5. WORK PLAN RATIONALE

This section presents the rationale for the OU 3-14 RI/FS. Subsection 5.1 presents assumptions and background information used to scope the RI/FS effort in areas including the following:

- Significant changes that have occurred since the OU 3-13 RI/FS was completed
- Integration with parallel programs (i.e., RCRA tank farm closure, operational interfaces, and WAG 3 Group 4 and 5 interfaces)
- TRU waste considerations
- Risk assessment
- Long-term land use planning
- RAOs
- Uncertainties remaining from the OU 3-13 RI/FS
- Overall objectives of the investigation.

Subsection 5.2 presents the development and discussion of DQOs for the OU 3-14 investigation, including a conceptual strategy for the investigation. The decision logic for each component of the field investigation, including known release sites and suspect/abandoned piping, is presented and discussed.

Subsection 5.3 presents the scope defined for Phases I and II of the field investigation and required to implement the decision logic for each investigation component.

5.1 OU 3-13 and OU 3-14 Remedial Investigation/Feasibility Study Assumptions

The purpose of this subsection is to (1) identify assumptions that will be used to bound the data collection effort and (2) the range of potential remedial alternatives that will be considered for tank farm soils. Although some of the principal assumptions remain unchanged from the OU 3-13 RI/FS, some modifications are necessary because of changes in the project's scope and interpretation of new data. The specific assumptions are presented and discussed in the general areas of RAO development, integration with concurrent programs (i.e., RCRA tank farm closure, operational interfaces, and OU 3-13 Group 4 and 5 interfaces), TRU waste considerations, and long-term land use and risk-assessment assumptions.

The primary purpose of the RI/BRA is to determine the risks to human health and the environment from OU 3-14 sources. The primary purpose of the feasibility study is to develop, analyze, and compare appropriate remedial responses that will reduce unacceptable risks to human health and the environment to allowable levels. Unacceptable risks from the tank farm soils identified in the OU 3-13 RI/FS (DOE-ID 1997a) were due to direct exposure to soil contaminants, primarily Cs-137, and to ingestion of groundwater contaminants, primarily Sr-90 and total plutonium. Since the OU 3-13 BRA was performed, the following significant inputs have changed:

1. The CSM has been changed with the addition to the source term of estimates of what the grouted tanks will contain at final closure; and updated information from OU 3-13 Groups 4 and 5 for flow and transport in the vadose zone and SRPA, respectively.

2. The CSM has been revised to locate the nearest future resident at the downgradient ICDF boundary.

3. Post-ROD data from OU 3-13 Groups 3, 4, and 5 have resulted in revised conceptual models for the vadose zone and SRPA, respectively. An integrated INTEC numerical model will incorporate these revisions.

4. The OU 3-14 boundary has changed and includes several additional known release sites.

5. The INTEC injection well (site CPP-23) has been removed from OU 3-14 through the OU 3-13 ROD ESD.

6. The revised conceptual model and the CSM identifying exposure pathways are discussed in Subsection 3.5.

5.1.1 Baseline Risk Assessment Assumptions

An OU 3-14 BRA that incorporates the changes and new information described previously will be prepared. Assumptions for the revised BRA developed to help scope this work plan are as follows:

1. The area-weighted approach used to determine soil exposure risks in the OU 3-13 BRA for the Tank Farm Group will be used for the OU 3-14 BRA to evaluate current and future worker exposure risks. This approach calculated cumulative direct exposure risks for the Tank Farm Group by pooling measurements for individual sites; the approach also evaluated risks for individual sites on an area and concentration-weighted basis. Required data for this approach include the area of the release site as well as a 95% UCL of the mean or maximum concentration. This approach was used successfully for the OU 3-13 Other Surface Soils Group and is, therefore, assumed to still be appropriate for the Tank Farm Group as well.

   This approach requires an estimate of the extent of contamination to calculate the relative risk contribution of an individual release site to the total risk posed by the grouped sites for each exposure pathway. An advantage of this approach is that the relative risk estimates can be used to scale the extent of characterization and remediation required. A disadvantage is that CERCLA risk-assessment calculations do not require detailed knowledge of extent of contamination: however, the feasibility study does require such knowledge. The net effect with respect to the OU-3-14 remedial investigation is minimal, since the extent is adequately known or bounded for most sites. Any further characterization of extent will be primarily focused on sites where contamination has been detected but is not consistent with the conceptual model of the release and, therefore, may indicate a separate, undefined release site. This characterization would also be focused on meeting feasibility study data needs for sites comprising a significant fractional risk of the total Tank Farm Group risk.

2. Risks to the SRPA from tank farm sources to future residents at the downgradient ICDF boundary will be assessed using an approach similar to that for OU 3-13. In that approach, cumulative risks for tank farm soil sites were calculated for the group, and individual release site risks were calculated based on the fraction of the total contaminant mass that was estimated to be present at

the individual site. Future workers are assumed to get their drinking water from a monitored, administratively controlled, uncontaminated, upgradient source.

This approach allows for individual release site contributions to cumulative tank farm groundwater risk to be calculated and used in making decisions about risk mitigation in the feasibility study and ROD. This approach also allows remedial decisions to be made about individual release sites independently.

3. Direct exposure risks calculated in the OU 3-13 BRA for individual release sites, and for the tank farm soils as a group, were accepted as conservative and bounding. However, uncertainties in the nature and extent of contamination were cited in the OU 3-13 ROD as a basis for deferring the tank farm soils to OU 3-14. Uncertainties about the nature and extent of contamination for specific sites, including CPP-20, -25, -28, -31 and -79, were cited in the OU 3-13 BRA (DOE-ID 1997a, Subsection 10.9) as data gaps. Therefore, the focus of the investigation to resolve questions related to the direct exposure risk will be on resolving any disparities between existing and new COPC lists for each site, establishing the extent of contamination in any cases where extent was not adequately established at the time of the OU 3-13 investigation, and resolving significant uncertainties cited in the OU 3-13 ROD or BRA for specific sites.

   The significance of this assumption is that some sites for which risks were calculated in the OU 3-13 BRA might need to be re-evaluated to adequately determine the extent of contamination. This approach also allows remedial decisions to be made about individual release sites independently.

4. The OU 3-14 BRA will use the estimated volumes and compositions at the time of the release and model decay and transport from that time forward, instead of measuring existing composition for use as the source term, for sites for which adequate estimates are available, including CPP-28 and -31, as modified based on results of the field investigation. The field investigation will provide information regarding the extent of contamination and current composition. However, this information will be used more to verify the conceptual models of the releases than to establish volume and composition.

   This assumption may be waived in cases where soil analysis during the field investigation for the tank farm COPCs defined in Section 3 indicate the presence of COPCs not previously analyzed for or detected.

   Using the initial estimated release compositions and volumes reduces the level of rigor required for the field investigation and eliminates the need to determine the extent of contamination that has migrated from the original release to deeper locations in the vadose zone, including basalts and interbeds, thereby focusing the field investigation on the tank farm soils.

5.1.2 Assumptions used to Scope the Feasibility Study Remedy Evaluation

The overall goal of the feasibility study is to provide information required for the defensible selection of a remedial alternative. Assumptions used to scope the OU 3-14 feasibility study remedy evaluation include the following:

1. The general response actions (GRAs) to be evaluated in the OU 3-14 feasibility study include no action, institutional controls, containment (capping), in situ and ex situ treatment, removal, and disposal. Adequate data will be acquired during the field investigation and other studies to support

analysis of alternatives that incorporate representative process options for these GRAs. The feasibility study process is discussed in more detail in Section 6.

2. The scope of the OU 3-14 RI/FS and ROD includes the final remedy for the SRPA within the INTEC security fence line, according to the OU 3-13 ROD (DOE-ID 1999a). In the OU 3-13 feasibility study (DOE-ID 1997b), final remedies evaluated for the SRPA within the INTEC security fence line are assumed to still be adequate, pending completion of the OU 3-14 RI/BRA, and are not discussed further in this work plan. If OU 3-13 remedy evaluations are found to be inadequate, the OU 3-14 feasibility study will further evaluate final remedies for the SRPA within the INTEC security fence line.

3. Quality required for specific feasibility study data needs is established somewhat qualitatively, with the overall goal of (1) producing a defensible feasibility study that can adequately compare alternatives and produce a cost estimate within the -30 to +50% range cited in CERCLA guidance and (2) ultimately allowing for selection of a remedial alternative. The field investigation should focus on assessing "go/no-go" criteria and cost-sensitive parameters associated with specific candidate technologies. These data needs are discussed in subsequent sections for specific technologies.

4. No single remedy is presumed to be applied to the entire Tank Farm Group of release sites or to the entire area of CPP-96. No single remedy can be presumed for reasons that include the following:

    a. Decision-makers may determine that some tank farm soil sites require excavation to meet ARARs or other regulatory agreements, to reduce groundwater risk, or simply because excavation and disposal of soil from small sites make more sense extending a contiguous tank farm cap to include such soil sites.

    b. Some tank farm soil sites that present direct exposure risks do not present groundwater risks and, therefore, would not require an ICDF-type infiltration control cap. Instead, these sites could be covered with a relatively thin, low-permeability layer of soil with a vegetated surface.

    c. No presumptive remedy has been identified for radionuclides in soil, and the EPA has requested that the previously identified GRAs be evaluated. The feasibility study alternatives will be specific for each site and will be integrated for the tank farm as a group.

5.1.3 Long-Term Land Use Assumptions

Occupational land use and government control is the anticipated long-term future land use for the INTEC. This scenario is consistent with CERCLA guidance, future land use plans, requirements for transfer of federal property, and the end-state condition expected for this area.

Future land use assumptions allow the baseline risk assessment and the feasibility study to be focused on developing practicable and cost-effective remedial alternatives. BRAs required under CERCLA and the NCP serve to define the potential effects that releases of hazardous substances might have on individuals or populations under possible future land use scenarios. These alternatives should lead to site activities that are consistent with the reasonably anticipated future land use. Although the NCP recommends that assessments be based on the conservative assumption of future residential use, the NCP also recognizes that such a conservative assumption may not be warranted for sites where residential use is unlikely. In such cases, other land use scenarios may be more appropriate.

Plans for future land use at the INEEL call for most of the developed areas of the site to remain occupational for the 100-year planning period (to 2095). Included in the future land use plan for the INEEL is the assumption that new development will, to the extent practicable, be encouraged in developed facility areas to take advantage of existing infrastructure. Preferred development corridors have been identified as part of the INEEL's facility and land use plans in order to take advantage of existing support infrastructure. Such development will reduce environmental degradation associated with construction activities in previously undeveloped areas. INTEC has an established infrastructure and is located adjacent to the preferred development corridor for the INEEL.

Current land use plans cover a 100-year planning period, but in 2095, INTEC will have experienced nearly 150 years of occupational use. In addition, permanent barrier systems that are designed to prevent future exposure to contaminated soils for up to 1,000 years will exist inside the current INTEC security fence (e.g., CPP-603 and -604/605) (DOE-ID 1999c). The presence of several permanent barrier systems alone, regardless of whether land use restrictions are imposed, will make future residential development of the property inside the INTEC security fence highly unlikely.

In addition to limitations imposed by anticipated physical characteristics on future development, institutional controls will continue to be implemented at the INTEC facility for as long as land use or access restrictions are necessary to maintain protection of human health and the environment. The use of institutional controls beyond 2095 has been established in the OU 3-13 ROD to prevent groundwater consumption by the public and prevent disturbance of the permanent barrier systems until the risks from exposure to contaminated groundwater and soils reaches acceptable levels.

Laws and regulations that govern the transfer of federal land are presented in the *INEEL Sitewide Institutional Controls Plan for CERCLA Response Actions* (DOE-ID 2003e). These will ensure future protection of human health and the environment through required property transfer documentation (e.g., notices, zoning and deed restrictions, and covenants). Because INEEL land was withdrawn in 1949 from the Bureau of Land Management for the NRTS, the land will return to the Bureau of Land Management if no longer needed for the INEEL. An exception to this occurred when land in the northern part of the INEEL was given to Jefferson County for a landfill. Before the land was transferred, however, it was certified by the DOE and EPA to be uncontaminated. Contaminated land that may remain at INTEC will be under government control in perpetuity. Five-year reviews will also continue for sites where contamination has been left in place and is above levels that allow for unlimited use and unrestricted exposure. These reviews will continue until the Agencies determine that the sites no longer pose an unacceptable risk to human health and the environment and site access restrictions or use restrictions are no longer required.

In summary, occupational use beyond 2095 is a reasonably anticipated future land use scenario for the area inside the current INTEC security fence. Requirements for transfer of federal property, CERCLA five-year reviews, institutional controls, and the presence of several designed permanent barrier systems together will make future residential land use highly unlikely and will ensure that unacceptable exposure to soil and groundwater contamination does not occur. Therefore, occupational land use is considered to be protective of human health and the environment beyond the end of the current 100-year land use planning period (2095).

5.1.4 Assumptions for Development of Preliminary Remedial Action Objectives

The primary purpose of the feasibility study is to develop, analyze, and compare appropriate remedial responses that will reduce unacceptable risks to human health and the environment. Remedial alternatives are identified and evaluated, in part, based on their ability to meet the RAOs. The RAOs are clear and specific statements that describe the cleanup goals for a remedial action and are expressed on a media- and contaminant-specific basis.

The assumptions used to develop the RAOs for the OU 3-13 RI/FS and, where necessary, the recommended changes to those assumptions for use in the OU 3-14 RI/FS are listed below. The OU 3-14 RAOs will be defined based in the CSM described in Section 3. They will address soil exposures for current and future workers inside the tank farm security fence and groundwater exposures to future residents located at the downgradient ICDF boundary. These preliminary OU 3-14 RAOs are as follows:

1. Based on the RAOs defined for the SRPA outside the INTEC security fence in the OU 3-13 ROD (DOE 1999a), preliminary RAOS for the SRPA at the ICDF downgradient boundary are defined as follows:

    a. "Prevent current and future on-site workers and general public from ingesting SRPA groundwater that exceeds a cumulative carcinogenic risk of 1×10^{-4}; a total HI [hazard index] of 1; or applicable State of Idaho groundwater quality standards (i.e., MCLs).

    b. In 2095 and beyond, ensure that SRPA groundwater at the downgradient ICDF boundary does not exceed a cumulative carcinogenic risk of 1×10^{-4}; a total HI of 1; or applicable State of Idaho groundwater quality standards (i.e., MCLs)."

    RAO 1a is assumed to be met through institutional controls and monitoring as currently scoped under the SRPA interim remedy defined in the OU 3-13 ROD (DOE-ID 1999a); the SRPA interim remedy is assumed to become an OU 3-14 final remedy component. RAO 1b is assumed to be met by mitigating contaminant flux from the tank farm soils and the closed tank farm.

2. RAOs for the tank farm soils will be developed, by OU 3-14 COC, for direct exposure to current and future workers and for groundwater risk to future residents at the downgradient ICDF boundary.

3. Any potential risks from radionuclides via the air pathway are associated only with remedial actions, and those risks will be addressed and mitigated through engineered controls. A conclusion of the OU 3-13 BRA (DOE-ID 1997a) was that no total excess cancer risks exceed 1E-06 for the air pathway. Additionally, the OU 3-13 ecological risk assessment determined that risks to the environment were within allowable levels. These conclusions are assumed to still apply to OU 3-14, and no further investigations or evaluations will be performed in order to assess exposures to human receptors via the air pathway or in order to assess risks to the environment.

5.1.5 Investigation-Derived Waste Management

Investigation-derived waste (IDW) will be managed in accordance with the OU 3-14 RI/FS waste management plan (see Appendix C). The ICDF will be available to accept IDW that is generated during the tank farm soils investigation and meets the waste acceptance criteria. Additionally, placement will not be triggered by placing OU 3-14 IDW in the ICDF, as stated in the OU 3-13 ROD.

5.1.6 HWMA/RCRA Tank Farm Closure/ CERCLA Transition

For purposes of scoping the RI/FS work plan, the following assumptions are made regarding transition of the HWMA/RCRA closure of the tank system and the CERCLA response for OU 3-14:

1. The NE-ID has ceased use of the five 300,000-gal tanks in pillar and panel vaults and must cease use of the remaining six 300,000-gal tanks by December 31, 2012, as specified in the *Second Modification to Consent Order to the Notice of Noncompliance* (DOE-ID 1998a) (see Table 1-1). The tank farm will continue to operate under interim RCRA status until 2012 while various parts of the tank system are being closed. The final closure of any component of the tank farm will not be complete until all of the tanks have been closed and the OU 3-14 RI/FS is completed (DOE-ID 2001a).

2. Coordination of activities and schedules will be planned and work implemented so that the HWMA/RCRA and CERCLA programs will be able to perform the required activities associated with closure, investigation, and remediation, as applicable.

3. Current planning for HWMA/RCRA closure of the tank farm provides for decontaminating the tanks and tank system, stabilizing the tank residuals in place, and stabilizing the remaining voids in the tanks. The HWMA/RCRA closure program will address contaminated and abandoned piping that is accessible in piping corridors or trenches where excavation is unnecessary.

4. The HWMA/RCRA and CERCLA programs will coordinate their activities to eliminate the duplication of effort that would occur with implementation of multiple-program closure requirements, including post-closure monitoring activities. It is assumed that this duplication will be eliminated by establishing ARARs that specify the standards for the design, installation, and monitoring of any required post-closure activity by CERCLA program.

5. Previously abandoned tank farm waste piping that is not accessible in piping corridors or trenches will be transferred from HWMA/RCRA to CERCLA for evaluation as part of the OU 3-14 RI/FS.

6. The HWMA/RCRA program will identify any requirements associated with documentation of releases of HWMA/RCRA contaminants to the soil as part of the handoff of post-closure activities to CERCLA.

7. The CERCLA feasibility study will consider constraints presented by the presence of the tank farm vaults, piping, buildings, and other infrastructure components in the soil remediation alternatives.

8. HWMA/RCRA post-closure requirements are ARARs for the tank farm soil CERCLA remedial response. Applicability of HWMA/RCRA post-closure requirements as an ARAR will facilitate the handoff of responsibilities from HWMA/RCRA to CERCLA and avoid duplication of activities.

9. Results for residuals remaining after closure of the tank farm will be evaluated during RD/RA to ensure that the final remediation goals and ARARs will be met.

5.1.7 Operational Interfaces

The tank farm is an operating facility with ongoing activities that will continue until final closure. These activities may affect field investigations and remedial activities at the tank farm. Additionally, other INTEC and ICDF operations may affect activities at the tank farm. Assumptions regarding operational interfaces with tank farm field investigation and remedial activities are listed below:

1. Purge water and well water collected as part of the OU 3-14 investigative activities before 2013 will meet the ICDF evaporation pond waste acceptance criteria and will be disposed of at the ICDF evaporation pond.

2. As long as the tank farm is operational, access is required for the following systems: tank risers, sump risers, valve boxes, relief valve pits, condenser pits, the cooling water system, and instrument buildings. Coordination with HLW operations will be needed for the field investigation and remedial activities.

3. Any interim actions or remedial alternatives implemented while the tank farm is operational must ensure that necessary operational access is maintained and load restrictions are not exceeded.

4. All CERCLA remedial actions are required to conform to a safety analysis envelope in accordance with applicable DOE orders.

5. Sites within the tank farm that are currently inaccessible until the facility that is preventing access has undergone DD&D will be coordinated with programs covering HWMA/RCRA, operations, or DD&D, as applicable, for implementation of final remediation.

6. The HWMA/RCRA closure and DD&D may include options that would preclude a potential future removal of underlying contaminated soil, e.g., entombment of portions of the tank farm facility. For operating facilities, any activity that may disturb a CERCLA site before CERCLA remediation will be controlled by CERCLA site disturbance notification procedures.

5.2 OU 3-14 Data Quality Objectives

This subsection documents the systematic planning of data collection activities required to support the OU 3-14 RI/FS. The overall objectives of the RI/FS are to determine (1) whether releases from tank farm piping to the soils result in risks exceeding allowable levels for possible future receptors identified in the CSM (see Section 3) and (2) which remedial alternatives best meet evaluation criteria in the event that risks exceed allowable levels. The DQO process is used to identify specific data that are required in order to meet these overall objectives and to identify the scope of the remedial investigation that will be done to provide the required data. Specific data gaps relate to the nature and extent of contamination in the soils, the migration of contaminants through the soils to groundwater, and the effectiveness, technical feasibility, and cost of potential remedial technologies.

The approach used for this project is based on the EPA DQO process. The current DQO process (EPA 2000a, 2000b) is based on the Scientific Method and provides a systematic approach to planning environmental data acquisition and decision-making. In this subsection, PSQs, required decision inputs, study boundaries, and other factors necessary to plan an efficient field investigation are specified.

The development of DQOs is an iterative process that includes participation by NE-ID, EPA Region 10, and IDEQ. DQOs may also be revised in response to new site data collected during initial investigations and/or change in work scope. The DQO process comprises seven steps:

1. *State the problem,* wherein the problem to be resolved by the data collection activity is sufficiently defined that the focus of the study will be unambiguous.

2. *Identify the decision,* wherein the PSQ that the study will try to resolve is defined. An output of this step is a decision statement that links the PSQ to possible actions that will solve the problem.

3. *Identify inputs to the decision,* the informational inputs required to resolve the decision statement are identified and the inputs that require environmental measurements are determined.

4. *Define the study boundaries,* wherein the spatial and temporal boundaries of the problem are defined.

5. *Develop a decision rule*, wherein the environmental measurement parameter of interest, the action level, and the inputs from previous steps are formulated in a single statement that describes a logical basis for choosing among alternative actions. An output of this step is an "if/then" statement that defines conditions that would cause the decision-maker to choose among alternative actions.

6. *Specify limits on decision errors*, wherein the decision-makers' tolerable limits on decision errors are used to establish performance goals for the data collection design.

7. *Optimize the design for obtaining data*, wherein an efficient strategy for obtaining data that satisfy the DQOs is identified.

Each DQO step for the tank farm soil field investigation is discussed in Subsections 5.2.1 through 5.2.7. The output of the steps is summarized in Table 5-1.

5.2.1 Problem Statement

5.2.1.1 Unresolved Issues in the OU 3-13 RI/FS. As discussed in Section 1, the OU 3-14 RI/FS is being conducted because unresolved issues in the OU 3-13 RI/FS (DOE-ID 1997a, 1997b) prevented development of a final remediation plan for the tank farm soils, specifically sites CPP-15, -16, -20, -24, -25, -26, -27/33, -28, -30, -31, -32E/W, -58, and -79. The unresolved issues remaining from OU 3-13 were discussed in Section 3 and are summarized below.

5.2.1.1.1 BRA Issues. The OU 3-13 ROD cited uncertainties in the nature and extent of contamination as contributing to the deferral of the tank farm soils to OU 3-14. The OU 3-13 RI/FS further identified lack of definitive data on the lateral and vertical extent of contamination at specific sites as significant uncertainties. At sites CPP-20 and -25, no samples were collected as part of prior investigations, and instead data from previously excavated tank farm soil were used to estimate contaminant concentrations. This was believed to overestimate the contaminant source, because these sites were at least partially excavated and backfilled with relatively clean soil.

At sites CPP-28 and -79, conservative bounding calculations were used to estimate the amounts of released liquids. While these calculations were believed to be conservative and to overestimate the volumes released, since they were not verified through soil sampling, the OU 3-13 BRA concluded that it is possible that the calculations underestimated or overestimated the volumes released. However, further evaluation of existing information discussed in Section 3 indicates that the CPP-28 release was overestimated in the OU 3-13 BRA and that the deep contamination at CPP-79 originated from a different source than CPP-28 or CPP-79-Shallow.

At sites CPP-28 and -31, the potential presence of nonradionuclide COPCs was identified as a data gap but was considered to contribute a relatively small underestimation of risk, given that the radionuclides are almost certainly present in much larger concentrations.

Overall uncertainties about the nature and extent of contamination in direct exposure risks were not believed to be significant, because, as described in Subsection 3.4.1, the magnitude of risk from surface exposure is large enough that the addition of small sites containing less than 1% of the tank farm inventory of radionuclides will not significantly affect this risk pathway. In addition, because the risk is well above the levels that drive remediation, further refinement of this risk will not be meaningful for the tank farm soils as a group. However, as stated in Section 5.1, risks and remedial alternatives must be

Table 5-1. Summary of DQO Steps 1 through 7 outputs.

	2: Identify the Decision			3: Identify Inputs to the Decision	4: Define the Study Boundaries
1: State the Problem	Principal Study Questions	Alternative Actions	Decision Statement		
Problem Statement: Soils at the INTEC tank farm are contaminated from historical spills and releases. Investigations to date are described in the OU 3-13 RI/BRA and in the OU 3-14 work plan. Data gaps and uncertainties that led to deferral of the tank farm soil remedy decisions cited in the OU 3-13 ROD included the following: - Nature and extent of tank farm contamination - Presence of nonradionuclide contaminants - Uncertainty in source term estimates—including the volume, mass and content—and in the interaction of the contaminant with the soil and basalt, parameterized as the distribution coefficient or K_d - Coordination with tank closures. These data are required to evaluate risks presented by, and remedial alternatives for, the tank farm soils. The primary exposure routes of concern based on current land use include the current and future workers and the residents at the downgradient ICDF boundary. The groundwater contaminant source term, based on process knowledge, operating records, and past investigations, is believed to conservatively bound the COPC masses and activities released. The OU 3-14 BRA will provide the estimated volumes and compositions at the time of the release for groundwater modeling, where estimates are available, including CPP-28 and -31, as modified based on results of the OU 3-14 field investigation. The OU 3-14 remedial investigation will focus on resolving data gaps and uncertainties identified in the OU 3-13 ROD. Additionally, site-specific flow and contaminant transport parameters will be determined and used in a revised OU 3-14 BRA. The revised BRA will include COPC release rates from the cleaned and closed tank farm tanks and piping. The COPCs, risk-based action levels, contaminant types, locations and dimensions of soils contaminated at levels above risk-based action levels, dose rates, and contaminant migration potential from the site need to be estimated for future remedial actions. COPCs and risk-based action levels will be identified using the current CSM that identifies exposure scenarios based on current understanding of future land use. Additional data types are required to assess specific candidate general response actions including: - No Action - Institutional controls - Containment - Removal - Treatment (in situ and ex situ) - Disposal. The OU 3-14 remedial investigation will be designed to cost-effectively collect the required data at the required quality levels.	PSQ-1: What are the risks resulting from exposure to contaminated soils by future workers at known release sites?	A. Control the soil exposure pathway if risks to future workers exceed allowable levels. B. If risks do not exceed allowable levels, control of the soil exposure pathway is not required based on risk.	DS-1: Determine whether concentrations of COPCs in tank farm soils exceed risk-based action levels, requiring control of the exposure pathway.	Location and depth of contaminated soils. 95% UCL or maximum contaminant concentrations by release site. Surface area and/or volume of exposed soil per release site and exposure scenario.	*Operational boundaries:* Ongoing activities in the tank farm area that may affect the study are listed chronologically through FY 2006: FY-04–FY-06: Tanks in the tank farm will be cleaned and closed. FY-04: Infiltration barriers will be installed over CPP-28, -31, and -79 as part of the TFIA. *Spatial boundaries:* The physical boundaries of the study include known soil release sites CPP-15, -16, -24, -25, -28, -30, -31, -32, and -79. Most of the contamination released is likely retained in the alluvial soils, averaging about 45 ft in depth. *Schedule boundaries*: The overall schedule is affected by the necessary integration with OU 3-13 Groups 4 and 5 and with the tank closure activities listed above. The overall project schedule is shown in Section 7 of this work plan.
	PSQ-2: What are the risks to future residents at the downgradient ICDF boundary resulting from COPC flux from known release sites to the SRPA?	A. Control the groundwater exposure pathway if risks to future residents exceed allowable levels. B. If risks do not exceed allowable levels, control of the groundwater exposure pathway is not required based on risk.	DS-2: Determine whether contaminants are transported out of the tank farm soils to the SRPA at rates sufficient to result in COPC concentrations exceeding allowable levels at the downgradient ICDF boundary, requiring control of the exposure pathway.	*Verify Conceptual Model for Release* Verify OU 3-13 conceptual model of releases at CPP-28, -79 and -31. Verify source term. *Infiltration Measurements* Spatially and temporally variable matric potential (tensiometer monitoring). Spatially and temporally variable water content (neutron access tube monitoring). *Water Balance* Perched water and source water chemistry. Time series perched water elevations. Flow metering anthropogenic sources. Flow gauging the Big Lost River. *Sorption Studies* K_d values for alluvium, interbed sediments and basalt. Solution (pore water) chemistry (Eh, pH, dissolved minerals, etc.). Atmospheric (soil gas) chemistry. Contaminant oxidation state (as applicable). Soil properties (mineralogy, gradation). Contaminant concentrations.	
	PSQ-3a: If BRA results show risks to future workers or residents exceeding allowable levels, does a remedial alternative that includes containment (capping) best meet feasibility study evaluation criteria to mitigate excess risks relative to other alternatives?	A. A remedial alternative involving capping best meets feasibility study evaluation criteria relative to other remedial alternatives. B. A remedial alternative involving capping does not best meet feasibility study evaluation criteria relative to other remedial alternatives.	DS-3c: Determine whether a remedial alternative that includes capping best meets feasibility study evaluation criteria to mitigate excess risks relative to other remedial alternatives.	Surface area of exposed soil to be capped per release site (±50%). Total surface area to be capped for Tank Farm Group. Surface interferences. Results of the feasibility study detailed analysis.	
	PSQ-3d: If BRA results show risks to future workers or residents exceeding allowable levels, does a remedial alternative that includes removal best meet feasibility study evaluation criteria to mitigate excess risks relative to other alternatives?	A. A remedial alternative involving removal best meets feasibility study evaluation criteria relative to other remedial alternatives. B. A remedial alternative involving removal does not best meet feasibility study evaluation criteria relative to other remedial alternatives.	DS-3c: Determine whether a remedial alternative that includes removal best meets feasibility study evaluation criteria to mitigate excess risks relative to other remedial alternatives.	Volume of soil requiring retrieval per release site (+- 50%). Locations of retrieval areas (+- 50%). Radiation exposure potential. Surface and subsurface interferences. Results of the feasibility study detailed analysis.	
	PSQ-3e: If BRA results show risks to future workers or residents exceeding allowable levels, does a remedial alternative that includes treatment (either in situ or ex situ) best meet feasibility study evaluation criteria to mitigate excess risks relative to other alternatives?	A. A remedial alternative involving treatment best meets feasibility study evaluation criteria relative to other remedial alternatives. B. A remedial alternative involving treatment does not best meet feasibility study evaluation criteria relative to other remedial alternatives.	DS-3c: Determine whether or not a remedial alternative that includes treatment best meets feasibility study evaluation criteria to mitigate excess risks relative to other remedial alternatives.	Volume of soil requiring treatment per release site (±50%). Locations of treatment areas (±50%). Physical properties of treatment areas (soil type, density, gradation, hydraulic conductivity). Geochemical properties of treatment areas (pH, Eh, mineralogy, pore water chemistry). Maximum COPC concentrations. Radiation exposure potential from grout returns/drill cuttings. Surface and subsurface interferences. Results of the feasibility study detailed analysis.	
	PSQ-3f: If BRA results show risks to future workers or residents exceeding allowable levels, does a remedial alternative that includes disposal best meet feasibility study evaluation criteria to mitigate excess risks relative to other alternatives?	A. A remedial alternative involving disposal best meets feasibility study evaluation criteria relative to other remedial alternatives. B. A remedial alternative involving disposal does not best meet feasibility study evaluation criteria relative to other remedial alternatives.	DS-3c: Determine whether a remedial alternative that includes disposal best meets feasibility study evaluation criteria to mitigate excess risks relative to other remedial alternatives.	Total waste volume per site (based on volumes to be retrieved). Average COPC concentrations for retrieval areas. Maximum gamma activity per site (i.e., remote-handled?). TRU isotope concentrations for retrieval areas. Preliminary listed waste determination per site. External exposure hazards during transport/treatment/disposal. Results of the feasibility study detailed analysis.	

Table 5-1. (continued).

<table>
<tr><th>5: Develop a Decision Rule</th><th>6: Specify Tolerable Limits on Decision Errors</th><th>7: Optimize the Design</th></tr>
<tr><td>DR-1: If 95% UCL or maximum COPC concentrations, whichever is less, in the upper 4 ft for each identified release site exceed(s) the 1E-04 occupational 100-year RBCs, then the exposure pathway requires control. If RBCs are not exceeded, control of the exposure pathway is not required based on risk.</td><td rowspan="5">Data collected to determine whether contaminants in the tank farm soil are present at concentration levels equal to or greater than risk-based action levels (DS-1) are amenable to statistically based limits on decision errors. Hypothesis testing will be utilized to determine if action levels are exceeded to resolve PSQ-1.

The null hypothesis, H_0, is that the true mean of a contaminant is greater than or equal to the risk-based action level. The alternative is that the true mean is less than the risk-based action level.

H_0: $\mu \geq$ action level

H_a: $\mu <$ action level

The hypothesis testing will be performed to a level of significance, α, of 0.05. In other words, with this level of significance, we limit the probability of a Type I error or of rejecting the null hypothesis, when it is true, to 5%. The hypothesis testing is designed to allow control of the probability of erroneously concluding that action levels are not exceeded when in fact they are exceeded. The null hypothesis was formulated based on the belief that the harmful consequences of incorrectly concluding that an action level is not exceeded when it actually is exceeded outweigh the consequences of incorrectly concluding that the action level is exceeded when in fact it is not.

Statistically based decision errors are not appropriate for DR-2 and DR-3a through -3f.</td><td rowspan="5">Decision logic will be developed to define the investigation strategy for each known release site. The field investigation is planned in two phases.

Phase I includes the following:
1. Completing evaluation of all existing information for borehole locations and historical gamma logging results, sampling locations, extent of excavations and backfill.
2. Gamma logging existing usable boreholes in cases where historical data have been lost or when logging meets defined site-specific data needs.
3. Based on the results of 1 and 2, and on locations of tank farm infrastructure, determine specific locations for boreholes required to meet site-specific data needs identified in Appendix D.
4. Gamma logging new probeholes.
5. Logging existing neutron probe access boreholes to monitor soil moisture flux.

Phase II includes the following:
1. Collecting samples for K_d studies for any media not available in archived cores or soils.
2. Collecting samples for chemical analysis.
3. Installing boreholes and collecting samples to resolve any data gaps remaining after the Phase I investigation.

Dynamic work plans that allow the field team leader some discretion in adding, deleting, or changing sampling locations will be used for both phases to allow for presence of infrastructure or to investigate detections of unexpected or otherwise anomalous contamination.</td></tr>
<tr><td>DR-2: If COPC concentrations at the residential receptor location at the ICDF downgradient boundary exceed the SRPA RAOs, then control of the groundwater exposure pathway is required. Otherwise, if future risk is in an acceptable range, then control of the groundwater exposure pathway is not required based on risk.</td></tr>
<tr><td>DR-3a: If a remedial alternative that includes containment best meets feasibility study evaluation criteria to mitigate excess risks at known release sites, then identify that alternative as the highest-ranking. If not, identify another alternative as highest-ranking.</td></tr>
<tr><td>DR-3b: If a remedial alternative that includes retrieval best meets feasibility study evaluation criteria to mitigate excess risks at known release sites, then identify that alternative as the highest-ranking. If not, identify another alternative as highest-ranking.</td></tr>
<tr><td>DR-3c: If a remedial alternative that includes treatment best meets feasibility study evaluation criteria to mitigate excess risks at known release sites, then identify that alternative as the highest-ranking. If not, identify another alternative as highest-ranking.</td></tr>
</table>

evaluated for individual sites, so the nature and extent of contamination, as well as other BRA and feasibility study data needs, must be determined adequately for individual sites.

The OU 3-13 ROD also identified "interaction of the contaminant with the soil and basalt, parameterized as the distribution coefficient or K_d" as another basis for deferring the tank farm soils from OU 3-13 to OU 3-14. K_ds for COCs, including Sr-90 and Pu-239/240, used in the OU 3-13 were extremely conservative and were based on literature review only, not direct measurements of values for INTEC media. Additional K_d data for Sr-90 in INTEC media have been obtained since the OU 3-13 BRA modeling, and additional K_d data have been obtained for plutonium from studies on Radioactive Waste Management Complex soils, from the literature, and from inference by the poor match between predicted plutonium in the perched water and actual concentrations. The impact of K_d on the transport time for Sr-90 is significant, because the half-life of Sr-90 (30 years) is relatively short, and the amount of Sr-90 modeled to be in the SRPA can vary by orders of magnitude with small changes in the K_d due to the combination of decay and travel time. The impact of K_d on the transport time of Pu-239/240 is significant, because the modeled risk from plutonium is within an order of magnitude of acceptable risk. The K_d used in OU 3-13 was 1 to 3 orders of magnitude smaller than the K_d used for vadose zone transport at other INEEL OUs.

5.2.1.1.2 Feasibility Study Issues. Uncertainties related to feasibility study issues were also identified in the OU 3-13 ROD. These uncertainties include the nature and extent of contamination that might require excavation or treatment, and they include process-specific information for candidate treatment technologies. Specific uncertainties related to the formulation and analysis of remedial alternatives for tank farm soils cited in the OU 3-13 feasibility study (DOE-ID 1997b, Subsection 6.4.1.1) include the following:

- "The distribution, quantities, and concentrations of contaminants, especially plutonium, in the tank farm soils are poorly known. Plutonium from the Tank Farm soil is predicted to impact the SRPA at a future time."

- "The limited characterization performed at the Tank Farm does not provide sufficient data concerning the contaminated soil volumes that require remediation. The surface soils surrounding the tanks that were not identified as specific release sites during the RI [remedial investigation] are assumed to be contaminated and may require remediation. The estimated volume of these additional soils is approximately 110,660 yd^3. The total volume of contaminated soils at the Tank Farm is estimated at 146,275 yd^3."

- "The percentage of the soil waste types requiring remediation is also not known. Process knowledge suggests that low- and high-activity LLW [low-level waste], mixed waste (including suspected listed hazardous constituents), and TRU wastes may be present at the Tank Farm."

- "The availability of appropriate on- or off-site waste disposal facilities, especially for the potential volume of TRU waste soils, may be limited."

- "Because of the potentially high radiation fields in surface soils at the tank farm, the soils may require remote excavation and treatment. Although the proposed remediation technologies have been demonstrated individually, the integrated, remote use of the proposed excavation and treatment technologies has not been demonstrated to date."

- Since the OU 3-13 feasibility study was published, uncertainties regarding the regulatory status of tank farm contaminated soils, e.g., RCRA-hazardous, mixed, and TRU, and effects on dispositioning if excavated, have been further identified as having very significant effects on cost and feasibility of remedial alternatives. Other significant uncertainties include locations, volumes and characteristics of hot spots related to evaluation of in situ treatment or excavation and ex situ treatment.

5.2.1.2 Conceptual Site Model. The CSM provided in Subsection 3.5 identifies exposure routes for the tank farm soils and includes external radiation exposure, ingestion, inhalation, and dermal exposure to current (incomplete exposure routes due to administrative controls) and hypothetical future workers after 2095 (potentially complete exposure routes). The CSM also includes leaching and transport of contaminants to the SRPA, from which hypothetical future residential groundwater users could consume contaminated groundwater after 2095 (potentially complete exposure routes). Figure 3-38 shows schematically the sources, release mechanisms, exposure pathways, and receptors that compose the tank farm soil exposure pathway conceptual model. This exposure pathway conceptual model and the data gaps discussed previously provide the basis for identifying the tank farm soil PSQs.

5.2.1.3 Contaminant Release Sites Under Investigation. The known release sites at the tank farm were discussed in Section 3. They consist of CPP-15, -16, -20, -24, -25, -26, -27/33, -28, -30, -31, -32, -33, -58, and -79. These sites and the interstitial soils between them are cumulatively known as site CPP-96. In addition to the known release sites, specific types or configurations of liquid waste system process transfer piping that leaked in the past will be investigated. These are also discussed in Section 3.

5.2.1.4 Contaminants of Potential Concern. COPCs for this investigation are identified and discussed in Section 3.

5.2.2 Decision Statements

In the second step of the DQO process, specific topics of investigation are derived from the problem description. This is done by defining PSQs, alternative actions, and resulting decision statements that must be answered to effectively address the above stated problem. This process is summarized in Table 5-2 and discussed in detail below.

The purpose of the PSQ is to identify key unknown conditions or unresolved issues that, when answered, provide a solution to the problem being investigated. The PSQs derived from the CSM can be summarized as follows:

- For each exposure pathway, what are the risks?
- If risks for a specific exposure pathway exceed allowable levels, which alternative best meets feasibility study evaluation criteria?

The PSQs, as for the DQO process itself, specifically address issues that require environmental data to resolve. Questions that are strictly programmatic in nature are excluded from this analysis.

Alternative actions are those possible actions that could be taken to resolve the problem statements. Alternative actions are taken only as a result of resolving the PSQ; they are not taken to resolve the PSQ. Decision statements simply combine the PSQ and associated alternative action into a concise statement of action.

The severity of consequences of making an incorrect decision (i.e., determining that risks resulting from an exposure pathway at a specific release site do not exceed allowable levels, when in fact they do, or determining that risks do exceed allowable levels when in fact they do not) will be based in part on consideration of the estimated percentage of total tank farm soil radionuclides released that are present at

Table 5-2. Summary of DQO Step 2 information.

PSQ-AA[a] #	Alternative Action	Consequences of Erroneous Actions	Severity of Consequences
PSQ-1: *What are the risks resulting from exposure to contaminated soils to future workers at known release sites?*			
1-1	Control the exposure pathway if soil exposure risks exceed allowable levels.	The site may be inappropriately remediated, resulting in unnecessary expenditure of funds.	Low. There would be additional costs. No long-term risks to human health or the environment exist. Some increased risk to remedial action workers exists, but the risk is mitigated by radiation control and safe work practices.
1-2	If soil exposure risks do not exceed allowable levels, control of the exposure pathway is not required based on risk.	The site may be inappropriately closed without remedial action, increasing risks of potential exposure to future workers.	Low. Additional samples can be collected in the post-ROD confirmatory sampling phase to support the decision if required.
Decision Statement 1— Determine whether concentrations of COPCs in tank farm soils exceed risk-based action levels, requiring control of the exposure pathway.			
PSQ-2: *What are the risks to future residents resulting from COPC flux from known release sites to the SRPA?*			
2-1	Control the exposure pathway if predicted COPC concentrations in the SRPA at the exposure point exceed allowable levels.	The site may be inappropriately remediated, resulting in unnecessary expenditure of funds.	Low, due to the additional costs. No long-term risks to human health or environment exist. Some increased risk to remedial action workers exists, but the risk is mitigated by radiation control and safe work practices.
2-2	If COPC concentrations in the SRPA at the exposure point do not exceed allowable levels, control of the exposure pathway is not required based on risk.	The site may be inappropriately closed without remedial action, increasing risks of potential exposure for future workers and/or residents.	Low to moderate. The groundwater pathway modeling and risk assessment are conducted to provide conservative estimates of potential future risk. Five-year reviews and other post-ROD monitoring that will likely be required will reduce the likelihood of exposures above allowable levels.
Decision Statement 2—Determine whether contaminants are transported out of the tank farm soils to the SRPA at rates sufficient to result in COPC concentrations exceeding allowable levels at the downgradient ICDF boundary, requiring control of the exposure pathway.			

Table 5-2. (continued).

PSQ-AA[a] #	Alternative Action	Consequences of Erroneous Actions	Severity of Consequences
PSQ-3: *If soil exposure risks at known release sites exceed allowable levels, or if BRA results show groundwater risks exceeding allowable levels, does a remedial alternative that includes [General Response Action] best meet feasibility study evaluation criteria to mitigate excess risks relative to other alternatives?*			
3-1	A remedial action including [General Response Action] best meets screening/detailed evaluation criteria relative to other remedial actions.	Inappropriate or inadequate remedial alternatives could be evaluated favorably in the feasibility study and implemented during the remedial action phase.	Low to moderate. Additional confirmatory sampling during the remedial action phase will limit the consequences. Contingent remedies or ROD amendments can identify alternative remedies if sampling during the remedial action reveals unanticipated conditions.
3-2	A remedial action including [General Response Action] does not best meet threshold criteria relative to other alternatives.	Inappropriate or inadequate remedial alternatives could be evaluated favorably in the feasibility study and implemented during the remedial action phase.	Low to moderate. Additional confirmatory sampling during the remedial action phase will limit the consequences. Contingent remedies or ROD amendments can identify alternative remedies if sampling during remedial action reveals unanticipated conditions.
Decision Statement 3—Determine whether a remedial action that includes [General Response Action] best meets feasibility study evaluation criteria to mitigate excess risks relative to other alternatives.			
a. AA – alternative action.			

a specific site. This evaluation of severity will help to determine the appropriate level of rigor required in DQO Step 6–Specify Tolerable Limits on decision errors. For example, specific sites estimated to have contained less than 1% of the cumulative release inventory for the Tank Farm Group at the time of release will require less investigation rigor to resolve DS-2 than sites that contain higher percentages. This approach is based on results of the OU 3-13 BRA, which predicted a cumulative groundwater risk of 5E-05 from all sources to future residents outside of the current INTEC security fence in 2095 and beyond; this risk is within allowable levels. Sites that comprise less than 1% of the source term producing this marginal risk, therefore, merit less investigation rigor to resolve DS-2.

The individual PSQs, alternative actions, and resulting decision statements are discussed below.

5.2.2.1 Principal Study Question 1

PSQ-1: What are the risks resulting from exposure to contaminated soils to future workers at known release sites?

PSQ-1 addresses the RI/BRA need to estimate future risk from the soil exposure pathways of the CSM. In the RI/BRA, investigators will assess the risk posed to hypothetical future workers at individual release sites across the tank farm, as well as cumulatively for the Tank Farm Group, and make a determination of whether the potential risk exceeds allowable levels (e.g., carcinogenic risk of 1E-4 or hazard index of 1). Current EPA RBCs for contaminants including radionuclides in soils can be used for these determinations for the future occupational scenario. PRGs from the previous OU 3-13 ROD are based on residential scenarios and will, therefore, not be used.

Alternative actions for PSQ-1 are (1) control the exposure pathway if COPC concentrations exceed risk-based action levels, or (2) if COPC concentrations do not exceed risk-based action levels, control of the exposure pathway is not required based on risk. The resulting decision statement is: Determine whether concentrations of COPCs in tank farm soils exceed risk-based action levels, requiring control of the exposure pathway.

5.2.2.2 Principal Study Question 2

PSQ-2: What are the risks to future residents at the downgradient ICDF boundary from COPC flux from known release sites to the SRPA?

PSQ-2 addresses the RI/BRA need to estimate future risk via the groundwater exposure pathway of the CSM. Information regarding the contaminant source term will be compiled and input to a detailed numerical model to calculate contaminant concentrations in the SRPA at the downgradient ICDF boundary as a function of time. These results will be used to estimate potential risk to future groundwater users. As discussed in detail in Subsection 5.2.3, investigators will require a variety of data types to resolve this question, including detailed information on the contaminant source term and a number of flow and transport parameters.

Alternative actions for PSQ-2 are (1) control the exposure pathway if predicted COPC concentrations in the SRPA at the exposure point exceed allowable levels, or (2) if COPC concentrations in the SRPA at the exposure point do not exceed allowable levels, control of the exposure pathway is not required based on risk. The resulting decision statement is: Determine whether contaminants are transported out of the tank farm soils to the SRPA at rates sufficient to result in COPC concentrations exceeding allowable levels at the exposure point, requiring control of the exposure pathway.

5.2.2.3 Principal Study Question 3

PSQ-3: If COPC concentrations at known release sites exceed risk-based action levels for soil exposures, or if BRA results show risks exceeding allowable levels for groundwater ingestion, does a remedial alternative that includes [General Response Action] best meet feasibility study evaluation criteria to mitigate excess risks relative to other alternatives?

PSQ-3 addresses the need to obtain information specific to each candidate GRA in order to complete the detailed and comparative analyses of alternatives in the feasibility study. Four GRAs have been identified for investigation (excluding the no action and institutional controls alternatives, which have no specific study questions or data needs beyond those identified for PSQs 1 and 2). These consist of containment (capping), retrieval (excavation), treatment (in situ or ex situ), and disposal. PSQ-3 will be addressed for each of these four GRAs. Information obtained in response to PSQ-3 will be used by authors of the feasibility study as they evaluate and rank individual alternatives.

Alternative actions for PSQ-3 are (1) a remedial alternative including [GRA] best meets screening/detailed evaluation criteria relative to other remedial alternatives, or (2) a remedial alternative including [GRA] does not best meet threshold criteria relative to other remedial alternatives. The resulting decision statement is: Determine whether a remedial action that includes [General Response Action] best meets feasibility study evaluation criteria to mitigate excess risks relative to other alternatives.

Because these DQOs are being written to support the planning phase of an RI/FS investigation, the alternative actions and subsequent decision statements are not directly related to the selection of one alternative or another, but rather, the results of the DQOs will be input to the CERLA feasibility study evaluation process to support the analysis of a number of candidate remedial alternatives. Table 5-2 summarizes the PSQs, alternative actions, consequences, severity, and decision statements.

5.2.3 Identify Decision Inputs

The objective of this step is to identify the decision inputs that will be required to resolve the PSQs and decision statements identified in Step 2 and determine which inputs require environmental measurements. Decision inputs are summarized in Table 5-3 and discussed in detail below.

Table 5-3. Summary of decision inputs required to resolve the PSQs.

PSQ	Required Data	Available Data	Remaining Data Needs
PSQ-1	**Exposure Data**		
	Contaminant concentrations at individual release sites	Field radiation measurements, known-release-site sample results, and process knowledge	See Appendix D for site-specific data needs
	Extent of contamination above PRGs at individual release sites	Field radiation measurements and known-release-site sample results	See Appendix D for site-specific data needs
PSQ-2	**Source Term**		
	Verification of OU 3-13 conceptual model of releases at CPP-28, -79-Deep, and -31	Process knowledge, field radiation measurements, and sample results from CPP-28, -79-Deep, and -31	See Appendix D for site-specific data needs
	Verification of source term	Process knowledge, field radiation measurements, and known-release-site sample results	See Appendix D for site-specific data needs
	Infiltration Rates		
	Site specific moisture content	Radioactive Waste Management Complex neutron probe studies INTEC neutron probe studies (Westinghouse) Existing data to be compiled and evaluated as part of the Phase I remedial investigation	Neutron probe access tube (NPATs) measurements over at least one wet/dry climatic cycle across tank farm; existing NPATs may be used for measurements
	Site specific matric potential	Existing data to be compiled and evaluated as part of the Phase I remedial investigation	Installation and monitoring of tensiometers over at least one wet/dry climatic cycle at various locations across tank farm

Table 5-3. (continued).

PSQ	Required Data	Available Data	Remaining Data Needs
	Water Balance		
	Perched water and source water chemistry	Existing data to be compiled and evaluated as part of the Phase I remedial investigation	Group 4 monitoring report and decision summary (MRDS)
	Time series of perched water elevations	Existing data to be compiled and evaluated as part of the Phase I remedial investigation	Group 4 MRDS report
	Inventory of anthropogenic water sources in northern INTEC	Existing data to be compiled and evaluated as part of the Phase I investigation	No additional data required
	Flow metering distribution lines	Existing data to be compiled and evaluated as part of the Phase I remedial investigation	No additional data required
	Flow gauging the Big Lost River	Existing data to be compiled and evaluated as part of the Phase I remedial investigation	Measurement of Big Lost River flows at INTEC over at least one wet/dry climatic cycle
	Moisture monitoring in vadose zone in northern INTEC	Existing data to be compiled and evaluated as part of the Phase I remedial investigation.	Installation and monitoring of NPATs and tensiometers to observe wetting fronts in the vadose zone from the Big Lost River over at least one wet/dry climatic cycle
	Sorption (k_d) Studies		
	Solution chemistry (e.g., Eh, pH, and dissolved minerals)	Existing data to be compiled and evaluated as part of the Phase I remedial investigation	To be determined pending results of Phase I existing data evaluation
	Atmospheric chemistry (e.g., soil gas O_2 and CO_2)	Existing data to be compiled and evaluated as part of the Phase I remedial investigation	To be determined pending results of Phase I existing data evaluation
	Contaminant oxidation state	Existing data to be compiled and evaluated as part of the Phase I remedial investigation	To be determined pending results of Phase I existing data evaluation
	Soil mineralogy	Existing data to be compiled and evaluated as part of the Phase I remedial investigation Archived interbed cores Archived alluvium samples	To be determined pending results of Phase I existing data evaluation

Table 5-3. (continued).

PSQ	Required Data	Available Data	Remaining Data Needs
	Particle size	Existing data to be compiled and evaluated as part of the Phase I remedial investigation Archived interbed cores Archived alluvium samples	To be determined pending results of Phase I existing data evaluation
	Contaminant concentrations	Existing data to be compiled and evaluated as part of the Phase I remedial investigation Archived interbed cores Archived alluvium samples	To be determined pending results of Phase I existing data evaluation
	K_d values	Existing Sr-90 studies on INTEC soils Other literature values Existing data to be compiled and evaluated as part of the Phase I remedial investigation	Batch and column tests on alluvium, interbed, and basalt samples
PSQ-3a: Containment	Extent of area requiring capping	As cited in Section 3	See Appendix D for site-specific data needs
	Subsidence potential in the tank farm area	Existing data to be compiled and evaluated as part of the feasibility study	None required
	Interferences with surface structures	Existing data to be compiled and evaluated as part of the feasibility study	None required
PSQ-3b: Retrieval	Extent of soil exceeding risk-based action levels for direct exposure pathway	Field radiation measurements and sample results from known release sites	See Appendix D for site-specific data needs
	Extent of soil exceeding risk-based action levels for groundwater pathway	Field radiation measurements and sample results from known release sites	See Appendix D for site-specific data needs
	Implementability of equipment/methodology	Past tank farm soil removal/construction work Existing data to be compiled and evaluated as part of the feasibility study	None required
	Radiation exposure potential from soil-handling activities (maximum R/hr of soils in potential retrieval areas)	Past tank farm soil removal/construction work Past borehole logging Existing data to be compiled and evaluated as part of the remedial investigation	None required

Table 5-3. (continued).

PSQ	Required Data	Available Data	Remaining Data Needs
PSQ-3c: Treatment	Extent of soil exceeding risk-based action levels for direct exposure pathway	As cited in Section 3	See Appendix D for site-specific data needs
	Extent of soil exceeding risk-based action levels for groundwater pathway	As cited in Section 3	See Appendix D for site-specific data needs
	Density and hydraulic conductivity of soils in release areas	Existing data to be compiled and evaluated as part of the remedial investigation	To be determined pending results of existing data evaluation
	pH and Eh of soils in release areas	Existing data to be compiled and evaluated as part of the remedial investigation	To be determined pending results of existing data evaluation
	Proximity of subsurface structures to release areas requiring treatment	Existing data to be compiled and evaluated as part of the feasibility study	To be determined pending results of existing data evaluation
	Implementability of equipment/techniques	Past grouting work industry and DOE Existing data to be compiled and evaluated as part of the feasibility study	To be determined pending results of existing data evaluation
	Radiation exposure potential from grout returns at surface (maximum R/hr of soils in potential treatment areas)	Existing data to be compiled and evaluated as part of the feasibility study	To be determined pending results of existing data evaluation
	Occupational safety hazards/mitigation	Past grouting work industry and DOE Existing data to be compiled and evaluated as part of the feasibility study	To be determined pending results of existing data evaluation
	Durability, effectiveness, and physical properties of grouted waste	Past grouting work by industry and DOE	Site- and waste-specific treatability studies
PSQ-3d: Disposal	Extent of soil exceeding risk-based action levels for direct exposure pathway	As cited in Section 3	See Appendix D for site-specific data needs
	Extent of soil exceeding risk-based action levels for groundwater pathway	As cited in Section 3	See Appendix D for site-specific data needs
	COPC concentrations per release site	As cited in Section 3	See Appendix D for site-specific data needs
	TRU concentrations at CPP-31, -28, and -79	As cited in Section 3	See Appendix D for site-specific data needs
	Contact radiation readings to determine remote-handling requirements	As cited in Section 3	See Appendix D for site-specific data needs

Subsections 5.2.3.1 through 5.3.3.6 identify decision input needs that will be resolved by collecting historical data or by additional environmental measurements (e.g., sampling). For each decision input, the anticipated sources of information, quality of data required, and utility of existing data are discussed. These subsections are organized around the PSQs and decision statements defined previously.

Subsection 5.2.3.7 identifies historic information and project team decisions required to design the data collection program. These data inputs do not require additional environmental measurements.

5.2.3.1 Principal Study Question 1 Decision Inputs. The CSM includes a worker exposure scenario. As part of the BRA, potential risks to future workers will be calculated. Decision inputs for these calculations include contaminant concentrations at each individual release site, the surface area of each release site, and the volume of soil to which the worker is exposed. The contaminant concentrations for each release site will be estimated from results of past borehole logging, surface gamma screening, and sampling/analysis. The surface area of each release site will be obtained from the OU 3-13 risk assessment calculations, revised as appropriate based on OU 3-14 investigations.

If new release sites are identified as a result of the remedial investigation, they will be characterized after the ROD and addressed during RD/RA. Additionally, if the evaluation of historic data indicates that the material used to backfill past excavations was not sufficiently characterized to support the direct exposure risk assessment, additional characterization of the backfill may be required if it occurs in the upper 4 ft of the tank farm surface. Furthermore, the OU 3-13 RI/FS indicated that the lack of definitive data on lateral and vertical extent of contamination at several sites within the tank farm contributed to uncertainty about the concentration term estimates and the resulting risk assessment. These sites will be bounded for the preliminary BRA and then further assessed in the OU 3-14 investigation if necessary.

5.2.3.2 Principal Study Question 2 Decision Inputs. The approach to estimate future potential risk resulting from the groundwater pathway is to model fate and transport of contaminants from their release point at the tank farm to a receptor location at the downgradient boundary of the ICDF. Detailed conceptual and numerical models will be developed by using the most recent subsurface transport information generated by OU 3-13 Group 4 (INTEC Perched Water) and 5 (SRPA) and by using soil moisture flux and contaminant transport data obtained specifically for the tank farm. The development of the numerical model is described in more detail in Subsection 4.2. In addition to the information being developed under OU 3-13 Groups 4 and 5, three decision inputs specific to the OU 3-14 investigation need to be developed and incorporated into the risk model to support the OU 3-14 RI/FS. Each of these three required decision inputs is described below.

5.2.3.2.1 Infiltration Rates. During the OU 3-13 RI/FS modeling, a default infiltration rate of 10 cm/yr was used. This value was developed using several years of moisture measurements taken in the overburden soils at the INEEL Subsurface Disposal Area. Because of differences in soil type, topography, vegetative cover, and the presence of a partial geomembrane cover at the tank farm, it is unclear whether the infiltration rates developed for the Radioactive Waste Management Complex provide a realistic estimate for infiltration at the tank farm. During the OU 3-14 RI/FS, it was determined that infiltration of moisture through the alluvium was a sensitive parameter in the risk calculation. That is, even small changes in the estimated rate of infiltration could drive significant changes in the future risk predictions. To develop infiltration rates that are known to be representative of tank farm conditions, several years of transient moisture content and matric potential measurements, taken at multiple depths, are needed. These data needs are discussed in more detail in Subsection 5.3.2.

5.2.3.2.2 Water Balance. From work completed during the 3-13 RI/FS, it was determined that one of the most sensitive and uncertain parameters in the contaminant transport model and the resulting future risk estimate is travel time of water through the vadose zone. Clarification of the source of perched water and better estimates of advective travel times to the SRPA will reduce the uncertainty in the groundwater risk predictions. Necessary decision inputs include the following:

- Identification of perched water recharge sources
- Measurement of transient perched water level decline over the next few years resulting from relocation of the percolation ponds and sewage treatment lagoons
- Comprehensive water balance for northern INTEC, including anthropogenic sources (e.g., leaking water-supply and fire-suppression lines) and natural sources (e.g., the Big Lost River).

Decision inputs related to perched water will be resolved by OU 3-13 Group 4. Decision inputs related to a comprehensive water balance for northern INTEC have not specifically been identified as part of OU 3-13 Group 4 scope. It is anticipated that these data can be gathered by flow metering water-distribution lines, gauging the Big Lost River, measuring soil moisture conditions in northern INTEC, and potentially performing chemical analysis of perched water and potential water sources. These data needs are discussed in more detail in Section 5.3.2 of this work plan.

5.2.3.2.3 Kds. Kds are commonly used in computer modeling as a mathematically simple representation of sorption. Kds are a bulk term used to encompass all processes that remove a contaminant from solution. They represent the ratio of adsorbed to dissolved concentrations, typically given in units of mL/g. Commonly, the value is obtained by fitting a linear isotherm to results of batch or column experiments, neglecting the actual mechanisms responsible for contaminant removal. Kds are a sensitive and uncertain parameter in most groundwater risk models. These data needs are discussed in more detail in Subsection 5.3.3.

5.2.3.3 Decision Inputs for PSQ-3a (Containment). Containment (capping) alternatives have been evaluated frequently in feasibility study processes at sites across the DOE complex. A substantial body of design and performance information related to capping is available. Caps could mitigate both direct exposure risks and groundwater risks to future workers. Based on previous analyses, however, it is unlikely that any cap can be determined to deter or prevent intrusion. It is assumed that for the OU 3-14 feasibility study, an ICDF-type, low-permeability, long-life, multi-layer cap will be the selected process option for controlling groundwater risk. It is assumed that ICDF design information will be readily available and would provide information necessary to evaluate the cost of a low-permeability cap for the tank farm area.

A relatively thinner soil cover, e.g., 5 to 10 ft of low-permeability soil, could adequately control future worker direct exposure risks, given that the depth of intrusion for that scenario is 4 ft. For sites with only direct exposure risks, therefore, a roughly 15-ft-thick, multi-layer, ICDF-type cap might not be required.

However, in addition to the available design information, several additional decision inputs will be needed. First, the area to be covered will need to be roughly estimated for each individual release site as well as for the Tank Farm Group overall. For individual sites, the areal extent of contamination is needed; for the Tank Farm Group, however, the size of a cap can be estimated based on the approximate boundary of CPP-96. Second, the load-bearing capacity of the tank farm soils needs to be evaluated, because potential subsidence could reduce the effectiveness of the low-permeability cover system. Geotechnical properties of the tank farm soils, including approximate densities of excavated and backfilled areas, will be obtained either from existing data or new field measurements. Because this is only the investigatory phase, design-quality data are not needed. Investigators will only need to know whether any potential subsidence issues exist and whether any stabilization work would need to be done before construction of the cap (e.g., compaction of backfill areas).

5.2.3.4 Decision Inputs for PSQ-3b (Retrieval). Several decision inputs are required to support the detailed and comparative analyses of retrieval process options in the feasibility study. First, worker exposure risks will need to be evaluated. Past borehole logging and excavations in the tank farm encountered high radiation areas. A preliminary hazard assessment covering potential worker exposures for each release site will have to be performed to determine whether traditional excavation methods would be protective or engineering controls such as shielding, containment systems, and/or remote operations would also be required. Existing data will be reviewed as part of Phase I of the investigation to determine if any specific areas within the tank farm will require additional probing and gamma logging to support the hazard assessment. The OU 3-13 feasibility study (DOE-ID 1997b) indicated that the integrated remote use of excavation and treatment technologies has not been demonstrated; however, since then, the Pit 9 Glovebox Excavator Project has made progress in this area. Significant site-specific uncertainty regarding the implementability of retrieval in high-radiation or contamination areas will persist through the OU 3-14 feasibility study evaluation.

The retrieval process option will also require definition of the soils requiring excavation. These areas are defined by COC concentrations above action levels, which may be direct exposure pathway RBCs or may be derived from BRA results indicating excess groundwater risks for specific COCs. Although design-quality data are not required, a rough estimate of the volumes and locations of soil requiring excavation will be needed. Existing data will be reviewed as part of Phase I of the investigation to determine if any specific areas within the tank farm will require additional probing and gamma logging to support this determination. The OU 3-13 feasibility study (DOE-ID 1997b) indicated that the paucity of data regarding the extent and distribution of contaminants, especially plutonium in the tank farm soils, limited the value of the feasibility study evaluation of remedial alternatives. The limited characterization performed at the tank farm did not provide enough data about the contaminated soil volumes that required removal. Therefore, additional sampling may be necessary to support the feasibility study estimate of the locations and volumes of soil to be removed.

5.2.3.5 Decision Inputs for PSQ-3c (Treatment). The primary process option that will be considered under the treatment GRA will be in situ grouting. Although in situ grouting has been used successfully for decades in the construction industry, its application as an in situ treatment technology is relatively new. As a result, there are a number of data needs associated with this process option. The specific data needs, related to implementability, diffusion rates, and hydraulic conductivity, are discussed below.

The first set of data needs is related to the implementability of in situ grouting equipment and techniques at the tank farm. However, because in situ grouting has been demonstrated in a variety of soil types across the DOE complex (including use of high-pressure injection grouting at the Radioactive Waste Management Complex in much denser and finer-grained soils than those at the tank farm), it can be reasonably assumed that the implementability questions can be evaluated using general descriptions of INTEC-type alluvial soils. In fact, because the alluvial soils at the tank farm are relatively coarse-grained with high hydraulic conductivity, permeation grouting (low pressure) may be well suited to this site. It is not anticipated that additional geotechnical measurements, such as densities, gradation, or hydraulic conductivity, will be needed for the feasibility study analysis of alternatives.

Long-term effectiveness of in situ grouting is typically assessed in the feasibility study by estimating contaminant flux from the grouted contamination area to surrounding water (pore water). It is anticipated that the flux will be calculated using diffusion-controlled rate equations, such as those used in DUST-MS (Sullivan 1993) or similar waste repository release models. The diffusion coefficient used in such calculations is typically developed from results of short-term leach tests such as ANS 16.1. By submersing cylindrical coupons of cured grout/soil/contaminant mixtures in water and measuring the rate at which various elements are dissolved, grout-specific and contaminant-specific diffusion rates can be estimated. Although leach tests are relatively straightforward, interpretation and application of the results are not without uncertainty. Variations on the test, including lengthening the leach time, simulating the site-specific water chemistry, and controlling water-atmosphere interaction to match actual soil gas conditions, must be considered in the design of the leach tests.

Although leach test data are available in the literature for a number of COPCs (Tc-99, C-14, and others), data are not available for all OU 3-14 COPCs. Additionally, the bulk of the literature data was derived from tests on cementitious grouts with neutral or slightly alkaline waste types. Because the tank farm soils in the vicinity of the release sites may have been altered by the extremely acidic waste solutions, the literature data may not be indicative of expected performance at the tank farm. Grouts that are silicon- or hydrocarbon-based, or that are strongly neutralizing, may need to be tested with soil samples from the known release sites. A literature study and evaluation of soil acidity from archived tank farm samples will be conducted during Phase I of the remedial investigation. Results of the study will be used to specify necessary Phase II leach tests.

Contaminant flux from grouted waste is also a function of the infiltration rate through the grouted waste form. Hydraulic conductivity is a controlling variable in the release rate calculation. In matrices with high hydraulic conductivity, contaminants are transported by advective flow. Alternatively, in low-conductivity conditions, the primary mechanism is diffusion, whereby contaminants are dissolved by, and diffuse through, the relatively static intergranular water to the edges of the monolith, where infiltrating water transports the contaminant away from the disposal area.

Typically, the hydraulic conductivity of grout matrices has been measured on laboratory scale using methods such as ASTM D-5084. Hydraulic conductivities measured on bench-scale samples of grout are consistently low (10^{-7} to 10^{-11} cm/s) for a wide variety of grout/soil mixtures. However, field-scale measurements of grouted hydraulic conductivity measurements are limited, and tests to date have proven that their estimation is problematic. In general, field-scale results are higher than laboratory results but still relatively low compared to ungrouted conditions (average field-scale values for cemetitious grouts are in the 10^{-7} cm/s range). Although uncertainties remain in the final hydraulic conductivity of in situ grouted waste forms, available test data should provide a sufficient basis to estimate a conservative infiltration rate. It is not anticipated that additional field-scale hydraulic conductivity testing will be required to support the feasibility study evaluation.

The grouting process option will also require definition of the areas needing to be treated. Grouting does not address direct exposure risks and would be most applicable for specific areas that contribute significantly to groundwater risks above allowable levels. Specific areas requiring grouting will likely be identified based on BRA results indicating excess groundwater risks for specific COCs and on characterization results indicating the presence of the COCs at those levels at specific locations. Although design-quality data are not required, a rough estimate of the volumes and locations of soil requiring stabilization will be needed. Existing data will be reviewed as part of Phase I of the investigation to determine if any specific areas within the tank farm will require additional probing and gamma logging to support this determination. The OU 3-13 feasibility study (DOE-ID 1999b) indicated that the paucity of data regarding the extent and distribution of contaminants, especially plutonium in the tank farm soils, impacted the feasibility study evaluation of remedial alternatives. The limited characterization performed at the tank farm did not provide sufficient data concerning the contaminated soil volumes that required treatment. Therefore, additional sampling may be necessary to support the feasibility study estimate of the locations and volumes of soil to be treated.

Finally, decision inputs related to worker protection issues are also needed. Potential radiation exposure hazards from surficial grout returns as well as background radiation working at high radiation release sites will need to be evaluated as part of the feasibility study. Because the amount of radioactive material entrained in the grout returns and brought to the surface is a small fraction of the total inventory, the exposure potential is significantly less than other more intrusive alternatives, such as retrieval. The radiation dose potential from grouting operations will be evaluated in a preliminary hazard assessment during development of the feasibility study. The hazard assessment will use inventory information as well as results of past radiation surveys.

5.2.3.6 Decision Inputs for PSQ-3d (Disposal). For each release site at which all or part of the contaminated soils present would potentially be retrieved, the final disposition of the waste soil needs to be evaluated in the feasibility study. The feasibility study data needs for characterization of the soil are driven by the potential disposal facilities and possible waste classifications of the soil. Contaminated soils at the tank farm are assumed to consist of low- and high-activity low-level waste, mixed waste, and TRU waste. Mixed waste soils may include characteristic and listed hazardous constituents. Based on these waste classifications, three representative sites—the Nevada Test Site, the Waste Isolation Pilot Plant, and the ICDF—were selected as disposal sites in the OU 3-13 RI/FS. Other commercial facilities, such as Envirocare, are also permitted for disposal of low-level radioactive and mixed waste with relatively low concentrations of radionuclides. Contact-handled low-level waste and mixed-waste soils could be disposed of onsite in the ICDF. Soils classified as TRU waste could be disposed of off-site at the Waste Isolation Pilot Plant in New Mexico. Soils identified as contact- or remote-handled mixed waste could be treated to remove the RCRA characteristic of the waste and disposed of off-site at the Nevada Test Site, assuming that site would become available.

Issues that would have a significant effect on the cost estimate for the disposal alternative include the occurrence of RCRA-listed waste constituents, soils that are determined to contain greater than 100 nCi/g TRU constituents, and soils exhibiting characteristic levels of metals contamination requiring stabilization before disposal. The OU 3-13 feasibility study (DOE-ID 1999b) indicated that the insufficient data were available to estimate how much soil would be classified as low-activity low-level waste, high-activity low-level waste, mixed waste, and TRU waste.

To support an evaluation of the disposal alternative in the feasibility study, investigators will need a site-by-site determination of whether the soil would meet waste acceptance criteria at each facility. Investigators will need a measure of contaminant concentration in the soil volume at a given site (e.g., the mean and 95% UCL concentrations for all COPCs, with a reasonably low probability of measurement error) and a determination of volumes of soils requiring remote handling (i.e., contact readings exceeding 200 mR/hr). In addition, for release sites CPP-31, -28, and -79-Deep, a determination will need to be made as to whether and what volume of soils could potentially contain TRU waste. This determination will require measurement of mean and 95% UCL concentrations of TRU isotopes within each release site.

5.2.3.7 Historical Data Review and Analysis. A number of the decision inputs discussed in the preceding sections will not be resolved through the field investigation but rather by evaluation of engineering information, process knowledge, historical records, and other information. Some of these decision inputs include release inventories, action levels, decision units, and evaluation of existing technology performance data. The approach for resolving these types of decision inputs is discussed below.

5.2.3.7.1 Release Inventory Information—Fourteen known release sites that resulted in significant soil contamination at the tank farm have been identified for evaluation under this RI/FS. These sites are described in Subsection 3.1. The contaminant inventory for each known release site was originally developed in the OU 3-13 BRA (DOE-ID 1997a) using facility operating records and process knowledge regarding the waste streams that were released. The OU 3-13 BRA determined that three release sites, CPP-28, -31 and -79, compose over 99% of the known contamination released at the tank farm. The BRA further determined that only these three sites present groundwater risks above allowable levels after 2095.

These results, as modified by further evaluation of existing data described in Section 3, will be used as decision inputs for PSQs 3b and 3c, i.e., "Extent of soil exceeding risk-based action levels for groundwater pathway." The OU 3-13 BRA results will be used to identify COCs that drive groundwater risk, which include Sr-90 and total plutonium and uranium. A preliminary definition of "Extent of soil exceeding risk-based action levels for the groundwater pathway" is a hot spot containing a significant fraction, e.g., 10%, of the total activity of one or more of the three groundwater COCs. The field investigation will attempt to determine the locations and volumes of these hot spots as decision inputs for PSQs 3b and 3c.

5.2.3.7.2 Liquid Waste System Residual Source. The revised BRA will include the source term and COPC release rates from the grouted tanks and piping. This information will be developed by the Tank Closure Program and provided to the OU 3-14 BRA team to include in the BRA calculations. No inventory investigations for the residual liquid waste system source will be performed under the OU 3-14 RI/FS.

5.2.3.7.3 Action Levels—Action level, as defined in the DQO guidance, is a value that is used to choose between alternative actions. For purposes of developing the OU 3-14 RI/FS, the project team will define several different types of action levels to support the feasibility study evaluation. The primary action levels to be defined include the following:

- **Preliminary Remediation Goals.** Risk-based PRGs for direct exposure to tank farm soils will be developed to support PSQ-1. It is anticipated that information that includes current EPA RBC tables for radionuclides will be used as a basis for risk-based action levels that apply specifically to the tank farm.

- **Preliminary Action Levels.** Preliminary action levels will be developed to address the groundwater exposure pathway. These contaminant-specific action levels will be derived from the BRA modeling to identify contamination areas, in terms of soil volume and contaminant concentration, that have a potential to result in exceedences of SRPA RAOs defined previously.

5.2.3.7.4 Evaluation of Existing Feasibility Study Data—As part of the data collection effort, the project team will search for existing data regarding the technology process options under consideration in the feasibility study. Data regarding such aspects as performance history, operational parameters and limits, costs, and worker hazards will be compiled from vendor information and other DOE projects. The available information will be screened for relevancy and used to the extent practical in the feasibility study analysis.

5.2.4 Define Study Boundaries

This subsection discusses the spatial, temporal, and operational boundaries that constrain the field investigation. The spatial scale of the investigation is also discussed in the context of specific decision statements.

5.2.4.1 Spatial Boundaries. The areal extent of OU 3-14 soil release sites, as well as specific boundaries of individual release sites, is shown in Section 3. By definition in the OU 3-13 ROD, OU 3-14 also includes the SRPA inside the INTEC security fence line. Site CPP-96 is composed of individual release sites CPP-15, -16, -20, -24, -25, -26, -27, -28, -30, -31, -32, -33, -58, and -79 and all interstitial soil between those sites. The vertical extent of this study is the surface soil (from the surface to top of basalt) at the tank farm. This depth varies with location but averages about 45 ft.

5.2.4.2 Spatial Scale of Decision-Making (Decision Units). The scale of decision-making, often referred to as the decision unit, is the smallest area or volume of media associated with the contamination problem of the site for which the planning team wishes to control decision errors. The goal of this step is to define subsets of media about which the planning team will be able to make independent decisions. Table 5-4 summarizes the output of this step. The scale can potentially range from the entire geographic boundaries of the site (i.e., the tank farm) to the smallest area that can be remediated with a given technology (i.e., retrieved). Setting the decision unit overly large can result in unnecessarily expensive remedial actions, while setting the decision unit too small can result in unnecessarily expensive field investigations. For this project, several different scales of decision-making are appropriate for the different decision statements identified in Table 5-4. The decision units are based on risk and pragmatic considerations such as the volume of soil that can be efficiently retrieved and containerized.

5.2.4.3 Temporal Boundaries. This investigation will be temporally bound by the enforceable schedule for the OU 3-14 ROD of 2010. Five years will be available for collecting and analyzing additional data.

For purposes of scoping the OU 3-14 RI/FS work plan, it is assumed that a ROD will be signed in 2010, and that institutional controls will effectively prevent access to OU 3-14 and to groundwater at the OU 3-14 downgradient boundary until at least 2095.

The overall schedule is also affected by the necessary integration with the tank closure activities discussed previously, OU 3-13 Groups 4 and 5, and tank farm interim action activities listed chronologically through 2007 below:

FY 2003

OU 3-13: Ongoing Group 4 water balance and geochemistry studies that feed the unsaturated zone model; update of the Group 5 SRPA model and publication of the Group 5 MRDS.

FY 2004

- *Tank Farm Interim Action*: Installation of infiltration barriers (asphalt pavement) over CPP-28, -31, and -79.

- *OU 3-13*: Ongoing Group 4 perched water monitoring required to support the unsaturated zone model; ongoing Group 5 SRPA monitoring.

FY 2005

- *OU 3-13*: Update of the Group 4 unsaturated zone model and publication of the Group 4 interim status report; ongoing Group 5 SRPA monitoring.

FY 2006

- *OU 3-13*: Ongoing Group 4 and 5 monitoring.

Table 5-4. Spatial scale of decision-making.

Decision Statement	Decision Unit	Comments
1. Determine whether concentrations of COPCs in tank farm soils exceed risk-based action levels, requiring control of the exposure pathway.	Variable	The surface area of each known release site that an occupational worker could be exposed to (surface area of each site) will be based on OU 3-13 calculations). Also will consider depth of excavation soil during occupational scenario.
2. Determine whether contaminants are transported out of the tank farm soils to the SRPA at rates sufficient to result in COPC concentrations exceeding allowable levels at the exposure point, requiring control of the exposure pathway.	Not applicable	The minimum volume that could practically be modeled as a source term for the transport model. Essentially this will be the size of a grid block in the refined discretization for the alluvium. Note that the groundwater risk is relatively insensitive to the resolution of the source term grid due to effects of such characteristics as dispersion.
3a. Determine whether a remedial action that includes containment best meets feasibility study evaluation criteria to mitigate excess risks relative to other alternatives.	3 acres	The surface area of the tank farm. For purposes of the feasibility study, the exact dimensions of a cap are not required; a rough estimate of the size can be based on the boundaries of CPP-96.
3b. Determine whether a remedial action that includes retrieval best meets feasibility study evaluation criteria to mitigate excess risks relative to other alternatives.	70 yd^3	Based roughly on 10% of the volume of the CPP-31 contaminated area (from DOE-ID 2000b, Fig 3-8 and 3-9, volume of a cone 50 ft diameter, 30 ft depth). The feasibility study will use results of the risk assessment to estimate a total volume for retrieval in increments of 70 yd^3.
3c. Determine whether a remedial action that includes treatment best meets feasibility study evaluation criteria to mitigate excess risks relative to other alternatives.	70 yd^3	Based roughly on 10% of the volume of the CPP-31 contaminated area (from DOE-ID 2000b, Fig 3-8 and 3-9, volume of a cone 50 ft diameter, 30 ft depth). The feasibility study will use results of the risk assessment to estimate a total volume for retrieval in increments of 70 yd^3.
3d. Determine whether a remedial action that includes disposal best meets feasibility study evaluation criteria to mitigate excess risks relative to other alternatives.	70 yd^3	Based roughly on 10% of the volume of the CPP-31 contaminated area (from DOE-ID 2000b, Fig 3-8 and 3-9, volume of a cone 50 ft diameter, 30 ft depth). The feasibility study will base total disposal volumes on the volumes estimated for retrieval.

FY 2007

- *OU 3-13:* Final update of the Group 4 unsaturated zone model, publication of the Group 4 MRDS, and ongoing Group 5 monitoring.

Another schedule consideration is the time required to plan field investigations in high-radiation and contamination areas, such as at the tank farm. Due to potential worker exposure issues, as well as potential interferences with other operations at the tank farm site, considerable time will be required to complete the necessary work planning and hazard analysis before the fieldwork starts.

5.2.4.4 Practical Constraints. The tank farm soils are in an area of complex engineering structures. Aboveground and subsurface features (e.g., piping, vaults, and valve boxes) will affect the field investigation. Specific investigation techniques have been developed to mitigate the potential for damaging underground utilities (vacuum lancing), but not all areas may be accessible for borehole installation and/or sampling. Existing drawings of the underground piping and other structures will be reviewed during planning for the field investigation. In addition to facility interferences, a significant amount of construction work has occurred in the tank farm area, removing and mixing contaminated soil areas—sometimes multiple times. For example, a substantial portion of the soil near release sites CPP-28 and -79 was previously excavated. Such excavations may affect the quality of any future data collected from these areas. These past construction and excavation activities will be evaluated as part of the planning process for the field investigation.

Furthermore, some areas with exceptionally high radiation fields were encountered during past construction and logging activities in the tank farm. As such, areas of high radiation may affect the field investigation. Before collecting any high-activity samples, a detailed hazard analysis will need to be conducted to ensure that appropriate controls are available for potential contamination spread and radiation doses to workers. Limits on the activity of samples that can be collected and analyzed may constrain the field investigation. Methods to remotely collect and analyze samples are not included in this work plan.

5.2.5 Define Decision Rules

Decision rules integrate outputs from DQO Steps 1 through 4 into logic statements describing the basis for choosing between various actions, given possible results of the data collection effort. When defining decision rules, the parameters of interest are defined, quantitative action levels are specified as appropriate, and decision rules are written. For the OU 3-14 investigation, the decision rules are framed in terms of the three PSQs. The parameters of interest, action levels, and decision rules are summarized in Table 5-5.

5.2.5.1 Principal Study Question 1 Decision Rule. The parameter of interest is a descriptive measure, such as a mean or proportion, that specifies the attribute that the decision-maker would like to know about the population. For PSQ-1, the parameters of interest are 95% UCL or maximum value, whichever is less, for each identified release site; and the site area. Both of these parameters are used in area-weighted average risk calculations for the Tank Farm Group.

The action level is a numerical criterion for deciding whether the contamination levels drive a certain action. For PSQ-1, the action levels will be based on the 1E-04 excess cancer risk occupational 100-year RBCs for soil exposure.

The resulting Decision Rule 1 is: If 95% UCL or maximum COPC concentrations, whichever is less, for each identified release site exceed the 1E-04 occupational 100-year RBCs, then the exposure pathway requires control. Otherwise, if RBCs are not exceeded, control of the exposure pathway is not required based on risk.

5.2.5.2 Principal Study Question 2 Decision Rule. The parameter of interest for the second PSQ is the risk factor calculated based on future potential contamination levels in the SRPA at the residential receptor location, as calculated through numerical modeling described previously. No statistic is associated with this estimate. The action levels in this case are the assumed SRPA RAOs (discussed in Subsection 5.1.4) at the downgradient groundwater exposure point, as determined through groundwater modeling. The time after which a future resident may receive exposures to groundwater is assumed to be 2095, as described previously. Currently, the residential receptor location is assumed to be between the INTEC security fence line and the downgradient tank farm boundary.

Table 5-5. Summary of parameters of interest, action levels, and decision rules.

Decision Statement	Parameters of Interest	Action Level	Decision Rule
1. Determine whether concentrations of COPCs at known release sites exceed risk-based action levels, requiring control of the exposure pathway.	95% UCL of the mean, and maximum values	RBCs for 100-year occupational scenario	1. If the 95% UCL or maximum value, whichever is less, for each identified release site exceeds the 1E-04 occupational 100-year RBCs, then the exposure pathway requires control. Otherwise, if RBCs are not exceeded, control of the exposure pathway is not required based on risk.
2. Determine whether contaminants are transported out of the tank farm soils to the SRPA at rates sufficient to result in COPC concentrations exceeding allowable levels at the exposure point, requiring control of the exposure pathway.	Groundwater exposure point concentration calculated by numerical model – no statistic associated with the estimate Time of arrival of contaminant concentrations above allowable calculated by numerical model	SRPA RAOs	2. If exposure point concentrations at the OU 3-14 residential receptor location are predicted to exceed SRPA RAOs after 2095, then control of the groundwater exposure pathway is required. Otherwise, if future risk is in an acceptable range, then control of the exposure pathway is not required based on risk.
3. Determine whether a remedial alternative that includes [GRA] best meets feasibility study evaluation criteria to mitigate excess risks for known release sites relative to other alternatives.	Feasibility study evaluation criteria	Not applicable	3. If a remedial alternative that includes [GRA] best meets feasibility study evaluation criteria to mitigate excess risks at known release sites, then identify that alternative as the highest-ranking. If the alternative does not meet these criteria, identify another alternative as highest-ranking.

The ultimate decision as to whether a particular site will require remedial action will be made as part of the proposed plan/ROD process. For purposes of the RI/FS analysis, however, control of the groundwater exposure pathway is assumed to be required if the risk factors calculated based on future potential contamination levels in the SRPA at the residential exposure point exceed the SRPA RAOs discussed in Subsection 5.1.4. Otherwise, control of the exposure pathway is assumed to not be required.

The resulting Decision Rule 2 is: If COPC concentrations at the downgradient residential receptor location exceed the SRPA RAOs, then control of the groundwater exposure pathway is required. Otherwise, control of the groundwater exposure pathway is not required based on risk.

5.2.5.3 Principal Study Question 3 Decision Rules. The parameter of interest, action levels, and decision rules as defined in EPA (2000a) are not directly applicable to feasibility study questions. However, it is useful to specify the parameter, or statistic, of interest required to ensure that the field investigation yields data needed for the feasibility study detailed analysis. For each of the four GRAs investigated under PSQ-3, the parameters of interest and action levels are briefly discussed below to facilitate development of future investigatory work. Note that GRAs will be evaluated in the feasibility study in combination as assembled alternatives, not independently.

5.2.5.3.1 Containment. For the feasibility study evaluation of containment, there are no specific statistical parameters of interest. The size of a cap for any specific release site will be based on the extent of contamination above RBCs for soil exposures and on the extent of contamination above action levels for groundwater risks. The potential for subsidence and any requirements for mitigation will also be evaluated in the feasibility study using engineering judgment.

5.2.5.3.2 Retrieval. For the feasibility study evaluation of retrieval, the first parameter of interest is the maximum contact reading. The action level is a contact radiation reading of 200 mR/hr, which drives remote handling-requirements. If soils at a given site are expected to exceed contact readings of 200 mR/hr, then remote-handling requirements would be included in the evaluation of this alternative.

The second parameter of interest for retrieval is the mean concentration of risk driving COPCs within a given volume of soil requiring retrieval at each site. The estimated COPC concentration is needed to estimate the volume and locations of soil requiring retrieval in the feasibility study analysis. For the direct exposure pathway, these volumes and locations will be determined by comparing the mean concentrations to action levels. For the groundwater pathway, these volumes and locations will be estimated by first reviewing the BRA groundwater risk results to determine which COCs exceed allowable levels at the groundwater exposure point. Then the mass or activity of each COC exceeding allowable levels that would have to be removed from the tank farm to reach allowable levels will be estimated. Finally, the soil volumes that would have to be removed at individual release sites to reduce the total activity or mass of the given COC and thereby reach allowable groundwater risk levels will be identified based on the mean concentration of the COC in each decision unit. The minimum decision unit dimensions are discussed in Subsection 5.2.4.2.

Other factors, such as the location and size of the contaminated areas, may also drive a particular site to be included in the feasibility study as a retrieval site. For example, noncontiguous outlying contamination areas, or areas adjacent to buildings or other structures, may be retrieved simply to facilitate the design and construction of a cap.

5.2.5.3.3 Treatment. For the feasibility study evaluation of treatment, the parameter of interest is the mean concentration of risk driving COPCs within a given volume of soil requiring treatment at each site. The estimated COPC concentration is needed to estimate the volume and location of soil requiring treatment in the feasibility study analysis. Since treatment using the representative process option of in situ grouting would be applied only to reduce groundwater risks, the volumes and locations would be identified as discussed previously for retrieval to mitigate groundwater risks.

5.2.5.3.4 Disposal. For the feasibility study evaluation of disposal, the primary parameters of interest are the maximum or 95% UCL concentrations for each COPC at a given release site, whichever is less. Maximum contact-radiation readings are also a parameter of interest, because the presence of high-activity waste could preclude certain disposal options. Several action levels will trigger disposal options included in the feasibility study analysis. The first is a contact radiation reading of 200 mR/hr for remote-handled waste. The second is the TRU waste concentration of 100 nCi/g. The third comprises the toxicity characteristic levels listed in 40 CFR 261.24. It is anticipated that the 95% UCL for each contaminant will be compared to the appropriate action level as a basis for deciding between disposal options in the feasibility study detailed analysis. Other factors, including the potential for soils to contain listed wastes, will also be incorporated into the analysis for this GRA. The volumes of soil requiring disposal will be based on the volumes estimated for the retrieval GRA.

The resulting Decision Rule 3 is: If a remedial alternative that includes [GRA] best meets feasibility study evaluation criteria to mitigate excess risks at known release sites, then identify that alternative as the highest-ranking. If the alternative does not meet these criteria, identify another alternative as highest-ranking.

5.2.6 Specify Tolerable Limits on Decision Errors

Because environmental measurements can only estimate the true condition of a site under investigation, all decisions that are made based on measurement data could be in error (i.e., decision error). Traditionally, the potential decision error is controlled by using statistical methods to design a data collection plan that will most efficiently control the probability of making an incorrect decision. Statistical procedures are preferable in many cases, because they provide a basis for defining performance criteria and assessing the achieved decision quality of the sample design. However, as acknowledged in EPA (2000b), statistical approaches are not applicable to every hazardous waste site investigation; in some cases, judgmental sampling designs or authoritative measurements may be applicable to confirm site characteristics. EPA (2000b) further acknowledges that in some studies, investigators may not be able to complete DQO Steps 6 and 7 according to the general approach described in the guidance. These and other sampling design issues are discussed below in the context of the OU 3-14 field investigation.

5.2.6.1 Statistical Versus Non-Statistical Sampling Designs. The first objective of Step 6 of the DQO process is to define which decision statements (if any) require a statistically based sample design. For decisions that do require statistically based sample designs, Step 6 allows decision-makers to establish a priori the desired maximum probability of making an incorrect decision. Using the EPA performance goal diagram, or power curve, decision-makers can evaluate the design of a given statistical hypothesis test. This approach is most appropriate for sites where the severity of consequences of making an incorrect decision is relatively high, as discussed in Subsection 5.2.2. This approach is less appropriate for sites for which the severity of consequences of making an incorrect decision is relatively low, because resolution of the extent of contamination above risk-based action levels at a given confidence level does little to improve resolution for the tank farm soils as a group.

Tolerable limits on decision errors should be established based on potential consequences of making a decision error (EPA 2000a, 2000b). When decision errors have the potential to harm people or the environment, or when decision errors could lead to a noncompliance issue, formal probability limits are established in a cooperative fashion by the investigators and regulatory Agencies. For example, required probabilities of erroneously concluding that a site has achieved final RAOs when in fact it has not are typically limited to values between 0.01 and 0.10, depending on the consequences of the decision (EPA 1992). When the consequence of a decision error may only have monetary or schedule impacts, the probability of error is typically set at a lower level.

Alternatively, non-statistical sampling designs, typically referred to as “biased” or “judgmental,” are established by the project team based on pre-existing knowledge about the site. Because non-statistical sampling does not allow the decision-makers to evaluate the probability of making a decision error regarding the characteristics of the site, non-statistical sampling is most appropriate when the severity of the consequences of making a decision error are low and when follow-on confirmatory sampling is not prohibited. Non-statistical sampling is commonly applied to hazardous substance releases when the location of the release is known and associated soil contamination can reliably be expected to be found. This type of sampling may also be appropriate when the contaminants have already been identified either by process knowledge or previous investigations. For those decision statements to be resolved using a non-statistical sampling design, there is no need to define tolerable limits on decision errors.

5.2.6.2 Sampling Design Selection for OU 3-14. A judgmental sampling design that targets known or suspected contamination areas within the tank farm is most appropriate for the OU 3-14 RI/FS investigation to resolve the decision statements listed previously. The reasons for selecting a non-statistical approach at this site are listed below:

1. By considering the results in Table 5-2, which describes the severity of decision errors, the severity of decision errors for all three decision statements are considered to be relatively low at this stage of the investigation. In general, the approximate areas of release are known, and the fact that the associated soil sites are contaminated with radioactive and hazardous constituents has been documented previously. Due to the potential surface exposures alone, it is probable that some remedial action will be taken. There is no risk that these sites will be erroneously categorized or considered for no action remediation alternatives.

2. The sites will remain accessible for resampling during the remedial design and remedial action phases. Confirmatory sampling is expected to guide the implementation and verify the effectiveness of the remedial action, as appropriate.

3. The waste-distribution systems in the tank farm released contaminants in a point-source or line-source manner. The contaminants that were released in such a manner have been shown to impact the soil immediately beneath the waste site with minimal lateral spread, unless facilitated by an engineered structure.

4. The COPCs are relatively well established based on process knowledge and past investigations. Additionally, the contaminants were generally co-released as leaks of liquid solutions, and, as such, it is not expected that individual constituents would be randomly distributed.

5. The sample population (alluvial soil within the tank farm) is constrained by the presence of numerous surface and subsurface structures and piping systems. Existing structures would interfere with large-scale systematic or random-sampling patterns. In addition, many of the contamination sites have been disturbed, or partially or entirely removed, by past remediation, construction excavations, and backfilling.

Decision-makers should note that results from a judgmental sampling design can only be used to make decisions about the locations from which the samples were taken and cannot be generalized or extrapolated to any other facility or population. Furthermore, error analysis cannot be performed on the resulting data. Thus, the use of judgmental designs prohibits any assessment of uncertainty in the decisions.

5.2.7 Optimize the Design

DQO Step 7, Optimize the Design, consists of reviewing the DQO outputs identified in DQO Steps 1 through 6 and determining the most efficient sampling design strategy. The decision logic for investigating known release sites is shown schematically and discussed in this subsection.

To implement the decision logic for each component, the field investigation will be carried out in two phases to minimize the time required to plan and mobilize for each and to allow for Phase I results to be used to scope Phase II. Dynamic work plans that allow the field team leader some discretion in adding, deleting, or changing sampling locations will be used for both phases to allow for the presence of infrastructure or to investigate detections of unexpected or otherwise anomalous contamination.

This subsection also discusses conceptually the investigation scope to be performed during and after the post-ROD remedial action phase. Other investigations described herein include a contaminant transport study and a treatability study.

Phase I and II data collection activities described in this work plan are focused on resolving PSQs 1 through 3, which will provide data required to determine whether the direct exposure and groundwater pathways present significant risks and to facilitate identification of which remedial alternatives best meet feasibility study evaluation criteria for each known release site. Post-ROD data needs for specific sites may be defined in the RD/RA work plan and determined in the remedial action, for example determining at high resolution the extent of contamination at specific sites. Verification sampling may be performed after the remedial action to verify that RAOs have been met, for example determining that all soils contaminated above specified action levels have been treated in situ.

5.2.7.1.1 Decision Logic for Investigating Known Release Sites. The decision logic for investigating known release sites is shown in Figure 5-1 and includes the following steps:

1. The sites to be investigated are defined, as listed in Appendix D.

2. Specific BRA and feasibility study data needs for each release site are defined, as discussed in Subsections 5.2.1 through 5.2.6 and as summarized in Appendix D.

3. The severity of consequences of an erroneous decision, and thereby the required investigation design rigor, is defined for each site based on the percentage of the total tank farm soil release inventory estimated to be present at each site, as shown in Appendix D.

4. The existing data for each release site are reviewed, including past investigations, previous excavations, and presence of infrastructure that may impede investigations.

5. If existing data are adequate to resolve the decision statements for a given site, no further investigation is required, and the BRA and feasibility study for that site may be completed using existing information.

6. If existing data are not adequate to resolve the decision statement, then the investigation strategy for each site is determined. Additional Phase I probehole and Phase II sampling locations are identified using a judgemental approach, as described in Subsection 5.2.6.2.

7. The extent and distribution of contamination above PRGs or action levels is determined based on available data, new data acquired during the OU 3-14 field investigation, or a combination of both. New data needed to determine the extent and distribution of contamination will be acquired by gamma logging both new and existing probeholes during Phase I.

   This step defines the areal and vertical extent of contamination above PRGs as well as the distribution of contamination, i.e., locations of hot spots above action levels or maximum concentrations. Available data or new data acquired during the OU 3-14 field investigation, or a combination of both, will be used to establish distribution.

8. The composition of contaminants at each release site is determined, based on the site-specific COPC lists provided in Subsection 3.4.2, within the extent and distribution defined in preceding steps. Either available data or new data acquired during the OU 3-14 field investigation, or a combination of both, will be used to establish composition. New data on the composition of contamination will be acquired by collecting samples for chemical analysis in Phase II when needed to resolve the decision statements.

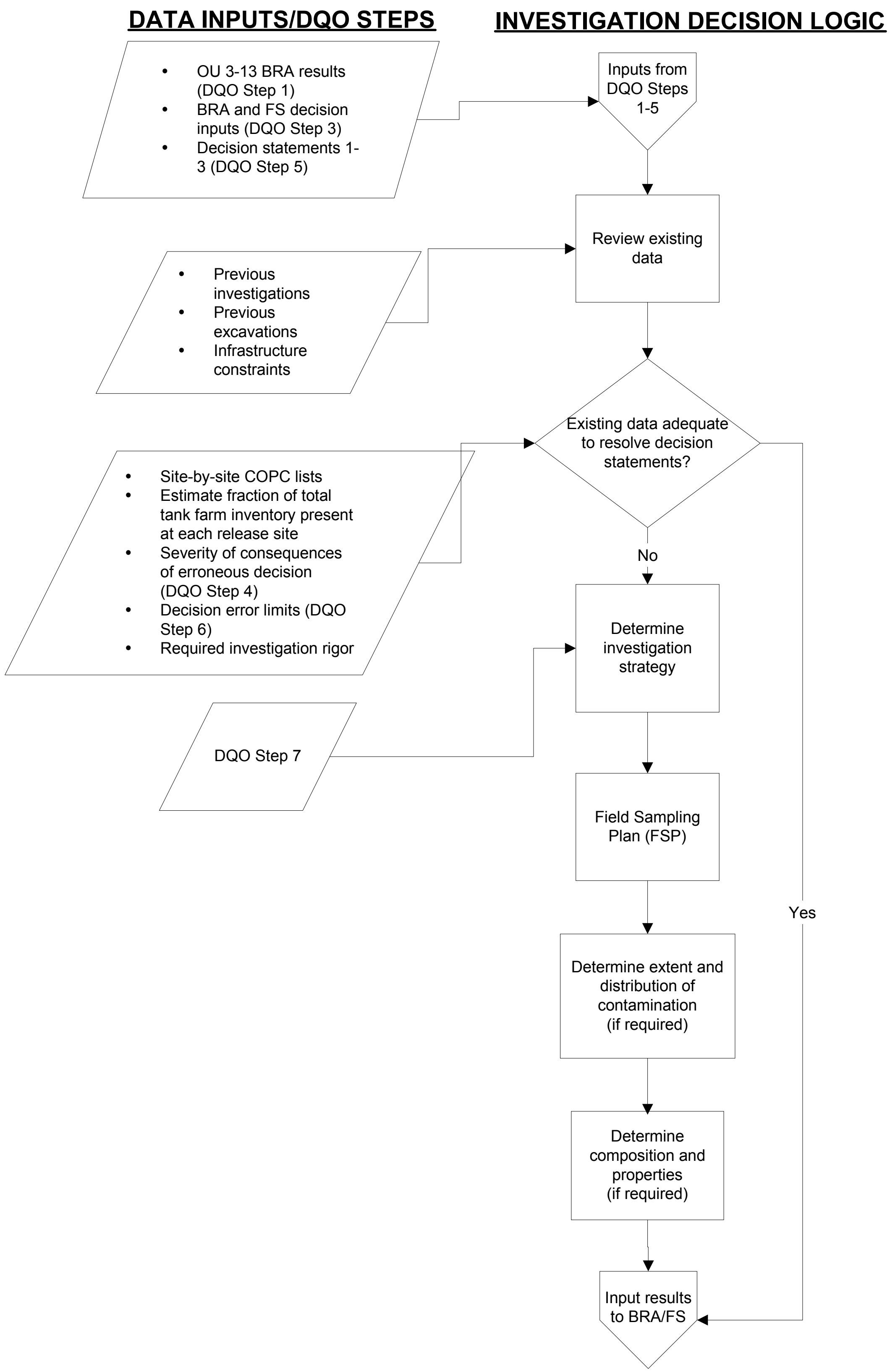

Figure 5-1. Decision logic for investigating known soil release sites.

The results of applying the decision logic through Step 4 (Determine investigation strategy) to each known release site are summarized in Appendix D. Existing data, including previous investigations and excavations and locations of infrastructure that constrain investigation, for each site are described in Subsection 3.1. Data gaps are described in Subsections 3.1 and 5.2. Data gaps for each site are summarized and grouped in Appendix D in the areas of extent of contamination, distribution of contamination (i.e., locations of hot spots within the area contaminated above PRGs), composition of contamination (i.e., the COPCs present at the site), and properties (e.g., transport parameters and physical properties needed for the feasibility study). Finally, Appendix D provides a recommended investigation strategy to resolve the data gaps for each site. This recommendation is necessarily subjective, given that a systematic or statistically based sampling approach is not merited, as discussed in Subsection 5.2.6.

5.2.7.2 Post-ROD Investigations. The remedial investigations of known tank farm soil release sites may reveal evidence of previously unknown releases of liquid wastes. If these locations are identified during field investigations, further characterization will be performed at the next opportunity, which would occur during investigations performed to support the remedial design or remedial action.

5.3 Phase I Field Investigation

The Phase I investigation to implement the decision logic described above will include completion of the historical data review begun under this work plan, logging existing boreholes, and probing and logging new boreholes. Scope defined for the Phase I investigation and described in the attached feasibility study includes the following:

1. Collating and evaluating all existing information for borehole locations and historical gamma logging results, sampling locations, extent of excavations, and backfill

2. Gamma logging existing usable boreholes in cases where historical data have been lost or when logging meets defined site-specific data needs

3. Based on the results of Items 1 and 2 above and on locations of tank farm infrastructure, determining specific locations for boreholes required to meet site-specific data needs identified in Appendix D

4. Gamma logging new probeholes

5. Installing and logging neutron-probe access boreholes to monitor soil moisture flux.

The *WAG 3 OU 3-14 RI/FS Tank Farm Soil Phase I Field Sampling Plan Probe Installation Technical Approach (Draft)* (INEEL 2001) describes demonstrations, designs, and assessments performed to implement the FY 2000 OU 3-14 RI/FS work plan (DOE-ID 2000b). Completed tasks described in INEEL (2001) include:

1. A gamma survey of the tank farm surface inside the fence

2. A cold test of the pilot hole vacuum system

3. A cold test of borehole installation using direct-push with percussion hammer to install casings for gamma logging

4. An assessment of seismic loading for the tanks resulting from use of the direct push with percussion hammer rig and an assessment of weight limits in the tank farm

5. A Unresolved Safety Question Screen and Safety Evaluation for the overall technical approach.

The information presented in the technical approach report will be integrated into the revised Phase I feasibility study.

Specific Phase I tasks are discussed below.

5.3.1 Installing and Gamma Logging Boreholes

Magnetic, electromagnetic, and ground-penetrating radar surveys are being considered to help locate subsurface structures and piping before drilling. Steel probehole casings that are 2.5 in. in diameter will be installed using a combination of vacuum excavation and direct-push drilling. A vacuum excavation unit will be used to excavate a pilot hole 5 to 7 in. in diameter to a depth of 15 ft bgs in areas where subsurface infrastructure is present near desired probing areas, thus minimizing the potential for damage to buried infrastructure. The pilot hole will be excavated in 5-ft increments. Vacuum excavation will be conducted using a closed loop system, with the soil finally placed in three 35- or 55-gal drums (each holding 5-ft intervals of soil). Soil will be temporarily contained in the drum(s) and then be labeled according to hole position and depth. Radiation and contamination surveys will be conducted during all vacuuming operations. Nine Phase I probeholes will be installed as described in Subsection 5.2.

After the pilot hole has been advanced to 15 ft, bentonite will be backfilled around the probehole casing. Collected soils may be stored for later sampling at the discretion of the field team leader. Using the direct-push drill rig, the remainder of the probehole casing will be installed in 4-ft sections to a depth of approximately 45 ft bgs or to the basalt contact.

Upon completion of the probehole, the direct-push drill rig will be detached from the probehole casing at the lowest possible point above ground. An all-weather cap will then be placed on the casing to preclude the inadvertent entry of unwanted material.

The installed probehole will be uncapped and logged using the downhole gamma-ray technique. Gamma-ray logging measurements will be conducted at intervals of 0.5 ft beginning at the lowest obtainable depth in the borehole and continuing upward to within 1 ft of the ground surface. The same technique will be used to log existing boreholes.

It is anticipated that the tank farm investigation will use a logging system with a 1- to 1.75-in. outer diameter and sensitivity sufficient to allow for the detection of Cs-137 at concentrations below 110 pCi/g, which is the EPA risk-based soil concentration resulting in a 1E-04 excess cancer risk for the 100-year occupational exposure scenario (note that PRGs cited in the OU 3-13 ROD are for residential exposures and, therefore, are not used). The gamma-ray logging tool will be calibrated to determine the gamma flux resulting from this Cs-137 concentration in tank farm soils.

The gamma-ray logging tool will be operated in a counts-per-second mode to detect and record gross gamma radiation flux with depth. The gamma-ray logging tool is deployed using a portable winch system that provides the electronic output of the detector reading and tool depth. The logging data will be acquired using a field laptop computer, and graphical results showing gross gamma-ray flux will be shown in real time. The feasibility study will be written to allow the field team leader to expand the probing area within the INTEC infrastructure and operational constraints, as needed.

5.3.2 Soil Moisture Monitoring

Soil moisture monitoring stations will be installed. It is anticipated that three background stations and eight contaminant source stations inside the tank farm will be required. Each station will likely include several probeholes instrumented with NPATs, tensiometers, moisture sensors, thermocouples, and suction lysimeters. All electronic information will be collected in data loggers and remotely downloaded to a computer. Associated data loggers and radios to transmit data will be installed at each station. The final locations, instruments, and sampling and analysis methods will be defined in the Phase I feasibility study.

The use of several instruments is planned. Neutron probes and Cone Penetrometer Test (CPT)/Resistivity probes will permit collection of moisture content both vertically (depth) and horizontally (lateral). The neutron probe will provide a continuous moisture profile with depth for the tank farm soil, while the CPTs provide the capability to collect automated point-source volumetric moisture content data. Both are required in order to develop accurate infiltration estimates for the calculation of flux rates. Tensiometers will be used to determine hydraulic gradient for moisture movement in the soil. Suction lysimeters will be used to collect soil pore water samples for contaminant analyses from within and below each hot spot. The information collected from the moisture stations will enable determination of vertical and horizontal flux rates through the tank farm soil and yield information about contaminant mobility and transport.

Soil moisture will be monitored both in background locations outside the tank farm area and within the tank farm. Each background location will have an auger hole drilled to collect site-specific soil data that will be used to calibrate the neutron moisture logging technique. In addition, samples for soil chemistry, moisture, physical properties, and contaminant leaching/absorption tests may be collected during probehole installation.

5.3.3 Contaminant Transport Studies

Contaminant transport data will be used in the fate and transport model to assess both risks and remedial alternatives. Contaminant transport studies are discussed in more detail in Subsection 6.5.1 of this work plan. While it is not anticipated that the contaminant transport study (CTS) will require field investigation materials or data, plans call for the CTS to begin during Phase I. Therefore, the CTS discussed in this subsection.

The anticipated scope of a CTS for the tank farm is to experimentally determine site-specific adsorption and desorption coefficients for OU 3-14 soil COPCs on tank farm geological materials, including soils, interbed materials, and basalts. The CTS provides the background and technical approach for quantifying the sorptive behavior of the COPCs in the OU 3-14 soil.

The CTS will resolve three data needs for the tank farm BRA. These are (1) the release rates of contaminants from sources in the tank farm soil, (2) the vertical profile of retardation capabilities, and (3) the spatial variability of retardation capabilities. Source-release information will be gathered as a result of leach tests conducted on tank farm soil. Retardation capabilities would be carried out on tank farm soil, interbed, and basalt samples for OU 3-14 COPCs identified for the tank farm soil. Existing archived materials will be used to the extent feasible for the CTS. If needed, additional sample locations can be determined and samples obtained during the Phase II field investigation as more information is gleaned from characterization of the tank farm soils.

5.4 Phase II Field Investigation

Scope defined for the Phase II investigation will include the following:

1. Collecting samples to determine composition of contaminated soils

2. Collecting samples for treatability studies

3. Collecting samples of media unavailable in archived cores or soils for use in K_d studies

4. Installing boreholes and collecting samples to resolve any data gaps remaining after the Phase I investigation.

Specific Phase II tasks are discussed below.

5.4.1 Collecting Samples to Determine Composition

Data gaps in the area of composition, as identified in Appendix D, will be resolved by collecting and analyzing samples during the Phase II investigation. Sample locations will be identified after results of the Phase I investigation are reviewed.

Soil samples will be transferred to the INTEC Radiological Analysis Laboratory (RAL). The RAL is anticipated to perform the subsampling and analysis of the soils, within a hot cell environment as needed based on radioactivity present. Sampling strategies and analytical requirements will be presented in detail in the Phase II tank farm soil feasibility study.

Soil samples in high-radiation zones will be collected using either conventional drilling and sampling methods or remote methods. Conventional methods will likely be used if the Phase I data indicate that radiation levels do not pose an unreasonable exposure hazard. At hot spot sites where an unreasonable exposure hazard exists, plans call for radiological data to be collected from the hot spot using in situ methods, and other soil data will be collected adjacent to, above, and/or beneath the hot spot where radioactivity levels allow for sampling and analysis.

5.4.2 Collecting Samples for Treatability Studies

Treatability studies may be required in order to evaluate in situ and ex situ treatment of tank farm soils using grouts or polymers. Tank farm soil treatability studies are discussed in more detail in Subsection 6.5.2. Soil may be collected at CPP-28 and -31 and stored onsite for characterization and feed material for treatability studies. The number and location of samples will be determined based on review of the field data. If required, treatability study samples may either be obtained from excess Phase II chemical characterization samples or from additional cores collected adjacent to Phase II chemical characterization coring locations.

If collected, soil samples will be transferred to the RAL. It is anticipated that the subsampling and analysis of the soil will be conducted within a hot cell environment at the RAL. Sampling strategies and analytical requirements will be presented in detail in the Phase II tank farm soil feasibility study.

Soil samples in high-radiation zones will be collected using either conventional drilling and sampling methods or remote methods. Conventional methods will likely be used if the Phase I data indicate that radiation levels in these zones do not pose an unreasonable exposure hazard. At hot spot sites where an unreasonable exposure hazard exists, it is planned that radiological data will be collected from the hot spot using in situ methods, and other soil data will be collected adjacent to, above, and/or beneath the hot spot.

5.4.3 Collecting Samples for K_d Studies

The conceptual approach for developing contaminant-specific sorption properties (described in Subsection 6.5.1) includes literature studies, bench-scale batch and column tests on actual and surrogate materials, and collection of field calibration data. The approach will be documented in a subsequent detailed test plan. Some tank farm alluvium, interbed, and basalt samples have been archived from past investigations and will be evaluated for possible use in OU 3-14 sorption studies. Depending on the representativeness of these samples, additional soil samples may need to be collected during Phase II.