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CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. Jim Piatt, Bureau Chief
Surface Water Quality Bureau
New Mexico Environment Department
1190 St. Francis Drive
P. O. Box 26110
Santa Fe, NM 87502

1992 NOV -5 PM 3:05
HAZARDOUS WASTE
RCRA PERMITS MANAGEMENT

Dear Mr. Piatt:

On September 15, 1992, Dave McInroy of Los Alamos National Laboratory (LANL) received a letter from your office requesting LANL to develop a Sampling and Remediation Plan for a Solid Waste Management Unit (SWMU) that is located adjacent to a surface watercourse. This SWMU has been identified by LANL's Environmental Restoration Group (EM-13) as SWMU Number 3-010.

The Department of Energy (DOE) and LANL intend to perform a Voluntary Corrective Action to investigate and remove this SWMU ahead of its originally scheduled date.

Enclosed please find a Sampling and Remediation Plan for SWMU Number 3-010. Prior to the start of this activity, DOE is requesting that your office and Barbara Driscoll of the Environmental Protection Agency (EPA), Region 6, supply comments and/or approve of this plan in writing. Because this area is a SWMU, Module VIII of LANL's Resource Conservation and Recovery Act (RCRA) Permit requires that EPA approve of the Plan prior to initiating any final remedy of the SWMU.

Should you have any questions, please contact Mr. Steve Slaten of my staff at (505) 665-5050.

Sincerely,

Joseph C. Vozella

Joseph C. Vozella, Acting Chief
Environment, Safety and Health
Branch

LESH:6SS-052

Enclosure:
See page 2

5407

SAMPLING AND REMEDIATION PLAN FOR MERCURY-CONTAMINATED SOILS AT TA-3-30

Contract Number
9-XS-2-Y5348-1

LOS ALAMOS NATIONAL LABORATORY
Los Alamos, New Mexico

Submitted by

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October 23, 1992

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1.0 INTRODUCTION

This Sampling and Remediation Plan (SRP) is prepared to address the remediation of contaminated soils found at Building TA-3-30 (SM-30) at Los Alamos National Laboratory (LANL). The current understanding is that mercury is the dominant contaminant of concern at the site. The primary objective of the sampling plan is to determine the vertical and lateral extent of the mercury contamination and provide the data that will be used to select and implement a remedial action at the site.

LANL's objectives are understood to be

- to determine the extent of the mercury contamination at Solid Waste Management Unit (SWMU) 3-010(a), TA-3-30;
- to evaluate remedial alternatives for cleanup of mercury-contaminated soils and to select an alternative for immediate implementation; and
- to verify that there are no releases from the site that will cause water quality standards to be exceeded at the conclusion of remediation.

This SRP is organized in the following manner:

Section 2.0 provides a description of the site, a brief summary of the regulatory issues, and a summary of the results obtained from previous sampling and analysis conducted by LANL at this site.

Section 3.0 describes the fate and transport pathways and the remedial objectives that apply to the contamination found at the site. These remedial objectives will quantify the cleanup level at the site. Section 3.0 also presents an evaluation of the remedial alternatives applicable to the site. These remedial alternatives are given a preliminary screening to identify the candidate alternatives, which are the alternatives having the greatest possibility of successful implementation at the site.

Section 4.0 contains a sampling plan that describes the numbers, locations, and types of samples that will be collected and the analytical procedures that will be followed.

Section 5.0 describes how the data collected during sampling will be used to achieve LANL's objectives. Section 5.0 also describes how the alternatives identified in Section 3.0 will be evaluated and analyzed and how the selected alternative will be implemented.

The appendixes contain the results of previous sampling and analysis, the Quality Assurance Project Plan, the Health and

Safety Plan, the Data Management Plan, and the Standard Operating Procedures (SOPs) that will control site characterization and remediation.

2.0 BACKGROUND

This section provides a brief history of the site and a summary of the results of recent soil and sediment sampling at the site. Subsection 2.1 summarizes the site history and regulatory involvement; Subsection 2.2 summarizes the results of the previous sampling.

2.1 History of the Site

The site, as shown in Figure 2-1, was historically used for disposal of waste vacuum pump oil, some of which was contaminated with mercury. Disposal occurred by dumping the waste oil on the ground surface. Later, oil was pumped from Building TA-3-30 and discharged from a pipe to the ground surface. The disposal area is located at the top of a slope that drains to an ephemeral stream channel flowing to Twomile Canyon. The disposal area appears to be at the top of a drainage feature leading toward the stream channel, a total area of less than 300 square feet. The site is listed as SWMU 3-010(a) under the Resource Conservation and Recovery Act (RCRA) and is being addressed by the LANL Environmental Restoration (ER) Program.

Recent erosion of soil has exposed significant and visible amounts of mercury. The mercury appears as small globules at the soil surface. In response, LANL initiated preliminary remedial actions to control and contain contamination at the site and to prevent any additional exposure of subsurface contaminants. These actions included sampling to define the area of contamination, diversion of run-off away from affected areas, and covering the site with impervious materials to prohibit further erosion of contaminated soil.

Although the site is being addressed by the ER Program under RCRA, the site is also regulated by the New Mexico Water Quality Control Commission (WQCC). WQCC Regulation Section 1-203.A requires that as soon as possible after learning of a discharge, the owner/operator of a facility takes the corrective actions necessary or appropriate to contain and remove or mitigate the damage caused by the discharge. Further, the discharger must submit a corrective action report to the New Mexico Environment Department (NMED) after learning of the discharge. The corrective action report will be reviewed for approval by the NMED.

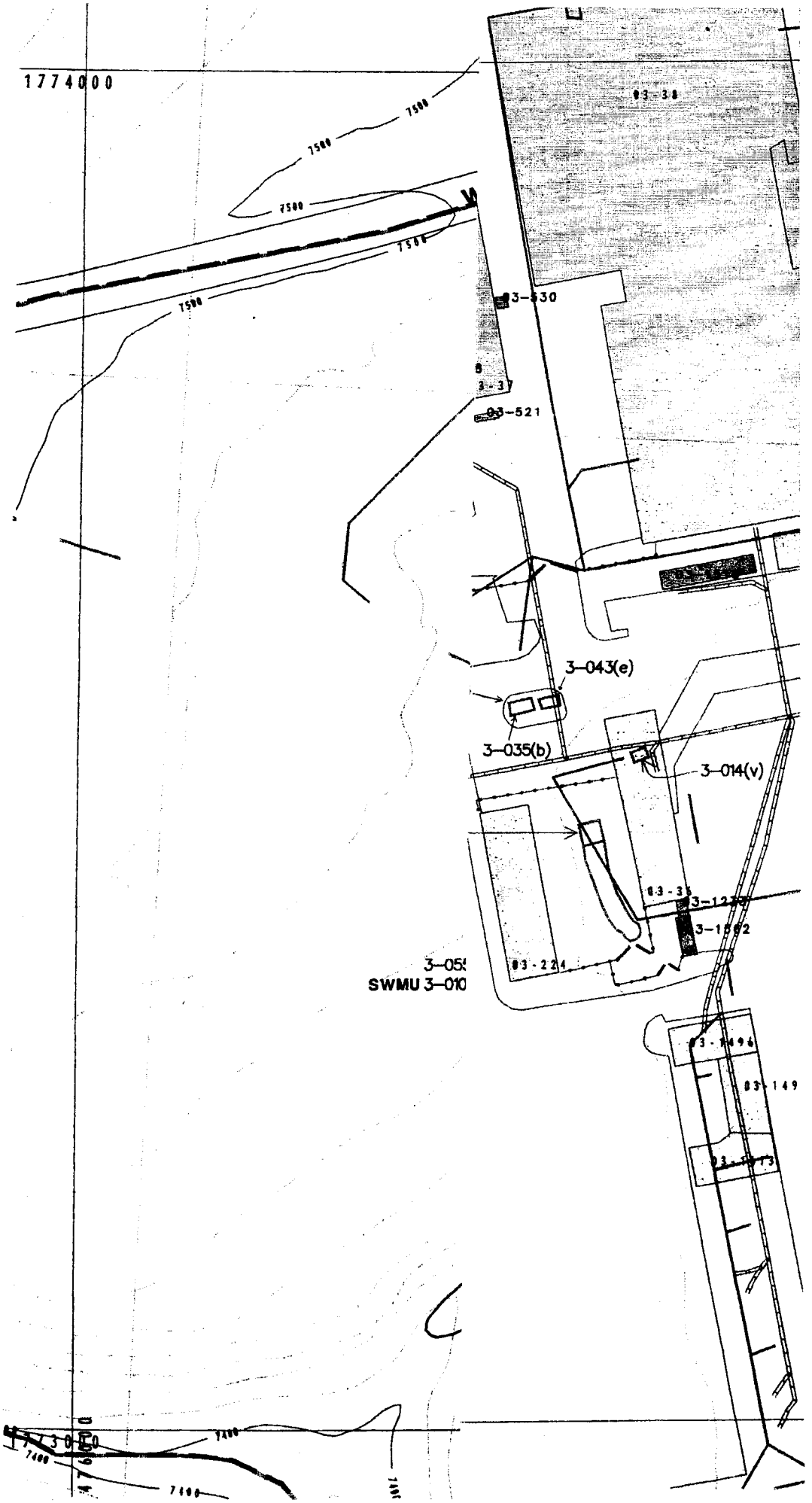


FIGURE 2-1. LOCATION MAP OF MERCUR

This SRP is being prepared in response to the requirements of the WQCC. Because the site is also a SWMU, actions taken to investigate and remediate the site will also be consistent with the requirements of the ER Program.

2.2 Results of Previous Investigations

To gain a better understanding of the contamination present at the site, LANL collected soil and sediment samples at five locations on August 26, 1992. The locations of the samples are shown on Figure 2-2. Sample 1 was collected at a depth of 0 to 3 inches in an area of obvious mercury contamination. Sample 2 was collected at a depth of 0 to 3 inches at a location approximately 27 feet downslope of Sample 1. Sample 3 was collected at the sediment/tuff interface in the stream channel downslope of Sample 2. Samples 4 and 5 were collected at the sediment/tuff interface at locations approximately 45 and 63 feet, respectively, downstream from Sample 3.

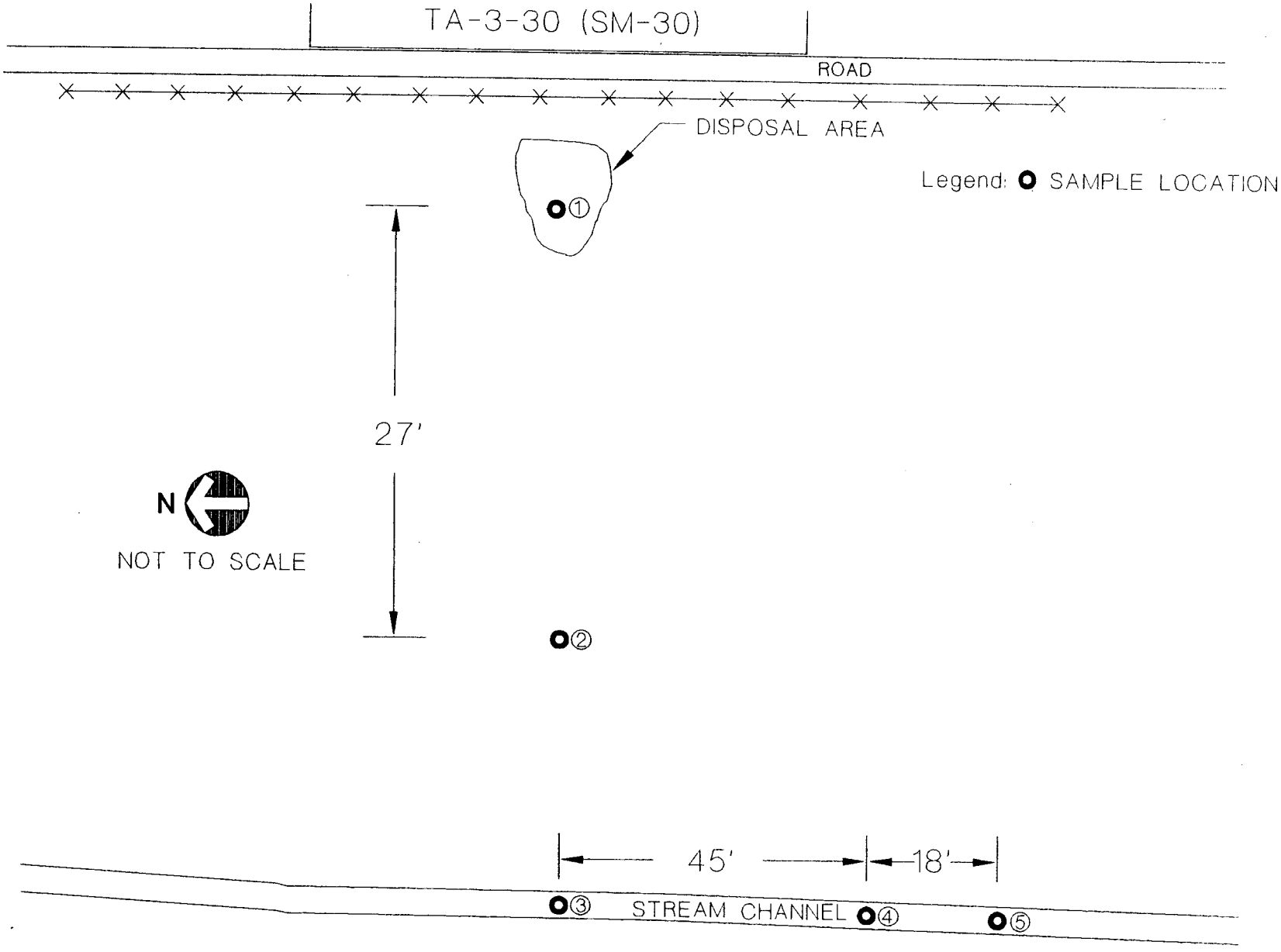
Sample 1 was analyzed for a full range of contaminants because of its location in the waste disposal area. This sample was analyzed for total mercury, total beryllium, toxicity characteristic leaching procedure (TCLP) metals, total uranium, isotopic plutonium, tritium, volatile organic compounds, total petroleum hydrocarbons (TPH), and polychlorinated biphenyls (PCBs). The remaining samples were analyzed for heavy metals and radionuclides.

The mercury concentrations in Samples 1 through 5 were 13,500, 1.7, 1.9, 0.05, and 0.002 mg/kg, respectively. TPH was present in Sample 1 at 37,000 mg/kg. Complete analytical results are provided in Appendix A. These results confirm that mercury is the contaminant of principal concern at the site. Organics and PCBs are below ER Program action levels. Elevated levels of TPH were detected at the disposal area (Sample 1). Preliminary results of radiological analysis indicate elevated levels of plutonium-239 and tritium in Samples 1, 2, and 3.

3.0 INITIAL EVALUATION

This section discusses the conceptual site model, the remedial objectives, and a preliminary evaluation of the remedial alternatives. Subsection 3.1 discusses the conceptual site model and the potential migration and exposure pathways. Subsection 3.2 presents the remedial objectives that the selected remedial alternative will have to meet. Section 3.3 contains a preliminary evaluation of the remedial alternatives.

FIGURE 2-2. LOCATION OF EXISTING SAMPLES



3.1 Conceptual Site Model

Conceptual site models describe the potential sources of contamination, potential migration pathways for contaminants released from the source, and subsequent human health and biota exposure points and pathways. The conceptual site model serves as a basis for planning the proposed field investigations.

Figure 3-1 presents the conceptual site model and exposure pathways and potential receptors for the contaminants found at TA-3-30. Only a limited number of potential migration and exposure pathways are considered to be significant at the site. The relative significance of each exposure pathway is indicated on the site model. The exposure pathways deemed significant include the dominant scenarios for risk assessment. Accordingly, if acceptable risk levels can be demonstrated for these pathways, then acceptable risk levels will be met for all exposure pathways.

A brief description of each column in Figure 3-1 is provided below.

- The source is the potential mode for release of contamination into the migration pathways.
- The Migration Pathway is the environmental pathway by which contaminants may move from source to receptors (e.g., mercury may volatilize).
- Exposure is the precise mechanism by which exposure occurs (e.g., ingestion of soil).
- Receptors are human and other receptors that may come in contact with a contaminated environmental medium (e.g., site workers having direct dermal contact with contaminated soil during excavation).
- Relative Significance is the anticipated importance of the identified exposure pathway relative to other exposure pathways at the site (e.g., the potential significance of exposure to contaminated soil may be high relative to exposure from ingestion of contaminated groundwater).

The dominant exposure pathways are expected to be dermal contact with or ingestion of soil material and exposure to volatilized mercury. Mercury has a relatively high vapor pressure (0.0018 mm at 25°C), and volatilized mercury could be inhaled by workers in the vicinity of the site. As an interim measure, volatilization

Figure 3-1

Conceptual Site Model for TA-3-30

Source	Migration Pathway	Receptors					Relative Significance
			<----Humans---->		<-----Biota---->		
Soil		Exposure	Residents	Visitors	Terrestrial	Aquatic	
	Volitilization/ Wind	Ingestion	•	•	•		Moderate
		Inhalation	•	•	•		
		Dermal	•	•	•		
	Soils/ Sediments	Ingestion	•	•	•		Moderate
		Dermal	•	•	•		
	Surface Water Run-off	Ingestion	•	•	•	•	Low
		Dermal	•	•	•	•	
	Percolation to Water Table	Ingestion	•	•			Low
		Dermal	•	•			

has been reduced by covering the site with plastic. This covering should also serve to reduce volatilization of any organic compounds found at the site. Mercury is a potential health risk through dermal exposure and ingestion. This ingestion pathway will drive a risk-based standard for mercury in soils.

Infiltration to groundwater is not expected to be a major exposure pathway. Elemental mercury is relatively insoluble and has a high surface tension. The high surface tension impedes the mercury from wetting the soil surface and migrating through the vadose zone. The high surface tension was evident during the site visit. The mercury was observed as tiny silver droplets in the surface soils. Based on the low solubility and high surface tension, it is not anticipated that extensive migration of mercury into the subsurface environment will occur. Further, infiltration at the site is expected to be low and should minimize the potential for vertical migration. If data collected during sampling indicate vertical migration of mercury, the conceptual model will be modified.

The low solubility and high surface tension of mercury also reduce the potential for exposure from surface water run-off. The initial sampling results are consistent with this model. The concentrations of mercury in soil and sediment decrease rapidly with distance from the disposal area. Concentrations in the sediment sample furthest down the stream channel appear to be within the background range for mercury.

3.2 Remedial Objectives

The results of the conceptual model evaluation suggest general objectives that must be addressed at the site. The first is protection of human health from exposure to mercury in contaminated soil. The second is protection of surface water quality downstream from the site. These objectives will be addressed through use of applicable standards for mercury in environmental media. Although preliminary results indicate elevated levels of several radionuclides at this site, the ER Program has not yet established cleanup levels for radionuclides. As a result, specific remedial objectives for radionuclides will not be addressed at this time. Levels of radioactivity remaining after cleanup of the mercury-contaminated soil will be characterized. Additional remedial actions related to radionuclides may be required under the ER Program at a future date.

Mercury levels in soil that are protective of human health can be established through performing a detailed, site-specific human health risk assessment. A conservative cleanup standard can be applied in lieu of performing a quantitative risk assessment because the site is relatively small and easily accessible for

remediation. Because this site is a SWMU, the screening action levels (SALs) contained in the Installation Work Plan (IWP) for Environmental Restoration at LANL were considered in selecting a cleanup level. The SAL for mercury in soil in the 1992 IWP is 80 mg/kg (LANL 1992, 0768). The SALs were developed on the basis of conservative assumptions for human exposure, assuming a residential scenario. While this level for cleanup is overly conservative, it will be used for a site of this magnitude and will ensure that the site is remediated to comply with NM WQCC Regulations.

Levels of mercury in water that are protective of the environment are contained in the water quality standards developed by the WQCC. The applicable standard for mercury in water discharged is 2 ug/L (WQCC Regulations, Part 3, August 18, 1991). This water quality standard cannot be directly related to an equivalent concentration of mercury in soil. As a result, compliance with the water quality standard will be evaluated at the conclusion of site remediation by monitoring water quality downstream of the site during periods of run-off, rather than by establishing a soil cleanup level.

The New Mexico WQCC Regulations also prohibit disposal of refuse in a watercourse (WQCC Regulations, Part 2, August 18, 1991). The remedial objectives for the site will, therefore, address removal from the watercourse of all waste material at the site.

The sampling and analysis strategy described in Section 4.0 proposes analyzing for metals other than mercury at highly contaminated areas. If any of these metals are present above their corresponding SAL in the IWP, the cleanup level for each will be established to ensure that the water quality standard for these metals will be met in water downstream from the site.

In summary, the following remedial objectives will apply to this site:

- prevent human exposure to all soils contaminated with mercury at a level above 80 mg/kg;
- prevent migration of mercury or other metals from the site at levels that would cause water quality standards to be exceeded downstream of the site; and
- remove waste from watercourses at the site.

3.3 Preliminary Evaluation of Remedial Alternatives

The objective of this section is to provide a preliminary identification of the technologies that are applicable and may be implemented at TA-3-30. Screening criteria are used to reduce the applicable remedial technologies to candidates with the most

promise for success at the site. In the following discussion, applicable is used to refer to the suite of remedial technologies that could be used at the site, candidate is used to refer to the reduced set of promising technologies, and appropriate is used to refer to technologies recommended for further consideration and possible implementation at the site. This preliminary identification of candidate remedial technologies has been developed to determine data needs for the various alternatives. The information is based on past experience that will be specifically referenced when data evaluation is complete.

The appropriate technologies listed in this section are those that are thought most likely to be successful, given the current state of knowledge about the site. The upfront determination of the data needs of the various technologies allows the appropriate data to be collected as the field work is performed; thereby reducing the likelihood of having to return to the field to collect additional data once the final remedial technologies to be employed are known. If the field data collected as part of this investigation suggest that alternative technologies may be more promising, additional data needs may be identified.

3.3.1 Description of Chemical Contamination Requiring Treatment

Based on preliminary sampling and site history, mercury is expected to be the contaminant of principal concern at the site. High levels of total petroleum hydrocarbons have also been identified. Additional sampling and analysis will focus on mercury and other inorganic constituents and the total petroleum hydrocarbons. Radionuclides will also be analyzed, but this analysis will be to characterize residuals rather than evaluate cleanup alternatives. Based on the previous sampling, site history, and site visits, the contamination appears to be restricted to a hot spot where direct discharges occurred. These discharges came from a pipe and, prior to the installation of the pipe, from hand disposal.

3.3.2 Discussion of the No-Action Alternative

From an assessment of the types of contamination present at the site, it is concluded that mercury is present at concentrations that could potentially pose a threat to human health or the environment. Mercury levels in the soil are of concern because of their potential for direct contact (ingestion of soil) or volatilization into the air pathway (inhalation). Soil concentrations of mercury are well above the SAL; therefore, it appears that the no-action alternative would result in unacceptable levels of risk.

3.3.3 Identification of Applicable Technologies

Three general classes of response actions have been identified for this site. These classes are removal and treatment/disposal, isolation, and in situ treatment. Technologies within these classes were reviewed to identify those that were applicable to the contaminants at this site, namely mercury and petroleum hydrocarbons. These technologies and applicable contaminants are identified in Tables 3-1 through 3-3.

Table 3-1
Summary Table of Applicable Remedial Technologies for Removal and Treatment/Disposal

Remedial Technologies	Applicable Contaminants
Excavation and off-site disposal	Mercury/petroleum hydrocarbons
Excavation and stabilization	Mercury/petroleum hydrocarbons
Excavation and thermal treatment	Mercury/petroleum hydrocarbons
Excavation and soil washing	Mercury/petroleum hydrocarbons

Table 3-2
Summary Table of Applicable Remedial Technologies for Isolation

Remedial Technologies	Applicable Contaminants
Containment with low-permeability walls	Mercury/petroleum hydrocarbons
Surface covers	Mercury/petroleum hydrocarbons
Bottom sealing through grouting	Mercury/petroleum hydrocarbons
Bottom sealing through block displacement	Mercury/petroleum hydrocarbons
Ground freezing	Mercury/petroleum hydrocarbons

Table 3-3
Summary Table of Applicable Remedial Technologies for In Situ Treatment

Remedial Technologies	Applicable Contaminants
Soil washing	Mercury/petroleum hydrocarbons
Vitrification	Mercury/petroleum hydrocarbons
Soil heating	Mercury/petroleum hydrocarbons
Vapor extraction	Mercury/petroleum hydrocarbons
Electroreclamation	Mercury
Stabilization	Mercury/petroleum hydrocarbons

The applicability of an individual remedial technology is determined by the nature of the contamination. Both inorganic and organic contaminants are found at this site. For the purposes of a preliminary identification of remedial alternatives, technologies that address contaminated soils have been identified. The remedial objectives for meeting water quality standards will be met by removing contamination sources rather than through cleanup of water. Technologies that address contaminated water were, therefore, not addressed.

3.3.4 Identification of Candidate Remedial Technologies

In this section, the applicable technologies provided in Tables 3-1 through 3-3 are reduced by the use of screening criteria to provide a list of candidate technologies. This screening is performed to be consistent with the procedures in the IWP. The candidate technologies are further reduced to the technologies deemed most appropriate for the site. These appropriate technologies are judged to have the greatest promise for success at this site. The list of appropriate technologies may change as the field work advances. The technologies are reduced to those thought to have the highest likelihood for use at the site so that the data requirements of these technologies can be satisfied with data generated through implementation of the work plan.

Even a preliminary screening of the many possible response actions requires formulation of remedial action goals and objectives. Remedial objectives were identified in Subsection 3.2. In addition to these primary goals, there are a number of other goals that must be considered. Generally, these secondary goals address the relative desirability of response alternatives.

After specific goals related to the remedial action are identified, criteria are developed to provide a means of

assessing whether these goals are being met. This assessment can be made less subjective if the criteria can be expressed in quantitative terms. The screening criteria are technical effectiveness, implementability, and cost-effectiveness, as discussed below.

Technical Effectiveness. Technical effectiveness criteria are based on the ability of an alternative to meet remedial action goals. Only technologies capable of meeting the remedial objectives developed in Subsection 3.2 with an acceptable level of risk are considered. Therefore, consideration of technical effectiveness is determined by the uncertainty involved in meeting these objectives, i,e., the reliability of a technology.

A general goal should be to select methods that are effective in meeting the remedial objectives with a high degree of certainty. The ability of an alternative to meet the objectives should be assessed by comparison of required performance with typical or expected performance. Assessment of effectiveness is expressed by the following criterion:

> The required technical performance of a remedial action should be within the typical range of operating performance for that alternative.

Implementability. Implementability criteria should address site-specific conditions that may impact implementation of the remedial action. Typically, implementability concerns result from requirements for materials or conditions that may not be present at the site. Remedial alternatives should generally be chosen that do not require materials or conditions not readily available at the site. This goal is reflected in the following criterion:

> The selected remedial technology should not be significantly impacted by site conditions or resources.

Cost-Effectiveness. Cost criteria are based on the overall cost of implementing a response action. In general, it is desirable to select the response action with the lowest overall cost. Because other important factors may be overlooked if decisions are based solely on cost, selections should be based on cost-effectiveness. Cost-effectiveness considers cost as well as technical feasibility, reliability, technical performance, and environmental protection.

This section is not meant to be a feasibility study, and no detailed cost analyses have been performed. Cost has been taken into consideration only in a general way to arrive at the technologies that have the greatest possibility for use and success at the TA-3-03 site.

A goal of response action selection should be to minimize cost while meeting all other goals. This goal is expressed in the following criterion:

> The most cost-effective alternative should be selected for implementation.

The candidate technologies are given below. Candidate technologies were identified through application of the three criteria to the list of applicable technologies listed in Subsection 3.3.3. The list of candidate technologies does not include institutional actions. Institutional actions protect public health and the environment by restricting site access and restricting future use. The data needs required for institutional actions are believed to be encompassed by the data needs of the preferred technologies. The data required to evaluate each technology and a summary of the data needed to address all the candidate technologies are discussed in Subsection 4.1.

Candidate technologies identified as having the greatest potential for application at the site are stabilization, excavation/removal, soil washing, capping, and thermal treatment. These technologies are described below. Information concerning the effectiveness and cost of the various alternatives was taken from a recent evaluation of technologies for cleanup of mercury-contaminated soils at the Department of Energy's Y-12 plant (Chatterjee and Moore, 1992).

Stabilization. Stabilization refers to treatment processes that physically and/or chemically immobilize contaminants in place. Other terms sometimes used interchangeably with stabilization are fixation, solidification, and encapsulation. Selection of materials or reagents for stabilization depends on such factors as the availability of raw materials, cost, the process vendor's proprietary position, and the treatability and compatibility of the waste with the reagents. Reagents that are often used to treat wastes are

- portland cement alone;
- portland cement/fly ash;
- lime/fly ash alone; and
- sodium silicate/portland cement or lime.

These reagents, however, are not appropriate for mercury-contaminated soils. Immobilization of mercury in the soil or waste matrix should generally be considered only when recovery is either impossible or impractical; however, it is often the preferred alternative from the standpoint of convenience and

short-term cost perspective. Several proprietary immobilization and stabilization processes for mercury treatment with demonstrated effectiveness in soils and sludges have been identified by the U.S. Environmental Protection Agency (EPA). These techniques are generally based on chemical fixation principles and involve mixing of contaminated soils with proprietary chemicals.

The EPA has recommended that these processes be employed only when recovery of mercury is impossible or inadvisable because of radioactive or other harmful contamination. Absorption technology employing calcium polysulfide with zinc dust and sulfuric acid has been found to be an excellent immobilization technique that produces insignificant mercury emissions to the air. In Japan, stabilization/solidification with sodium sulfide and ferrous chloride has been considered a basic treatment method for soils contaminated with greater than 10 mg/kg of mercury. It is estimated that this technology could cost approximately $150 to $200 per ton for the immobilization of mercury-contaminated soils.

Stabilization can occur in place, on site, using transportable process equipment, or at a fixed-base disposal facility. Equipment requirements are largely determined by the type of mixing employed. All systems consist of the following steps:

- mixing the waste with the treatment ingredients;
- allowing time for the absorption, gelling reaction, or curing to take place; and
- disposing of the solidified product.

In situ mixing of reagents and waste has primarily been used for the closure of ponds or lagoons; however, in situ site closures have been performed on soils. In situ mixing of reagents with soils has been accomplished using pneumatic vibrating fingers that feed and inject the solidifying reagents into the waste. The mixture is allowed to cure and remain in place. An alternative in situ technique uses a giant auger that mixes soils and reagents. The auguring process is repeated until the entire contaminated volume is treated. In situ stabilization using the reagents identified as appropriate for mercury is a viable alternative.

If the solidified waste is returned to the excavation site for disposal, increases in waste volume after treatment must be taken into account. Volume increases may vary from 10 to 100 percent.

Excavation/Removal. Excavation and removal of contaminated soils is a well-developed and well-understood technology. Successful implementation relies on standard excavating equipment, vehicles

to transport the excavated soil, and a permitted facility for treatment/disposal.

Excavation and redisposal is not generally a preferred option for cleanups under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Specifically, this approach does not comply with statutory requirements for treatment to reduce volume, toxicity, and mobility. Furthermore, excavation and removal of contaminated waste to a hazardous landfill presents the potential for adverse environmental effects caused by exposure to the excavated material and raises the probability of releases resulting from transportation accidents.

Excavation, transport, and storage of contaminated waste presents a number of potential problems with respect to implementation. Several additional investigations are needed to address the associated engineering considerations and needs.

Excavation of the contaminated soil presents health and safety concerns. Because of the potential hazard posed by inhalation of contaminated dust, respiratory protection may be required for all site workers. In addition, dust-suppression activities would have to be employed to prevent the spread of contaminated dust to surrounding areas.

Transportation and disposal regulations stipulate the absence of free liquids in waste materials. The truck beds on the trucks used to haul material would have to be lined and covered to prevent contaminated soil from escaping during transportation. Trucks would have to be decontaminated after loading and before leaving the site. Transportation regulations would dictate the size of trucks and loads that could be used.

Soil Washing. Soil washing is a physical and/or chemical process whereby contaminants are removed from soils. The soils are contacted with liquid reagents to accomplish the washing process. This technique can be carried out in equipment that is designed for contacting excavated soil with the liquid, or the washing can be carried out in situ by applying or injecting the liquid into the contaminated soil. After contact with the soil, the washing solution is extracted and treated for removal of the contaminants. After the contaminants are removed from the washing solution, the solution is available to wash additional soils. In some cases, multiple washings are required to reduce the contaminants to acceptably low levels. In cases where the soil is excavated before washing, the decontaminated soil is redeposited in the excavation area.

An understanding of two basic mechanisms by which contaminants are held within the soil matrix is needed for effective soil washing. First, contaminants can be held on the surfaces of soil particles through adsorption processes. Second, precipitated

contaminants can be retained within the interstices of the soil particles. The relative influence of these two mechanisms of contaminant retention may vary considerably from site to site, depending on site-specific conditions. Removal of contaminants from the soil matrix is accomplished by physical displacement of loosely held contaminants, by desorption of more tightly retained contaminants, and by dissolution of precipitated contaminants.

The most important parameters that influence the effectiveness of soil washing techniques are the organic matter content, the initial water content, the particle size gradation of the soil, and the contaminant type for a given soil matrix. Organic materials have large surface areas that act as adsorption surfaces; therefore, high organic matter content makes it more difficult to remove contaminants from the soil by a washing procedure. Coarse soils (i.e., sandy) facilitate the removal of contaminants through soil washing.

Acid leaching solubilizes low concentrations of mercury in wastes/soils. In certain situations, chemical oxidation is conducted first to release the mercury, followed by sludge dewatering and acid washing to convert all mercury to a soluble ionic form in the leachate, which requires treatment by chemical precipitation. This technology has been examined in detail by the EPA and is an appropriate best demonstrated available technology (BDAT) for wastes or contaminated soils containing less than 260 mg/kg mercury. Acid leaching of incineration residues also is an effective method for removing mercury from such residues.

Acid leaching of mercury-contaminated soils will require laboratory- and field-scale testing. Preliminary assessment indicates that the cost of such treatment may range between $200 to $250 per ton, depending on the nature of the required chemical oxidation and precipitation processes. A more detailed laboratory investigation is needed to analyze the application of this technology.

Extraction of metal contaminants, such as mercury, from soils can be conducted by complexing agents like anhydrous ammonia. Ammonia is an excellent complexing agent for metals in aqueous solution. Its strong tendency to donate a pair of electrons to a central atom (Lewis Basicity) makes ammonia a good ligand for coordination with metal ions. It is also a low-cost extractant ($0.05/pound in fertilizer grade) with low cylinder pressure (115 psig at 22°C) and ample availability.

A recent study shows that approximately 26 percent of the spiked mercury could be removed by anhydrous ammonia in batch Soxhlet Extraction tests. The results were verified by the commercially available Supercritical Extraction screening system. The available experimental data clearly indicate the need for

investigating potential extraction-enhancing ligands and other extractants to improve the performance of this technology.

The implementability of soil washing as a technique for cleaning contaminated soils depends on the ability to effectively carry out the following steps:

- contact the soil particles with the washing solution;
- flush and desorb contaminants from soil;
- recover wash solution following contact with soil;
- separate the contaminants from the washing solution;
- recycle washing solution for additional contaminant removal; and
- dispose of the concentrated contaminant waste.

In situ soil washing is often considered more economical than excavation and ex situ washing because the excavation phase of the soil washing procedure is eliminated. However, the savings in excavation costs may be negated by longer cleanup times and the cost involved in reclaiming injected solutions.

Capping. The purpose of surface covers (caps) is to reduce the percolation of water through the waste unit. The cover also acts as a physical barrier to keep subsurface wastes isolated from the environment, thereby preventing fugitive-dust migration. Caps are constructed out of relatively impermeable materials in a single (asphalt) or multiple-layer (clay) design. Caps are usually dome-shaped and include a capillary transport barrier and provisions for run-off control. Caps often contain features to protect them against erosion or intrusion from deep-rooted plants.

A cover reduces the infiltration of precipitation. Preventing water from contacting the contaminated soils will help soil contaminants remain in place. If an extract test, such as the extraction procedure (EP), TCLP, or water extraction, is the criterion by which the effectiveness of the remedial action is measured, then the cover alternative may not be judged effective for certain areas. The cover material will not change the waste characteristics; therefore, contaminated soils that currently have the EP or TCLP characteristic of toxicity will retain that characteristic under a cover. A cover helps preclude the possibility of a storm providing sufficient moisture to cause contaminant migration. Thus, a cover provides an added measure of assurance over the no-action alternative.

The convex shape of the cover aids in conveying precipitation away from the contaminated zone boundary. Gentle slopes are used to control water run-off velocity and minimize erosion. An outer layer of soil is sometimes used to support the growth of shallow-rooting grasses for wind and water erosion control. An inner compacted clay layer is typically placed to achieve a permeability of 10^{-7} cm/second or less to resist water infiltration from the soil layer. Sand and/or gravel layers or a synthetic drainage net may be placed between the soil and clay layers if the cover is extensive. The sand and/or gravel layers facilitate run-off from the soil layer. If burrowing rodents are a potential problem, a barrier may be incorporated in the cover. A barrier typically consists of a 1.5- to 3-foot layer of riprap over the compacted clay layer. A flexible membrane liner may also be included in the cap to further decrease infiltration of surface water.

Thermal treatment. A recent EPA study has determined that retorting or roasting technology can serve as an effective BDAT for high mercury-containing wastes, i.e., more than 260 mg/kg of total mercury. These technologies are employed by the chloralkali industry in the United States, Europe, and Japan. A vertical multistage roasting furnace (Herreshoff Furnace) was used in Japan to treat and recover mercury from 3,600 tons/year of contaminated soil. The roasting furnace was equipped with condensers (to recover mercury), flue-gas cleaning devices, and a chelate-resin water treatment system, operated in compliance with environmental standards.

Mercury is a volatile metal possessing significant vapor pressure below 1000°C. Since emission control is technically difficult and costly, it is not recommended to incinerate wastes with high concentrations of volatile metals. For materials containing high concentrations of volatile metals, the recovery by retorting or roasting is considered to be an effective and promising treatment option that is clearly applicable to mercury. Pyrolysis and infrared thermal destruction could, however, reduce the mobility of these metals by binding them into solid residues.

The on-site rotary kiln is considered to be an immature technology for controlling gaseous mercury emissions. The EPA has observed that the multiple-hearth furnace provides better control over residence time and eliminates short-circuiting; hence, its performance is superior to the rotary kiln. The cost of soil roasting was reported to be approximately $300/ton for a demonstration project in Japan.

3.3.5 Secondary Screening of Technologies

The five technologies described in Subsection 3.3.4 were screened with respect to the three screening criteria. The results of this screening are described below and summarized in Table 3-4.

Table 3-4

Summary of Screening of Remedial Technologies

Technology	Effectiveness	Implementability	Cost	Conclusion
Stabilization	Effective when combined with excavation.	Could be implemented using commercially available equipment. Effectiveness with site soils must be verified.	Moderate to high	Selected for further consideration with excavated soils.
Excavation/ Removal	Effective in meeting all objectives, but must be combined with treatment and/or disposal.	Readily implementable.	Low	Selected for further consideration in combination with soil treatment or disposal.
Soil Washing	Effective in situ or ex situ application. Ex situ is the more reliable alternative.	Implementable using commercially available equipment. Effectiveness with high mercury levels must be proven.	Moderate to high	Selected for further consideration with excavated soils.
Capping	Not effective in removing waste from watercourse.	Readily implementable.	Low	Do not consider further due to ineffectiveness.
Thermal Treatment	Effective when combined with excavation. BDAT for soils with high concentrations.	Availability of treatment facility must be determined.	High	Selected for further consideration with excavated soils.

Stabilization. In general, stabilization has been found to be an effective treatment for immobilizing mercury. Stabilization could be implemented in situ or ex situ. In situ application would not meet the remedial objective for removal of wastes from a watercourse. Ex situ stabilization would be effective in combination with excavation.

Stabilization could be implemented at the site using commercial transportable treatment equipment. The effectiveness of stabilization with the specific contaminants found at the site would have to be verified.

The cost of stabilization is expected to be moderate to high.

Excavation/Removal. Excavation/removal of contaminated soils would be effective in meeting all of the remedial objectives. Excavation could be implemented at the site using readily available equipment, such as a backhoe. Excavation is a low-cost technology. Based on this screening, excavation was retained for further consideration.

It is important to note that excavation would have to be combined with treatment and/or disposal. Because of the high levels of mercury present in the excavated material, the material would have to be managed as hazardous waste or mixed waste, and some type of treatment would be necessary before disposal.

Soil Washing. Soil washing (acid leaching) is the BDAT for mercury-contaminated soils with concentrations less than 260 ppm. Soil washing could be implemented in situ or ex situ. While both alternatives could be effective in meeting all remedial objectives, ex situ is preferred because of greater reliability. Ex situ washing would have to be combined with soil excavation.

Soil washing could be implemented at the site using commercial transportable treatment equipment. The effectiveness of soil washing with high mercury concentrations, such as are found at the site, has not been demonstrated; however, appropriate chelating and washing agents may be effective in significantly reducing mercury concentrations.

The cost of soil washing is expected to be moderate to high.

Capping. Capping would not be effective in meeting all of the remedial objectives. While capping could prevent exposure, it would cause waste to remain in the watercourse. For this reason, capping was eliminated from further consideration after discussions with NMED. Capping could be readily implemented at the site and would constitute a low-cost technology.

Thermal Treatment. As discussed previously, the BDAT for soils with mercury concentrations greater than 260 mg/kg is thermal

treatment. Combined with excavation, thermal treatment would be effective in meeting remedial objectives. The use of thermal treatment will depend on finding an acceptable facility within a reasonable distance and the costs associated with this technology. Thermal treatment is generally considered to be more expensive than soil washing or stabilization.

Summary. Based on the screening analysis, excavation of contaminated soils is selected as the only technology that would be effective in meeting all remedial objectives. The three treatment technologies (stabilization, soil washing, and thermal treatment) will be considered for treatment of the excavated soils before their disposal.

4.0 SAMPLING PLAN

This section presents a specific plan for sampling and analysis at SWMU 3-010(a). First, specific data needs that will be met by sampling and analysis are identified; the specific strategy for sampling is then described, followed by identification of analytical methods.

4.1 Identification of Data Needs

The initial evaluation of data presented in Section 3.0 has allowed identification of data needs to be addressed in the sampling plan. Specific data needs are related to refining and confirming the conceptual site model, determining whether remedial objectives will be met, and evaluating remedial alternatives. These data needs are discussed in more detail in the following paragraphs.

The conceptual site model indicates that significant mercury contamination is confined to a limited area, both horizontally and vertically, around the disposal point. Data describing the horizontal and vertical extent of mercury contamination in soil are needed to verify this model. Specific data needs are the concentrations of mercury in soil samples collected around the source. Specific sample locations are described in Subsection 4.2.

The conceptual model also indicates that mercury has not migrated to any appreciable extent down the channel below the site. Data describing the concentration of mercury in sediment samples downstream of the site are needed to verify this model. Mercury concentrations in sediments upstream from the site are also needed to verify the absence of other sources. Locations of samples in the stream channel are described in Subsection 4.2.

The remedial objectives described in Subsection 3.2 are based on the conceptual model and the pathways of concern identified in

the model. Verification of the model will serve to assure that these remedial objectives will result in protection of human health and the environment. The data collected to define the concentrations of mercury in soil around the site will indicate the extent of soil contamination that exceeds the levels identified in the remedial objectives.

The remedial objectives also require that water quality standards not be exceeded in surface water downstream from the site. Concentrations of mercury and other identified contaminants in surface water are needed to verify that this objective has been met.

The preliminary evaluation of remedial alternatives identified several technologies that may be implemented. Data needed to evaluate these technologies are summarized in Table 4-1. Some of these data are already available; other data will be collected through the sampling activities.

In general, the area, volume, and depth of soil contaminated above cleanup levels will be needed to evaluate and implement the excavation alternative. Evaluation of all options for treatment of the excavated soil will depend on the levels of contamination found in the soil. Each treatment alternative will also require specific data related to the effectiveness of the alternative. Waste characteristics of interest include TPH and total metals.

These data needs will be met through collecting samples to define the vertical and horizontal extent of mercury contamination in the soil. These samples will be analyzed for toxic metals, including mercury and TPH. As described earlier, it will also be necessary to characterize the amount of radiological contamination remaining, if any, after cleanup of the mercury-contaminated soils. This information will be evaluated after establishment of cleanup levels for radionuclides to determine if additional remedial actions are needed. For this reason, samples will also be analyzed for gross alpha, beta, and gamma radioactivity, tritium, isotopic plutonium, and cesium-137.

4.2 Sampling Strategy

As described in Subsection 4.1, most of the data needs are related to establishing the horizontal and vertical extent of soil contamination. Key elements of the sampling strategy developed to satisfy these data needs include

- establishing a grid on the hillside between the fence and the stream channel to collect horizontally distributed samples;

Table 4-1

Summary of Data Needs for Remedial Technologies

Technology	Data Needs
Excavation/Removal	• Moisture content • Geologic characteristics • Topography • Horizontal and vertical extent of contamination • Waste characteristics
Stabilization	• Soil properties - such as particle size and moisture content • Waste characteristics - including constituents present and concentrations, pH, total organic carbon, and oxidation state of constituents
Thermal Treatment	• Moisture content • Heat capacity of soil • Concentrations of contaminants
Soil Washing	• Soil texture - includes quantities and types of clays • Soil permeability • Soil organic carbon content • Waste characteristics • Soil mineralogy - including iron and manganese content

- collecting samples at discrete depths at selected grid points to determine the vertical contamination profile; and

- collecting samples at intervals along the stream channel to determine the extent of contaminant migration along the channel.

The sampling strategy includes a combination of discrete samples and composite samples. Discrete samples will be collected at points expected to have high concentrations (i.e., within the area expected to exceed cleanup levels). Discrete samples will also be collected to establish vertical profiles. Composite samples will be collected at other points. Composite samples will provide indication of the areal distribution of contamination, while reducing the number of required analyses. Soil sampling locations are shown in Figure 4-1 and described below. Sample locations and analyses are summarized in Table 4-2.

A grid system of ten rows and five columns will be established. The rows start at the visibly contaminated area (hot spot) and extend down the slope to the intermittent stream channel. The first six rows will be spaced approximately one meter apart and the remaining four, approximately two meters apart. The closer spacing is used nearer the source, where more rapid changes in concentration with distance are expected. The grid will have five columns, with the center column through the hot spot. The column spacing is approximately one meter, or sufficient to be outside of the hot spot.

Samples will be collected at all of the grid points, with the exception of those located in the hot spot. Samples will not be collected in the hot spot because this area is already known to be highly contaminated. The sample from each grid point will be split into triplicates. One of the triplicates will be used for making a row composite and one for a column composite; the other will be retained for possible subsequent analysis, if indicated by the results of the composite analyses.

Composite samples from Rows 1 through 5 will be created by compositing the samples from Columns 1, 2, 4, and 5. The samples from Column 3 will not be included because they will be located in the hot spot or retained for discrete analysis. The composite samples outside the hot spot are intended to be representative of average concentrations outside the zone expected to require cleanup. Concentrations immediately downslope of the source will be assessed through collection of discrete samples along Column 3 at Rows 3, 4, and 5. These samples are located within areas expected to exceed cleanup levels. Composite samples from Rows 6 through 10 will be created by compositing the samples from all five columns. These samples are intended to be representative of

FIGURE 4-1. LOCATIONS OF SOIL SAMPLES

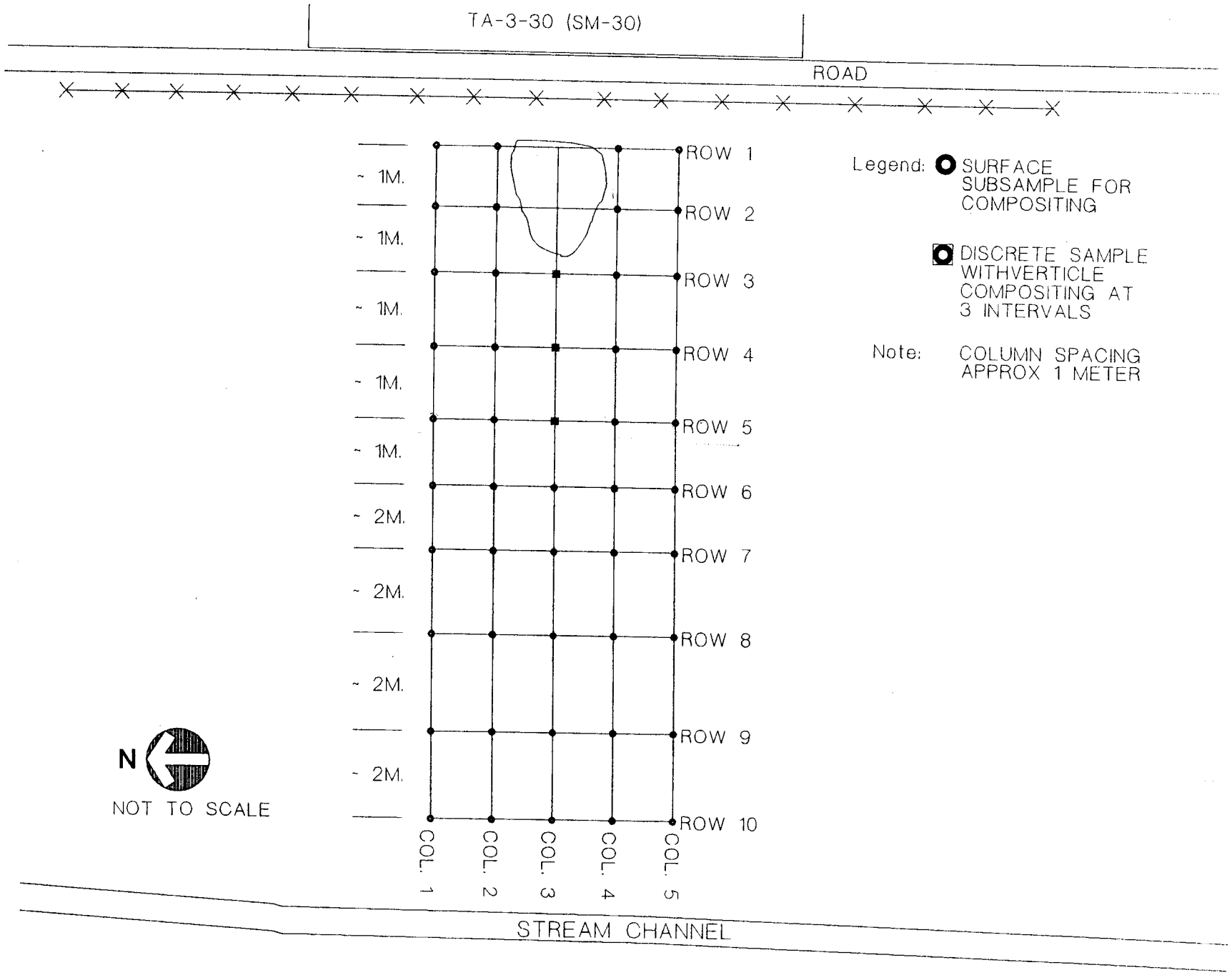


Table 4-2
Summary of Samples and Analyses

Location	Depth	Toxic Metals	Mercury	TPH	Rad[1]
Composite Row 1	Surface	X		X	X
Composite Row 2	Surface	X		X	X
Composite Row 3	Surface	X		X	X
Composite Row 4	Surface	X		X	X
Composite Row 5	Surface	X		X	X
Composite Row 6	Surface		X		X
Composite Row 7	Surface		X		X
Composite Row 8	Surface		X		X
Composite Row 9	Surface		X		X
Composite Row 10	Surface		X		X
Composite Column 1	Surface		X		X
Composite Column 2	Surface		X		X
Composite Column 3	Surface		X		X
Composite Column 4	Surface		X		X
Composite Column 5	Surface		X		X
Row 3, Column 3	Surface	X		X	X
Row 3, Column 3	0 - 0.5 m	X		X	X
Row 3, Column 3	0.5 - 1.0 m	X		X	X
Row 3, Column 3	1.5 - 2.0 m	X		X	X
Row 4, Column 3	Surface	X		X	X
Row 4, Column 3	0 - 0.5 m	X		X	X
Row 4, Column 3	0.5 - 1.0 m	X		X	X
Row 4, Column 3	1.5 - 2.0 m	X		X	X
Row 5, Column 3	Surface	X		X	X
Row 5, Column 3	0 - 0.5 m	X		X	X
Row 5, Column 3	0.5 - 1.0 m	X		X	X
Row 5, Column 3	1.5 - 2.0 m	X		X	X
Stream Sediment, Upstream	0 - 0.5 m		X		X
Stream Sediment, 0 to 40 m Composite	0 - 0.5 m		X		X
Stream Sediment, 50 to 90 m Composite	0 - 0.5 m		X		X

Table 4-2
Summary of Samples and Analyses
(continued)

Note: (1) Radiological analysis includes gross alpha, beta, and gamma radioactivity, tritium, isotopic plutonium, and cesium-137.

average concentrations along the transcects downslope from the source, where minimal migration is expected to have occurred (i.e., areas not expected to require cleanup).

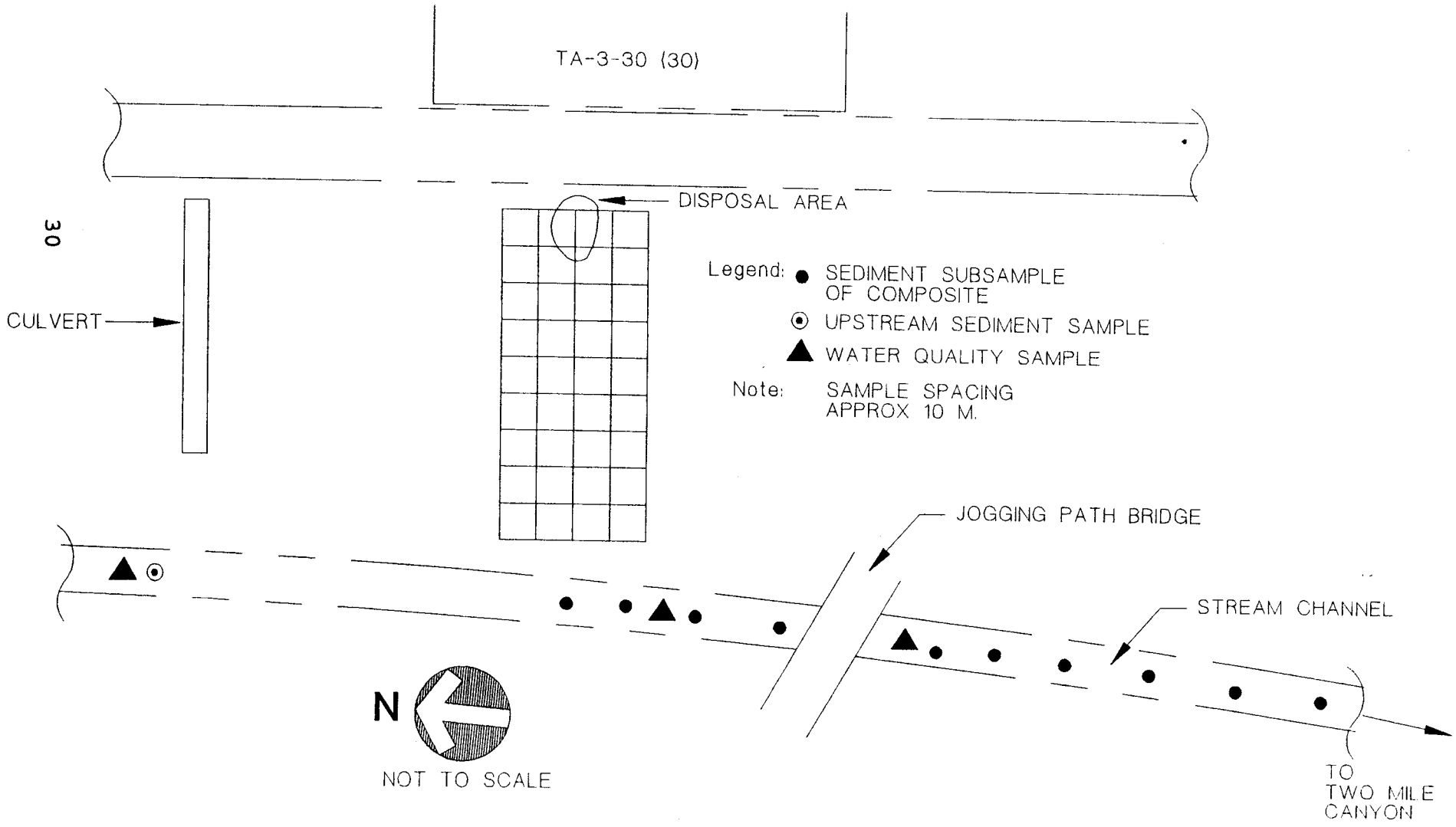
Composite samples from Rows 1 through 5 will be analyzed for toxic metals and TPH. Composite samples from Rows 6 through 10 will be analyzed for mercury only. All samples will be analyzed for gross alpha, beta, and gamma radioactivity, tritium, isotopic plutonium, and cesium-137.

As noted above, discrete samples will be collected from Column 3 immediately downslope from the hot spot (Rows 3, 4, and 5). These samples will not be included in the row and column composites because the concentrations are expected to be much higher than the concentrations along the lateral columns. At the locations defined by Column 3 and Rows 3 and 5, samples will also be collected on a vertical profile. In addition to the surface sample, vertical composite samples will be collected from the depth intervals 0 to 0.5 m, 0.5 to 1.0 m, and 1.5 to 2.0 m. If bedrock is encountered before 2.0 m, the sample will be composited over the interval 0.5 m above bedrock. These samples should be sufficient to establish the vertical extent of contamination for purposes of evaluating remedial actions. These samples will be analyzed for toxic metals and TPH, and will also undergo radiological analysis.

Sediment samples from the stream channel will be collected upstream from the point where run-off from the site reaches the channel and at ten points downstream from the site. These sample locations are shown in Figure 4-2. The upstream sample will be located downstream from where a culvert discharges to the stream. This sample will be used to determine whether there are other upstream sources of contamination. The ten samples along the steam channel will be spaced approximately 10 meters apart. Sample locations will be in catchments whenever possible. Because the concentrations are not expected to vary substantially along the channel, composite sampling will be used. At each location, a vertical composite will be made from interval of the surface to 0.5 m or bedrock, whichever is shallower. The vertical composites from the first five locations will be composited into one sample. Those from the next five locations will also be composited into a single sample. All sediment samples will be analyzed for total mercury, and will also undergo radiological analysis.

Surface water samples will be collected at three locations in the stream channel when water is present. Sample locations are shown in Table 4-2. The first location is upstream from the site, at the same location of the upstream sediment sample. The second location is immediately downstream from the gridded area. The third location is downstream from the site, immediately downstream from where the bridge crosses the jogging path.

FIGURE 4-2. LOCATIONS OF SEDIMENT AND WATER SAMPLES



Samples will be collected at three times, corresponding to the first three significant run-off events following completion of the remedial action. All water samples will be analyzed for total and dissolved metals, and for gross alpha, beta, and gamma radioactivity.

Surface and subsurface soil samples and water samples will be collected using the SOPs given in Appendix B. Quality control samples consisting of duplicates and blanks will be collected as described in the Quality Assurance Project Plan (Appendix C). Field activities will be conducted in accordance with the Health and Safety Plan (Appendix D).

4.3 Analytical Methods

As described in Subsection 4.1, soil samples will be analyzed for total metals, mercury, and TPH. Total metals analysis will involve analysis for the 23 metals contained in the EPA target analyte list (TAL). Analysis for TAL metals will involve a combination of inductively coupled plasma (ICP) spectroscopy and atomic absorption (AA) spectroscopy. Mercury analyses will be by cold vapor AA. Samples will be extracted by digestion using EPA SW-846 Method 3050. Samples for TPH analysis will be extracted using EPA SW-846 Method 3550, and the extract analyzed using EPA Method 418.1. Analytes, methods, and estimated detection limits are summarized in Table 4-3.

Water samples will be analyzed for total metals using the same analytical methods as for soils. Water samples will be extracted using EPA SW-846 Method 3005, instead of 3050. Radionuclide analyses will include radio-chemical alpha spectrometry for isotopic plutonium, liquid scintillation for tritium, and gamma spectroscopy for cesium.

5.0 REMEDIATION PLAN

This section discusses the general actions that will be undertaken as part of the remedial action at the site. These actions include evaluation of the sampling and analysis data, evaluation of alternatives, and implementation of alternatives.

5.1 Data Evaluation

The results from analysis of soil samples for total metals and mercury will be evaluated to determine the area and depth of soil to be excavated. These data will be evaluated as described below. Data management will be described in the Data Management Plan (Appendix E).

Table 4-3

Summary of Analytical Methods

Analyte	Method	EPA Method Number	Approximate Detection Limit, mg/kg
Aluminum	ICP	6010	20
Antimony	ICP	6010	6
Arsenic	Graphite Furnace AA	7060	0.5
Barium	ICP	6010	5
Beryllium	ICP	6010	0.5
Cadmium	ICP	6010	0.5
Calcium	ICP	6010	500
Chromium	ICP	6010	1
Cobalt	ICP	6010	4
Copper	ICP	6010	2.5
Iron	ICP	6010	10
Lead	ICP	6010	10
Magnesium	ICP	6010	50
Manganese	ICP	6010	1.5
Mercury	Cold Vapor AA	7470	0.25
Nickel	ICP	6010	4
Potassium	ICP	6010	10
Selenium	Graphite Furnace AA	7740	0.5
Silver	ICP	6010	1
Sodium	ICP	6010	50
Thallium	ICP	6010	10
Vanadium	ICP	6010	4
Zinc	ICP	6010	2
TPH		418.1	30
Gross Alpha			pCi/g
Gross Beta			pCi/g

Analyte	Method	EPA Method Number	Approximate Detection Limit, mg/kg
Gross Gamma			pCi/g
Tritium			pCi/g
Plutonium			pCi/g
Cesium-137			pCi/g

Results of the row and column composite samples will be reviewed to identify any mercury results above the 80 mg/kg cleanup level. For a row having results of 80 mg/kg or above, the following procedure will be used. If any column composites are 40 mg/kg or above, the reserved triplicate sample for that row and column will be submitted for mercury analysis. If none of the column composites is 40 mg/kg or above, all of the reserved triplicates for that row will be submitted for mercury and radiological analysis. Once the results of analysis of the reserved samples is complete, all mercury results will be used to define the area exceeding the 80 mg/kg cleanup level. A similar procedure will be used if there are any other metals present above the SALs given in the 1992 IWP (LANL 1992, 0768).

If all samples for a row are above the cleanup level, two approaches may be taken: If the results are slightly above the SAL, the existing results may be used to extrapolate the horizontal extent of contamination; if the results are greatly above the cleanup level, additional samples may be taken and analyzed to define the extent of contamination.

The results of the vertical sampling will be evaluated to estimate the vertical extent of soil contaminated above the 80 mg/kg cleanup level. If all results are above the level, soil will be excavated to the top of bedrock.

After evaluation of all data, the volume of soil to be excavated will be plotted on a map of the site.

The results of the metal and TPH analyses will be used to estimate the range of concentrations of mercury, TPH, and any other metals of concern. These results will also be used to estimate the average concentrations of these constituents. The estimated averages should be representative of the bulk concentration of contaminants in the soil after excavation. The range and average concentrations will be needed to determine the applicability and effectiveness of the various treatment alternatives. The results of the radiological analyses will be used to determine whether the excavated soil will be treated as mixed waste.

5.2 Evaluation of Alternatives

Presently, three alternatives are being considered for treatment of the excavated soil. These alternatives are

- stabilization;
- soil washing; and
- thermal treatment.

The alternative selected will depend on the concentrations of contaminants present in the soil. General guidelines for selection of the alternatives are described below.

The primary factor governing treatment of the mercury-contaminated soils is the RCRA Land Disposal Restrictions (LDRs) (40 CFR 268). The LDRs determine the type and extent of treatment that will be required to dispose of the soils. If the excavated soil is not mixed waste and the average concentration of mercury is expected to be greater than 260 mg/kg, the LDRs require that thermal treatment be used. Thermal treatment options specified in the LDRs include incineration, or roasting or retorting in a unit capable of recovering volatilized mercury. These types of facilities are not available at LANL, and the soil would have to be sent off site for treatment.

If the soils are not mixed waste and have a mercury concentration below 260 mg/kg, either stabilization or soil washing could be used. The LDR in this case requires that the treated soil pass the TCLP. That is, the concentration of mercury leached from the treated soil must be less than 0.2 mg/L. The selection of a treatment method will be based on evaluation of the physical and chemical properties of the soil. Examples of important factors are described below.

Concentrations of other leachable metals materials	The concentrations of other materials that can be leached along with mercury will determine the total amount of metals in the leachate. This, in turn, will determine the total amount of sludge produced by treatment of the leachate and the amount of secondary waste requiring disposal.
Soil particle size	In general, soil washing would be given preference for coarse soils, and stabilization for fine soils. Soil particles in the clay size range are difficult to separate from the soil washing solution and can contribute to the amount of secondary waste generated.
Soil texture	The soil texture will affect the ease of mixing for incorporating stabilization chemicals into the soil. If the soils are highly plastic, mixing may be difficult and stabilization may be ineffective.
Concentrations of other metals potentially reacting with	The stabilization process involves incorporating chemicals into the soil that will react with mercury to form insoluble sulfides. Other metals may be

Stabilization agents	present in the soil that would undergo similar reactions. The concentration of such metals would affect the amount of stabilization chemicals that would need to be added.

If the soils are determined to be mixed waste, different LDR standards may apply. The LDR standard for elemental mercury contaminated with radioactive materials is treatment by amalgamation (e.g., with zinc). The LDR standard for hydraulic oil contaminated with mercury is incineration. It is presently uncertain which, if either, standard would apply to the contaminated soil. This determination will be made after collection of sampling and analysis data. If neither standard applies, the standards for nonradioactive mercury wastes described previously would apply.

5.3 Implementation

The specific actions to be taken during implementation will be identified after evaluation of the data. In general, remedial action will involve the following major components: excavation, soil management, confirmatory sampling, and backfilling. Implementation of these components is described below. Prior to implementing the remedial action, the Health and Safety Plan will be revised to address the additional hazards posed by implementation of the remedial action.

The method of excavation will depend on the area and depth of soil to be excavated. It is currently expected that all of the soil can be excavated from the road behind Building TA-3-30 using a backhoe excavator. The size of the excavator used will depend on the required reach.

Management of the soil after excavation will depend on the treatment to be employed. If off-site treatment will be required, the soil will be loaded directly into lined, covered, 20- or 30-cubic-yard dump trucks. The soil will be transported to the treatment facility under applicable RCRA and Department of Transportation requirements. If on-site treatment is to be used, soil will be transported to the place of treatment in a similar manner. If necessary, the soil will be stockpiled for treatment by placing it on an impervious liner and covering it with an impervious cover. The stockpiled soil will be inspected daily until treatment is complete. Treated soil will be transported to an off-site disposal facility in a manner similar to untreated soil. If the soil is determined to be mixed waste, it will be transported to an on-site RCRA-compliant storage area, as there are currently no facilities capable of treating such waste.

A confirmatory sampling program will be used to verify that cleanup levels have been met. A grid of five rows and five

columns will be established within the area defined by the sides and bottom of the excavation. Triplicate grab surface samples (0 to 3 inches) will be collected at each grid point and used to create composite row and column samples, as described in Subsection 4.2. These samples will be analyzed for total mercury and any other metal originally present above SALs. One of the triplicate samples from each point will be reserved for further analysis, if needed. The methods for sample collection and analysis will be the same as those described in Subsections 4.2 and 4.3. These samples will also undergo radiological analysis to determine residual radioactivity remaining after the cleanup.

After receipt of analyses confirming that cleanup levels have been met, the excavation will be backfilled using clean soil. The fill will be compacted during placement to prevent subsidence. After backfilling is completed, the site will be revegetated with native vegetation to prevent erosion.

REFERENCES

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LANL (Los Alamos National Laboratory), November 1992. "Installation Work Plan for Environmental Restoration, Los Alamos National Laboratory Report LA-UR 92-_____, Los Alamos, New Mexico. **(LANL 1992, 0768)**

State of New Mexico Water Quality Control Commission Regulations, as amended through August 18, 1991.

APPENDIX A

ANALYTICAL RESULTS FROM PREVIOUS SAMPLING

Contaminant Concentration / Sample Number	Total Hg ppm (XRF)	Total Hg ppb (AA)	TCLP Hg ppb	TCLP Pb ppm	TPH ppm	Pu-239 pCi/gm	H-3 pCi/gm
1	13,500.	>> 2000.	23.1	3.6	37,000.	.139	115.
2	--	1709.	8.3	0.3	--	1.55	186.
3	--	1942.	<0.1	0.2	--	0.24	4.6
4	--	49.5	<0.1	<0.05	--	0.008	6.5
5	--	1.9	<0.1	<0.05	--	0.002	0.2

APPENDIX B

STANDARD OPERATING PROCEDURES

1.1.0 PURPOSE

This SOP provides instructions that are to be followed in collecting soil and sediment samples at sites assigned under the ARCSWEST contract. This SOP is to be used in conjunction with SOP No. 1.4, Sample Containers and Preservation, and SOP No. 1.5, Sample Packaging and Shipment.

1.1.1 SOIL SAMPLING

Soil samples may be collected by either using hand tools, i.e., trowel, shovel, post hole digger, auger, or by a power drive sampling device such as split spoon or Shelby Tube. The sample collection method used should be noted in the field logbook. Sections 1.1.1.1 through 1.1.1.3 provide instructions for soil sampling using hand tools. Section 1.1.1.4 discusses split spoon and Shelby Tube sampling. For hand-tool sampling the following table is provided to aid in selecting the proper tool based on the prescribed depth of the sample.

Depth	Hand Tool
0-1 foot	stainless steel trowel
½-2 feet	shovel
1-6 feet	post hole digger
1-8 feet	auger

Once the sampling location has been selected, all vegetation and loose material shall be removed from a circular area approximately 2 feet in diameter. The purpose of this step is to prohibit surface material from falling into the sample hole and possibly contaminating the sample. Also, a level surface will facilitate hole depth measurements.

To prevent potential surface contamination from any subsurface sample contaminants, plastic sheeting should be placed adjacent to the sample location. All subsurface material that is collected must be placed on this sheeting.

1.1.1.1 Shovel and Trowel

When the prescribed sample depth is less than 2 feet, a decontaminated shovel and stainless steel trowel can be used, following the sequence of steps described below:

(1) Label all bottles with required tags and labels. Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, measure distances and direction from stationary landmarks. If possible, photograph the location. As appropriate, spray paint or wooden stakes should be used to mark the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Use a decontaminated shovel to remove the overburden to the prescribed depth and place excavated material on the plastic sheeting.

(5) Remove loose material from the bottom of the hole and place into a decontaminated stainless steel bucket. Attempt to eliminate all non-soil materials from the sample, such as rocks, trash, leaves, etc.

(6) If the samples are being analyzed for volatile organic compounds (VOCs), collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(7) Using the trowel, fill the remaining sample containers 3/4 full.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler should contain ice when specified by the site-specific sample plan.

(9) Replace excavated material from the plastic sheeting into hole and cap with removed vegetation.

(10) Decontaminate the sampling equipment for the next sample. (If possible, have a sufficient quantity of clean decontaminated trowels available so that each of the soil samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(11) Field soil simple duplicates are to be collected either by compositing the soil in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

1.1.1.2 Post Hole Digger

Depending on the required depth (1 to 6 feet) of the sample, a post hole digger may be used to remove overburden. Most post hole diggers are painted when new. Scrape the paint off prior to sampling.

(1) Label all bottles with required tags and labels. Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well-documented system, measure distances and direction from stationary landmarks. If possible, photograph the location. As appropriate, spray paint or wooden stakes should be used to mark the location.

(3) At the time of individual sample collection, should record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide transparent waterproof tape to ensure label integrity.

(4) Begin removal of overburden with a hole approximately 1 foot in diameter (samples taken from a depth of 5 to 6 feet will require a top-of-hole diameter of 1½ feet). During overburden removal, ensure that cross contamination does not occur.

(5) When the desired level is reached, record depth with a tape measure, remove loose material from the bottom of the hole and place into a decontaminated stainless steel bucket. Attempt to eliminate all non-soil materials from the sample, such as rocks, trash, leaves, etc.

(6) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed using a decontaminated stainless steel trowel leaving no airspace in the vial.

(7) Using the trowel, fill the remaining sample containers 3/4 full.

(8) If VOCs are not an analytical parameter and if a composite sample is preferred, periodically place a small amount of soil in a decontaminated stainless steel bucket (e.g., every foot) and, using a decontaminated stainless steel trowel, mix soil prior to filling sample containers.

(9) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation, the cooler must contain ice when specified by the site-specific sample plan.

(10) Measure the total depth of the hole. Sample depth should be recorded as beginning sample depth to final sample depth (i.e., 5.0' to 5.4').

(11) Refill hole using the excavated material. If the sample hole was dug through a clay cap or if downward migration of contaminants is a concern, use bentonite when refilling the hole.

(12) Decontaminate the sampling equipment for the next sample. (If possible, have a sufficient quantity of clean decontaminated trowels available so that each of the soil samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(13) Field soil sample duplicates are to be collected either by compositing the soil in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

1.1.1.3 Auger

An auger may be used for sample collections between 1 and 8 feet. For sample depths greater than approximately 3 feet, it is usually easier to use a post hole digger to remove overburden prior to sample collection with an auger. Augers do not work well in rocky soils.

(1) Label all bottles with required tags and labels. Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well-documented system, measure distances and direction from stationary landmarks. If possible, photograph the location. As appropriate, spray paint or wooden stakes should be used to mark the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide transparent waterproof tape to ensure label integrity.

(4) On the auger, use a tape measure to locate the appropriate sampler distance from the bottom of the auger and attach a piece of tape to the auger extension to indicate the prescribed sample depth.

(5) Place the auger above the selected sample location and turn the "T" handle clockwise (as viewed from above) to screw the auger into the soil.

(6) Remove soil in approximately 1-foot intervals until sample depth is reached. Expel the "plug" by pushing from the top of the auger. Place excavated material on a plastic sheet.

(7) When the auger is at the desired depth, collect the sample and place into sample containers using a decontaminated stainless steel trowel.

(8) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed using a decontaminated stainless steel trowel leaving no airspace in the vial.

(9) Using the trowel, fill the remaining sample containers 3/4 full.

(10) If VOCs are not an analytical parameter and if a composite sample is preferred, periodically place a small amount of soil in a decontaminated stainless steel bucket (e.g., every foot) and, using a decontaminated stainless steel trowel, mix soil prior to filling sample containers.

(11) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(12) Replace excavated material or use bentonite and cement grout if downward migration of contaminants is a concern.

(13) Decontaminate the sampling equipment for the next sample. (If possible, have a sufficient quantity of clean decontaminated trowels available so that each of the soil samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(14) Field soil sample duplicates are to be collected either by compositing the soil in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field log book.

1.1.1.4 Split Spoon/Shelby Tube

A split spoon sampler is used to take subsurface soil or sediment samples by being forcefully driven into the soil at the bottom of a bore hole. Samples may be retrieved along the entire length of the bore hole to obtain an unbroken record of the subsurface layers or at selected intervals. Continuous samples may also be taken from the surface down to a specified level or from a subsurface point downward.

The split spoon is threaded on to the end of the drill rod in place of the drill bit. The bore hole may contain casing (steel or plastic pipe), depending upon future use of the hole and the rigidity of the penetrated formation. The sampler is lowered on the drill rod to the bottom of the boring by heavy steel cable connected to the drilling mast. The sampler is forced into the soil by a drive weight which is dropped repeatedly onto the drive head located at the top of the drill rod. Weights up to 350 pounds are available but the most commonly used for a 2-inch diameter sampler is a 140-pound weight. The weight is typically allowed to fall a distance of 30 inches. The sampler is driven into the sediment to a depth which is about 6 inches shorter than the length of the sampler itself. Split spoon samplers are manufactured in 18- and 24-inch lengths with 2- to 3-inch outside diameters.

Occasionally bedrock or extremely compacted sediments are encountered which make further advance of the sampler extremely difficult or impossible without damage to the sample. This is known as "refusal" and is defined as a "penetration of less than 1 foot for

100 blows"; a blow being the act of striking the drive rod with the drive weight. Six inches for 50 blows is also commonly recognized as refusal. Upon refusal, the bore hole is to be either abandoned or the sampler removed and replaced by a drill bit.

Split spoon sample collection procedure.

(1) Label all bottles with required tags and labels. Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, measure distances and direction from stationary landmarks. If possible, photograph the location. As appropriate, spray paint or wooden stakes may also be used to mark the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Receive sampler from driller and place on a secure bench or rack for opening.

(5) Separate the sample tube (a flat-blade screwdriver is useful), exposing either the sample or, if used, brass liners.

(6) Run a knife between the liners to separate and immediately seal the cut ends with teflon film if VOCs analysis is required. Wrap with teflon plumber's tape, cap with plastic lids, and wrap with grey duct tape. Apply sample label.

(7) If no liner is used, the sample may be collected from the open spoon using decontaminated stainless steel spoons.

(8) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(9) If VOCs are not an analytical parameter and if a composite sample is preferred, periodically place a small amount of soil in a decontaminated stainless steel bucket (e.g., every foot) and, using a decontaminated stainless steel trowel, mix soil prior to filling sample containers.

(10) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler should contain ice as specified by the site-specific sample plan.

(11) Alternately, field duplicates may be collected either by compositing the soil in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Collocated field duplicates are to be collected from adjacent liners. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

A similar type of sampling apparatus is the "Shelby" tube. While the split spoon is a multiple piece sampler, the Shelby tube is a single-piece metal tube of thinner gauge than the split spoon. Like the split spoon, soil is forced into the Shelby tube and stored inside. However because the Shelby tube is typically, advanced hydraulically, it allows the capture of a relatively undisturbed sample. The Shelby tube requires much less effort to push into the soil due to its thinner walls and sharp cutting edge. Care must be taken not to compress the soil sample by forcing the tube deeper than its own length. The entire Shelby tube is sent to the laboratory with the sample inside, while the split spoon allows sampling personnel to take only the amount required.

1.1.2 SEDIMENT SAMPLING

Sediments are the deposited material underlying a body of water. Since streams, lakes, and impoundments are likely to demonstrate significant variations in sediment composition with respect to distance from inflow, discharges, and the like, it is critical to document exact sampling locations by means of triangulation with stable references on the banks of the body of water. The presence of rocks, debris, and organic material may also complicate the sampling and may preclude the use of, or require modification to, some devices in cases where the water level is low, the sediment layer is exposed due to evaporation, stream rerouting, or other means of water loss. In deeper water, with the use of a boat as a sampling base, a stainless steel beaker on an extension pole, corers, or clam-shell type dredges can be utilized. In all situations in a body of water, where sediment and water samples are to be obtained at the same location, water samples must be collected first. This is done because sediment collection activities can disturb the bottom and cause sediment suspension resulting in contaminated water samples. For similar reasons, when sampling in bodies of flowing waters such as streams and rivers, the sediment samples should be collected starting furthest downstream and working upstream.

1.1.2.1 Trowel

Sediment samples can be collected using a garden type trowel, provided the water depth is very shallow (i.e., a few inches). A stainless steel trowel or scoop is recommended due to its inert nature. Single grab samples may be collected or, if the area in question is large, it can be divided into grids and multiple samples can be collected and composited. The procedure outlined below should be followed:

(1) Label all bottles with required tags and labels. Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, triangulate and measure distances and direction from stationary onshore landmarks. As appropriate, photograph the location.

(3) At the time of individual sample collection, the record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Insert a decontaminated stainless steel trowel into the sediment and begin to remove material. Avoid collecting large rocks or organic debris.

(5) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(6) Using the trowel fill the remaining sample containers to about 1/2 inch from the top.

(7) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(8) Decontaminate the sampling equipment for the next sample. (If possible have a sufficient quantity of clean decontaminated trowels available so that each of the sediment samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(9) Field duplicates for sediments are collected either by compositing the sediment in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the for duplicate collection process in the field logbook.

1.1.2.2 Hand Corer

The hand corer is essentially the same type of thin-wall corer that is used for collecting sediment samples. It has a handle to facilitate driving the corer into the sediment and a check valve on the top to prevent sample washout during retrieval through an overlying water layer.

Hand corers are applicable to the same situations and materials as the trowel described above. However, has the advantage of collecting a relatively undisturbed sample and can thus profile sediment stratification. Some hand corers can be fitted with extension handles which allow collection of sediment samples in water of moderate depth (6 feet). Most corers can be fitted with liners of brass, polycarbonate plastic, or Teflon. The appropriate liner can be chosen to match the type of contamination expected in the sample and the intended analytical procedures.

(1) Label all bottles with required tags and labels. Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, triangulate and measure distances and direction's from stationary onshore landmarks. As appropriate, photographs the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Force the corer into the sediment with a smooth continuous motion.

(5) Twist the corer and withdraw it in a single smooth motion. Avoid collecting large rocks or organic debris.

(6) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be

tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(7) Using the trowel fill the remaining sample containers to about 1/2 inch from the top.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(9) Decontaminate the sampling equipment for the next sample. (If possible have a sufficient quantity of clean decontaminated trowels available so that each of the sediment samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(10) Field duplicates for sediments are collected either by compositing the sediment in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

1.1.2.3 Gravity Corer

A gravity corer is similar to the hand corer described above, it has a removable tapered nosepiece on the bottom and a ball or other type of check valve on the top. A check valve allows water to pass through the corer on descent but prevents sample washout during recovery. A tapered nosepiece allows the corer to penetrate the sediment and reduces core disturbance during the penetration. Most corers are constructed of brass or steel and many can accept plastic liners and additional weights.

Corers are capable of collecting undisturbed samples of sediments and can thus provide a profile of the sediment stratigraphy. Depending on the compaction of the substrate and the weight of the corer, penetration depths of 30 inches can be obtained. **Care should be exercised when using gravity corers in lagoons or ponds that have liners because penetration depths can exceed that of the substrate and result in damage to the liner materials.**

(1) Label all bottles with required tags and labels. Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, triangulate and measure distances and direction from stationary on shore landmarks. As appropriate, photograph the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Measure the depth of the water body using a decontaminated measuring tape. Attach a decontaminated gravity corer to the required length of rope and secure the free end of the rope to a fixed support to prevent accidental loss of the corer. Lower the corer allowing it to fall into the sediment.

(5) Retrieve the corer with a smooth, continuous lifting motion. Avoid bumping the corer or jerking on the rope since this may cause some loss of sample.

(6) Remove the nosepiece from the corer and slide the sample out of the corer into a stainless steel or Teflon pan.

(7) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(8) Using the trowel fill the remaining sample containers to about 1/2 inch from the top.

(9) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(10) Decontaminate the sampling equipment for the next sample. (If possible have a sufficient quantity of clean decontaminated trowels available so that each of the sediment samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(11) Field duplicates for sediments are collected either by compositing the sediment in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field dupli-

cate). Follow the site-specific sample plan and document for duplicate collection process in the field logbook.

1.1.2.4 Clamshell Dredge

Two clamshell type samplers are typically used: the Ponar grab dredge and the Eckman dredge. The Ponar grab is activated by a counter lever system. The two halves of the sampler are opened, latched in place and the sampler is slowly lowered to the bottom. When tension is released on the lowering cable, the latch releases and upward tension on the rope closes the clamshell. The Eckman dredge works in a similar manner except that the two halves of the clamshell snap shut under the action of a strong spring when a messenger is sent down the rope.

Clamshell dredges are capable of sampling most types of sludges and sediments from silty to granular materials. Penetration depths will usually not exceed several inches. These types of samplers, unlike the corers described previously, are not capable of collecting undisturbed samples. In addition, the sampling action of these devices causes agitation currents which may temporarily resuspend some settled solids. This disturbance can be minimized by slowly lowering the sampler over the last half yard and allowing gentle contact with the bottom. With the use of dredges, all overlying water samples should be collected prior to the sediment samples.

(1) Label all bottles with required tags and labels. Fill out all information except sampler's name/initials and the actual date and time. Sort bottles, one set per sampling location with additional sets as needed for field duplicates.

(2) Note exact location of the sample in the field logbook. If not tied in to a surveyed grid system or some other well documented system, triangulate and measure distances and directions from stationary landmarks. As appropriate, photograph the location.

(3) At the time of individual sample collection, record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) Measure the depth of the pond or lagoon using a decontaminated measuring tape. Attach a decontaminated sampler to the appropriate length of rope.

(5) Mark the distance to the bottom on the rope, also place a secondary mark, one yard shallower, to indicate proximity

to the bottoms so that the lowering rate can be reduced to prevent unnecessary bottom disturbance.

(6) Open the sampler's jaws until they latch open. **When using the Eckman dredge, extreme care should be taken when opening the dredge prior to sampling (or during decontamination) in order to avoid having the two halves accidentally snap shut on fingers or other parts of the sampler's body.** In the case of the Ponar sampler, from this point on the sampler should be supported only by its rope otherwise the sampler will be tripped and the jaws will close. If the Eckman dredge is being used, the messenger should be threaded onto the rope at this time.

(7) Tie the free end of the rope to a fixed support to prevent accidental loss of the sampler.

(8) Begin lowering the sampler until the proximity mark is reached.

(9) Slow the rate of descent through the last yard until contact is felt.

(10) When using the Ponar sampler, allow the rope to slacken by several inches; in strong currents more slack may be necessary to release the closing mechanism. In the case of the Eckman dredge, the messenger is sent down the rope to trigger the closing spring.

(11) Slowly raise the dredge until it is clear of the water surface.

(12) Place the dredge into a stainless steel or Teflon tray and open it. Lift the sampler clear of the tray.

(13) If the samples are being analyzed for VOCs, collect the VOC fraction first. VOC sample containers should be tightly packed, using a decontaminated stainless steel trowel, leaving no airspace in the vial.

(14) Using the trowel fill the remaining sample containers to about 1/2 inch from the top.

(15) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice when specified by the site-specific sample plan.

(16) Decontaminate the sampling equipment for the next sample. (If possible have a sufficient quantity of clean decontaminated trowels available so that each of the sediment

samples can be taken with a separate trowel and decontamination can be performed on all the trowels at the end of the sampling effort rather than between each sample.)

(17) Field duplicates for sediments are collected either by compositing the sediment in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a close adjacent location (a collocated field duplicate). Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

1.1.3 HIGH HAZARD LEVEL SAMPLES

High hazard samples are those that contain hazardous substances in concentrations of over 200 ppm. Typically, these samples are direct chemical waste rather than a contaminant in soil or sediment. Knowledge of the hazardous substance(s) anticipated prior to sampling is imperative. The site-specific Health and Safety plan should document each anticipated chemical and should be consulted to prevent unnecessary danger when handling these samples. Extreme caution must be exercised when obtaining samples in this category.

1.1.4 DIOXINS/FURANS

Any sample suspected of containing dioxins/furans must be treated with extreme caution regardless of the parameter(s) for which it is being analyzed. No extra volume should be taken as the laboratory must dispose of the sample remnants.

1.2.0 PURPOSE

This SOP provides instructions that are to be followed in collecting groundwater and surface water samples at sites assigned under the ARCSWEST contract. This SOP is to be used in conjunction with SOP No. 1.4, Sample Containers and Preservation, and SOP No. 1.5, Sample Packaging and Shipment.

1.2.1 GROUNDWATER SAMPLING

There are many types of wells from which groundwater samples may be collected, including monitoring wells, public wells, residential wells, industrial wells, irrigation wells, and livestock wells, all with a wide range of diameters, depths, and construction features. As part of field planning activities, the following information about the well(s) should be obtained:

- Well owner;
- Well driller;
- Type of well (monitoring, residential, etc.)
- Well depth and diameter;
- Well condition;
- Well elevation and reference point;
- Type of casing;
- Screen depth(s) and length(s);
- Well logs (if possible);
- Previous sampling data;
- Depth to groundwater;
- Pump capacity;
- Water treatment process (fluoride, water softeners, etc.); and
- Spigot location (i.e., before or after treatment process).

1.2.1.1 Monitoring Well Purging

Prior to collecting groundwater samples from a monitoring well, the well should be purged to remove any stagnant water from the well casing and draw water from the formation so that representative

groundwater samples can be obtained. The well has been sufficiently purged when consecutive measurements of specific conductivity, pH, and temperature have stabilized to within 10 percent of one another. These measurements are to be taken from samples drawn from the well before purging is started and at regular intervals thereafter. For estimation purposes, it can be assumed that the required purge volume will be within three to five well casing volumes. The formula for determining a well casing volume is:

$$Vc = \pi r^2 h$$

Where: Vc = well casing volume
π = 3.14
r = well casing radius
h = water column height in casing

By incorporating π and necessary conversion factors into a single constant, the following formula is obtained:

$$Vc = 0.041\ d^2 h$$

Where: Vc = well casing volume in gallons
d = well casing diameter in inches
h = water column height in casing in feet

The second formula is easier to apply in the field. Alternately, the following chart provides well casing volumes for the commonly encountered well casing diameters.

Well Diameter (inches)	Gallons Of Fluid Per Linear Foot
1	0.04
2	0.16
3	0.37
4	0.65
6	1.47
8	2.61
10	4.08
12	5.88

Example: If a well casing has a diameter of 4 inches, a total depth of 55 feet, and a depth to static water level of 15 feet, then the well casing volume would be:

55 ft - 15 ft = 40 lineal ft

40 ft x 0.65 gallons/ft = 26 gallons

Steps to consider when purging and sampling include:

- Begin purging and sampling the least contaminated wells first (as practicable) to minimize potential transfer of contaminants between wells.

- After the purging has been completed, always don new gloves and use a new bailer suspension cord and a decontaminated bailer when taking this sample. Tripods and any other equipment that were used for purging must also be decontaminated before taking samples.

- Avoid allowing the bailer suspension cord to touch the ground. A large plastic bag placed inside an empty drum is suitable for containing the suspension cord.

- After each use decontaminate the beaker used for obtaining water parameters.

- After each reading, blot dry and decontaminate the pH probe, conductivity probe, and thermometer with deionized water.

- Decontaminate the pump and all accessories that are placed in the well. Most bladder pumps can be disassembled and cleaned. Most submersible pumps can not be easily decontaminated; thus it is important to ensure that the pump is flushed and cleaned after each use.

1.2.1.1.1 Purging With Bailers

For monitoring wells, the most common purging device is a bailer. Bailers are usually made of PVC, stainless steel, or Teflon. The widest and largest bailer that will comfortably fit down the well is recommended for use. (In finer-grained aquifers, use under-sized bailers so as to avoid creating suction upon bailer removal which could cause formation erosion.)

The following steps must be followed at each well. Procedural modifications may be necessary based on conditions and sound engineering judgement. However, if modifications are required and made, the variances from this SOP must be fully documented in the field logbook.

(1) Prior to approaching the well, the HNu or OVA operator must be in the appropriate level of protection as prescribed in the Site Health and Safety Plan. The well shall be unlocked as necessary and the inner casing uncapped from an position located upwind, but not so as to not block the wind. The breathing zone and headspace must be monitored with the HNu or OVA upon well opening to measure any volatile organic compounds (VOCs) and ensure proper protection of those working around the wellhead.

(2) The depth to water and total depth of the well should be measured with a water level indicator, using a chalked steel tape with weighted end, electric sounder, or other method. A direct reading with an electric sounder should be made as soon as the probe contacts the water. Several readings are to be obtained and, when the readings are consistent, the depth is to be recorded. Note the location of the reference point for these measurements. Typically there is a mark at the top of the inner casing made by the drillers or surveyors. Always decontaminate equipment before and after each use.

(3) Determine the well water volume and minimum purge quantities required using the formula presented above.

(4) To initiate purging, tie clean bailer suspension cord securely to the bailer and lower the bailer into the well to below the water level. Allow time for the bailer to fill before hauling it back up. Make certain that the Teflon or stainless steel ball properly seals. (Clean off any sediment at bottom of bailer with deionized water.) If a proper seal cannot be achieved, use another decontaminated bailer and cord.

(5) During purging, periodically measure for VOCs with a HNu or OVA, and measure water temperature, pH, and conductivity. Measurements shall be taken in a beaker which shall be cleaned and dried after each use. Obtain at least three to five readings at 5 minute intervals. Conductivity and pH may change rapidly when initially purging and then begin to stabilize with increased purge volume. If the well becomes dry before the minimum amount is purged, allow it to recharge so that sufficient volume is available for sampling. Since the well has been purged dry and new water has entered the water column, further purging should not be necessary.

(6) The purged water shall be containerized and not allowed to fall back into the well or onto the ground. A plastic bag should be used to hold excess bailer suspension cord and to prevent suspension cord contact with the ground. It may be helpful to use a tripod with a pulley over the well as an aid in purging.

(7) Purge until pH, conductivity, and temperature readings are stable and a minimum amount has been purged. If the parameters do not stabilize after a maximum amount has been purged, stop purging, and note in the logbook that the parameters did not stabilize prior to sampling. Document to approximate volume purged in the field logbook.

1.2.1.1.2 Purging With Pumps

When wells are purged with pumps, the pump materials and design must be compatible with the suspected contaminants. The purge rate should not exceed the well development rate, as this would cause additional development, and considerably more water may be removed than is necessary to stabilize pH, conductivity, and temperature values. For purging with pumps, follow all steps described above in Section 1.2.1.1.1 except Step 4; substitute the following for step 4:

Complete piping and electrical wire connections as necessary to the pump and lower it to the desired level at approximately the mid-point of the screen. Start the pump and ensure that the intake port does not become exposed to the air. Observe the pump discharge. If the discharge is turbid, stop operations and raise the pump 1 to 2 feet and repeat operation.

1.2.1.2 Monitoring Well Sampling

After purging is completed, monitoring well samples are to be collected. It may be necessary to allow the well to recharge before collecting the sample. The well must be sampled within 24 hours after purging and should be sampled immediately after purging if conditions allow.

The following steps shall be followed at each well. Procedural modifications may be necessary based on conditions and sound engineering judgement. If modifications made, the variances from this SOP shall be fully documented in the field logbook.

(1) Label all sample containers with all appropriate tags and labels. Complete all information except sampler's name/initials and the actual date and time. Sort sample containers, one set per well with additional sets for field duplicates.

(2) Record water parameters (temperature, pH, and conductivity) for the sample. Record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(3) Change gloves and obtain new bailer suspension cord and a decontaminated bailer to collect the sample.

(4) Slowly lower bailer into well to obtain sample and retrieve carefully.

(5) Collect the VOC sample first, (see procedure below), directly from the bailer. Fill remaining grab-sample containers directly from bailer.

VOC Sample Container Filling Procedure. The VOC sample containers required are 40-ml glass vials with septum. These vials shall be slowly filled until a convex meniscus forms above the top of the vial. Allow the sample to reach equilibrium; permit air bubbles to rise to the surface for several seconds. Place the cap over the mouth of the vial so that the septum is properly oriented and screw down the cap firmly. Invert the vial to observe any entrapped air bubbles. Tap the vial be on the palm of the hand to dislodge air bubbles. If bubbles are detected, open the vial and add additional sample, secure the vial and check for air bubbles as described above. If preservatives are contained in sample vials, do not overfill.

(6) When collecting a non-filtered metal fraction, add metals-grade (Ultrex or equivalent) nitric acid either before or after collecting sample. The volume required will depend on the pH of the sample, and may range from 0.5 ml up to 10 ml, but will probably be about the same for samples collected from the same source. To check for pH less than 2, pour a few drops of the preserved sample on a strip of wide-range pH paper.

(7) To filter a sample for metals using an intermediate "transfer vessel," perform the following steps.

(a) Obtain a decontaminated transfer vessel and pour at least 100 ml of sample into transfer vessel. Using hand pump, pump sample through and discard into waste bucket.

(b) Open transfer vessel and fill with sample from the bailer. Screw on disposable filter and pump sample through, allowing the first 10 or 20 ml to fall into waste bucket before filling the sample container. Metals-grade (Ultrex or equivalent) nitric acid may be added before or after sample collection. Check for pH less than 2 by pouring a few drops of preserved sample onto wide range pH paper.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice or blue ice when specified by the site-specific sample plan.

(9) Bag contaminated equipment (bailers, buckets, beakers, etc.), remove tripod, containerize disposables, and recap well.

(10) Decontaminate the outside of the sample container and bag samples in a ziplock bag at the sampling point. Line each

cooler with a trash bag packed with vermiculite, and seal trash bag with twist tie. Return to the command post for decontamination.

(11) There are various techniques for collecting groundwater duplicates. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

1.2.1.2.1 Sampling with a Kemmerer

A Kemmerer is widely used for sampling groundwater primarily in situations where a sample is needed from a discrete depth, for example, in the case of dichloroethane which tends to sink to the bottom of an aquifer. The Kemmerer is a messenger-activated sampling device. When the device is open, water flows through the sampler. Once lowered to a desired depth of sampling, a messenger is dropped down the sample line, tripping a release mechanism that closes the device. As it closes, the bottle is sealed on top and bottom.

The following steps should be performed when using the Kemmerer.

(1) Label all sample containers with all appropriate tags and labels. Complete all information except sampler's name/initials and the actual date and time. Sort sample containers, one set per well with additional sets for field duplicates.

(2) Record water parameters (temperature, pH, and conductivity) for the sample. Record date, time, and sampler's name/initials on all sample containers and in the field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(3) Inspect the decontaminated Kemmerer, make sure that the sample drain valve is closed, if the bottle is so equipped.

(4) Mark the sample line after measuring to the desired sample depth.

(5) Open the Kemmerer by lifting the top stopper-trip head assembly.

(6) Lower the Kemmerer slowly to the desired level and release the messenger on the sample line.

(7) Retrieve the Kemmerer, holding it by the center stem.

(8) Recover the sample by lifting the top stopper and carefully pouring water into the sample containers, or, if a drain valve is available, open the valve over the sample bottle.

(9) Collect the VOC sample first, (see procedure below), directly from the bailer. Fill remaining grab-sample containers directly from bailer.

VOC Sample Container Filling Procedure. The VOC sample containers required are 40-ml glass vials with septum. These vials should be slowly filled until a convex meniscus forms above the top of the vial. Allow the sample to reach equilibrium; permit air bubbles to rise to the surface for several seconds. Place the cap over the mouth of the vial so that the septum is properly oriented and screw down the cap firmly. Invert the vial to observe any entrapped air bubbles. Tap the vial on the palm of the hand to dislodge air bubbles. If air bubbles are detected, discard the sample and collect another in a new VOA vial. If preservatives are contained in sample vials, do not overfill.

(10) When collecting a non-filtered metal fraction, add metals-grade (Ultrex or equivalent) nitric acid either before or after collecting sample. The volume required will depend on the pH of the sample, and may range from 0.5 ml up to 10 ml, but will probably be about the same for samples collected from the same source. To check for pH less than 2, pour a few drops of the preserved sample on a strip of wide-range pH paper.

(11) To filter sample for metals using an intermediate "transfer vessel," perform the following steps.

(a) Obtain a decontaminated transfer vessel and pour at least 100 ml of sample into transfer vessel. Using hand pump, pump sample through and discard into waste bucket.

(b) Open transfer vessel and fill with sample from the bailer. Screw on disposable filter and pump sample through, allowing the first 10 or 20 ml to fall into waste bucket before filling the sample container. Metals-grade (Ultrex or equivalent) nitric acid may be added before or after sample collection. Check for pH less than 2 by pouring a few drops of preserved sample onto wide range pH paper.

(12) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock

bag, and place in a cooler. For sample preservation the cooler must contain ice or blue ice when specified by the site-specific sample plan.

(13) Bag contaminated equipment (bailers, buckets, beakers, etc.), remove tripod, containerize disposables, and recap well. Return to the command post for decontamination.

(14) There are various techniques for collecting groundwater duplicates. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

1.2.2 DRINKING WATER AND IRRIGATION WELL SAMPLING PROCEDURES

When obtaining samples from drinking water sources, the sample should be taken, if possible, before any treatment process begins (for example, water softeners, chlorine, or fluoride additives.) If this is not possible, it is important to completely document the treatment process in the field logbook. This information will be used in the sample data analysis.

The following steps shall be followed when taking samples from drinking water wells.

(1) Determine the well volume (if possible) and minimum purge quantities. If the well volume is unknown, the spigot closest to the well should be turned on and allowed to flow until pH, temperature, and conductivity values have stabilized. Generally, these wells can be purged onto the ground, unless contamination is known, in which case the purged water must be disposed appropriately.

(2) Label all samples containers with all appropriate tags and labels. Fill out all information except sampler's name/initials, and the actual date and time. Sort sample containers, one set per well with additional sets for field duplicates.

(3) While purging, pH, conductivity, and temperature measurements should be taken and recorded approximately every 5 minutes until stabilized.

(4) After purging, the sample should be taken immediately. Samplers must wear appropriate gloves. Sample containers shall be filled directly from the spigot.

(5) Collect the VOC sample first. The flow of water should be turned down to approximately 10-ml/minute when collecting VOC samples.

VOC Sample Container Filling Procedure. The VOC sample containers required are 40-ml glass vials with septum. The water flow should be turned down to approximately 10 ml/minutes. Vials must be slowly filled until a convex meniscus forms above the top of the vial. Allow the sample to reach equilibrium; permit air bubbles to rise to the surface for several seconds. Place the cap over the mouth of the vial so that the septum is properly oriented and screw down the cap firmly. Invert the vial to observe any entrapped air bubbles. Tap the vial on the palm of the hand to dislodge air bubbles. If air bubbles are detected, open the vial and add additional sample to the vial, secure it and check for air bubbles as described above. If preservatives are contained in sample vials, do not overfill.

(6) When collecting a non-filtered metal fraction, add metals-grade (Ultrex or equivalent) nitric acid either before or after collecting sample. The volume required will depend on the pH of the sample, and may range from 0.5 ml up to 10 ml, but will probably be about the same for samples collected from the same source. To check for pH less than 2, pour a few drops of the preserved sample on a strip of wide-range pH paper.

(7) To filter sample for metals using an intermediate "transfer vessel," perform the following steps.

(a) Obtain a decontaminated transfer vessel and pour at least 100 ml of sample into transfer vessel. Using hand pump, pump sample through and discard into waste bucket.

(b) Open transfer vessel and fill with sample from the bailer. Screw on disposable filter and pump sample through, allowing the first 10 or 20 ml to fall into waste bucket before filling the sample container. Metals-grade (Ultrex or equivalent) nitric acid may be added before or after sample collection. Check for pH less than 2 by pouring a few drops of preserved sample onto wide range pH paper.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice or blue ice when specified by the site-specific sample plan.

(9) Bag contaminated equipment (bailers, buckets, beakers, etc.), remove tripod, containerize disposables, and recap well. Return to the command post for decontamination.

(10) There are various techniques for collecting groundwater duplicates. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

1.2.3 SURFACE WATER SAMPLING

Surface water sampling may include the sampling of rivers, streams, discharges, ponds, lakes, and impoundments. In moving bodies of water, stand downstream from the flow so as to minimize sediment disturbance. The procedures for sampling are as follows.

(1) Label all sample containers with all appropriate tags and labels. Fill out all information except sampler's name/initials, and the actual date and time. Sort sample containers, one set per sampling location with additional sets as needed for blanks and duplicates.

(2) Note exact location of the sample in the logbook, measuring distances and direction from stationary landmarks, and, if possible, photograph the location.

(3) Record date, time, and sampler's name/initials on all sample containers and in field logbook. Cover all container labels with wide, transparent, waterproof tape to ensure label integrity.

(4) To collect sample, submerge the sample container and fill with sample, adding preservatives after sample is collected.

(5) Collect the VOC sample first, as described below.

<u>VOC Sample Container Filling Procedure</u>. The VOC sample containers required are 40-ml glass vials with septum. These vials shall be slowly filled until a convex meniscus forms above the top of the vial. Allow the sample to reach equilibrium; permit air bubbles to rise to the surface for several seconds. Place the cap over the mouth of the vial so that the septum is properly oriented and screw down the cap firmly. Invert the vial to observe any entrapped air bubbles. Tap the vial on the palm of the hand to dislodge air bubbles. If air bubbles are detected, open the vial and add additional sample, secure it and check for air bubbles as described above. If preservatives are contained in sample vials, do not overfill.

(6) When collecting a non-filtered metal fraction, add metals-grade (Ultrex or equivalent) nitric acid either before or after collecting sample. The volume required will depend on the pH of the sample and may range from 0.5 ml up to 10 ml, but will probably be about the same for samples collected from the same source. To check for pH less than 2, pour a

few drops of the preserved sample on a strip of wide-range pH paper.

(7) To filter sample for metals using an intermediate "transfer vessel," perform the following steps.

(a) Obtain a decontaminated transfer vessel and pour at least 100 ml of sample into transfer vessel. Using hand pump, pump sample through and discard into waste bucket.

(b) Open transfer vessel and fill with sample from the bailer. Screw on disposable filter and pump sample through, allowing the first 10 or 20 ml to fall into waste bucket before filling the sample container. Metals-grade (Ultrex or equivalent) nitric acid may be added before or after sample collection. Check for pH less than 2 by pouring a few drops of preserved sample onto wide- range pH paper.

(8) At the sampling location, decontaminate the outside of the sample containers, bag the samples in a ziplock bag, and place in a cooler. For sample preservation the cooler must contain ice or blue ice when specified by the site-specific sample plan.

(9) Bag contaminated equipment (bailers, buckets, beakers, etc.), remove tripod, containerize disposables, and recap well. Return to the command post for decontamination.

(10) Field duplicates for surface water are collected consecutively from the same sampling location. Follow the site-specific sample plan and document the duplicate collection process in the field logbook.

1.2.4 HIGH HAZARD LEVEL SAMPLES

High hazard samples are those samples that have concentrations greater than 200 ppm of hazardous substances. Typically, these samples are direct chemical waste rather than a contaminant in water. Knowledge of the hazardous substance(s) anticipated prior to sampling is imperative. The site-specific Health and Safety plan should document each anticipated chemical and should be consulted to prevent unnecessary danger when handling these samples. Extreme caution must be exercised when obtaining samples in this category.

1.2.5 DIOXINS/FURANS

Any sample suspected of containing dioxins/furans must be treated with extreme caution regardless of the parameter(s) for which it is being analyzed. No extra volume should be taken as the laboratory must dispose of the sample remnants.

1.3.0 PURPOSE

The purpose of this SOP is to provide instructions that are to be followed in collecting QA/QC samples at sites assigned under the ARCSWEST contract. The number and locations of primary and duplicate samples should be specified in the sampling and analysis plan. The specification should be according to the following requirements unless the site manager identifies special requirements for the site.

1.3.1 FIELD DUPLICATE SAMPLES

For a given matrix, one field duplicate should be collected for every 10 samples or as specified in the site-specific sampling plan. Field duplicates should be collected from among the samples where contaminants are expected to be found. They must be treated as a separate sample from the original and reported on separate traffic reports (TRs). Field duplicates must never be identified as such on any paperwork that the analytical laboratory will receive including sample ID tags or TRs; however, the other copies of paperwork must indicate which samples are field duplicates.

Examples: For a sampling event with 11 low-level water samples and 8 low-level soil samples, 2 water duplicate samples and 1 soil duplicate sample will be required.

A sampling mission with 25 low-level and 6 medium-level water samples, and 6 low-level and 6 medium-level soil samples will require 4 water and 2 soil duplicate samples.

Field duplicates for soils are collected either by compositing the soil in a decontaminated stainless steel bucket (a composited field duplicate) or sampling from a closely adjacent location (a collocated field duplicate). For example, shallow surface soils are easily composited in a bucket when volatiles are not a concern. Colocated samples should be collected when the duplicates would be

analyzed for volatiles, or if samples would be taken at depths below the surface (0-2').

There are various techniques for collecting water sample duplicates (see SOP 1.2). For all types of duplicate sampling, follow the site-specific sample plan and document the process for duplicate collection in the field logbook. If it is deemed necessary to vary from the original site-specific sample plan (i.e., by quantity or technique), the duplicate collection process and the rationale for the variance shall be documented in the field logbook.

1.3.2 LAB QA/QC SAMPLES

Lab QA/QC samples are taken to determine if matrix interferences are present during analysis. Extra volumes are only required for low- and medium-level water samples. EPA Region IX requires double volumes for Lab QA/QC samples (water only). In EPA Region X, triple volumes are required for organic Routine Analytical Services analyses. Both regions require double volumes for inorganic analyses. The Authorized Sample Requestor or the Analytical Services Coordinator should be contacted regarding the required volume for all Special Analytical Services sampling.

A Lab QA/QC sample must be collected for every 20 samples and, if possible, taken at a sample location known to be somewhat, though not heavily, contaminated. The total volume is considered as "one" sample. "Extra volume for Lab QA/QC" must be clearly written in the analysis section of the TR. The "remarks" section of the extra volume sample tags must also be labeled as "Lab QA/QC".

Soil samples do not require an additional volume for Lab QA/QC. However, to inform the Contract Laboratory Program (CLP) as to which soil sample(s) should be used for Lab QA/QC, "Lab QA/QC" must be clearly written in the remarks section of the sample tags. If a sample is not designated for Lab QA/QC, the CLP will randomly choose a sample. The TRs must also be marked for "Lab QA/QC" analysis. Lab QA/QC samples should be provided for every 20 soil samples.

1.3.3 BLANK SAMPLES

Normally, at least one type of blank sample is required per day of water sampling. Rinsate blanks are collected when equipment subject to contamination is being reused during a sampling mission. Field bottle or transfer blanks are routinely collected when no rinsate is collected. Trip or transport blanks are routinely transported with sample containers throughout the field sampling activities and accompany sample shipments to the laboratory. All blanks shall be collected, preserved, labelled, and treated like any other sample. Blanks must be sent "blind" to the laboratory. Information identifying blank samples must not appear on the laboratory copies of paperwork. EPA generally only requires one

type of blank be collected, preferably an equipment of field bottle blank (if decon is not performed) on long projects, these may be varied.

EPA Region IX requires distilled/deionized water for inorganic parameters, but HPLC-grade water for organic parameters. Region IX requires that only one type of blank be collected per day. If possible, a rinsate blank should be collected. If the sample is collected directly from the source using no sampling equipment, then field bottle blanks must be collected instead of a rinsate blank.

EPA Region X requires distilled/deionized water for both organic and inorganic parameters. Region X often requires that trip or transport blanks, field bottle or transfer blanks, and rinsate blanks be collected during the same sampling event.

1.3.3.1 Field Bottle or Transfer Blanks

Field bottle or transfer blanks should be collected by filling a full-parameter container set with the appropriate water at a sampling point if possible. The purpose of the field bottle or transfer blank is to check for entrainment of contaminants into the blank from the sampling location during the sample collection process. This type of blank is collected when there is no decontamination of sampling equipment (i.e., dedicated pumps).

1.3.3.2 Rinsate Blanks

Rinsate blanks shall be taken after the equipment has been decontaminated following sampling of the most contaminated well and before the equipment is reused. Rinsate blanks are taken in the field only when equipment is reused during a sampling mission. The number of rinsate blanks taken in the field depends on the amount of equipment that must be reused, and should be about 10 percent of samples using these techniques (on long projects). If few pieces of equipment are to be used more than once, only one rinsate blank will be necessary. However, if the same equipment is used for several days, to ensure the equipment is clean prior to sampling, a rinsate blank must be taken each day before beginning work. If equipment is cleaned in a batch, a rinsate blank for the batch may be taken. All sampling equipment to be reused must be rinsed with distilled or distilled deionized water and the rinsate blank must be collected in a stainless steel pail. The rinsate blank should be collected from the sampling train set-up as would have been used for collecting a sample. For example, water should be poured through a decontaminated split spoon into the appropriate sampler (blank) container.

Rinsate blanks are considered low-level water samples and thus have the same container and preservative requirements. Each rinsate blank is a separate sample and should be labeled as a regular

sample on the lab copies of TRs and the sample tags. Sample Management Office and Quality Assurance Management Section copies of the paperwork must indicate which samples are rinsate blanks.

1.3.3.3 Trip or Transport Blanks

If it is specified in the sampling and analysis plan by EPA, trip or transport blanks must be taken when water samples are collected. Trip blanks should be taken onsite, previously prepared by the laboratory to accompany sample containers to the field, and must be shipped along with the samples to the laboratory. They are considered distinct samples. When trip blanks are taken in the field, deionized/distilled water must be used to fill the trip blank sample container(s) under laboratory conditions on the first day of sampling. The trip blank is typically shipped out with the last samples of the sampling mission. If the sampling mission is extensive, there may be more than one trip blank. In that case, the first trip blank should be shipped out at the end of the first week or whenever convenient. During sampling, the trip blank must be kept at the sample container storage area.

1.4.1 PURPOSE

This SOP provides instructions for the selection of containers and preservatives for samples collected at sites assigned under the ARCSWEST contract. Container requirements and sample preservation vary according to sample type, sample hazard level, and analyses to be performed. This SOP describes container and preservation requirements and the storage criteria for low-, medium-, and high-hazard level sample designations.

1.4.2 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

For EPA projects using Contract Laboratory Program (CLP) analytical support services, sample containers are to be obtained through EPA Quality Assurance Management Section (QAMS) whenever possible. If QAMS is unable to provide containers, they are to be purchased directly and charged to the specific project. Table 1.4-1 presents sample container requirements for CLP Routine Analytical Services (RAS) samples. For non-CLP sampling, container supply is to be requested during laboratory procurement. Detailed preservation requirements are presented in Table 1.4-2, which should be consulted for specific requirements when planning and conducting field sampling activities.

1.4.3 LOW- AND MEDIUM-HAZARD LEVEL SAMPLES

Low-hazard level samples contain up to 20 parts per million (ppm) of each hazardous substance present. Medium-hazard level samples contain between 20 and 200 ppm of at least one hazardous substance and require special packing. Paint cans must be used for shipping <u>all</u> medium- and high-level samples. Specific packing and shipping instructions for medium- and high-level samples are presented in SOP 1.5, <u>Sample Packaging and Shipment</u>.

1.4.3.1 Low-Hazard Water Samples

Low-hazard water samples taken for organic extractable analysis are to be collected in four 1-liter amber glass bottles. Volatile

organic compound (VOC) samples shall be taken in two 40-ml vials with teflon-lined septa in the lids. Two full vials are required for RAS VOC samples. Low detection limit samples for RAS and Special Analytical Services (SAS) VOC samples require three or four 40-ml vials.

Low-hazard level inorganic water samples for metals analysis are to be collected in a 1-liter polyethylene bottle and the contents preserved to a pH of less than 2 with a metals-grade (Ultrex or equivalent) nitric acid (HNO_3). Usually, 10-ml HNO_3 is sufficient. Cyanide analysis also requires a 1-liter polyethylene bottle and shall be preserved to a pH of greater than 12 with sodium hydroxide solution (NaOH). Sodium hydroxide solutions of varying concentrations can be purchased from several vendors. Check the pH by pouring sample into the container cap, checking with the pH indicator strip and discarding the waste sample in to an appropriate container for proper disposal. Replace cap on sample.

TABLE 1.4-1

CLP SAMPLE CONTAINER REQUIREMENTS

		ORGANIC ANALYSIS			INORGANIC ANALYSIS	
SAMPLE MEDIUM	HAZARD LEVEL	RAS EXTRACTABLES	RAS VOLATILES	SAS DIOXIN	RAS METALS	RAS CYANIDE
Water	Low	4 x 1L amber glass bottles	2 x 40ml glass vials w/teflon lined septa lids	2 x 1L amber glass bottles	1 x 1L polyethylene bottle	1 x 1L polyethylene bottle
	Medium	4 x 32oz wide-mouth glass jars	2 x 40ml glass vials w/teflon-lined septa lids	2 x L amber glass bottles	1 x 16oz wide-mouth glass jar	1 x 16oz wide-mouth glass jar
Soil	Low & Medium	1 x 8oz wide-mouth glass jar	2 x 120ml wide-mouth glass jars	1 x 4oz wide-mouth glass jar	1 x 8oz wide-mouth glass jar	
Water & Soil	High	1 x 8oz wide-mouth glass jar		1 x 8oz wide-mouth glass jar	1 x 8oz wide-mouth glass jar	

TABLE 1.4-2

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT[1]

MEASUREMENT	VOLUME REQUIRED (ml)	CONTAINER[2]	PRESERVATIVE[3,4]	HOLDING TIME[5]
Physical Properties				
Color	50	P,G	Cool, 4°C	48 hours
Conductance	100	P,G	Cool, 4°C	28 days
Hardness	100	P,G	HNO_3 to pH <2	6 months
Odor	200	G only	Cool, 4°C	24 hours
pH	25	P,G	None Required	Analyze Immediately
Residue				
Filterable	100	P,G	Cool, 4°C	7 days
Non-Filterable	100	P,G	Cool, 4°C	7 days
Total	100	P,G	Cool, 4°C	7 days
Volatile	100	P,G	Cool, 4°C	7 days
Settleable Matter	1000	P,G	Cool, 4°C	48 hours
Temperature	1000	P,G	None Required	Analyze Immediately
Turbidity	100	P,G	Cool, 4°C	48 hours
Metals				
Dissolved	200	P only	Filter on site HNO_3 to pH <2	6 months
Suspended	200	P only	Filter on site	6 months
Total	100	P,G	HNO_3 to pH <2	6 months
Chromium VI	200	P,G	Cool, 4°C	24 hours
Mercury				
Dissolved	100	P,G	Filter on site HNO_3 to pH <2	28 days
Total	100	P,G	HNO_3 to pH <2	28 days
Inorganics, Non-Metallics				
Acidity	100	P,G	Cool, 4°C	14 days
Alkalinity	100	P,G	Cool, 4°C	14 days
Bromide	100	P,G	None Required	28 days
Chloride	50	P,G	None Required	28 days

TABLE 1.4-2

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT[1]

MEASUREMENT	VOLUME REQUIRED (ml)	CONTAINER[2]	PRESERVATIVE[3,4]	HOLDING TIME[5]
Inorganics, Non-Metallics (continued)				
Chlorine	200	P,G	None Required	Analyze Immediately
Cyanides	500	P,G	Cool, 4°C NaOH to pH >12 0.6g ascorbic acid[7]	14 days[6]
Fluoride	300	P,G	None Required	28 days
Iodide	100	P,G	Cool, 4°C	24 hours
Nitrogen				
Ammonia	400	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days
Kjeldahl, Total	500	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days
Nitrate plus Nitrite	100	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days
Nitrate[8]	100	P,G	Cool, 4°C	48 hours
Nitrite	50	P,G	Cool, 4°C	48 hours
Dissolved Oxygen				
Probe	300	G bottle and top	None Required	Analyze Immediately
Winkler	300	G bottle and top	Fix on site and store in dark	8 hours
Phosphorus				
Orthophosphate, Dissolved	50	P,G	Filter on site Cool, 4°C	48 hours
Hydrolyzable	50	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days
Total	50	P,G	Cool, 4°C H_2SO_4 to pH <2	28 days
Total, Dissolved	50	P,G	Filter on site Cool, 4°C H_2SO_4 to pH <2	24 hours
Silica	50	P only	Cool, 4°C	28 days
Sulfate	50	P,G	Cool, 4°C	28 days

TABLE 1.4-2

RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO MEASUREMENT[1]

MEASUREMENT	VOLUME REQUIRED (ml)	CONTAINER[2]	PRESERVATIVE[3,4]	HOLDING TIME[5]
Inorganics, Non-Metallics (continued)				
Sulfide	500	P,G	Cool, 4°C add 2 ml zinc acetate plus NaOH to pH >9	7 days
Sulfite	50	P,G	None Required	Analyze Immediately
Organics				
Volatile Organics	water 2 x 40 soil[10] 2 x 120 wide-mouth glass vials	G, Teflon-lined Septum	Add 2 drops 1:1 HCl to vial before sample collection[9] No headspace Cool, 4°C	14 days
Semivolatile Organics	water 2 x 1 L soil[10] 1 x 4 oz wide-mouth glass jar	G, Teflon-lined Septum	Cool, 4°C	7 days until extraction, 40 days after extraction
Pesticides/PCBs	water 2 x 1 L soil[10] 1 x 4 oz wide-mouth glass jar	G, Teflon-lined Septum	Cool, 4°C	7 days until extraction, 40 days after extraction
BOD	1000	P,G	Cool, 4°C	48 hours
COD	50	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days
Oil & Grease	1000	G only	Cool, 4°C H_2SO_4 to pH<2	28 days
Organic carbon	25	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days
Phenolics	500	G only	Cool, 4°C H_2SO_4 to pH<2	28 days
MBAS	250	P,G	Cool, 4°C	48 hours
NTA	50	P,G	Cool, 4°C	24 hours

TABLE 1.4-2 - FOOTNOTES

(1) A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.

(2) Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

(3) Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

(4) When any sample is to be shipped by common carrier or sent through the United State Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table 1.4-2, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: hydrochloric acid (HCL) in water solution at concentrations of 0.04% by weight or less (pH about 1.96 or greater); nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

(5) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee or monitoring laboratory has data on file to show that the specific types of sample under study are stable for the longer time and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period in the table. A permittee or monitoring laboratory is obligated to hold the sample for a shorter time if knowledge exists to show this in necessary to maintain sample stability.

(6) Maximum holding times is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

(7) Should only be used in the presence of residual chlorine.

(8) For samples from non-chlorinated drinking water supplies concentrated H_2SO_4 should be added to lower sample pH to less than 2. The sample should be analyzed before 14 days.

(9) For volatile organics analysis, acidify all <u>low</u> concentration groundwater and other drinking water samples. Do not acidify surface water, wastewater or any medium/high concentration samples. If acidification causes bubbling, do not acidify and notify the Quality Assurance Officer.

(10) Surface soil samples. Soil boring samples are collected in brass or stainless steel rings.

1.4.3.2 Medium-Hazard Water Samples

Organic extractable analysis for medium-hazard level water samples requires four 32-ounce wide-mouth glass jars. VOC samples are to be taken in two 40-ml vials with teflon-lined septa in the lids. Inorganic analysis for metals and cyanide in medium-hazard level samples are to be taken in two separate 16-ounce jars and require no preservatives.

1.4.3.3 Low- and Medium-Hazard Soil Samples

The following container requirements apply to low- and medium-hazard level soil samples. Organic-extractable soil samples are to be collected in one 8-ounce wide-mouth glass jar. VOC samples require two 120-ml wide-mouth glass jars. Inorganic soil samples shall be collected in one 8-ounce wide-mouth glass jar and will be analyzed for both metals and cyanide. Soil samples do not require chemical preservation.

1.4.4 HIGH-HAZARD SAMPLES

High-hazard samples have concentrations over 200 ppm of the hazardous substances. Liquids, sludges, and solids require one 8-ounce wide-mouth glass jar 3/4-full for both organic and inorganic analyses. This volume is considered adequate for complete routine analysis.

1.4.5 SPECIAL REQUESTS

All CLP analysis not otherwise routine (i.e., target compound list, volatile organic analysis, semi-target analyte list metals) are considered SAS if requested for CLP analysis. Two examples are dioxins and furans. Others may be Standard Methods, drinking water methods, ASTM methods, modified EPA methods, or more complicated analyses like the Toxicity Characteristic Leaching Procedure. Quick turnaround requests of a RAS analysis become a RAS+SAS, if done under CLP analysis.

The container requirements will vary for the type of constituent(s) sampled, and the appropriate methods need to be referenced for each parameter under investigation to ensure proper collection volumes, preservation, containers, and holding times are met.

Analyses for dioxins and furans are SAS techniques. The persons responsible for obtaining sample containers must be consulted 6 to 8 weeks prior to sampling. CLP laboratory space should be procured at least 3 weeks prior to sample collection. Soil analyses require one 4-ounce wide-mouth glass jar. Water analyses require two 1-liter amber bottles. No extra volume should be taken as the laboratory must dispose of the sample remnants.

1.5.0 PURPOSE

This SOP provides instructions that are to be followed in the packaging, labeling, and shipment of samples collected at sites assigned under the ARCSWEST contract. This SOP is to be used in conjunction with SOP No. 1.1, Soil/Sediment Sampling, and SOP No. 1.2, Groundwater/Surface Water Sampling.

1.5.1 INTRODUCTION

As with all field work, the ease and efficiency with which sample handling is conducted is proportional to the amount of preparation before entering the field. Organization and a thorough understanding of the sampling plan are essential for the person designated to complete paperwork and ship samples. Sufficient amounts of packaging materials must be assembled, shipping requirements determined, and shipping offices located before the trip.

While the completion of some of the paperwork in the office is advisable, this practice must be tempered by judgement. The completion of too much paperwork can be a problem if sampling plans or circumstances change in the field. Each person must determine the balance between too much and too little pre-field paperwork and preparation through experience.

Sample packaging, labeling, and shipment procedures are designed (1) to preserve sample quality so that analyses will yield results representative of site conditions, (2) to protect and inform sample handlers including shippers and laboratory personnel, and (3) to provide a papertrail to allow cross referencing of sample collection locations with analytical results. For the purpose of sample packaging and shipment, samples are categorized as "hazardous" samples unless it can be reasonably assumed that dioxins are not present and all other contaminants are at concentrations below 10 ppm. If both these conditions are met, the

sample can be packaged and shipped as an "environmental" sample. Procedures for handling these two types of samples follow.

1.5.2 PREPARATION FOR FIELD WORK

- Determine sample locations.
- Determine number of samples (including QA/QC and duplicates).
- Determine analysis required.
- Number stations unambiguously.
- Determine probable concentrations of samples.
- Determine number and type of sample bottles required.
- Determine packaging materials required (e.g., strapping tape, ice chests, vermiculite, bubble wrap, paint cans, warning labels, etc.).
- Have authorized person contact SMO for Case and/or SAS Number(s), blank paperwork, and laboratory space.
- Contact all interested parties (i.e., EPA representatives, state agencies, site owners, site operators, etc.).
- Assemble sample bottles and packaging materials.
- Check applicable United States Department of Transportation (USDOT) shipping regulations.
- Make plans for sample shipments (e.g., locate Fed-Ex, obtain laboratory address, etc.).
- To avoid confusion, prior to sampling, bottles can be temporarily numbered with station numbers.
- Plan for likely site conditions (e.g., hazards on the site, weather, accessibility of the site, etc.).

1.5.3 SAMPLE HANDLING

Once samples have been sealed in the ice chests, they are to be expeditiously transported to the analytical laboratory. If the laboratory is located near the sampling site (e.g., if a non-CLP laboratory has been reserved) the sampling team may drive the samples to the laboratory. Otherwise, samples are to be routinely shipped by the overnight service.

There are two types of airbills, the nonrestricted materials airbill, for the shipment of environmental samples and the restricted articles airbill, for the shipment of hazardous materials. Environmental samples are generally those collected from sources not expected to show significant contamination, for example, ponds, streams, and off-site soils. Samples from obviously contaminated sources such as on-site soils and groundwater, drums, leachate, and tanks must be considered as hazardous materials and shipped according to USDOT regulation. If enough information is known about a site, samples from these sources may be shipped as low level environmental samples. Only low concentration samples are considered environmental while medium and high concentration samples are considered hazardous.

1.5.3.1 Packaging

Samples suspected of containing dioxins at any concentration, or suspected of containing other hazardous contaminants at concentrations over 10 ppm are to be overpacked and shipped according to USDOT regulations (see Exhibit 1.5-1). The following procedure is to be used for low level environmental sample packaging.

- Decontaminate outside of sample containers.
- Affix sample labels to corresponding sample containers.
- Add preservatives to water samples as required.
- For Region X, attach sample tags and matching sample labels to sample containers.
- Affix custody seals to the neck of the container, over the cap.
- Use bubble wrap bags to protect glass sample bottles.
- Enclose all samples containers and bottles in sealed ziplock bags.
- Place sample containers in an ice chest lined with a plastic trash bag, checking against chain-of-custody record to ensure all samples are listed and are in the correct ice chest.
- Add styrofoam packing material to the trash bag to fill the empty space between samples.
- Fasten trash bag with twist-tie.
- Detach and retain the first two copies of the traffic report and chain-of-custody form.

- Seal remaining paperwork in a ziplock bag. Tape the bag to the inside of ice chest lid.
- Fill 1 to 3 ziplock bags with ice and include in the ice chest shipment if required by sampling and analysis plan. All ice should be double bagged in heavy duty ziplock bags.
- Affix airbill or airbill sticker to outside of the ice chest.
- Affix "This End Up" stickers to the ice chest.
- Seal the ice chest with three (3) custody seals (two in the front and one in the back).
- Tape the ice chest shut using strapping tape.
- Affix the laboratory address to all ice chests.
- Remove extraneous stickers from the ice chests.
- Ensure that ice chests have an ICF Technology return address on them.

Before relying on a shipping service, call that service to locate the drop off point nearest the site, then call that site to obtain the business hours and prepare them for your shipment. Occasionally, service operators are not aware that they can ship environmental or hazardous samples and it is inconvenient to have them attempt to learn the procedures just before the shipment deadline. Also the shipping deadline for laboratories on the East Coast may be several hours earlier than West Coast deadline. Calling in advance can identify these considerations.

1.5.3.2 Chain-of-Custody Seal

This form is used to show that no tampering has occurred between the time the sample left the field personnel to when it arrived at the laboratory. It is an adhesive form and should be placed over the container top and neck so that the lid cannot be removed without breaking the seal. Custody Seals are also used to seal the ice chests and paint cans shut before shipping.

(1)	Date	Sample date.
(2)	ID#	Project code number for the sampling event.
(3)	Signature	Signature of the person sealing the container.

1.5.3.3 Environmental Samples Airbill

Federal Express is used to ship the vast majority of samples to analytical laboratories. This section describes the procedures used when shipping samples via Federal Express. However, this does not prevent samplers from utilizing other carriers.

Federal Express requires a completed "Nonrestricted Materials Airbill" for the shipment of environmental samples. A separate airbill is required for each destination but multiple ice chests can be shipped under one airbill if they are being sent to the same laboratory. The Federal Express Nonrestricted Materials Airbill is completed as follows. An example of a Federal Express airbill is shown in Exhibit 1.5-2.

(1) Date	The date the sample is shipped.
Sender's Federal Express Account Number	ICF Fed-Ex account should be typed or printed in here, it is 1105-2301-7
From	Team leader's name.
Phone	Phone number of office. (If the team expects to be in the field for an extensive period the hotel phone number may be more helpful.)
Company	Self explanatory.
(2) Recipient's Name	Name of laboratory contact, laboratory phone number, and laboratory address from the Field Operations Notebook.
(3) Billing Reference Payment	ICF project code. Check "Bill Sender."
(4) Services Delivery	Check box # 1, "Priority 1" Check box # 1, 2 or 3 as required.

H. Fill out if necessary.

(5) Leave Blank, <u>do not sign</u>.

Examples of airbills from other carriers are shown in Exhibit 1.5-3 and 1.5-4.

1.5.3.4 Hazardous Materials Airbills

Unlike the regular airbill the Dangerous Goods or Restricted Articles airbill has two parts. In addition to the upper portion which is identical to the typical airbill, the Restricted Articles airbill has a lower portion entitled "Shipper's Certification for Dangerous Goods." Every effort must be made to fill out this portion correctly, as shippers may be subject to fines for the improper transport of restricted articles.

(1-5)		These sections are filled out in the same way as the normal airbill.
(6)		Check the box labeled "49 CFR."
(7)	No. of Packages Packages	Write in the number of ice chests being shipped on that airbill.
(8)	Proper Shipping Name	One of the following will usually apply; "Flammable Liquid, NOS," "Flammable Solid, NOS," "Compressed Gas, NOS" "Corrosive" or "Hydrogen." Regulations require that the hazardous constituents must be entered along with the NOS designation (i.e., "Compressed Gas NOS [0.1% hexane in air]).
(9)	Class or Division	One of the following will usually apply; "Nonflammable Gas," "Flammable Liquid," "Flammable Solid," or "Flammable Gas."
(10)	UN or NA Number	Consult USDOT Tables (Appendices A and B) for proper UN or NA number. (UN numbers should be written "UN1992" not "1992").
(11)	Subsidiary Risk	This column is filled out when the substance has more than one hazard as listed in USDOT Tables.
(12)	Total Net Quantity	Write the total quantity of hazardous materials in the shipment in appropriate units.
(13)	Radioactive Materials	
(14)	Transport Details	

Shipping limitations as follows:

a. Flammable Liquids
   - -- Less than 32 oz--Passenger aircraft
   - -- 32 oz to 10 gal--Cargo aircraft

b. Flammable Solids
   - -- Less than 25 lbs--Passenger or cargo aircraft.
   - -- 25 lbs--1000 lbs cargo aircraft
   - -- Greater than 1000 lbs requires more extensive procedures. (25 lbs being the total weight of the ice chest). (An empty ice chest weighs approximately 18 lbs).

(15) Print shipper's name and title.

(16) Write in the name of the city the shipment is being made from.

(17) Telephone number of INFOTRAC Inc (1-800-535-5305). ICF has contracted with INFOTRAC to provide a 24 hour emergency response telephone number.

(18) Shipper's signature.

1.5.3.5 Carrier Sticker

The carrier sticker is attached by carrier employees to the additional ice chests when more than one is going to the same laboratory. These are bar code stickers which are adhesive backed and are easily attached to the outside of the ice chest.

1.5.3.6 Warning Labels

USDOT regulations require warning labels for hazardous materials. USDOT regulations must be consulted and adhered to for all shipments.

1.5.4 SAMPLE SHIPMENT

When shipping hazardous materials (which may include sample or equipment), personnel must be aware that specific regulations govern the packaging, labeling, and transport of these items. Hazardous materials are defined by the Hazardous Materials Regulation Board and set forth in 49 CFR Parts 171-178, and must be shipped in strict accordance with USDOT procedures. ICF staff members should be aware that regulatory agencies have the authority to levy substantial financial penalties on violators. These regulations apply to shipment by non-commercial (i.e., personal,

rented or company vehicles) as well as by commercial carrier. Persons making shipments should remember that only designated air carrier offices will accept hazardous materials.

1.5.4.1 Environmental Samples

Samples which are not expected to contain significant levels of contamination , such as those taken from streams, ponds, and off-site soils are considered environmental samples. That is, all low concentration samples are shipped as "Environmental Samples." These samples have no packaging, labeling, or shipping requirements beyond the usual procedures. (Most air carriers require an address of the sender and of the receiver to be on the ice chest.) The primary concern in the case of "Environmental Samples" is that the samples reach their destination in a timely and undamaged state.

1.5.4.2 Hazardous Materials Samples

Samples taken from such potentially contaminated sources as on-site soils, drums, storage tanks, ponds, impoundments, lagoons, or leachates or from obviously contaminated locations must be treated as hazardous material samples and be shipped accordingly. If there is any doubt, a sample should be shipped as a hazardous material. Both medium and high concentration samples are shipped as hazard materials.

Hazardous materials must be packaged differently than the more common environmental samples. The sample is bubble wrapped, sealed in a plastic bag, then placed in a metal paint can, one sample per can. The dead air space is filled with vermiculite and the can is sealed with metal clips. The paint cans are labeled with the following: Sample Tag #, SAS #, Case #, the date, and any applicable warning labels. The cans are then shipped in an appropriately labeled ice chest.

1.5.4.3 Known Materials

Hazardous materials are further divided into known materials and unknown materials depending on the situation at the site. If <u>all</u> the hazardous substances in the sample are known or can be accurately identified, the sample is packaged, labeled, and shipped according to the instructions for that material, as detailed in the USDOT Hazardous Materials Table, 49 CFR 172.101 and the HM181 Rule - new package requirements. These change too frequently to include here.

1.5.4.4 Unknown Materials

When one or more substances in the sample cannot be identified, the sample must be shipped as an "unknown material." The appropriate transportation procedures are determined by classifying

the sample through a process of elimination using the USDOT Hazardous Materials Table.

Radioactive Materials. If radiation survey instruments indicate, or there is a reasonable suspicion the samples contain radioactive materials, they must be shipped as radioactive materials. Regulations governing transport of radioactive materials are given in 49 CFR parts 173.389 to 173.398.

Poison A. USDOT defines Poison A as extremely dangerous non-radioactive poisonous gas or liquid of such a nature that a very small amount of gas or vapor of the liquid will be dangerous to life. Most Poison A materials are gases and would not be commonly found in field activities. Al samples found in closed containers do not have to e shipped as Poison A. Judgement based on available information must be used to decide if a sample is a Poison A. Special efforts to personally be familiar with all regulations governing transport of Poison A samples should be made by all team leaders expecting to ship such samples. Begin with 49 CFR 173.2.

Flammable Liquids. The next two categories in the USDOT classification are flammable gas and nonflammable gas. In usual circumstances sampling does not includes gases, nor are sampling containers expected to contain a significant amount of gas in their airspace. For samples containing unknown materials, other classifications listed below flammable liquid are not usually considered. In order to classify a substance as nonflammable a flash point test is required. Such tests would be impractical of even dangerous in the field. Thus unknown hazardous samples are usually shipped as flammable liquids. The phrase "flammable liquid" does not necessarily mean the sample is either flammable or a liquid; it merely refers to a shipping classification in accordance with USDOT regulations. If the sample is a solid or a sludge it may be shipped as a "flammable solid." Any unknown material that is not classified as Poison A, flammable gas, or nonflammable gas should be shipped as a flammable liquid or a flammable solid.

"Flammable liquid" and "flammable solid" samples must be packed in paint cans as "high" or "medium" concentration samples for shipment. (Conversely, unknown sample of high or medium concentration must be packed and shipped as "flammable liquids" or "flammable solids.") The following information must be placed on each paint can:

- Laboratory name and address.
- "FLAMMABLE LIQUID, NOS UN1993" or "FLAMMABLE SOLID, NOS UN1325" (NOS means Not Otherwise Specified or Not Otherwise Stated)
- "DANGEROUS WHEN WET" if applicable

- Sample Tag #
- SAS #
- Case #
- The date

The ice chest in which the paint cans are packed should have the following labels;

- Laboratory name and address
- "FLAMMABLE LIQUID, NOS UN1993" or "FLAMMABLE SOLID, NOT UN1325"
- "DANGEROUS WHEN WET" if applicable
- "CARGO AIRCRAFT ONLY"
- "LABORATORY SAMPLES"
- "INSIDE PACKAGES COMPLY WITH PRESCRIBED SPECIFICATIONS"
- "THIS END UP"

Unknown hazardous materials can be transported by truck, rail, or overnight carriers, but must not be transported by passenger carrying aircraft.

1.5.5 SHIPMENT COORDINATION

Once samples have been shipped to the analytical laboratory, the sample team leader must notify the Regional Sample Control Center (RSCC). Notification must be on the day of shipment and if after hours, the team leader may need to leave a detailed message. The following information is to be provided to the RSCC.

- Team leader name.
- Telephone number (office or hotel) for following-day contact.
- Site name or code.
- Batch numbers (for dioxin analyses).
- Exact number of samples shipped by matrix and environmental or hazardous concentrations.
- Laboratories that samples were shipped to.
- Shipping company and airbill numbers.
- Method of shipment (overnight).
- Date of shipment.
- Analyses requested by laboratory and matrix.

- Any irregularities or problem with samples including special handling instructions.
- Status of sampling mission (e.g. final shipment or future sampling schedule).

1.6.0 PURPOSE

This SOP provides instructions for personnel and equipment decontamination that are to be followed at sites assigned under the ARCSWEST contracts. This SOP is to be used in conjunction with SOP No. 1.7, Handling of Investigation-Derived Waste.

1.6.1 INTRODUCTION

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and/or equipment at hazardous waste sites. Decontamination is required to protect personnel from the potential effects of hazardous substances and to minimize the spread of those substances. Decontamination methods include: physical removal of contaminants; chemical detoxification and disinfection/sterilization.

This SOP describes decontamination, responsibilities and procedures to be implemented at hazardous waste sites. The procedures outlined are to be followed by all personnel who participate in site activities in areas which may contain hazardous substances. A full scenario of decontamination procedures are presented that will not necessarily all be appropriate for a given site. Project procedures may be prepared as part of the site Health and Safety Plan (HASP) that focus of site-specific conditions and incorporate the appropriate procedures presented in this SOP.

1.6.2 RESPONSIBILITIES

Personnel health and safety takes precedence over all other considerations in ICF operations. The Site Safety Officer (SSO) has the responsibility for establishing the project decontamination program. HASP decontamination procedures for all projects shall be reviewed and authorized by the ARCSWEST Health and Safety Officer. These modifications must not compromise personnel health and safety. All modifications/changes must be noted in the field logbook and documented as HASP revisions and initialed by all field personnel.

The Site Manager is charged with the responsibility for assuring that all site personnel become familiar with and follow the decontamination procedures described in this SOP or in the site-specific HASP.

1.6.3 PERSONNEL DECONTAMINATION

Contamination avoidance is the best way to prevent the spread of contaminants. Direct contact with contaminants is to be minimized by not leaning against objects, and not kneeling or sitting on the ground; through the use of remote sampling, handling and container opening techniques wherever appropriate; and through the use of disposable equipment wherever appropriate.

1.6.3.1 Decontamination Program Planning

The SSO shall research the background information on the particular site when planning the decontamination procedures for the field work at that site. The physical, chemical, toxicological and pathogenic properties (if any) as well as the amounts and concentrations of each contaminant present at the site are the determining factors in selecting the levels of protection for personnel and the extent of decontamination required. Sources of information for the characterization of hazardous waste sites include site records, State and Federal agency files and interviews with knowledgeable people. Hazardous and toxicological references, industrial process references and manufacturers handbooks are also good sources of information. Topography, local meteorological conditions (most probable wind direction, rainfall, etc.) and other site specific features are factors to be considered in defining decontamination measures.

1.6.3.2 Decontamination Station Layout

When site conditions require, a dedicated area shall be established as a decontamination station. The decontamination station shall be located upwind of the Exclusion Zone. This is especially important when either airborne contaminants are detected at above background levels or when such a potential exists. This is to prevent the airborne contamination of the Contamination Reduction Zone and the Support Zone. Exclusion, Contamination Reduction and Support Zones are depicted in Figure 1 and defined as follows:

<u>Exclusion Zone</u>: The zone encompassing the contaminated area which must be large enough to prevent the spread of contaminants beyond its boundaries. The extent of the exclusion zone will depend on:

- Toxicity of the contaminants;
- Physical form of the contaminants (solid, liquid or gas);

- Amounts and concentrations of the contaminants;
- Fire and explosive potential of contamination;
- Site specific conditions such a topography and meteorology, and potential and active migration pathways to air, water and soil.

Contamination Reduction Zone (CRZ): The area between the Exclusion and Support Zones where contamination is controlled and or removed. A contamination reduction corridor is an area within the CRZ that is the point of entry and exit for personnel to and from the Exclusion Zone. The decontamination line is set up along the corridor.

Support Area: The Support Area is separated from the CRZ by the contamination control line (CCL). The Support Area must be free from all contamination at all times.

The boundaries of the decontamination station should be clearly visible to all field personnel. The decontamination line should be set up along a straight line to facilitate identifying each station in the decontamination process.

Site specific conditions to consider when locating the decontamination station are the location(s) of field investigation activities, accessibility to site personnel, and site terrain and safety. The decontamination station should be moved if site investigation activities are moved significantly.

The SSO will determine if gross contamination has spread beyond the exclusion zone, wind direction changes (when airborne contaminants are suspected), inclement weather develops, or other site specific factors.

Multiple decontamination stations may be deemed necessary by the SSO depending on the particular project.

Decontamination equipment, materials and supplies are generally selected on basis of availability and compatibility with contaminants encountered. Other considerations include ease of equipment decontamination, disposability and site specific requirements. Recommended equipment for a decontamination station include the following:

- Plastic sheeting or other suitable materials on which the decon tubs, clean equipment, and contaminated equipment can be set down.
- Collection containers such as drums or suitably lined trash cans for storing disposable clothing and contaminated personnel protective clothing.

- Long-handled soft-bristled wire brushes to help scrub off contaminants.
- Large galvanized tubs or other suitable tubs. These should be large enough for a worker to step in.
- Paper towels for drying protective clothing and equipment.
- Metal DOT approved drums with lids for contaminated wash and rinse solutions and for contaminated disposal items, trash cans.
- Wash cloths, soap, towels and cans for hand rinse.
- Pressurized spray cans for deionized/distilled water, water containers.
- Portable shower facilities for full body wash (if needed).
- Folding chairs and tables.
- Pocket knife.
- Stakes and rope for demarcating the hot line.
- First aid kit.
- Decon solutions and detergents.
- Distilled and DI water. Potable tap water for decon.

1.6.3.3 Personnel Decontamination Solutions

The detergents alconox or Liquinox and water are the preferred surfactants for most decontamination procedures. Selection of specific solvents and decontamination solutions are to be defined in the site work plan.

The effectiveness of decontamination solutions shall be continuously verified. Visual observations of discoloration, stains and substances adhering to objects are indications that the decontamination solution is not effective in removing contamination. Decontamination solutions must be replenished frequently with use, to assure their continued effectiveness.

The quality of rinse water used in the decontamination process shall be verified. A distilled/deionized rinse is the final step in the decontamination of equipment and to remove all traces of contaminants.

1.6.3.4 Personnel Decontamination

Personnel decontamination procedures depend on the level of personal protection worn by the field crew as required by the site health and safety plan, and upon the degree of contamination the crew members experience. The objective of personal decontamination is to protect the health of all crew members and to prevent the spread of contamination from the site. Therefore, the following procedures should be extended and modified by the site safety officer until he/she and the field crew are satisfied that complete decontamination has been accomplished. In a case of emergency, the site health and safety officer may judge it necessary to curtail these decontamination procedures to evacuate the site or initiate first aid.

1.6.3.4.1 Level A Decontamination

Level A is the highest level of personal protection and requires the most extensive decontamination procedures. All other levels of personnel protection and decontamination procedures can be considered abbreviated versions of Level A. Crew members responsible for Level A decontamination must allow sufficient time to set up and maintain each decontamination station. Because Level A decontamination requires significant volumes of detergent solutions and rinse water, provisions must be made for adequate water supplies and waste solution storage.

The equipment required for personal protection in Level A includes: fully encapsulating suit, SCBA, hard-hat, steel-toe/shank boots, boot covers, and inner and outer gloves. Level A decontamination procedures can be divided into four sublevels: (1) highly contaminated personnel exiting the exclusion zone, (2) minimally contamination personnel exiting the exclusion zone, (3) highly contaminated personnel crossing hot line to exchange SCBA tank, and (4) minimally contaminated personnel crossing the hot line to exchange SCBA tank. These distinctions are be noted in the decontamination station descriptions below.

Station 1 - Segregated Equipment Drop (All Sublevels)

Before crossing the hot line, personnel returning from the field deposit all equipment and/or sample bottles in segregated areas on plastic sheeting. Highly contaminated equipment such as samplers and sample containers are kept separate from minimally contaminated equipment such air monitoring meters.

Station 2 - Boot Cover and Outer Glove Wash (Minimally Contaminated Personnel May Omit Stations 2 and 3)

Personnel step into a wash tub containing a detergent solution. Boot covers and outer gloves are scrubbed with a long-handled, soft-bristled brush. All surfaces of the boots and gloves are washed including boot soles and duct tape used to seal covers and gloves to suit.

Station 3 - Boot Cover and Outer Glove Rinse

Personnel step into a wash tub containing tap water. Boot covers including bottoms and outer gloves are rinsed with a long-handled, soft-bristled brush.

Station 4 - Tape Removal

Tape is removed from boot covers and outer gloves and deposited into a plastic-lined disposal drum.

Station 5 - Boot Cover and Outer Glove Removal

Boot covers and outer gloves are removed and deposited into a plastic-lined disposal drum. A knife may help in the removal of tight-fitting boot covers.

Station 6 - Encapsulating Suit and Safety Boot Wash

Personnel step into a wash tub containing a detergent solution. Encapsulating suit and safety boots are scrubbed with a long-handled, soft-bristled brush. Continue to scrub all surfaces of the suit and boots including boot soles until visible contamination is removed.

Station 7 - Encapsulating Suit and Safety Boot Rinse

Personnel step into a wash tub containing tap water. Encapsulating suit and safety boots are rinsed with a long-handled, soft-bristled brush. A pressure sprayer may be used to apply rinse water.

Station 8 - SCBA Tank Change (Applies Only to Personnel Returning to the Exclusion Zone)

Crew member's air tank is replaced with a recharged tank. New outer gloves and boot covers are donned and sealed with duct tape. Member exits the decontamination series and returns to the exclusion zone.

Station 9 - Safety Boot and Encapsulating Suit Removal

Boots and hard hat are removed and set on plastic sheet. With assistance, the fully encapsulating suit is removed and set on plastic sheet.

Station 10 - SCBA Backpack Removal

While still wearing the face-piece, the SCBA backpack is removed and set on a chair or table. The air supply hose is disconnected from the regulator valve.

Station 11 - Inner Glove Wash (Stations 11 and 12 may be Omitted by Minimally Contaminated Personnel)

Inner gloves are scrubbed by rubbing hands together with a detergent solution.

Station 12- Inner Glove Rinse

Inner gloves are rinsed with tap water.

Station 13 - SCBA Face Piece Removal

The SCBA face piece is removed without touching inner gloves to face. Deposit face piece on a plastic sheet.

Station 14- Inner Glove Removal

Inner gloves are removed and disposed to a plastic-lined disposal drum.

Station 15 - Field Wash/Field Shower

Hands and face are washed with hand soap, then rinsed and dried with paper towels. If highly toxic, skin-corrosive, or skin-absorbable materials are at the site, shower entire body.

1.6.3.4.2 Level B Decontamination

Level B provides less personal protection than Level A, mainly because it substitutes a chemically-resistant, disposable coverall, which is open at the face and hands, for the fully encapsulating suit. Level B personal protection includes: chemical-resistant disposable coverall, SCBA, hard-hat, steel-toe/shank boots, boot covers, and inner and outer gloves. Level B decontamination procedures also can be divided into four sublevels: (1) highly contaminated personnel exiting the exclusion zone, (2) minimally contamination personnel exiting the exclusion zone, (3) highly contaminated personnel crossing hot line to exchange SCBA tank, and

(4) minimally contaminated personnel crossing the hot line to exchange SCBA tank. These distinctions are noted in the decontamination station descriptions below.

Station 1 - Segregated Equipment Drop (All Sublevels)

Before crossing the hot line, personnel returning from the field deposit all equipment and/or sample bottles in segregated areas on plastic sheeting. Highly contaminated equipment such as samplers and sample containers are kept separate from minimally contaminated and difficult to clean equipment such air monitoring equipment.

Station 2 - Boot Cover and Outer Glove Wash (Minimally Contaminated Personnel may combine Stations 2 through 5)

Personnel step into a wash tub containing a detergent solution. Boot covers and outer gloves are scrubbed with a long-handled, soft-bristled brush. All surfaces of the boots and gloves are washed including boot soles and duct tape used to seal covers and gloves to coverall.

Station 3 - Boot Cover and Outer Glove Rinse

Personnel step into a wash tub containing a tap water. Boot covers including soles and outer gloves are rinsed with a long-handled, soft-bristled brush.

Station 4 - Tape, Boot Cover and Outer Glove Removal

Tape is removed from boot covers and outer gloves and deposited into a plastic-lined disposal drum. Boot covers and outer gloves are removed and deposited into plastic-lined disposal drum. A knife may be used to aid in the removal of tight-fitting boot covers.

Station 5 - Coverall, SCBA, and Safety Boot Wash

At this station, all exposed surfaces of personal protective gear are washed with the detergent solution. Personnel step into a wash tub containing a detergent solution. All gear is scrubbed with a long-handled, soft-bristled brush. Continue to scrub all surfaces of gear including boot soles until visible contamination is removed.

Station 6 - Coverall, SCBA, and Safety Boot Rinse

All exposed surfaces of personal protective gear are rinsed to remove detergent. Personnel step into a wash tub containing a tap water. All gear is rinsed with a long-handled, soft-bristled brush. Pressure sprayers containing tap water may be use to aid in rinsing.

Station 7 - SCBA Tank Change (Applies Only to Personnel Returning to the Exclusion Zone)

Crew member's air tank is replaced with a recharged tank. New outer gloves and boot covers are donned and sealed with duct tape. Member exits the decontamination station series and returns to the exclusion zone.

Station 8 - Safety Boot and SCBA Backpack Removal

Boots are removed and set on plastic sheet. While still wearing the face-piece, the SCBA backpack is removed and set on a chair or table. The air supply hose is disconnected from the regulator valve.

Station 9 - Chemically-Resistant Overall Removal

Chemically resistant overalls are removed and disposed to a plastic-lined disposal drum.

Station 10 - Inner Glove Wash and Rinse

Inner gloves are scrubbed by rubbing hands together with a detergent solution then rinsed in tap water.

Station 11 - SCBA Face Piece Removal

The SCBA face piece is removed without touching inner gloves to face. Deposit face piece on a plastic sheet.

Station 12 - Inner Glove Removal

Inner gloves are removed and disposed to a plastic-lined disposal drum.

Station 13 - Field Wash/Field Shower

Hands and face are washed with hand soap, then rinsed and dried with paper towels. If highly toxic, skin-corrosive, or skin-absorbable materials are at the site, shower entire body.

1.6.3.4.3 Level C Decontamination

Level C is the next lower level of personal protection. It substitutes air purifying respirators for supplied air. Level C personal protection includes: chemical-resistant disposable coverall, APR, hard-hat, steel-toe/shank boots, boot covers, and inner and outer gloves. Depending on exposure hazard, boot covers and outer gloves may not be required, and tyvek coverall may be substituted for chemically-resistant coverall.

Station 1 - Segregated Equipment Drop

Before crossing the hot line, personnel returning from the field deposit all equipment and/or sample bottles in segregated areas on plastic sheeting. Highly contaminated equipment such as samplers and sample containers are kept separate from minimally contaminated and difficult to clean equipment such air monitoring equipment.

Station 2 - Boot Cover/Outer Glove Wash (Skip if Not Worn)

Personnel step into a wash tub containing a detergent solution. Boot covers and outer gloves are scrubbed with a long-handled, soft-bristled brush. All surfaces of the boots and gloves are washed including boot soles and duct tape used to seal covers and gloves to coverall.

Station 3 - Boot Cover and Outer Glove Rinse (Skip if Not Worn)

Personnel step into a wash tub containing a tap water. Boot covers including bottoms and outer gloves are rinsed with a long-handled, soft-bristled brush.

Station 4 - Tape, Boot Cover and Outer Glove Removal (Skip if Not Worn)

Tape sealing boot covers and outer gloves is removed and deposited into a plastic-lined disposal drum. Boot covers and outer gloves are removed and deposit into plastic-lined disposal drum. A knife may be used to aid in the removal of tight-fitting boot covers.

Station 5 - Safety Boot Wash

Personnel step into a wash tub containing a detergent solution. Boots are scrubbed with a long-handled, soft-bristled brush. If leather safety boots are worn, the soles are scrubbed and the upper surfaces are wiped with a paper towel dipped in detergent solution. If water-proof coverall is worn, it is scrubbed also. Continue to scrub all surfaces of gear including boot soles until visible contamination is removed.

Station 6 - Safety Boot Rinse

Personnel step into a wash tub containing tap water. Boots are rinsed with a long-handled, soft-bristled brush.

Station 7 - Safety Boot and Coverall Removal

Boots are removed and set on plastic sheet. Coverall is removed and disposed to the plastic-lined disposal drum.

Station 8 - Inner Glove Wash and Rinse

Inner gloves are scrubbed by rubbing hands together with a detergent solution. Finish with a rinse in tap water.

Station 9 - APR Removal

The APR is removed without touching inner gloves to face. Deposit on a plastic sheet.

Station 10 - Inner Glove Removal

Inner gloves are removed and disposed to plastic-lined disposal drum.

1.6.3.4.4 Level D Decontamination

Level D is the lowest level of personal protection and is worn when exposure to contaminant is not expected. Level D personal protection includes: hard-hat and steel-toe/shank leather boots. Depending on the anticipated activities, it may also include tyvek coverall and gloves.

Station 1 - Segregated Equipment Drop

Personnel returning from the field deposit all equipment and/or sample bottles in segregated areas on plastic sheeting. Highly contaminated equipment such as samplers and sample containers are kept separate from minimally contaminated and difficult to clean equipment such air monitoring meters.

Station 2 - Safety Boot Wash

Boot soles are scrubbed with a long-handled, soft-bristled brush. Continue to scrub all surfaces of gear including boot soles until visible contamination is removed.

Station 3 - Safety Boot Rinse

Boot soles are rinsed with tap water using a long-handled, soft-bristled brush.

Station 4 - Safety Boot and Coverall Removal

Boots are removed and set on plastic sheet. If worn, remove coverall and dispose to the plastic-lined disposal drum.

Station 5 - Glove Wash, Rinse and Removal

If worn, inner gloves are scrubbed by rubbing hands together with a detergent solution. Finish with a rinse in tap water. Gloves are removed and disposed to a plastic-lined disposal drum.

1.6.3.5 Priorities for Worker Decontamination

The following members of the work team returning from the exclusion zone shall have priority over others when being decontaminated.

- A worker who is in need of first aid, or is in physical discomfort.
- A worker who is low on air or whose SCBA is malfunctioning.
- A worker who has been grossly contaminated.
- A worker who did the major part of physical activity required on site.

It is the responsibility of the SSO to decide which workers receive priority.

1.6.3.6 Emergency Decontamination

In an emergency the primary concern shall be to prevent the loss of life or severe injury to personnel. If immediate administration of medical treatment is required to prevent further deterioration of health, then decontamination may be eliminated, modified or done later when the condition has stabilized. The SSO and team leader must weigh the consequences of delaying, modifying or eliminating decontamination against the consequences of delaying treatment, before making a decision on a case by case basis.

First aid equipment shall be readily available in the support area and, as specified in the Site Safety Plan. At least one response team members shall be trained in first aid and CPR.

Arrangements shall also be made to advise medical personnel on the nature of contaminants the patient was exposed to and the extent of decontamination. In some cases, the SSO will need to contact nearby emergency response medical facilities in advance to alert them of the possibility of a problem. This will help the medical facility to prepare for the specific sort of health care which may be required in an emergency.

1.6.3.7 Cold Weather Decontamination

In freezing temperatures a small quantity of ethanol can be added to the wash tubs containing decontamination and tap water to

prevent freezing. DI water and distilled water containers shall be kept warm in the heated van or car for use when needed. Orchard sprayers shall also be kept in a warm place when not in use.

1.6.4 DECONTAMINATION OF EQUIPMENT

1.6.4.1 Protection of Monitoring Instruments

All equipment and monitoring instruments shall be protected from contamination while in use, by wrapping them in clean plastic bags and taping them.

1.6.4.2 Heavy Equipment

Heavy equipment like bulldozers, trucks and drilling equipment are difficult to decontaminate. Decontamination shall consist of either steam cleaning or washing with suitable detergent solutions and then water under high pressure. Decontamination equipment that may be needed include long handled brushes, pressurized sprayers, curtains and enclosures to contain splashes from pressurized sprayers and wire brushes. A decontamination pad lined with heavy duty plastic sheeting may be needed for the decontamination of heavy equipment.

1.6.4.3 Tools/Sampling Equipment

Disposable tools shall be used wherever possible. Typically, decontamination of tools shall include brushing with decontamination solution followed by tap water. This shall be followed by spraying with distilled water and then deionized water (DI). The tools shall be segregated and wrapped in clean plastic bags and taped securely.

Decontamination of sampling equipment such as split spoons, stainless steel buckets, and filtration transfer vessels shall be in accordance with the following steps:

- Set up clean buckets to collect wash and rinse solutions.
- Scrub item with alconox or liquinox and water until visually clean. Use liquinox when phosphate is an analytical parameter.
- Rinse with tap water, if available. If not available, or if the source of the tapwater is questionable in quality, (particularly if it comes from an aquifer which is being sampled), this step may/should be skipped.
- Rinse with distilled or deionized water, the variety which can be found in any grocery store. A garden sprayer may be used, or squirt bottles.

- Rinse with 0.1% nitric acid solution if metals are being analyzed.

1.6.4.4 Personnel Protective Equipment

Parts made of cloth or leather are difficult to decontaminate and may need to be discarded. Rubber parts can be decontaminated by scrubbing them with soap and water. The inside of respirator masks must be cleaned with sanitizing solution to remove perspiration and body oils. Persistent contamination may require the use of compatible solvents to remove them.

1.6.4.5 Sample Bottles

Try to minimize the amount of sample which comes in contact with the outside of the container. After sample collection and prior to inserting sample container into a ziplock bag, the outside of sample containers shall be wiped with paper towels to clean off any residual material which may have adhered to the surface during sampling. Discard paper towels as "investigation derived waste", and dispose of properly. If the presence of extremely toxic compounds is suspected, the outside of the sample container may require more thorough cleaning with alconox and water. If so, care shall be taken to ensure that the sample integrity is not compromised. Sample containers shall not be completely submerged in any wash or rinse solution. Keep wash and rinse solutions away from the lip of the lid.

- Rinse (sparingly to minimize production of investigation-derived wastes) with hexane if organic parameters are being analyzed for. Keep organic solvent rinsate wastes separate from aqueous rinsate waste.

- Final rinse (sparingly since it is expensive) with HPLC grade water if sampling for organic parameters (this step is not required by Region X).

- Final rinse with distilled or deionized water (in Region X and in Region IX) if organic parameters are not analytes.

1.6.5 LEVEL OF PROTECTION FOR DECONTAMINATION TEAM

Decontamination workers who initially come into contact with personnel and equipment returning from the Exclusion Zone shall either be required to wear the same level of protection as the returning team, or one level lower. The level of protection for decontamination workers can be progressively decreased without compromising worker safety, the further away the stations are from the hot line; for example, Station 6 (Inner gloves removal) will require a lower level of protection than Station 4 (safety boots and outer glove decontamination). The SSO shall determine the level of protection required for the decontamination team.

Decontamination workers who decontaminate sample bottles shall wear gloves securely taped up as a minimum. Face shield and splash suit will be necessary if there is danger of splashing.

Decontamination workers who decontaminate sampling tools and other equipment are required to wear suitable protection to prevent contamination. Face shields will be required if there is danger of splashing.

1.6.6 CLOSURE OF DECONTAMINATION STATION

Decontamination team members who have actively helped with the decontamination process must then go through decontamination. The decontamination shall essentially consist of scrubbing, gloves with decontamination solution and spraying with decontamination solution to remove any visible sign of contamination. This shall be followed by continuing the process with tap water. All disposable items are to be put into disposable plastic bags. Two members near the support zone shall be designated to do the final closure.

Sampling equipment, PPE, sample bottles and finally after most of the decontamination team have been through decontamination, the stations shall be dismantled starting with the most contaminated station (Station 1) and moving to the last station. Chairs and other equipment shall be decontaminated by spraying with orchard sprayers containing decontamination solution and catching the run off in tubs. This shall be followed by spraying with tap water and collecting the run-off in tubs.

SOP 1.7, Handling of Investigation-Derived Waste contains more detail on disposal of decontamination solutions and other decontaminated items such as paper towels and tyveks. Usually, the tubs containing decontamination solution and rinse water shall be emptied into DOT (Department of Transportation) approved drums. The wash tubs shall be sprayed with decontamination solution and tap water which is also emptied into the drums. All solid waste shall be double-bagged and disposed of in drums. The drums shall be securely fastened and labeled as "decon water", or "solid waste". Include the name of the site, the date, the company name, and level of fullness.

In situations where the concentrations of contaminants in the decontamination solution and rinse water tubs are low, at the direction of the EPA RPM, the wash water may be disposed off on-site and the solid waste such as booties, gloves, and disposable clothing double bagged and disposed appropriately.

1.7.0 PURPOSE

Management of investigation-derived waste minimizes the potential for the spread of hazardous waste on-site or off-site through investigation activities. The purpose of this SOP is to provide instructions for the proper management of contaminated materials derived from the field investigations assigned under the ARCSWEST contract. This SOP is to be used in conjunction with SOP No. 1.1, Soil/Sediment Sampling, SOP No. 1.2, Groundwater/Surface Water Sampling, and SOP No. 1.6, Decontamination.

1.7.1 INTRODUCTION

Materials that are known or suspected to be contaminated with hazardous substances through the actions of sample collection or personnel and equipment decontamination are said to be investigation-derived wastes. These wastes include decontamination solutions, disposable equipment, drill cuttings and fluids, and groundwater monitoring well development and purge waters. To the extent possible, the site manager will attempt to minimize the generation of these wastes through careful design of decontamination schemes and groundwater sampling programs. Testing conducted on soil and water investigation-derived wastes will show if they are also hazardous wastes as defined by RCRA. This will determine the proper handling and ultimate disposal requirements.

The criteria for designating a substance a hazardous waste according to RCRA is provided in 40 CFR 261.3 If investigation-derived wastes meet these criteria, RCRA requirements must be followed for packaging, labeling, transporting, storing and record keeping as described in 40 CFR 262.34 Those wastes judged to potentially meet the criteria for hazardous wastes shall be stored in DOT approved 55 gallon steel drums.

Wastes that can be shown not to be RCRA-designated hazardous wastes may be handled and disposed on-site or off-site to municipal wastewater and/or solid waste systems at direction of the EPA RPM. Investigation-derived waste is assumed to be RCRA-designat-

ed hazardous waste unless analytical evidence indicates otherwise.

1.7.2 INVESTIGATION-DERIVED WASTE MANAGEMENT

Procedures that minimize potential for the spread of hazardous waste include minimizing the volume of waste generated, waste segregation, appropriate storage, and disposal according to RCRA requirements.

1.7.2.1 Waste Minimization

Within the absolute constraints demanded by worker health and safety and project quality assurance/quality control, the generation of investigation-derived wastes is to be limited. In the development of the investigation work plan, each aspect of the investigation is to be reviewed to identify areas where excess waste generation can be eliminated. General procedures which will eliminate waste include avoidance of unnecessary exposure of materials to hazardous waste, and coordination of sampling schedules to avoid repetitious purging of wells and use of sampling equipment.

1.7.2.2 Waste Segregation

Waste storage and handling procedures to be used depend upon the type of generated waste. For this reason, investigation-derived hazardous wastes described below are segregated into separate 55-gallon storage drums. Waste materials that are known free of hazardous waste contamination (such as broken sample bottles or equipment containers and wrappings) must be collected separately for disposal to municipal systems. Large plastic garbage or "lawn and leaf" bags are useful for collecting this trash. Even "clean" sample bottles or tyvek should be disposed with care. Even though they are not legally a problem, if they are discovered by the public they may cause tremendous panic. Therefore, items that are known to be free from contamination but are also known to represent "hazardous or toxic waste" to the public, must not be disposed into any public dumpster such as found at your hotel or park. Items free from contamination may be freely transported in our vehicle until an appropriate disposal site is found.

1.7.2.2.1 Decontamination Solutions

Decontamination solutions are generated from the washing and rinsing of personal protective equipment and sampling equipment. Solutions considered investigation-derived wastes range from detergents, organic solvents and acids used to decontaminate small hand samplers to steam cleaning rinsate used to wash drill rigs and other large equipment. These

solutions are to be stored in 55-gallon drums with bolt-sealed lids.

1.7.2.2.2 Soil Cuttings and Drilling Muds

Soil cuttings are solid to semisolid soils generated during trenching activities or drilling for the collection of subsurface soil samples or the installation of monitoring wells. Depending on the type of drilling, drilling fluids known as "muds" may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Drill cuttings, whether generated with or without drilling fluids, are to be removed with a flat-bottomed shovel and stored in 55-gallon drums with bolt-sealed lids.

1.7.2.2.3 Well Development and Purge Waters

Well development and purge waters are groundwaters removed from monitoring wells to repair damage to the aquifer following well installation, obtain characteristic aquifer groundwater samples, or measure aquifer hydraulic properties. The volume of groundwater to be generated will determined the appropriate storage procedure. Well purging and well development will generate approximately two to ten well casing volumes of groundwater. This volume can stored in 55-gallon drums. Measurement of aquifer properties through pump tests can generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Use of the large-volume portable tanks such "Baker Tanks" should be considered for temporary storage pending results of groundwater analysis.

1.7.2.2.4 Disposable Equipment

Disposable equipment includes used personal protective gear such as tyvek coveralls, gloves, booties and APR cartridges and some inexpensive sampling equipment such as trowels or disposable bailers. This equipment is assumed to be contaminated if it is used at a hazardous waste site, because it is impractical to submit these items for analysis. These materials are to be stored on-site in 55-gallon drums pending final disposal.

1.7.2.3 Waste Storage

The wastes that are accumulated through investigations must be stored on-site prior to disposal. An on-site waste staging area should be designated to provide a secure and controlled storage for the drums. Per RCRA requirements, storage cannot exceed 90 days for materials presumed or shown to be RCRA-designated

hazardous wastes; waste which is known not to be RCRA-designated wastes should be promptly disposed to municipal waste systems.

1.7.2.3.1 Storage Containers

Containers shall be DOT approved (DOT 17H 18/16GA OH unlined) open-head steel drums. The lids should lift completely off the drum, and be secured by a bolt ring. Order enough drums to store all anticipated purge water (at least five times the well casing volume), plus extra drums for solid waste and decon water. Solid and liquid wastes are not to be mixed in the drums. A typical decon line uses approximately 30 gallons of water.

Pallets are often required to allow transport of filled drums to the staging area with a forklift. Normal pallets are 3' x 4' and will hold two to three 55-gallon drums depending on the filled weight. If pallets are required for drum transport or storage, ICF Technology field personnel are responsible for ensuring that the empty drums are placed on pallets before they are filled and that the lids are sealed on with the bolt-tighten ring after the drums are filled. **Because the weight of one drum can exceed 500 pounds, under no circumstances should ICF Technology personnel attempt to move the drums by hand.** Nor should ICF Technology personnel operate forklifts as part of their regular field activities. Removal of drums to the staging area is normally the responsibility of the client, unless other arrangements have been made.

1.7.2.3.2 Drum Labeling

Each drum that is used will be assigned a unique number which will remain with that drum for the life of the drum. This number will be written in permanent marker on the drum itself; do not label drum lids. Drum labels will contain the following information:

(1) waste accumulation start date
(2) well number or boring number, if applicable
(3) drum number
(4) contents matrix (soil, water, slurry, etc.)
(5) EPA project name

1.7.3 WASTE DISPOSAL

Responsibility for the final disposal of investigation derived-waste will be determined before field activities are begun and will be described in the investigation work plan. Disposal or long-term storage (over 90 days) of RCRA-designated hazardous wastes requires procedures which are beyond the scope of this SOP.

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN

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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPjP) for the sampling and remediation of mercury-contaminated soils at TA-3-30 presents specific procedures that will be used to meet the Quality Assurance (QA) Program requirements established by the U.S. Environmental Protection Agency (EPA). This QAPjP addresses

1. the QA objectives of the project;
2. specific QA and quality control (QC) procedures that will be implemented to achieve these objectives;
3. staff organization and responsibility; and
4. sampling and sample-handling methods.

The EPA requirements focus on the acquisition of environmental data of known and acceptable quality. Other aspects of the project will be controlled by internal Quality Assurance Program requirements.

2.0 PROJECT DESCRIPTION

The site at TA-3-30 was historically used for the disposal of mercury-bearing waste vacuum pump oil. Erosion at the site has exposed elemental mercury in the immediate vicinity of the disposal location. The site is currently listed as a solid waste management unit and is being addressed by the LANL Environmental Restoration (ER) Program under the Resource Conservation and Recovery Act. In addition, the site is subject to regulation by the New Mexico Water Quality Control Commission (WQCC). This Sampling and Remediation Plan (SRP) is being prepared in response to the requirements of the WQCC. Further, actions taken to investigate and remediate the site will be consistent with the requirements of the ER Program.

The project objectives are to determine the extent of contamination at TA-3-30, evaluate remedial alternatives for cleanup of mercury-contaminated soils and identify a recommended alternative, and verify that there are no releases from the site causing water quality standards to be exceeded.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

ICF KE has responsibility for all phases of site sampling and remediation. Qualified personnel have been assigned to the task with the following responsibilities:

1. Task Manager

   The Task Manager will coordinate contractual agreements with the CLS Division and EM-8 and will maintain contact with CLS-DO regarding any modifications to the work assignment. The Task Manager will provide project oversight and is responsible for ensuring that the work is performed in accordance with the scope of work and satisfies the objectives of the project.

2. Field Operations Manager

   The Field Operations Manager is responsible for the Sampling and Remediation Plan, the Quality Assurance Project Plan, and the completion of field activities. The Field Operations Manager will coordinate project planning and monitor project implementation and project expenditures. The Field Operations Manager will coordinate with the appropriate LANL Division/Group to ensure timely and compliant sampling, analysis, and remediation.

3. Site Safety Officer

   The Site Safety Officer prepares the Site Safety Plan on the basis of best available information and performs site safety oversight during field activities. The Site Safety Officer works directly with the Task Manager and Field Operations Manager.

Primary responsibility for project quality rests with the Task Manager. All work performed will be reviewed by the Task Manager and the internal QA officer.

4.0 QUALITY ASSURANCE OBJECTIVES

The overall QA objective is to develop and implement procedures for sample collection, sample shipment, and reporting that will allow the levels of metal contamination to be verified with reasonable and quantifiable certainty. The QA objective will be achieved through the implementation of specific procedures for sampling, chain-of-custody, calibration, internal quality control, audits, preventive maintenance, and corrective actions, as described in this QAPjP. The purpose of this section is to define QA goals for precision, representativeness, completeness, and accuracy.

4.1 Precision

Precision refers to the level of agreement among repeated measurements of the same parameter. It is usually stated in terms of standard deviation, relative standard deviation, relative percent difference, range, or relative range. The overall precision of a piece of data is a mixture of sampling and analytical factors. The analytical precision is much easier to control and quantify because the laboratory is a controlled and, therefore, measurable environment. Sampling precision is unique to each site, making it much harder to control and quantify. The goals for each factor will be addressed separately.

Sampling precision will be checked by obtaining a duplicate sample for every 10 soil samples collected. Precision will be evaluated by calculating the relative percent difference (RPD) as follows:

$$\text{RPD} = \frac{\text{difference between the two measure values}}{\text{average of two measure values}}$$

The RPD will be calculated for each analytical parameter. It is expected that duplicates will have RPDs of less than 35 percent for metal analyses. If these criteria are grossly exceeded, a careful examination of the sampling techniques, matrices, and analytical procedures will be conducted to identify the cause of the high RPD and the usability of the data.

Laboratory precision will be addressed by duplicate analysis of the QA/QC sample (matrix spike). Advisory limits are established for RPD between matrix spike and matrix spike duplicate recoveries. The RPD for several specific analyses will be calculated as a measure of precision; however this data alone will not be used to reject or accept data on individual samples.

4.2 Representativeness

Representativeness is a measure of the degree to which the results accurately reflect the medium being sampled. It is a qualitative parameter that is addressed through the proper design of the sampling program in terms of sample location, number of samples, and actual material collected as a sample of the whole.

Sampling protocols have been developed to assure that samples collected are representative of the media. Field handling protocols (e.g., storage, handling in the field, and shipping) have also been designed to protect the representativeness of the collected samples. Proper field documentation will be used to establish that protocols have been followed and that sample identification and integrity have been maintained.

4.3 Completeness

Completeness is a measure of the amount of information that must be collected during the field investigation to allow for successful achievement of the objectives. A certain amount and type of data must be collected for conclusions to be valid. A complete set of data are necessary to verify that the site has been adequately characterized.

4.4 Accuracy

Accuracy refers to the difference between a measured value for a parameter and the true value of the parameter. It is an indicator of the bias in the measurement system. Sources of error measured by this parameter include the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical technique.

For every 10 analyses performed, a QA/QC sample will be designated so that the laboratory can perform matrix spike and matrix spike duplicate analyses as a test of the accuracy of the method. Matrix spike recoveries (%R) will be compared to advisory limits established in EPA Functional Guidelines. This will provide a measure of how the sample matrix affects the accuracy of the analyses.

5.0 SAMPLING PROCEDURES

Sampling will be conducted as outlined in Chapter 4 of the SRP.

5.1 Surface Soil Samples, Surface Water Samples, and Hand Auger Samples

Sampling activities will be conducted in accordance with the Standard Operating Procedures (SOPs) for Soil and Sediment Sampling and for Groundwater and Surface Water Sampling included as Appendix B. The SOPs were developed by ICF KE under the ARCSWEST contract with the EPA for use at Superfund sites. Further, postsampling activities will be conducted in accordance with the SOPs for Decontamination and for Handling of Investigation-Derived Wastes.

5.2 Quality Assurance/Quality Control Samples

QA/QC sampling requirements are addressed in the SOPs for sample collecting and sample hHandling and in the QA/QC Samples SOP included in Appendix B.

5.3 Sample-handling Procedures

Sample handling is addressed in the Sample Container and Preservation Requirements and in the Sample Packaging and Shipment SOPs included in Appendix B.

5.4 Logbooks

This section outlines the requirements for writing in the field activity logbook. Its purpose is to ensure that all field activities are properly documented. The basic and most important requirement of a field logbook is that it be complete, detailed, and up-to-date.

The logbook is a legal document that will be used in the event legal action is taken against a site; therefore, it must qualify as evidence in legal actions.

The Task Manager is ultimately responsible for maintaining a logbook and making sure it is complete; however, it is impossible for the Task Manager to record everything that is going on at a site, especially in cases such as sampling missions. In such cases, one or two other team members should be designated to maintain additional logbooks. If, at any time, someone other than the Task Manager makes an entry in the Task Manager logbook, the team member must sign and date his/her entry.

Logbook entries should always be made in black waterproof ink to facilitate photocopying. Entries should be factual statements only; no judgmental remarks should be included.

Logbook entries should include the following:

1. the date the entries are made in the upper right-hand corner of every page;

2. the site name and address;

3. the project number;

4. the date and I.D. number on subsequent pages, provided the entries are made on the same day;

5. the time of site entry (according to military time);

6. the names of all team members and their responsibilities;

7. the names of site representatives with titles;

8. the names of any accompanying visitors (press, state representatives, etc.);

9. weather conditions;

10. calibration of all equipment and the results;

11. background measurements and their locations;

12. recordings of all conversations held with the site representatives and other persons responsible for or involved with the site. (e.g., local authorities on the regional geology, concerned citizens, Audobon Society members, etc); and

13. a step-by-step description of the site as the field activities were conducted.

6.0 SAMPLE CUSTODY

Strict chain-of-custody procedures shall be used to ensure the proper handling of samples during collection and analysis. Custody procedures for this project will be based on procedures detailed in NEICJ Policies and Procedures, EPA 330/9-78-001-R, revised June 1985. Sample custody is divided into sample collection, laboratory, and final evidence files.

A sample or evidence file is under your custody if it

1. is in your possession;
2. is in your view, after being in your possession;
3. was in your possession and you placed it in a secure location; or
4. is in a designated secure area.

6.1 Field Custody Procedures

The procedure outlined below will document sample custody from collection until arrival at the laboratory

1. The field sampler has custody of the samples from the time they are collected until they are transferred to the sample packager.
2. All bottles are tagged with a sample number and location by the sampler and/or packager. Sample tags are completed for each sample using waterproof ink, unless prohibited by weather conditions. Each bottle has a custody seal placed around its cap.
3. The sample numbers and locations are listed on the chain-of-custody form. When transferring possession of the samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. This form documents transfer of sample custody from the sampler to another person, to the analytical laboratory, to the sample shipper, or to a secure storage area.
4. Shipping containers are secured for shipment to the laboratory with strapping tape and a custody seal.
5. The samples are sent by common carrier and a copy of the bill of lading is retained as part of the permanent documentation. Commercial carriers are not required to sign off on the chain-of-custody form.

6.2 Laboratory Custody Procedures

The analytical laboratory will adhere to the sample chain-of-custody procedures required under standard EPA protocol. The analytical laboratory's Quality Assurance Program provides detailed information and can be provided on request.

6.3 File Custody Procedure

The files, along with all relevant records, reports, logs, field notebooks, subcontractor reports, and data reviews, will be maintained in a secure, limited access area and under custody of the site manager or document custodian.

6.4 Chain-of-Custody Record

A chain-of-custody record will accompany each sample package. Its purpose is to accurately describe the contents of each sample package. The appropriate sample numbers are listed in the REMARKS section. This form requires that the samplers (as listed on the sample tags) sign under SAMPLERS and under RELINQUISHED BY. The person shipping the sample package should sign under RECEIVED BY.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

7.1 Field Procedures

Field instruments will not be used for site characterization sample data. Calibration procedures do not apply to this QAPjP.

7.2 Laboratory Procedures

The analytical laboratory will analyze the samples and will conform to their own calibration procedures and frequency to provide quality data.

8.0 ANALYTICAL

The Quality Assurance Program for the analytical laboratory should be based on the use of control standards obtained from the EPA Environmental Monitoring and Support Laboratories and from performance evaluations of each method using individualized performance procedures. These performance procedures include but are not limited to the running of blanks, the use of calibrations standards (spiked blanks), the use of matrix spikes, and the use of matrix spike duplicates. The performance procedures are run at the rate of 10 to 20 percent of the samples measured, depending on the method and the client's requirements. The analytical laboratory should also adhere to strict sample holding time parameters, as recommended by the EPA.

The analytical laboratory should be committed to providing quality data that

1. are reliable and of known accuracy and precision;

2. are defensible and have the necessary documentation available to support the accuracy and precision; and

3. satisfy all of the individual project requirements.

9.0 DATA VALIDATION AND REPORTING

In accordance with standard laboratory practices, the analytical laboratory should review quality control requirements of the data prior to release to ICF KE. Additional data validation reviews will be made by ICF KE chemists to insure that data quality requirements, according to standard EPA protocols, have been met by the laboratory.

Additional data management requirements are addressed in the Data Management Plan included as Appendix E.

10.0 INTERNAL QUALITY CONTROL PROCEDURES

10.1 Field Analyses

On-site field analyses will not be performed.

10.2 Report Preparation

Report preparation for this project will include a summation of analytical data and documentation of all field work. All reports will be reviewed by the ICF KE QA officer before submittal to LANL.

10.3 Analytical Laboratory Guidelines

Internal quality control procedures for soil and water samples should be contained in the laboratory's statement of work guidelines and QA/QC documents. Quality control requirements should be addressed for instrument tuning, calibration, method blanks, surrogate recoveries, and matrix spikes/matrix spike duplicates.

The following QA/QC samples should be used by the laboratory to evaluate internal quality control procedures:

1. Method Blanks. A method blank is a purified solid matrix for soil or sediment samples that is carried through the entire analytical scheme (extraction, concentration, and analysis.) It is used to prove that laboratory glassware, spatulas, instruments, and other equipment that contact the sample are free of contamination. The sample is prepared by the laboratory and analyzed in conjunction with the field samples. All reagents, internal standards, and surrogates added to the field samples are also added to the method blank. In this way, small amounts of contamination attributable to laboratory procedures can be quantified. No contamination should be found in the method blank for pesticides.

2. Matrix Spike. A matrix spike is a field sample in which a known quantity of a chosen analyte is added to a sample before any preparation or analysis. Analysis of this sample indicates how the matrix affects the sample and whether the method is appropriate for the matrix. No action is taken on matrix spike/matrix spike duplicate data alone to evaluate a sample.

3. Matrix Spike Duplicate. An aliquot of the matrix spike sample is spiked and analyzed a second time to determine the precision of the analysis method.

4. Internal Standards. Internal standards are selected compounds added to every standard method blank, matrix spike and matrix spike duplicate sample, and sample extracts at a known concentration before analysis. Internal standards are used as the basis for quantitation of the target compounds. Evaluation of internal standards performance also ensures that instrument sensitivity and response are stable during every run.

5. Surrogates. Laboratory performance on individual samples is established by addition of surrogate compounds. All samples are spiked with surrogate compounds before sample preparation. Review of surrogate data provides information on the overall performance of the laboratory for a given sample.

6. Calibration Standards. Calibration standards are used to calibrate the instruments to a known amount of analyte. Four or five standards at incremental concentrations are usually used to establish a response curve. Sample responses are then quantified in comparison to the response curve of the calibration standards.

7. Laboratory Duplicates. Laboratory duplicates measure the precision of the laboratory performance. All duplicates give an indication of the homogeneity of the sample.

11.0 PERFORMANCE AND SYSTEM AUDITS

11.1 Field Analyses

Performance/system audits are the responsibility of the ICF KE Task Manager and the ICF KE QA Officer.

12.0 PREVENTIVE MAINTENANCE

All laboratory and field equipment will be maintained to manufacturers' recommendations. System checks and service will be performed annually or on a schedule specified by the manufacturer, whichever is more frequent. Maintenance will be performed when the instrument will not adequately tune or calibrate. The professional judgement of the lead analyst will determine when maintenance is necessary.

All field equipment will be checked daily when in use, before sampling or measurement. Field equipment that does not meet the requirements will be taken out of service until acceptable performance can be verified.

13.0 DATA ASSESSMENT AND COMPLETENESS

ICF KE will review the data to determine representativeness and completeness. The actual sampling techniques used by the field crew will be reviewed by the Task Manager for deviations from the written sampling procedures. If deviations are found, their impact on the representativeness of data will be assessed.

14.0 CORRECTIVE ACTION PROCEDURES

14.1 Field Analyses

Corrective action is initiated when the following situations arise:

1. field data or review indicate that data are incomplete; that improper calculation, methodology, or technique were employed; or that an instrument has malfunctioned;

2. data quality objectives for precision, accuracy, and completeness are not achieved; or

3. specific requirements of the method or standard operating procedures are not met.

Where deficiencies are found, corrective action will be taken. Corrective action may include one or more of the following:

1. personnel supply additional information or recalculations;

2. personnel repeat the task using the same procedure;

3. a different individual repeats the task using the same procedure;

4. personnel repeat the task using a validated new or modified procedure; or

5. if practical, a new sample is collected and analyzed.

If the above steps are taken and the anomaly is not resolved, the data are reported with qualifying statements. In some cases, depending on the nature and degree of deviation, no data may be reported.

All personnel are responsible for identifying the need for corrective action, and the Task Manager will approve all corrective actions taken.

15.0 QUALITY ASSURANCE REPORTS

A QA summary report may be prepared for this project. The information summarized may include

1. analytical results of QA/QC samples from the analytical laboratory;
2. field duplicate results;
3. method blank, duplicate, and spike analytical results;
4. data quality assessment; and
5. significant QA problems and corrective actions.

APPENDIX D

HEALTH AND SAFETY PLAN

The Health and Safety Plan has been submitted to Los Alamos National Laboratory for review.

APPENDIX E

DATA MANAGEMENT PLAN

1.0 INTRODUCTION

This data management plan specifies procedures to be used for management of data collected during sampling and remediation activities for the mercury-contaminated soil at TA-3-30. Specific procedures are presented for data management, data evaluation, and data presentation.

2.0 DATA MANAGEMENT

Raw data collected during sampling and analysis will include

- field observations and measurements recorded in the field notebook; and
- analytical data received from the analytical laboratory.

Specific procedures for recording and managing field data are presented in Subsection 5.4 of the Quality Assurance Project Plan (QAPjP) (Appendix C).

Analytical laboratory data to be generated during this project include the results of chemical analysis of soil, sediment, and water samples for metals, mercury, total petroleum hydrocarbons, and radionuclides.

Data reports from the analytical laboratory will be submitted to the Data Manager. The Data Manager, or a designee, will input the analytical data to a computer spreadsheet or data base. One data record will be created for each sample. The record will contain fields that identify the following:

- Field sample number;
- Laboratory sample number;
- Sample location;
- Sample type (i.e., grab, composite);
- Sample depth;
- Media sampled;
- Date of sampling; and
- Results for each analyte, including analyte name, numeric value, units, and data qualifiers.

Once the results have been input, they will be independently verified by a second person. After verification, the data values will be protected from alteration (i.e., data fields will be protected or file will be read-only). The raw data, original data base, and backup data base will be maintained by the Data Manager. Copies of the protected data base will be distributed to project staff as needed for data evaluation. Each copy of the distributed data will be controlled by the Data Manager. If a revision is made to the data base, the Data Manager will distribute revised copies of the data base and destroy all old copies.

Only the Data Manager will be able to make changes to the data base. Any changes made to the data base will be documented in the project log book.

3.0 DATA EVALUATION

All data to be used for evaluation will be taken from controlled copies of the data base (electronic or hard copy) provided by the Data Manager. This procedure must be followed to assure use of a consistent, accurate set of data. All evaluations made using the data base must reference the date and revision number of the data base.

Data evaluations for this project will include calculation of representative concentrations for various areas at the site, and comparison of these concentrations with cleanup standards. All calculations will be documented and checked as described in Section 9.0 of the QAPjP.

Data evaluations will also include calculation of relative percent difference (RPD) of field duplicate samples. Percent RPD will be calculated as described in Section 4.0 of the QAPjP.

4.0 DATA PRESENTATION

Data will be presented in documents in tabular format or graphical format. Tables and graphs will be generated directly from the protected spreadsheet or data base to assure that the reported values are correct.