Appendix J

Data Quality Objectives Summary Report for Nonintrusive and Intrusive Characterization at the 200-SW-2 Operable Unit Landfills

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Terms

CHPRC	CH2M HILL Plateau Remediation Company
CMS	corrective measures study
COPC	contaminant of potential concern
CSM	conceptual site model
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
DQO	data quality objective
Ecology	Washington State Department of Ecology
EMI	electromagnetic induction
FS	feasibility study
GPR	ground-penetrating radar
HHE	human health and the environment
LIDAR	light detection and ranging
OU	operable unit
PSQ	principal study question
PUREX	Plutonium-Uranium Extraction
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction-Oxidation
RFI	RCRA field investigation
RI	remedial investigation
SAP	sampling and analysis plan
SWITS	Solid Waste Information Tracking System
UPR	unplanned release
VOC	volatile organic compound

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J1 Systematic Planning for 200-SW-2 Operable Unit Landfill Characterization

A data quality objectives (DQOs) workshop was conducted on August 22, 2014, to support design of a sampling and analysis plan (SAP) (Appendix A) for the 200-SW-2 Operable Unit (OU) landfills. The following sections of this appendix summarize the output of the DQO process. This document was prepared collaboratively with the U.S. Department of Energy (DOE), Richland Operations Office (RL); the Washington State Department of Ecology (Ecology); and CH2M HILL Plateau Remediation Company (CHPRC) and represents tentatively agreed to DQOs for the 200-SW-2 OU. Further refinement may be made of the DQOs.

J2 Step 1: State the Problem

Summary: *Create the problem statement to define clearly the issues that require new environmental data, so the focus of the study will be distinct and unambiguous. Pertinent information from similar studies and assumptions should be organized, reviewed, identified, evaluated, and documented.*

1. Give a concise description of the problem.
2. Identify the planning team.
3. Develop conceptual site models (CSMs).
4. Determine resources.

Output of Step 1

- Documentation of the four previously listed elements

J2.1 200-SW-2 Operable Unit Problem Statement

1. Is there an unacceptable risk to human health and the environment (HHE) posed by the waste in the 200-SW-2 OU landfills?
2. Are there complete pathways to HHE?
3. Collect data to support the *Resource Conservation and Recovery Act of 1976* (RCRA) field investigation (RFI)/corrective measures study (CMS)/remedial investigation (RI)/feasibility study (FS) and eventual selection of a remedial action alternative(s).
4. Collect sufficient data to support evaluation of the long-term effects of leaving the waste in place.

J2.2 Planning Team

The 200-SW-2 OU planning team is outlined in Table J-1.

J2.3 Conceptual Site Models

As presented in Appendix D of this work plan, CSMs for each of the landfills also will be refined following the collection of additional field data.

Table J-1. 200-SW-2 OU Planning Team

Name	Organization	Role
Doug Hildebrand*	DOE-RL	DOE Project Manager
Phil Burke*	CHPRC	OU Lead
Chris Haas*	TerraGraphics	Work Plan Support
Nancy Welliver	TerraGraphics	Work Plan Support
Evan Griffiths*	CH2M HILL	Work Plan Document Lead
Ed Kilduff	CH2M HILL	Work Plan Support
Deborah Singleton*	Ecology	Ecology Project Manager
Elis Eberlein*	Ecology	Ecology Support
Steve Lowe*	Ecology	Ecology Support
Janice Horton*	CH2M HILL	Work Plan Support
Jessica Ni*	CHPRC	Work Plan Support
Leland Scantlebury*	CHPRC	Work Plan Support

* Workshop participant.

CHPRC = CH2M HILL Plateau Remediation Company
DOE = U.S. Department of Energy
DOE-RL = DOE Richland Operations Office
Ecology = Washington State Department of Ecology

J2.4 Resources

- Historical records research (e.g., logbooks and burial records)
- Direct-push sampling data
- Groundwater monitoring data
- Personnel interviews
- Active and passive soil gas sampling data
- Geophysical surveys (e.g., frequency domain electromagnetic induction [EMI], total magnetic field/vertical magnetic gradient, ground-penetrating radar [GPR], and time-domain electromagnetics)
- Radiological surveys
- Historical and aerial photos
- Light detection and ranging (LIDAR) surveys
- M-091 Project sample data

- Hanford Site as-built drawings (e.g., H-2 drawings)
- Unplanned releases (UPRs) and ponds characterization data
- Facility process knowledge (i.e., Plutonium-Uranium Extraction [PUREX], B Plant, and Reduction-Oxidation [REDOX] processes)

J3 Step 2: Identify the Goals of the Study

Summary: *Identify the question(s) that the study will address and alternative actions that may be necessary or outcomes that may occur based on the results. Define the decision statement that will be resolved using the data collected to address the problem.*

1. Identify principal study question(s) (PSQs).
2. Consider alternative actions.
3. For decision problems, develop decision statement(s).
4. For estimation problems, state what needs to be estimated and key assumptions.

Outputs of Step 2

- Well-defined PSQs
- A list of alternative actions as a result of addressing the PSQs
- For decision problems, a list of decision statements that address the PSQ
- For estimation problems, a list of estimation statements that address the PSQ

J3.1 200-SW-2 Operable Unit Principal Study Questions

In addition to the PSQs presented in Table 2-2 of D&D-27257, *Data Quality Objectives Summary Report for Nonintrusive Characterization of Bin 3A and Bin 3B Waste Sites in the 200-SW-2 Operable Unit*, the following PSQs also will be addressed:

1. What data are required to support evaluation of risk, pathways, and development of remedial action alternatives?
2. Were enough data collected to support the RFI/CMS/RI/FS and selection of remedial action alternatives?
3. Were enough data collected to evaluate whether buried waste presents a long-term effect on HHE?

J3.2 Alternative Actions

1. The design of the RFI/RI characterization approach was sufficient to support evaluation of risk, pathways, and development of remedial action alternatives, or the design of the RFI/RI characterization approach did not provide sufficient data, and additional data will need to be collected.
2. Enough data were collected to support the RFI/CMS/RI/FS and select remedial action alternatives, or additional data will need to be collected.
3. Enough data were collected to support evaluation of leaving the waste in place, or additional data will need to be collected.

J3.3 Decision Statements

1. Collect additional data to evaluate risk, pathways, and remedial alternatives.
2. Develop and select alternatives to break the complete pathways that create excess risk.
3. Develop and select alternatives that minimize or reduce long-term effects on HHE above acceptable risk levels.

J4 Step 3: Identify Information Inputs

Summary: *Identify information inputs needed to support the decision statements, and specify which inputs will require environmental measurements.*

1. Identify types and sources of information needed to produce estimates or resolve decision problems.
2. Identify the basis of information that will guide or support choices to be made in later steps of the DQO process.
3. Select appropriate sampling and analysis methods for generating the information.

Outputs of Step 3

- Potential sources for environmental characteristics that will produce estimates or resolve decision problems
- Number of variables needed
- Information needed to meet performance or acceptance criteria
- Performance of appropriate sampling and analysis methods

J4.1 200-SW-2 Operable Unit Input

The inputs (contaminants of potential concern [COPCs] and other site-specific data) to the DQO processes are described as follows.

J4.1.1 Contaminants of Potential Concern

A set of radiological and organic COPCs that may be present in the 200-SW-2 OU landfills was developed, based on the following documents:

- 200 Area plant operations as identified in various DQO documents for the 200 Area OUs, including the 200-CW-1, 200-CS-1, 200-CW-5, 200-LW-1, 200-LW-2, 200-MW-1, 200-PW-1, 200-PW-2, 200-PW-4, 200-TW-1, and 200-TW-2 OUs
- The ecological risk assessment DQOs for the 200 Areas (WMP-20570, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report – Phase I*; WMP-25493, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report-Phase II*; and WMP-29253, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report – Phase III*)
- DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*

In order to ensure that contaminants from waste from other Hanford Site areas (such as the 100 and 300 Areas) and offsite are represented, the COPC input list also included potential contaminants listed in the following information sources:

- Nonradiological constituents in containers with a “dangerous waste” flag set in the Solid Waste Information Tracking System (SWITS) for landfills that are within scope
- Radiological constituents listed in all containers in SWITS for in-scope landfills
- Nonradiological constituents listed in WAC 173-340-900, “Model Toxics Control Act–Cleanup,” “Tables,” Table 749-3 (“Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals”)

The COPC input list consisted of over 800 potential contaminants. Radionuclides were eliminated from the list if they had short half-lives, were naturally occurring, or were produced only in minute quantities. Chemicals were eliminated if they were used in minute quantities, were nonhazardous, or are unable to exist in conditions in the landfills (i.e., exist in a gaseous state or naturally degrade very quickly). The COPC list is presented in Table J-2.

Table J-2. 200-SW-2 OU Landfills COPC List

Radionuclides					
Am-241	Cm-244	I-129	Pu-239/240	Th-228	H-3
C-14	Eu-152	Ni-63	Se-79	Th-230	U-233/234
Cs-137	Eu-154	Np-237	Sr-90	Th-232	U-235
Co-60	Eu-155	Pu-238	Tc-99	Th-234	U-238
Cm-243					

Metals			
Aluminum – Al	Boron – B	Lithium – Li	Silver – Ag
Antimony – Sb	Cadmium – Cd	Manganese – Mn	Strontium – Sr
Arsenic – As	Chromium – Cr	Mercury – Hg	Thallium – Tl
Barium – Ba	Cobalt – Co	Molybdenum – Mo	Uranium – U
Beryllium – Be	Copper – Cu	Nickel – Ni	Vanadium – V
Bismuth – Bi	Lead – Pb	Selenium – Se	Zinc – Zn

Anions			
Fluoride – F^-	Nitrate – NO_3^-	Sulfate – SO_4^{2-}	Phosphate – PO_4^{3-}
Nitrite – NO_2^-	Chloride – Cl^-	Bromide – Br^-	

Other
Ammonium – NH^{4+} (pH also to be measured)
Asbestos kerosene
Cyanide – CN^-

Volatile Organics			
1,1,1-Trichloroethane	2-Nitropropane	cis-1,2-Dichloroethene	Tetrachloroethene
1,1,2,2-Tetrachloroethane	4-Methyl-2-pentanone	Diethyl ether	Toluene
1,1,1,2-Tetrachloroethane	Acetone	Ethyl acetate	trans-1,2-Dichloroethene

Table J-2. 200-SW-2 OU Landfills COPC List

1,1,2-Trichloro-1,2,2-trifluoroethane	Acetonitrile	Ethylbenzene	trans-1,3-Dichloropropene
1,1,2-Trichloroethane	Benzene	Isobutanol	Trichloroethene
1,1-Dichloroethene	Carbon disulfide	Methanol	Trichlorofluoromethane
1,1-Dichloroethane	Carbon tetrachloride	Methylene chloride	Vinyl chloride
1,2-Dichloroethane	Chlorobenzene	n-Butyl alcohol (1-butanol)	Xylenes (total)
2-Butanone	Chloroform		
Semivolatile Organics			
1,2,4-Trichlorobenzene	Acenaphthene	Di-n-octylphthalate	N-nitroso-di-n-propylamine
2,4,5-Trichlorophenol	Benzo(a)anthracene	Fluoranthene	Naphthalene
2,4,6-Trichlorophenol	Benzo(a)pyrene	Hexachlorobenzene	n-Nitrosomorpholine
2,4-Dinitrotoluene	Benzo(b)fluoranthene	Hexachlorobutadiene	o-Dichlorobenzene
2-Chlorophenol	Benzo(k)fluoranthene	Di-n-butylphthalate	o-Nitrophenol
2-Ethoxyethanol	Bis(2-ethylhexyl)phthalate	Dibenz(a,h)anthracene	Pentachlorophenol
2-Methylphenol (o-cresol)	Butylbenzylphthalate	Hexachloroethane	Pyrene
3+4-Methylphenol (m+p-cresol)	Chrysene	Indeno(1,2,3-d)pyrene	Pyridine
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	Cyclohexanone	Nitrobenzene	Tributyl phosphate
Pesticides			
Aldrin	Alpha-BHC	Gamma-BHC (Lindane)	Endrin
4-4'-DDT	Beta-BHC	Chlordane	Heptachlor
4-4'-DDD	Delta-BHC	Dieldrin	Heptachlor epoxide
4-4'-DDE			
Aroclors (Polychlorinated Biphenyls)			
Aroclor 1016	Aroclor 1232	Aroclor 1248	Aroclor 1260
Aroclor 1221	Aroclor 1242	Aroclor 1254	

Am-241	= americium-241	Eu-152	= europium-152	Sr-90	= strontium-90
BHC	= benzene hexachloride	Eu-154	= europium-154	Tc-99	= technetium-99
DDD	= dichlorodiphenyldichloroethane	Eu-155	= europium-155	Th-228	= thorium-228
DDE	= dichlorodiphenyldichloroethylene	I-129	= iodine-129	Th-230	= thorium-230
DDT	= dichlorodiphenyltrichloroethane	Ni-63	= nickel-63	Th-232	= thorium-232
C-14	= carbon-14	Np-237	= neptunium-237	Th-234	= thorium-234
Co-60	= cobalt-60	OU	= operable unit	H-3	= hydrogen-3
COPC	= contaminant of potential concern	Pu-238	= plutonium-238	U-233/234	= uranium-233/234
Cm-243	= curium-243	Pu-239/240	= plutonium-239/240	U-235	= uranium-235
Cm-244	= curium-244	Se-79	= selenium-79	U-238	= uranium-238
Cs-137	= cesium-137				

J4.1.2 Other Data Inputs

- Historical records research (logbooks and burial records)
- Direct-push sampling data
- Groundwater monitoring data
- Personnel interviews
- Active and passive soil gas sampling data
- Geophysical surveys (e.g., frequency domain EMI, total magnetic field/vertical magnetic gradient, GPR, and time-domain electromagnetics)
- Radiological surveys
- Historical and aerial photos
- LIDAR surveys
- M-091 Project sample data
- Hanford Site as-built drawings (e.g., H-2 drawings)
- UPRs and ponds characterization data
- Facility process knowledge (i.e., PUREX, B Plant, and REDOX processes)

J4.2 Field Approach and Sampling and Analysis Methods

- **Direct-push borings** will be installed to 18.28 m (60 ft) below ground surface. The proposed locations for the pushes are shown in the SAP (Appendix A). Soil and soil gas samples will be collected every 1.5 m (5 ft). Soil samples will be analyzed for COPCs. Soil gas samples will be analyzed for volatile organic compounds (VOCs).
- **Horizontal borings** will be drilled in the vadose zone under targeted landfills shown in the SAP (Appendix A). The borings will extend approximately 152.4 to 182.9 m (500 to 600 ft) laterally under one or more landfills. At a minimum, samples will be collected under each trench. Opportunistic samples will be collected during boring, as necessary.
- **Soil gas samples** (passive and active) will be collected. Passive soil gas samples will be collected from specific landfills not previously investigated (see Appendix A). Where there are passive soil gas hits (>1,000 ng), active soil gas samples will be collected. As described elsewhere in the SAP (Appendix A), prior to collecting active soil gas samples, additional passive soil gas samples will be collected in a stepped-out manner to confirm the location of high passive soil gas prior to collecting active soil gas samples.
- **Test pit excavations** will be conducted in selected landfills. Two test pits will be excavated: one selected at random and one focused. The focused test pit locations will be determined based on historical knowledge about the landfill and will be excavated to confirm that landfill contents are consistent with historical knowledge.
- **Baseline geophysical methods** will be used to detect subsurface anomalies and landfill boundaries for those landfills not previously investigated.

- **Advanced geophysical methods** will be used to detect subsurface anomalies, classify potential pathways, and identify releases into the vadose zone. Resistivity instrumentation will remain in place in the subsurface for long-term monitoring. Advanced geophysical methods will be used on targeted landfills as listed in the SAP (Appendix A).
- **Samples** will be analyzed for COPCs, and analytical methods will meet the required detection limits. The analytical methods used for each of the sampling methods are presented in the SAP (Appendix A).

J5 Step 4: Define the Boundaries of the Study

Summary: *Define the specific spatial and temporal boundaries that are included in the decision statement.*

1. Define the target population of interest and its relevant spatial boundaries.
2. Define what constitutes a sampling unit.
3. Specify temporal boundaries and other practical constraints associated with data collection.
4. Specify the smallest unit on which decisions or estimates will be made.

Outputs of Step 4

- Definition of the target population with detailed descriptions of geographic limits (spatial boundaries)
- Detailed descriptions of what constitutes a sampling unit
- Time frame appropriate for collecting data and making the decision or estimate, together with those practical constraints that may interfere with data collection
- The appropriate scale for decision making or estimation

J5.1 Target Population and Spatial Boundaries

- Target population (i.e., landfill contents such as large metallic objects, liquid organics, and radioactive materials)
- Borders and bottom of landfill trenches
- Vadose zone beneath the landfills (below the trench bottom)
- Soil gas within the landfill and within the vadose zone
- Groundwater beneath the landfills

J5.2 Temporal Boundaries

- Characterization activities are subject to congressional approval for funding.
- Characterization will be conducted in two phases. The first phase will be reconnaissance to focus Phase II efforts. Phase II characterization will satisfy the data needs for the RFI/CMS/RI/FS.

- Phase I – nonintrusive characterization activities:
  - Passive soil gas sampling
  - Baseline geophysical investigations
  - Advanced geophysical investigations
  - Aerial radiological surveys
- Phase II – intrusive characterization activities:
  - Direct pushes
  - Horizontal borings
  - Soil sampling
  - Test pit excavations
  - Active soil gas sampling

- Characterization efforts may be affected by seasonal weather changes.
- Collection of organic vapors is most effective if collection units are left in place for at least 3 days to take advantage of daily changes in barometric pressure.
- Precipitation events are not likely to affect organic sampling unless the soil becomes saturated to the point that vapor cannot pass through the soil.
- Geophysical surveys should be avoided during times of snow accumulation.

J5.3 Decision Units

- The smallest decision unit is a landfill trench.
- The typical decision unit is the landfill itself.

J5.4 Practical Constraints

- Field-screening techniques may not allow analysis of all contaminants of concern within remedial action levels.
- Nonintrusive investigation techniques have limitations that may prevent their use at certain waste sites and with particular analytes.
- Soil matrices may render data meaningless for certain nonintrusive survey techniques (e.g., GPR is affected by the reflection from fly ash that was used for surface stabilization on some trenches/landfills).
- Contamination transferred as a result of biological activities may be indistinguishable from buried waste without further investigation.
- Shielding provided by the soil cover can limit the usefulness of some nonintrusive methods because results may be skewed by the type and quantity of cover present.
- Soil vapor can migrate laterally and vertically within the vadose zone. Barometric pumping also may affect soil vapor sample collection. Soil vapor sampling may produce false negative results or transient results. The known carbon tetrachloride plume in the 200 West Area might confound the nonintrusive measurements in that area.

- High radiation activity areas pose a threat to worker safety.
- There are limits on how deep direct pushes can go, and they may encounter rocks, causing rejection.
- Topography and graded surfaces may constrain sampling/surveying locations.
- Access to sites may be constrained for issues such as worker health and safety, security restrictions, cultural, and/or infrastructure intrusion. No walk and no drive zones are known to exist in the 200-SW-2 OU landfills.
- Overlapping project work may limit access to some locations.
- The potential for collapse of burial boxes or nonstandard containers may restrict worker and equipment access.

J6 Step 5: Develop the Decision Rule

Summary: *Integrate the outputs from the previous steps into a statement(s) that describes the logical basis to select among the alternative actions. This includes specifying the population parameter (e.g., mean, percentile), determining the action level, and constructing the decision rule. A decision rule is determined for each PSQ.*

1. Specify appropriate population parameters for making decisions or estimates.
2. For decision problems, choose a workable action level and generate an “if… then… else” decision rule.
3. For estimation problems, specify the estimator and the estimation procedure.

Outputs of Step 5

- Identification of the population parameters most relevant for making inferences and conclusions on the target population
- For decision problems, the “if..., then...else...” theoretical decision rule based on a chosen action level
- For estimation problems, the specification of the estimator to be used

J6.1 200-SW-2 Operable Unit Parameters of Interest

- Presence of COPCs in the vadose zone beneath and adjacent to each landfill
- Comparison of observations to CSMs

J6.2 200-SW-2 Operable Unit Decision Rules

The PSQs are presented in Table J-3.

Table J-3. Principal Study Questions

PSQ		Decision Rule
1	What data are required to support evaluation of risk, pathways, and development of remedial action alternatives?	If the design of the RFI/CMS/RI/FS characterization approach was sufficient to support evaluation of risk, pathways, and development of remedial action alternatives, then perform the evaluation of risk and select the appropriate alternative; otherwise, additional data will need to be collected.
2	Were enough data collected to support the RFI/CMS/RI/FS and selection of remedial action alternatives?	If enough data were collected to support the RFI/CMS/RI/FS and select remedial action alternatives, then select the appropriate alternative; otherwise, additional data will need to be collected.
3	Were enough data collected to evaluate whether buried waste presents a long-term effect on HHE?	If enough data were collected to evaluate whether buried waste presents a long-term effect on HHE, then select the appropriate alternative; otherwise, additional data will need to be collected.

HHE = human health and the environment
PSQ = principal study question
RCRA = *Resource Conservation and Recovery Act of 1976*
RFI/CMS/RI/FS = RCRA field investigation/corrective measures study/remedial investigation/feasibility study

J7 Step 6: Specify Performance or Acceptance Criteria

Summary: *Define how much uncertainty can be tolerated when making the decision of interest, and establish appropriate performance goals for limiting uncertainty in the data. Discuss the severity of consequences of making wrong decisions based on less than perfect information.*

1. For decision problems, specify the decision rule as a statistical hypothesis test, examine consequences of making incorrect decisions from the test, and place acceptable limits on the likelihood of making decision errors.

2. For estimation problems, specify acceptable limits on estimation uncertainty.

Output of Step 6

- A set of performance or acceptance criteria (i.e., DQOs) that collected data should meet in order to minimize the possibility of either making a decision error or failing to keep uncertainty in estimates to within acceptable levels

J7.1 200-SW-2 Operable Unit Sampling Design Criteria

Traditional statistical sample designs are not typically suitable for investigating landfills. Sampling design will be judgmental. Criteria for evaluating the data with respect to PSQs will employ both statistical and nonstatistical methods.

J7.2 Decision Errors and Mitigating Measures

The following text describes possible errors for each of the major decision rules. The sources of errors that lead to those decision errors, and factors that mitigate them, are listed in Table J-4.

Table J-4. Sources of Decision Errors

Source of Error	Mitigating Measures
Spatial variability in the sampling approach, causing inaccurate assessment	Robust sampling plan to locate releases using aerial radiation surveys, direct pushes, horizontal borings, active and passive soil gas sampling, baseline and advanced geophysics, and test pit excavations
Not detecting releases from landfills	Monitor near the bottom of trenches, and focus characterization sampling in areas with the greatest potential for release and highest concentrations of contaminants of potential concern.
Analytical error	Robust QA/QC program to minimize analytical uncertainties

QA = quality assurance
QC = quality control

- **Decision Rule #1:** If the design of the RFI/CMS/RI/FS characterization approach was sufficient to support evaluation of risk, pathways, and development of remedial action alternatives, then perform the evaluation of risk and select the appropriate alternative; otherwise, additional data will need to be collected.

  Decision Error #1: Additional characterization may be required to develop adequate landfill information regarding the presence or absence of a complete pathway.

  - ***Consequence:*** Additional characterization funding could be diverted from higher priority projects.
  - ***Severity:*** Low to moderate.

- **Decision Rule #2:** If enough data were collected to support the RFI/CMS/RI/FS and select remedial action alternatives, then select the appropriate alternative; otherwise, additional data will need to be collected.

  Decision Error #2a: Choosing the wrong remedial action alternative.

  - ***Consequence:*** Release to the environment, wasted resources, and threat to worker safety.
  - ***Severity:*** Moderate to high.

- ***Decision Error #2b:*** Characterization data may not be sufficiently complete to evaluate adequately the presence of a complete pathway.

  - ***Consequence:*** Difficult to confirm the presence of a contaminant pathway.
  - ***Severity:*** Low to moderate.

- **Decision Rule #3:** If enough data were collected to evaluate whether buried waste presents a long-term effect on HHE, then select the appropriate alternative; otherwise, additional data will need to be collected.

Decision Error #3: If complete pathways are not identified, additional characterization may be required to confirm the lack of a pathway or to look for a pathway in a different location, which could pose unacceptable risk to potential receptors.

- ***Consequence:*** Potentially greater outlay of resources.

Severity: Moderate to high.

J8 Step 7: Develop the Plan for Obtaining Data

Summary: *Using results from the previous steps, identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs.*

1. Compile all information and outputs generated in Steps 1 through 6.
2. Use this information to identify alternative sampling and analysis designs that are appropriate for their intended use.
3. Select and document a design that will yield data that best achieve the performance or acceptance criteria.

Outputs of Step 7

- Full documentation of the final sampling and analysis design, along with a discussion of the key assumptions underlying this design
- Details on how the design should be implemented, together with contingency plans for unexpected events
- The quality assurance (QA) and quality control (QC) procedures that would be performed to detect and correct problems and, thereby, ensure defensible results

The QA/QC procedures are documented in the SAP (Appendix A).

J8.1 200-SW-2 Operable Unit Sampling and Analysis Plan

During the workshop, the planning team developed locations for direct pushes and horizontal borings, and determined which landfills would receive passive soil gas sampling, which would receive active soil gas monitoring, which would receive baseline and/or advanced geophysical investigations, and which would have test pit excavations completed. The planning team determined that all landfills would have an aerial radiation survey completed. The investigations proposed for each landfill are presented in the SAP (Appendix A) and summarized briefly as follows:

- **Organize existing records:** Existing records will be organized and cross-referenced.
- **Conduct aerial radiological surveys:** A wide-area radiological survey map of the 200 East and 200 West Areas will be made to provide additional information about near-surface radioactive contamination. This radiological mapping may provide insight on potential near-surface releases.
- **Collect direct-push samples:** Direct-push samples will be obtained from specific locations for each landfill. Samples will be taken between trenches and will not sample or disturb any waste. The purpose of the sample is to provide control for geophysical and geologic interpretation, and to provide information on potential contamination beneath each landfill.

- **Baseline geophysical investigations:** Baseline geophysical investigations will be performed at landfills that have not previously been investigated. Geophysical investigations can provide data regarding waste trench location and configuration, existence of potential anomalies, and metallic objects beneath the surface.
- **Advanced geophysical investigations:** Advanced geophysical investigations are proposed for landfills that have not been previously investigated, using methods that may have preferential pathways for contaminants to reach groundwater.
- **Horizontal boreholes:** Installation of horizontal boreholes is proposed beneath select landfills, based on waste volume density and landfill contents.
- **Active and passive soil gas sampling:** Passive soil gas sampling will be performed on landfills not previously investigated to look for VOCs. Active soil gas sampling will be performed where passive soil gas sampling indicates organic contamination.
- **Test pit excavations:** Focused and random test pits will be excavated in landfills to confirm waste burial record accuracy. Test pits will be excavated in each landfill bin type.
- **Multidetector probe:** A multidetector probe will be used to investigate the caissons.
- **Continue ongoing environmental monitoring:** The regular and routine environmental surveillance processes at the Hanford Site will continue to provide updated data on potential releases from the landfills.

J8.1.1 Sampling Frequency

The proposed characterization is not intended as part of an ongoing monitoring of the landfills. It is intended to identify releases to the vadose zone and/or environment for use in completing the risk assessment for the 200-SW-2 OU. The direct pushes and horizontal borings will be capable of being equipped with instruments in the event that monitoring for releases in the future is warranted or desired. An attempt will be made to collect a sample under each trench that the horizontal borehole encounters.

J8.1.2 Quality Assurance and Quality Control Program

Soil and Groundwater Remediation Project QA/QC will apply. Details of project QA/QC are described in the quality assurance project plan in the SAP.

J9 References

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