0090135

TRI-PARTY AGREEMENT

Change Notice Number TPA-CN- 368	TPA CHANGE NOTICE FORM	Date: June 30, 2010
Document Number, Title, and Revision: DOE/RL-2009-40, *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2,100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study*, Rev. 0		Date Document Last Issued: March 25, 2010
Originator Jon McKibben/Fred Biebesheimer		Phone: 373.4677/373.1928

Description of Change:

Replaces pages 2-13/14, 2-21/22, 2-27/28, 2-33/34, 2-39/40, 2-45/46, 2-55/56, 2-61/62, 2-67/68, 2-73/74, 2-79/80, 2-85/86, 2-93/94, 2-99/100, 2-107/108, 2-113/114, and 2-127 through 2-130, including Table 2-21 with the attached.

Removes well 199-D5-41 from the spatial and temporal uncertainty groundwater well network for the May 2010 high river stage sampling event (no replacement pages issued). The well is now an injection well.

Briant Charboneau (**DOE**) and Nina Menard (**Lead Regulatory Agency**) agree that the proposed change modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records,* and not Chapter 12.0, *Changes to the Agreement.*

Note: Include affected page number(s)

Justification and Impacts of Change:

Changes to Tables 2-3 through 2-18 correct the quantitation limit for hexavalent chromium for batch leach analysis from 3.7 µg/L to 30 µg/L. A change in quantitation limit from 100 µg/L to 3.7 µg/L was made in error, not in response to an agency comment. The 3.7 µg/L limit is difficult for laboratories to achieve under ideal conditions with no interferences. It is expected that some interferences will exist (soil that may "color" extract, etc.); therefore, the 3.7 µg/L limit would routinely not be met during "real-world" analysis. The revision to 30 µg/L reflects a quantitation limit that would be often achievable for "real" samples. The laboratories will attempt to achieve quantitation limits less than the listed 30 µg/L.

The change to Section 2.2.4 removes the requirement for pH adjustment of demineralized water by EPA's West Coast recommendation for batch leaching procedure.

In the changes to Section 2.2.5 and Table 2-21, the collection frequency for field duplicate samples was revised to one per borehole per media sampled and for field transfer blank samples to one per borehole per media sampled where samples undergo volatile organic analysis. The field duplicate sample and field transfer blank sample collection frequencies for groundwater monitoring activities was not changed.

Well 199-D5-41 was converted from a monitoring well to an injection well and is no longer available for sampling. The changes include:

- To Table 1-1, "Sample spatial/temporal uncertainty groundwater monitoring wells," add footnote "c. Well 199-D5-41 converted to injection well and will not be included in network for all sampling rounds." Change affects pages 1-1 and 1-2.
- To Table 3-1, "Sample 53 spatial and temporal uncertainty monitoring wells; three rounds," add footnote "j. Fifty two wells in network after well 199-D5-41 is converted to injection well." Change affects pages 3-28 and 3-30.
- Table 3-1, change entry in "Water/Sample Measurement, Sample Interval/Depth (ft bgs)" column for spatial and temporal uncertainty groundwater samples to "Three rounds of sampling will be occur that will represent low (October 2009), high (May 2010), and transition (February 2010) river stages (157 samples)." Change affects page 3-28.
- Table 3-1, change "Estimated total number of samples" for "Spatial and temporal uncertainty samples" to 187. Change affects page 3-29.
- To Table 3-2, add footnote for well 199-D5-41, "Well will be excluded from network after conversion to injection well."

Approvals:

BRIANT CHARBONEAU DOE Project Manager	8-19-2010 Date	☒ Approved [ ] Disapproved
Nina M. Menard Ecology Project Manager	8-26-2010 Date	☒ Approved [ ] Disapproved

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Table 2-1. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 100-D-12

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]

This revised Table 2-3 (pages 2-13 and 2-14) were approved under TPA-CN-358

Table 2-1. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 100-D-12

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in the Washington Administrative Code (WAC) 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Soil will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

e. Field measurements have no specific QC requirement for accuracy except to perform checks to verify manufacturer's expected performance.

f. Strontium-90 will be assessed as total radioactive strontium.

This revised Table 2-3 (pages 2-13 and 2-14) were approved under TPA-CN-358

Table 2-2. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 100-D-4

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[k]	70-130[k]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals) or EPA 200.8	≤30[k]	70-130[k]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A

This revised Table 2-4 (pages 2-21 and 2-22) were approved under TPA-CN-358

Table 2-2. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 100-D-4

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in the Washington Administrative Code (WAC) 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Soil will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

e. Field measurements have no specific QC requirement for accuracy except to perform checks to verify manufacturer's expected performance.

f. Generic RESRAD modeling reported in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, predicts the contaminant will not reach groundwater within 1,000 years; however, site-specific modeling will be performed, as necessary, to determine whether preliminary cleanup goals have been met.

g. Accuracy criteria shown are for associated batch laboratory control sample percent recoveries. Except for gamma energy analysis, additional accuracy criteria include analysis-specific evaluations performed for matrix spike, tracer, and/or carrier recoveries, as appropriate to the method. The precision criteria shown are for batch laboratory replicate sample relative percent differences.

h. The groundwater protection and river protection preliminary cleanup goal values for cesium-137, cobalt-60, tritium, strontium-90, and nickel-63 were established in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, Revision 6.

i. Strontium-90 will be assessed as total radioactive strontium.

j. The Uranium-238 groundwater and river protection preliminary cleanup goal values are not risk-based. The values are based on Hanford Site Background.

k. Accuracy criteria specified are for calculated percent recoveries for associated analytical batch matrix spike samples. Additional accuracy evaluation based on statistical control limits for analytical batch laboratory control samples also is performed. The precision criteria shown are for batch laboratory replicate matrix spike or replicate sample relative percent differences.

l. The preliminary cleanup goal value for arsenic will be re-evaluated as described in DOE/RL-2008-46, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan*.

m. To meet or approach calculated cleanup goals, laboratories must use axial-based ("trace") ICP analytical methods. The laboratory also may substitute graphite furnace or ICP/MS methods if estimated quantitation limits are met.

This revised Table 2-4 (pages 2-21 and 2-22) were approved under TPA-CN-358

Table 2-3. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-D-1A/116-D-1B

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
11097-69-1	Aroclor-1254 (PCB)	0.017 mg/kg[k]	0.5 mg/kg	0.0664 mg/kg	0.000315 mg/kg	EPA 8082 (PCB by GC)	≤30[r]	70-130[r]
319-85-7	beta-BHC	0.00165 mg/kg	0.556 mg/kg	0.00227 mg/kg	0.00259 mg/kg	EPA 8081 (pesticides by GC)	≤30[r]	70-130[r]
60-57-1	Dieldrin	0.0033 mg/kg[k]	0.0625 mg/kg	0.00282 mg/kg	0.000089 mg/kg			
7440-61-1	Uranium (total)[s]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[l]	70-130[l]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[l]	70-130[l]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals) or EPA 200.8	≤30[l]	70-130[l]

This revised Table 2-5 (pages 2-27 and 2-28) were approved under TPA-CN-358

Table 2-3. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-D-1A/116-D-1B

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[i]	70-130[i]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in the Washington Administrative Code (WAC) 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Borehole will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

This revised Table 2-5 (pages 2-27 and 2-28) were approved under TPA-CN-358

Table 2-4. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-D-4

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
18540-29-9	Hexavalent chromium[p]	0.5 mg/kg	TBD	TBD	TBD	EPA 7196 (Hexavalent chromium)	≤30[k]	70-130[k]
7439-97-6	Mercury	0.2 mg/kg	24 mg/kg	2.09 mg/kg	0.33 mg/kg	EPA 7471 (mercury by cold vapor)	≤30[k]	70-130[k]
67-66-3	Chloroform	0.005 mg/kg	164 mg/kg	0.038 mg/kg	0.0607 mg/kg	EPA 8260 (volatile organic compounds)	≤30[q]	70-130[q]
75-35-4	1,1-Dichloroethene	0.01 mg/kg[r]	1.67 mg/kg	0.0005 mg/kg	0.0008 mg/kg			
75-01-4	Vinyl Chloride	0.01 mg/kg[r]	0.667 mg/kg	0.00018 mg/kg	0.0252 mg/kg			
117-81-7	Bis(2-ethylhexyl) phthalate	0.33 mg/kg	71.4 mg/kg	13.9 mg/kg	8.01 mg/kg	EPA 8270 (semivolatile organic compounds)	≤30[q]	70-130[q]
84-74-2	di-n-Butyl phthalate	0.33 mg/kg	8,000 mg/kg	56.5 mg/kg	191 mg/kg			
7440-61-1	Uranium (total)[s]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[k]	70-130[k]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]

This revised Table 2-6 (pages 2-33 and 2-34) were approved under TPA-CN-358

Table 2-4. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-D-4

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[k]	70-130[k]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

This revised Table 2-6 (pages 2-33 and 2-34) were approved under TPA-CN-358

Table 2-5. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-D-7

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-22-4	Silver	1 mg/kg[n]	400 mg/kg	13.6 mg/kg	0.884 mg/kg			
7440-28-0	Thallium	5 mg/kg[n]	5.6 mg/kg	1.59 mg/kg	4.46 mg/kg			
7440-62-2	Vanadium	2.5 mg/kg	560 mg/kg	2,240 mg/kg	NV			
7440-66-6	Zinc	1 mg/kg	24,000 mg/kg	5,970 mg/kg	226 mg/kg			
18540-29-9	Hexavalent chromium[q]	0.5 mg/kg	TBD	TBD	TBD	EPA 7196 (Hexavalent chromium)	≤30[m]	70-130[m]
7439-97-6	Mercury	0.2 mg/kg	24 mg/kg	2.09 mg/kg	0.33 mg/kg	EPA 7471 (mercury by cold vapor)	≤30[m]	70-130[m]
71-43-2	Benzene	0.005 mg/kg[j]	18.2 mg/kg	0.00448 mg/kg	0.014 mg/kg	EPA 8260 (volatile organic compounds)	≤30[r]	70-130[r]
56-23-5	Carbon tetrachloride	0.005mg/kg[j]	7.69 mg/kg	0.031 mg/kg	0.0046 mg/kg			
67-66-3	Chloroform	0.005 mg/kg	164 mg/kg	0.038 mg/kg	0.0607 mg/kg			
79-01-6	Trichloroethene	0.005 mg/kg[j]	11.2 mg/kg	0.00323 mg/kg	0.0355 mg/kg			
117-81-7	Bis(2-ethylhexyl) phthalate	0.33 mg/kg	71.4 mg/kg	13.9 mg/kg	8.01 mg/kg	EPA 8270 (semivolatile organic compounds)	≤30[r]	70-130[r]
108-95-2	Phenol	0.33 mg/kg	24,000 mg/kg	11 mg/kg	192 mg/kg			
7440-61-1	Uranium (total)[s]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[m]	70-130[m]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]

This revised Table 2-7 (pages 2-39 and 2-40) were approved under TPA-CN-358

Table 2-5. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-D-7

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A

This revised Table 2-7 (pages 2-39 and 2-40) were approved under TPA-CN-358

Table 2-6. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-DR-1&2

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-39-3	Barium	2 mg/kg	16,000 mg/kg	1,650 mg/kg	3,300 mg/kg	EPA 6010 or 200.8 (ICP or ICP/MS metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	0.5 mg/kg[n]	80 mg/kg	0.69 mg/kg	0.25 mg/kg			
7440-47-3	Chromium (total)	1 mg/kg	120,000 mg/kg	2,000 mg/kg	2,600 mg/kg			
7440-50-8	Copper	1 mg/kg	3,200 mg/kg	284 mg/kg	1,150 mg/kg			
7439-92-1	Lead	5 mg/kg	250 mg/kg	3,000 mg/kg	840 mg/kg			
7439-96-5	Manganese[o]	5 mg/kg	3,760 mg/kg	512 mg/kg	512 mg/kg			
7440-02-0	Nickel	4 mg/kg	1,600 mg/kg	130 mg/kg	357 mg/kg			
7440-22-4	Silver	1 mg/kg[n]	400 mg/kg	13.6 mg/kg	0.884 mg/kg			
7440-28-0	Thallium	5 mg/kg[n]	5.6 mg/kg	1.59 mg/kg	4.46 mg/kg			
7440-62-2	Vanadium	2.5 mg/kg	560 mg/kg	2,240 mg/kg	NV			
7440-66-6	Zinc	1 mg/kg	24,000 mg/kg	5,970 mg/kg	226 mg/kg			
18540-29-9	Hexavalent chromium[p]	0.5 mg/kg	TBD	TBD	TBD	EPA 7196 (Hexavalent chromium)	≤30[m]	70-130[m]
75-35-4	1,1-Dichloroethene	0.01 mg/kg[j]	1.67 mg/kg	0.0005 mg/kg	0.0008 mg/kg	EPA 8260 (volatile organic compounds)	≤30[q]	70-130[q]
67-64-1	Acetone	0.02 mg/kg	72,000 mg/kg	28.9 mg/kg	NV			
67-66-3	Chloroform	0.005 mg/kg	164 mg/kg	0.038 mg/kg	0.0607 mg/kg			
75-09-2	Methylene chloride	0.005 mg/kg	133 mg/kg	0.218 mg/kg	0.0409 mg/kg			
108-88-3	Toluene	0.005 mg/kg	6,400 mg/kg	4.65 mg/kg	99 mg/kg			
75-01-4	Vinyl Chloride	0.01 mg/kg[j]	0.667 mg/kg	0.00018 mg/kg	0.0252 mg/kg			

This revised Table 2-8 (pages 2-45 and 2-46) were approved under TPA-CN-358

Table 2-6. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-DR-1&2

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
541-43-1	1,3-Dichlorobenzene	0.33 mg/kg	2,400 mg/kg	3.09 mg/kg	10.3 mg/kg	EPA 8270 (semivolatile organic compounds)	≤30[q]	70-130[q]
106-46-7	1,4-Dichlorobenzene	0.33 mg/kg	41.7 mg/kg	0.030 mg/kg	0.160 mg/kg			
95-57-8	2-Chlorophenol	0.33 mg/kg	400 mg/kg	0.422 mg/kg	2.28 mg/kg			
59-50-7	4-Chloro-3-methylphenol[r]	0.33 mg/kg	4,000 mg/kg	5.07 mg/kg	10.1 mg/kg			
84-74-2	di-n-Butyl phthalate	0.33 mg/kg	8,000 mg/kg	56.5 mg/kg	191 mg/kg			
7440-61-1	Uranium (total)[s]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[m]	70-130[m]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]

This revised Table 2-8 (pages 2-45 and 2-46) were approved under TPA-CN-358

Table 2-7. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-DR-9

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
18540-29-9	Hexavalent chromium	~~3.7 µg/L~~ 30 µg/L NM	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[k]	70-130[k]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[k]	70-130[k]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in WAC 173-340"Model Toxics Control Act – Cleanup," 2007.

This revised Table 2-9 (pages 2-55 and 2-56) were approved under TPA-CN-358

Table 2-7. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-DR-9

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Borehole will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

e. Field measurements have no specific QC requirement for accuracy except to perform checks to verify manufacturer's expected performance.

f. Generic RESRAD modeling reported in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, predicts the contaminant will not reach groundwater within 1,000 years; however, site-specific modeling will be performed, as necessary, to determine whether preliminary cleanup goals have been met.

g. Accuracy criteria shown are for associated batch laboratory control sample percent recoveries. Except for gamma energy analysis, additional accuracy criteria include analysis-specific evaluations performed for matrix spike, tracer, and/or carrier recoveries, as appropriate to the method. The precision criteria shown are for batch laboratory replicate sample relative percent differences.

h. The groundwater protection and river protection preliminary cleanup goal values for cesium-137, cobalt-60, technetium-99, tritium, strontium-90, and nickel-63 were established in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, Revision 6.

i. The Uranium-238 groundwater and river protection preliminary cleanup goal values are not risk-based. The values are based on Hanford Site Background.

j. Strontium-90 will be assessed as total radioactive strontium.

k. Accuracy criteria specified are for calculated percent recoveries for associated analytical batch matrix spike samples. Additional accuracy evaluation based on statistical control limits for analytical batch laboratory control samples also is performed. The precision criteria shown are for batch laboratory replicate matrix spike or replicate sample relative percent differences.

l. To meet or approach calculated cleanup goals, laboratories must use axial-based ("trace") ICP analytical methods. The laboratory also may substitute graphite furnace or ICP/MS methods if estimated quantitation limits are met.

m. The preliminary cleanup goal value for arsenic will be re-evaluated as described in DOE/RL-2008-46, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan*.

n. The manganese groundwater and river protection preliminary cleanup goal values are not risk based. They are based on Hanford site background.

o. A task is included in DOE/RL-2008-46, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* to re-evaluate hexavalent chromium cleanup levels.

Table 2-8. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 118-D-6

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

This revised Table 2-10 (pages 2-61 and 2-62) were approved under TPA-CN-358

Table 2-8. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 118-D-6

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in WAC 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Borehole will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

e. Field measurements have no specific QC requirement for accuracy except to perform checks to verify manufacturer's expected performance.

f. Generic RESRAD modeling reported in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, predicts the contaminant will not reach groundwater within 1,000 years; however, site-specific modeling will be performed, as necessary, to determine whether preliminary cleanup goals have been met.

g. Accuracy criteria shown are for associated batch laboratory control sample percent recoveries. Except for gamma energy analysis, additional accuracy criteria include analysis-specific evaluations performed for matrix spike, tracer, and/or carrier recoveries, as appropriate to the method. The precision criteria shown are for batch laboratory replicate sample relative percent differences.

h. The groundwater protection and river protection preliminary cleanup goal values for cesium-137, cobalt-60, neptunium-237, technetium-99, tritium, strontium-90, and nickel-63 were established in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, Revision 6.

i. The Uranium-233/234 and Uranium-238 groundwater and river protection preliminary cleanup goal values are not risk-based. The values are based on Hanford Site Background.

j. The Uranium-235 groundwater and river protection preliminary cleanup goal values are based on the recommended daily limit.

k. Calculated preliminary cleanup goals are less than established analytical methodology capabilities. The analytical detection limits will be used for working levels, and will be periodically reviewed to establish if lower detection limit capabilities have become available.

l. Strontium-90 will be assessed as total radioactive strontium.

m. Accuracy criteria specified are for calculated percent recoveries for associated analytical batch matrix spike samples. Additional accuracy evaluation based on statistical control limits for analytical batch laboratory control samples also is performed. The precision criteria shown are for batch laboratory replicate matrix spike or replicate sample relative percent differences.

n. The preliminary cleanup goal value for arsenic will be re-evaluated as described in DOE/RL-2008-46, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan*.

o. Cobalt groundwater and river protection preliminary cleanup goal values are based on Hanford Site background values.

This revised Table 2-10 (pages 2-61 and 2-62) were approved under TPA-CN-358

Table 2-9. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-1

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
191-24-2	Benzo(ghi) perylene	0.03 mg/kg	2,400 mg/kg	25,700 mg/kg	7,070 mg/kg			
207-08-9	Benzo(k) fluoranthene	0.015 mg/kg	1.37 mg/kg	21.5 mg/kg	0.138 mg/kg			
218-01-9	Chrysene	0.1 mg/kg[k]	13.7 mg/kg	9.56 mg/kg	0.0446 mg/kg			
206-44-0	Fluoranthene	0.05 mg/kg	3,200 mg/kg	631 mg/kg	178 mg/kg			
193-39-5	Indeno(1,2,3-cd) pyrene	0.03 mg/kg	1.37 mg/kg	8.33 mg/kg	0.389 mg/kg			
85-01-8	Phenanthrene	0.05 mg/kg	24,000 mg/kg	1,140 mg/kg	9,100 mg/kg			
129-00-0	Pyrene	0.05 mg/kg	2,400 mg/kg	655 mg/kg	2,620 mg/kg			
7440-61-1	Uranium (total)[s]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[m]	70-130[m]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]

This revised Table 2-11 (pages 2-67 and 2-68) were approved under TPA-CN-358

Table 2-9. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-1

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7439-92-1	Leac	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in WAC 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

This revised Table 2-11 pages 2-67 and 2-68) were approved under TPA-CN-358

Table 2-10. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-2

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
53469-21-9	Aroclor-1242 (PCB)	0.017 mg/kg[j]	0.5 mg kg	0.0394 mg/kg	0.000187 mg/g	EPA 8082 (PCBs by GC)	≤30[s]	70-130[s]
11096-82-5	Aroclor-1260 (PCB)	0.017 mg/kg[j]	0.5 mg kg	0.721 mg/kg	0.00342 mg/kg			
71-43-2	Benzene	0.005 mg/kg[j]	18.2 mg/kg	0.00448 mg/kg	0.014 mg/kg	EPA 8260 (volatile organic compounds)	≤30[s]	70-130[s]
67-66-3	Chloroform	0.005 mg/kg	164 mg/kg	0.038 mg/kg	0.0607 mg/kg			
75-35-4	1,1-Dichloroethene	0.01 mg/kg[j]	1.67 mg/kg	0.0005 mg/kg	0.0008 mg/kg			
75-01-4	Vinyl Chloride	0.01 mg/kg[j]	0.667 mg/kg	0.00018 mg/kg	0.0252 mg/kg			
117-81-7	Bis(2-ethylhexyl) phthalate	0.33 mg/kg	71.4 mg/kg	13.9 mg/kg	8.01 mg/kg	EPA 8270 (semivolatile organic compounds)	≤30[s]	70-130[s]
84-74-2	di-n-Butyl phthalate	0.33 mg/kg	8,000 mg/kg	56.5 mg/kg	191 mg/kg			
7440-61-1	Uranium (total)[t]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[m]	70-130[m]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]

This revised Table 2-12 (pages 2-73 and 2-74) were approved under TPA-CN-358

Table 2-10. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-2

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in WAC 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17 Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Soils will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

This revised Table 2-12 pages 2-73 and 2-74) were approved under TPA-CN-358

Table 2-11. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-4

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-62-2	Vanadium	2.5 mg/kg	560 mg/kg	2,240 mg/kg	NV			
7440-66-6	Zinc	1 mg/kg	24,000 mg/kg	5,970 mg/kg	226 mg/kg			
7439-97-6	Mercury	0.2 mg/kg	24 mg/kg	2.09 mg/kg	0.33 mg/kg	EPA 7471 (mercury by cold vapor)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium[r]	0.5 mg/kg	TBD	TBD	TBD	EPA 7196 (Hexavalent chromium)	≤30[m]	70-130[m]
71-43-2	Benzene	0.005 mg/kg[i]	18.2 mg/kg	0.00448 mg/kg	0.014 mg/kg	EPA 8260 (volatile organic compounds)	≤30[s]	70-130[s]
56-23-5	Carbon tetrachloride	0.005 mg/kg[i]	7.69 mg/kg	0.031 mg/kg	0.0046 mg/kg			
67-66-3	Chloroform	0.005 mg/kg	164 mg/kg	0.038 mg/kg	0.0607 mg/kg			
79-01-6	Trichloroethene	0.005 mg/kg[i]	11.2 mg/kg	0.00323 mg/kg	0.0355 mg/kg			
7440-61-1	Uranium (total)[t]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[m]	70-130[m]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]

This revised Table 2-13 (pages 2-79 and 2-80) were approved under TPA-CN-358

Table 2-11. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-4

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in WAC 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

This revised Table 2-13 (pages 2-79 and 2-80) were approved under TPA-CN-358

Table 2-12. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-6

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
18540-29-9	Hexavalent chromium[r]	0.5 mg/kg	TBD	TBD	TBD	EPA 7196 (Hexavalent chromium)	≤30[m]	70-130[m]
7439-97-6	Mercury	0.2 mg/kg	24 mg/kg	2.09 mg/kg	0.33 mg/kg	EPA 7471 (mercury by cold vapor)	≤30[m]	70-130[m]
71-55-6	1,1,1-Trichloroethane	0.005 mg/kg	165,000 mg/kg	1.58 mg/kg	3.17 mg/kg	EPA 8260 (volatile organic compounds)	≤30[s]	70-130[s]
75-35-4	1,1-Dichloroethene	0.01 mg/kg[k]	1.67 mg/kg	0.0005 mg/kg	0.0008 mg/kg			
78-93-3	2-Butanone	0.01 mg/kg	NV	48,000 mg/kg	19.6 mg/kg			
591-78-6	2-Hexanone	0.02 mg/kg	3,200 mg/kg	2.73 mg/kg	NV			
108-10-1	4-Methyl-2-pentanone	0.01 mg/kg	6,400 mg/kg	2.71 mg/kg	NV			
67-64-1	Acetone	0.02 mg/kg	72,000 mg/kg	28.9 mg/kg	NV			
71-43-2	Benzene	0.005 mg/kg[k]	18.2 mg/kg	0.00448 mg/kg	0.014 mg/kg			
56-23-5	Carbon tetrachloride	0.005 mg/kg[k]	7.69 mg/kg	0.031 mg/kg	0.0046 mg/kg			
67-66-3	Chloroform	0.005 mg/kg	164 mg/kg	0.038 mg/kg	0.0607 mg/kg			
100-41-4	Ethylbenzene	0.005 mg/kg	8,000 mg/kg	6.05 mg/kg	53.6 mg/kg			
75-09-2	Methylene chloride	0.005 mg/kg	133 mg/kg	0.218 mg/kg	0.0409 mg/kg			
127-18-4	Tetrachloroethene	0.005 mg/kg	1.85 mg/kg	0.008 mg/kg	0.008 mg/kg			
156-60-5	trans-1,2-Dichloroethylene	0.005 mg/kg	1,600 mg/kg	0.54 mg/kg	356 mg/kg			
79-01-6	Trichloroethene	0.005 mg/kg[k]	11.2 mg/kg	0.00323 mg/kg	0.0355 mg/kg			
75-01-4	Vinyl Chloride	0.01 mg/kg[k]	0.667 mg/kg	0.00018 mg/kg	0.0252 mg/kg			

This revised Table 2-14 (pages 2-85 and 2-86) were approved under TPA-CN-358

Table 2-12. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-6

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
1330-20-7	Xylenes (total)	0.01 mg/kg	16,000 mg/kg	3.09 mg/kg	10.3 mg/kg			
7440-61-1	Uranium (total)[t]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[m]	70-130[m]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]

This revised Table 2-14 (pages 2-85 and 2-86) were approved under TPA-CN-358

Table 2-13. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-7

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A

This revised Table 2-15 (pages 2-93 and 2-94) were approved under TPA-CN-358

Table 2-13. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 116-H-7

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in WAC 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Borehole will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

e. Field measurements have no specific QC requirement for accuracy except to perform checks to verify manufacturer's expected performance.

f. The groundwater protection and river protection preliminary cleanup goal values for cesium-137, cobalt-60, technetium-99, tritium, strontium-90, and nickel-63 were established in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, Revision 6.

g. Accuracy criteria shown are for associated batch laboratory control sample percent recoveries. Except for gamma energy analysis, additional accuracy criteria include analysis-specific evaluations performed for matrix spike, tracer, and/or carrier recoveries, as appropriate to the method. The precision criteria shown are for batch laboratory replicate sample relative percent differences.

h. Generic RESRAD modeling reported in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, predicts the contaminant will not reach groundwater within 1,000 years; however, site-specific modeling will be performed, as necessary, to determine whether preliminary cleanup goals have been met.

This revised Table 2-15 (pages 2-93 and 2-94) were approved under TPA-CN-358

Table 2-14. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 118-H-6

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-28-0	Thallium	5 mg/kg[n]	5.6 mg/kg	1.59 mg/kg	4.46 mg/kg			
7440-62-2	Vanadium	2.5 mg/kg	560 mg/kg	2,240 mg/kg	NV			
7440-66-6	Zinc	1 mg/kg	24,000 mg/kg	5,970 mg/kg	226 mg/kg			
18540-29-9	Hexavalent chromium[r]	0.5 mg/kg	TBD	TBD	TBD	EPA 7196 (Hexavalent chromium)	≤30[m]	70-130[m]
7439-97-6	Mercury	0.2 mg/kg	24 mg/kg	2.09 mg/kg	0.33 mg/kg	EPA 7471 (mercury by cold vapor)	≤30[m]	70-130[m]
12674-11-2	Aroclor-1016 (PCB)	0.017 mg/kg[k]	0.5 mg/kg	0.0942 mg/kg	0.000447 mg/kg	EPA 8082 (PCB by GC)	≤30[s]	70-130[s]
11104-28-2	Aroclor-1221 (PCB)	0.017 mg/kg[k]	0.5 mg/kg	0.00920 mg/kg	0.0000437 mg/kg			
11141-16-5	Aroclor-1232 (PCB)	0.017 mg/kg[k]	0.5 mg/kg	0.00920 mg/kg	0.0000437 mg/kg			
53469-21-9	Aroclor-1242 (PCB)	0.017 mg/kg[k]	0.5 mg/kg	0.0394 mg/kg	0.000187 mg/kg			
12672-29-6	Aroclor-1248 (PCB)	0.017 mg/kg[k]	0.5 mg/kg	0.0386 mg/kg	0.000183 mg/kg			
11097-69-1	Aroclor-1254 (PCB)	0.017 mg/kg[k]	0.5 mg/kg	0.0664 mg/kg	0.000315 mg/kg			
11096-82-5	Aroclor-1260 (PCB)	0.017 mg/kg[k]	0.5 mg/kg	0.721 mg/kg	0.00342 mg/kg			
71-43-2	Benzene	0.005 mg/kg[k]	18.2 mg/kg	0.00448 mg/kg	0.014 mg/kg	EPA 8260 (volatile organic compounds)	≤30[s]	70-130[s]
56-23-5	Carbon tetrachloride	0.005 mg/kg[k]	7.69 mg/kg	0.031 mg/kg	0.0046 mg/kg			

This revised Table 2-16 (pages 2-99 and 2-100) were approved under TPA-CN-358

Table 2-14. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 118-H-6

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
67-66-3	Chloroform	0.005 mg/kg	164 mg/kg	0.038 mg/kg	0.0607 mg/kg			
79-01-6	Trichloroethene	0.005 mg/kg[k]	11.2 mg/kg	0.00323 mg/kg	0.0355 mg/kg			
7440-61-1	Uranium (total)[t]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[m]	70-130[m]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[m]	70-130[m]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[m]	70-130[m]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A

This revised Table 2-16 (pages 2-99 and 2-100) were approved under TPA-CN-358

Table 2-15. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 1607-H4

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
193-39-5	Indeno(1,2,3-cd) pyrene	0.03 mg/kg	1.37 mg/kg	8.33 mg/kg	0.389 mg/kg			
85-01-8	Phenanthrene	0.05 mg/kg	24,000 mg/kg	1,140 mg/kg	9,100 mg/kg			
129-00-0	Pyrene	0.05 mg/kg	2,400 mg/kg	655 mg/kg	2,620 mg/kg			
86-74-8	Carbazole	0.33 mg/kg[j]	50 mg/kg	0.314 mg/kg	NV	EPA 8270 (semivolatile organic compounds)	≤30[r]	70-130[r]
72-54-8	4,4'-DDD	0.0033 mg/kg[j]	4.17 mg/kg	0.335 mg/kg	0.000464 mg/kg	EPA 8081 (pesticides)	≤30[r]	70-130[r]
72-55-9	4,4'-DDE	0.0033 mg/kg[j]	2.94 mg/kg	0.446 mg/kg	0.00123 mg/kg			
5103-74-2	gamma-Chlordane	0.0165 mg/kg[j]	2.86 mg/kg	2.06 mg/kg	0.00117 mg/kg			
7440-61-1	Uranium (total)[s]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[l]	70-130[l]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[l]	70-130[l]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]

This revised Table 2-17 (pages 2-107 and 2-108) were approved under TPA-CN-358

Table 2-15. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from 1607-H4

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[l]	70-130[l]
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in WAC 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Soils will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

This revised Table 2-17 (pages 2-107 and 2-108) were approved under TPA-CN-358

Table 2-16. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from Groundwater Wells During Drilling

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-61-1	Uranium (total)[r]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via isotopic	≤30[j]	70-130[j]
7440-38-2	Arsenic	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[j]	70-130[j]
7440-39-3	Barium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[j]	70-130[j]
7440-43-9	Cadmium	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[j]	70-130[j]
7440-47-3	Chromium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[j]	70-130[j]
18540-29-9	Hexavalent chromium	30 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 7196	≤30[j]	70-130[j]
7439-92-1	Lead	50 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[j]	70-130[j]
7440-22-4	Silver	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[j]	70-130[j]
7782-49-2	Selenium	100 µg/L	N/A	N/A	N/A	Batch leach followed by EPA 6010 (ICP metals)	≤30[j]	70-130[j]
—	Distribution coefficient for metals	N/A	N/A	N/A	N/A	1:1 water extract followed by SW-846 Method 6010, 6020, 7196, 7470, or EPA 200.8	N/A	N/A

This revised Table 2-18 (pages 2-113 and 2-114) were approved under TPA-CN-358

Table 2-16. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from Groundwater Wells During Drilling

CAS No.	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
Performance Requirements for Physical Properties								
—	Grain size (sieve) analysis	N/A	N/A	N/A	N/A	Field procedure or ASTM D422-63	N/A	N/A
—	Porosity	N/A	N/A	N/A	N/A	Calculation	N/A	N/A
—	Sediment moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A	N/A
—	Saturated hydraulic conductivity	N/A	N/A	N/A	N/A	ASTM D5084 for soil with low hydraulic conductivity (silt or a mud) ASTM D2434 for soil with high hydraulic conductivity (sand or sandy gravel)	N/A	N/A
—	Bulk density	N/A	N/A	N/A	N/A	ASTM D2937	N/A	N/A

Notes:

a. Unless otherwise noted, Preliminary Cleanup Goals are established in WAC 173-340, "Model Toxics Control Act – Cleanup," 2007.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). A task is included in the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46) to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730 (6)(b) (2007).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Borehole will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

e. Field measurements have no specific QC requirement except to perform checks to verify manufacturer's expected performance.

f. The groundwater protection and river protection preliminary cleanup goal values for cesium-137, cobalt-60, technetium-99, tritium, and strontium-90 were established in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, Revision 6.

This revised Table 2-18 (pages 2-113 and 2-114) were approved under TPA-CN-358

Laboratories providing analytical services in support of this SAP will have in place a corrective action program addressing analytical system failures and documents on the effectiveness of corrective actions. Issues affecting analytical results are to be resolved by Sample Management and Reporting in coordination with the project lead.

Batch leach tests will be performed on soil and aquifer sediment samples. Standardized batch leach tests are done using a leach procedure based on ASTM D3987, *Standard Test Method for Shake Extraction of Solid Waste with Water*. The procedure will be preferentially performed using a 2-mm sieve to include the entire sand fraction based on the USDA soil grain size classification scheme, though ASTM recommends using soil screened through 3/8 inch mesh. If insufficient sample mass with less than 2-mm particle diameter is available based on actual field conditions, a 3/8-inch mesh screen will be used instead. Demineralized water will be used as the leaching liquid. Selected soil samples will be leached at soil to water weight ratios of 1 to 1, 1 to 2.5, and 1 to 5 with one test in each series duplicated. Soil/water mixtures are placed in clean water tight sample containers (extraction vessels) and rotated end over end through the vessel centerline at a rate of about 30 rotations per minute for 18 hours. Following 18 hours of mixing, the soil/water slurry is filtered using a 0.45-μm filter. The leachate will be analyzed for pH and conductivity. The leachate and untreated soil will be analyzed for metals or other contaminants of interest as identified in Tables 2-3 through 2-18. Metals analysis for leachate and soil digests will be done using Method 6010, 6020, or 200.8 for ICP metals, as applicable (bulk soil will be digested using Method 3050B or 3051 for metals and Method 3060A for hexavalent chromium to prepare for analysis). Separate aliquots of material will be used for bulk soil analysis and leaching. Analytical results are compared between different soil to water ratios and duplicate tests to evaluate repeatability and attainment of equilibrium conditions. Details of the test will be discussed with the laboratory personnel before analysis.

Distribution coefficient values will be established to support modeling needs. Distribution coefficient calculations will be performed using the analytical results from bulk soils analysis and leach testing of soils collected from the same location. The distribution coefficient is calculated as the ratio of contaminant sorbed to soil to the contaminant in solution by the following equation:

$$K_d = \frac{(C_S \times M_S) - (C_L \times V_L)}{M_S} \times \frac{1}{C_L}$$

Where,

C_S = Contaminant concentration in bulk soil matrix prior to leaching (μg/g)

M_S = Dry mass of soil used for leaching (g)

C_L = Contaminant concentration in leachate (μg/L)

V_L = Liquid volume used for leaching (L)

Contamination present in pore water within the bulk soil matrix is not analyzed or accounted for separately, as the associated contaminant mass is included within the bulk leachate. Distribution coefficient values are calculated separately for each contaminant and each dilution ratio. The series of calculated values is then qualitatively evaluated to determine if the variation within results is reasonable and explainable.

A minimum of 10 independent samples (e.g., from different locations) will be analyzed by this method.

Grain size (sieve) analysis may be performed as a field procedure or in the laboratory based on ASTM D422-63, *Standard Test Method for Particle Size Analysis of Soils*. Field grain size analysis may be used to select well screens for groundwater wells.

2.1.1 Quality Control

To ensure reliable data are obtained, QC procedures must be followed in the field and laboratory. Field personnel will collect QC samples to evaluate the potential for cross-contamination and to provide information pertinent to field variability. Field QC sampling will require the collection of field duplicates, trip or field transfer blanks, equipment rinsate blanks, and field split samples. Laboratory QC samples estimate the precision and bias of the analytical data. Table 2-21 summarizes field and laboratory QC samples. Additional QC samples may be collected if conditions arise.

Table 2-17. Project Quality Control Checks

QC Sample Type	Purpose	Frequency
	Field Quality Control	
Full trip blank	Assess contamination from containers or transportation	One per 20 samples, *per media sampled.*
Field transfer blank	Assess contamination from sampling site	One per day when volatile organic compounds are sampled or groundwater monitoring activities. A minimum of one field transfer blank will be collected at each borehole *per media sampled* where the sample will undergo volatile organic analysis.
Equipment rinsate blank	Verify adequacy of sampling equipment decontamination	As needed.[a] If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment rinsate blank is not required. Otherwise, 1 per 20 samples, *per media sampled.*
Field duplicates	Estimate precision, including sampling and analytical variability	One per batch,[b] 20 samples maximum, for groundwater monitoring activities. A minimum of one field duplicate will be collected at each borehole, *per media sampled.*
Field split	Estimate precision, including sampling, analytical, and inter-laboratory variability	At a minimum, one per analytical method, per media, for analyses performed where detection limit and precision and accuracy criteria have been defined in the Performance Requirements Tables.
	Laboratory Quality Control[b]	
Method blank	Assess response of an entire laboratory analytical system	One per batch,[b] 20 samples maximum, or as required by the method guidance, *per media sampled.*
Matrix spike	Identify analytical (preparation and analysis) bias; possible matrix affect on the analytical method used	When required by the method guidance, one per batch,[b] 20 samples maximum, or as required by the method guidance, *per media sampled.*
Matrix duplicate or matrix spike duplicate	Estimate analytical bias and precision	One per batch,[b] 20 samples maximum, or as required by the method guidance, *per media sampled.*
Laboratory control samples	Assess method accuracy	One per batch,[b] 20 samples maximum, or as required by the method guidance, *per media sampled.*

This revised Section 2.2.4, 2.2.5, and Table 2-21 (pages 2-127 through 2-130) were approved under TPA-CN-358

Table 2-17. Project Quality Control Checks

QC Sample Type	Purpose	Frequency
Surrogates	Estimate recovery or yield	When required by the method guidance, as required by the method guidance.

Notes: a. Whenever a new type of non-dedicated equipment is used, an equipment rinsate blank will be collected every time sampling occurs until it can be shown that less frequent collection of equipment rinsate blanks is adequate to monitor the decontamination procedure for the non-dedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., Hanford Site groundwater).

2.1.1.1 Field QC Samples

The Field QC sample types are discussed within this section.

Full trip blanks are samples prepared by the sampling team before traveling to the sampling site. The preserved bottle set is identical to the set collected in the field, but it is filled with reagent water or silica sand, as appropriate to the primary sample media. The bottles are sealed and transported, unopened, to the field in the same storage container used for samples collected the same day. Full trip blanks are typically analyzed for the same constituents as the samples from the associated sampling event. However, the analytical list for full trip blanks for soil may be limited to volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and total petroleum hydrocarbons (TPH). Full trip blanks are not required for aquifer sediments being analyzed for metals, mercury, and hexavalent chromium.

Field transfer blanks are preserved VOC sample vials filled at the sample collection site with reagent water or silica sand . The samples are prepared during the sampling to evaluate potential contamination caused by field conditions. After collection, field transfer blank bottles are sealed and placed in the same storage container with the samples from the associated sampling event. Field transfer blank samples are analyzed for VOCs only.

The field transfer blank will consist of reagent water, or silica sand, added to clean sample vials at the location where the VOC sample was collected. The field transfer blank will be batched with samples for which VOC analysis is requested.

Equipment rinsate blanks are collected for reused sampling devices to assess the adequacy of the decontamination process. Equipment rinsate blanks will consist of silica sand or reagent water poured over the decontaminated sampling equipment and placed in containers, as identified on the project sampling authorization form. If disposable (e.g., single-use) equipment is used, equipment rinsate blanks will not be required.

For the field blank samples (e.g., full trip blank, field transfer blank, equipment rinsate blank), results greater than two times the method detection limit are identified as suspected contamination. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is five times the method detection limit. For radiological data, blank results are flagged as suspected contamination if they are greater than two times the total minimum detectable activity.

Field duplicate samples are used to evaluate sample consistency and the precision of field sampling methods. Field duplicates are independent samples collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently.

This revised Section 2.2.4, 2.2.5, and Table 2-21 (pages 2-127 through 2-130) were approved under TPA-CN-358

The duplicate should be collected generally from an area expected to have some contamination, so valid comparisons between the samples can be made (e.g., at least some of the constituents will be greater than the detection limit). When sampling is performed from a split spoon, VOC samples and VOC duplicate samples are collected directly from the sampler. The remaining soil/aquifer sediment is then composited in a stainless steel mixing bowl. The soil/aquifer sediment sample and duplicate sample are collected from this composited material.

Evaluation of the results can provide an indication of intra-laboratory variability. Evaluation criteria for field duplicate sample results is described in Section 2.2.5.3.

A **field split** is a representative sample from a sampling event sent to a third party laboratory (i.e., reference laboratory). Evaluation of the results can provide an indication of inter-laboratory variability. Field split sample result evaluation criteria are described in Section 2.2.5.3.

2.1.1.2 Laboratory QC Samples

The laboratory QC samples (e.g., method blanks, laboratory control sample/blank spike, matrix spike) are defined for three-digit EPA methods (EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes,* and EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*) and four-digit EPA methods (SW-846), and will be run at the frequency specified in the respective reference. Quality control checks outside of control limits will be reflected in the data validation process and during the DQA described in Section 2.4.

2.1.1.3 QC Requirements

If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment rinsate blank is not required. If no VOC samples are collected, then a field transfer blank is not required.

Only those field duplicate result pairs with at least one result greater than five times the appropriate detection limit or minimum detectable activity are evaluated. Field duplicate sample results must agree within 20 percent, as measured by the relative percent difference, to be acceptable. Unacceptable field duplicate results are flagged with a "Q" qualifier in the HEIS database. Large relative percent differences can be an indication of laboratory performance problems and should be investigated.

Only those field split result pairs with at least one result greater than five times the appropriate detection limit or minimum detectable activity are evaluated. Field split sample results must agree within 20 percent, as measured by the relative percent difference, to be acceptable. Unacceptable field spilt results are qualified and flagged in the HEIS database, as appropriate. Large relative percent differences can be an indication of inter-laboratory variability and potential laboratory performance problems, and should be investigated.

Table 2-2 presents the precision and accuracy requirements for downhole geophysical logging performed in the field. Tables 2-3 through 2-19 present the acceptance criteria for laboratory duplicate sample, matrix spike sample, matrix spike duplicate sample, and laboratory control sample results for chemical analyses.

Holding time is the elapsed time period between sample collection and analysis, or sample collection to extraction and sample extraction to analysis, as applicable to the method. Exceeding recommended holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Recommended holding times depend on the analytical method, as specified