-57:1 Subsite Cleanup Verification 95% UCL Calculations | | | **Sheet No.** 4 of 10 |

**Summary (continued)**

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

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

| Analyte | Duplicate Analysis | |
|---|---|---|
| | Excavation | Overburden |
| Aluminum | 3.7% | 4.4% |
| Barium | 67.6% | 5.1% |
| Calcium | 10.0% | 13.0% |
| Chromium | 19.5% | 8.4% |
| Copper | 4.8% | 3.3% |
| Iron | 3.6% | 6.6% |
| Magnesium | 5.4% | 7.1% |
| Manganese | 5.9% | 2.3% |
| Mercury | 16.7% | |
| Silicon | 21.4% | 2.7% |
| Vanadium | 3.6% | 10.6% |
| Zinc | 1.4% | 3.6% |

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

**CALCULATION SHEET**

*Washington Closure Hanford*

Originator N. K. Schiffern
Project 100-F Field Remediation
Subject 100-F-57:1 Subsite Cleanup Verification 95% UCL Calculations

Date 02/27/12
Job No. 14655

Calc. No. 0100F-CA-V0404
Checked I. B. Berezovskiy

Rev. No. 0
Date 02/27/12
Sheet No. 5 of 10

1 **100-F-57:1 Subsite Statistical Calculations**

2 **Verification Data - Excavation**

| 3 | Sample | Sample | Sample | Antimony | | | Arsenic | | | Barium | | | Beryllium | | | Cadmium | | | Chromium | | | Cobalt | | | Copper | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Area | Number | Date | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| 5 | EX-12 | J1N2M2 | 1/16/2012 | 0.37 | BJ | 0.35 | 2.3 | | 0.61 | 67.3 | | 0.070 | 0.42 | | 0.030 | 0.050 | B | 0.038 | 9.7 | X | 0.053 | 3.9 | X | 0.092 | 12.3 | | 0.20 |
| 6 | EX-12 duplicate | J1N2M3 | 1/16/2012 | 0.59 | J | 0.37 | 2.0 | | 0.64 | 33.3 | | 0.074 | 0.41 | | 0.032 | 0.064 | B | 0.040 | 11.8 | X | 0.056 | 4.1 | X | 0.097 | 12.9 | | 0.21 |
| 7 | EX-1 | J1N2L1 | 1/16/2012 | 0.99 | J | 0.33 | 2.5 | | 0.58 | 68.4 | | 0.067 | 0.68 | | 0.029 | 0.045 | B | 0.036 | 9.9 | X | 0.051 | 6.1 | X | 0.088 | 12.6 | | 0.19 |
| 8 | EX-2 resample | J1N3V0 | 2/1/2012 | 1.4 | | 0.39 | 6.5 | M | 0.68 | 76.5 | | 0.078 | 0.034 | U | 0.034 | 0.13 | B | 0.042 | 11.4 | X | 0.059 | 5.5 | X | 0.10 | 15.1 | X | 0.22 |
| 9 | EX-3 | J1N2L3 | 1/16/2012 | 0.75 | J | 0.35 | 2.8 | | 0.61 | 50.4 | | 0.070 | 0.46 | | 0.031 | 0.057 | B | 0.038 | 11.5 | X | 0.054 | 4.7 | X | 0.093 | 13.3 | | 0.20 |
| 10 | EX-4 | J1N2L4 | 1/16/2012 | 0.83 | J | 0.37 | 2.1 | | 0.65 | 39.8 | | 0.075 | 0.46 | | 0.032 | 0.047 | B | 0.040 | 12.0 | X | 0.057 | 4.5 | X | 0.098 | 13.6 | | 0.21 |
| 11 | EX-5 resample | J1N3V1 | 2/1/2012 | 0.39 | U | 0.39 | 2.3 | | 0.67 | 46.7 | | 0.077 | 0.033 | U | 0.033 | 0.11 | B | 0.042 | 15.2 | X | 0.059 | 5.8 | X | 0.10 | 14.5 | X | 0.22 |
| 12 | EX-6 | J1N2L6 | 1/16/2012 | 0.79 | J | 0.34 | 4.2 | | 0.60 | 87.7 | | 0.069 | 0.62 | | 0.030 | 0.070 | B | 0.037 | 30.1 | X | 0.052 | 5.8 | X | 0.090 | 15.3 | | 0.20 |
| 13 | EX-7 | J1N2L7 | 1/16/2012 | 0.63 | J | 0.38 | 2.6 | | 0.66 | 39.8 | | 0.076 | 0.47 | | 0.033 | 0.055 | B | 0.041 | 12.6 | X | 0.058 | 5.1 | X | 0.10 | 14.3 | | 0.22 |
| 14 | EX-8 resample | J1N3V2 | 2/1/2012 | 0.37 | U | 0.37 | 1.7 | | 0.64 | 38.5 | | 0.074 | 0.032 | U | 0.032 | 0.10 | B | 0.040 | 9.5 | X | 0.056 | 5.2 | X | 0.097 | 13.9 | X | 0.21 |
| 15 | EX-9 | J1N2L9 | 1/16/2012 | 0.69 | J | 0.37 | 2.3 | | 0.64 | 35.1 | | 0.074 | 0.46 | | 0.032 | 0.040 | U | 0.040 | 11.8 | X | 0.056 | 4.5 | X | 0.097 | 14.7 | | 0.21 |
| 16 | EX-10 resample | J1N3V3 | 2/1/2012 | 0.38 | U | 0.38 | 2.4 | | 0.66 | 67.0 | | 0.076 | 0.048 | B | 0.033 | 0.15 | B | 0.041 | 39.4 | X | 0.058 | 5.7 | X | 0.10 | 29.0 | X | 0.22 |
| 17 | EX-11 | J1N2M1 | 1/16/2012 | 0.72 | J | 0.38 | 2.7 | | 0.65 | 41.5 | | 0.075 | 0.43 | | 0.033 | 0.043 | B | 0.041 | 10.5 | X | 0.058 | 4.4 | X | 0.099 | 11.7 | | 0.22 |

18 **Statistical Computation Input Data**

| 19 | Sample | Sample | Sample | Antimony | Arsenic | Barium | Beryllium | Cadmium | Chromium | Cobalt | Copper |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Area | Number | Date | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 21 | EX-12 | J1N2M2/J1N2M3 | 1/16/2012 | 0.48 | 2.2 | 50.3 | 0.42 | 0.057 | 10.8 | 4.0 | 12.6 |
| 22 | EX-1 | J1N2L1 | 1/16/2012 | 0.99 | 2.5 | 68.4 | 0.68 | 0.045 | 9.9 | 6.1 | 12.6 |
| 23 | EX-2 resample | J1N3V0 | 2/1/2012 | 1.4 | 6.5 | 76.5 | 0.017 | 0.13 | 11.4 | 5.5 | 15.1 |
| 24 | EX-3 | J1N2L3 | 1/16/2012 | 0.75 | 2.8 | 50.4 | 0.46 | 0.057 | 11.5 | 4.7 | 13.3 |
| 25 | EX-4 | J1N2L4 | 1/16/2012 | 0.83 | 2.1 | 39.8 | 0.46 | 0.047 | 12.0 | 4.5 | 13.6 |
| 26 | EX-5 resample | J1N3V1 | 2/1/2012 | 0.20 | 2.3 | 46.7 | 0.017 | 0.11 | 15.2 | 5.8 | 14.5 |
| 27 | EX-6 | J1N2L6 | 1/16/2012 | 0.79 | 4.2 | 87.7 | 0.62 | 0.070 | 30.1 | 5.8 | 15.3 |
| 28 | EX-7 | J1N2L7 | 1/16/2012 | 0.63 | 2.6 | 39.8 | 0.47 | 0.055 | 12.6 | 5.1 | 14.3 |
| 29 | EX-8 resample | J1N3V2 | 2/1/2012 | 0.19 | 1.7 | 38.5 | 0.016 | 0.10 | 9.5 | 5.2 | 13.9 |
| 30 | EX-9 | J1N2L9 | 1/16/2012 | 0.69 | 2.3 | 35.1 | 0.46 | 0.020 | 11.8 | 4.5 | 14.7 |
| 31 | EX-10 resample | J1N3V3 | 2/1/2012 | 0.19 | 2.4 | 67.0 | 0.048 | 0.15 | 39.4 | 5.7 | 29.0 |
| 32 | EX-11 | J1N2M1 | 1/16/2012 | 0.72 | 2.7 | 41.5 | 0.43 | 0.043 | 10.5 | 4.4 | 11.7 |

33 **Statistical Computations**

| 34 | | Antimony | Arsenic | Barium | Beryllium | Cadmium | Chromium | Cobalt | Copper |
|---|---|---|---|---|---|---|---|---|---|
| 35 | 95% UCL based on | Large data set (n ≥10), use MTCAStat normal distribution. | Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥10), use MTCAStat lognormal distribution. | Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥10), use MTCAStat lognormal distribution. | Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥10), use MTCAStat lognormal distribution. | Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic. |
| 36 | N | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| 37 | % < Detection limit | 25% | 0% | 0% | 25% | 8% | 0% | 0% | 0% |
| 38 | Mean | 0.65 | 2.9 | 53.5 | 0.34 | 0.074 | 15.4 | 5.1 | 15.1 |
| 39 | Standard deviation | 0.36 | 1.3 | 17.2 | 0.25 | 0.040 | 9.4 | 0.68 | 4.5 |
| 40 | 95% UCL on mean | 0.84 | 3.5 | 63.9 | 0.46 | 0.11 | 19.8 | 5.5 | 17.2 |
| 41 | Maximum value | 1.4 | 6.5 | 87.7 | 0.68 | 0.15 | 39.4 | 6.1 | 29.0 |
| 42 | **Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)** | 5 GW & River Protection | 20 DE, GW & River Protection | 200 GW Protection | 1.51 GW & River Protection | 0.81 GW & River Protection | 18.5 GW & River Protection | 15.7 GW Protection | 22.0 River Protection |
| 43 | **WAC 173-340 3-PART TEST** | | | | | | | | |
| 44 | 95% UCL > Cleanup Limit? | NA | NO | NA | NA | NA | YES | NA | NO |
| 45 | > 10% above Cleanup Limit? | NA | NO | NA | NA | NA | YES | NA | NO |
| 46 | Any sample > 2X Cleanup Limit? | NA | NO | NA | NA | NA | YES | NA | NO |
| 47 | **WAC 173-340 Compliance?** | Because all values are below background (5 mg/kg) the WAC 173-340 3-part test is not required. | The data set meets the 3-part test criteria when compared to the most stringent RAG. | Because all values are below background (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. | A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG. | Because all values are below background (15.7 mg/kg) the WAC 173-340 3-part test is not required. | The data set meets the 3-part test criteria when compared to the most stringent RAG. |

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CALCULATION SHEET

***Washington Closure Hanford***

**Originator** N. K. Schiffern
**Project** 100-F Field Remediation
**Subject** 100-F-57:1 Subsite Cleanup Verification 95% UCL Calculations

**Date** 02/27/12
**Job No.** 14655

**Calc. No.** 0100F-CA-V0404
**Checked** I. B. Berezovskiy

**Rev. No.** 0
**Date** 02/27/12
**Sheet No.** 6 of 10

1 **100-F-57:1 Subsite Statistical Calculations**

2 **Verification Data - Excavation**

| 3 | Sample | Sample | Sample | Lead | | | Manganese | | | Mercury | | | Nickel | | | Vanadium | | | Zinc | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Area | Number | Date | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| 5 | EX-12 | J1N2M2 | 1/16/2012 | 2.7 | | 0.25 | 215 | X | 0.092 | 1.1 | | 0.050 | 9.1 | X | 0.11 | 35.4 | | 0.086 | 29.2 | X | 0.37 |
| 6 | EX-12 duplicate | J1N2M3 | 1/16/2012 | 2.9 | | 0.26 | 228 | X | 0.097 | 1.3 | | 0.059 | 11.0 | X | 0.12 | 36.7 | | 0.091 | 29.6 | X | 0.39 |
| 7 | EX-1 | J1N2L1 | 1/16/2012 | 4.2 | | 0.24 | 317 | X | 0.088 | 0.011 | B | 0.0062 | 11.0 | X | 0.11 | 52.5 | | 0.082 | 40.1 | X | 0.35 |
| 8 | EX-2 resample | J1N3V0 | 2/1/2012 | 11.3 | | 0.28 | 219 | | 0.10 | 0.023 | | 0.0069 | 10.1 | | 0.13 | 36.2 | | 0.096 | 53.9 | | 0.41 |
| 9 | EX-3 | J1N2L3 | 1/16/2012 | 4.5 | | 0.25 | 244 | X | 0.093 | 0.0079 | B | 0.0052 | 11.0 | X | 0.11 | 38.8 | | 0.087 | 32.9 | X | 0.37 |
| 10 | EX-4 | J1N2L4 | 1/16/2012 | 4.1 | | 0.26 | 253 | X | 0.098 | 0.014 | B | 0.0049 | 11.0 | X | 0.12 | 41.3 | | 0.092 | 32.8 | X | 0.39 |
| 11 | EX-5 resample | J1N3V1 | 2/1/2012 | 4.8 | | 0.27 | 263 | | 0.10 | 0.018 | B | 0.0069 | 11.3 | | 0.12 | 37.3 | | 0.095 | 31.6 | | 0.40 |
| 12 | EX-6 | J1N2L6 | 1/16/2012 | 88.8 | | 0.24 | 308 | X | 0.090 | 0.037 | | 0.0047 | 12.7 | X | 0.11 | 42.8 | | 0.085 | 46.8 | X | 0.36 |
| 13 | EX-7 | J1N2L7 | 1/16/2012 | 4.3 | | 0.27 | 238 | X | 0.10 | 0.041 | | 0.0058 | 21.5 | X | 0.12 | 41.1 | | 0.094 | 40.7 | X | 0.40 |
| 14 | EX-8 resample | J1N3V2 | 2/1/2012 | 2.9 | | 0.26 | 215 | | 0.097 | 0.0053 | U | 0.0053 | 10 | | 0.12 | 34.9 | | 0.091 | 27.5 | | 0.39 |
| 15 | EX-9 | J1N2L9 | 1/16/2012 | 3.1 | | 0.26 | 237 | X | 0.097 | 0.011 | B | 0.0065 | 10.8 | X | 0.12 | 41.8 | | 0.091 | 30.3 | X | 0.38 |
| 16 | EX-10 resample | J1N3V3 | 2/1/2012 | 46.6 | | 0.27 | 245 | | 0.10 | 0.084 | | 0.0061 | 11.6 | | 0.12 | 35.7 | | 0.094 | 34.6 | | 0.40 |
| 17 | EX-11 | J1N2M1 | 1/16/2012 | 5.4 | | 0.27 | 240 | X | 0.099 | 0.033 | | 0.0065 | 10.8 | X | 0.12 | 35.8 | | 0.093 | 33.2 | X | 0.39 |

18 **Statistical Computation Input Data**

| 19 | Sample | Sample | Sample | Lead | Manganese | Mercury | Nickel | Vanadium | Zinc |
|---|---|---|---|---|---|---|---|---|---|
| 20 | Area | Number | Date | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 21 | EX-12 | J1N2M2/J1N2M3 | 1/16/2012 | 2.8 | 222 | 1.2 | 10.1 | 36.1 | 29.4 |
| 22 | EX-1 | J1N2L1 | 1/16/2012 | 4.2 | 317 | 0.011 | 11.0 | 52.5 | 40.1 |
| 23 | EX-2 resample | J1N3V0 | 2/1/2012 | 11.3 | 219 | 0.023 | 10.1 | 36.2 | 53.9 |
| 24 | EX-3 | J1N2L3 | 1/16/2012 | 4.5 | 244 | 0.0079 | 11.0 | 38.8 | 32.9 |
| 25 | EX-4 | J1N2L4 | 1/16/2012 | 4.1 | 253 | 0.014 | 11.0 | 41.3 | 32.8 |
| 26 | EX-5 resample | J1N3V1 | 2/1/2012 | 4.8 | 263 | 0.018 | 11.3 | 37.3 | 31.6 |
| 27 | EX-6 | J1N2L6 | 1/16/2012 | 88.8 | 308 | 0.037 | 12.7 | 42.8 | 46.8 |
| 28 | EX-7 | J1N2L7 | 1/16/2012 | 4.3 | 238 | 0.041 | 21.5 | 41.1 | 40.7 |
| 29 | EX-8 resample | J1N3V2 | 2/1/2012 | 2.9 | 215 | 0.0027 | 10 | 34.9 | 27.5 |
| 30 | EX-9 | J1N2L9 | 1/16/2012 | 3.1 | 237 | 0.011 | 10.8 | 41.8 | 30.3 |
| 31 | EX-10 resample | J1N3V3 | 2/1/2012 | 46.6 | 245 | 0.084 | 11.6 | 35.7 | 34.6 |
| 32 | EX-11 | J1N2M1 | 1/16/2012 | 5.4 | 240 | 0.033 | 10.8 | 35.8 | 33.2 |

33 **Statistical Computations**

| 34 | | Lead | Manganese | Mercury | Nickel | Vanadium | Zinc |
|---|---|---|---|---|---|---|---|
| 35 | 95% UCL based on | Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥10), use MTCAStat lognormal distribution. |
| 36 | N | 12 | 12 | 12 | 12 | 12 | 12 |
| 37 | % < Detection limit | 0% | 0% | 8% | 0% | 0% | 0% |
| 38 | Mean | 15.2 | 250 | 0.12 | 11.8 | 39.5 | 36.2 |
| 39 | Standard deviation | 26.2 | 32.3 | 0.34 | 3.1 | 4.9 | 7.8 |
| 40 | 95% UCL on mean | 27.7 | 265 | 0.29 | 13.3 | 41.9 | 40.4 |
| 41 | Maximum value | 88.8 | 317 | 1.3 | 21.5 | 52.5 | 53.9 |
| 42 | **Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)** | 10.2 GW & River Protection | 512 GW Protection | 0.33 GW & River Protection | 19.1 GW Protection | 85.1 GW Protection | 67.8 River Protection |
| 43 | **WAC 173-340 3-PART TEST** | | | | | | |
| 44 | 95% UCL > Cleanup Limit? | YES | NA | NO | NO | NO | NA |
| 45 | > 10% above Cleanup Limit? | YES | NA | NO | NO | NO | NA |
| 46 | Any sample > 2X Cleanup Limit? | YES | NA | YES | NO | NO | NA |
| 47 | **WAC 173-340 Compliance?** | A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG. | Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required. | A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG. | The data set meets the 3-part test criteria when compared to the most stringent RAG. | 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. |

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Sheet No. 7 of 10

**Ecology Software (MTCAStat) Results, 100-F-57:1 Subsite Excavation**

**Antimony 95% UCL Calculation**

| DATA | ID |
|---|---|
| 0.48 | J1N2M2/J1N2M3 |
| 0.99 | J1N2L1 |
| 1.4 | J1N3V0 |
| 0.75 | J1N2L3 |
| 0.83 | J1N2L4 |
| 0.20 | J1N3V1 |
| 0.79 | J1N2L6 |
| 0.63 | J1N2L7 |
| 0.19 | J1N3V2 |
| 0.69 | J1N2L9 |
| 0.19 | J1N3V3 |
| 0.72 | J1N2M1 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 0.65 |
| Censored | | Lognormal mean | 0.69 |
| Detection limit or PQL | | Std. devn. | 0.36 |
| Method detection limit | | Median | 0.71 |
| TOTAL | 12 | Min. | 0.19 |
| | | Max. | 1.4 |

Lognormal distribution? r-squared is: 0.859
Normal distribution? r-squared is: 0.924
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.84

**Arsenic 95% UCL Calculation**

| DATA | ID |
|---|---|
| 2.2 | J1N2M2/J1N2M3 |
| 2.5 | J1N2L1 |
| 6.5 | J1N3V0 |
| 2.8 | J1N2L3 |
| 2.1 | J1N2L4 |
| 2.3 | J1N3V1 |
| 4.2 | J1N2L6 |
| 2.6 | J1N2L7 |
| 1.7 | J1N3V2 |
| 2.3 | J1N2L9 |
| 2.4 | J1N3V3 |
| 2.7 | J1N2M1 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 2.9 |
| Censored | | Lognormal mean | 2.8 |
| Detection limit or PQL | | Std. devn. | 1.3 |
| Method detection limit | | Median | 2.5 |
| TOTAL | 12 | Min. | 1.7 |
| | | Max. | 6.5 |

Lognormal distribution? r-squared is: 0.807
Normal distribution? r-squared is: 0.664
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 3.5

**Barium 95% UCL Calculation**

| DATA | ID |
|---|---|
| 50.3 | J1N2M2/J1N2M3 |
| 68.4 | J1N2L1 |
| 76.5 | J1N3V0 |
| 50.4 | J1N2L3 |
| 39.8 | J1N2L4 |
| 46.7 | J1N3V1 |
| 87.7 | J1N2L6 |
| 39.8 | J1N2L7 |
| 38.5 | J1N3V2 |
| 35.1 | J1N2L9 |
| 67.0 | J1N3V3 |
| 41.5 | J1N2M1 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 53.5 |
| Censored | | Lognormal mean | 53.6 |
| Detection limit or PQL | | Std. devn. | 17.2 |
| Method detection limit | | Median | 48.5 |
| TOTAL | 12 | Min. | 35.1 |
| | | Max. | 87.7 |

Lognormal distribution? r-squared is: 0.925
Normal distribution? r-squared is: 0.887
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 63.9

**Beryllium 95% UCL Calculation**

| DATA | ID |
|---|---|
| 0.42 | J1N2M2/J1N2M3 |
| 0.68 | J1N2L1 |
| 0.017 | J1N3V0 |
| 0.46 | J1N2L3 |
| 0.46 | J1N2L4 |
| 0.017 | J1N3V1 |
| 0.62 | J1N2L6 |
| 0.47 | J1N2L7 |
| 0.016 | J1N3V2 |
| 0.46 | J1N2L9 |
| 0.048 | J1N3V3 |
| 0.43 | J1N2M1 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 0.34 |
| Censored | | Lognormal mean | 0.60 |
| Detection limit or PQL | | Std. devn. | 0.25 |
| Method detection limit | | Median | 0.45 |
| TOTAL | 12 | Min. | 0.016 |
| | | Max. | 0.68 |

Lognormal distribution? r-squared is: 0.735
Normal distribution? r-squared is: 0.842
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 0.46

**Cadmium 95% UCL Calculation**

| DATA | ID |
|---|---|
| 0.057 | J1N2M2/J1N2M3 |
| 0.045 | J1N2L1 |
| 0.13 | J1N3V0 |
| 0.057 | J1N2L3 |
| 0.047 | J1N2L4 |
| 0.11 | J1N3V1 |
| 0.070 | J1N2L6 |
| 0.055 | J1N2L7 |
| 0.10 | J1N3V2 |
| 0.020 | J1N2L9 |
| 0.15 | J1N3V3 |
| 0.043 | J1N2M1 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 0.074 |
| Censored | | Lognormal mean | 0.075 |
| Detection limit or PQL | | Std. devn. | 0.040 |
| Method detection limit | | Median | 0.057 |
| TOTAL | 12 | Min. | 0.020 |
| | | Max. | 0.15 |

Lognormal distribution? r-squared is: 0.943
Normal distribution? r-squared is: 0.910
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.11

**Chromium 95% UCL Calculation**

| DATA | ID |
|---|---|
| 10.8 | J1N2M2/J1N2M3 |
| 9.9 | J1N2L1 |
| 11.4 | J1N3V0 |
| 11.5 | J1N2L3 |
| 12.0 | J1N2L4 |
| 15.2 | J1N3V1 |
| 30.1 | J1N2L6 |
| 12.6 | J1N2L7 |
| 9.5 | J1N3V2 |
| 11.8 | J1N2L9 |
| 39.4 | J1N3V3 |
| 10.5 | J1N2M1 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 15.4 |
| Censored | | Lognormal mean | 15.2 |
| Detection limit or PQL | | Std. devn. | 9.4 |
| Method detection limit | | Median | 11.7 |
| TOTAL | 12 | Min. | 9.5 |
| | | Max. | 39.4 |

Lognormal distribution? r-squared is: 0.714
Normal distribution? r-squared is: 0.611
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 19.8

**Cobalt 95% UCL Calculation**

| DATA | ID |
|---|---|
| 4.0 | J1N2M2/J1N2M3 |
| 6.1 | J1N2L1 |
| 5.5 | J1N3V0 |
| 4.7 | J1N2L3 |
| 4.5 | J1N2L4 |
| 5.8 | J1N3V1 |
| 5.8 | J1N2L6 |
| 5.1 | J1N2L7 |
| 5.2 | J1N3V2 |
| 4.5 | J1N2L9 |
| 5.7 | J1N3V3 |
| 4.4 | J1N2M1 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 5.1 |
| Censored | | Lognormal mean | 5.1 |
| Detection limit or PQL | | Std. devn. | 0.68 |
| Method detection limit | | Median | 5.2 |
| TOTAL | 12 | Min. | 4.0 |
| | | Max. | 6.1 |

Lognormal distribution? r-squared is: 0.951
Normal distribution? r-squared is: 0.955
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 5.5

**Copper 95% UCL Calculation**

| DATA | ID |
|---|---|
| 12.6 | J1N2M2/J1N2M3 |
| 12.6 | J1N2L1 |
| 15.1 | J1N3V0 |
| 13.3 | J1N2L3 |
| 13.6 | J1N2L4 |
| 14.5 | J1N3V1 |
| 15.3 | J1N2L6 |
| 14.3 | J1N2L7 |
| 13.9 | J1N3V2 |
| 14.7 | J1N2L9 |
| 29.0 | J1N3V3 |
| 11.7 | J1N2M1 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 15.1 |
| Censored | | Lognormal mean | 15.0 |
| Detection limit or PQL | | Std. devn. | 4.5 |
| Method detection limit | | Median | 14.1 |
| TOTAL | 12 | Min. | 11.7 |
| | | Max. | 29.0 |

Lognormal distribution? r-squared is: 0.640
Normal distribution? r-squared is: 0.530
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 17.2

**Lead 95% UCL Calculation**

| DATA | ID |
|---|---|
| 2.8 | J1N2M2/J1N2M3 |
| 4.2 | J1N2L1 |
| 11.3 | J1N3V0 |
| 4.5 | J1N2L3 |
| 4.1 | J1N2L4 |
| 4.8 | J1N3V1 |
| 88.8 | J1N2L6 |
| 4.3 | J1N2L7 |
| 2.9 | J1N3V2 |
| 3.1 | J1N2L9 |
| 46.6 | J1N3V3 |
| 5.4 | J1N2M1 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 15.2 |
| Censored | | Lognormal mean | 12.7 |
| Detection limit or PQL | | Std. devn. | 26.2 |
| Method detection limit | | Median | 4.4 |
| TOTAL | 12 | Min. | 2.8 |
| | | Max. | 88.8 |

Lognormal distribution? r-squared is: 0.732
Normal distribution? r-squared is: 0.519
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 27.7

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Date 02/27/12
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Rev. No. 0
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Sheet No. 8 of 10

**Ecology Software (MTCAStat) Results, 100-F-57:1 Subsite Excavation**

| | DATA | ID | Manganese 95% UCL Calculation | | | DATA | ID | Mercury 95% UCL Calculation | | | DATA | ID | Nickel 95% UCL Calculation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DATA | ID | Manganese 95% UCL Calculation | | | DATA | ID | Mercury 95% UCL Calculation | | | DATA | ID | Nickel 95% UCL Calculation | | |
| 2 | 222 | J1N2M2/J1N2M3 | | | | 1.2 | J1N2M2/J1N2M3 | | | | 10.1 | J1N2M2/J1N2M3 | | | |
| 3 | 317 | J1N2L1 | | | | 0.011 | J1N2L1 | | | | 11.0 | J1N2L1 | | | |
| 4 | 219 | J1N3V0 | Number of samples | Uncensored values | | 0.023 | J1N3V0 | Number of samples | Uncensored values | | 10.1 | J1N3V0 | Number of samples | Uncensored values | |
| 5 | 244 | J1N2L3 | Uncensored 12 | Mean | 250 | 0.0079 | J1N2L3 | Uncensored 12 | Mean | 0.12 | 11.0 | J1N2L3 | Uncensored 12 | Mean | 11.8 |
| 6 | 253 | J1N2L4 | Censored | Lognormal mean | 250 | 0.014 | J1N2L4 | Censored | Lognormal mean | 0.080 | 11.0 | J1N2L4 | Censored | Lognormal mean | 11.8 |
| 7 | 263 | J1N3V1 | Detection limit or PQL | Std. devn. | 32.3 | 0.018 | J1N3V1 | Detection limit or PQL | Std. devn. | 0.34 | 11.3 | J1N3V1 | Detection limit or PQL | Std. devn. | 3.1 |
| 8 | 308 | J1N2L6 | Method detection limit | Median | 242 | 0.037 | J1N2L6 | Method detection limit | Median | 0.021 | 12.7 | J1N2L6 | Method detection limit | Median | 11.0 |
| 9 | 238 | J1N2L7 | TOTAL 12 | Min. | 215 | 0.041 | J1N2L7 | TOTAL 12 | Min. | 0.0027 | 21.5 | J1N2L7 | TOTAL 12 | Min. | 10 |
| 10 | 215 | J1N3V2 | | Max. | 317 | 0.0027 | J1N3V2 | | Max. | 1.2 | 10 | J1N3V2 | | Max. | 21.5 |
| 11 | 237 | J1N2L9 | | | | 0.011 | J1N2L9 | | | | 10.8 | J1N2L9 | | | |
| 12 | 245 | J1N3V3 | | | | 0.084 | J1N3V3 | | | | 11.6 | J1N3V3 | | | |
| 13 | 240 | J1N2M1 | | | | 0.033 | J1N2M1 | | | | 10.8 | J1N2M1 | | | |
| 14 | | | | | | | | | | | | | | | |
| 15 | | | Lognormal distribution? | Normal distribution? | | | | Lognormal distribution? | Normal distribution? | | | | Lognormal distribution? | Normal distribution? | |
| 16 | | | r-squared is: 0.879 | r-squared is: 0.846 | | | | r-squared is: 0.863 | r-squared is: 0.347 | | | | r-squared is: 0.588 | r-squared is: 0.507 | |
| 17 | | | Recommendations: | | | | | Recommendations: | | | | | Recommendations: | | |
| 18 | | | Reject BOTH lognormal and normal distributions | | | | | Reject BOTH lognormal and normal distributions | | | | | Reject BOTH lognormal and normal distributions | | |
| 19 | | | | | | | | | | | | | | | |
| 20 | | | UCL (based on Z-statistic) is | 265 | | | | UCL (based on Z-statistic) is | 0.29 | | | | UCL (based on Z-statistic) is | 13.3 | |
| 21 | | | | | | | | | | | | | | | |
| 22 | DATA | ID | Vanadium 95% UCL Calculation | | | DATA | ID | Zinc 95% UCL Calculation | | | | | | | |
| 23 | 36.1 | J1N2M2/J1N2M3 | | | | 29.4 | J1N2M2/J1N2M3 | | | | | | | | |
| 24 | 52.5 | J1N2L1 | | | | 40.1 | J1N2L1 | | | | | | | | |
| 25 | 36.2 | J1N3V0 | Number of samples | Uncensored values | | 53.9 | J1N3V0 | Number of samples | Uncensored values | | | | | | |
| 26 | 38.8 | J1N2L3 | Uncensored 12 | Mean | 39.5 | 32.9 | J1N2L3 | Uncensored 12 | Mean | 36.2 | | | | | |
| 27 | 41.3 | J1N2L4 | Censored | Lognormal mean | 39.5 | 32.8 | J1N2L4 | Censored | Lognormal mean | 36.2 | | | | | |
| 28 | 37.3 | J1N3V1 | Detection limit or PQL | Std. devn. | 4.9 | 31.6 | J1N3V1 | Detection limit or PQL | Std. devn. | 7.8 | | | | | |
| 29 | 42.8 | J1N2L6 | Method detection limit | Median | 38.1 | 46.8 | J1N2L6 | Method detection limit | Median | 33.1 | | | | | |
| 30 | 41.1 | J1N2L7 | TOTAL 12 | Min. | 34.9 | 40.7 | J1N2L7 | TOTAL 12 | Min. | 27.5 | | | | | |
| 31 | 34.9 | J1N3V2 | | Max. | 52.5 | 27.5 | J1N3V2 | | Max. | 53.9 | | | | | |
| 32 | 41.8 | J1N2L9 | | | | 30.3 | J1N2L9 | | | | | | | | |
| 33 | 35.7 | J1N3V3 | | | | 34.6 | J1N3V3 | | | | | | | | |
| 34 | 35.8 | J1N2M1 | | | | 33.2 | J1N2M1 | | | | | | | | |
| 35 | | | | | | | | | | | | | | | |
| 36 | | | Lognormal distribution? | Normal distribution? | | | | Lognormal distribution? | Normal distribution? | | | | | | |
| 37 | | | r-squared is: 0.839 | r-squared is: 0.796 | | | | r-squared is: 0.916 | r-squared is: 0.868 | | | | | | |
| 38 | | | Recommendations: | | | | | Recommendations: | | | | | | | |
| 39 | | | Reject BOTH lognormal and normal distributions | | | | | Use lognormal distribution. | | | | | | | |
| 40 | | | | | | | | | | | | | | | |
| 41 | | | UCL (based on Z-statistic) is | 41.9 | | | | UCL (Land's method) is | 40.4 | | | | | | |
| 42 | | | | | | | | | | | | | | | |

**CALCULATION SHEET**

***Washington Closure Hanford***

**Originator** N. K. Schiffern
**Project** 100-F Field Remediation
**Subject** 100-F-57:1 Subsite Cleanup Verification 95% UCL Calculations

**Date** 02/27/12
**Job No.** 14655

**Calc. No.** 0100F-CA-V0404
**Checked** I. B. Berezovskiy

**Rev. No.** 0
**Date** 02/27/12
**Sheet No.** 9 of 10

**Duplicate Analysis - 100-F-57:1 Subsite Excavation**

| Sampling Area | Sample Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | | Cadmium | | | Calcium | | | Chromium | | | Cobalt | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EX-12 | J1N2M2 | 1/16/2012 | 6070 | | 1.4 | 0.37 | BJ | 0.35 | 2.3 | | 0.61 | 67.3 | | 0.070 | 0.42 | | 0.030 | 0.050 | B | 0.038 | 4760 | X | 13.0 | 9.7 | X | 0.053 | 3.9 | X | 0.092 |
| EX-12 duplicate | J1N2M3 | 1/16/2012 | 6300 | | 1.5 | 0.59 | J | 0.37 | 2.0 | | 0.64 | 33.3 | | 0.074 | 0.41 | | 0.032 | 0.064 | B | 0.040 | 5260 | X | 13.7 | 11.8 | X | 0.056 | 4.1 | X | 0.097 |

**Analysis:**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TDL | | 5 | 0.6 | 10 | 2 | 0.2 | 0.2 | 100 | 1 | 2 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) | No-Stop (acceptable) | No-Stop (acceptable) | Yes (calc RPD) | No-Stop (acceptable) | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) | No-Stop (acceptable) |
| | RPD | 3.7% | | | 67.6% | | | 10.0% | 19.5% | |
| | Difference > 2 TDL? | Not applicable | No - acceptable | No - acceptable | Not applicable | No - acceptable | No - acceptable | Not applicable | Not applicable | No - acceptable |

**Duplicate Analysis - 100-F-57:1 Subsite Excavation**

| Sampling Area | Sample Number | Sample Date | Copper | | | Iron | | | Lead | | | Magnesium | | | Manganese | | | Mercury | | | Nickel | | | Potassium | | | Silicon | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EX-12 | J1N2M2 | 1/16/2012 | 12.3 | | 0.20 | 13700 | X | 3.5 | 2.7 | | 0.25 | 3810 | X | 3.4 | 215 | X | 0.092 | 1.1 | | 0.050 | 9.1 | X | 0.11 | 663 | | 37.7 | 225 | XJ | 5.2 |
| EX-12 duplicate | J1N2M3 | 1/16/2012 | 12.9 | | 0.21 | 14200 | X | 3.7 | 2.9 | | 0.26 | 4020 | X | 3.6 | 228 | X | 0.097 | 1.3 | | 0.059 | 11.0 | X | 0.12 | 708 | | 39.7 | 279 | XJ | 5.5 |

**Analysis:**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TDL | | 1 | 5 | 5 | 75 | 5 | 0.2 | 4 | 400 | 2 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) | Yes (calc RPD) | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) | Yes (calc RPD) | No-Stop (acceptable) | No-Stop (acceptable) | Yes (calc RPD) |
| | RPD | 4.8% | 3.6% | | 5.4% | 5.9% | 16.7% | | | 21.4% |
| | Difference > 2 TDL? | Not applicable | Not applicable | No - acceptable | Not applicable | Not applicable | Not applicable | No - acceptable | No - acceptable | Not applicable |

**Duplicate Analysis - 100-F-57:1 Subsite Excavation**

| Sampling Area | Sample Number | Sample Date | Sodium | | | Vanadium | | | Zinc | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EX-12 | J1N2M2 | 1/16/2012 | 208 | | 54.2 | 35.4 | | 0.086 | 29.2 | X | 0.37 |
| EX-12 duplicate | J1N2M3 | 1/16/2012 | 207 | | 57.1 | 36.7 | | 0.091 | 29.6 | X | 0.39 |

**Analysis:**

| | | | | |
|---|---|---|---|---|
| TDL | | 50 | 2.5 | 1 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) |
| | RPD | | 3.6% | 1.4% |
| | Difference > 2 TDL? | No - acceptable | Not applicable | Not applicable |

**CALCULATION SHEET**

***Washington Closure Hanford***

**Originator** N. K. Schiffern
**Project** 100-F Field Remediation
**Subject** 100-F-57:1 Subsite Cleanup Verification 95% UCL Calculations

**Date** 02/27/12
**Job No.** 14655

**Calc. No.** 0100F-CA-V0404
**Checked** I. B. Berezovskiy

**Rev. No.** 0
**Date** 02/27/12
**Sheet No.** 10 of 10

**Duplicate Analysis - 100-F-57:1 Subsite Overburden**

| Sampling Area | Sample Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | | Cadmium | | | Calcium | | | Chromium | | | Cobalt | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| OB-4 | J1N2M7 | 1/16/2012 | 6710 | | 1.4 | 0.71 | J | 0.35 | 2.6 | | 0.60 | 52.1 | | 0.070 | 0.54 | | 0.030 | 0.057 | B | 0.037 | 5420 | X | 12.9 | 9.1 | X | 0.053 | 5.0 | X | 0.091 |
| OB-4 duplicate | J1N2M8 | 1/16/2012 | 7010 | | 1.5 | 0.69 | J | 0.36 | 2.2 | | 0.63 | 54.8 | | 0.073 | 0.59 | | 0.032 | 0.053 | B | 0.039 | 4760 | X | 13.5 | 9.9 | X | 0.056 | 5.3 | X | 0.096 |

**Analysis:**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TDL | | 5 | 0.6 | 10 | 2 | 0.2 | 0.2 | 100 | 1 | 2 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) | No-Stop (acceptable) | No-Stop (acceptable) | Yes (calc RPD) | No-Stop (acceptable) | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) | No-Stop (acceptable) |
| | RPD | 4.4% | | | 5.1% | | | 13.0% | 8.4% | |
| | Difference > 2 TDL? | Not applicable | No - acceptable | No - acceptable | Not applicable | No - acceptable | No - acceptable | Not applicable | Not applicable | No - acceptable |

**Duplicate Analysis - 100-F-57:1 Subsite Overburden**

| Sampling Area | Sample Number | Sample Date | Copper | | | Iron | | | Lead | | | Magnesium | | | Manganese | | | Mercury | | | Nickel | | | Potassium | | | Silicon | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| OB-4 | J1N2M7 | 1/16/2012 | 12.0 | | 0.20 | 17500 | X | 3.5 | 6.7 | | 0.25 | 3830 | X | 3.4 | 254 | X | 0.091 | 0.032 | | 0.0061 | 10 | X | 0.11 | 1000 | | 37.5 | 372 | XJ | 5.2 |
| OB-4 duplicate | J1N2M8 | 1/16/2012 | 12.4 | | 0.21 | 18700 | X | 3.6 | 5.0 | | 0.26 | 4110 | X | 3.6 | 260 | X | 0.096 | 0.013 | B | 0.0061 | 10.5 | X | 0.12 | 1130 | | 39.4 | 382 | XJ | 5.4 |

**Analysis:**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TDL | | 1 | 5 | 5 | 75 | 5 | 0.2 | 4 | 400 | 2 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | Yes (calc RPD) | Yes (calc RPD) | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) | No-Stop (acceptable) | No-Stop (acceptable) | No-Stop (acceptable) | Yes (calc RPD) |
| | RPD | 3.3% | 6.6% | | 7.1% | 2.3% | | | | 2.7% |
| | Difference > 2 TDL? | Not applicable | Not applicable | No - acceptable | Not applicable | Not applicable | No - acceptable | No - acceptable | No - acceptable | Not applicable |

**Duplicate Analysis - 100-F-57:1 Subsite Overburden**

| Sampling Area | Sample Number | Sample Date | Sodium | | | Vanadium | | | Zinc | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| OB-4 | J1N2M7 | 1/16/2012 | 219 | | 54.0 | 43.9 | | 0.086 | 35.5 | X | 0.36 |
| OB-4 duplicate | J1N2M8 | 1/16/2012 | 239 | | 56.6 | 48.8 | | 0.090 | 36.8 | X | 0.38 |

**Analysis:**

| | | | | |
|---|---|---|---|---|
| TDL | | 50 | 2.5 | 1 |
| Duplicate Analysis | Both > PQL? | Yes (continue) | Yes (continue) | Yes (continue) |
| | Both >5xTDL? | No-Stop (acceptable) | Yes (calc RPD) | Yes (calc RPD) |
| | RPD | | 10.6% | 3.6% |
| | Difference > 2 TDL? | No - acceptable | Not applicable | Not applicable |

**Attachment 1. 100-F-57:1 Subsite Verification Sample Results (Metals).**

| SAMPLE LOCATION | HEIS Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | | Boron | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EX-12 | J1N2M2 | 1/16/2012 | 6070 | | 1.4 | 0.37 | BJ | 0.35 | 2.3 | | 0.61 | 67.3 | | 0.070 | 0.42 | | 0.030 | 0.90 | U | 0.90 |
| EX-12 duplicate | J1N2M3 | 1/16/2012 | 6300 | | 1.5 | 0.59 | J | 0.37 | 2.0 | | 0.64 | 33.3 | | 0.074 | 0.41 | | 0.032 | 0.95 | U | 0.95 |
| EX-1 | J1N2L1 | 1/16/2012 | 8400 | | 1.4 | 0.99 | J | 0.33 | 2.5 | | 0.58 | 68.4 | | 0.067 | 0.68 | | 0.029 | 1.0 | B | 0.86 |
| EX-2 | J1N2L2 | 1/16/2012 | 7430 | | 1.4 | 0.75 | J | 0.35 | 3.4 | | 0.61 | 91.3 | | 0.070 | 0.46 | | 0.030 | 1.8 | | 0.90 |
| EX-2 resample[a] | J1N3V0 | 2/1/2012 | 6580 | | 1.6 | 1.4 | | 0.39 | 6.5 | M | 0.68 | 76.5 | | 0.078 | 0.034 | U | 0.034 | 2.4 | | 1.0 |
| EX-3 | J1N2L3 | 1/16/2012 | 6930 | | 1.4 | 0.75 | J | 0.35 | 2.8 | | 0.61 | 50.4 | | 0.070 | 0.46 | | 0.031 | 0.91 | U | 0.91 |
| EX-4 | J1N2L4 | 1/16/2012 | 6650 | | 1.5 | 0.83 | J | 0.37 | 2.1 | | 0.65 | 39.8 | | 0.075 | 0.46 | | 0.032 | 0.96 | U | 0.96 |
| EX-5 | J1N2L5 | 1/16/2012 | 7770 | | 1.6 | 11.9 | J | 0.39 | 15.6 | | 0.67 | 109 | | 0.077 | 0.74 | | 0.034 | 8.9 | | 0.99 |
| EX-5 resample[a] | J1N3V1 | 2/1/2012 | 5870 | | 1.6 | 0.39 | U | 0.39 | 2.3 | | 0.67 | 46.7 | | 0.077 | 0.033 | U | 0.033 | 1.1 | B | 0.99 |
| EX-6 | J1N2L6 | 1/16/2012 | 9840 | | 1.4 | 0.79 | J | 0.34 | 4.2 | | 0.60 | 87.7 | | 0.069 | 0.62 | | 0.030 | 2.1 | | 0.88 |
| EX-7 | J1N2L7 | 1/16/2012 | 6670 | | 1.5 | 0.63 | J | 0.38 | 2.6 | | 0.66 | 39.8 | | 0.076 | 0.47 | | 0.033 | 0.98 | U | 0.98 |
| EX-8 | J1N2L8 | 1/16/2012 | 6950 | | 1.4 | 0.73 | J | 0.34 | 3.6 | | 0.59 | 56.7 | | 0.068 | 0.53 | | 0.029 | 2.5 | | 0.87 |
| EX-8 resample[a] | J1N3V2 | 2/1/2012 | 5160 | | 1.5 | 0.37 | U | 0.37 | 1.7 | | 0.64 | 38.5 | | 0.074 | 0.032 | U | 0.032 | 0.95 | U | 0.95 |
| EX-9 | J1N2L9 | 1/16/2012 | 6530 | | 1.5 | 0.69 | J | 0.37 | 2.3 | | 0.64 | 35.1 | | 0.074 | 0.46 | | 0.032 | 0.95 | U | 0.95 |
| EX-10 | J1N2M0 | 1/16/2012 | 6450 | | 1.5 | 8.5 | J | 0.38 | 14.7 | | 0.66 | 62.2 | | 0.076 | 0.54 | | 0.033 | 4.4 | | 0.98 |
| EX-10 resample[a] | J1N3V3 | 2/1/2012 | 6130 | | 1.6 | 0.38 | U | 0.38 | 2.4 | | 0.66 | 67.0 | | 0.076 | 0.048 | B | 0.033 | 1.4 | B | 0.98 |
| EX-11 | J1N2M1 | 1/16/2012 | 6280 | | 1.5 | 0.72 | J | 0.38 | 2.7 | | 0.65 | 41.5 | | 0.075 | 0.43 | | 0.033 | 0.97 | U | 0.97 |
| OB-4 | J1N2M7 | 1/16/2012 | 6710 | | 1.4 | 0.71 | J | 0.35 | 2.6 | | 0.60 | 52.1 | | 0.070 | 0.54 | | 0.030 | 0.90 | U | 0.90 |
| OB-4 duplicate | J1N2M8 | 1/16/2012 | 7010 | | 1.5 | 0.69 | J | 0.36 | 2.2 | | 0.63 | 54.8 | | 0.073 | 0.59 | | 0.032 | 0.94 | U | 0.94 |
| OB-1 | J1N2M4 | 1/16/2012 | 5750 | | 1.4 | 0.35 | BJ | 0.33 | 2.0 | | 0.58 | 35.9 | | 0.067 | 0.37 | | 0.029 | 0.86 | U | 0.86 |
| OB-2 | J1N2M5 | 1/16/2012 | 6740 | | 1.3 | 0.52 | J | 0.33 | 2.1 | | 0.57 | 40.8 | | 0.066 | 0.44 | | 0.029 | 0.85 | U | 0.85 |
| OB-3 | J1N2M6 | 1/16/2012 | 7030 | | 1.5 | 0.40 | BJ | 0.36 | 2.8 | | 0.63 | 45.7 | | 0.073 | 0.46 | | 0.031 | 0.93 | U | 0.93 |
| Equipment Blank | J1N2M9 | 1/16/2012 | 171 | | 1.3 | 0.32 | UJ | 0.32 | 0.56 | U | 0.56 | 3.5 | | 0.065 | 0.045 | B | 0.028 | 0.84 | U | 0.84 |

[a] Due to RAG exceedances and presence of asbestos, further remediation was performed and resamples were taken.

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

Gray cells indicate not applicable.

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

B = Estimated result. Result is less than the RL, but greater than MDL

C= Analyzed for but not detected.

HEIS = Hanford Environmental Information System

J = Estimate (organic) = blank contamination (inorganic)

M = Sample duplicate precision not met.

N = presumptive evidence of a compound.

ND = none detect

PQL = Practical quantitation limit

Q = Qualifier

TRA = <1%

U = Analyzed for but not detected.

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

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 1 of 6 |
| Originator | N. K. Schiffern | Date | 3/1/12 |
| Checked | I. B. Berezovskiy | Date | 3/1/12 |
| Calc. No. | 0100F-CA-V0404 | Rev. No. | 0 |

**Attachment 1. 100-F-57:1 Subsite Verification Sample Results (Metals).**

| SAMPLE LOCATION | HEIS Number | Sample Date | Cadmium | | | Calcium | | | Chromium | | | Cobalt | | | Copper | | | Hexavalent 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 |
| EX-12 | J1N2M2 | 1/16/2012 | 0.050 | B | 0.038 | 4760 | X | 13.0 | 9.7 | X | 0.053 | 3.9 | X | 0.092 | 12.3 | | 0.20 | 0.155 | U | 0.155 |
| EX-12 duplicate | J1N2M3 | 1/16/2012 | 0.064 | B | 0.040 | 5260 | X | 13.7 | 11.8 | X | 0.056 | 4.1 | X | 0.097 | 12.9 | | 0.21 | 0.155 | U | 0.155 |
| EX-1 | J1N2L1 | 1/16/2012 | 0.045 | B | 0.036 | 4310 | X | 12.3 | 9.9 | X | 0.051 | 6.1 | X | 0.088 | 12.6 | | 0.19 | 0.155 | U | 0.155 |
| EX-2 | J1N2L2 | 1/16/2012 | 0.15 | B | 0.038 | 19200 | X | 13.0 | 14.9 | X | 0.053 | 4.5 | X | 0.092 | 14.5 | | 0.20 | 0.455 | | 0.155 |
| EX-2 resample[a] | J1N3V0 | 2/1/2012 | 0.13 | B | 0.042 | 23800 | | 14.4 | 11.4 | X | 0.059 | 5.5 | X | 0.10 | 15.1 | X | 0.22 | 0.155 | U | 0.155 |
| EX-3 | J1N2L3 | 1/16/2012 | 0.057 | B | 0.038 | 6540 | X | 13.1 | 11.5 | X | 0.054 | 4.7 | X | 0.093 | 13.3 | | 0.20 | 0.155 | U | 0.155 |
| EX-4 | J1N2L4 | 1/16/2012 | 0.047 | B | 0.040 | 6560 | X | 13.8 | 12.0 | X | 0.057 | 4.5 | X | 0.098 | 13.6 | | 0.21 | 0.155 | U | 0.155 |
| EX-5 | J1N2L5 | 1/16/2012 | 0.65 | | 0.042 | 14500 | X | 14.3 | 1020 | X | 0.059 | 9.8 | X | 0.10 | 94.8 | | 0.22 | 4.23 | | 0.155 |
| EX-5 resample[a] | J1N3V1 | 2/1/2012 | 0.11 | B | 0.042 | 9180 | | 14.3 | 15.2 | X | 0.059 | 5.8 | X | 0.10 | 14.5 | X | 0.22 | 0.155 | U | 0.155 |
| EX-6 | J1N2L6 | 1/16/2012 | 0.070 | B | 0.037 | 13700 | X | 12.7 | 30.1 | X | 0.052 | 5.8 | X | 0.090 | 15.3 | | 0.20 | 0.155 | U | 0.155 |
| EX-7 | J1N2L7 | 1/16/2012 | 0.055 | B | 0.041 | 5760 | X | 14.1 | 12.6 | X | 0.058 | 5.1 | X | 0.10 | 14.3 | | 0.22 | 0.155 | U | 0.155 |
| EX-8 | J1N2L8 | 1/16/2012 | 0.11 | B | 0.037 | 18400 | X | 12.6 | 67.9 | X | 0.052 | 4.6 | X | 0.089 | 13.8 | | 0.19 | 0.440 | | 0.155 |
| EX-8 resample[a] | J1N3V2 | 2/1/2012 | 0.10 | B | 0.040 | 5120 | | 13.7 | 9.5 | X | 0.056 | 5.2 | X | 0.097 | 13.9 | X | 0.21 | 0.155 | U | 0.155 |
| EX-9 | J1N2L9 | 1/16/2012 | 0.040 | U | 0.040 | 3970 | X | 13.6 | 11.8 | X | 0.056 | 4.5 | X | 0.097 | 14.7 | | 0.21 | 0.155 | U | 0.155 |
| EX-10 | J1N2M0 | 1/16/2012 | 0.52 | | 0.041 | 16100 | X | 14.1 | 946 | X | 0.058 | 7.8 | X | 0.10 | 56.7 | | 0.22 | 3.74 | | 0.155 |
| EX-10 resample[a] | J1N3V3 | 2/1/2012 | 0.15 | B | 0.041 | 9090 | | 14.2 | 39.4 | X | 0.058 | 5.7 | X | 0.10 | 29.0 | X | 0.22 | 0.155 | U | 0.155 |
| EX-11 | J1N2M1 | 1/16/2012 | 0.043 | B | 0.041 | 6060 | X | 14.0 | 10.5 | X | 0.058 | 4.4 | X | 0.099 | 11.7 | | 0.22 | 0.155 | U | 0.155 |
| OB-4 | J1N2M7 | 1/16/2012 | 0.057 | B | 0.037 | 5420 | X | 12.9 | 9.1 | X | 0.053 | 5.0 | X | 0.091 | 12.0 | | 0.20 | 0.155 | U | 0.155 |
| OB-4 duplicate | J1N2M8 | 1/16/2012 | 0.053 | B | 0.039 | 4760 | X | 13.5 | 9.9 | X | 0.056 | 5.3 | X | 0.096 | 12.4 | | 0.21 | 0.155 | U | 0.155 |
| OB-1 | J1N2M4 | 1/16/2012 | 0.040 | B | 0.036 | 6160 | X | 12.4 | 9.1 | X | 0.051 | 4.0 | X | 0.088 | 11.3 | | 0.19 | 0.155 | U | 0.155 |
| OB-2 | J1N2M5 | 1/16/2012 | 0.044 | B | 0.036 | 4470 | X | 12.3 | 10.5 | X | 0.050 | 4.8 | X | 0.087 | 12.5 | | 0.19 | 0.155 | U | 0.155 |
| OB-3 | J1N2M6 | 1/16/2012 | 0.053 | B | 0.039 | 5510 | X | 13.5 | 11.4 | X | 0.055 | 4.8 | X | 0.095 | 12.9 | | 0.21 | 0.155 | U | 0.155 |
| Equipment Blank | J1N2M9 | 1/16/2012 | 0.035 | U | 0.035 | 47.8 | X | 12.1 | 0.11 | BX | 0.050 | 0.14 | BX | 0.086 | 0.44 | B | 0.19 | 0.155 | U | 0.155 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 2 of 6 |
| Originator | N. K. Schiffern | Date | 3/1/12 |
| Checked | I. B. Berezovskiy | Date | 3/1/12 |
| Calc. No. | 0100F-CA-V0404 | Rev. No. | 0 |

**Attachment 1. 100-F-57:1 Subsite Verification Sample Results (Metals).**

| SAMPLE LOCATION | HEIS Number | Sample Date | Iron | | | Lead | | | Magnesium | | | Manganese | | | Mercury | | | Molybdenum | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EX-12 | J1N2M2 | 1/16/2012 | 13700 | X | 3.5 | 2.7 | | 0.25 | 3810 | X | 3.4 | 215 | X | 0.092 | 1.1 | | 0.050 | 0.24 | U | 0.24 |
| EX-12 duplicate | J1N2M3 | 1/16/2012 | 14200 | X | 3.7 | 2.9 | | 0.26 | 4020 | X | 3.6 | 228 | X | 0.097 | 1.3 | | 0.059 | 0.25 | U | 0.25 |
| EX-1 | J1N2L1 | 1/16/2012 | 21400 | X | 3.3 | 4.2 | | 0.24 | 4090 | X | 3.2 | 317 | X | 0.088 | 0.011 | B | 0.0062 | 0.28 | B | 0.23 |
| EX-2 | J1N2L2 | 1/16/2012 | 16200 | X | 3.5 | 32.7 | | 0.25 | 4340 | X | 3.4 | 229 | X | 0.092 | 0.098 | | 0.0059 | 0.40 | B | 0.24 |
| EX-2 resample[a] | J1N3V0 | 2/1/2012 | 14400 | | 3.9 | 11.3 | | 0.28 | 3770 | | 3.8 | 219 | | 0.10 | 0.023 | | 0.0069 | 0.35 | B | 0.27 |
| EX-3 | J1N2L3 | 1/16/2012 | 15500 | X | 3.5 | 4.5 | | 0.25 | 3860 | X | 3.4 | 244 | X | 0.093 | 0.0079 | B | 0.0052 | 0.24 | U | 0.24 |
| EX-4 | J1N2L4 | 1/16/2012 | 16400 | X | 3.7 | 4.1 | | 0.26 | 4060 | X | 3.6 | 253 | X | 0.098 | 0.014 | B | 0.0049 | 0.26 | U | 0.26 |
| EX-5 | J1N2E5 | 1/16/2012 | 85300 | X | 3.9 | 613 | | 0.27 | 3850 | X | 3.8 | 459 | X | 0.10 | 3.0 | | 0.062 | 17.5 | | 0.26 |
| EX-5 resample[a] | J1N3V1 | 2/1/2012 | 15700 | | 3.9 | 4.8 | | 0.27 | 4090 | | 3.8 | 263 | | 0.10 | 0.018 | B | 0.0069 | 0.41 | B | 0.26 |
| EX-6 | J1N2L6 | 1/16/2012 | 21000 | X | 3.4 | 88.8 | | 0.24 | 4310 | X | 3.3 | 308 | X | 0.090 | 0.037 | | 0.0047 | 0.32 | B | 0.23 |
| EX-7 | J1N2L7 | 1/16/2012 | 16100 | X | 3.8 | 4.3 | | 0.27 | 4410 | X | 3.7 | 238 | X | 0.10 | 0.041 | | 0.0058 | 0.26 | U | 0.26 |
| EX-8 | J1N2L8 | 1/16/2012 | 19800 | X | 3.4 | 42.0 | | 0.24 | 6060 | X | 3.3 | 267 | X | 0.089 | 0.43 | | 0.0064 | 0.37 | B | 0.23 |
| EX-8 resample[a] | J1N3V2 | 2/1/2012 | 13900 | | 3.7 | 2.9 | | 0.26 | 3780 | | 3.6 | 215 | | 0.097 | 0.0053 | U | 0.0053 | 0.25 | U | 0.25 |
| EX-9 | J1N2L9 | 1/16/2012 | 15800 | X | 3.7 | 3.1 | | 0.26 | 4110 | X | 3.6 | 237 | X | 0.097 | 0.011 | B | 0.0065 | 0.25 | U | 0.25 |
| EX-10 | J1N2M0 | 1/16/2012 | 79000 | X | 3.8 | 201 | | 0.27 | 3800 | X | 3.7 | 455 | X | 0.10 | 0.90 | | 0.0071 | 4.7 | | 0.26 |
| EX-10 resample[a] | J1N3V3 | 2/1/2012 | 17400 | | 3.8 | 46.6 | | 0.27 | 3960 | | 3.7 | 245 | | 0.10 | 0.084 | | 0.0061 | 0.38 | B | 0.26 |
| EX-11 | J1N2M1 | 1/16/2012 | 14800 | X | 3.8 | 5.4 | | 0.27 | 3880 | X | 3.7 | 240 | X | 0.099 | 0.033 | | 0.0065 | 0.26 | U | 0.26 |
| OB-4 | J1N2M7 | 1/16/2012 | 17500 | X | 3.5 | 6.7 | | 0.25 | 3830 | X | 3.4 | 254 | X | 0.091 | 0.032 | | 0.0061 | 0.24 | U | 0.24 |
| OB-4 duplicate | J1N2M8 | 1/16/2012 | 18700 | X | 3.6 | 5.0 | | 0.26 | 4110 | X | 3.6 | 260 | X | 0.096 | 0.013 | B | 0.0061 | 0.25 | U | 0.25 |
| OB-1 | J1N2M4 | 1/16/2012 | 12800 | X | 3.3 | 2.7 | | 0.24 | 3750 | X | 3.3 | 226 | X | 0.088 | 0.0071 | B | 0.0053 | 0.23 | U | 0.23 |
| OB-2 | J1N2M5 | 1/16/2012 | 15300 | X | 3.3 | 4.6 | | 0.23 | 3990 | X | 3.2 | 245 | X | 0.087 | 0.010 | B | 0.0065 | 0.23 | U | 0.23 |
| OB-3 | J1N2M6 | 1/16/2012 | 16000 | X | 3.6 | 10.2 | | 0.26 | 4080 | X | 3.5 | 249 | X | 0.095 | 0.010 | B | 0.0063 | 0.25 | U | 0.25 |
| Equipment Blank | J1N2M9 | 1/16/2012 | 1850 | X | 3.2 | 0.77 | | 0.23 | 26.6 | X | 3.2 | 108 | X | 0.086 | 0.0050 | U | 0.0050 | 0.22 | U | 0.22 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 3 of 6 |
| Originator | N. K. Schiffern | Date | 3/1/12 |
| Checked | I. B. Berezovskiy | Date | 3/1/12 |
| Calc. No. | 0100F-CA-V0404 | Rev. No. | 0 |

Attachment 1. 100-F-57:1 Subsite Verification Sample Results (Metals).

| SAMPLE LOCATION | HEIS Number | Sample Date | Nickel | | | Potassium | | | Selenium | | | Silicon | | | Silver | | | Sodium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EX-12 | J1N2M2 | 1/16/2012 | 9.1 | X | 0.11 | 663 | | 37.7 | 0.79 | U | 0.79 | 225 | XJ | 5.2 | 0.15 | U | 0.15 | 208 | | 54.2 |
| EX-12 duplicate | J1N2M3 | 1/16/2012 | 11.0 | X | 0.12 | 708 | | 39.7 | 0.83 | U | 0.83 | 279 | XJ | 5.5 | 0.15 | U | 0.15 | 207 | | 57.1 |
| EX-1 | J1N2L1 | 1/16/2012 | 11.0 | X | 0.11 | 1400 | | 35.9 | 0.85 | B | 0.75 | 493 | XNJ | 5.0 | 0.14 | U | 0.14 | 268 | | 51.7 |
| EX-2 | J1N2L2 | 1/16/2012 | 11.0 | X | 0.11 | 1300 | | 37.7 | 0.79 | U | 0.79 | 460 | XJ | 5.2 | 0.15 | U | 0.15 | 586 | | 54.2 |
| EX-2 resample[a] | J1N3V0 | 2/1/2012 | 10.1 | | 0.13 | 1330 | | 41.9 | 0.88 | U | 0.88 | 121 | | 5.8 | 0.16 | U | 0.16 | 527 | | 60.4 |
| EX-3 | J1N2L3 | 1/16/2012 | 11.0 | X | 0.11 | 950 | | 38.0 | 0.80 | U | 0.80 | 457 | XJ | 5.2 | 0.15 | U | 0.15 | 276 | | 54.7 |
| EX-4 | J1N2L4 | 1/16/2012 | 11.0 | X | 0.12 | 818 | | 40.2 | 0.84 | U | 0.84 | 363 | XJ | 5.6 | 0.16 | U | 0.16 | 280 | | 57.9 |
| EX-5 | J1N2L5 | 1/16/2012 | 42.4 | X | 0.12 | 1110 | | 41.6 | 0.87 | U | 0.87 | 364 | XJ | 5.7 | 0.25 | | 0.16 | 471 | | 59.9 |
| EX-5 resample[a] | J1N3V1 | 2/1/2012 | 11.3 | | 0.12 | 914 | | 41.6 | 0.87 | U | 0.87 | 286 | | 5.7 | 0.17 | B | 0.16 | 309 | | 59.8 |
| EX-6 | J1N2L6 | 1/16/2012 | 12.7 | X | 0.11 | 1900 | | 37.0 | 1.0 | | 0.78 | 705 | XJ | 5.1 | 0.14 | U | 0.14 | 764 | | 53.3 |
| EX-7 | J1N2L7 | 1/16/2012 | 21.5 | X | 0.12 | 818 | | 40.9 | 0.86 | U | 0.86 | 338 | XJ | 5.7 | 0.16 | U | 0.16 | 401 | | 58.9 |
| EX-8 | J1N2L8 | 1/16/2012 | 10.3 | X | 0.11 | 1040 | | 36.6 | 0.77 | U | 0.77 | 339 | XJ | 5.1 | 0.14 | U | 0.14 | 392 | | 52.7 |
| EX-8 resample[a] | J1N3V2 | 2/1/2012 | 10 | | 0.12 | 671 | | 39.9 | 0.84 | U | 0.84 | 178 | | 5.5 | 0.16 | U | 0.16 | 211 | | 57.4 |
| EX-9 | J1N2L9 | 1/16/2012 | 10.8 | X | 0.12 | 786 | | 39.7 | 0.83 | U | 0.83 | 271 | XJ | 5.5 | 0.15 | U | 0.15 | 213 | | 57.1 |
| EX-10 | J1N2M0 | 1/16/2012 | 27.2 | X | 0.12 | 907 | | 40.9 | 1.0 | | 0.86 | 434 | XJ | 5.7 | 0.16 | U | 0.16 | 369 | | 58.9 |
| EX-10 resample[a] | J1N3V3 | 2/1/2012 | 11.6 | | 0.12 | 1000 | | 41.2 | 0.86 | U | 0.86 | 264 | | 5.7 | 0.16 | U | 0.16 | 277 | | 59.2 |
| EX-11 | J1N2M1 | 1/16/2012 | 10.8 | X | 0.12 | 853 | | 40.7 | 0.85 | U | 0.85 | 417 | XJ | 5.6 | 0.16 | U | 0.16 | 277 | | 58.5 |
| OB-4 | J1N2M7 | 1/16/2012 | 10 | X | 0.11 | 1000 | | 37.5 | 0.79 | U | 0.79 | 372 | XJ | 5.2 | 0.15 | U | 0.15 | 219 | | 54.0 |
| OB-4 duplicate | J1N2M8 | 1/16/2012 | 10.5 | X | 0.12 | 1130 | | 39.4 | 0.83 | U | 0.83 | 382 | XJ | 5.4 | 0.15 | U | 0.15 | 239 | | 56.6 |
| OB-1 | J1N2M4 | 1/16/2012 | 8.9 | X | 0.11 | 622 | | 36.1 | 0.76 | U | 0.76 | 269 | XJ | 5.0 | 0.14 | U | 0.14 | 183 | | 51.9 |
| OB-2 | J1N2M5 | 1/16/2012 | 10.3 | X | 0.11 | 774 | | 35.7 | 0.75 | U | 0.75 | 343 | XJ | 4.9 | 0.14 | U | 0.14 | 205 | | 51.3 |
| OB-3 | J1N2M6 | 1/16/2012 | 10.0 | X | 0.12 | 921 | | 39.1 | 0.82 | U | 0.82 | 326 | XJ | 5.4 | 0.15 | U | 0.15 | 191 | | 56.3 |
| Equipment Blank | J1N2M9 | 1/16/2012 | 0.34 | BX | 0.11 | 49.0 | B | 35.1 | 0.74 | U | 0.74 | 117 | XJ | 4.8 | 0.14 | U | 0.14 | 50.5 | U | 50.5 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 4 of 6 |
| Originator | N. K. Schiffern | Date | 3/1/12 |
| Checked | I. B. Berezovskiy | Date | 3/1/12 |
| Calc. No. | 0100F-CA-V0404 | Rev. No. | 0 |

Attachment 1. 100-F-57:1 Subsite Verification Sample Results (Metals and Physical).

| SAMPLE LOCATION | HEIS Number | Sample Date | Vanadium | | | Zinc | | | Percent moisture (wet sample) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | % | Q | PQL |
| EX-12 | J1N2M2 | 1/16/2012 | 35.4 | | 0.086 | 29.2 | X | 0.37 | 1.1 | | 0.10 |
| EX-12 duplicate | J1N2M3 | 1/16/2012 | 36.7 | | 0.091 | 29.6 | X | 0.39 | 1.6 | | 0.10 |
| EX-1 | J1N2L1 | 1/16/2012 | 52.5 | | 0.082 | 40.1 | X | 0.35 | 2.4 | | 0.10 |
| EX-2 | J1N2L2 | 1/16/2012 | 38.6 | | 0.086 | 71.0 | X | 0.37 | 2.9 | | 0.10 |
| EX-2 resample[a] | J1N3V0 | 2/1/2012 | 36.2 | | 0.096 | 53.9 | | 0.41 | 12.7 | | 0.10 |
| EX-3 | J1N2L3 | 1/16/2012 | 38.8 | | 0.087 | 32.9 | X | 0.37 | 1.9 | | 0.10 |
| EX-4 | J1N2L4 | 1/16/2012 | 41.3 | | 0.092 | 32.8 | X | 0.39 | 2.0 | | 0.10 |
| EX-5 | J1N2L5 | 1/16/2012 | 53.9 | | 0.095 | 208 | X | 0.40 | 4.4 | | 0.10 |
| EX-5 resample[a] | J1N3V1 | 2/1/2012 | 37.3 | | 0.095 | 31.6 | | 0.40 | 9.5 | | 0.10 |
| EX-6 | J1N2L6 | 1/16/2012 | 42.8 | | 0.085 | 46.8 | X | 0.36 | 2.0 | | 0.10 |
| EX-7 | J1N2L7 | 1/16/2012 | 41.1 | | 0.094 | 40.7 | X | 0.40 | 2.8 | | 0.10 |
| EX-8 | J1N2L8 | 1/16/2012 | 43.0 | | 0.084 | 53.9 | X | 0.36 | 1.8 | | 0.10 |
| EX-8 resample[a] | J1N3V2 | 2/1/2012 | 34.9 | | 0.091 | 27.5 | | 0.39 | 5.7 | | 0.10 |
| EX-9 | J1N2L9 | 1/16/2012 | 41.8 | | 0.091 | 30.3 | X | 0.38 | 1.5 | | 0.10 |
| EX-10 | J1N2M0 | 1/16/2012 | 46.8 | | 0.094 | 142 | X | 0.40 | 4.6 | | 0.10 |
| EX-10 resample[a] | J1N3V3 | 2/1/2012 | 35.7 | | 0.094 | 34.6 | | 0.40 | 9.5 | | 0.10 |
| EX-11 | J1N2M1 | 1/16/2012 | 35.8 | | 0.093 | 33.2 | X | 0.39 | 1.2 | | 0.10 |
| OB-4 | J1N2M7 | 1/16/2012 | 43.9 | | 0.086 | 35.5 | X | 0.36 | 2.4 | | 0.10 |
| OB-4 duplicate | J1N2M8 | 1/16/2012 | 48.8 | | 0.090 | 36.8 | X | 0.38 | 2.6 | | 0.10 |
| OB-1 | J1N2M4 | 1/16/2012 | 31.6 | | 0.083 | 27.7 | X | 0.35 | 1.2 | | 0.10 |
| OB-2 | J1N2M5 | 1/16/2012 | 38.6 | | 0.082 | 30.9 | X | 0.35 | 1.8 | | 0.10 |
| OB-3 | J1N2M6 | 1/16/2012 | 38.5 | | 0.090 | 35.6 | X | 0.38 | 2.0 | | 0.10 |
| Equipment Blank | J1N2M9 | 1/16/2012 | 2.3 | | 0.080 | 1.6 | X | 0.34 | 0.10 | U | 0.10 |

| SAMPLE LOCATION | HEIS Number | Sample Date | Mercury - TCLP | | | Arsenic - TCLP | | | Barium - TCLP | | | Cadmium - TCLP | | | Chromium - TCLP | | | Lead - TCLP | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/L | Q | PQL | mg/L | Q | PQL | mg/L | Q | PQL | mg/L | Q | PQL | mg/L | Q | PQL | mg/L | Q | PQL |
| EX-5 | J1N2L5 | 1/16/2012 | 0.000048 | B | 0.000030 | 0.022 | U | 0.022 | 0.57 | B | 0.0020 | 0.0062 | BCUJ | 0.0020 | 0.025 | B | 0.0030 | 0.044 | BCUJ | 0.013 |
| EX-10 | J1N2M0 | 1/16/2012 | 0.000036 | B | 0.000030 | 0.022 | U | 0.022 | 0.42 | B | 0.0020 | 0.0031 | BCUJ | 0.0020 | 0.014 | B | 0.0030 | 0.023 | BCUJ | 0.013 |

| SAMPLE LOCATION | HEIS Number | Sample Date | Selenium - TCLP | | | Silver - TCLP | | |
|---|---|---|---|---|---|---|---|---|
| | | | mg/L | Q | PQL | mg/L | Q | PQL |
| EX-5 | J1N2L5 | 1/16/2012 | 0.024 | U | 0.024 | 0.0040 | U | 0.0040 |
| EX-10 | J1N2M0 | 1/16/2012 | 0.024 | U | 0.024 | 0.0040 | U | 0.0040 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 5 of 6 |
| Originator | N. K. Schiffern | Date | 3/1/12 |
| Checked | I. B. Berezovskiy | Date | 3/1/12 |
| Calc. No. | 0100F-CA-V0404 | Rev. No. | 0 |

**Attachment 1. 100-F-57:1 Subsite Verification Sample Results (Asbestos).**

| Sample Location | HEIS Number | Sample Date | Chrysotile | | | Amosite | | | Crocidolite | | | Tremolite | | | Actinolite | | | Anthophyllite | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | Q | RDL | % | Q | RDL | % | Q | RDL | % | Q | RDL | % | Q | RDL | % | Q | RDL |
| EX-12 | J1N2P1 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-12 duplicate | J1N2P2 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-1 | J1N2N0 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-2 | J1N2N1 | 1/16/2012 | ND | U | ND | 3 | | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-2 reanalysis | J1N2N1 | 1/16/2012 | 2 | | ND | 2 | | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-2 resample[a] | J1N3T6 | 2/1/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-3 | J1N2N2 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-4 | J1N2N3 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-5 | J1N2N4 | 1/16/2012 | 2 | | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-5 reanalysis | J1N2N4 | 1/16/2012 | 2 | | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-5 resample[a] | J1N3T7 | 2/1/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-6 | J1N2N5 | 1/16/2012 | ND | U | ND | TRA | | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-7 | J2N2N6 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-8 | J1N2N7 | 1/16/2012 | ND | U | ND | 2 | | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-8 reanalysis | J1N2N7 | 1/16/2012 | TRA | | ND | TRA | | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-8 resample[a] | J1N3T8 | 2/1/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-9 | J1N2N8 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-10 | J1N2N9 | 1/16/2012 | 3 | | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-10 reanalysis | J1N2N9 | 1/16/2012 | 2 | | ND | 2 | | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-10 resample[a] | J1N3T9 | 2/1/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| EX-11 | J1N2P0 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| OB-4 | J1N2P6 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| OB-4 duplicate | J1N2P7 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| OB-1 | J1N2P3 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| OB-2 | J1N2P4 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |
| OB-3 | J1N2P5 | 1/16/2012 | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND | ND | U | ND |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 6 of 6 |
| Originator | N. K. Schiffern | Date | 2/27/12 |
| Checked | I. B. Berezovskiy | Date | 2/27/12 |
| Calc. No. | 0100F-CA-V0404 | Rev. No. | 0 |

Acrobat 8.0

# CALCULATION COVER SHEET

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

Area: 100-F

Discipline: Environmental Calculation No: 0100F-CA-V0405

Subject: 100-F-57:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

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<br>Summary = 3<br>Total = 4 | N. K. Schiffern<br>N.K. Schiffern | J. D. Skoglie | I. B. Berezovskiy<br>IB Berezovskiy | S. W. Callison<br>SW Callison | 4-12-12 |
| | | | | | | |

## SUMMARY OF REVISION

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|---|---|
| | |

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | N. K. Schiffern | Date: | 2/22/2012 | Calc. No.: | 0100F-CA-V0405 | Rev.: | 0 |
| Project: | 100-F Field Remediation | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 2/22/2012 |
| Subject: | 100-F-57:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 1 of 3 | |

**PURPOSE:**

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-F-57:1 subsite. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009a); the following criteria must be met:

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

**GIVEN/REFERENCES:**


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

2) DOE-RL, 2009b, *100 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-96-22, Rev. 5, 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, 2012, *Remaining Sites Verification Package for the 100-F-57:1, Eastern 190-F Water Pump House Debris and Overburden Stockpile*, Attachment to Waste Site Reclassification Form 2011-010, 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 2009a).

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 2009a).

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

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | N. K. Schiffern | Date: | 2/22/2012 | Calc. No.: | 0100F-CA-V0405 | Rev.: | 0 |
| Project: | 100-F Field Remediation | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 2/22/2012 |
| Subject: | 100-F-57:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 2 of 3 | |

## METHODOLOGY:

The 100-F-57:1 subsite underwent statistical sampling from the excavation area where twelve samples were collected. Also taken are four composite samples from the overburden area. The direct contact hazard quotient and carcinogenic risk calculations for the 100-F-57:1 subsite were conservatively calculated for the entire waste site using the greater of the statistical or focused verification soil sample results (WCH 2012). Of the contaminants of potential concern (COPCs) for this site, boron and molybdenum require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Chromium (total) and selenium require HQ and risk calculations because these analytes were detected above background. Lead was detected above background; however, lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the statistical value for boron is 2.4 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is $3.3 \times 10^{-4}$. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

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

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, then multiplied by $1.0 \times 10^{-6}$. Since the 100-F-57:1 subsite doesn't have any constituents with a carcinogenic RAG value, the requirement of $<1 \times 10^{-6}$ is met. Also the requirement for the sum of the excess cancer risk of $<1 \times 10^{-5}$ 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 hazard quotient and excess cancer risk calculations.

Washington Closure Hanford, Inc. CALCULATION SHEET

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Originator: | N. K. Schiffern | Date: | 2/22/2012 | Calc. No.: | 0100F-CA-V0405 | Rev.: | 0 |
| Project: | 100-F Field Remediation | Job No: | 14655 | Checked: | J. D. Skoglie | Date: | 2/22/2012 |
| Subject: | 100-F-57:1 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. 3 of 3 | |

**Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-F-57:1 Subsite.**

| 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 | 2.4 | 7,200 | 3.3E-04 | -- | -- |
| Chromium, total | 19.8 | 80,000 | 2.5E-04 | -- | -- |
| Lead[c] | 27.7 | 353 | -- | -- | -- |
| Molybdenum | 0.41 | 400 | 1.0E-03 | -- | -- |
| Selenium | 1.0 | 400 | 2.5E-03 | -- | -- |
| *Totals* | | | | | |
| **Cumulative Hazard Quotient:** | | | **4.1E-03** | | |
| **Cumulative Excess Cancer Risk:** | | | | | **0.0E+00** |

[a] = From WCH (2012).

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

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

-- = not applicable RAG = remedial action goal

## CONCLUSION:

The calculations in Table 1 demonstrate that the 100-F-57:1 subsite meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2009a) and SAP (DOE-RL 2009b). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

# APPENDIX D

# DATA QUALITY ASSESSMENT

# APPENDIX D

# DATA QUALITY ASSESSMENT

## VERIFICATION SAMPLING

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2011). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2009).

A review of the sample design (WCH 2011), the field logbooks (WCH 2012), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. To ensure quality data, the 100 Area SAP 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 2006).

Verification sample data collected at the 100-F-57:1 waste site were provided by the laboratories in three sample delivery groups (SDGs): SDG J01402, JP0347, and MA04440. SDG J01402 was submitted for third-party validation.

Samples in the 100-F-57:1 waste subsite and overburden stockpile data set were analyzed using EPA method 6010 (inductively coupled plasma [ICP] metals), EPA method 7471 (mercury), and EPA method 7196 (hexavalent chromium). The ICP metals include antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

No major deficiencies were found in any of the SDGs. Minor deficiencies are discussed by SDG as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies in the quality of the data were found. Unless otherwise noted, deficiencies listed below are specific to the individual SDG, but apply to all samples within that SDG.

### SDG J01402

This SDG comprises 19 field samples (J1N2L1 through J1N2L9 and J1N2M0 through J1N2M9) collected from the excavation of the 100-F-57:1 waste site and the overburden stockpile. Sample J1N2M3 is a field duplicate of sample J1N2M2, and J1N2M8 is a field duplicate of sample J1N2M7. Sample J1N2M9 is the equipment blank. Samples J1N2L2, J1N2L5, J1N2L8, and J1N2M0 were replaced by samples J1N3V0, J1N3V1, J1N3V2, and J1N3V3, respectively,

which were analyzed in SDG JP0347. SDG J01402 was submitted for formal third-party validation. Minor deficiencies found in SDG J01402 are as follows:

In the ICP metals analysis, the laboratory control sample recovery for silicon (19%) was below project-acceptance criteria (70% to 130%). Third-party validation has qualified all silicon results in SDG J01402 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries for silicon (12%) and antimony (50%) were below project-acceptance criteria (70% to130 %). Third-party validation has qualified all silicon and antimony results in SDG J01402 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis using the toxic characteristic leachate procedure, cadmium and lead were detected in the method blank at a concentration less than the contract-required quantitation limit. Third-party validation has qualified all toxic characteristic leachate procedure results for cadmium and lead in SDG J01402 as estimated with "UJ" flags. Estimated data are usable for decision-making purposes.

**SDG JP0347**

This SDG comprises four field samples (J1N3V0 through J1N3V3) from the 100-F-57:1 waste subsite. Minor deficiencies noted in SDG JP0347 are as follows:

In the ICP metals analysis, the common laboratory contaminant, iron, was detected in the method blank at a concentration greater than the reporting limit. The detected results for iron in SDG JP0347 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample recovery for silicon (16%) was below project-acceptance criteria (70% to 130%). All silicon results in SDG JP0347 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for silicon (27%) and antimony (57%) were below project-acceptance criteria (70% to130 %). All silicon and antimony results in SDG JP0347 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate relative percent difference (RPD) calculated for arsenic (57%) was above the acceptance criteria (30%). All arsenic results in SDG JP0347 may be considered estimated. Estimated data are usable for decision-making purposes.

## FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance and quality control (QA/QC) measures are used to assess potential sources of error and cross contamination of samples that could bias results. Two sets of field QA/QC samples (main sample and duplicate) were collected, as documented in the field logbook (WCH 2011a). The first QA/QC set comprises samples J1N2M2 (main) and J1N2M3 (duplicate) from the main excavation. The second QA/QC set comprises samples J1N2M7 (main) and J1N2M8 (duplicate) from the overburden pile.

The entire sample data set, including the duplicate sample data, is presented in the 95% upper confidence limit (UCL) calculation in Appendix C. RPDs for the field-duplicate samples have been calculated and are also presented in the 95% UCL calculation. Please refer to the 95% UCL calculation for details.

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 sample/duplicate pair(s) for each contaminant of concern. No major deficiencies in the RPD calculations were found for the duplicate samples. The only minor deficiency noted was for the main excavation, and it is discussed below. The RPDs calculated for the overburden pile were less than 30%.

**Main Excavation**

In the duplicate evaluation, the RPD calculated for barium (67.6%) was above the field-duplicate acceptance criteria (less than 30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The data are usable 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 usable for decision-making purposes.

## SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues, such as those discussed above, are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-F-57:1 waste subsite and overburden stockpile verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling.

The DQA review for the 100-F-57:1 waste subsite and overburden stockpile 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.

## REFERENCES

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

BHI, 2000b, *Data Validation Procedure for Radiochemical Analysis*, BHI-01433, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

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

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WCH, 2011, *Work Instruction for Verification Sampling of the 100-F-57:1, Eastern 190-F Process Water Pump House Debris and Overburden Stockpile*, 0100F-WI-G0087, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2012, *100F Field Remediation Sampling*, EL-1651-02, pp. 75-77 and 83-84, Washington Closure Hanford, Richland, Washington.