100-H-36, 1904-H SPILLWAY WASTE SITE CONCRETE SAMPLE RESULTS

100-H-36 BACKGROUND

The 100-H-36, 1904-H Spillway waste site, part of the 100-HR-1 Operable Unit, was an emergency overflow spillway that served as an alternate discharge point for the 116-H-5 outfall structure in the 100-H Area of the Hanford Site. Figure 1 shows the location of the 100-H-36 waste site relative to the 105-H Reactor Building. The spillway extended from the south face of the 116-H-5 outfall structure approximately 41 m (135 ft) to the ordinary high water mark of the Columbia River. The spillway is 7 m (23 ft) wide and consists of a concrete flume partitioned into three side-by-side rectangular channels buried below grade. Figure 2 shows the inlet side of the spillway after removal of the 116-H-5 outfall structure. At the terminus of the spillway on the river's edge, a shallow dish-shaped concrete runoff pad extends to the low water line (Figure 3). The ground surface on the slope of the river bank between the (former) outfall and the ordinary high water mark is covered with large basalt riprap boulders that have been mortared in place. During remediation of the 116-H-5 outfall structure, a distinct high water mark was observed on the wall of the outfall above the invert of the spillway, indicating that the spillway was used for effluent discharge.

CONCRETE CORE SAMPLES

In July 2015, concrete core samples were obtained from the 100-H-36 spillway structure from locations exhibiting staining. Three focused concrete core samples and one field duplicate were collected from the lower half of the sidewall of the exposed western channel. All three of the concrete core samples penetrated the entire thickness of the spillway, which measured approximately 30 cm (12 in.) thick. A summary of samples collected is provided in Table 1. The analytical methods are provided in Table 2. All samples were collected and submitted for full protocol laboratory analysis.

Table 1. 100-H-36 Waste Site Concrete Core Sample Summary.

Sample Number	Sample Date	Sample Location	Northing	Easting	Requested Analyses
J1V7W3	7/27/2015	FS-1	152812.9	578108.1	ICP metals [a], mercury, GEA, total beta radiostrontium
J1V7W4	7/27/2015	FS-2	152812.8	578108.3	
J1V7W5	7/27/2015	FS-3	152812.5	578108.6	
J1V7W6	7/27/2015	Duplicate of J1V7W4	152812.8	578108.3	
J1V7W7	7/27/2015	Equipment blank	NA	NA	ICP metals [a], mercury

[a] Metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

GEA = gamma energy analysis
ICP = inductively coupled plasma
NA = not applicable

Ref.: 1240093

Figure 1. The 100-H-36 Spillway Waste Site Location Map.

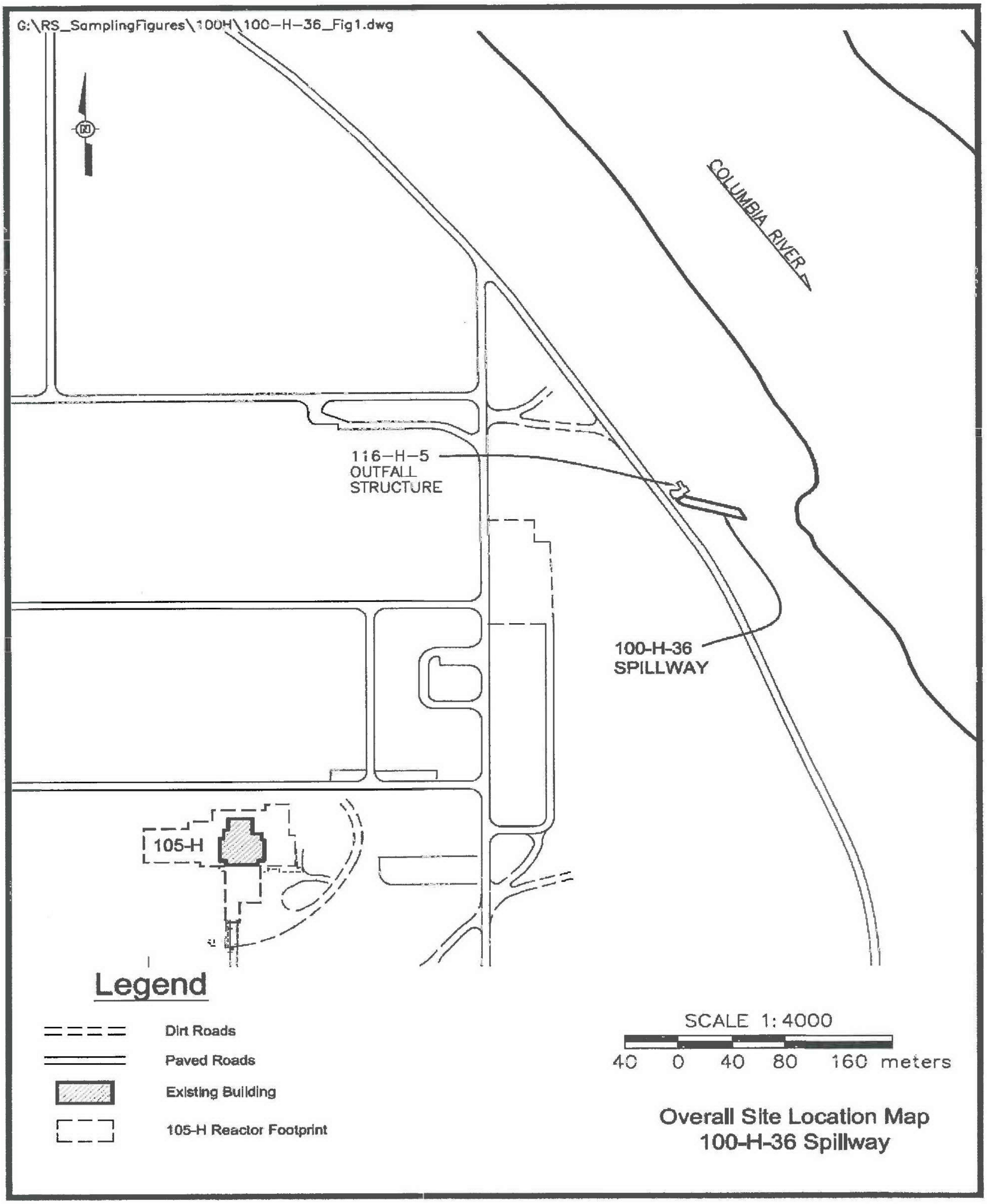

Figure 2. The 100-H-36 Inlet Side After Removal of the 116-H-5 Outfall Structure (April 2009).

Figure 3. The 100-H-36 Spillway Run-Off Pad (March 2009).

Table 2. Laboratory Analytical Methods for the 100-H-36 Waste Site.

Analytical Method	Contaminant of Potential Concern
GEA – gamma spectroscopy	Americium-241, cesium-137, cobalt-60, europium-152, europium-154, europium-155
Total beta radiostrontium – GPC	Strontium-90
ICP metals [a] – EPA Method 6010	Metals
Mercury – EPA Method 7471	Mercury

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

EPA = U.S. Environmental Protection Agency
GEA = gamma energy analysis
GPC = gas proportional counting
ICP = inductively coupled plasma

Sample Results

Maximum results from the concrete samples are summarized in Table 3. The soil remedial action goals from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009) are provided as a point of informational comparison. No significant radionuclide contamination was observed. Metal constituents observed in the samples may be present as part of the constituents in the original concrete matrix. These constituents may also have been introduced into samples as a result of coring collection. Constituents that were not detected by laboratory analysis are excluded from this table. Aluminum, calcium, iron, magnesium, potassium, silicon, sodium are not considered contaminants of potential concern and are not included in the table. The complete laboratory results for all constituents are stored in a Washington Closure Hanford project-specific database prior to archival in the Hanford Environmental Information System and are provided in Appendix A. The data quality assessment is provided in Appendix B.

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

Ecology, 1994, *Natural Background Soil Metals Concentrations in Washington State*, Publication No. 94-115, Washington State Department of Ecology, Olympia, Washington.

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

WDOH, 1997, *Hanford Guidance for Radiological Cleanup*, WDOH/320-015, Rev. 1, Washington State Department of Health, Olympia, Washington.

Table 3. Maximum Constituent Results for the 100-H-36 Concrete Spillway Focused Samples.

COPC	Maximum Result [b] (pCi/g)	Soil Remedial Action Goals [a]		
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection
Europium-152	1.08	3.3	-- [c]	-- [c]
COPC	**Maximum Result [b] (mg/kg)**	**Soil Remedial Action Goals [a]**		
		Direct Exposure	**Soil Cleanup Level for Groundwater Protection**	**Soil Cleanup Level for River Protection**
Antimony [d]	0.73 (<BG)	32	5 [e]	5 [e]
Arsenic	5.0 (<BG)	20 [e]	20 [e]	20 [e]
Barium	126 (<BG)	5,600	200	400
Beryllium	0.64 (<BG)	10.4 [f]	1.51 [e]	1.51 [e]
Boron [g]	5.6	7,200	320	-- [h]
Cadmium [d]	1.4	13.9 [f]	0.81 [e]	0.81 [e]
Chromium (total)	20.7	80,000	18.5 [e]	18.5 [e]
Cobalt	19.1	24	15.7 [e]	-- [h]
Copper	122	2,960	59.2	22.0 [e]
Lead	8.4 (<BG)	353	10.2 [e]	10.2 [e]
Manganese	356 (<BG)	3,760	512 [e]	512 [e]
Molybdenum [g]	2.7	400	8	-- [h]
Nickel	37.9	1,600	19.1 [e]	27.4
Silver	4.2	400	8	0.73 [e]
Vanadium	59.1 (<BG)	560	85.1 [e]	-- [h]
Zinc	110	24,000	480	67.8 [e]

[a] Remedial action goals obtained from the 100 Area RDR/RAWP (DOE-RL 2009).

[b] All results provided in Appendix A.

[c] No value; because the distribution coefficient value for this contaminant is greater than 80 mL/g, RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009) predicts that the contaminant will show no migration within the 100 Area vadose zone, and no impact on groundwater or the Columbia River.

[d] Hanford Site-specific soil background value is not available. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

[e] 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 2009).

[f] 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]).

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

[h] No parameters (bioconcentration factors or ambient water quality criteria 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]).

-- = not applicable
BG = background (for soil)
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

APPENDIX A

100-H-36 CONCRETE SAMPLE RESULTS

Attachment 1. 100-H-36 Waste Site Characterization Results (Radionuclides).

Sample Location	HEIS Number	Sample Date	Americium-241			Cesium-137			Cobalt-60		
			pC/g	Q	MDA	pC/g	Q	MDA	pC/g	Q	MDA
FS-2	J1V7W4	7/27/15	0.0264	U	0.049	0.074	U	0.0724	0.074	U	0.097
Duplicate of J1V7W4	J1V7W6	7/27/15	0.0143	U	0.206	0.0485	U	0.101	0.106	U	0.13
FS-1	J1V7W3	7/27/15	-0.0836	U	0.235	0.0424	U	0.0872	0.00604	U	0.0837
FS-3	J1V7W5	7/27/15	-0.00674	U	0.0505	0.0476	U	0.0722	0.0979	U	0.107

Sample Location	HEIS Number	Sample Date	Europium-152			Europium-154			Europium-155		
			pC/g	Q	MDA	pC/g	Q	MDA	pC/g	Q	MDA
FS-2	J1V7W4	7/27/15	1.08		0.12	0.0952	U	0.227	0.0169	U	0.0869
Duplicate of J1V7W4	J1V7W6	7/27/15	0.735	U	0.314	0.0354	U	0.296	-0.0221	U	0.175
FS-1	J1V7W3	7/27/15	-0.392	U	0.198	0.0825	U	0.256	-0.0275	U	0.173
FS-3	J1V7W5	7/27/15	0.592		0.138	0.0615	U	0.221	0.0451	U	0.0987

Sample Location	HEIS Number	Sample Date	Potassium-40			Total Beta Radiostrontium		
			pC/g	Q	MDA	pC/g	Q	MDA
FS-2	J1V7W4	7/27/15	9.56		0.699	0.369	U	0.47
Duplicate of J1V7W4	J1V7W6	7/27/15	8.84		0.804	-0.0551	U	0.541
FS-1	J1V7W3	7/27/15	12.7		0.647	0.158	U	0.485
FS-3	J1V7W5	7/27/15	10.5		0.572	0.0648	U	0.49

B = Estimanted result. Result is less than the RL, but greater than the MDL.
C = The analyte was detected in both the sample and the associated QC blank, and the sample concentration was </= 5X the blank concentration.
HEIS = Hanford Environmental Information System
M = Sample duplicate precision not met.
N = Recovery exceeds upper or lower control limits.
PQL = practical quantitation limit
Q = qualifier
U = Analyzed for but not detected undetected.
X = Serial dilution in the analytical batch indicats that physical and chemical interferences are present.

Attachment 1. 100-H-36 Waste Site Characterization Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-2	J1V7W4	7/27/15	12400		1.4	0.34	UJ	0.34	3.1		0.59	126		0.068
Duplicate of J1V7W4	J1V7W6	7/27/15	11900		1.4	0.35	UJ	0.35	3.2		0.60	125		0.069
FS-1	J1V7W3	7/27/15	11100		1.4	0.73	J	0.34	5.0		0.59	110		0.068
FS-3	J1V7W5	7/27/15	11900		1.4	0.34	UJ	0.34	2.9		0.59	120		0.068
Equipment blank	J1V7W7	7/27/15	129		1.4	0.36	UJ	0.36	0.62	U	0.62	1.6		0.071

Sample Location	HEIS Number	Sample Date	Beryllium			Boron			Cadmium			Calcium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-2	J1V7W4	7/27/15	0.61		0.029	5.6		0.88	0.27		0.037	54300	X	13.4
Duplicate of J1V7W4	J1V7W6	7/27/15	0.61		0.030	5.4		0.89	1.4		0.037	53900	X	11.8
FS-1	J1V7W3	7/27/15	0.52		0.029	4.8		0.88	0.24	M	0.037	48900	X	11.9
FS-3	J1V7W5	7/27/15	0.64		0.030	4.7		0.88	0.10	B	0.037	46700	X	11.9
Equipment blank	J1V7W7	7/27/15	0.033	B	0.031	0.92	U	0.92	0.038	U	0.038	51.5	CXUJ	13.2

Sample Location	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Iron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-2	J1V7W4	7/27/15	16.5		0.052	8.3	X	0.089	32.3		0.19	19400		3.4
Duplicate of J1V7W4	J1V7W6	7/27/15	14.8		0.053	8.2	X	0.091	21.3		0.20	19000		3.5
FS-1	J1V7W3	7/27/15	20.7		0.052	19.1	X	0.089	122		0.19	38000		3.4
FS-3	J1V7W5	7/27/15	11.6		0.052	8.5	X	0.090	19.4		0.20	20700		3.4
Equipment blank	J1V7W7	7/27/15	0.17	B	0.054	0.093	UX	0.093	0.39	B	0.20	281		3.6

Sample Location	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-2	J1V7W4	7/27/15	8.4		0.24	5540	X	3.3	284		0.089	0.0060	U	0.0060
Duplicate of J1V7W4	J1V7W6	7/27/15	8.2		0.25	5260	X	3.4	268		0.091	0.0064	U	0.0064
FS-1	J1V7W3	7/27/15	7.6		0.24	5250	X	3.3	356		0.089	0.0055	U	0.0055
FS-3	J1V7W5	7/27/15	7.8		0.24	5420	X	3.3	260		0.090	0.0063	U	0.0063
Equipment blank	J1V7W7	7/27/15	0.38	B	0.25	24.0	CXUJ	3.5	3.5		0.093	0.0058	U	0.0058

Sample Location	HEIS Number	Sample Date	Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-2	J1V7W4	7/27/15	1.1	B	0.23	16.3	X	0.11	2070		36.6	0.77	U	0.77
Duplicate of J1V7W4	J1V7W6	7/27/15	0.75	B	0.24	13.7	X	0.11	1940		37.3	0.78	U	0.78
FS-1	J1V7W3	7/27/15	2.7		0.23	37.9	X	0.11	1670		36.6	0.77	U	0.77
FS-3	J1V7W5	7/27/15	0.53	B	0.23	11.4	X	0.11	1920		36.9	0.77	U	0.77
Equipment blank	J1V7W7	7/27/15	0.24	U	0.24	0.17	BX	0.11	57.8	B	38.3	0.80	U	0.80

Attachment 1. 100-H-36 Waste Site Characterization Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-2	J1V7W4	7/27/15	128	NJ	5.1	0.17	B	0.14	1850		52.7	55.5		0.084
Duplicate of J1V7W4	J1V7W6	7/27/15	116	NJ	5.1	4.2		0.15	1790		53.6	55.6		0.085
FS-1	J1V7W3	7/27/15	129	NJ	5.1	0.31		0.14	1720		52.7	50.8		0.084
FS-3	J1V7W5	7/27/15	132	NJ	5.1	0.14	U	0.14	1900		53.2	59.1		0.085
Equipment blank	J1V7W7	7/27/15	84.4	NJ	5.3	0.15	U	0.15	55.1	U	55.1	0.43	B	0.088

Sample Location	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
FS-2	J1V7W4	7/27/15	110	X	0.38
Duplicate of J1V7W4	J1V7W6	7/27/15	94.8	X	0.33
FS-1	J1V7W3	7/27/15	87.1	X	0.34
FS-3	J1V7W5	7/27/15	87.7	X	0.34
Equipment blank	J1V7W7	7/27/15	0.59	BX	0.37

APPENDIX B

100-H-36 DATA QUALITY ASSESSMENT

APPENDIX B

DATA QUALITY ASSESSMENT

CHARACTERIZATION SAMPLING

A data quality assessment (DQA) was performed to compare the characterization 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* (100 Area 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. All samples were collected and analyzed per the sample design.

To ensure quality data, the 100 Area SAP (DOE-RL 2009) data assurance requirements and the data validation procedures for chemical analysis and radiochemical analysis (BHI 2000a, 2000b) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., 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).

Characterization sample data collected at the 100-H-36 waste site were provided by the laboratory in sample delivery group (SDG) JP0982. The SDG JP0982 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 100-H-36 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 JP0982

This SDG comprises three focused concrete core samples from the 100-H-36 waste site spillway structure. This SDG includes one field duplicate pair (J1V7W4/J1V7W6). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, gamma energy analysis, and total beta radiostrontium. In addition, one field equipment blank (J1V7W7) was collected and analyzed for ICP metals and mercury. SDG JP0982 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. Due to method blank contamination, third-party validation qualified calcium and magnesium results in sample J1V7W7 as undetected with "UJ' flags. Data are useable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries are out of project acceptance criteria for six analytes (aluminum [939%], antimony [27%], copper [1,435%], manganese [260%], iron [8,823%], and silicon [18%]). For aluminum, copper, manganese, 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 JP0982 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 recovery for silicon was below the project recovery limit at 9%. All silicon results in SDG JP0982 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 duplicate relative percent difference (RPD) for cadmium (31%) 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, cadmium results in SDG JP0982 may be considered estimated. Estimated data are useable 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 B-1. The main and QA/QC sample results are presented in Appendix A.

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

Sample Area	Main Sample	Duplicate Sample
100-H-36 Spillway structure	J1V7W4	J1V7W6

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. 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.

In the duplicate evaluation, the RPD calculated for copper (41%) is above the duplicate acceptance criteria of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The data are useable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the target detection limit, including undetected analytes. In these cases, a control limit of ±2 times the target detection limit is used (Appendix A) to indicate that a visual check of the data is required by the reviewer. No sample 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 useable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues, such as those discussed above, are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-H-36 waste site characterization 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-36 waste site data set concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes.

The characterization 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 characterization sample analytical data are also summarized in Appendix A.

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

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