NOTICE

All drawings located at the end of the document.

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SUBMITTAL OF **"DRAFT SAMPLING AND ANALYSIS PLAN (SAP) FOR MONITORING OF NATURAL ATTENUATION AT IHSS 118.1, Rev. 0" RF/RMRS-98-252 - JEL-133-98**

KH-00003NS1A July 31, 1998

Discussion and/or Comments:

Attached are seven (7) copies of the *"Draft Sampling And Analysis Plan For Monitoring Of Natural Attenuation At IHSS 118.1"* for review by Kaiser-Hill and the Department of Energy Rocky Flats Field Office. Please forward three (3) copies to DOE. It is requested that comments be returned by Thursday, August 6, 1998. A draft transmittal letter to the Department of Energy's Rocky Flats Field Office has been attached for your convenience.

If you have any questions please contact Craig Cowdery at extension 2055.

Enclosures:
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DRAFT SAMPLING AND ANALYSIS PLAN FOR MONITORING OF NATURAL ATTENUATION AT IHSS 118.1

Rocky Mountain Remediation Services, L.L.C.

July 31. 1998
Revision 0

DRAFT SAMPLING AND ANALYSIS PLAN FOR MONITORING OF NATURAL ATTENUATION AT IHSS 118.1

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ACRONYMS

ADM	Administrative Procedures Manual
ASD	Analytical Services Division
CDPHE	Colorado Department of Public Health and the Environment
DNAPL	Dense Non-Aqueous Phase Liquid
DOE	United States Department of Energy
DQO(s)	Data Quality Objectives
EMD	Environmental Management Department
EPA	Environmental Protection Agency
ER	Environmental Restoration
FIDLER	Field Instrument for the Detection of Low Energy Radiation
HCl	Hydrochloric Acid
IHSS	Individual Hazardous Substance Site
OU	Operable Unit
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
QA	Quality Assurance
QC	Quality Control
QE	Quality Engineer
REP	Radiological Engineering Procedure
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RIN	Report Identification Number
RMRS	Rocky Mountain Remediation Services, L.L.C.
RPD	Relative Percent Difference
ROI	Radiological Operating Instruction
SAP	Sampling and Analysis Plan
SOPs	Standard Operating Procedures
SOW	Statement of Work
SWD	Soil and Water Database
TCLP	Toxicity Characteristic Leaching Procedure
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

LIST OF STANDARD OPERATING PROCEDURES (SOPS)

Applicable Field and Administrative Standard Operating Procedures

Procedure Number	Procedure Title
RMRS-QAPD-001, Appx. 3	Measuring and Test Equipment
QA-05.01	Preparation and Control of RMRS Documents
RF/RMRS-98-200	Evaluation of Analytical Data for Usability in Final Reports
2-S47-ER-ADM-05.14	Use of Field Logbooks and Forms
5-21000-OPS-FO.3	General Equipment Decontamination
5-21000-OPS-FO.6	Handling of Personal Protective Equipment
5-21000-OPS-FO.7	Handling of Decontaminated Water and Waste Water
5-21000-OPS-FO.10	Receiving, Labeling, and Handling Environmental Material Containers
5-21000-OPS-FO.11	Field Communications
5-21000-OPS-FO.13	Containerization, Preserving, Handling and Shipping of Soil and Water Samples
5-21000-OPS-FO.14	Field Data Management
5-21000-OPS-FO.15	Photoionization Detectors and Flame Ionization Detectors
5-21000-OPS-FO.16	Field Radiological Measurements
5-21000-ER-OPS-GT.01	Logging Alluvial and Bedrock Material
5-21000-ER-OPS-GT.05	Plugging and Abandonment of Boreholes
5-21000-ER-OPS-GT.06	Monitoring Wells and Piezometer Installation
5-21000-ER-OPS-GT.10	Borehole Clearing
5-21000-ER-OPS-GW.01	Water Level Measurements in Wells and Piezometers
5-21000-ER-OPS-GW.06	Groundwater Sampling
ROI 6.6	Operation of the Bicron Field Instrument for the Detection of Low Energy radiation (FIDLER)
3PRO-088-RSP-09.02	Radioactive Material Transfer and Shipment
3PRO-141-RSP-09.01	Unrestricted Release of Property, Material, Equipment and Waste
1-C88-WP1027-NONRAD	Non-Radioactive Waste Packaging
1-C80-WO-1102-WRT	Waste/Residue Traveler Instructions
PADC-96-00003	WSRIC for OU Operations, Version 6.0, Section No. 1

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) supports the monitoring of natural attenuation carbon tetrachloride at Individual Hazardous Substance Site (IHSS) 118.1, Multiple Solvent Spills West of Building 730. The project approach for 118.1 is described in the Final Technical Memorandum No.1, Monitored Natural Attenuation of IHSS 118.1 (RMRS, 1998) (Tech Memo I). This SAP and Tech Memo I (RMRS, 1998) are intended to provide guidance for collecting accurate and reproducible samples to support the technical approach and project decisions. Sampling activities will be conducted in accordance with the Rocky Mountain Remediation Services (RMRS) Quality Assurance (QA) Program Description (RMRS, 1996). Sampling for the purposes of health and safety will be described in an addendum to the *IHSS 118.1 Health and Safety Plan* (RMRS, 1997a).

1.1 BACKGROUND

IHSS 118.1 is located within the Industrial Area Operable Unit (OU) and was previously designated as a part of the former OU 8. IHSS 118.1 is ranked number eight (of over 200 sites) in the Environmental Restoration (ER) Ranking (Attachment 4 to the Rocky Flats Environmental Cleanup Agreement [RFCA], [DOE, 1996a]) and the groundwater plume associated with IHSS 118.1 is ranked eighteenth. IHSS 118.1 is the result of releases that occurred in the 1960s, 1970s, and early 1980s associated with the operation of one 5,000-gallon underground carbon tetrachloride storage tank located adjacent to Building 730 (Figure 1-1). Over this time period, an unknown quantity of carbon tetrachloride was released into the environment. Remedial investigation results indicate that carbon tetrachloride migrated below the water table and accumulated in the bedrock depression encompassing a group of subsurface process waste tanks (Tanks T-9 and T-10) located adjacent to the former carbon tetrachloride tank. The carbon tetrachloride partially displaced the groundwater to create a zone of dense non-aqueous phase liquid (DNAPL) in the heterogeneous fill material with mixed permeabilities beneath the base of the Tanks T-9 and T-10. Because the DNAPL zone is surrounded by low permeability bedrock, the DNAPL is confined to the bedrock depression.

Based on the results of an alternative analysis presented in RMRS (1998), the best approach to address near-term risk is to monitor natural attenuation of the contamination. Natural attenuation includes "a variety of physical, chemical, and biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume or concentration of contaminants in soil or groundwater" (EPA, 1997). Monitored natural attenuation was selected because more aggressive remedial technologies were not implementable due to the presence of utilities and Tanks T-9/T-10. In addition, many of the technologies evaluated would have left residual DNAPL that would effectively sustain contaminant concentrations for decades.

Site conditions at IHSS 118.1 are favorable for natural processes that control and limit the migration of carbon tetrachloride. Most significantly, the historical absence of contaminants in surface water suggests that natural attenuation processes are sufficient to prevent exceedances of standards in surface water. A key element of the project approach is downgradient monitoring of surface water and groundwater to verify protectiveness.

The selection of natural attenuation is also based on the technical impracticability of restoring the subsurface zone in which nonaqueous phase carbon tetrachloride is present. This observation is partly due to the physical inaccessibility due to tanks and utilities. Partial source removal through pumping or other means is ineffective because residual DNAPL would not be completely recovered and would continue to contaminate groundwater. Furthermore, even with complete removal or containment of the carbon tetrachloride at IHSS 118.1, other sources in the Industrial Area would continue to impact groundwater quality in the Industrial Area.

2.0 DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) to monitor natural attenuation at IHSS 118.1 were developed using the seven-step process in *Guidelines for Data Quality Objective Process*, Environmental Protection Agency (EPA) QA/G4 (EPA, 1994). The seven step process used for identifying data quality objectives is as follows:

1. State the Problem
2. Identify the Decision
3. Identify Inputs to the Decision
4. Define the Study Boundaries
5. Develop a Decision Rule
6. Specify Limits on Decision Errors
7. Optimize the Design for Obtaining Data

2.1 STATE THE PROBLEM

Problem Statement

Carbon tetrachloride is present as a source at IHSS 118.1 in the form of a DNAPL. A contaminated groundwater plume is also present and has the potential to migrate into the Walnut Creek drainage. Source removal of DNAPLs identified at IHSS 118.1 is not possible until the T-9/T-10 process waste tanks and area utilities are no longer in use. Data collected during the pre-remedial investigation of IHSS 118.1 (RMRS, 1997b) indicate that attenuation processes could be occurring that limit the migration of IHSS 118.1 contaminants. As described in Tech Memo 1, additional information is needed to verify these natural attenuation processes and their effectiveness.

2.2 IDENTIFY THE DECISION

The principal decision is: Are natural attenuation processes sufficient to address plausible risks associated with the 118.1 subsurface release? If natural attenuation processes are not sufficient, then an alternative project approach may need to be developed either as an interim or final response; however, any action would most likely be implemented when accessibility to the DNAPL is available (i.e., removal of utilities and decontamination and decommissioning of surrounding facilities). If natural attenuation processes are sufficient to address plausible risks, monitoring and evaluation will be performed to predict and verify long-term protection of surface water.

2.3 IDENTIFY INPUTS TO THE DECISION

More specifically, decision inputs include the following:

- Groundwater Flow Direction; and
- Groundwater Chemistry

This decision will be determined by evaluating hydrogeologic and geochemical data from the site monitoring wells and ongoing water quality monitoring activities. These data will be evaluated according to a screening process presented in the *Overview of the Technical Protocol for Natural Attenuation of Chlorinated Aliphatic Hydrocarbons in Groundwater Under Development for the U.S. Air Force Center for Environmental Excellence* (Wiedemeier, et al, 1997). The process will be revised to address a carbon tetrachloride contaminant source. This protocol is a point scoring method that will be performed on source area and downgradient wells. The scores are summed and that value is used to determine whether there is adequate evidence of natural attenuation.

Groundwater Flow Direction

The present understanding of the groundwater flow direction will be refined by the completion of eight additional groundwater monitoring wells (Figure 1). Two wells will be constructed upgradient of the source area, two wells will be added to the source area where smaller diameter wells already exist, and four additional wells will be installed downgradient of the source area. Groundwater monitoring wells will be installed according to RFETS Standard Operating Procedure (SOP) GT. 05, Monitoring Wells and Piezometer Installation. Groundwater wells will be developed according to GW.02, Well Development, and water levels will be determined following procedure GW.01 Water Level Measurements in Wells and Piezometers.

Groundwater Chemistry

Groundwater contaminant concentrations, specifically VOCs, will be determined from the analysis of groundwater samples. Samples will be collected from all wells installed in support of this project (i.e., groundwater samples will be collected from monitoring all eight wells which were constructed and developed as described in the Groundwater Flow Direction section discussed above). Groundwater samples will be collected according to procedure GW.06, Groundwater Sampling, using a bladder pump. Samples will be analyzed according to EPA method 8260A, which provides method quantitation limits below RFCA-regulated surface water standards for VOCs and anticipated degradation products. DNAPL thickness will be measured using a clear bailer or an interface probe Procedure 5-21000-ER-OPS-GW.01, Water Level Measurements in Wells and Piezometers)

Inorganic natural attenuation indicators will also be analyzed relative to the groundwater plume. Upgradient and source area samples will be used to determine changes in organic indicators in the source area. Source area and downgradient samples will be used to determine changes in inorganic indicators downgradient from the source area. Indicators within the study area will be evaluated through the collection and analysis of groundwater samples from all eight wells to be constructed and existing wells. Groundwater quality parameters to be measured in the wells are listed in Table 2-1. Specific analytical methods to support the determination of these parameters are provided in Section 3.0. Sampling and Analyses - Strategy and Design.

As discussed in this section and Section 2.5, a screening method for biodegradation as described in Weidemeier et al., 1997 will be utilized as a basis of the decision rule. The analytical results for each well will be compared to the concentration criteria in Table 2-1; if the criteria is met then the score in the last column will be awarded. All of the scores will be added and evaluated against the criteria in Section 2.5.

Table 2-1: Analytical Parameters and Weighting for Preliminary Screen

Analyte	Concentration Criteria	Interpretation	Score
Oxygen	< 0.5 mg/L	Tolerated; Suppresses reductive dechlorination at higher concentration	3
Oxygen	> 1 mg/L	Reductive dechlorination will not occur.	-3
Nitrate	< 1 mg/L	May compete with reductive pathway at higher concentrations	2
Iron (II)	> 1 mg/L	Reductive pathway possible	3
Sulfate	< 20 mg/L	May compete with reductive pathway at higher concentrations	2
Sulfide	> 1 mg/L	Reductive pathway possible	3
Methane	> 0.1 mg/L	Reductive degradation product of organic carbon	2

Table 2-1: Analytical Parameters and Weighting for Preliminary Screen (Continued)

Analyte	Concentration Criteria	Interpretation	Score
Oxidation Reduction Potential	< 50 mV against Ag/AgCl	Reductive pathway possible	< 50 mV = 1 < -100 mV = 2
pH	5 < pH < 9	Tolerated range for reductive pathway	0
DOC	> 20 mg/L	Carbon and energy source; drives dechlorination can be natural or anthopogenic	2
Temperature	> 20°C	At T > 20°C	1
Carbon Dioxide	> 2x Background	Ultimate oxidation product of volatile organic compounds	1
Hydrogen	> 1 nM	Reductive pathway possible	3
Carbon Tetrachloride	Material Released		0
Chloroform	Above background	Degradation product of carbon tetrachloride	2
Methylene Chloride	Above background	Degradation product of carbon tetrachloride	2
Chloromethane	Above background	Degradation product of carbon tetrachloride	2
Carbon Disulfide	Above background	Degradation product of carbon tetrachloride	2
Hexachloroethane	Above background	Degradation product of carbon tetrachloride	2
Tetrachloroethene	Above background	Degradation product of carbon tetrachloride	2
Hexachlorobutadiene	Above background	Degradation product of carbon tetrachloride	2

2.4 DEFINE THE STUDY BOUNDARIES

The study boundaries have been defined as Buildings 776/777 to south, Building 701 to the west, Well 43592 to the east and Buildings 771/774 to the north. This study area includes the source area wells, the downgradient monitoring wells, and the upgradient wells. This study area also includes the Building 771 footing drains (Figure 1). In terms of vertical boundaries, only the upper hydrographic unit will be

evaluated. This bounds the evaluation from the top of the water table (including any organic layers) to the top of bedrock. The vadose zone and bedrock will not be evaluated.

The temporal boundary will be based on the results of a yearly evaluation of the data which will determine whether the data set is sufficient to meet the requirements of the DQO. To minimize the impact of seasonal fluctuations, annual sampling will be performed at approximately the same time of year. A five-year monitoring period is proposed; however, if statistically it can be adequately demonstrated that natural attenuation is occurring, then additional samples will not be taken.

2.5 DEVELOP A DECISION RULE

The decision rule is: Is natural attenuation occurring and is it protective of surface water receptors? This decision will be made following the comparison of upgradient (local background), and source area water quality and contaminant data. The decision will be made based on the sum of points awarded for evidence of biodegrading of carbon tetrachloride (See Table 2-2).

Table 2-2 Interpretation For Points Awarded During Screening Process

SCORE	INTERPRETATION
0 to 5	Inadequate evidence for biodegradation of chlorinated organics.
6 to 14	Limited evidence for biodegradation of chlorinated organics.
15 to 20	Adequate evidence for biodegradation of chlorinated organics.
> 20	Strong evidence for biodegradation of chlorinated organics.

2.6 SPECIFY LIMITS ON DECISION ERRORS

The decision limits are based on whether there is adequate evidence of biodegradation as described in Table 2-2 . All scores above 15 will be considered adequate evidence. Scores between 0 and 14 will be considered inadequate and trigger an evaluation of the need for further sampling. As part of this evaluation other criteria will be taken into account such as sampling history, past evidence , seasonal effects, etc.

2.7 OPTIMIZE THE DESIGN FOR OBTAINING DATA

Based the decision rule, the approach for IHSS 118.1 Sampling and Analysis is straight forward. Samples for the parameters identified in (Weidemeir, et al, 1997) needed to be taken and analyzed. Aside from sampling for these parameters in the source area (two wells), samples are also needed to confirm whether attenuation was occurring downgradient, what the chemical state of the ground water is, and what the background concentrations are. The number of upgradient wells (for determining background) was selected as two in case one of the wells was too close to the plume or was not truly upgradient. Three of the downgradient monitoring wells were put in a line approximately perpendicular to the direction of groundwater flow. This design was used to more accurately resolve the direction of groundwater flow, the width of plume, and the total mass flux from the source zone. An additional

downgradient well will be installed to the east to evaluate whether IHSS 118.1 is the source of carbon tetrachloride near the Solar Ponds. This additional well will be placed just south of the easternmost downgradient well (see Figure 1-1) to yield a line of two wells to the east. The new two-inch diameter source area wills are required because the existing one-inch wells will not support the analytical requirements. Table 2-3 summarizes the benefits and features of the IHSS 118.1 sampling and analysis design.

Table 2-3 Features and Benefits of the IHSS 118.1 Sampling And Analysis Design

SAP Feature	Number Of Locations	Analytes	Purpose	Benefit
Upgradient wells	Two	VOCs and natural attenuation parameters in ground water	To establish what chemical constituents are already in the water.	Changes in water chemistry due to natural attenuation can be calculated. Also, it can be determined whether an additional source of contamination exists upgradient.
Source area wells	Two	VOCs and natural attenuation parameters in ground water, VOCs in DNAPL	To evaluate natural attenuation parameters downstream from the source area,	Initial source concentration. Evaluate natural attenuation in the bedrock depression.
Line of three downgradient wells to north	Three	VOCs and natural attenuation parameters in ground water	To evaluate natural attenuation parameters downstream from the source area,	Total mass flux can be determined for carbon tetrachloride and its degradation produces.
Downgradient well to the east	One	VOCs and natural attenuation parameters in ground water	To determine whether IHSS 118.1 is a contributing source to the VOC plume to the east.	Total mass flux to the east can be calculated. Can determine whether the flow changes direction.
771 footing drain sampling	One or more	VOCs and natural attenuation parameters in 771 Footing Drain water	Determine the impacts on the 771 footing drain	This downgradient location likely captures the whole plume. The total mass flux between the wells and surface water can be calculated.

The distance between downgradient wells will be approximately 60 to 70 feet. This distance assumes that if no dispersion has occurred, the plume should be about the size of the original tank excavation (i.e., 70 to 80 feet in diameter). A monitoring well spacing of 60 to 70 feet should ensure that at least one of the wells intercepts the plume. If dispersion has occurred, the plume may be wider then two or more wells might be in the plume. Prior to installation an evaluation will be performed to ensure that utilities and other subsurface features are not impacted and any offsets due to utility conflicts will be documented. If this occurs, efforts will be made to offset the wells axially to the groundwater flow direction so that same spacing of wells can be maintained perpendicular to the groundwater flow.

The wells in the source area will have to be replaced with larger diameter wells (2") to obtain enough sample volume for the proposed analytical suite because the existing monitoring wells are only one inch

in diameter which is too small to support all of the analytical methods.

3.0 SAMPLING AND ANALYSIS - STRATEGY AND DESIGN

There are two types of samples specified in this SAP: VOCs and natural attenuation parameters. Sampling for VOCs will be performed to determine the concentration of carbon tetrachloride and its volatile byproducts for evaluation of physical, chemical and biological natural attenuation and for waste determination of drill cuttings. Sampling for natural attenuation parameters will be performed to determine whether the chemical and/or biological conditions are present to support the degradation of carbon tetrachloride and its byproducts. Table 3-1 shows the analytical methodology, preservation, etc. for all of the analytes.

Table 3-1 Sample Types/Analytical Methods

Line Item Code	Analytes	Analytical Method	Media Type	Container	Preservative	Comments/Holding Time
SS01B005	Volatile Organic Compounds	SW-846 Method 8260	Water	2 x 40 ml VOA vials - Teflon lined septa lids	Cool, 4° C, HCl	Zero head space 14 day hold time
SS01B006	Volatile Organic Compounds	SW-846 Method 8260	Soil, Waste	60-ml wide mouth glass jar with Teflon lined lid	Cool, 4° C,	Zero head space 14 day hold time
SS02B006	Semivolatiles	SW-846 Method 8270B	Water	3-liter glass jar	Cool, 4° C	7 day hold time
SS02B006	Semivolatiles	SW-846 Method 8270B	Soil	250-ml wide mouth glass jar with Teflon lined lid	Cool, 4° C	14 days to extraction, 40 days from extraction to analysis
RC01B0003	Americium, Plutonium and Uranium	ASD SOW for Isotopics RC01	Soil	125-g wide mouth glass jar	Cool, 4° C	
OS01A002	Gross Alpha/Beta	ASD SOW for Isotopics RC01 Module OS01A	Water	1 liter plastic bottle	Cool, 4° C	
OS01A003	Gross Alpha/Beta	ASD SOW for Isotopics RC01 Module OS01A	Soil	60-g wide mouth glass jar	Cool, 4° C	
SS06B037	Sulfates	SW-846, 9035, 9036	Water	1 liter plastic bottle	Cool, 4° C	Sulfates, Sulfites and Alkalinity come from same bottle 28 day hold time
SS06B039	Sulfides	SW-846 9030A	Water	1 liter plastic bottle	Cool, 4° C	Sulfates, Sulfites and Alkalinity come from same bottle 7 day hold time
SS06B002	Alkalinity	SW-846 310.1, 320.2	Water	1 Liter plastic bottle	Cool, 4° C	Sulfates, Sulfites and Alkalinity come from same bottle 14 day hold time
SS06B020	Nitrates	SW-846 , 300.0	Water	1 liter plastic bottle	Cool, 4° C	48 day hold time
SS06B025	Total Organic Carbon	SW-846 415.1	Water	1 liter plastic bottle	Cool, 4° C pH<2 w/HCl	28 day hold time
SS06B024	Dissolved Organic Carbon	SW-846 415.1	Water	1 liter plastic bottle	Cool, 4° C	28 day hold time
SS06B010	Chlorides	E300.0	Water	100 ml. plastic bottle	None	28 day hold time
Field	pH	SW9040	Water			
Field	Dissolved Oxygen	E360.1	Water			
Field	Oxidation-Reduction Potential	ASTM D1498	Water			
Field	Temperature	E170.1	Water			
Field	Conductivity	SW9050	Water			

3.1 Volatile Organic Compound Sampling

As discussed in Section 2.3, eight wells will be sampled:

- Two upgradient wells,
- Two source area wells, and
- Four downgradient wells.

Figure 1-1 shows the well locations as proposed in the IHSS 118.1 Technical Memorandum (RMRS, 1998): On the first round of sampling, all of the proposed monitoring wells will be sampled for volatile organic compounds (VOCs). Previously installed wells such as the one inch pre-remedial characterization wells around the original process waste tanks will not be sampled. Samples will be collected of the DNAPL, if present at sampling locations, to establish the organic phase concentrations of carbon tetrachloride and its degradation products. Based on an evaluation of the first round data, the sampling approach will be reexamined and revised if needed. The VOC data from the groundwater, can be used to calculate the total mass flux of carbon tetrachloride and the degradation products. Based on the generation of degradation products, the rate of degradation can be determined by making a component mass balance based on the carbon atoms in carbon tetrachloride. One VOC soil sample per well will be collected from the drill cuttings for each of the eight wells installed to classify the Investigative Derived Material (IDM). Table 3-2 presents the basis for volatile organic sampling for monitoring natural attenuation at IHSS 118.1.

Table 3-2: Basis for Volatile Organic Compound Sampling

Analyte	Media	Analytical Location	Basis
DNAPL Levels	DNAPL	Field	This will allow periodic evaluation of the extent of the DNAPL and whether its migration is being limited.
Volatile Organic Compounds	Groundwater and DNAPL	Laboratory	Characterization of the types and concentration of organic contaminants this analysis will be used to determine whether carbon tetrachloride and its byproducts are increasing or decreasing and whether there is evidence that carbon tetrachloride is transforming into degradation products.
Volatile Organic Compounds	Soil	Laboratory	Needed to characterize the IDM.

One suite of groundwater samples will be collected from each of the eight wells shown in Figure 1-1 in addition to the quality assurance (QA) /quality controls (QC) samples described in Section 5.1. Samples will be collected using a bladder pump. Field analysis will be done using a flow-through cell. One suite of soil samples will be taken for each well installed (eight plus QA/QC samples). Because volatile organic compounds are of the most concern samples will be taken from the core section with the highest readings on a photo-ionization detector and/or a flame ionization detector. Soil sampling is planned for only the first round.

3.2 NATURAL ATTENUATION PARAMETERS

Like the VOC sampling, all the wells will be sampled for natural attenuation parameters during the first round. As shown in Table 3-3, some of the analytes will be measured in the field and some of the analytes will be measured at a off-site analytical laboratory. Using observational approach, the first round results will be evaluated and the sampling approach will be modified as needed. Observational approach will also be used for subsequent rounds.

Table 3-3: Basis for Natural Attenuation Parameters

Analyte	Media	Analytical Location	Basis
VOCs	Groundwater	Laboratory	Used to determine whether Volatile Organic Compounds are degrading
Sulfates	Groundwater	Laboratory	Electron acceptor, reduced concentrations from background suggests favorable condition for reductive dehalogenation
Sulfides	Groundwater	Laboratory	Reduced form of sulfur - presence is consistent with favorable conditions for reductive dehalogenation
Nitrate	Groundwater	Laboratory	Electron acceptor, reduced concentrations indicate anaerobic conditions
Iron	Groundwater	Laboratory	Electron acceptor, elevated concentrations indicate anaerobic conditions
Manganese	Groundwater	Laboratory	Electron acceptor, low concentrations indicate anaerobic conditions
Chloride	Groundwater	Laboratory	Levels above background are an indication of reductive dehalogenation
pH	Groundwater	Field	Characterization of basic water chemistry Levels could impact chemical and biological processes
Redox Potential	Groundwater	Field	Indicator of aqueous oxidation state
Alkalinity	Groundwater	Laboratory	Elevated levels can be associated with oxidation of hydrocarbon to CO_2 and H_2O
Methane	Groundwater	Laboratory	Degradation product of carbon tetrachloride
Total Organic Carbon	Groundwater	Laboratory	Absence or depressed levels are consistent with active degradation of non-chlorinated hydrocarbons and conditions for reductive dehalogenation
Dissolved Oxygen	Groundwater	Field	Higher concentrations would indicate that reduction is not occurring.
Dissolved Hydrogen	Groundwater	Laboratory	Source of hydrogen for reductive dehalogenation
Conductivity	Groundwater	Field	General water quality parameter
Temperature	Groundwater	Field	General water quality parameter
Water Levels	Groundwater	Field	Determine ground water flow rate and direction

3.3 SAMPLE AND DATA COLLECTION

Prior to implementation of the field program, Environmental Approval Process for Construction/Excavation Activities (1-F20-ER-EMR-EM.001) will be completed. Information collected in the field will be recorded in the field logbook per ADM.05.14, Use of Field Logbooks and Forms. Monitoring well locations shall be cleared according to GT.10, Borehole Clearing. Boreholes will be completed by procedure GT.02, Drilling and Sampling Using Hollow-Stem Auger Techniques, or by GT.39, Push Subsurface Soil Sample. If hollow-stem auger techniques are selected, soil samples will be collected utilizing either continuous core auger sampling or continuous drive sampling, depending on which method provides the best percentage of core recovery. Soil cores will be screened with field instruments per FO.15, Photoionization Detectors and Flame Ionization Detectors. Boreholes will be logged according to procedure GT.01, Logging Alluvial and Bedrock Material. Boring locations will be identified with their unique location number assigned and surveyed for location and elevation using GPS receivers or equivalent equipment.

3.4 SAMPLE HANDLING AND DESIGNATION

Samples collected for laboratory analysis will follow *Environmental Management Department (EMD) Operating Procedures Volume I, Field Operations 5-21000-OPS-FO.13, Containerization, Preserving, Handling, and Shipping of Soil and Water Samples*. Field data shall be documented on the forms (field log sheets) developed for this project, and in accordance with the referenced procedure. The originator shall authenticate (legibly sign and date) each completed hard copy of the data. A peer reviewer, someone other than the originator, shall perform a peer review on each hard copy of data. The peer reviewer shall authenticate each hard copy completed by the originator. Any modifications shall be lined-through, initialed, and dated by the reviewer (in ink). Data planned for computerized reduction and analysis shall be entered into electronic form in accordance with the current Analytical Services Division (ASD) and Soil and Water Database (SWD) requirements.

The QA Records for the project include the field log sheet and chain-of-custody (COC) forms used in the project. Each QA Record is subject to the applicable QA records management procedure(s). Normally, data from the field log sheets and COC forms will be entered into the SWD system to facilitate accessibility. However, use of the SWD system is at the discretion of the project manager, for efficiency, and is not required to provide an adequate assurance of quality. Note that data stored in the SWD system are often the most useful and accessible project records, but are not QA Records.

Each sample will be assigned a unique sample number in accordance with the RFETS/ASD requirements. The unique sample number will be broken down into three parts. These are:

- The Report Identification Number (RIN)
- The Event Number
- The Bottle Number

The first part of the number will be the RIN which is assigned by the ASD. The RIN is used by the ASD to track/file analytical data. Unique RINs will be assigned to different types of sampling events. The RIN will be a 7 digit alpha-numeric code starting with "98" for 1998, "99 for 1999, etc..... This RIN will be followed by a dash "-" and then the event number. The event number is a three digit code, starting with "001" under the RIN and will be sequential. Each typical sample location will have a

unique event number under the RIN. QC samples (e.g., duplicates) will have unique event numbers to support a "blind" submittal to the analytical laboratories. The event number will be followed by a period "." and then the sequential bottle number. The bottle number will be a three digit code starting with "001" and will be sequential under each event number. The bottle number will be used to identify individual sample containers under the same location (same event number).

In addition to the sample numbering scheme described above, each sample will require the following information:

Sample Type	
Location Code	
QC Code	
REAL:	Regular Sample
DUP:	Duplicate Sample
RNS:	Rinsate Sample
TB:	Trip Blank Sample

This section states the general approach for QC sample collection for this project. Additional details regarding these samples are given in Table 3-2 and Section 5.1of this document.

The location and depth interval of surface or subsurface media, either soil or water, recovered during the course of this investigation will be recorded in the field log book. RFEDS location codes will be cross indexed to appropriate sample location designations in the field logbook. Soil core and other material that is subject to only field screening will be identified by the sample location code and depth interval where the sample is obtained. Samples undergoing VOC or radioisotope analysis will have Kaiser Hill-Analytical Services Division (KH-ASD) sample numbers and labels applied to the container in the field. A block of location codes will be of sufficient size to include the entire number of possible locations scheduled and an additional twenty percent for potential additional locations. The KH-ASD database system will be used to manage the analytical data from the laboratories which in turn will be accessed by the RMRS Soil and Water Database for management and archival.

Although not anticipated, radioactive samples (equal to or greater than 2 nCi/g) will be transported to offsite laboratories in accordance with hazardous waste transportation shipping requirements (49CFR 172, 172.101, 173.403, and 173.421) with the appropriate shipping memo. Soil samples with greater than 6,000 to 8,000 counts per minute on the FIDLER are suspected to be characterized as US Department of Transportation radioactive material (potentially greater than 2,000 pCi/g gross alpha/beta total activity). Approximately 30 grams of soil sample will be collected for isotopic analysis and placed into pre-weighed sample container. The sample container containing the soil will be weighed to confirm approximately 30 grams of soil in the sample container.

3.5 EQUIPMENT DECONTAMINATION /WASTE HANDLING

When reusable sampling equipment is used, the equipment will be decontaminated in accordance with EMD Operating Procedure 5-21000-OPS-FO.03, *General Equipment Decontamination, Section 5.3, Cleaning Procedures for Stainless Steel or Metal Sampling Equipment.* Reusable sampling equipment will be decontaminated in accordance with procedure FO.03, Field Decontamination Procedures. Decontamination waters generated during the project will be managed according to procedure FO.07,

Handling of Decontamination Water and Wash Water with the exception that the water will be transferred directly to the Consolidated Water Treatment Facility. Drilling equipment will be decontaminated between work areas using procedure FO.04, Decontamination of Equipment at Decontamination Facilities.

Drill cuttings will be handled in accordance with FO.08, Handling and Containerizing Drilling Fluids and Cuttings. Returned sample media will be managed in accordance with FO.09, Handling of Residual Samples. Containers will be labeled in compliance with FO.10, Receiving, Marking and Labeling Environmental Containers. Waste containers will be managed by procedure FO.23, Management of Soil and Sediment Investigation Derived Materials (IDM) and FO.29, Disposition of Soil and Sediment Investigation-Derived Materials. Personal protective equipment shall be disposed according to procedure FO.06, Handling of Personal Protective Equipment. In the event that hazardous, low level, or mixed wastes are generated project waste generators will be responsible for ensuring that the waste containers are properly filled, labeled, and have the waste residue traveler documentation in accordance with plant procedures (1-C88-WP1027-NONRAD, "Non-Radioactive Waste Packaging"; 1-M12-WO4034, "Radioactive Waste Packaging Requirements"; 4-099-WO-1100, "Solid Radioactive Waste Packaging"; 1-C80-WO-1102-WRT, "Waste/Residue Traveler Instructions"; 1-PRO-079-WGI-001, "Waste Characterization, Generation, and Packaging; and the WSRIC for Operable Unit Operations, "Version 6.0, Section No. 1, PADC-96-00003).

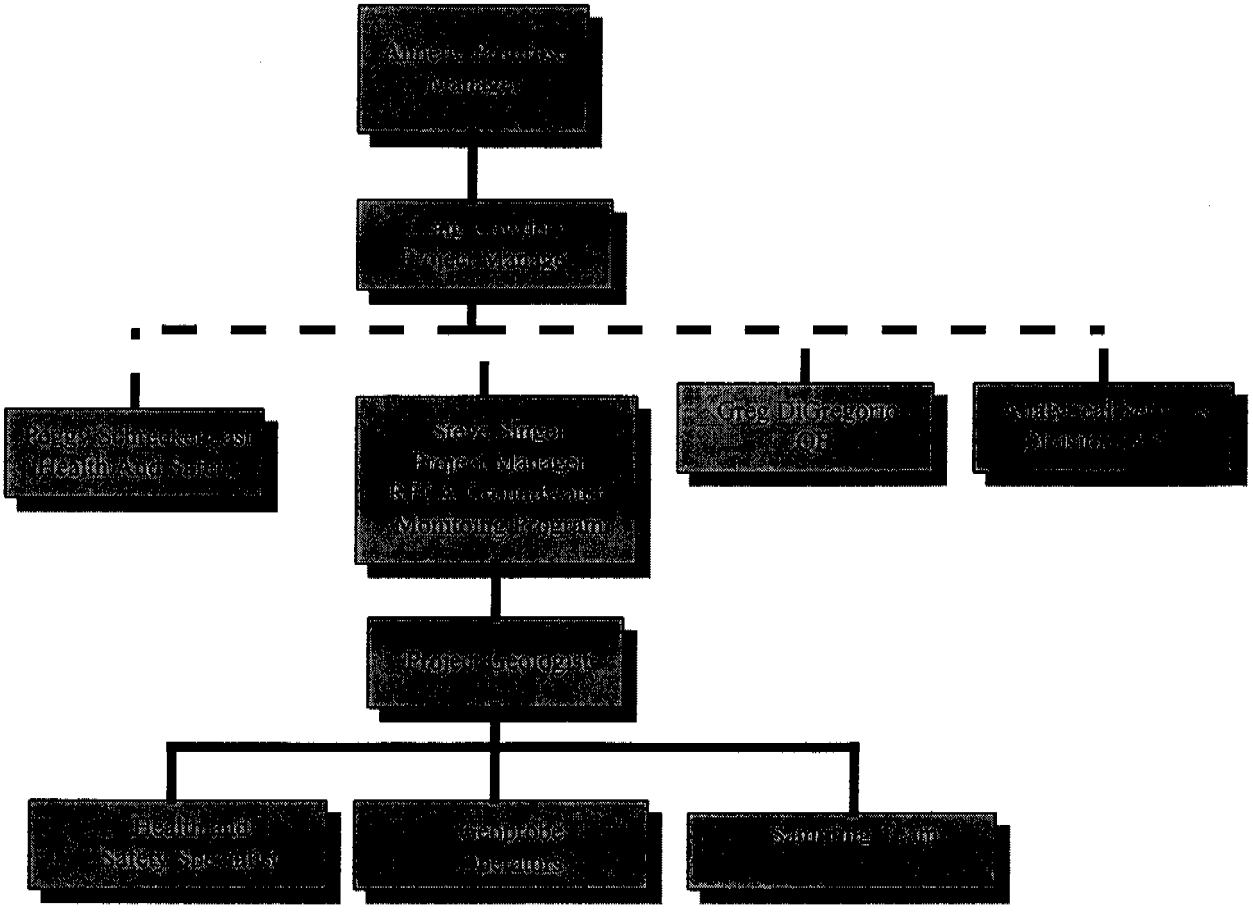
4.0 PROJECT ORGANIZATION

Figure 4-1 represents the organization structure for this project. All personnel performing tasks under this SAP will be trained in accordance with the requirements stipulated in the RMRS Training Scheduling and Records Database. Sample coordination will be implemented through a groundwater sampling subcontractor. This includes ensuring that all data are collected, verified, transmitted and stored in a manner consistent with relevant operating procedures. The Sample Coordinator, or designee, will obtain from the ASD, sample numbers (RINs) and will ensure that appropriate location codes are used..

The sample crew will be responsible for field data collection. The field crew's data management tasks will include completing all appropriate data management forms (e.g., logsheets) and completing the chain-of-custody form. The sample crew will coordinate sample shipment with the ASD.

RMRS Quality Engineers (QEs) will provide the first level of oversight and support implementation of quality controls within all quality-affecting activities of the project. RMRS oversight activities measure compliance of the project with corporate and DOE (site-specific) quality requirements.

Figure 4-1: IHSS 118.1 Monitoring Natural Attenuation Project Organization Chart



5.0 QUALITY ASSURANCE

All components and processes within this project will comply with the RMRS QA Program Description RMRS-QAPD-001, 1/1/97 which is consistent with the K-H Team QA Program (K-H, 1997). The RMRS QA Program is consistent with quality requirements and guidelines mandated by the EPA, CDPHE and DOE. In general, the applicable categories of quality control (QC) are as follows:

- Quality Program
- Training;
- Quality Improvement;
- Documents/Records;
- Work Processes;
- Design;
- Procurement;
- Inspection/Acceptance Testing;
- Management Assessments; and
- Independent Assessments.

The project manager will be in direct contact with QA to identify and correct issues with potential quality affecting issues. Field sampling quality control will be conducted to ensure that data generated from all samples collected in the field for laboratory analysis represent the actual conditions in the field. The confidence levels of the data will be verified by the collection of QC and duplicate samples, equipment rinsate samples, and trip blanks.

5.1 QUALITY ASSURANCE SAMPLES

The following types of QC samples will be collected to support the evaluation of IHSS 118.1:

- Duplicates: These samples will be collected at the rate of at least one duplicate in twenty regular samples. These samples will be submitted blind to the laboratory. All duplicate samples will be collected using the same sampling equipment used for collection of the regular samples. Sampling equipment will not be decontaminated while collecting regular and QC samples from the same location.

- Equipment rinsate blanks: These samples will be prepared by collecting distilled water, poured over decontaminated sampling equipment, between collection of regular samples. These blanks will be submitted with the regular samples.

- Trip blanks: Trip blank samples will be shipped with coolers sent off-site containing samples being analyzed for VOCs. These trip blanks will be pre-prepared (not in the field) with minimal headspace and preserved to a pH<2 with hydrochloric acid (HCl). Trip blanks will not be required for samples shipped for radiochemical or metal analysis only.

Data validation will be performed on 25% of the laboratory data according to the Rocky Flats ASD, Performance Assurance Group procedures. Data validation will be performed in accordance with the

Rocky Flats ASD, Data Assessment Guidelines (DAGR01), and will done prior to reporting if it is feasible. Table 5.1 provides the QA/QC samples and frequency requirements of QA sample generation. Data usability shall be performed on laboratory validated data according to procedure 2-G32-ER-ADM-08.02, Evaluation of ERM Data for Usability in Final Reports. Samples will be randomly selected by ASD personnel to fulfill data validation of 25% of the total number of analyses.

Table 5-1 QA/QC Sample Type, Frequency, and Quantity

Sample Type	Frequency	Comments
Duplicate	One duplicate for each twenty real samples	
Rinse Blank	One rinse blank for each twenty real samples	To be performed with reusable sampling equipment following decontamination procedures
Trip Blank	One trip blank per shipping container	VOC analysis shipments only

5.2 PARCC PARAMETERS

Analytical data collected will be evaluated using the guidance established by the Rocky Flats Administrative Procedure 2-G32-ER-ADM-08.02, *Evaluation of ERM Data for Usability in Final Reports*. This procedure establishes the guidelines for evaluating analytical data with respect to precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters.

A definition of PARCC parameters and the specific applications to the investigation are as follows:

Precision - A quantitative measure of data quality that refers to the reproducibility or degree of agreement among replicate or duplicate measurements of a parameter. The closer the numerical values of the measurements are to each other, the lower the relative percent difference and the greater the precision. The relative percent difference (RPD) for results of duplicate and replicate samples will be tabulated according to matrix and analytical suites to compare for compliance with established precision DQOs. Specifications on repeatability are provided in Table 5.2. Deficiencies will be noted and qualified, if required.

Accuracy- A quantitative measure of data quality that refers to the degree of difference between measured or calculated values and the true value of a parameter. The closer the measurement to the true value, the more accurate the measurement. The actual analytical method and detection limits will be compared with the required analytical method and detection limits for VOCs and radionuclides to assess the DQO compliance for accuracy.

Representativeness - A qualitative characteristic of data quality defined by the degree to which the data absolutely and exactly represent the characteristics of a population. Representativeness is accomplished by obtaining an adequate number of samples from appropriate spatial locations within the medium of interest. The actual sample types and quantities will be compared with those stated in the SAP or other related documents and organized by media type and analytical suite. Deviation from the required and actual parameters will be justified.

Completeness - A quantitative measure of data quality expressed as the percentage of valid or acceptable data obtained from a measurement system. A completeness goal of 90% has been set for this SAP. Real samples and QC samples will be reviewed for the data usability and achievement of internal DQO usability goals. If sample data cannot be used, the non-compliance will be justified, as required.

Comparability - A qualitative measure defined by the confidence with which one data set can be compared to another. Comparability will be attained through consistent use of industry standards and standard operating procedures, both in the field and in laboratories. Statistical tests may be used for quantitative comparison between sample sets (populations). Deficiencies will be qualified, as required. Quantitative values for PARCC parameters for the project are provide in Table 5.2.

Table 5-2 PARCC Parameter Summary

PARCC	Radionuclides	Non-Radionuclides
Precision	Statistical Test $\leq$ 1.96	RPD $\leq$ 30% for Organics RPD $\leq$ 40% for Non-Organics
Accuracy	Detection Limits per method and APO Laboratory SOW.	Comparison of Laboratory Control Sample Results with Real Sample Results
Representativeness	Based on SOPs and SAP	Based on SOPs and SAP
Comparability	Based on SOPs and SAP	Based on SOPs and SAP
Completeness	90% Useable	90% Useable

6.0 SCHEDULE

Groundwater monitoring well installation is tentatively scheduled for October, 1998. Investigation derived material will be generated and sampled during well installation. Following installation the first round of sampling will be done on the wells including water samples and DNAPL samples. An evaluation of sample results is tentatively scheduled for March 1999. As part of this evaluation recommendations will be made whether to proceed and proposed changes to the project approach. Locating and sampling of the Building 771 footing drain will be done concurrent to other sampling activities. This activity is tentatively scheduled for November, 1998. A second round of samples will be taken approximately six months from the first round or tentatively in April, 1999. An annual evaluation report will be prepared for the Annual RFCA Groundwater Monitoring Report due in September, 1999.

7.0 REFERENCES

EPA, 1994. Guidance for the Data Quality Procedure, EPA QA/G-4. US Environmental Protection Agency, Quality Assurance Management Staff, Washington, DC 20460

EPA, 1997, *Use of Monitored Natural Attenuation At Superfund, RCRA Corrective Action, and Underground Storage Sites*, OSWER Directive 9200.4-17, U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response, Washington, D.C., November.

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RMRS, 1997b, *Final Pre-remedial Investigation of IHSS 118.1, Data Summary Report* RF/RMRS-97-111.UN, Golden, Colorado, December.

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Wiedemeier, T.H., M. A. Swanson, D. E. Moutoux, J. T. Wilson, D. H. Kampbell, J. E. Hansen, and P. Haas, 1997, "Overview of the Technical Protocol for Natural Attenuation of Chlorinated Aliphatic Hydrocarbons in Ground Water Under Development for the U. S. Air Force Center for Environmental Excellence," Proceedings of the Symposium on Natural Attenuation of Chlorinated Organics in Ground Water, Dallas, Texas, September 11-13, 1996, EPA/540/R-97/504.

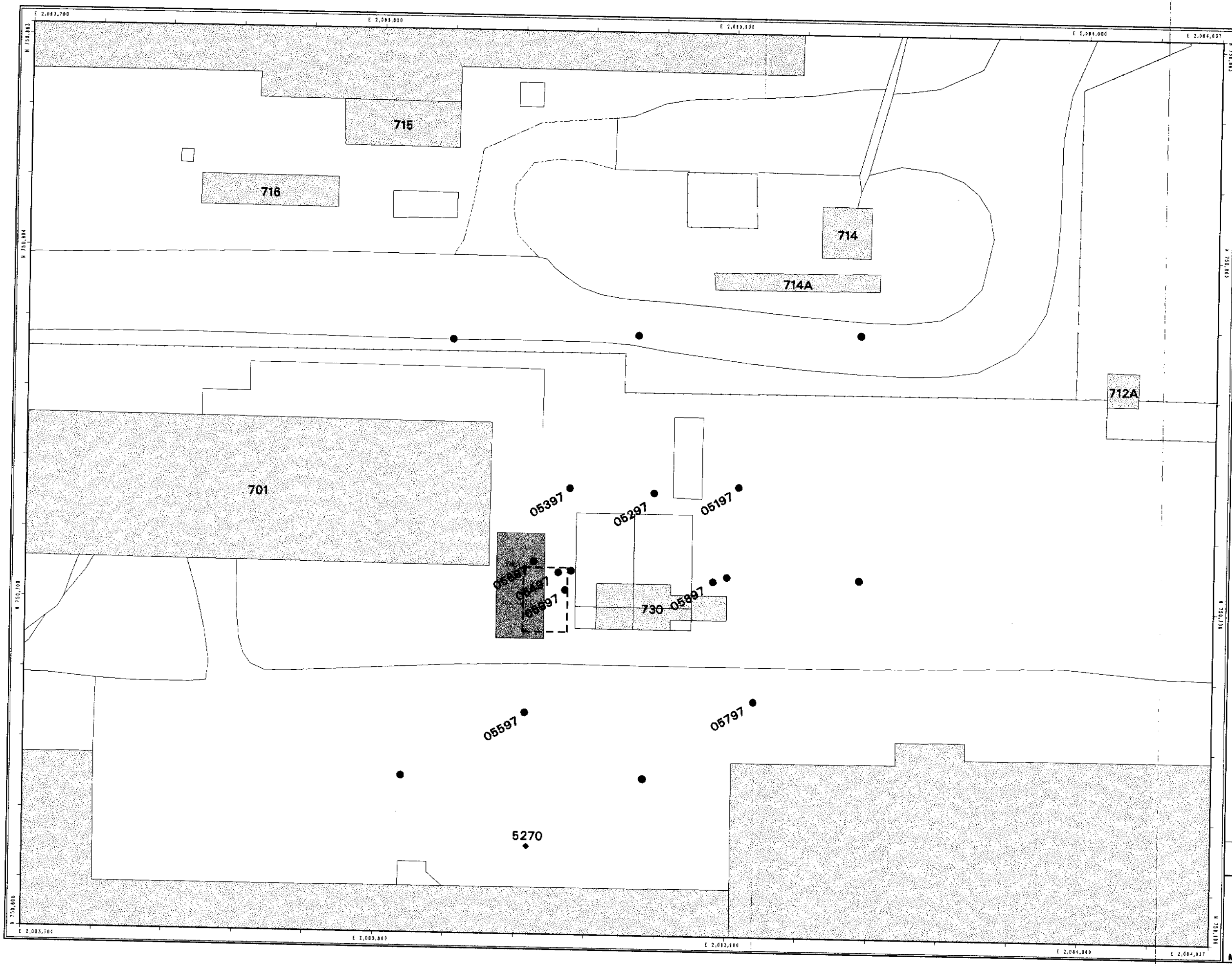

Figure 1-1
IHSS 118.1
Map Showing Proposed Well Configuration

EXPLANATION

- Proposed Groundwater Monitoring Wells
- Geoprobe Boreholes & Wells (FY97)
- Pre-existing GW Monitoring Wells
- Process Waste Tanks (IHSS 132)
- IHSS 118.1
- Former Location Carbon Tetrachloride Tank

Standard Map Features

- Buildings and other structures
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs. 1/95

Scale = 1 : 320
1 inch represents approximately 27 feet

10 0 20 40ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
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