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DATA QUALITY OBJECTIVES
FOR OPERABLE UNIT 7

PRESENT LANDFILL (IHSS 114), INACTIVE HAZARDOUS WASTE STORAGE AREA (IHSS 203), AND EAST LANDFILL POND AND ADJACENT SPRAY EVAPORATION AREAS

U.S. Department of Energy
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INTRODUCTION

Operable Unit 7 (OU7) comprises the Present Landfill, which is referred to as Individual Hazardous Substance Site (IHSS) 114, the Inactive Hazardous Waste Storage Area (IHSS 203), and the East Landfill Pond and adjacent spray evaporation areas. A Phase I Resource Conservation Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) was conducted at OU7 pursuant to the Interagency Agreement (IAG) in 1992 and 1993 to characterize the site physical features, describe contaminant sources, and determine the nature and extent of contamination in soils Data obtained during the Phase I investigation, along with existing data, were to be used to begin developing and screening remedial alternatives, and estimate the risks to human health and the environment posed by sources within OU7. A Phase II RFI/RI was planned to characterize the nature and extent of contamination in surface water and groundwater.

Prior to completion of the Phase I RFI/RI and initiation of Phase II, the focus of investigations at OU7 changed due to the adoption of the presumptive-remedy strategy for streamlined site characterization and site remediation. This streamlined approach is consistent with Colorado Hazardous Waste Act (CHWA) closure requirements supported by guidance in the National Contingency Plan (NCP) and recent EPA guidance for landfills (*Conducting Remedial Investigations/ Feasibility Studies for CERCLA Municipal Landfill Sites*, EPA, 1991; *Superfund Accelerated Cleanup Bulletin, Presumptive Remedies for Municipal Landfill Sites*, EPA, 1993; *Presumptive Remedy for CERCLA Municipal Landfill Sites*, EPA, 1993). As a result of this strategy, the Phase I RFI/RI report and comprehensive baseline risk assessment will not be completed. Data needed for the design of the presumptive remedies, an assessment of the nature and extent of groundwater contamination, and a focused risk assessment will be addressed in the *Revised Work Plan Technical Memorandum for OU7*. Data will be collected during implementation of the *Revised Work Plan Technical Memorandum for OU7*. This will be followed by preparation of an interim measure/interim remedial action (IM/IRA) decision document, and finally, implementation of the IM/IRA.

The Data Quality Objective (DQO) Process presented in the *Interim Final Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process* (EPA, 1993) was used to identify the type, quantity, and quality of data needed to make decisions about remedial actions at OU7. The process consists of the following seven steps (1) state the problem - review prior studies and existing

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information to gain an acceptable understanding of the problem and then concisely describe the problem, (2) identify the decision - identify the decision that will solve the problem using new data, (3) identify inputs to the decision - identify the information needed to resolve the decision, (4) define the study area boundaries - specify the time period to which the decisions will apply and within which the data should be collected, (5) develop a decision rule - use the outputs from previous steps to devise an "if...then" statement that defines the conditions that would cause the decision maker to choose among alternative actions, (6) specify limits on decision errors - define acceptable decision error rates considering the consequences of making an incorrect decision, and (7) optimize the design for obtaining data - develop alternative sampling designs using information from the previous steps. Developing DQOs is an iterative process; the conclusions from any step may influence prior steps and cause them to be redefined

For the purpose of streamlined site characterization and site remediation, OU7 has been divided into three areas: (1) groundwater and surface water, (2) East Landfill Pond sediments and adjacent soils potentially impacted by spray evaporation, and (3) the Present Landfill and IHSS 203. The DQO Process outlined in the *Interim Final Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process* (EPA, 1993) is most applicable to decisions about groundwater and surface water and East Landfill Pond sediments and adjacent soils because they require the collection of additional field data The DQO Process is least applicable to the Present Landfill because (1) existing data have already lead to a decision to adopt the presumptive remedy strategy, (2) decisions are made on the basis of presumptive remediation (i.e., experience gained from other similar sites) rather than quantification of site characteristics, decision rules, and decision error rates, and (3) the quantitative method in the DQO Process is often not applicable to the types of data needed to support remedial design (For example, a topographic map is needed to support the design of the landfill cap The appropriate contour interval and quality of the survey data for the map are determined on the basis of standard engineering and surveying practices rather than the statistically based methodology in the DQO Process.) However, where appropriate, the DQO Process has been applied to the Present Landfill to conceptualize the type, quality, and quantity of data necessary to support design of the presumptive remedies. A final draft of the DQO document will be incorporated in the *Revised Work Plan Technical Memorandum for OU7* and will guide the field investigations and remedial actions at the site.

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Activities for step one of the DQO Process include identifying members of the planning team that developed DQOs for the study, identifying the primary decision makers, and defining roles and responsibilities for each team member. Because these activities are the same for each of the three areas/media at OU7, they are discussed first. What follows is a discussion of the seven steps of the DQO Process for groundwater and surface water, the East Landfill Pond sediments and adjacent soils, and the Present Landfill and IHSS 203.

Members of the planning team include the following·

Dave Norbury	CDH	OU7 Project Manager
Arturo Duran	EPA	OU7 Project Manager
Jen Pepe	DOE	OU7 Project Manager
Dave George	DOE/BOR	DOE Project Management Support
Tim O'Rourke	EG&G	OU7 Project Manager
Fritz Kloer	EG&G	Engineer
Tom Lindsay	EG&G	Engineer
Rick Roberts	EG&G	Risk Assessment
Laura Brooks	EG&G	ARARs
Steve Luker	EG&G	QA Manager
Greg Davis	Stoller	Geoscientist
Kathy Tegtmeyer	Stoller	Geoscientist
Myra Vaag	Stoller	Geoscientist
Dave Ellerbroek	Stoller	Statistician
Brian Caruso	Stoller	Engineer
Mark Lewis	Stoller	Risk Assessment
Yvette Lowney	Gradient	Risk Assessment
Dave Garcia	Stoller	ARARs
John Cummings	Montgomery Watson	Engineer

Decisions will be reached through consensus. Disputes will be resolved in accordance with Chapter 2, Part 12, Paragraphs 92-100 (Resolution of Disputes) of the IAG. The Colorado Department of Health (CDH) is designated as the lead agency for OU7 in accordance with Table 3, Attachment 2 of the IAG. Public involvement has not been addressed. Available personnel include current CDH, U S. Environmental Protection Agency (EPA), U.S Department of Energy (DOE), EG&G, S.M. Stoller (Stoller), Montgomery Watson, and Gradient team members. The contractual vehicle is the current EG&G and Stoller Contract ASC 221460BK. The budget is a function of the current contract. Deadlines have not been determined.

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DATA QUALITY OBJECTIVES FOR GROUNDWATER AND SURFACE WATER

Step 1 - State the Problem

A Phase I RFI/RI was conducted at OU7 in 1992 and 1993 to characterize the sources of contamination and to describe the nature and extent of contamination present at the source and in soils. Existing data for OU7 also include background geochemical data; RCRA groundwater monitoring results for the Present Landfill; and data from sitewide groundwater, surface water and geologic characterization programs. Results of the Phase I and other investigations provide information on groundwater and surface water quality at the site including dissolved and total analyte concentrations in groundwater from the upper hydrostratigraphic unit (UHSU) and lower hydrostratigraphic unit (LHSU), and analyte concentrations in surface water from the pond and the two intercept system discharge points. Information to determine groundwater flow paths and hydraulic gradients in the UHSU and LHSU in the vicinity of the landfill, hydraulic conductivity estimates for geologic units in the UHSU and LHSU, and migration pathways for contaminants in surface water and groundwater, and exposure point concentrations and exposure pathways for human and ecological receptors as described in the *Exposure Scenarios Technical Memorandum for OU7* (DOE, 1993) was also obtained

Data collected during the Phase I RFI/RI and other investigations are considered usable for site characterization, risk assessment, and remedial design activities. In addition, other data collected since 1990 are considered fully usable because the 1990 data represent the first full year of data collection following implementation of sampling and data quality guidelines in the *General Radiochemical and Routine Analytical Services Protocol (GRRASP)* (EG&G, 1991) and task-specific *Standard Operating Procedures (SOPs)* (EG&G, 1991) Data collected prior to 1990 can be used qualitatively.

Data analysis activities are ongoing to identify potential chemicals of concern (PCOCs) for groundwater and surface water through statistical comparisons of OU7 contaminant concentrations versus background concentrations As agreed to by CDH, EPA, and DOE, PCOC identification is based on statistically significant differences in analyte concentrations in site data versus background data The statistical comparisons will be performed for

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inorganics and radionuclides following procedures in *Statistical Comparison of Site-to-Background Data in Support of RFI/RI Investigations* (EG&G, 1994). The methodology includes a hot measurement test using a 99 percent upper tolerance limit ($UTL_{99/99}$), Gehan test (*A Generalized Wilcoxon Test for Comparing Arbitrarily Singly-Censored Samples*, Gehan, 1965) or other nonparametric analysis-of-variance (ANOVA) test (Wilcoxon Rank Sum or Kruskal-Wallis as described in the *Addendum to the Interim Final Guidance on Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities*, EPA, 1992), quantile test (*Statistical Sampling and Analysis Issues and Needs for Testing Attainment of Background-Based Cleanup Standards at Superfund Sites*, Gilbert and Simpson, 1992), slippage test (*Tables for a Nonparametric Test of Location*, Rosenbaum, 1954), and t-test. Professional judgement is applied only to spatial distribution, temporal distribution, and pattern-recognition concepts to determine if analyte concentrations are indicative of contamination

As discussed earlier, a presumptive-remedy strategy has been adopted for the landfill to streamline site characterization and site remediation. The East Landfill Pond will be clean closed in concert with the presumptive-remedy strategy. Surface water may be considered an F0.39 listed waste under RCRA, and therefore, leachate flow to the pond must be stopped before the surface water can be delisted. After being delisted, surface water from the pond will likely be pumped to a treatment facility at RFP. Remediation of pond sediments will be addressed under the Corrective Action Management Unit (CAMU) strategy discussed in the next section. The presumptive remedy does not address the long-term groundwater response action.

The remaining problems are (1) to identify and fully describe the impacts to groundwater resulting from contaminant releases from the landfill (nature and extent of contamination) to determine whether these impacts require a response action, (2) to design a monitoring network that will meet requirements for post-closure care of the Present Landfill based on an analysis of contaminant fate and transport, and plug and abandon existing wells that will not be part of the monitoring network, and (3) to identify discharge requirements (or regulations for delisting) for surface water to clean close the East Landfill Pond.

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Step 2 - Identify the Decision

2.1 State the decision(s):

(1) Are concentrations of PCOCs in UHSU/LHSU groundwater above or below applicable or relevant and appropriate requirements (ARARs) and will response actions be required?

(2) Are locations of existing wells adequate to meet ongoing groundwater monitoring and post-closure care requirements?

(3) Are analyte concentrations in surface water above or below discharge requirements and will response actions be required?

2 2 State actions (outcomes) that result from resolution of the decision:

(1) No action is required if analyte concentrations in the UHSU/LHSU groundwater are below ARARs. Collection and treatment of groundwater are required if analyte concentrations exceed ARARs.

(2) No action is required if locations of wells are adequate for ongoing groundwater monitoring and post-closure care requirements. Additional wells are required if locations of existing wells do not meet requirements for ongoing groundwater monitoring and post-closure care.

(3) No action is required if analyte concentrations in surface water are below ARARs. Treatment of surface water prior to discharge is required if analyte concentrations exceed ARARs.

Step 3 - Identify the Inputs to the Decision

3.1 Identify the information that is not currently available but will be required to make the decisions:

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OU7 chemical-specific ARARs, developed from Rocky Flats Plant (RFP) benchmarks, location-specific ARARs, and action-specific ARARs

Requirements for the post-closure, groundwater-monitoring program

Vertical and areal extent (downgradient limit) of impacted groundwater

Requirements for clean closure of surface impoundments and treatment or delisting of listed waste (RCRA FO.39)

3.2 Determine the sources for each item of information identified.

Stoller and EG&G are developing a strategy for determining chemical-specific ARARs from the benchmarks and are identifying location-specific and action-specific ARARs.

State Subtitle D and RCRA Subtitle C closure requirements (if applicable)

Additional downgradient monitoring wells along groundwater migration pathways from known source areas.

Clean-closure requirements for the East Landfill Pond and RCRA requirements for delisting an FO.39 listed waste.

3.3 Identify the information that is needed to identify the action level:

ARARs are the basis for action levels when and where available.

3.4 Confirm that appropriate field sampling techniques and analytical methods exist to provide the necessary data·

EPA-approved field sampling techniques and analytical methods were and will be used to collect the necessary data

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Step 4 - Define the Boundaries of the Study

4.1 Define the geographic area within which all decisions must apply

Surface water and groundwater outside the Present Landfill and contaminant plumes that originate from OU7. Includes the vertical extent of contamination.

4.2 Specify the characteristics that define the population of interest

UHSU/LHSU groundwater - concentrations of PCOCs at each well location and the downgradient limit of concentrations exceeding background concentrations

Extent of groundwater contamination - monitoring-well network configuration with respect to current and predicted plume geometry

Surface water from the pond and intercept system discharge points - concentrations of PCOCs at each location sampled

4.3 Define the temporal boundary of the decision.

All data from 1990 through 1993 will be used to make the decision.

4.4 Identify practical constraints on the data collection.

Limited road access in No Name Gulch to collect samples and install wells, if required. Wetlands issues for the drainage. Schedule constraints on the number and frequency of groundwater samples needed from wells in No Name Gulch, if required Schedule constraints related to the time required to perform laboratory analysis and validate laboratory analytical procedures

Step 5 - Develop Decision Rules

5.1 Specify the parameters that characterize the population of interest

UHSU/LHSU groundwater - average concentration of PCOCs at each well location

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Extent of groundwater contamination - vertical and areal extent (downgradient limit)

Surface water from the pond and intercept system discharge points - average concentration of PCOCs

5.2 Specify the action level for the study.

ARARs for groundwater and surface water.

5.3 Develop a decision rule (i.e , if x, then y) for each population of interest.

UHSU/LHSU groundwater - If the concentration of PCOCs does not exceed ARARs, no action is required If the concentration of PCOCs exceeds ARARs, then design and implement a response action as part of the IM/IRA decision document

Extent of groundwater contamination - If downgradient monitoring wells are not located along migration pathways for contaminated groundwater, then install additional monitoring wells to detect contaminant releases downgradient of the landfill to fulfill the monitoring requirements for post-closure care. Wells will be installed during additional RFI/RI field activities and potentially during the IM/IRA for performance monitoring.

Surface water from the pond and intercept system discharge points - If the concentration of PCOCs does not exceed ARARs, no action is required. If the concentration of PCOCs exceeds ARARs, then treat or delist surface water as appropriate.

Step 6 - Specify Acceptable Limits on Decision Errors

Members of the planning team need to agree on acceptable decision error rates for the decision rules and action levels identified in Step 5. The decision error rates will be based on consideration of the consequences of making incorrect decisions given potential impacts to costs, schedule, resource expenditure, human health, and ecological conditions (*Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process*, EPA 1993). Decision error rates are used to establish appropriate

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performance goals for limiting uncertainty. Establishing acceptable error rates is necessary prior to determining the acceptable number of datum (samples or tests) necessary to support the decision with a specified level of confidence.

For groundwater and surface water, the two decision errors are: (1) deciding that analyte concentrations exceed ARARs when they actually do not, and (2) deciding that analyte concentrations do not exceed ARARs when they actually do. The consequence of deciding that analyte concentrations exceed ARARs when they actually do not will be additional cost incurred installing unneeded treatment systems. The consequence of deciding that analyte concentrations do not exceed ARARs when they actually do would be possibly endangering human health or the environment. Also, additional costs may be incurred at a later date for environmental cleanup.

To reach a decision, a null hypothesis is formulated so that a given exceedance of the ARAR (delta) can be detected with a known probability This probability is known as the power of the test. The power of a statistical test is defined as one minus the Type II error rate For groundwater and surface water, the null hypothesis (Ho) is· groundwater or surface water concentrations do not exceed ARARs The alternative hypothesis (Ha) is groundwater or surface water concentrations exceed ARARs False positive decision errors (Type I) occur when the null hypothesis is erroneously rejected (see Table 1). This decision error occurs when groundwater or surface water concentrations are determined to exceed ARARs when they actually do not. False negative decision errors (Type II) occur when the null hypothesis is erroneously accepted The false negative decision error occurs when groundwater or surface water concentrations are determined not to exceed ARARs when they actually do

In accordance with EPA's *Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process* (EPA 1993), the following activities must be performed to define decision errors and assess potential consequences of incorrect decisions·

- Members of the planning team reach agreement upon the range of possible concentrations on either side of a numerical standard (ARAR) where the consequences of decision errors are relatively minor (defined by the value delta)

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- Assign probability values for Type I and Type II errors (i.e., alpha and beta) that reflect the acceptable probability for the occurrence of decision errors

- Check the limits on the decision errors to ensure that they accurately reflect the concerns of the planning team about the relative consequences for each type of decision error

Table 1
Defining the Decision Rule and Type I and II Errors

	True Condition	
Decision Reached Based on Data from Site	Concentrations in Groundwater and Surface Water DO NOT Exceed Action Levels	Concentrations in Groundwater and Surface Water Exceed Action Levels
Do Not Exceed Action Levels	Correct Decision Accept H_o	Error (Type II) Accept H_o
Do Exceed Action Levels	Error (Type I) Reject H_o	Correct Decision Reject H_o

Type I error rate (probability) = alpha

Type II error rate (probability) = beta

Power (to reject H_o) = 1-beta

A range of concentrations about each action level (ARAR) will be specified where the consequences of decision errors are relatively minor. A range from plus to minus 25 percent of the ARAR concentration has been selected to reflect the concentration range where the consequences of decision errors are relatively minor and costs and schedule impacts associated with improving the tests ability to discern between the null and alternative

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hypotheses are high. Increasing this range decreases the power of the test to detect concentrations greater than the ARAR. However, increasing the range decreases the number of samples necessary to achieve the desired performance of the test. A range of plus or minus 25 percent of the ARAR has been chosen as a compromise between increased performance of the statistical test and increased costs and impacts to schedule The Type I error rate was chosen based upon common statistical practices.

Probability values to points above and below the action level were chosen that reflect the acceptable probability for the occurrence of decision errors: acceptable decision error rates are chosen as 20 percent for the false positive decision error (Type I error) and 5 percent for the false negative decision error (Type II error).

Step 7 - Optimize the Design

The objective of this step is to identify the most resource-effective sampling design expected to generate data that satisfies the DQOs specified in the preceding steps. Activities included in this step are reviewing the DQO outputs and existing environmental data and developing general sampling and analysis design alternatives. For each design alternative, the mathematical expressions needed to solve the design problem are formulated and the optimal sample size that satisfies the DQOs is selected. Then, the most resource-effective design that satisfies all of the DQOs is selected. Finally, the operational details and theoretical assumptions of the selected design are documented. These activities will be performed and documentation of the activities will be presented in the sampling and analysis plan part of the *Revised Work Plan Technical Memorandum for OU7.*

DATA QUALITY OBJECTIVES FOR EAST LANDFILL POND SEDIMENTS AND ADJACENT SOILS

Step 1 - State the Problem

A Phase I RFI/RI was conducted at OU7 in 1992 and 1993 to characterize the sources of contamination and to describe the nature and extent of contamination present at the source and in soils. Results of the Phase I investigations provide information that describes contamination in East Landfill Pond sediments and adjacent soils where spray evaporation of pond water occurred, such as analyte concentrations in soils collected from two depth intervals (0 to 2 inches and 0 to 10 inches) and analyte concentrations in pond sediments Information on soil type, vegetative cover over soils, climate data (wind directions, speeds and stability classes; precipitation and evapotranspiration rates), surface runoff rates, migration pathways for contaminants in soil and sediment (wind dispersion, vegetable/plant uptake, leaching, and direct contact), and exposure pathways for human and ecological receptors (inhalation, ingestion, and dermal contact) was also obtained.

Other sources of data include. background geochemical data describing soils and sediments and data from sitewide hydrologic and geologic characterization programs. Data collected during the Phase I RFI/RI are considered usable for site characterization, risk assessment, and remedial design activities. In addition, other data collected since 1990 are considered fully usable. The 1990 data represent the first full year of data collection following implementation of sampling and data quality guidelines in the GRRASP and SOPs Data collected prior to 1990 can be used qualitatively.

A CAMU strategy has been recommended to manage remediation wastes at OU7. Under the final rule (58 Federal Register FR 8662), remediation wastes generated within the boundaries of a DOE site can be managed in a CAMU at the site without being subject to land disposal restrictions (LDRs). As applied to OU7 and the OU6 IHSSs within OU7, contaminated surface soils around the East Landfill Pond and in IHSSs 166 1, 166.2, 166.3, 167.1, 167.2, and 167.3, and contaminated pond sediments can be excavated and placed on top of the Present Landfill before the landfill is capped. The CAMU will help implement a cost-effective remedy for contaminated soils and sediments. Because the CAMU (Present

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Landfill) is a regulated unit, the previously applicable RCRA Subtitle D groundwater monitoring, closure and post-closure care requirements will continue to apply.

Data analysis activities are ongoing to identify potential chemicals of concern (PCOCs) for East Landfill Pond sediments and adjacent soils through statistical comparisons of onsite contaminant concentrations versus background concentrations. As agreed to by CDH, EPA, and DOE, PCOC identification is based on statistically significant differences in analyte concentrations in site data versus background data. The statistical comparisons will be performed for inorganics and radionuclides following procedures in *Statistical Comparison of Site-to-Background Data in Support of RFI/RI Investigations* (EG&G, 1994) The methodology includes a hot measurement test using a 99 percent upper tolerance limit ($UTL_{99/99}$), Gehan test (*A Generalized Wilcoxon Test for Comparing Arbitrarily Singly-Censored Samples*, Gehan, 1965) or other nonparametric analysis-of-variance (ANOVA) test (Wilcoxon Rank Sum or Kruskal-Wallis as described in the *Addendum to the Interim Final Guidance on Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities*, EPA, 1992), quantile test (*Statistical Sampling and Analysis Issues and Needs for Testing Attainment of Background-Based Cleanup Standards at Superfund Sites*, Gilbert and Simpson, 1992), slippage test (*Tables for a Nonparametric Test of Location*, Rosenbaum, 1954), and t-test Professional judgement is applied only to spatial distribution, temporal distribution, and pattern-recognition concepts to determine if analyte concentrations are indicative of contamination.

The remaining problems are (1) to identify and fully describe the impacts to soils and sediments resulting from contaminant releases from the landfill (leachate that seeps into the pond) and spray areas around the pond (nature and extent of contamination), and (2) to determine the contaminants that present a risk to human health and the environment and the appropriate response action required to reduce those risks.

Step 2 - Identify the Decision

2.1 State the decision(s):

(1) Do concentrations of constituents in pond sediments and soils present a risk to human health or the environment?

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(2) What response actions are required to reduce risk to an acceptable level?

2.2 State actions (outcomes) that result from resolution of the decision:

No action is required if no risk is associated with contaminated environmental media Remediation may be required if contaminated media pose a risk to human health or the environment. The media comprise two distinct populations (pond sediments and soils) that have potentially different outcomes and associated actions.

Step 3 - Identify the Inputs to the Decision

3.1 Identify the information that is not currently available but will be required to make a decision:

(1) Estimations of risk to human health and the environment resulting from exposure to contaminants associated with the East Landfill Pond sediments and adjacent soils will be needed to determine whether remediation is needed. Risks will be calculated from exposure estimations. Information needed to estimate exposures and potential toxicity includes the following:

Contaminant release mechanisms

Delineation and characterization of exposure pathways

Delineation of the nature and extent of contamination including volume of contaminated media and total areal concentrations of contaminants

Approach and methods for estimating exposure to human and ecological receptors

Contaminants of concern (COCs) for human receptors in East Landfill Pond sediments and adjacent soils

Toxicological information such as slope factors and reference doses (RfDs) associated with the COCs

Exposure point concentrations for COCs

Determination of what constitutes unacceptable risk will be made by risk managers at DOE, CDH, and EPA. Site-specific information will be used to develop criteria

(2) The selection of response actions will be based on the amount of risk reduction required and the remediation technologies available Specific information needed to screen remediation alternatives includes the following:

Exposure pathways and points that result in unacceptable risks to human health and ecological receptors.

Information on the effectiveness of remedial alternatives in reducing releases and exposures associated with the exposure pathways

Physical properties (moisture content, grain size, proctor density, and Atterberg limits) of the East Landfill Pond sediment.

3.2 Determine the sources for each item of information identified

Approach and methods to be used in estimating exposures will be identified in the revised *Human Health Risk Assessment Exposure Scenarios Technical Memorandum* and *Model Description Technical Memorandum*. COCs will be presented in the *Contaminant of Concern Identification Technical Memorandum*, based on site-specific data and toxicity information available through EPA. Toxicological information on COCs will be developed in the *Toxicity Assessment Technical Memorandum*. Information in each of the technical memoranda will be approved by EPA and CDH before use in the risk assessments or feasibility studies.

Remedial alternatives will be evaluated in the IM/IRA decision document.

Pond sediment samples will be collected and physical properties will be measured under the Revised Field Sampling Plan, if necessary.

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3.3 Identify the information that is needed to determine the action level:

An assessment to determine the risk associated with contaminated soils or sediments

3.4 Confirm that appropriate field sampling techniques and analytical methods exist to provide the necessary data:

EPA-approved field sampling techniques and analytical methods were used to collect the necessary data. The risk assessment will be performed following EPA guidelines for exposure assessment.

Step 4 - Define the Boundaries of the Study

4.1 Define the geographic area within which all decisions must apply.

In general, within the boundary of OU7 including surface areas adjacent to the East Landfill Pond and pond sediments

4.2 Specify the characteristics that define the population of interest.

Pond sediments - concentrations of PCOCs in sediment; volume and distribution of contaminated sediments

Soils - concentrations of PCOCs in soil; volume and distribution of contaminated soil

4.3 Define the temporal boundary of the decision.

All data from 1990 through 1993 will be used to make the decisions

4.4 Identify practical constraints on the data collection.

Sufficient data have been collected to make decisions regarding the need for remediation. However, potential designation of areas near the East Landfill Pond as wetlands may affect remediation activities.

Step 5 - Develop Decision Rules

5.1 Specify the parameter that characterizes the population of interest.

Pond sediments - average concentration for each PCOC, distribution of contaminants, and risk associated with contaminated sediments

Soils - average areal concentration for each PCOC and PCOC concentrations at hot spots, distribution of contaminants, and risk associated with contaminated soils

5.2 Specify the action level for the study.

A risk-based value.

5.3 Develop a decision rule (i.e., if x, then y) for each population of interest.

Pond sediments - If the concentration of PCOCs in pond sediments does not exceed the risk-based standard, then no action is required If the concentration of PCOCs in pond sediments exceeds the risk-based standard, then removal actions or other risk-reduction actions as part of the CAMU are required.

Soils - If the concentration of PCOCs in surface and shallow subsurface soils does not exceed the risk-based standard, then no action is required. If the concentration of PCOCs in surface and shallow subsurface soils exceeds the risk-based standard, then removal or risk-reduction actions as part of the CAMU are required

Step 6 - Specify Acceptable Limits on Decision Errors

Members of the planning team need to agree on acceptable decision error rates for the decision rules and action levels identified in Step 5. The decision error rates will be based on consideration of the consequences of making incorrect decisions Decision error rates are used to establish appropriate performance goals for limiting uncertainty. Establishing acceptable error rates is necessary prior to determining the appropriate number of datum (samples or tests) necessary to support the decision with a specified level of confidence

given potential impacts to costs, schedule, resource expenditure, human health, and ecological conditions (*Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process*, EPA, 1993).

For East Landfill Pond sediments and adjacent surface soils, the two decision errors are· (1) deciding that analyte concentrations exceed risk-based standards when they actually do not, and (2) deciding that analyte concentrations do not exceed risk-based standards when they actually do. The consequence of deciding that analyte concentrations exceed Risk Based Standards when they actually do not will be additional cost incurred excavating sediments or surface soils that are not contaminated. The consequence of deciding that analyte concentrations do not exceed risk-based standards when they actually do would be possibly endangering human health or the environment. Also, additional costs may be incurred at a later date for environmental cleanup.

To reach a decision, a null hypothesis is formulated so that a given exceedance of the risk-based standard (delta) can be detected with a known probability This probability is known as the power of the test. The power of a statistical test is defined as one minus the Type II error rate. For East Landfill Pond sediments and adjacent surface soils, the null hypothesis (Ho) is: sediment or surface soil concentrations do not exceed risk- based standards. The alternative hypothesis (Ha) is: sediment or surface soil concentrations exceed risk-based standards False positive decision errors (Type I) occur when the null hypothesis is erroneously rejected. This decision error occurs when sediment or soil concentrations are determined to exceed risk-based standards when they actually do not. False negative decision errors (Type II) occur when the null hypothesis is erroneously accepted. This decision error occurs when sediment or surface soil concentrations are determined not to exceed risk-based standards when they actually do

In accordance with EPA's *Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process* (EPA 1993), the following activities must be performed to define decision errors and assess potential consequences of incorrect decisions:

- Members of the planning team reach agreement upon the range of concentrations on either side of the action level (risk-based standard) where the consequences of decision errors are relatively minor

- Assign probability values for Type I and Type II errors (i.e., alpha and beta) that reflect the acceptable probability for the occurrence of decision errors

- Check the limits on the decision errors to ensure that they accurately reflect the concerns of the planning team about the relative consequences for each type of decision error

A range of concentrations about the action level (risk-based standard) needs to be specified where the consequences of decision errors are relatively minor. A range from plus to minus 25 percent of the risk-based standard has been selected to reflect the concentration range where the consequences of decision errors are relatively minor and costs associated with improving the tests ability to discern between the null and alternative hypotheses are high Increasing this range decreases the power of the test to detect concentrations greater than the risk based standard. However, increasing the width of the grey area decreases the number of samples necessary to achieve the desired performance of the test An area of plus or minus 25 percent of the risk-based standard has been chosen as a compromise between increased performance of the statistical test and increased costs and impacts to schedule. The Type I error rate was chosen based upon common statistical practices Probability values to points above and below the action level were chosen that reflect the acceptable probability for the occurrence of decision errors: acceptable decision error rates are chosen as 20 percent for the false positive decision error (Type I error) and 5 percent for the false negative decision error (Type II error).

Step 7 - Optimize the Design

The objective of this step is to identify the most resource-effective sampling design expected to generate data that satisfies the DQOs specified in the preceding steps. Activities included in this step are reviewing the DQO outputs and existing environmental data and developing general sampling and analysis design alternatives. For each design alternative, the mathematical expressions needed to solve the design problem are formulated and the optimal sample size that satisfies the DQOs is selected. Then, the most resource-effective design that satisfies all of the DQOs is selected. Finally, the operational details and theoretical assumptions of the selected design are documented. These activities will be performed and documentation of the activities will be presented in the sampling and analysis plan part of the *Revised Work Plan Technical Memorandum for OU7.*

DATA QUALITY OBJECTIVES (DQOs) FOR PRESENT LANDFILL AND IHSS 203

Step 1 - Statement of the Problem

A Phase I RFI/RI was conducted at the Present Landfill and IHSS 203 in 1992 and 1993 to characterize the sources of contamination within OU7 and to describe the nature and extent of contamination present at the source and in soils. Results of the Phase I investigations provide information to develop a site hydrogeologic model, calculate hydraulic conductivity values for bedrock underlying the landfill, and describe groundwater flow paths and hydraulic gradients within the landfill. Information describing the contaminant source, such as total volume and areal extent of landfill waste, depth of landfill waste and elevation of subgrade, qualitative descriptions of waste materials, age of landfill waste, approximate amount of interim soil cover per lift, and volume of saturated landfill waste was also obtained. The volume and composition of leachate, leachate head measurements, rough estimates of leachate seep rates, volume and composition of landfill-generated gases, and location and concentrations of landfill-associated gas were determined. In addition, the effectiveness of the existing containment system (intercept system) was investigated and an area was identified on the northern side of the system where leakage may occur. Information from the Phase I and other investigations include *in situ* permeability of the interim soil cover estimated using existing geological information, classification of soils around the landfill using the Unified Soil Classification System (USCS), climate data such as evapotranspiration and precipitation data, input parameters for the LANDFIL2 model to predict gas emission rates, and exposure pathways for human and ecological receptors as described in the *Human Health Risk Assessment Exposure Scenarios Technical Memorandum* (DOE, 1993).

Other sources of data include the following: background geochemical data, RCRA groundwater monitoring results for the Present Landfill, and data from sitewide groundwater, surface water, and geologic characterization programs. Data collected during the Phase I RFI/RI are considered usable for site characterization and remedial design activities. In addition, other data collected since the start of 1990 as part of RCRA monitoring and sitewide programs are also considered fully usable. Data prior to 1990 can

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be used qualitatively. The 1990 data represent the first full year of data collection following implementation of sampling and data quality guidelines outlined in the GRRASP and SOPs.

Prior to the completion of the Phase I RFI/RI and the initiation of Phase II, the focus of investigations at OU7 shifted as a result of the adoption of the presumptive-remedy strategy for streamlined site characterization and site remediation. The presumptive remedy for CERCLA municipal landfill sites relates primarily to containment of the landfill mass including the control or collection and treatment of leachate/groundwater and landfill gas The presumptive remedy does not address exposure pathways outside the source area, nor does it include the long-term groundwater response action.

Thus, the problem is to determine what additional data are required from the Present Landfill and IHSS 203 to support closure under CHWA and RCRA, design the landfill cap, leachate control system, leachate collection and treatment system, gas control system, and gas collection and treatment system, if necessary, and meet the IAG milestone of July 1997 for IM/IRA implementation.

Step 2 - Identify the Decisions

2.1 State the decisions and the actions (outcomes) that result from resolution of the decisions:

In accordance with CHWA regulations, RCRA closure requirements, and *Superfund Accelerated Cleanup Bulletin, Presumptive Remedies for Municipal Landfill Sites* (EPA, 1993) and *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA, 1993), the basis for action will be the answers to the following decisions.

(1) What containment design (cap and institutional controls) will satisfy regulatory requirements (State Subtitle D and RCRA Subtitle C closure requirements)?

(2) The control of groundwater/leachate is a necessary component of the presumptive remedy to prevent migration from the source area. Will the existing intercept system prohibit groundwater from flowing into the landfill and mitigate leachate formation?

(3) Treatment of leachate concentrations is assumed to be a component of the presumptive remedy.

(4) The control of landfill-generated gas is frequently a necessary component of the presumptive remedy to ensure cap integrity. Will treatment of landfill-generated gas be required? Guidance is forthcoming on this issue (*Superfund Accelerated Cleanup Bulletin, Presumptive Remedies for Municipal Landfill Sites*, EPA, 1993). In some cases, State ARARs may identify gas clean-up levels (i.e., emissions) for such contaminants, and in some cases, health-based levels will be appropriate.

Step 3 - Identify the Inputs to the Decisions

3.1 Identify the information that is not currently available but will be required to make the decisions:

(1) Information for landfill cap design:

Topographic map

Location of utilities

Physical properties of interim soil cover

Location and soil characteristics of potential borrow areas

(2) Information for leachate control:

Additional water levels and horizontal gradient across the groundwater intercept system

Predicted rate of water infiltration through landfill cap and seepage generation rate (HELP model output)

(3) Information for leachate collection and treatment.

Rate of leachate seepage (measured)

(4) Information for landfill gas control/treatment·

Landfill gas emission rates

3.2 Determine the sources for each item of information identified·

Data not in existing sources will be collected under the Revised Field Sampling Plan

(1) Information for landfill cap design:

A topographic contour map will be prepared using survey data. The map will show the locations of property features, topographic contours, spot elevations, and areas that have recently been graded or mounded. Plans for future mounding of waste are needed to determine final configuration of the landfill

Location of utilities aboveground or underground that may interfere with construction will be identified. In addition, the nearest service locations for electricity, water, and communication lines will be identified for construction and operation of the remedial system

Physical properties (standard proctor density, grain size, Atterberg limits, *in situ* moisture content, and unconfined compressive strength) of interim soil cover material will be obtained from Waste Operations. If these parameters are not available, the interim soil cover material will be sampled and analyzed

Location and soil characteristics (*in situ* moisture, Atterberg limits, grain size, standard proctor density, and remolded falling-head permeability) of potential borrow areas for clay, sand/gravel, and topsoil will be obtained from existing sources or measured in the field, if necessary

(2) Information for leachate control:

Water levels and hydraulic conductivity values will be measured in temporary well points straddling the groundwater intercept system between existing well pairs on the north side.

The predicted rate of water infiltration through landfill cap and the volume of leachate generated will be calculated using the HELP model.

(3) Information for leachate collection and treatment:

Leachate seep rates will be quantified in the field

(4) Information for landfill gas treatment:

Landfill gas emissions will be modeled using LANDFIL2 as recommended in the EPA guidance document on *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (EPA, 1991) Measurements at existing venting wells will be used to calibrate the model.

3.3 Identify the information that is needed to establish the action level:

CHWA and RCRA closure requirements, and presumptive remedies applicable to municipal solid waste landfills, and chemical-specific and action-specific ARARs

3.4 Confirm that appropriate field sampling techniques and analytical methods exist to provide the necessary data:

EPA-approved field sampling techniques and analytical methods will be used to collect and analyze data.

Step 4 - Define the Boundaries of the Study

4.1 Define the geographic area within which all decisions must apply.

The Present Landfill including IHSSs 203 and underlying media to the first uncontaminated confining layer (i.e., unweathered bedrock).

4.2 Specify the characteristics that define the media/population of interest.

Landfill waste - physical properties of the interim soil cover material; parameters for landfill cap design; areal extent, total volume, and depth of waste material; volume of saturated waste material; characterization of the waste is not required in accordance with the NCP

Leachate control - infiltration rate, water levels, gradient, and hydraulic connection at various points across the groundwater intercept system

Leachate treatment - composition, volume, and flow rate

Gas treatment - composition, volume, and generation rate

4.3 Define the temporal boundary of the decision.

Additional data will be collected now through post-closure care. Closure of the landfill will commence by July 1997.

4.4 Identify practical constraints on the data collection

IAG milestones.

Step 5 - Develop Decision Rules

5.1 Specify the parameter that characterizes the population of interest.

Landfill waste - parameters for final landfill cap design

Leachate control - water level elevations on either side of the system

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Leachate treatment - average and maximum concentration for each analyte, average and peak flow rates

Gas treatment - average and maximum concentration for each analyte, landfill gas generation rates

5.2 Specify the action level for the study

Landfill waste - Regulatory guidance specifies containment of the landfill mass as the appropriate response action or "presumptive remedy". Therefore, specification of an action level is not required. Design criteria specified in RCRA and CHWA regulations include a hydraulic conductivity value of 10^{-7} cm/sec for the compacted clay liner of the double barrier/cap and a 40 to 60 mil synthetic membrane

Leachate - Regulatory guidance indicates that containment/control of leachate is a component of the presumptive remedy. Therefore, specification of an action level is not required. The effectiveness of the existing containment structures (the intercept system and underlying unweathered bedrock) to control leachate migration must be evaluated. Treatment of leachate is also considered a component of the presumptive remedy. Treated leachate must meet National Pollutant Discharge Elimination System (NPDES) standards or other ARARs.

Landfill gas - Landfill gas collection is typically considered a necessary component of the remedy to insure cap integrity. To evaluate the need to treat landfill gas, an action level must be specified. Based on proposed emission standards for EPA Office of Air Quality, Planning, and Standards, the action level for emission of non-methane organic compounds (NMOCs) is 100 megagrams per year. Other action levels may be identified during the development of ARARs.

5.3 Develop a decision rule

Landfill wastes - In accordance with regulatory guidance, construction of a containment structure is a presumed component of the response action.

Leachate - Containment/control of leachate is a presumed component of the response action. The performance (effectiveness) of the existing containment structure will be evaluated using hydrologic data Treatment of leachate is a presumed component of the response action.

Landfill gas - Treatment of landfill gas may be required If concentrations of NMOCs in gas do not exceed 100 megagrams per year (or some other identified ARAR), then no action is required. If concentrations of NMOCs in gas exceed 100 megagrams per year (or some other identified ARAR), then a gas treatment system is required.

Step 6 - Specify Acceptable Limits on Decision Errors

In this step, members of the planning team typically establish decision error rates for the decision rules and action levels identified in Step 5. Decision error rates are used to establish appropriate performance goals for limiting uncertainty (*Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process*, EPA, 1993). Establishing acceptable error rates is necessary prior to determining the appropriate number of datum (samples or tests) necessary to support the decision with a specified level of confidence. However, as mentioned previously, the statistically-based DQO Process is least applicable to the Present Landfill because (1) remedial action decisions are made on the basis of presumptive remediation (i.e., experience gained from other similar sites) rather than quantitative evaluation of environmental data to "choose among alternative actions" (Step 5 of the DQO Process), (2) the quantitative method in the DQO Process is not applicable to many of the types of information needed to support remedial design (such as maps showing topography or utility locations), and (3) the amount of existing quantitative data is considered more than sufficient to support design of the presumptive remedy given standard engineering practices without invoking the statistically-based DQO Process. Discussed below (and presented in Table 2) are the methodologies for DQO development appropriate to the type of information needed and the amount of existing quantitative data available at the Present Landfill.

The majority of the types of information needed to support the design of the landfill cover (such as maps showing topography, future mounding of waste, utility locations, and soil types suitable for cap materials) obviously do not require the statistically-based methodology of

the EPA DQO Process. These types of information will be obtained using standard engineering, surveying, and USCS practices Other types of information needed to support the construction of the landfill cap include the physical properties of the interim soil cover and the cap materials. The physical properties of the cap materials will be evaluated during construction of the landfill cap. The quality assurance quality control (QA/QC) Plan will specify the appropriate number of samples or tests required to ensure that construction design criteria are meet. Although existing data may be available to describe the physical properties of the interim soil cover, additional sampling may be required However, standard engineering practices require only a qualitative approach for determining the appropriate number of samples or tests required.

A qualitative approach, rather than a statistically-based methodology, is also more appropriate for identifying the number and location of well points needed to further characterize the performance of the intercept system on the north side of the landfill.

To support the design of the leachate collection and treatment system, the amount and quality of available data are considered more than adequate based on standard engineering practices and a statistically-based methodology is considered unnecessary. Currently, chemical data from approximately 70 samples are available to characterize leachate composition. These include approximately six samples from ten monitoring wells within the landfill, four samples collected at cone penetration test locations during the Phase I RFI/RI, and a minimum of four samples from the leachate seep. Samples have been analyzed for metals, radionuclides, volatile organic compounds, and water quality parameters using analytical methodologies achieving EPA Level IV and V data quality. Additional data are being obtained quarterly from the ten monitoring wells.

Conservative, EPA-recommended models will be used to estimate leachate discharge rates and landfill-gas emission rates. Uncertainties in the model output are addressed by incorporating conservative assumptions and designing remedies using safety design factors in accordance with standard engineering practices.

Step 7 - Optimize the Design

Not applicable

Table 2

Approach to Establishing DQOs for Information to Support Design of Presumptive Remedy for the Present Landfill

Component of the Remedy	Information Type	DQO Methodology
Landfill Cap Design	Topographic contour map Map of future waste mounding Location of utilities Physical properties of interim soil cover Location of suitable cap materials (i e, soil maps) Physical properties of cap materials	Standard engineering practices Standard engineering practices Standard engineering practices Qualitative approach Standard engineering practices QA/QC Plan - Standard engineering practices
Leachate Control	Water levels straddling intercept system	Qualitative approach
Leachate Collection and Treatment	Composition Discharge rate (Predictive Modeling - HELP)	Qualitative evaluation of existing data Conservative assumptions and standard engineering practices
Landfill Gas Treatment	Composition Emission rate (Predictive Modeling - LANDFIL2)	Qualitative evaluation of existing data Conservative assumptions and standard engineering practices