# WASTE SITE RECLASSIFICATION FORM

**Operable Unit:** 100-HR-1 **Control No.:** 2015-074

**Waste Site Code(s)/Subsite Code(s):** 100-H-59:2

**Reclassification Category:** Interim ☒ Final ☐

**Reclassification Status:** Closed Out ☒ No Action ☐ Rejected ☐
RCRA Postclosure ☐ Consolidated ☐ None ☐

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

**Description of current waste site condition:**

The 100-H-59:2, Debris Piles Near 100-H Area Railroad Track subsite is part of the 100-H-59, Soil Contamination Area and Debris Piles Near 100-H Area Railroad Track waste site. The 100-H-59 waste site was added to the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999), as a candidate site for confirmatory sampling in the Fact Sheet *100 Area "Plug-In" and Candidate Waste Sites for Calendar Year 2011,* U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2012). The 100-H-59 waste site was recommended for remediation without confirmatory sampling in December 2012. Debris unrelated to the 100-H-59 waste site was discovered in April 2014 during waste site remediation; therefore, the 100-H-59 waste site was divided into subsites. The 100-H-59:2 subsite was created in December 2014.

Remedial action at the 100-H-59:2 subsite began on March 23, 2015, and continued through April 30, 2015. The depth of the remediation ranged from 1 to 3 m (3.3 to 9.8 ft) below ground surface, resulting in approximately 4,181 bank cubic meters (BCM) (5,469 bank cubic yards [BCY]) of soil and debris along with approximately 1,383 BCM (1,809 BCY) of additional plating material being removed and disposed at the Environmental Restoration Disposal Facility (ERDF). The soil and debris was direct loaded for disposal at ERDF; therefore, no waste staging pile areas were generated. No overburden material was salvaged for use as clean backfill. One anomaly, a glass bottle containing unknown liquid, was encountered during the remediation. The liquid was sampled on May 12, 2015. The entire volume of liquid within the bottle was consumed during sampling; therefore, no liquid remained for disposal. The bottle was disposed at ERDF.

Verification samples from the 100-H-59:2 subsite were collected on July 6, 2015. The sampling was performed to determine if the site met the remedial action objectives and remedial action goals established by the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP), DOE/RL-97-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009b), and the 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 the ERDF, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification to Interim Closed Out.

**Basis for reclassification:**

The verification sampling and modeling results for the 100-H-59:2 subsite demonstrate that the site meets the remedial action objectives and corresponding remedial action goals established in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999) to support a reclassification to Interim Closed Out. These sampling and modeling results established that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-H-59:2, Debris Piles Near 100-H Area Railroad Track Subsite* (attached).

# WASTE SITE RECLASSIFICATION FORM

**Operable Unit:** 100-HR-1 **Control No.:** 2015-074

**Waste Site Code(s)/Subsite Code(s):** 100-H-59:2

**Regulator comments:**

**Waste Site Controls:**

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

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

| | | |
|---|---|---|
| J. P. Neath | | 11/4/15 |
| DOE Federal Project Director (printed) | Signature | Date |
| N. Menard | | 11/9/15 |
| Ecology Project Manager (printed) | Signature | Date |
| NA | | |
| EPA Project Manager (printed) | Signature | Date |

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-59:2, DEBRIS PILES NEAR 100-H AREA RAILROAD TRACK SUBSITE

**Attachment to Waste Site Reclassification Form 2015-074**

**November 2015**

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-59:2, DEBRIS PILES NEAR 100-H AREA RAILROAD TRACK SUBSITE

## EXECUTIVE SUMMARY

The 100-H-59:2, Debris Piles Near 100-H Area Railroad Track subsite is part of the 100-H-59, Soil Contamination Area and Debris Piles Near 100-H Area Railroad Track waste site and is located within the 100-HR-1 Operable Unit. The 100-H-59:2 subsite consisted of debris piles along the railroad track and included a glass bottle with an unknown liquid. The site was located approximately 500 m (1,640 ft) south of the 105-H Reactor along the railroad spur.

Remedial action at the 100-H-59:2 subsite began on March 23, 2015, and continued through April 30, 2015. The depth of the remediation ranged from 1 to 3 m (3.3 to 9.8 ft) below ground surface, resulting in approximately 4,181 bank cubic meters (BCM) (5,469 bank cubic yards [BCY]) of soil and debris along with approximately 1,383 BCM (1,809 BCY) of additional plating material being removed and disposed at the Environmental Restoration Disposal Facility (ERDF). Debris removed from the excavation included steel, wire cable, pipe, signs, concrete and brick pieces, glass, and asbestos insulation. No overburden material was salvaged for use as clean backfill. Additionally, all material was direct loaded from the excavation; therefore, no waste staging pile areas were generated. One anomaly, a glass bottle containing an unknown liquid, was encountered during remediation. The bottle was staged in a small anomaly storage area adjacent to the northern edge of the excavation prior to being sampled for disposal. The liquid was sampled on May 12, 2105, and the bottle was disposed at the ERDF. No liquid remained in the bottle after sample collection.

Following remediation, verification soil sampling was conducted on July 6, 2015. The verification sampling results indicate that the waste removal action achieved compliance with the remedial action objectives and remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999).

A summary of the cleanup evaluation for the results from verification sampling compared to applicable criteria is presented in Table ES-1.

**Table ES-1. Summary of Remedial Action Goals for the 100-H-59:2 Subsite. (2 Pages)**

| Regulatory Requirement | Remedial Action Goals | Results | Remedial Action Objectives Attained? |
|---|---|---|---|
| Direct Exposure – Radionuclides | Attain a dose rate of <15 mrem/yr above background for 1,000 years. | Radionuclides were not identified as COPCs for the 100-H-59:2 subsite. | NA |
| Direct Exposure – Nonradionuclides | Attain individual COPC direct exposure RAGs. | All individual COPC concentrations are below the direct exposure RAGs. | Yes |
| Risk Requirements – Nonradionuclides | Attain a hazard quotient of <1 for all individual noncarcinogens. | The hazard quotients for individual nonradionuclide COPCs are <1. | Yes |
| | Attain a cumulative hazard quotient of <1 for noncarcinogens. | The cumulative hazard quotient for the 100-H-59:2 subsite ($5.3 \times 10^{-3}$) is <1. | |
| | Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens. | The excess cancer risk for individual carcinogens are $<1 \times 10^{-6}$. | |
| | Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens. | The cumulative excess cancer risk for the 100-H-59:2 subsite ($1.0 \times 10^{-6}$) is $<1 \times 10^{-5}$. | |
| Groundwater/River Protection – Radionuclides | Attain single-COPC groundwater and river protection RAGs. | Radionuclides were not identified as COPCs for the 100-H-59:2 subsite. | NA |
| | Attain national primary drinking water standards [a]: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs. | | |
| | Meet drinking water MCL for alpha emitters. | | |
| | Meet total uranium standard of 30 µg/L (21.2 pCi/L) [b]. | | |

**Table ES-1. Summary of Remedial Action Goals for the 100-H-59:2 Subsite. (2 Pages)**

| Regulatory Requirement | Remedial Action Goals | Results | Remedial Action Objectives Attained? |
|---|---|---|---|
| Groundwater/River Protection – Nonradionuclides | Attain individual nonradionuclide groundwater and river cleanup requirements. | Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene exceeded soil RAGs for groundwater and river protection. However, based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), it is predicted that the residual concentrations of these contaminants will not reach groundwater (and thus the Columbia River) within 1,000 years [c]. | Yes |

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

[b] 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).

[c] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentration of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene are not predicted to migrate vertically within 1,000 years (based on the lowest soil-partitioning coefficient of the contaminants [benzo(a)pyrene] of 360 mL/g). A contaminant with a soil-partitioning coefficient of 80 mL/g or greater is not predicted to migrate vertically through the soil. The vadose zone underlying the 100-H-59:2 subsite is approximately 7 m (23 ft) thick. Therefore, the residual concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene are predicted to be protective of groundwater and the Columbia River.

COPC = contaminant of potential concern
MCL = maximum contaminant level
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)

The results of verification sampling are used to make reclassification decisions for the 100-H-59:2 subsite in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011). In accordance with this evaluation, the verification sampling results support a reclassification of this subsite to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals of the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (surface to 4.6 m [15 ft] below ground surface), and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River.

Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the 100-H-59:2 subsite

contaminants of potential concern and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron and vanadium. The U.S. Environmental Protection Agency's ecological soil screening levels were exceeded for antimony, manganese, and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, and vanadium are below Hanford Site background values, it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

# REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-59:2, DEBRIS PILES NEAR 100-H AREA RAILROAD TRACK SUBSITE

## STATEMENT OF PROTECTIVENESS

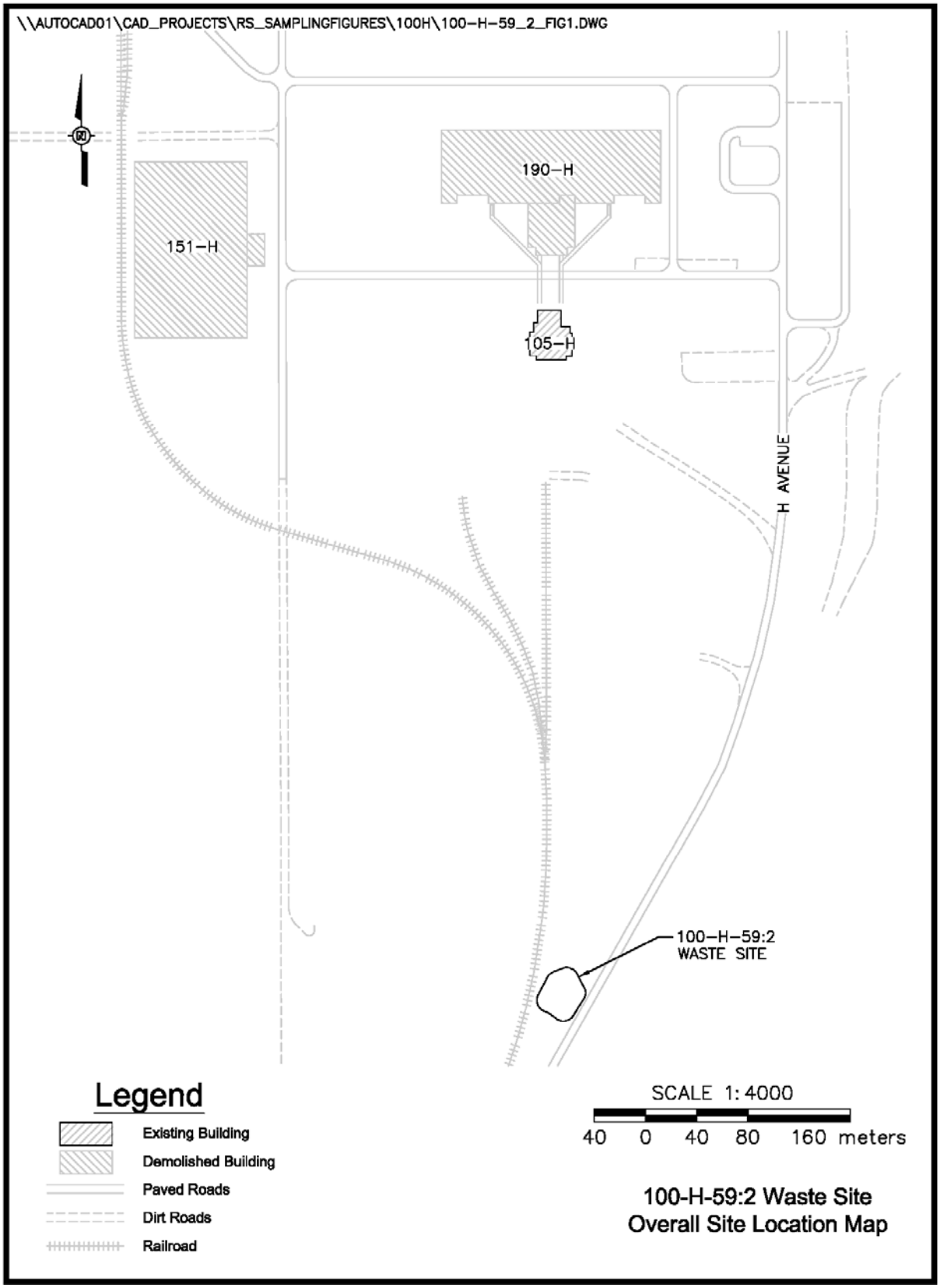
The 100-H-59:2 subsite verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of 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 above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the 100-H-59:2 subsite contaminants of potential concern (COPCs) and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for boron and vanadium. The U.S. Environmental Protection Agency's (EPA) ecological soil screening levels were exceeded for antimony, manganese, and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, and vanadium are below Hanford Site background values, it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

## GENERAL SITE INFORMATION AND BACKGROUND

The 100-H-59:2, Debris Piles Near 100-H Area Railroad Track subsite was located within the 100-HR-1 Operable Unit and consisted of buried debris found during the remediation of the 100-H-59 waste site. The debris included steel wire cable, pipe, signs, concrete and brick pieces, glass, and asbestos insulation. An intact glass bottle containing an unknown liquid was also encountered. The overall site location map is provided in Figure 1.

**Figure 1. 100-H-59:2 Overall Site Location Map.**



## REMEDIAL ACTION SUMMARY

Remedial action at the 100-H-59:2 subsite began on March 23, 2015, and continued through April 30, 2015. The depth of remediation ranged from 1 to 3 m (3.3 to 9.8 ft) below ground surface, resulting in approximately 4,181 bank cubic meters (BCM) (5,469 bank cubic yards [BCY]) of soil and debris along with approximately 1,383 BCM (1,809 BCY) being removed and disposed at the Environmental Restoration Disposal Facility (ERDF). Debris removed from the excavation included steel, wire cable, pipe, signs, concrete and brick pieces, glass, and asbestos insulation. One glass bottle anomaly containing an unknown liquid was also encountered during remediation. The glass bottle anomaly was staged in a small anomaly staging area adjacent to the northern edge of the excavation prior to being sampled for disposal. The liquid was sampled on May 12, 2015, and the glass bottle was disposed at the ERDF. No liquid remained in the bottle following sample collection.

The soil and debris were direct loaded for disposal at ERDF; therefore, no waste staging pile areas were generated. No overburden material was salvaged for use as clean backfill. Several in-process soil samples were collected during the remediation. A summary of the in-process samples collected and the resulting data are presented in Appendix B.

A post-excavation civil survey was performed at the 100-H-59:2 subsite following remediation. The survey is presented in Figure 2. Photographs taken following remediation are provided in Figures 3 and 4.

## VERIFICATION SAMPLING ACTIVITIES

Verification soil sampling was conducted on July 6, 2015, per the *Work Instruction for Verification Sampling of the 100-H-59:2, Debris Piles Near 100-H Area Railroad Track Waste Site* (WCH 2015b). 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 sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 100-H-59:2 subsite. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site.

**Figure 2. 100-H-59:2 Post-Excavation Civil Survey.**

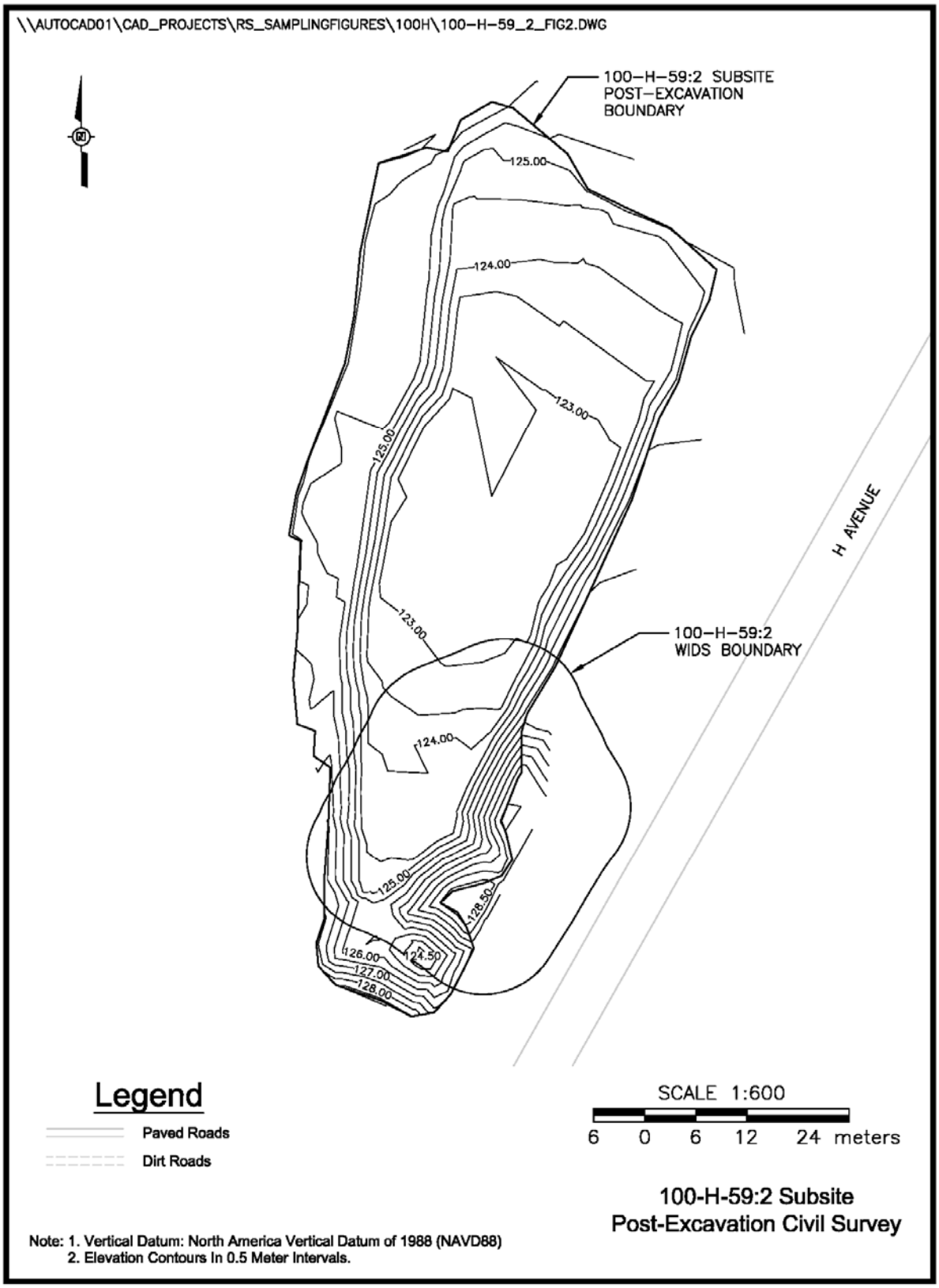


**Figure 3. Post-Remediation Photograph of the 100-H-59:2 Subsite Looking North, Dated May 4, 2015.**

**Figure 4. Post-Remediation Photograph of the 100-H-59:2 Subsite Looking South, Dated May 4, 2015.**

## Contaminants of Potential Concern for Verification Sampling

The COPCs for the 100-H-59:2 subsite were determined based on the field observations and in-process samples collected during remediation. Lead, total petroleum hydrocarbons (TPH), benzo(a)pyrene, aroclor-1254, and aroclor-1260 were detected in the in-process samples above direct exposure RAGs; therefore, they were included as site COPCs. Antimony, barium, cadmium, chromium, cobalt, copper, manganese, mercury, molybdenum, nickel, selenium, silver, zinc, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and heptachlor epoxide were detected in the in-process samples above groundwater and/or river protection RAGs; therefore, they were included as site COPCs. Additionally, arsenic was detected above the background value; therefore, it was included as a COPC. Hexavalent chromium was added as a COPC for verification sampling because it is a known contaminant of concern in the 100-H Area.

An inspection of the area following remediation, as well as in-process soil samples collected and submitted for asbestos analysis, determined that all observed suspect asbestos-containing material was removed. Therefore, asbestos analysis was not requested for verification sampling. Although cesium-137, europium-155, and potassium-40 were detected in the in-process samples, they were detected below the background levels; therefore, they were not included as site COPCs for verification sampling. Because the glass bottle anomaly was found intact and no releases to the soil were noted, no additional COPCs were added for verification sampling.

The analytical methods that were performed to evaluate the site COPCs are provided in Table 1.

**Table 1. Laboratory Analytical Methods for the 100-H-59:2 Subsite.**

| Analytical Method | Contaminant of Potential Concern |
|---|---|
| ICP metals [a] – EPA Method 6010 | Lead, antimony, barium, cadmium, chromium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, zinc |
| Mercury – EPA Method 7471 | Mercury |
| Hexavalent chromium – EPA Method 7196 | Hexavalent chromium |
| PAH – EPA Method 8310 | Benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene |
| PCBs – EPA Method 8082 | Aroclor-1254, aroclor-1260 |
| Pesticides – EPA Method 8081 | Pesticides |
| TPH – NWTPH-Dx | Total petroleum hydrocarbons (diesel range, diesel range extended) |

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

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
NWTP = Northwest total petroleum hydrocarbons – diesel range organics
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

## Verification Sampling Design

Two decision units were identified for the 100-H-59:2 subsite; specifically, the excavation and the anomaly staging area. A combination of a statistical and focused sample design was used to evaluate the 100-H-59:2 excavation. Twelve statistical verification soil samples plus one duplicate and one split were collected from the excavation. Additionally, one focused soil sample (FS-1) was collected from the excavation at the location where the glass bottle anomaly was encountered within the excavation. One focused soil sample (ASA-1) was collected from the approximate center of the anomaly staging area, located outside of the excavation boundary, where the anomaly was staged prior to being sampled. One equipment blank sample was also collected.

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). All samples were grab samples collected at the predetermined coordinates identified in Table 2. Additional information related to verification sampling can be found in the field sampling logbook (WCH 2015a). The verification sample locations for the excavation are shown in Figure 5.

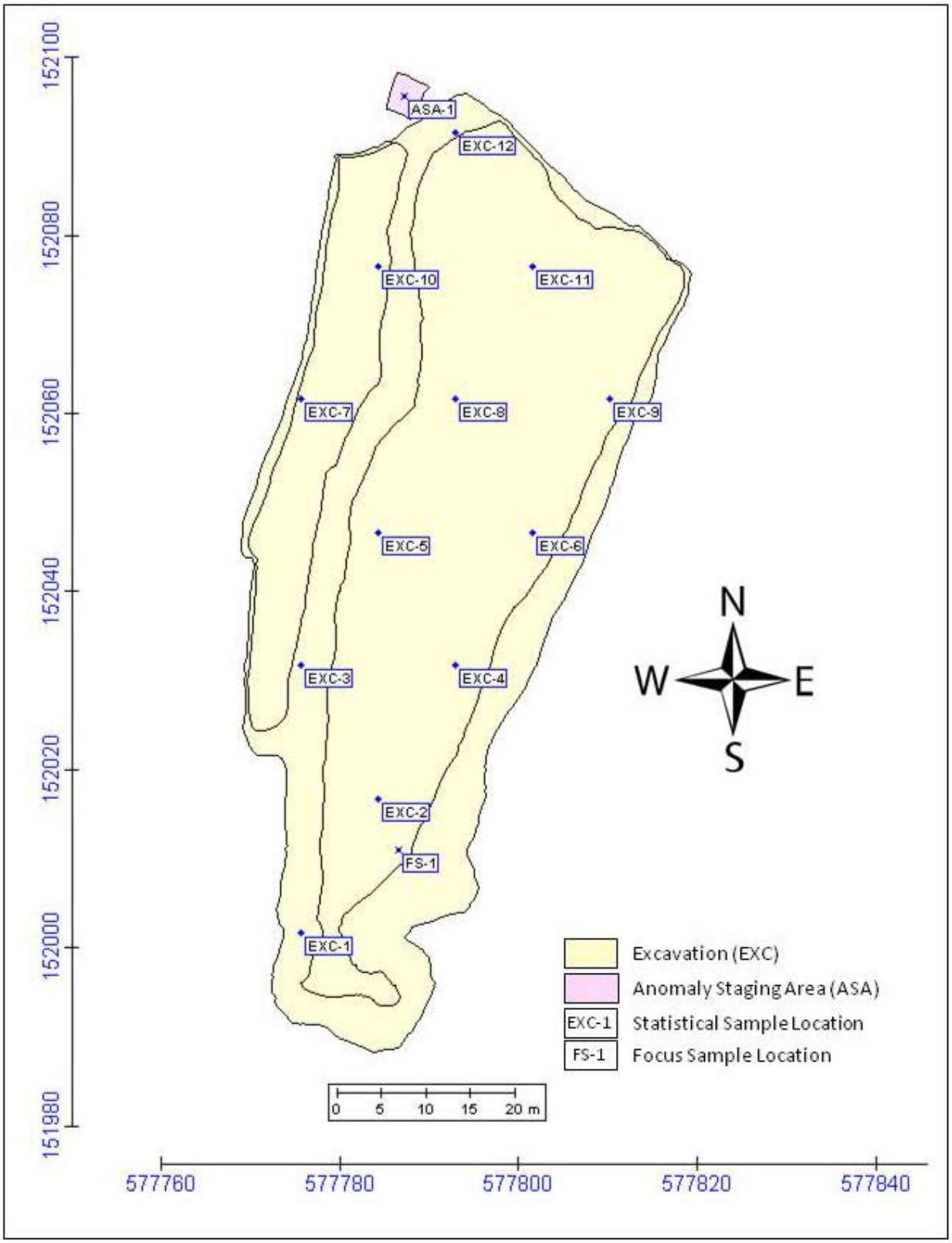
**Table 2. 100-H-59:2 Subsite Verification Sample Summary.**

| Sample Location | HEIS Sample Number | Washington State Plane Coordinates (m) | | Sample Analysis |
|---|---|---|---|---|
| | | Northing | Easting | |
| EXC-1 | J1V7P6 | 152001.7 | 577775.6 | ICP metals [a], mercury, hexavalent chromium, PAH, PCB, pesticides, TPH |
| EXC-2 | J1V7P7 | 152016.7 | 577784.3 | |
| EXC-3 | J1V7P8 | 152031.7 | 577775.6 | |
| EXC-4 | J1V7P9 | 152031.7 | 577792.9 | |
| EXC-5 | J1V7R0 | 152046.6 | 577784.3 | |
| EXC-6 | J1V7R1 | 152046.6 | 577801.6 | |
| EXC-7 | J1V7R2 | 152061.6 | 577775.6 | |
| EXC-8 | J1V7R3 | 152061.6 | 577792.9 | |
| EXC-9 | J1V7R4 | 152061.6 | 577810.3 | |
| EXC-10 | J1V7R5 | 152076.6 | 577784.3 | |
| EXC-11 | J1V7R6 | 152076.6 | 577801.6 | |
| EXC-12 | J1V7R7 | 152091.6 | 577792.9 | |
| Duplicate of EXC-1 (J1V7P6) | J1V7R8 | 152001.7 | 577775.6 | |
| Split of EXC-1 (J1V7P6) | J1V7T2 | 152001.7 | 577775.6 | |
| FS-1 | J1V7R9 | 152011.0 | 577786.6 | |
| ASA-1 | J1V7T0 | 152095.7 | 577787.3 | |
| Equipment blank | J1V7T1 | NA | NA | ICP metals [a], mercury |

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

ASA = anomaly staging area
EXC = excavation
FS = focus sample
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

**Figure 5. The 100-H-59:2 Subsite Verification Sample Locations.**



### Verification Sampling Results

All verification samples were collected for full protocol laboratory analysis and analyzed using EPA-approved analytical methods. Evaluation of the verification data from the 100-H-59:2 subsite was performed by direct comparison of the statistical or maximum sample results for each COPC against the cleanup criteria.

Comparisons of the results for site COPCs from the 100-H-59:2 subsite against the RAGs are summarized in Tables 3, 4, and 5. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2015) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in the table.

The complete laboratory results for all constituents are stored in a Washington Closure Hanford (WCH) project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are presented in Attachment 1 of the *100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).

## DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-H-59:2 subsite 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).

### Attainment of Nonradionuclide RAGs

Tables 3, 4, and 5 compare the cleanup verification sample values for the 100-H-59:2 subsite to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River. All COPCs were quantified below direct exposure RAGs. All COPCs were quantified below groundwater and/or river protection soil RAGs with the exception of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene. However, based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), residual concentrations of these contaminants are not predicted to migrate vertically in 1,000 years (based on the lowest distribution coefficient ($K_d$) of these contaminants [benzo(a)pyrene] of 360 mL/g). A contaminant with a $K_d$ of 80 mL/g or greater is not predicted to migrate vertically through the soil. Therefore, the residual concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene are predicted to be protective of groundwater and the Columbia River. The vadose zone beneath the 100-H-59:2 subsite is approximately 7 m (23 ft) thick.

**Table 3. Comparison of Contaminant Concentrations to Action Levels for the 100-H-59:2 Excavation (Statistical) Verification Samples.**

| COPC | Statistical Result [b] (mg/kg) | Remedial Action Goals [a] | | | Do the Results Exceed RAGs? | Do the Results Pass RESRAD Modeling? |
|---|---|---|---|---|---|---|
| | | Direct Exposure | Soil Cleanup Level for Groundwater Protection | Soil Cleanup Level for River Protection | | |
| Antimony [c] | 0.43 (<BG) | 32 | 5 [d] | 5 [d] | No | -- |
| Arsenic | 3.5 (<BG) | 20 [d] | 20 [d] | 20 [d] | No | -- |
| Barium | 84.5 (<BG) | 5,600 | 200 | 400 | No | -- |
| Beryllium | 0.38 (<BG) | 10.4 [e] | 1.51 [d] | 1.51 [d] | No | -- |
| Boron [f] | 3.7 | 7,200 | 320 | -- [g] | No | -- |
| Cadmium [c] | 0.10 (<BG) | 13.9 [e] | 0.81 [d] | 0.81 [d] | No | -- |
| Chromium (total) | 13.1 (<BG) | 80,000 | 18.5 [d] | 18.5 [d] | No | -- |
| Cobalt | 7.1 (<BG) | 24 | 15.7 [d] | -- [g] | No | -- |
| Copper | 18.6 (<BG) | 2,960 | 59.2 | 22.0 [d] | No | -- |
| Hexavalent chromium [f] | 0.723 | 2.1 [e] | 4.8 | 2 | No | -- |
| Lead | 9.1 (<BG) | 353 | 10.2 [d] | 10.2 [d] | No | -- |
| Manganese | 323 (<BG) | 3,760 | 512 [d] | 512 [d] | No | -- |
| Mercury | 0.033 (<BG) | 24 | 0.33 [d] | 0.33 [d] | No | -- |
| Molybdenum [f] | 0.56 | 400 | 8 | -- [g] | No | -- |
| Nickel | 14.1 (<BG) | 1,600 | 19.1 [d] | 27.4 | No | -- |
| Vanadium | 47.6 (<BG) | 560 | 85.1 [d] | -- [g] | No | -- |
| Zinc | 43.6 (<BG) | 24,000 | 480 | 67.8 [d] | No | -- |
| TPH – diesel range, extended | 5.2 | 200 | 200 | 200 | No | -- |
| TPH – diesel range | 2.7 | 200 | 200 | 200 | No | -- |
| Dieldrin | 0.00085 | 0.0625 | 0.0033 [h] | 0.0033 [h] | No | -- |

[a] Remedial action goals obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum or 95% UCL result, depending on data censorship, as described in the *100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).
[c] Hanford Site-specific background value is not available. 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). 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) (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m$^3$ (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[f] 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 2015) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii] [Method B for surface waters]).
[h] Where cleanup levels are less than the RDLs, cleanup levels default to RDLs per WAC 173-340-707(2).

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
UCL = upper confidence limit

**Table 4. Comparison of Contaminant Concentrations to Action Levels for the 100-H-59:2 Excavation (Focused) Verification Samples.**

| COPC | Maximum Result [b] (mg/kg) | Remedial Action Goals [a] | | | Do the Results Exceed RAGs? | Do the Results Pass RESRAD Modeling? |
|---|---|---|---|---|---|---|
| | | Direct Exposure | Soil Cleanup Level for Groundwater Protection | Soil Cleanup Level for River Protection | | |
| Arsenic | 3.5 (<BG) | 20 [c] | 20 [c] | 20 [c] | No | -- |
| Barium | 86.7 (<BG) | 5,600 | 200 | 400 | No | -- |
| Beryllium | 0.42 (<BG) | 10.4 [d] | 1.51 [c] | 1.51 [c] | No | -- |
| Boron [e] | 1.5 | 7,200 | 320 | -- [f] | No | -- |
| Cadmium [g] | 0.097 (<BG) | 13.9 [d] | 0.81 [c] | 0.81 [c] | No | -- |
| Chromium (total) | 13.4 (<BG) | 80,000 | 18.5 [c] | 18.5 [c] | No | -- |
| Cobalt | 7.6 (<BG) | 24 | 15.7 [c] | -- [f] | No | -- |
| Copper | 15.6 (<BG) | 2,960 | 59.2 | 22.0 [c] | No | -- |
| Hexavalent chromium [e] | 0.336 | 2.1 [d] | 4.8 | 2 | No | -- |
| Lead | 5.2 (<BG) | 353 | 10.2 [c] | 10.2 [c] | No | -- |
| Manganese | 327 (<BG) | 3,760 | 512 [c] | 512 [c] | No | -- |
| Nickel | 15.7 (<BG) | 1,600 | 19.1 [c] | 27.4 | No | -- |
| Vanadium | 44.7 (<BG) | 560 | 85.1 [c] | -- [f] | No | -- |
| Zinc | 40.0 (<BG) | 24,000 | 480 | 67.8 [c] | No | -- |
| TPH – diesel range, extended | 1.4 | 200 | 200 | 200 | No | -- |
| TPH – diesel range | 1.1 | 200 | 200 | 200 | No | -- |

[a] Remedial action goals obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum result, depending on data censorship, as described in the *100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).
[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d). 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) (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m$^3$ (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[e] No Hanford Site-specific or Washington State background value available.
[f] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2015) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii] [Method B for surface waters]).
[g] Hanford Site-specific background value is not available. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity )dose model
TPH = total petroleum hydrocarbons
UCL = upper confidence limit

**Table 5. Comparison of Contaminant Concentrations to Action Levels for the 100-H-59:2 Anomaly Staging Area (Focused) Verification Samples. (2 Pages)**

| COPC | Maximum Result [b] (mg/kg) | Remedial Action Goals [a] | | | Do the Results Exceed RAGs? | Do the Results Pass RESRAD Modeling? |
|---|---|---|---|---|---|---|
| | | Direct Exposure | Soil Cleanup Level for Groundwater Protection | Soil Cleanup Level for River Protection | | |
| Arsenic | 3.2 (<BG) | 20 [c] | 20 [c] | 20 [c] | No | -- |
| Barium | 67.4 (<BG) | 5,600 | 200 | 400 | No | -- |
| Beryllium | 0.29 (<BG) | 10.4 [d] | 1.51 [c] | 1.51 [c] | No | -- |
| Boron [e] | 1.5 | 7,200 | 320 | -- [f] | No | -- |
| Cadmium [g] | 0.10 (<BG) | 13.9 [d] | 0.81 [c] | 0.81 [c] | No | -- |
| Chromium (total) | 9.6 (<BG) | 80,000 | 18.5 [c] | 18.5 [c] | No | -- |
| Cobalt | 5.6 (<BG) | 24 | 15.7 [c] | -- [f] | No | -- |
| Copper | 12.6 (<BG) | 2,960 | 59.2 | 22.0 [c] | No | -- |
| Hexavalent chromium [e] | 0.155 | 2.1 [d] | 4.8 | 2 | No | -- |
| Lead | 7.0 (<BG) | 353 | 10.2 [c] | 10.2 [c] | No | -- |
| Manganese | 273 (<BG) | 3,760 | 512 [c] | 512 [c] | No | -- |
| Nickel | 10.2 (<BG) | 1,600 | 19.1 [c] | 27.4 | No | -- |
| Vanadium | 42.4 (<BG) | 560 | 85.1 [c] | -- [f] | No | -- |
| Zinc | 34.9 (<BG) | 24,000 | 480 | 67.8 [c] | No | -- |
| TPH – diesel range, extended | 13 | 200 | 200 | 200 | No | -- |
| TPH – diesel range | 5.4 | 200 | 200 | 200 | No | -- |
| Acenaphthene | 0.031 | 4,800 | 96 | 129 | No | -- |
| Anthracene | 0.024 | 24,000 | 240 | 1,920 | No | -- |
| Benzo(a)anthracene | 0.100 | 1.37 | 0.015 [h] | 0.015 [h] | Yes | Yes [i] |
| Benzo(a)pyrene | 0.069 | 0.137 | 0.015 [h] | 0.015 [h] | Yes | Yes [i] |
| Benzo(b)fluoranthene | 0.100 | 1.37 | 0.015 [h] | 0.015 [h] | Yes | Yes [i] |
| Benzo(ghi)perylene [j] | 0.056 | 2,400 | 48 | 192 | No | -- |
| Benzo(k)fluoranthene | 0.031 | 1.37 | 0.015 [h] | 0.015 [h] | Yes | Yes [i] |
| Chrysene | 0.085 | 13.7 | 0.12 | 0.1 [h] | No | -- |
| Fluoranthene | 0.160 | 3,200 | 64 | 18.0 | No | -- |
| Fluorene | 0.023 | 3,200 | 64 | 260 | No | -- |
| Indeno(1,2,3-cd)pyrene | 0.053 | 1.37 | 0.33 [h] | 0.33 [h] | No | -- |

**Table 5. Comparison of Contaminant Concentrations to Action Levels for the 100-H-59:2 Anomaly Staging Area (Focused) Verification Samples. (2 Pages)**

| COPC | Statistical Result [b] (mg/kg) | Remedial Action Goals [a] | | | Do the Results Exceed RAGs? | Do the Results Pass RESRAD Modeling? |
|---|---|---|---|---|---|---|
| | | Direct Exposure | Soil Cleanup Level for Groundwater Protection | Soil Cleanup Level for River Protection | | |
| Phenanthrene [j] | 0.098 | 24,000 | 240 | 1,920 | No | -- |
| Pyrene | 0.160 | 2,400 | 48 | 192 | No | -- |

[a] Remedial action goals obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum result, depending on data censorship, as described in the *100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).
[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d). 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) (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m$^3$ (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[e] No Hanford Site-specific or Washington State background value available.
[f] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2015) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii] [Method B for surface waters]).
[g] Hanford Site-specific background value is not available. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[h] Where cleanup levels are less than the RDLs, cleanup levels default to RDLs per WAC 173-340-707(2).
[i] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentration of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene are not predicted to migrate vertically within 1,000 years (based on the lowest soil-partitioning coefficient of the contaminants [benzo(a)pyrene] of 360 mL/g). A contaminant with a soil-partitioning coefficient of 80 mL/g or greater is not predicted to migrate vertically through the soil. Therefore, the residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River. The vadose zone underlying the 100-H-59:2 subsite is approximately 7 m (23 ft) thick.
[j] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals.
Contaminant: benzo(ghi)perylene, surrogate: pyrene
Contaminant: phenanthrene, surrogate: anthracene

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
UCL = upper confidence limit

## Three-Part Test for Nonradionuclides

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

The application of the three-part test for the 100-H-59:2 subsite is included in the *100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations* in Appendix C of this remaining sites verification package, where half or more of the data set was detected. The results of this evaluation indicate that residual COPC concentrations pass the three-part test in comparison against applicable RAGs with the exception of lead, which fails two parts of the

three-part test to be protective of groundwater and the Columbia River. However, based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of lead are not predicted to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the lead $K_d$ of 30 mL/g). The vadose zone beneath the 100-H-59:2 subsite is approximately 7 m (23 ft) thick. Therefore, the residual concentrations of lead are predicted to be protective of groundwater and the Columbia River.

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

**Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained**

Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than $1 \times 10^{-6}$, and a cumulative carcinogenic risk of less than $1 \times 10^{-5}$. For the 100-H-59:2 subsite, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background. All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detected levels is $5.3 \times 10^{-3}$, which is less than 1.0. The individual carcinogenic risk values for the carcinogenic constituents detected above background are less than $1 \times 10^{-6}$, and the cumulative carcinogenic risk value is $1.0 \times 10^{-6}$, which is less than $1 \times 10^{-5}$. The 100-H-59:2 subsite meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the 100 Area RDR/RAWP (DOE-RL 2009b).

**Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained**

Assessment of the risk requirements for the 100-H-59:2 subsite included a calculation of the hazard quotient and carcinogenic (excess cancer) risk values for groundwater protection for nonradionuclides. The requirements include an individual and cumulative hazard quotient of less than 1.0, an individual excess carcinogenic risk of less than $1 \times 10^{-6}$, and a cumulative excess carcinogenic risk of less than $1 \times 10^{-5}$. Risk values were calculated for constituents that were detected at concentrations above Hanford Site or Washington State background values or for which there is no background value. In addition, the soil-partitioning coefficients for these contaminants must be less than that necessary to show no migration to groundwater in 1,000 years based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). Based on this model and a vadose zone of approximately 7 m (23 ft) in thickness, a $K_d$ of 10 or greater is required to show no predicted migration to groundwater in 1,000 years. All individual hazard quotients for the noncarcinogenic constituents subject to the groundwater hazard quotient calculation are less than 1.0, and the cumulative hazard quotient is $1.6 \times 10^{-1}$, which is less than 1.0. No carcinogenic constituents met the criteria for groundwater protection evaluation at the 100-H-59:2 subsite; therefore, no calculations of excess carcinogenic risk were performed. Therefore, nonradionuclide risk requirements related to groundwater are met.

## DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2015b), the field logbook (WCH 2015a), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 100-H-59:2 subsite established that the data are of the right type, quality, and quantity to support site closeout decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in a WCH project-specific database for data evaluation prior to archival in HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

## SUMMARY FOR INTERIM CLOSURE

The 100-H-59:2 subsite has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009b). Verification sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at the site meet the RAOs for direct exposure, groundwater protection, and river protection.

In accordance with this evaluation, the verification sampling results support a reclassification of the 100-H-59:2 subsite to Interim Closed Out. Contamination above direct exposure levels was not observed in the shallow zone soils and is concluded to not exist in deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the sites are not required.

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WCH, 2015b, *Work Instruction for Verification Sampling of the 100-H-59:2, Debris Piles Near 100-H Railroad Track Waste Site*, 0100H-WI-G0070, Rev. 0, Washington Closure Hanford, Richland, Washington.

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# APPENDIX A

# ECOLOGICAL RISK COMPARISON TABLE

**Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-H-59:2 Subsite [a].**

| Hazardous Substance | | 2007 WAC 173-340 Table 749-3 | | | EPA Ecological Soil Screening Levels [b] | | | | Waste Site Analyses |
|---|---|---|---|---|---|---|---|---|---|
| | | Plants | Soil Biota | Wildlife | Plants | Soil Biota | Avian [c] | Mammalian [c] | |
| | Background | | | | | | | | |
| Antimony | 5 | 5 | -- | -- | -- | 78 | -- | 0.27 | 0.43 (<BG) |
| Boron | -- | 0.5 | -- | -- | -- | -- | -- | -- | 3.7 |
| Manganese | 512 | 1,100 [d] | -- | 1,500 | 220 | 450 | 4,300 | 4,000 | 327 (<BG) |
| Vanadium | 85.1 | 2 | -- | -- | -- | -- | 7.8 | 280 | 47.6 (<BG) |

NOTE: Shaded cells indicate screening values that are exceeded.

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

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

[c] Wildlife.

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

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

# APPENDIX B

# IN-PROCESS SAMPLE SUMMARY TABLE AND ANALYTICAL DATA

**Table B-1. 100-H-59:2 In-Process Sample Summary Table. (2 Pages)**

| Sample Number | Sample Date | Sample Description | Northing | Easting | Requested Analyses |
|---|---|---|---|---|---|
| J1V4X6 | 03/04/15 | Composite sample collected for waste designation purposes. Sandy gravel. | NA | NA | ICP metals [a], mercury, TPH – diesel, PAH, PCB, pesticides, GEA |
| J1V4X7 | 03/04/15 | Composite sample collected for waste designation purposes. Silty sandy gravel, metal debris, stained soil, broken glass. | NA | NA | ICP metals [a], mercury, TPH – diesel, PAH, PCB, pesticides, GEA |
| J1V546 | 03/12/15 | Tan and grayish white chunk, fibrous, friable. Partially attached to board/tile, with black rubbery looking material. | 152013.4 | 577783.7 | Asbestos |
| J1V547 | 03/12/15 | Compact, brown, top of it appeared fibrous. | 152011.4 | 577784.7 | Asbestos |
| J1V548 | 03/12/15 | White, fibrous, chunky mass, friable, visible fibers | 152013.8 | `577784.8 | Asbestos |
| J1V549 | 03/12/15 | Tan, compact. Appears to be possible piece of transite tile. | 152014.4 | 577781.4 | Asbestos |
| J1V550 | 03/12/15 | White, fibrous, chunky mass. Fibers visible. Friable. | 152014.4 | 577777.4 | Asbestos |
| J1V5L9 | 03/25/15 | Composite from test pit. Sandy gravel with reddish soil. | 152073.8 | 577804.3 | ICP metals [b] |
| J1V5M0 | 03/25/15 | Composite from test pit. Sandy gravel. Lots of debris. | 152073.6 | 577786.1 | ICP metals [b] |
| J1V5M2 | 03/25/15 | Composite from test pit. Sandy gravel, no debris. | 152046.9 | 577777.1 | ICP metals [b] |
| J1V5M3 | 03/25/15 | Composite rom test pit. Sandy gravel, debris, odor observed. | 152024.1 | 577782.4 | ICP metals [b] |
| J1V5M4 | 03/25/15 | Composite from test pit. Sandy gravel, no debris | 152002.2 | 577777.3 | ICP metals [b] |
| J1V609 | 04/08/15 | Composite collected from excavation. East sidewall of LDR area. Silty, sandy gravel. | NA | NA | ICP metals [b] |
| J1V610 | 04/08/15 | Composite collected from excavation. Floor of LDR area. Silt, moist from dust suppression water. | NA | NA | ICP metals [b] |
| J1V655 | 04/13/15 | Composite from excavation. Sandy gravel. | NA | NA | TPH – diesel, PCB |
| J1V660 | | | | | Asbestos |
| J1V656 | 04/13/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | TPH – diesel, PCB |
| J1V661 | | | | | Asbestos |
| J1V611 | 04/13/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V657 | | | | | TPH – diesel, PCB |
| J1V662 | | | | | Asbestos |
| J1V612 | 04/13/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V658 | | | | | TPH – diesel, PCB |
| J1V663 | | | | | Asbestos |

**Table B-1. 100-H-59:2 In-Process Sample Summary Table. (2 Pages)**

| Sample Number | Sample Date | Sample Description | Northing | Easting | Requested Analyses |
|---|---|---|---|---|---|
| J1V613 | 04/13/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V659 | | | | | TPH – diesel, PCB |
| J1V664 | | | | | Asbestos |
| J1V650 | 04/13/15 | Composite from excavation. Sandy gravel. | NA | NA | ICP metals [b] |
| J1V665 | | | | | TPH – diesel, PCB |
| J1V670 | | | | | Asbestos |
| J1V651 | 04/16/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V666 | | | | | TPH – diesel, PCB |
| J1V671 | | | | | Asbestos |
| J1V652 | 04/16/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V667 | | | | | TPH – diesel, PCB |
| J1V672 | | | | | Asbestos |
| J1V653 | 04/16/15 | Metal debris, broken glass, ash, iron oxide residue, fire bricks, evidence of burning, discolored soil. | 152035.7 | 577786.8 | ICP metals [b] |
| J1V668 | | | | | TPH – diesel, PCB |
| J1V687 | 04/24/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V680 | | | | | TPH – diesel, PCB |
| J1V674 | | | | | Asbestos |
| J1V688 | 04/24/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V692 | | | | | Asbestos |
| J1V689 | 04/24/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V682 | | | | | TPH – diesel, PCB |
| J1V693 | | | | | Asbestos |
| J1V690 | 04/24/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V694 | | | | | Asbestos |
| J1V654 | 04/27/15 | Composite from excavation. Silty, sandy, gravel. | NA | NA | ICP metals [b] |
| J1V669 | | | | | TPH – diesel, PCB |
| J1V673 | | | | | Asbestos |
| J1V750 | 05/04/15 | Composite from excavation. Sandy gravel (course sand). | NA | NA | Asbestos |
| J1V751 | 05/04/15 | Composite from excavation. Silty gravel. | NA | NA | Asbestos |

[a] ICP metals list – aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, selenium, silicon, silver, sodium, vanadium, zinc.

[b] Quick turn ICP metals list – arsenic, barium, beryllium cadmium, chromium, lead, selenium, silver.

GEA = gamma energy analysis
ICP = inductively coupled plasma
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

## Table B-2. 100-H-59:2 In-Process Analytical Data. (6 Pages)

| Sample Number | Sample Date | Northing | Easting | Americium-241 | | | Cesium-137 | | | Cobalt-60 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | GEA | | | GEA | | | GEA | | |
| | | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| J1V4X6 | 3/4/15 | | | -0.00442 | U | 0.0283 | 0.0105 | U | 0.0235 | 0.0125 | U | 0.0273 |
| J1V4X7 | 3/4/15 | | | 0.0201 | U | 0.0299 | 0.127 | | 0.0234 | -0.00109 | U | 0.0236 |

| Sample Number | Sample Date | Northing | Easting | Europium-152 | | | Europium-154 | | | Europium-155 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | GEA | | | GEA | | | GEA | | |
| | | | | pCi/g | Q | MDA | pCi/g | Q | MDA | pCi/g | Q | MDA |
| J1V4X6 | 3/4/15 | | | -0.00083 | U | 0.0458 | -0.016 | U | 0.0806 | 0.0269 | U | 0.042 |
| J1V4X7 | 3/4/15 | | | 0.0231 | U | 0.0569 | 0.0358 | U | 0.0883 | 0.0528 | | 0.0424 |

| Sample Number | Sample Date | Northing | Easting | Potassium-40 | | |
|---|---|---|---|---|---|---|
| | | | | GEA | | |
| | | | | pCi/g | Q | MDA |
| J1V4X6 | 3/4/15 | | | 13.4 | | 0.237 |
| J1V4X7 | 3/4/15 | | | 10.9 | | 0.247 |

| Sample Number | Sample Date | Northing | Easting | THP-Diesel Ext. | | | TPH-Diesel | | | Percent Moisture (wet sample) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ug/kg | Q | PQL | ug/kg | Q | PQL | % | Q | PQL |
| J1V4X6 | 3/4/15 | | | 3800 | J | 980 | 2900 | J | 670 | 3.3 | | 0 |
| J1V4X7 | 3/4/15 | | | 450000 | N | 1100 | 370000 | N | 720 | 5.7 | | 0 |
| J1V655 | 4/13/15 | | | 2000 | JB | 1000 | 2000 | JB | 680 | 2.5 | | 0 |
| J1V656 | 4/13/15 | | | 8000 | B | 1100 | 5700 | B | 720 | 6 | | 0 |
| J1V657 | 4/13/15 | | | 2300 | JB | 1000 | 2300 | JB | 680 | 6.1 | | 0 |
| J1V658 | 4/13/15 | | | 3100 | JB | 1000 | 2800 | JB | 710 | 6.1 | | 0 |
| J1V659 | 4/13/15 | | | 4600 | B | 1000 | 3300 | JB | 700 | 5.1 | | 0 |
| J1V665 | 4/13/15 | | | 1600 | J | 940 | 1600 | JB | 640 | 1 | | 0 |
| J1V666 | 4/16/15 | | | 2500 | J | 1000 | 2500 | JB | 690 | 3.4 | | 0 |
| J1V667 | 4/16/15 | | | 28000 | | 1000 | 16000 | B | 700 | 5.2 | | 0 |
| J1V668 | 4/16/15 | 152035.7 | 577786.8 | 130000 | | 1100 | 79000 | B | 740 | 9 | | 0 |
| J1V669 | 4/27/15 | | | 1100 | U | 1100 | 730 | U | 730 | 8.4 | | 0 |
| J1V682 | 4/27/15 | | | 4300 | | 980 | 2100 | J | 670 | 3.8 | | 0 |
| J1V680 | 4/27/15 | | | 12000 | | 990 | 7900 | | 680 | 1.6 | | 0 |

# Table B-2. 100-H-59:2 In-Process Analytical Data. (6 Pages)

| Sample Number | Sample Date | Northing | Easting | Aluminum | | | Antimony | | | Arsenic | | | Barium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V4X6 | 3/4/15 | | | 6430 | X | 1.4 | 0.79 | | 0.35 | 2.1 | M | 0.62 | 60.9 | X | 0.071 |
| J1V4X7 | 3/4/15 | | | 12600 | X | 1.6 | 11.3 | | 0.4 | 13.4 | | 0.69 | 330 | X | 0.08 |

| Sample Number | Sample Date | Northing | Easting | Beryllium | | | Boron | | | Cadmium | | | Calcium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V4X6 | 3/4/15 | | | 0.88 | | 0.031 | 1 | B | 0.91 | 0.11 | B | 0.038 | 5610 | X | 13.1 |
| J1V4X7 | 3/4/15 | | | 0.62 | | 0.035 | 30.5 | | 1 | 12.2 | | 0.043 | 9620 | X | 14.8 |

| Sample Number | Sample Date | Northing | Easting | Chromium | | | Cobalt | | | Copper | | | Iron | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V4X6 | 3/4/15 | | | 10.8 | X | 0.054 | 6.6 | X | 0.093 | 19.2 | | 0.2 | 20000 | X | 3.5 |
| J1V4X7 | 3/4/15 | | | 316 | X | 0.061 | 22.1 | X | 0.11 | 1580 | | 0.23 | 89300 | X | 4 |

| Sample Number | Sample Date | Northing | Easting | Lead | | | Magnesium | | | Manganese | | | Mercury | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V4X6 | 3/4/15 | | | 10.8 | | 0.25 | 4170 | X | 3.4 | 277 | X | 0.093 | 0.024 | M | 0.0065 |
| J1V4X7 | 3/4/15 | | | 2650 | | 0.28 | 4400 | X | 3.9 | 999 | X | 0.11 | 2.1 | | 0.034 |

| Sample Number | Sample Date | Northing | Easting | Molybdenum | | | Nickel | | | Potassium | | | Selenium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V4X6 | 3/4/15 | | | 0.24 | B | 0.24 | 12 | X | 0.11 | 983 | | 38.2 | 0.8 | U | 0.8 |
| J1V4X7 | 3/4/15 | | | 80.5 | | 0.27 | 287 | X | 0.13 | 1180 | | 43.1 | 1.2 | | 0.9 |

| Sample Number | Sample Date | Northing | Easting | Silicon | | | Silver | | | Sodium | | | Vanadium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V4X6 | 3/4/15 | | | 286 | XN | 5.3 | 0.15 | U | 0.15 | 196 | | 55 | 47.9 | | 0.088 |
| J1V4X7 | 3/4/15 | | | 432 | XN | 5.9 | 30.6 | | 0.17 | 1010 | | 62 | 31.7 | | 0.099 |

| Sample Number | Sample Date | Northing | Easting | Zinc | | |
|---|---|---|---|---|---|---|
| | | | | mg/kg | Q | PQL |
| J1V4X6 | 3/4/15 | | | 47.7 | X | 0.37 |
| J1V4X7 | 3/4/15 | | | 2050 | X | 0.42 |

| Sample Number | Sample Date | Northing | Easting | Bromide | | | Chloride | | | Fluoride | | | Nitrogen in Nitrate | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V718 | 5/12/15 | 152011 | 577786 | 0.39 | U | 0.39 | 20.8 | MNC | 2 | 2.5 | BN | 0.82 | 1.9 | BM | 0.31 |

| Sample Number | Sample Date | Northing | Easting | Nitrogen in Nitrite | | | Phosphorous in phosphate | | | Sulfate | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V718 | 5/12/15 | 152011 | 577786 | 1.2 | BMN | 0.34 | 1.2 | UN | 1.2 | 20.1 | MN | 1.7 |

## Table B-2. 100-H-59:2 In-Process Analytical Data. (6 Pages)

| Sample Number | Sample Date | Northing | Easting | Arsenic | | | Barium | | | Beryllium | | | Cadmium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | QT METAL | | | QT METAL | | | QT METAL | | | QT METAL | | |
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V5L9 | 3/25/15 | 152073.8 | 577804.3 | 1.4 | U | 1.73 | 55.9 | | 0.399 | 0.265 | | 0.0259 | 0.141 | U | 0.199 |
| J1V5M0 | 3/25/15 | 152073.6 | 577786.1 | 1.7 | U | 1.72 | 73 | | 0.395 | 0.332 | | 0.0257 | 0.136 | U | 0.198 |
| J1V5M2 | 3/25/15 | 152046.9 | 577777.1 | 1.5 | U | 1.75 | 63.3 | | 0.403 | 0.306 | | 0.0262 | 0.159 | U | 0.202 |
| J1V5M3 | 3/25/15 | 152024.1 | 577782.4 | 8.92 | U | 1.74 | 431 | | 0.401 | 0.32 | | 0.0261 | 8.33 | | 0.2 |
| J1V5M4 | 3/25/15 | 152002.2 | 577777.3 | 2.1 | U | 1.73 | 55.5 | | 0.398 | 0.273 | | 0.0259 | 0.157 | U | 0.199 |
| J1V609 | 4/8/15 | | | 1.82 | U | 1.73 | 61.3 | | 0.398 | 0.296 | | 0.0258 | 0.173 | U | 0.199 |
| J1V610 | 4/8/15 | | | 2.18 | U | 1.75 | 62.5 | | 0.402 | 0.274 | | 0.0261 | 0.176 | U | 0.201 |
| J1V611 | 4/13/15 | | | 1.76 | U | 1.77 | 68.1 | | 0.407 | 0.263 | | 0.0264 | 0.151 | U | 0.203 |
| J1V612 | 4/13/15 | | | 3.02 | U | 1.76 | 82 | | 0.406 | 0.339 | | 0.0264 | 0.158 | U | 0.203 |
| J1V613 | 4/13/15 | | | 2.22 | U | 1.7 | 80.1 | | 0.392 | 0.329 | | 0.0255 | 0.186 | U | 0.196 |
| J1V650 | 4/13/15 | | | 2.33 | U | 1.77 | 66.8 | | 0.406 | 0.292 | | 0.0264 | 0.141 | U | 0.203 |
| J1V651 | 4/16/15 | | | 2.21 | U | 1.71 | 62.3 | | 0.394 | 0.294 | | 0.0256 | 0.176 | U | 0.197 |
| J1V652 | 4/16/15 | | | 2.02 | U | 1.71 | 136 | | 0.393 | 0.288 | | 0.0256 | 0.517 | U | 0.197 |
| J1V653 | 4/16/15 | 152035.7 | 577786.8 | 5.86 | U | 1.74 | 258 | | 0.401 | 0.333 | | 0.0261 | 4.79 | | 0.2 |
| J1V654 | 4/27/15 | | | 2.22 | U | 1.72 | 67.4 | | 0.396 | 0.308 | | 0.0258 | 0.173 | U | 0.198 |
| J1V687 | 4/27/15 | | | 3.13 | U | 1.71 | 96.4 | | 0.394 | 0.401 | | 0.0256 | 0.502 | U | 0.197 |
| J1V688 | 4/27/15 | | | 2.91 | U | 1.75 | 75.1 | | 0.403 | 0.395 | | 0.0262 | 0.209 | U | 0.201 |
| J1V689 | 4/27/15 | | | 2.16 | U | 1.74 | 67.7 | | 0.4 | 0.362 | | 0.026 | 0.168 | U | 0.2 |
| J1V690 | 4/27/15 | | | 2.73 | U | 1.74 | 68.9 | | 0.4 | 0.36 | | 0.026 | 0.152 | U | 0.2 |

| Sample Number | Sample Date | Northing | Easting | Chromium | | | Lead | | | Selenium | | | Silver | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | QT METAL | | | QT METAL | | | QT METAL | | | QT METAL | | |
| | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| J1V5L9 | 3/25/15 | 152073.8 | 577804.3 | 8.62 | U | 0.797 | 3.59 | U | 0.857 | 0.867 | U | 2.39 | -0.078 | U | 1.91 |
| J1V5M0 | 3/25/15 | 152073.6 | 577786.1 | 10.8 | | 0.791 | 4.2 | U | 0.85 | 0.693 | U | 2.37 | -0.036 | U | 1.9 |
| J1V5M2 | 3/25/15 | 152046.9 | 577777.1 | 9.63 | U | 0.806 | 4.93 | U | 0.867 | 0.851 | U | 2.42 | -0.043 | U | 1.94 |
| J1V5M3 | 3/25/15 | 152024.1 | 577782.4 | 181 | | 0.802 | 697 | | 0.862 | 2.46 | U | 2.41 | 4.93 | U | 1.92 |
| J1V5M4 | 3/25/15 | 152002.2 | 577777.3 | 9.41 | U | 0.796 | 3.64 | U | 0.856 | 0.766 | U | 2.39 | -0.084 | U | 1.91 |
| J1V609 | 4/8/15 | | | 8.26 | U | 0.795 | 4.46 | U | 0.855 | 1.02 | U | 2.39 | -0.213 | U | 1.91 |
| J1V610 | 4/8/15 | | | 9.58 | U | 0.803 | 9.94 | U | 0.863 | 0.33 | U | 2.41 | -0.372 | U | 1.93 |
| J1V611 | 4/13/15 | | | 12.6 | | 0.813 | 5.15 | U | 0.874 | 1.01 | U | 2.44 | -0.056 | U | 1.95 |
| J1V612 | 4/13/15 | | | 13.7 | | 0.811 | 8.18 | U | 0.872 | 1.25 | U | 2.43 | 0.0278 | U | 1.95 |
| J1V613 | 4/13/15 | | | 11.9 | | 0.783 | 5.86 | U | 0.842 | 1.09 | U | 2.35 | -0.04 | U | 1.88 |
| J1V650 | 4/13/15 | | | 10.2 | | 0.812 | 5.21 | U | 0.873 | 1.11 | U | 2.44 | -0.097 | U | 1.95 |
| J1V651 | 4/16/15 | | | 8.99 | U | 0.788 | 5.81 | U | 0.847 | 0.41 | U | 2.36 | -0.193 | U | 1.89 |
| J1V652 | 4/16/15 | | | 75.4 | | 0.786 | 60.2 | | 0.845 | 0.218 | U | 2.36 | -0.111 | U | 1.89 |
| J1V653 | 4/16/15 | 152035.7 | 577786.8 | 444 | | 0.802 | 498 | | 0.862 | 1.55 | U | 2.4 | 1.2 | U | 1.92 |
| J1V654 | 4/27/15 | | | 9.9 | U | 0.792 | 8.34 | U | 0.852 | 0.404 | U | 2.38 | -0.13 | U | 1.9 |
| J1V687 | 4/27/15 | | | 14.3 | | 0.788 | 28.2 | | 0.847 | 0.865 | U | 2.36 | 0.51 | U | 1.89 |
| J1V688 | 4/27/15 | | | 18 | | 0.806 | 15.1 | | 0.866 | 0.719 | U | 2.42 | -0.106 | U | 1.93 |
| J1V689 | 4/27/15 | | | 9.9 | U | 0.799 | 5.55 | U | 0.859 | 0.661 | U | 2.4 | -0.104 | U | 1.92 |
| J1V690 | 4/27/15 | | | 11.2 | | 0.799 | 6.27 | U | 0.859 | 0.811 | U | 2.4 | -0.135 | U | 1.92 |

# Table B-2. 100-H-59:2 In-Process Analytical Data. (6 Pages)

| Sample Number | | J1V4X6 | | | J1V4X7 | | | J1V655 | | | J1V656 | | | J1V657 | | | J1V658 | | | J1V659 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Constituent | Class | 3/4/15 | | | 3/4/15 | | | 4/13/15 | | | 4/13/15 | | | 4/13/15 | | | 4/13/15 | | | 4/13/15 | | |
| | | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL |
| Acenaphthene | PAH | 9.9 | U | 9.9 | 190 | X | 11 | | | | | | | | | | | | | | | |
| Acenaphthylene | PAH | 8.9 | U | 8.9 | 38 | JNX | 9.5 | | | | | | | | | | | | | | | |
| Anthracene | PAH | 3 | U | 3 | 600 | N | 3.2 | | | | | | | | | | | | | | | |
| Benzo(a)anthracene | PAH | 3.2 | U | 3.2 | 1100 | | 3.4 | | | | | | | | | | | | | | | |
| Benzo(a)pyrene | PAH | 6.4 | U | 6.4 | 820 | N | 6.7 | | | | | | | | | | | | | | | |
| Benzo(b)fluoranthene | PAH | 4.2 | U | 4.2 | 620 | | 4.4 | | | | | | | | | | | | | | | |
| Benzo(ghi)perylene | PAH | 7.1 | U | 7.1 | 360 | NX | 7.6 | | | | | | | | | | | | | | | |
| Benzo(k)fluoranthene | PAH | 3.9 | U | 3.9 | 290 | N | 4.1 | | | | | | | | | | | | | | | |
| Chrysene | PAH | 4.8 | U | 4.8 | 840 | N | 5.1 | | | | | | | | | | | | | | | |
| Dibenz[a,h]anthracene | PAH | 11 | U | 11 | 110 | NX | 12 | | | | | | | | | | | | | | | |
| Fluoranthene | PAH | 13 | U | 13 | 1700 | N | 14 | | | | | | | | | | | | | | | |
| Fluorene | PAH | 5.2 | U | 5.2 | 230 | XN | 5.5 | | | | | | | | | | | | | | | |
| Indeno(1,2,3-cd)pyrene | PAH | 12 | U | 12 | 320 | X | 13 | | | | | | | | | | | | | | | |
| Naphthalene | PAH | 12 | U | 12 | 13 | UN | 13 | | | | | | | | | | | | | | | |
| Phenanthrene | PAH | 12 | U | 12 | 1300 | N | 13 | | | | | | | | | | | | | | | |
| Pyrene | PAH | 12 | U | 12 | 1300 | N | 13 | | | | | | | | | | | | | | | |
| Aroclor-1016 | PCB | 2.8 | U | 2.8 | 280 | UD | 280 | 2.8 | U | 2.8 | 2.9 | U | 2.9 | 2.7 | U | 2.7 | 2.9 | U | 2.9 | 2.9 | U | 2.9 |
| Aroclor-1221 | PCB | 8.1 | U | 8.1 | 820 | UD | 820 | 8 | U | 8 | 8.4 | U | 8.4 | 7.9 | U | 7.9 | 8.4 | U | 8.4 | 8.4 | U | 8.4 |
| Aroclor-1232 | PCB | 2 | U | 2 | 200 | UD | 200 | 2 | U | 2 | 2.1 | U | 2.1 | 2 | U | 2 | 2.1 | U | 2.1 | 2.1 | U | 2.1 |
| Aroclor-1242 | PCB | 4.7 | U | 4.7 | 480 | UD | 480 | 4.6 | U | 4.6 | 4.9 | U | 4.9 | 4.6 | U | 4.6 | 4.9 | U | 4.9 | 4.9 | U | 4.9 |
| Aroclor-1248 | PCB | 4.7 | U | 4.7 | 480 | UD | 480 | 4.6 | U | 4.6 | 4.9 | U | 4.9 | 4.6 | U | 4.6 | 4.9 | U | 4.9 | 4.9 | U | 4.9 |
| Aroclor-1254 | PCB | 45 | | 2.6 | 6300 | D | 270 | 2.6 | U | 2.6 | 76 | | 2.7 | 2.5 | U | 2.5 | 2.7 | U | 2.7 | 2.7 | U | 2.7 |
| Aroclor-1260 | PCB | 2.6 | U | 2.6 | 270 | UD | 270 | 2.6 | U | 2.6 | 2.7 | U | 2.7 | 2.5 | U | 2.5 | 2.7 | U | 2.7 | 2.7 | U | 2.7 |
| Aldrin | PEST | 0.26 | U | 0.26 | 2.7 | UD | 2.7 | | | | | | | | | | | | | | | |
| Alpha-BHC | PEST | 0.22 | U | 0.22 | 2.3 | UD | 2.3 | | | | | | | | | | | | | | | |
| alpha-Chlordane | PEST | 0.33 | U | 0.33 | 3.4 | UD | 3.4 | | | | | | | | | | | | | | | |
| beta-1,2,3,4,5,6-Hexachlorocyclohexane | PEST | 0.68 | U | 0.68 | 7 | UD | 7 | | | | | | | | | | | | | | | |
| Delta-BHC | PEST | 0.41 | U | 0.41 | 4.3 | UD | 4.3 | | | | | | | | | | | | | | | |
| Dichlorodiphenyldichloroethane | PEST | 0.56 | U | 0.56 | 5.8 | UD | 5.8 | | | | | | | | | | | | | | | |
| Dichlorodiphenyldichloroethylene | PEST | 0.25 | U | 0.25 | 2.5 | UD | 2.5 | | | | | | | | | | | | | | | |
| Dichlorodiphenyltrichloroethane | PEST | 0.61 | U | 0.61 | 6.3 | UD | 6.3 | | | | | | | | | | | | | | | |
| Dieldrin | PEST | 2.7 | | 0.22 | 2.2 | UD | 2.2 | | | | | | | | | | | | | | | |
| Endosulfan I | PEST | 0.18 | U | 0.18 | 1.9 | UD | 1.9 | | | | | | | | | | | | | | | |
| Endosulfan II | PEST | 0.3 | U | 0.3 | 3 | UD | 3 | | | | | | | | | | | | | | | |
| Endosulfan sulfate | PEST | 0.28 | U | 0.28 | 2.9 | UD | 2.9 | | | | | | | | | | | | | | | |
| Endrin | PEST | 0.32 | U | 0.32 | 3.2 | UD | 3.2 | | | | | | | | | | | | | | | |
| Endrin aldehyde | PEST | 0.18 | U | 0.18 | 1.8 | UD | 1.8 | | | | | | | | | | | | | | | |
| Endrin ketone | PEST | 0.5 | U | 0.5 | 5.2 | UD | 5.2 | | | | | | | | | | | | | | | |
| Gamma-BHC (Lindane) | PEST | 0.48 | U | 0.48 | 4.9 | UD | 4.9 | | | | | | | | | | | | | | | |
| gamma-Chlordane | PEST | 0.27 | U | 0.27 | 2.8 | UD | 2.8 | | | | | | | | | | | | | | | |
| Heptachlor | PEST | 0.22 | U | 0.22 | 2.3 | UD | 2.3 | | | | | | | | | | | | | | | |
| Heptachlor epoxide | PEST | 0.44 | U | 0.44 | 33 | XD | 4.5 | | | | | | | | | | | | | | | |
| Methoxychlor | PEST | 0.46 | U | 0.46 | 4.8 | UD | 4.8 | | | | | | | | | | | | | | | |
| Toxaphene | PEST | 16 | U | 16 | 170 | UD | 170 | | | | | | | | | | | | | | | |

## Table B-2. 100-H-59:2 In-Process Analytical Data. (6 Pages)

| Sample Number | | J1V665 | | | J1V666 | | | J1V667 | | | J1V668 | | | J1V669 | | | J1V680 | | | J1V682 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Constituent | Class | 4/13/15 | | | 4/16/15 | | | 4/16/15 | | | 4/16/15 | | | 4/27/15 | | | 4/27/15 | | | 4/27/15 | | |
| | | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL |
| Acenaphthene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Acenaphthylene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Anthracene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Benzo(a)anthracene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Benzo(a)pyrene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Benzo(b)fluoranthene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Benzo(ghi)perylene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Benzo(k)fluoranthene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Chrysene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Dibenz[a,h]anthracene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Fluoranthene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Fluorene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Indeno(1,2,3-cd)pyrene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Naphthalene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Phenanthrene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Pyrene | PAH | | | | | | | | | | | | | | | | | | | | | |
| Aroclor-1016 | PCB | 2.7 | U | 2.7 | 2.9 | U | 2.9 | 12 | UD | 12 | 60 | UD | 60 | 2.9 | U | 2.9 | 2.8 | U | 2.8 | 2.7 | U | 2.7 |
| Aroclor-1221 | PCB | 7.9 | U | 7.9 | 8.3 | U | 8.3 | 33 | UD | 33 | 170 | UD | 170 | 8.4 | U | 8.4 | 8 | U | 8 | 7.9 | U | 7.9 |
| Aroclor-1232 | PCB | 2 | U | 2 | 2.1 | U | 2.1 | 8.3 | UD | 8.3 | 43 | UD | 43 | 2.1 | U | 2.1 | 2 | U | 2 | 2 | U | 2 |
| Aroclor-1242 | PCB | 4.6 | U | 4.6 | 4.8 | U | 4.8 | 19 | UD | 19 | 100 | UD | 100 | 4.9 | U | 4.9 | 4.7 | U | 4.7 | 4.6 | U | 4.6 |
| Aroclor-1248 | PCB | 4.6 | U | 4.6 | 4.8 | U | 4.8 | 19 | UD | 19 | 100 | UD | 100 | 4.9 | U | 4.9 | 4.7 | U | 4.7 | 4.6 | U | 4.6 |
| Aroclor-1254 | PCB | 2.6 | U | 2.6 | 2.7 | U | 2.7 | 190 | D | 11 | 56 | UD | 56 | 2.7 | U | 2.7 | 43 | | 2.6 | 2.6 | U | 2.6 |
| Aroclor-1260 | PCB | 2.6 | U | 2.6 | 2.7 | U | 2.7 | 11 | UD | 11 | 900 | D | 56 | 2.7 | U | 2.7 | 2.6 | UN | 2.6 | 2.6 | U | 2.6 |
| Aldrin | PEST | | | | | | | | | | | | | | | | | | | | | |
| Alpha-BHC | PEST | | | | | | | | | | | | | | | | | | | | | |
| alpha-Chlordane | PEST | | | | | | | | | | | | | | | | | | | | | |
| beta-1,2,3,4,5,6-Hexachlorocyclohexane | PEST | | | | | | | | | | | | | | | | | | | | | |
| Delta-BHC | PEST | | | | | | | | | | | | | | | | | | | | | |
| Dichlorodiphenyldichloroethane | PEST | | | | | | | | | | | | | | | | | | | | | |
| Dichlorodiphenyldichloroethylene | PEST | | | | | | | | | | | | | | | | | | | | | |
| Dichlorodiphenyltrichloroethane | PEST | | | | | | | | | | | | | | | | | | | | | |
| Dieldrin | PEST | | | | | | | | | | | | | | | | | | | | | |
| Endosulfan I | PEST | | | | | | | | | | | | | | | | | | | | | |
| Endosulfan II | PEST | | | | | | | | | | | | | | | | | | | | | |
| Endosulfan sulfate | PEST | | | | | | | | | | | | | | | | | | | | | |
| Endrin | PEST | | | | | | | | | | | | | | | | | | | | | |
| Endrin aldehyde | PEST | | | | | | | | | | | | | | | | | | | | | |
| Endrin ketone | PEST | | | | | | | | | | | | | | | | | | | | | |
| Gamma-BHC (Lindane) | PEST | | | | | | | | | | | | | | | | | | | | | |
| gamma-Chlordane | PEST | | | | | | | | | | | | | | | | | | | | | |
| Heptachlor | PEST | | | | | | | | | | | | | | | | | | | | | |
| Heptachlor epoxide | PEST | | | | | | | | | | | | | | | | | | | | | |
| Methoxychlor | PEST | | | | | | | | | | | | | | | | | | | | | |
| Toxaphene | PEST | | | | | | | | | | | | | | | | | | | | | |

## Table B-2. 100-H-59:2 In-Process Analytical Data. (6 Pages)

| Sample Number | Sample Date | Northing | Easting | Sample Type | Total Asbestos | Comments |
|---|---|---|---|---|---|---|
| J1V546 | 3/12/15 | 152013.4 | 577783.7 | Solid, misc. material | ND | |
| J1V547 | 3/12/15 | 152011.4 | 577782.7 | Solid, misc. material | ND | |
| J1V548 | 3/12/15 | 152013.8 | 577784.8 | Solid, misc. material | 40 | |
| J1V549 | 3/12/15 | 152014.4 | 577781.4 | Solid, misc. material | ND | |
| J1V550 | 3/12/15 | 152014.4 | 577777.4 | Solid, misc. material | **46** | |
| J1V660 | 4/13/15 | NA | NA | Soil | ND | |
| J1V661 | 4/13/15 | NA | NA | Soil | ND | |
| J1V662 | 4/13/15 | NA | NA | Soil | ND | |
| J1V663 | 4/13/15 | NA | NA | Soil | ND | |
| J1V664 | 4/13/15 | NA | NA | Soil | ND | |
| J1V670 | 4/13/15 | NA | NA | Soil | ND | |
| J1V671 | 4/16/15 | NA | NA | Soil | ND | |
| J1V672 | 4/16/15 | NA | NA | Soil | ND | |
| J1V674 | 4/27/15 | NA | NA | Soil | ND | |
| J1V692 | 4/27/15 | NA | NA | Soil | **6** | |
| J1V693 | 4/27/15 | NA | NA | Soil | ND | |
| J1V694 | 4/27/15 | NA | NA | Soil | **1** | |
| J1V673 | 4/27/15 | NA | NA | Soil | ND | |
| J1V750 | 5/4/15 | NA | NA | Soil | ND | Collected from same location as J1V692 after additional soil removed |
| J1V751 | 5/4/15 | NA | NA | Soil | ND | Collected from same location as J1V694 after additional soil removed |

# APPENDIX C

# CALCULATIONS

# APPENDIX C

## CALCULATION BRIEFS

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

*100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations*, 0100H-CA-V0233, Rev. 0, Washington Closure Hanford, Richland, Washington.

*100-H-59:2 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations*, 0100H-CA-V0234, Rev. 0, Washington Closure Hanford, Richland, Washington.

*100-H-59:2 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater*, 0100H-CA-V0235, Rev. 0, Washington Closure Hanford, Richland, Washington.

**DISCLAIMER FOR CALCULATIONS**

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

Acrobat 8.0

# CALCULATION COVER SHEET

Project Title: 100-H Area Closure Operations **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0233

Subject: 100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

| Rev. | Sheet Numbers | Originator | Checker | Reviewer | Approval | Date |
|---|---|---|---|---|---|---|
| 0 | Cover = 1<br>Sheets = 10<br>Attm. 1 = 6<br>Total = 17 | R. J. Nielson | I. B. Berezovskiy | T. Q. Howell | S. G. Wilkinson | 11/12/15 |
| | | | | | | |
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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

**CALCULATION SHEET**

***Washington Closure Hanford***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Originator** | R. J. Nielson | **Date** | 08/26/15 | **Calc. No.** | 0100H-CA-V0233 | **Rev. No.** | 0 |
| **Project** | 100-H Area Closure Operations | **Job No.** | 14655 | **Checked** | I. B. Berezovskiy | **Date** | 08/26/15 |
| **Subject** | 100-H-59:2 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 7- Calculation Sheet Verification Data - Excavation Area
Sheet 8 to 9 - Ecology Software (MTCAStat) Results
Sheet 10 - Calculation Sheet Duplicate and Split Analysis
Attachment 1 - 100-H-59:2 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, 2014, 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-H-59:2 subsite. The data were entered into an EXCEL 2010 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2009b) is documented by this calculation. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

**Methodology:**
The 100-H-59:2 subsite underwent statistical sampling at two decision units for verification sampling that included the excavation and the anomaly staging area.

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

**CALCULATION SHEET**

***Washington Closure Hanford***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Originator** | R. J. Nielson | **Date** | 08/26/15 | **Calc. No.** | 0100H-CA-V0233 | **Rev. No.** | 0 |
| **Project** | 100-H Area Closure Operations | **Job No.** | 14655 | **Checked** | I. B. Berezovskiy | **Date** | 08/26/15 |
| **Subject** | 100-H-59:2 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 (2014) under WAC 173-340-740(3) for aluminum, calcium, iron, 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 RPD is calculated when both the primary value and either the duplicate or split value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed in Table 2-1 of the SAP (DOE-RL 2009a) for certain constituents. All other constituents will have their own pre-determined TDL's based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For splits, a threshold of 35% is used. If the RPD is greater than 30% (or 35% for split data), further investigation regarding the usability of the data is performed. To assist in the identification of anomalous sample pairs, when an analyte is detected in the primary or duplicate/split sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate/split result exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable RSVP.

**CALCULATION SHEET**

***Washington Closure Hanford***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Originator** | R. J. Nielson | **Date** | 08/26/15 | **Calc. No.** | 0100H-CA-V0233 | **Rev. No.** | 0 |
| **Project** | 100-H Area Closure Operations | **Job No.** | 14655 | **Checked** | I. B. Berezovskiy | **Date** | 08/26/15 |
| **Subject** | 100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations | | | | | **Sheet No.** | 3 of 10 |

**Summary (continued)**

**QUALIFIER LIST**

* = duplicate analysis not within control limits
B = estimated result. The result is less than the RL but greater than the MDL
C = analyte was detected in both the sample and the associated QC blank, sample concentration </= 5x the blank.
D = result is reported from a diluted aliquot of sample
J = value is estimated
M = sample duplicate precision not met
N = recovery is outside control limits
U = undetected
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals)
X = more than 40% difference between columns, lower result reported (organics)

**ACRONYM LIST**

-- = not applicable
ASA = anomaly staging area
COC/COPC = contaminant of concern/contaminant of potential concern
DE = direct exposure
EXC = excavation
FS = focused sample
GW = groundwater
MDL = method detection limit
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)
RL = reporting limit
RPD = relative percent difference
RSVP = remaining sites verification package
SAP = sampling and analysis plan
TDL = target detection limit
UCL = upper confidence limit
WAC = Washington Administrative Code

**CALCULATION SHEET**

***Washington Closure Hanford***

| | | | | | |
|---|---|---|---|---|---|
| **Originator** R. J. Nielson | **Date** 08/26/15 | **Calc. No.** 0100H-CA-V0233 | | **Rev. No.** 0 | |
| **Project** 100-H Area Closure Operations | **Job No.** 14655 | **Checked** I. B. Berezovskiy | | **Date** 08/26/15 | |
| **Subject** 100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations | | | | **Sheet No.** 4 of 10 | |

**Summary (continued)**

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

**Results Summary [a]**

| Analyte | Excavation | | | Anomaly Staging Area Maximum Result | Units |
|---|---|---|---|---|---|
| | 95% UCL Result | Maximum Result | Focused Maximum Result | | |
| Antimony | 0.43 | -- | -- | -- | mg/kg |
| Arsenic | 3.5 | -- | 3.5 | 3.2 | mg/kg |
| Barium | 84.5 | -- | 86.7 | 67.4 | mg/kg |
| Beryllium | 0.38 | -- | 0.42 | 0.29 | mg/kg |
| Boron | 3.7 | -- | 1.5 | 1.5 | mg/kg |
| Cadmium | 0.10 | -- | 0.097 | 0.10 | mg/kg |
| Chromium | 13.1 | -- | 13.4 | 9.6 | mg/kg |
| Cobalt | 7.1 | -- | 7.6 | 5.6 | mg/kg |
| Copper | 18.6 | -- | 15.6 | 12.6 | mg/kg |
| Hexavalent chromium | 0.723 | -- | 0.336 | 0.155 | mg/kg |
| Lead | 9.1 | -- | 5.2 | 7.0 | mg/kg |
| Manganese | 323 | -- | 327 | 273 | mg/kg |
| Mercury | -- | 0.033 | -- | -- | mg/kg |
| Molybdenum | -- | 0.56 | -- | -- | mg/kg |
| Nickel | 14.1 | -- | 15.7 | 10.2 | mg/kg |
| Vanadium | 47.6 | -- | 44.7 | 42.4 | mg/kg |
| Zinc | 43.6 | -- | 40.0 | 34.9 | mg/kg |
| TPH - diesel range extended | -- | 5.2 | 1.4 | 13 | mg/kg |
| TPH - diesel range | -- | 2.7 | 1.1 | 5.4 | mg/kg |
| Acenaphthene | -- | -- | -- | 0.031 | mg/kg |
| Anthracene | -- | -- | -- | 0.024 | mg/kg |
| Benzo(a)anthracene | -- | -- | -- | 0.100 | mg/kg |
| Benzo(a)pyrene | -- | -- | -- | 0.069 | mg/kg |
| Benzo(b)fluoranthene | -- | -- | -- | 0.100 | mg/kg |
| Benzo(ghi)perylene | -- | -- | -- | 0.056 | mg/kg |
| Benzo(k)fluoranthene | -- | -- | -- | 0.031 | mg/kg |
| Chrysene | -- | -- | -- | 0.085 | mg/kg |
| Fluoranthene | -- | -- | -- | 0.160 | mg/kg |
| Fluorene | -- | -- | -- | 0.023 | mg/kg |
| Indeno(1,2,3-cd)pyrene | -- | -- | -- | 0.053 | mg/kg |
| Phenanthrene | -- | -- | -- | 0.098 | mg/kg |
| Pyrene | -- | -- | -- | 0.160 | mg/kg |
| Dieldrin | -- | 0.00085 | -- | -- | mg/kg |
| **3 Part Test Evaluation:** | | | | | |
| 95% UCL or Maximum[a] > Cleanup Limit? | NO | NO | NA | NA | |
| > 10% above Cleanup Limit? | YES | NO | NA | NA | |
| Any sample > 2x Cleanup Limit? | YES | NO | NA | NA | |

[a]The 95% UCL result or maximum value, depending on data censorship,

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

| Analyte | Excavation Duplicate Analysis | Excavation Split Analysis |
|---|---|---|
| Aluminum | 0.0% | ***50.4%*** |
| Barium | 5.1% | 9.6% |
| Calcium | 3.0% | 25.4% |
| Chromium | 1.5% | 19.8% |
| Copper | 4.5% | 14.2% |
| Iron | 0.5% | 8.3% |
| Magnesium | 1.4% | 9.2% |
| Manganese | 2.5% | 5.0% |
| Silicon | 0.6% | ***107.4%*** |
| Sodium | 5.9% | -- |
| Vanadium | 3.2% | 3.3% |
| Zinc | 0.7% | 1.4% |

[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% (or 35% for split data), is addressed in the data quality assessment section of the RSVP.

**CALCULATION SHEET**

***Washington Closure Hanford***

**Originator** R. J. Nielson
**Project** 100-H Area Closure Operations
**Subject** 100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations

**Date** 08/26/15
**Job No.** 14655

**Calc. No.** 0100H-CA-V0233
**Checked** I. B. Berezovskiy

**Rev. No.** 0
**Date** 08/26/15
**Sheet No.** 5 of 10

**100-H-59:2 Subsite Statistical Calculations**

**Verification Data -Excavation**

| Sample Area | Sample Number | Sample Date | Antimony mg/kg | Q | PQL | Arsenic mg/kg | Q | PQL | Barium mg/kg | Q | PQL | Beryllium mg/kg | Q | PQL | Boron mg/kg | Q | PQL | Cadmium mg/kg | Q | PQL | Chromium mg/kg | Q | PQL | Cobalt mg/kg | Q | PQL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EXC-1 | J1V7P6 | 7/6/15 | 0.61 | J | 0.36 | 3.3 | | 0.63 | 85.4 | | 0.072 | 0.41 | | 0.031 | 1.5 | B | 0.93 | 0.086 | B | 0.039 | 13.3 | | 0.055 | 7.3 | X | 0.095 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 0.46 | BJ | 0.36 | 3.5 | | 0.62 | 89.9 | | 0.071 | 0.41 | | 0.031 | 1.4 | B | 0.92 | 0.12 | B | 0.038 | 13.5 | | 0.054 | 7.3 | X | 0.093 |
| EXC-2 | J1V7P7 | 7/6/15 | 0.55 | BJ | 0.38 | 3.8 | | 0.65 | 73.6 | | 0.075 | 0.35 | | 0.033 | 6.9 | | 0.97 | 0.11 | B | 0.041 | 13.6 | | 0.058 | 7.0 | X | 0.099 |
| EXC-3 | J1V7P8 | 7/6/15 | 0.37 | UJ | 0.37 | 3.0 | | 0.63 | 56.4 | | 0.073 | 0.31 | | 0.032 | 1.0 | B | 0.94 | 0.11 | B | 0.039 | 12.3 | | 0.056 | 6.9 | X | 0.096 |
| EXC-4 | J1V7P9 | 7/6/15 | 0.35 | UJ | 0.35 | 3.1 | | 0.61 | 63.1 | | 0.071 | 0.34 | | 0.031 | 2.7 | | 0.91 | 0.080 | B | 0.038 | 13.0 | | 0.054 | 6.7 | X | 0.093 |
| EXC-5 | J1V7R0 | 7/6/15 | 0.34 | UJ | 0.34 | 2.8 | | 0.58 | 83.6 | | 0.067 | 0.40 | | 0.029 | 2.6 | | 0.87 | 0.093 | B | 0.036 | 12.4 | | 0.051 | 7.7 | X | 0.088 |
| EXC-6 | J1V7R1 | 7/6/15 | 0.36 | UJ | 0.36 | 2.9 | | 0.62 | 43.0 | | 0.071 | 0.29 | | 0.031 | 3.6 | | 0.92 | 0.041 | B | 0.039 | 11.7 | | 0.055 | 5.6 | X | 0.094 |
| EXC-7 | J1V7R2 | 7/6/15 | 0.39 | UJ | 0.39 | 4.0 | | 0.68 | 84.5 | | 0.079 | 0.38 | | 0.034 | 1.3 | B | 1.0 | 0.084 | B | 0.043 | 13.0 | | 0.060 | 7.0 | X | 0.10 |
| EXC-8 | J1V7R3 | 7/6/15 | 0.50 | BJ | 0.36 | 2.0 | | 0.62 | 35.4 | | 0.071 | 0.27 | | 0.031 | 1.5 | B | 0.92 | 0.057 | B | 0.038 | 11.4 | | 0.054 | 5.4 | X | 0.094 |
| EXC-9 | J1V7R4 | 7/6/15 | 0.54 | BJ | 0.38 | 3.2 | | 0.66 | 67.3 | | 0.076 | 0.34 | | 0.033 | 1.4 | B | 0.98 | 0.078 | B | 0.041 | 12.0 | | 0.058 | 6.8 | X | 0.10 |
| EXC-10 | J1V7R5 | 7/6/15 | 0.37 | UJ | 0.37 | 3.1 | | 0.65 | 59.2 | | 0.075 | 0.34 | | 0.032 | 0.96 | U | 0.96 | 0.084 | B | 0.040 | 11.9 | | 0.057 | 6.6 | X | 0.098 |
| EXC-11 | J1V7R6 | 7/6/15 | 0.52 | J | 0.32 | 3.8 | | 0.56 | 95.4 | | 0.064 | 0.45 | | 0.028 | 1.6 | B | 0.83 | 0.089 | B | 0.035 | 14.4 | | 0.049 | 7.8 | X | 0.085 |
| EXC-12 | J1V7R7 | 7/6/15 | 0.46 | BJ | 0.35 | 3.4 | | 0.62 | 91.1 | | 0.071 | 0.34 | | 0.031 | 2.5 | | 0.91 | 0.11 | B | 0.038 | 12.1 | | 0.054 | 6.8 | X | 0.093 |

**Statistical Computation Input Data**

| Sample Area | Sample Number | Sample Date | Antimony mg/kg | Arsenic mg/kg | Barium mg/kg | Beryllium mg/kg | Boron mg/kg | Cadmium mg/kg | Chromium mg/kg | Cobalt mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|
| EXC-1 | J1V7P6/ J1V7R8 | 7/6/15 | 0.54 | 3.4 | 87.7 | 0.41 | 1.5 | 0.10 | 13.4 | 7.3 |
| EXC-2 | J1V7P7 | 7/6/15 | 0.55 | 3.8 | 73.6 | 0.35 | 6.9 | 0.11 | 13.6 | 7.0 |
| EXC-3 | J1V7P8 | 7/6/15 | 0.19 | 3.0 | 56.4 | 0.31 | 1.0 | 0.11 | 12.3 | 6.9 |
| EXC-4 | J1V7P9 | 7/6/15 | 0.18 | 3.1 | 63.1 | 0.34 | 2.7 | 0.080 | 13.0 | 6.7 |
| EXC-5 | J1V7R0 | 7/6/15 | 0.17 | 2.8 | 83.6 | 0.40 | 2.6 | 0.093 | 12.4 | 7.7 |
| EXC-6 | J1V7R1 | 7/6/15 | 0.18 | 2.9 | 43.0 | 0.29 | 3.6 | 0.041 | 11.7 | 5.6 |
| EXC-7 | J1V7R2 | 7/6/15 | 0.20 | 4.0 | 84.5 | 0.38 | 1.3 | 0.084 | 13.0 | 7.0 |
| EXC-8 | J1V7R3 | 7/6/15 | 0.50 | 2.0 | 35.4 | 0.27 | 1.5 | 0.057 | 11.4 | 5.4 |
| EXC-9 | J1V7R4 | 7/6/15 | 0.54 | 3.2 | 67.3 | 0.34 | 1.4 | 0.078 | 12.0 | 6.8 |
| EXC-10 | J1V7R5 | 7/6/15 | 0.19 | 3.1 | 59.2 | 0.34 | 0.5 | 0.084 | 11.9 | 6.6 |
| EXC-11 | J1V7R6 | 7/6/15 | 0.52 | 3.8 | 95.4 | 0.45 | 1.6 | 0.089 | 14.4 | 7.8 |
| EXC-12 | J1V7R7 | 7/6/15 | 0.46 | 3.4 | 91.1 | 0.34 | 2.5 | 0.11 | 12.1 | 6.8 |

**Statistical Computations**

| | Antimony | Arsenic | Barium | Beryllium | Boron | Cadmium | Chromium | Cobalt |
|---|---|---|---|---|---|---|---|---|
| 95% UCL based on | Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥ 10), use MTCAStat normal distribution. | Large data set (n ≥ 10), use MTCAStat lognormal distribution. | Large data set (n ≥ 10), use MTCAStat lognormal distribution. | Large data set (n ≥ 10), use MTCAStat lognormal distribution. | Large data set (n ≥ 10), use MTCAStat normal distribution. | Large data set (n ≥ 10), use MTCAStat lognormal distribution. | Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic. |
| N | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| % < Detection limit | 50% | 0% | 0% | 0% | 8% | 0% | 0% | 0% |
| Mean | 0.35 | 3.2 | 70.0 | 0.35 | 2.3 | 0.087 | 12.6 | 6.8 |
| Standard deviation | 0.18 | 0.54 | 19.3 | 0.051 | 1.7 | 0.021 | 0.89 | 0.71 |
| 95% UCL on mean | 0.43 | 3.5 | 84.5 | 0.38 | 3.7 | 0.10 | 13.1 | 7.1 |
| Maximum value | 0.61 | 4.0 | 95.4 | 0.45 | 6.9 | 0.12 | 14.4 | 7.8 |
| **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 | 320 GW Protection | 0.81 GW & River Protection | 18.5 GW & River Protection | 15.7 GW Protection |
| **WAC 173-340 3-PART TEST** | | | | | | | | |
| 95% UCL > Cleanup Limit? | NA | NA | NA | NA | NO | NA | NA | NA |
| > 10% above Cleanup Limit? | NA | NA | NA | NA | NO | NA | NA | NA |
| Any sample > 2X Cleanup Limit? | NA | NA | NA | NA | NO | NA | NA | NA |
| **WAC 173-340 Compliance?** | Because all values are below background (5 mg/kg), the WAC 173-340 3-part test is not required. | Because all values are below background (6.5 mg/kg), the WAC 173-340 3-part test is not required. | Because all values are below background (132 mg/kg), the WAC 173-340 3-part test is not required. | Because all values are below background (1.51 mg/kg), the WAC 173-340 3-part test is not required. | The data set meets the 3-part test criteria when compared to the most stringent RAG. | Because all values are below background (0.81 mg/kg), the WAC 173-340 3-part test is not required. | Because all values are below background (18.5 mg/kg), the WAC 173-340 3-part test is not required. | Because all values are below background (15.7 mg/kg), the WAC 173-340 3-part test is not required. |

**CALCULATION SHEET**

***Washington Closure Hanford***

**Originator** R. J. Nielson
**Project** 100-H Area Closure Operations
**Subject** 100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations

**Date** 08/26/15
**Job No.** 14655

**Calc. No.** 0100H-CA-V0233
**Checked** I. B. Berezovskiy

**Rev. No.** 0
**Date** 08/26/15
**Sheet No.** 6 of 10

**100-H-59:2 Subsite Statistical Calculations**

**Verification Data -Excavation**

| Sample Area | Sample Number | Sample Date | Copper mg/kg | Copper Q | Copper PQL | Hexavalent Chromium mg/kg | Hexavalent Chromium Q | Hexavalent Chromium PQL | Lead mg/kg | Lead Q | Lead PQL | Manganese mg/kg | Manganese Q | Manganese PQL | Nickel mg/kg | Nickel Q | Nickel PQL | Vanadium mg/kg | Vanadium Q | Vanadium PQL | Zinc mg/kg | Zinc Q | Zinc PQL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EXC-1 | J1V7P6 | 7/6/15 | 15.1 | | 0.21 | 0.796 | | 0.155 | 5.0 | | 0.26 | 351 | | 0.095 | 13.0 | X | 0.12 | 47.2 | | 0.089 | 41.7 | X | 0.38 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 15.8 | | 0.20 | 0.341 | | 0.155 | 5.1 | | 0.25 | 360 | | 0.093 | 12.8 | X | 0.11 | 45.7 | | 0.088 | 42.0 | X | 0.37 |
| EXC-2 | J1V7P7 | 7/6/15 | 15.9 | | 0.22 | 0.639 | | 0.155 | 4.3 | | 0.27 | 313 | | 0.099 | 12.5 | X | 0.12 | 47.4 | | 0.093 | 37.9 | X | 0.39 |
| EXC-3 | J1V7P8 | 7/6/15 | 25.7 | | 0.21 | 0.426 | | 0.155 | 10.6 | | 0.26 | 299 | | 0.096 | 13.6 | X | 0.12 | 52.6 | | 0.090 | 39.4 | X | 0.38 |
| EXC-4 | J1V7P9 | 7/6/15 | 17.6 | | 0.20 | 0.597 | | 0.155 | 4.3 | | 0.25 | 280 | | 0.093 | 14.4 | X | 0.11 | 49.4 | | 0.087 | 37.8 | X | 0.37 |
| EXC-5 | J1V7R0 | 7/6/15 | 15.9 | | 0.19 | 0.959 | | 0.155 | 5.3 | | 0.24 | 342 | | 0.088 | 13.8 | X | 0.11 | 45.0 | | 0.083 | 39.1 | X | 0.35 |
| EXC-6 | J1V7R1 | 7/6/15 | 17.8 | | 0.20 | 0.460 | | 0.155 | 3.0 | | 0.25 | 249 | | 0.094 | 11.8 | X | 0.12 | 46.3 | | 0.088 | 32.3 | X | 0.37 |
| EXC-7 | J1V7R2 | 7/6/15 | 14.6 | | 0.23 | 0.335 | | 0.155 | 4.7 | | 0.28 | 319 | | 0.10 | 14.3 | X | 0.13 | 44.0 | | 0.098 | 37.8 | X | 0.41 |
| EXC-8 | J1V7R3 | 7/6/15 | 14.9 | | 0.20 | 0.278 | | 0.155 | 3.6 | | 0.25 | 209 | | 0.094 | 10.4 | X | 0.12 | 37.4 | | 0.088 | 28.1 | X | 0.37 |
| EXC-9 | J1V7R4 | 7/6/15 | 15.3 | | 0.22 | 0.217 | | 0.155 | 5.0 | | 0.27 | 301 | | 0.10 | 12.4 | X | 0.12 | 43.3 | | 0.094 | 41.3 | X | 0.40 |
| EXC-10 | J1V7R5 | 7/6/15 | 15.2 | | 0.21 | 0.260 | | 0.155 | 4.4 | | 0.26 | 290 | | 0.098 | 15.1 | X | 0.12 | 46.2 | | 0.092 | 36.7 | X | 0.39 |
| EXC-11 | J1V7R6 | 7/6/15 | 18.6 | | 0.18 | 0.402 | | 0.155 | 6.3 | | 0.23 | 350 | | 0.085 | 15.1 | X | 0.10 | 45.3 | | 0.080 | 40.8 | X | 0.34 |
| EXC-12 | J1V7R7 | 7/6/15 | 18.7 | | 0.20 | 0.155 | U | 0.155 | 22.1 | | 0.25 | 312 | | 0.093 | 12.6 | X | 0.11 | 47.1 | | 0.088 | 62.7 | X | 0.37 |

**Statistical Computation Input Data**

| Sample Area | Sample Number | Sample Date | Copper mg/kg | Hexavalent Chromium mg/kg | Lead mg/kg | Manganese mg/kg | Nickel mg/kg | Vanadium mg/kg | Zinc mg/kg |
|---|---|---|---|---|---|---|---|---|---|
| EXC-1 | J1V7P6/ J1V7R8 | 7/6/15 | 15.5 | 0.569 | 5.1 | 356 | 12.9 | 46.5 | 41.9 |
| EXC-2 | J1V7P7 | 7/6/15 | 15.9 | 0.639 | 4.3 | 313 | 12.5 | 47.4 | 37.9 |
| EXC-3 | J1V7P8 | 7/6/15 | 25.7 | 0.426 | 10.6 | 299 | 13.6 | 52.6 | 39.4 |
| EXC-4 | J1V7P9 | 7/6/15 | 17.6 | 0.597 | 4.3 | 280 | 14.4 | 49.4 | 37.8 |
| EXC-5 | J1V7R0 | 7/6/15 | 15.9 | 0.959 | 5.3 | 342 | 13.8 | 45.0 | 39.1 |
| EXC-6 | J1V7R1 | 7/6/15 | 17.8 | 0.460 | 3.0 | 249 | 11.8 | 46.3 | 32.3 |
| EXC-7 | J1V7R2 | 7/6/15 | 14.6 | 0.335 | 4.7 | 319 | 14.3 | 44.0 | 37.8 |
| EXC-8 | J1V7R3 | 7/6/15 | 14.9 | 0.278 | 3.6 | 209 | 10.4 | 37.4 | 28.1 |
| EXC-9 | J1V7R4 | 7/6/15 | 15.3 | 0.217 | 5.0 | 301 | 12.4 | 43.3 | 41.3 |
| EXC-10 | J1V7R5 | 7/6/15 | 15.2 | 0.260 | 4.4 | 290 | 15.1 | 46.2 | 36.7 |
| EXC-11 | J1V7R6 | 7/6/15 | 18.6 | 0.402 | 6.3 | 350 | 15.1 | 45.3 | 40.8 |
| EXC-12 | J1V7R7 | 7/6/15 | 18.7 | 0.078 | 22.1 | 312 | 12.6 | 47.1 | 62.7 |

**Statistical Computations**

| | Copper | Hexavalent Chromium | Lead | Manganese | Nickel | Vanadium | Zinc |
|---|---|---|---|---|---|---|---|
| 95% UCL based on | Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥ 10), use MTCAStat lognormal distribution. | Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥ 10), use MTCAStat normal distribution. | Large data set (n ≥ 10), use MTCAStat lognormal distribution. | Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic. | Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic. |
| N | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| % < Detection limit | 0% | 8% | 0% | 0% | 0% | 0% | 0% |
| Mean | 17.1 | 0.435 | 6.6 | 302 | 13.2 | 45.9 | 39.6 |
| Standard deviation | 3.1 | 0.234 | 5.3 | 42.0 | 1.4 | 3.6 | 8.2 |
| 95% UCL on mean | 18.6 | 0.723 | 9.1 | 323 | 14.1 | 47.6 | 43.6 |
| Maximum value | 25.7 | 0.959 | 22.1 | 360 | 15.1 | 52.6 | 62.7 |
| **Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)** | 22.0 River Protection | 2 River Protection | 10.2 GW & River Protection | 512 GW & River Protection | 19.1 GW Protection | 85.1 GW Protection | 67.8 River Protection |
| **WAC 173-340 3-PART TEST** | | | | | | | |
| 95% UCL > Cleanup Limit? | NO | NO | NO | NA | NA | NA | NA |
| > 10% above Cleanup Limit? | NO | NO | YES | NA | NA | NA | NA |
| Any sample > 2X Cleanup Limit? | NO | NO | YES | NA | NA | NA | NA |
| **WAC 173-340 Compliance?** | The data set meets the 3-part test criteria when compared to the most stringent RAG. | The data set meets the 3-part test criteria when compared to the most stringent RAG. | 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. | Because all values are below background (19.1 mg/kg), the WAC 173-340 3-part test is not required. | Because all values are below background (85.1 mg/kg), the WAC 173-340 3-part test is not required. | Because all values are below background (67.8 mg/kg), the WAC 173-340 3-part test is not required. |

**MAXIMUM VALUE 3-PART TEST CALCULATION SHEET**

***Washington Closure Hanford***
**Originator** R. J. Nielson
**Project** 100-H Area Closure Operations
**Subject** 100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations

**Date** 08/26/15
**Job No.** 14655

**Calc. No.** 0100H-CA-V0233
**Checked** I. B. Berezovskiy

**Rev. No.** 0
**Date** 08/26/15
**Sheet No.** 7 of 10

1 **100-H-59:2 Subsite Maximum Calculations**
2 **Verification Data - Excavation**

| 3 | Sample Area | Sample Number | Sample Date | Mercury | | | Molybdenum | | | TPH - Diesel Range Extended | | | TPH - Diesel Range | | | Dieldrin | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | | | | mg/kg | Q | PQL | mg/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL |
| 5 | EXC-1 | J1V7P6 | 7/6/15 | 0.0059 | UN | 0.0059 | 0.40 | B | 0.25 | 990 | U | 990 | 680 | U | 680 | 0.19 | U | 0.19 |
| 6 | Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 0.0062 | U | 0.0062 | 0.24 | U | 0.24 | 3000 | J | 960 | 1800 | J | 650 | 0.19 | U | 0.19 |
| 7 | EXC-2 | J1V7P7 | 7/6/15 | 0.0060 | U | 0.0060 | 0.56 | B | 0.26 | 990 | U | 990 | 670 | U | 670 | 0.20 | U | 0.20 |
| 8 | EXC-3 | J1V7P8 | 7/6/15 | 0.0091 | B | 0.0057 | 0.25 | U | 0.25 | 980 | U | 980 | 670 | U | 670 | 0.21 | U | 0.21 |
| 9 | EXC-4 | J1V7P9 | 7/6/15 | 0.0062 | U | 0.0062 | 0.24 | B | 0.24 | 960 | U | 960 | 660 | U | 660 | 0.21 | U | 0.21 |
| 10 | EXC-5 | J1V7R0 | 7/6/15 | 0.033 | | 0.0057 | 0.23 | U | 0.23 | 1000 | U | 1000 | 680 | U | 680 | 0.21 | U | 0.21 |
| 11 | EXC-6 | J1V7R1 | 7/6/15 | 0.0065 | U | 0.0065 | 0.24 | U | 0.24 | 990 | U | 990 | 670 | U | 670 | 0.21 | U | 0.21 |
| 12 | EXC-7 | J1V7R2 | 7/6/15 | 0.0061 | U | 0.0061 | 0.27 | U | 0.27 | 990 | U | 990 | 670 | U | 670 | 0.21 | U | 0.21 |
| 13 | EXC-8 | J1V7R3 | 7/6/15 | 0.0058 | U | 0.0058 | 0.24 | U | 0.24 | 1000 | U | 1000 | 680 | U | 680 | 0.20 | U | 0.20 |
| 14 | EXC-9 | J1V7R4 | 7/6/15 | 0.0059 | U | 0.0059 | 0.26 | U | 0.26 | 980 | U | 980 | 670 | U | 670 | 0.20 | U | 0.20 |
| 15 | EXC-10 | J1V7R5 | 7/6/15 | 0.0059 | U | 0.0059 | 0.26 | U | 0.26 | 980 | U | 980 | 660 | U | 660 | 0.21 | U | 0.21 |
| 16 | EXC-11 | J1V7R6 | 7/6/15 | 0.0058 | U | 0.0058 | 0.22 | U | 0.22 | 930 | U | 930 | 630 | U | 630 | 0.19 | U | 0.19 |
| 17 | EXC-12 | J1V7R7 | 7/6/15 | 0.0060 | U | 0.0060 | 0.35 | B | 0.24 | 5200 | | 990 | 2700 | J | 680 | 0.85 | JX | 0.21 |

18 **3-Part Test Evaluations**

| 19 | | Mercury | Molybdenum | TPH - Diesel Range Extended | TPH - Diesel Range | Dieldrin |
|---|---|---|---|---|---|---|
| 20 | % < Detection limit | 83% | 67% | 83% | 83% | 92% |
| 21 | Maximum value | 0.033 | 0.56 | 5200 | 2700 | 0.85 |
| 22 | **Most Stringent Cleanup Limit and RAG type (mg/kg unless otherwise stated)** | 0.33 GW & River Protection | 8 GW Protection | 200000 ug/kg GW & River Protection | 200000 ug/kg GW & River Protection | 3.3 ug/kg GW & River Protection |
| 23 | **3-PART TEST** | | | | | |
| 24 | Maximum > Cleanup Limit? | NA | NO | NO | NO | NO |
| 25 | > 10% above Cleanup Limit? | NA | NO | NO | NO | NO |
| 26 | Any sample > 2X Cleanup Limit? | NA | NO | NO | NO | NO |
| 27 | **3-Part Test Compliance?** | Because all values are below background (0.33 mg/kg) the 3-part test is not required. | The data set meets the 3-part test criteria when compared to the most stringent RAG. | The data set meets the 3-part test criteria when compared to the most stringent RAG. | The data set meets the 3-part test criteria when compared to the most stringent RAG. | The data set meets the 3-part test criteria when compared to the most stringent RAG. |

**CALCULATION SHEET**

***Washington Closure Hanford***

**Originator** R. J. Nielson RN
**Project** 100-H Area Closure Operations
**Subject** 100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations

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**Calc. No.** 0100H-CA-V0233
**Checked** I. B. Berezovskiy

**Rev. No.** 0
**Date** 08/26/15
**Sheet No.** 8 of 10

**Ecology Software (MTCAStat) Results, 100-H-59:2 Subsite Excavation**

### Antimony 95% UCL Calculation

| DATA | ID |
|---|---|
| 0.54 | J1V7P6/ J1V7R8 |
| 0.55 | J1V7P7 |
| 0.19 | J1V7P8 |
| 0.18 | J1V7P9 |
| 0.17 | J1V7R0 |
| 0.18 | J1V7R1 |
| 0.20 | J1V7R2 |
| 0.50 | J1V7R3 |
| 0.54 | J1V7R4 |
| 0.19 | J1V7R5 |
| 0.52 | J1V7R6 |
| 0.46 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 0.35 |
| Censored | | Lognormal mean | 0.36 |
| Detection limit or PQL | | Std. devn. | 0.18 |
| Method detection limit | | Median | 0.33 |
| TOTAL | 12 | Min. | 0.17 |
| | | Max. | 0.55 |

Lognormal distribution? r-squared is: 0.761
Normal distribution? r-squared is: 0.767
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 0.43

### Arsenic 95% UCL Calculation

| DATA | ID |
|---|---|
| 3.4 | J1V7P6/ J1V7R8 |
| 3.8 | J1V7P7 |
| 3.0 | J1V7P8 |
| 3.1 | J1V7P9 |
| 2.8 | J1V7R0 |
| 2.9 | J1V7R1 |
| 4.0 | J1V7R2 |
| 2.0 | J1V7R3 |
| 3.2 | J1V7R4 |
| 3.1 | J1V7R5 |
| 3.8 | J1V7R6 |
| 3.4 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 3.2 |
| Censored | | Lognormal mean | 3.2 |
| Detection limit or PQL | | Std. devn. | 0.54 |
| Method detection limit | | Median | 3.2 |
| TOTAL | 12 | Min. | 2.0 |
| | | Max. | 4.0 |

Lognormal distribution? r-squared is: 0.876
Normal distribution? r-squared is: 0.931
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 3.5

### Barium 95% UCL Calculation

| DATA | ID |
|---|---|
| 87.7 | J1V7P6/ J1V7R8 |
| 73.6 | J1V7P7 |
| 56.4 | J1V7P8 |
| 63.1 | J1V7P9 |
| 83.6 | J1V7R0 |
| 43.0 | J1V7R1 |
| 84.5 | J1V7R2 |
| 35.4 | J1V7R3 |
| 67.3 | J1V7R4 |
| 59.2 | J1V7R5 |
| 95.4 | J1V7R6 |
| 91.1 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 70.0 |
| Censored | | Lognormal mean | 70.5 |
| Detection limit or PQL | | Std. devn. | 19.3 |
| Method detection limit | | Median | 70.5 |
| TOTAL | 12 | Min. | 35.4 |
| | | Max. | 95.4 |

Lognormal distribution? r-squared is: 0.919
Normal distribution? r-squared is: 0.961
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 84.5

### Beryllium 95% UCL Calculation

| DATA | ID |
|---|---|
| 0.41 | J1V7P6/ J1V7R8 |
| 0.35 | J1V7P7 |
| 0.31 | J1V7P8 |
| 0.34 | J1V7P9 |
| 0.40 | J1V7R0 |
| 0.29 | J1V7R1 |
| 0.38 | J1V7R2 |
| 0.27 | J1V7R3 |
| 0.34 | J1V7R4 |
| 0.34 | J1V7R5 |
| 0.45 | J1V7R6 |
| 0.34 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 0.35 |
| Censored | | Lognormal mean | 0.35 |
| Detection limit or PQL | | Std. devn. | 0.051 |
| Method detection limit | | Median | 0.34 |
| TOTAL | 12 | Min. | 0.27 |
| | | Max. | 0.45 |

Lognormal distribution? r-squared is: 0.966
Normal distribution? r-squared is: 0.959
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.38

### Boron 95% UCL Calculation

| DATA | ID |
|---|---|
| 1.5 | J1V7P6/ J1V7R8 |
| 6.9 | J1V7P7 |
| 1.0 | J1V7P8 |
| 2.7 | J1V7P9 |
| 2.6 | J1V7R0 |
| 3.6 | J1V7R1 |
| 1.3 | J1V7R2 |
| 1.5 | J1V7R3 |
| 1.4 | J1V7R4 |
| 0.48 | J1V7R5 |
| 1.6 | J1V7R6 |
| 2.5 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 2.3 |
| Censored | | Lognormal mean | 2.3 |
| Detection limit or PQL | | Std. devn. | 1.7 |
| Method detection limit | | Median | 1.6 |
| TOTAL | 12 | Min. | 0.48 |
| | | Max. | 6.9 |

Lognormal distribution? r-squared is: 0.948
Normal distribution? r-squared is: 0.764
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 3.7

### Cadmium 95% UCL Calculation

| DATA | ID |
|---|---|
| 0.10 | J1V7P6/ J1V7R8 |
| 0.11 | J1V7P7 |
| 0.11 | J1V7P8 |
| 0.080 | J1V7P9 |
| 0.093 | J1V7R0 |
| 0.041 | J1V7R1 |
| 0.084 | J1V7R2 |
| 0.057 | J1V7R3 |
| 0.078 | J1V7R4 |
| 0.084 | J1V7R5 |
| 0.089 | J1V7R6 |
| 0.11 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 0.087 |
| Censored | | Lognormal mean | 0.087 |
| Detection limit or PQL | | Std. devn. | 0.021 |
| Method detection limit | | Median | 0.087 |
| TOTAL | 12 | Min. | 0.041 |
| | | Max. | 0.11 |

Lognormal distribution? r-squared is: 0.834
Normal distribution? r-squared is: 0.910
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.10

### Chromium 95% UCL Calculation

| DATA | ID |
|---|---|
| 13.4 | J1V7P6/ J1V7R8 |
| 13.6 | J1V7P7 |
| 12.3 | J1V7P8 |
| 13.0 | J1V7P9 |
| 12.4 | J1V7R0 |
| 11.7 | J1V7R1 |
| 13.0 | J1V7R2 |
| 11.4 | J1V7R3 |
| 12.0 | J1V7R4 |
| 11.9 | J1V7R5 |
| 14.4 | J1V7R6 |
| 12.1 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 12.6 |
| Censored | | Lognormal mean | 12.6 |
| Detection limit or PQL | | Std. devn. | 0.888 |
| Method detection limit | | Median | 12.4 |
| TOTAL | 12 | Min. | 11.4 |
| | | Max. | 14.4 |

Lognormal distribution? r-squared is: 0.963
Normal distribution? r-squared is: 0.953
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 13.1

### Cobalt 95% UCL Calculation

| DATA | ID |
|---|---|
| 7.3 | J1V7P6/ J1V7R8 |
| 7.0 | J1V7P7 |
| 6.9 | J1V7P8 |
| 6.7 | J1V7P9 |
| 7.7 | J1V7R0 |
| 5.6 | J1V7R1 |
| 7.0 | J1V7R2 |
| 5.4 | J1V7R3 |
| 6.8 | J1V7R4 |
| 6.6 | J1V7R5 |
| 7.8 | J1V7R6 |
| 6.8 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 6.8 |
| Censored | | Lognormal mean | 6.8 |
| Detection limit or PQL | | Std. devn. | 0.71 |
| Method detection limit | | Median | 6.9 |
| TOTAL | 12 | Min. | 5.4 |
| | | Max. | 7.8 |

Lognormal distribution? r-squared is: 0.873
Normal distribution? r-squared is: 0.899
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 7.1

### Copper 95% UCL Calculation

| DATA | ID |
|---|---|
| 15.5 | J1V7P6/ J1V7R8 |
| 15.9 | J1V7P7 |
| 25.7 | J1V7P8 |
| 17.6 | J1V7P9 |
| 15.9 | J1V7R0 |
| 17.8 | J1V7R1 |
| 14.6 | J1V7R2 |
| 14.9 | J1V7R3 |
| 15.3 | J1V7R4 |
| 15.2 | J1V7R5 |
| 18.6 | J1V7R6 |
| 18.7 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 17.1 |
| Censored | | Lognormal mean | 17.1 |
| Detection limit or PQL | | Std. devn. | 3.06 |
| Method detection limit | | Median | 15.9 |
| TOTAL | 12 | Min. | 14.6 |
| | | Max. | 25.7 |

Lognormal distribution? r-squared is: 0.789
Normal distribution? r-squared is: 0.721
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 18.6

**CALCULATION SHEET**

***Washington Closure Hanford***

**Originator** R. J. Nielson RJN
**Project** 100-H Area Closure Operations
**Subject** 100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations

**Date** 08/26/15
**Job No.** 14655

**Calc. No.** 0100H-CA-V0233
**Checked** I. B. Berezovskiy

**Rev. No.** 0
**Date** 08/26/15
**Sheet No.** 9 of 10

**Ecology Software (MTCAStat) Results, 100-H-59:2 Subsite Excavation**

### Hexavalent Chromium 95% UCL Calculation

| DATA | ID |
|---|---|
| 0.569 | J1V7P6/ J1V7R8 |
| 0.639 | J1V7P7 |
| 0.426 | J1V7P8 |
| 0.597 | J1V7P9 |
| 0.959 | J1V7R0 |
| 0.460 | J1V7R1 |
| 0.335 | J1V7R2 |
| 0.278 | J1V7R3 |
| 0.217 | J1V7R4 |
| 0.260 | J1V7R5 |
| 0.402 | J1V7R6 |
| 0.0775 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 0.435 |
| Censored | | Lognormal mean | 0.457 |
| Detection limit or PQL | | Std. devn. | 0.234 |
| Method detection limit | | Median | 0.414 |
| TOTAL | 12 | Min. | 0.0775 |
| | | Max. | 0.959 |

Lognormal distribution? r-squared is: 0.912
Normal distribution? r-squared is: 0.948
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.723

### Lead 95% UCL Calculation

| DATA | ID |
|---|---|
| 5.05 | J1V7P6/ J1V7R8 |
| 4.3 | J1V7P7 |
| 10.6 | J1V7P8 |
| 4.3 | J1V7P9 |
| 5.3 | J1V7R0 |
| 3.0 | J1V7R1 |
| 4.7 | J1V7R2 |
| 3.6 | J1V7R3 |
| 5.0 | J1V7R4 |
| 4.4 | J1V7R5 |
| 6.3 | J1V7R6 |
| 22.1 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 6.6 |
| Censored | | Lognormal mean | 6.4 |
| Detection limit or PQL | | Std. devn. | 5.3 |
| Method detection limit | | Median | 4.9 |
| TOTAL | 12 | Min. | 3.0 |
| | | Max. | 22.1 |

Lognormal distribution? r-squared is: 0.784
Normal distribution? r-squared is: 0.571
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 9.1

### Manganese 95% UCL Calculation

| DATA | ID |
|---|---|
| 356 | J1V7P6/ J1V7R8 |
| 313 | J1V7P7 |
| 299 | J1V7P8 |
| 280 | J1V7P9 |
| 342 | J1V7R0 |
| 249 | J1V7R1 |
| 319 | J1V7R2 |
| 209 | J1V7R3 |
| 301 | J1V7R4 |
| 290 | J1V7R5 |
| 350 | J1V7R6 |
| 312 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 302 |
| Censored | | Lognormal mean | 302 |
| Detection limit or PQL | | Std. devn. | 42.0 |
| Method detection limit | | Median | 307 |
| TOTAL | 12 | Min. | 209 |
| | | Max. | 356 |

Lognormal distribution? r-squared is: 0.889
Normal distribution? r-squared is: 0.932
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 323

### Nickel 95% UCL Calculation

| DATA | ID |
|---|---|
| 12.9 | J1V7P6/ J1V7R8 |
| 12.5 | J1V7P7 |
| 13.6 | J1V7P8 |
| 14.4 | J1V7P9 |
| 13.8 | J1V7R0 |
| 11.8 | J1V7R1 |
| 14.3 | J1V7R2 |
| 10.4 | J1V7R3 |
| 12.4 | J1V7R4 |
| 15.1 | J1V7R5 |
| 15.1 | J1V7R6 |
| 12.6 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 13.2 |
| Censored | | Lognormal mean | 13.2 |
| Detection limit or PQL | | Std. devn. | 1.41 |
| Method detection limit | | Median | 13.3 |
| TOTAL | 12 | Min. | 10.4 |
| | | Max. | 15.1 |

Lognormal distribution? r-squared is: 0.944
Normal distribution? r-squared is: 0.960
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 14.1

### Vanadium 95% UCL Calculation

| DATA | ID |
|---|---|
| 46.5 | J1V7P6/ J1V7R8 |
| 47.4 | J1V7P7 |
| 52.6 | J1V7P8 |
| 49.4 | J1V7P9 |
| 45.0 | J1V7R0 |
| 46.3 | J1V7R1 |
| 44.0 | J1V7R2 |
| 37.4 | J1V7R3 |
| 43.3 | J1V7R4 |
| 46.2 | J1V7R5 |
| 45.3 | J1V7R6 |
| 47.1 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 45.9 |
| Censored | | Lognormal mean | 45.9 |
| Detection limit or PQL | | Std. devn. | 3.63 |
| Method detection limit | | Median | 46.3 |
| TOTAL | 12 | Min. | 37.4 |
| | | Max. | 52.6 |

Lognormal distribution? r-squared is: 0.873
Normal distribution? r-squared is: 0.896
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 47.6

### Zinc 95% UCL Calculation

| DATA | ID |
|---|---|
| 41.9 | J1V7P6/ J1V7R8 |
| 37.9 | J1V7P7 |
| 39.4 | J1V7P8 |
| 37.8 | J1V7P9 |
| 39.1 | J1V7R0 |
| 32.3 | J1V7R1 |
| 37.8 | J1V7R2 |
| 28.1 | J1V7R3 |
| 41.3 | J1V7R4 |
| 36.7 | J1V7R5 |
| 40.8 | J1V7R6 |
| 62.7 | J1V7R7 |

| Number of samples | | Uncensored values | |
|---|---|---|---|
| Uncensored | 12 | Mean | 39.6 |
| Censored | | Lognormal mean | 39.7 |
| Detection limit or PQL | | Std. devn. | 8.24 |
| Method detection limit | | Median | 38.5 |
| TOTAL | 12 | Min. | 28.1 |
| | | Max. | 62.7 |

Lognormal distribution? r-squared is: 0.806
Normal distribution? r-squared is: 0.725
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 43.6

**CALCULATION SHEET**

***Washington Closure Hanford***

**Originator** R. J. Nielson **Date** 08/26/15 **Calc. No.** 0100H-CA-V0233 **Rev. No.** 0
**Project** 100-H Area Closure Operations **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 08/26/15
**Subject** 100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 10 of 10

**Duplicate Analysis - 100-H-59:2 Subsite Excavation**

| Sampling Area | Sample Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | | Boron | | | Cadmium | | | Calcium | | | Chromium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EXC-1 | J1V7P6 | 7/6/15 | 11400 | X | 1.5 | 0.61 | J | 0.36 | 3.3 | | 0.63 | 85.4 | | 0.072 | 0.41 | | 0.031 | 1.5 | B | 0.93 | 0.086 | B | 0.039 | 4790 | | 13.4 | 13.3 | | 0.055 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 11400 | X | 1.4 | 0.46 | BJ | 0.36 | 3.5 | | 0.62 | 89.9 | | 0.071 | 0.41 | | 0.031 | 1.4 | B | 0.92 | 0.12 | B | 0.038 | 4650 | | 13.2 | 13.5 | | 0.054 |
| Split of J1V7P6 | J1V7T2 | 7/6/15 | 6810 | | 6.65 | 2.02 | BD | 1.61 | 2.81 | B | 0.489 | 77.6 | | 0.0978 | 0.846 | | 0.0978 | 5.56 | | 0.978 | 0.179 | B | 0.0978 | 3710 | | 7.82 | 10.9 | | 0.147 |

**Analysis:**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **TDL** | | 5 | 0.6 | 10 | 2 | 0.5 | 2 | 0.5 | 100 | 1 |
| Duplicate Analysis | Both > PQL? | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** |
| | Both >5xTDL? | **Yes (calc RPD)** | No-Stop (acceptable) | No-Stop (acceptable) | **Yes (calc RPD)** | No-Stop (acceptable) | No-Stop (acceptable) | No-Stop (acceptable) | **Yes (calc RPD)** | **Yes (calc RPD)** |
| | RPD | 0.0% | | | 5.1% | | | | 3.0% | 1.5% |
| | Difference > 2 TDL? | Not applicable | No - acceptable | No - acceptable | Not applicable | No - acceptable | No - acceptable | No - acceptable | Not applicable | Not applicable |
| Split Analysis | Both > PQL? | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** |
| | Both >5xTDL? | **Yes (calc RPD)** | No-Stop (acceptable) | No-Stop (acceptable) | **Yes (calc RPD)** | No-Stop (acceptable) | No-Stop (acceptable) | No-Stop (acceptable) | **Yes (calc RPD)** | **Yes (calc RPD)** |
| | RPD | *50.4%* | | | 9.6% | | | | 25.4% | 19.8% |
| | Difference > 2 TDL? | Not applicable | Yes - assess further | No - acceptable | Not applicable | No - acceptable | Yes - assess further | No - acceptable | Not applicable | Not applicable |

**Duplicate Analysis - 100-H-59:2 Subsite Excavation**

| Sampling Area | Sample Number | Sample Date | Cobalt | | | Copper | | | Hexavalent Chromium | | | Iron | | | Lead | | | Magnesium | | | Manganese | | | Molybdenum | | | Nickel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EXC-1 | J1V7P6 | 7/6/15 | 7.3 | X | 0.095 | 15.1 | | 0.21 | 0.796 | | 0.155 | 21400 | X | 3.6 | 5.0 | | 0.26 | 4440.0 | X | 3.5 | 351 | | 0.095 | 0.40 | B | 0.25 | 13.0 | X | 0.12 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 7.3 | X | 0.093 | 15.8 | | 0.20 | 0.341 | | 0.155 | 21500 | X | 3.6 | 5.1 | | 0.25 | 4380.0 | X | 3.5 | 360 | | 0.093 | 0.24 | U | 0.24 | 12.8 | X | 0.11 |
| Split of J1V7P6 | J1V7T2 | 7/6/15 | 7.85 | D | 0.733 | 13.1 | | | 0.404 | | 0.12 | 19700 | | 7.82 | 5.64 | | 0.323 | 4050 | | 8.31 | 334 | | 0.196 | 0.384 | B | 0.196 | 10.1 | | 0.147 |

**Analysis:**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **TDL** | | 2 | 1 | 0.5 | 5 | 5 | 75 | 5 | 2 | 4 |
| Duplicate Analysis | Both > PQL? | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | No-Stop (acceptable) | **Yes (continue)** |
| | Both >5xTDL? | No-Stop (acceptable) | **Yes (calc RPD)** | No-Stop (acceptable) | **Yes (calc RPD)** | No-Stop (acceptable) | **Yes (calc RPD)** | **Yes (calc RPD)** | | No-Stop (acceptable) |
| | RPD | | 4.5% | | 0.5% | | 1.4% | 2.5% | | |
| | Difference > 2 TDL? | No - acceptable | Not applicable | No - acceptable | Not applicable | No - acceptable | Not applicable | Not applicable | No - acceptable | No - acceptable |
| Split Analysis | Both > PQL? | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** |
| | Both >5xTDL? | No-Stop (acceptable) | **Yes (calc RPD)** | No-Stop (acceptable) | **Yes (calc RPD)** | No-Stop (acceptable) | **Yes (calc RPD)** | **Yes (calc RPD)** | No-Stop (acceptable) | No-Stop (acceptable) |
| | RPD | | 14.2% | | 8.3% | | 9.2% | 5.0% | | |
| | Difference > 2 TDL? | No - acceptable | Not applicable | No - acceptable | Not applicable | No - acceptable | Not applicable | Not applicable | No - acceptable | No - acceptable |

**Duplicate Analysis - 100-H-59:2 Subsite Excavation**

| Sampling Area | Sample Number | Sample Date | Potassium | | | Silicon | | | Sodium | | | Vanadium | | | Zinc | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EXC-1 | J1V7P6 | 7/6/15 | 1830 | | 39.0 | 461 | NJ | 5.4 | 367 | | 56.1 | 47.2 | | 0.089 | 41.7 | X | 0.38 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 1890 | | 38.3 | 464 | J | 5.3 | 346 | | 55.1 | 45.7 | | 0.088 | 42.0 | X | 0.37 |
| Split of J1V7P6 | J1V7T2 | 7/6/15 | 1390 | N | 6.26 | 1530 | *DN | 7.33 | 161 | C | 6.84 | 48.8 | D | 0.489 | 42.3 | D | 1.96 |

**Analysis:**

| | | | | | | |
|---|---|---|---|---|---|---|
| **TDL** | | 400 | 2 | 50 | 2.5 | 1 |
| Duplicate Analysis | Both > PQL? | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** |
| | Both >5xTDL? | No-Stop (acceptable) | **Yes (calc RPD)** | **Yes (calc RPD)** | **Yes (calc RPD)** | **Yes (calc RPD)** |
| | RPD | | 0.6% | 5.9% | 3.2% | 0.7% |
| | Difference > 2 TDL? | No - acceptable | Not applicable | Not applicable | Not applicable | Not applicable |
| Split Analysis | Both > PQL? | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** | **Yes (continue)** |
| | Both >5xTDL? | No-Stop (acceptable) | **Yes (calc RPD)** | No-Stop (acceptable) | **Yes (calc RPD)** | **Yes (calc RPD)** |
| | RPD | | *107.4%* | | 3.3% | 1.4% |
| | Difference > 2 TDL? | No - acceptable | Not applicable | Yes - assess further | Not applicable | Not applicable |

**Attachment 1. 100-H-59:2 Subsite Verification Sample Results (Organics).**

| CONSTITUENT | CLASS | J1V7P6 | | | J1V7R8 | | | J1V7P7 | | | J1V7P8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EXC-1 | | | Duplicate of J1V7P6 | | | EXC-2 | | | EXC-3 | | |
| | | 7/6/15 | | | 7/6/15 | | | 7/6/15 | | | 7/6/15 | | |
| | | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL |
| Acenaphthene | PAH | 10 | U | 10 | 10 | U | 10 | 9.8 | U | 9.8 | 10 | U | 10 |
| Acenaphthylene | PAH | 9.0 | U | 9.0 | 9.0 | U | 9.0 | 8.8 | U | 8.8 | 9.0 | U | 9.0 |
| Anthracene | PAH | 3.0 | U | 3.0 | 3.0 | U | 3.0 | 3.0 | U | 3.0 | 3.1 | U | 3.1 |
| Benzo(a)anthracene | PAH | 3.2 | U | 3.2 | 3.2 | U | 3.2 | 3.1 | U | 3.1 | 3.2 | U | 3.2 |
| Benzo(a)pyrene | PAH | 6.4 | U | 6.4 | 6.4 | U | 6.4 | 6.3 | U | 6.3 | 6.4 | U | 6.4 |
| Benzo(b)fluoranthene | PAH | 4.2 | U | 4.2 | 4.2 | U | 4.2 | 4.1 | U | 4.1 | 4.2 | U | 4.2 |
| Benzo(ghi)perylene | PAH | 7.2 | U | 7.2 | 7.2 | U | 7.2 | 7.1 | U | 7.1 | 7.2 | U | 7.2 |
| Benzo(k)fluoranthene | PAH | 3.9 | U | 3.9 | 3.9 | U | 3.9 | 3.9 | U | 3.9 | 3.9 | U | 3.9 |
| Chrysene | PAH | 4.8 | U | 4.8 | 4.8 | U | 4.8 | 4.8 | U | 4.8 | 4.9 | U | 4.9 |
| Dibenz[a,h]anthracene | PAH | 11 | U | 11 | 11 | U | 11 | 11 | U | 11 | 11 | U | 11 |
| Fluoranthene | PAH | 13 | U | 13 | 13 | U | 13 | 13 | U | 13 | 13 | U | 13 |
| Fluorene | PAH | 5.3 | U | 5.3 | 5.3 | U | 5.3 | 5.2 | U | 5.2 | 5.3 | U | 5.3 |
| Indeno(1,2,3-cd)pyrene | PAH | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 |
| Naphthalene | PAH | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 |
| Phenanthrene | PAH | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 |
| Pyrene | PAH | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 |
| Aroclor-1016 | PCB | 2.8 | U | 2.8 | 2.8 | U | 2.8 | 2.5 | U | 2.5 | 2.5 | U | 2.5 |
| Aroclor-1221 | PCB | 8.0 | U | 8.0 | 8.1 | U | 8.1 | 7.4 | U | 7.4 | 7.3 | U | 7.3 |
| Aroclor-1232 | PCB | 2.0 | U | 2.0 | 2.0 | U | 2.0 | 1.8 | U | 1.8 | 1.8 | U | 1.8 |
| Aroclor-1242 | PCB | 4.6 | U | 4.6 | 4.7 | U | 4.7 | 4.3 | U | 4.3 | 4.3 | U | 4.3 |
| Aroclor-1248 | PCB | 4.6 | U | 4.6 | 4.7 | U | 4.7 | 4.3 | U | 4.3 | 4.3 | U | 4.3 |
| Aroclor-1254 | PCB | 2.6 | U | 2.6 | 2.6 | U | 2.6 | 2.4 | U | 2.4 | 2.4 | U | 2.4 |
| Aroclor-1260 | PCB | 2.6 | U | 2.6 | 2.6 | U | 2.6 | 2.4 | U | 2.4 | 2.4 | U | 2.4 |
| Aroclor-1262 | PCB | | | | | | | | | | | | |
| Aroclor-1268 | PCB | | | | | | | | | | | | |
| Aldrin | PEST | 0.23 | U | 0.23 | 0.23 | U | 0.23 | 0.23 | U | 0.23 | 0.25 | U | 0.25 |
| Alpha-BHC | PEST | 0.20 | U | 0.20 | 0.20 | U | 0.20 | 0.20 | U | 0.20 | 0.21 | U | 0.21 |
| alpha-Chlordane | PEST | 0.30 | U | 0.30 | 0.30 | U | 0.30 | 0.30 | U | 0.30 | 0.32 | U | 0.32 |
| beta-1,2,3,4,5,6-Hexachlorocyclohexane | PEST | 0.62 | U | 0.62 | 0.61 | U | 0.61 | 0.62 | U | 0.62 | 0.66 | U | 0.66 |
| Delta-BHC | PEST | 0.37 | U | 0.37 | 0.37 | U | 0.37 | 0.37 | U | 0.37 | 0.40 | U | 0.40 |
| Dichlorodiphenyldichloroethane | PEST | 0.51 | U | 0.51 | 0.50 | U | 0.50 | 0.51 | U | 0.51 | 0.54 | U | 0.54 |
| Dichlorodiphenyldichloroethylene | PEST | 0.22 | U | 0.22 | 0.22 | U | 0.22 | 0.22 | U | 0.22 | 0.24 | U | 0.24 |
| Dichlorodiphenyltrichloroethane | PEST | 0.55 | U | 0.55 | 0.54 | U | 0.54 | 0.55 | U | 0.55 | 0.58 | U | 0.58 |
| Dieldrin | PEST | 0.19 | U | 0.19 | 0.19 | U | 0.19 | 0.20 | U | 0.20 | 0.21 | U | 0.21 |
| Endosulfan I | PEST | 0.16 | U | 0.16 | 0.16 | U | 0.16 | 0.16 | U | 0.16 | 0.17 | U | 0.17 |
| Endosulfan II | PEST | 0.27 | U | 0.27 | 0.26 | U | 0.26 | 0.27 | U | 0.27 | 0.28 | U | 0.28 |
| Endosulfan sulfate | PEST | 0.26 | U | 0.26 | 0.25 | U | 0.25 | 0.26 | U | 0.26 | 0.27 | U | 0.27 |
| Endrin | PEST | 0.28 | U | 0.28 | 0.28 | U | 0.28 | 0.29 | U | 0.29 | 0.30 | U | 0.30 |
| Endrin aldehyde | PEST | 0.16 | U | 0.16 | 0.16 | U | 0.16 | 0.16 | U | 0.16 | 0.17 | U | 0.17 |
| Endrin ketone | PEST | 0.45 | U | 0.45 | 0.45 | U | 0.45 | 0.46 | U | 0.46 | 0.48 | U | 0.48 |
| Gamma-BHC (Lindane) | PEST | 0.43 | U | 0.43 | 0.43 | U | 0.43 | 0.43 | U | 0.43 | 0.46 | U | 0.46 |
| gamma-Chlordane | PEST | 0.25 | U | 0.25 | 0.24 | U | 0.24 | 0.25 | U | 0.25 | 0.26 | U | 0.26 |
| Heptachlor | PEST | 0.20 | U | 0.20 | 0.20 | U | 0.20 | 0.20 | U | 0.20 | 0.21 | U | 0.21 |
| Heptachlor epoxide | PEST | 0.39 | U | 0.39 | 0.39 | U | 0.39 | 0.40 | U | 0.40 | 0.42 | U | 0.42 |
| Methoxychlor | PEST | 0.42 | U | 0.42 | 0.41 | U | 0.41 | 0.42 | U | 0.42 | 0.45 | U | 0.45 |
| Toxaphene | PEST | 15 | UJ | 15 | 14 | UJ | 14 | 15 | UJ | 15 | 16 | UJ | 16 |

Acronyms and notes apply to all of the tables in this attachment.
Note: Data qualified with B, C, and/or J are considered acceptable values.
* = duplicate analysis not within control limits.
B = estimated result. The result is less than the RL but greater than the MDL.
C = analyte was detected in both the sample and the associated QC blank, sample concentratin </= 5x the blank.
D = result is reported from a diluted aliquot of sample.
HEIS = Hanford Environmental Information System
J = value is estimated.
M = sample duplicate precision not met.
MDA = minimum detectable activity
N = recovery is outside control limits.
PQL = practical quantitation limit
Q = qualifier
U = undetected
X = serial dilution in the anlaytical batch indicates that physical and chemcial interferences are present (metals)
X = more than 40% difference between columns, lower result reported (organics)

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 1 of 6 |
| Originator | R. J. Nielson | Date | 8/26/15 |
| Checked | I. B. Berezovskiy | Rev. No. | 0 |
| Calc. No. | 0100H-CA-V0233 | Job No. | 14655 |

**Attachment 1. 100-H-59:2 Subsite Verification Sample Results (Organics).**

| CONSTITUENT | CLASS | J1V7P9 | | | J1V7R0 | | | J1V7R1 | | | J1V7R2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EXC-4 | | | EXC-5 | | | EXC-6 | | | EXC-7 | | |
| | | 7/6/15 | | | 7/6/15 | | | 7/6/15 | | | 7/6/15 | | |
| | | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL |
| Acenaphthene | PAH | 9.9 | U | 9.9 | 10 | U | 10 | 9.7 | U | 9.7 | 9.8 | U | 9.8 |
| Acenaphthylene | PAH | 8.9 | U | 8.9 | 9.0 | U | 9.0 | 8.7 | U | 8.7 | 8.8 | U | 8.8 |
| Anthracene | PAH | 3.0 | U | 3.0 | 3.1 | U | 3.1 | 3.0 | U | 3.0 | 3.0 | U | 3.0 |
| Benzo(a)anthracene | PAH | 3.2 | U | 3.2 | 3.2 | U | 3.2 | 3.1 | U | 3.1 | 3.1 | U | 3.1 |
| Benzo(a)pyrene | PAH | 6.4 | U | 6.4 | 6.4 | U | 6.4 | 6.2 | U | 6.2 | 6.3 | U | 6.3 |
| Benzo(b)fluoranthene | PAH | 4.2 | U | 4.2 | 4.2 | U | 4.2 | 4.1 | U | 4.1 | 4.1 | U | 4.1 |
| Benzo(ghi)perylene | PAH | 7.1 | U | 7.1 | 7.2 | U | 7.2 | 7.0 | U | 7.0 | 7.1 | U | 7.1 |
| Benzo(k)fluoranthene | PAH | 3.9 | U | 3.9 | 3.9 | U | 3.9 | 3.8 | U | 3.8 | 3.9 | U | 3.9 |
| Chrysene | PAH | 4.8 | U | 4.8 | 4.8 | U | 4.8 | 4.7 | U | 4.7 | 4.8 | U | 4.8 |
| Dibenz[a,h]anthracene | PAH | 11 | U | 11 | 11 | U | 11 | 11 | U | 11 | 11 | U | 11 |
| Fluoranthene | PAH | 13 | U | 13 | 13 | U | 13 | 13 | U | 13 | 13 | U | 13 |
| Fluorene | PAH | 5.2 | U | 5.2 | 5.3 | U | 5.3 | 5.1 | U | 5.1 | 5.2 | U | 5.2 |
| Indeno(1,2,3-cd)pyrene | PAH | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 |
| Naphthalene | PAH | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 |
| Phenanthrene | PAH | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 |
| Pyrene | PAH | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 |
| Aroclor-1016 | PCB | 2.8 | U | 2.8 | 2.8 | U | 2.8 | 2.8 | U | 2.8 | 2.8 | U | 2.8 |
| Aroclor-1221 | PCB | 8.1 | U | 8.1 | 8.1 | U | 8.1 | 8.1 | U | 8.1 | 8.2 | U | 8.2 |
| Aroclor-1232 | PCB | 2.0 | U | 2.0 | 2.0 | U | 2.0 | 2.0 | U | 2.0 | 2.0 | U | 2.0 |
| Aroclor-1242 | PCB | 4.7 | U | 4.7 | 4.7 | U | 4.7 | 4.7 | U | 4.7 | 4.7 | U | 4.7 |
| Aroclor-1248 | PCB | 4.7 | U | 4.7 | 4.7 | U | 4.7 | 4.7 | U | 4.7 | 4.7 | U | 4.7 |
| Aroclor-1254 | PCB | 2.6 | U | 2.6 | 2.6 | U | 2.6 | 2.6 | U | 2.6 | 2.6 | U | 2.6 |
| Aroclor-1260 | PCB | 2.6 | U | 2.6 | 2.6 | U | 2.6 | 2.6 | U | 2.6 | 2.6 | U | 2.6 |
| Aroclor-1262 | PCB | | | | | | | | | | | | |
| Aroclor-1268 | PCB | | | | | | | | | | | | |
| Aldrin | PEST | 0.25 | U | 0.25 | 0.25 | U | 0.25 | 0.25 | U | 0.25 | 0.25 | U | 0.25 |
| Alpha-BHC | PEST | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.22 | U | 0.22 |
| alpha-Chlordane | PEST | 0.32 | U | 0.32 | 0.32 | U | 0.32 | 0.32 | U | 0.32 | 0.33 | U | 0.33 |
| beta-1,2,3,4,5,6-Hexachlorocyclohexane | PEST | 0.66 | U | 0.66 | 0.65 | U | 0.65 | 0.67 | U | 0.67 | 0.67 | U | 0.67 |
| Delta-BHC | PEST | 0.40 | U | 0.40 | 0.39 | U | 0.39 | 0.40 | U | 0.40 | 0.40 | U | 0.40 |
| Dichlorodiphenyldichloroethane | PEST | 0.54 | U | 0.54 | 0.53 | U | 0.53 | 0.55 | U | 0.55 | 0.55 | U | 0.55 |
| Dichlorodiphenyldichloroethylene | PEST | 0.23 | U | 0.23 | 0.23 | U | 0.23 | 0.24 | U | 0.24 | 0.24 | U | 0.24 |
| Dichlorodiphenyltrichloroethane | PEST | 0.58 | U | 0.58 | 0.58 | U | 0.58 | 0.59 | U | 0.59 | 0.59 | U | 0.59 |
| Dieldrin | PEST | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.21 | U | 0.21 |
| Endosulfan I | PEST | 0.17 | U | 0.17 | 0.17 | U | 0.17 | 0.18 | U | 0.18 | 0.18 | U | 0.18 |
| Endosulfan II | PEST | 0.28 | U | 0.28 | 0.28 | U | 0.28 | 0.29 | U | 0.29 | 0.29 | U | 0.29 |
| Endosulfan sulfate | PEST | 0.27 | U | 0.27 | 0.27 | U | 0.27 | 0.28 | U | 0.28 | 0.28 | U | 0.28 |
| Endrin | PEST | 0.30 | U | 0.30 | 0.30 | U | 0.30 | 0.31 | U | 0.31 | 0.31 | U | 0.31 |
| Endrin aldehyde | PEST | 0.17 | U | 0.17 | 0.17 | U | 0.17 | 0.17 | U | 0.17 | 0.17 | U | 0.17 |
| Endrin ketone | PEST | 0.48 | U | 0.48 | 0.48 | U | 0.48 | 0.49 | U | 0.49 | 0.49 | U | 0.49 |
| Gamma-BHC (Lindane) | PEST | 0.46 | U | 0.46 | 0.45 | U | 0.45 | 0.47 | U | 0.47 | 0.47 | U | 0.47 |
| gamma-Chlordane | PEST | 0.26 | U | 0.26 | 0.26 | U | 0.26 | 0.27 | U | 0.27 | 0.27 | U | 0.27 |
| Heptachlor | PEST | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.22 | U | 0.22 |
| Heptachlor epoxide | PEST | 0.42 | U | 0.42 | 0.42 | U | 0.42 | 0.43 | U | 0.43 | 0.43 | U | 0.43 |
| Methoxychlor | PEST | 0.44 | U | 0.44 | 0.44 | U | 0.44 | 0.45 | U | 0.45 | 0.45 | U | 0.45 |
| Toxaphene | PEST | 16 | UJ | 16 | 15 | UJ | 15 | 16 | UJ | 16 | 16 | UJ | 16 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 2 of 6 |
| Originator | R. J. Nielson | Date | 8/26/15 |
| Checked | I. B. Berezovskiy | Rev. No. | 0 |
| Calc. No. | 0100H-CA-V0233 | Job No. | 14655 |

**Attachment 1. 100-H-59:2 Subsite Verification Sample Results (Organics).**

| CONSTITUENT | CLASS | J1V7R3 | | | J1V7R4 | | | J1V7R5 | | | J1V7R6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EXC-8 | | | EXC-9 | | | EXC-10 | | | EXC-11 | | |
| | | 7/6/15 | | | 7/6/15 | | | 7/6/15 | | | 7/6/15 | | |
| | | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL |
| Acenaphthene | PAH | 10 | U | 10 | 9.4 | U | 9.4 | 10 | U | 10 | 9.8 | U | 9.8 |
| Acenaphthylene | PAH | 9.0 | U | 9.0 | 8.4 | U | 8.4 | 9.1 | U | 9.1 | 8.9 | U | 8.9 |
| Anthracene | PAH | 3.1 | U | 3.1 | 2.9 | U | 2.9 | 3.1 | U | 3.1 | 3.0 | U | 3.0 |
| Benzo(a)anthracene | PAH | 3.2 | U | 3.2 | 3.0 | U | 3.0 | 3.2 | U | 3.2 | 3.1 | U | 3.1 |
| Benzo(a)pyrene | PAH | 6.4 | U | 6.4 | 6.0 | U | 6.0 | 6.5 | U | 6.5 | 6.3 | U | 6.3 |
| Benzo(b)fluoranthene | PAH | 4.2 | U | 4.2 | 3.9 | U | 3.9 | 4.2 | U | 4.2 | 4.1 | U | 4.1 |
| Benzo(ghi)perylene | PAH | 7.2 | U | 7.2 | 6.7 | U | 6.7 | 7.3 | U | 7.3 | 7.1 | U | 7.1 |
| Benzo(k)fluoranthene | PAH | 3.9 | U | 3.9 | 3.7 | U | 3.7 | 4.0 | U | 4.0 | 3.9 | U | 3.9 |
| Chrysene | PAH | 4.8 | U | 4.8 | 4.5 | U | 4.5 | 4.9 | U | 4.9 | 4.8 | U | 4.8 |
| Dibenz[a,h]anthracene | PAH | 11 | U | 11 | 10 | U | 10 | 11 | U | 11 | 11 | U | 11 |
| Fluoranthene | PAH | 13 | U | 13 | 12 | U | 12 | 13 | U | 13 | 13 | U | 13 |
| Fluorene | PAH | 5.3 | U | 5.3 | 4.9 | U | 4.9 | 5.3 | U | 5.3 | 5.2 | U | 5.2 |
| Indeno(1,2,3-cd)pyrene | PAH | 12 | U | 12 | 11 | U | 11 | 12 | U | 12 | 12 | U | 12 |
| Naphthalene | PAH | 12 | U | 12 | 11 | U | 11 | 12 | U | 12 | 12 | U | 12 |
| Phenanthrene | PAH | 12 | U | 12 | 11 | U | 11 | 12 | U | 12 | 12 | U | 12 |
| Pyrene | PAH | 12 | U | 12 | 11 | U | 11 | 12 | U | 12 | 12 | U | 12 |
| Aroclor-1016 | PCB | 2.8 | U | 2.8 | 2.6 | U | 2.6 | 2.8 | U | 2.8 | 2.6 | U | 2.6 |
| Aroclor-1221 | PCB | 8.0 | U | 8.0 | 7.6 | U | 7.6 | 8.1 | U | 8.1 | 7.6 | U | 7.6 |
| Aroclor-1232 | PCB | 2.0 | U | 2.0 | 1.9 | U | 1.9 | 2.0 | U | 2.0 | 1.9 | U | 1.9 |
| Aroclor-1242 | PCB | 4.6 | U | 4.6 | 4.4 | U | 4.4 | 4.7 | U | 4.7 | 4.4 | U | 4.4 |
| Aroclor-1248 | PCB | 4.6 | U | 4.6 | 4.4 | U | 4.4 | 4.7 | U | 4.7 | 4.4 | U | 4.4 |
| Aroclor-1254 | PCB | 2.6 | U | 2.6 | 2.5 | U | 2.5 | 2.6 | U | 2.6 | 2.5 | U | 2.5 |
| Aroclor-1260 | PCB | 2.6 | U | 2.6 | 2.5 | U | 2.5 | 2.6 | U | 2.6 | 2.5 | U | 2.5 |
| Aroclor-1262 | PCB | | | | | | | | | | | | |
| Aroclor-1268 | PCB | | | | | | | | | | | | |
| Aldrin | PEST | 0.24 | U | 0.24 | 0.24 | U | 0.24 | 0.25 | U | 0.25 | 0.23 | U | 0.23 |
| Alpha-BHC | PEST | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.20 | U | 0.20 |
| alpha-Chlordane | PEST | 0.31 | U | 0.31 | 0.31 | U | 0.31 | 0.32 | U | 0.32 | 0.30 | U | 0.30 |
| beta-1,2,3,4,5,6-Hexachlorocyclohexane | PEST | 0.64 | U | 0.64 | 0.65 | U | 0.65 | 0.65 | U | 0.65 | 0.61 | U | 0.61 |
| Delta-BHC | PEST | 0.39 | U | 0.39 | 0.39 | U | 0.39 | 0.39 | U | 0.39 | 0.37 | U | 0.37 |
| Dichlorodiphenyldichloroethane | PEST | 0.53 | U | 0.53 | 0.53 | U | 0.53 | 0.54 | U | 0.54 | 0.50 | U | 0.50 |
| Dichlorodiphenyldichloroethylene | PEST | 0.23 | U | 0.23 | 0.23 | U | 0.23 | 0.23 | U | 0.23 | 0.22 | U | 0.22 |
| Dichlorodiphenyltrichloroethane | PEST | 0.57 | U | 0.57 | 0.58 | U | 0.58 | 0.58 | U | 0.58 | 0.54 | U | 0.54 |
| Dieldrin | PEST | 0.20 | U | 0.20 | 0.20 | U | 0.20 | 0.21 | U | 0.21 | 0.19 | U | 0.19 |
| Endosulfan I | PEST | 0.17 | U | 0.17 | 0.17 | U | 0.17 | 0.17 | U | 0.17 | 0.16 | U | 0.16 |
| Endosulfan II | PEST | 0.28 | U | 0.28 | 0.28 | U | 0.28 | 0.28 | U | 0.28 | 0.26 | U | 0.26 |
| Endosulfan sulfate | PEST | 0.27 | U | 0.27 | 0.27 | U | 0.27 | 0.27 | U | 0.27 | 0.25 | U | 0.25 |
| Endrin | PEST | 0.30 | U | 0.30 | 0.30 | U | 0.30 | 0.30 | U | 0.30 | 0.28 | U | 0.28 |
| Endrin aldehyde | PEST | 0.17 | U | 0.17 | 0.17 | U | 0.17 | 0.17 | U | 0.17 | 0.16 | U | 0.16 |
| Endrin ketone | PEST | 0.47 | U | 0.47 | 0.48 | U | 0.48 | 0.48 | U | 0.48 | 0.45 | U | 0.45 |
| Gamma-BHC (Lindane) | PEST | 0.45 | U | 0.45 | 0.45 | U | 0.45 | 0.46 | U | 0.46 | 0.42 | U | 0.42 |
| gamma-Chlordane | PEST | 0.26 | U | 0.26 | 0.26 | U | 0.26 | 0.26 | U | 0.26 | 0.24 | U | 0.24 |
| Heptachlor | PEST | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.20 | U | 0.20 |
| Heptachlor epoxide | PEST | 0.41 | U | 0.41 | 0.42 | U | 0.42 | 0.42 | U | 0.42 | 0.39 | U | 0.39 |
| Methoxychlor | PEST | 0.43 | U | 0.43 | 0.44 | U | 0.44 | 0.44 | U | 0.44 | 0.41 | U | 0.41 |
| Toxaphene | PEST | 15 | UJ | 15 | 15 | UJ | 15 | 16 | UJ | 16 | 14 | UJ | 14 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 3 of 6 |
| Originator | R. J. Nielson | Date | 8/26/15 |
| Checked | I. B. Berezovskiy | Rev. No. | 0 |
| Calc. No. | 0100H-CA-V0233 | Job No. | 14655 |

**Attachment 1. 100-H-59:2 Subsite Verification Sample Results (Organics).**

| CONSTITUENT | CLASS | J1V7R7 | | | J1V7R9 | | | J1V7T0 | | | J1V7T2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EXC-12 | | | FS-1 | | | ASA-1 | | | Split of J1V7P6 | | |
| | | 7/6/15 | | | 7/6/15 | | | 7/6/15 | | | 07/06/15 09:28 AM | | |
| | | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL |
| Acenaphthene | PAH | 9.8 | U | 9.8 | 10 | U | 10 | 31 | JX | 10 | 5.02 | U | 5.02 |
| Acenaphthylene | PAH | 8.8 | U | 8.8 | 9.0 | U | 9.0 | 9.0 | U | 9.0 | 5.02 | U | 5.02 |
| Anthracene | PAH | 3.0 | U | 3.0 | 3.0 | U | 3.0 | 24 | X | 3.1 | 1.67 | U | 1.67 |
| Benzo(a)anthracene | PAH | 3.1 | U | 3.1 | 3.2 | U | 3.2 | 100 | X | 3.2 | 0.535 | U | 0.535 |
| Benzo(a)pyrene | PAH | 6.3 | U | 6.3 | 6.4 | U | 6.4 | 69 | X | 6.4 | 0.535 | U | 0.535 |
| Benzo(b)fluoranthene | PAH | 4.1 | U | 4.1 | 4.2 | U | 4.2 | 100 | | 4.2 | 0.535 | U | 0.535 |
| Benzo(ghi)perylene | PAH | 7.0 | U | 7.0 | 7.2 | U | 7.2 | 56 | | 7.2 | 0.535 | U | 0.535 |
| Benzo(k)fluoranthene | PAH | 3.9 | U | 3.9 | 3.9 | U | 3.9 | 31 | | 3.9 | 0.268 | U | 0.268 |
| Chrysene | PAH | 4.7 | U | 4.7 | 4.8 | U | 4.8 | 85 | X | 4.8 | 0.535 | U | 0.535 |
| Dibenz[a,h]anthracene | PAH | 11 | U | 11 | 11 | U | 11 | 11 | U | 11 | 0.535 | U | 0.535 |
| Fluoranthene | PAH | 13 | U | 13 | 13 | U | 13 | 160 | | 13 | 0.535 | U | 0.535 |
| Fluorene | PAH | 5.2 | U | 5.2 | 5.3 | U | 5.3 | 23 | J | 5.3 | 5.02 | U | 5.02 |
| Indeno(1,2,3-cd)pyrene | PAH | 12 | U | 12 | 12 | U | 12 | 53 | X | 12 | 0.535 | U | 0.535 |
| Naphthalene | PAH | 12 | U | 12 | 12 | U | 12 | 12 | U | 12 | 5.02 | U | 5.02 |
| Phenanthrene | PAH | 12 | U | 12 | 12 | U | 12 | 98 | | 12 | 5.02 | U | 5.02 |
| Pyrene | PAH | 12 | U | 12 | 12 | U | 12 | 160 | | 12 | 0.535 | U | 0.535 |
| Aroclor-1016 | PCB | 2.7 | U | 2.7 | 2.8 | U | 2.8 | 2.7 | U | 2.7 | 1.11 | U | 1.11 |
| Aroclor-1221 | PCB | 7.7 | U | 7.7 | 8.1 | U | 8.1 | 7.8 | U | 7.8 | 1.11 | U | 1.11 |
| Aroclor-1232 | PCB | 1.9 | U | 1.9 | 2.0 | U | 2.0 | 1.9 | U | 1.9 | 1.11 | U | 1.11 |
| Aroclor-1242 | PCB | 4.5 | U | 4.5 | 4.7 | U | 4.7 | 4.5 | U | 4.5 | 1.11 | U | 1.11 |
| Aroclor-1248 | PCB | 4.5 | U | 4.5 | 4.7 | U | 4.7 | 4.5 | U | 4.5 | 1.11 | U | 1.11 |
| Aroclor-1254 | PCB | 2.5 | U | 2.5 | 2.6 | U | 2.6 | 2.5 | U | 2.5 | 1.11 | U | 1.11 |
| Aroclor-1260 | PCB | 2.5 | U | 2.5 | 2.6 | U | 2.6 | 2.5 | U | 2.5 | 1.11 | U | 1.11 |
| Aroclor-1262 | PCB | | | | | | | | | | 1.11 | U | 1.11 |
| Aroclor-1268 | PCB | | | | | | | | | | 1.11 | U | 1.11 |
| Aldrin | PEST | 0.25 | U | 0.25 | 0.24 | U | 0.24 | 0.23 | U | 0.23 | 0.167 | U | 0.167 |
| Alpha-BHC | PEST | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.20 | U | 0.20 | 0.167 | U | 0.167 |
| alpha-Chlordane | PEST | 0.32 | U | 0.32 | 0.31 | U | 0.31 | 0.30 | U | 0.30 | 0.167 | U | 0.167 |
| beta-1,2,3,4,5,6-Hexachlorocyclohexane | PEST | 0.66 | U | 0.66 | 0.64 | U | 0.64 | 0.62 | U | 0.62 | 0.167 | U | 0.167 |
| Delta-BHC | PEST | 0.40 | U | 0.40 | 0.39 | U | 0.39 | 0.37 | U | 0.37 | 0.167 | U | 0.167 |
| Dichlorodiphenyldichloroethane | PEST | 0.54 | U | 0.54 | 0.53 | U | 0.53 | 0.51 | U | 0.51 | 0.335 | U | 0.335 |
| Dichlorodiphenyldichloroethylene | PEST | 0.23 | U | 0.23 | 0.23 | U | 0.23 | 0.22 | U | 0.22 | 0.335 | U | 0.335 |
| Dichlorodiphenyltrichloroethane | PEST | 0.58 | U | 0.58 | 0.57 | U | 0.57 | 0.55 | U | 0.55 | 0.335 | U | 0.335 |
| Dieldrin | PEST | 0.85 | JX | 0.21 | 0.20 | U | 0.20 | 0.20 | U | 0.20 | 0.335 | U | 0.335 |
| Endosulfan I | PEST | 0.17 | U | 0.17 | 0.17 | U | 0.17 | 0.16 | U | 0.16 | 0.167 | U | 0.167 |
| Endosulfan II | PEST | 0.28 | U | 0.28 | 0.28 | U | 0.28 | 0.27 | U | 0.27 | 0.335 | U | 0.335 |
| Endosulfan sulfate | PEST | 0.27 | U | 0.27 | 0.27 | U | 0.27 | 0.26 | U | 0.26 | 0.335 | U | 0.335 |
| Endrin | PEST | 0.30 | U | 0.30 | 0.30 | U | 0.30 | 0.28 | U | 0.28 | 0.335 | U | 0.335 |
| Endrin aldehyde | PEST | 0.17 | U | 0.17 | 0.17 | U | 0.17 | 0.16 | U | 0.16 | 0.335 | U | 0.335 |
| Endrin ketone | PEST | 0.48 | U | 0.48 | 0.47 | U | 0.47 | 0.45 | U | 0.45 | 0.335 | U | 0.335 |
| Gamma-BHC (Lindane) | PEST | 0.46 | U | 0.46 | 0.45 | U | 0.45 | 0.43 | U | 0.43 | 0.167 | U | 0.167 |
| gamma-Chlordane | PEST | 0.26 | U | 0.26 | 0.26 | U | 0.26 | 0.25 | U | 0.25 | 0.167 | U | 0.167 |
| Heptachlor | PEST | 0.21 | U | 0.21 | 0.21 | U | 0.21 | 0.20 | U | 0.20 | 0.167 | U | 0.167 |
| Heptachlor epoxide | PEST | 0.42 | U | 0.42 | 0.41 | U | 0.41 | 0.40 | U | 0.40 | 0.167 | U | 0.167 |
| Methoxychlor | PEST | 0.44 | U | 0.44 | 0.43 | U | 0.43 | 0.42 | U | 0.42 | 1.67 | U | 1.67 |
| Toxaphene | PEST | 16 | UJ | 16 | 15 | UJ | 15 | 15 | UJ | 15 | 5.57 | U | 5.57 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 4 of 6 |
| Originator | R. J. Nielson | Date | 8/26/15 |
| Checked | I. B. Berezovskiy | Rev. No. | 0 |
| Calc. No. | 0100H-CA-V0233 | Job No. | 14655 |

**Attachment 1. 100-H-59:2 Subsite Verification Sample Results (Metals, TPH, and Physical).**

| Sample Location | HEIS Number | Sample Date | Aluminum | | | Antimony | | | Arsenic | | | Barium | | | Beryllium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EXC-1 | J1V7P6 | 7/6/15 | 11400 | X | 1.5 | 0.61 | J | 0.36 | 3.3 | | 0.63 | 85.4 | | 0.072 | 0.41 | | 0.031 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 11400 | X | 1.4 | 0.46 | BJ | 0.36 | 3.5 | | 0.62 | 89.9 | | 0.071 | 0.41 | | 0.031 |
| EXC-2 | J1V7P7 | 7/6/15 | 9690 | X | 1.5 | 0.55 | BJ | 0.38 | 3.8 | | 0.65 | 73.6 | | 0.075 | 0.35 | | 0.033 |
| EXC-3 | J1V7P8 | 7/6/15 | 8430 | X | 1.5 | 0.37 | UJ | 0.37 | 3.0 | | 0.63 | 56.4 | | 0.073 | 0.31 | | 0.032 |
| EXC-4 | J1V7P9 | 7/6/15 | 8530 | X | 1.4 | 0.35 | UJ | 0.35 | 3.1 | | 0.61 | 63.1 | | 0.071 | 0.34 | | 0.031 |
| EXC-5 | J1V7R0 | 7/6/15 | 11100 | X | 1.4 | 0.34 | UJ | 0.34 | 2.8 | | 0.58 | 83.6 | | 0.067 | 0.40 | | 0.029 |
| EXC-6 | J1V7R1 | 7/6/15 | 7650 | X | 1.5 | 0.36 | UJ | 0.36 | 2.9 | | 0.62 | 43.0 | | 0.071 | 0.29 | | 0.031 |
| EXC-7 | J1V7R2 | 7/6/15 | 9810 | X | 1.6 | 0.39 | UJ | 0.39 | 4.0 | | 0.68 | 84.5 | | 0.079 | 0.38 | | 0.034 |
| EXC-8 | J1V7R3 | 7/6/15 | 6660 | X | 1.5 | 0.50 | BJ | 0.36 | 2.0 | | 0.62 | 35.4 | | 0.071 | 0.27 | | 0.031 |
| EXC-9 | J1V7R4 | 7/6/15 | 9030 | X | 1.6 | 0.54 | BJ | 0.38 | 3.2 | | 0.66 | 67.3 | | 0.076 | 0.34 | | 0.033 |
| EXC-10 | J1V7R5 | 7/6/15 | 8460 | X | 1.5 | 0.37 | UJ | 0.37 | 3.1 | | 0.65 | 59.2 | | 0.075 | 0.34 | | 0.032 |
| EXC-11 | J1V7R6 | 7/6/15 | 12500 | X | 1.3 | 0.52 | J | 0.32 | 3.8 | | 0.56 | 95.4 | | 0.064 | 0.45 | | 0.028 |
| EXC-12 | J1V7R7 | 7/6/15 | 8970 | X | 1.4 | 0.46 | BJ | 0.35 | 3.4 | | 0.62 | 91.1 | | 0.071 | 0.34 | | 0.031 |
| FS-1 | J1V7R9 | 7/6/15 | 11500 | X | 1.6 | 0.38 | UJ | 0.38 | 3.5 | | 0.66 | 86.7 | | 0.076 | 0.42 | | 0.033 |
| ASA-1 | J1V7T0 | 7/6/15 | 7320 | X | 1.5 | 0.38 | UJ | 0.38 | 3.2 | | 0.65 | 67.4 | | 0.075 | 0.29 | | 0.033 |
| Equipment Blank | J1V7T1 | 7/6/15 | 158 | X | 1.4 | 0.35 | UJ | 0.35 | 0.78 | B | 0.60 | 4.1 | | 0.069 | 0.077 | B | 0.030 |
| Split of J1V7P6 | J1V7T2 | 7/6/15 | 6810 | | 6.65 | 2.02 | BD | 1.61 | 2.81 | B | 0.489 | 77.6 | | 0.0978 | 0.846 | | 0.0978 |

| Sample Location | HEIS Number | Sample Date | Boron | | | Cadmium | | | Calcium | | | Chromium | | | Cobalt | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EXC-1 | J1V7P6 | 7/6/15 | 1.5 | B | 0.93 | 0.086 | B | 0.039 | 4790 | | 13.4 | 13.3 | | 0.055 | 7.3 | X | 0.095 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 1.4 | B | 0.92 | 0.12 | B | 0.038 | 4650 | | 13.2 | 13.5 | | 0.054 | 7.3 | X | 0.093 |
| EXC-2 | J1V7P7 | 7/6/15 | 6.9 | | 0.97 | 0.11 | B | 0.041 | 6520 | | 14.0 | 13.6 | | 0.058 | 7.0 | X | 0.099 |
| EXC-3 | J1V7P8 | 7/6/15 | 1.0 | B | 0.94 | 0.11 | B | 0.039 | 6050 | | 13.5 | 12.3 | | 0.056 | 6.9 | X | 0.096 |
| EXC-4 | J1V7P9 | 7/6/15 | 2.7 | | 0.91 | 0.080 | B | 0.038 | 6580 | | 13.1 | 13.0 | | 0.054 | 6.7 | X | 0.093 |
| EXC-5 | J1V7R0 | 7/6/15 | 2.6 | | 0.87 | 0.093 | B | 0.036 | 3930 | | 12.5 | 12.4 | | 0.051 | 7.7 | X | 0.088 |
| EXC-6 | J1V7R1 | 7/6/15 | 3.6 | | 0.92 | 0.041 | B | 0.039 | 7560 | | 13.3 | 11.7 | | 0.055 | 5.6 | X | 0.094 |
| EXC-7 | J1V7R2 | 7/6/15 | 1.3 | B | 1.0 | 0.084 | B | 0.043 | 6290 | | 14.6 | 13.0 | | 0.060 | 7.0 | X | 0.10 |
| EXC-8 | J1V7R3 | 7/6/15 | 1.5 | B | 0.92 | 0.057 | B | 0.038 | 9430 | | 13.2 | 11.4 | | 0.054 | 5.4 | X | 0.094 |
| EXC-9 | J1V7R4 | 7/6/15 | 1.4 | B | 0.98 | 0.078 | B | 0.041 | 6530 | | 14.2 | 12.0 | | 0.058 | 6.8 | X | 0.10 |
| EXC-10 | J1V7R5 | 7/6/15 | 0.96 | U | 0.96 | 0.084 | B | 0.040 | 6800 | | 13.8 | 11.9 | | 0.057 | 6.6 | X | 0.098 |
| EXC-11 | J1V7R6 | 7/6/15 | 1.6 | B | 0.83 | 0.089 | B | 0.035 | 4420 | | 11.9 | 14.4 | | 0.049 | 7.8 | X | 0.085 |
| EXC-12 | J1V7R7 | 7/6/15 | 2.5 | | 0.91 | 0.11 | B | 0.038 | 6340 | | 13.1 | 12.1 | | 0.054 | 6.8 | X | 0.093 |
| FS-1 | J1V7R9 | 7/6/15 | 1.5 | B | 0.98 | 0.097 | B | 0.041 | 4540 | | 14.1 | 13.4 | | 0.058 | 7.6 | X | 0.10 |
| ASA-1 | J1V7T0 | 7/6/15 | 1.5 | B | 0.97 | 0.10 | B | 0.041 | 6620 | | 14.0 | 9.6 | | 0.058 | 5.6 | X | 0.099 |
| Equipment Blank | J1V7T1 | 7/6/15 | 0.89 | U | 0.89 | 0.037 | U | 0.037 | 35.6 | BCUJ | 12.8 | 0.18 | | 0.053 | 0.66 | BX | 0.091 |
| Split of J1V7P6 | J1V7T2 | 7/6/15 | 5.56 | | 0.978 | 0.179 | B | 0.0978 | 3710 | | 7.82 | 10.9 | | 0.147 | 7.85 | D | 0.733 |

| Sample Location | HEIS Number | Sample Date | Copper | | | Hexavalent Chromium | | | Iron | | | Lead | | | Magnesium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EXC-1 | J1V7P6 | 7/6/15 | 15.1 | | 0.21 | 0.796 | | 0.155 | 21400 | X | 3.6 | 5.0 | | 0.26 | 4440 | X | 3.5 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 15.8 | | 0.20 | 0.341 | | 0.155 | 21500 | X | 3.6 | 5.1 | | 0.25 | 4380 | X | 3.5 |
| EXC-2 | J1V7P7 | 7/6/15 | 15.9 | | 0.22 | 0.639 | | 0.155 | 20200 | X | 3.8 | 4.3 | | 0.27 | 4460 | X | 3.7 |
| EXC-3 | J1V7P8 | 7/6/15 | 25.7 | | 0.21 | 0.426 | | 0.155 | 20300 | X | 3.7 | 10.6 | | 0.26 | 4470 | X | 3.6 |
| EXC-4 | J1V7P9 | 7/6/15 | 17.6 | | 0.20 | 0.597 | | 0.155 | 19800 | X | 3.5 | 4.3 | | 0.25 | 4380 | X | 3.4 |
| EXC-5 | J1V7R0 | 7/6/15 | 15.9 | | 0.19 | 0.959 | | 0.155 | 21300 | X | 3.4 | 5.3 | | 0.24 | 4530 | X | 3.3 |
| EXC-6 | J1V7R1 | 7/6/15 | 17.8 | | 0.20 | 0.460 | | 0.155 | 16900 | X | 3.6 | 3.0 | | 0.25 | 4530 | X | 3.5 |
| EXC-7 | J1V7R2 | 7/6/15 | 14.6 | | 0.23 | 0.335 | | 0.155 | 20400 | X | 3.9 | 4.7 | | 0.28 | 4940 | X | 3.8 |
| EXC-8 | J1V7R3 | 7/6/15 | 14.9 | | 0.20 | 0.278 | | 0.155 | 14000 | X | 3.6 | 3.6 | | 0.25 | 4110 | X | 3.5 |
| EXC-9 | J1V7R4 | 7/6/15 | 15.3 | | 0.22 | 0.217 | | 0.155 | 18400 | X | 3.8 | 5.0 | | 0.27 | 4330 | X | 3.7 |
| EXC-10 | J1V7R5 | 7/6/15 | 15.2 | | 0.21 | 0.260 | | 0.155 | 19300 | X | 3.7 | 4.4 | | 0.26 | 4490 | X | 3.6 |
| EXC-11 | J1V7R6 | 7/6/15 | 18.6 | | 0.18 | 0.402 | | 0.155 | 22400 | X | 3.2 | 6.3 | | 0.23 | 4910 | X | 3.1 |
| EXC-12 | J1V7R7 | 7/6/15 | 18.7 | | 0.20 | 0.155 | U | 0.155 | 20000 | X | 3.5 | 22.1 | | 0.25 | 4620 | X | 3.5 |
| FS-1 | J1V7R9 | 7/6/15 | 15.6 | | 0.22 | 0.336 | | 0.155 | 21500 | X | 3.8 | 5.2 | | 0.27 | 4910 | X | 3.7 |
| ASA-1 | J1V7T0 | 7/6/15 | 12.6 | | 0.22 | 0.155 | U | 0.155 | 17200 | X | 3.8 | 7.0 | | 0.27 | 3860 | X | 3.7 |
| Equipment Blank | J1V7T1 | 7/6/15 | 0.65 | B | 0.20 | | | | 925 | X | 3.5 | 0.41 | B | 0.25 | 23.3 | CX | 3.4 |
| Split of J1V7P6 | J1V7T2 | 7/6/15 | 13.1 | | 0.293 | 0.404 | | 0.12 | 19700 | | 7.82 | 5.64 | | 0.323 | 4050 | | 8.31 |

| | | | |
|---|---|---|---|
| Attachment | 1 | Sheet No. | 5 of 6 |
| Originator | R. J. Nielson | Date | 8/26/15 |
| Checked | I. B. Berezovskiy | Rev. No. | 0 |
| Calc. No. | 0100H-CA-V0233 | Job No. | 14655 |

**Attachment 1. 100-H-59:2 Subsite Verification Sample Results (Metals, TPH, and Physical).**

| Sample Location | HEIS Number | Sample Date | Manganese | | | Mercury | | | Molybdenum | | | Nickel | | | Potassium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EXC-1 | J1V7P6 | 7/6/15 | 351 | | 0.095 | 0.0059 | UN | 0.0059 | 0.40 | B | 0.25 | 13.0 | X | 0.12 | 1830 | | 39.0 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 360 | | 0.093 | 0.0062 | U | 0.0062 | 0.24 | U | 0.24 | 12.8 | X | 0.11 | 1890 | | 38.3 |
| EXC-2 | J1V7P7 | 7/6/15 | 313 | | 0.099 | 0.0060 | U | 0.0060 | 0.56 | B | 0.26 | 12.5 | X | 0.12 | 1470 | | 40.7 |
| EXC-3 | J1V7P8 | 7/6/15 | 299 | | 0.096 | 0.0091 | B | 0.0057 | 0.25 | U | 0.25 | 13.6 | X | 0.12 | 1200 | | 39.4 |
| EXC-4 | J1V7P9 | 7/6/15 | 280 | | 0.093 | 0.0062 | U | 0.0062 | 0.24 | B | 0.24 | 14.4 | X | 0.11 | 1160 | | 38.1 |
| EXC-5 | J1V7R0 | 7/6/15 | 342 | | 0.088 | 0.033 | | 0.0057 | 0.23 | U | 0.23 | 13.8 | X | 0.11 | 1890 | | 36.3 |
| EXC-6 | J1V7R1 | 7/6/15 | 249 | | 0.094 | 0.0065 | U | 0.0065 | 0.24 | U | 0.24 | 11.8 | X | 0.12 | 796 | | 38.6 |
| EXC-7 | J1V7R2 | 7/6/15 | 319 | | 0.10 | 0.0061 | U | 0.0061 | 0.27 | U | 0.27 | 14.3 | X | 0.13 | 1500 | | 42.5 |
| EXC-8 | J1V7R3 | 7/6/15 | 209 | | 0.094 | 0.0058 | U | 0.0058 | 0.24 | U | 0.24 | 10.4 | X | 0.12 | 726 | | 38.5 |
| EXC-9 | J1V7R4 | 7/6/15 | 301 | | 0.10 | 0.0059 | U | 0.0059 | 0.26 | U | 0.26 | 12.4 | X | 0.12 | 1450 | | 41.2 |
| EXC-10 | J1V7R5 | 7/6/15 | 290 | | 0.098 | 0.0059 | U | 0.0059 | 0.26 | U | 0.26 | 15.1 | X | 0.12 | 1310 | | 40.2 |
| EXC-11 | J1V7R6 | 7/6/15 | 350 | | 0.085 | 0.0058 | U | 0.0058 | 0.22 | U | 0.22 | 15.1 | X | 0.10 | 2070 | | 34.7 |
| EXC-12 | J1V7R7 | 7/6/15 | 312 | | 0.093 | 0.0060 | U | 0.0060 | 0.35 | B | 0.24 | 12.6 | X | 0.11 | 1830 | | 38.2 |
| FS-1 | J1V7R9 | 7/6/15 | 327 | | 0.10 | 0.0061 | U | 0.0061 | 0.26 | U | 0.26 | 15.7 | X | 0.12 | 2100 | | 41.0 |
| ASA-1 | J1V7T0 | 7/6/15 | 273 | | 0.099 | 0.0062 | U | 0.0062 | 0.26 | U | 0.26 | 10.2 | X | 0.12 | 1450 | | 40.7 |
| Equipment Blank | J1V7T1 | 7/6/15 | 15.9 | | 0.091 | 0.0061 | U | 0.0061 | 0.24 | U | 0.24 | 0.56 | BX | 0.11 | 53.8 | B | 37.3 |
| Split of J1V7P6 | J1V7T2 | 7/6/15 | 334 | | 0.196 | 0.00356 | B | 0.00356 | 0.384 | B | 0.196 | 10.1 | | 0.147 | 1390 | N | 6.26 |

| Sample Location | HEIS Number | Sample Date | Selenium | | | Silicon | | | Silver | | | Sodium | | | Vanadium | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL | mg/kg | Q | PQL |
| EXC-1 | J1V7P6 | 7/6/15 | 0.82 | U | 0.82 | 461 | NJ | 5.4 | 0.15 | U | 0.15 | 367 | | 56.1 | 47.2 | | 0.089 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 0.80 | U | 0.80 | 464 | J | 5.3 | 0.15 | U | 0.15 | 346 | | 55.1 | 45.7 | | 0.088 |
| EXC-2 | J1V7P7 | 7/6/15 | 0.85 | U | 0.85 | 439 | J | 5.6 | 0.16 | U | 0.16 | 382 | | 58.5 | 47.4 | | 0.093 |
| EXC-3 | J1V7P8 | 7/6/15 | 0.83 | U | 0.83 | 365 | J | 5.4 | 0.15 | U | 0.15 | 315 | | 56.7 | 52.6 | | 0.090 |
| EXC-4 | J1V7P9 | 7/6/15 | 0.80 | U | 0.80 | 331 | J | 5.3 | 0.15 | U | 0.15 | 344 | | 54.8 | 49.4 | | 0.087 |
| EXC-5 | J1V7R0 | 7/6/15 | 0.76 | U | 0.76 | 468 | J | 5.0 | 0.14 | U | 0.14 | 276 | | 52.2 | 45.0 | | 0.083 |
| EXC-6 | J1V7R1 | 7/6/15 | 0.81 | U | 0.81 | 248 | J | 5.3 | 0.15 | U | 0.15 | 302 | | 55.5 | 46.3 | | 0.088 |
| EXC-7 | J1V7R2 | 7/6/15 | 0.89 | U | 0.89 | 410 | J | 5.9 | 0.17 | U | 0.17 | 345 | | 61.2 | 44.0 | | 0.098 |
| EXC-8 | J1V7R3 | 7/6/15 | 0.81 | U | 0.81 | 282 | J | 5.3 | 0.15 | U | 0.15 | 210 | | 55.4 | 37.4 | | 0.088 |
| EXC-9 | J1V7R4 | 7/6/15 | 0.86 | U | 0.86 | 403 | J | 5.7 | 0.16 | U | 0.16 | 268 | | 59.2 | 43.3 | | 0.094 |
| EXC-10 | J1V7R5 | 7/6/15 | 0.84 | U | 0.84 | 319 | J | 5.6 | 0.16 | U | 0.16 | 239 | | 57.9 | 46.2 | | 0.092 |
| EXC-11 | J1V7R6 | 7/6/15 | 0.73 | U | 0.73 | 486 | J | 4.8 | 0.14 | U | 0.14 | 260 | | 49.9 | 45.3 | | 0.080 |
| EXC-12 | J1V7R7 | 7/6/15 | 0.80 | U | 0.80 | 440 | J | 5.3 | 0.15 | U | 0.15 | 266 | | 55.0 | 47.1 | | 0.088 |
| FS-1 | J1V7R9 | 7/6/15 | 0.86 | U | 0.86 | 423 | J | 5.7 | 0.16 | U | 0.16 | 337 | | 59.1 | 44.7 | | 0.094 |
| ASA-1 | J1V7T0 | 7/6/15 | 0.85 | U | 0.85 | 376 | J | 5.6 | 0.16 | U | 0.16 | 245 | | 58.5 | 42.4 | | 0.093 |
| Equipment Blank | J1V7T1 | 7/6/15 | 0.78 | U | 0.78 | 146 | J | 5.1 | 0.15 | U | 0.15 | 53.6 | U | 53.6 | 1.0 | B | 0.085 |
| Split of J1V7P6 | J1V7T2 | 7/6/15 | 1.01 | D | 0.321 | 1530 | *DN | 7.33 | 0.0978 | U | 0.0978 | 161 | C | 6.84 | 48.8 | D | 0.489 |

| Sample Location | HEIS Number | Sample Date | Zinc | | | TPH-Diesel Ext. | | | TPH-Diesel | | | TPH-Motor Oil | | | Percent Moisture | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | ug/kg | Q | PQL | % | Q | PQL |
| EXC-1 | J1V7P6 | 7/6/15 | 41.7 | X | 0.38 | 990 | U | 990 | 680 | U | 680 | | | | 0.75 | | 0.10 |
| Duplicate of J1V7P6 | J1V7R8 | 7/6/15 | 42.0 | X | 0.37 | 3000 | J | 960 | 1800 | J | 650 | | | | 0.91 | | 0.10 |
| EXC-2 | J1V7P7 | 7/6/15 | 37.9 | X | 0.39 | 990 | U | 990 | 670 | U | 670 | | | | 1.2 | | 0.10 |
| EXC-3 | J1V7P8 | 7/6/15 | 39.4 | X | 0.38 | 980 | U | 980 | 670 | U | 670 | | | | 0.90 | | 0.10 |
| EXC-4 | J1V7P9 | 7/6/15 | 37.8 | X | 0.37 | 960 | U | 960 | 660 | U | 660 | | | | 1.3 | | 0.10 |
| EXC-5 | J1V7R0 | 7/6/15 | 39.1 | X | 0.35 | 1000 | U | 1000 | 680 | U | 680 | | | | 0.83 | | 0.10 |
| EXC-6 | J1V7R1 | 7/6/15 | 32.3 | X | 0.37 | 990 | U | 990 | 670 | U | 670 | | | | 0.63 | | 0.10 |
| EXC-7 | J1V7R2 | 7/6/15 | 37.8 | X | 0.41 | 990 | U | 990 | 670 | U | 670 | | | | 3.6 | | 0.10 |
| EXC-8 | J1V7R3 | 7/6/15 | 28.1 | X | 0.37 | 1000 | U | 1000 | 680 | U | 680 | | | | 0.40 | | 0.10 |
| EXC-9 | J1V7R4 | 7/6/15 | 41.3 | X | 0.40 | 980 | U | 980 | 670 | U | 670 | | | | 0.41 | | 0.10 |
| EXC-10 | J1V7R5 | 7/6/15 | 36.7 | X | 0.39 | 980 | U | 980 | 660 | U | 660 | | | | 1.1 | | 0.10 |
| EXC-11 | J1V7R6 | 7/6/15 | 40.8 | X | 0.34 | 930 | U | 930 | 630 | U | 630 | | | | 0.68 | | 0.10 |
| EXC-12 | J1V7R7 | 7/6/15 | 62.7 | X | 0.37 | 5200 | | 990 | 2700 | J | 680 | | | | 0.70 | | 0.10 |
| FS-1 | J1V7R9 | 7/6/15 | 40.0 | X | 0.40 | 1400 | J | 1000 | 1100 | J | 690 | | | | 1.1 | | 0.10 |
| ASA-1 | J1V7T0 | 7/6/15 | 34.9 | X | 0.39 | 13000 | | 990 | 5400 | | 670 | | | | 0.14 | M | 0.10 |
| Equipment Blank | J1V7T1 | 7/6/15 | 0.94 | X | 0.36 | | | | | | | | | | 0.10 | U | 0.10 |
| Split of J1V7P6 | J1V7T2 | 7/6/15 | 42.3 | D | 1.96 | | | | 2180 | U | 2180 | 4820 | BJ | 2180 | | | |

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|---|---|---|---|
| Attachment | 1 | Sheet No. | 6 of 6 |
| Originator | R. J. Nielson | Date | 8/26/15 |
| Checked | I. B. Berezovskiy | Rev. No. | 0 |
| Calc. No. | 0100H-CA-V0233 | Job No. | 14655 |

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# CALCULATION COVER SHEET

Project Title: 100-H Area Closure Operations **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0234

Subject: 100-H-59:2 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

| Rev. | Sheet Numbers | Originator | Checker | Reviewer | Approval | Date |
|---|---|---|---|---|---|---|
| 0 | Cover = 1<br>Sheets = 3<br>Total = 4 | R. J. Nielson | I. B. Berezovskiy | T. Q. Howell | S. G. Wilkinson | 11/12/15 |
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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

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|---|---|---|---|---|---|---|---|
| Originator: | R. J. Nielson | Date: | 09/09/15 | Calc. No.: | 0100H-CA-V0234 | Rev.: | 0 |
| Project: | 100-H Area Closure Operations | Job No: | 14655 | Checked: | I. B. Berezovskiy | Date: | 09/09/15 |
| Subject: | 100-H-59:2 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-H-59:2 subsite. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009b), the following criteria must be met:

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

## GIVEN/REFERENCES:

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

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

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

4) WCH, 2015, *100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations*, 0100H-CA-V0233, Rev. 0, Washington Closure Hanford, Richland, Washington.

## SOLUTION:

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

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

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

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

## METHODOLOGY:

The 100-H-59:2 subsite is comprised of two decision units for verification sampling; specifically, the excavation and the anomaly staging area. Statistical samples and a focused sample were collected from

Washington Closure Hanford CALCULATION SHEET

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|---|---|---|---|---|---|---|---|
| Originator: | R. J. Nielson | Date: | 09/09/15 | Calc. No.: | 0100H-CA-V0234 | Rev.: | 0 |
| Project: | 100-H Area Closure Operations | Job No: | 14655 | Checked: | I. B. Berezovskiy | Date: | 09/09/15 |
| Subject: | 100-H-59:2 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations | | | | | Sheet No. | 2 of 3 |

the excavation and a focused sample was collected from the anomaly staging area. The direct contact hazard quotient and carcinogenic risk calculations for the 100-H-59:2 subsite were conservatively calculated using the greater of the statistical or maximum value for each analyte from all decision units from WCH (2015). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, molybdenum, dieldrin, and the detected polycyclic aromatic hydrocarbons require the HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Although total petroleum hydrocarbons (diesel range extended) were detected and no background value is available, the risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation. All other site nonradionuclide COPCs were either not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) The statistical value for boron is 3.7 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 $5.1 \times 10^{-4}$. 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 is obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation. The sum of the HQ values is $5.3 \times 10^{-3}$. 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, and then multiplied by $1.0 \times 10^{-6}$. For example, the statistical value for hexavalent chromium is 0.723 mg/kg; divided by 2.1 mg/kg, and multiplied as indicated, is $3.4 \times 10^{-7}$. Comparing this value to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk is obtained by summing the individual values. The excess cancer risk for the carcinogenic constituents detected is $1.1 \times 10^{-6}$. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

## RESULTS:

***Hazard Quotient and Excess Cancer Risk Calculations***

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

The direct contact hazard quotient and carcinogenic risk calculation results are provided in Table 1.

Washington Closure Hanford CALCULATION SHEET

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|---|---|---|---|---|---|---|---|
| Originator: | R. J. Nielson | Date: | 09/09/15 | Calc. No.: | 0100H-CA-V0234 | Rev.: | 0 |
| Project: | 100-H Area Closure Operations | Job No: | 14655 | Checked: | I. B. Berezovskiy | Date: | 09/09/15 |
| Subject: | 100-H-59:2 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-H-59:2 Subsite.**

| Contaminants of Potential Concern | Maximum or Statistical Value [a] (mg/kg) | Noncarcinogen RAG [b] (mg/kg) | Hazard Quotient | Carcinogen RAG [b] (mg/kg) | Carcinogen Risk |
|---|---|---|---|---|---|
| ***Metals*** | | | | | |
| Boron | 3.7 | 7,200 | 5.1E-04 | -- | -- |
| Chromium, hexavalent [c] | 0.723 | 240 | 3.0E-03 | 2.1 | 3.4E-07 |
| Molybdenum | 0.56 | 400 | 1.4E-03 | -- | -- |
| ***Polycyclic Aromatic Hydrocarbons*** | | | | | |
| Acenaphthene | 0.031 | 4,800 | 6.5E-06 | -- | -- |
| Anthracene | 0.024 | 24,000 | 1.0E-06 | -- | -- |
| Benzo(a)anthracene | 0.100 | -- | -- | 1.37 | 7.3E-08 |
| Benzo(a)pyrene | 0.069 | -- | -- | 0.137 | 5.0E-07 |
| Benzo(b)fluoranthene | 0.100 | -- | -- | 1.37 | 7.3E-08 |
| Benzo(ghi)perylene [d] | 0.056 | 2,400 | 2.3E-05 | -- | -- |
| Benzo(k)fluoranthene | 0.031 | -- | -- | 13.7 | 2.3E-09 |
| Chrysene | 0.085 | -- | -- | 137 | 6.2E-10 |
| Fluoranthene | 0.160 | 3,200 | 5.0E-05 | -- | -- |
| Fluorene | 0.023 | 3,200 | 7.2E-06 | -- | -- |
| Indeno(1,2,3-cd)pyrene | 0.053 | -- | -- | 1.37 | 3.9E-08 |
| Phenanthrene [d] | 0.098 | 24,000 | 4.1E-06 | -- | -- |
| Pyrene | 0.160 | 2,400 | 6.7E-05 | -- | -- |
| Dieldrin | 0.00085 | 4 | 2.1E-04 | 0.0625 | 1.4E-08 |
| ***Total Petroleum Hydrocarbons*** | | | | | |
| TPH - diesel range extended [e] | 13 | 200 | -- | -- | -- |
| ***Totals*** | | | | | |
| **Cumulative Hazard Quotient:** | | | **5.3E-03** | | |
| **Cumulative Excess Cancer Risk:** | | | | | **1.0E-06** |

Notes:

[a] From (WCH 2015).

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

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

[d] Toxicity data for these chemicals are not available. The cleanup levels are based on use of surrogate chemicals.
benzo(g,h,i)perylene surrogate: pyrene
phenanthrene surrogate: anthracene

[e] The risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation.

-- = not applicable

RAG = remedial action goal

## CONCLUSION:

The calculations in Table 1 demonstrate that the 100-H-59:2 subsite meet the requirements for the direct contact hazard quotient and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2009b) and SAP (DOE-RL 2009a). The direct contact hazard quotient and carcinogenic (excess cancer) risk calculations are for use in the RSVP for the 100-H-59:2 subsite.

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# CALCULATION COVER SHEET

Project Title: 100-H Area Closure Operations **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0235

Subject: 100-H-59:2 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

| Rev. | Sheet Numbers | Originator | Checker | Reviewer | Approval | Date |
|---|---|---|---|---|---|---|
| 0 | Cover = 1<br>Summary = 3<br>Total = 4 | R. J. Nielson | I. B. Berezovskiy | T. Q. Howell | S. G. Wilkinson | 11/12/15 |
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## SUMMARY OF REVISION

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Washington Closure Hanford CALCULATION SHEET

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|---|---|---|---|---|---|---|---|
| Originator: | R. J. Nielson | Date: | 8/26/2015 | Calc. No.: | 0100H-CA-V0235 | Rev.: | 0 |
| Project: | 100-H Area Closure Operations | Job No: | 14655 | Checked: | I. B. Berezovskiy | Date: | 8/26/2015 |
| Subject: | 100-H-59:2 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater | | | | | Sheet No. | 1 of 3 |

## PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-H-59:2 subsite. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009), the following criteria must be met:

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

## GIVEN/REFERENCES:

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

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

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

4) WCH, 2015, *100-H-59:2 Subsite Cleanup Verification 95% UCL Calculations*, 0100H-CA-V0233, Rev. 0, Washington Closure Hanford, Richland, Washington.

## SOLUTION:

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

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

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

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

Washington Closure Hanford CALCULATION SHEET

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|---|---|---|---|---|---|---|---|
| Originator: | R. J. Nielson | Date: | 9/9/2015 | Calc. No.: | 0100H-CA-V0235 | Rev.: | 0 |
| Project: | 100-H Area Closure Operations | Job No: | 14655 | Checked: | I. B. Berezovskiy | Date: | 9/9/2015 |
| Subject: | 100-H-59:2 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater | | | | | Sheet No. 2 of 3 | |

## METHODOLOGY:

The 100-H-59:2 subsite is comprised of two decision units for verification sampling; specifically, the excavation and the anomaly staging area. Statistical samples and a focused sample were collected from the excavation and a focused sample was collected from the anomaly staging area. The hazard quotient and carcinogenic risk calculations for potential impact to groundwater were conservatively calculated for all decision units using the greater of the statistical or maximum value for each analyte from the 95% UCL calculation (WCH 2015). Based on the generic site RESRAD model (BHI 2005) and a vadose zone of approximately 7 m (23 ft) thick, a $K_d$ of 10 mL/g or greater is required to show no predicted migration to groundwater in 1,000 years. Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, acenaphthene, and fluorene are included because no Washington State or Hanford background value has been established and the distribution coefficient ($K_d$) is less than that necessary to show no migration to groundwater in 1,000 years using the generic site RESRAD model. All other site nonradionuclide COPCs were either not detected, quantified below background levels, or has a $K_d$ greater than or equal to 10 mL/g. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum or statistical value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (mg/L) (calculated with, and related to the hazard quotient through, WAC 173-340-720(3)(a)(ii)(A), 1996) x 100 x 1 mg/1000 mg (conversion factor). This is based on the "100 times rule" of WAC 173-340-740(3)(a)(ii)(A) (1996). For example, the statistical value for boron is 3.7 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is $1.2 \times 10^{-2}$. Comparing this value to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The cumulative HQ for the 100-H-59:2 subsite $1.6 \times 10^{-1}$. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, and then multiplied by $1 \times 10^{-6}$. The 100-H-59:2 subsite does not have any constituents with carcinogenic RAGs; therefore, the criterion for excess cancer risk is met. Consequently, the criterion for cumulative excess cancer risk for carcinogens is also met.

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

Washington Closure Hanford CALCULATION SHEET

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| Originator: | R. J. Nielson | Date: | 8/26/2015 | Calc. No.: | 0100H-CA-V0235 | Rev.: | 0 |
| Project: | 100-H Area Closure Operations | Job No: | 14655 | Checked: | I. B. Berezovskiy | Date: | 8/26/2015 |
| Subject: | 100-H-59:2 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater | | | | | Sheet No. | 3 of 3 |

## RESULTS:

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

The hazard quotient and excess cancer risk calculation results are provided in Table 1.

**Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-H-59:2 Subsite.**

| Contaminants of Potential Concern[a] | Statistical or Maximum Value[a] (mg/kg) | Noncarcinogen RAG[b] (mg/kg) | Hazard Quotient | Carcinogen RAG[b] (mg/kg) | Carcinogen Risk |
|---|---|---|---|---|---|
| ***Metals*** | | | | | |
| Boron | 3.7 | 320 | 1.2E-02 | -- | -- |
| Chromium, hexavalent | 0.723 | 4.8 | 1.5E-01 | -- | -- |
| ***Polycyclic Aromatic Hydrocarbones*** | | | | | |
| Acenaphthene | 0.031 | 96 | 3.2E-04 | -- | -- |
| Fluorene | 0.023 | 64 | 3.6E-04 | -- | -- |
| ***Totals*** | | | | | |
| **Cumulative Hazard Quotient:** | | | **1.6E-01** | | |
| **Cumulative Excess Cancer Risk:** | | | | | **0.0E+00** |

Notes:
[a] From WCH (2015).
[b] Value obtained from the Cleanup Levels and Risk Calculations (CLARC) database using Groundwater, Method B, results and the "100 times" model.
-- = not applicable
RAG = remedial action goal

## CONCLUSION:

This calculation demonstrates that the 100-H-59:2 subsite meets the requirements for the hazard quotient and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2009). The hazard quotient and carcinogenic risk calculations for protection of groundwater 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 2015b). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009).

A review of the sample design (WCH 2015b), the field logbook (WCH 2015a), and applicable analytical data packages has been performed as part of this DQA. To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Verification sample data collected at the 100-H-59:2 subsite were provided by the laboratory in two sample delivery groups (SDGs): SDG JP0979 and SDG XP0217. SDG JP0979 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 100-H-59:2 data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

## MINOR DEFICIENCIES

### SDG JP0979

This SDG comprises 13 statistical soil samples (J1V7P6 through J1V7P9, J1V7R0 through J1V7R8) and one focused soil sample (J1V7R9) from the 100-H-59:2 subsite excavation area, and one focused sample (J1V7T0) from the anomaly staging area. This SDG includes one field duplicate pair (J1V7P6/J1V7R8). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, polychlorinated biphenyls (PCBs), total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), and pesticides. In addition, one field equipment blank (J1V7T1) was collected and analyzed for ICP metals and mercury. SDG JP0979 was submitted for third-party validation. Minor deficiencies are as follows.

In the ICP metals analysis, calcium and magnesium were detected in the method blank (MB). Third-party validation qualified calcium and magnesium results in sample J1V7T1 as undetected, with “UJ” flags. The data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries are out of project acceptance criteria for four analytes (aluminum [1,511%], antimony [43%], iron [881%], and silicon [18%]). For aluminum and iron, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. All antimony and silicon results for SDG JP0979 were qualified as estimated with "J" flags by third-party validation. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample (LCS) recovery for silicon was below the project recovery limit at 60%. All silicon results in SDG JP0979 were qualified as estimated with "J" flags by third-party validation. Estimated data are usable for decision-making purposes.

In the pesticide analysis, due to the lack of MS, matrix spike duplicate, and LCS analysis, all toxaphene results were qualified as estimates with "J" flags by third party validation. Estimated data are usable for decision-making purposes.

**SDG XP0217**

This SDG comprises one statistical soil sample (J1V7T2) from the excavation decision unit. Field sample J1V7T2 is a split sample associated with J1V7P6. This sample was analyzed for ICP metals, mercury, hexavalent chromium, PCBs, TPH, PAH, and pesticides. Minor deficiencies are as follows.

In the pesticide analysis, due to the lack of MS, matrix spike duplicate, and LCS analysis, all toxaphene results may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate relative percent difference (RPD) for antimony (52.2%), cadmium (60.6%), and silicon (43.8%) is above the project acceptance criteria of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for the RPD above the quality control (QC) limits, antimony, cadmium, and silicon results in SDG XP0217 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recovery for silicon (0%) is out of project acceptance criteria. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Silicon did not have mismatched spike and native concentrations in the MS. Although not qualified for MS recovery outside the project acceptance criteria, all silicon results for SDG XP0217 may be considered estimated. Estimated data are usable for decision-making purposes.

## FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2015a), are shown in Table D-1. The main and QA/QC sample results are presented in Appendix C.

**Table D-1. Field Quality Assurance/Quality Control Samples.**

| Sample Area | Main Sample | Duplicate Sample | Split Sample |
|---|---|---|---|
| Excavation area | J1V7P6 | J1V7R8 | J1V7T2 |

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

Field split samples are used to determine systematic differences (bias) between laboratories. A statistical determination of systematic differences would require larger data sets than are presented here. Such a determination is complicated by variability introduced by the natural heterogeneities inherent in field soil samples and the analytical variability that each individual laboratory experiences. Therefore, when evaluating limited field split data relatively large RPDs are expected. No major deficiencies in the RPD calculations were found for the split sample. Minor deficiencies for the field duplicate and split samples are as follows.

None of the RPDs calculated for the field duplicate sample are above the acceptance criteria (30%). In the split evaluation, the RPDs calculated for aluminum (50.4%) and silicon (107.4%) were above the field split acceptance criteria (less than 35%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The data are usable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and split) is less than five times the TDL, including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. Antimony and sodium required this check.

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

## SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues, such as those discussed above, are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-H-59:2 subsite 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-H-59:2 subsite data sets conclude that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes.

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

## REFERENCES

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WCH, 2015a, *100-H Field Remediation and Sampling*, Logbook EL-1627-09, pp. 64-67, Washington Closure Hanford, Richland, Washington.

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