Resource Conservation and Recovery Act
Post-Closure Care Permit Application

For U.S.D.O.E.-Rocky Flats Plant
Hazardous & Radioactive Mixed Wastes

CO7890010526

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In Association with:

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WEST SPRAY FIELD

CLOSURE PLAN

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
GOLDEN, COLORADO

OCTOBER 3, 1988

ROCKWELL INTERNATIONAL
NORTH AMERICAN AEROSPACE OPERATIONS
ROCKY FLATS PLANT

APPENDIX A

SAMPLING AND ANALYSIS PLANS

This appendix contains the sampling and analysis plans for work conducted in the West Spray Field Area. The plans are presented in the following order:

Appendix A-1: Sampling and Analysis Plan--Solar Pond 207B-North, Interceptor Trench Pump House, and West Spray Field, February 1986.

Appendix A-2: Draft Work Plan--Geological and Hydrological Site Characterization, July 21, 1986

Appendix A-3: Sampling Plan for Test Pits--West Spray Field, 1988

APPENDIX A-1

SAMPLING AND ANALYSIS PLAN
SOLAR POND 207B-NORTH, INTERCEPTOR TRENCH
PUMP HOUSE, AND WEST SPRAY FIELD
FEBRUARY 1986

SAMPLING AND ANALYSES PLAN

USDOE ROCKY FLATS PLANT

Solar Pond 207B-North, Interceptor Trench
Pump House and West Spray Field

February 28, 1986

Submitted to

Rockwell International
North American Space Operations
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1.0 INTRODUCTION

This sampling plan has been designed to provide a chemical characterization of the groundwater downgradient of the solar ponds at the interceptor trench, the contents of Solar Pond 207B-North, and soils at the West Spray Field. Water and soil samples will be collected and analyzed for a comprehensive suite of parameters that will provide the basis to determine if closure requirements may be necessary for the West Spray Field.

2.0 BACKGROUND

The solar evaporation ponds (see Figure 1) were constructed primarily to store and treat (by evaporation) low level radioactive process wastes. During the history of pond operation, leakage has been observed. To minimize pond leakage from entering the North Walnut Creek drainage, a series of two groundwater interceptor trenches were constructed. These trenches and a pump system intercept groundwater and return the water to Pond 207B-North.

The intercepted groundwater contains tritium, a radioactive substance, and slightly elevated concentrations of alpha and beta radioactivity. The major chemical constituent is nitrate at concentrations ranging from 500 to 800 mg/l. Additionally, two samples that were collected to meet an NPDES discharge permit requirement were found to have trace concentrations (2 to 3 ppb) of chloroform and trichloroethylene.

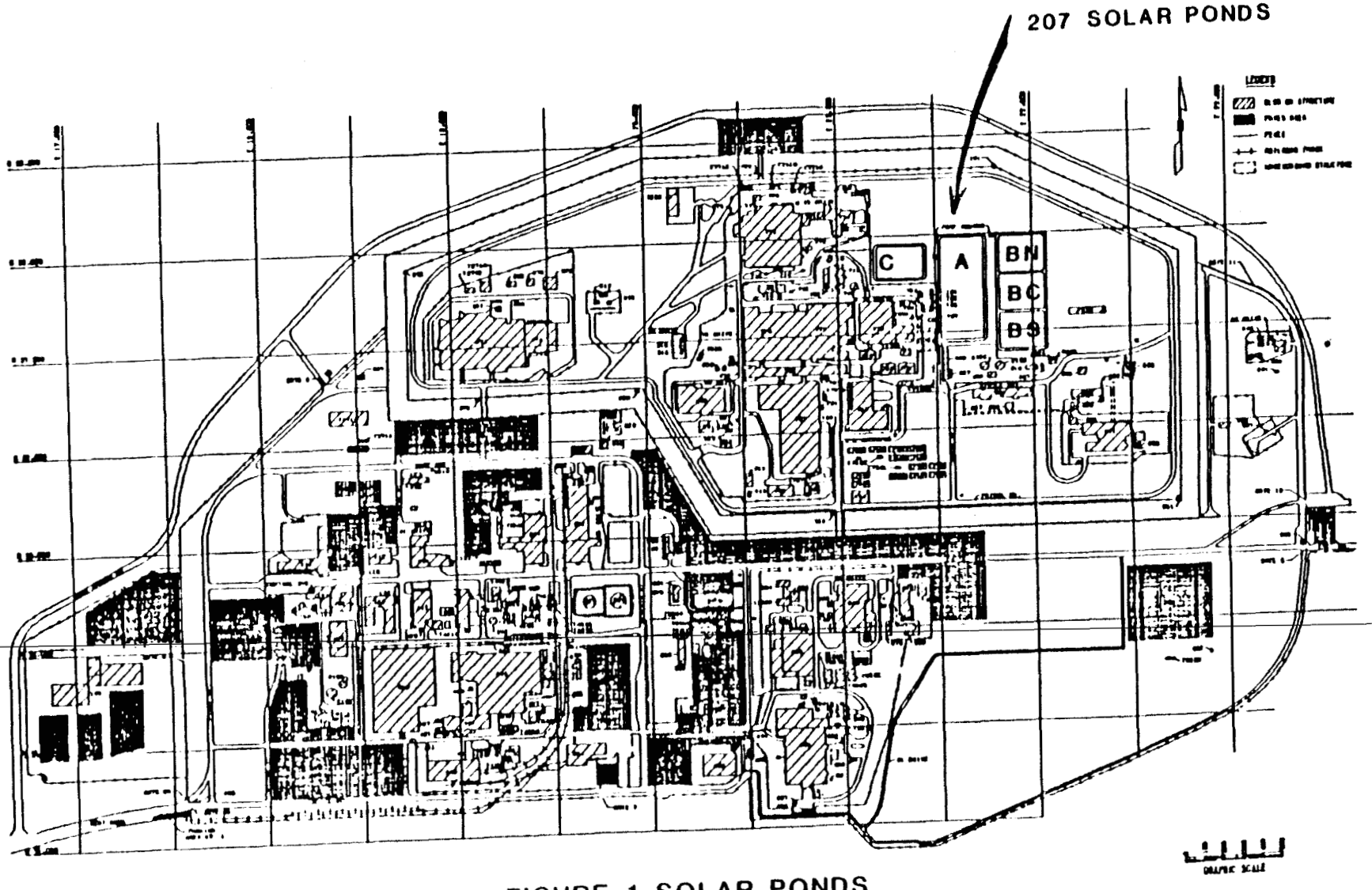


FIGURE 1 SOLAR PONDS

From 1977 through October 1985, the contents of Pond 207B-North were used for spray irrigation at the West Spray Field. The water was applied west of the facility through an agricultural irrigation system on two fields each approximately 2000' x 1200' in size. Hydraulic loading was based on nitrate concentrations and the assimilative capacity of the soil/vegetation system for nitrate. This information was included in the Rocky Flats Plant "Radioactive Mixed Waste" Part B Permit application which was submitted to the U.S. Environmental Protection Agency (U.S. EPA) on November 8, 1985. It was indicated in the Permit that additional data would be collected to evaluate the West Spray Field before making a determination whether or not spray irrigation could constitute land application of a "Radioactive Mixed Waste".

On November 12, 1985, the Rocky Flats Plant Area Office of the Department of Energy responded to the U.S. EPA letter which requested information regarding active and inactive land disposal units. Irrigation in the West Spray Field was identified as possible land application of "Radioactive Mixed Wastes" and it was stated that a time extension was needed to conduct additional sampling and analysis before any closure decision could be made. The U.S. EPA agreed in a November 25, 1985 response letter. Subsequently, planning meetings were held with the U.S. EPA on December 2, and December 19, 1985. This sampling plan provides the details for sampling the groundwater from the interceptor trench, water from Solar Pond 207B North, and soil in the West Spray Field.

3.0 SAMPLING PLAN

3.1 Analysis Rationale

Because the wastes contained in the pond have not been thoroughly characterized to date, it is proposed that the contents of the pond, interceptor trench, and soils at the West Spray Field be analyzed for the Hazardous Substance List (HSL) defined in CERCLA, Sections 101 (14) and 104 (a) (2) which are presented in Appendix A of this sampling plan. EPA approved analytical methods exist for their measurement in soils and water. Because the solar pond waste is also radioactive, all samples will be analyzed for plutonium 239, americium 241, tritium, uranium 233, 234 and 238, and gross alpha and gross beta using the EML HASL 300 methodologies which are acceptable to EPA. Estimated detection limits for selected radiological analyses are also presented in Appendix A.

Another purpose for sampling is to establish whether the contents of Solar Pond 207B-North are characteristic of a radioactive mixed waste. To achieve this the pond waste characteristics will be compared to the hazardous and radioactive waste characteristics criteria listed below:

1. Exhibits characteristics of a hazardous waste identified in Subpart C (40 CFR 261.3 (a) (2) (i)).

2. It is a mixture of a solid waste and a hazardous waste listed in Subpart D (40 CFR 261.3 (a) (2) (iii) & (iv)).

3. It poses a potential hazard to human health or the environment (40 CFR 261.1 (b)).

4. It contains radioactive constituents including tritium, americium, plutonium, and uranium.

In order to provide sufficient analytical information to preliminarily determine if the pond contents are radioactive mixed wastes, by criteria 1, it will be necessary to perform the Subpart C characteristic testing (ignitability, corrosivity, reactivity, and EP toxicity). Classification of a waste as hazardous by criteria 2 is generally made through prior knowledge of co-disposal with a Subpart D listed waste. Records of waste disposed at the solar pond are incomplete regarding hazardous waste components; and, therefore, a RCRA classification of the solar pond contents cannot be made based on criteria 2. The simple presence of 40 CFR 261 Appendix VII constituents (constituents present in the Subpart D listed wastes) in the solar ponds is also inadequate information to determine if the solar pond contents are hazardous by criteria 2.

As for criteria 3, the presence of 40 CFR 261 Appendix VIII constituents in a waste is a factor the EPA would consider in a formal listing of a particular waste stream as a RCRA hazardous waste (Appendix VII is a subset of Appendix VIII). The EPA has not developed no approved analytical methodologies for many of the Appendix VIII constituents. Furthermore, in a RCRA waste characterization program it is only necessary to analyze a waste stream for Appendix VIII constituents that are likely to be present.

Therefore, measurement of the hazardous substances will be used to address criteria 3. The HSL contains many of the Appendix VIII constituents and all of the priority pollutants, and there are EPA approved methodologies for their analysis. Radiological characteristics will be addressed by analysis for Am-241, Pu-239

3.2 Location of Sampling Points

3.2.1 Water - Pond 207B-North

Three water samples will be collected at the surface of Pond 207B-North. Grab samples will be taken at three of the four corners of the pond. Grab sampling was selected to preclude the loss of trace volatile organic compounds that might occur during composite sampling.

3.2.2 Interceptor Trench Pump House

Three grab samples of the interceptor trench liquid will be collected from a location upstream of the collection sump.

3.2.3 Soils - West Spray Field

As shown in Figure 2, water from Solar Pond 207B-North has been spray irrigated in the past over an area, approximately 1200' x 2000' on the west side of the plant. The area of high application is the focus of this preliminary sampling effort because it is expected to provide worst case information on soil in the West Spray Field. The high application area is a 2.8 acre circular zone in the West Spray Field. Water was irrigated using a water cannon with an application radius of 200 feet.

Because of the lack of available data on the presence or absence of contamination in the West Spray area, the primary objective in sampling will be to determine average concentration levels in the high application area.

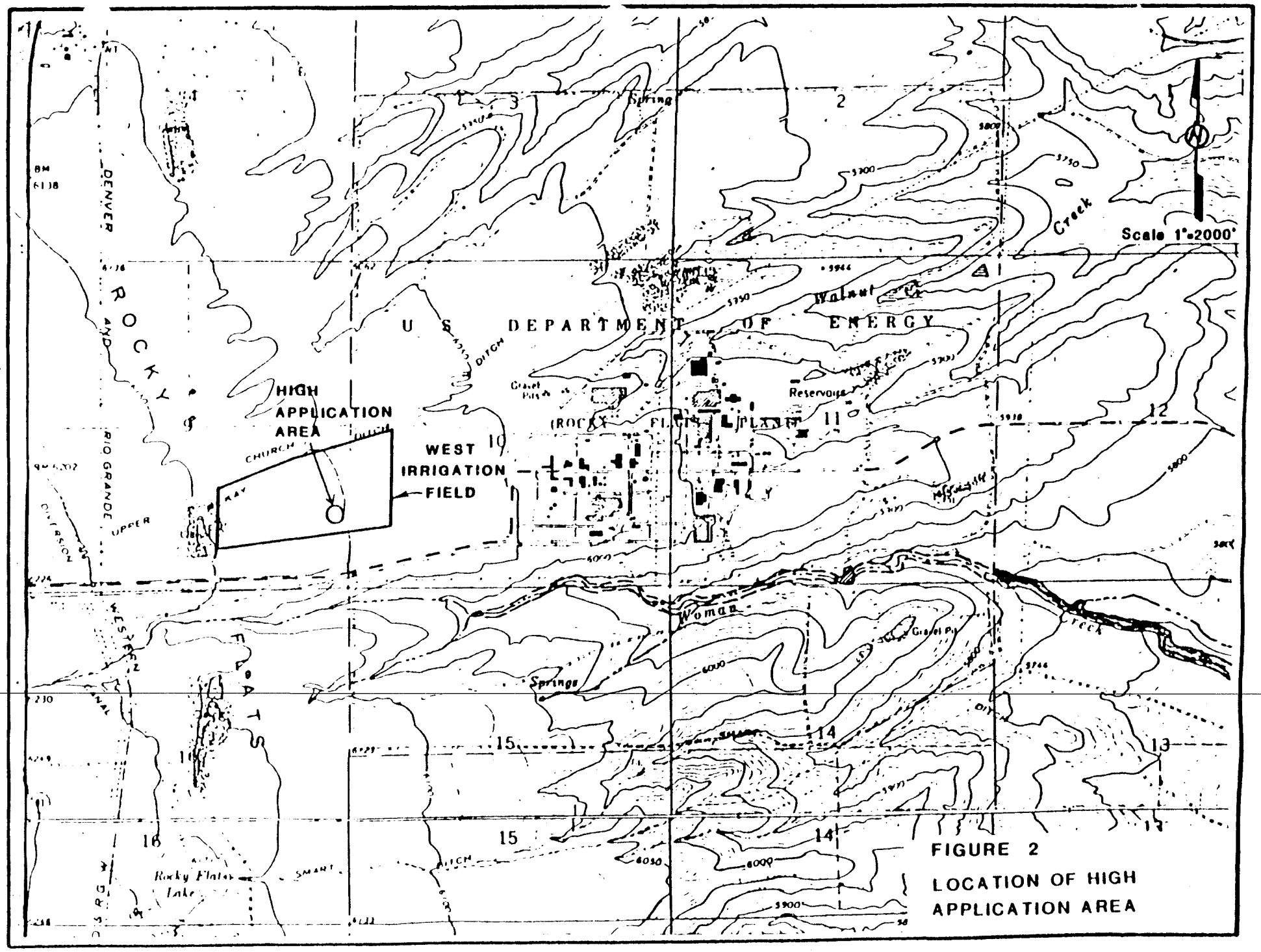


FIGURE 2

LOCATION OF HIGH APPLICATION AREA

As shown in Figure 3, sample locations within the circular spray area were identified by enclosing the area within a hypothetical 400 ft x 400 ft square subdivided into 100 squares each 40 ft x 40 ft. The squares were numbered and a random number generator used to identify 18 squares within the circular area for sampling. At the center of each of the 18 squares, a surface core (0-6") and subsurface core (6-12") will be collected. The 18 surface and 18 subsurface cores will then be randomly composited to produce 3 composite surface soil samples and 3 composite subsurface soil samples for subsequent analysis. Soil sample collection points will be located with a field compass and tape measure using the center of the circular spray area as a reference point. The sample collection points will be staked for future reference.

Consistent with the method described for sampling the circular spray area, six soil samples will also be collected from a 200 ft x 400 ft non-irrigated area. These samples will consist of three composite surface (0- 6") samples and three composite subsurface (6-12") samples and will be collected northwest of the spray field along the facility western boundary (see Figure 4). This area is generally upwind (prevailing winds are from the west-northwest) and over 0.5 miles from the spray area. As described for the circular spray area, a grid system will be established and random numbers will be used to determine the 18 sample locations on the grid. A particle size analysis (ASTM D422-63) will be used for all samples to verify if the non-irrigated soil type is similar to that in the irrigated area.

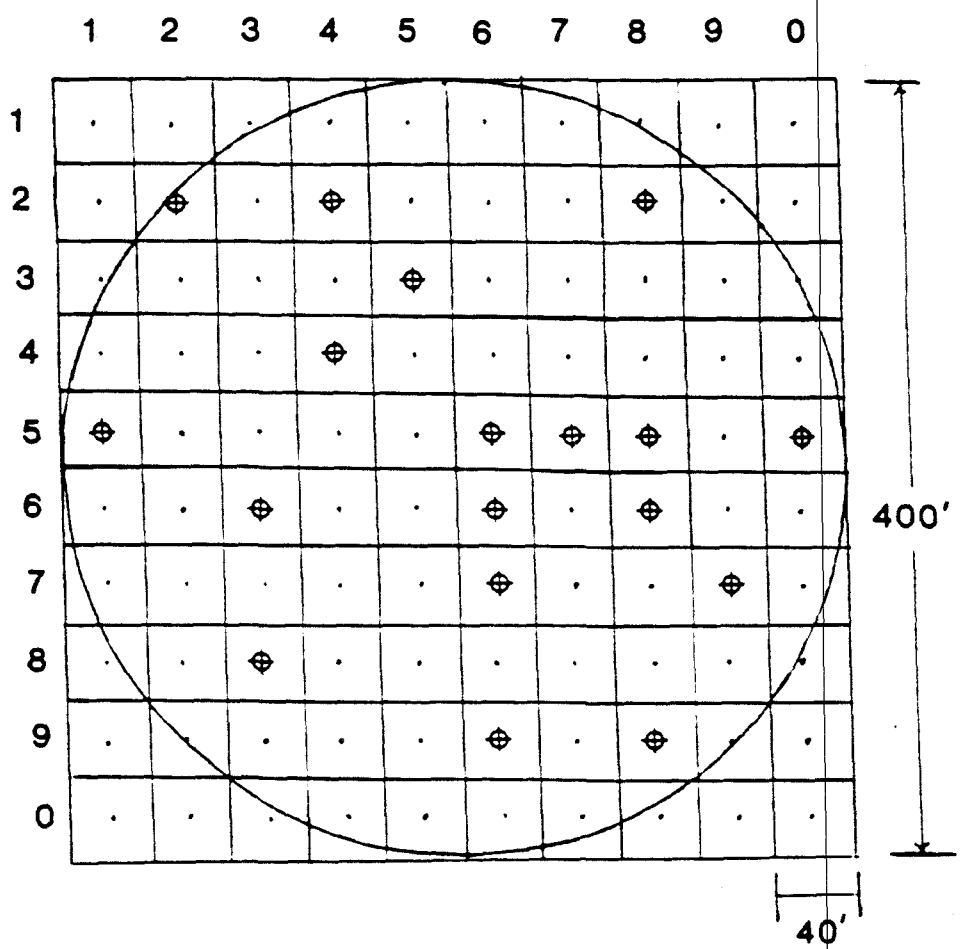


FIGURE 3 DIAGRAM OF SOIL SAMPLING LOCATIONS

WEST SPRAY FIELD - HIGH APPLICATION AREA

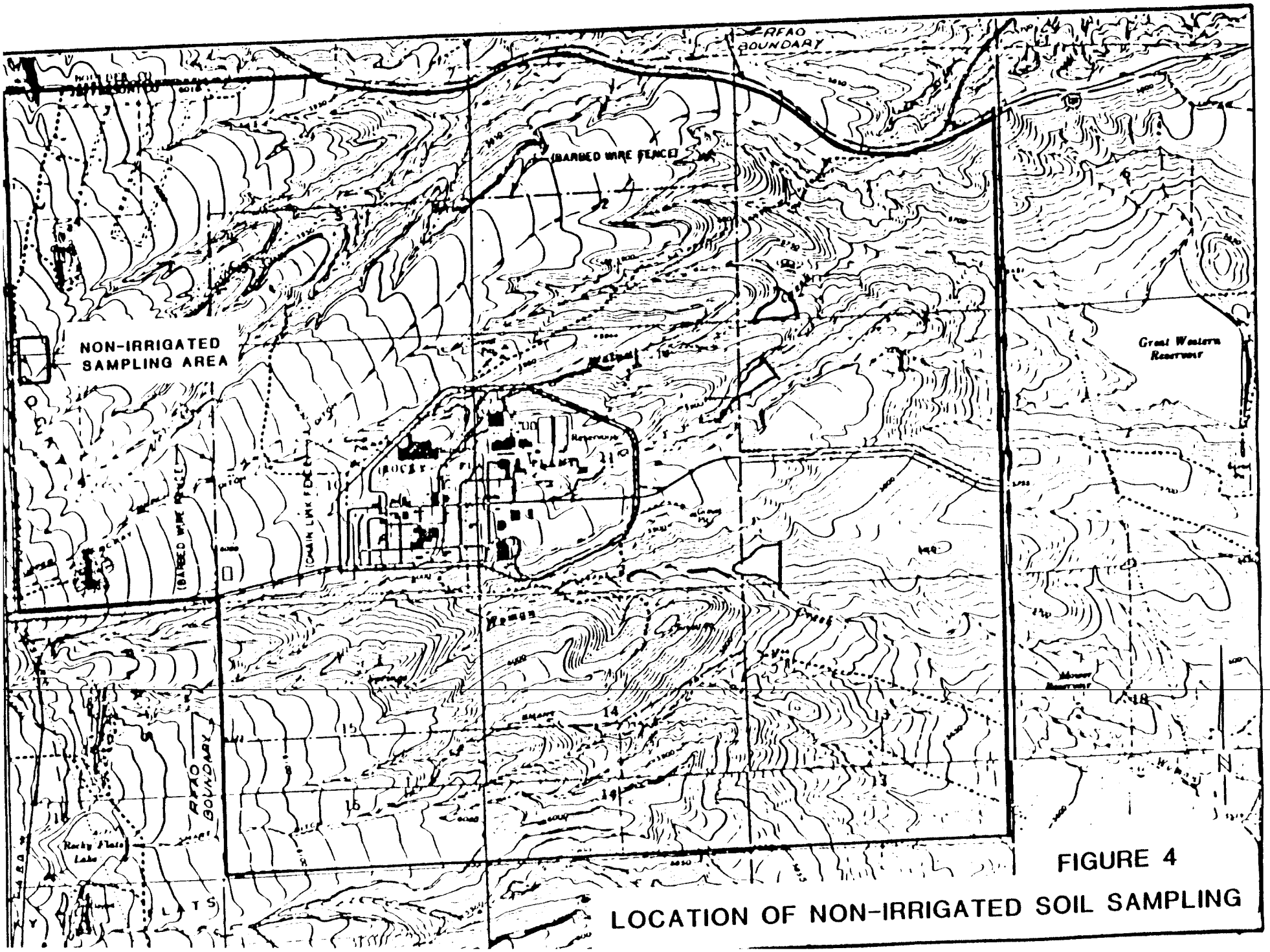


FIGURE 4

LOCATION OF NON-IRRIGATED SOIL SAMPLING

3.3 SAMPLING METHODOLOGY

This section presents a discussion of the sampling procedures. Information is included on analytical requirements, container type, preservation, field measurements, and holding time for the analyses requested.

3.3.1 Sampling Procedure - Pond 207B-North Water

Surface Water - Grab samples will be collected from three corners of the pond. Samples will be collected by immersing the sample container under the surface of the water until it is filled to the proper level as described below:

Volatile Organic Analysis - Vials should be filled completely so that a meniscus is visible on the top of the vial. The Teflon cap is slowly placed on the meniscus taking care not to force air into the sample. Screw the cap on the vial tightly and invert the vial. Tap lightly on the vial and observe whether there are any air bubbles trapped inside the vial. If air bubbles are observed, remove the cap and resample until no bubbles are visible inside the vial when it is inverted.

Remaining Analyses - Sample containers need not be completely filled for these analyses. Fill bottles up to shoulder level to allow sufficient ullage for transportation.

Field measurement of pH, conductivity and temperature will be performed on samples of the water from each location in Pond 207B-North. A beaker or sample jar will be immersed and a sample withdrawn for the measurement of these parameters. pH and conductivity will be measured by conventional pH and conductivity meters calibrated prior to sampling. pH buffer solutions will be available at the sampling site to double check calibration before analysis. Temperature will be measured using a partial immersion thermometer calibrated in 0.1°C or 0.2°F with a range of 0-50°C. The thermometer will be accurate to ±0.1°C as checked against a Bureau of Standards calibrated thermometer. pH, conductivity, and temperature readings will be recorded after equilibrium in measurements is achieved.

Table 3.1 summarizes the analyses to be performed, numbers and types of containers, preservation and holding times, and analytical methodology for water samples collected at the pond.

3.3.2 Interceptor Trench Pump House Liquids

The Interceptor Trench Pump House liquids will be sampled using the grab sampling approach. Samples will be collected simply by immersing the sample container in the pumphouse still well until it is filled to the proper level.

Analytical requirements, types of sample containers, preservation, holding times, and analytical methodology for water samples collected at the Interceptor Trench Pump House will follow that presented in Table 3.1. Field measurements of pH, conductivity, and temperature will be as described in Section 3.3.1.

TABLE 3.1 CONTAINERS AND PRESERVATION FOR POND 207B-NORTH AND INTERCEPTOR TRENCH WATER SAMPLES

Analyses	Number of Samples	Recommended Container Type and Volume per Sample	Preservation	Holding Time	Method
Hazardous Substance List Volatiles (HSL)	6	(2) 40ml[a] glass vials w/teflon septum	Cool to 4°C	Analyze within 7 days	EPA 624
HSL Extractable analysis, acid, base-neutral pesticides, PCB	6	(2) 2 liter amber glass jars w/Teflon cap	Cool to 4°C	10 days	EPA 625
HSL Metals	6	(1) liter[a] plastic	Filter, Acidify pH<2 HNO_3	6 months	*
Phenol	6	(1) liter plastic[a]	$CuSO_4$, Cool to 4°C	28 days	*
Cyanide	6	(1) liter plastic[a]	Cool to 4°C pH > 12 NaOH	14 days	*
RCRA characterization ignitability, corrosivity, reactivity	6	(2) 250 ml glass w/ Teflon lid	Cool to 4°C	none specified	**
Radiological					
Americium[241] Plutonium[239] Uranium[233, 234, 238] Tritium gross beta gross alpha	6	(1) 4 liter[a] cubitainer	Filter, acidify pH<2 HNO_3 (optional for medium level contamination)	6 months	EML HASL 300

[a]may require additional sample for lower detection limits
* "Methods for Chemical Analysis of Water and Waste" (EPA-600/4-79-020)
** "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods" July 82, SW-846

3.3.3 West Spray Field Soils

A discussion of sampling rationale and sample locations, including grid layout, was presented in Section 3.2.3. The following sections describe equipment, sampling procedures, containers and preservation, and field measurements.

Core samples will be collected in the non-irrigated area by using a sledge hammer to drive a split spoon sampler to a depth of 12". Each core will be split in half using a disposable sample trier or scoop and each half placed in a separate clean aluminum tray. The core half closest to the cutting edge of the split spoon will represent the 6-12" depth; the other core will represent the 0-6" depth. After each core is withdrawn and split, the split spoon sampler will be brushed off to remove excess soil. It is not necessary to decontaminate the split spoon after each core because the cores will be mixed to form a composite. After all cores have been collected, split and segregated into their respective trays, they will be crushed and mixed thoroughly with a shovel or trowel. The crushed samples are now a composite of either the 0-6" depth or the 6-12" depth, and can be distributed evenly into their respective labelled containers. The same method will be used to collect soil samples from the high application area.

After sampling the non-irrigated soil, the split spoon sampler and aluminum trays will be thoroughly decontaminated. The split spoon samplers and trays will be scrubbed with a tap water and detergent solution, rinsed with tap water, rinsed with methanol, and finally rinsed with distilled water. Mixing trowels will also be decontaminated after each grid has been sampled.

Table 3.2 summarizes analytical requirements, numbers and types of sample containers, preservation, holding times, and analytical methodologies for soil sampling at the West Spray Field.

3.4 SAMPLING EQUIPMENT - WATER AND SOIL

Instrumentation

- pH meter/buffer solutions
- conductivity meter
- thermometer
- beaker for field measurements
- plastic squeeze bottles for decontamination of instrument probes

Sampling Equipment

- logbook/ink pens
- watch
- sample containers/labels
- field filtration apparatus
- split spoon sampler
- sledgehammer
- preservatives, copper sulfate, sodium hydroxide, nitric acid
- stainless steel bucket for compositing
- polyethylene sheeting
- paper towels
- shovel or trowels
- plastic or metal scoops
- HPLC/distilled water

TABLE 3.2 CONTAINERS AND PRESERVATION FOR WEST SPRAY FIELD SOILS

Analyses	Number of Samples and Type	Recommended Container Type and Volume per Sample	Preservation	Holding Time	Method
Hazardous Substance List Volatiles (HSL)	12-Composite	(2) 4 oz glass[a] w/Teflon lid	Cool to 4°C	Analyze within 7 days	EPA 800 series
HSL Semi-volatiles, pesticides, PCB	12-Composite	(2) 8 oz glass[a] w/Teflon lid	Cool to 4°C	10 days	EPA 800 series (sonification for pre-extraction)
HSL Metals/CN^-	12-Composite	(1) 8 oz glass[a] w/Teflon lid		6 months	SW-846 or EPA 600
RCRA characterization Ignitability Corrosivity Reactivity EP Toxicity (Less pesticides)	12-Composite	(2) 8 oz glass[a] w/Teflon lid	None	none specified	
Radiological					
Americium 241 Plutonium 239 Uranium 233, 234, 238 Tritium gross beta gross alpha	12-Composite	(2) 16 oz glass[a] w/Teflon lid	None	6 months	EML HASL 300

[a]may require additional sample for lower detection limits

aluminum trays
coolers with ice
camera

Sample/Equipment Decontamination

wash bucket
rinse bucket
alkaline detergent
brushes
paper towels/plastic trash bags
methanol
tap water
distilled water

4.0 SAMPLE HANDLING

This section describes procedures for special sample handling, decontamination, and sample identification. Procedures for marking, labelling, packaging, and shipping of environmental and hazardous substance samples not classified as DOT Radioactive Materials are included in Appendix B. Specific shipping requirements for DOT Radioactive Materials are presented in Appendix C.

4.1 Decontamination

To minimize cross contamination between samples and to protect sampling and laboratory personnel from potential exposure to possible hazardous or radioactive contaminants, all samples will be decontaminated prior to packaging. At each sample location sample containers and equipment will be washed on the exterior with a detergent, rinsed with tap water, and dryed with paper towels. Decontamination solutions and rinse waters will be containerized and stored. After the sample analysis data are received and evaluated, appropriate disposal of these liquids will be determined.

4.2 Sample Identification

Individual sample containers will be numbered sequentially using a white or colored grease pen to identify the sample number before sampling. Grease pens will be used to prevent loss of sample numbers during sampling. Often times, identifying marks on pre-labelled containers are lost during sample immersion in aqueous wastes or during decontamination. After samples have been decontaminated and dried, permanent gum labels or sample tags will be affixed to the sample containers. Permanent labels or tags will include the following information at a minimum:

- Exact location of the sample
- Time and date of sample collection
- Name of sampler and witnesses
- Sample sequential identification number (corresponding to that listed on the chain of custody record)
- Type of sample (grab or composite)
- Analyses requested
- Preservation methods (nitric acid, NaOH, $CuSO_4$, etc.)
- Destination (Lab name)
- Other pertinent information

4.3 Packaging, Marking, Labelling, and Shipping

Because samples are expected to contain radionuclides, all samples will be transported in compliance with U.S. Department of Transportation requirements for packaging, marking, and labelling of radioactive materials. Regulations pertaining to the transportation of radioactive materials are detailed in 49 CFR Sections 100 - 177, and are summarized in Appendix C of this sampling plan.

To ensure compliance with DOT shipping requirements, the following procedures must be initiated prior to offering a package for shipment:

1. A representative number of containers will be smear sampled using 47 mm filter paper and then counted for alpha activity. If counts exceed Rocky Flats Plant guidelines, containers will be decontaminated, smeared, and recounted until alpha activity meets these guidelines (see Appendix C).

2. An exterior gamma survey will be performed on individual sample containers. Results of this survey will dictate the appropriate internal and external packaging requirement per DOT specifications (see Appendix C).

3. An exterior gamma survey will be conducted on each package to determine external packaging requirements per DOT specifications (see Appendix C).

4. Hazardous Material Bill of Lading including shipper's certification, chain of custody records, and instructions for the laboratory will accompany each package offered for shipment.

Personnel responsible for shipping samples will review DOT regulations concerning the shipment of Radioactive Material (49 CFR 172.203) and prepare each shipment accordingly. To assist in this preparation, the Hazardous Materials Form (shown on page 21) will be completed and included with the Dangerous Goods Bill of Lading, Chain of Custody Records, and other information enclosed with the sample shipment.

4.4 Documentation/Chain of Custody

All aspects of the sampling effort will be documented in various forms by sampling personnel. Documentation is required to assist laboratory personnel in identifying samples, aid in data collection and reporting, and to provide evidence on the validity of information gathered. One member of the sampling team will be assigned as the document coordinator and will be responsible for recording all information during sampling.

HAZARDOUS MATERIALS FORM

Pkg. Certified by: _____ Date: _____ Destination: _____

Mode of transport: _____ Carrier: _____

SHIPPING PAPER ENTRIES (49 CFR 172 B & C)

Material (proper shipping name): _____

Hazard Classes: _____

Identification Number: _____

Quantity (weight or volume): _____

RADIOACTIVE MATERIALS (RAM) (49 CFR 172.203

Radionuclides: _____

Form (physical or chemical): _____

Activity (Ci, mCi, or uCi): _____

Label Category: _____

Transport Index: _____

Specific Activity: _____ pCi/g Pkg. Contam. _____

MARKING REQUIREMENTS (49 CFR 172.D)

_____ Proper shipping name
_____ Identification No.
_____ Gross weight (RAM, exceeds 110 lbs)
_____ Type A (RAM only)
_____ This End Up (liquid only)

LABELING REQUIREMENTS (49 CFR 172 E)

_____ Hazard class labels
_____ Two opposite pkg. sides
_____ Cargo Aircraft Only

PACKAGING REQUIREMENTS
(Give appropriate Section of 40 CFR):

_____

PLACARD REQUIREMENTS

_____ Placards required; offered to carrier

REVIEWED BY:

_____ _____
Signature Date

4.4.1 Logbook

All information pertinent to field activities will be recorded in bound, sequentially page numbered logbooks. The following information will be recorded prior to sampling and at each sampling location:

- Date and time of entry
- Brief objective of sampling
- Calibration information of field instrumentation
- Names of sampling personnel
- Sample location and proposed sampling methodology
- Results of field measurement (pH, temperature, conductivity, etc.)
- Number and types of samples collected, as well as container types and preservation methods
- Date and time of sample collection
- Sequential sample ID number
- Field observations (weather, etc.)
- Description of sample handling after collection (labelling, packaging, destination of sample)

4.4.2 Photographs

Photographs will be taken to document sampling activities. Information on photographs will be recorded in the site logbook and will include at a minimum:

- Date and time of photograph
- Name of photographer
- General direction faced and description of subject photographed
- Sequential number of photograph and the roll number

4.4.3 Chain of Custody

(adapted from EPA Office of Emergency Preparedness Remedial Response, Hazardous Response Support Division, Personnel and Safety Training Manual)

Chain of Custody will be maintained from sample collection through laboratory receipt of samples. Samples will be transferred from samplers to document coordinator who will be responsible for documentation, sample identification, packaging and shipping of samples. A Standard EPA Chain of Custody Record (presented on page 24) will be used to record sample transfers. Samples will remain in the custody of the document coordinator until they are shipped to the laboratory.

A sample is in someone's "custody" if:

- It is in actual physical possession; or
- It is in view, after being in physical possession; or
- It is in physical possession and then locked up so that no one can tamper with it; or
- It is kept in a secured area, restricted to authorized personnel only.

4.4.3.1 Transfer of Custody and Shipment

When transferring custody of the samples, the original custodian and document coordinator will sign and date the Chain of Custody Record until time of shipment. At the time of shipment the document coordinator and the courier will sign and date the Chain of Custody Record.

EPA United States Environmental Protection Agency

Chain of Custody Record

Sample Number	Task Number
Inspection Number	
Sample Name	
Date Sample	Time
Duplicate Requested ( ) Yes ( ) No	
Inspector Name and Address	
Inspector Signature	Location of Sampling
Analysis/Testing Required	

Laboratory			
Date Received			
Received By			
Sent Via			
Sample Condition			
Condition of Seals			
Units Received			
Storage Location			
Assigned By			
Assigned To			
Delivered By			
Date Delivered			
Number of Units Received			
Units Analyzed			
Date Seal Broken			
Date Resealed			
Resealed By			
Storage Location			
Date Results of Analysis Issued to EPA		Date Results of Analysis Issued to Facility	
Remarks			

A photocopy of the signed Custody Record will be retained by the coordinator. The original Chain of Custody Record will accompany the shipment to the laboratory.

4.4.3.2 Laboratory Custody Procedures

Upon arrival of the samples at the laboratory, laboratory personnel will sign and date receipt of the samples on the Chain of Custody Record. Laboratory personnel will then be responsible for maintaining custody until time of analyses. The laboratory must be able to provide a locked and secured area.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Samplers will implement the following quality assurance procedures to ensure the production of high quality data.

5.1 Sample Blanks

Trip Blanks - A full set of sample glassware and plastic containers will be filled with laboratory grade water and analyzed for all parameters under observation for the purpose of detecting contaminant contributions from the glassware.

Field Blanks - Aqueous field blanks will be prepared on-site by filling each sample container with laboratory grade water to simulate collection of an aqueous environmental sample. Field blanks will be collected, filtered, containerized, preserved, decontaminated, and shipped as if they were environmental samples. Samples will be analyzed to screen for cross contamination during sample handling.

5.2 Laboratory Quality Control

An EPA contract laboratory capable of providing analyses of Hazardous Substance List compounds, RCRA characterization and radiological constituents will be selected for all analyses. The laboratory will incorporate in-house quality control procedures and use EPA approved analytical methodologies. Data reporting under the EPA contract laboratory program is standardized, and provides detection limits required by the respective EPA methodology.

To assure quality data the laboratory must be able to provide the following quality control:

I. Requirement for Organics

The laboratory shall use its analytical experience and equipment to perform qualitative and quantitative analyses of the organic Hazardous Substance List pollutants. The Hazardous Substance List Compounds and their respective detection limits are presented in Appendix A. The laboratory shall follow the protocols established by the U.S. EPA for sample preparation, analysis, storage, and preservation before and after the analysis. Method 600 series for organics in water and Method 800 series for organics in solids shall be followed.

During preparation, the laboratory shall fortify all samples, blanks, matrix spikes with surrogate spiking compounds as given in EPA reference methods. Additionally, all sample semi-volatile extracts and aliquots for volatile organics analysis shall be spiked with internal standard compounds before injection or purging.

All soil samples for full organic (except volatile) analysis shall be prepared by sonification prior to solvent extraction. Volatile Organic Analysis shall be performed within 7 days for water samples and within 10 days for soil samples. Volatile Organic Analysis samples should not be stored with pure solvent such as methylene chloride. A matrix spike for Volatile Organic Analysis should be prepared at the beginning of the analysis and should be analyzed at the end of analysis. Sample extraction shall be completed within 5 days for water samples and within 10 days for soil samples.

The laboratory shall perform one spiked sample analysis and one duplicate spiked sample analysis on each group of samples of a similar matrix and concentration level for each batch of samples received or for each 20 samples, whichever is more frequent. The laboratory shall prepare and analyze one laboratory reagent blank for each group of samples of a similar matix for each batch or for each 20 samples, whichever is more frequent.

The laboratory shall perform instrument calibration and performance audits for each 12-hour period. Initial multi-level calibration for each HSL compound and continuing calibration for each HSL compound shall be performed. The Gas Chromatograph/Mass Spectrometer instrument should be tuned for both volatile and semi-volatile compound analysis. Gas Chromatograph/Mass Spectrometer performance audit shall include decafluorotriphenylphosphine (DFTPP) and/or bromofluorobenzene (BFB) tuning.

Blank run high value samples shall be performed to rule out any residual amount in the Gas Chromatograph column. EPA or NBS check standards can be used as a performance audit.

Calculations and identification shall be checked by a second person and signed. For calculations, use of a permanent computer program is advisable.

II. Inorganic Requirement

The laboratory shall use its analytical experience and equipment to perform qualitative and quantitative analyses of the inorganic Hazardous Substance List pollutants. The laboratory shall follow the protocols established by the U.S. EPA for sample preparation, analysis, storage, and preservation before and after the analysis. For water, methods given in "Method for Chemical Analysis of Water and Waste" (EPA-600/4-79-020) should be used. Soil samples should be digested with appropriate acid mix or sonified to extract inorganics.

The laboratory shall perform one spiked sample analysis and one duplicate spiked sample analysis on each group of samples of a similar matrix and concentration level for each batch of samples received or for each 10 samples, whichever is more frequent. The laboratory shall prepare and analyze one laboratory reagent blank for each group of samples of a similar matrix for each batch or for each 10 samples, whichever is more frequent. Duplicate sample analysis (preferably sample with some values) shall be done on each group of samples of a similar matrix for each batch of samples or for each 10 samples, whichever is more frequent.

Initial multi-level calibrations and calibration verification shall be performed in a 12-hour period. ICP or Atomic Adsorption interference check shall be performed. The laboratory control sample (or EPA or NBS) shall be carried through sample preparation and analysis procedures to document the performance of the entire sample process.

Calculations should be checked by a second person. Calibration down slope and intercept should preferably be calculated by using regression. A program for each calculation is advisable.

APPENDIX A

Estimated Detection Limits for Hazardous Substance List Compounds and Radiological Analyses

Hazardous Substance List (HSL) and
Required Detection Limits **

Volatiles	CAS Number	Detection Limits* Low Water[a] ug/L	Low Soil/Sediment[b] ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-35-3	5	5
10. trans-1,2-Dichloroethene	156-60-5	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
19. 1,2-Dichloropropane	78-87-5	5	5
20. trans-1,3-Dichloropropene	10061-02-6	5	5
21. Trichloroethene	79-01-6	5	5
22. Dibromochloromethane	124-48-1	5	5
23. 1,1,2-Trichloroethane	79-00-5	5	5
24. Benzene	71-43-2	5	5
25. cis-1,3-Dichloropropene	10061-01-5	5	5

Volatiles	CAS Number	Detection Limits* Low Water[a] ug/L	Low Soil/Sediment[b] ug/Kg
26. 2-Chloroethyl Vinyl Ether	110-75-8	10	10
27. Bromoform	75-25-2	5	5
28. 2-Hexanone	591-78-6	10	10
29. 4-Methyl-2-pentanone	108-10-1	10	10
30. Tetrachloroethene	127-18-4	5	5
31. Toluene	108-88-3	5	5
32. Chlorobenzene	108-90-7	5	5
33. Ethyl Benzene	100-41-4	5	5
34. Styrene	100-42-5	5	5
35. Total Xylenes		5	5

[a]Medium Water Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Water CRDL.

[b]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Soil/Sediment CRDL.

Semi-Volatiles	CAS Number	Detection Limits* Low Water[c] ug/L	Low Soil/Sediment[d] ug/Kg
36. N-Nitrosodimethylamine	62-75-9	10	330
37. Phenol	108-95-2	10	330
38. Aniline	62-53-3	10	330
39. bis(2-Chloroethyl) ether	111-44-4	10	330
40. 2-Chlorophenol	95-57-8	10	330
41. 1,3-Dichlorobenzene	541-73-1	10	330
42. 1,4-Dichlorobenzene	106-46-7	10	330
43. Benzyl Alcohol	100-51-6	10	330
44. 1,2-Dichlorobenzene	95-50-1	10	330
45. 2-Methylphenol	95-48-7	10	330
46. bis(2-Chloroisopropyl) ether	39638-32-9	10	330
47. 4-Methylphenol	106-44-5	10	330
48. N-Nitroso-Dipropylamine	621-64-7	10	330
49. Hexachloroethane	67-72-1	10	330
50. Nitrobenzene	98-95-3	10	330
51. Isophorone	78-59-1	10	330
52. 2-Nitrophenol	88-75-5	10	330
53. 2,4-Dimethylphenol	105-67-9	10	330
54. Benzoic Acid	65-85-0	50	1600
55. bis(2-Chloroethoxy) methane	111-91-1	10	330
56 2,4-Dichlorophenol	120-83-2	10	330
57. 1,2,4-Trichlorobenzene	120-82-1	10	330
58. Naphthalene	91-20-3	10	330
59. 4-Chloroaniline	106-47-8	10	330
60. Hexachlorobutadiene	87-68-3	10	330
61. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
62. 2-Methylnaphthalene	91-57-6	10	330
63. Hexachlorocyclopentadiene	77-47-4	10	330
64. 2,4,6-Trichlorophenol	88-06-2	10	330
65. 2,4,5-Trichlorophenol	95-95-4	50	1600

Semi-Volatiles	CAS Number	Detection Limits* Low Water[c] ug/L	Low Soil/Sediment[d] ug/Kg
66. 2-Chloronaphthalene	91-58-7	10	330
67. 2-Nitroaniline	88-74-4	50	1600
68. Dimethyl Phthalate	131-11-3	10	330
69. Acenaphthylene	208-96-8	10	330
70. 3-Nitroaniline	99-09-2	50	1600
71. Acenaphthene	83-32-9	10	330
72. 2,4-Dinitrophenol	51-28-5	50	1600
73. 4-Nitrophenol	100-02-7	50	1600
74. Dibenzofuran	132-64-9	10	330
75. 2,4-Dinitrotoluene	121-14-2	10	330
76. 2,6-Dinitrotoluene	606-20-2	10	330
77. Diethylphthalate	84-66-2	10	330
78. 4-Chlorophenyl Phenyl ether	7005-72-3	10	330
79. Fluorene	86-73-7	10	330
80. 4-Nitroaniline	100-01-6	50	1600
81. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
82. N-nitrosodiphenylamine	86-30-6	10	330
83. 4-Bromophenyl Phenyl ether	101-55-3	10	330
84. Hexachlorobenzene	118-74-1	10	330
85. Pentachlorophenol	87-86-5	50	1600
86. Phenanthrene	85-01-8	10	330
87. Anthracene	120-12-7	10	330
88. Di-n-butylphthalate	84-74-2	10	330
89. Fluoranthene	206-44-0	10	330
90. Benzidine	92-87-5	50	1600
91. Pyrene	129-00-0	10	330
92. Butyl Benzyl Phthalate	85-68-7	10	330
93. 3,3'-Dichlorobenzidine	91-94-1	20	660
94. Benzo(a)anthracene	56-55-3	10	330
95. bis(2-ethylhexyl)phthalate	117-81-7	10	330
96. Chrysene	218-01-9	10	330
97. Di-n-octyl Phthalate	117-84-0	10	330
98. Benzo(b)fluoranthene	205-99-2	10	330
99. Benzo(k)fluoranthene	207-08-9	10	330
100. Benzo(a)pyrene	50-32-8	10	330

Semi-Volatiles	CAS Number	Detection Limits* Low Water[c] ug/L	Low Soil/Sediment[d] ug/Kg
101. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
102. Dibenz(a,h)anthracene	53-70-3	10	330
103. Benzo(g,h,i)perylene	191-24-2	10	330

[c]Medium Water Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 100 times the individual Low Water CRDL.

[d]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 60 times the individual Low Soil/Sediment CRDL.

Pesticides	CAS Number	Detection Limits* Low Water[e] ug/L	Low Soil/Sediment[f] ug/Kg
104. alpha-BHC	319-84-6	0.05	2.0
105. beta-BHC	319-85-7	0.05	2.0
106. delta-BHC	319-86-8	0.05	2.0
107. gamma-BHC (Lindane)	58-89-9	0.05	2.0
108. Heptachlor	76-44-8	0.05	2.0
109. Aldrin	309-00-2	0.05	2.0
110. Heptachlor Epoxide	1024-57-3	0.05	2.0
111. Endosulfan I	959-98-8	0.05	2.0
112. Dieldrin	60-57-1	0.10	4.0
113. 4,4'-DDE	72-55-9	0.10	4.0
114. Endrin	72-20-8	0.10	4.0
115. Endosulfan II	33213-65-9	0.10	4.0
116. 4,4'-DDD	72-54-8	0.10	4.0
117. Endrin Aldehyde	7421-93-4	0.10	4.0
118. Endosulfan Sulfate	1031-07-8	0.10	4.0
119. 4,4'-DDT	50-29-3	0.10	4.0
120. Endrin Ketone	53494-70-5	0.10	4.0
121. Methoxychlor	72-43-5	0.5	20.0
122. Chlordane	57-74-9	0.5	20.0
123. Toxaphene	8001-35-2	1.0	40.0
124. AROCLOR-1016	12674-11-2	0.5	20.0
125. AROCLOR-1221	11104-28-2	0.5	20.0
126. AROCLOR-1232	11141-16-5	0.5	20.0
127. AROCLOR-1242	53469-21-9	0.5	20.0
128. AROCLOR-1248	12672-29-6	0.5	20.0
129. AROCLOR-1254	11097-69-1	1.0	40.0
130. AROCLOR-1260	11096-82-5	1.0	40.0

[e]Medium Water Contract Required Detection Limits (CRDL) for Pesticide HSL Compounds are 100 times the individual Low Water CRDL.

[f]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Pesticide HSL compounds are 60 times the individual Low Soil/Sediment CRDL.

*Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

** Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

RECOMMENDED WAVELENGTHS[2] AND ESTIMATED INSTRUMENTAL DETECTION LIMITS

Element	Wavelength, nm[1]	Estimated Detection Limit, ug/L[2]
Aluminum	308.215	45
Antimony	206.833	32
Arsenic	193.696	53
Barium	455.403	2
Beryllium	313.042	0.3
Boron	249.773	5
Cadmium	226.502	4
Calcium	317.933	10
Chromium	267.716	7
Cobalt	228.616	7
Copper	324.754	6
Iron	259.940	7
Lead	220.353	42
Magnesium	279.079	30
Manganese	257.610	2
Molybdenum	202.030	8
Nickel	231.604	15
Potassium	766.491	see[3]
Selenium	196.026	75
Silica (SiO_2)	288.158	58
Silver	328.068	7
Sodium	588.995	29
Thallium	190.864	40
Vanadium	292.402	8
Zinc	213.856	2

(1) The wavelengths listed are recommended because of their sensitivity and overall acceptance. Other wavelength may be substituted if they can provide the needed sensitivity and are treated with the same corrective techniques for spectral interference. (See 5.1.1). The use of alternate wavelengths must be reported (in nm) with the sample data.

(2) The estimated instrumental detection limits as shown are taken from "Inductively Coupled Plasma-Atomic Emission Spectroscopy-Prominent Lines," EPA-600/4-79-017. They are given as a guide for an instrumental limit. The actual method detection limits are sample dependent and may vary as the sample matrix varies.

(3) Highly dependent on operating conditions and plasma position.

ESTIMATED DETECTION LIMITS FOR RADIOLOGICAL ANALYSES

Analyses	Estimated Detection Limit
Aqueous Matrix	
Tritium	200 pCi/l
Plutonium 239	0.05 pCi/l
Americium 241	0.05 pCi/l
Uranium 233 234	0.05 pCi/l
Uranium 238	0.05 pCi/l
gross alpha	3.0 pCi/l
gross beta	3.0 pCi/l
* * * * * * * *	
Soil Matrix	
Tritium	200 pCi/l
Plutonium 239	0.05 pCi/l
Americium 241	0.05 pCi/l
Uranium 233 234	0.05 pCi/l
Uranium 238	0.05 pCi/l
gross alpha	3.0 pCi/l
gross beta	3.0 pCi/l

Groundwater Radiochemistry Results

for Regulated Units at Rocky Flats Plant

Well Number	Field Sample Number	Date Sampled	Qtr.	Americium 241	Cesium 137	Tritium
West Spray Field Bedrock Wells						
5286	52-86-05-13-87	05/13/87	1	0.0 +/- 2.1 pc/l	NR	150 pc/l
5286	52-86-06-18-87	06/18/87	2	0.0 +/- 1.2 pci/l	NR	<110 pci/l
5286	52-86-08-19-87	08/19/87	3	NR	NR	<459 pci/l
5286	52-86-10-02-86	10/02/86		NA	NA	NA
5286	52-86-10-02-87	10/02/87		-0.021 +/- 0.036 pci/l	NR	NR
5286	52-86D-10-02-87	10/02/87	4	0.003 +/- 0.039 pci/l	NR	NR
5286	52-86-10-02-87	10/02/87	4	0.00 +/- .02 pci/l	NR	500 pci/l
5286	52-86-02-08-88	02/08/88	1	NR	NR	<210 pci/l
4886	48-86-06-18-87	06/18/87	2	0.0 +/- 1.2 pci/l	NR	110 pci/l
4886	48-86-08-25-87	08/25/87	3	.03 +/- .37 pci/l	NR	526 pci/l
4886	48-86-04-08-87	04/08/87	1	0.0 +/- 2.3 pci/l	NR	310 pci/l
4886	48-86-12-14-87	12/14/87	4	0.00 +/- 4.3 pci/l	NR	220 pci/l
4686	G468611B60	11/13/86		NA	NA	NA
4686	46-86-05-14-87	05/14/87	1	0.0 +/- 1.4 pc/l	NR	<110 pc/l
4686	46-86-06-22-87	06/22/87	2	0.0 +/- 1.2 pci/l	NR	110 pci/l
4686	46-86-08-14-87	08/14/87	3	-.04 +/- .38 pci/l	NR	526 pci/l
4686	46-86-10-05-87	10/05/87		NA	NA	NA
4686	46-86-10-06-87	10/06/87	4	-0.020 +/- 0.037 pci/l	NR	NR
4686	46-86-10-05-87	10/05/87	4	.24 +/- .71 pci/l	NR	460 pci/l
4686	46-86-02-12-88	02/12/88	1	0.00 +/- 0.30 pci/l	NR	<210 pci/l

Notes: NR = Analyte not reported
NA = Insufficient water in well for analysis

APPENDIX B

HAZARDOUS SUBSTANCE SAMPLES

Packing, Marking, Labelling & Shipping

APPENDIX B

HAZARDOUS SUBSTANCE SAMPLES

Packaging, Marking, Labeling & Shipping

I. INTRODUCTION

Samples collected during incident response operations may have to be transported elsewhere for analysis. The transportation of samples must be accomplished not only in a manner designed to protect the integrity of the sample, but also to prevent any detrimental effects from the potentially hazardous nature of the samples. Regulations for packaging, marking, labeling and shipping of hazardous materials, hazardous substances and hazardous wastes are promulgated by the U.S. Department of Transportation (DOT) and described in the Code of Federal Regulations (49 CFR 171 through 177, in particular, 172.402h, packages containing samples). In general, these regulations were not intended to cover the shipment of samples collected at controlled or uncontrolled hazardous waste sites or samples collected at emergency responses. However, the U.S. Environmental Protection Agency has deemed it prudent to package, mark, label and ship samples observing DOT procedures. The information contained in this training outline is for general guidance and, although factual, should not be misconstrued as identical to DOT regulations for transportation of hazardous materials.

II. ENVIRONMENTAL SAMPLES VERSUS HAZARDOUS SUBSTANCE SAMPLES

Samples collected at an incident should be classified as either environmental or hazardous substances (or wastes) samples. In general, environmental samples are collected off-site, such as water samples from streams, ponds or wells, and are not expected to be grossly contaminated with high levels of toxic substances. On-site samples of soil or water, samples from drums or bulk storage tanks, obviously contaminated ponds, lagoons, pools, leachates from hazardous waste sites, etc., are considered to be hazardous substances. A distinction between the two types of samples, environmental and hazardous, must be made for two major reasons. One, to determine the appropriate procedures for the transportation of the samples. Secondly, to protect the health and safety of the laboratory personnel receiving the samples. Special precautions, procedures and secondary containment areas within laboratories are used when samples other than environmental samples are received. If there is any doubt as to the classification of a sample, it should be considered a hazardous sample and shipped accordingly.

III. ENVIRONMENTAL SAMPLES

Samples judged to be environmental are not considered hazardous materials; however, environmental samples will be packaged and shipped according to the following procedures.

A. Packing

1. Environmental samples can be packaged following the procedures for samples classified as "flammable liquids" or "flammable solids." See section V.A. 1-5. Marking, labeling, and shipping papers do not apply.

2. Environmental samples can also be packaged without being placed inside metal cans as required for "flammable liquids".

   a. Sample containers properly identified and with a sealed lid, in sealed polyethylene bags, can be packed in fiberboard containers or metal picnic cooler-type containers. Sufficient incombustible, absorbent cushioning material must be used to minimize the possibility of sample container breakage.

   b. To further reduce the possibility of leakage, if a sample container and the sample bottles and absorbent material placed in the larger bag which is also sealed.

B. Marking & Labeling

1. Sample containers must have a completed sample identification tag.

2. Outside container should be marked "Environmental Sample".

3. No DOT marking and labeling is required.

C. Shipping Papers

1. No DOT shipping papers are required.

D. Transportation

1. No DOT restrictions on mode of transportation.

IV. HAZARDOUS SUBSTANCE SAMPLES - RATIONALE

Samples not determined to be environmental samples or samples known or expected to contain hazardous materials must be considered hazardous substance samples and transported according to the following requirements. If the material in the sample is known or can be identified, then it should be packaged, marked, labeled and shipped according to the specific instructions for that material (if listed) found in the DOT Hazardous Materials Table, 49 CFR 172.101. For those samples of hazardous substances where the contents are unknown, the selection of the appropriate transportation category is based upon the DOT Hazardous Materials Classification, a prioritized system of transportation categories.

A. DOT Hazardous Material Classification (173.2)

1. Radioactive Material
2. Poison 'A'
3. Flammable Gas
4. Non-Flammable Gas
5. Flammable Liquid
6. Oxidizer
7. Flammable Solid
8. Corrosive Material (liquid)
9. Poison 'B'
10. Corrosive Material (solid)
11. Irritating Material
12. Combustible Liquid (in containers having capacities exceeding 110 gal)
13. ORM-B
14. ORM-A
15. Combustible Liquid (in containers having capacities of 110 gal or less)
16. ORM-E

B. The selection of the correct category for an unknown sample is through a process of elimination, utilizing the DOT classification system.

1. Unless known or demonstrated otherwise (through the use of radiation survey instruments), the sample is considered radioactive and appropriate shipping regulations for radioactive material followed.

2. If radioactive material is eliminated, the sample is considered to contain Poison 'A' materials, the next material on the list. Poison 'A' is defined by DOT as extremely dangerous poisonous gases or liquids of such a nature that a very small amount of gas, or vapor of the liquid, mixed with air is dangerous to life.

3. The class 'A' poisons listed in 49 CFR 172.101 and their physical state at normal temperatures are:

arsine	gas
bromoacetone	liquid
chloropicrin & methyl chloride mixture	gas
chloropicrin & non-flammable, non-liquified compressed gas mixture	gas
cyanogen chloride	gas at temperature greater than 13.1 degrees Centigrade
cyanogen gas	gas
gas identification set	
gelatin dynamite (H.E. Germaine)	-
grenade (with poison 'A' gas charge)	-
hexaethyl tetraphosphate and compressed gas mixture	gas
hydrocyanic acid (prussic) solution	liquid
hydrocyanic acid, lfquified	gas
insecticide liquified gas, containing poison 'A' or poison 'B' material	gas
methyldichloroarsine	liquid
nitric oxide	gas
nitrogen peroxide	gas
nitrogen tetroxide	gas
nitrogen dioxide, liquid	gas
parathion & compressed gas mixture	gas
phosgene (diphosgene)	liquid

Many of the poison 'A' materials are gases or compressed gases and would not be found in drum type containers. The liquid poison 'A's would probably be found in closed containers only. All samples taken from closed drums do not have to be shipped as poison 'A's, which provides a "worst case" situation. Based upon the information available, a judgement must be made as to the hazard class of the sample.

4. If poison 'A' is eliminated as a shipment category, the next two classifications are "flammable" or "non-flammable" gases. Since few gas samples are collected, flammable liquids would be the next applicable category. The elimination of the classification of radioactive, poison 'A', flammable gas, and non-flammable gas which require more stringent shipping procedures, then permits the sample to be classified as flammable liquid (or solid) and shipped accordingly. The shipping requirements for flammable liquids would also suffice for shipping any other samples classified below flammable liquids on the DOT classification schedule.

5. For samples containing unknown material, other categories listed below flammable liquids/solids on the table, are generally not considered because:

   a. Eliminating other substances as flammable liquids requires flashpoint testing which is impractical and possibly dangerous at a site.

   b. Unless it is demonstrated that the sample consists of material listed below flammable liquid on the table, it is to be considered a flammable liquid (or solid) and shipped as such.

V. SAMPLES CLASSIFIED AS FLAMMABLE LIQUIDS OR FLAMMABLE SOLIDS - PROCEDURES

A. Packaging

1. Collect sample in a glass container with non-metallic, teflon-lined screw cap. Allow sufficient ullage (approximately 10% by volume) so that the container is not liquid-full at 130 degrees Fahrenheit. If an air space in the inner most container cannot be tolerated in order to maintain sample integrity, place it within a second container to provide the required ullage.

2. Attach properly completed sample identification tag to sample container.

3. Seal sample container closure and place in 2-mil thick (or thicker) polyethylene bag, one sample per bag. The sample identification tag should be positioned to enable it to be read through the bag.

4. Place sealed bag inside an appropriate sized metal can with enough incombustible, absorbent, cushioning material (e.g. vermiculite or diatomaceous earth) to prevent breakage and absorb liquid; one bag per can. Pressure close the can and use clips, tape or other positive means to hold the lid securely, tightly, and effectively.

5. Place one or more metal cans (or single 1-gallon bottle) surrounded with incombustible, absorbing packaging material for stability during transport into a strong outside container, such as a metal picnic cooler or inside an approved fiber-board box.

B. Marking and Labeling

1. Use abbreviations only where specified. Place the following information on the metal can (or 1 gallon bottle), either hand printed or in label form.

   Laboratory Name and Address
   "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325". Not otherwise specified (n.o.s.) is not used if the flammable liquid (or solid) is identified. In that cases, the name of the specific material is used and listed before the category (i.e. "Flammable Liquid", etc.).

2. Place the following DOT labels on the outside of the can (or bottle).

   "Flammable Liquid" or "Flammable Solid". The "Dangerous When Wet" label must be used with the "Flammable Solid" label if the material meets the definition of a water reactive material. The "Cargo Aircraft Only" label must be used if the net quantity of the sample in each package is greater than one quart (for "Flammable Liquid", n.o.s.) or 25 lbs. (for "Flammable Solid", n.o.s.). (172.402, 172.101)

3. If the cans are placed in an exterior container, both that container and inside can (or bottle) must have the same markings and labels as above.

   The words: "This End Up" or "This Side Up" must be clearly printed on the top of the outer package. Upward pointing arrows should be placed on the sides of package. The words: "Laboratory Samples" should also be printed on the top of the package.

C. Shipping Papers

1. Use abbreviations only where specified below. Complete the carrier-provided bill of lading and sign the certification statement (if the carrier does not provide, use standard industry form) with the following information in the order listed. One form may be used for more than one exterior container.

   "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325"; "Limited Quantity" (or "Ltd. Qty."); net weight or net volume (abbreviations of weight or volume are acceptable). Further descriptions such as "Laboratory Samples" or "Cargo Aircraft Only" (if applicable) are allowed if they do not contradict the required information.

   The net weight or net volume must be placed just before or just after the "Flammable Liquid, n.o.s." or "Flammable Solid, n.o.s." description.

2. A chain-of-custody record, properly executed, must be included in the exterior container if samples are collected for legal evidence or if there is an expectation that at some future date they may be needed as evidence.

D. Tranportation

1. Unknown hazardous substance samples classified as flammable liquids may be transported by rented or common carrier truck, but, railroad, or by Federal Express Corporation, but they should not be transported by any other common carrier air transport, even "cargo only" aircraft. (DOT regulations permit "cargo only" aircraft such as TWA, United, etc.; however, difficulties with regular airlines transportation suggests avoiding these types of transportation.)

   These EPA procedures are designed to enable air cargo shipment by entities like Federal Express; however, they should not be construed as an endorsement by EPA of a particular commercial carrier.

2. If samples are transported by any type of government-owned vehicle, including aircraft, DOT regulations are not applicable. However, EPA personnel will use the packaging procedures described, except the bill of lading with a certification, does not have to be executed.

E. Other Considerations

1. The size of the sample to be collected should be ascertained by the analytical laboratory.

2. Use of sample preservatives or packaging in ice should be determined by the analytical laboratory.

3. Using "flammable" does not convey the certain knowledge that a sample is in fact flammable, or how flammable, but is intended to prescribe the class of packaging in order to follow DOT regulations.

4. EPA employees will accompany shipping containers to the transport carrier and if required, open outside container(s) for inspection.

5. For overnight shipments, weight restrictions should be determined. Federal Express, for instance is 70 pounds or less.

VI. SAMPLES CLASSIFIED AS POISON 'A' - PROCEDURES

A. Packaging

1. Collect samples in a polyethylene or glass container which is of an outer diameter narrower than the valve hole on a DOT Spec. #3A1800 or #3AA1800 metal cylinder. Fill sample container allowing sufficient ullage (approximately 10% by volume) so it will not be liquid-full at 130 degrees Fahrenheit. Seal sample container.

2. Attach a properly collected sample identification tag to sample container.

3. With a string or flexible wire attached to the neck of the sample container, lower it into a metal cylinder which has been partially filled with incombustible, absorbent loose packaging material (vermiculite or earth). Allow sufficient absorbing material between the bottom and sides of the container and the metal cylinder to prevent breakage and absorb leakage. After the cylinder is filled with cushioning material, drop the ends of the string or wire into the cylinder valve hole. Only one sample may be placed in a metal cylinder.

4. Replace valve, torque to 250 feet/pound (for 1 inch opening) and replace valve protector on metal cylinder, using teflon tape.

5. One or more cylinders may be placed in a DOT approved outside container.

B. Marking & Labeling

1. Use abbreviations only where specified. Place the following information on the side of the cylinder, or on a tag wired to the cylinder valve protector, either handprinted or in label form.

   "Poisonous Liquid, n.o.s." or "Poisonous Gas, n.o.s. NA9035", laboratory name and address, and place the following DOT label on the cylinder - "Poisonous Gas" (even if the sample is liquid).

2. If the metal cylinders are placed in an outside container, both the container and cylinders inside must have the same markings and labels as above. In addition, "Laboratory Sample" and "Inside Packages Comply With Prescribed Specifications" should be marked on the top and/or front side of the outside container. "THIS SIDE UP" marking must be placed on the topside of the container, and upward pointing arrows on all 4 sides.

C. Shipping Papers

1. Complete the shipper-provided bill of lading and sign the certification statement (if the carrier does not provide, use standard industry form) with the following information in the order listed. One form may be used for more than one exterior container. Use abbreviations only as specified.

   "Poisonous Liquid, n.o.s. NA9035", "Limited Quality" or "Ltd. Qty.", net weight or net volume. The net weight or net volume must be placed just before or just after the "Poisonous Liquid, n.o.s." marking.

2. A chain-of-custody record form should also be properly executed and included in the container or with the cylinder, if legal use of samples is required or anticipated.

3. Unless samples are driven to the laboratory, an EPA employee will accompany shipping container to the transport carrier and if required, open outside container for freight inspection.

4. Using the word "poisonous"does not convey the certain knowledge that a sample is in fact poisonous, or how poisonous, but is intended to describe the class of packaging in order to comply with DOT regulations.

D. Transportation

1. Poison 'A' categorized packages may not be transported by Federal Express Corporation (air cargo) or other common carrier aircraft, or by rental, non-government aircraft. Samples may be shipped by ground transport or government-owned aircraft.

VII. SAMPLE IDENTIFICATION

The sample tag is the means by which the sample is identified and the pertinent, necessary information recorded about the sample. The sample card should be legibly written and completed in full with an indelible pencil or pen. Information about the sample should also be recorded in a log book. The tag should be firmly affixed to the sample container. The minimum information on the identification card should include:

1. Exact location of the sample.
2. Time and date that sample was collected.
3. Name of sampler and witnesses, if necessary.
4. Project codes, sample station number, and identifying code, if applicable.
5. Type of sample, if known.
6. Hazardous substances or environmental sample.
7. Tag number (if sequential tag system is used).
8. Laboratory number (if applicable).
9. Any other pertinent information about sample.

U.S. Department of Transportation

Research and Special Programs Administration

GUIDE FOR
HAZARDOUS MATERIALS SHIPPING PAPERS

The following information has been abstracted from the Code of Federal Regulations, Title 49, Parts 100-177

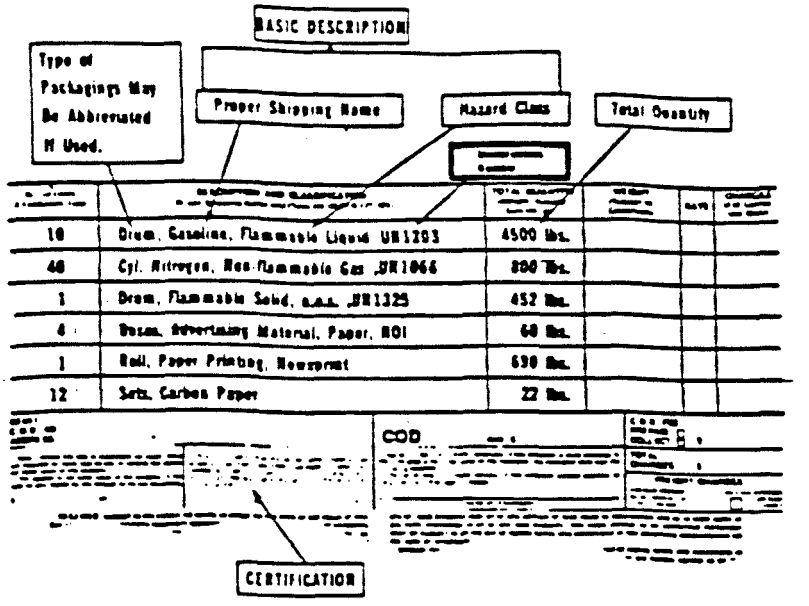
1. DEFINITIONS
   A. SHIPPING PAPER (Sec. 171.8) A shipping paper may be a shipping order, bill of lading, manifest, or other shipping document serving a similar purpose containing the information required by Sec. 172.202, 172.203 and 172.204.

   B. HAZARDOUS WASTE MANIFEST (CFR, Title 40, Sec. 262.20) A hazardous waste manifest is a document (shipping paper) on which all hazardous waste is identified. A copy of the manifest must accompany each shipment of waste from the point of pick-up to the destination (CFR, Title 49, Sec. 172.205)

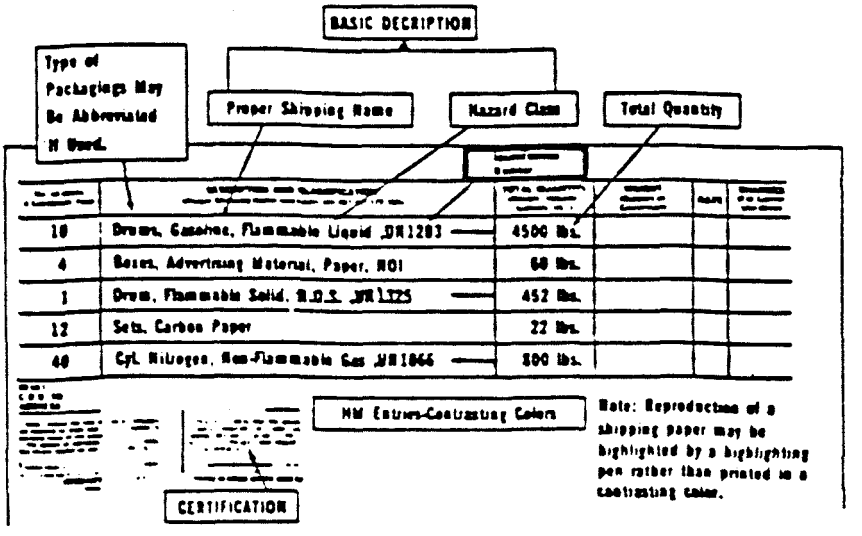
2. SHIPPERS RESPONSIBILITY [Sec. 172.200(a)] The shipper has the responsibility to properly prepare the shipping paper when offering a hazardous material for transport.
   NOTE: For shipments of hazardous waste, the hazardous waste manifest is the only authorized documentation. (CFR, Title 40, Sec. 262.23)

3. HAZARDOUS MATERIALS DESCRIPTION (Sec. 172.202) The shipping description of a hazardous material on a shipping paper must include the following information:
   A. Proper shipping name- Sec. 172.101 or Sec. 172.102 (when authorized);
   B. The hazard class prescribed for the material in the same section; [See exceptions Sec. 172.202(a)(2)]
   C. The identification number for the material (preceded by "UN" or "NA" as appropriate); and
   D. Except for empty packagings, the total quantity (by weight, volume, or as otherwise appropriate) of the hazardous materials covered by the description.
   E. Except as otherwise provided in the regulations, the basic description in 3A, B and C above must be shown in sequence. For example "Acetone, Flammable Liquid, UN1090."
   F. The total quantity of the material covered by one description must appear before or after (or both before and after) the basic description as indicated in 3A, B and C above.
      (1) Abbreviations may be used to specify the type of packaging, weight or volume. Example: "40 Cyl. Nitrogen Nonflammable gas UN 1066, 800 pounds"; "1 box Cement liquid, n.o.s., Flammable liquid, NA1133, 25 lbs."
      (2) Type of packaging and destination marks may be entered in any appropriate manner before or after the basic description.
   G. Technical and chemical group names may be entered in parentheses between the proper shipping name and hazard class. Example: Corrosive liquid, n.o.s. (capryrl chloride), corrosive material.

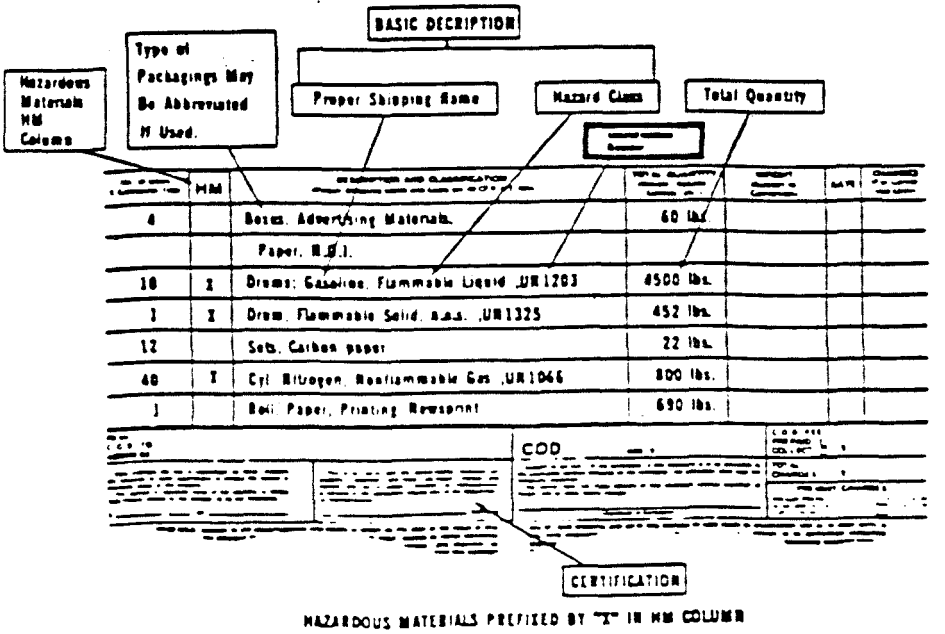
4. GENERAL ENTRIES ON SHIPPING PAPERS (Sec. 172.201)
   A. CONTENTS When describing a hazardous material on the shipping paper(s), that description must conform to the following requirements:
      (1) When a hazardous material, including materials not subject to the regulations, is described on the same shipping paper, the hazardous material description entries required by Sec. 172.202 and those additional entries that may be required by Sec. 172.203.
         a. Must be entered first (See Figure 1), or
         b. Must be entered in a contrasting color, except that a description on a reproduction of a shipping paper may be highlighted, rather than printed, in a contrasting color (these requirements apply only to the basic description required by Sec. 172.202(a)(1), (2) and (3), (See Figure 1); or
         c. Must be identified by the entry "X" placed before the proper shipping name in a column captioned "HM" [the "X" may be replaced by "RQ" (Reportable Quantity), if appropriate] See Figure 1.
      (2) The required shipping description on a shipping paper and all copies that are used for transportation purposes must be legible and printed (manually or mechanically) in English.
      (3) Unless it is specifically authorized or required, the required shipping description may not contain any code or abbreviation.



HAZARDOUS MATERIALS ENTRIES LISTED FIRST



HAZARDOUS MATERIALS ENTRIES-CONTRASTING COLOR



HAZARDOUS MATERIALS PREFIXED BY "X" IN HM COLUMN

FIGURE 1. HAZARDOUS MATERIALS LISTED ON SHIPPING PAPERS

(4) A shipping paper may contain additional information concerning the material provided the information is not inconsistent with the required description. Unless otherwise permitted or required, additional information must be placed after the basic description required by Sec. 172.202(a).

a. When appropriate, the entries "IMCO" or "IMCO Class" may be entered immediately before or immediately following the class entry in the basic description.

b. If a material meets the definition of more than one hazard class, the additional hazard class or classes may be entered after the hazard class in the basic description.

B. NAME OF SHIPPER A shipping paper for a shipment by water must contain the name of the shipper.

5. ADDITIONAL DESCRIPTION REQUIREMENTS (Sec. 172.203) (ALL MODES)

A. Exemptions - Each shipping paper issued in connection with a shipment made under an exemption must bear the notation "DOT-E" followed by the exemption number assigned (Example: DOT-E 4648) and so located that the exemption number is clearly associated with the description to which the exemption applies.

B. Limited Quantities - Descriptions for materials defined as "Limited Quantities"...must include the words "Limited Quantities" or "Ltd. Qty." following the basic description.

C. Hazardous Substances

(1) If the proper shipping name for a mixture or solution that is a hazardous substance does not identify the constituents making it a hazardous substance, the name or names of such constituents shall be entered in association with the basic description.

(2) The letters "RQ" (Reportable Quantity) shall be entered on the shipping paper either before or after the basic description required by Sec. 172.202 for each hazardous substance. (See definition Sec. 171.8) Example: RQ, Cresol, Corrosive Material, NA2076; or Adipic Acid, ORM-E, NA9077, RQ.

D. Radioactive Materials - For additional description for radioactive materials, refer to Sec. 172.203(d).

E. Empty Packagings

(1) Except for a tank car, or any packaging that still contains a hazardous substance, the description on the shipping paper for an empty packaging containing the residue of a hazardous material may include the word(s) "EMPTY" or "EMPTY: Last Contained (Name of Substance)" as appropriate in association with the basic description of the hazardous material last contained in the packaging.

(2) For empty tank cars, see Sec. 174.25(c).

(3) If a packaging, including a tank car, contains a residue that is a hazardous substance the description on the shipping paper shall be prefaced with the phrase "EMPTY: Last Contained (Name of Substance)" and shall have "RQ" entered before or after the basic description.

F. Dangerous When Wet - The words "Dangerous When Wet" shall be entered on the shipping paper in association with the basic description when a package covered by the basic description is required to be labeled with a "DANGEROUS WHEN WET" label.

G. Poisonous Materials - Notwithstanding the class to which a material is assigned:

(1) If the name of the compound or principal constituent that causes the material to meet the definition of a poison is not included in the proper shipping name for the material, the name of that compound or constituent shall be entered on the shipping paper in association with the shipping description for the material.

(2) The name of the compound or principal constituent may be either a technical name or any name for the material that is listed in the NIOSH Registry. (Registry of Toxic Effects of Chemical Substances, 1978 Edition) [Sec. 172.203(k)]

NOTE: For additional details, see Sec. 172.203(k)

H. Exceptions: OTHER REGULATED MATERIAL (ORM - A, B, C, AND D)

(1) Shipping paper requirements do not apply to any material other than a hazardous waste or a hazardous substance that is:

a. An ORM-A, B or C unless it is offered or intended for transportation by air or water when it is subject to the regulations pertaining to transportation by air or water as specified in Sec. 172.101 (Hazardous Materials Table); or

b. An ORM-D unless it is offered or intended for transportation by air.

MODAL REQUIREMENTS
(ADDITIONAL INFORMATION)

NOTE: In addition to the basic requirements for shipping papers, additional information is listed for each mode.

TRANSPORTATION BY RAIL

SHIPPING PAPERS (Sec. 174.24)

(1) Except as provided in paragraph (b) of this section, no person may accept for transportation by rail any hazardous material which is subject to this subchapter unless he has received a shipping paper prepared in a manner specified in Sec. 172.200. In addition, the shipping paper must include a certificate, if required by Sec. 172.204. However, no member of the train crew of a train transporting the hazardous material is required to have a shippers certificate on the shipping paper in his possession if the original shipping paper containing the certificate is in the originating carriers possession.

(2) This subpart does not apply to materials classed as ORM-A, B, C or D.

B. ADDITIONAL DESCRIPTION FOR SHIPPING PAPERS [Sec. 172.203(g)]

(1) The shipping paper for a rail car containing a hazardous material must contain the notation "Placarded" followed by the name of the placard required for the rail car.

(2) The shipping paper for each specification DOT 112A or 114A tank car (without head shields) containing a flammable compressed gas must contain the notation "DOT 112A" or "DOT 114A", as appropriate, and either "Must be handled in accordance with FRA E.O. No. 5" or "Shove to rest per E.O. No. 5."

NOTE: For additional details, refer to Part 174.

2. TRANSPORTATION BY AIR

A. SHIPPING PAPERS ABOARD AIRCRAFT (Sec. 175.35) A copy of the shipping papers required by Sec. 175.30(a)(2) must accompany the shipment it covers during transportation aboard an aircraft.

NOTE: The documents required (shipping papers and notification of pilot-in-command) may be combined into one document if it is given to the pilot-in-command before departure of the aircraft. [Sec. 175.35(b)].

B. NOTIFICATION OF PILOT-IN-COMMAND (Sec. 175.33) The operator of the aircraft shall give the pilot-in-command the following information in writing before takeoff (Sec. 175.35):

(1) Description of hazardous material on shipping papers (Sec. 172.202 and 172.203);

(2) Location of the hazardous material in the aircraft; and

(3) The results of the inspection requirements by Sec. 175.30(b).

NOTE: For additional details, refer to Part 175.

3. TRANSPORTATION BY WATER

A. SHIPPING PAPERS (Sec. 176.24) A carrier may not transport a hazardous material by vessel unless the material is properly described on the shipping paper in the manner prescribed in Part 172.

B. CERTIFICATE (Sec. 176.27)

(1) A carrier may not transport a hazardous material by vessel unless he has received a certificate prepared in accordance with Sec. 172.204.

(2) In the case of an import or export shipment of hazardous materials which will not be transported by rail, highway, or air, the shipper may certify on the bill of lading or other shipping paper that the hazardous material is properly classed, described, marked, packaged and labeled according to Part 172 or in accordance with the requirements of the IMCO Code. (See Sec. 171.12)

C. DANGEROUS CARGO MANIFEST (Sec. 176.30) The master of a vessel transporting hazardous materials or his authorized representative shall prepare a dangerous cargo manifest, list, or stowage plan. This document may not include a material which is not subject to the requirements of CFR, Title 49, or the IMCO Code. This document must be kept in a designated holder on or near the vessel's bridge. (See Sec. 176.30 for details)

D. EXEMPTIONS (Sec. 176.31) If a hazardous material is being transported by vessel under the authority of an exemption and a copy of the exemption is required to be on board the vessel, it must be kept with the dangerous cargo manifest.

NOTE: For additional details, refer to Part 176.

E. ADDITIONAL DESCRIPTION FOR SHIPPING PAPERS [Sec. 172.203(i)]

(1) Each shipment by water must have the following additional shipping paper entries:

a. Indentification of the type of packages such as barrels, drums, cylinders, and boxes,

b. The number of each type of packages including those in freight container or on a pallet, and

c. The gross weight of each type of package or the individual gross weight of each package.

(2) The shipping papers for a hazardous material offered for transportation by water to any country outside the United States must have in parenthesis the technical name of the material following the proper shipping name when the material is described by a "n.o.s." entry in Sec. 172.101 (Hazardous Materials Table). For example: Corrosive liquid, n.o.s. (caprylyl chloride), Corrosive material. However, for a mixture, only the technical name of any hazardous material giving the mixture its hazardous properties must be identified.

9. TRANSPORTATION BY HIGHWAY

A. SHIPPING PAPERS (Sec. 177.817)

(1) General - A carrier may not transport a hazardous material unless it is accompanied by a shipping paper that is prepared in accordance with Sec. 172.201, 172.202 and 172.203.

(2) Shipper's certification - An initial carrier may not accept hazardous materials offered for transportation unless the shipping paper describing the material includes a shipper's certification which meets the requirements in Sec. 172.204 of thi subchapter. The certification is not required for shipments to be transported entirely by private carriage and for bulk shipments to be transported in a cargo tank supplied by the carrier. [Sec. 177.817(c)]

(3) Interlining with carriers by rail - A motor carrier shall mark on the shipping paper required by this section, if it offers or delivers a freight container or transport vehicle to a rail carrier for further transportation: [Sec. 177.817(c)]

a. A description of the freight container or transport vehicle; and

b. The kind of placard affixed to the freight container or transport vehicle.

(4) This subpart does not apply to materials classed as an ORM-A, B, C or D.

(5) Accessibility of shipping papers: The driver and each carrier using the vehicle shall ensure that the shipping paper is readily available and recognizable by authorities in the case of an accident or inspection. [See Sec. 177.817(e) for details]

B. ADDITIONAL DESCRIPTION FOR SHIPPING PAPERS [Sec. 172.203(h)] For additional descriptions for Anhydrous ammonia see Sec. 172.203(h)(1); Liquefied petroleum gas see Sec. 172.203(h)(2) and Exemptions see Sec. 172.203(a).

10. SHIPPER'S CERTIFICATION (Sec. 172.204)

A. GENERAL (Except B and D below)

(1) Except as provided in paragraphs (b) and (c) of Sec. 172.204, each person who offers a hazardous material for transportation shall certify that the material offered for transportation is in accordance with the regulations by printing (manually or mechanically) the following statement on the shipping paper containing the required description:

> This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.*

NOTE: The works "herein-named" may be substituted for the words "above named".

*NOTE: For hazardous waste shipments, the words "and the EPA" must be added to the end of the certification. [See CFR, Title 40, Sec. 262.21(b)]

B. AIR TRANSPORTATION

(1) General - Certification containing the following language may be used in place of the certification required by paragraph A(1) above:

> I hereby certify that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled, and in proper condition for carriage by air according to applicable national governmental regulations.

(2) Duplicate Certificate - Each person who offers a hazardous material to an aircraft operator for transportation by air shall provide two (2) copies of the certificate. (Sec. 175.30)

(3) Passenger and Cargo Aircraft - If hazardous materials are offered for transportation by air, add to the certificate the following statement:

> This shipment is within the limitations prescribed for passenger/cargo-only aircraft. (delete non-applicable)

(4) Radioactive Material - Each person who offers any radioactive material for transportation aboard a passenger-carrying aircraft shall sign (mechanically or manually) a printed certificate stating that the shipment contains radioactive material intended for use in, or incident to, research, medical diagnosis or treatment. NOTE: See Sec. 175.10 for exceptions.

C. SIGNATURE - The certifications required above must be legibly signed (mechanically or manually) by a principal, officer, partner or employee of the shipper or his agent. [Sec. 172.204(d)]

D. EXCEPTIONS - Except for a hazardous waste, no certification is required for hazardous material offered for transportation by motor vehicle and transported:

(1) In a cargo tank supplied by the carrier, or

(2) By the shipper as a private carrier except for a hazardous material that is to be reshipped or transferred from one carrier to another.

(3) No certification is required for the return of an empty tank car which previously contained a hazardous material and which has not been cleaned or purged.

HAZARDOUS WASTE MANIFEST INFORMATION

The following information has been abstracted from the Code of Federal Regulations (CFR), Title 49, Parts 100-177 and CFR, Title 40, Part 262.

1. DEFINITIONS

A. HAZARDOUS WASTE MANIFEST (CFR Title 40, §262.20)
A hazardous waste manifest is a shipping document on which all hazardous wastes are identified.

B. SHIPPING PAPER - A shipping order, bill of lading, manifest, or other shipping document serving a similar purpose and containing the information required by §172.202, §172.203 and §172.204.

2. DOT HAZARDOUS MATERIALS MANIFEST REQUIREMENTS (§172.205)

A. No person may offer, transport, transfer or deliver a hazardous waste unless a hazardous waste manifest is prepared, signed, carried and given as required of that person by §172.205.

B. The shipper (generator) must prepare the manifest in accordance with the EPA Regulations, CFR Title 40, Part 262.

C. The original copy of the manifest must be dated by, and bear the handwritten signature of the person representing the:

(1) Shipper (generator) of waste at the time it is offered for transportation, and

(2) Initial carrier accepting the waste for transportation.

D. A copy of the manifest must be dated by, and bear the handwritten signature of the person representing:

(1) Each subsequent carrier accepting the waste for transportation, at the time of acceptance, and

(2) The designated facility receiving the waste, upon receipt.

E. A copy of the manifest bearing all required dates and signatures must be:
   (1) Given to a person representing each carrier accepting the waste for transportation,
   (2) Carried during transportation in the same manner as required for shipping papers,
   (3) Given to a person representing the designated facility receiving the waste,
   (4) Returned to the shipper (generator) by the carrier that transported the waste from the United States to a foreign destination with a notation of the date of departure from the United States, and
   (5) Retained by the shipper (generator) and by the initial and each subsequent carrier for three (3) years from the date the waste was accepted by the initial carrier. Each retained copy must bear all required signatures and dates up to and including those entered by the next person who received the waste.

F. The requirements of §172.205(d) and (3) do not apply to a rail carrier when waste is delivered to a designated facility by railroad if:
   (1) All of the information required to be entered on the manifest (except generator and carrier identification numbers and the generator's certification) is entered on the shipping paper carried in accordance with §174.26(c);
   (2) The delivering rail carrier obtains and retains a receipt for the waste that is dated by and bears the handwritten signature of the person representing the designated facility; and
   (3) A copy of the shipping paper is retained for three (3) years by each railroad transporting the waste.

G. The person delivering a hazardous waste to an initial rail carrier shall send a copy of the manifest, dated and signed by a representative of the rail carrier, to the person representing the designated facility.

H. A hazardous waste manifest required by CFR, Title 40, Part 262 containing all the information required by CFR, Title 49, Subpart C, may be used as the shipping paper.

3. THE MANIFEST-GENERAL REQUIREMENTS (§262.20)

A. A generator (shipper) who transports, or offers for transportation, hazardous waste for off-site treatment, storage, or disposal must prepare a manifest before transporting the waste off-site.

B. A generator (shipper) must designate on the manifest one facility which is permitted to handle the waste described on the manifest.

C. A generator (shipper) may also designate on the manifest one alternate facility which is permitted to handle his waste in the event an emergency prevents delivery of the waste to the primary designated facility.

D. If the transporter (carrier) is unable to deliver the waste to the designated facility, the generator must either designate another facility or instruct the transporter to return the waste.

4. MANIFEST INFORMATION (§262.21)

A. The manifest must contain:
   (1) Manifest document number;
   (2) Generator's (Shipper's) name, mailing address, telephone number, and the EPA identification number;
   (3) Name and EPA identification number of each transporter (carrier);
   (4) Name, address and EPA identification number of the designated facility and an alternate facility, if any;
   (5) Description of the waste(s) (e.g. proper shipping name required by the Department of Transportation Hazardous Materials Regulations CFR, Title 49, §172.101, §172.202 and §172.203); and
   (6) Total quantity of each hazardous waste by units of weight or volume, and the type and number of containers loaded into or onto the transport vehicle.

B. Certification [§262.21(b)] The following certification must appear on the manifest: "This is to certify that the above named materials are properly classified, described, packaged, marked, labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the EPA"

5. COPIES OF MANIFEST REQUIRED (§262.22)
The manifest must consist of at least the number of copies to provide the generator, each transporter and the owner or operator of the designated facility with one copy each for their records and another copy to be returned to the generator.

6. USE OF THE MANIFEST (§262.23)
   A. The generator must:
      (1) Sign the manifest certification by hand;
      (2) Obtain the handwritten signature of the initial transporter and date of acceptance of manifest; and
      (3) Retain one copy in accordance with §262.40(a).
   B. The generator must give the transporter the remaining copies of the manifest.
   C. Shipment of hazardous waste within the United States solely by railroad or water (bulk shipments only); the generator must send three (3) copies of the manifest dated and signed in accordance with §262.20 to the owner or operator of the designated facility. NOTE: Copies of the manifest are not required for each transporter. For special provisions for rail or water (bulk shipment) transporters see §263.20(e).

7. PREPARATION OF HAZARDOUS WASTE FOR SHIPMENT (§262.30)
   A. Packaging Hazardous Waste - The generator (shipper) has the responsibility for the classification and packaging of hazardous waste prior to offering for transportation. The requirements for packaging will be found in the Department of Transportation Regulations CFR, Title 49, Parts 172, 173, 178 and 179.
   B. Labeling Requirements (§262.31) - Prior to offering a hazardous waste for transportation off-site, the generator (shipper) must label each package in accordance with CFR Title 49, Part 172, Subpart E.
   C. Marking Requirements (§262.32) - Prior to offering hazardous waste for transportation off-site, the generator must:
      (1) Mark each package of the hazardous waste; and
      (2) Mark each container 110 gallons or less offered for transportation with the following words and information displayed in accordance with the requirements of CFR, Title 49, Sec. 172.304.
         "HAZARDOUS WASTE-Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the United States Environmental Protection Agency"
         Generator's Name and Address _____
         Manifest Document Number _____
   D. Placarding Requirements (§262.33) - Prior to offering a hazardous waste for transportation off-site, the generator must:
      (1) Placard the shipment; or
      (2) Offer the initial transporter (carrier) the appropriate placards. (CFR Title 49, Part 172, Subpart F)

NOTE: This handout is designed as a training aid only. It does not relieve persons from complying with the Department of Transportation's Hazardous Materials Regulations. Final authority for use of shipping papers is found in the Code of Federal Regulations, Title 49, Part 100-177.

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DEPARTMENT OF TRANSPORTATION
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
MATERIALS TRANSPORTATION BUREAU
OFFICE OF OPERATIONS AND ENFORCEMENT
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WASHINGTON, D.C. 20590

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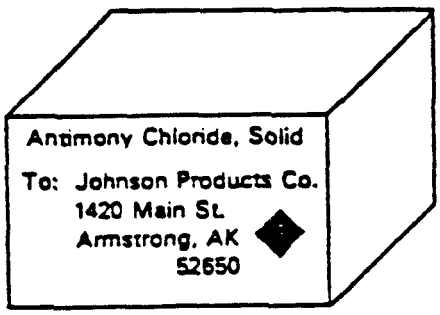
HAZARDOUS MATERIALS TRANSPORTATION
GUIDE FOR MARKINGS

Marking, as addressed in the Hazardous Materials Regulations, refers to application of descriptive information, instructions, cautions, weight, retest dates, or combination thereof on outside packages as required by Title 49, Code of Federal Regulations (49 CFR), Parts 100-199. Marking also means applying the specification marks for both inside and outside containers as required. This definition does not include the requirements for labeling and placarding, as set forth in 49 CFR, Parts 100-199.

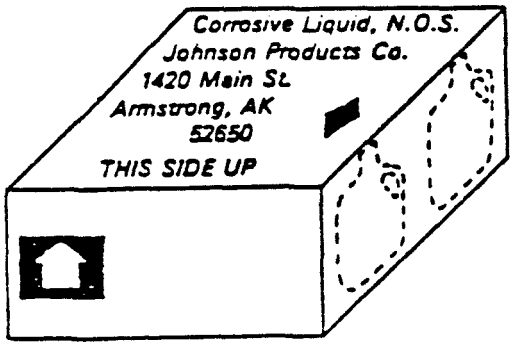
DESCRIPTIVE INFORMATION



- GENERAL (§ 172.300 - § 172.304)

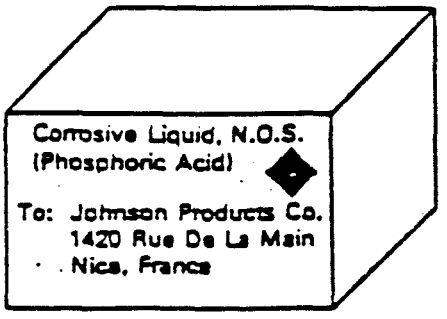
All containers of hazardous materials must, unless specifically excepted, be marked with the proper shipping name of the contents and the name and address of either the consignee or consignor. This marking must be:

1. Durable, in English, and printed on or affixed to the surface of a package or on a label, tag, or sign.
2. In a sharply contrasting color to its background.
3. Unobscured.
4. Away from other markings which will reduce its effectiveness.



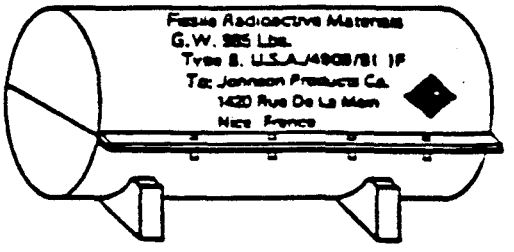
- PACKAGES CONTAINING INSIDE CONTAINERS WHICH HOLD LIQUID HAZARDOUS MATERIALS (§ 172.312)

1. Inside containers must be oriented with closures up.
2. Must be marked on outside "This End Up" or "This Side Up".
3. Arrows other than those which show package orientation must not be used. The use of ANSI standard MH6.11968 "This Way Up" arrows is recommended.



● EXPORT BY WATER (§ 172.302)

All n.o.s. entries must have the technical name of the commodity immediately following the (proper shipping name) for export by water. (For mixtures, only the hazardous materials which give the mixture its hazard need be identified.)



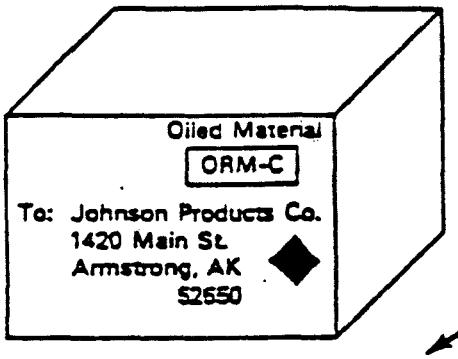
● RADIOACTIVE MATERIALS (§ 172.310)

1. If over 110 lbs. the gross weight must be marked on the container.

2. Must be marked "TYPE A" or "TYPE B" as required in letters at least 1/2" high.

3. For export, the letters USA must follow the specification marking or package certification.

ORM MATERIALS (§ 172.316)



ORM-B KEEP DRY

Example

● ORM materials must be designated immediately following or below the proper shipping name marking within a rectangular border approximately 1/4" larger than the designation. This designation must be one of the following:

1.	ORM-A	4.	ORM-C
2.	ORM-B-Keep Dry	5.	ORM-D
3.	ORM-B	6.	ORM-D-Air

(This marking is the certification, for surface transportation, by the shipper that the materials is properly described, classed, packaged, and labeled and in proper condition for transportation, etc.)

● AUTHORIZED CONTAINERS IN OUTSIDE PACKAGES

When a DOT specification container is required for a commodity and that container is further overpacked in another container meeting the requirements of §§ 173.21 and 173.24, the outside container must be marked in compliance with § 173.25.

- CYLINDERS

All cylinders must be marked in compliance with § 173.34 and § 173.301. Those cylinders having been periodically tested and qualifying for reuse must be marked according to the requirements of § 173.34(e)(6).

- PORTABLE TANKS (§ 172.326)

For portable tanks, the proper shipping name, in letters at least 2" in height, must be displayed on two opposing sides. The name of the owner or lessee must be displayed. The contents of the tank may not be changed and offered for transportation without changing the proper shipping name on the tank. Portable tanks carrying compressed gases (DOT 51) must have all inlets and outlets, except safety relief devices marked to indicate whether they communicate with liquid or vapor (§ 178.245-6(b)).

- CARGO TANKS CONTAINING GASES (§ 172.328(c)(d))

Cargo tanks must be marked, in letters of at least 2" in height, with either the proper shipping name or an appropriate common name, such as "Refrigerant Gas". Each cargo tank made to Specification MC 330 and MC 331 must be marked near the Spec. plate, in letters of at least 2" in height, NQT or QT, as appropriate, to designate whether made with quenched and tempered steel or not. Cargo tanks must only be marked for the material contained therein. DOT MC 331 tanks must have inlets and outlets, except safety relief devices, marked to designate whether they communicate with vapor or liquid when the tank is filled to its maximum allowable filling density (§ 178.337-9(c)).

- TANK CARS (§ 172.330)

Tank cars, when required to be marked with the proper shipping name by Part 173 and 179, must be marked in letters at least 4" in height with at least a 5/8" stroke, with the proper shipping name or appropriate common name such as "Refrigerant Gas". These markings must be on both sides of the tank car and clearly visible from either side. Tank cars must only be marked for the material contained therein. See the referenced section for special application for 106 and 110 tank car tanks.

OTHER MARKING REQUIREMENTS

- REQUALIFIED CONTAINERS

Reusable cylinders, portable tanks, cargo tanks, and tank cars are required to be either visually inspected or retested at periodic intervals. When so inspected or tested, the date of requalification must be shown on the container as stated in §§ 173.24, 173.31, 173.32, 173.33, and 173.34.

- REUSE OF CONTAINERS

Some single trip containers in the DOT 17 Series may be qualified for reuse by a reconditioner registered with the Department of Transportation. These drums must have their old labels, exemption numbers (if any) and descriptive markings removed and must be marked as reconditioned. Specific rules for this removal of markings and re-marking are contained in § 173.28.

- CARGO HEATERS

Cargo heaters authorized for use with flammable liquids must be marked in accordance with § 177.834(1)(2)(i).

- MARKING OF MOTOR VEHICLES

The requirements for marking of motor vehicles is addressed in § 177.823, as well as specific relief in emergency situations from these requirements.

SPECIFICATIONS ON CONTAINERS

The marking of specification containers must generally identify: (1) the specification to which a container is made; and (2) the manufacturers name and address or symbol (registered with the Bureau of Explosives). All containers made to a specification must comply with the marking provisions of § 173.24. Certain exceptions for Canadian and other import/export situations may be found in §§ 171.12 and 173.8. In some cases, specific detailed information, such as original test date information and type of material, may be required by the applicable section of Parts 178 and 179.

Additional marking requirements may be found in Parts 173 and 179, either in general terms or specifically by commodity.

- This publication is intended to be used solely as a guide. It does not include all the required markings required in 49 CFR, Parts 100-199. To assure total compliance, use of the current regulations is required.

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Department of Transportation
Research and Special Programs Administration
Materials Transportation Bureau
Information Services Division (DMT-43)
Washington, D.C. 20590

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APPENDIX C

Shipping of Radioactive Materials

From: THE HEALTH PHYSICS AND RADIOLOGICAL HANDBOOK
Bernard Schleien and Michael S. Terpilak
Nucleon Lectern Associates, Inc., 1984

Shipping of Radioactive Materials

This chapter is intended to be a comprehensive guide to the more prominent and basic regulatory requirements for the safe transportation of radioactive materials. Information is included on the shippers' requirements for limitation of activity content of packages, packaging, labeling, shipping documentation and control of radiation and contamination.

Basic guidance also is included on the handling of transport incidents and emergencies during the transport of radioactive materials.

The tables and illustrations in this chapter are directed toward the practical. The references listed in the bibliography are extensive, and should be consulted for a more detailed discussion of the information in this chapter. A great deal of the basic information contained herein is based on a Federal USDOT training publication which reviews the transport regulations for radioactive material. (Pamphlet "A Review of the DOT Regulations for Transportation of Radioactive Material," Revised Fall 1983)

Table 12.1 Regulatory Organizations And Sources

Statutory authority to regulate safety in the transport of radioactive materials is vested principally in two Federal Agencies -- the U.S. Department of Transportation (DOT) and the U.S. Nuclear Regulatory Commission (NRC). The U.S. Postal Service also has established rules for certain very small mailable quantities of radioactive material. Pursuant to the Transportation Safety Act of 1974 ("Transportation Safety Act of 1974", as amended, Public Law 93-633, 88 Stat. 2156, 49 USC 1808, Jan. 3, 1975) and earlier legislation, (The Department of Transportation Act of October 15, 1967, Public Law 89.670 Stat. 937, 49 USC 1657) the DOT is the Federal agency charged with the overall responsibility to regulate shippers and carriers of all types of hazardous materials in interstate and foreign commerce. Under its authority of the Atomic Energy Act of 1954 ("The Atomic Energy Act of 1954," as amended, Public Law 83-703, 68 Stat. 919, 42-USC Chapter 23) and the Energy Reorganization Act of 1974 ("Energy Reorganization Act of 1974," as amended, 42 USC 5841), the NRC regulates the use, possession and transfer (including transportation) of licensed byproduct, source and special nuclear material.

In certain Agreement States*, the state regulates the use, possession and intra-state transportation of byproduct and source materials licensed by the state. Common and contract carriers however are exempted from licensing to the extent that they possess, transport or store licensed material delivered by a licensee for transport. Because of the overlapping and duplicative authority to regulate transport of radioactive materials, the NRC and DOT have accomplished a written Memorandum of Understanding, ("Transportation of Radioactive Materials; Memorandum of Understanding", Federal Register, (44 FR 38690), July 2, 1979), intended to avoid duplicative effort and conflicts.

Table 12.1. Sources of Federal Regulations
Transportation of Radioactive Materials

Title 49 Department of Transportation's Hazardous Materials Regulations, (49 CFR Part 100-77 "Hazardous Regulations" of the US Department of Transportation, Revised as of Oct. 1)
Parts 100-177 and 178-179.

Main Headings

49 CFR 106 - Rulemaking Procedures
49 CFR 107 - Hazardous Materials Program Procedures
49 CFR 171 - General Information, Regulations and Definitions

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*States which have entered into an agreement with the NRC pursuant to Section 274 of the Atomic Energy Act of 1954, as amended, under which the NRC has relinquished to such States the majority of its regulatory authority over source, byproduct, and special nuclear materials in quantities not sufficient to form a critical mass.

Table 12.1. Sources of Federal Regulations Transportation of Radioactive Materials (continued)

49 CFR 172	- Hazardous Materials Table and Hazardous Materials Communications Regulations
49 CFR 173	- Shippers-General Requirements for Shipments and Packagings
49 CFR 174	- Carriage by Rail
49 CFR 175	- Carriage by Aircraft
49 CFR 176	- Carriage by Vessel
49 CFR 177	- Carriage by Public Highway
49 CFR 178	- Shipping Container Specifications

Title 10 U.S. Nuclear Regulatory Commission (10 CFR Part 71, "Packaging and Transportation of Radioactive Material." Revised annually as of January 1)

10 CFR 71 - Packaging and Transportation of Radioactive Material

Title 39 Postal Service (US Postal Service Publication No. 6, Dec. 1975 "Radioactive Material, as amended by US Postal Bulletin, June 30, 1983, pages 2-5.)

Domestic Mail Manual, U.S. Postal Service Regulations, Part 124. (Postal Regulations for Transport of Radioactive Matter are published in U.S. Postal Service Publication #6, December 1975 and in the U.S. Postal Manual and in the U.S. Postal Manual.)

Table 12.2 Definition of Radioactive Material

For purposes of transportation, radioactive materials having a specific activity not exceeding two nanocuries per gram (0.002 μCi/gm) are not subject to regulation in transportation. This is, however, a "de minimus" level which applies only to transportation. For purposes of licensing during use and possession, such materials may still be subject to regulation by NRC or an Agreement State.

Safety during the transport of radioactive material is achieved principally by the use of proper packaging, considering the type, quantity and form of the material, and by limitation of the level of radiation from the material. Much less reliance is placed on operational or carriers controls. In establishing the proper type of packaging and activity content limitation within the package, the following factors must therefore be considered:

a. the type of material, e.g., the radionuclide;
b. the quantity of radioactivity; and
c. the form of the material, e.g., whether in:
    1. Special form; or
    2. Normal (non-special) form.

Special Form and Normal Forms of radioactive material are illustrated in Figure 12.1.

Table 12.3 Quantity Limits and Packaging

After considering the type, quantity, and form of the radioactive material, the appropriate packaging and limitationof the activity content of such packaging can then be established. Packaging types generally fall within one of the following broad types:

Type A (Figure 12.2)
Type B (Figure 12.2)
Excepted or exempt
Strong Tight

Table 12.4 A_1/A_2 System for Limiting Package Activity Content

Prior to July 1983, the regulations utilized a "transport group" system to establish activity content limits of packages. Under the old system, each radionuclide was assigned to one of seven transport groups. The activity limit of that material in normal form was the limit for the group, which was based on the most radioactive member of the group. For special form materials, the Type A limit was the same for all nuclides -- 20 curies. After the A_1/A_2 system each radionuclide is assigned an A_1 and A_2 value. The A limit, based on external radiation considerations is the type A limit for that nuclide in special form. The A_2 limit, based on radiotoxicity, is its limit in Type A packaging, when in normal form. The A_1/A_2 values are used to derive limits for excepted (limited) quantities, radioactive articles (devices), and low specific activity (LSA) materials. Quantities exceeding A_1 or A_2 are Type B. The table below lists typical A_1/A_2 limits for several common nuclides.

Table 12.4 Examples of A_1/A_2 Limits

Symbol of Radionuclide	Element and Element Number	A_1 (Ci) (Special Form)	A_2 (Ci) (Normal Form)
^{14}C	Carbon (6)	1000	60
^{137}Cs	Cesium (55)	30	10
^{99}Mo	Molybdenum (42)	100	20
^{235}U	Uranium (92)	100	0.2
^{226}Ra	Radium (88)	10	0.05
^{201}Pb	Lead (82)	20	20
^{239}Pu	Plutonium (94)	2	0.002
^{35}S	Sulfur (16)	1000	60
^{60}Co	Cobalt (27)	7	7
^{90}Sr	Strontium (38)	10	0.4
^{241}Am	Americium (95)	8	0.008
^{192}Ir	Iridium (77)	20	10

Table 12.5 Types of Packaging

Figure 12.2 is an illustration of "Typical Type A Packaging Schemes." Type A packaging is that which must be designed in accordance with the applicable general packaging requirements as prescribed in the regulations (Sections 173.24, 173.411, 173.412), and which must be adequate to prevent the loss or dispersal of its radioactive contents and to maintain its radiation shielding properties if the package is subjected to normal conditions of transport. The regulations prescribe (Section 173.465) the performance criteria to simulate normal and rough handling conditions of transport. Typically, the Type A packaging prescribed in the regulations is the performance-based DOT Spec. 7A (Section 178.350) Type A general packaging for which each shipper must make his own assessment and certification of the particular package design against the performance requirements. The regulatory framework, therefore, provides for the use of Type A packaging without prior specific approval by DOT of the package designs via the use of DOT Spec. 7A performance specifications. Additionally, foreign-made Type A packages are acceptable internationally, provided they are so marked as Type A and comply with the requirements of the country of origin. It should be noted that the shipper of each DOT Spec. 7A is required to maintain on file for at least one year after the latest shipment, and be prepared to provide to DOT a complete certification and supporting safety analysis demonstrating that the construction methods, packaging design, and materials of construction are in compliance with the specification (see Section 173.415). The information in this file must show, through any of the methods given in Section 173.461, that all the requirements of Sections 173.24, 173.463 and 173.465 are met. The file must also relate the contents of the package(s) being shipped to the contents which were used for testing purposes.

Except for a limited number of specification Type B packagings (e.g., DOT-6M) described in the DOT regulations, all Type B package designs require PRIOR APPROVAL of the U.S. Nuclear Regulatory Commission or Department of Energy (DOE). (See Section 173.471 for standard requirements and conditions pertaining to NRC approved packages and Section 173.7 for DOE certified packages.)

"Type B Packages," "Highway Route Controlled Quantities," and "Fissile Radioactive Materials" present more unusual and specific problems for packaging and carrier's operational controls. These materials are additionally controlled by the specific packaging standards as promulgated by the Nuclear Regulatory Commission in Title 10 CFR Part 71. Operational and administrative requirements for "highway route controlled quantities" (formerly called "large quantities") are prescribed in 173.403 and 177.825.

Type B Packaging (see Figure 12.2), must meet the general packaging requirements and all of the performance standards for Type A packages. In addition, it must withstand certain serious accident damage test conditions. After the tests, there must be only limited loss of shielding capability and essentially no loss of containment. The performance criteria which the package designer must use to assess Type B packaging against these empirically established accident damage test conditions of transport are prescribed in the Nuclear Regulatory Commission regulations (10 CFR 71.73) and include the following:

1. A 30-foot free drop onto an unyielding surface.

2. A puncture test which is a free drop (over 40 inches) onto a six-inch diameter steel pin.

3. Thermal exposure at 1,475°F for 30 minutes.

4. Water immersion at 3 ft. depth for eight hours (for fissile materials packaging only).

5. Water immersion at 50 ft. for eight hours.

Table 12.6 Limited Quantities, Instruments and Articles

The A_1 and A_2 values are also used as a basis for defining the package quantity limits for limited quantities and both the item and package limits for radioactive instruments and articles, as illustrated below. Packages containing materials within these quantity limits are excepted from some of the requirements which apply to Type A packages. These exceptions include not having to provide specification packaging, shipping papers, certification, marking or labeling. However, there are a number of conditions which the limited quantity, instrument or article must meet. They include:

1. Activity limits per package and, if appropriate, per instrument or article;

2. The materials must be packed in strong, tight packages that will not leak ANY of the radioactive material during conditions normally incident to transportation;

3. The radiation level at any point on the external surface of the package cannot exceed 0.5 millirem per hour;

4. The external surface of the package must be free of significant removable contamination;

5. For instruments or articles, the radiation level at 4 inches from any point on the surface of the unpackaged instrument or article may not exceed 10 millirem per hour; and

6. A prescribed description of the contents on a document which is in or on the package or forwarded with it.

Table 12.6

Limited Quantities, Instruments and Articles (continued)

Nature of Contents 1/	Instruments and Articles		Materials
	Instrument and article limits 1/	Package limits	Package limits
Solids			
Special form	$10^{-2}A_1$	A_1	$10^{-3}A_1$
Other forms	$10^{-2}A_2$	A_2	$10^{-3}A_2$
Liquids			
Tritiated water			
< 0.1 Ci/liter	-	-	1,000 curies
0.1 Ci to 1.0 Ci/l	-	-	100 curies
> 1.0 Ci/liter	-	-	1 curie
Other liquids	$10^{-3}A_2$	$10^{-1}A_2$	$10^{-4}A_2$
Gases			
Tritium 2/	20 curies	200 curies	20 curies
Special form	$10^{-3}A_1$	$10^{-2}A_1$	$10^{-3}A_1$
Other forms	$10^{-3}A_2$	$10^{-2}A_2$	$10^{-3}A$

1/ For mixture of radionuclides see Section 173.433(b).

2/ These values also apply to tritium in activated luminous paint and tritium absorbed on solid carriers.

Refer to Sections 173.421 through 173.424 for the complete requirements pertaining to these materials.

The U.S. Postal Service has revised its rules (U.S. Postal Service Publication No. 6, Dec. 1975 as amended June 30, 1983.) for mailable radioactive materials. The mailable amounts of material are now (since July 1983) one-tenth the values listed above. Other additional restrictions apply to mailable materials and the Postal Regulations should be consulted for complete specifications.

Table 12.7 Low Specific Activity (LSA) Materials

The levels of radioactive materials packaging and methods of limiting activity contents during transport, as described previously except for the "deminimus" definition of .002 uCi/gm all have one common characteristic, e.g., limitation by total activity content of the package. There is another extremely important transport classification for radioactive materials, e.g., "Low Specific Activity", or "LSA" which is controlled and limited principally on a specific activity, e.g., activity per unit of weight basis. Historically the LSA category was originally developed and premised on a basis of imposing less stringent packaging and shipment requirements on radioactive materials deemed to pose much less risk and were presumably "inherently safe". The categories of LSA have generally included solids, limited either on the specific activity basis or by name, tritiated water and surface contaminated objects. Looking at the most significant of these categories further; i.e., solids:

Solid LSA materials are limited to those in which the activity must be essentially uniformly distributed and in which the estimated average concentration per gram of material does not exceed:

1. 0.0001 millicurie of radionuclides for which the A_2 quantity is not more than 0.005 Curies;
2. 0.005 millicurie of radionuclides, for which the A_2 quantity is more than 0.05 Curies, but not more than 1 curie; or
3. 0.3 millicurie of radionuclides for which the A_2 quantity is more than 1 curie.

In the original derivation of LSA limits for solids in the international regulations, inhalation of dispersed airborne material was considered, and for modeling purposes it was assumed that the airborne materials at a very dusty (10 mg/m^3) concentration was inhaled at the breathing rate of 2 m^3/h for a one-half hour exposure resulting in a 10 mg uptake. Little reliance was placed therefore on packaging requirements per se. More recently, the modeling and assumptions for solid LSA materials have been under extensive reexamination by IAEA as well as DOT/NRC. It is anticipated that in the future proposed changes to LSA requirements will be published, aimed principally at establishing more realistic models so as to control hazards of beta-emitting as well as Gamma-emitting materials. It is likely that future regulations for LSA may include limitations on activity of such materials in packages, as well as more precise packaging prescriptions.

Solid LSA wastes include a very wide range of fuel cycle, industrial and institutional wastes; contributing a major portion of the materials which are transported from waste generator facilities to the commercial low level waste burial sites.

Shipment Requirements for LSA Materials

Under the DOT regulations in 49 CFR, the specific shipment requirements for LSA materials depend upon the type of vehicle involved in the shipment:

o Nonexclusive use shipments - "essentially Type A packages"

The first method, "nonexclusive use" transportation, requires that the material be transported in essentially a Type A package. "Essentially a Type

A" package means a package that must survive the physical tests, such as the drop and compression tests for Type A packages - but which is expected from some of the general Type A requirements. The actual test requirements are found in Section 173.465. Although the packages are excepted from certain design requirements, their integrity must be equal to a Type A.

- Exclusive use - "strong, tight package"

LSA materials which are transported by conveyances assigned for the "exclusive use" of the consignor may be shipped in packages that are of less rigorous construction. Users of the exclusive use provision MUST ENSURE that there will be no loading or unloading of the material except under the direction of the consignee or consignor. The limitation on loading and unloading, plus the requirement that the material be in exclusive use, safely allows the exception from certain packaging test requirements. Exclusive use LSA, therefore, is allowed to be made in the so-called "strong, tight package."

There are no specific test requirements for the strong, tight packages. However, a performance criteria must be met -- there can be no release of radioactive content during transportation and like any other package of hazardous material, the requirements of Section 173.24 must be met. Materials which are consigned as exclusive use LSA shipments MUST have the packages marked "Radioactive LSA." And the vehicle on which they are being transported MUST be placarded with the RADIOACTIVE MATERIAL placard.

Certified Type A Packages for LSA

In general, approval of Type A package designs, by a regulatory agency is not usually required. The shipment of Type A quantities of radioactive material is more frequently made in designs conforming to DOT Specification 7A. This specification is based solely on the performance test requirements of the regulations. Shippers utilizing such packagings are however required to maintain documentation of the results of their safety analyses of the design against the regulatory criteria.

A major exception to the above involves shipments by USNRC licensees of LSA materials in packages wherein the activity exceeds a Type A quantity. Ordinarily, under DOT regulations, LSA materials are not limited only on the basis of specific activity of the material, and not on total package activity. However, due to the provisions of 10 CFR Part 71, the shipment of LSA in packages where the quantity exceeds Type A requires the use of certified Type A packaging. This certification is obtained by submittal of an application which addresses the results of the evaluation of the package against the Type A conditions, e.g., normal conditions of transport. Effectively therefore, Type B quantities of LSA material are required to be in NRC-certified Type A packagings. This exception is extremely important to fuel cycle waste shipment considerations. The NRC has certified several dozen such Type A designs for LSA shipments. These are listed in the NRC Directory of certified packages. (NUREG-0383 "Directory of Certificates of Compliance for Radioactive Material Packagings," revised annually in three volumes). They each are similar in design and appearances to Type B packages (see Figure 12.2), but are not required to be subjected to the Type B tests.

Table 12.8 Fissile Radioactive Materials

In addition to considerations for the radioactivity content, a shipper of radioactive materials which are also fissile, i.e., capable of sustaining a nuclear chain reaction, such as enriched uranium, plutonium, or U-233; must take account in the packaging design certain additional requirements which are intended to ensure against accidental nuclear criticality during transport of the material. These specific criteria and requirements are addressed in DOT and NRC regulations. Again, as in the case of Type B non-fissile package designs, only a few "DOT Specification" packages for fissile radioactive materials are listed in 49 CFR, e.g., DOT-6L, DOT-6M, and DOT 20PF. Other designs which have been specifically approved and certified by NRC are listed in the NRC Directory of Certified Packages. (NUREG-0383 "Directory of Certificates of Compliance for Radioactive Material Packaging," revised annually in three volumes). For purposes of control of nuclear safety during transport, each design is assigned a "fissile Class" number of 1, 2, or 3, which is an indication of the degree of control to be exercised during transport to assure nuclear safety of the shipment. These controls are listed in the Table below.

Table 12.8
Shipment Controls for Fissile Radioactive Materials
(Section 173.455)

1. Fissile Class I - Packages may be transported in unlimited numbers (Transport Index* is based only on external radiation levels).
2. Fissile Class II - Number of packages limited by aggregate maximum of transport indexes of 50 (50 unit rule). No single package may exceed a transport index of 10. Transport index shall be based on criticality or external radiation level basis, whichever is most restrictive.
3. Fissile Class III - Shipments of packages which do not meet the requirements of Fissile Class I or II. Controlled by specific arrangements between the shipper and carrier. (See Section 173.457(b)).

* Exposure rate in mrem/h at three feet from external surface of package.

Table 12.9 Radiation Limits

The regulations set limits on the external radiation on packages and in some cases on the vehicles transporting radioactive materials packages. These limits, which depend upon whether the packages are transported as non-exclusive use (mixed freight) or as exclusive use, are listed below:

Table 12.9 Radiation Level Limits (173.441)

Packages Transported As Non-Exclusive Use:
At Surface: 200 mrem/hour
At 1 meter from package surface: 10 mrem/hr.

Packages Transported As Exclusive Use
At package surface: 1000 mrem/hour (in closed transport vehicle only)
200 mrem/hour (un open vehicle)
At 2 meters (6.6 ft.) from lateral surfaces of vehicle: 10 mrem/hour
In occupied area of vehicle: 2 mrem/hour
At outer surfaces of transport vehicle: 200 mrem/hour.

Table 12.10 Contamination Limits (173.443)

Regulatory limits are also set for the allowable removable surface contamination on packages, as measured on wipe (smear) samples. These limits are listed below:

Table 12.10 Removable External Radioactive Contamination Limits

Removable External Radioactive Contamination Limits

Contaminant	Maximum permissible limits	
	uCi/cm^2	dpm/cm^2
Beta-gamma emitting radionuclides; all radionuclides with half-lives less than ten days; natural uranium; natural thorium; uranium-235; uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical concentrates	10^{-5}	22
All other alpha emitting radionuclides	10^{-6}	2.2

In applying the limits of this table and the assessment of the surface contamination of a package, sufficient measurements (wipes) must be taken in the most appropriate location of a package surface so as to yield a representative assessment of the non-fixed contamination levels. Averaging of wipe samples may be done only within any given 300 cm^2 area that is wiped. For packages transported as exclusive use, the removable contamination should not exceed ten times the levels prescribed here. Each transport vehicle used to transport packages with these higher units must be surveyed after use. Before release for other use, the vehicle must not be returned to service until the non-fixed contamination levels meet the above limits.

Table 12.11 Communications Requirements

The regulations contain a number of "communications" requirements which are intended to convey certain hazard characteristic information to package handlers, carrier personnel, receivers, and the general public. These requirements include warning labels, vehicle placarding, and shipping paper descriptions.

Warning Labels (172.403)

Each package of radioactive material, unless excepted, must be labeled on two opposite sides, with a distinctive warning label. Each of the three label types bears the unique trefoil symbol (Figure 12.3). The label alerts persons that the package contains radioactive materials and that the package may require special handling. A label with an all white background color indicates that the external radiation level is low and no special handling is required. If the upper half of the label is yellow, the package may have an external radiation level or fissile properties requiring consideration during transportation. If the package bears a yellow label with three stripes, the transport vehicle must be placarded RADIOACTIVE. Placarding is discussed in more detail below. The criteria which the shipper must consider in choosing the appropriate label are listed below:

Other package labels are illustrated in figures 12.4 and 12.5.

A vehicle placard is shown in figure 12.6 and its placement illustrated in figure 12.7.

For all labels, vertical bars on each label are in red. Each label is diamond-shaped, four inches on each side, and has a black solid-line border one-fourth inch from the edge. The background color of the upper half (within the black line) is white for the "I" label. It is yellow for the "II" and "III" labels.

Table 12.6
Radioactive Materials Packages Labeling Criteria
Section 172.403

Transport Index[a] (T.I.)	Radiation Level at Package Surface (RL)	Fissile Criteria	Label Category[b]
N/A	RL $\leq$ 0.5 millirem per hour (mrem/h)	Fissile Class I No Fissile Class II or III	White - I
T.I. $\leq$ 1.0	0.5 mrem/h $<$ RL $\leq$ 50	Fissile Class I, Fissile Class II with T.I. $\leq$ 1.0, No Fissile Class III	Yellow - II
1.0 $<$ T.I.	50 mrem/h $<$ RL	Fissile Class II with 1.0 $<$ T.I., Fissile Class III	Yellow - III

[a] Exposure rate in mrem/h at three feet from external surface of package.

[b] Any package containing a "Highway Route Controlled Quantity" (173.403) must be labeled as Radioactive Yellow - III.

Table 12.12 Shipping Papers

Like any shipment of regulated hazardous materials in commerce, each shipment of radioactive material must be accompanied by a properly completed and shipper-certified shipping paper (also known as bill of lading, air bill, cargo manifest, etc.) For limited quantities and excepted radioactive articles, this shipping paper/certificate may be a specially worded notice which may be in or on the package (i.e., packing list), or separately accompanying the shipment. The elements of information which must be included, as applicable, on shipping papers includes:

(1) Proper shipping name from Section 172.101;

(2) Hazard class (see Section 172.202(a)(2)), hazard class from Column 3, Section 172.101, except when the hazard class is contained in the shipping name;

(3) Identification number (see Section 172.202(a)(3) from Column 3A, Section 172.101);

(4) Net quantity of material by weight or volume as stated in Sections 172.202(a)(4) and (c). For <u>most</u> radioactive materials packages, it is not required to list the weight or volume. The requirements of Section 172.203(d) provide better indications of potential hazards and controls required. These requirements include the package contents as measured in curies and the transport index. A listing of weight or volume measurements for radioactive materials is <u>usually</u> needed only for establishing transportation charges;

(5) Radionuclide(s) contained in package (abbreviations are allowed). For a mixture of radionuclides, only those radionuclides which comprise 1% or more of the total activity in the package must be listed;

(6) Physical and chemical form of material, or statement that the material is "special form" (if it is special form). A generic description of material, such as protein, carbohydrate, enzyme, or organic salt, is authorized if exact chemical form is difficult to specify;

(7) Activity in curies (Ci), millicuries (mCi), or microcuries (uCi). If the package contains a "Highway Route Controlled Quantity," those words must also be shown on the shipping papers;

(8) Category of RADIOACTIVE labels applied to package;

(9) Transport index of the package if labeled RADIOACTIVE Yellow-II or RADIOACTIVE Yellow-III;

(10) The information required in Section 172.203(d)(I)(vi) must be included if the shipment is "fissile" radioactive material;

(11) The identification markings shown on the package must appear on the shipping paper if the package is approvied and certified by the Nuclear Regulatory Commission or the Department of Energy, OR is certified by DOT or other National Competent Authority for international shipment.

(12) Other information as required by the mode of transportation or subsidiary hazard of the material. (See Section 172.203).

The regulations require that certain specific descriptive information must be included on shipping papers. While there is no specification for shipping paper format, the first three entries of the description must be in a specific order (see above). Other descriptive information is allowed, such as the functional description of the product. However, other information must not confuse or detract from the required descriptions of the hazardous materials.

Table 12.12
Most Commonly Used Shipping Names for Radioactive Material[a]
(From Hazardous Materials Table, Section 172.101)

Radioactive Material, Limited Quantity, n.o.s.[b]	UN 2910
Radioactive Material, Instruments, <u>and</u> Articles[c]	UN 2911
Radioactive Material, Fissile, n.o.s.	UN 2918
Radioactive Material, Low Specific Activity <u>or</u> LSA, n.o.s.	UN 2912
Radioactive Material, Special Form, n.o.s.	UN 2974
Radioactive Material, n.o.s.	UN 2982
Uranium Hexafluoride, Fissile (<u>Containing more than 1% U-235</u>)	UN 2977
Uranium Hexafluoride, Low Specific Activity	UN 2978

[a]Refer to Section 172.101 for other proper shipping names.

[b]n.o.s. means "not otherwise specified."

[c]Underlined words are not part of the proper shipping name.

Table 12.13. Transportation Accident Radiological Incident Call List

Offices may have different names in your locale; change those below to fit your situation.

Phone: _____
Local law enforcement agency

Phone: _____
State radiological health office/civil defense

Phone: _____ Name: _____
Local medical facility Physician

Phone: _____ Name: _____
Local civil defense or disaster office Civil defense officer

Phone: _____
State Governor's Office

Phone: _____ Name: _____
Mayor's office Mayor

Phone: _____
Local individual known to you to be trained as hazardous materials expert.

	Toll free:	Calls from D.C. area:	Calls outside U.S.:
Phone: CHEMTREC*	800-424-9300	483-7616	202-483-7616

*CHEMTREC is the Chemical Transportation Emergency Center, a public service of the Manufacturing Chemists Association, Washington, D.C. CHEMTREC operates on a 24-hour basis and is designed to deal with chemical transportation emergencies. Note: CHEMTREC is not intended to function as a general information source. For more information, write: Manager, Chemical Transportation Emergency Center, 1825 Connecticut Avenue, N.W., Washington, D.C. 20009.

Phone: (617) 482-8755
NFPA*

*NFPA is the National Fire Protection Association and provides information and training related to handling hazardous materials in emergencies involving fire or the potential for fire. For more information, write: NFPA, 470 Atlantic Avenue, Boston, MA 02210.

Phone: _____ Name: _____
Additional contact*

Phone: _____ Name: _____
Additional contact*

*See Figure 12.8 and 12.9 for DOE and NRC Regional Offices.

Figure 12.1 Forms of Radioactive Materials for Transport
From: A Review of the Department of Transportation (DOT) Regulations For Transportation of Radioactive Material (Summer 1980)

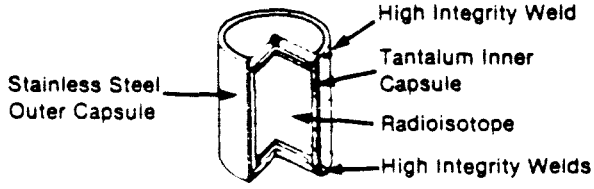
"Special Form" R.A.M. (173.403 (z) and 173.469 (a))

May Present a Direct Radiation Hazard if Released From Package, but Little Hazard Due to Contamination

"Special Form" R.A.M. May Be "Natural" Characteristic, i.e., Massive Solid Metal, or "Acquired" Through High Integrity Encapsulation

Massive
Solid Metal

High Integrity
Encapsulation
as a Sealed Source



Normal Form Radioactive Materials 49 CFR 173.403(s)

Normal Form Materials May Be Solid, Liquid or Gaseous and Include any Material Which Has *Not* Been Qualified as Special Form

Type A Package Limits are A_2 Values

Waste Material in
Plastic Bag

Liquid in Bottle Within
Metal Container

Powder in Glass
or
Plastic Bottle

Gas in Cylinder

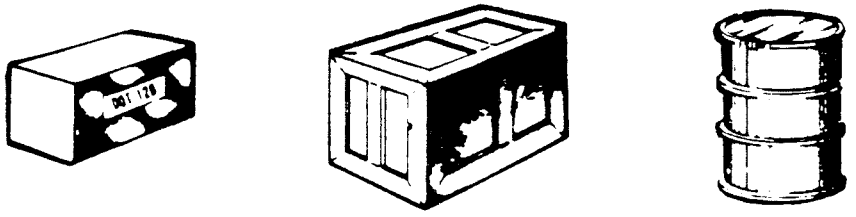
Figure 12.2. Types of Packaging
(From A Review of the Department of Transportation (DOT) Regulations for Transportation of Radioactive Materials (Summer 1980))

Type A

All packaging design is directed at preventing the release of the radioactive contents and damage to the radiation shielding so that a severe radiological hazard will not develop. Because of the smaller quantities of material permitted in Type A packages, accidents that might cause damage to such packages would not be likely to result in serious radiation hazards. Therefore such packaging must only withstand moderate degrees of stress. These include conditions of heat, cold, reduced air pressure, vibration, impact, water, drop, penetration, and compression. The majority of radioactive material shipments are made in Type A packages.

TYPICAL TYPE A PACKAGING

PACKAGE MUST WITHSTAND NORMAL CONDITIONS (173.398(B)) OF TRANSPORT ONLY WITHOUT LOSS OR DISPERSAL OF THE RADIOACTIVE CONTROL CONTENTS.



FIBERBOARD BOX WOODEN BOX STEEL DRUM

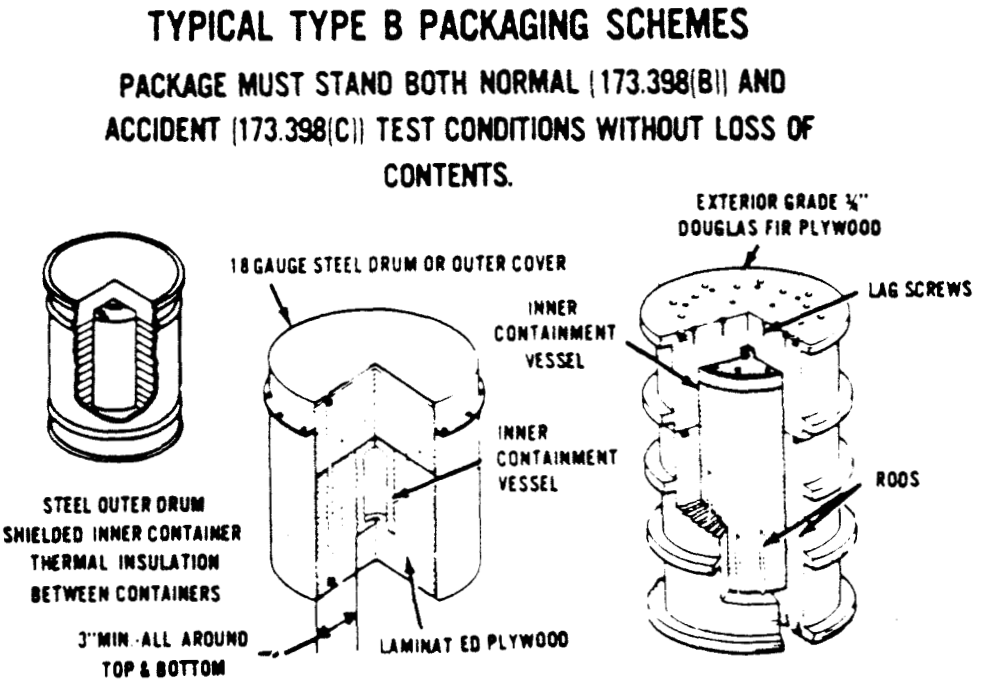
TYPICAL SCHEMES

DOT SPECIFICATION 7A

Figure 12.2 (Continued)

Type B

Type B packages are designed for transport of greater quantities of material. Since the potential for hazard resulting from damage to this type of package would be greater than that from a Type A package, there are additional structural design requirements. In addition to meeting standards for Type A packages, Type B packaging must withstand puncture, drop, thermal, and water immersion stresses that might be experienced under actual or hypothetical transportation accident conditions.



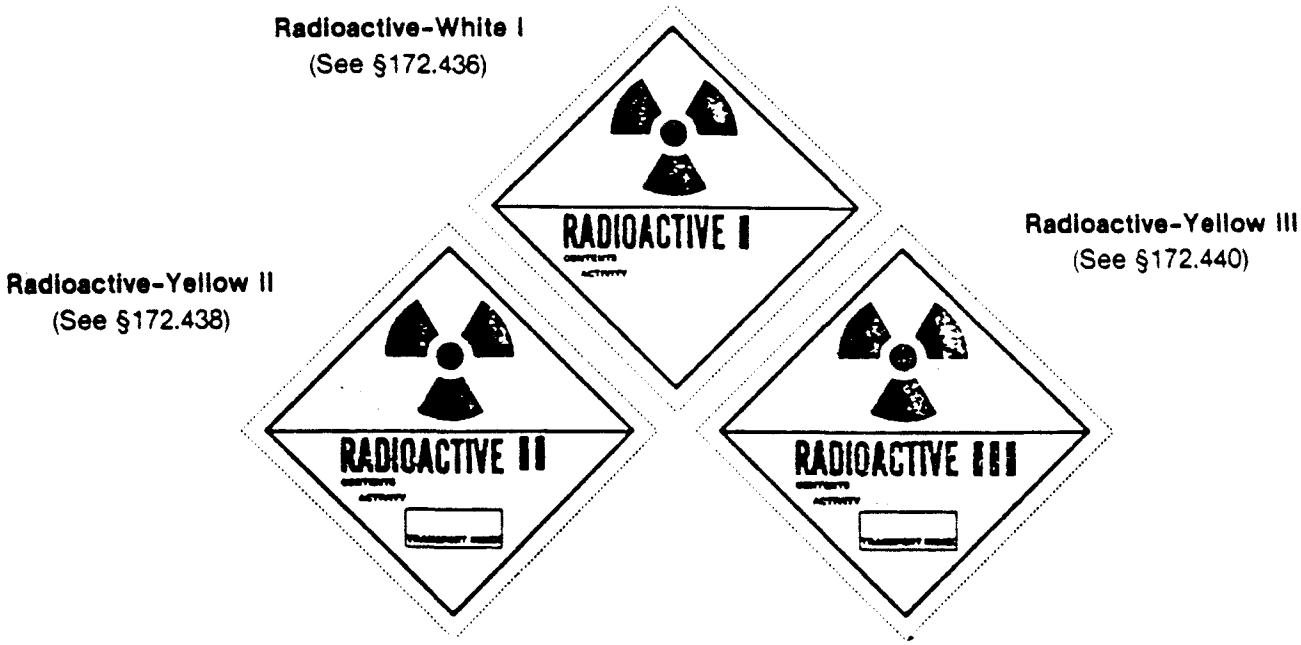
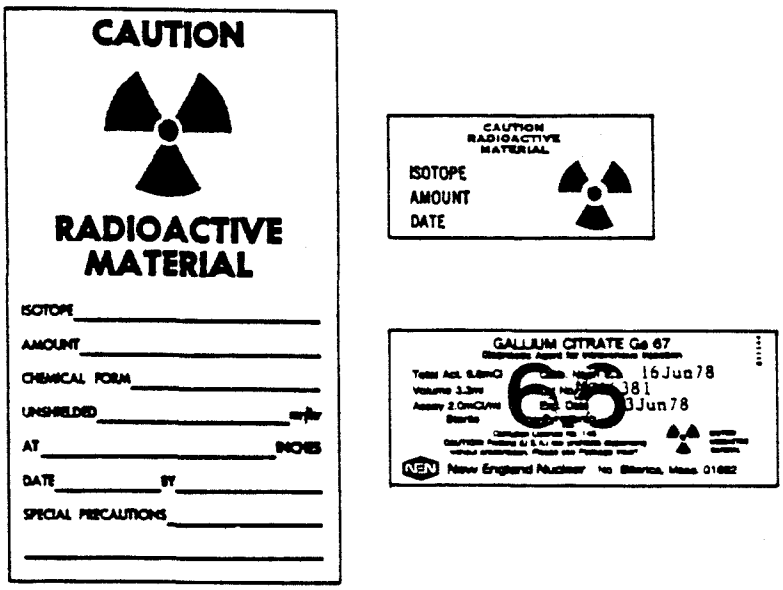


Figure 12.3 Labels Required on Exterior Package

Three different labels are used on packages for radioactive material (see above). The required label is usually determined by the external radiation level or, in some cases, the type and quantity of radionuclide within the package (see Labeling Criteria table). Package labels must specify the radionuclide (contents) and quantity (curies). In addition, Yellow II and Yellow III labels contain the transport index, which is equal to the maximum radiation level at 3 feet from the package or, for packages containing fissile material, the degree of nuclear safety control required.

Figure 12.4 Radioactive Material Warning Labels
(From DOT/RSPA/MTB-79/8)

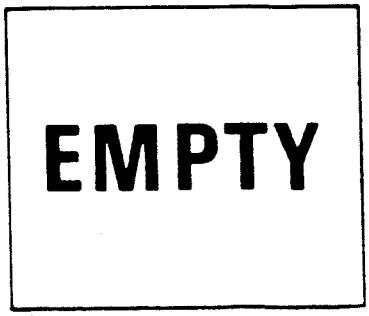
All packages of radioactive material, with the exception of those containing Limited Quantities or Low-Specific-Activity materials (which would present no severe hazard if involved in an accident), must bear two identifying warning labels affixed to opposite sides of the outer package. Limited shipments do not require outer package labeling; however, they, like all shipments of radioactive material, must have standard yellow and magenta radiation warning labels on the inner containers.



Warning Labels

Figure 12.5 Empty Label
(From DOT/RSPA/MTB-79/8)

Reusable shipping containers are frequently transported in an empty, but possibly internally contaminated condition. When in transit, these containers must bear the EMPTY label shown below. There is minimal hazard from containers displaying this label.



Typical label required to indicate empty shipping container.

Figure 12.6 Vehicle Warning Placards
(From DOT/RSPA/MTB-79/8)

Placards

The carrier must apply the RADIOACTIVE placard to the transport vehicle (rail or highway) if ANY radioactive material package on board bears a "Radioactive YELLOW-III" label (Section 172.440). The format for the placard is illustrated in Figure 12.7. The requirements for placarding are in Section 172.504 and Table 1 footnotes of that Section.

Figure 12.6

(The background color for the black trefoil in the upper half of this 12" x 12" placard is yellow.)

Vehicles transporting ANY package which contains a highway route controlled quantity must display the above placard upon the square white background with black border as specified in Section 172.507.

For shipments of LSA materials in exclusive-use vehicles, the shipper is required to placard the transport vehicle, even though the packages of LSA within the vehicle are excepted from labeling requirements.

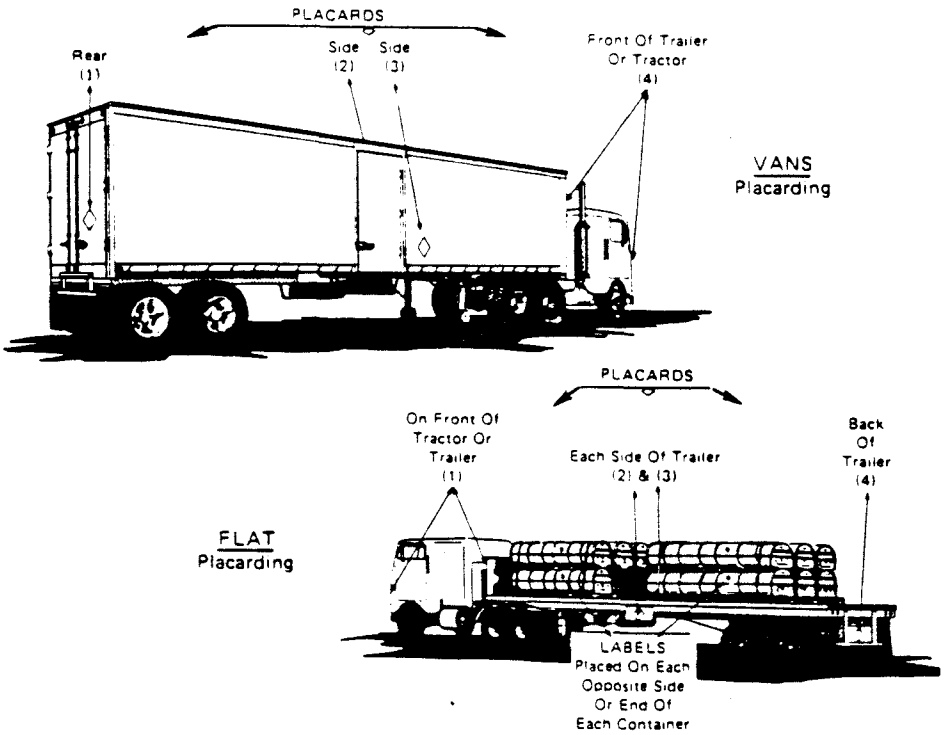
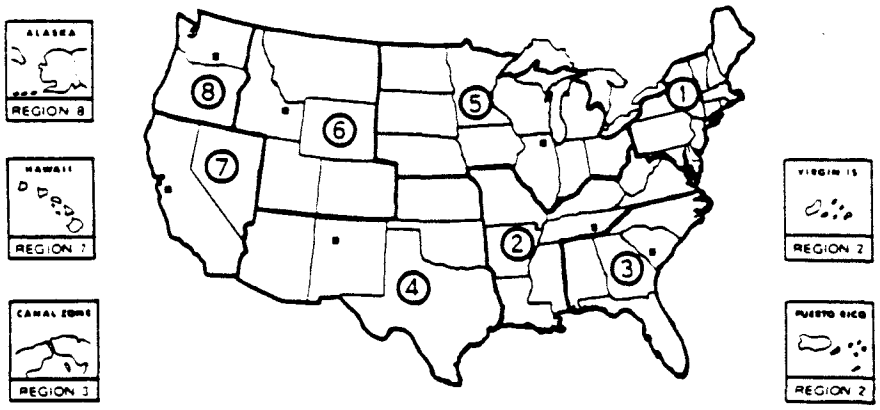


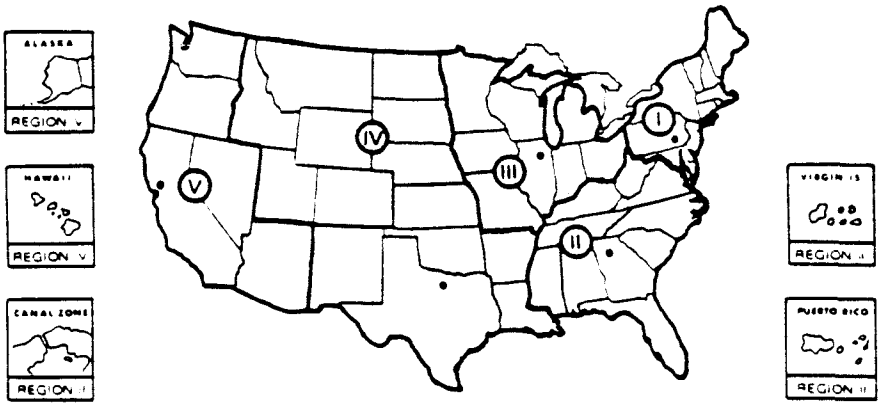
Figure 12.7 Diagrammatic representation of placard location on vans and flatbed trucks (From DOT/RSPA/MTB-81/4)

Figure 12.7 is a guide to placement of placards on motor vehicles. Where placards are impractical, i.e., on aircraft or water vessels, they are not required to be displayed.



Regional Coordinating Office	Post Office Address	Telephone
1 Brookhaven Area Office	Upton, L.I., New York 11973	(516) 345-2200
2 Oak Ridge Operations Office	P.O. Box E, Oak Ridge, Tennessee 37830	(615) 576-1005 or (615) 525-7885
3 Savannah River Operations Office	P.O. Box A, Aiken, S.C. 29801	(803) 725-3333
4 Albuquerque Operations Office	P.O. Box 5400, Albuquerque, N. M. 87115	(505) 264-4667
5 Chicago Operations Office	9800 S. Cass Ave., Argonne, Illinois 60439	(312) 972-4800 Off Duty Hrs. (312) 972-5731
6 Idaho Operations Office	P.O. Box 2108, Idaho Falls, Idaho 83401	(208) 526-1515
7 San Francisco Operations Office	1333 Broadway, Oakland, California 94612	(415) 273-4237
8 Richland Operations Office	P.O. Box 550, Richland, Washington 99352	(509) 942-7381

Figure 12.8 Department of Energy regional coordinating offices for radiological assistance and geographical areas of responsibility.



Address	Telephone Daytime	Telephone Nights/Holidays
Region I, Office of Inspection and Enforcement, USNRC 631 Park Avenue, King of Prussia, Pennsylvania 19406	(215) 337-1150	(215) 337-1150
Region II, Office of Inspection and Enforcement, USNRC 230 Peachtree Street, N.W., Suite 818, Atlanta, GA 30303	(404) 526-4503	(404) 526-4503
Region III, Office of Inspection and Enforcement, USNRC 799 Roosevelt Road, Glen Ellyn, Illinois 60137	(312) 858-2660	(312) 858-2660
Region IV, Office of Inspection and Enforcement, USNRC 611 Ryan Plaza Drive, Suite 1000, Arlington, Texas 76012	(817) 334-2841	(817) 334-2841
Region V, Office of Inspection and Enforcement, USNRC 1990 N. California Blvd., Suite 202, Walnut Creek Plaza Walnut Creek, California 94596	(415) 486-3141	(415) 486-3141

Figure 12.9 United States Nuclear Regulatory Commission regional offices.

APPENDIX D

HEALTH & SAFETY PLAN

[redacted]

WESTON

WORK LOCATION PERSONNEL PROTECTION AND SAFETY EVALUATION FORM

Attach Pertinent Documents/Data

Fill in Blanks As Appropriate

WO # 2029-13-02-0034

Division DCMD

Office Denver, Colorado

Prepared by Bill Somers/Mark Selman

Date 2/24/86

Reviewed by _____

Date _____

Approved by _____

Date _____

A. Work Location Description

1. Name U.S.D.O.E. ROCKY FLATS PLANT

2. Location Jefferson County, Colorado

3. Type: HW Site (X) Industrial (X)

Spill ( ) Construction ( )

(X) Existing WESTON Work Location

(X) Existing Client Work Location

Other ( ) Describe _____

4. Status existing plutonium, uranium processing facility, government owned

5. Anticipated activities: soil sampling at the spray irrigation area and water sampling of Solar Pond 207 B-North and interceptor trench Pump House

6. Size plant buildings occupy 384 acres: total plant area is eleven square mil

7. Surrounding Population no immediate population within 2 mile radius

8. Buildings/Homes/Industry approximately 102 structures exist on the plant site consisting of manufacturing, chemical processing, plutonium recovery, waste treatment, storage and administrative facilities.

9. Topography majority of plant site exhibits flat topography; maximum of 10% slope near manufacturing facilities

10. Anticipated Weather clear, cold and dry

11. Unusual Features

12. Site History see attached sheet

B. Hazard Description

1. Background Review: Complete ( ) Partial (X)

If partial, why? no ambient air monitoring for organic vapors

2. Hazard Level: A ( ) B ( )

Unknown ( ) C (X) D ( )

Justification attached sheets (see section 8)

3. Types of Hazards: (Attach additional sheets as necessary)

A. Chemical ( ) Inhalation (X) Explosive ( )

Biological ( ) Ingestion (X) O_2 Def. ( )

Skin Contact (X) Toxic ( )

Describe attached sheets (see section 8)

B. Physical ( ) Cold Stress (X) Noise ( )

Heat Stress ( ) Other ( )

Section A(12) Work Location Description/Site History

Site History

Plant liquid waste streams are stored and treated by evaporation in solar ponds located at the northeast corner of the manufacturing complex. Waste streams entering these ponds include beryllium, plutonium processing wastes, elevated nitrate water and possible intermittent disposal of cutting oils. Monitoring data from RCRA interim status wells indicates that there may be subsurface migration of some of the more soluble solvent compounds into the groundwater from these ponds. Planned activities are to include monitoring for volatile organic priority pollutants in liquid in Solar Pond 207B-North and interceptor trenches in the vicinity of the solar ponds. The liquid in Pond 207B-North was pumped to a spray irrigation area on the west side of the plant. Surface and subsurface soil samples will be taken in this area and a non-irrigated area and analyzed for chemical and radiological parameters.

Describe _____

C. Radiation (X)

Describe liquid in solar pond 207B North receives seepage from groundwater interceptor trenches

4. Nature of Hazards:

Air (X) Describe Ambient air monitoring indicates no airborne radioactivity hazard. No ambient monitoring has been conducted for organic vapors.

Soil (X) Describe Soil concentrations for organic vapors have not been determined. Plutonium concentrations in soil are low enough to not present a hazard.

Surface Water ( ) Describe _____

Groundwater (X) Describe Monitoring data indicates possible low concentrations of organics and measurable radioactivity

Other ( ) Describe _____

5. Chemical Contaminants of Concern ( ) N/A

Contaminant	TLV (PPM)	I.D.L.H. (PPM)	Source/Quantity Characteristics	Route of Exposure	Symptoms of Acute Exposure	Instruments Used to Monitor Contaminant
Sulfuric Acid	1 mg/m^3 (.25 ppm)	80 mg/m^3 (20 ppm)	unknown	inhalation ingestion	eye, nose, throat irritation	
Hydrochloric Acid				contact		
Nitric Acid	2	100	unknown		irritant eyes muc. membrane	
Chrome (VI)	.001 mg/m^3		unknown		respiratory irritant sens. derm.	
Cyanide	5 mg/m^3 (2 ppm)	50 mg/m^3 (20 ppm)			eye, skin irritant headache, asphyxia	

6. Physical Hazards of Concern (X) N/A

Hazard	Description	Location	Procedures Used to Monitor Hazard

7. Work Location Instrument Readings ( ) N/A

Location _____

% O_2 _____ % LEL _____

Radioactivity _____ PID _____

FID _____ Other _____

Other _____ Other _____

Location _____

% O_2 _____ % LEL _____

Radioactivity _____ PID _____

FID _____ Other _____

Other _____ Other _____

Location _____

% O_2 _____ % LEL _____

Radioactivity _____ PID _____

FID _____ Other _____

Other _____ Other _____

Location _____

% O_2 _____ % LEL _____

Radioactivity _____ PID _____

FID _____ Other _____

Other _____ Other _____

8. Hazards expected in preparation for work assignment. ( ) N/A

Describe: See attached diagram showing proposed work locations and the attached description of site activities and hazard decsription

WESTON

C. Personnel Protective Equipment

1. Level of Protection

A ( ) B ( ) C (X) D ( ) Location/Activity:

207B North, spray irrigation area, interceptor trench pump house

A ( ) B ( ) C ( ) D ( ) Location/Activity:

_____

2. Protective Equipment (specify probable quantity required)

Respiratory ( ) N/A

( ) SCBA, Airline

(X) Full Face Respirator (Cart. radionuclide organic vapors)

( ) Escape Mask

( ) None

( ) Other _____

( ) Other _____

_____

Clothing ( ) N/A

( ) Fully Encapsulating Suit

( ) Chemically Resistant Splash Suit

( ) Apron, Specify _____

( ) Tyvek Coverall

( ) Saranex Coverall

( ) Coverall, Specify _____

( ) Other _____

( ) Other _____

_____

Head & Eye ( ) N/A

( ) Hard Hat

( ) Goggles

( ) Face Shield

( ) Chemical Eyeglasses

( ) None

(X) Other safety glasses if protection is downgraded.

Hand Protection ( ) N/A

(X) Undergloves latex Type

(X) Gloves nitrile Type

(X) Overgloves cotton or leather Type

( ) None

( ) Other _____

_____

Foot Protection ( ) N/A

(X) Safety Boots

( ) Disposable Overboots

( ) Other _____

_____

3. Monitoring Equipment ( ) N/A

( ) CGI

(X) O_2 Meter

(X) Rad Survey

( ) Detector Tubes

Type: _____

_____

_____

( ) PID

(X) FID

( ) Other _____

_____

( ) Other _____

_____

D. Personnel Decontamination (Attach Diagram)

Required (X) Not Required ( )

Equipment Decontamination (Attach Diagram)

Required (X) Not Required ( )

If required, describe and list equipment Soap and water wash, water rinse of equipment, alcohol rinse, collect rinsate for proper disposal by Rockwell personnel.

WESTON

E. Personnel

	NAME	WORK LOCATION TITLE/TASK	MEDICAL CURRENT	FIT TEST CURRENT	CERTIFICATION LEVEL
1.	Mark Selman	Sampler	( )	(X)	(B)
2.	Karen Holliway	Sampler	(X)	(X)	(B)
3.			( )	( )	( )
4.			( )	( )	( )
5.			( )	( )	( )
6.			( )	( )	( )
7.			( )	( )	( )
8.			( )	( )	( )
9.			( )	( )	( )
10.			( )	( )	( )

Site Safety Coordinator William Somers

F. Activities Covered Under this Plan

Task No.	Description	Preliminary Schedule
1	Collect soil samples in areas of high application in the West Spray Field.	
2	Collect water samples from the interceptor trench pump house.	
3	Collect water samples from Pond 207B North.	

G. Subcontractor's Health and Safety Program Evaluation (X) N/A

Name and Address of Subcontractor: _____

_____

Activities to be Conducted by Subcontractor: _____

_____

EVALUATION CRITERIA

Item	Adequate	Inadequate	Comments
Medical Surveillance Program	( )	( )	
Personal Protective Equipment Availability	( )	( )	
On-Site Monitoring Equipment Availability	( )	( )	
Safe Working Procedures Specification	( )	( )	
Training Protocols	( )	( )	
Ancillary Support Procedures (if needed)	( )	( )	
Emergency Procedures	( )	( )	
Evacuation Procedures Contingency Plan	( )	( )	
Decontamination Procedures Equipment	( )	( )	
Decontamination Procedures Personnel	( )	( )	

GENERAL HEALTH AND SAFETY PROGRAM EVALUATION: ADEQUATE ( ) INADEQUATE ( )

ADDITIONAL COMMENTS: _____

_____

EVALUATION CONDUCTED BY: _____ DATE: _____

WESTON

H. Contingency Contacts

Agency	Contact	Phone Number
Fire Department	on-site service	303-966-2911
Police Department	on-site service	303-966-2911
Health Department	CO Dept. of Health	303-320-8333
Poison Control Center	Denver & vicinity	303-629-1123
State Environmental Agency	CO Dept. of Health	303-320-8333
EPA-Regional Office	Region VIII	303-844-2407
EPA-ERT. ICOM		
Spill Contractor		
State Police	Colo. State Patrol	303-757-9475
F.A.A.	Local Coordinator	303-340-5525
Civil Defense	Div. of DIS. Emer. Ser.	303-279-2511
On Site Coordinator	Chuck Illsley	303-966-7079
Site Telephone		303-966-2911
Nearest Telephone	Guard Post (Location)	
Other		

I. Contingency Plans

Spill, Accidental Release; Describe On-site emergency coordinator will implement contingency plan

Fire Explosion; Describe On-site emergency coordinator to implement fire and explosion contingency plan.

Other; Describe Evacuation by signal; internal communications already exist.

Exit Routes, Communication Systems; Describe Rockwell internal communication systems exist, evacuation routes on file at site.

WESTON

MEDICAL EMERGENCY

Name of Hospital St. Anthony North

Address: 2551 West 84th Avenue Phone No. 303-399-1211

Name of Contact Rockwell medical staff

Address: Rocky Flats Plant Phone No. 303-966-2911

Route to Hospital: (Attach Map) Medical facilities are available on plant site, if further treatment is required, Rocky Flats ambulance will be used. In extreme emergency, St. Anthony Flight For Life helicopter can be used.

Travel Time From Site (Minutes) _____ Distance to Hospital (Miles) _____

Name/Number of 24 Hr. Ambulance Service On-site

HEALTH AND SAFETY PLAN
APPROVAL/SIGN OFF FORMAT

I have read, understood, and agreed with the information set forth in this Health and Safety Plan (and attachments) and discussed in the Personnel Health and Safety briefing.

Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Site Safety Coordinator	Signature	Date
Director, Corporate Health and Safety	Signature	Date
Project Manager	Signature	Date
Project Director/ Department Manager	Signature	Date

Personnel Health and Safety Briefing Conducted By:

Name	Signature	Date

ATTACHMENTS

Section B8. Hazard Description

Section C. Personnel Protective Equipment

Hazards Expected in Preparation for Work Assignment

.lease refer to diagram of proposed work locations

A. Area 1 - Spray Irrigation

West of Plant Boundaries

Soil samples will be collected in six areas with a potential for contamination and six non-irrigated areas. The samples will be collected using a split spoon to depth of 6" and 1 foot. The soil samples will be placed in jars for transport to the laboratory. Monitoring well data has indicated only trace levels of select volatile organic compounds in shallow wells, and ambient air monitoring for radioactivity reveals only background levels in this area. No real-time ambient air monitoring or air samples for organic vapors have been collected; however, background information on the compounds sprayed and their concentrations in the effluent and in the groundwater indicates that Level C respiratory protection (full face, air-purifying respirator) is sufficient for planned work activities.

i. Personnel Protective Equipment

a) Respiratory Protection - full face, air-purifying respirator equipped with combination organic vapor radionuclide cartridges or canisters shall be used in Area 1 until potential hazards have been adequately characterized.

b) Clothing - Saran coated Tyvek coverall with hood will be used for work activities in Area 1.

c) Head and Eye Protection - Hard hats will be required head protection. Eye protection will be afforded by the use of full face respirators. If the safety coordinator elects to downgrade the level of protection from C to D based on air monitoring information, Safety glasses will be the required eye protection.

d) Hand and Foot Protection - Until organic and radioactive contaminant levels are quantified, hand protection will consist of an inner PVC or Latex glove and an outer nitrile glove. Nitrile affords good protection from halogenated solvents. An outer cotton or leather work glove may be used if required. Required foot protection will be steel-toed, steel-shanked work boots and disposable latex rubber outer booties.

ii. Personnel Monitoring

- Organic vapors will be monitored using an OVA.

- Alpha activity will be monitored by taking smears on the sample containers and checking for contamination using an air proportional detector. Soil samples previously collected in this area reveal only background alpha activity levels.

- Oxygen and Combustible Gases will not be monitored because all planned activities will occur outside.

iii. Personnel Decontamination - Area 1

Each work location will be divided into three distinct work zones similar to that pictured in the attached diagram of Site Work Zones. The Work Zones are as follows:

Zone 1: Exclusion Zone - the zone where contamination does or could exist. All personnel entering the exclusion zone must wear the level of protection specified for that work area.

Zone 3: Support Zone - area of work site considered to be non-contaminated (located upwind of the Exclusion Zone). This is a storage area for support equipment and provides a point of personnel access and traffic control to the Exclusion Zone.

Zone 2: Contamination Reduction Zone (CRZ) - provides a transition zone between the Exclusion Zone and the Support Zone to prevent the spread of contaminants from the Exclusion Zone. Decontamination is performed in this zone.

A diagram of the minimum Level C decontamination layout is attached showing the required decontamination stages. Alpha activity will be monitored during each stage of decontamination. Personnel will repeat decontamination steps until background levels of activity are indicated.

iv. Equipment Decontamination

Equipment will be decontaminated to prevent spread of contamination to adjacent areas and reduce the possibility of cross-contamination between test holes. The split spoon should be the only equipment that will come in direct contact with contaminated soil. The following decontamination procedure should be initiated after each sample and prior to leaving the contamination reduction zone in each of the three areas tested:

Step 1 - Brush excess soil from split spoon and wash with an alkaline, non-sudsing detergent.

Step 2 - Rinse with tap water and distilled water.

Step 3 - Rinse with methanol.

Step 4 - Survey with both the OVA probe and the alpha detector probe to determine if any residual contamination exists. If so, repeat steps 1, 2, and 3 until no contamination is detected. Proceed to next sampling location.

B. Area 2 - Pump House

Water samples will be collected from the still well in the interceptor trench pump house for the purpose of detecting the presence of priority pollutant compounds. Background information suggests the potential for encountering alpha radioactivity, tritium and volatile organics in the liquid due to pond seepage.

i. Personnel Protective Equipment

Personnel protective equipment required for Area 2 will be identical to that used in Area 1 (Spray irrigation area).

Level C protection was selected because the main hazard presented in Area 2 is the potential for ingestion and/or inhalation of particulates contaminated with alpha emitters. Adequate protection from these hazards is afforded by an air-purifying full-face respirator equipped with combination organic/radionuclide cartridges or canisters.

In addition, all work activities and decontamination procedures will be monitored continuously with real-time instruments to assure proper levels of personnel protection and efficient decontamination.

ii. Personnel Monitoring

- The presence of organic vapors will be monitored using an OVA.
- Alpha activity will be monitored with air proportional alpha survey meters and by counting smears taken on equipment.
- Oxygen and Combustible Gases will be monitored because of the possibility of accumulation in the pump house.

iii. Personnel Decontamination (identical to Area 1).

iv. Equipment Decontamination (identical to Area 1).

C. Area 3 - Solar Pond 207B North

Water and sediment samples are to be collected from this pond. Pond seepage collected by interceptor trenches is pumped into this pond. The intercepted groundwater generally contains slightly elevated concentrations of alpha and beta radioactivity and tritium. The major chemical constituent is nitrate at concentrations ranging from 500 to 800 mg/l. Additionally, two samples that were collected to meet an NPDES discharge permit requirement were found to have trace concentrations (2 to 3 ppb) of chloroform and trichloroethylene.

No real-time ambient air monitoring or air samples for organic vapors have been collected at the site. Background information and analytical data of the liquid in the pond indicates that Level C respiratory protection (full face, air-purifying respirator) is sufficient for planned work activities.

i. Personnel Protective Equipment (identical to Area 1).

ii. Personnel Monitoring (identical to Area 1).

iii. Personnel Decontamination (identical to Area 1).

iv. Equipment Decontamination (identical to Area 1).

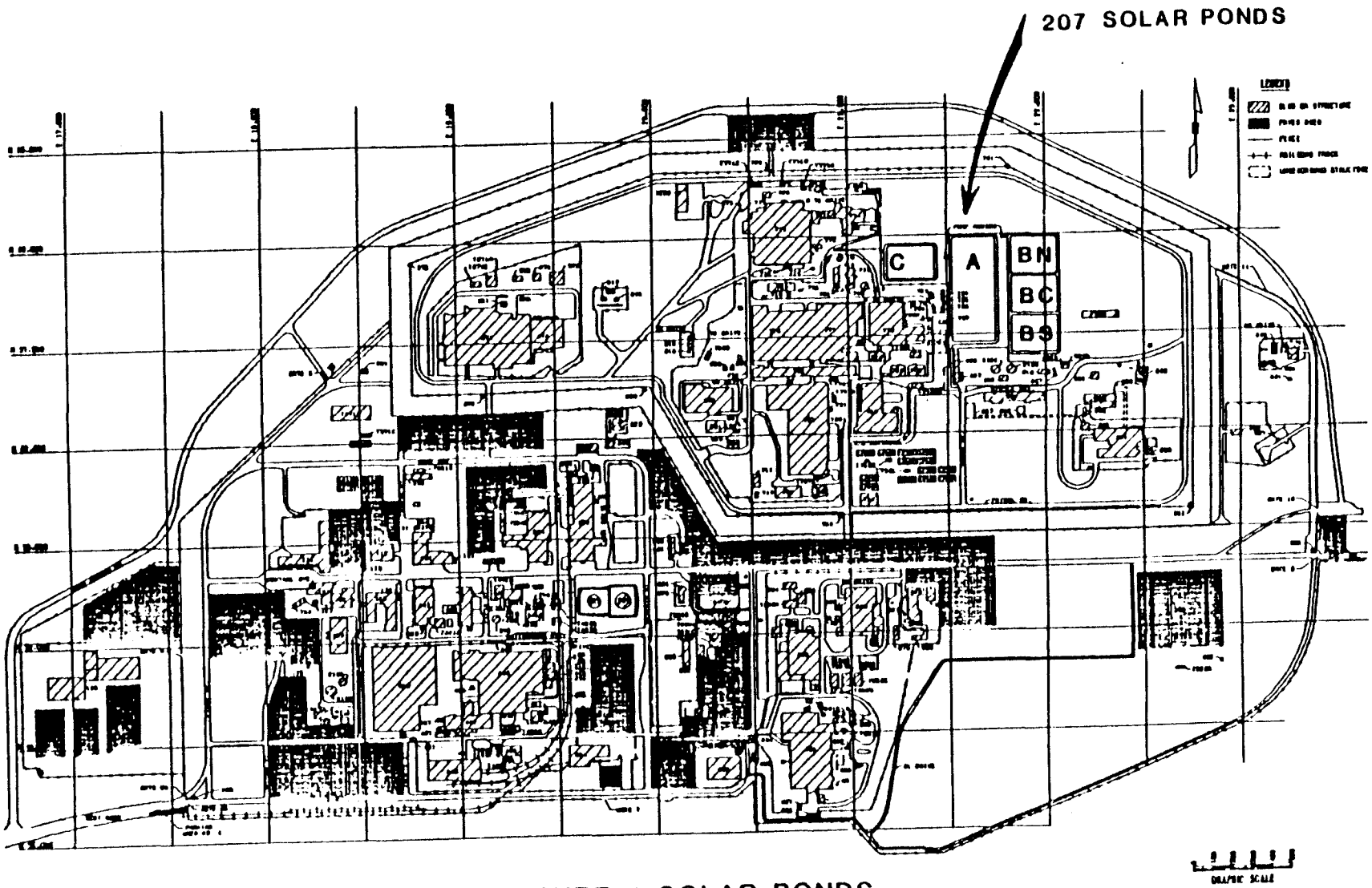


FIGURE 1 SOLAR PONDS

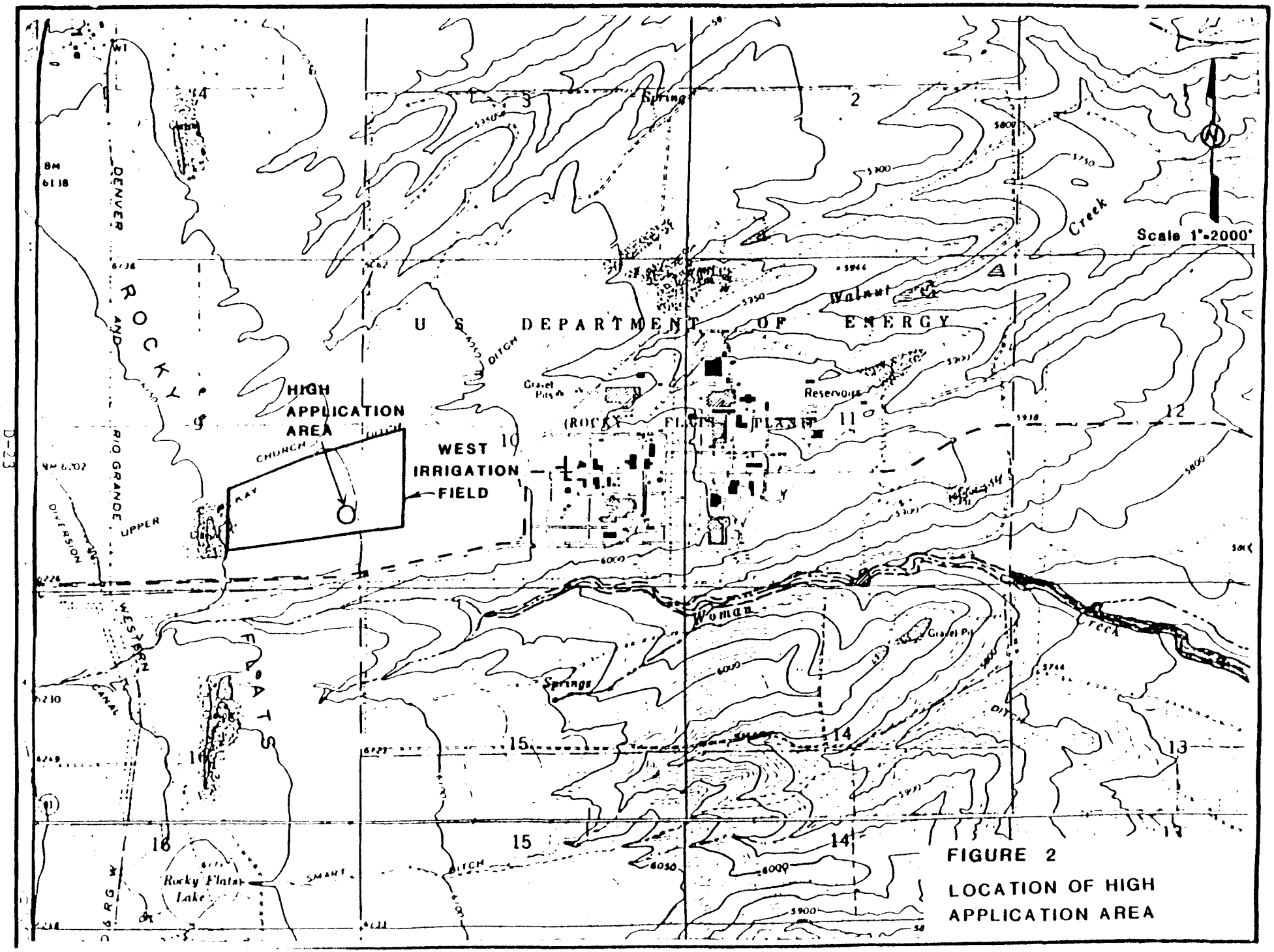
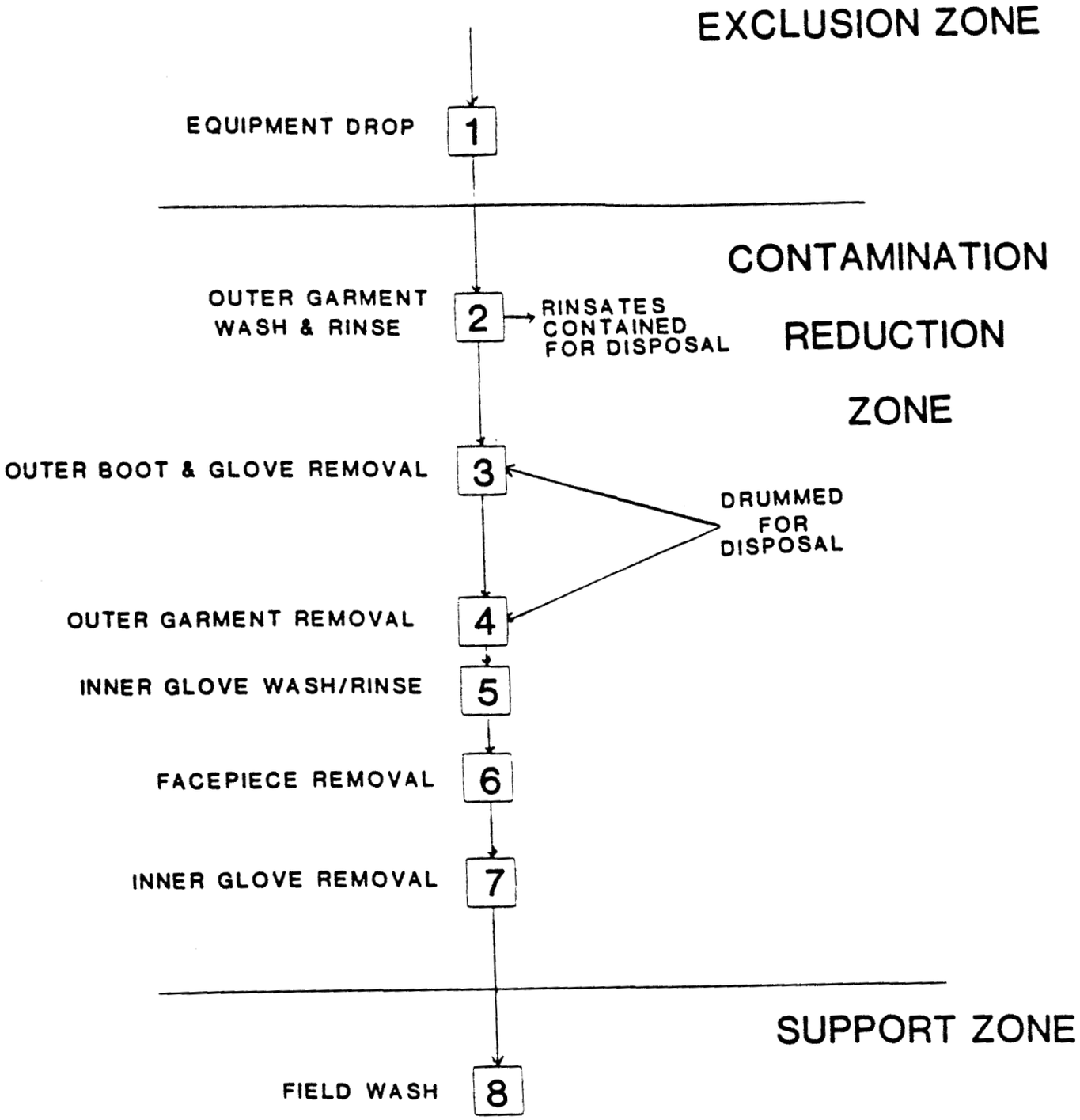


FIGURE 2

LOCATION OF HIGH APPLICATION AREA



MINIMUM DECONTAMINATION

LAYOUT

LEVEL C PROTECTION

APPENDIX A-2

DRAFT WORK PLAN
GEOLOGICAL AND HYDROLOGICAL SITE CHARACTERIZATION
JULY 21, 1986

DRAFT WORK PLAN

GEOLOGICAL AND HYDROLOGICAL SITE CHARACTERIZATION

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
GOLDEN, COLORADO
JULY 21, 1986

ROCKWELL INTERNATIONAL
NORTH AMERICAN SPACE OPERATIONS
ROCKY FLATS PLANT

DRAFT WORK PLAN

GEOLOGICAL AND HYDROLOGICAL SITE CHARACTERIZATION

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS PLANT
GOLDEN, COLORADO
JULY 21, 1986

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Prepared for the U.S. Department of Energy

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PLATES *

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* See Plates E-VI and E-VII in Section E.

1.0 INTRODUCTION

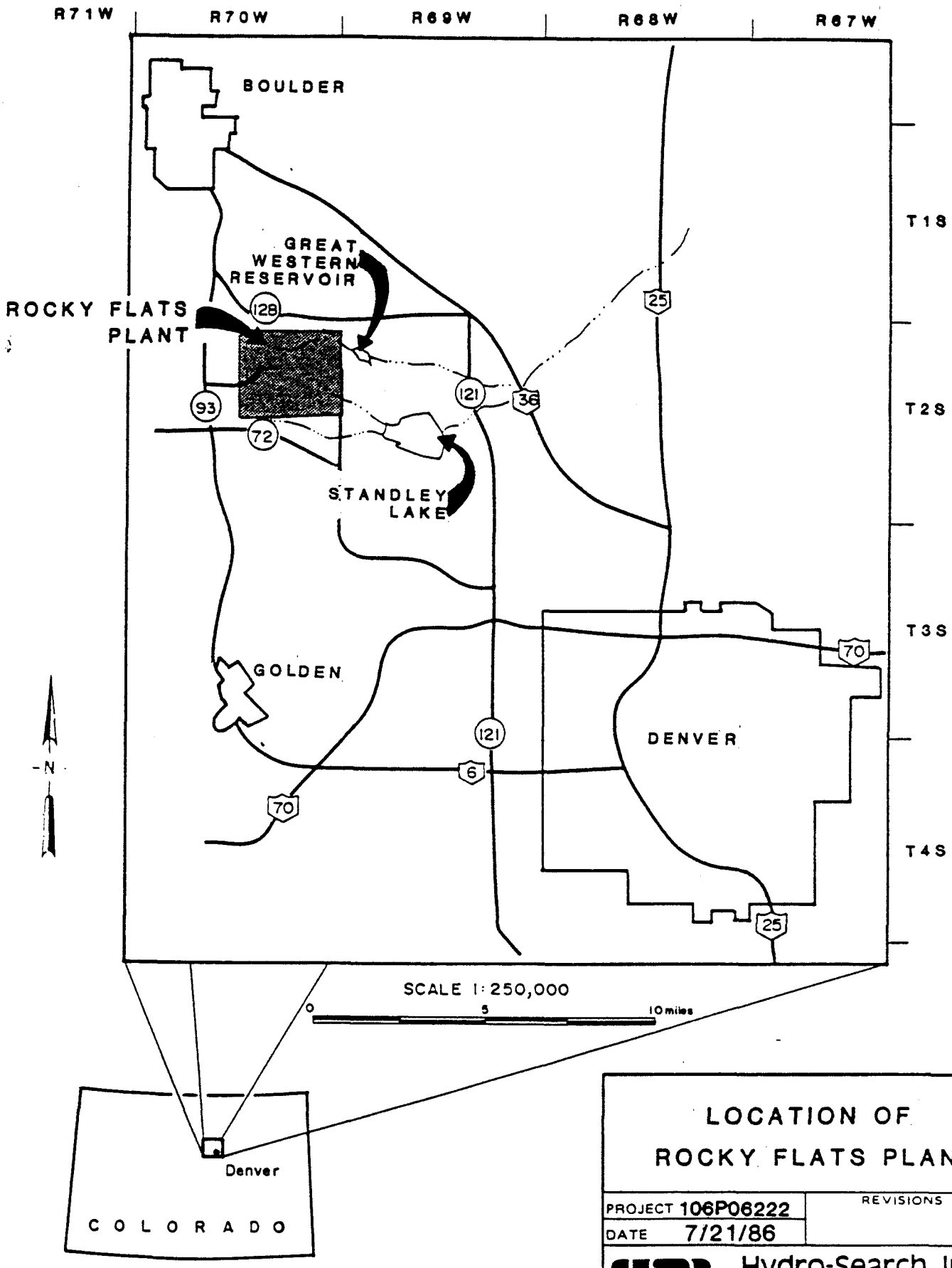
This Work Plan describes the tasks and activities to be performed at the Rocky Flats Plant in order to characterize site geology, hydrology and water quality. Detailed procedures for sampling and analysis, data management, laboratory analysis, quality assurance, and health and safety are contained in the Project Operations Plan.

1.1 SITE LOCATION AND HISTORY

The Rocky Flats Plant is located in northern Jefferson County, Colorado, approximately 16 miles northwest of downtown Denver (Figure 1). The site consists of approximately 6550 acres of federally owned land in sections 1 through 4 and 9 through 15 of T. 2 S., R. 70 W. Major plant structures are located within the plant security area of approximately 400 acres. The security area is surrounded by a buffer zone of approximately 6150 acres.

The Rocky Flats Plant is a government-owned and contractor-operated facility. It is part of a nation-wide nuclear weapons research, development, and production complex administered by the Albuquerque Operations Office of the U.S Department of Energy (DOE). The prime operating contractor for the Rocky Flats Plant is Rockwell International.

The plant is a key DOE facility that produces components for nuclear weapons; therefore, its product is directly related to national defense. The plant is involved in fabricating components from plutonium, uranium, beryllium, and stainless steel. Production activities include metal fabrication and assembly, chemical recovery and purification of process-produced transuranic radionuclides, and related quality control functions. Research and engineering programs supporting these activities



LOCATION OF ROCKY FLATS PLANT

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FIGURE 1

involve chemistry, physics, materials technology, nuclear safety, and mechanical engineering.

Approximately 129 structures on the plant site contain approximately 2.63 million square feet of floor space. Of this space, major manufacturing, chemical processing, plutonium recovery, and waste treatment facilities occupy about 1.65 million square feet, and major laboratory and research buildings occupy about 170,000 square feet. The remaining floor space is divided among administrative, utility, security, warehouse, storage, and construction contractor facilities, and occupies about 814,000 square feet (Rockwell International, 1985).

The Rocky Flats Plant was constructed in 1951, and limited operations began in 1952 under direction of the Atomic Energy Commission. In 1975, responsibility for the plant was assigned to the Energy Research and Development Administration, which was succeeded by DOE in 1977. Dow Chemical Company was the prime operating contractor at the facility from 1951 until 1975, when Rockwell International was awarded the contract.

1.2 PROJECT OVERVIEW

A comprehensive, phased program of site characterizations, remedial investigations, feasibility studies and remedial/corrective actions is in progress at Rocky Flats pursuant to DOE's Comprehensive Environmental Assessment and Response Program (CEARP) and an Agreement in Principle signed by representatives of the U.S. Department of Energy, the U.S. Environmental Protection Agency (EPA) and the State of Colorado (CDH) on June 4, 1986. The Agreement addresses hazardous and radioactive waste management at the Rocky Flats Plant. The program developed by DOE, EPA, and CDH in response to the Agreement addresses RCRA and CERCLA issues and has been integrated with CEARP investigations.

Specific projects and schedules for ground-water related activities have been developed within the broad categories of Site Characterizations and Corrective Actions and Closure and Post-Closure Plans.

This program can be subdivided into four phases. Phase I will result in the characterization of site geology, hydrology, and water quality with investigations focusing on areas of suspected contamination sources. Phase I includes a detailed characterization of ground water and water quality in the vicinity of the solar ponds and preparation of closure and post-closure plans. Phase II will focus on characterization of potential contaminant sources and delineation of contaminated ground-water plumes. Phase III will include risk assessments and feasibility studies of remedial alternatives, and Phase IV will involve design and implementation of remedial action(s).

1.3 OBJECTIVES

This work plan has been prepared to obtain the necessary data for geological and hydrological characterization of the Rocky Flats Plant. It encompasses sampling, mapping, and characterization of surface and subsurface geology, soils, sediments, surface and subsurface hydrology, and water quality at Rocky Flats and surrounding areas as necessary to understand local and regional hydrology. The plan has also been developed to obtain ground-water quality data in the vicinity of the solar ponds.

Specific objectives of this plan are: 1) to characterize Rocky Flats geology, hydrology, and water quality in support of a revised RCRA Part B permit application to be submitted to the Colorado Department of Health on November 28, 1986, and 2) to serve as the first phase of a remedial investigation of potential hazardous and radioactive waste sites at the Plant under CEARP.

The work plan is based on a summary of existing data (Rockwell International, 1986a) and a preliminary prioritization of potential contaminant source areas for remedial investigations (Rockwell International, 1986b).

1.4 PROJECT REPORTS

The following documents will be prepared based on the results of the site characterization:

1) Post-Closure Plan for the Solar Evaporation Ponds/Surface Impoundments

   The post-closure plan will address regulatory requirements of 40 CFR 264 and 270. The plan will be based on data obtained through September 30, 1986. The plan will include details of the ground-water monitoring program, an assessment of ground-water contamination resulting from solar ponds leakage, and an evaluation of the effectiveness of the existing ground-water interceptor trench system below the solar ponds.

2) Ground-water Monitoring and Protection Section of Revised RCRA Part B Permit Application

   This report will detail results of the site characterization investigations. The report will include information addressing the Part 100, Part 264, and Part 265 ground-water requirements for a Part B permit application, interim status compliance, and solid waste management units. The application will be based on data obtained through September 30, 1986.

2.0 INITIAL SITE EVALUATION

This section briefly characterizes the Rocky Flats Plant site based on existing data. Included is a discussion of the hydrogeologic setting, past waste disposal practices, a preliminary prioritization of potential contaminant source areas, and the nature and extent of contamination.

2.1 HYDROGEOLOGIC SETTING

2.1.1 Geology

The Rocky Flats Plant is located on the northwestern flank of the Denver Basin, a large asymmetric syncline containing up to 13,000 feet of sedimentary rocks (Costa and Bilodeau, 1982). The basin trends north-south with a steep western flank and gently dipping eastern flank. The western flank is bounded by high angle reverse faults (the Golden Fault and others) located several miles west of the plant.

As shown in Figure 2 and Figure 3, the upper 800 feet of sedimentary Cretaceous formations beneath the Rocky Flats Plant include the Fox Hills Sandstone, the Laramie Formation, and the Arapahoe Formation, in ascending order. The Fox Hills Sandstone and the Laramie Formation outcrop west of the plant where they are nearly vertical. These beds dip eastward approximately 5 to 15 degrees beneath the plant (Hurr, 1976).

Bedrock immediately beneath the Rocky Flats Plant consists of the Cretaceous Arapahoe Formation. The formation strikes generally north-south and dips 5 to 15 degrees east toward the center of the Denver Basin (Hurr, 1976). The Arapahoe Formation consists of interbedded claystones and lenticular sandstones. The sandstone lenses are concentrated near the base of the formation (Hurr, 1976). Based on available data, most of the

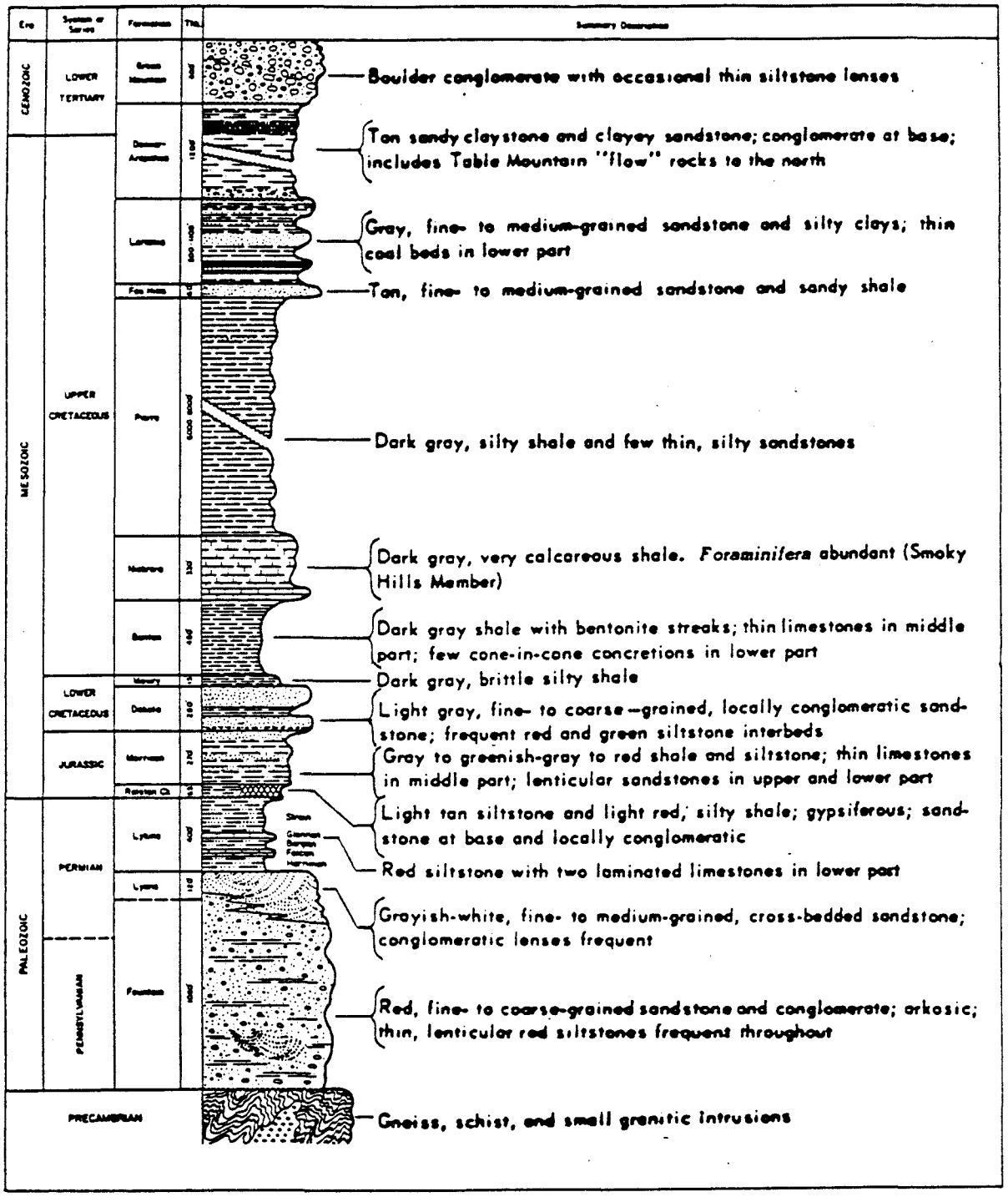

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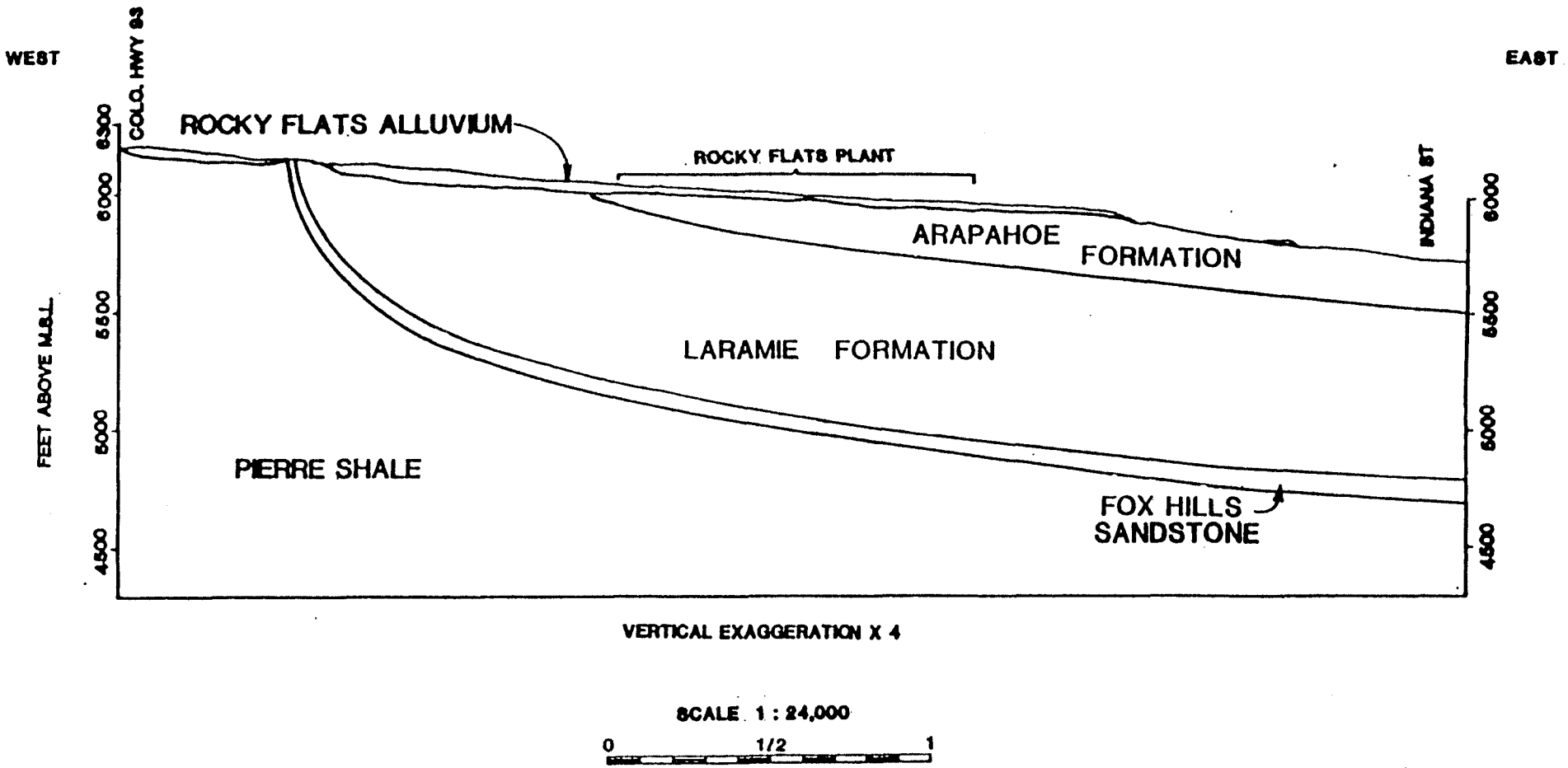
FIGURE 2.

GENERALIZED STRATIGRAPHIC COLUMN
GOLDEN - MORRISON AREA

(after LeRoy and Weimer, 1971).



After Hurr, 1976

PROJECT 106P06222	REVISIONS	FIGURE 3.
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bedrock beneath the site appears to be claystone (Hydro-Search, Inc., 1985).

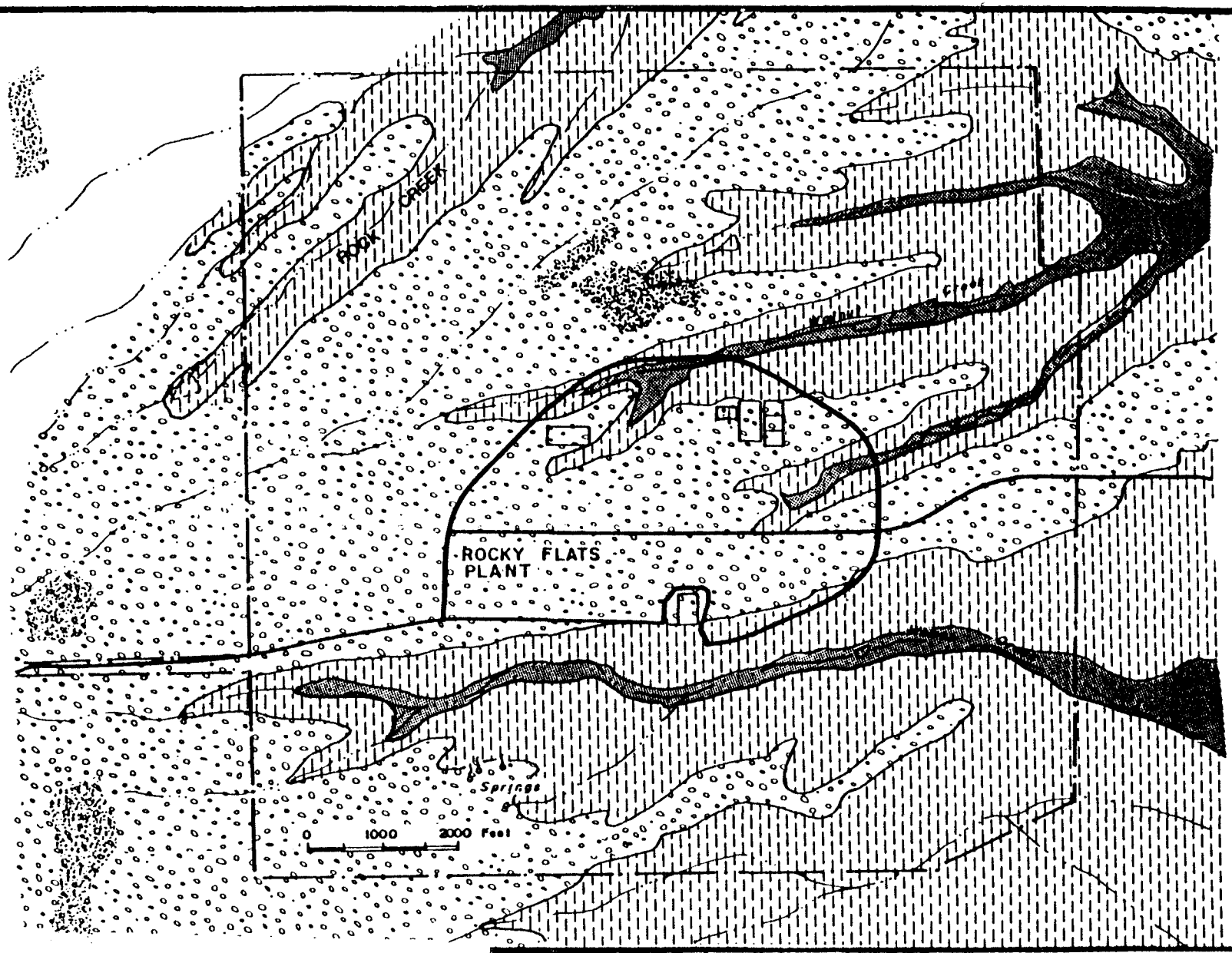
Surficial materials beneath the Rocky Flats Plant consist primarily of the Quaternary Rocky Flats Alluvium which forms a relatively flat and erosion resistant surface (Figure 4). The east-west trending drainages of Walnut and Woman Creeks dissect the alluvium, and the plant is located on a terrace between the drainages. The Rocky Flats Alluvium consists of poorly sorted sands, gravels, and cobbles in a clay matrix up to 50 feet thick.

Valley fill and colluvial materials are present in the drainages and on slopes along the edge of the Rocky Flats Alluvium terrace. These materials overlie the Arapahoe Formation and consist of sandy silt and clay with some sand and gravel lenses. They range from 0 to 25 feet in thickness.

2.1.2 Ground-Water Hydrology

Two ground-water flow systems are present beneath the Rocky Flats Plant. A shallow flow system occurs in surficial materials, and a deeper flow system occurs in the claystones and sandstones of the Arapahoe Formation (Hydro-Search, Inc., 1985).

The shallow flow system in the Rocky Flats Alluvium, colluvium, and valley fill alluvium is recharged by infiltration of incident precipitation. Ground-water flow in the shallow system is generally from west to east but also toward the drainages following topography. Some ground-water discharge occurs along the edges of the Rocky Flats Alluvium as small springs and seeps. Ground water in the drainages also flows eastward within valley fill alluvium. In addition, ground water in both of these materials recharges the bedrock flow system (Hydro-Search, Inc., 1985).



Rocky Flats Alluvium

Slope Wash

Valley Fill

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FIGURE 4.

SURFICIAL GEOLOGY

The majority of ground-water flow in the Arapahoe Formation occurs in the lenticular sandstones (Hydro-Search, Inc., 1985). Recharge to the sandstones occurs where they subcrop beneath overlying surficial materials or by leakage through claystones in contact with surficial materials. Ground water in the sandstone units flows eastward toward the regional discharge zone along the South Platte River (Robson et al., 1981).

2.1.3 Surface-Water Hydrology

There are three intermittent drainages present at the Rocky Flats Plant site (Figure 4). Walnut and Woman Creeks drain the plant and Rock Creek crosses the northwestern corner of the property. Interceptor ditches are present at the plant to collect and divert runoff from the plant operational areas.

Three tributaries of Walnut Creek originate within the plant. North Walnut, South Walnut, and a northern unnamed tributary drain the northern portion of the plant and flow eastward. The confluence of these three drainages is east of the plant in the buffer zone where they join to form Walnut Creek. Walnut Creek flows eastward into Great Western Reservoir.

Woman Creek drains the south side of the plant and flows eastward into Standley Lake. Rock Creek drains the extreme northwestern corner of the plant and flows northeast across the plant buffer zone. Rock Creek does not receive runoff directly from the plant site.

Several retention ponds designated as the A, B, and C series ponds are located in the drainages of Walnut and Woman Creeks (Figure 5). The four A series ponds are located in the North Walnut Creek drainage and are designated A-1, A-2, A-3, and A-4

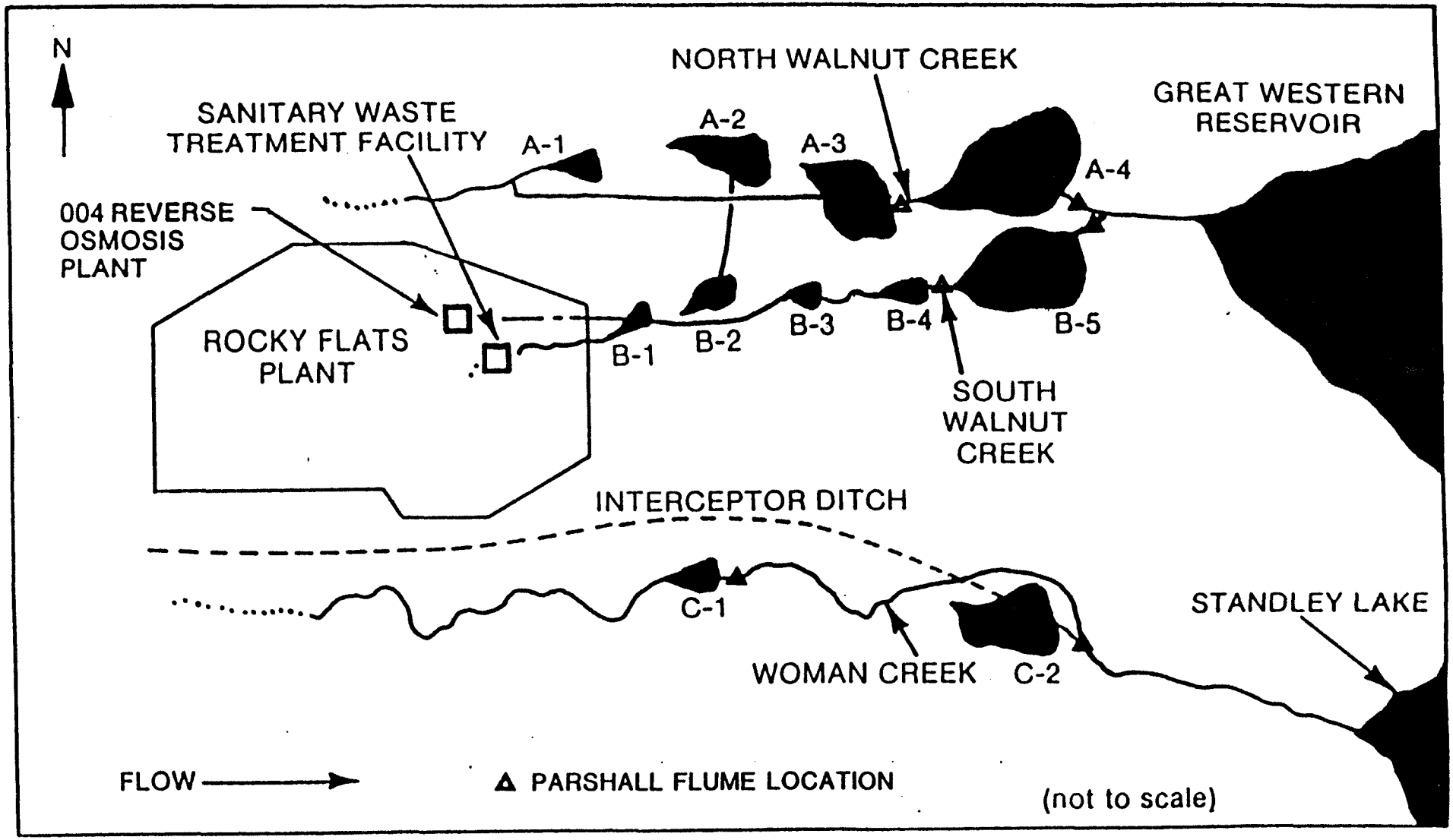

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FIGURE 5.

SURFACE WATER MONITORING LOCATIONS

from west to east. Ponds A-1 and A-2 are used only for spill control, and North Walnut Creek stream flow is diverted around them through an underground pipe. Pond A-3 receives the North Walnut Creek stream flow and plant runoff. Pond A-4 is used for surface water control and receives discharge from pond A-3. Discharge from pond A-4 is in accordance with the plant's NPDES permit.

The five B series ponds are located in the South Walnut Creek drainage and are designated B-1, B-2, B-3, B-4, and B-5 from west to east. Ponds B-1 and B-2 are reserved for spill control, and pond B-3 receives effluent from the plant's sanitary sewage treatment plant. Ponds B-4 and B-5 receive surface runoff and occasional discharge from pond B-3. Discharge from pond B-5 is in accordance with the plant's NPDES permit.

The two C series ponds are located along Woman Creek and are designated C-1 and C-2 from west to east. Pond C-1 receives stream flow from Woman Creek, which is then diverted around pond C-2 into the Woman Creek channel. Pond C-2 is offset from Woman Creek and receives surface runoff from an interceptor ditch along the south side of the plant security area. Water in pond C-2 is discharged downstream into Woman Creek in accordance with the plant's NPDES permit.

2.2 PAST WASTE DISPOSAL ACTVITIES AND PRIORITIZATION OF POTENTIAL CONTAMINANT SOURCE AREAS

Radioactive and nonradioactive wastes are generated at the Rocky Flats Plant. Currently, nonradioactive wastes are segregated as nonhazardous for on-site disposal and hazardous for resale to commercial recycling vendors (U.S. DOE, 1985). Solidified radioactive wastes are shipped off-site for disposal at DOE facilities (U.S. DOE, 1985).

Past disposal practices were not always consistent with the current practices. Some areas on-site have received radioactive waste, hazardous waste or radioactive hazardous waste.

Potential contaminant source areas identified in the CEARP Phase I Installation Assessment report (U.S. DOE, 1986) were evaluated and prioritized in order to focus site characterization activities in areas of known or suspected ground-water contamination. Criteria for site prioritization included:

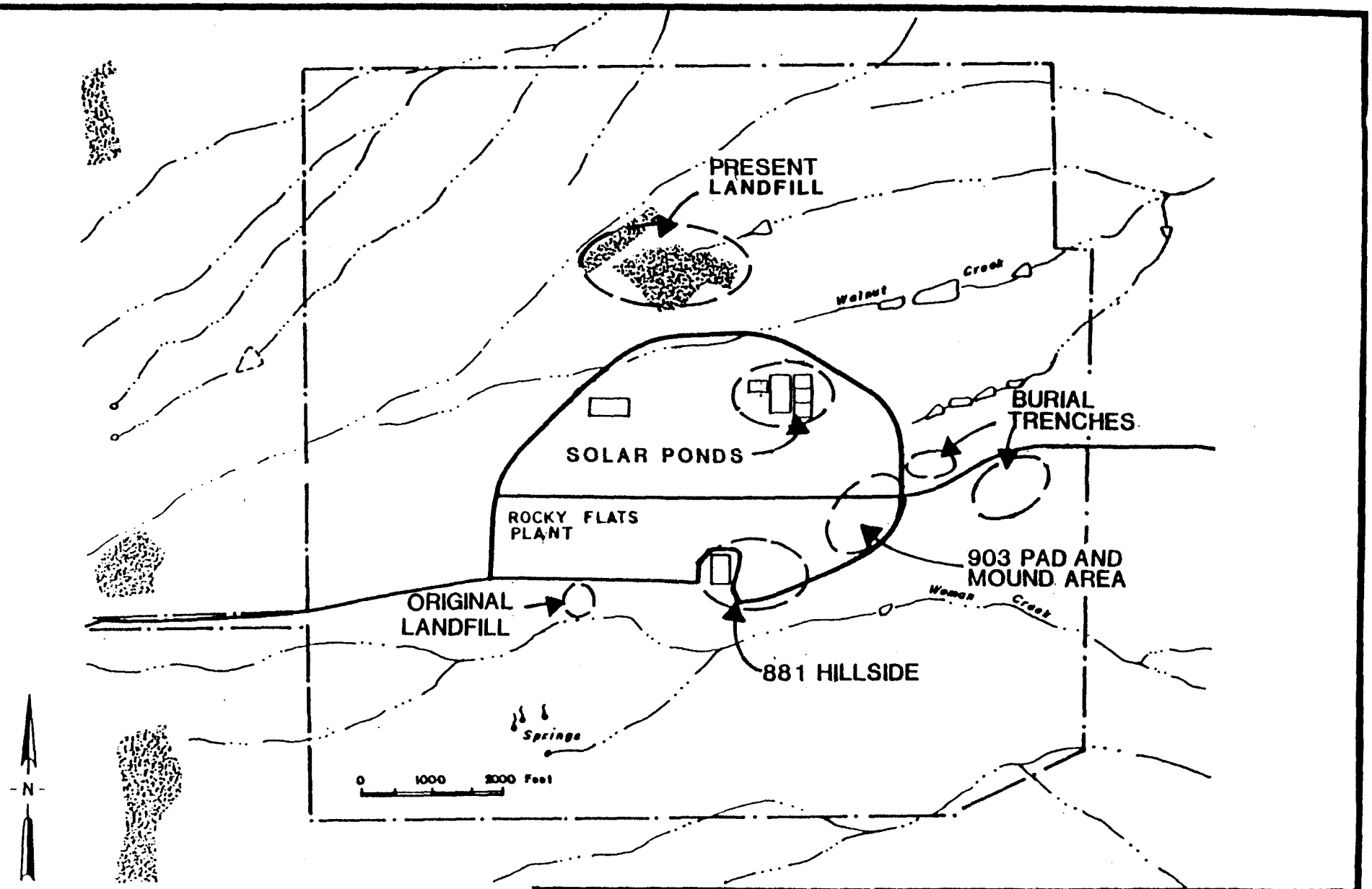
1) Federal Facility Site Discovery and Identification Findings,
2) Volumes and types of wastes,
3) Waste management history,
4) Relative mobility of wastes,
5) Perceived health risk, and
6) Evidence of existing contaminant migration.

Details of the evaluation and prioritization methodology are provided in "Preliminary Prioritization of Sites" (Rockwell International, 1986b).

Five potential contaminant source areas were identified as priority areas for the Phase I remedial investigations. They are:

1) 207 solar evaporation ponds,
2) the 881 hillside,
3) trenches T-1 to T-11,
4) the 903 pad and mound areas, and
5) the present and original landfills.

The Phase I characterization activities will emphasize these areas (Figure 6). However, detailed characterization of the waste sources and delineation of specific ground-water contamination plumes are outside the scope of Phase I.



PROJECT 106P06222	REVISIONS	FIGURE 6
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The 207 solar evaporation ponds consist of three units, 207A, 207B (North, Central and South) and 207C. Ponds 207A and 207C store process waste waters containing high nitrate concentrations and radionuclides (U.S. DOE, 1985). Historical discharges to the 207A and 207C ponds have included sodium nitrate, ferric chloride, lithium chloride, sulfuric acid, ammonium persulfate, hydrochloric acid, nitric acid, hexavalent chromium, cyanide, and aluminum hydroxide (U.S. DOE, 1985). Pond 207A is currently being closed. Neither ponds 207A nor 207C have received process waste waters since 1985. Pond 207B North receives water from an interceptor system installed to collect ground-water seepage from the hillside north of the solar ponds. Ponds 207B Central and South receive treated sanitary effluent.

Past waste disposal practices also appear to have contributed to ground-water contamination of the 881 hillside area. These include: oil sludge disposal south of the building; unknown chemical burial south of the building; fuel oil leaks south of the building; liquid dumping and drum disposal east and southwest of the building; and various chemical spills north and west of the building (U.S. DOE, 1986).

Waste burial trenches, designated T-1 through T-11, located east and southeast of the main plant received hazardous waste, radioactive waste and/or radioactive hazardous waste. These wastes included depleted uranium chips, plutonium and beryllium contaminated lathe coolant (consisting of hydraulic oil and carbon tetrachloride), and sanitary sewage sludge contaminated with radionuclides (U.S. DOE, 1986).

The 903 pad area and the mound area are located west of the East Guard Gate within the plant security area. The 903 area received hazardous waste, radioactive waste, and radioactive hazardous

waste. These wastes included plutonium and beryllium contaminated lathe coolant, residuals from the destruction of lithium and calcium metals, and uranium contaminated oil. The mound area received radioactive hazardous waste consisting of depleted uranium and beryllium wastes, and plutonium and beryllium contaminated lathe coolant (U.S. DOE, 1986).

The original landfill is south of Building 440 outside of the plant security area. The landfill operated from 1952 to 1968 and is believed to contain nonhazardous solid wastes, depleted uranium ash, solvents, beryllium, and sanitary sewage sludge (U.S. DOE, 1986).

The present landfill was placed in service in 1968 and was expanded in 1972. An estimated nine million pounds of waste are disposed annually at this landfill. Records show that the landfill received approximately 2,200 pounds of sanitary sewage sludge between 1968 and 1974, which may have been contaminated with heavy metals and radionuclides. The landfill is also believed to have received chromates, solvents, and small amounts of organic chemicals in addition to sanitary sewage sludge (U.S. DOE, 1986).

2.3 NATURE AND EXTENT OF CONTAMINATION

Previous studies conducted at Rocky Flats indicate some areas of contamination in the shallow ground-water system. An analysis of Rocky Flats Plant ground-water quality data indicates that higher than background concentrations of total dissolved solids (TDS), nitrates, volatile organics, radionuclides (tritium, uranium) and trace metals (cesium, manganese, molybdenum, selenium, and strontium) appear to be present in some areas of the shallow ground-water system (Hydro-Search, Inc., 1985).

Dissolved uranium concentrations in ground water appear elevated downgradient of the plant; however, even these concentrations are low. Elevated uranium concentrations appear to be associated with the 881 hillside, the burial trenches, the solar ponds, and possibly the B and C series ponds in Walnut and Woman Creeks, respectively. Tritium concentrations appear elevated only in the vicinity of the solar ponds.

Based on results from sampling for volatile organic compounds (VOCs) during the period March 1985 through March 1986, elevated concentrations occur in the areas of the 881 hillside, the 903 pad and mound areas, burial trenches, solar ponds, and 371/374 buildings. The highest concentrations (greater than 100 ppb) occur in the southeast perimeter of the plant security area and near the old east gate. These VOCs are probably associated with sites on the 881 hillside, the 903 pad and mound areas, and the old burial trenches.

Elevated VOC levels have also been detected in ground-water northeast of the plant security area in the North Walnut Creek and landfill drainages. Wells 1-81 (North Walnut Creek drainage) and 2-81 (lanfill drainage) were sampled in April, 1985, December, 1985, and January, 1986. As shown in Table 1, the April, 1985 results show all VOC concentrations below 1 ug/l in these wells. However, detectable concentrations of VOCs were found in wells 1-81 and 2-81 in December, 1985 and again in January, 1986. The January sampling event was performed to verify findings of the December sampling. Tracer Research, Inc. (1986) found VOC concentrations less than 1 ug/l in the vicinity of these wells. Thus, the presence of VOCs in the ground water at this location is questionable.

An electromagnetic survey of the periphery of the plant security area and the downgradient drainages was performed to prelim-

Table 1. VOC's in Ground Water (December 1985 and January 1986 Samples at Wells 1-81 and 2-81).

VOC*	VOC Concentration (ug/l)			
	1-81		2-81	
	Dec.	Jan.	Dec.	Jan.
TCE	<1	5	10	<1
PCE	12	7	<1	6
DCE	<1	11	<1	<1
TCA	<1	7	<1	<1
DCA	<1	5	8	<1
CCL_4	4	7	3	<1
$CHCL_3$	2	6	5	<1

Trichloroethylene (TCE)

Tetrachloroethylene (PCE)

1,1-Dichloroethylene (DCE)

1,1,1-Trichloroethane (TCA)

1,2-Dichloroethane (DCA)

Carbon Tetrachloride (CCL_4)

Chloroform ($CHCL_3$)

inarily evaluate the extent of high TDS waters in the shallow ground-water system (Hydro-Search, Inc., 1986). Based on this survey, all of the drainages leaving the plant area apparently contain high TDS ground water which may indicate contamination. However, these high TDS waters appear to be at least 3,500 feet west of the eastern property boundary (Indiana Street).

A soil gas investigation was also performed at the plant site to provide an indirect measure of the presence of chlorinated hydrocarbons in soils and ground water (Tracer Research Corp., 1986). Soil gas samples were analyzed for the presence of chloroform, carbon tetrachloride, 1,1,1-trichloroethane, trichloroethylene, perchloroethylene, and 1,1-dichloroethylene. Based on results of this study, it does not appear that solvents or their degradation products are migrating off DOE property. Trichloroethylene (TCE) is the most widely distributed chlorinated hydrocarbon within the plant site. The highest soil gas concentrations of TCE and other solvents occurred along the southeast and northeast borders of the plant security area.

3.0 SITE CHARACTERIZATION

Plans for geologic, hydrologic, and water quality characterization are presented in this document including well locations, sampling locations, and sampling parameters. Detailed procedures for each activity are presented in the Project Operations Plan.

3.1 TOPOGRAPHY

Topographic maps of the Rocky Flats Plant are being prepared at scales of one inch equals 100 feet with a two-foot contour interval, one inch equals 200 feet with a two-foot contour interval, and one inch equals 500 feet with a five-foot contour interval. The maps are being developed from recent (June, 1986) air photos and encompass the entire Rocky Flats Plant property. The one inch equals 200 feet scale map will extend 2000 feet beyond the property boundaries in all directions.

3.2 GEOLOGY

Geologic mapping, drilling, and geophysical logging will be performed to further evaluate the geologic setting at the Rocky Flats Plant. The scope of these activities is described below.

3.2.1 Geologic Mapping

Geologic maps will be prepared of the entire property at a scale of one inch equals 200 feet. Both surficial and bedrock geology maps will be prepared utilizing black and white aerial photography in conjunction with field mapping techniques, drilling results, and existing data. Specific goals of the mapping program are to evaluate the locations and continuity of sandstone horizons and to establish the aerial distribution of both bedrock and surficial units. Mapping procedures are described in the Project Operations Plan.

3.2.2 Drilling

Sixty-seven boreholes (Plate I) will be drilled at the Rocky Flats Plant to characterize site geology. Drilling methods will be documented, and lithologic logs will be prepared following procedures described in the Project Operations Plan.

Fifty holes will be drilled in surficial materials and continuously sampled through hollow stem augers where possible (alternate drilling methods may be required where boulders in the Rocky Flats Alluvium prohibit augering). These holes will terminate after confirming the presence and lithology of bedrock; however, they will be completed in surficial materials as shallow ground-water monitor wells.

Seventeen boreholes will extend into bedrock to be completed as bedrock monitoring wells. The bedrock holes will be augered and continuously sampled through surficial materials (where possible), and steel surface casing will be cemented in place to prevent interconnection of the shallow and deep flow systems through the borehole. The boreholes will then be cored (size NX) through bedrock. These holes will terminate in the first saturated sandstone interval with an aggregate thickness of three feet in ten feet. If sufficient sandstone thickness is not encountered after drilling through 70 feet of claystone with an average hydraulic conductivity of 5×10^{-7} centimeters/sec (cm/sec), the borehole will terminate in claystone and be completed as a piezometer (Section 3.3). Average hydraulic conductivities will be determined in the field using packer tests (Section 3.3).

3.2.3 Geophysical Logging

A minimum of four cored boreholes will be geophysically logged in order to establish a correlation between the logs and lithology. If an adequate correlation between geophysical logs and lithologic logs can be identified during this investigation, some bedrock coring may be replaced with geophysical logging in future site investigations. Geophysical logs will include natural gamma, spontaneous potential, single point resistance, and 16" resistivity.

3.3 GROUND-WATER HYDROLOGY

Both the shallow and bedrock ground-water flow systems beneath the plant will be characterized by a program of hydrologic mapping, drilling, and monitor well installation. Hydrologic properties of the subsurface materials will be evaluated by field and laboratory testing. Ground-water quality will be characterized by sampling the 67 new wells and 27 of the existing wells.

3.3.1 Hydrologic Mapping

Surficial hydrologic features such as seeps and springs will be mapped at a scale of one inch equals 200 feet. This effort will be concurrent with the geologic mapping and results will be presented on the surficial geology map. Spring discharge rates will be measured and water quality samples collected on the same schedule as the ground-water sampling program. The samples will be analyzed for ground-water quality parameters as discussed in Section 3.3.4.

3.3.2 Monitor Well Installation

Well Locations

The 67 monitor well locations shown on Plate I were selected primarily to characterize the hydrogeologic systems. Some of the monitor wells are also targeted around areas of potential ground-water contamination. Pairs of one deep well and one shallow well are shown on Plate I at several locations. These well pairs will serve to evaluate interconnection of the shallow and deep (bedrock) ground-water flow systems and vertical gradients between the two flow systems.

There are five background wells in the monitor well program to evaluate ground-water quality upgradient of the plant. One well pair (wells 54-86 and 55-86) will be located on the ridge south of Woman Creek, and another well pair (wells 46-86 and 47-86) will be located northwest of the plant security area. These wells will serve to characterize ground-water quality upgradient of the plant security area in both the Rocky Flats Alluvium and the Arapahoe Formation. A fifth background well (53-86) will be located west of the plant in the valley fill materials of Woman Creek. The well will monitor the quality of shallow ground water entering the plant site through valley fill materials.

Wells 1-86 through 4-86 have already been installed at the eastern plant property boundary and will serve to characterize ground-water quality leaving the site. Wells 1-86, 2-86, and 4-86 are completed in valley fill materials. Well 3-86 is completed in a saturated Arapahoe sandstone, which subcrops beneath the valley fill. The valley fill at this location was unsaturated at the time of drilling.

Twenty-three wells (13-86 through 36-86) are located around the solar evaporation ponds to evaluate the nature and extent of contamination from this source. These well locations have already been approved by CDH and EPA representatives. Wells 23-86 and 24-86 are located southwest of pond 207C to characterize ground-water quality upgradient of the ponds. Wells 21-86, 22-86, 25-86, 26-86, 27-86, 28-86, 31-86, and 32-86, which are located just off of the pond berms and ring the solar ponds, will be used to evaluate ground-water levels immediately adjacent to the solar ponds. Wells 20-86 and 30-86 are located along the slope north of the ponds to investigate downgradient conditions to the north, and 29-86 is located east of the ponds to evaluate ground-water flow and quality downgradient to the east. Well 18-86 is located downgradient of the ground-water interceptor trench. Water quality data from this well will be compared to data from wells upgradient of the trench to evaluate the effectiveness of the interceptor system. Wells 13-86 through 17-86 and wells 33-86 through 36-86 are located in the drainages of North Walnut Creek and South Walnut Creek, respectively, to investigate the downgradient extent of ground-water contamination emanating from the solar ponds.

Five wells are located in the vicinity of the present landfill. One well pair (wells 9-86 and 10-86) is located west of the landfill to characterize upgradient conditions,and another well pair (wells 7-86 and 8-86) is located immediately east of the landfill to evaluate downgradient conditions. A third shallow well (6-86) is located further downgradient in the landfill drainage. This well will help evaluate the downgradient extent of contamination.

Six wells are situated around the west spray field. One well pair (wells 51-86 and 52-86) is located west of the area to evaluate upgradient conditions, and a second well pair (wells 48-86 and 49-86) is located east of the spray fields to examine

downgradient conditions. Well 50-86 is located south of the spray fields, and well 45-86 is located northeast of the spray fields, to investigate ground-water flow toward Woman Creek, and North Walnut Creek, respectively.

Seven wells are located in and around the 881 and 903/mound areas. Well 61-86 is located east of Building 881 to evaluate ground-water quality and geologic conditions in this suspected source area. Wells 59-86 and 60-86 (a well pair) are located on the sideslope south of Building 881 to investigate downgradient conditions. Another well pair, 62-86 and 63-86, is located on the sideslope below the 903 area to characterize downgradient conditions in that area. Wells 43-86 and 42-86 are located upgradient and downgradient, respectively, of the mound area to evaluate ground-water flow and quality in that region.

Wells 40-86, 41-86, and 67-86 are located in the vicinity of the burial trenches east of the plant security area. Wells 40-86 and 41-86 are located on the ridge east of the trenches, and well 67-86 is located in the depression below the ridge to investigate water quality impacts of this past disposal area.

Six shallow wells are located along Woman Creek. Wells 56-86, 58-86, 64-86, 65-86, and 66-86 are located within the Woman Creek drainage to characterize ground-water flow and quality within the valley fill. Well 57-86 is located immediately downslope of the original south landfill to evaluate its impacts on ground-water quality.

Six wells (5-86, 11-86, 12-86, 37-86, and 38-86) are located in the tributaries of Walnut Creek. These wells will serve to investigate downgradient ground-water conditions within the valley fill alluvium.

One well 39-86 is located east of the plant security area on the ridge north of Walnut Creek because the soil gas survey (Tracer Research Corp., 1986) detected TCE in this area. Well 39-86 will evaluate the presence or absence of volatile organics in this area.

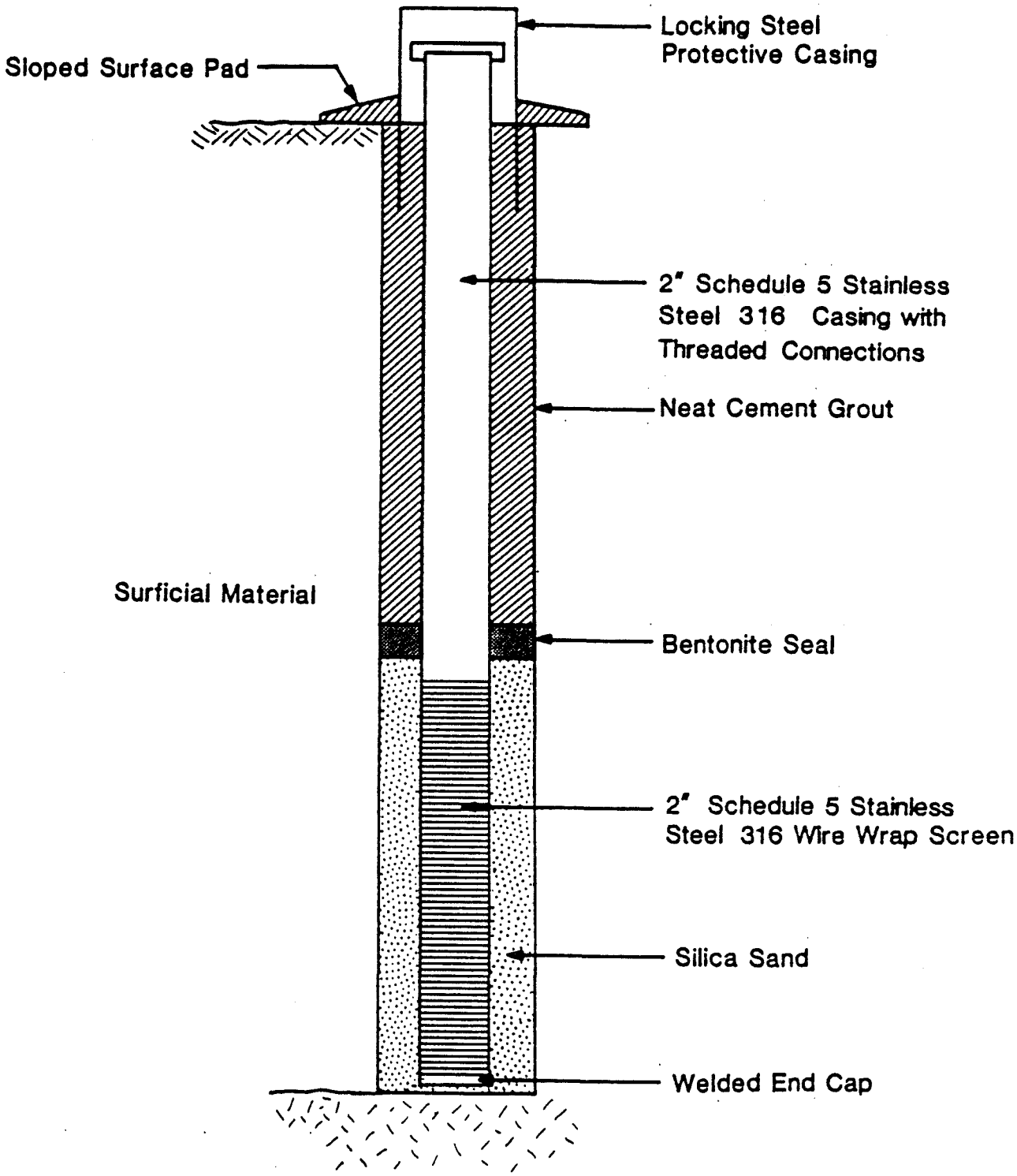
A topographic survey will be used to establish the as-built well locations to an accuracy of one foot and elevations to an accuracy of 0.01 feet.

Well Completions

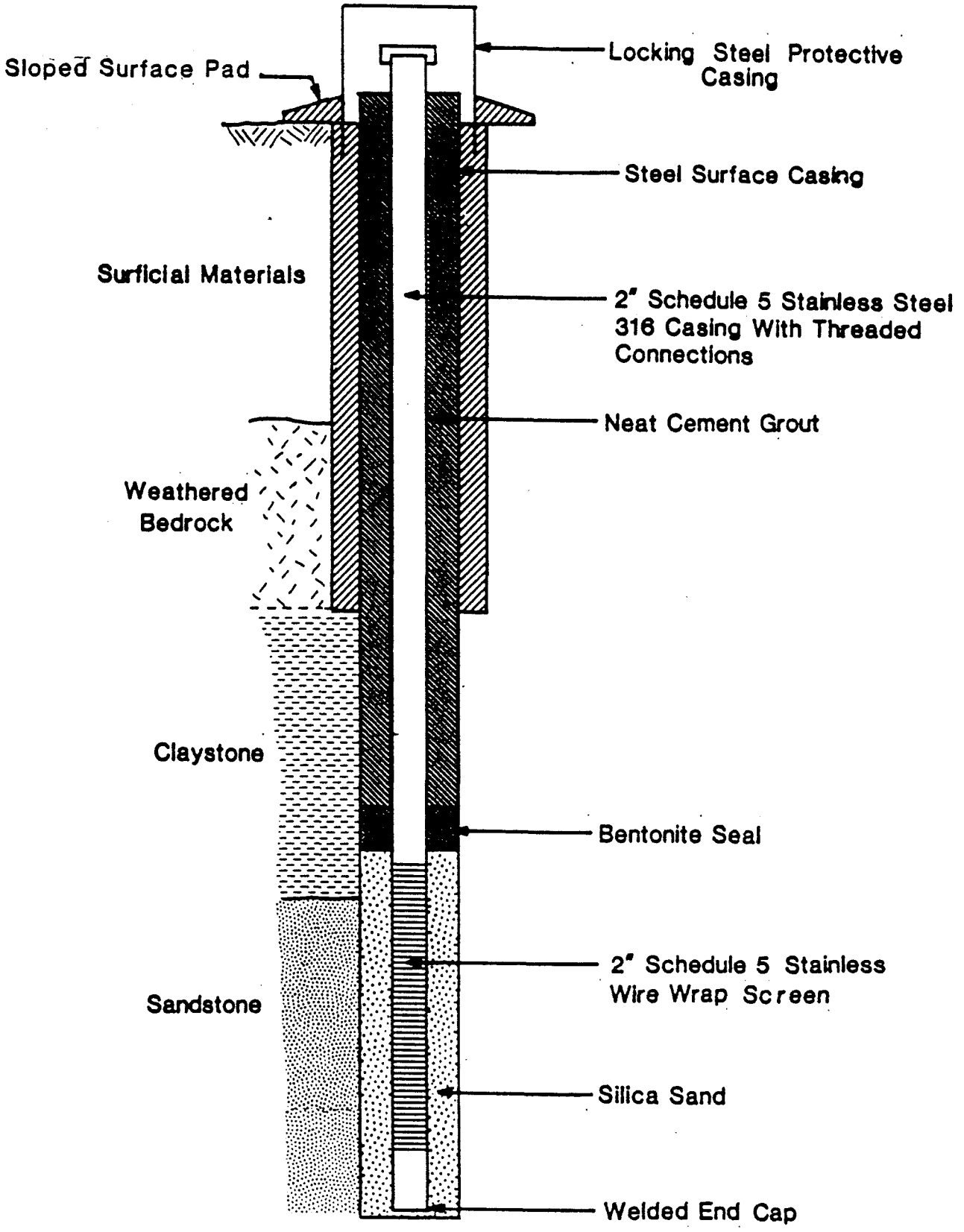
Shallow boreholes and bedrock boreholes penetrating sufficient sandstone thickness will be completed as monitor wells with two-inch diameter, Type 316, stainless steel casing. Figures 6 and 7 present well completion designs for shallow and bedrock monitor wells, respectively.

The screened interval in shallow monitor wells will extend from approximately one foot below the top of bedrock to approximately two to five feet above the water table (Figure 7). Bedrock monitor wells will be screened across the interval of saturated sandstone with a minimum screened interval of ten feet (Figure 8). A filter pack will be placed around the screened interval and will not extend more than two feet above the screen. A one-foot thick layer of bentonite pellets will be placed on top of the filter pack. The annulus above the bentonite seal will be tremie grouted to the surface using neat cement grout, and a locking steel surface casing will be cemented in place over the well. A three foot diameter concrete pad will be formed around the surface casing and slightly sloped to drain away from the casing.

Piezometers (Section 3.2) will be completed with two-inch, schedule 80 PVC casing with a ten foot screened interval at the



PROJECT 106P06222	REVISIONS	FIGURE 7.
DATE 7/21/86		SHALLOW MONITOR WELL COMPLETION DIAGRAM
Hydro-Search, Inc. CONSULTING HYDROLOGISTS-GEOLOGISTS Milwaukee • Denver • Reno		



PROJECT 106P06222	REVISIONS	FIGURE 8.
DATE 7/21/86		DEEP MONITOR WELL COMPLETION DIAGRAM
Hydro-Search, Inc. CONSULTING HYDROLOGISTS-GEOLOGISTS Milwaukee • Denver • Reno		

bottom of the hole (Figure 9). Filter pack, bentonite pellets, cement grout, a concrete surface pad, and a locking protective casing will be installed as described above. Piezometers will be used for water level measurements only and will not be sampled.

After the grout has set for at least 24 hours, all wells will be developed by either bailing, pumping, or air lifting with filtered air. Specific procedures and specifications for well completion and development are presented in the Project Operations Plan.

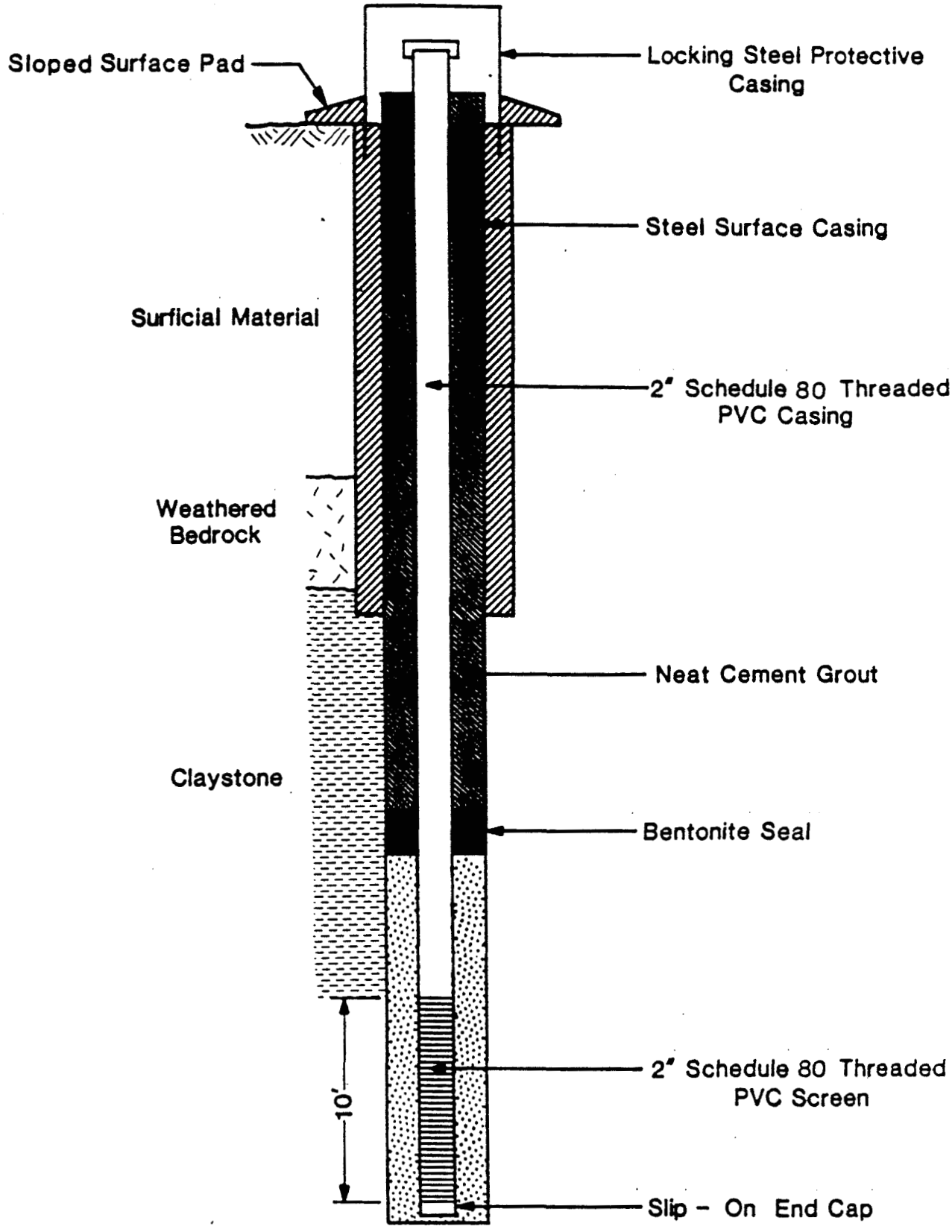
3.3.3 In-Situ Hydraulic Testing

Packer Tests

Constant head packer tests will be performed in the cored intervals of bedrock holes to evaluate in-situ hydraulic conductivities of the Arapahoe claystones and sandstones. The results of the packer tests will also be used to decide how a bedrock hole should be completed if a bedrock borehole is drilled 70 feet through claystone without encountering sufficient sandstone thickness (Section 3.2). Detailed test and analysis procedures are described in the Project Operations Plan.

Drawdown-Recovery Tests

Single hole drawdown-recovery tests will be performed in all monitor wells to evaluate the hydraulic conductivity of materials in the completion interval. Nearby monitor wells and piezometers will be used as observation wells where appropriate. Constant discharge tests will be conducted using a two-inch, stainless steel piston pump. Standard Theis techniques will be used to analyze the resulting data. Detailed test and analysis procedures are outlined in the Project Operations Plan.



PROJECT 106P06222
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REVISIONS

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CONSULTING HYDROLOGISTS-GEOLOGISTS
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FIGURE 9.

PIEZOMETER COMPLETION DIAGRAM

3.3.4 Ground-Water Sampling

Ground-water samples will be collected from both the new monitor wells and from 27 existing monitor wells (Plate I). The 27 existing wells were selected for one of two reasons. Either available data indicate they are completed in a single hydrologic unit, or concentrations of a volatile organic compound exceeded 10 ppb in samples collected from wells located near suspected contaminant source areas.

Ground-water samples will be analyzed in the field for pH, specific conductance, and temperature. With the exception of samples designated for volatile organic analysis (VOA), ground-water samples will be filtered within four hours of collection. VOA samples will not be filtered. Laboratory analyses for the initial sampling effort will include the parameters listed in Table 2. The Hazardous Substance List (HSL) constituents will be analyzed in lieu of the Appendix VIII constituents because EPA approved methodologies exist for their quantitation in soil and water. Many of the Appendix VIII constituents are not stable in water or do not have approved EPA methodologies for their quantitation.

After the Phase I investigation, ground-water sampling will continue on a quarterly basis. Quarterly analyses will include the parameters listed in Table 3 in addition to any HSL constituents identified at or above their quantitation limit during Phase I. Water levels will be measured in all sampled wells on a monthly basis.

Table 2. Phase I Ground-Water Sampling Parameters.

Field Parameters

pH
Specific Conductance
Temperature

Indicators

Total Dissolved Solids

Metals

Hazardous Substance List - Metals
Cesium
Molybdenum
Strontium

Anions

Carbonate
Bicarbonate
Chloride
Sulfate
Nitrate
Cyanide

Organics

Hazardous Substance List - Volatiles
Hazardous Substance List - Semi-Volatiles
Hazardous Substance List - Pesticides/PCB

Radionuclides

Gross Alpha
Gross Beta
Uranium 233, 234, and 238
Americium 241
Plutonium 239
Tritium

Table 3. Quarterly Ground-Water Sampling Parameters

Field Parameters

pH
Specific Conductance
Temperature

Indicators

Total Dissolved Solids

Metals

Hazardous Substance List - Metals
Cesium
Molybdenum
Strontium

Anions

Carbonate
Bicarbonate
Chloride
Sulfate
Nitrate
Cyanide

Organics

Hazardous Substance List - Volatiles

Radionuclides

Gross Alpha
Gross Beta
Uranium 233, 234, and 238
Americium 241
Plutonium 239
Tritium

3.4 SURFACE-WATER HYDROLOGY

An initial characterization of the surface-water hydrology will be achieved during Phase I by measuring discharge rates and collecting water quality samples for subsequent chemical analysis from the stations shown on Plate II.

3.4.1 Surface-Water Monitoring Locations

Forty-one surface-water monitoring stations and 13 pond sampling locations are shown on Plate II. Continuous discharge measurements and daily water quality samples are currently being collected by Rockwell International at the sites below retention ponds A-3, A-4, B-5, and C-2 and in Walnut Creek at the eastern property boundary as part of the plant NPDES permit requirements (Figure 5). Permanent Parshall flumes are located at these sites, which will be used to measure discharge during the surface-water investigation. All monitoring stations will be staked and identified in the field for future monitoring events.

Four monitoring stations are located west of the plant security area to evaluate surface-water entering the plant site. One of these stations is located in Rock Creek, two in Walnut Creek (upstream and downstream of the clay pits), and one in Woman Creek.

Three stations are located at the eastern property boundary to investigate surface-water leaving the Rocky Flats Plant. One station is in Woman Creek and another is in the Woman Creek diversion ditch. The third station is in Walnut Creek where it leaves the property. A Parshall flume is already installed at this station as part of the plant NPDES permit requirements.

Nine stations are located along Woman Creek south of the plant security area. Stations will be placed both upstream and downstream of drainage confluences to evaluate the discharge rates and water quality of each tributary. Two stations are located between ponds C-1 and C-2 to examine pond C-1 discharge and water quality. The station below pond C-2 is an existing station with a Parshall flume and will serve to measure pond C-2 discharge and water quality.

Seven surface-water monitoring stations are located along the interceptor ditch south of the plant security area. These stations are located upstream and downstream of suspected contaminant sources north of the ditch (original south landfill, Building 881, 903 hillside, and burial trenches).

Five stations are located in the South Walnut Creek drainage. One station is upstream and one station is downstream of the waste treatment plant to examine its impacts on surface water. The other two stations are located further downstream. One station is below pond B-4 and another is below pond B-5 to investigate pond discharge rates and quality. A permanent Parshall flume is located below pond B-5 and will be used to measure discharge rates at this station. The fifth station is located in the ditch just east of the plant security area, north of South Walnut Creek.

Six monitoring locations are shown along North Walnut Creek. Three stations are located northwest of the plant security area upstream and downstream of the McKay Ditch diversion structure. Another station is located east of Building 371 to investigate plant runoff from the 300 area. A fifth station is located east of the perimeter road to evaluate surface water flowing into the A series ponds, and the sixth station is located below pond A-4 to evaluate discharge from pond A-4.

Three surface-water monitoring stations are located in the landfill drainage. One station is located upstream of the landfill pond and will be sampled during storm events. Another station is located below the landfill pond to investigate discharge and water quality from the pond, and the third station is located further downstream to evaluate surface water entering Walnut Creek from the landfill drainage.

Two stations are located along the Central Avenue drainage ditch and will be sampled to investigate plant runoff quality if sufficient flow exists.

The remaining three monitoring stations are located northwest of the plant security area. One is on McKay Ditch north of the plant, and the other two are in Rock Creek to evaluate discharge rates and water quality leaving the plant site in these drainages.

When a major precipitation event occurs that results in runoff from the plant, discharge rates will be measured and quality samples collected at eight of the monitoring stations (Plate II). Six of these stations are located close to plant facilities to evaluate the impacts of plant runoff during peak flows. The other two stations are downgradient of the plant.

One-time water samples will be collected from the A, B, and C series ponds, the landfill pond, and the raw water supply pond as part of this monitoring effort (Plate II). These samples will serve to evaluate the relationship between pond and surface water quality. Three samples will also be collected from pond 207B-North, 207B-Center, and 207B-South. Ponds 207B-Center and 207B-South receive waste water from the sewage treatment plant, and pond 207B-North receives water pumped back from the groundwater interceptor system. Ponds 207A and 207C were recently

sampled as part of a process waste stream characterization. Therefore, they will not be sampled during this investigation.

3.4.2 Surface-Water Monitoring Events

Surface-water monitoring in the drainages and ditches will consist of grab sample collection and discharge measurement. A Cutthroat flume will be temporarily placed in the drainages at the designated station during monitoring to measure discharge rates. If channel dimensions or flow conditions render a flume installation infeasible, discharge rates will be estimated by measuring channel dimensions and flow velocity.

Only one monitoring event is scheduled for the stations shown on Plate II during this investigation. However, surface-water monitoring will continue on a quarterly basis.

3.4.3 Surface-Water Sampling Parameters

Surface-water samples will be analyzed in the field for pH, specific conductance, temperature, and dissolved oxygen, and in the laboratory for the parameters listed in Table 4 during Phase I. Quarterly analyses will be made thereafter for the parameters listed in Table 5 in addition to any hazardous substances identified at or above their quantitation limit during the Phase I investigation. The Project Operations Plan presents detailed surface-water sampling procedures.

3.5 SEDIMENTS

One time sediment sampling will be performed in the drainages and ditches in order to evaluate:

1) transport of suspended constituents by surface water;

Table 4. Phase I Surface-Water Sampling Parameters.

Field Parameters

pH
Specific Conductance
Temperature
Dissolved Oxygen

Indicators

Total Dissolved Solids
Total Suspended Solids

Metals

Hazardous Substance List - Metals
Cesium
Molybdenum
Strontium

Anions

Carbonate
Bicarbonate
Chloride
Sulfate
Nitrate
Cyanide
Phosphate

Organics

Hazardous Substance List - Volatiles
Hazardous Substance List - Semi-Volatiles
Hazardous Substance List - Pesticides/PCB

Radionuclides

Gross Alpha
Gross Beta
Uranium 233, 234, and 238
Americium 241
Plutonium 239
Tritium

Table 5. Quarterly Surface-Water Sampling Parameters.

Field Parameters

pH
Specific Conductance
Temperature
Dissolved Oxygen

Indicators

Total Dissolved Solids
Total Suspended Solids

Metals

Hazardous Substance List - Metals
Cesium
Molybdenum
Strontium

Anions

Carbonate
Bicarbonate
Chloride
Sulfate
Nitrate
Cyanide
Phosphate

Radionuclides

Gross Alpha
Gross Beta
Uranium 233, 234, and 238
Americium 241
Plutonium 239
Tritium

2) attenuation of constituents dissolved in surface water by the sediments; and

3) potential for leaching of constituents from the sediments into either surface or ground water.

3.5.1 Sediment Sampling Locations

Sediment sampling stations are located in close proximity to surface water stations (Plate II) and up- and downgradient of suspected contaminant sources. These locations will be staked and identified in the field for future sampling events.

3.5.2 Sediment Sampling Parameters

Sediment samples will be analyzed for the parameters listed in Table 6. The Project Operations Plan describes detailed sediment sampling procedures.

3.6 LABORATORY MATERIALS TESTING

3.6.1 Chemical Analyses

Chemical analyses will be conducted on surficial and bedrock samples obtained from the shallow monitoring wells in the vicinity of the solar evaporation ponds to evaluate the nature and vertical extent of contamination. This information will be used in conjunction with the ground-water plume characterization to develop closure and post-closure plans for the solar evaporation ponds. Surficial and bedrock samples for chemical analyses will be obtained with split spoon samplers, according to the procedures specified in the Project Operations Plan, at monitoring wells 18-86, 20-86, 22-86, 25-86, and 28-86.

Three materials samples will be obtained at each boring. One sample will be obtained in surficial materials, one sample in

Table 6. Phase I Sediment Sampling Parameters.

Metals

Hazardous Substance List - Metals
Cesium
Molybdenum
Strontium

Anions

Chloride
Sulfate
Nitrate
Cyanide
Phosphate

Organics

Hazardous Substance List - Volatiles
Hazardous Substance List - Semi-Volatiles
Hazardous Substance List - Pesticides

Radionuclides

Gross Alpha
Gross Beta
Uranium 233, 234, and 238
Americium 241
Plutonium 239
Tritium

weathered bedrock, and one sample five feet into unweathered bedrock. Sampling depths will be determined in the field by visual logging of continuous samples, the drill cuttings, and drilling resistance. Obtaining samples in the Rocky Flats Alluvium will probably not be possible. Therefore, samples of the alluvium will be collected from the fine-grained portions of the deposit.

Samples obtained for chemical testing will be analyzed for the parameters in Table 6. Procedures for sampling, sample management, and testing are presented in the Project Operations Plan.

3.6.2 Physical Testing

Laboratory tests will be performed on selected materials to evaluate permeabilities, effective porosities, and grain size distributions of subsurface materials.

Permeability Testing

Falling head laboratory permeability tests will be performed on undisturbed samples of the Arapahoe claystones and sandstones to investigate the relationship between horizontal and vertical permeabilities. At least six samples of each lithology will be tested to account for sample variability. Samples will be selected by the field operations manager considering factors such as representativeness of the sample, condition of the core for laboratory preparation, location of the sample within the geologic profile, and the location of the monitoring well relative to known or suspected hazardous releases.

Capillary Moisture Testing

The physical property testing discussed above and capillary moisture tests will conducted on bedrock samples obtained from the core as close to the permeability test sample as possible. The capillary moisture testing will be conducted to estimate effective porosity following ASTM Method D-3152-72.

Physical Properties Testing

Physical testing will be conducted on surficial materials and bedrock samples obtained from the monitoring wells. Testing will be conducted to:

1) develop a basis for selecting screen and filter pack sizes for the monitoring wells;
2) compare the visual field classifications on the drill logs with the laboratory results; and
3) calculate permeability values for the lithologic units based on empirical correlations to physical properties.

Physical properties testing will be performed on selected samples of the Rocky Flats Alluvium, valley fill alluvium, colluvium, and Arapahoe sandstones and claystones. Hydrometer tests will also be performed if more than 50 percent of a sample passes the 200 mesh sieve. Grain size testing will begin with samples of valley fill and Arapahoe sandstone from wells 1-86 through 4-86. Additional grain size analyses will be performed on these and other materials as drilling progresses.

Samples will be obtained for each lithologic unit encountered in twenty-one monitoring wells located outside the plant security area. Samples will be obtained from monitoring wells 5-86, 7-86, 8-86, 14-86, 15-86, 39-86, 40-86, 41-86, 46-86, 47-86, 48-86, 49-86, 54-86, 55-86, 56-86, 59-86, 60-86, 62-86, 63-86, 64-86 and 65-86. Where well pairs are drilled, surficial materials will be

sampled in the shallow wells, and bedrock will be sampled in the deep wells. The well locations for physical property testing were selected to provide representative samples of the surficial and bedrock units based on existing knowledge of the site. Sufficient data exists within the plant security area from previous soil and foundation investigations to characterize the Rocky Flats Alluvium and near surface Arapahoe Formation. Thus, in the plant security area, physical property testing will only be conducted on samples taken adjacent to the soil chemistry samples around the solar ponds.

The following table lists the proposed physical testing of soil and bedrock samples along with a citation of the appropriate procedure.

Test	Reference
Grain Size Distribution	ASTM D-422, ASTM D-1140
Atterberg Limits	ASTM D-4318
Unit Weight	EM 1110-2-1906
Hydrometer Analysis	ASTM D-4221
Water Content	ASTM D-2216
Preparation of Soil Samples	ASTM D-421, ASTM D-2217

Detailed laboratory test procedures are presented in the Project Operations Plan.

The physical property testing of the soil and bedrock may be suspended if the test results are consistent. Consistency will be measured by physical property data which results in the same Unified Soil Classification soil symbol for granular soils and plasticity limits with a range of plus or minus 5 for soils finer than the U.S. No. 200 sieve.

4.0 SCHEDULING

Figure 8 presents the graphic schedule for all Phase I activities. Field work is scheduled to begin the week of August 4th pending approval of this work plan by CDH and EPA.

FIGURE 10 GRAPHIC SCHEDULE

PROJECT: 106P06222
PREPARED BY: HSI
PREPARED FOR: ROCKWELL INTERNATIONAL

TASK DESCRIPTION		JULY 7	14	21	28	AUGUST 4	11	18	25	SEPTEMBER 1	8	15	22	29	OCTOBER 6	13	20	27	NOVEMBER 3	10	17	24	DECEMBER 1	8	15
PHASE I WORK PLAN	PROPOSED																								
	ACTUAL		7/21																						
DRAFT	PROPOSED																								
	ACTUAL																								
REVIEW	PROPOSED																								
	ACTUAL																								
FINAL	PROPOSED																								
	ACTUAL																								
	PROPOSED																								
	ACTUAL																								
PHASE I INVESTIGATION	PROPOSED																								
	ACTUAL																								
SURFICIAL MAPPING	PROPOSED																								
	ACTUAL																								
DRILLING & WELL COMPLETION	PROPOSED																								
	ACTUAL																								
WELL DEVELOPMENT	PROPOSED																								
	ACTUAL																								
GROUND - WATER SAMPLING	PROPOSED																								
	ACTUAL																								
SINGLE HOLE PUMP TESTS	PROPOSED																								
	ACTUAL																								
SURFACE - WATER SAMPLING	PROPOSED																								
	ACTUAL																								
SEDIMENT SAMPLING	PROPOSED																								
	ACTUAL																								
LABORATORY ANALYSES	PROPOSED																								
	ACTUAL																								
CHEMICAL	PROPOSED																								
	ACTUAL																								
PHYSICAL	PROPOSED																								
	ACTUAL																								
DATA ANALYSIS	PROPOSED																								
	ACTUAL																								
	PROPOSED																								
	ACTUAL																								
PHASE I REPORTS	PROPOSED																								
	ACTUAL																								
DRAFT	PROPOSED																								
	ACTUAL																								
REVIEW	PROPOSED																								
	ACTUAL																					11/28			
FINAL	PROPOSED																								
	ACTUAL																								
	PROPOSED																								
	ACTUAL																								
	PROPOSED																								
	ACTUAL																								
	PROPOSED																								
	ACTUAL																								

COMMENTS:

APPROVED BY:

DATE OF REPORT: 7/21/86

REVISION DATE:

SHEET NO.

Hydro-Search, Inc.

5.0 REFERENCES

Costa, J.E. and Bilodeau, S.W., 1982, Geology of Denver, Colorado, United States of America: Bulletin of the Association of Engineering Geologists, XIX, 3, pp. 261-314)

Hurr, R.T., 1976, Hydrology of a Nuclear-Processing Plant Site, Rocky Flats, Jefferson County, Colorado: U.S. Geological Survey Open File Report 76-268.

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Robson, S.G., Romero, J.C., and Zawistowki, S., 1981, Geologic Structure, Hydrology, and Water Quality of the Arapahoe Aquifer in the Denver Basin, Colorado: U.S. Geological Survey, Atlas HA-647.

Rockwell International, 1985, Annual Environmental Monitoring Report, Rocky Flats Plant, Golden, Colorado.

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Tracer Research Corp., 1986, Shallow Soil Gas Investigation of the Rocky Flats Plant, Golden, Colorado.

U.S. Department of Energy, 1985, RCRA Part B Permit Application for Radioactive Mixed Waste, Rocky Flats Plant, Golden, Colorado.

U.S. Department of Energy, 1986, Comprehensive Environmental Assessment and Response Program Phase I: Installation Assessment, Rocky Flats Plant.

APPENDIX A-3

SAMPLING PLAN FOR TEST PITS
WEST SPRAY FIELDS
1988

The Sampling Plan for the test pits in the West Spray Field is currently being prepared by Chen & Associates under the direction of Frank Blaha (Rockwell International). An agreement has been made between Chen and Rockwell stipulating that the Sampling Plan will be completed by September 15, 1988.

APPENDIX B

HYDROGEOLOGIC DATA

1986 MONITOR WELLS

EXPLANATION OF SYMBOLS AND TERMS ON BORING LOGS

SAMPLE TYPE

Split Spoon

NC Core

Continuous Drive

Bulk

GRAPHIC LOG

Clay or Shale

Clayey Sand or Sandy Clay

Gravel

Sand or Sandstone

Sand and Gravel

Silt or Siltstone

WATER CONTENT

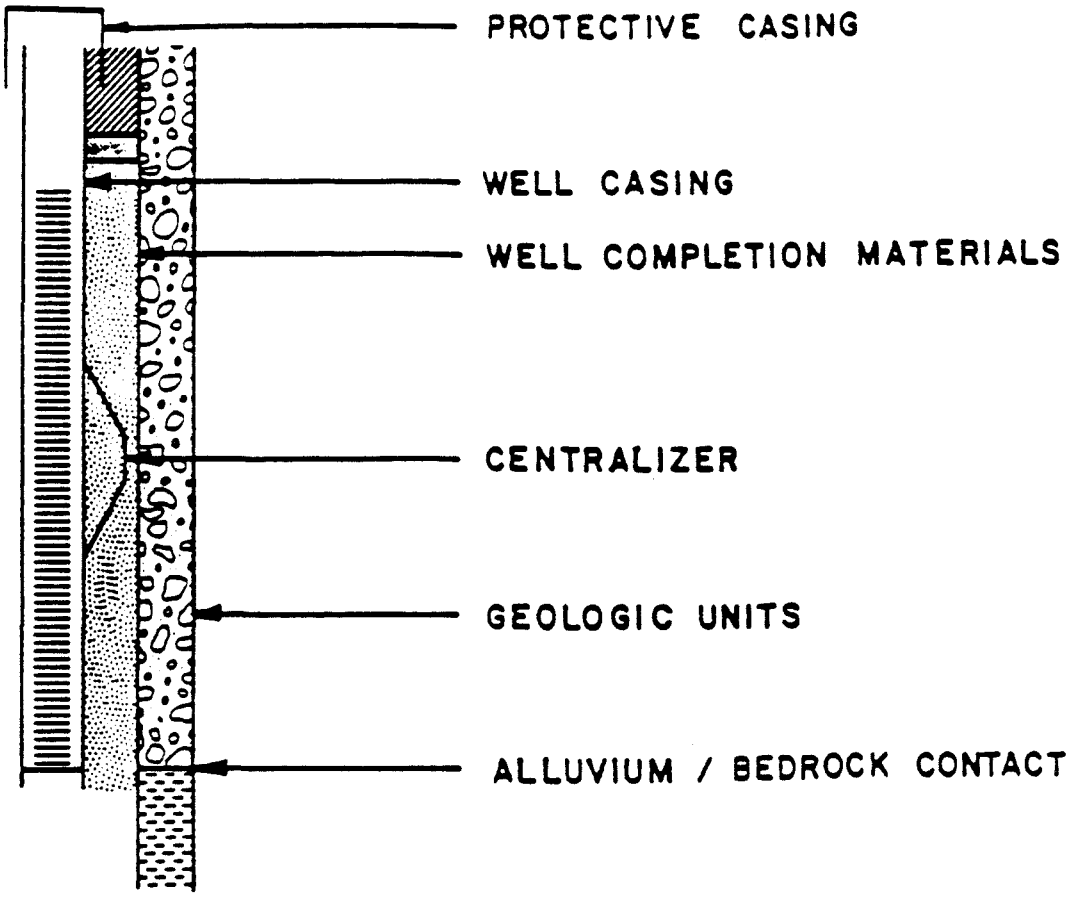
WATER LEVEL FOUND DURING DRILLING

STATIC WATER LEVEL ON 10/13/88

PENETRATION RESISTANCE

6/6 STANDARD PENETRATION TEST RESULTS BLOWS PER INCH.

EXPLANATION OF SYMBOLS ON WELL CONSTRUCTION SUMMARIES



WELL CASING

BLANK

SCREEN

WELL COMPLETION MATERIALS

CEMENT GROUT

BENTONITE PELLETS

SAND PACK

CUTTINGS

GEOLOGIC MATERIALS

EXPLANATION PRESENTED IN LOG OF BORING EXPLANATION.

INDEX OF DATA

Boring No.: 45-86

Completed as well? Yes

Data in File

X Log of Borehole

X Well Construction Summaries

X Well Development Summaries

X Hydraulic Conductivity Test Data and Results

____ Packer Test Data and Results

X Water Level Data

____ Saturated Thickness Hydrograph

Project:	Rocky Flats Plant	LOG OF BORING NO.	45-86

Date Drilled	10/2/86	**Coordinates**	N 37348.3 E 16363.2
Boring Method	Casing Driver	**Ground Surface Elevation**	6049.74'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	0			ROCKY FLATS ALLUVIUM			
				0-3.0'-Cuttings. GRAVEL: moderate brown (10YR 4/4); ~60% granitic pebbles and cobbles; 40% sand and silt; poorly sorted, unconsolidated; damp.			
				3.0-8.0'-Cuttings. GRAVEL: moderate brown (10YR 4/4); granite and quartzite pebbles and cobbles; <5% sand and silt; poorly sorted, unconsolidated; damp.			
	5						
				8.0-10.0'-Cuttings. GRAVEL: Same as above; moist.			
	10			10.0-14.5'-Cuttings. GRAVEL: Same as above; moist.			
	15			14.5-19.0'-Cuttings. BOULDERS: quartzite cobbles and boulders; poorly sorted; unconsolidated; damp.			
	20						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO.	45-86
Date Drilled	10/2/86	Coordinates	N 37348.3 E 16363.2
Boring Method	Casing Driver	Ground Surface Elevation	6049.74'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	20			19.0-23.0'-Cuttings. GRAVEL: moderate brown (10YR 4/4); granitic pebbles and cobbles; sandy and silty; poorly sorted; unconsolidated; damp.			
				23.0-25.0'-Cuttings. GRAVEL: Same as above; damp.			
	25			25.0-28.0'-Cuttings. SAND: light olive gray (5Y 5/2); medium to coarse-grained; some granitic pebbles; poorly sorted; subrounded; unconsolidated; damp.			
				28.0-43.0'-Cuttings. GRAVEL: moderate brown (10YR 4/4); some silt and sand; poorly sorted; unconsolidated; wet.			
	30						
	35						
	40						

Remarks: Logged by: T. Gulliver

Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO.	45-86

Date Drilled	10/2/86	**Coordinates**	N 37348.3 E 16363.2
Boring Method	Casing Driver	**Ground Surface Elevation**	6049.74'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	40			43.0-47.0'-Cuttings. GRAVEL: moderate brown (10YR 4/4); 20-30% sand and silt; poorly sorted; unconsolidated; wet.			
	45			LARAMIE FORMATION 47.0-55.0'-Cuttings. SILTSTONE: light olive brown (5Y 5/6); well sorted; damp.			
	50						
	55			TOTAL DEPTH: 55.0'			
	60						

Remarks Logged by: T. Gulliver Checked by: [illegible]

Project No. 106P06222

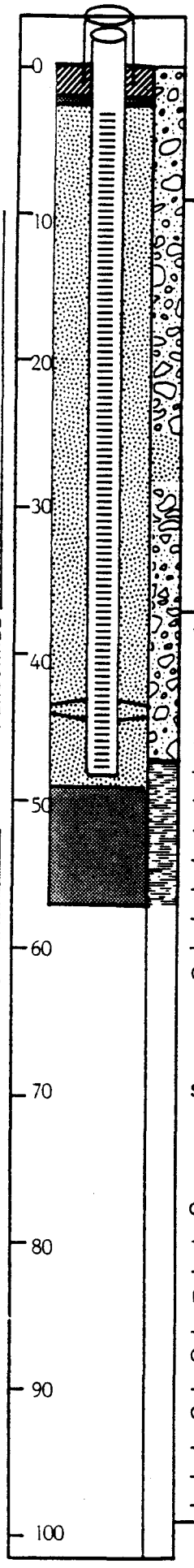
Hydro-Search, Inc.

WELL 45-86

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: N 37348.3 E 16363.2

ELEVATION: GROUND LEVEL 6049.74'
TOP OF CASING 6051.72'



PROJECT 106PO6222 Rocky Flats Plant
PERSONNEL T. Gulliver
LOCATION Golden, CO

DRILLING SUMMARY:

TOTAL DEPTH Well: 48.20' Hole: 57.00'
BOREHOLE DIAMETER 5 5/8"

DRILLER Boyles Brothers Drilling Co.
15865 W. 5th Avenue, Golden, CO
(Subcontracted Arrow Drilling, Tom High)
RIG Casing Advancer
BIT(S) Down hole hammer

DRILLING FLUID None

SURFACE CASING 5" x 4.5' steel w/ locking cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00'	2.99'	C1			
2.99'	48.20'	S1			

CASING: C1 2" I.D. Sch. 5 type 316, stainless steel, threaded and flush jointed.

SCREEN: S1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed, 0.010" wire wrap screen, 0.25' welded bottom cap.

CENTRALIZERS Type 304 stainless steel
43.47' - 44.70'

FILTER MATERIAL 32-42 silica sand
2.48' - 49.30'

CEMENT Portland Type I
0.00' - 1.80'

OTHER 3/8" bentonite pellets
1.80' - 2.48'
49.30' - 57.00'

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" casing driver	10/2	0900	10/2	1515
GEOPHYS. LOGGING:	—	—	—	—
CASING:				
2" stainless	10/3	0950	10/3	1000
FILTER PLACEMENT:	10/3	1000	10/3	1600
CEMENTING:	10/3	1605	10/3	1620
DEVELOPMENT:				
OTHER:				
Bentonite	10/3	0935	10/3	0950
	10/3	1600	10/3	1605

WELL DEVELOPMENT

See Well Development Summary Sheet

COMMENTS:

No water encountered during drilling.

Top of stainless steel casing: 1.97'

Well No.: 45-86

WELL DEVELOPMENT SUMMARY SHEET

DATE	TIME	METHOD	VOLUME	APPEARANCE	COMMENTS
10-7-86	0915				1 Well Bore Volume = 4.24 10 Well Bore Volume = 42.4
10-7-86	0915	Airlifted	N/A	Lt-med brown spray-lots of sand	7' of sand lifted out before reaching TD
10-8-86	1500	Bailed	12 gals	Med-dark brown highly turbid; lots of sand	12/42.4 gals purged to date
10-9-86	0900	Airlifted	~ 4.2 gals	Med-dark brown spray	
10-9-86	1500	Bailed	16 gals	Medium brown clearing slightly	28/42.4 gals purged to date
10-12-86	1410	Bailed	16 gals	Bottom 3' Lt brown rest of well medium brown	44/42.4 gals purged to date
10-14-86	1200	Bailed	12 gals	Light-medium brown	56/42.4 gals purged to date
10-15-86	0830	Airlifted	---	Med brown mist A lot of sand	-----
10-15-86	1400	Bailed	25 gals	Lt-clear bottom; Lt-med brown top	81/42.4 gals purged to date
10-16-86	1200	Bailed	---	Lt to clear bottom Lt-med brown top	Sampled

RAW DATA

WELL # 45-86

WELL DIAMETER= 5.63 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER= 1.53 GALLONS *
LENGTH OF AQUIFER TESTED= 26.19 FEET
VALUE OF H0= 9.36 FEET
STATIC WATER LEVEL= 22.01 FEET
LENGTH OF SCREEN= 45.21 FEET
WATER TABLE TO BOTTOM OF WELL= 26.19 FEET

SLUG TEST DATA:

TIME	WATER LEVEL (FEET)	TIME SINCE TEST BEGAN (MINUTES)
0. 0.45	31.37	.75
0. 1.15	29.62	1.25
0. 1.30	28.90	1.50
0. 2. 0	28.03	2.00
0. 2.30	27.43	2.50
0. 3. 0	27.10	3.00
0. 3.30	26.72	3.50
0. 4. 0	26.34	4.00
0. 4.30	25.87	4.50
0. 5. 0	25.58	5.00
0. 5.30	25.27	5.50
0. 6. 0	25.00	6.00
0. 7. 0	24.73	7.00
0. 8. 0	24.45	8.00
0. 9. 0	24.16	9.00
0.10. 0	23.87	10.00
0.11. 0	23.63	11.00
0.12. 0	23.43	12.00
0.13. 0	23.25	13.00
0.14. 0	23.08	14.00
0.15. 0	22.98	15.00

* Value of Ho set at drawdown at 45 seconds. Volume of water recovered is calculated from this assumed Ho. Test data sheet indicates no water was removed from well by airlift.

WELL # 45-86

WELL DIAMETER= 5.63 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= 1.53 GALLONS
LENGTH OF AQUIFER TESTED= 26.19 FEET
VALUE OF H0= 9.36 FEET
STATIC WATER LEVEL= 22.01 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.75	31.37	9.36	1.000	1.333
1.25	29.62	7.61	.813	.800
1.50	28.90	6.89	.736	.667
2.00	28.03	6.02	.643	.500
2.50	27.43	5.42	.579	.400
3.00	27.10	5.09	.544	.333
3.50	26.72	4.71	.503	.286
4.00	26.34	4.33	.463	.250
4.50	25.87	3.86	.412	.222
5.00	25.58	3.57	.381	.200
5.50	25.27	3.26	.348	.182
6.00	25.00	2.99	.319	.167
7.00	24.73	2.72	.291	.143
8.00	24.45	2.44	.261	.125
9.00	24.16	2.15	.230	.111
10.00	23.87	1.86	.199	.100
11.00	23.63	1.62	.173	.091
12.00	23.43	1.42	.152	.083
13.00	23.25	1.24	.132	.077
14.00	23.08	1.07	.114	.071
15.00	22.98	.97	.104	.067

WELL # 45-86

PERMEABILITY BASED ON COOPER, BREDEHOEFT, AND PAPADOPULOS METHOD

```
          PERMEABILITY=1.35E-04/ MATCH TIME (IN MINUTES)
          STORAGE COEF=  .13     * ALPHA
     COMPUTER CALCULATES
          ALPHA=1.00E-05 MATCH TIME=  1.6
          PERMEABILITY= 8.32E-05 CM/SEC
          STORAGE COEF=1.26E-06
          CORRELATION NUMBER=  1.00
```

PERMEABILITY BASED ON REGRESSION FIT OF HEAD RATIO DATA

```
          HVORSLEV PERMEABILITY=3.18E-04 / LAG TIME
          BOUWER PERMEABILTY=3.35E-04 * -SLOPE

     COMPUTER CALCULATES
          HVORSLEV PERMEABILITY=5.60E-05 CM/SEC
          BOUWER PERMEABILITY=2.10E-05 CM/SEC
               REGRESSION STATISTICS
                    X ON Y
                      INTERCEPT= -.08
                      SLOPE=-6.23E-02
                    Y ON X
                      INTERCEPT= -.07
                      SLOPE=-6.29E-02
                    CORRELATION COEFFICIENT=-1.00
     CALCULATIONS INDICATE THAT A VALUE OF  10.47 FEET FOR H0
          OR A VALUE OF    1.891 INCHES FOR EFFECTIVE CASING DIA.
          MAY YIELD BETTER RESULTS
```

PERMEABILITY BASED ON REGRESSION FIT OF DATA - FERRIS & KNOWLES METH

```
          PERMEABILITY=3.15E-04 / SLOPE
          PERMEABILITY=1.82E-05 CM/SEC
               REGRESSION STATISTICS
                    X ON Y
                      INTERCEPT=  .05
                      SLOPE= 1.72E+01
                    Y ON X
                      INTERCEPT=  .01
                SLOPE= 1.75E+01
                    CORRELATION COEFFICIENT=  .99
```

WELL #	PERMEABILITY METHOD 1	PERMEABILITY METHOD 2	STORAGE COEF METHOD 2	PERMEABILITY METHOD 3	PERMEABILI METHOD 4
45-86	5.60E-05	8.32E-05	1.26E-06	1.82E-05	2.10E-05

* METHOD 1 IS HVORSLEV
  METHOD 2 IS COOPER, BREDEHOEFT, AND PAPADOPULOS
  METHOD 3 IS FERRIS AND KNOWLES
  METHOD 4 IS BOUWER

AQUIFER TEST DATA

WELL 45-86
PUMPING or OBSERVATION WELL
PUMPING or RECOVERY DATA
PAGE 1 OF 1

TYPE OF AQUIFER TEST Airlift Recovery Test
HOW Q MEASURED 4½ Gallon Bucket
HOW W.L.'s MEASURED Olympic Well Probe
RAD./DIST. OF/FROM PUMPING WELL —
MEAS. POINT FOR W.L.'s top of PVC
ELEVATION OF MEAS. POINT —

DEPTH OF PUMP/AIRPIPE
PUMP ON: date 10-22-86 time 15:08:3
PUMP OFF: date 10-22-86 time 15:14:
DURATION OF AQUIFER TEST 20.5 minu

LOCATION
PERSONNEL
PROJECT

TIME t = 5:30 at t' = 0				WATER LEVEL DATA STATIC WATER LEVEL 22.01'					DISCHARGE		RECORDED BY	COMMENTS
DAY	CLOCK TIME	t	t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	s or s'		READING	Q		
	1503			20+3.95	1.94	22.01	—				OP	STATIC
												TD @ 50.
	1508	30	0									Surged 2 t
	1514	5.5	0		2.48							Stop Air li
	1514:45	6	.25	30+3.85	1.94+0.54	31.37	9.36					
	1515:13	6.75	1.25	30+2.10	"	29.62	7.61					No water
	30	7.0	1.5	30+1.38	"	28.90	6.89					come out of
	1516	7.5	2	30+0.51	"	28.03	6.02					column, gra
	30	8.0	2.5	25+4.91	2.48	27.43	5.42					water level
	1517	8.5	3	25+4.58	"	27.10	5.09					drop into
	30	9.0	3.5	25+4.20	"	26.72	4.71					formation
	1518	9.5	4	25+3.82	"	26.34	4.33					
	30	10.0	4.5	25+3.35	"	25.87	3.86					
	1519	10.5	5	25+3.06		25.58	3.57					
	30	11.0	5.5	25+2.75		25.27	3.26					
	1520	11.5	6	25+2.48		25.00	2.99					
	1521	12.5	7	25+2.21		24.73	2.72					
	1522	13.5	8	25+1.93		24.45	2.44					
	1523	14.5	9	25+1.64		24.16	2.15					
	1524	15.5	10	25+1.35		23.87	1.86					90% @ 20
	1525	16.5	11	25+1.11		23.63	1.62					
	1526	17.5	12	25+0.91		23.43	1.42					
	1527	18.5	13	25+0.73		23.25	1.24					
	1528	19.5	14	25+0.56		23.08	1.07					
	1529	20.5	15	25+0.46		22.98	0.97					Stop Test

6.45 / 7.45 / 40

08/15/88

ROCKY FLATS WEST SPRAY FIELD

WATER LEVEL SUMMARY

WELL NUMBER	SAMPLE DATE	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	STICK UP	DEPTH OF SI BASE	ELEVATION OF SI TOP	ELEVATION OF SI BOTTOM	TOTAL DEPTH OF WELL	WATER DEPTH BELOW TOC	WATER SURFACE ELEVATION
4586	10/07/86	6049.74	6051.72	1.98	48.20	6046.75	6001.54	48.20	24.15	6027.57
	10/08/86								24.15	6027.57
	10/10/86								23.62	6028.10
	10/13/86								23.81	6027.91
	10/15/86								24.13	6027.59
	10/16/86								24.05	6027.67
	11/26/86								9.03	6042.69
	01/01/87								6.75	6044.97
	02/01/87								8.90	6042.82
	03/31/87								4.31	6047.41
	05/06/87								4.52	6047.20
	06/01/87								4.83	6046.89
	07/08/87								5.35	6046.37
	08/03/87								8.00	6043.72
	08/14/87								21.10	6030.62
	08/31/87								20.40	6031.32
	09/28/87								43.50	6008.22
	11/03/87								21.60	6030.12
	12/07/87								20.20	6031.52
	01/05/88								23.10	6028.62
	02/03/88								6.50	6045.22
	03/14/88								5.80	6045.92
	04/11/88								6.70	6045.02
	05/12/88								5.20	6046.52

INDEX OF DATA

Boring No.: 46-86

Completed as well? Yes

Data in File

X Log of Borehole

X Well Construction Summaries

X Well Development Summaries

____ Hydraulic Conductivity Test Data and Results

X Packer Test Data and Results

X Water Level Data

____ Saturated Thickness Hydrograph

Project:	Rocky Flats Plant	LOG OF BORING NO. 46-86
Date Drilled	9/16/86, 9/17/86, 10/9/86	Coordinates N 37890.6 E 15178.8
Boring Method	Casing Driver /NC Core	Ground Surface Elevation 6081.71'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/ Inch) 20 40	Water Content (%) 20 40	Other Tests
	0			ROCKY FLATS ALLUVIUM 0-8.0'-Cuttings. GRAVEL: gray orange (10YR 7/6); granite and quartzite pebbles and cobbles; some silt and quartz sand; poorly sorted; unconsolidated; dry.			
	5						
				8.0-13.0'-Cuttings. GRAVEL: same as above; wet.			
	10						
				13.0-17.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); granite, quartzite and muscovite pebbles; some sand and silt; trace limonitic clay; poorly sorted; angular; unconsolidated; damp.			
	15						
				17.0-20.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); 40-60% quartzite cobbles; sandy and silty; poorly sorted; unconsolidated; damp.			
	20						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 46-86
Date Drilled	9/16/86, 9/17/86, 10/9/86	Coordinates N 37890.6 E 15178.8
Boring Method	Casing Driver/NC Core	Ground Surface Elevation 6081.71'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Inch) 20 40	Water Content (%) 20 40	Other Tests
	20			20.0-29.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4) granite and quartzite cobbles and boulders, coarse to fine-grained sand and silt; poorly sorted; angular; unconsolidated; dry to damp.			
	25						
				29.0-36.0'-Cuttings. GRAVEL: same as above; damp.			
	30						
	35						
				36.0-44.0'-Cuttings. GRAVEL: same as above; damp.			
	40						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 46-86
Date Drilled	9/16/86, 9/17/86, 10/9/86	Coordinates N 37890.6 E 15178.8
Boring Method	Casing Driver/NC Core	Ground Surface Elevation 6081.71'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/ Inch) 20 40	Water Content (%) 20 40	Other Tests
	40						
	45			44.0-52.5'-Cuttings. GRAVEL: moderate brown (5YR 4/4); ~40-60% quartzite cobbles; silty and sandy matrix; poorly sorted; unconsolidated; damp.			
	50						
				52.5-53.0'-Cuttings. SAND: moderate brown (5YR 4/4); very fine-grained; silty; poorly sorted; unconsolidated; damp.			
	55			53.0-57.0'-Cuttings. BOULDERS: moderate brown (5YR 4/4); 60-70% granitic boulders; silty gravel matrix; poorly sorted; unconsolidated; moist.			
				57.0-63.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); 30-50% granitic pebbles and cobbles; silty sand matrix; poorly sorted; unconsolidated; moist.			
	60						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 46-86

Date Drilled 9/16/86, 9/17/86, 10/9/86 **Coordinates** N 37890.6 E 15178.8

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6081.71'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	60			63.0-65.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); granite and quartzite pebbles and cobbles; clayey sand matrix; poorly sorted; unconsolidated; moist.			
	65			65.0-80.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty sand matrix; poorly sorted; unconsolidated; moist.			
	70						
	75						
	80						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 46-86
Date Drilled	9/16/86, 9/17/86, 10/9/86	Coordinates N 37890.6 E 15178.8
Boring Method	Casing Driver/NC Core	Ground Surface Elevation 6081.71'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	80			80.0-88.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); 70% granite and quartzite pebbles and cobbles; sandy; poorly sorted; unconsolidated; moist.			
	85						
				88.0-90.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); granite and quartzite pebbles and cobbles; silty; poorly sorted; unconsolidated; wet.			
	90			LARAMIE FORMATION			
				90.0-96.5'-Cuttings. CLAYSTONE: dark yellowish orange (10YR 6/6); laminated; consolidated; wet.			
	95						
				97.0-102.0'-Sample. Recovered 0.0/5.0'. Cuttings indicate a medium light gray (N 6) claystone with black (N 1) organic wood fragments.			
	100						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project: Rocky Flats Plant

LOG OF BORING NO. 46-86

Date Drilled 9/16/86, 9/17/86, 10/9/86
Boring Method Casing Driver/NC Core

Coordinates N 37890.6 E 15178.8
Ground Surface Elevation 6081.71'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	100			102.0-105.0'-Sample. Recovered 0.4/3.0'=13%. RQD=0.4/0.4'=100%. CLAYSTONE: light olive gray (5Y 5/2) to olive gray (5Y 3/2); medium light gray (N 5) mottles; dark yellowish orange (10YR 6/6) limonite stain; vertical fractures with limonite stains; fine-grained sand pocket in center of core; some wood fragments; firm; damp.			
	105			105.0-109.5'-Depth correction. CLAYSTONE: Same as above; damp.			
	110			109.5-112.5'-Sample. Recovered 0.4/3.0'=13%. RQD=0/0.4'=0%. CLAYSTONE: Same as above; iron concretions; damp.			
				112.5-116.5'-Sample. Recovered 3.0/4.0'=75%. RQD=0/3.0'=0%. CLAYSTONE: medium gray (N 5) to light olive gray (5Y 5/2) claystone; firm; damp.			
	115			116.5-121.5'-Sample. Recovered 2.7/5.0'=54%. RQD=2.5/2.7'=93%. CLAYSTONE: medium dark gray (N 4); light olive brown (5Y 5/2) to light olive gray(5Y 5/6) mottles; some silt; vertical fracture; firm; dry to damp.			
	120						

Remarks Logged by: T. Gulliver

Checked by: [illegible]

Project No. 106P06222

Hydro-Search, Inc.

Project: Rocky Flats Plant	LOG OF BORING NO. 46-86
Date Drilled 9/16/86, 9/17/86, 10/9/86	Coordinates N 37890.6 E 15178.8
Boring Method Casing Driver/NC Core	Ground Surface Elevation 6081.71'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	120			121.5-126.5'-Sample. Recovered 2.6/5.0'=52%. RQD=4.3/4.8'=90%. CLAYSTONE: medium dark gray (N 4); trace silt; unweathered; soft; sticky; damp to moist.			
	125			126.5-131.5'-Sample. Recovered 4.8/5.0'=96%. RQD=4.3/4.8'=90%.			
				126.5-126.9': CLAYSTONE: medium dark gray (N 4); trace silt; calcite filled fracture at bottom of core; firm; damp.			
	130			126.9-127.6': SANDSTONE: dark greenish gray (5GY 4/1) to dark medium gray (N 3); very silty; fine to medium-grained; moderately to poorly sorted; slightly calcareous; firm; moist.			
				131.5-136.5'-Sample. Recovered 1.3/5.0'=26%. RQD=0.5/1.3'=38%. CLAYSTONE: Same as above; damp.			
	135			136.5-141.5'-Sample. Recovered 2.3/5.0'=46%. RQD=0.4/2.3'=17%. CLAYSTONE: Same as above; trace very fine-grained sand beds 0.5' thick; very firm; damp.			
	140						

Remarks Logged by: T. Gulliver

Checked by: [illegible]

Project No. 106P06222

Hydro-Search, Inc.

Project: Rocky Flats Plant

LOG OF BORING NO. 46-86

Date Drilled 9/16/86, 9/17/86, 10/9/86
Boring Method Casing Driver/NC Core

Coordinates N 37890.6 E 15178.8
Ground Surface Elevation 6081.71'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	140			141.5-146.5'-Sample. Recovered 3.8/5.0'=76%. RQD=2.8/3.8'=74%. SILTSTONE: medium light gray (N 6); sandy; interbedded with thin to thick beds of fine to very fine-grained SANDSTONE; moderate sorting; silty; abundant convoluted contacts; beds dipping at 30 to 50 degrees; firm; damp to moist.			
	145			146.5-151.1'-Sample. Recovered 0.5/5.0'=10%. RQD=0/0.5'=0%. SILTSTONE: Same as above with some claystone; sandstone laminations in fragments; damp to moist.			
	150			151.1-154.5'-Sample. Recovered 3.0/3.0'=100%. RQD=0/3.0'=0%. SILSTONE: Same as above with very fine-grained, medium gray (N 5) sand; damp to moist.			
	155			154.5-156.5'-Sample. Recovered 0.7/2.0'=35%. RQD=0/0.7'=0%. SILTSTONE: Same as above; medium gray (N 5) with medium dark gray (N 4) laminations of claystone; firm; damp.			
	160						

Remarks Logged by: T. Gulliver

Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project: Rocky Flats Plant

LOG OF BORING NO. 46-86

Date Drilled 9/16/86, 9/17/86, 10/9/86
Boring Method Casing Driver/NC Core

Coordinates N 37890.6 E 15178.8
Ground Surface Elevation 6081.71'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	160			156.5-161.5'-Sample. Recovered 5.0/5.0'=100%. RQD=4.0/5.0'=80%. SILTSTONE: Same as above with interbedded silty sandstone at 157.5' to 158.5' and 160.5' to 161.5'; sandstone is medium gray (N 4); silty; very fine to fine-grained; laminated; cross-bedded; horizontal bedding apparent; firm; tight; moist.			
	165			161.5-166.5'-Sample. Recovered 2.3/5.0'=46%. RQD=0.5/2.3'=22%. SILTSTONE: Same as above; clayey; interbedded with claystone; thin (0.3') calcite cemented sandy cement; moist.			
				TOTAL DEPTH: 166.5'			
	170						
	175						
	180						

Remarks Logged by: T. Gulliver

Checked by:

Project No. 106P06222

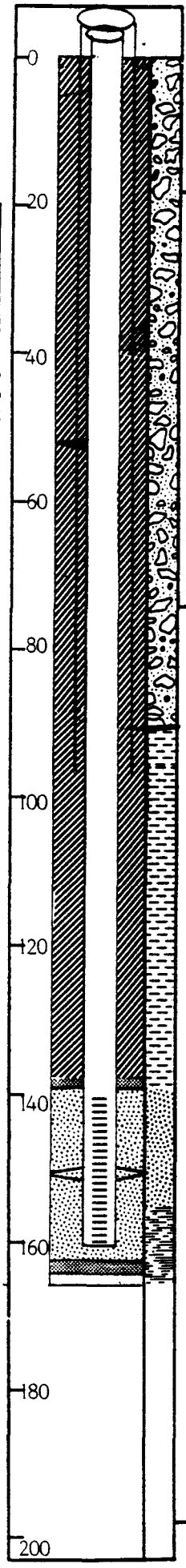
Hydro-Search, Inc.

WELL 46-86

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: N 37890.6 E 15178.8

ELEVATION: GROUND LEVEL 6081.71'
TOP OF CASING 6083.89'



PROJECT 106P06222 Rocky Flats Plant

PERSONNEL T. Gulliver/T. Murphy

LOCATION Golden, CO

DRILLING SUMMARY:

TOTAL DEPTH Well: 160.79' Hole: 166.50'

BOREHOLE DIAMETER 0.00' - 96.50': 5 5/8"
96.50' - 166.50': 4¼"

DRILLER Boyles Brothers Drilling Co.
15865 W. 5th Ave., Golden, CO
(Tom High, Robert Roach)

RIG 0.00' - 96.50': Casing advancer; 96.50' - 160.79': Failing

BIT(S) 0.00' - 96.50': Down hole hammer
96.50' - 166.50': Coring bit

DRILLING FLUID 0.00' - 96.50': None
96.50' - 166.50: air/water mist

SURFACE CASING 5" x 98.5' steel w/ locking cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00'	96.50'	C1			
0.00'	140.33'	C2			
140.33'	160.79'	S1			

CASING: C1 5" I.D. steel surface casing
C2 2" I.D. Sch. 5 type 316 stain-
C3 less steel, threaded and flush
C4 jointed.

SCREEN: S1 2" I.D. Sch. 5 type 316 stain-
S2 less steel, threaded and flush
S3 jointed, 0.010" wire wrap screen,
S4 0.25' welded bottom cap.

CENTRALIZERS Type 304 stainless steel
150.49' - 151.66'

FILTER MATERIAL 32-42 silica sand
138.90' - 163.00'

CEMENT Portland Type I
0.00' - 138.90'

OTHER 3/8" bentonite pellets
137.50' - 138.90'
163.00' - 165.00'

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" casing advancer	9/16	0840	9/16	1643
NC Core	10/9	1100	10/15	1645
Reaming	10/20	1030	10/20	1511
GEOPHYS. LOGGING:	10/20	1310	10/20	1511
CASING:				
5" steel	9/16	0840	9/16	1643
2" stainless	10/21	1600	10/21	1645
FILTER PLACEMENT:	10/21	1645	10/21	1120
CEMENTING:	10/22	1228	10/23	1000
DEVELOPMENT:	10/30	1050	11/13	1100
OTHER:				
Bentonite	10/22	1602	10/22	1605
	10/22	1140	10/22	1150
Packer testing	10/16	0829	10/19	1030

WELL DEVELOPMENT

See Well Development Summary Sheet.

COMMENTS:

Water encountered at 60' during drilling.

Top of stainless steel casing: 2.17'

Cave from TD to 165.00'

Well No.: 46-86

WELL DEVELOPMENT SUMMARY SHEET

DATE	TIME	METHOD	VOLUME	APPEARANCE	COMMENTS
10-30-86	1050				1 Well Bore Volume = 0.93 gals 10 Well Bore Volume = 9.33 gals
10-30-86	1050	Airlifted		Clear with med brown spray on bottom	
11-03-86	1320	Bailed	6.5 gals	Medium grayish brown	6.5/9.33 gals purged to date
11-04-86	1030	Bailed	1.5 gals	Light brown with sand - turbid	8.0/9.33 gals purged to date
11-05-86	0820	Bailed	1.4 gals	Med-light brown with silt - turbid	9.41/9.33 gals purged to date
11-06-86	1230	Bailed	1 gal	Medium-light brown turbid	10.4/9.33 gals purged to date
11-07-86	0945	Bailed	1.3 gals	Medium brown very turbid	11.7/9.33 gals purged to date
11-10-86	0945	Bailed	2.5 gals	Medium brown Very turbid	14.2/9.33 gals purged to date
11-11-86	1330	Bailed	1 gal	Light brown and silty	15.2/9.33 gals purged to date
11-12-86	1000	Bailed	1 gal	Light-medium brown; turbid	16.2/9.33 gals purged to date
11-13-86	1100	Sampled			

WESTON
MANAGERS DESIGNERS/CONSULTANTS

SHEET ___ of ___

CLIENT/SUBJECT Rockwell W.O. NO 2029-29-02
TASK DESCRIPTION West Sprayfield Closure Characterization TASK NO. 0030
PREPARED BY H.G.B. DEPT 1582 DATE 27 July 1988
MATH CHECK BY JBB DEPT 1582 DATE 1 August 1988
METHOD REV. BY ___ DEPT ___ DATE ___

APPROVED BY
DEPT ___ DATE ___

WELL 46-86

Hydraulic Conductivity (cm/s) = 5×10^{-3}

Flowrate (gpm) = 0.0583 gpm

Screened Interval (ft. below GL):

140.33 - 160.79'

140.33 - 141.5 : claystone

141.5 - 160.79 : siltstone

Method of Analysis: Residual-drawdown Plot (Driscoll, 1986 - pg 256).

WESTON
MANAGERS DESIGNERS/CONSULTANTS

SHEET ____ of ____

CLIENT/SUBJECT Rockwell W.O. NO. 2029-29-02
TASK DESCRIPTION West Sprayfield Closure Characterization TASK NO. 0030
PREPARED BY H.G.B. DEPT 1582 DATE 27 July 1988
MATH CHECK BY JBB DEPT 1582 DATE 1 August 1988
METHOD REV. BY ____ DEPT ____ DATE ____

APPROVED BY
DEPT ____ DATE ____

WELL 46-86

$$T\,(gpd/ft) = \frac{264\,Q}{\Delta s'} = \frac{(264)\,(0.0583)}{678} = 0.0227$$

where $Q\,(gpm) = 3.5\ gal/60\ min. = 0.0583\ gpm$

$\Delta s'$ = ft change in residual drawdown / log cycle

= 678 ft/log cycle

$$K\,(gpd/ft^2) = T/b = (0.0227\ gpd/ft)/20.46\ ft. = 1.11\times10^{-3}$$

where $b\,(ft) = 20.46\ ft$

$$K\,(cm/sec) = 1.11\times10^{-3}\ gpd/ft^2 \times \frac{4.72\times10^{-5}\ cm/s}{gpd/ft^2} = 5\times10^{-}$$

This method is valid where $u \leq 0.01$

solving for t where $u \leq 0.01$:

$$t\,(min) = \frac{r^2 S}{4Tu} = \frac{(0.177)^2\ 10^{-3}}{4\,(.0227)\,(.01)} \times \frac{1440\ min}{day}\ \frac{7.482\ gal}{ft^3}$$

$= 372$

where $r\,(ft) = \left(\frac{4.25}{24}\right) ft = 0.177\ ft$

and $S = 10^{-3}$ (assumed S for confined aquifer)

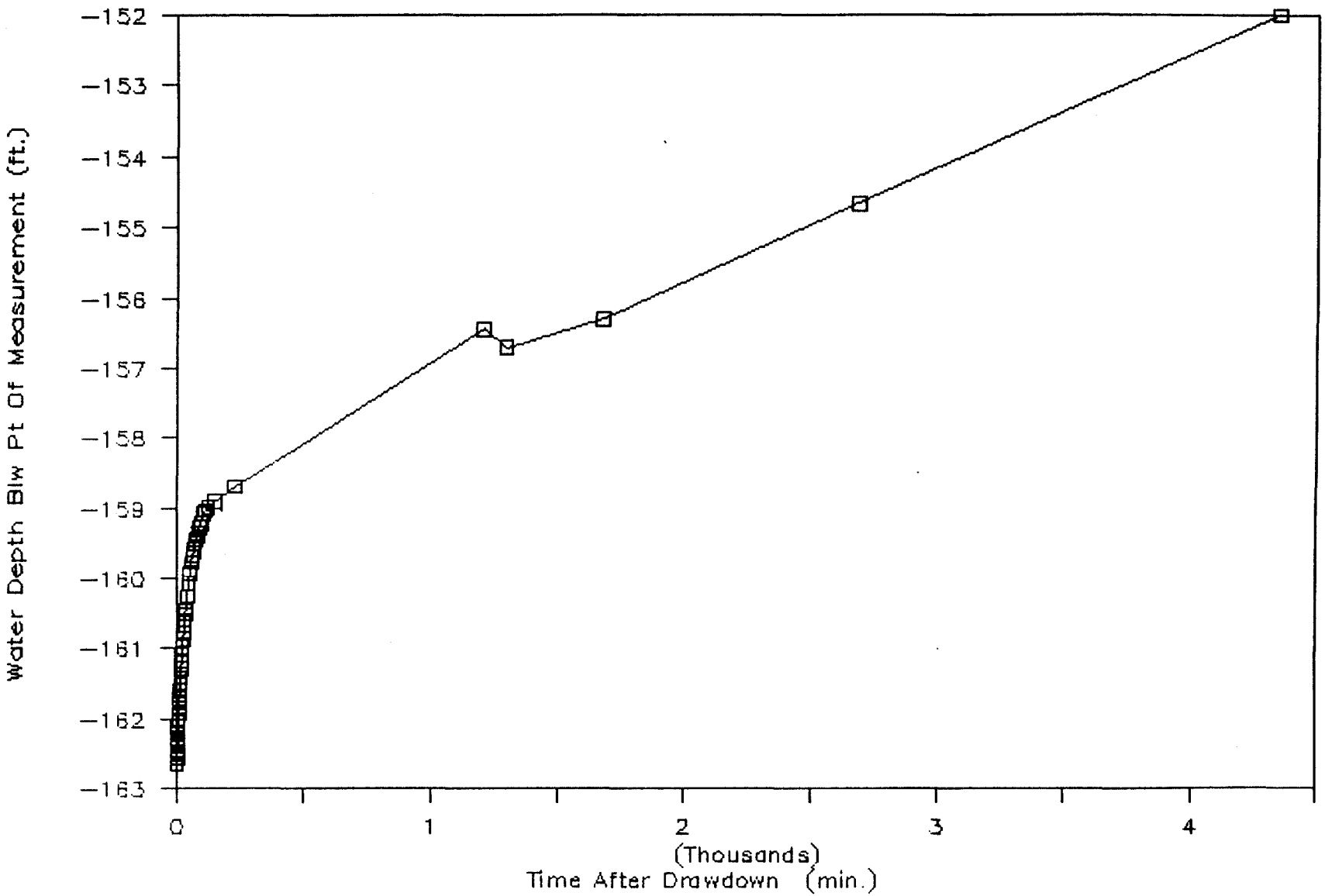
or $S = 0.1$ (assumed S for unconfined aquifer).

$\Delta s'$ is based on pts where $t \geq 2745$ min.

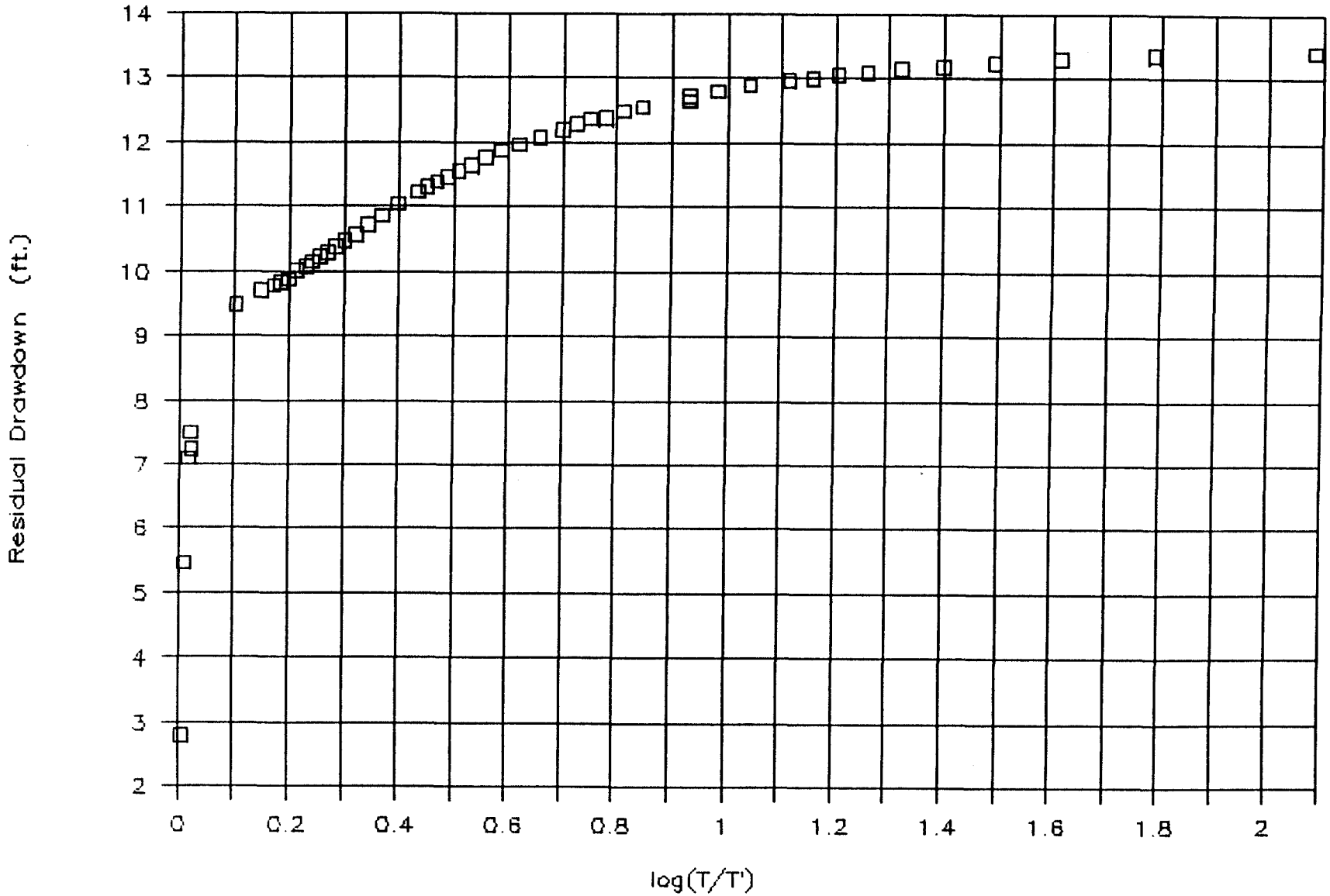
WELL 46-86

T Time (min.)	T' T Prime (min.)	Water Level (ft.)	s' Rsd Drwdn (ft.)	log(T/T')
60.50	0.50	162.63	13.42	2.08
61.00	1.00	162.57	13.36	1.79
61.50	1.50	162.51	13.30	1.61
62.00	2.00	162.46	13.25	1.49
62.50	2.50	162.40	13.19	1.40
63.00	3.00	162.37	13.16	1.32
63.50	3.50	162.31	13.10	1.26
64.00	4.00	162.27	13.06	1.20
64.50	4.50	162.21	13.00	1.16
65.00	5.00	162.17	12.96	1.11
66.00	6.00	162.10	12.89	1.04
67.00	7.00	162.01	12.80	0.98
68.00	8.00	161.92	12.71	0.93
68.00	8.00	161.85	12.64	0.93
70.00	10.00	161.77	12.56	0.85
71.00	11.00	161.70	12.49	0.81
72.00	12.00	161.60	12.39	0.78
73.00	13.00	161.57	12.36	0.75
74.00	14.00	161.50	12.29	0.72
75.00	15.00	161.41	12.20	0.70
77.00	17.00	161.29	12.08	0.66
79.00	19.00	161.18	11.97	0.62
81.00	21.00	161.08	11.87	0.59
83.00	23.00	160.97	11.76	0.56
85.00	25.00	160.86	11.65	0.53
87.00	27.00	160.76	11.55	0.51
89.00	29.00	160.67	11.46	0.49
91.00	31.00	160.59	11.38	0.47
93.00	33.00	160.51	11.30	0.45
95.00	35.00	160.44	11.23	0.43
100.00	40.00	160.25	11.04	0.40
105.00	45.00	160.07	10.86	0.37
110.00	50.00	159.92	10.71	0.34
115.00	55.00	159.77	10.56	0.32
120.00	60.00	159.68	10.47	0.30
125.00	65.00	159.59	10.38	0.28
130.00	70.00	159.50	10.29	0.27
135.00	75.00	159.44	10.23	0.26
141.00	81.00	159.36	10.15	0.24
146.00	86.00	159.28	10.07	0.23
155.00	95.00	159.22	10.01	0.21
165.00	105.00	159.08	9.87	0.20
175.00	115.00	159.03	9.82	0.18
185.00	125.00	158.99	9.78	0.17
210.00	150.00	158.91	9.70	0.15
290.00	230.00	158.70	9.49	0.10
1270.00	1210.00	156.45	7.24	0.02
1358.00	1298.00	156.71	7.50	0.02
1735.00	1675.00	156.30	7.09	0.02
2745.00	2685.00	154.67	5.46	0.01
4408.00	4348.00	152.00	2.79	0.01

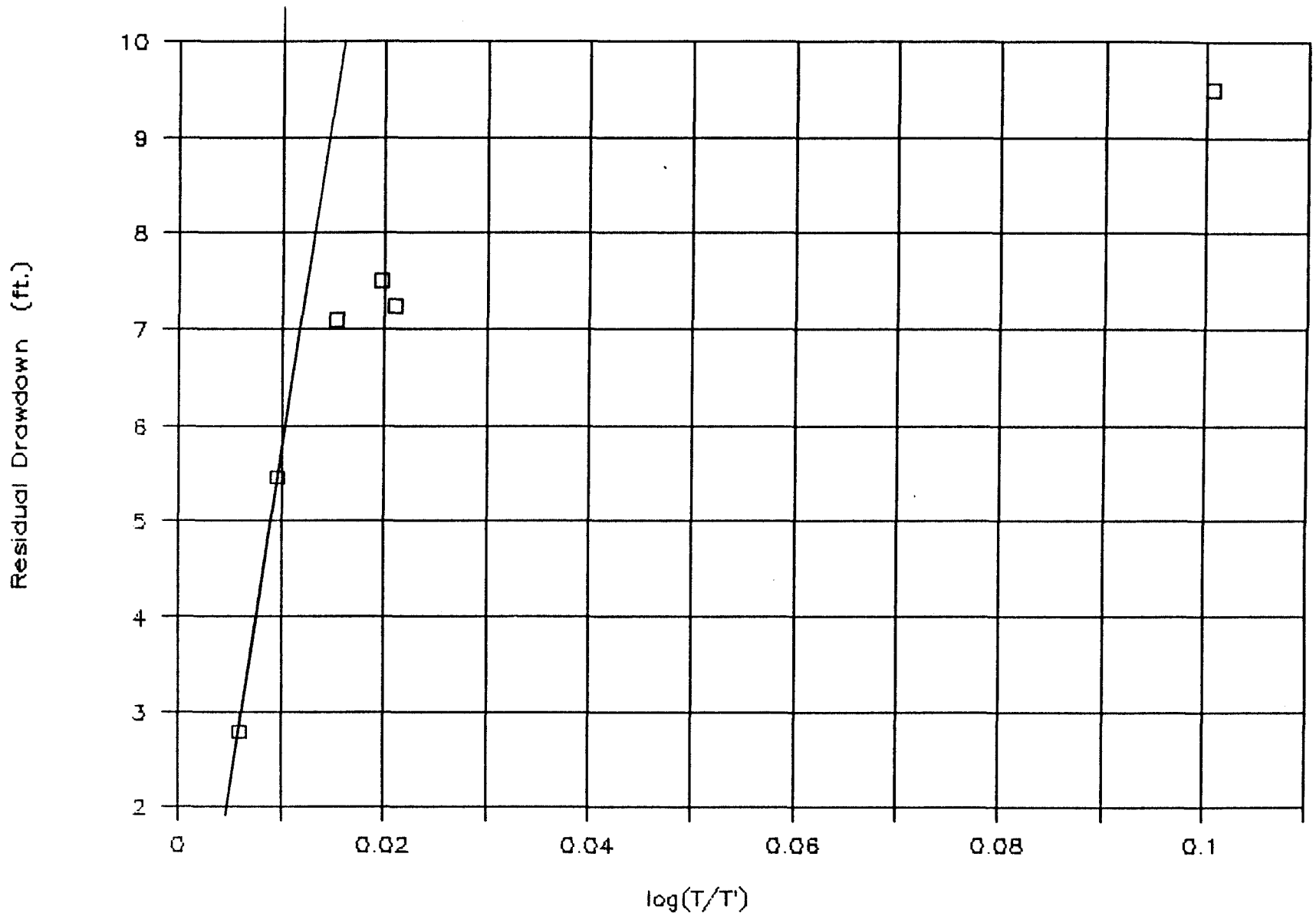
WELL 46-86


-152
-153
-154
-155
-156
-157
-158
-159
-160
-161
-162
-163
Water Depth Blw Pt Of Measurement (ft.)
0
1
2
3
4
(Thousands)
Time After Drawdown (min.)

WELL 46-86


Residual Drawdown (ft.)
14
13
12
11
10
9
8
7
6
5
4
3
2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
log(T/T')

WELL 46-86



$$\Delta s' = \frac{(10-2)\ ft}{(.0100 - .0041)} = 6.78\ ft/\log cycle$$

AQUIFER TEST DATA

WELL 46-86
PUMPING or OBSERVATION WELL
PUMPING or RECOVERY DATA
PAGE 1 OF ____

TYPE OF AQUIFER TEST Bail down / Recovery
HOW Q MEASURED 4 1/2 gal bucket
HOW W.L.'s MEASURED ____
RAD./DIST. OF/FROM PUMPING WELL ____
MEAS. POINT FOR W.L.'s ____
ELEVATION OF MEAS. POINT ____

DEPTH OF PUMP/AIRPIPE ____
PUMP ON: date ____ time ____
PUMP OFF: date ____ time ____
DURATION OF AQUIFER TEST ____

LOCATION ____
PERSONNEL ____
PROJECT ____

TIME t = ____ at t' = 0					WATER LEVEL DATA STATIC WATER LEVEL ____					DISCHARGE		RECORDED BY	COMMENTS
DAY	CLOCK TIME	t	t'		READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	s or s' FT/MIN		READING	Q		
1	1115				145 + 4.21								Static
	1120												Begin bailing
	1218												End bailing 3 1/2
	1220	0			160 + 2.74								GAL OUT
	1220:30				2.63			.22					
	1221				2.57			.12					
	1221:30				2.51			.12					
	1222				2.46			.10					
	1222:30				2.40			.12					
	1223				2.37			.06					
	1223:30				2.31			.12					
	1224				2.27			.08					
	1224:30				2.21			.12					
	1225				2.17			.08					
	1226				2.10			.07					
	12:27				2.01			.09					
	12:28				1.92								
	12:29				1.85								
	12:30				1.77								
	12:31				1.70								
	12:32				1.60								
	12:33				1.57								
	12:34				1.50								
	12:35				1.41								
	12:37				1.29								
	12:39				1.18								
	12:41				1.08								
	12:43				0.97								
	12:45				0.84								
	12:47				0.76								
	12:49				0.67								
	12:51				0.59								
	12:53				0.51								
	12:55				0.44								
	13:00				0.25								
	1305				0.07								
	1310				155 + 4.92								
	1315				155 + 4.77								
	1320				155 + 4.68								
	1325				155 + 4.59								

MARK

HYDRO-SEARCH RENO • DENVER CONSULTING HYDROLOGISTS-GEOLOGISTS

AQUIFER TEST DATA

WELL 46-86
PUMPING or OBSERVATION WELL
PUMPING or RECOVERY DATA
PAGE _____ OF _____

TYPE OF AQUIFER TEST _____
HOW Q MEASURED _____
HOW W.L.'s MEASURED _____
RAD./DIST. OF/FROM PUMPING WELL _____
MEAS. POINT FOR W.L.'s _____
ELEVATION OF MEAS. POINT _____

DEPTH OF PUMP/AIRPIPE _____
PUMP ON: date _____ time _____
PUMP OFF: date _____ time _____
DURATION OF AQUIFER TEST _____

LOCATION _____
PERSONNEL _____
PROJECT _____

TIME t = _____ at t' = o					WATER LEVEL DATA STATIC WATER LEVEL _____					DISCHARGE			
DAY	CLOCK TIME	t	t'		READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	s or s'		READING	Q	RECORDED BY	COMMENTS
	13:30				155+4.50								
	13:35				4.44								
	13:41				4.36								
	13:48				4.28								
	13:55				4.22								
	14:05				4.08								
	1415				4.03								
	1425				3.99								
	1430				3.91								
	1455												
	1610				3.70								
2	0830				155+1.45								? DELETE
	0958				155+1.71								
2	1615				155+1.30								
3	0905				150+4.67								
4	1248				150+2.00								TTO

PACKER TEST ANALYSIS
WELL NO. 46-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 10/17/86 BY: C.W. WALKER
TEST INTERVAL (FEET BELOW G.S.): 107.27 - 117.30
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 132.63

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00009268 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS ABOVE WATER TABLE
HEAD = DEPTH OF CENTER OF INTERVAL + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 112.29 + 5.90 + 1.70 * 2.31 = 122.11
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000501 FT/MIN
K = .00000003 CM/SEC

P2/3 TEST ABORTED

PACKER TEST ANALYSIS
WELL NO. 46-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 10/17/86 BY: C.W. WALKER
TEST INTERVAL (FEET BELOW G.S.): 130.22 - 140.25
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 132.63

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00003765 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS ABOVE WATER TABLE
HEAD = DEPTH OF CENTER OF INTERVAL + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 135.24 + 5.90 + 1.98 * 2.31 = 145.71
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000171 FT/MIN
K = .00000001 CM/SEC

P2/3 TEST

Q = INJECTION RATE = .00103825 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS ABOVE WATER TABLE
HEAD = DEPTH OF CENTER OF INTERVAL + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 135.24 + 5.90 + 28.30 * 2.31 = 206.51
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000003320 FT/MIN
K = .00000017 CM/SEC

2ND P1/3 TEST

Q = INJECTION RATE = .00027368 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS ABOVE WATER TABLE
HEAD = DEPTH OF CENTER OF INTERVAL + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 135.24 + 5.90 + 1.70 * 2.31 = 145.06
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000001246 FT/MIN
K = .00000006 CM/SEC

PACKER TEST ANALYSIS
WELL NO. 46-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 10/17/86 BY: C.W. WALKER
TEST INTERVAL (FEET BELOW G.S.): 140.64 - 150.67
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 132.63

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00003620 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 132.63 + 5.90 + 1.80 * 2.31 = 142.69
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000168 FT/MIN
K = .00000001 CM/SEC

P2/3 TEST

Q = INJECTION RATE = .00319439 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 132.63 + 5.90 + 30.50 * 2.31 = 208.99
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000010094 FT/MIN
K = .00000051 CM/SEC

2ND P1/3 TEST

Q = INJECTION RATE = .00046917 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 132.63 + 5.90 + 1.90 * 2.31 = 142.92
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000002168 FT/MIN
K = .00000011 CM/SEC

PACKER TEST ANALYSIS
WELL NO. 46-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 10/17/86 BY: C.W. WALKER
TEST INTERVAL (FEET BELOW G.S.): 151.00 - 161.03
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 132.63

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00005792 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 132.63 + 5.90 + 1.80 * 2.31 = 142.69
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000268 FT/MIN
K = .00000001 CM/SEC

P2/3 TEST

Q = INJECTION RATE = .00047641 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 132.63 + 5.90 + 33.25 * 2.31 = 215.34
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000001461 FT/MIN
K = .00000007 CM/SEC

2ND P1/3 TEST

Q = INJECTION RATE = .00006371 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.03 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 132.63 + 5.90 + 1.90 * 2.31 = 142.92
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000294 FT/MIN
K = .00000001 CM/SEC

PACKER TEST DATA SHEET

JOB NO. 106006222 NAME Rocky Flats HOLE NO. 46-86 SHEET 1 OF 1

LOCATION Rocky Flats Plant; West Spray Field ENGR. C.W. Walker DATE 10/17/86

GROUND SFC. ELEV. 6065.72' HOLE DIA. 3-3/4" TYPE OF BORING NC Core

HEIGHT OF CASING ABOVE GR.	DEPTH TO G.W.T.	DEPTH OF TOP PACKER	DEPTH OF BTM. PACKER	TEST STATION LENGTH	HEIGHT OF GAGE ABOVE GR.	PRESSURE (PSI)	TIME (MIN)	FLOWMETER	ΔQ UNITS	REMARKS
2.17'	132.63' below g.s. (5/12/88)	151.00'	161.03'	10.03'	5.9'	1.8	15	.04'	5.33×10^{-5}	
						33.25	15	.329'	4.387×10^{-4}	
						1.9	15	-.044'	5.867×10^{-5}	
		140.64'	150.67'	10.03'	5.9'	1.8	15	.025'	3.33×10^{-5}	
						30.5	15	2.206'	2.94×10^{-3}	
						1.9	15	.324'	4.32×10^{-4}	
		130.22'	140.25'	10.03'	5.9'	1.98	15	.026'	3.47×10^{-5}	
						28.30	15	.717'	9.56×10^{-4}	
						1.7	15	.189'	2.52×10^{-4}	
		107.27'	117.30'	10.03'	5.9'	1.7	15	.064'	8.53×10^{-5}	
						-	-	-	-	Packer failed

08/15/88

ROCKY FLATS WEST SPRAY FIELD

WATER LEVEL SUMMARY

WELL NUMBER	SAMPLE DATE	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	STICK UP	DEPTH OF SI BASE	ELEVATION OF SI TOP	ELEVATION OF SI BOTTOM	TOTAL DEPTH OF WELL	WATER DEPTH BELOW TOC	WATER SURFACE ELEVATION
4686	10/30/86	6081.71	6083.89	2.18	160.79	5941.38	5920.92	160.8	100.27	5983.62
	11/03/86								137.21	5946.68
	11/11/86								145.52	5938.37
	11/12/86								157.43	5926.46
	11/13/86								157.71	5926.18
	11/26/86								143.35	5940.54
	01/01/87								85.19	5998.70
	02/01/87								78.00	6005.89
	03/31/87								74.23	6009.66
	05/06/87								72.25	6011.64
	06/01/87								112.20	5971.69
	07/08/87								117.20	5966.69
	08/03/87								92.20	5991.69
	08/13/87								87.90	5995.99
	08/31/87								116.90	5966.99
	09/28/87								158.50	5925.39
	11/02/87								105.70	5978.19
	12/07/87								117.00	5966.89
	01/05/88								83.70	6000.19
	02/03/88								80.80	6003.09
	02/04/88								80.80	6003.09
	03/14/88								92.00	5991.89
	04/11/88								82.60	6001.29
	05/12/88								134.80	5949.09

INDEX OF DATA

Boring No.: 47-86

Completed as well? Yes

Data in File

X Log of Borehole

X Well Construction Summaries

X Well Development Summaries

X Hydraulic Conductivity Test Data and Results

____ Packer Test Data and Results

X Water Level Data

____ Saturated Thickness Hydrograph

Project:	Rocky Flats Plant	LOG OF BORING NO. 47-86
Date Drilled	10/24/86, 10/27/86	Coordinates N 37860.9 E 15184.1
Boring Method	Casing Driver	Ground Surface Elevation 6081.92'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	0			**ROCKY FLATS ALLUVIUM**			
				0-7.0'-Cuttings. GRAVEL: quartzite cobble gravel; fines <5%, dry.			
	5			7.0-8.0'-Cuttings. GRAVEL: moderate yellowish brown (10YR 5/4); moderate sorting; subrounded; dry.			
				8.0-10.0'-Cuttings. GRAVEL: moderate yellowish brown (10YR 5/4); poorly sorted; subrounded; dry.			
	10			10.0-18.0'-Cuttings. GRAVEL: moderate yellowish brown (10YR 5/4); 5% silt; 5-20% sand; poorly sorted; subrounded; thin sand and silt units 0.1-0.2' thick; dry.			
	15			18.0-42.0'-Cuttings. GRAVEL: moderate yellowish brown (10YR 5/4); quartzite cobbles and boulders; granitic material common; fines <1%; dry.			
	20						

Remarks Logged by: T. Gulliver Checked by: [illegible]

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 47-86

Date Drilled 10/24/86, 10/27/86 **Coordinates** N 37860.9 E 15184.1

Boring Method Casing Driver **Ground Surface Elevation** 6081.92'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	20						
	25						
	30						
	35						
	40						

Remarks Logged by: T. Gulliver Checked by: JLP

Project No. 106P06222	Hydro-Search, Inc.	Page 2 of 5

Project:	Rocky Flats Plant	LOG OF BORING NO.	47-86
Date Drilled	10/24/86, 10/27/86	Coordinates	N 37860.9 E 15184.1
Boring Method	Casing Driver	Ground Surface Elevation	6081.92'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	40						
				42.0-44.0'-Cuttings. SILT: moderate brown (5YR 4/4); clayey; sandy; some carbonaceous fragments; subplastic; damp.			
				44.0-45.0'-Cuttings. SAND: light brown (5YR 5/6); fine gravel; subrounded; dry.			
	45			45.0-48.0'-Cuttings. GRAVEL: light brown (5YR 5/6); poorly sorted; subrounded; dry.			
				48.0-56.0'-Cuttings. GRAVEL: light brown (5YR 5/6); abundant cobbles and boulders; fines <5%; poorly sorted; subrounded; dry.			
	50						
	55			56.0-58.0'-Cuttings. SILT: moderate brown (5YR 4/4); sandy; poorly sorted; fines <15%; dry.			
				58.0-59.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); cobbles; fines <1%; poorly sorted; dry.			
	60						

Remarks Logged by: T. Gulliver Checked by: JLP

Project No. 106P06222	Hydro-Search, Inc.	Page 3 of 5

Project:	Rocky Flats Plant	LOG OF BORING NO. 47-86
Date Drilled	10/24/86, 10/27/86	Coordinates N 37860.9 E 15184.1
Boring Method	Casing Driver	Ground Surface Elevation 6081.92'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	60			59.0-68.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); abundant muscovite from 63.0-68.0'; silt 30-60%; damp.			
	65						
	70			68.0-78.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty; fines 10-30%; poorly sorted; dry.			
	75			78.0-93.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); moderate brown (5YR 4/4); fines <5%; abundant cobbles; poorly sorted; dry.			
	80						

Remarks Logged by: T. Gulliver Checked by: AHP

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 47-86

Date Drilled	10/24/86, 10/27/86	**Coordinates**	N 37860.9 E 15184.1
Boring Method	Casing Driver	**Ground Surface Elevation**	6081.92'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	80						
	85						
	90			LARAMIE FORMATION 93.0-100.0'-Cuttings. SILTSTONE: light olive gray (5Y 6/1); clayey; well laminated; plastic; moist.			
	95						
	100			TOTAL DEPTH: 100'			

Remarks Logged by: T. Gulliver Checked by: [illegible]

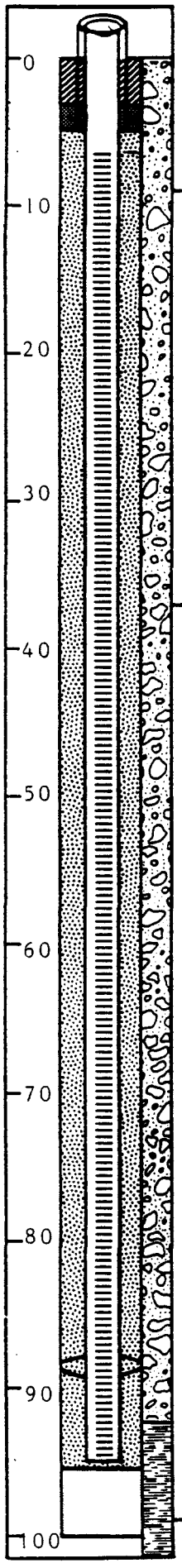
Project No. 106P06222	Hydro-Search, Inc.	Page 5 of 5

WELL 47-86

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: N 37860.9 E 15184.1

ELEVATION: GROUND LEVEL 6081.92'
TOP OF CASING 6084.08'



PROJECT 106P06222 Rocky Flats Plant
LOCATION Golden, CO
PERSONNEL T. Gulliver

DRILLING SUMMARY:

TOTAL DEPTH Well: 94.49' Hole: 100.00'
BOREHOLE DIAMETER 0.00' - 53.50': 5 5/8"
53.50' - 100.00': 4 7/8"
DRILLER Boyles Brothers Drilling Co.
15865 W. 5th Avenue, Golden, CO
(Arrow Drilling, Tom High)
RIG Casing advancer
BIT(S) 0.00' - 56.00': Down hole hammer
56.00' - 100.00': Tricone bit
DRILLING FLUID None
SURFACE CASING 5" x 5' steel w/ locking cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00'	6.23'	C1			
6.23'	94.49'	S1			

CASING: C1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed.

SCREEN: S1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed, 0.010" wire wrap screen, 0.25' welded bottom cap.

CENTRALIZERS Type 304 stainless steel
87.56' - 88.79'

FILTER MATERIAL 32-42 silica sand
4.60' - 95.00'

CEMENT Portland Type I
0.00' - 2.90'

OTHER 3/8" bentonite pellets
2.90' - 4.60'

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" casing advancer	10/24	1235	10/27	1215
GEOPHYS. LOGGING:	—	—	—	—
CASING:				
2" stainless	10/27	1340	10/27	1350
FILTER PLACEMENT:	10/27	1350	10/28	0900
CEMENTING:	10/28	0915	10/28	0920
DEVELOPMENT:				
OTHER:				
Bentonite	10/28	0900	10/28	0915

WELL DEVELOPMENT

COMMENTS:

Water encountered at 92' during drilling.

Top of stainless steel casing: 2.07'

Cave from TD to 95'.

Well No.: 47-86

WELL DEVELOPMENT SUMMARY SHEET

DATE	TIME	METHOD	VOLUME	APPEARANCE	COMMENTS
10-30-86	0815				1 Well Bore Volume = 6.26 gals 10 Well Bore Volume = 62.68 gals
10-30-86	0815	Airlifted		Tan - light brown spray	-----
11-03-86	1420	Bailed	17.5 gals	Medium to dark reddish brown	17.5/62.68 gals purged to date
11-04-86	0930	Airlifted	---	Tan - light brown spray	-----
11-05-86	1340	Bailed	16 gals	Medium brown Very turbid	33.5/62.68 gals purged to date
11-06-86	1215	Bailed	31 gals	Medium brown Very turbid	64/62.68 gals purged to date
11-07-86	1130	Bailed	18 gals	Medium brown slightly turbid	Purged 18 gals; 82/62.68 purged to date

WESTON
MANAGERS DESIGNERS/CONSULTANTS

SHEET ____ of ____

CLIENT/SUBJECT Rockwell W.O. NO 2029-29-02
TASK DESCRIPTION West Sprayfield Closure Characterization TASK NO. 0030
PREPARED BY H.G.B. DEPT 1582 DATE 27 July 1988
MATH CHECK BY JBG DEPT 1582 DATE 1 August 1988
METHOD REV. BY ____ DEPT ____ DATE ____

APPROVED BY
DEPT ____ DATE ____

WELL 47-86

Hydraulic Conductivity (cm/s) = 2.6×10^{-5}

Flowrate (gpm) = 0.238 gpm

Screened Interval (ft. below GL):

6.23 - 94.49'
static water level: 56.8

56.8 - 58.0 silt
58.0 - 93.0 gravel
93.0 - 94.49 siltstone

Method of Analysis: Residual-drawdown Plot (Driscoll, 1986 - pg 256).

WESTON

SHEET ___ of ___

CLIENT/SUBJECT Rockwell W.O. NO. 2029-29-02

TASK DESCRIPTION West Sprayfield Closure Characterization TASK NO. 0030

PREPARED BY H.G.B. DEPT 1582 DATE 27 July 1988

MATH CHECK BY JBB DEPT 1582 DATE 1 July 1988

METHOD REV. BY ___ DEPT ___ DATE ___

APPROVED BY ___ DEPT ___ DATE ___

WELL 47-86

$$T\ (gpd/ft) = \frac{264\ Q}{\Delta s'} = \frac{(264)(0.238)}{(3.06)} = 20.5$$

where $Q\ (gpm) = 15.5\ gal / 65\ minutes = 0.238\ gpm$

$\Delta s'$ = ft change in residual drawdown / log cycle

$= 3.06$

$$K\ (gpd/ft^2) = T/b = (20.5\ gpd/ft)/37.69\ ft = 0.544$$

where $b\ (ft) = (94.49 - 58.87 + 2.07)\ ft. = 37.69$

$$K\ (cm/sec) = 0.544\ gpd/ft^2 \times \frac{4.72 \times 10^{-5}\ cm/s}{gpd/ft^2} = 2.6 \times 10^{-5}$$

* b calculated based upon an assumed stick up of 2.07 ft.

This method is valid where $u \leq 0.01$

solving for t where $u \leq 0.01$:

$$t\ (min) = \frac{r^2 S}{4 T u} = \frac{(.203)^2 (.1)}{4 (20.5)(.01)} \times \frac{1440\ min}{day} \frac{7.482\ gal}{ft^3}$$

$= 54$ min.

where $r\ (ft) = \left(\frac{4.875}{24}\right) = 0.203$

and $S = 10^{-3}$ (assumed S for confined aquifer)

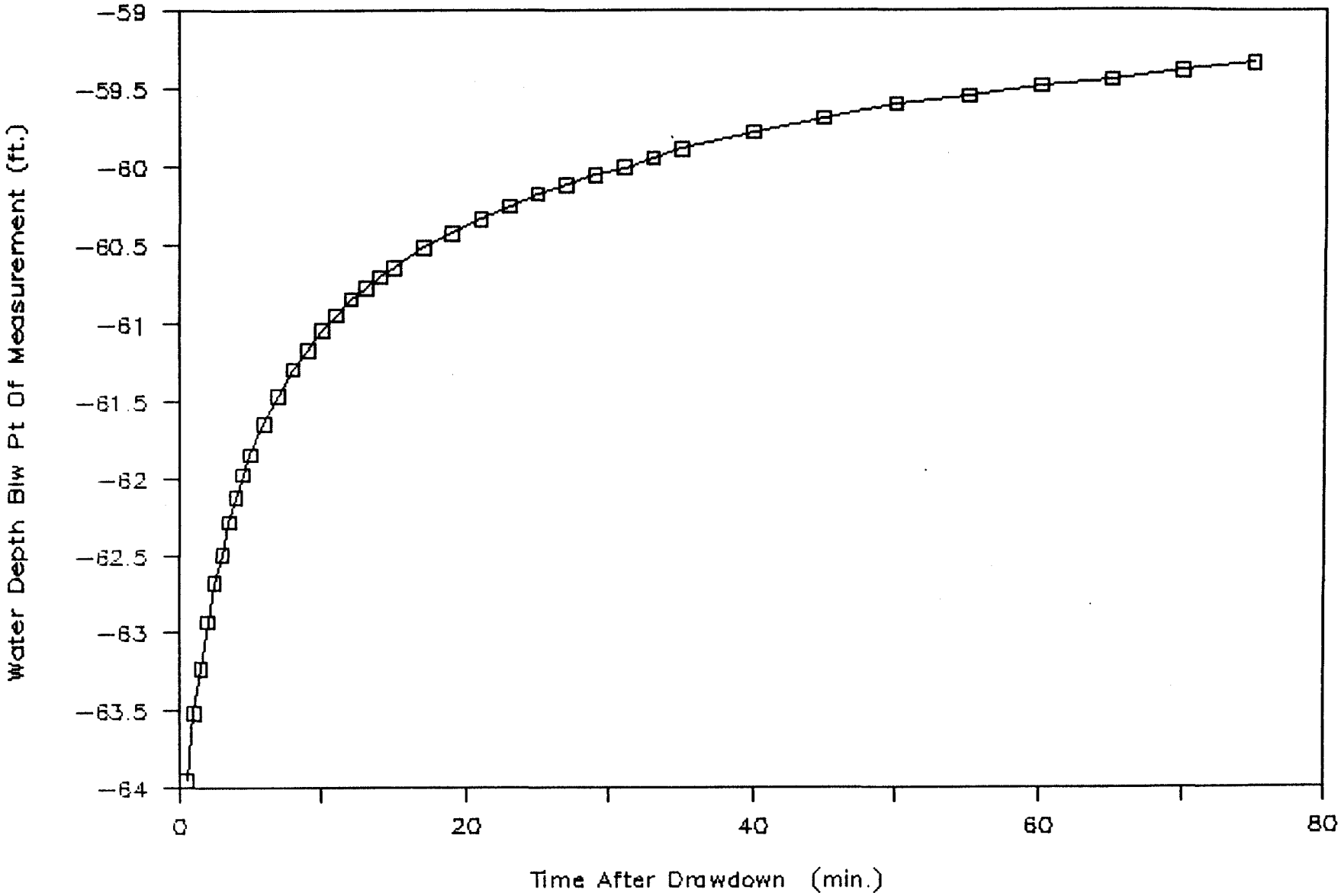
or $S = 0.1$ (assumed S for unconfined aquifer).

$\Delta s'$ is based upon pts ≥ 55 min.

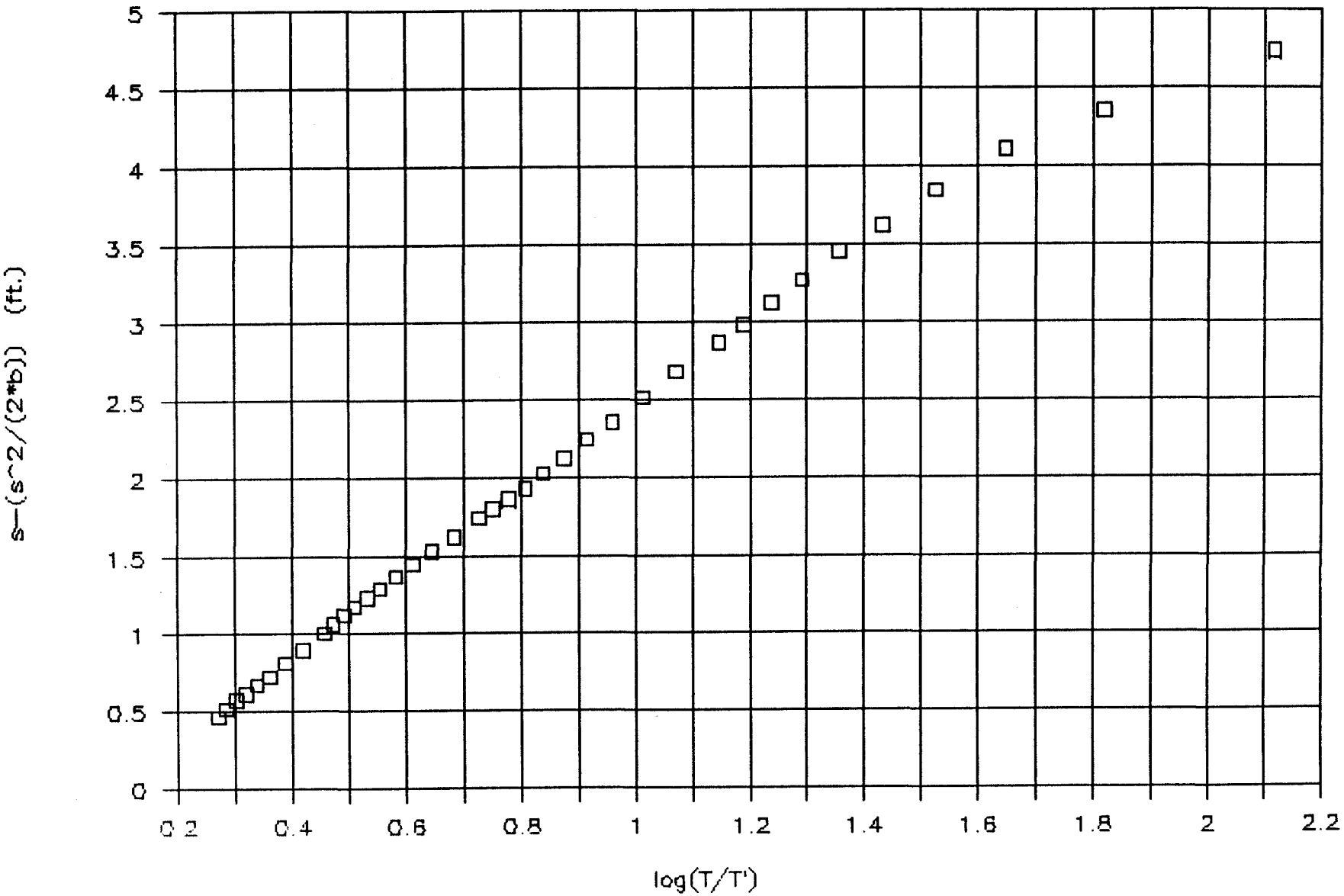
WELL 47-86

T Time (min.)	T' T Prime (min.)	Water Level (ft.)	s' Rsd Drwdn (ft.)	s-(s^2/2b) b=37.69' (ft.)	log(T/T')
65.50	0.50	63.95	5.08	4.74	2.12
66.00	1.00	63.51	4.64	4.35	1.82
66.50	1.50	63.23	4.36	4.11	1.65
67.00	2.00	62.93	4.06	3.84	1.53
67.50	2.50	62.68	3.81	3.62	1.43
68.00	3.00	62.50	3.63	3.46	1.36
68.50	3.50	62.29	3.42	3.26	1.29
69.00	4.00	62.13	3.26	3.12	1.24
69.50	4.50	61.98	3.11	2.98	1.19
70.00	5.00	61.85	2.98	2.86	1.15
71.00	6.00	61.65	2.78	2.68	1.07
72.00	7.00	61.47	2.60	2.51	1.01
73.00	8.00	61.30	2.43	2.35	0.96
74.00	9.00	61.18	2.31	2.24	0.91
75.00	10.00	61.05	2.18	2.12	0.88
76.00	11.00	60.95	2.08	2.02	0.84
77.00	12.00	60.85	1.98	1.93	0.81
78.00	13.00	60.78	1.91	1.86	0.78
79.00	14.00	60.71	1.84	1.80	0.75
80.00	15.00	60.65	1.78	1.74	0.73
82.00	17.00	60.52	1.65	1.61	0.68
84.00	19.00	60.43	1.56	1.53	0.65
86.00	21.00	60.34	1.47	1.44	0.61
88.00	23.00	60.26	1.39	1.36	0.58
90.00	25.00	60.18	1.31	1.29	0.56
92.00	27.00	60.12	1.25	1.23	0.53
94.00	29.00	60.06	1.19	1.17	0.51
96.00	31.00	60.01	1.14	1.12	0.49
98.00	33.00	59.95	1.08	1.06	0.47
100.00	35.00	59.89	1.02	1.01	0.46
105.00	40.00	59.78	0.91	0.90	0.42
110.00	45.00	59.69	0.82	0.81	0.39
115.00	50.00	59.60	0.73	0.72	0.36
120.00	55.00	59.55	0.68	0.67	0.34
125.00	60.00	59.49	0.62	0.61	0.32
130.00	65.00	59.45	0.58	0.58	0.30
135.00	70.00	59.39	0.52	0.52	0.29
140.00	75.00	59.34	0.47	0.47	0.27

WELL 47-86


-59
-59.5
-60
-60.5
-61
-61.5
-62
-62.5
-63
-63.5
-64
Water Depth Blw Pt Of Measurement (ft.)
0
20
40
60
80
Time After Drawdown (min.)

WELL 47-86



AQUIFER TEST DATA

WELL 47-86
PUMPING or OBSERVATION WELL
PUMPING or RECOVERY DATA
PAGE 1 OF 2

TYPE OF AQUIFER TEST Bail down / Recovery TD = 95.56'
HOW Q MEASURED 4½ gal bucket
HOW W.L.'s MEASURED Olympic
RAD./DIST. OF/FROM PUMPING WELL
MEAS. POINT FOR W.L.'s
ELEVATION OF MEAS. POINT

DEPTH OF PUMP/AIRPIPE
PUMP ON: date 11/18/86 time
PUMP OFF: date 11/18/86 time
DURATION OF AQUIFER TEST

LOCATION
PERSONNEL
PROJECT

Jim.

TIME t = ____ at t' = 0					WATER LEVEL DATA STATIC WATER LEVEL ____					DISCHARGE		RECORDED BY	COMMENTS
DAY	CLOCK TIME	t	t'		READING	CONVERSIONS & CORRECTIONS	WATER LEVEL	s or s'		READING	Q		
1	1110				55+3.87								Static
	1125												Begin bailing
	12												END BAILING. GOT 15 GAL
	1230	0											
	1230:30				60+3.95		+					TG	
	1231				3.51			.44					
	1231:30				3.23			.56					Calculate 90%
	1232				2.93			.60					recovery = 59.33
	1232:30				2.68			.50					or 55+4.33
	1233				2.50			.36					
	1233:30				2.29			.22					
	1234				2.13			.32					
	1234:30				1.98			.30					
	1235				1.85			.26					
	1236				1.65			.20					
	1237				1.47			.36					
	1238				1.30			.36					
	1239				1.18								
	1240				1.05			.26					
	1241				0.95								
	1242				0.85								
	1243				0.78								
	1244				0.71								
	1245				0.65							TG	
	1247				0.52							JP	
	1249				0.43								
	1251				0.34								
	1253				0.26								
	1255				0.18								
	1257				0.12								
	1259				0.06								
	1301				60+0.01								
	1303				55+4.95								
	1305				+4.89								
	1310				4.78								
	1315				4.69								
	1320				4.60								
	1325				4.55								
	1330				4.49								
	1335				55+4.45							PP	

AQUIFER TEST DATA

WELL 47-86
PUMPING or OBSERVATION WELL
PUMPING or RECOVERY DATA
PAGE 2 OF 2

TYPE OF AQUIFER TEST
HOW Q MEASURED
HOW W.L.'s MEASURED
RAD./DIST. OF/FROM PUMPING WELL
MEAS. POINT FOR W.L.'s
ELEVATION OF MEAS. POINT

DEPTH OF PUMP/AIRPIPE
PUMP ON: date time
PUMP OFF: date time
DURATION OF AQUIFER TEST

LOCATION
PERSONNEL
PROJECT

TIME (t = ____ at t' = 0)					WATER LEVEL DATA (STATIC WATER LEVEL ____)					DISCHARGE		RECORDED BY	COMMENTS
DAY	CLOCK TIME	t	t'		READING	CONVERSIONS & CORRECTIONS	WATER LEVEL	s or s'		READING	Q		
1	1340				5514.39								
	1345				5514.34								90% recovery

08/15/88

ROCKY FLATS WEST SPRAY FIELD

WATER LEVEL SUMMARY

WELL NUMBER	SAMPLE DATE	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	STICK UP	DEPTH OF SI BASE	ELEVATION OF SI TOP	ELEVATION OF SI BOTTOM	TOTAL DEPTH OF WELL	WATER DEPTH BELOW TOC	WATER SURFACE ELEVATION
4786	10/30/86	6081.92	6084.08	2.16	94.49	6075.69	5987.43	94.49	58.67	6025.41
	11/03/86								58.74	6025.34
	11/05/86								58.30	6025.78
	11/06/86								58.68	6025.40
	11/07/86								58.68	6025.40
	11/26/86								58.91	6025.17
	01/01/87								59.50	6024.58
	02/23/87								59.42	6024.66
	03/31/87								59.23	6024.85
	05/06/87								56.67	6027.41
	06/01/87								54.43	6029.65
	07/08/87								53.90	6030.18
	08/03/87								54.20	6029.88
	08/13/87								54.10	6029.98
	08/31/87								54.70	6029.38
	09/28/87								55.00	6029.08
	11/02/87								55.10	6028.98
	12/07/87								55.00	6029.08
	01/05/88								56.30	6027.78
	02/03/88								56.40	6027.68
	02/04/88								56.40	6027.68
	03/14/88								56.80	6027.28
	04/11/88								57.30	6026.78
	05/12/88								57.40	6026.68

INDEX OF DATA

Boring No.: 48-86

Completed as well? Yes

Data in File

X Log of Borehole

X Well Construction Summaries

____ Well Development Summaries

____ Hydraulic Conductivity Test Data and Results

X Packer Test Data and Results

X Water Level Data

____ Saturated Thickness Hydrograph

Project: Rocky Flats Plant

LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	0			**ROCKY FLATS ALLUVIUM** 0-7.0'-Cuttings. GRAVEL: moderate brown (10YR 4/4); granite and quartzite cobbles and boulders; silty sand matrix; poorly sorted; unconsolidated; dry.			
	5						
				7.0-9.0'-Cuttings. BOULDER: large quartzite boulder. 9.0-33.0'-Cuttings. GRAVEL: moderate brown (10YR 4/4); granitic pebbles and cobbles; 15-30% sand; poorly sorted; unconsolidated; damp.			
	10						
	15						
	20						

Remarks Logged by: T. Gulliver & T. Murphy Checked by: [illegible]

Project No. 106P06222

Hydro-Search, Inc.

Project: Rocky Flats Plant

LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Inch) 20 40	Water Content (%) 20 40	Other Tests
	20						
	25						
	30						
				33.0-35.0'-Cuttings. BOULDER: large quartzite boulder.			
	35			35.0-46.0'-Cuttings. GRAVEL: moderate brown (10YR 4/4); granitic pebbles and cobbles; 15-30% sand; poorly sorted; unconsolidated; damp.			
	40						

Remarks Logged by: T. Gulliver & T. Murphy Checked by: [illegible]

Project No. 106P06222

Hydro-Search, Inc.

Project: Rocky Flats Plant

LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.58'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Inch) 20 40	Water Content (%) 20 40	Other Tests
	40						
	45						
				46.0-60.0'-Cuttings. SAND: moderate brown (10YR 4/4); 20-30% granitic pebbles and cobbles; sand and silt matrix; poorly sorted; unconsolidated; moist to wet.			
	50						
	55						
	60						

Remarks Logged by: T. Gulliver & T. Murphy Checked by: [illegible]

Project No. 106P06222

Hydro-Search, Inc.

Project: Rocky Flats Plant

LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	60			60.0-70.0'-Cuttings. GRAVEL: moderate brown (10YR 4/4); 50-60% granite and quartzite pebbles and cobbles; silty sand matrix; poorly sorted; unconsolidated; wet.			
	65			LARAMIE FORMATION			
	70			70.0-74.0'-Cuttings. CLAYSTONE: light olive gray (5Y 5/2); laminated; soft; wet.			
	75			74.0-79.0'-Sample. Recovered 0.3/5.0'=6%. RQD=0/0.3'=0%. CLAYSTONE: medium light gray (N 6/0); abundant wood fragments; trace silt; abundant fractures with limonite stain (10YR 6/6); soft to moderately firm; damp.			
	80			79.0-84.0'-Sample. Recovered 2.8/5.0'=56%. RQD=2.6/2.8'=93%.			

Remarks Logged by: T. Gulliver & T. Murphy Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project: Rocky Flats Plant	LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	80			79.0-81.2': CLAYSTONE: same as above; yellowish gray (5YR 7/2); soft; iron stained. 81.2-82.2': IRONSTONE; dark reddish brown (10R 3/4); mottled with olive gray (5Y 3/2) claystone; grades into yellowish gray (5Y 7/2) to light gray claystone at 82.3 to 84.0'; trace silt; abundant vertical and horizontal fractures with limonite stains (10YR 6/6); firm to hard; damp.			
	85			84.0-89.0'-Sample. Recovered 5.0/5.0'=100%. RQD=3.6/5.0'=72%. CLAYSTONE: medium light gray (N 5/0) to medium gray (N 4/0); silty in places; wood fragments; subvertical and horizontal fractures with limonite stain (10YR 6/6); no apparent bedding; highly fractured; soft to moderately firm; damp.			
	90			89.0-94.0'-Sample. Recovered 4.0/5.0'=80%. RQD=4.0/4.0'=100%. 89.0-90.8': SILTSTONE: medium light gray (N 4/0); fine sand and clay; grades down into claystone; subvertical fractures (60-80°) to subhorizontal fractures; firm; damp. 90.8-94.0': CLAYSTONE: same as 84.0-89.0'; fractures at 92.4-94.0'; coated with limonite stain (10YR 6/6); firm; damp.			
	95			94.0-99.0'-Sample. Recovered 4.6/5.0'=92%. RQD=2.8/4.6'=61%. CLAYSTONE: same as above; light olive gray (5Y 5/2); numerous horizontal and subhorizontal thin ironstone and limonite layers (<.01") with			
	100						

Remarks Logged by: T. Gulliver & T. Murphy Checked by: AHP

Project No. 106P06222	Hydro-Search, Inc.	Page 5 of 11

Project: Rocky Flats Plant	LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	100			ironstone fragments; altered wood fragments; interbedded fine sandy clayey siltstone beds; 0.8' thick; firm; damp.			
				99.0-104.0'-Sample. Recovered 1.4/5.0'=28%. RQD=1.0/1.4'=71%. SILTSTONE: light olive gray (5YR 5/2) to medium light gray (N 5/0); trace very fine sand; clayey; limonite fractures (horizontal).			
	105						
				104.0-109.0'-Sample. Recovered 2.9/5.0'=58%. RQD= 1.9/2.9'=66%. CLAYSTONE: light medium gray (N 4/10) to dark yellowish orange (10YR 6/6); numerous subhorizontal limonite stained fractures; soft; damp to moist.			
	110						
				109.0-112.0'-Sample. Recovered 3.0/3.0'=100%. RQD= 2.9/3.0'=97%. SILTSTONE: medium gray to dark gray (N 4/0 to N 3/0); trace sand; clayey; carbonaceous; occasional thin claystone beds; yellowish gray (5Y 7/2) concretions; slightly calcareous.			
				Depth correction: total depth of borehole=114.2'.			
	115						
				114.2-117.2'-Sample. Recovered 2.9/3.0'=97%. RQD=0.7/2.9'=24%. SILTSTONE: same as above with sandy laminations; calcite cemented layer (0.2'); few yellowish gray (5Y 7/2) concretions; firm; damp.			
	120						

Remarks Logged by: T. Gulliver & T. Murphy Checked by: [illegible]

Project: Rocky Flats Plant	LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	120			117.2-122.2'-Sample. Recovered 4.6/5.0'=92%. RQD=3.5/4.6'=76%. SILTSTONE: dark to medium gray (N 5/0 to N 3/0); interbedded layers of silty sandstone; sandy siltstone and clayey siltstone; bed 0.1 to 0.2'-thick; carbonaceous; calcareous from 121.0-122.2'; bedding dips from 40-50° in upper 117.2-119.0' then shallows to 15-20° in upper 117.2-119.0' then shallows to 15-20° at bottom of core; flaser bedding characteristics; firm; damp.			
	125			122.2-127.2'-Sample. Recovered 1.6/5.0'=32%. RQD=0.7/1.6'=44%. SILTSTONE: same as above; damp to moist.			
	130			127.2-132.2'-Sample. Recovered 5.0/5.0'=100%. RQD=3.2/5.0'=64%. SILTSTONE: medium gray (N 4/0); trace sand; clayey; vertical and horizontal calcite filled fractures at 128.5-129.5'; carbonaceous fragments; bedding appears massive; firm to hard; damp.			
	135			132.2-137.7'-Sample. Recovered 4.0/5.0'=80%. RQD=0.0/4.0'=0%. SILTSTONE: medium light gray (N 6/0); clayey; sandy; interbedded layers of silty sandstone; very fine-grained; tight; firm; damp.			
	140			137.2-142.2'-Sample. Recovered 5.0/5.0'=100%. RQD=3.2/5.0'=64%. 137.2-138.0': SILTY SANDSTONE: very fine-grained; cemented with calcite.			

Remarks Logged by: T. Gulliver & T. Murphy Checked by:

Project: Rocky Flats Plant	LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	140			138.0-142.2': CLAYEY SILTSTONE: concretion layer at 138.2 to 138.8'; subvertical calcite vein at 139.0; firm; damp.			
				142.2-147.2'-Sample. Recovered 4.6/5.0'=93%. RQD=1.6/4.6'=35%. SILTSTONE: medium dark gray (N 4/0); trace sand; clayey; carbonaceous layers.			
	145						
				147.2-152.2'-Sample. Recovered 3.9/5.0'=78%. RQD=1.3/3.9'=33%. 147.2-151.3': SILTSTONE: same as above; firm; damp. 151.3-152.2': SANDSTONE: silty; laminations of siltstone; very fine-grained; convoluted bedding; 20°-30° dip; firm; damp.			
	150						
				152.2-157.2'- Sample. Recovered 4.3/5.0'=86%. RQD=1.2/4.3'=28%. 152.2-153.0': SILTY SANDSTONE: as above.			
				153.0-157.2': SILTSTONE: medium gray (N 5/0); clayey; trace sand; carbonaceous; firm; damp.			
	155						
				157.2-162.2'-Sample. recovered 3.4/5.0'= 68%. RQD=0.6/3.4'=18%. SILTSTONE: same as above; damp.			
	160						

Remarks Logged by: T. Gulliver & T. Murphy Checked by: AHP

Project No. 106P06222	Hydro-Search, Inc.	Page 8 of 11

Project: Rocky Flats Plant	LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	160						
				162.2-167.2'-Sample. Recovered 4.0/5.0'=80%. RQD=0.8/4.0'=20%. SILTSTONE: same as above; alternating layers of clayey siltstone and sandy siltstone; beds average 0.25' thick; appear to be close to horizontal; firm; damp.			
	165						
				167.2-173.0'-Sample. Recovered 1.0/6.0'=17%. RQD=0.0/1.0'=0%. SILTSTONE: medium dark gray (N 4/0); clayey; trace sand; abundant carbonaceous fragments; moderately firm; damp on fresh surface.			
	170						
				173.0-178.0'=Sample. Recovered 4.3/5.0'=86%. RQD=3.4/4.3'=79%. SILTSTONE: same as above; damp.			
	175						
				178.0-183.0'-Sample. Recovered 4.0/5.0'=80%. RQD=1.2/4.0'=30%. SILTSTONE: same as above with coaly layer at 179.3' to 179.7'; highly fractured from 181.0-183.0'; firm; damp.			
	180						

Remarks Logged by: T. Gulliver & T. Murphy Checked by:

Project No. 106P06222	Hydro-Search, Inc.	Page 9 of 11

Project: Rocky Flats Plant	LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	180						
	185			183.0-187.0'-Sample. Recovered 2.7/4.0'=68%. RQD=0.5/2.7'=19%. SILTSTONE: same as above; clayey; highly fractured throughout; firm; damp.			
	190			187.0-192.0'-Sample. Recovered 3.9/5.0'=78%. RQD=0.0/3.9=0%. SILTSTONE: same as above; less clay-rich; trace very fine-grained sand; coarser silt; fractured; damp.			
	195			192.0-197.0'-Sample. Recovered 4.2/5.0'=84%. RQD=3.0/4.2'=71%. SILTSTONE: similar to above; coarser grained; less clay; trace very fine-grained sand; grades to interbedded silty sandstone and sandy siltstone at 194.5'; thin to thick bedded; highly convoluted contacts; abundant pene-contemporaneous deformation chartacteristics; bedding appears flat; firm; damp to moist.			
	200			197.0-202.0'-Sample. Recovered 5.0/5.0'=100%. RQD=1.1/5.0'=22%. SANDSTONE: medium dark gray (N 4/0); fine to very fine-grained; silty, interbedded with siltstone and sandy siltstone; thin to thick bedded; convoluted; 50% sandstone; 50% siltstone; firm to soft; wet.			

Remarks Logged by: T. Gulliver & T. Murphy Checked by:

Project: Rocky Flats Plant	LOG OF BORING NO. 48-86

Date Drilled 9/18/86, 9/19/86, 10/23/86 - 11/13/86 **Coordinates** N 36025.2 E 15175.9

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6096.68'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	200						
	205			202.0-207.0'-Sample. Recovered 4.6/5.0'=92%. RQD=2.8/4.6'=61%. SANDSTONE: medium light gray (N 6/0); very fine to medium-grained; poorly sorted; interbedded with siltstone and clayey siltstone; flaser bedding common; beds range from .001'to 1' in thickness; firm; wet.			
				207.0-212.0'-Sample. Recovered 4.2/5.0'=84%. RQD=0.9/4.2'=21%.			
	210			207.0-208.3': SANDSTONE: same as above.			
				208.3-212.0': SILTSTONE: dark gray (N 3/0); interbedded with medium gray (N 5/0); coaly; bedding is convoluted; appears horizontal.			
				TOTAL DEPTH: 212.0'			
	215						
	220						

Remarks Logged by: T. Gulliver & T. Murphy Checked by: [illegible]

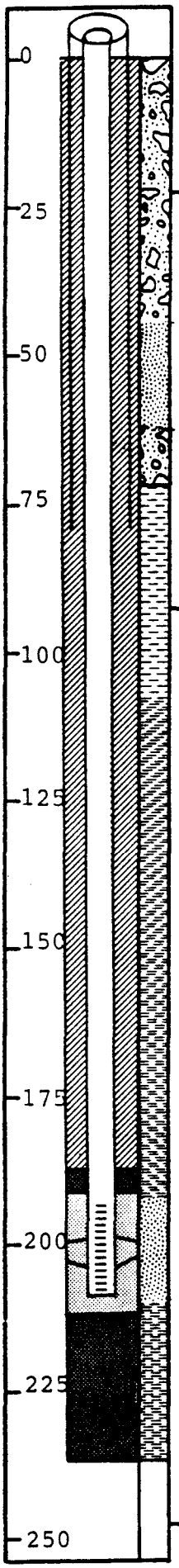
Project No. 106P06222	Hydro-Search, Inc.	Page 11 of 11

WELL 48-86

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: N 36025.2 E 15175.9

ELEVATION: GROUND LEVEL 6096.68'
TOP OF CASING 6099.05'



LOCATION Rocky Flats Plant
PERSONNEL T. Gulliver/T. Murphy
PROJECT 106P06222

DRILLING SUMMARY:

TOTAL DEPTH Well: 207.07' Hole: 238.00'

BOREHOLE DIAMETER 0.00' - 78.30': 5 5/8" 78.00' - 212.00': 4 3/4" 212.00' - 238.00': 4"

DRILLER Boyles Brothers Drilling Co. 15865 W. 5th Avenue, Golden, CO (Tom High, Robert Roach)

RIG 0.00' - 78.30': Casing advancer; 78.30' - 238.00': Failing

BIT(S) 0.00' - 78.30': Down hole hammer; 78.30' - 212.00': Coring bit; 212.00' - 238.00: Chop rod

DRILLING FLUID 0.00' - 78.30': None 78.30' - 238.00': Air/water mist to drill, bentonite mud to ream.

SURFACE CASING 5" x 78.4' steel w/ locking cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00'	78.40'	C1			
0.00'	191.99'	C2			
191.99'	207.07'	S1			

CASING: C1 5" I.D. steel surface casing
C2 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed.

SCREEN: S1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed, 0.010" wire wrap screen, 0.25' welded bottom cap.

CENTRALIZERS Type 304 stainless steel 199.27' - 200.47'

FILTER MATERIAL 32-42 silica sand 188.50' - 209.00'

CEMENT Portland Type I 0.00' - 186.00'

OTHER 3/8" bentonite pellets 186.00' - 188.50' 209.00' - 238.00'

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" casing advancer	9/18	1024	9/19	1110
NC Core	10/23	1310	10/28	1500
Reaming	11/13	1500	11/13	1630
GEOPHYS. LOGGING:	—	—	—	—
CASING:				
5" steel	9/18	1024	9/19	1110
2" stainless	11/14	0838	11/14	0900
FILTER PLACEMENT:	11/13	1631	11/14	1342
CEMENTING:	11/17	0857	11/18	1142
DEVELOPMENT:				
OTHER:				
Bentonite	11/14	1630	11/14	1645
	11/13	1600	11/13	1631
Packer testing	10/29	0730	11/3	1135

WELL DEVELOPMENT

See Well Development Summary Sheet.

COMMENTS:

No water encountered during drilling.

Top of stainless steel casing: 2.69'

Well built through 4" casing.

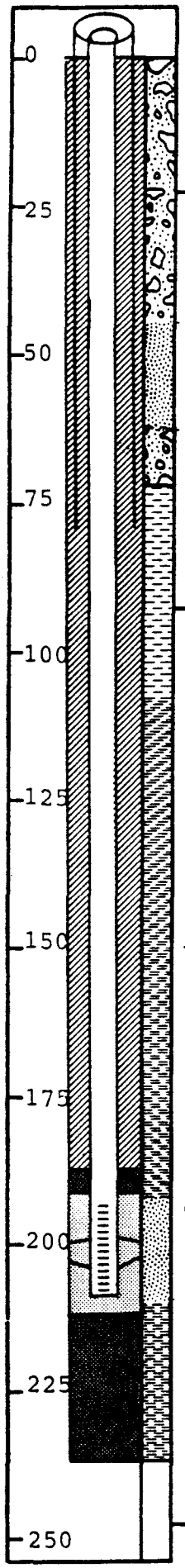
HYDRO-SEARCH RENO•DENVER CONSULTING HYDROLOGISTS-GEOLOGIST

WELL 48-86

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: N 36025.2 E 15175.9

ELEVATION: GROUND LEVEL 6096.68'
TOP OF CASING 6099.05'



LOCATION Rocky Flats Plant
PERSONNEL T. Quilliver/T. Murphy
PROJECT 106P06222

DRILLING SUMMARY:

TOTAL DEPTH Well: 207.07' Hole: 238.00'

BOREHOLE DIAMETER 0.00' - 78.30': 5 5/8" 78.00' - 212.00': 4 3/4" 212.00' - 238.00': 4"

DRILLER Boyles Brothers Drilling Co. 15865 W. 5th Avenue, Golden, CO (Tom High, Robert Roach)

RIG 0.00' - 78.30': Casing advancer; 78.30' - 238.00': Failing

BIT(S) 0.00' - 78.30': Down hole hammer; 78.30' - 212.00': Coring bit; 212.00' - 238.00: Chop rod

DRILLING FLUID 0.00' - 78.30': None 78.30' - 238.00': Air/water mist to drill, bentonite mud to ream.

SURFACE CASING 5" x 78.4' steel w/ locking cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00'	78.40'	C1			
0.00'	191.99'	C2			
191.99'	207.07'	S1			

CASING: C1 5" I.D. steel surface casing
C2 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed.

SCREEN: S1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed, 0.010" wire wrap screen, 0.25' welded bottom cap.

CENTRALIZERS Type 304 stainless steel
199.27' - 200.47'

FILTER MATERIAL 32-42 silica sand
188.50' - 209.00'

CEMENT Portland Type I
0.00' - 186.00'

OTHER 3/8" bentonite pellets
186.00' - 188.50'
209.00' - 238.00'

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" casing advancer	9/18	1024	9/19	1110
NC Core	10/23	1310	10/28	1500
Reaming	11/13	1500	11/13	1630
GEOPHYS. LOGGING:	—	—	—	—
CASING:				
5" steel	9/18	1024	9/19	1110
2" stainless	11/14	0838	11/14	0900
FILTER PLACEMENT:	11/13	1631	11/14	1342
CEMENTING:	11/17	0857	11/18	1142
DEVELOPMENT:				
OTHER:				
Bentonite	11/14	1630	11/14	1645
	11/13	1600	11/13	1631
Packer testing	10/29	0730	11/3	1135

WELL DEVELOPMENT

See Well Development Summary Sheet.

COMMENTS:

No water encountered during drilling.

Top of stainless steel casing: 2.69'

Well built through 4" casing.

HYDRO-SEARCH RENO•DENVER CONSULTING HYDROLOGISTS-GEOLOGISTS

PROGRAM SLUGT, VERSION 4,OCT. 1985

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS. 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE. 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

PROJECT NO.: 6-011B-87 CLIENT: Rockwell International

ITE LOCATION: Rocky Flats Plant DATE OF SLUG TEST: 1-22-88

FIELD INVESTIGATOR: K. McNeill

WELL NO.: 43-86

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 4.75 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = .25
LENGTH OF SCREEN OR INTAKE PORTION = 5.75 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 145.21 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 9.75 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF HEAD-TIME DATA POINTS = 20

TIME (sec)	HEAD (FEET)
45.00	1.280
56.00	1.280
66.00	1.270
86.00	1.270
96.00	1.270
106.00	1.270
116.00	1.270
136.00	1.270
156.00	1.270
206.00	1.270
236.00	1.270
296.00	1.270
356.00	1.270
386.00	1.260
506.00	1.260
646.00	1.260
736.00	1.250
916.00	1.250
1096.00	1.250
1246.00	1.240
1636.00	1.230

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO

(FEET)

1.2754
1.2753

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 1.29 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/sec AND PERMEABILITY UNITS ARE IN FT/sec

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF 'T' RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	3.459E-08	3.555E-09	1.275E-08	9.455E-09	2.365002	334.25	.00
1.000E-02	1.000E-02	1.721E-07	1.769E-08	7.172E-08	4.935E-07	2.449997	313.35	20.90
1.000E-03	1.000E-03	5.541E-07	5.694E-08	1.926E-07	1.603E-06	2.545279	373.42	-60.07
1.000E-04	1.000E-04	1.048E-06	1.077E-07	3.321E-07	3.027E-06	2.571122	398.89	-25.47
1.000E-05	1.000E-05	1.549E-06	1.592E-07	4.704E-07	4.468E-06	2.580601	409.73	-10.84
1.000E-06	1.000E-06	2.039E-06	2.095E-07	6.058E-07	5.872E-06	2.583490	415.19	-5.46
1.000E-07	1.000E-07	2.519E-06	2.589E-07	7.385E-07	7.254E-06	2.586534	418.35	-3.17
1.000E-08	1.000E-08	2.992E-06	3.075E-07	8.690E-07	8.614E-06	2.588350	420.48	-2.12
1.000E-09	1.000E-09	3.462E-06	3.558E-07	9.990E-07	9.961E-06	2.588688	422.01	-1.53
1.000E-10	1.000E-10	3.927E-06	4.036E-07	1.128E-06	1.131E-05	2.591604	423.15	-1.14

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METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 3.47E-08 FT/sec = 1.06E-06 CM/sec

TRANSMISSIVITY = 3.38E-07 FT**2/sec

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 4.11E-08 FT/sec = 1.25E-06 CM/sec

TRANSMISSIVITY = 4.00E-07 FT**2/sec

1

WELL NO.: 48-B6

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 4.75 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = .25
LENGTH OF SCREEN OR INTAKE PORTION = 9.73 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 145.32 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 9.73 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF HEAD-TIME DATA POINTS = 20

TIME (sec)	HEAD (FEET)
45.00	1.230
50.00	1.230
56.00	1.270
66.00	1.270
86.00	1.270
106.00	1.270
146.00	1.270
176.00	1.270
206.00	1.270
236.00	1.270
296.00	1.270
356.00	1.270
386.00	1.260
506.00	1.260
546.00	1.260
726.00	1.250
916.00	1.250
1096.00	1.250
1246.00	1.240
1626.00	1.230

H0 WAS COMPUTED FROM KNOWN VOLUME OF SLUG

VOLUME OF SLUG ENTERED = .00250 CUBIC FEET

1

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 1.49 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/sec AND PERMEABILITY UNITS ARE IN FT/sec

ALPHA	STORATIVITY	MEAN	MEAN	MINIMUM	MAXIMUM	RATIO OF	ROOT MEAN	DIFFERENCE

		TRANSMIS-SIVITY	PERMEA-BILITY	TRANS.	TRANS.	'T' RANGE TO TBAR	SQUARE OF TIME DEVIATIONS	IN RMS
1.000E-01	1.000E-01	1.622E-06	1.667E-07	2.050E-07	4.959E-06	2.931592	518.02	.00
1.000E-02	1.000E-02	5.326E-06	5.474E-07	6.303E-07	1.654E-05	2.986329	522.53	-4.51
1.000E-03	1.000E-03	1.910E-05	1.038E-06	1.157E-06	3.160E-05	3.013752	524.69	-2.16
1.000E-04	1.000E-04	1.493E-05	1.534E-06	1.686E-06	4.685E-05	3.025089	525.58	-.89
1.000E-05	1.000E-05	1.966E-05	2.020E-06	2.203E-06	6.179E-05	3.031452	526.08	-.50
1.000E-06	1.000E-06	2.429E-05	2.496E-06	2.710E-06	7.642E-05	3.034861	526.35	-.27
1.000E-07	1.000E-07	2.886E-05	2.966E-06	3.211E-06	9.086E-05	3.037248	526.54	-.19
1.000E-08	1.000E-08	3.338E-05	3.431E-06	3.707E-06	1.051E-04	3.038870	526.66	-.13
1.000E-09	1.000E-09	3.787E-05	3.892E-06	4.199E-06	1.193E-04	3.040122	526.76	-.10
1.000E-10	1.000E-10	4.234E-05	4.351E-06	4.688E-06	1.334E-04	3.041059	526.83	-.08

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 101.23 - 110.88
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00004344 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000412 FT/MIN
K = .00000002 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 113.80 - 123.53
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00033305 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.73 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000003141 FT/MIN
K = .00000016 CM/SEC

P2/3 TEST

Q = INJECTION RATE = .00017377 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.73 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 14.00 * 2.31 = 94.75
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000001239 FT/MIN
K = .00000006 CM/SEC

2ND P1/3 TEST

Q = INJECTION RATE = .00001448 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.73 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000137 FT/MIN
K = .00000001 CM/SEC

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 124.69 - 134.34
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00047786 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000004535 FT/MIN
K = .00000023 CM/SEC

P2/3 TEST

Q = INJECTION RATE = .00212195 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 18.50 * 2.31 = 105.14
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000013724 FT/MIN
K = .00000070 CM/SEC

2ND P1/3 TEST

Q = INJECTION RATE = .00020273 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000001924 FT/MIN
K = .00000010 CM/SEC

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 128.05 - 137.70
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00078738 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000007473 FT/MIN
K = .00000038 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 130.05 - 139.70
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00113508 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000010773 FT/MIN
K = .00000055 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 141.03 - 150.39
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00018101 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.36 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 3.80 * 2.31 = 71.19
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000001769 FT/MIN
K = .00000009 CM/SEC

P2/3 TEST

Q = INJECTION RATE = .00224697 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.36 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 26.00 * 2.31 = 122.47
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000012768 FT/MIN
K = .00000065 CM/SEC

2ND P1/3 TEST

Q = INJECTION RATE = .00005792 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.36 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000563 FT/MIN
K = .00000003 CM/SEC

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 141.03 - 150.39
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00068058 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.36 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000006610 FT/MIN
K = .00000034 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 144.00 - 153.65
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00052130 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000004948 FT/MIN
K = .00000025 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 145.94 - 155.59
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00039097 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000003711 FT/MIN
K = .00000019 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 160.00 - 169.65
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00089779 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.50 * 2.31 = 72.81
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000008386 FT/MIN
K = .00000043 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 161.88 - 171.53
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00027513 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000002611 FT/MIN
K = .00000013 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 165.20 - 174.80
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00020273 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.60 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000001932 FT/MIN
K = .00000010 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 167.10 - 176.74
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00063714 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.64 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000006052 FT/MIN
K = .00000031 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 175.85 - 185.50
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00047786 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 5.00 * 2.31 = 73.96
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000004394 FT/MIN
K = .00000022 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 177.75 - 187.40
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00001401 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 3.50 * 2.31 = 70.50
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000135 FT/MIN
K = .00000001 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 181.21 - 190.86
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00031857 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 3.80 * 2.31 = 71.19
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000003043 FT/MIN
K = .00000015 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 183.11 - 192.76
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00008688 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 5.00 * 2.31 = 73.96
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000799 FT/MIN
K = .00000004 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 192.00 - 201.65
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00001448 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 3.80 * 2.31 = 71.19
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000138 FT/MIN
K = .00000001 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 194.00 - 203.60
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00062266 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.60 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 4.00 * 2.31 = 71.65
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000005933 FT/MIN
K = .00000030 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 196.15 - 206.80
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00024617 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 10.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 5.00 * 2.31 = 73.96
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000002100 FT/MIN
K = .00000011 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST ANALYSIS
WELL NO. 48-86
ROCKY FLATS PLANT; WEST SPRAY FIELD JOB NO. 106P06222
DATE TESTED: 11/3/86 BY: T.M. MURPHY
TEST INTERVAL (FEET BELOW G.S.): 198.76 - 208.41
MATERIAL TESTED: ARAPAHOE FORMATION
DEPTH TO WATER (FEET BELOW G.S.): 54.91

$$K = \frac{Q}{2(PI)(L)(H)} LN\left(\frac{L}{R}\right)$$

1ST P1/3 TEST

Q = INJECTION RATE = .00005792 (FEET3/MIN)
L = LENGTH OF TEST INTERVAL = 9.65 FEET
TEST INTERVAL IS BELOW WATER TABLE
HEAD = DEPTH TO WATER + GAGE HEIGHT
+ GAGE PRESSURE (IN FEET)
= 54.91 + 7.50 + 6.00 * 2.31 = 76.27
R = BOREHOLE RADIUS = .16 FEET

K = HYDRAULIC CONDUCTIVITY = .0000000516 FT/MIN
K = .00000003 CM/SEC

P2/3 TEST

TEST FAILED

PACKER TEST DATA SHEET

JOB NO. 106006222 NAME Rocky Flats HOLE NO. 48-86 SHEET 1 OF 3

LOCATION Rocky Flats Plant; West Spray Field ENGR. T.M. Murphy DATE 11/3/86

GROUND SFC. ELEV. 6079.68' HOLE DIA. 3-3/4" TYPE OF BORING NC Core

HEIGHT OF CASING ABOVE GR.	DEPTH TO G.W.T.	DEPTH OF TOP PACKER	DEPTH OF BTM. PACKER	TEST STATION LENGTH	HEIGHT OF GAGE ABOVE GR.	PRESSURE (PSI)	TIME (MIN)	FLOWMETER	ΔQ UNITS	REMARKS
2.69'	54.91' below g.s. (5/12/88)	198.76'	208.41'	9.65'	7.5'	6	15	.04'	5.3x10-5	Pwc+Pgh+Pg=94.3 P 2/3 test failed
		196.15'	206.8'	9.65'	7.5'	5	15	.17'	2.3x10-4	P=92.5 P 2/3 test failed
		194.0'	203.6'	9.65'	7.5'	4	15	.43'	.001	P=90.2 P 2/3 test failed
		192.0'	201.65'	9.65'	7.5'	3.8	15	.01'	1.3x10-5	P=89.5 P 2/3 test failed
		183.11'	192.76'	9.65'	7.5'	5	15	.06'	8x10-5	P=86.8 P 2/3 test failed
		181.21'	190.86'	9.65'	7.5'	3.8	15	.22'	2.9x10-4	P=84.9 P 2/3 test failed
		177.75'	187.4'	9.65'	7.5'	3.5	15.5	.01'	1.3x10-5	P=82.9 P 2/3 test failed
		175.85'	185.5'	9.65'	7.5'	5	15	.33'	4.4x10'4	P 2/3 test failed
		167.10'	176.74'	9.65'	7.5'	4	15	.44'	.001	P=79.0 P 2/3 test failed
		165.2'	174.8'	9.65'	7.5'	4	15	.14'	1.87x10-4	P=78.2 P 2/3 test failed

PACKER TEST DATA SHEET

JOB NO. 106006222 NAME Rocky Flats HOLE NO. 48-86 (cont'd.) SHEET 2 OF 3

LOCATION Rocky Flats Plant; West Spray Field ENGR. T.M. Murphy DATE 11/3/86

GROUND SFC. ELEV. 6079.68' HOLE DIA. 3-3/4" TYPE OF BORING NC Core

HEIGHT OF CASING ABOVE GR.	DEPTH TO G.W.T.	DEPTH OF TOP PACKER	DEPTH OF BTM. PACKER	TEST STATION LENGTH	HEIGHT OF GAGE ABOVE GR.	PRESSURE (PSI)	TIME (MIN)	FLOWMETER	ΔQ UNITS	REMARKS
2.69'	54.91' below g.s. (5/12/88)	161.88'	171.53'	9.65'	7.5'	4	15	.19'	2.53x10-4	P=76.7 P 2/3 test failed
		160.0'	169.65'	9.65'	7.5'	4.5	15	.62'	.001	P=76.5 P 2/3 test failed
		145.94'	155.59'	9.65'	7.5'	4	15	.27'	3.6x10-4	P=69.95 P 2/3 test failed
		144.0'	153.65'	9.65'	7.5'	4	15	.36'	4.8x10-4	P=69.1 P 2/3 test failed
		141.03'	150.39'	9.65'	7.5'	4	15	.47	.001	P=67.8 P 2/3 test failed
		141.03'	150.39'	9.65'	7.5'	3.8 26 4	18 14.5 15	.15' 1.5' .04'	1.66x10-4 .002 5.3x10-5	P=67.6 P=89.8 P=67.8
		130.05'	139.70'	9.65'	7.5'	4	15.5	.81	.001	P=63.10 P 2/3 test failed
		128.05'	137.7'	9.65'	7.5'	4	16	.58	.001	P=62.2 P 2/3 test failed
		124.69'	134.34'	9.65'	7.5'	4 18.5 4	15 13 15	.33 1.27 .14	4.4x10-4 .002 1.87x10-4	P=60.81 P=75.31 P=60.81

PACKER TEST DATA SHEET

JOB NO. 106006222 NAME Rocky Flats HOLE NO. 48-86 (cont'd) SHEET 3 OF 3

LOCATION Rocky Flats Plant; West Spray Field ENGR. T.M. Murphy DATE 11/3/86

GROUND SFC. ELEV. 6079.68' HOLE DIA. 3-3/4" TYPE OF BORING NC Core

HEIGHT OF CASING ABOVE GR.	DEPTH TO G.W.T.	DEPTH OF TOP PACKER	DEPTH OF BTM. PACKER	TEST STATION LENGTH	HEIGHT OF GAGE ABOVE GR.	PRESSURE (PSI)	TIME (MIN)	FLOWMETER	ΔQ UNITS	REMARKS
2.69'	54.91' below g.s. (5/12/88)	113.8'	123.53'	9.65'	7.5'	4	15	.23	3.33x10-4	P=56.13
						14	15	.12	1.6x10-4	P=67.93
						4	12	.01	1.67x10-5	P=56.13
		101.23'	110.88'	9.65'	7.5'	4	15	.03	4x10-5	P=50.72 P 2/3 test failed

08/15/88

ROCKY FLATS WEST SPRAY FIELD

WATER LEVEL SUMMARY

WELL NUMBER	SAMPLE DATE	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	STICK UP	DEPTH OF SI BASE	ELEVATION OF SI TOP	ELEVATION OF SI BOTTOM	TOTAL DEPTH OF WELL	WATER DEPTH BELOW TOC	WATER SURFACE ELEVATION
4886	11/19/86	6096.68	6099.05	2.37	207.07	5904.69	5889.61	207.1	15.85	6083.20
	11/20/86								154.67	5944.38
	12/11/86								68.21	6030.84
	12/15/86								134.04	5965.01
	01/01/87								63.96	6035.09
	02/01/87								59.29	6039.76
	03/31/87								57.83	6041.22
	05/06/87								64.02	6035.03
	06/01/87								59.00	6040.05
	07/08/87								69.65	6029.40
	08/03/87								60.20	6038.85
	08/24/87								58.70	6040.35
	08/31/87								97.80	6001.25
	09/28/87								61.70	6037.35
	11/02/87								58.90	6040.15
	12/07/87								59.40	6039.65
	01/05/88								59.20	6039.85
	02/04/88								58.10	6040.95
	03/14/88								57.80	6041.25
	04/11/88								58.90	6040.15
	05/12/88								57.60	6041.45

INDEX OF DATA

Boring No.: 49-86

Completed as well? Yes

Data in File

X Log of Borehole

X Well Construction Summaries

____ Well Development Summaries

X Hydraulic Conductivity Test Data and Results

____ Packer Test Data and Results

X Water Level Data

____ Saturated Thickness Hydrograph

Project:	Rocky Flats Plant	LOG OF BORING NO. 49-86

Date Drilled	10/16/86	**Coordinates**	N 36000.5 E 15176.7
Boring Method	Casing Driver	**Ground Surface Elevation**	6096.92'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	0			ROCKY FLATS ALLUVIUM			
				0-7'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty; abundant quartzite; micaceous; 2% gravel limonite coated; dry.			
	5						
				7.0-13.0'-Cuttings. GRAVEL: Same as above with no limonite coatings; dry.			
	10						
				13.0-16.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty; sandy; poorly sorted; subangular; 20-30% fines; damp.			
	15						
				16.0-26.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty; sandy; 10% silt; 30% sand; poorly sorted; subangular; moist.			
	20						

Remarks Logged by: T. Gulliver Checked by: [illegible]

Project No. 106P06222	Hydro-Search, Inc.	Page 1 of 4

Project:	Rocky Flats Plant	LOG OF BORING NO. 49-86

Date Drilled	10/16/86	Coordinates	N 36000.5 E 15176.7
Boring Method	Casing Driver	Ground Surface Elevation	6096.92'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	20						
	25			26.0-32.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty; abundant boulders; 5% silt; moist.			
	30			32.0-38.0'-Cuttings. GRAVEL: Same as above; silt 5%; sand 10%; moist.			
	35						
	40			38.0-40.0'-Cuttings. GRAVEL: Same as above; fines <1%; dry.			

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222	Hydro-Search, Inc.	Page 2 of 4

Project:	Rocky Flats Plant	LOG OF BORING NO. 49-86
Date Drilled	10/16/86	Coordinates N 36000.5 E 15176.7
Boring Method	Casing Driver	Ground Surface Elevation 6096.92'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	40			40.0-49.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty; sandy; poorly sorted; subangular; silt 20%; sand 20-30%; moist.			
	45						
				49.0-50.0'-Cuttings. SAND: light brown (5YR 5/6); fine-grained; well sorted; subrounded; damp.			
	50			50.0-56.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); sandy; silty; gravel 10-20%; sand 20-30%; poorly sorted; subangular; moist.			
	55			56.0-57.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); coarse, sandy gravel; moderately well sorted; rounded; wet.			
				57.0-64.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty; sandy; silt 10%; coarse to medium-grained sand 20-30%; subrounded; wet.			
	60						

Remarks Logged by: T. Gulliver Checked by: [illegible]

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 49-86

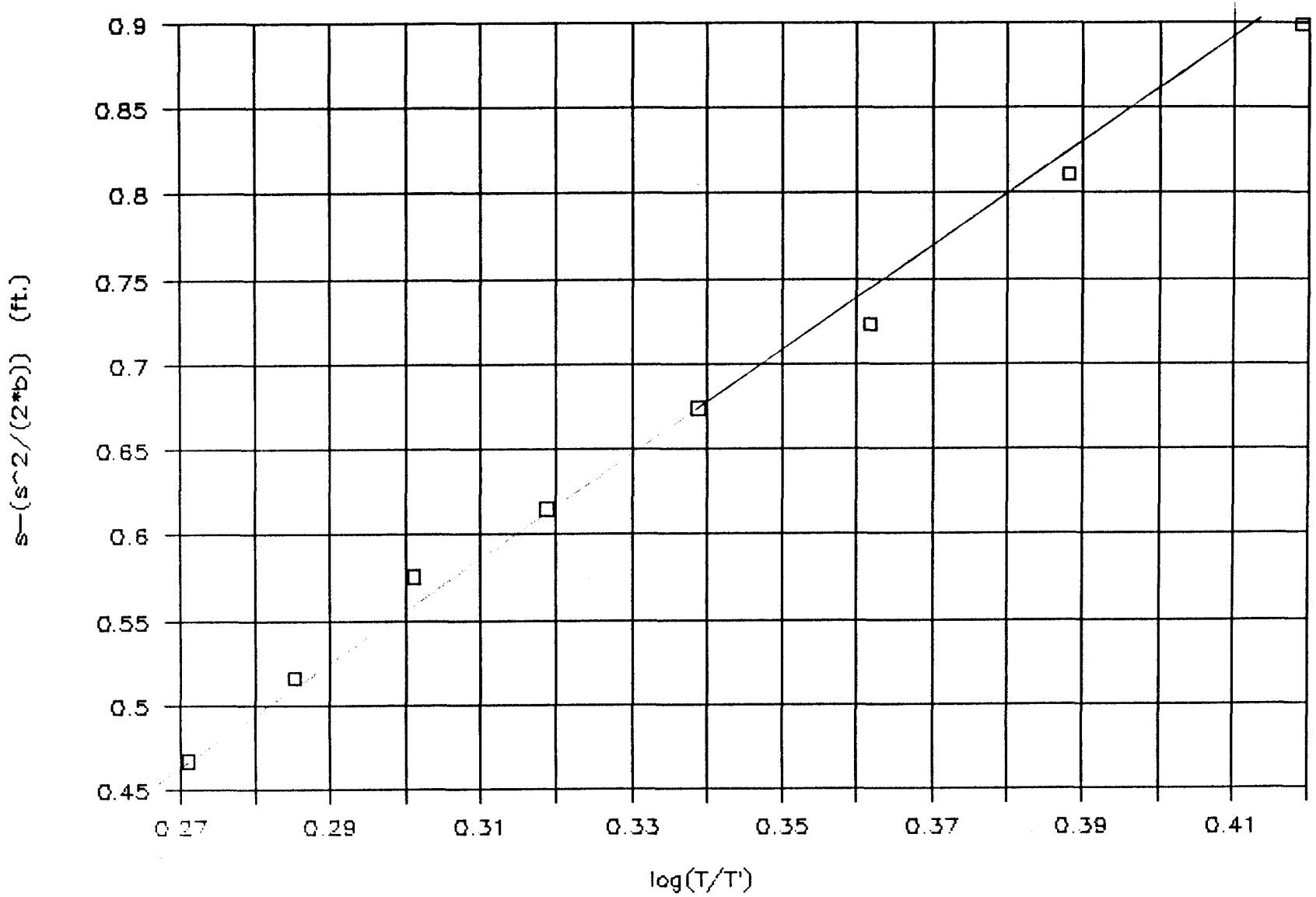
Date Drilled	10/16/86	Coordinates	N 36000.5 E 15176.7
Boring Method	Casing Driver	Ground Surface Elevation	6096.92'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	60						
	65			64.0-66.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); sandy; silty; fine to medium-grained sand 20%; silt 30%; wet.			
				66.0-67.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty; sandy; 20% gravel; 30% medium-grained sand; poorly sorted; very wet.			
	70			67.0-67.5'-Cuttings. CLAY: moderate brown (5YR 4/4); sandy; silty; plastic; soft; wet.			
				67.5-68.0'-Cuttings. SAND: moderate brown (5YR 4/4); gravelly; silty 5%; wet.			
				LARAMIE FORMATION			
	75			68.0-69.0'-Cuttings. CLAYSTONE: light olive gray (5Y 5/2); subplastic; damp.			
				69.0-70.0'-Cuttings. SILTSTONE: light olive gray (5Y 5/2); subplastic; damp.			
				70.0-74.0'-Cuttings. CLAYSTONE: medium gray (N 5); laminated; damp.			
	80			TOTAL DEPTH: 74.0'			

Remarks Logged by: T. Gulliver Checked by: [illegible]

Project No. 106P06222	Hydro-Search, Inc.	Page 4 of 4

WELL 47-86

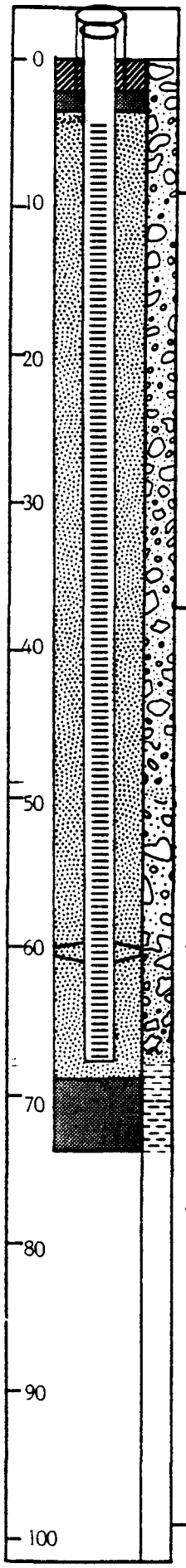

0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
s-(s^2/(2*b)) (ft.)
0.27
0.29
0.31
0.33
0.35
0.37
0.39
0.41
log(T/T')

WELL 49-86

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: N 36000.5 E 15176.7

ELEVATION: GROUND LEVEL 6096.92'
TOP OF CASING 6098.90'



LOCATION Golden, CO
PERSONNEL T. Gulliver
PROJECT 106P06222 Rocky Flats Plant

DRILLING SUMMARY:

TOTAL DEPTH Well: 67.60' Hole: 74.00'
BOREHOLE DIAMETER 5 5/8"

DRILLER Boyles Brothers Drilling Co.
15865 W. 5th Avenue, Golden, CO
(Arrow Drilling, Tom High)
RIG Casing advancer
BIT(S) Down hole hammer

DRILLING FLUID None

SURFACE CASING 5" x 4.40' steel w/ locking cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00'	4.10'	C1			
4.10'	67.60'	S1			

CASING: C1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed.

SCREEN: S1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed, 0.010" wire wrap screen, 0.25' welded bottom cap.

CENTRALIZERS Type 304 stainless steel
58.80' - 60.05'

FILTER MATERIAL 32-42 silica sand
3.57' - 69.00'

CEMENT Portland Type I
0.00' - 2.40'

OTHER 3/8" bentonite pellets
2.40' - 3.57'
69.00' - 74.00'

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" casing advancer	10/16	0900	10/16	1515
GEOPHYS. LOGGING:	—	—	—	—
CASING:				
2" stainless	10/17	1230	10/17	1246
FILTER PLACEMENT:	10/17	1250	10/20	0900
CEMENTING:	10/17	1000	10/17	1100
DEVELOPMENT:				
OTHER:				
Bentonite	10/17	1225	10/17	1246
	10/20	0920	10/20	0925

WELL DEVELOPMENT

See Well Development Summary Sheet.

COMMENTS:

Water encountered at 52' during drilling.

Top of stainless steel casing: 2.32'

PROGRAM SLUGT, VERSION 4,OCT. 1985

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

PROJECT NO.: 6-011B-87 CLIENT: Rockwell International

ITE LOCATION: Rocky Flats Plant DATE OF SLUG TEST: 1-22-88

FIELD INVESTIGATOR: K. McNeill

WELL NO.: 49-86

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = .25
LENGTH OF SCREEN OR INTAKE PORTION = 10.64 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 10.64 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.64 FEET
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF HEAD-TIME DATA POINTS = 10

TIME (sec)	HEAD (FEET)
209.00	.110
214.00	.100
264.00	.090
324.00	.080
394.00	.070
444.00	.060
514.00	.050
584.00	.040
764.00	.030
1124.00	.020

H0 WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR H0 (FEET)
.1467
.1670
.1658

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF HO = .17 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/sec AND PERMEABILITY UNITS ARE IN FT/sec

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.182E-05	5.002E-07	5.843E-06	1.838E-05	1.059861	241.38	.00
1.000E-02	1.000E-02	2.131E-05	9.012E-07	1.401E-05	2.778E-05	.646365	120.02	121.36
1.000E-03	1.000E-03	3.098E-05	1.310E-06	2.292E-05	3.743E-05	.468419	71.17	48.85
1.000E-04	1.000E-04	4.051E-05	1.714E-06	3.170E-05	4.699E-05	.377459	50.26	20.91
1.000E-05	1.000E-05	4.991E-05	2.111E-06	4.024E-05	5.648E-05	.325307	41.38	8.88
1.000E-06	1.000E-06	5.919E-05	2.504E-06	4.869E-05	6.623E-05	.297289	38.11	3.27
1.000E-07	1.000E-07	6.788E-05	2.871E-06	5.707E-05	7.671E-05	.282440	52.96	-14.85
1.000E-08	1.000E-08	7.629E-05	3.227E-06	6.100E-05	8.629E-05	.271523	80.33	-27.37
1.000E-09	1.000E-09	8.302E-05	3.596E-06	6.726E-05	9.622E-05	.340649	81.08	-.75
1.000E-10	1.000E-10	9.367E-05	3.962E-06	7.697E-05	1.061E-04	.310979	68.86	12.23

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 3.17E-06 FT/sec = 9.67E-05 CM/sec

TRANSMISSIVITY = 7.50E-05 FT**2/sec

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.45E-06 FT/sec = 4.43E-05 CM/sec

TRANSMISSIVITY = 3.44E-05 FT**2/sec

1

WELL NO.: 49-86

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 5.63 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = .25

LENGTH OF SCREEN OR INTAKE PORTION = 23.58 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 23.64 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 23.64 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 10

TIME (sec)	HEAD (FEET)
209.00	.110
234.00	.100
264.00	.090
324.00	.080
384.00	.070
444.00	.060
504.00	.050
584.00	.050
764.00	.030
1124.00	.020

H0 WAS COMPUTED FROM KNOWN VOLUME OF SLUG

VOLUME OF SLUG ENTERED = .03250 CUBIC FEET

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = 1.49 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/sec AND PERMEABILITY UNITS ARE IN FT/sec

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF TM RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.319E-04	5.578E-06	1.098E-04	1.546E-04	.339702	42.62	.00
1.000E-02	1.000E-02	1.597E-04	6.756E-06	1.230E-04	2.051E-04	.514551	84.55	-41.93
1.000E-03	1.000E-03	1.828E-04	7.731E-06	1.246E-04	2.546E-04	.711460	119.01	-34.46
1.000E-04	1.000E-04	1.998E-04	8.450E-06	1.347E-04	3.047E-04	.850919	130.29	-11.28
1.000E-05	1.000E-05	2.071E-04	8.760E-06	1.622E-04	3.163E-04	.744120	102.46	27.83
1.000E-06	1.000E-06	2.305E-04	9.752E-06	1.792E-04	3.001E-04	.524252	95.66	6.80
1.000E-07	1.000E-07	2.747E-04	1.162E-05	1.903E-04	3.443E-04	.560874	127.30	-31.64
1.000E-08	1.000E-08	3.163E-04	1.338E-05	2.005E-04	4.227E-04	.702531	157.78	-30.48

1.000E-09	1.000E-09	3.568E-04	1.509E-05	2.142E-04	5.084E-04	.824452	174.07	-16.29
1.000E-10	1.000E-10	3.922E-04	1.659E-05	2.307E-04	5.895E-04	.914933	181.12	-7.05

08/15/88

ROCKY FLATS WEST SPRAY FIELD

WATER LEVEL SUMMARY

WELL NUMBER	SAMPLE DATE	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	STICK UP	DEPTH OF SI BASE	ELEVATION OF SI TOP	ELEVATION OF SI BOTTOM	TOTAL DEPTH OF WELL	WATER DEPTH BELOW TOC	WATER SURFACE ELEVATION
4986	11/19/86	6096.92	6098.90	1.98	67.60	6092.82	6029.32	67.60	46.87	6052.03
	11/21/86								48.35	6050.55
	11/24/86								49.00	6049.90
	01/01/87								49.46	6049.44
	02/01/87								49.50	6049.40
	03/31/87								49.02	6049.88
	05/06/87								47.15	6051.75
	06/01/87								45.27	6053.63
	07/08/87								41.40	6057.50
	08/03/87								54.00	6044.90
	08/24/87								44.00	6054.90
	08/31/87								44.60	6054.30
	09/28/87								44.90	6054.00
	11/02/87								44.60	6054.30
	12/07/87								45.60	6053.30
	01/05/88								46.00	6052.90
	02/03/88								46.80	6052.10
	03/14/88								47.20	6051.70
	04/11/88								47.00	6051.90
	05/12/88								46.70	6052.20

INDEX OF DATA

Boring No.: 50-86

Completed as well? Yes

Data in File

X Log of Borehole

X Well Construction Summaries

X Well Development Summaries

X Hydraulic Conductivity Test Data and Results

____ Packer Test Data and Results

X Water Level Data

____ Saturated Thickness Hydrograph

Project:	Rocky Flats Plant	LOG OF BORING NO.	50-86
Date Drilled	10/7/86	Coordinates	N 34822.0 E 14184.0
Boring Method	Casing Driver	Ground Surface Elevation	6121.98'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	0			ROCKY FLATS ALLUVIUM 0-12.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); granite and quartzite pebbles, cobbles, and boulders; <2% sand and silt; iron coated surfaces; poorly sorted; dry.			
	5						
	10			12.0-14.0'-Cuttings. GRAVEL: Same as above; damp.			
	15			14.0-15.0'-Cuttings. SAND: moderate brown (5YR 4/4); very fine-grained; 1% mica; moderate sorting; subangular; unconsolidated; damp.			
				15.0-25.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); granite and quartzite pebbles, cobbles and boulders; some boulders >2' in diameter; 1-2% sand and silt; poorly sorted; unconsolidated; dry.			
	20						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222	Hydro-Search, Inc.	Page 1 of 6

Project:	Rocky Flats Plant	LOG OF BORING NO.	50-86
Date Drilled	10/7/86	Coordinates N 34822.0	E 14184.0
Boring Method	Casing Driver	Ground Surface Elevation	6121.98'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	20						
	25			25.0-25.5'-Cuttings. GRAVEL: moderate brown (5YR 4/4); granitic pebbles; sandy; silty; poorly sorted; unconsolidated; damp.			
				25.5-75.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); granitic pebbles and cobbles with some light gray (N 7) quartzite cobbles; 1-5% sand and silt; poorly sorted; unconsolidated; damp.			
	30						
	35						
	40						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO.	50-86
Date Drilled	10/7/86	Coordinates	N 34822.0 E 14184.0
Boring Method	Casing Driver	Ground Surface Elevation	6121.98'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	40						
	45						
	50						
	55						
	60						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO.	50-86
Date Drilled	10/7/86	Coordinates	N 34822.0 E 14184.0
Boring Method	Casing Driver	Ground Surface Elevation	6121.98'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	60						
	65						
	70						
	75			75.0-92.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); granitic pebbles and cobbles; ~20% medium to coarse-grained sand and silty sand; poorly sorted; subangular; unconsolidated; damp.			
	80						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO.	50-86

Date Drilled 10/7/86 **Coordinates** N 34822.0 E 14184.0

Boring Method Casing Driver **Ground Surface Elevation** 6121.98'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	80						
	85						
	90						
				92.0-98.0'-Cuttings. GRAVEL: Same as above; wet.			
	95						
				LARAMIE FORMATION			
				98.0-102.0'-Cuttings. CLAYSTONE: very light gray (N 8); plastic; laminated; moist.			
	100						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222	Hydro-Search, Inc.	Page 5 of 6

Project:	Rocky Flats Plant	LOG OF BORING NO.	50-86

Date Drilled 10/7/86 **Coordinates** N 34822.0 E 14184.0

Boring Method Casing Driver **Ground Surface Elevation** 6121.98'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	100						
				TOTAL DEPTH: 102.0'			
	105						
	110						
	115						
	120						

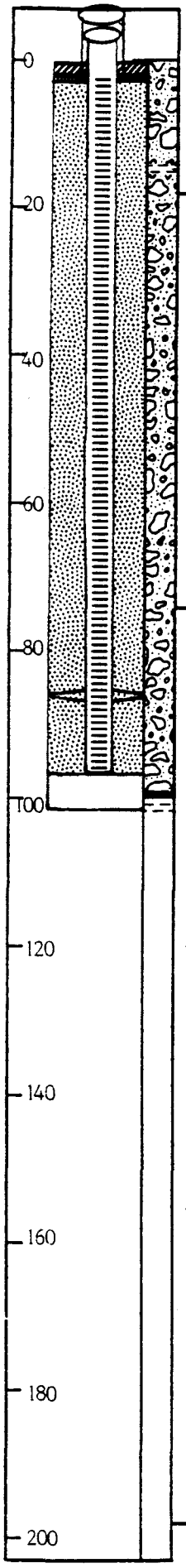
Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

WELL 50-86

WELL CONSTRUCTION SUMMARY



LOCATION Golden, CO

PERSONNEL T. Gulliver

PROJECT 106P06222 Rocky Flats Plant

LOCATION or COORDS: N 34822.0 E 14184.0

ELEVATION: GROUND LEVEL 6121.98'
TOP OF CASING 6123.25'

DRILLING SUMMARY:

TOTAL DEPTH Well: 96.15' Hole: 102.00'

BOREHOLE DIAMETER 0.00' - 37.00': 5 5/8"
37.00' - 102.00': 5"

DRILLER Boyles Brothers Drilling Co.
15865 W. 5th Avenue, Golden, CO
(Arrow Drilling, Tom High)

RIG Casing advancer

BIT(S) Down hole hammer

DRILLING FLUID None

SURFACE CASING 5" x 4.13' steel w/ locking cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00'	2.90'	C1				
2.90'	96.15'	S1				

CASING: C1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed.

SCREEN: S1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed, 0.010" wire wrap screen, 0.25' welded bottom cap.

CENTRALIZERS Type 304 stainless steel
85.71' - 86.95'
92.93' - 94.10'

FILTER MATERIAL 16-40 silica sand
2.40' - 96.15'

CEMENT Portland Type I
0.00' - 1.60'

OTHER 3/8" bentonite pellets
1.60' - 2.40'

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" & 5" casing advancer	10/7	0820	10/7	1400
GEOPHYS. LOGGING:	—	—	—	—
CASING:				
2" stainless	10/14	1052	10/14	1105
FILTER PLACEMENT:	10/14	1200	10/14	1440
CEMENTING:	10/14	1450	10/14	1500
DEVELOPMENT:	10/23	1355	10/31	1045
OTHER:				
Bentonite	10/14	1440	10/14	1441

WELL DEVELOPMENT

See Well Development Summary Sheet.

COMMENTS:

Water encountered at 49' during drilling.

Top of stainless steel casing: 1.19'

Cave from TD to 95.15'

Well No.: 50-86

WELL DEVELOPMENT SUMMARY SHEET

DATE	TIME	METHOD	VOLUME	APPEARANCE	COMMENTS
10-23-86	1355				1 Well Bore Volume = 7.86 gals 10 Well Bore Volumes = 78.6 gals
10-23-86	1355	Airlifted	~ 7.8 gals	Medium to dark brown	
10-24-86	1150	Airlifted	~ 7.8 gals	Medium to dark brown spray	
10-27-86	1440	Bailed	24 gals	Med to dark brown trace oily sheen on bailed water	24/78.6 gals purged to date
10-28-86	1445	Bailed	16 gals	Med reddish brown highly turbid	40/78.6 gals purged to date
10-29-86	0900	Bailed	24 gals	Med to dark brown No significant change	64/78.6 gals purged to date
10-31-86	0840	Bailed	22 gals	Medium brown highly turbid	86/78.6 gals purged to date
10-31-86	1045	Bailed		Medium brown Highly turbid	Sampled

1

PROGRAM SLUGT, VERSION 4,OCT. 1985

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3,NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

PROJECT NO.: 6-011B-87 CLIENT: Rockwell International

ITE LOCATION: Rocky Flats Plant DATE OF SLUG TEST: 1-28-88

FIELD INVESTIGATOR: K. McNeill

WELL NO.: 50-86

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 5.00 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = .25
LENGTH OF SCREEN OR INTAKE PORTION = 49.43 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 49.43 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 49.43 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF HEAD-TIME DATA POINTS = 10

TIME (sec)	HEAD (FEET)
30.00	.110
35.00	[illegible]
40.00	[illegible]
45.00	[illegible]
50.00	[illegible]
55.00	[illegible]
57.00	[illegible]
67.00	[illegible]
83.00	.030
101.00	.020

H0 WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR H0 (FEET)

.2135
.2244

1

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = .22 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/sec AND PERMEABILITY UNITS ARE IN FT/sec

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF "T" RANGE TO TBAR	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.707E-04	3.453E-06	1.014E-04	2.706E-04	.991316	21.91	.00
1.000E-02	1.000E-02	2.802E-04	5.669E-06	2.058E-04	3.698E-04	.585211	12.41	9.51
1.000E-03	1.000E-03	3.888E-04	7.866E-06	3.112E-04	4.673E-04	.401531	8.16	4.25
1.000E-04	1.000E-04	4.962E-04	1.004E-05	4.143E-04	5.655E-04	.304683	5.94	2.22
1.000E-05	1.000E-05	6.020E-04	1.218E-05	5.139E-04	6.633E-04	.248040	4.67	1.27
1.000E-06	1.000E-06	6.952E-04	1.406E-05	6.132E-04	7.591E-04	.209836	3.82	.45
1.000E-07	1.000E-07	7.906E-04	1.599E-05	6.533E-04	8.669E-04	.269952	6.54	-2.32
1.000E-08	1.000E-08	8.842E-04	1.789E-05	7.601E-04	9.776E-04	.241435	5.51	.37
1.000E-09	1.000E-09	9.841E-04	1.991E-05	8.761E-04	1.076E-03	.203562	4.71	1.09
1.000E-10	1.000E-10	1.086E-03	2.198E-05	9.787E-04	1.186E-03	.190741	3.89	1.12

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.74E-05 FT/sec = 5.31E-04 CM/sec

TRANSMISSIVITY = 5.21E-04 FT**2/sec

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 9.20E-06 FT/sec = 2.80E-04 CM/sec

TRANSMISSIVITY = 4.55E-04 FT**2/sec

WELL NO.: 50-86

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 5.00 INCHES
ESTIMATED POROSITY OF GRAVEL PACK = .25

LENGTH OF SCREEN OR INTAKE PORTION = 49.38 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 49.43 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 49.43 FEET
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)

NUMBER OF HEAD-TIME DATA POINTS = 10

TIME (sec)	HEAD (FEET)
30.00	.110
35.00	.100
40.00	.080
45.00	.070
50.00	.060
55.00	.060
59.00	.050
67.00	.040
83.00	.030
101.00	.020

H0 WAS COMPUTED FROM KNOWN VOLUME OF SLUG

VOLUME OF SLUG ENTERED = .00250 CUBIC FEET

METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS

COMPUTED RESULTS:

COMPUTED VALUE OF H0 = .049 FEET

NOTE: TRANSMISSIVITY UNITS ARE IN FT**2/sec AND PERMEABILITY UNITS ARE IN FT/sec

ALPHA	STORATIVITY	MEAN TRANSMIS-SIVITY	MEAN PERMEA-BILITY	MINIMUM TRANS.	MAXIMUM TRANS.	RATIO OF TR RANGE TO MEAN	ROOT MEAN SQUARE OF TIME DEVIATIONS	DIFFERENCE IN RMS
1.000E-01	1.000E-01	1.106E-03	2.238E-05	9.960E-04	1.420E-03	.353061	9.33	.00
1.000E-02	1.000E-02	1.312E-03	2.653E-05	1.193E-03	1.507E-03	.237650	5.86	3.67
1.000E-03	1.000E-03	1.473E-03	2.980E-05	1.233E-03	1.774E-03	.366934	6.19	-.52
1.000E-04	1.000E-04	1.587E-03	3.211E-05	1.240E-03	2.123E-03	.556324	7.29	-1.11
1.000E-05	1.000E-05	1.701E-03	3.441E-05	1.424E-03	2.204E-03	.458682	5.42	1.88
1.000E-06	1.000E-06	1.922E-03	3.889E-05	1.778E-03	2.091E-03	.162717	3.31	2.10
1.000E-07	1.000E-07	2.240E-03	4.531E-05	1.963E-03	2.413E-03	.201032	4.51	-1.20
1.000E-08	1.000E-08	2.560E-03	5.179E-05	2.208E-03	2.945E-03	.287911	6.99	-2.48

1.000E-09	1.000E-09	2.829E-03	5.723E-05	2.384E-03	3.542E-03	.409245	8.08	-1.09
1.000E-10	1.000E-10	3.091E-03	6.253E-05	2.567E-03	4.107E-03	.498122	8.68	-.59

08/15/88

ROCKY FLATS WEST SPRAY FIELD

WATER LEVEL SUMMARY

WELL NUMBER	SAMPLE DATE	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	STICK UP	DEPTH OF SI BASE	ELEVATION OF SI TOP	ELEVATION OF SI BOTTOM	TOTAL DEPTH OF WELL	WATER DEPTH BELOW TOC	WATER SURFACE ELEVATION
5086	10/23/86	6121.98	6123.25	1.27	96.15	6119.08	6025.83	96.15	49.50	6073.75
	10/27/86								49.25	6074.00
	10/28/86								49.46	6073.79
	10/31/86								49.35	6073.90
	11/26/86								49.32	6073.93
	01/01/87								49.33	6073.92
	03/31/87								49.52	6073.73
	05/06/87								49.08	6074.17
	06/01/87								47.65	6075.60
	07/08/87								47.00	6076.25
	08/03/87								47.60	6075.65
	08/14/87								46.40	6076.85
	08/31/87								46.60	6076.65
	09/28/87								46.50	6076.75
	11/02/87								46.00	6077.25
	12/07/87								46.60	6076.65
	01/05/88								47.20	6076.05
	02/03/88								47.00	6076.25
	03/14/88								47.30	6075.95
	04/11/88								47.70	6075.55
	05/12/88								47.80	6075.45

INDEX OF DATA

Boring No.: 51-86

Completed as well? Yes

Data in File

X Log of Borehole

X Well Construction Summaries

X Well Development Summaries

X Hydraulic Conductivity Test Data and Results

____ Packer Test Data and Results

X Water Level Data

____ Saturated Thickness Hydrograph

Project:	Rocky Flats Plant	LOG OF BORING NO. 51-86
Date Drilled	10/22/86	Coordinates N 35618.3 E 13023.6
Boring Method	Casing Driver	Ground Surface Elevation 6142.29'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	0			ROCKY FLATS ALLUVIUM			
				0-5.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); sandy; 10-20% sand; poorly sorted; limonitic; dry.			
	5			5.0-17.0'-Cuttings. GRAVEL: Same as above; abundant quartzite boulders; dry.			
	10						
	15			17.0-20.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); sandy; silty; 10% sand; 20-30% gravel; damp.			
	20						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222	Hydro-Search, Inc.	Page 1 of 5

Project:	Rocky Flats Plant	LOG OF BORING NO. 51-86
Date Drilled	10/22/86	Coordinates N 35618.3 E 13023.6
Boring Method	Casing Driver	Ground Surface Elevation 6142.29'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	20			20.0-22.0'-Cuttings. SAND AND GRAVEL: moderate brown (5YR 4/4); poorly sorted; subangular; gravel 40%; damp.			
				22.0-28.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); sandy; silty; 10-20% sand; poorly sorted; subangular; moist.			
	25						
				28.0-30.0'-Cuttings. CLAY: moderate brown (5YR 4/4); 10-20% gravel; plastic; wet.			
	30			30.0-32.0'-Cuttings. SAND: moderate brown (5YR 4/4); 5% gravel; silty; poorly sorted; subangular; wet.			
				32.0-38.0'-Cuttings. SILT: moderate brown (5YR 4/4); sandy; gravelly; 20% sand; moderate sorting; subrounded; 20-30% gravel; damp.			
	35						
				38.0-45.0'-Cuttings. SAND: light brown (5YR 5/6); fine-grained; 5% gravel; moderate sorting; subrounded; dry.			
	40						

Remarks

Logged by: T. Gulliver

Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 51-86
Date Drilled	10/22/86	Coordinates N 35618.3 E 13023.6
Boring Method	Casing Driver	Ground Surface Elevation 6142.29'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	40						
	45			45.0-55.0'-Cuttings. BOULDER GRAVEL: pale yellowish brown (10YR 6/2); abundant quartzite and quartz sandstone; dry.			
	50						
	55			55.0-74.0'-Cuttings. BOULDER GRAVEL: same as above; silty; damp.			
	60						

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 51-86
Date Drilled	10/22/86	Coordinates N 35618.3 E 13023.6
Boring Method	Casing Driver	Ground Surface Elevation 6142.29'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	60						
	65						
	70						
	75			74.0-78.5'-Cuttings. CLAY: moderate brown (5YR 4/4); sandy; silty; subplastic; damp.			
				LARAMIE FORMATION			
	80			78.5-81.0'-Cuttings. CLAYSTONE: light brown (5YR 5/6); silty; damp.			

Remarks Logged by: T. Gulliver Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 51-86
Date Drilled	10/22/86	Coordinates N 35618.3 E 13023.6
Boring Method	Casing Driver	Ground Surface Elevation 6142.29'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	80			81.0-94.0'-Cuttings. SILTSTONE: light olive brown (5YR 5/6); minor claystone; damp.			
	85						
	90						
				TOTAL DEPTH: 94.0'			
	95						
	100						

Remarks Logged by: T. Gulliver Checked by: [illegible]

Project No. 106P06222

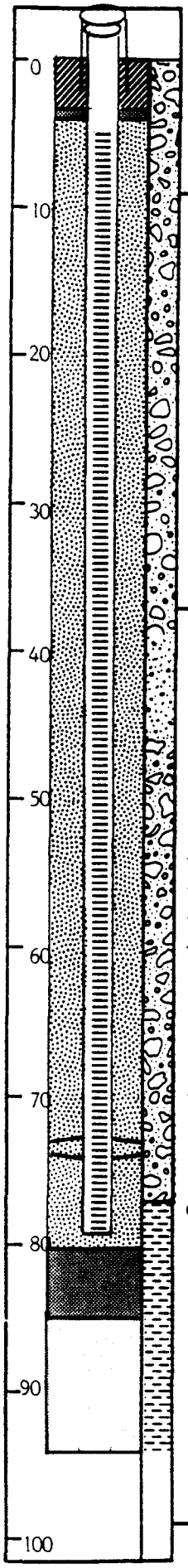
Hydro-Search, Inc.

WELL 51-86

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: N 35618.3 E 13023.6

ELEVATION: GROUND LEVEL 6142.29'
TOP OF CASING 6144.52'



PROJECT 106P06222 Rocky Flats Plant
PERSONNEL T. Gulliver
LOCATION Golden, CO

DRILLING SUMMARY:

TOTAL DEPTH Well: 79.06' Hole: 94.00'
BOREHOLE DIAMETER 5 5/8"

DRILLER Boyles Brothers Drilling Co.
15865 W. 5th Avenue, Golden, CO
(Arrow Drilling, Tom High)
RIG Casing advancer
BIT(S) Down hole hammer

DRILLING FLUID None

SURFACE CASING 5" x 5.4' steel w/ locking cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00'	4.83'	C1			
4.83'	79.06'	S1			

CASING: C1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed.
C2
C3
C4

SCREEN: S1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed, 0.010" wire wrap screen,
S2
S3
S4 0.25' welded bottom cap.

CENTRALIZERS Type 304 stainless steel
72.58' - 73.82'

FILTER MATERIAL 32-42 silica sand
4.00' - 80.30'

CEMENT Portland Type I
0.00' - 3.10'

OTHER 3/8" bentonite pellets
3.10' - 4.00'
80.30' - 85.00'

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" casing advancer	10/22	0830	10/22	1700
GEOPHYS. LOGGING:	—	—	—	—
CASING:				
2" stainless	10/23	1150	10/23	1200
FILTER PLACEMENT:	10/23	1200	10/23	1430
CEMENTING:	10/23	1505	10/23	1510
DEVELOPMENT:	10/27	1230	11/7	1420
OTHER:				
Bentonite	10/23	1440	10/23	1445
	10/23	1050	10/23	1150

WELL DEVELOPMENT

See Well Development Summary Sheet.

COMMENTS:

No water encountered during drilling.

Top of stainless steel casing: 2.52'

Cave from TD to 85'

Well No.: 51-86

WELL DEVELOPMENT SUMMARY SHEET

DATE	TIME	METHOD	VOLUME	APPEARANCE	COMMENTS
10-27-86	1230				1 Well Bore Volume = 3.76 gal 10 Well Bore Volumes = 37.6 gals
10-27-86	1230	Airlifted	3.76 gals	Light brown spray	
10-29-86	1440	Water level	only		
10-30-86	1525	Bailed	7 gals	Light brown Slightly turbid	7/37.6 gals purged to date
11-03-86	1105	Bailed	9.5 gals	Light brown Slightly turbid	16.5/37.6 gals purged to date
11-05-86	1055	Bailed	9.5 gals	Light brown Slightly turbid	26/37.6 gals purged to date
11-06-86	1341	Bailed	9.0 gals	Light gray Slightly turbid	35/37.6 gals purged to date
11-07-86	1420	Bailed	---	Clear	Sampled

Hydraulic conductivity cannot be calculated from the following aquifer test data for Well 51-86 because the volume of bailed ground water is not recorded.

AQUIFER TEST DATA

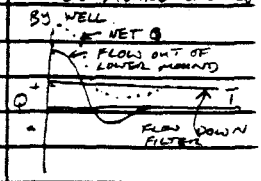
WELL 51-86
PUMPING or OBSERVATION WELL
PUMPING or RECOVERY DATA
PAGE 1 OF 2

TYPE OF AQUIFER TEST BAILER RECOVERY
HOW Q MEASURED
HOW W.L.'s MEASURED OLYMPIC
RAD./DIST. OF/FROM PUMPING WELL
MEAS. POINT FOR W.L.'s NTH TOP 2" CSG
ELEVATION OF MEAS. POINT

DEPTH OF PUMP/AIRPIPE
BAIL PUMP ON: date 11/14/86 time 1300
PUMP OFF: date time 1404
DURATION OF AQUIFER TEST

LOCATION Rocky Flats
PERSONNEL Peace / Gallion

PROJECT 106P06222

TIME t = ____ at t' = 0					WATER LEVEL DATA STATIC WATER LEVEL 60+1.68-SM					DISCHARGE			
DAY	CLOCK TIME	t	t'		READING	CONVERSIONS OR CORRECTIONS	WATER LEVEL	s or s'	FT/MIN	READING	Q	RECORDED BY	COMMENTS
1	1405				75+3.88								
	1405:30				3.59				.58				? RECHARGE FROM
	1406				3.29				.60				PERCHED LENS PLUS
	1406:30				3.04				.50				LOWER MOUND CREATED
	1407				2.78				.50				BY WELL
	1407:30				2.53				.50				
	1408				2.33				.40				
	1408:30				2.21				.26				
	1409				2.12				.18				
	1409:30				2.07				.10				? FLOW THRU FILTER
	1410				1.99				.16				GOES INTO RECHARGE
	1411				1.83				.16				OF LOWER MOUND
	1412				1.60				.17				
	1413				1.32				.28				
	1414				1.02				.30				
	1415				0.74				.28				RECHARGE FROM
	1416				0.48				.26				LENS VIA FILTER
	1417				0.22				.26				TAPERS SLOWLY AS
	1418				75+0.00				.22				GET DRAWDOWN IN LENS
	1419				70+4.75				.25				
	1420				4.52				.23				
	1422				4.04				.24				
	1424				3.59				.23				
	1426				3.03				.28				
	1428				2.51				.26				
	1430				2.02				.25				
	1432				1.58				.22				
	1434				1.16				.21				
	1436				0.79				.19				
	1438				0.47				.16				
	1440				70+0.16				.16				
	1446				65+4.25				.15				
	1450				3.77				.12				
	1455				3.11				.13				
	1500				2.51				.12				
	1505				1.95				.11				
	1510				1.36				.12				
	1515				0.80				.11				
	1520				65+0.25				.11				
	1525				60+4.77				.10				
	1530				60+4.27				.10				

80 TD
61.68 STATIC
18

80
18
62.90

AQUIFER TEST DATA

WELL 51-86
PUMPING or OBSERVATION WELL
PUMPING or RECOVERY DATA
PAGE 2 OF 2

TYPE OF AQUIFER TEST BAILER RECOVERY
HOW Q MEASURED
HOW W.L.'s MEASURED
RAD./DIST. OF/FROM PUMPING WELL
MEAS. POINT FOR W.L.'s
ELEVATION OF MEAS. POINT

DEPTH OF PUMP/AIRPIPE
PUMP ON: date 11/14/86 time
PUMP OFF: date time
DURATION OF AQUIFER TEST

LOCATION
PERSONNEL
PROJECT

TIME t= ____ at t'=0					WATER LEVEL DATA STATIC WATER LEVEL ____					DISCHARGE		RECORDED BY	COMMENTS
DAY	CLOCK TIME	t	t'		READING	CONVERSIONS & CORRECTIONS	WATER LEVEL	s or s'	FT/MIN	READING	Q		
1	1540				60+3.43		–		.08				
	1550				2.88				.06				
	1600				2.67				.02				
	1610				2.60				.01				QUITS

08/15/88

ROCKY FLATS WEST SPRAY FIELD

WATER LEVEL SUMMARY

WELL NUMBER	SAMPLE DATE	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	STICK UP	DEPTH OF SI BASE	ELEVATION OF SI TOP	ELEVATION OF SI BOTTOM	TOTAL DEPTH OF WELL	WATER DEPTH BELOW TOC	WATER SURFACE ELEVATION
5186	10/27/86	6142.29	6144.52	2.23	79.06	6137.46	6063.23	79.06	58.17	6086.35
	10/29/86								52.89	6091.63
	10/30/86								47.50	6097.02
	11/03/86								55.83	6088.69
	11/05/86								60.73	6083.79
	11/06/86								61.88	6082.64
	11/07/86								61.10	6083.42
	11/26/86								60.88	6083.64
	01/01/87								62.69	6081.83
	02/23/87								61.60	6082.92
	03/31/87								56.85	6087.67
	05/06/87								53.75	6090.77
	06/01/87								46.90	6097.62
	07/08/87								47.50	6097.02
	08/03/87								50.00	6094.52
	08/19/87								50.80	6093.72
	08/31/87								54.60	6089.92
	09/28/87								56.10	6088.42
	11/02/87								58.90	6085.62
	12/07/87								59.00	6085.52
	01/05/88								64.10	6080.42
	02/03/88								63.40	6081.12
	03/14/88								63.40	6081.12
	04/11/88								57.80	6086.72
	05/12/88								57.60	6086.92

INDEX OF DATA

Boring No.: 52-86

Completed as well? Yes

Data in File

X Log of Borehole

X Well Construction Summaries

____ Well Development Summaries

____ Hydraulic Conductivity Test Data and Results

X Packer Test Data and Results

X Water Level Data

____ Saturated Thickness Hydrograph

Project:	Rocky Flats Plant	LOG OF BORING NO. 52-86
Date Drilled	10/20/86 and 11/17/86 to 11/20/86	Coordinates: N 35649.9 E 13019.6
Boring Method	Casing Driver/NC Core	Ground Surface Elevation 6142.22'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	0			ROCKY FLATS ALLUVIUM			
				0-7.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); 20% sand; limonitic; poorly sorted; angular; dry.			
	5						
				7.0-16.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); 20% silt; poorly sorted; angular; dry to damp.			
	10						
				Perched water table at 12.0'.			
	15						
				16.0-20.0'-Cuttings. GRAVELLY SANDY SILT: moderate brown (5YR 4/4); silty; 20% gravel; 30% sand; angular; moist.			
	20						

Remarks

Logged by: T. Gulliver and T. Murphy

Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 52-86
Date Drilled	10/20/86 and 11/17/86 to 11/20/86	Coordinates N 35649.9 E 13019.6
Boring Method	Casing Driver/NC Core	Ground Surface Elevation 6142.22'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	20			20.0-22.0'-Cuttings. GRAVELLY SAND: moderate yellowish brown (10YR 5/4); poorly sorted; subangular; moist.			
				22.0-29.0'-Cuttings. GRAVELLY SILTY SAND: Same as above; 30% gravel; wet.			
	25						
				29.0-30.0'-Cuttings. CLAY: moderate yellowish brown (10YR 5/4); 10-20% gravel; plastic; moist.			
	30			30.0-32.0'-Cuttings. SAND: moderate brown (5YR 4/4); silty and gravelly; 20% gravel; 30% sand; subangular; damp.			
				32.0-33.0'-Cuttings. GRAVELLY SANDY SILT: moderate brown (5YR 4/4); 20-40% boulders; poorly sorted; damp.			
	35			33.0-57.0'-Cuttings. GRAVEL: moderate yellowish brown (10YR 5/4); abundant quartzite, sandstone and pink granitoids; sandy; poorly sorted; subangular; damp.			
	40						

Remarksc

Logged by: T. Gulliver and T. Murphy

Checked by:

Project No. 106P06222	Hydro-Search, Inc.	Page 2 of 8

Project:	Rocky Flats Plant	LOG OF BORING NO.

Date Drilled 10/20/86 and 11/17/86 to 11/20/86 **Coordinates** N 35649.9 E 13019.6

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6142.22'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	40						
	45						
	50						
	55						
				57.0-59.0'-Cuttings. GRAVEL: moderate yellowish brown (10YR 5/4); sandy; 25% fines; subangular; damp.			
				59.0-69.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); abundant quartzite and sandstone boulders; poorly sorted; subangular; damp.			
	60						

Remarks **Logged by:** T. Gulliver and T. Murphy **Checked by:**

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO.	52-86
Date Drilled	10/20/86 and 11/17/86 to 11/20/86	Coordinates	N 35649.9 E 13019.6
Boring Method	Casing Driver/NC Core	Ground Surface Elevation	6142.22'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	60						
	65						
	70			69.0-70.0'-Cuttings. GRAVEL: moderate brown (5YR 4/4); silty; poorly sorted; subangular; damp.			
				70.0-72.0'-Cuttings. CLAY: grayish brown (5YR 3/2); sandy; carbon and mica common; plastic; damp.			
				LARAMIE FORMATION			
	75			72.0-76.0'-Cuttings. CLAYSTONE: light olive brown (5Y 5/6) to light olive gray (5Y 5/6); plastic to subplastic; damp.			
				76.0-80.0'-Cuttings. CLAYSTONE AND SILTSTONE: light olive gray (5Y 5/6); interbedded; subplastic; damp.			
	80						

Remarks

Logged by: T. Gulliver and T. Murphy

Checked by:

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO.	52-86

Date Drilled 10/20/86 and 11/17/86 to 11/20/86 **Coordinates** N 35649.9 E 13019.6

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6142.22'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	80			80.0-88.0'-Cuttings. SILTSTONE AND CLAYSTONE: dusky yellow (5Y 6/4); nonplastic; damp.			
	85						
	90			88.0-93.0'-Sample. Recovered 4.0/5.0'=80%. RQD=2.0/4.0'=50%. SILTSTONE: yellowish gray (5Y 7/2) stained in bands; dark yellowish orange (10YR 6/6); sandy; trace clay; beds 1-3" thick of silty sandstone; apparent dip of 10-15°; iron nodules present; soft; damp.			
	95			93.0-98.0'-Sample. Recovered 1.7/5.0'=34%. RQD= 1.7/1.7'=100%. CLAYSTONE: light olive gray (5Y 5/2); stained along fractures moderate yellow (5Y 7/6); trace silt; bedding dipping 15-20°; some bedding plane fractures with iron stains; also present subvertical fractures; some stained; soft; damp.			
	100						

Remarks **Logged by:** T. Gulliver and T. Murphy **Checked by:**

Project No. 106P06222	Hydro-Search, Inc.	Page 5 of 8

Project:	Rocky Flats Plant	LOG OF BORING NO.	52-86

Date Drilled	10/20/86 and 11/17/86 to 11/20/86	Coordinates	N 35649.9 E 13019.6
Boring Method	Casing Driver/NC Core	Ground Surface Elevation	6142.22'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	100			98.0-101.5'-Sample. Recovered 2.7/3.5'=77%. RQD=0.6/2.7'=22%. CLAYSTONE: light olive gray (5Y 5/2) grading to grayish red (5R 4/2) to yellowish gray (5Y 4/2); highly fractured and stained; iron stained fractures are subvertical 60°; lower portion of core becoming more silty.			
	105			101.5-106.5'-Sample. Recovered 0.4/5.0'=8% RQD=0/0.4'=0%. SANDSTONE: light gray (N 7/0); medium to very fine-grained; 10-20% mafics; mostly quartz; silica cement; hard; damp to wet.			
				106.5-108.5'-Sample. Recovered 0.0/2.0'=0%.			
	110			108.5-111.5'-Sample. Recovered 0.8/3.0'=27%. RQD=0.0/0.8'=0%. SANDSTONE: same as 101.5-106.5' with dark yellowish orange stained siltstone (10YR 6/6) interbedded with sandstone; medium to fine-grained; very silty; cross-bedded; hard; damp.			
	115			111.5-114.5'-Sample. Recovered 1.0/3.0'=33%. RQD=0.0/3.0'=0%. SANDSTONE: same as above; light gray stained in band; dark yellowish orange (at high angles 60-70°); very silty and clayey; bedding appears to be similiar to staining; soft; damp to wet.			
	120						

Remarks Logged by: T. Gulliver and T. Murphy Checked by:

Project No. 106P06222	Hydro-Search, Inc.	Page 6 of 8

Project:	Rocky Flats Plant	LOG OF BORING NO. 52-86

Date Drilled 10/20/86 and 11/17/86 to 11/20/86 **Coordinates** N 35649.9 E 13019.6

Boring Method Casing Driver/NC Core **Ground Surface Elevation** 6142.22'

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	120			114.5-118.0'-Sample. Recovered 3.0/3.5'=86%. RQD= 0/3.0'=0%. SANDSTONE: yellowish gray (5Y 7/2); medium to very fine-grained; interbedded with silty sandstone and clayey siltstone; dark yellowish orange stains (10YR 6/6) throughout; appears in bands at 60-70° from horizontal; soft; damp.			
	125			118.0-123.0'-Sample. Recovered 3.0/5.0'=60%. RQD=2.7/3.0'=90%. SANDSTONE: yellowish gray (5Y 7/2); bounded with dark yellowish orange (10YR 6/6); fine to very fine-grained; grades into silty sandstone, sandy siltstone and clayey siltstone; beds are 0.3-0.8 ft. thick; bedding is dipping 35°-40° from horizontal; some cross bedding; cut and fill structures; banding of iron stain follows bedding; soft; wet.			
	130			123.0-128.0'-Sample. Recovered 4.0/5.0'=80%. RQD=3.4/4.0'=85%. SANDSTONE: same as above; dips of bedding at 40-45°; wet.			
	135			128.0-133.0'-Sample. Recovered 1.3/5.0'=26%. RQD=1.0/1.3'=77%. SILTSTONE: yellowish gray (5Y 3/2); banded iron stain; sandy; sand clayey layers; soft; wet.			
	140						

Remarks **Logged by:** T. Gulliver and T. Murphy **Checked by:**

Project No. 106P06222

Hydro-Search, Inc.

Project:	Rocky Flats Plant	LOG OF BORING NO. 52-86
Date Drilled	10/20/86 and 11/17/86 to 11/20/86	Coordinates N 35649.9 E 13019.6
Boring Method	Casing Driver/NC Core	Ground Surface Elevation 6142.22"

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/Foot) 20 40	Water Content (%) 20 40	Other Tests
	140			133.0-136.0'-Sample. Recovered 2.8/3.0'=93%. RQD=0.6/2.8'=21%. SILTSTONE: similiar to above with alternating layers of sandy siltstone and clayey siltstone; dark gray (N 3/0) with occasional dark yellowish orange (10YR 6/6) layers; wood fragments; highly fractured; bedding appears to be at very high angles (40-60°); firm; damp.			
	145			136.0-141.0'-Sample. Recovered 1.6/5.0'=32%. RQD=0.6/1.6'=38%. SILTSTONE: same as above; calcareous cement; dark gray (N 3/0) layer of laminated siltstone and fine-grained sandstone; light gray (N 5/0) to dark gray (N 3/0); hard; damp.			
	150			141.0-145.0'-Sample. Recovered 4.2/4.0'=105%. RQD=2.0/4.2'=97%. SILTSTONE: same as above.			
				145.0-149.0'-Sample. Recovered 2.3/4.0'=57%. RQD=2.0/2.3'=87%. SILTSTONE: dark gray (N 3/0); clayey; some sandstone beds (.2 to .4' thick); sandstones and silty, very fine to fine-grained; color change to medium light gray (N 5/0); 50-60° dip; firm; damp.			
	155			149.0-154.0'-Sample. Recovered 3.5/5.0'=70%. RQD=2.0/3.5=57%. SILTSTONE: same as above.			
				TOTAL DEPTH: 153.50'			
	160						

Remarks Logged by: T. Gulliver and T. Murphy Checked by:

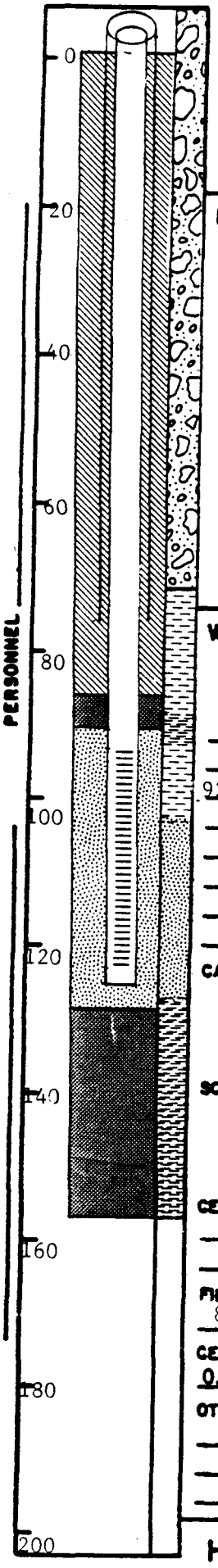
Project No. 106P06222	Hydro-Search, Inc.	Page 8 of 8

WELL 52-86

WELL CONSTRUCTION SUMMARY

LOCATION or COORDS: N 35649.9 E 13019.6

ELEVATION: GROUND LEVEL 6142.22'
TOP OF CASING 6144.86'



LOCATION Rocky Flats Plant
PERSONNEL
PROJECT 106R06222

DRILLING SUMMARY:

TOTAL DEPTH Well: 125.65 Hole: 155.80'

BOREHOLE DIAMETER 0.00' -76.00': 5 5/8"
76.00 - 153.20' : 4 3/4"

DRILLER Boyles Brothers Drilling Co.
15865 W. 5th Ave., Golden, CO
(Robert Roach)

RIG 0.00'-76.00': Casing advancer;
76.00'-155.80': Failing

BIT(S) 0.00'-76.00': Down-hole hammer
76.00'-155.80': Coring bit.

DRILLING FLUID Air/Water mist and 11-22 bentonite mud.

SURFACE CASING 5" x 76.0' steel w/ locking cap

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" casing advancer	10/20	0820	10/20	1455
Core	11/17	1500	11/19	1600
Reaming	11/20	0900	11/24	1000
GEOPHYS. LOGGING:	—	—	—	—
CASING:				
5" steel	10/20	0820	10/20	1455
2" stainless	11/26	0900	11/26	0930
FILTER PLACEMENT:	11/26	0930	11/26	1500
CEMENTING:	11/26	1600	11/26	1730
DEVELOPMENT:				
OTHER:				
Bentonite	11/26	1500	11/26	1600
	11/25	1145	11/25	1200
Packer testing	11/20	0730	11/20	1700

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00' - 73.45'	C1	
0.00' - 92.00'	C2	
92.00' - 125.80'	S1	

CASING: C1 5" I.D. steel surface casing
C2 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed.

SCREEN: S1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed, 0.010" wire wrapped screen, 0.25' welded bottom cap.

CENTRALIZERS None

FILTER MATERIAL 16-40 silica sand
87.00' - 125.80'

CEMENT Portland Type I
0.00' - 85.00'

OTHER 3/8" bentonite pellets
85.00' - 90.00'
128.00' - 147.00'

WELL DEVELOPMENT

See Well Development Summary Sheet.

COMMENTS:

No water encountered during drilling.

Top of stainless steel casing: 2.55'
Well built through 4" casing.
11/22-Used bentonite mud drilling fluid.
11/25-Washed hole with 2400 gallons of water
11/26-Pulled 4" casing & lost 18.05 ft of casing in hole. Broke off from 129.0 - 147.0

The Packer test data for Well 52-86
shown in the following data sheets
could not be analyzed

PACKER TEST DATA SHEET

JOB NO. 106006222 NAME Rocky Flats HOLE NO. 52-86 SHEET 1 OF 1

LOCATION Rocky Flats Plant; West Spray Field ENGR. T.M. Murphy DATE 11/20/86

GROUND SFC. ELEV. 6124.00' HOLE DIA. 3-3/4" TYPE OF BORING NC Core

HEIGHT OF CASING ABOVE GR.	DEPTH TO G.W.T.	DEPTH OF TOP PACKER	DEPTH OF BTM. PACKER	TEST STATION LENGTH	HEIGHT OF GAGE ABOVE GR.	PRESSURE (PSI)	TIME (MIN)	FLOWMETER	ΔQ UNITS ft^3/min	REMARKS
2.69'	65.41' below g.s. (5/12/88)	140.23'	149.88'	9.65'	7.4'	-	-	-	-	Packer failed
		138.53'	148.18'	9.65'	7.4'	67.49	15	0.95'	.001	
		138.53'	148.18'	9.65'	7.4'	-	-	-	-	Packer failed @ P=8 psi
		135.03'	144.68'	9.65'	7.4'	-	-	-	-	
		133.33'	142.98'	9.65'	7.4'	64.5	15	1.75'	.003	
		133.33'	142.98'	9.65'	7.4'	-	-	-	-	Packer failed @ P=6 psi
		123.05'	132.7'	9.65'	7.4'	59.9	15	1.94'	.003	
		123.05'	132.7'	9.65'	7.4'	-	-	-	-	Packer failed @ P=15 psi
		119.23'	128.88'	9.65'	7.4'	-	-	-	-	Packer failed
		117.5'	127.18'	9.65'	7.4'	-	-	-	-	Packer failed
		106.81'	116.46'	9.65'	7.4'	-	-	-	-	Packer failed

08/15/88

ROCKY FLATS WEST SPRAY FIELD

WATER LEVEL SUMMARY

WELL NUMBER	SAMPLE DATE	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	STICK UP	DEPTH OF SI BASE	ELEVATION OF SI TOP	ELEVATION OF SI BOTTOM	TOTAL DEPTH OF WELL	WATER DEPTH BELOW TOC	WATER SURFACE ELEVATION
5286	12/11/86	6142.22	6144.86	2.64	125.65	6050.22	6016.57	125.8	64.64	6080.22
	12/12/86								70.05	6074.81
	12/15/86								68.90	6075.96
	01/01/87								68.79	6076.07
	02/23/87								68.10	6076.76
	03/31/87								68.56	6076.30
	05/06/87								68.60	6076.26
	06/01/87								68.20	6076.66
	07/08/87								68.20	6076.66
	08/03/87								67.50	6077.36
	08/18/87								68.90	6075.96
	08/31/87								68.20	6076.66
	09/28/87								67.40	6077.46
	11/02/87								67.70	6077.16
	12/07/87								66.90	6077.96
	01/05/88								67.70	6077.16
	02/03/88								67.50	6077.36
	03/14/88								67.60	6077.26
	04/11/88								67.60	6077.26
	05/12/88								68.10	6076.76

INDEX OF DATA

Boring No.: 56-86

Completed as well? Yes

Data in File

X Log of Borehole

X Well Construction Summaries

X Well Development Summaries

X Hydraulic Conductivity Test Data and Results

____ Packer Test Data and Results

X Water Level Data

____ Saturated Thickness Hydrograph

Project: Rocky Flats Plant

LOG OF BORING NO. 56-86

Date Drilled 9/26/86

Boring Method Casing Driver

Coordinates N 34071.9 E 17104.2

Ground Surface Elevation 5977.16

Elev. (feet)	Depth (feet)	Sample Type	Graphic Log	Material Description	Penetration Resistance (Blows/inch) 20 40	Water Content (%) 20 40	Other Tests
	0			**ROCKY FLATS ALLUVIUM** 0-7.0'-Cuttings. BOULDERS: granite and quartzite; <1% sand; dry.			
	5			7.0-9.0'-Cuttings. SILT: moderate brown (5YR 3/4); clayey; sandy; poorly sorted; unconsolidated; non-plastic; moist.			
	10			**LARAMIE FORMATION** 9.0-10.0'-Cuttings. CLAYSTONE: light olive gray (5Y 5/2) to moderate brown (5YR 4/4); plastic; moist. 10.0-17.0'-Cuttings. SILTSTONE: light olive gray (5Y 5/2) to moderate brown (5YR 4/4); well sorted; dry.			
	15						
	20			**TOTAL DEPTH: 17.0'**			

Remarks Logged by: T. Gulliver

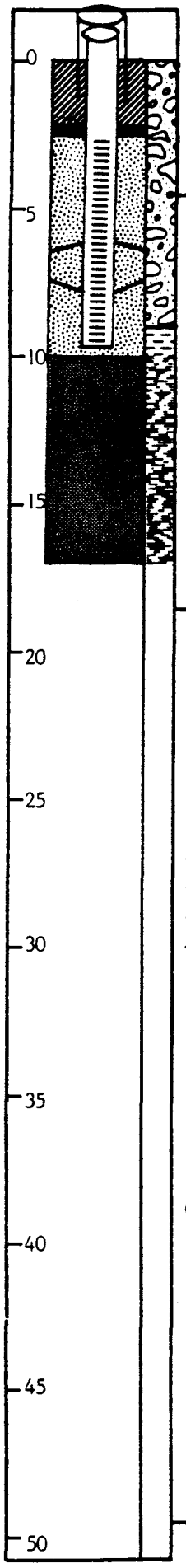
Checked by:

Project No. 106P06222

Hydro-Search, Inc.

WELL 56-86

WELL CONSTRUCTION SUMMARY



LOCATION Golden, CO

PERSONNEL T. Gulliver

PROJECT 106P06222 Rocky Flats Plant

LOCATION or COORDS: N 34071.9 E 17104.2

ELEVATION: GROUND LEVEL 5977.16'

TOP OF CASING 5979.15'

DRILLING SUMMARY:

TOTAL DEPTH Well: 9.60' Hole: 17.00'

BOREHOLE DIAMETER 5 5/8"

DRILLER Boyles Brothers Drilling Co. 15865 W. 5th Avenue, Golden, CO Arrow Drilling, Tom High)

RIG Failing 1500

BIT(S) Down hole hammer

DRILLING FLUID None

SURFACE CASING 5" x 3.81' steel w/ locking cap

WELL DESIGN:

BASIS: GEOLOGIC LOG X GEOPHYSICAL LOG ___

CASING STRING(S): C=CASING S=SCREEN

0.00'	2.60'	C1			
2.60'	9.60'	S1			

CASING: C1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed.

SCREEN: S1 2" I.D. Sch. 5 type 316 stainless steel, threaded and flush jointed, 0.010" wire wrap screen 0.25' welded bottom cap.

CENTRALIZERS Type 304 stainless steel 6.33' - 7.55'

FILTER MATERIAL 32-42 silica sand 2.45' - 10.00'

CEMENT Portland Type I 0.00' - 2.30'

OTHER 3/8" bentonite pellets 2.30' - 2.45' 10.00' - 17.00'

CONSTRUCTION TIME LOG:

TASK	START DATE 1986	START TIME	FINISH DATE 1986	FINISH TIME
DRILLING:				
5 5/8" casing advancer	9/26	0815	9/26	0920
GEOPHYS. LOGGING:	—	—	—	—
CASING:				
2" stainless	9/26	1500	9/26	1505
FILTER PLACEMENT:	9/26	1505	9/26	1530
CEMENTING:	9/26	1535	9/25	1540
DEVELOPMENT:	9/30	1330	10/2	1130
OTHER:				
Bentonite	9/26	1445	9/26	1500
	9/26	1530	9/26	1535

WELL DEVELOPMENT

See Well Development Summary Sheet.

COMMENTS:

Water encountered at 7.0' during drilling.

Top of stainless steel casing: 1.99'

First well construction attempt failed. Screen pulled, hole washed, and well rebuilt.

Well No.: 56-86

WELL DEVELOPMENT SUMMARY SHEET

DATE	TIME	METHOD	VOLUME	APPEARANCE	COMMENTS
09-30-86	1330	Teflon bailer	10 WBV's 5.2 gl Bailed 2.5 gl Total 2.5/5.2	Moderately turbid Med=Dark brown Clearing to Lt brn	Recharges Mod. Well

WESTON
MANAGERS DESIGNERS/CONSULTANTS

SHEET ___ of ___

CLIENT/SUBJECT Rockwell W.O. NO 2029-29-02

TASK DESCRIPTION West Sprayfield Closure Characterization TASK NO. 0030

PREPARED BY H.G.B. DEPT 1582 DATE 27 July 1988

MATH CHECK BY JBB DEPT 1582 DATE 1 August 1988

METHOD REV. BY ___ DEPT ___ DATE ___

APPROVED BY ___ DEPT ___ DATE ___

WELL 56-86

Hydraulic Conductivity (cm/s) = NA

Flowrate (gpm) = 0.0492 gpm

Screened Interval (ft. below GL):

2.60 - 9.60'

Static Water level = 6.16'

6.16 - 7.0' Boulders

7.0 - 9.0' Silt

9.0 - 9.60' Claystone

Method of Analysis: Residual-drawdown Plot (Driscoll, 1986 - pg 256).

RFW 10-05-003/A-5.85

WESTON
MANAGERS DESIGNERS/CONSULTANTS

SHEET ____ of ____

CLIENT/SUBJECT Rockwell W.O. NO. 2029-29-02
TASK DESCRIPTION West Sprayfield Closure Characterization TASK NO. 0030
PREPARED BY H.G.B. DEPT 1582 DATE 27 July 1988
MATH CHECK BY JBB DEPT 1582 DATE 1 August 1988
METHOD REV. BY ____ DEPT ____ DATE ____

APPROVED BY
DEPT ____ DATE ____

WELL 56-86

$$T\,(gpd/ft) = \frac{264\,Q}{\Delta s'} = \frac{(264)\,(.0492)}{.431} = 30.1$$

where $Q\,(gpm)$ = 3 gallons / 61 minutes = 0.0492 gpm

$\Delta s'$ = ft change in residual drawdown / log cycle

= 0.431

$$K\,(gpd/ft^2) = T/b = 0.431/3.44 = 0.125$$

where $b\,(ft) = (9.6 - 6.16)\,ft = 3.44\,ft$

$$K\,(cm/sec) = 0.125\ gpd/ft^2 \times \frac{4.72\times10^{-5}\,cm/s}{gpd/ft^2} = 5.9\times10^{-6}$$

This method is valid where $u \leq 0.01$

solving for t where $u \leq 0.01$:

$$t\,(min) = \frac{r^2 S}{4\,T\,u} = \frac{(.234)^2(0.1)}{4\,(30.1)\,(0.01)} \times \frac{1440\ min}{day}\ \frac{7.482\ gal}{ft^3}$$

= 49 min.

where $r\,(ft) = \left(\frac{5.625}{24}\right) = .234\ ft$

and $S = 10^{-3}$ (assumed S for confined aquifer)

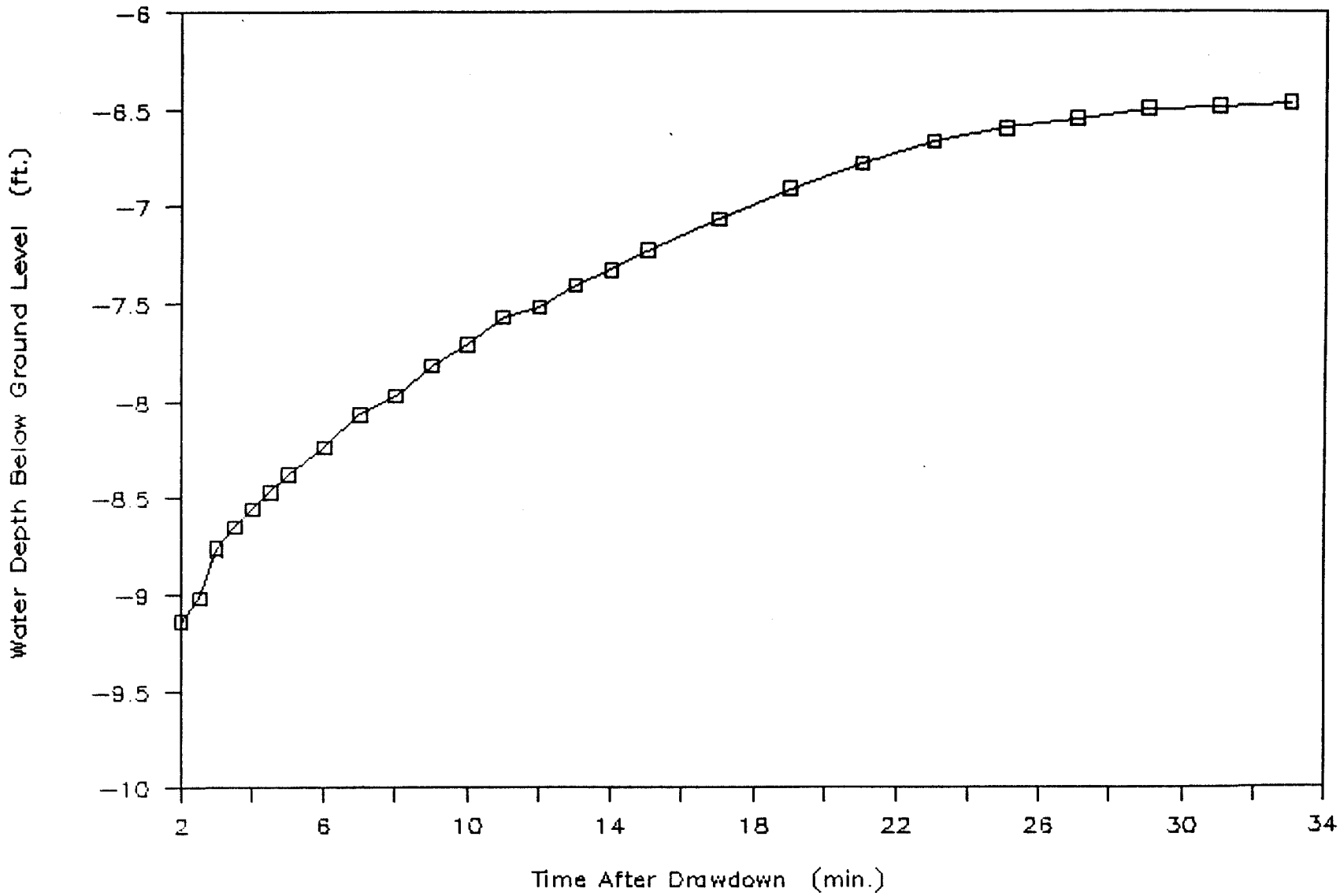
or $S = 0.1$ (assumed S for unconfined aquifer).

$\Delta s'$ is invalid; K is undetermined

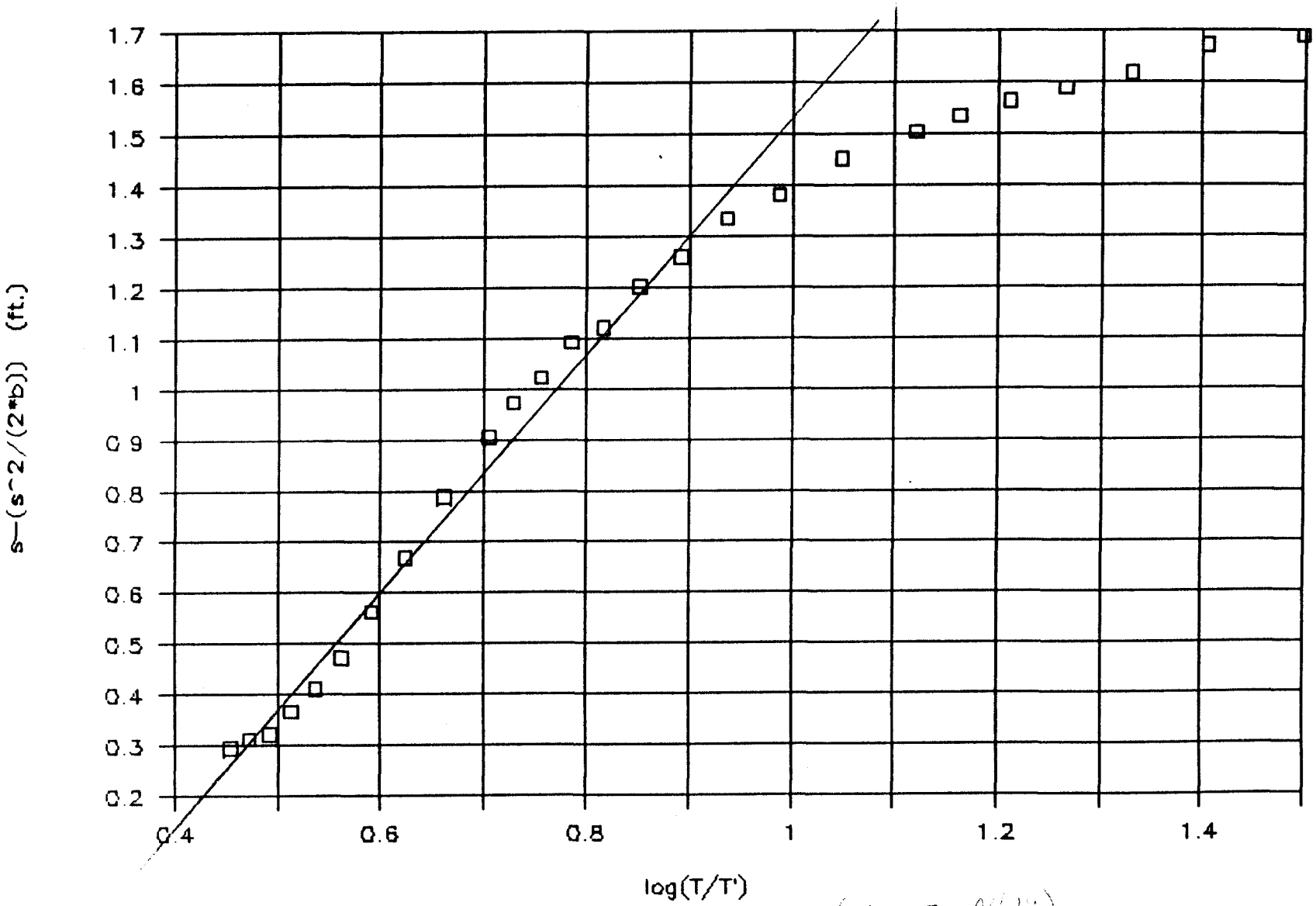
WELL 56-86

T Time (min.)	T' T Prime (min.)	Water Level (ft.)	s' Rsd Drwdn (ft.)	s-(s^2/2b) b=3.44 (ft.)	log(T/T')
63.00	2.00	9.14	2.98	1.69	1.50
63.50	2.50	9.02	2.86	1.67	1.40
64.00	3.00	8.76	2.60	1.62	1.33
64.50	3.50	8.65	2.49	1.59	1.27
65.00	4.00	8.56	2.40	1.56	1.21
65.50	4.50	8.47	2.31	1.53	1.16
66.00	5.00	8.38	2.22	1.50	1.12
67.00	6.00	8.24	2.08	1.45	1.05
68.00	7.00	8.07	1.91	1.38	0.99
69.00	8.00	7.97	1.81	1.33	0.94
70.00	9.00	7.82	1.66	1.26	0.89
71.00	10.00	7.71	1.55	1.20	0.85
72.00	11.00	7.57	1.41	1.12	0.82
73.00	12.00	7.52	1.36	1.09	0.78
74.00	13.00	7.41	1.25	1.02	0.76
75.00	14.00	7.33	1.17	0.97	0.73
76.00	15.00	7.23	1.07	0.90	0.70
78.00	17.00	7.07	0.91	0.79	0.66
80.00	19.00	6.91	0.75	0.67	0.62
82.00	21.00	6.78	0.62	0.56	0.59
84.00	23.00	6.67	0.51	0.47	0.56
86.00	25.00	6.60	0.44	0.41	0.54
88.00	27.00	6.55	0.39	0.37	0.51
90.00	29.00	6.50	0.34	0.32	0.49
92.00	31.00	6.49	0.33	0.31	0.47
94.00	33.00	6.47	0.31	0.30	0.45

WELL 56-86


-6
-6.5
-7
-7.5
-8
-8.5
-9
-9.5
-10
Water Depth Below Ground Level (ft.)
2
6
10
14
18
22
26
30
34
Time After Drawdown (min.)

WELL 56-86



$\Delta s' = \frac{(1.075 - 0.42)}{(1.7 - 0.2)} = .437$ ft/log cycle

Test 1 of 2

AQUIFER TEST DATA

WELL 56-86
PUMPING or OBSERVATION WELL
PUMPING or RECOVERY DATA
PAGE 1 OF 1

TYPE OF AQUIFER TEST Bail Down- recovery
HOW Q MEASURED 4½ gallon bucket
HOW W.L.'s MEASURED OLYMPIC WELL SOUNDER
RAD./DIST. OF/FROM PUMPING WELL Ø
MEAS. POINT FOR W.L.'s ⊥ side of inner casing
ELEVATION OF MEAS. POINT ?

DEPTH OF PUMP/AIRPIPE
PUMP ON: date 10/01/86 time
PUMP OFF: date time
DURATION OF AQUIFER TEST

LOCATION Rocky Flats Plant, Golden, Co
PERSONNEL W. Herst M. Bergman

PROJECT 106P06222

TIME t= at t'=0					WATER LEVEL DATA STATIC WATER LEVEL 6.16 ft					DISCHARGE		RECORDED BY	COMMENTS
DAY	CLOCK TIME	t (min)	t' (min)		READING (ft)	CONVERSIONS or CORRECTIONS	WATER LEVEL	s or s' (ft)		READING	Q		
	1000				5+3.03	1.87	6.16					WH	Recovery measurements made immediately after bailing 3 gallons for well development.
	1101		Ø										
	1103		2		10+1.01	1.87	9.14	2.98				WH	T.D. = 9.38 ft
	1103:30		2.5		10+0.89	"	9.02	2.86				"	
	1104		3		10+0.63	"	8.76	2.60				"	
	1104:30		3.5		10+0.52	"	8.65	2.49				"	
	1105		4		10+0.43	"	8.56	2.40				"	
	1105:30		4.5		10+0.34	"	8.47	2.31				"	
	1106		5		10+0.25	"	8.38	2.22				"	
	1107		6		10+0.11	"	8.24	2.08				"	
	1108		7		5+4.94	"	8.07	1.91				"	
	1109		8		5+4.84	"	7.97	1.81				"	
	1110		9		5+4.69	"	7.82	1.66				"	
	1111		10		5+4.58	"	7.71	1.55				"	
	1112		11		5+4.44	"	7.57	1.41				"	
	1113		12		5+4.39	"	7.52	1.36				"	
	1114		13		5+4.28	"	7.41	1.25				"	
	1115		14		5+4.20	"	7.33	1.17				"	
	1116		15		5+4.10	"	7.23	1.07				"	
	1118		17		5+3.94	"	7.07	0.91				"	90% [illegible] = 6.48
	1120		19		5+3.78	"	6.91	0.75				"	
	1122		21		5+3.65	"	6.78	0.62				"	
	1124		23		5+3.54	"	6.67	0.51				"	
	1126		25		5+3.47	"	6.60	0.44				"	
	1128		27		5+3.42	"	6.55	0.39				"	
	1130		29		5+3.37	"	6.50	0.34				"	
	1132		31		5+3.36	"	6.49	0.33				"	
	1134		33		5+3.34	"	6.47	0.31				"	>90% Recovery.

RAW DATA

WELL # 56-86

WELL DIAMETER= 5.63 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER= .54 GALLONS*
LENGTH OF AQUIFER TESTED= 3.44 FEET
VALUE OF H0= 3.31 FEET
STATIC WATER LEVEL= 6.16 FEET
LENGTH OF SCREEN= 7.00 FEET
WATER TABLE TO BOTTOM OF WELL= 3.44 FEET

SLUG TEST DATA:

TIME	WATER LEVEL (FEET)	TIME SINCE TEST BEGAN (MINUTES)
0. 0.35	9.47	.58
0. 1. 0	9.23	1.00
0. 1.30	9.11	1.50
0. 2. 0	8.79	2.00
0. 2.30	8.60	2.50
0. 3. 0	8.45	3.00
0. 3.30	8.31	3.50
0. 4. 0	8.19	4.00
0. 4.30	8.09	4.50
0. 5. 0	7.97	5.00
0. 6. 0	7.81	6.00
0. 7. 0	7.62	7.00
0. 8. 0	7.48	8.00
0. 9. 0	7.33	9.00
0.10. 0	7.21	10.00
0.11. 0	7.10	11.00
0.12. 0	7.01	12.00
0.13. 0	6.85	13.00
0.14. 0	6.83	14.00
0.15. 0	6.75	15.00
0.17. 0	6.67	17.00
0.19. 0	6.59	19.00
0.21. 0	6.54	21.00
0.23. 0	6.50	23.00
0.25. 0	6.51	25.00
0.27. 0	6.48	27.00

* Value of Ho set at drawdown at 35 seconds. Volume of water recovered is calculated from this assumed Ho. Test data sheet does not record volume of water recovered.

WELL # 56-86

WELL DIAMETER= 5.63 INCHES
CASING DIAMETER= 2.00 INCHES
VOLUME OF WATER REMOVED OR ADDED TO WELL= .54 GALLONS
LENGTH OF AQUIFER TESTED= 3.44 FEET
VALUE OF H0= 3.31 FEET
STATIC WATER LEVEL= 6.16 FEET

SLUG TEST DATA:

TIME SINCE TEST BEGAN (MINUTES)	WATER LEVEL (FEET)	DRAWDOWN (FEET)	HEAD RATIO	RECIPROCAL TIME (1/MINUTES)
.58	9.47	3.31	1.000	1.714
1.00	9.23	3.07	.927	1.000
1.50	9.11	2.95	.891	.667
2.00	8.79	2.63	.795	.500
2.50	8.60	2.44	.737	.400
3.00	8.45	2.29	.692	.333
3.50	8.31	2.15	.650	.286
4.00	8.19	2.03	.613	.250
4.50	8.09	1.93	.583	.222
5.00	7.97	1.81	.547	.200
6.00	7.81	1.65	.498	.167
7.00	7.62	1.46	.441	.143
8.00	7.48	1.32	.399	.125
9.00	7.33	1.17	.353	.111
10.00	7.21	1.05	.317	.100
11.00	7.10	.94	.284	.091
12.00	7.01	.85	.257	.083
13.00	6.85	.69	.208	.077
14.00	6.83	.67	.202	.071
15.00	6.75	.59	.178	.067
17.00	6.67	.51	.154	.059
19.00	6.59	.43	.130	.053
21.00	6.54	.38	.115	.048
23.00	6.50	.34	.103	.043
25.00	6.51	.35	.106	.040
27.00	6.48	.32	.097	.037

WELL # 56-86

PERMEABILITY BASED ON COOPER, BREDEHOEFT, AND PAPADOPULOS METHOD

```
          PERMEABILITY=1.03E-03/ MATCH TIME (IN MINUTES)
          STORAGE COEF=  .13     * ALPHA
     COMPUTER CALCULATES
          ALPHA=1.00E-05 MATCH TIME=  2.7
          PERMEABILITY= 3.84E-04 CM/SEC
          STORAGE COEF=1.26E-06
          CORRELATION NUMBER=  1.00
```

PERMEABILITY BASED ON REGRESSION FIT OF HEAD RATIO DATA

```
          HVORSLEV PERMEABILITY=1.38E-03 / LAG TIME
          BOUWER PERMEABILTY=1.21E-03 * -SLOPE

     COMPUTER CALCULATES
          HVORSLEV PERMEABILITY=1.50E-04 CM/SEC
          BOUWER PERMEABILITY=5.01E-05 CM/SEC
               REGRESSION STATISTICS
                    X ON Y
                      INTERCEPT= -.06
                      SLOPE=-4.08E-02
                    Y ON X
                      INTERCEPT= -.05
                      SLOPE=-4.21E-02
                    CORRELATION COEFFICIENT= -.98
     CALCULATIONS INDICATE THAT A VALUE OF   3.67 FEET FOR H0
          OR A VALUE OF    1.898 INCHES FOR EFFECTIVE CASING DIA.
          MAY YIELD BETTER RESULTS
```

PERMEABILITY BASED ON REGRESSION FIT OF DATA - FERRIS & KNOWLES METH

```
          PERMEABILITY=8.48E-04 / SLOPE
          PERMEABILITY=1.02E-04 CM/SEC
               REGRESSION STATISTICS
                    X ON Y
                      INTERCEPT=  .11
                      SLOPE=  8.1
                    Y ON X
                      INTERCEPT=  .06
                SLOPE=  8.5
                    CORRELATION COEFFICIENT=  .98
```

WELL #	PERMEABILITY METHOD 1	PERMEABILITY METHOD 2	STORAGE COEF METHOD 2	PERMEABILITY METHOD 3	PERMEABILIT METHOD 4
56-86	1.50E-04	3.84E-04	1.26E-06	1.02E-04	5.01E-05

* METHOD 1 IS HVORSLEV
  METHOD 2 IS COOPER, BREDEHOEFT, AND PAPADOPULOS
  METHOD 3 IS FERRIS AND KNOWLES
  METHOD 4 IS BOUWER

Test 2 of 2

AQUIFER TEST DATA

WELL 56-86
PUMPING or OBSERVATION WELL
PUMPING or RECOVERY DATA
PAGE 1 OF 1

TYPE OF AQUIFER TEST Bail Down - Recovery
HOW Q MEASURED 4½ gallon bucket
HOW W.L.'s MEASURED OLYMPIC WELL SOUNDER
RAD./DIST. OF/FROM PUMPING WELL Ø
MEAS. POINT FOR W.L.'s N side of inner casing
ELEVATION OF MEAS. POINT ?

DEPTH OF PUMP/AIRPIPE
PUMP ON: date 10/01/86 time
PUMP OFF: date time
DURATION OF AQUIFER TEST

LOCATION Rocky Flats Plant, Golden, Co
PERSONNEL W. Herst M. Bergman
PROJECT 106 PO6 222

TIME t = at t' = o					WATER LEVEL DATA STATIC WATER LEVEL 6.16 ft					DISCHARGE		RECORDED BY	COMMENTS
DAY	CLOCK TIME	t	t'		READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	s or s'		READING	Q		
	1000				5+3.03	1.87	6.16	Ø				WH	Taken prior to 1st
													Bail-down test
	1153	13	Ø										T.D. = 9.38 ft.
	1153:35		0.58		10+1.34	1.87	9.47	3.31				WH	
	1154		1		10+1.10	"	9.23	3.07				"	
	1154:30		1.5		10+0.98	"	9.11	2.95				"	90% Recovery = 6.48 ft.
	1155		2		10+0.66	"	8.79	2.63				"	
	1155:30		2.5		10+0.47	"	8.60	2.44				"	
	1156		3		10+0.32	"	8.45	2.29				"	
	1156:30		3.5		10+0.18	"	8.31	2.15				"	
	1157		4		10+0.06	"	8.19	2.03				"	
	1157:30		4.5		5+4.96	"	8.09	1.93				"	
	1158		5		5+4.84	"	7.97	1.81				"	
	1159		6		5+4.68	"	7.81	1.65				"	
	1200		7		5+4.49	"	7.62	1.46				"	
	1201		8		5+4.35	"	7.48	1.32				"	
	1202		9		5+4.20	"	7.33	1.17					
	1203		10		5+4.08	"	7.21	1.05				"	
	1204		11		5+3.97	"	7.10	0.94				"	
	1205		12		5+3.88	"	7.01	0.85				"	
	1206		13		5+3.72	"	6.85	0.69				"	
	1207		14		5+3.70	"	6.83	0.67				"	
	1208		15		5+3.62	"	6.75	0.59				"	
	1210		17		5+3.54	"	6.67	0.51				"	
	1212		19		5+3.46	"	6.59	0.43				"	
	1214		21		5+3.41	"	6.54	0.39				"	
	1216		23		5+3.37	"	6.50	0.35				"	
	1218		25		5+3.38	"	6.51	0.36				"	
	1220		27		5+3.35	"	6.48	0.33				"	90% Recovery

ROCKY FLATS WEST SPRAY FIELD

WATER LEVEL SUMMARY

WELL NUMBER	SAMPLE DATE	GROUND SURFACE ELEVATION	TOP OF CASING ELEVATION	STICK UP	DEPTH OF SI BASE	ELEVATION OF SI TOP	ELEVATION OF SI BOTTOM	TOTAL DEPTH OF WELL	WATER DEPTH BELOW TOC	WATER SURFACE ELEVATION est.
5686	09/30/86	5990.16 est. ~~5977.16~~	~~5979.15~~	1.99	9.60	5987.56 est. ~~5974.56~~	~~5967.56~~	9.60	8.01	~~5971.14~~ 5984.14
	10/01/86		5982.15 est.				5980.56 est.		8.03	~~5971.12~~ 5984.12
	10/02/86								7.97	~~5971.18~~ 5984.18
	10/13/86								6.33	~~5972.82~~ 5985.82
	11/26/86								6.69	~~5972.46~~ 5985.46
	01/01/87								6.83	~~5972.32~~ 5985.32
	05/08/87								5.02	~~5974.13~~ 5987.13
	06/02/87								6.61	~~5972.54~~ 5985.54
	07/07/87								6.73	~~5972.42~~ 5985.42
	07/14/87								6.80	~~5972.35~~ 5985.35
	08/03/87								7.50	~~5971.65~~ 5984.65
	08/31/87								6.70	~~5972.45~~ 5985.45
	09/29/87								7.10	~~5972.05~~ 5985.05
	11/09/87								6.90	~~5972.25~~ 5985.25
	12/18/87								7.10	~~5972.05~~ 5985.05
	01/09/88								6.50	~~5972.65~~ 5985.65
	02/24/88								6.30	~~5972.85~~ 5985.85
	03/07/88								5.80	~~5973.35~~ 5986.35
	04/04/88								4.70	~~5974.45~~ 5987.45
	05/02/88								6.10	~~5973.05~~ 5986.05

Note: Survey data incorrect for this well. Hand-written values reflect corrections based on estimated ground surface elevations from the topographic map. 8/15/88

APPENDIX C

TEST PIT DATA

TEST PIT LOGS

For the lithographic descriptions of the test pits at the West Spray Field a modified Wentworth Grain-Size Scale was used. Additionally, the Unified Soil Classification System (USCS) by B.W. Pipkin was used in describing the soils.

Following are the Grain-Size Scale and USCS information from the American Geological Institute, 2nd Edition, 1985.

Grain-size Scales

By Roy L. Ingram, University of North Carolina

GRAIN-SIZE SCALE USED BY AMERICAN GEOLOGISTS

Modified Wentworth Scale — after Lane, et al., 1947, Trans. American Geophysical Union, v. 28, p. 936-938

GRADE LIMITS				U.S. Standard Sieve Series	GRADE NAME		
phi	mm	mm	inches				
−12	4096		161.3				
					very large		
−11	2048		80.6				
					large		
−10	1024		40.3			Boulders	
					medium		
−9	512		20.2				
					small		
−8	256		10.1				
					large		
−7	128		5.0			Cobbles	
					small		GRAVEL
−6	64		2.52	63 mm			
					very coarse		
−5	32		1.26	31.5 mm			
					coarse		
−4	16		0.63	16 mm			
					medium	Pebbles	
−3	8		0.32	8 mm			
					fine		
−2	4		0.16	No. 5			
					very fine		
−1	2		0.08	No. 10			
					very coarse		
0	1		0.04	No. 18			
					coarse		
+1	1/2	0.500		No. 35			
					medium	Sand	SAND
+2	1/4	0.250		No. 60			
					fine		
+3	1/8	0.125		No. 120			
					very fine		
+4	1/16	0.062		No. 230			
					coarse		
+5	1/32	0.031					
					medium		
+6	1/64	0.016				Silt	
					fine		
+7	1/128	0.008					
					very fine		
+8	1/256	0.004					MUD
					coarse		
+9	1/512	0.002					
					medium		
+10	1/1024	0.001				Clay size	
					fine		
+11	1/2048	0.0005					
					very fine		
+12	1/4096	0.00025					

Unified Soil Classification System

Compiled by B. W. Pipkin, University of Southern California

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than half of material is larger than no. 200 sieve size.	GRAVELS More than half of coarse fraction is larger than no. 4 sieve size.	Clean gravels	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction is smaller than no. 4 sieve size.	Clean sands	SW	Well-graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands, gravelly sands, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS More than half of material is smaller than no. 200 sieve size.	SILTS AND CLAYS	Low liquid limit.	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts, with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
		High liquid limit.	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
Highly organic soils			Pt	Peat and other highly organic silts.

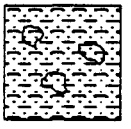
NOTES:

1. Boundary Classification: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example, GW-GC, well-graded gravel-sand mixture with clay binder.
2. All sieve sizes on this chart are U.S. Standard.
3. The terms "silt" and "clay" are used respectively to distinguish materials exhibiting lower plasticity from those with higher plasticity. The minus no. 200 sieve material is silt if the liquid limit and plasticity index plot below the "A" line on the plasticity chart (next page), and is clay if the liquid limit and plasticity index plot above the "A" line on the chart.
4. For a complete description of the Unified Soil Classification System, see "Technical Memorandum No. 3-357," prepared for Office, Chief of Engineers, by Waterways Equipment Station, Vicksburg, Mississippi, March 1953. (See also Data Sheet 17.)

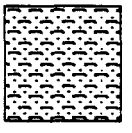
First published by GSA Engineering Geology Division.

EXPLANATION OF SYMBOLS AND TERMS FOR TEST PIT LOGS

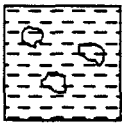
GRAPHIC LOG



Gravelly sandy clay or gravelly clayey sand or clayey sand and gravel or sandy clayey gravel



Sandy clay



Gravelly clay

USCS SYMBOL

(Unified Soil Classification System)

OL	Organic silt and organic silty clays of low plasticity
CL	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay, and/or silty clay
SC	Clayey sand, sand–clay mixtures
GC	Clayey gravel, gravek–sand–clay mixtures

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N 35520.83 E 15020.21
Total Depth 5.2'
Date Logged May 3, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF01
Ground Surface Elevation 6102.22'
Water Level Encountered 1.3'
Checked By
Site Manager

Comments

Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL		No readings over background with HNu.
			0.0-1.3'. GRAVELLY SANDY CLAY: dusky brown (5 YR 2/2); ~ 35% gravel; organic clay (OL-CL); some very fine-grained sand, trace medium-grained sand; some fine-graded pebbles to small cobbles generally subrounded; overall poorly sorted; medium stiff; moist. Sharp contact.	1.0' SAMPLE: WSF0101
2		SC		
			1.3-3.5'. GRAVELLY SANDY CLAY: moderate brown (5 YR 4/4); alluvial soil (SC) medium-grained to coarse-grained, subangular to subrounded sand; clay; some fine-graded pebbles ranging to large-graded cobbles and occasional small boulders, poorly sorted, generally subrounded; some pockets of olive gray clay; highly plastic; saturated. Gradational contact 3.2'-3.5'.	2.5' SAMPLE: WSF0102
4				
			3.5-5.2'. GRAVELLY CLAYEY SAND: light brown (5 YR 5/6); alluvial soil (SC); 30% gravel; some medium-grained to coarse-grained sand, subangular to subrounded sand; fine-graded pebbles ranging to occasional large cobbles, mostly medium-grade pebbles, subrounded; poorly sorted; medium plastic; moist.	4.5' SAMPLE: WSF0104
6				
			TOTAL DEPTH = 5.2'	
8				
10				

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N 35785.89 E 15024.74
Total Depth 4.4'
Date Logged May 3, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF02
Ground Surface Elevation 6099.52'
Water Level Encountered 1.2'
Checked By
Site Manager

Comments

Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/SC		No readings over background with HNu.
			0.0-1.2'. GRAVELLY SANDY CLAY: dusky brown (5 YR 2/2); ~ 30% gravel; 20% sand; organic clay (OL-CL/SC); very fine-grained sand; fine-graded pebbles to large cobbles, subrounded and subangular, poorly sorted; roots to 0.85'; medium plastic; moist to wet. Wavy, sharp contact at 1.2'.	0.9' SAMPLE: WSF0201
2		SC		
		SC/GC	1.2-2.8'. GRAVELLY CLAYEY SAND: moderate brown (5 YR 4/4); 30% gravel; alluvial soil (SC) fairly well sorted, medium-grained to coarse-grained, subangular to subrounded sand; some clay; poorly sorted, fine-graded pebbles to large cobbles, generally subrounded; stringers of organic soils from above zone are occasional, friable to firm; moist. Irregular gradational contact.	2.2' SAMPLE: WSF0202
4				
			2.8-4.4'. GRAVELLY SANDY CLAY: light brown (5 YR 5/6) and moderate yellowish brown (10 YR 5/4); alluvial soil (SC/GC); moderately sorted, fine-grained to medium-grained sand, subangular and subrounded; poorly sorted fine-graded pebbles to small boulders, generally subrounded, occasionally associated olive gray clay; medium firm or stiff; moist.	4.4' SAMPLE: WSF0204
6				
			TOTAL DEPTH = 4.4'	
8				
10				

LOG OF TEST PIT

Location: Rocky Flats Plant: West Spray Field
Coordinates: N 36078.77 E 15021.92
Total Depth: 4.9'
Date Logged: May 3, 1988
Excavation Method: Backhoe
Logged By: KD Holliway, Geologist

Test Pit No.: WSF03
Ground Surface Elevation: 6098.81'
Water Level Encountered: 1.1'
Checked By: _____ Site Manager

Comments: _____

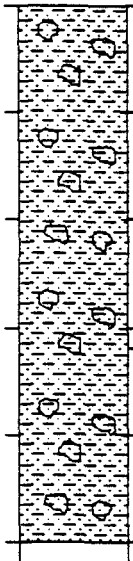
Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/SC		No readings over background with HNu.
			0.0-1.1'. GRAVELLY SANDY CLAY: grayish brown (5 YR 3/2); organic clay (OL-CL) and alluvial soil (SC); very fine-grained sand; moderately sorted and subangular fine-graded pebbles to medium-graded pebbles; firm to slightly plastic; moist to wet. Wavy, sharp contact at 1.1'.	0.9' SAMPLE: WSF0301
		GC/SC		
2			1.2-2.5'. CLAYEY SAND AND GRAVEL: moderate brown (5 YR 4/4); alluvial soil (GC/SC); 40% gravel; trace clay; medium-grained to coarse-grained, moderately sorted, subangular and subrounded sand; some clay; fine-graded to coarse-graded pebbles ranging to accasional large cobbles, subrounded; trace stringers of organic soil from above; firm; moist to wet. Gradational contact.	2.2' SAMPLE: WSF0302
4				
			2.5-4.9'. GRAVELLY SAND AND CLAY: light brown (5 YR 5/6) and moderate yellowish brown (10 YR 5/4); 30% gravel; alluvium (GC/SC); poorly sorted, fine-grained to coarse-grained subangular sand; poorly sorted gravels ranging fine-graded pebbles to medium boulders, generally subrounded; pockets of olive gray clay associated with boulders; slightly firm; moist.	4.7' SAMPLE: WSF0305
6				
			TOTAL DEPTH = 4.9'	
8				
10				

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N 35830.20 E 15153.24
Total Depth 5.0'
Date Logged May 3, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF04
Ground Surface Elevation 6096.82'
Water Level Encountered 1.35'
Checked By
Site Manager

Comments

Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/ SC		No readings over background (0.2 units) with HNu.
			0.0-1.35'. GRAVELLY SANDY CLAY: dusky brown (5 YR 2/2); organic clay (OL-CL) and alluvium (SC); very fine-grained sand; moderately sorted gravels ranging from fine-graded to coarse-graded pebbles to large cobbles, generally subrounded; slightly plastic; moist to wet.	0.9' SAMPLE: WSF0401
2				
			1.35-3.2'. GRAVELLY SANDY CLAY: moderate brown (5 YR 4/4); with red staining in clayey zone 1.35'-2.2'; alluvium (SC) poorly sorted fine-grained to coarse-grained subangular and subrounded sand; moderately sorted gravels ranging from medium-graded pebbles to large cobbles, subrounded; trace stringers organic soil from above zone; medium firm to firm; moist. Irregular, gradational contact.	2.5' SAMPLE: WSF0402
		GC/SC		
4				
			3.2-5.0'. CLAYEY SAND AND GRAVEL: light brown (5 YR 5/6) and moderate yellowish brown (10 YR 5/4); alluvium (GC/SC); moderately sorted, fine-grained to medium-grained subangular and subrounded sand; some clay; moderately sorted gravels ranging from fine-grained pebbles to some large cobbles with occasional small boulders, subrounded; pockets of olive gray clay are associated with cobbles and boulders; firm; moist.	4.1' SAMPLE: WSF0404
6				
8			TOTAL DEPTH = 5.0'	
10				

LOG OF TEST PIT

Location: Rocky Flats Plant; West Spray Field
Coordinates: N 36284.59 E 15165.46
Total Depth: 5.1'
Date Logged: May 3, 1988
Excavation Method: Backhoe
Logged By: KD Holliway, Geologist

Test Pit No.: WSF05
Ground Surface Elevation: 6095.61'
Water Level Encountered: 1.3'
Checked By: _____ Site Manager

Comments: _____

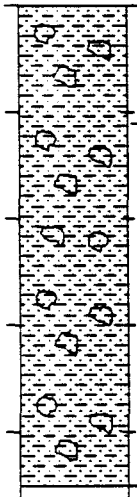
Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/SC		No readings over background with HNu.
			0.0-1.3'. GRAVELLY SANDY CLAY: dusky brown (5 YR 2/2); organic clay (OL-CL) and alluvium (SC); some very fine-grained sand; moderately well sorted gravels ranging from medium-graded to very coarse-graded subrounded pebbles; firm; moist to wet	0.75' SAMPLE: WSF0501
		SC		
2			1.3-3.4'. GRAVELLY SANDY CLAY: moderate brown (5 YR 4/4); alluvium (SC) moderately sorted medium-grained to coarse-grained sand with some fine-grained sand, subangular and subrounded; poorly sorted gravel ranging from fine-grained pebbles to small cobbles with occasional large cobbles to small boulders, subrounded; medium firm; high clay zone 2.3-2.7'; trace organic soil stringers from upper zone; moist.	2.0' SAMPLE: WSF0502
		GC/SC		
4			3.4-5.1'. CLAYEY SAND AND GRAVEL: light brown (5 YR 5/6) to moderate yellowish brown (10 YR 5/4); alluvium (GC/SC); moderately to poorly sorted, fine-grained to coarse-grained subangular to subrounded sand; moderately sorted gravels ranging from fine-graded to medium-graded pebbles with occasional small to large cobbles, subrounded; pockets of olive gray clay are found associated with cobbles; medium firm; moist.	4.2' SAMPLE: WSF0504
6				
			TOTAL DEPTH = 5.1'	
8				
10				

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N36537.97 E 15392.74
Total Depth 4.5'
Date Logged May 4, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF06
Ground Surface Elevation 6090.81'
Water Level Encountered 2.2'
Checked By
Site Manager

Comments

Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/ SC		No readings over background with HNu.
		SC	0.0-1.1'. GRAVELLY SANDY CLAY: dusky brown (5 YR 2/2); organic clay (OL-CL) and alluvium (SC); <20% fine-grained sand; moderately sorted gravels ranging from medium-graded pebbles to very coarse-graded pebbles, subrounded; roots to 0.9'; moist to wet. Wavy, sharp contact.	0.7' SAMPLE: WSF0601
2			1.3-3.5'. GRAVELLY SANDY CLAY: moderate brown (5 YR 4/4) intense red and brown color variations; alluvium (SC) moderately sorted fine-grained to medium-grained sand; moderately well sorted gravels ranging from fine-graded to coarse-graded pebbles with occasional small cobbles, subrounded; pockets of clay associated with cobbles; trace organic soil stringers from upper zone; moist to wet; wet zones occurring at approximately 2.2'. Gradational Contact 3.2'-3.5'.	2.1' SAMPLE: WSF0602 Saturated at 2.2' · Water seeping into trench.
4			3.4-4.5'. CLAYEY SAND AND GRAVEL: light brown (5 YR 5/6) and moderate yellowish brown (10 YR 5/4) intense colors of reds and browns; alluvium (SC); moderately sorted medium-grained sand with trace fine-grained to coarse-grained sand, subangular to subrounded; moderately sorted gravels ranging from fine-graded to coarse-graded pebbles with occasional small cobbles, subrounded; occasional pockets of olive gray clay associated with the cobbles; some caliche at 4.4'; moist to saturated at 4.5'.	4.6' SAMPLE: WSF0604
6				
8			TOTAL DEPTH = 4.5'	
10				

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N 35892.92 E 15295.62
Total Depth 4.8'
Date Logged May 4, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF07
Ground Surface Elevation 6093.92'
Water Level Encountered 1.3'
Checked By
Site Manager

Comments

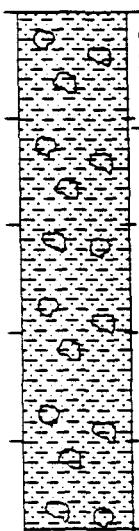
Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/ SC		No readings over background with HNu.
			0.0-1.3'. GRAVELLY SANDY CLAY: dusky brown (5 YR 2/2); organic clay (OL-CL) and alluvium (SC); some very fine-grained sand; moderately sorted gravels ranging from fine-graded pebbles to very coarse-graded pebbles and occasional small cobbles, subrounded and subangular; medium firm; moist to wet.	0.5' SAMPLE: WSF0701
2		SC/GC		
			1.3-3.5'. GRAVELLY CLAYEY SAND TO SANDY CLAY: moderate brown (5 YR 4/4) to light brown (5 YR 5/6); alluvium (SC/GC); poorly sorted fine-grained to coarse-grained subangular and subrounded sand; occasional medium-graded to very coarse-graded pebbles and small cobbles; occasional clay; plastic to highly plastic; wet to moist.	2.0' SAMPLE: WSF0702
4		GC		
			3.5-4.8'. CLAYEY SAND AND GRAVEL: light brown (5 YR 5/6) and moderate yellowish brown (10 YR 5/4) and light olive gray (5 Y 6/1); clay zone at 3.8' with caliche; alluvium (GC); moist, firm, pockets of red and pink staining; some moderately sorted fine-grained to medium-grained sand, subangular; some subrounded fine-graded to very coarse-graded pebbles with some small to large cobbles; medium firm to stiff moist.	3.8' SAMPLE: WSF0704
6				
			TOTAL DEPTH = 4.8'	
8				
10				

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N 36214.47 E 13774.47
Total Depth 4.8'
Date Logged May 4, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF08
Ground Surface Elevation 6122.38'
Water Level Encountered 1.0'
Checked By
Site Manager

Comments

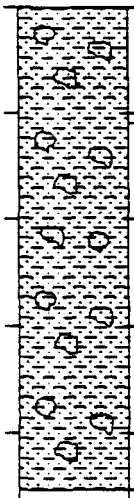
Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/ SC		No readings over background with HNu.
		GC	0.0-1.1'. SANDY CLAY AND GRAVEL: dusky brown (5 YR 2/2); organic clay (OL-CL) and alluvium (SC); some very fine-grained sand; moderately sorted gravels ranging from medium-graded to very coarse-graded pebbles with occasional small cobbles, subrounded; roots to 0.9'; medium plasticity to firm; water at 1-foot depth; moist to wet.	0.65' SAMPLE: WSF0801
2			1.1-3.3'. CLAYEY SAND AND GRAVEL: moderate brown (5 YR 4/4) intensely colored and mottled; alluvium (GC); moderately well sorted medium-grained to coarse-grained sand, subangular and subrounded; subrounded gravel ranging from fine-graded to very coarse-graded pebbles with some small to large cobbles and occasional small boulders; highly plastic; saturated.	2.0' SAMPLE: WSF0802
4			Gradational contact 3.2'-3.5'.	
			3.3-4.8'. SANDY CLAY AND GRAVEL: light brown (5 YR 5/6) and moderate yellowish brown (10 YR 5/4) to dark yellowish orange (10 YR 6/6) with yellowish gray (5 Y 7/2) to light olive gray (5 Y 6/1) clay; alluvium (GC); moderately to poorly sorted, subangular and subrounded fine-grained to medium-grained sand, poorly sorted, subrounded gravels ranging from medium-graded to very coarse-graded pebbles with small cobbles to small boulders; pockets of dark reddish brown (10 R 3/4) staining; highly plastic and sticky; moist to wet.	4.6' SAMPLE: WSF0805
6				
8			TOTAL DEPTH = 4.8'	
10				

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N 36157.79 E 14076.13
Total Depth 4.5'
Date Logged May 4, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF09
Ground Surface Elevation 6117.48'
Water Level Encountered 1.1'
Checked By
Site Manager

Comments

Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/ SC		No readings over background with HNu.
		GC	0.0-1.1'. GRAVELLY SANDY CLAY: dusky brown (5 YR 2/2); organic clay (OL-CL) and alluvium (SC); some very fine-grained sand; moderately sorted, subrounded gravels ranging from medium-graded to very coarse-graded pebbles; slightly plastic to firm; water at 1.1'; moist to wet. Sharp contact at 1.1'.	0.5' SAMPLE: WSF0901
2			1.1-3.3'. SANDY CLAY AND GRAVEL: moderate brown (5 YR 4/4); alluvium (GC); poorly sorted, subangular and subrounded fine-grained to coarse-grained sand; pockets of clay common; poorly sorted, subrounded gravels ranging from fine-graded to very coarse-graded pebbles and small cobbles to small boulders; varied colored dark yellowish orange (10 YR 6/6) and moderate reddish brown (10 R 4/6) sandy zones grading into clay zones with intense staining; highly plastic to firm or stiff; wet to saturated. Gradational contact 3-3.5'.	2.0' SAMPLE: WSF0902
4				
6			3.3-4.5'. SANDY CLAY AND GRAVEL: moderate yellowish brown (10 YR 5/4), dark yellowish orange (10 YR 6/6) and yellowish gray (5 Y 7/2); alluvium (GC) moderately sorted, subangular and subrounded, fine-grained to medium-grained sand with occasional zones coarse-grained sand; poorly sorted, subrounded gravels ranging from fine-graded to very coarse-graded pebbles and small cobbles to small boulders; pockets of bedded sandstone quartzitic; yellowish gray (5 Y 7/2), fine-grained to medium-grained, subrounded, well sorted; firm; moist to wet.	4.4' SAMPLE: WSF0904
8			TOTAL DEPTH = 4.5'	
10				

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N 35558.85 E 14188.40
Total Depth 4.0'
Date Logged May 5, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF10
Ground Surface Elevation 6118.53'
Water Level Encountered 2.25'
Checked By
Site Manager

Comments

Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/ SC		No readings over background with HNu.
			0.0-1.25'. GRAVELLY SANDY CLAY: dusky brown (5 YR 2/2); organic clay (OL-CL) and alluvium (SC); some very fine-grained sand, moderately sorted, subrounded, gravel ranging from fine-graded to very coarse-graded with small cobbles and small boulders; roots to 0.8'; firm; moist. Wavy sharp contact at 1.25'.	0.5' SAMPLE: WSF1001
2		GC		
		SC	1.25-2.25'. GRAVELLY SANDY CLAY: moderate brown (5 YR 4/4); alluvium (GC); some very fine-grained sand; moderately well sorted, subrounded gravels ranging from very fine-graded to coarse-graded pebbles with trace of small cobbles to small boulders; firm and slightly plastic; intense coloration; moist to wet.	1.7' SAMPLE: WSF1002
4				
			2.25-3.0'. SANDY CLAY: light brown (5 YR 5/6); alluvium (SC); fairly well sorted, subangular, fine-grained to medium-grained sand; poorly sorted subrounded gravel ranging from fine-graded to very coarse-graded pebbles with occasional small to large cobbles; friable to firm; moist.	
6				
			3.0-4.0'. SANDY CLAY AND GRAVEL: mottled and intense coloring of reds, yellows, browns and olive gray; alluvium (SC); poorly sorted, subangular, fine-grained to coarse-grained sand; poorly sorted subrounded gravel ranging from fine-graded to very coarse-graded pebbles with some small cobbles to small boulders; firm; moist.	3.5' SAMPLE: WSF1004
8				
			TOTAL DEPTH = 4.0'	
10				

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N 35625.92 E 13797.28
Total Depth 4.9'
Date Logged May 5, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF11
Ground Surface Elevation 6126.33'
Water Level Encountered 1.3'
Checked By
Site Manager

Comments

Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL/ SC		No readings over background with HNu.
			0.0-1.3'. GRAVELLY SANDY CLAY: dusky brown (5 YR 2/2); organic clay (OL-CL) and alluvium (SC); some very fine-grained sand with trace medium-grained sand; moderately sorted, subrounded gravel ranging from trace fine-graded pebbles with mostly medium-graded to very coarse-graded pebbles with occasional small and large cobbles; roots to approximately 0.8'; firm; moist. Irregular and wavy sharp contact at 1.3'.	0.5' SAMPLE: WSF1101
2		GC		
			1.3-3.0'. CLAYEY SANDY GRAVEL: moderate brown (5 YR 4/4) with varied intense red and brown staining; alluvium (GC); moderately sorted, subangular fine-grained to coarse-grained sands; poorly sorted, subrounded; trace fine-graded to medium-graded pebbles with mostly coarse-graded pebbles with mostly coarse-graded pebbles to large cobbles with occasional small boulders; firm to highly plastic; moist to saturated. Gradational contact 3.0-3.4'.	2.0' SAMPLE: WSF1102
4				
6			3.4-4.9'. SANDY CLAYEY GRAVEL: moderate yellowish brown (10 YR 5/4) and yellowish gray (5 Y 7/2) with varied intense yellow and red staining; alluvium (GC); poorly sorted, subangular and subrounded, fine-grained to very coarse-grained sand, friable; clays have moderately sorted fine-grained to medium-grained sands; poorly sorted subrounded gravel ranging from fine-graded pebbles to small cobbles and small boulders; plastic; firm; moist to wet.	4.5' SAMPLE: WSF1105
8			TOTAL DEPTH = 4.9'	
10				

LOG OF TEST PIT

Location Rocky Flats Plant; West Spray Field
Coordinates N 35639.86 E 13457.88
Total Depth 4.5'
Date Logged May 5, 1988
Excavation Method Backhoe
Logged By KD Holliway
Geologist

Test Pit No. WSF12
Ground Surface Elevation 6133.03'
Water Level Encountered 3.2'
Checked By
Site Manager

Comments

Depth Feet	Graphic Log	USCS Symbol	Lithographic Description	Samples Collected or Other Tests Performed
0		OL-CL		No readings over background with HNu.
			0.0-1.3'. GRAVELLY CLAY: dusky brown (5 YR 2/2); organic clay (OL-CL); some very fine-grained to medium-grained sand; poorly sorted subrounded gravel ranging from very fine-graded pebbles to small cobbles; slightly firm to friable; moist to damp. Wavy sharp contact at 1.3'.	0.5' SAMPLE: WSF1201
		GC		
2			1.3-3.2'. SANDY CLAY AND GRAVEL: moderate brown (5 YR 4/4); alluvium (GC); poorly sorted subangular and subrounded very fine-grained to coarse-grained sand; moderately to poorly sorted, subrounded gravel ranging from fine-graded pebbles to small boulders; some pockets of clay with little sand; plastic; firm; moist. Gradational Contact.	2.0' SAMPLE: WSF1202
4			3.2-4.5'. CLAYEY SAND AND GRAVEL: moderate yellowish brown (10 YR 5/4) and light brown (5 Y 5/6); alluvium (GC); moderately well sorted, subangular and subrounded, medium-grained to coarse-grained sand with trace of clay; poorly sorted, subrounded gravel ranging from medium-graded pebbles to small boulders; loose to firm; no cementation; saturated.	4.0' SAMPLE: WSF1205
6				
			TOTAL DEPTH = 4.5'	
8				
10				

INORGANICS

Groundwater Inorganic Results for WEST SPRAY FIELDS

BEDROCK Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	$CO_3^=$	HCO_3^-	Chloride	Sulfate	pH	Fluoride	Nitrate-Nitrite-Nitrogen
West Spray Field Bedrock Wells										
5286	52-86-05-13-87	05/13/87	1	NR	58.0 mg/l	1.70 mg/l	64.0 mg/l	NR	NR	0.20 U mg/l
5286	52-86-06-18-87	06/18/87	2	NR	29.8 mg/l	1.33 mg/l	59.0 mg/l	NR	NR	0.20 U mg/l
5286	52-86-08-19-87	08/19/87	3	2.0 mg/l	35.6 mg/l	21.4 mg/l	66.0 mg/l	NR	NR	0.20 U mg/l
5286	52-86-10-02-86	10/02/86		NA	NA	NA	NA	NA	NA	NA
5286	52-86-10-02-87	10/02/87		NA	NA	NA	NA	NA	NA	NA
5286	52-86D-10-02-87	10/02/87	4	18.5 mg/l	23.4 mg/l	1.30 mg/l	57.3 mg/l	NR	NR	0.20 U mg/l
5286	52-86-10-02-87	10/02/87	4	13.4 mg/l	28.4 mg/l	1.20 mg/l	55.0 mg/l	NR	NR	0.20 U mg/l
5286	52-86-02-08-88	02/08/88	1	NR	33.4 mg/l	5.19 mg/l	43.4 mg/l	NR	NR	0.05 mg/l
4886	48-86-06-18-87	06/18/87	2	NR	104 mg/l	10.7 mg/l	20.0 mg/l	NR	NR	0.20 U mg/l
4886	48-86-08-25-87	08/25/87	3	NR	107 mg/l	12.50 mg/l	12.0 mg/l	NR	NR	0.20 U mg/l
4886	48-86-04-08-87	04/08/87	1	NR	80.2 mg/l	15.6 mg/l	96.0 mg/l	NR	NR	0.20 U mg/l
4886	48-86-12-14-87	12/14/87	4	NR	171 mg/l	12.0 mg/l	12.7 mg/l	NR	NR	0.02 U mg/l
4686	G468611860	11/13/86		NA	NA	NA	NA	NA	NA	NA
4686	46-86-05-14-87	05/14/87	1	NR	248 mg/l	3.90 mg/l	20.0 mg/l	NR	NR	0.54 mg/l
4686	46-86-06-22-87	06/22/87	2	NR	180 mg/l	2.97 mg/l	19.0 mg/l	NR	NR	0.20 U mg/l
4686	46-86-08-14-87	08/14/87	3	NR	210 mg/l	2.64 mg/l	12.5 mg/l	NR	NR	0.20 U mg/l
4686	46-86-10-05-87	10/05/87		NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-06-87	10/06/87	4	NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-05-87	10/05/87	4	NR	NR	NR	NR	NR	NR	0.20 U mg/l
4686	46-86-02-12-88	02/12/88	1	NR	237 mg/l	2.80 mg/l	17.0 mg/l	NR	NR	0.07 mg/l

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

Groundwater Inorganic Results for WEST SPRAY FIELDS

BEDROCK Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Sulfide	Phosphate	Cyanide, Total	Hexavalent Chromium (Cr+6)	Total Dissolved Solids	Suspended Solids	% Solids
West Spray Field Bedrock Wells										
5286	52-86-05-13-87	05/13/87	1	NR	NR	1.0 U mg/l	NR	147 mg/l	NR	NR
5286	52-86-06-18-87	06/18/87	2	NR	NR	1.0 U mg/l	NR	129 mg/l	NR	NR
5286	52-86-08-19-87	08/19/87	3	NR	NR	1 U mg/l	NR	153 mg/l	NR	NR
5286	52-86-10-02-86	10/02/86		NA	NA	NA	NA	NA	NA	NA
5286	52-86-10-02-87	10/02/87		NA	NA	NA	NA	NA	NA	NA
5286	52-86D-10-02-87	10/02/87	4	NR	NR	NR	NR	150 mg/l	NR	NR
5286	52-86-10-02-87	10/02/87	4	NR	NR	NR	NR	136 mg/l	NR	NR
5286	52-86-02-08-88	02/08/88	1	NR	NR	NR	NR	115 mg/l	NR	NR
4886	48-86-06-18-87	06/18/87	2	NR	NR	1.0 U mg/l	NR	175 mg/l	NR	NR
4886	48-86-08-25-87	08/25/87	3	NR	NR	1 U mg/l	NR	211 mg/l	NR	NR
4886	48-86-04-08-87	04/08/87	1	NR	NR	1.0 U mg/l	NR	133 mg/l	NR	NR
4886	48-86-12-14-87	12/14/87	4	NR	NR	NR	NR	200 mg/l	NR	NR
4686	G46861186O	11/13/86		NA	NA	NA	NA	NA	NA	NA
4686	46-86-05-14-87	05/14/87	1	NR	NR	1.0 U mg/l	NR	228 mg/l	NR	NR
4686	46-86-06-22-87	06/22/87	2	NR	NR	1.0 U mg/l	NR	242 mg/l	NR	NR
4686	46-86-08-14-87	08/14/87	3	NR	NR	1 U mg/l	NR	244 mg/l	NR	NR
4686	46-86-10-05-87	10/05/87		NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-06-87	10/06/87	4	NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-05-87	10/05/87	4	NR	NR	NR	NR	NR	NR	NR
4686	46-86-02-12-88	02/12/88	1	NR	NR	NR	NR	245 mg/l	NR	NR

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

METALS

Groundwater Metals Results for WEST SPRAY FIELDS

BEDROCK Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Silver (Ag), total	Aluminum (Al), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Calcium (Ca), total	Cadmium (Cd), total	Cobalt (Co), total	Chromium (Cr), total	Cesium (Cs), total
West Spray Field Bedrock Wells														
5286	52-86-05-13-87	05/13/87	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5286	52-86-06-18-87	06/18/87	2	mg/l	NR	NR	0.01 U	NR	0.005 U	NR	0.005 U	NR	NR	0.2 U
5286	52-86-08-19-87	08/19/87	3	mg/l	0.0076 U	0.0229	0.004 J	0.0755	0.005 U	25.1182	0.001 U	0.0220 U	0.0100 U	0.02 U
5286	52-86-10-02-86	10/02/86			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5286	52-86-10-02-87	10/02/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5286	52-86D-10-02-87	10/02/87	4	mg/l	0.0076 U	0.0506	0.002 J	0.0409	0.001 J	21.1280	0.001 U	0.0220 U	0.0100 U	0.02 U
5286	52-86-10-02-87	10/02/87	4	mg/l	0.0076 U	0.0638	0.003 J	0.0401	0.005 U	20.6578	0.0003 J	0.0220 U	0.0100 U	0.02 U
5286	52-86-02-08-88	02/08/88	1	mg/l	0.0076 U	0.0810	0.004 J	0.0622	0.005 U	17.7181	0.001 U	0.0220 U	0.0100 U	0.02 U
4886	48-86-06-18-87	06/18/87	2	mg/l	0.0076 U	0.0407	0.01 U	0.0100 U	0.005 U	9.0635	0.005 U	0.0220 U	0.0100 U	0.2 U
4886	48-86-08-25-87	08/25/87	3	mg/l	0.0076 U	0.0353	0.004 J	0.1318	0.005 U	18.1628	0.001 U	0.0220 U	0.0100 U	0.02 U
4886	48-86-04-08-87	04/08/87	1	mg/l	0.0076 U	0.0510	0.0100 U	0.0357	0.005 U	7.0742	0.0050 U	0.0220 U	0.0100 U	0.2 U
4886	48-86-12-14-87	12/14/87	4	mg/l	0.0076 U	0.0779	0.002 J	0.0813	0.005 U	15.0728	0.001 U	0.0220 U	0.0100 U	0.02 U
4686	G468611860	11/13/86		mg/l	0.009 U	0.350	0.010 U	0.144	0.005 U	13.900	0.005 U	0.025 U	0.010 U	0.150 U
4686	46-86-05-14-87	05/14/87	1	mg/l	0.0076 U	0.7932	0.01 U	0.2010	0.005 U	33.8259	0.005 U	0.0220 U	0.0100 U	0.2 U
4686	46-86-06-22-87	06/22/87	2	mg/l	0.0076 U	0.0290 U	0.01 U	0.1498	0.005 U	36.0500	0.005 U	0.0220 U	0.0100 U	0.2 U
4686	46-86-08-14-87	08/14/87	3	mg/l	0.0076 U	0.0379	0.005 U	0.2224	0.005 U	43.8021	0.001 U	0.0220 U	0.0100 U	0.02 U
4686	46-86-10-05-87	10/05/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-06-87	10/06/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-05-87	10/05/87	4	mg/l	0.0076 U	0.0290 U	0.005 U	0.1851	0.005 U	38.3442	0.001 U	0.0220 U	0.0100 U	0.02 U
4686	46-86-02-12-88	02/12/88	1	mg/l	0.0076 U	0.0290 U	0.002 J	0.1642	0.005 U	38.8745	0.001 U	0.0220 U	0.0116	0.02 U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

Groundwater Metals Results for WEST SPRAY FIELDS

BEDROCK Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Copper (Cu), total	Iron (Fe), total	Mercury (Hg), total	Potassium (K), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Molybdenum (Mo), total	Sodium (Na), total	Nickel (Ni), total
West Spray Field Bedrock Wells														
5286	52-86-05-13-87	05/13/87	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5286	52-86-06-18-87	06/18/87	2	mg/l	NR	NR	0.0002 U	5.0 U	NR	NR	NR	NR	NR	NR
5286	52-86-08-19-87	08/19/87	3	mg/l	0.0083	0.0114	0.0002 U	1.2	NR	1.8027	0.0051 U	0.0553	21.5207	0.0370 U
5286	52-86-10-02-86	10/02/86			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5286	52-86-10-02-87	10/02/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5286	52-86D-10-02-87	10/02/87	4	mg/l	0.0063 U	0.0069 U	0.0002 U	2.0	0.1 U	0.5983	0.0051 U	0.0415	19.1059	0.0370 U
5286	52-86-10-02-87	10/02/87	4	mg/l	0.0063 U	0.0187	0.0002 U	1.9	0.1 U	0.5833	0.0051 U	0.0401	19.4135	0.0370 U
5286	52-86-02-08-88	02/08/88	1	mg/l	0.0063 U	0.0395	0.0002 U	1.9	0.1 U	0.4424	0.0051 U	0.0398	15.8001	0.0370 U
4886	48-86-06-18-87	06/18/87	2	mg/l	0.0063 U	0.0646	0.0002 U	5.8	NR	1.9987	0.0051 U	0.0220 U	45.4743	0.0370 U
4886	48-86-08-25-87	08/25/87	3	mg/l	0.0083	0.0089	0.0002 U	5.7	NR	5.6337	0.0769	0.0220 U	46.7407	0.0370 U
4886	48-86-04-08-87	04/08/87	1	mg/l	0.0063 U	0.0087	0.0002 U	6.0	NR	1.4113	0.0051 U	0.0327	37.2643	0.0370 U
4886	48-86-12-14-87	12/14/87	4	mg/l	0.0353	0.0523	0.0002 U	5.5	0.1 U	4.4842	0.0508	0.0220 U	42.0372	0.0370 U
4686	G468611860	11/13/86		mg/l	0.020 U	0.122	0.0002 U	7.200	NR	1.190	0.013	0.100 U	31.400	0.020 U
4686	46-86-05-14-87	05/14/87	1	mg/l	0.0093	0.5391	0.0002 U	5.0 U	NR	9.6724	0.0884	0.0220 U	28.5185	0.0370 U
4686	46-86-06-22-87	06/22/87	2	mg/l	0.0063 U	0.0279	0.0002	8.0	NR	10.7961	0.0680	0.0244	32.6587	0.0370 U
4686	46-86-08-14-87	08/14/87	3	mg/l	0.0090	0.0137	0.0002 U	4.4	NR	11.7295	0.0710	0.0224	37.7556	0.0370 U
4686	46-86-10-05-87	10/05/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-06-87	10/06/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-05-87	10/05/87	4	mg/l	0.0063 U	0.0069 U	0.0002 U	3.7	0.03 J	11.0213	0.0545	0.0220 U	31.6284	0.0370 U
4686	46-86-02-12-88	02/12/88	1	mg/l	0.0063 U	0.0069 U	0.0002 U	4.6	0.1 U	10.5546	0.0579	0.0220 U	31.8506	0.0370 U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
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B : Present in laboratory blank

Groundwater Metals Results for WEST SPRAY FIELDS

BEDROCK Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Lead (Pb), total		Antimony (Sb), total		Selenium (Se), total		Strontium (Sr), total		Thallium (Tl), total		Vanadium (V), total		Zinc (Zn), total	
West Spray Field Bedrock Wells																		
5286	52-86-05-13-87	05/13/87	1			NA		NA		NA		NA		NA		NA		NA
5286	52-86-06-18-87	06/18/87	2	mg/l	0.011		0.06	U	0.005	U		NR	0.01	U		NR	0.02	U
5286	52-86-08-19-87	08/19/87	3	mg/l	0.005	U	0.02	U	0.005	U	0.1715		0.01	U	0.0304		0.0200	U
5286	52-86-10-02-86	10/02/86				NA		NA		NA		NA		NA		NA		NA
5286	52-86-10-02-87	10/02/87				NA		NA		NA		NA		NA		NA		NA
5286	52-86D-10-02-87	10/02/87	4	mg/l	0.002	J	0.02	U	0.005	U	0.1747		0.01	U	0.0422		0.0200	U
5286	52-86-10-02-87	10/02/87	4	mg/l	0.005	U	0.02	U	0.005	U	0.1697		0.01	U	0.0467		0.0271	
5286	52-86-02-08-88	02/08/88	1	mg/l	0.005	U	0.02	U	0.005	U	0.1702		0.01	U	0.0379		0.0947	
4886	48-86-06-18-87	06/18/87	2	mg/l	0.029		0.06	U	0.005	U	0.1417		0.01	U	0.0334		0.0200	U
4886	48-86-08-25-87	08/25/87	3	mg/l	0.005	U	0.02	U	0.005	U	0.3266		0.01	U	0.0240	U	0.0200	U
4886	48-86-04-08-87	04/08/87	1	mg/l	0.0050	U	0.06	U	0.005	U	0.1795		0.0100	U	0.0240	U	0.09	
4886	48-86-12-14-87	12/14/87	4	mg/l	0.005	U	0.02	U	0.005		0.3071		0.01	U	0.0240	U	0.0231	
4686	G468611860	11/13/86		mg/l	0.005	U	0.060	U	0.009		0.117		0.010	U	0.025	U	0.020	U
4686	46-86-05-14-87	05/14/87	1	mg/l	0.005	U	0.0600	U	0.0050	U	0.3764		0.01	U	0.0240	U	0.02	U
4686	46-86-06-22-87	06/22/87	2	mg/l	0.030	U	0.06	U	0.005	U	0.4548		0.01	U	0.0240	U	0.0200	U
4686	46-86-08-14-87	08/14/87	3	mg/l	0.005	U	0.02	U	0.005	U	0.4952		0.01	U	0.0240	U	0.0200	U
4686	46-86-10-05-87	10/05/87				NA		NA		NA		NA		NA		NA		NA
4686	46-86-10-06-87	10/06/87	4			NA		NA		NA		NA		NA		NA		NA
4686	46-86-10-05-87	10/05/87	4	mg/l	0.005	U	0.02	U	0.005	U	0.4530		0.01	U	0.0240	U	0.0200	U
4686	46-86-02-12-88	02/12/88	1	mg/l	0.005	U	0.02	U	0.005	U	0.4510		0.01	U	0.0240	U	0.0200	U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

APPENDIX D

ANALYTICAL CHEMISTRY

APPENDIX D

This appendix contains analytical data for the West Spray Field Area. The appendix is presented in the following order:

- Appendix D-1: Soils Analytical Data
- Appendix D-2: Ground-Water Analytical Data Alluvial Wells
- Appendix D-3: Ground-Water Analytical Data Bedrock Wells

APPENDIX D-1

SOILS ANALYTICAL DATA

BOREHOLE SAMPLE INFORMATION

WEST SPRAY FIELD TEST PITS

	SAMPLE INFORMATION				LABORATORY BATCH NUMBERS					
BOREHOLE NUMBER	NUMBER	DATE	DEPTH INCREMENT (ft)	SAMPLE TYPE*	VOLATILE ORGANICS	SEMI-VOL ORGANICS	PESTICIDES AND PCB'S	METALS	INORGANICS	RADIO-CHEMISTRY
WSF01	WSF0101	05/03/88	1.00 - 1.00		0188-881-243	No Sample	No Sample	0188-881-243	0188-881-243	0188-881-243
WSF01	WSF0102	05/03/88	2.50 - 2.50		0188-881-242	No Sample	No Sample	0188-881-242	0188-881-242	0188-881-242
WSF01	WSF0104	05/03/88	4.50 - 4.50		0188-881-241	No Sample	No Sample	0188-881-241	0188-881-241	0188-881-241
WSF02	WSF0201	05/03/88	0.90 - 0.90		0188-881-246	No Sample	No Sample	0188-881-246	0188-881-246	0188-881-246
WSF02	WSF0202	05/03/88	2.20 - 2.20		0188-881-245	No Sample	No Sample	0188-881-245	0188-881-245	0188-881-245
WSF02	WSF0204	05/03/88	4.40 - 4.40		0188-881-244	No Sample	No Sample	0188-881-244	0188-881-244	0188-881-244
WSF03	WSF0301	05/03/88	0.90 - 0.90		0188-881-249	No Sample	No Sample	0188-881-249	0188-881-249	0188-881-249
WSF03	WSF0302	05/03/88	2.20 - 2.20		0188-881-248	No Sample	No Sample	0188-881-248	0188-881-248	0188-881-248
WSF03	WSF0305	05/03/88	4.70 - 4.70		0188-881-247	No Sample	No Sample	0188-881-247	0188-881-247	0188-881-247
WSF04	WSF0401	05/03/88	0.90 - 0.90		0188-881-252	No Sample	No Sample	0188-881-252	0188-881-252	0188-881-252
WSF04	WSF0402	05/03/88	2.50 - 2.50		0188-881-251	No Sample	No Sample	0188-881-251	0188-881-251	0188-881-251
WSF04	WSF0404	05/03/88	4.10 - 4.10		0188-881-250	No Sample	No Sample	0188-881-250	0188-881-250	0188-881-250
WSF05	WSF0501	05/03/88	0.75 - 0.75		0188-881-255	No Sample	No Sample	0188-881-255	0188-881-255	0188-881-255
WSF05	WSF0502	05/03/88	2.00 - 2.00		0188-881-254	No Sample	No Sample	0188-881-254	0188-881-254	0188-881-254
WSF05	WSF0504	05/03/88	4.20 - 4.20		0188-881-253	No Sample	No Sample	0188-881-253	0188-881-253	0188-881-253
WSF06	WSF0601	05/04/88	0.70 - 0.70		0188-881-258	No Sample	No Sample	0188-881-258	0188-881-258	0188-881-258
WSF06	WSF0602	05/04/88	2.10 - 2.10		0188-881-257	No Sample	No Sample	0188-881-257	0188-881-257	0188-881-257
WSF06	WSF0604	05/04/88	4.60 - 4.60		0188-881-256	No Sample	No Sample	0188-881-256	0188-881-256	0188-881-256
WSF07	WSF0701	05/04/88	0.50 - 0.50		0188-881-261	No Sample	No Sample	0188-881-261	0188-881-261	0188-881-261
WSF07	WSF0702	05/04/88	2.00 - 2.00		0188-881-260	No Sample	No Sample	0188-881-260	0188-881-260	0188-881-260
WSF07	WSF0704	05/04/88	3.80 - 3.80		0188-881-259	No Sample	No Sample	0188-881-259	0188-881-259	0188-881-259
WSF08	WSF0801	05/04/88	0.65 - 0.65		0188-881-264	No Sample	No Sample	0188-881-264	0188-881-264	0188-881-264
WSF08	WSF0802	05/04/88	2.00 - 2.00		0188-881-263	No Sample	No Sample	0188-881-263	0188-881-263	0188-881-263
WSF08	WSF0805	05/04/88	4.60 - 4.60		0188-881-262	No Sample	No Sample	0188-881-262	0188-881-262	0188-881-262
WSF09	WSF0901	05/04/88	0.50 - 0.50		0188-881-267	No Sample	No Sample	0188-881-267	0188-881-267	0188-881-267
WSF09	WSF0902	05/04/88	2.00 - 2.00		0188-881-266	No Sample	No Sample	0188-881-266	0188-881-266	0188-881-266
WSF09	WSF0904	05/04/88	4.40 - 4.40		0188-881-265	No Sample	No Sample	0188-881-265	0188-881-265	0188-881-265
WSF10	WSF1001	05/05/88	0.50 - 0.50		0188-881-270	No Sample	No Sample	0188-881-270	0188-881-270	0188-881-270
WSF10	WSF1002	05/05/88	1.70 - 1.70		0188-881-269	No Sample	No Sample	0188-881-269	0188-881-269	0188-881-269
WSF10	WSF1004	05/05/88	3.50 - 3.50		0188-881-268	No Sample	No Sample	0188-881-268	0188-881-268	0188-881-268
WSF11	WSF1101	05/05/88	0.50 - 0.50		0188-881-273	No Sample	No Sample	0188-881-273	0188-881-273	0188-881-273
WSF11	WSF1102	05/05/88	2.00 - 2.00		0188-881-272	No Sample	No Sample	0188-881-272	0188-881-272	0188-881-272
WSF11	WSF1105	05/05/88	4.50 - 4.50		0188-881-271	No Sample	No Sample	0188-881-271	0188-881-271	0188-881-271
WSF12	WSF1201	05/05/88	0.50 - 0.50		0188-881-276	No Sample	No Sample	0188-881-276	0188-881-276	0188-881-276
WSF12	WSF1202	05/05/88	2.00 - 2.00		0188-881-275	No Sample	No Sample	0188-881-275	0188-881-275	0188-881-275
WSF12	WSF1205	05/05/88	4.00 - 4.00		0188-881-274	No Sample	No Sample	0188-881-274	0188-881-274	0188-881-274

* Sample type codes: BR - Bedrock C - Core CO - Composite CT - Contact DH - Direct Hit FS - Field Screen UC - Upper Contact WT - Water Table

VOLATILE ORGANICS

Volatile Organic Results

West Spray Field Test Pits

Test Pit Number	Field Sample Number	Date Sampled	Depth Increment (ft)	Units	Chloro methane	Bromo methane	Vinyl Chloride	Chloro ethane	Methylene Chloride	Acetone	Carbon Disulfide	1,1-Dichloro ethene	1,1-Dichloro ethane
WEST SPRAY FIELD TEST PITS													
WSF01	WSF0101	05/03/88	1.00 - 1.00	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF01	WSF0102	05/03/88	2.50 - 2.50	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF01	WSF0104	05/03/88	4.50 - 4.50	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF02	WSF0201	05/03/88	0.90 - 0.90	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF02	WSF0202	05/03/88	2.20 - 2.20	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF02	WSF0204	05/03/88	4.40 - 4.40	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF03	WSF0301	05/03/88	0.90 - 0.90	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF03	WSF0302	05/03/88	2.20 - 2.20	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF03	WSF0305	05/03/88	4.70 - 4.70	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF04	WSF0401	05/03/88	0.90 - 0.90	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF04	WSF0402	05/03/88	2.50 - 2.50	ug/kg	10 U	10 U	10 U	10 U	5 U	16	5 U	5 U	5 U
WSF04	WSF0404	05/03/88	4.10 - 4.10	ug/kg	10 U	10 U	10 U	10 U	5 U	78	5 U	5 U	5 U
WSF05	WSF0501	05/03/88	0.75 - 0.75	ug/kg	10 U	10 U	10 U	10 U	5 U	7 J	5 U	5 U	5 U
WSF05	WSF0502	05/03/88	2.00 - 2.00	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF05	WSF0504	05/03/88	4.20 - 4.20	ug/kg	10 U	10 U	10 U	10 U	5 U	89	5 U	5 U	5 U
WSF06	WSF0601	05/04/88	0.70 - 0.70	ug/kg	10 U	10 U	10 U	10 U	5 U	16	5 U	5 U	5 U
WSF06	WSF0602	05/04/88	2.10 - 2.10	ug/kg	10 U	10 U	10 U	10 U	5 U	41	5 U	5 U	5 U
WSF06	WSF0604	05/04/88	4.60 - 4.60	ug/kg	10 U	10 U	10 U	10 U	5 U	34	5 U	5 U	5 U
WSF07	WSF0701	05/04/88	0.50 - 0.50	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF07	WSF0702	05/04/88	2.00 - 2.00	ug/kg	10 U	10 U	10 U	10 U	5 U	15	5 U	5 U	5 U
WSF07	WSF0704	05/04/88	3.80 - 3.80	ug/kg	10 U	10 U	10 U	10 U	5 U	6 J	5 U	5 U	5 U
WSF08	WSF0801	05/04/88	0.65 - 0.65	ug/kg	10 U	10 U	10 U	10 U	5 U	5 J	5 U	5 U	5 U
WSF08	WSF0802	05/04/88	2.00 - 2.00	ug/kg	10 U	10 U	10 U	10 U	5 U	9 J	5 U	5 U	5 U
WSF08	WSF0805	05/04/88	4.60 - 4.60	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF09	WSF0901	05/04/88	0.50 - 0.50	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF09	WSF0902	05/04/88	2.00 - 2.00	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF09	WSF0904	05/04/88	4.40 - 4.40	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF10	WSF1001	05/05/88	0.50 - 0.50	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF10	WSF1002	05/05/88	1.70 - 1.70	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF10	WSF1004	05/05/88	3.50 - 3.50	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF11	WSF1101	05/05/88	0.50 - 0.50	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF11	WSF1102	05/05/88	2.00 - 2.00	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF11	WSF1105	05/05/88	4.50 - 4.50	ug/kg	10 U	10 U	10 U	10 U	5 U	33	5 U	5 U	5 U
WSF12	WSF1201	05/05/88	0.50 - 0.50	ug/kg	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
WSF12	WSF1202	05/05/88	2.00 - 2.00	ug/kg	10 U	10 U	10 U	10 U	5 U	30	5 U	5 U	5 U
WSF12	WSF1205	05/05/88	4.00 - 4.00	ug/kg	10 U	10 U	10 U	10 U	5 U	6 J	5 U	5 U	5 U

Volatile Organic Results

West Spray Field Test Pits

Test Pit Number	Field Sample Number	Date Sampled	Depth Increment (ft)	Units	Chloroform	1,2-Dichloro ethane	2-Butanone	1,1,1-Trichloro ethane	Carbon Tetra chloride	Vinyl Acetate	Bromo dichloro methane	1,2-Dichloro propane	Trans-1,3-Dichloro propene
WEST SPRAY FIELD TEST PITS													
WSF01	WSF0101	05/03/88	1.00 - 1.00	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF01	WSF0102	05/03/88	2.50 - 2.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF01	WSF0104	05/03/88	4.50 - 4.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF02	WSF0201	05/03/88	0.90 - 0.90	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF02	WSF0202	05/03/88	2.20 - 2.20	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF02	WSF0204	05/03/88	4.40 - 4.40	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF03	WSF0301	05/03/88	0.90 - 0.90	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF03	WSF0302	05/03/88	2.20 - 2.20	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF03	WSF0305	05/03/88	4.70 - 4.70	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF04	WSF0401	05/03/88	0.90 - 0.90	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF04	WSF0402	05/03/88	2.50 - 2.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF04	WSF0404	05/03/88	4.10 - 4.10	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF05	WSF0501	05/03/88	0.75 - 0.75	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF05	WSF0502	05/03/88	2.00 - 2.00	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF05	WSF0504	05/03/88	4.20 - 4.20	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF06	WSF0601	05/04/88	0.70 - 0.70	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF06	WSF0602	05/04/88	2.10 - 2.10	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF06	WSF0604	05/04/88	4.60 - 4.60	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF07	WSF0701	05/04/88	0.50 - 0.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF07	WSF0702	05/04/88	2.00 - 2.00	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF07	WSF0704	05/04/88	3.80 - 3.80	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF08	WSF0801	05/04/88	0.65 - 0.65	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF08	WSF0802	05/04/88	2.00 - 2.00	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF08	WSF0805	05/04/88	4.60 - 4.60	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF09	WSF0901	05/04/88	0.50 - 0.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF09	WSF0902	05/04/88	2.00 - 2.00	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF09	WSF0904	05/04/88	4.40 - 4.40	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF10	WSF1001	05/05/88	0.50 - 0.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF10	WSF1002	05/05/88	1.70 - 1.70	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF10	WSF1004	05/05/88	3.50 - 3.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF11	WSF1101	05/05/88	0.50 - 0.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF11	WSF1102	05/05/88	2.00 - 2.00	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF11	WSF1105	05/05/88	4.50 - 4.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF12	WSF1201	05/05/88	0.50 - 0.50	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF12	WSF1202	05/05/88	2.00 - 2.00	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U
WSF12	WSF1205	05/05/88	4.00 - 4.00	ug/kg	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U

Volatile Organic Results

West Spray Field Test Pits

Test Pit Number	Field Sample Number	Date Sampled	Depth Increment (ft)	Units	Trichloro ethene	Dibromo chloro methane	1,1,2-Trichloro ethane	Benzene	cis-1,3-Dichloro propene	Bromoform	4-Methyl-2-pentanone	2-Hexanone	Tetrachloro ethene
WEST SPRAY FIELD TEST PITS													
WSF01	WSF0101	05/03/88	1.00 - 1.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	3 J
WSF01	WSF0102	05/03/88	2.50 - 2.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF01	WSF0104	05/03/88	4.50 - 4.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF02	WSF0201	05/03/88	0.90 - 0.90	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF02	WSF0202	05/03/88	2.20 - 2.20	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF02	WSF0204	05/03/88	4.40 - 4.40	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF03	WSF0301	05/03/88	0.90 - 0.90	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF03	WSF0302	05/03/88	2.20 - 2.20	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF03	WSF0305	05/03/88	4.70 - 4.70	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF04	WSF0401	05/03/88	0.90 - 0.90	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF04	WSF0402	05/03/88	2.50 - 2.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF04	WSF0404	05/03/88	4.10 - 4.10	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF05	WSF0501	05/03/88	0.75 - 0.75	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF05	WSF0502	05/03/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF05	WSF0504	05/03/88	4.20 - 4.20	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF06	WSF0601	05/04/88	0.70 - 0.70	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF06	WSF0602	05/04/88	2.10 - 2.10	ug/kg	21	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF06	WSF0604	05/04/88	4.60 - 4.60	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF07	WSF0701	05/04/88	0.50 - 0.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF07	WSF0702	05/04/88	2.00 - 2.00	ug/kg	3 J	5 U	5 U	5 U	5 U	5 U	10 U	10 U	2 J
WSF07	WSF0704	05/04/88	3.80 - 3.80	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF08	WSF0801	05/04/88	0.65 - 0.65	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF08	WSF0802	05/04/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF08	WSF0805	05/04/88	4.60 - 4.60	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF09	WSF0901	05/04/88	0.50 - 0.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF09	WSF0902	05/04/88	2.00 - 2.00	ug/kg	3 J	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF09	WSF0904	05/04/88	4.40 - 4.40	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF10	WSF1001	05/05/88	0.50 - 0.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF10	WSF1002	05/05/88	1.70 - 1.70	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF10	WSF1004	05/05/88	3.50 - 3.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF11	WSF1101	05/05/88	0.50 - 0.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF11	WSF1102	05/05/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF11	WSF1105	05/05/88	4.50 - 4.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF12	WSF1201	05/05/88	0.50 - 0.50	ug/kg	23	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF12	WSF1202	05/05/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U
WSF12	WSF1205	05/05/88	4.00 - 4.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U	10 U	10 U	5 U

Volatile Organic Results

West Spray Field Test Pits

Test Pit Number	Field Sample Number	Date Sampled	Depth Increment (ft)	Units	1,1,2,2-Tetrachloro ethane	Toluene	Chloro benzene	Ethyl benzene	Styrene	Total Xylenes
WEST SPRAY FIELD TEST PITS										
WSF01	WSF0101	05/03/88	1.00 - 1.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF01	WSF0102	05/03/88	2.50 - 2.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF01	WSF0104	05/03/88	4.50 - 4.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF02	WSF0201	05/03/88	0.90 - 0.90	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF02	WSF0202	05/03/88	2.20 - 2.20	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF02	WSF0204	05/03/88	4.40 - 4.40	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF03	WSF0301	05/03/88	0.90 - 0.90	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF03	WSF0302	05/03/88	2.20 - 2.20	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF03	WSF0305	05/03/88	4.70 - 4.70	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF04	WSF0401	05/03/88	0.90 - 0.90	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF04	WSF0402	05/03/88	2.50 - 2.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF04	WSF0404	05/03/88	4.10 - 4.10	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF05	WSF0501	05/03/88	0.75 - 0.75	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF05	WSF0502	05/03/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF05	WSF0504	05/03/88	4.20 - 4.20	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF06	WSF0601	05/04/88	0.70 - 0.70	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF06	WSF0602	05/04/88	2.10 - 2.10	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF06	WSF0604	05/04/88	4.60 - 4.60	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF07	WSF0701	05/04/88	0.50 - 0.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF07	WSF0702	05/04/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF07	WSF0704	05/04/88	3.80 - 3.80	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF08	WSF0801	05/04/88	0.65 - 0.65	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF08	WSF0802	05/04/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF08	WSF0805	05/04/88	4.60 - 4.60	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF09	WSF0901	05/04/88	0.50 - 0.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF09	WSF0902	05/04/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF09	WSF0904	05/04/88	4.40 - 4.40	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF10	WSF1001	05/05/88	0.50 - 0.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF10	WSF1002	05/05/88	1.70 - 1.70	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF10	WSF1004	05/05/88	3.50 - 3.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF11	WSF1101	05/05/88	0.50 - 0.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF11	WSF1102	05/05/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF11	WSF1105	05/05/88	4.50 - 4.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF12	WSF1201	05/05/88	0.50 - 0.50	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF12	WSF1202	05/05/88	2.00 - 2.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U
WSF12	WSF1205	05/05/88	4.00 - 4.00	ug/kg	5 U	5 U	5 U	5 U	5 U	5 U

RADIONUCLIDES

Radiochemistry Results

West Spray Field Test Pits

Test Pit Number	Field Sample Number	Date Sampled	Depth Increment (ft)	Gross Alpha	Gross Beta	Uranium 233, 234	Uranium 238	Plutonium 239, 240
WEST SPRAY FIELD TEST PITS								
WSF01	WSF0101	05/03/88	1.00 - 1.00	13 +/- 9 pci/g	21 +/- 12 pci/g	0.73 +/- 0.26 pci/g	0.65 +/- 0.15 pci/g	0.59 +/- 0.06 pci/g
WSF01	WSF0102	05/03/88	2.50 - 2.50	19 +/- 10 pci/g	15 +/- 11 pci/g	0.85 +/- 0.26 pci/g	0.84 +/- 0.15 pci/g	0.02 +/- 0.06 pci/g
WSF01	WSF0104	05/03/88	4.50 - 4.50	14 +/- 9 pci/g	36 +/- 13 pci/g	0.86 +/- 0.26 pci/g	0.84 +/- 0.15 pci/g	0.03 +/- 0.06 pci/g
WSF02	WSF0201	05/03/88	0.90 - 0.90	10 +/- 8 pci/g	19 +/- 12 pci/g	0.82 +/- 0.26 pci/g	0.79 +/- 0.15 pci/g	0.01 +/- 0.06 pci/g
WSF02	WSF0202	05/03/88	2.20 - 2.20	9 +/- 8 pci/g	24 +/- 12 pci/g	0.79 +/- 0.26 pci/g	0.84 +/- 0.15 pci/g	0.02 +/- 0.06 pci/g
WSF02	WSF0204	05/03/88	4.40 - 4.40	12 +/- 9 pci/g	27 +/- 12 pci/g	1.0 +/- 0.3 pci/g	1.0 +/- 0.2 pci/g	0.00 +/- 0.06 pci/g
WSF03	WSF0301	05/03/88	0.90 - 0.90	12 +/- 9 pci/g	19 +/- 12 pci/g	1.2 +/- 0.26 pci/g	1.2 +/- 0.15 pci/g	0.02 +/- 0.06 pci/g
WSF03	WSF0302	05/03/88	2.20 - 2.20	3 +/- 6 pci/g	30 +/- 12 pci/g	0.91 +/- 0.26 pci/g	0.85 +/- 0.15 pci/g	0.00 +/- 0.06 pci/g
WSF03	WSF0305	05/03/88	4.70 - 4.70	12 +/- 7 pci/g	22 +/- 12 pci/g	0.78 +/- 0.26 pci/g	0.85 +/- 0.15 pci/g	0.01 +/- 0.06 pci/g
WSF04	WSF0401	05/03/88	0.90 - 0.90	9 +/- 5 pci/g	14 +/- 11 pci/g	0.89 +/- 0.26 pci/g	0.85 +/- 0.15 pci/g	0.37 +/- 0.06 pci/g
WSF04	WSF0402	05/03/88	2.50 - 2.50	19 +/- 6 pci/g	24 +/- 12 pci/g	0.83 +/- 0.26 pci/g	0.70 +/- 0.15 pci/g	0.08 +/- 0.06 pci/g
WSF04	WSF0404	05/03/88	4.10 - 4.10	15 +/- 7 pci/g	31 +/- 12 pci/g	0.92 +/- 0.26 pci/g	0.90 +/- 0.15 pci/g	0.25 +/- 0.06 pci/g
WSF05	WSF0501	05/03/88	0.75 - 0.75	10 +/- 6 pci/g	11 +/- 11 pci/g	0.93 +/- 0.26 pci/g	0.92 +/- 0.15 pci/g	0.24 +/- 0.06 pci/g
WSF05	WSF0502	05/03/88	2.00 - 2.00	19 +/- 7 pci/g	29 +/- 12 pci/g	1.4 +/- 0.3 pci/g	1.3 +/- 0.2 pci/g	NR *
WSF05	WSF0504	05/03/88	4.20 - 4.20	39 +/- 10 pci/g	34 +/- 13 pci/g	1.2 +/- 0.3 pci/g	1.2 +/- 0.2 pci/g	0.01 +/- 0.06 pci/g
WSF06	WSF0601	05/04/88	0.70 - 0.70	16 +/- 7 pci/g	36 +/- 13 pci/g	0.83 +/- 0.26 pci/g	0.81 +/- 0.15 pci/g	0.00 +/- 0.06 pci/g
WSF06	WSF0602	05/04/88	2.10 - 2.10	14 +/- 6 pci/g	27 +/- 12 pci/g	0.72 +/- 0.26 pci/g	0.83 +/- 0.15 pci/g	0.00 +/- 0.06 pci/g
WSF06	WSF0604	05/04/88	4.60 - 4.60	12 +/- 5 pci/g	14 +/- 11 pci/g	0.76 +/- 0.26 pci/g	0.83 +/- 0.15 pci/g	0.00 +/- 0.06 pci/g
WSF07	WSF0701	05/04/88	0.50 - 0.50	7 +/- 10 pci/g	36 +/- 13 pci/g	1.1 +/- 0.3 pci/g	0.97 +/- 0.15 pci/g	0.03 +/- 0.06 pci/g
WSF07	WSF0702	05/04/88	2.00 - 2.00	9 +/- 10 pci/g	28 +/- 12 pci/g	1.2 +/- 0.3 pci/g	0.94 +/- 0.15 pci/g	0.05 +/- 0.06 pci/g
WSF07	WSF0704	05/04/88	3.80 - 3.80	15 +/- 8 pci/g	20 +/- 12 pci/g	0.83 +/- 0.26 pci/g	0.73 +/- 0.15 pci/g	0.08 +/- 0.06 pci/g
WSF08	WSF0801	05/04/88	0.65 - 0.65	15 +/- 11 pci/g	38 +/- 12 pci/g	0.96 +/- 0.26 pci/g	0.97 +/- 0.15 pci/g	0.50 +/- 0.06 pci/g
WSF08	WSF0802	05/04/88	2.00 - 2.00	16 +/- 10 pci/g	29 +/- 12 pci/g	1.3 +/- 0.3 pci/g	0.94 +/- 0.15 pci/g	0.00 +/- 0.06 pci/g
WSF08	WSF0805	05/04/88	4.60 - 4.60	21 +/- 12 pci/g	23 +/- 11 pci/g	0.92 +/- 0.26 pci/g	0.98 +/- 0.15 pci/g	0.03 +/- 0.06 pci/g
WSF09	WSF0901	05/04/88	0.50 - 0.50	12 +/- 11 pci/g	27 +/- 12 pci/g	0.83 +/- 0.26 pci/g	0.67 +/- 0.15 pci/g	0.02 +/- 0.06 pci/g
WSF09	WSF0902	05/04/88	2.00 - 2.00	14 +/- 12 pci/g	24 +/- 13 pci/g	1.6 +/- 0.3 pci/g	1.4 +/- 0.2 pci/g	0.03 +/- 0.06 pci/g
WSF09	WSF0904	05/04/88	4.40 - 4.40	14 +/- 12 pci/g	25 +/- 12 pci/g	0.83 +/- 0.26 pci/g	0.67 +/- 0.15 pci/g	0.02 +/- 0.06 pci/g
WSF10	WSF1001	05/05/88	0.50 - 0.50	3 +/- 6 pci/g	16 +/- 12 pci/g	0.83 +/- 0.26 pci/g	0.82 +/- 0.15 pci/g	0.00 +/- 0.06 pci/g
WSF10	WSF1002	05/05/88	1.70 - 1.70	6 +/- 7 pci/g	19 +/- 13 pci/g	1.3 +/- 0.3 pci/g	1.3 +/- 0.2 pci/g	0.02 +/- 0.06 pci/g
WSF10	WSF1004	05/05/88	3.50 - 3.50	4 +/- 7 pci/g	20 +/- 12 pci/g	1.1 +/- 0.3 pci/g	0.96 +/- 0.15 pci/g	0.00 +/- 0.06 pci/g
WSF11	WSF1101	05/05/88	0.50 - 0.50	3 +/- 7 pci/g	16 +/- 12 pci/g	0.73 +/- 0.26 pci/g	0.92 +/- 0.15 pci/g	0.02 +/- 0.06 pci/g
WSF11	WSF1102	05/05/88	2.00 - 2.00	4 +/- 7 pci/g	NR	0.95 +/- 0.26 pci/g	0.82 +/- 0.15 pci/g	0.00 +/- 0.06 pci/g
WSF11	WSF1105	05/05/88	4.50 - 4.50	7 +/- 8 pci/g	19 +/- 11 pci/g	0.59 +/- 0.26 pci/g	0.71 +/- 0.15 pci/g	0.00 +/- 0.06 pci/g
WSF12	WSF1201	05/05/88	0.50 - 0.50	30 +/- 12 pci/g	29 +/- 13 pci/g	1.3 +/- 0.3 pci/g	1.4 +/- 0.2 pci/g	0.03 +/- 0.06 pci/g
WSF12	WSF1202	05/05/88	2.00 - 2.00	5 +/- 7 pci/g	29 +/- 13 pci/g	1.1 +/- 0.3 pci/g	1.1 +/- 0.2 pci/g	0.06 +/- 0.06 pci/g
WSF12	WSF1205	05/05/88	4.00 - 4.00	7 +/- 7 pci/g	22 +/- 12 pci/g	1.0 +/- 0.3 pci/g	0.94 +/- 0.2 pci/g	0.01 +/- 0.06 pci/g

* Insufficient Chemical Recovery

INORGANICS

Inorganic Results

West Spray Field Test Pits

Test Pit Number	Field Sample Number	Date Sampled	Depth Increment (ft)	Total Organic Carbon		Nitrate-Nitrite-Nitrogen		% Solids	
WEST SPRAY FIELD TEST PITS									
WSF01	WSF0101	05/03/88	1.00 - 1.00	900	mg/kg	20 U	mg/kg	84.5	%
WSF01	WSF0102	05/03/88	2.50 - 2.50	500	mg/kg	20 U	mg/kg	87.1	%
WSF01	WSF0104	05/03/88	4.50 - 4.50	800	mg/kg	30	mg/kg	89.2	%
WSF02	WSF0201	05/03/88	0.90 - 0.90	1400	mg/kg	20 U	mg/kg	83.1	%
WSF02	WSF0202	05/03/88	2.20 - 2.20	1400	mg/kg	20 U	mg/kg	89.6	%
WSF02	WSF0204	05/03/88	4.40 - 4.40	900	mg/kg	30	mg/kg	86.5	%
WSF03	WSF0301	05/03/88	0.90 - 0.90	700	mg/kg	20 U	mg/kg	79.7	%
WSF03	WSF0302	05/03/88	2.20 - 2.20	1000	mg/kg	20 U	mg/kg	78.7	%
WSF03	WSF0305	05/03/88	4.70 - 4.70	300	mg/kg	20 U	mg/kg	86.6	%
WSF04	WSF0401	05/03/88	0.90 - 0.90	400	mg/kg	20 U	mg/kg	81.9	%
WSF04	WSF0402	05/03/88	2.50 - 2.50	600	mg/kg	60	mg/kg	85.9	%
WSF04	WSF0404	05/03/88	4.10 - 4.10	400	mg/kg	60	mg/kg	84.2	%
WSF05	WSF0501	05/03/88	0.75 - 0.75	600	mg/kg	60	mg/kg	81.4	%
WSF05	WSF0502	05/03/88	2.00 - 2.00	500	mg/kg	40	mg/kg	82.6	%
WSF05	WSF0504	05/03/88	4.20 - 4.20	300	mg/kg	60	mg/kg	85.7	%
WSF06	WSF0601	05/04/88	0.70 - 0.70	500	mg/kg	20 U	mg/kg	84.1	%
WSF06	WSF0602	05/04/88	2.10 - 2.10	1400	mg/kg	20 U	mg/kg	85.5	%
WSF06	WSF0604	05/04/88	4.60 - 4.60	500	mg/kg	20 U	mg/kg	87.2	%
WSF07	WSF0701	05/04/88	0.50 - 0.50	100	mg/kg	20 U	mg/kg	70.0	%
WSF07	WSF0702	05/04/88	2.00 - 2.00	100	mg/kg	150	mg/kg	84.0	%
WSF07	WSF0704	05/04/88	3.80 - 3.80	1400	mg/kg	140	mg/kg	81.7	%
WSF08	WSF0801	05/04/88	0.65 - 0.65	100	mg/kg	20 U	mg/kg	77.1	%
WSF08	WSF0802	05/04/88	2.00 - 2.00	400	mg/kg	20 U	mg/kg	82.9	%
WSF08	WSF0805	05/04/88	4.60 - 4.60	200	mg/kg	20 U	mg/kg	88.1	%
WSF09	WSF0901	05/04/88	0.50 - 0.50	400	mg/kg	20 U	mg/kg	71.7	%
WSF09	WSF0902	05/04/88	2.00 - 2.00	600	mg/kg	20 U	mg/kg	74.8	%
WSF09	WSF0904	05/04/88	4.40 - 4.40	200	mg/kg	20 U	mg/kg	80.5	%
WSF10	WSF1001	05/05/88	0.50 - 0.50	900	mg/kg	20 U	mg/kg	72.4	%
WSF10	WSF1002	05/05/88	1.70 - 1.70	1100	mg/kg	110*	mg/kg	75.2	%
WSF10	WSF1004	05/05/88	3.50 - 3.50	600	mg/kg	20 U	mg/kg	82.8	%
WSF11	WSF1101	05/05/88	0.50 - 0.50	300	mg/kg	20 U	mg/kg	79.2	%
WSF11	WSF1102	05/05/88	2.00 - 2.00	1800	mg/kg	30	mg/kg	84.5	%
WSF11	WSF1105	05/05/88	4.50 - 4.50	700	mg/kg	80	mg/kg	87.8	%
WSF12	WSF1201	05/05/88	0.50 - 0.50	1600	mg/kg	20 U	mg/kg	79.8	%
WSF12	WSF1202	05/05/88	2.00 - 2.00	1600	mg/kg	20 U	mg/kg	89.8	%
WSF12	WSF1205	05/05/88	4.00 - 4.00	300	mg/kg	420*	mg/kg	87.1	%

* Sample to be reanalyzed

METALS

Metals Results

West Spray Field Test Pits

Test Pit Number	Field Sample Number	Date Sampled	Depth Increment (ft)	Units	Mercury (Hg), total	Lead (Pb), total
WEST SPRAY FIELD TEST PITS						
WSF01	WSF0101	05/03/88	1.00 - 1.00	mg/kg	0.10 U	9.1
WSF01	WSF0102	05/03/88	2.50 - 2.50	mg/kg	0.46	13
WSF01	WSF0104	05/03/88	4.50 - 4.50	mg/kg	0.10 U	9.4
WSF02	WSF0201	05/03/88	0.90 - 0.90	mg/kg	0.18 J	9.7
WSF02	WSF0202	05/03/88	2.20 - 2.20	mg/kg	0.13 J	9.4
WSF02	WSF0204	05/03/88	4.40 - 4.40	mg/kg	0.17 J	15
WSF03	WSF0301	05/03/88	0.90 - 0.90	mg/kg	0.10 U	14
WSF03	WSF0302	05/03/88	2.20 - 2.20	mg/kg	0.24	13
WSF03	WSF0305	05/03/88	4.70 - 4.70	mg/kg	0.15 J	14
WSF04	WSF0401	05/03/88	0.90 - 0.90	mg/kg	0.10 U	11
WSF04	WSF0402	05/03/88	2.50 - 2.50	mg/kg	0.10 U	10
WSF04	WSF0404	05/03/88	4.10 - 4.10	mg/kg	0.12 J	13
WSF05	WSF0501	05/03/88	0.75 - 0.75	mg/kg	0.10 U	17
WSF05	WSF0502	05/03/88	2.00 - 2.00	mg/kg	0.12 J	24
WSF05	WSF0504	05/03/88	4.20 - 4.20	mg/kg	0.10 U	15
WSF06	WSF0601	05/04/88	0.70 - 0.70	mg/kg	0.10 U	13
WSF06	WSF0602	05/04/88	2.10 - 2.10	mg/kg	0.21	13
WSF06	WSF0604	05/04/88	4.60 - 4.60	mg/kg	0.34	17
WSF07	WSF0701	05/04/88	0.50 - 0.50	mg/kg	0.10 U	20
WSF07	WSF0702	05/04/88	2.00 - 2.00	mg/kg	0.17 J	10
WSF07	WSF0704	05/04/88	3.80 - 3.80	mg/kg	0.14 J	12
WSF08	WSF0801	05/04/88	0.65 - 0.65	mg/kg	0.10 U	26
WSF08	WSF0802	05/04/88	2.00 - 2.00	mg/kg	NR	11
WSF08	WSF0805	05/04/88	4.60 - 4.60	mg/kg	0.15 J	9.3
WSF09	WSF0901	05/04/88	0.50 - 0.50	mg/kg	0.10 U	14
WSF09	WSF0902	05/04/88	2.00 - 2.00	mg/kg	0.20	17
WSF09	WSF0904	05/04/88	4.40 - 4.40	mg/kg	0.10 U	8.5
WSF10	WSF1001	05/05/88	0.50 - 0.50	mg/kg	0.10 U	19
WSF10	WSF1002	05/05/88	1.70 - 1.70	mg/kg	NR	15
WSF10	WSF1004	05/05/88	3.50 - 3.50	mg/kg	0.34	15
WSF11	WSF1101	05/05/88	0.50 - 0.50	mg/kg	0.10 U	20
WSF11	WSF1102	05/05/88	2.00 - 2.00	mg/kg	0.23	11
WSF11	WSF1105	05/05/88	4.50 - 4.50	mg/kg	0.10 U	10
WSF12	WSF1201	05/05/88	0.50 - 0.50	mg/kg	0.10 U	21
WSF12	WSF1202	05/05/88	2.00 - 2.00	mg/kg	0.100	8.3
WSF12	WSF1205	05/05/88	4.00 - 4.00	mg/kg	0.10 U	7.3

[illegible] not detected J - Present below detection limit B - Present in laboratory blank

APPENDIX D-2

GROUND-WATER ANALYTICAL DATA
ALLUVIAL WELLS

VOLATILE ORGANICS

Groundwater Volatile Organic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Chloro methane	Bromo methane	Vinyl Chloride	Chloro ethane	Methylene Chloride	Acetone	Carbon Disulfide	1,1-Dichloro ethene	1,1-Dichloro ethane	Trans 1,2-Dichloro ethene
West Spray Field Alluvial Wells														
1081	10-81-08-21-87	08/21/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
1081	10-81-05-11-87	05/11/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
1081	10-81-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
1081	G108108860	08/08/86		ug/l	10 U	10 U	10 U	10 U	5 U	3 B	5 U	5 U	5 U	5 U
1081	10-81-01-12-88	01/12/88	4	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
1081	10-81D-08-21-87	08/21/87	3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1081	10-81D-01-12-88	01/12/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1081	10-81-02-04-88	02/04/88	1	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
5186	51-86-08-20-87	08/20/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
5186	51-86-05-13-87	05/13/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5186	51-86-06-17-87	06/17/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5186	G518611860	11/07/86		ug/l	10 U	10 U	10 U	10 U	83	90 B	5 U	5 U	5 U	5 U
5186	51-86-12-10-87	12/10/87	4	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
5186	51-86-02-08-88	02/08/88	1	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
5086	G508610860	10/31/86		ug/l	10 U	10 U	10 U	10 U	5 U	8 JB	5 U	5 U	5 U	5 U
5086	G508610862	10/31/86		ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
5086	50-86-05-11-87	05/11/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5086	50-86-06-16-87	06/16/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5086	50-86-08-14-87	08/14/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
5086	50-86-12-10-87	12/10/87	4	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
4986	G498611860	11/24/86		ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
4986	49-86-04-08-87	04/08/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4986	49-86-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4986	49-86-08-25-87	08/25/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
4986	49-86-12-14-87	12/14/87	4	ug/l	10 U	10 U	10 U	10 U	8	10 U	5 U	5 U	5 U	5 U
4786	G478611860	11/07/86		ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
4786	G478611862	11/07/86		ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
4786	47-86-05-13-87	05/13/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4786	47-86-06-22-87	06/22/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4786	47-86-08-14-87	08/14/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
4786	47-86-10-05-87	10/05/87		ug/l	10 U	10 U	10 U	10 U	5 U	3 JB	5 U	5 U	5 U	5 U
4786	47-86-10-05-87	10/05/87	4	ppb	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
4786	47-86-02-08-88	02/08/88	1	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
4586	G458610860	10/16/86		ug/l	10 U	10 U	10 U	10 U	5 U	15 B	5 U	5 U	5 U	5 U
4586	G458610862	10/16/86		ug/l	10 U	10 U	10 U	10 U	5 U	3 BJ	5 U	5 U	5 U	5 U
4586	45-86-05-15-87	05/14/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4586	45-86-06-12-87	06/12/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4586	45-86-08-14-87	08/14/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
4586	45-86-09-30-87	09/30/87		ug/l	10 U	10 U	10 U	10 U	5 U	1 JB	5 U	5 U	5 U	5 U
4586	45-86-10-01-87	10/01/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4586	45-86-09-30-87	09/30/87	4	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
5686	G568610860	10/02/86		ug/l	10 U	10 U	10 U	10 U	5 B	10 U	5 U	5 U	5 U	5 U
5686	56-86-05-19-87	05/19/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5686	56-86-05-27-87	05/27/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

Groundwater Volatile Organic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Chloroform	1,2-Dichloro ethane	2 Butanone	1,1,1-Trichloro ethane	Carbon Tetra chloride	Vinyl Acetate	Bromo dichloro methane	1,2-Dichloro propane	Trans-1,3-Dichloro propene	Trichloro ethene
West Spray Field Alluvial Wells														
1081	10-81-08-21-87	08/21/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
1081	10-81-05-11-87	05/11/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
1081	10-81-06-18-87	06/18/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
1081	G1081088 60	08/08/86		ug/l	5 U	5 U	6 B	5 U	5 U	10 U	5 U	5 U	5 U	5 U
1081	10-81-01-12-88	01/12/88	4	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
1081	10-81D-08-21-87	08/21/87	3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1081	10-81D-01-12-88	01/12/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1081	10-81-02-04-88	02/04/88	1	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5186	51-86-08-20-87	08/20/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
5186	51-86-05-13-87	05/13/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5186	51-86-06-17-87	06/17/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5186	G5186118 60	11/07/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5186	51-86-12-10-87	12/10/87	4	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5186	51-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5086	G5086108 60	10/31/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5086	G5086108 62	10/31/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5086	50-86-05-11-87	05/11/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5086	50-86-06-16-87	06/16/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5086	50-86-08-14-87	08/14/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
5086	50-86-12-10-87	12/10/87	4	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4986	G4986118 60	11/24/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4986	49-86-04-08-87	04/08/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4986	49-86-06-18-87	06/18/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4986	49-86-08-25-87	08/25/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
4986	49-86-12-14-87	12/14/87	4	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4786	G4786118 60	11/07/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4786	G4786118 62	11/07/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4786	47-86-05-13-87	05/13/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4786	47-86-06-22-87	06/22/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4786	47-86-08-14-87	08/14/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
4786	47-86-10-05-87	10/05/87		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4786	47-86-10-05-87	10/05/87	4	ppb	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
4786	47-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4586	G4586108 60	10/16/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4586	G4586108 62	10/16/86		ug/l	5 U	5 U	6 J	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4586	45-86-05-15-87	05/14/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4586	45-86-06-12-87	06/12/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4586	45-86-08-14-87	08/14/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
4586	45-86-09-30-87	09/30/87		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4586	45-86-10-01-87	10/01/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4586	45-86-09-30-87	09/30/87	4	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
5686	G5686108 60	10/02/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5686	56-86-05-19-87	05/19/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5686	56-86-05-27-87	05/27/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U

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Groundwater Volatile Organic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Dibromo chloro methane	1,1,2-Trichloro ethane	Benzene	cis-1,3-Dichloro propene	2-Chloro ethylvinyl ether	Bromoform	4-Methyl-2-pentanone	2-Hexanone	Tetrachloro ethene	1,1,2,2-Tetrachloro ethane
West Spray Field Alluvial Wells														
1081	10-81-08-21-87	08/21/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
1081	10-81-05-11-87	05/11/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
1081	10-81-06-18-87	06/18/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
1081	G108108860	08/08/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
1081	10-81-01-12-88	01/12/88	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
1081	10-81D-08-21-87	08/21/87	3		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1081	10-81D-01-12-88	01/12/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1081	10-81-02-04-88	02/04/88	1	ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
5186	51-86-08-20-87	08/20/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
5186	51-86-05-13-87	05/13/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5186	51-86-06-17-87	06/17/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5186	G518611860	11/07/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
5186	51-86-12-10-87	12/10/87	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
5186	51-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
5086	G508610860	10/31/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
5086	G508610862	10/31/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
5086	50-86-05-11-87	05/11/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5086	50-86-06-16-87	06/16/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5086	50-86-08-14-87	08/14/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
5086	50-86-12-10-87	12/10/87	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
4986	G498611860	11/24/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4986	49-86-04-08-87	04/08/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4986	49-86-06-18-87	06/18/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4986	49-86-08-25-87	08/25/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
4986	49-86-12-14-87	12/14/87	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
4786	G478611860	11/07/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4786	G478611862	11/07/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4786	47-86-05-13-87	05/13/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4786	47-86-06-22-87	06/22/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4786	47-86-08-14-87	08/14/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
4786	47-86-10-05-87	10/05/87		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4786	47-86-10-05-87	10/05/87	4	ppb	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
4786	47-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4586	G458610860	10/16/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4586	G458610862	10/16/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4586	45-86-05-15-87	05/14/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4586	45-86-06-12-87	06/12/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4586	45-86-08-14-87	08/14/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
4586	45-86-09-30-87	09/30/87		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4586	45-86-10-01-87	10/01/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4586	45-86-09-30-87	09/30/87	4	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
5686	G568610860	10/02/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
5686	56-86-05-19-87	05/19/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5686	56-86-05-27-87	05/27/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR

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Groundwater Volatile Organic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Toluene	Chloro benzene	Ethyl benzene	Styrene	Total Xylenes
West Spray Field Alluvial Wells									
1081	10-81-08-21-87	08/21/87	3	ug/l	NR	NR	NR	NR	NR
1081	10-81-05-11-87	05/11/87	1	ug/l	NR	NR	NR	NR	NR
1081	10-81-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR
1081	G10B108860	08/08/86		ug/l	5 U	5 U	5 U	5 U	5 U
1081	10-81-01-12-88	01/12/88	4	ug/l	5 U	5 U	5 U	5 U	5 U
1081	10-81D-08-21-87	08/21/87	3		NA	NA	NA	NA	NA
1081	10-81D-01-12-88	01/12/88	4		NA	NA	NA	NA	NA
1081	10-81-02-04-88	02/04/88	1	ug/l	5 U	5 U	5 U	5 U	5 U
5186	51-86-08-20-87	08/20/87	3	ug/l	NR	NR	NR	NR	NR
5186	51-86-05-13-87	05/13/87	1	ug/l	NR	NR	NR	NR	NR
5186	51-86-06-17-87	06/17/87	2	ug/l	NR	NR	NR	NR	NR
5186	G518611860	11/07/86		ug/l	2 J	5 U	5 U	5 U	5 U
5186	51-86-12-10-87	12/10/87	4	ug/l	5 U	5 U	5 U	5 U	5 U
5186	51-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	5 U	5 U	5 U
5086	G508610860	10/31/86		ug/l	5 U	5 U	5 U	5 U	5 U
5086	G508610862	10/31/86		ug/l	5 U	5 U	5 U	5 U	5 U
5086	50-86-05-11-87	05/11/87	1	ug/l	NR	NR	NR	NR	NR
5086	50-86-06-16-87	06/16/87	2	ug/l	NR	NR	NR	NR	NR
5086	50-86-08-14-87	08/14/87	3	ug/l	NR	NR	NR	NR	NR
5086	50-86-12-10-87	12/10/87	4	ug/l	5 U	5 U	5 U	5 U	5 U
4986	G498611860	11/24/86		ug/l	5 U	5 U	5 U	5 U	5 U
4986	49-86-04-08-87	04/08/87	1	ug/l	NR	NR	NR	NR	NR
4986	49-86-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR
4986	49-86-08-25-87	08/25/87	3	ug/l	NR	NR	NR	NR	NR
4986	49-86-12-14-87	12/14/87	4	ug/l	5 U	5 U	5 U	5 U	5 U
4786	G478611860	11/07/86		ug/l	5 U	5 U	5 U	5 U	5 U
4786	G478611862	11/07/86		ug/l	3 J	5 U	5 U	5 U	5 U
4786	47-86-05-13-87	05/13/87	1	ug/l	NR	NR	NR	NR	NR
4786	47-86-06-22-87	06/22/87	2	ug/l	NR	NR	NR	NR	NR
4786	47-86-08-14-87	08/14/87	3	ug/l	NR	NR	NR	NR	NR
4786	47-86-10-05-87	10/05/87		ug/l	5 U	5 U	5 U	5 U	5 U
4786	47-86-10-05-87	10/05/87	4	ppb	NR	NR	NR	NR	NR
4786	47-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	5 U	5 U	5 U
4586	G458610860	10/16/86		ug/l	5 U	5 U	5 U	1 J	5 U
4586	G458610862	10/16/86		ug/l	5 U	5 U	5 U	2 J	5 U
4586	45-86-05-15-87	05/14/87	1	ug/l	NR	NR	NR	NR	NR
4586	45-86-06-12-87	06/12/87	2	ug/l	NR	NR	NR	NR	NR
4586	45-86-08-14-87	08/14/87	3	ug/l	NR	NR	NR	NR	NR
4586	45-86-09-30-87	09/30/87		ug/l	5 U	5 U	5 U	5 U	5 U
4586	45-86-10-01-87	10/01/87	4		NA	NA	NA	NA	NA
4586	45-86-09-30-87	09/30/87	4	ug/l	NR	NR	NR	NR	NR
5686	G568610860	10/02/86		ug/l	5 U	5 U	5 U	5 U	5 U
5686	56-86-05-19-87	05/19/87	1	ug/l	NR	NR	NR	NR	NR
5686	56-86-05-27-87	05/27/87	2	ug/l	NR	NR	NR	NR	NR

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Groundwater Volatile Organic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Chloro methane	Bromo methane	Vinyl Chloride	Chloro ethane	Methylene Chloride	Acetone	Carbon Disulfide	1,1-Dichloro ethene	1,1-Dichloro ethane	Trans-1,2 Dichloro ethene
West Spray Field Alluvial Wells														
5686	56-86-07-15-87	07/15/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5686	56-86-09-30-87	09/30/87		ug/l	10 U	10 U	10 U	10 U	1 J	8 JB	5 U	5 U	5 U	5 U
5686	56-86-10-01-87	10/01/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5686	56-86-09-30-87	09/30/87	4	ppb	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
5686	56-86-02-15-88	02/15/88	4	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
0881	8-81-08-18-87	08/18/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
0881	8-81-05-14-87	05/14/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
0881	8-81-06-23-87	06/23/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
0881	G088108860	08/18/86		ug/l	10 U	10 U	10 U	10 U	62	10 U	5 U	5 U	5 U	5 U
0881	8-81-01-14-88	01/14/88	4	ug/l	10 U	10 U	10 U	10 U	9	10 U	5 U	5 U	5 U	5 U
0881	8-81-01-14-88	01/14/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0981	9-81-08-18-87	08/18/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
0981	9-81-05-19-87	05/19/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
0981	9-81-06-23-87	06/23/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
0981	G098108860	08/14/86		ug/l	10 U	10 U	10 U	10 U	23	6 B	5 U	5 U	5 U	5 U
0981	9-81-01-13-88	01/13/88	4	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
[illegible]	[illegible]	09/17/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
[illegible]	[illegible]	05/13/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
[illegible]	[illegible]	06/18/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
[illegible]	[illegible]	08/13/86		ug/l	10 U	10 U	10 U	10 U	3 J	20 B	5 U	5 U	5 U	5 U
0682	6-82-01-07-88	01/07/88	4	ug/l	10 U	10 U	10 U	10 U	6	3 J	5 U	5 U	5 U	5 U
0682	6-82-08-18-87	08/18/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
0682	6-82-05-12-87	05/12/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
0682	6-82-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
0682	G068208860	08/18/86		ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
0682	6-82-01-07-88	01/07/88	4	ug/l	10 U	10 U	10 U	10 U	7	4 J	5 U	5 U	5 U	5 U
0782	DRY	12/05/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	DRY	08/20/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
0782	07-82-02-04-88	02/04/88	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
5186	51-86-05-13-87	05/13/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5186	51-86-06-17-87	06/17/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5186	G518611860	11/07/86		ug/l	10 U	10 U	10 U	10 U	83	90 B	5 U	5 U	5 U	5 U
5186	51-86-12-10-87	12/10/87	4	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U
5186	51-86-02-08-88	02/08/88	1	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U

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Groundwater Volatile Organic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Chloroform	1,2-Dichloro ethane	2-Butanone	1,1,1-Trichloro ethane	Carbon Tetra chloride	Vinyl Acetate	Bromo dichloro methane	1,2-Dichloro propane	Trans-1,3-Dichloro propene	Trichloro ethene
West Spray Field Alluvial Wells														
5686	56-86-07-15-87	07/15/87	3	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5686	56-86-09-30-87	09/30/87		ug/l	5 U	5 U	8 J	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5686	56-86-10-01-87	10/01/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5686	56-86-09-30-87	09/30/87	4	ppb	5 U	NR	NR	5 U	5 U	NR	NR	NR	NR	5 U
5686	56-86-02-15-88	02/15/88	4	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
0881	8-81-08-18-87	08/18/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
0881	8-81-05-14-87	05/14/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
0881	8-81-06-23-87	06/23/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
0881	G088108860	08/18/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
0881	8-81-01-14-88	01/14/88	4	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
0881	8-81-01-14-88	01/14/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0981	9-81-08-18-87	08/18/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
0981	9-81-05-19-87	05/19/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
0981	9-81-06-23-87	06/23/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
0981	G098108860	08/14/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
0981	9-81-01-13-88	01/13/88	4	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
0582	5-82-09-17-87	09/17/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
0582	5-82-05-13-87	05/13/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
0582	5-82-06-18-87	06/18/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
0582	G058208860	08/13/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
0582	5-82-01-07-88	01/07/88	4	ug/l	5 U	5 U	10 U	5 U	8	10 U	5 U	5 U	5 U	5 U
0682	6-82-08-18-87	08/18/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
0682	6-82-05-12-87	05/12/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
0682	6-82-06-18-87	06/18/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
0682	G068208860	08/18/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
0682	6-82-01-07-88	01/07/88	4	ug/l	5 U	5 U	10 U	5 U	8	10 U	5 U	5 U	5 U	5 U
0782	DRY	12/05/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	DRY	08/20/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
0782	07-82-02-04-88	02/04/88	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
5186	51-86-05-13-87	05/13/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5186	51-86-06-17-87	06/17/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5186	G518611860	11/07/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5186	51-86-12-10-87	12/10/87	4	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5186	51-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U

Notes: NR = Analyte not reported
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Groundwater Volatile Organic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Dibromo chloro methane	1,1,2-Trichloro ethane	Benzene	cis-1,3-Dichloro propene	2-Chloro ethylvinyl ether	Bromoform	4-Methyl-2-pentanone	2-Hexanone	Tetrachloro ethene	1,1,2,2-Tetrachloro ethane
West Spray Field Alluvial Wells														
5686	56-86-07-15-87	07/15/87	3	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5686	56-86-09-30-87	09/30/87		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
5686	56-86-10-01-87	10/01/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5686	56-86-09-30-87	09/30/87	4	ppb	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
5686	56-86-02-15-88	02/15/88	4	ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
0881	8-81-08-18-87	08/18/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
0881	8-81-05-14-87	05/14/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
0881	8-81-06-23-87	06/23/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
0881	G088108860	08/18/86		ug/l	5 U	5 U	2 J	5 U	10 U	5 U	10 U	10 U	5 U	5 U
0881	8-81-01-14-88	01/14/88	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
0881	8-81-01-14-88	01/14/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0981	9-81-08-18-87	08/18/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
0981	9-81-05-19-87	05/19/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
0981	9-81-06-23-87	06/23/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
0981	G098108860	08/14/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	2 J	5 U	5 U
0981	9-81-01-13-88	01/13/88	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
0582	5-82-09-17-87	09/17/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
0582	5-82-05-13-87	05/13/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
0582	5-82-06-18-87	06/18/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
0582	G058208860	08/13/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
0582	5-82-01-07-88	01/07/88	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
0682	6-82-08-18-87	08/18/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
0682	6-82-05-12-87	05/12/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
0682	6-82-06-18-87	06/18/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
0682	G068208860	08/18/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
0682	6-82-01-07-88	01/07/88	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
0782	DRY	12/05/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	DRY	08/20/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
0782	07-82-02-04-88	02/04/88	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
5186	51-86-05-13-87	05/13/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5186	51-86-06-17-87	06/17/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5186	G518611860	11/07/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
5186	51-86-12-10-87	12/10/87	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
5186	51-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U

Notes: NR = Analyte not reported
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Groundwater Volatile Organic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Toluene	Chloro benzene	Ethyl benzene	Styrene	Total Xylenes
West Spray Field Alluvial Wells									
5686	56-86-07-15-87	07/15/87	3	ug/l	NR	NR	NR	NR	NR
5686	56-86-09-30-87	09/30/87		ug/l	5 U	5 U	5 U	5 U	5 U
5686	56-86-10-01-87	10/01/87			NA	NA	NA	NA	NA
5686	56-86-09-30-87	09/30/87	4	ppb	NR	NR	NR	NR	NR
5686	56-86-02-15-88	02/15/88	4	ug/l	5 U	5 U	5 U	5 U	5 U
0881	8-81-08-18-87	08/18/87	3	ug/l	NR	NR	NR	NR	NR
0881	8-81-05-14-87	05/14/87	1	ug/l	NR	NR	NR	NR	NR
0881	8-81-06-23-87	06/23/87	2	ug/l	NR	NR	NR	NR	NR
0881	G088108860	08/18/86		ug/l	5 U	5 U	5 U	5 U	5 U
0881	8-81-01-14-88	01/14/88	4	ug/l	5 U	5 U	5 U	5 U	5 U
0881	8-81-01-14-88	01/14/88	4		NA	NA	NA	NA	NA
0981	9-81-08-18-87	08/18/87	3	ug/l	NR	NR	NR	NR	NR
0981	9-81-05-19-87	05/19/87	1	ug/l	NR	NR	NR	NR	NR
0981	9-81-06-23-87	06/23/87	2	ug/l	NR	NR	NR	NR	NR
0981	G098108860	08/14/86		ug/l	5 U	5 U	5 U	5 U	5 U
0981	9-81-01-13-88	01/13/88	4	ug/l	5 U	5 U	5 U	5 U	5 U
0582	5-82-09-17-87	09/17/87	3	ug/l	NR	NR	NR	NR	NR
0582	5-82-05-13-87	05/13/87	1	ug/l	NR	NR	NR	NR	NR
0582	5-82-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR
0582	G058208860	08/13/86		ug/l	5 U	5 U	5 U	5 U	5 U
0582	5-82-01-07-88	01/07/88	4	ug/l	5 U	5 U	5 U	5 U	5 U
0682	6-82-08-18-87	08/18/87	3	ug/l	NR	NR	NR	NR	NR
0682	6-82-05-12-87	05/12/87	1	ug/l	NR	NR	NR	NR	NR
0682	6-82-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR
0682	G068208860	08/18/86		ug/l	5 U	5 U	5 U	5 U	5 U
0682	6-82-01-07-88	01/07/88	4	ug/l	5 U	5 U	5 U	5 U	5 U
0782	DRY	12/05/87	4		NA	NA	NA	NA	NA
0782	DRY	08/20/87			NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1	ug/l	NR	NR	NR	NR	NR
0782	07-82-02-04-88	02/04/88	1		NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	ug/l	NR	NR	NR	NR	NR
5186	51-86-05-13-87	05/13/87	1	ug/l	NR	NR	NR	NR	NR
5186	51-86-06-17-87	06/17/87	2	ug/l	NR	NR	NR	NR	NR
5186	G518611860	11/07/86		ug/l	2 J	5 U	5 U	5 U	5 U
5186	51-86-12-10-87	12/10/87	4	ug/l	5 U	5 U	5 U	5 U	5 U
5186	51-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	5 U	5 U	5 U

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RADIONUCLIDES

Groundwater Radiochemistry Results WEST SPRAY FIELDS

ALLUVIAL Wells for Regulated Units at Rocky Flats Plant

Well Number	Field Sample Number	Date Sampled	Qtr.	Gross Alpha	Gross Beta	Uranium 233, 234	Uranium 235	Uranium 238	Strontium 89, 90	Plutonium 239, 240
West Spray Field Alluvial Wells										
1081	10-81-08-21-87	08/21/87	3	7 +/- 17 pci/l	29 +/- 45 pci/l	0.0 +/- 1.0 pci/l	0.4 +/- 0.4 pci/l	-0.3 +/- 0.6 pci/l	<1.0 pci/l	-.32 +/- .46 pci/l
1081	10-81-05-11-87	05/11/87	1	15 +/- 11 pc/l	-9 +/- 0 pc/l	.04 +/- .56 pc/l	0.0 +/- .30 pc/l	.12 +/- .40 pc/l	0.8 pc/l	.10 +/- .70 pc/l
1081	10-81-06-18-87	06/18/87	2	5 +/- 15 pci/l	5 +/- 28 pci/l	0.0 +/- 0.57 pci/l	0.0 +/- 0.3 pci/l	0.17 +/- 0.42 pci/l	<1.0 pci/l	0.32 +/- 0.77 pci/l
1081	G108108860	08/08/86		22 +/- 7 pci/l	22 +/- 3 pci/l	0.96 +/- 0.24 pci/l	NR	0.59 +/- 0.19 pci/l	NR	0.03 +/- 0.06 pci/l
1081	10-81-01-12-88	01/12/88	4	3 +/- 4 pci/l	1 +/- 9 pci/l	.05 +/- .10 pci/l	0.00 +/- .02 pci/l	.20 +/- .12 pci/l	<1.0 pci/l	0.00 +/- .14 pci/l
1081	10-81D-08-21-87	08/21/87	3	8 +/- 19 pci/l	39 +/- 43 pci/l	-0.4 +/- 1.7 pci/l	3.2 +/- 1.9 pci/l	-1.1 +/- 2.3 pci/l	1.3 pci/l	-.04 +/- .50 pci/l
1081	10-81D-01-12-88	01/12/88	4	NA	NA	NA	NA	NA	NA	NA
1081	10-81-02-04-88	02/04/88	1	-2 +/- 4 pci/l	-9 +/- 11 pci/l	0.02 +/- 0.08 pci/l	0.01 +/- 0.06 pci/l	0.12 +/- 0.08 pci/l	NR	0.00 +/- 0.21 pci/l
5186	51-86-08-20-87	08/20/87	3	4 +/- 19 pci/l	6 +/- 44 pci/l	-0.4 +/- 1.1 pci/l	0.0 +/- 0.3 pci/l	0.0 +/- 0.5 pci/l	<1.0 pci/l	-1.6 +/- 6.0 pci/l
5186	51-86-05-13-87	05/13/87	1	28 +/- 24 pc/l	11 +/- 7 pc/l	.22 +/- .61 pc/l	0.0 +/- .30 pc/l	.61 +/- .54 pc/l	1.34 pc/l	0.0 +/- .71 pc/l
5186	51-86-06-17-87	06/17/87	2	-5 +/- 0 pci/l	24 +/- 28 pci/l	0.0 +/- 0.06 pci/l	0.0 +/- 0.33 pci/l	0.12 +/- 0.37 pci/l	1.0 pci/l	0.29 +/- 0.8 pci/l
5186	G518611860	11/07/86		-1 +/- 4 pci/l	7 +/- 5 pci/l	1.8 +/- 0.4 pci/l	NR	2.4 +/- 0.5 pci/l	NR	0.06 +/- 0.11 pci/l
5186	51-86-12-10-87	12/10/87	4	43 +/- 9 pci/l	42 +/- 10 pci/l	.10 +/- .10 pci/l	.02 +/- .04 pci/l	.07 +/- .08 pci/l	<1.0 pci/l	0.00 +/- .14 pci/l
5186	51-86-02-08-88	02/08/88	1	9 +/- 5 pci/l	12 +/- 12 pci/l	0.03 +/- 0.12 pci/l	0.02 +/- 0.06 pci/l	0.13 +/- 0.10 pci/l	NR	0.00 +/- 0.18 pci/l
5086	G508610860	10/31/86		120 +/- 40 pci/l	100 +/- 20 pci/l	9.0 +/- 1.0 pci/l	NR	6.3 +/- 0.8 pci/l	NR	0.12 +/- 0.16 pci/l
5086	G508610862	10/31/86		190 +/- 50 pci/l	83 +/- 14 pci/l	7.9 +/- 1.0 pci/l	NR	5.2 +/- 0.9 pci/l	NR	0.02 +/- 0.13 pci/l
5086	50-86-05-11-87	05/11/87	1	54 +/- 15 pc/l	56 +/- 23 pc/l	2.5 +/- 1.2 pc/l	.03 +/- .43 pc/l	3.5 +/- 1.2 pc/l	2.62 pc/l	1.0 +/- 1.0 pc/l
5086	50-86-06-16-87	06/16/87	2	-4 +/- 0 pci/l	26 +/- 5 pci/l	0.08 +/- 0.65 pci/l	0.0 +/- 0.03 pci/l	0.2 +/- 0.44 pci/l	<1.0 pci/l	0.0 +/- 0.67 pci/l
5086	50-86-08-14-87	08/14/87	3	6 +/- 15 pci/l	-8 +/- 42 pci/l	NR	NR	NR	3.5 pci/l	-.32 +/- .65 pci/l
5086	50-86-12-10-87	12/10/87	4	30 +/- 8 pci/l	32 +/- 9 pci/l	.23 +/- 12 pci/l	.01 +/- .04 pci/l	.18 +/- .10 pci/l	<1.0 pci/l	0.00 +/- .10 pci/l
4986	G498611860	11/24/86		350 +/- 60 pci/l	1200 +/- 100 pci/l	12 +/- 2 pci/l	NR	12 +/- 2 pci/l	NR	0.02 +/- 0.14 pci/l
4986	49-86-04-08-87	04/08/87	1	20 +/- 10 pci/l	21 +/- 6 pci/l	0.0 +/- .91 pci/l	0.4 +/- 1.7 pci/l	0.7 +/- 3.6 pci/l	NR	0.0 +/- 2.2 pci/l
4986	49-86-06-18-87	06/18/87	2	71 +/- 15 pci/l	118 +/- 29 pci/l	3.5 +/- 0.9 pci/l	0.09 +/- 0.32 pci/l	4.0 +/- 0.9 pci/l	<1.0 pci/l	0.42 +/- 0.82 pci/l
4986	49-86-08-25-87	08/25/87	3	6 +/- 16 pci/l	-9 +/- 34 pci/l	0.9 +/- 1.4 pci/l	0.6 +/- 0.7 pci/l	0.0 +/- 1.0 pci/l	1.5 pci/l	-.32 +/- .64 pci/l
4986	49-86-12-14-87	12/14/87	4	620 +/- 110 pci/l	440 +/- 30 pci/l	.13 +/- .09 pci/l	.01 +/- .03 pci/l	.01 +/- .06 pci/l	<1.0 pci/l	0.00 +/- .18 pci/l
4786	G478611860	11/07/86		57 +/- 20 pci/l	50 +/- 12 pci/l	10 +/- 2 pci/l	NR	14 +/- 2 pci/l	NR	-0.05 +/- 0.74 pci/l
4786	G478611862	11/07/86		61 +/- 22 pci/l	42 +/- 12 pci/l	6.0 +/- 1.1 pci/l	NR	7.7 +/- 1.2 pci/l	NR	0.09 +/- 0.18 pci/l
4786	47-86-05-13-87	05/13/87	1	-8 +/- 6 pc/l	14 +/- 0 pc/l	0.0 +/- .53 pc/l	.005 +/- .31 pc/l	0.0 +/- .38 pc/l	<0.6 pc/l	.08 +/- .71 pc/l
4786	47-86-06-22-87	06/22/87	2	-2 +/- 4 pci/l	-2 +/- 31 pci/l	0.0 +/- 0.59 pci/l	0.0 +/- 0.3 pci/l	0.36 +/- 0.48 pci/l	<1.0 pci/l	0.0 +/- 0.7 pci/l
4786	47-86-08-14-87	08/14/87	3	10 +/- 17 pci/l	6 +/- 41 pci/l	0.4 +/- 1.4 pci/l	4.0 +/- 1.4 pci/l	5.5 +/- 2.1 pci/l	<1.0 pci/l	.11 +/- .78 pci/l
4786	47-86-10-05-87	10/05/87		NA	NA	NA	NA	NA	NA	NA
4786	47-86-10-05-87	10/05/87	4	3 +/- 4 pci/l	7 +/- 9 pci/l	.15 +/- .09 pci/l	.04 +/- .04 pci/l	.18 +/- .08 pci/l	<1.0 pci/l	.11 +/- .14 pci/l
4786	47-86-02-08-88	02/08/88	1	3 +/- 4 pci/l	15 +/- 13 pci/l	0.16 +/- 0.12 pci/l	0.00 +/- 0.06 pci/l	0.05 +/- 0.07 pci/l	NR	0.00 +/- 0.21 pci/l
4586	G458610860	10/16/86		200 +/- 80 pci/l	140 +/- 30 pci/l	11 +/- 1 pci/l	NR	10 +/- 1 pci/l	NR	0.13 +/- 0.21 pci/l
4586	G458610862	10/16/86		190 +/- 100 pci/l	250 +/- 40 pci/l	15 +/- 2 pci/l	NR	16 +/- 2 pci/l	NR	-0.02 +/- 0.08 pci/l
4586	45-86-05-15-87	05/14/87	1	55 +/- 21 pc/l	23 +/- 15 pc/l	1.5 +/- 1.1 pc/l	.28 +/- .49 pc/l	1.0 +/- 0.9 pc/l	1.61 pc/l	4.7 +/- 1.8 pc/l
4586	45-86-06-12-87	06/12/87	2	0 +/- 0 pci/l	18 +/- 21 pci/l	0.0 +/- 0.59 pci/l	0.0 +/- 0.36 pci/l	0.0 +/- 0.35 pci/l	1.0 pci/l	0.0 +/- 0.68 pci/l
4586	45-86-08-14-87	08/14/87	3	25 +/- 24 pci/l	27 +/- 41 pci/l	2.0 +/- 1.5 pci/l	0.2 +/- 0.6 pci/l	9.8 +/- 2.3 pci/l	2.1 pci/l	.10 +/- .86 pci/l
4586	45-86-09-30-87	09/30/87		NA	NA	NA	NA	NA	NA	NA
4586	45-86-10-01-87	10/01/87	4	NR	NR	0.099 +/- 0.174 pci/l	NR	0.085 +/- 0.053 pci/l	NR	0.106 +/- 0.062 pci/l
4586	45-86-09-30-87	09/30/87	4	21 +/- 5 pci/l	26 +/- 10 pci/l	0.00 +/- 0.06 pci/l	0.00 +/- 0.03 pci/l	0.02 +/- 0.96 pci/l	<1.0 pci/l	0.00 +/- 0.09 pci/l
5686	G568610860	10/02/86		14 +/- 11 pci/l	24 +/- 5 pci/l	1.5 +/- 0.3 pci/l	NR	1.5 +/- 0.3 pci/l	NR	0.09 +/- 0.06 pci/l
5686	56-86-05-19-87	05/19/87	1	15 +/- 12 pc/l	2 +/- 6 pc/l	.34 +/- .69 pc/l	0.0 +/- .26 pc/l	.86 +/- .60 pc/l	4.01 pc/l	.28 +/- .70 pc/l
5686	56-86-05-27-87	05/27/87	2	23 +/- 8 pci/l	32 +/- 17 pci/l	0.0 +/- 0.85 pci/l	0.0 +/- 0.72 pci/l	0.0 +/- 0.71 pci/l	1.76 pci/l	0.003 +/- 0.76 pci/l

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis

Groundwater Radiochemistry Results WEST SPRAY FIELDS

ALLUVIAL Wells for Regulated Units at Rocky Flats Plant

Well Number	Field Sample Number	Date Sampled	Qtr.	Americium 241		Cesium 137	Tritium	
West Spray Field Alluvial Wells								
1081	10-81-08-21-87	08/21/87	3	-.04 +/- .56	pci/l	NR	<526	pci/l
1081	10-81-05-11-87	05/11/87	1	0.0 +/- 1.2	pc/l	NR	110	pc/l
1081	10-81-06-18-87	06/18/87	2	0.0 +/- 1.2	pci/l	NR	<110	pci/l
1081	G108108860	08/08/86		0.03 +/- 0.04	pci/l	NR	0.33 +/- 0.23	pci/ml
1081	10-81-01-12-88	01/12/88	4	0.00 +/- .47	pci/l	NR	<220	pci/l
1081	10-81D-08-21-87	08/21/87	3	-.04 +/- .18	pci/l	NR	<471	pci/l
1081	10-81D-01-12-88	01/12/88	4	NA		NA	NA	
1081	10-81-02-04-88	02/04/88	1	0.00 +/- 0.32	pci/l	NR	230 +/- 100	pci/l
5186	51-86-08-20-87	08/20/87	3	-.04 +/- .47	pci/l	NR	<492	pci/l
5186	51-86-05-13-87	05/13/87	1	0.0 +/- 1.2	pc/l	NR	150	pc/l
5186	51-86-06-17-87	06/17/87	2	0.0 +/- 1.3	pci/l	NR	<110	pci/l
5186	G518611860	11/07/86		-0.03 +/- 0.08	pci/l	NR	0.37 +/- 0.20	pci/ml
5186	51-86-12-10-87	12/10/87	4	0.00 +/- .19	pci/l	NR	<220	pci/l
5186	51-86-02-08-88	02/08/88	1	NR		NR	<210	pci/l
5086	G508610860	10/31/86		-0.01 +/- 0.08	pci/l	NR	0.30 +/- 0.22	pci/ml
5086	G508610862	10/31/86		0.03 +/- 0.09	pci/l	NR	0.15 +/- 0.22	pci/ml
5086	50-86-05-11-87	05/11/87	1	0.0 +/- 2.0	pc/l	NR	160	pc/l
5086	50-86-06-16-87	06/16/87	2	0.0 +/- 1.2	pci/l	NR	<110	pci/l
5086	50-86-08-14-87	08/14/87	3	-.04 +/- .43	pci/l	NR	487 +/- 291	pci/l
5086	50-86-12-10-87	12/10/87	4	0.00 +/- .19	pci/l	NR	<220	pci/l
4986	G498611860	11/24/86		0.04 +/- 0.10	pci/l	NR	0.03 +/- 0.24	pci/ml
4986	49-86-04-08-87	04/08/87	1	0.0 +/- 4.4	pci/l	NR	<110	pci/l
4986	49-86-06-18-87	06/18/87	2	0.0 +/- 1.3	pci/l	NR	<110	pci/l
4986	49-86-08-25-87	08/25/87	3	.03 +/- .45	pci/l	NR	2218 +/- 397	pci/l
4986	49-86-12-14-87	12/14/87	4	NR		NR	<220	pci/l
4786	G478611860	11/07/86		-0.01 +/- 0.08	pci/l	NR	-0.09 +/- 0.18	pci/ml
4786	G478611862	11/07/86		-0.02 +/- 0.08	pci/l	NR	-0.08 +/- 0.19	pci/ml
4786	47-86-05-13-87	05/13/87	1	0.0 +/- 1.5	pc/l	NR	<110	pc/l
4786	47-86-06-22-87	06/22/87	2	0.0 +/- 1.2	pci/l	NR	110	pci/l
4786	47-86-08-14-87	08/14/87	3	-.04 +/- .82	pci/l	NR	<526	pci/l
4786	47-86-10-05-87	10/05/87		NA		NA	NA	
4786	47-86-10-05-87	10/05/87	4	0.00 +/- .05	pci/l	NR	<460	pci/l
4786	47-86-02-08-88	02/08/88	1	NR		NR	<210	pci/l
4586	G458610860	10/16/86		0.03 +/- 0.07	pci/l	NR	0.10 +/- 0.22	pci/ml
4586	G458610862	10/16/86		-0.01 +/- 0.03	pci/l	NR	0.13 +/- 0.22	pci/ml
4586	45-86-05-15-87	05/14/87	1	0.0 +/- 1.4	pc/l	NR	<110	pc/l
4586	45-86-06-12-87	06/12/87	2	0.0 +/- 1.5	pci/l	NR	330	pci/l
4586	45-86-08-14-87	08/14/87	3	.69 +/- .91	pci/l	NR	<535	pci/l
4586	45-86-09-30-87	09/30/87		NA		NA	NA	
4586	45-86-10-01-87	10/01/87	4	-0.019 +/- 0.036	pci/l	NR	NR	
4586	45-86-09-30-87	09/30/87	4	0.00 +/- 0.44	pci/l	NR	<460	pci/l
5686	G568610860	10/02/86		0.01 +/- 0.06	pci/l	NR	0.06 +/- 0.22	pci/ml
5686	56-86-05-19-87	05/19/87	1	0.0 +/- 1.3	pc/g	NR	120	pc/l
5686	56-86-05-27-87	05/27/87	2	0.0 +/- 1.2	pci/l	NR	<110	pci/l

Notes: NR : Analyte not reported

Groundwater Radiochemistry Results WEST SPRAY FIELDS

ALLUVIAL Wells for Regulated Units at Rocky Flats Plant

Well Number	Field Sample Number	Date Sampled	Qtr.	Gross Alpha	Gross Beta	Uranium 233, 234	Uranium 235	Uranium 238	Strontium 89, 90	Plutonium 239, 240
West Spray Field Alluvial Wells										
5686	56-86-07-15-87	07/15/87	3	7 +/- 24 pci/l	88 +/- 49 pci/l	0.8 +/- 1.1 pci/l	0.5 +/- 0.3 pci/l	0.4 +/- 0.6 pci/l	1.3 pci/l	.00 +/- .46 pci/l
5686	56-86-09-30-87	09/30/87		NA	NA	NA	NA	NA	NA	NA
5686	56-86-10-01-87	10/01/87		NR	NR	NR	NR	0.172 +/- 0.064	NR	0.001 +/- 0.045 pci/l
5686	56-86-09-30-87	09/30/87	4	6 +/- 4 pci/l	16 +/- 10 pci/l	.04 +/- .13 pci/l	.04 +/- .05 pci/l	.11 +/- .09 pci/l	<1.0 pci/l	0.00 +/- .05 pci/l
5686	56-86-02-15-88	02/15/88	4	10 +/- 4 pci/l	4 +/- 12 pci/l	0.00 +/- 0.09 pci/l	0.00 +/- 0.06 pci/l	0.00 +/- 0.08 pci/l	NR	0.00 +/- 0.19 pci/l
0881	8-81-08-18-87	08/18/87	3	29 +/- 24 pci/l	7 +/- 39 pci/l	4.4 +/- 1.6 pci/l	0.2 +/- 0.4 pci/l	4.6 +/- 1.4 pci/l	2.6 pci/l	-.32 +/- .55 pci/l
0881	8-81-05-14-87	05/14/87	1	30 +/- 3 pc/l	33 +/- 20 pc/l	3.7 +/- 1.0 pc/l	.09 +/- .32 pc/l	3.3 +/- 0.8 pc/l	0.8 pc/l	.25 +/- .82 pc/l
0881	8-81-06-23-87	06/23/87	2	295 +/- 32 pci/l	238 +/- 43 pci/l	3.2 +/- 1.0 pci/l	0.26 +/- 0.37 pci/l	4.5 +/- 1.0 pci/l	<1.0 pci/l	0.0 +/- 0.66 pci/l
0881	G088108860	08/18/86		5 +/- 4 pci/l	2 +/- 3 pci/l	3.2 +/- 0.4 pci/l	NR	1.7 +/- 0.3 pci/l	NR	0.16 +/- 0.10 pci/l
0881	8-81-01-14-88	01/14/88	4	4 +/- 7 pci/l	-2 +/- 11 pci/l	3.6 +/- 0.5 pci/l	.12 +/- .06 pci/l	2.5 +/- 0.4 pci/l	<1.0 pci/l	0.00 +/- .18 pci/l
0881	8-81-01-14-88	01/14/88	4	NA	NA	NA	NA	NA	NA	NA
0981	9-81-08-18-87	08/18/87	3	14 +/- 27 pci/l	43 +/- 44 pci/l	-0.1 +/- 1.1 pci/l	0.0 +/- 0.2 pci/l	0.1 +/- 0.7 pci/l	<1.0 pci/l	-.13 +/- .58 pci/l
0981	9-81-05-19-87	05/19/87	1	6 +/- 0 pc/l	12 +/- 33 pc/l	0.0 +/- .47 pc/l	0.0 +/- .26 pc/l	0.0 +/- .25 pc/l	0.8 pc/l	0.0 +/- .63 pc/l
0981	9-81-06-23-87	06/23/87	2	6 +/- 15 pci/l	-2 +/- 24 pci/l	0.0 +/- 0.55 pci/l	0.0 +/- 0.27 pci/l	0.09 +/- 0.42 pci/l	<1.0 pci/l	0.0 +/- 0.59 pci/l
0981	G098108860	08/14/86		4 +/- 5 pci/l	4 +/- 3 pci/l	0.57 +/- 0.17 pci/l	NR	0.25 +/- 0.11 pci/l	NR	-0.03 +/- 0.04 pci/l
0981	9-81-01-13-88	01/13/88	4	3 +/- 7 pci/l	5 +/- 12 pci/l	0.00 +/- .07 pci/l	0.00 +/- .04 pci/l	.08 +/- .11 pci/l	<1.0 pci/l	0.00 +/- .17 pci/l
0582	5-82-09-17-87	09/17/87	3	4 +/- 16 pci/l	-4 +/- 40 pci/l	0.0 +/- 1.2 pci/l	0.0 +/- 0.4 pci/l	-0.3 +/- 1.0 pci/l	1.2 pci/l	.11 +/- .76 pci/l
0582	5-82-05-13-87	05/13/87	1	24 +/- 40 pc/l	14 +/- 2 pc/l	0.0 +/- .53 pc/l	0.0 +/- .29 pc/l	0.0 +/- .41 pc/l	0.8 pc/l	0.0 +/- .68 pc/l
0582	5-82-06-18-87	06/18/87	2	-4 +/- 0 pci/l	-6 +/- 3 pci/l	0.0 +/- 0.6 pci/l	0.0 +/- 0.4 pci/l	0.09 +/- 0.41 pci/l	<1.0 pci/l	0.0 +/- 0.5 pci/l
0582	G058208860	08/13/86		2 +/- 3 pci/l	3 +/- 2 pci/l	0.01 +/- 0.04 pci/l	NR	0.00 +/- 0.01 pci/l	NR	-0.03 +/- 0.04 pci/l
0582	5-82-01-07-88	01/07/88	4	1 +/- 7 pci/l	8 +/- 12 pci/l	0.00 +/- .09 pci/l	0.00 +/- .04 pci/l	0.00 +/- .07 pci/l	<1.0 pci/l	0.00 +/- .14 pci/l
0682	6-82-08-18-87	08/18/87	3	12 +/- 19 pci/l	14 +/- 39 pci/l	0.1 +/- 1.1 pci/l	0.0 +/- 0.3 pci/l	-0.2 +/- 0.6 pci/l	<1.0 pci/l	-.32 +/- .60 pci/l
0682	6-82-05-12-87	05/12/87	1	120 +/- 72 pc/l	71 +/- 12 pc/l	4.6 +/- 1.2 pc/l	.28 +/- .42 pc/l	9.7 +/- 1.7 pc/l	4.69 pc/l	.44 +/- .84 pc/l
0682	6-82-06-18-87	06/18/87	2	311 +/- 115 pci/l	336 +/- 69 pci/l	8.9 +/- 1.4 pci/l	0.03 +/- 0.31 pci/l	7.4 +/- 1.2 pci/l	<1.0 pci/l	0.0 +/- 0.8 pci/l
0682	G068208860	08/18/86		79 +/- 39 pci/l	110 +/- 30 pci/l	4.9 +/- 0.6 pci/l	NR	3.7 +/- 0.6 pci/l	NR	0.05 +/- 0.17 pci/l
0682	6-82-01-07-88	01/07/88	4	26 +/- 8 pci/l	24 +/- 12 pci/l	.02 +/- .08 pci/l	.01 +/- .04 pci/l	.14 +/- .10 pci/l	<1.0 pci/l	0.00 +/- .17 pci/l
0782	DRY	12/05/87	4	NA	NA	NA	NA	NA	NA	NA
0782	DRY	08/20/87		NA	NA	NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1	NA	NA	NA	NA	NA	NA	NA
0782	07-82-02-04-88	02/04/88	1	NA	NA	NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	4 +/- 19 pci/l	6 +/- 44 pci/l	-0.4 +/- 1.1 pci/l	0.0 +/- 0.3 pci/l	0.0 +/- 0.5 pci/l	<1.0 pci/l	-1.6 +/- 6.0 pci/l
5186	51-86-05-13-87	05/13/87	1	28 +/- 24 pc/l	11 +/- 7 pc/l	.22 +/- .61 pc/l	0.0 +/- .30 pc/l	.61 +/- .54 pc/l	1.34 pc/l	0.0 +/- .71 pc/l
5186	51-86-06-17-87	06/17/87	2	-5 +/- 0 pci/l	24 +/- 28 pci/l	0.0 +/- 0.06 pci/l	0.0 +/- 0.33 pci/l	0.12 +/- 0.37 pci/l	1.0 pci/l	0.29 +/- 0.8 pci/l
5186	G518611860	11/07/86		-1 +/- 4 pci/l	7 +/- 5 pci/l	1.8 +/- 0.4 pci/l	NR	2.4 +/- 0.5 pci/l	NR	0.06 +/- 0.11 pci/l
5186	51-86-12-10-87	12/10/87	4	43 +/- 9 pci/l	42 +/- 10 pci/l	.10 +/- .10 pci/l	.02 +/- .04 pci/l	.07 +/- .08 pci/l	<1.0 pci/l	0.00 +/- .14 pci/l
5186	51-86-02-08-88	02/08/88	1	9 +/- 5 pci/l	12 +/- 12 pci/l	0.03 +/- 0.12 pci/l	0.02 +/- 0.06 pci/l	0.13 +/- 0.10 pci/l	NR	0.00 +/- 0.18 pci/l

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis

Groundwater Radiochemistry Results WEST SPRAY FIELDS

ALLUVIAL Wells for Regulated Units at Rocky Flats Plant

Well Number	Field Sample Number	Date Sampled	Qtr.	Americium 241	Cesium 137	Tritium
West Spray Field Alluvial Wells						
5686	56-86-07-15-87	07/15/87	3	-.04 +/- .59 pci/l	NR	493 pci/l
5686	56-86-09-30-87	09/30/87		NA	NA	NA
5686	56-86-10-01-87	10/01/87		-0.008 +/- 0.038 pci/l	NR	NR
5686	56-86-09-30-87	09/30/87	4	0.00 +/- .17 pci/l	NR	<500 pci/l
5686	56-86-02-15-88	02/15/88	4	0.00 +/- 0.16 pci/l	NR	<210 pci/l
0881	8-81-08-18-87	08/18/87	3	-.04 +/- .65 pci/l	NR	<535 pci/l
0881	8-81-05-14-87	05/14/87	1	NR	NR	<110 pc/l
0881	8-81-06-23-87	06/23/87	2	0.0 +/- 1.5 pci/l	NR	<110 pci/l
0881	G088109860	08/18/86		0.00 +/- 0.04 pci/l	NR	0.02 +/- 0.22 pci/ml
0881	8-81-01-14-88	01/14/88	4	.07 +/- .10 pci/l	NR	<220 pci/l
0881	8-81-01-14-88	01/14/88	4	NA	NA	NA
0981	9-81-08-18-87	08/18/87	3	.16 +/- .38 pci/l	NR	<535 pci/l
0981	9-81-05-19-87	05/19/87	1	0.0 +/- 1.3 pc/l	NR	<110 pc/l
0981	9-81-06-23-87	06/23/87	2	0.0 +/- 1.2 pci/l	NR	<110 pci/l
0981	G098108860	08/14/86		0.04 +/- 0.04 pci/l	NR	0.00 +/- 0.22 pci/ml
0981	9-81-01-13-88	01/13/88	4	0.00 +/- .21 pci/l	NR	<220 pci/l
0582	5-82-09-17-87	09/17/87	3	.04 +/- .62 pci/l	NR	1005 +/- 316 pci/l
0582	5-82-05-13-87	05/13/87	1	0.0 +/- 1.2 pc/l	NR	120 pc/l
0582	5-82-06-18-87	06/18/87	2	0.0 +/- 1.8 pci/l	NR	<110 pci/l
0582	G058208860	08/13/86		0.05 +/- 0.05 pci/l	NR	-0.03 +/- 0.22 pci/ml
0582	5-82-01-07-88	01/07/88	4	NR	NR	<200 pci/l
0682	6-82-08-18-87	08/18/87	3	-.04 +/- .43 pci/l	NR	<459 pci/l
0682	6-82-05-12-87	05/12/87	1	0.0 +/- 2.6 pc/l	NR	<110 pc/l
0682	6-82-06-18-87	06/18/87	2	0.0 +/- 12 pci/l	NR	<110 pci/l
0682	G068208860	08/18/86		0.03 +/- 0.07 pci/l	NR	-0.01 +/- 0.22 pci/ml
0682	6-82-01-07-88	01/07/88	4	0.00 +/- .20 pci/l	NR	<200 pci/l
0782	DRY	12/05/87	4	NA	NA	NA
0782	DRY	08/20/87		NA	NA	NA
0782	7-82-05-11-87	05/11/87	1	NA	NA	NA
0782	07-82-02-04-88	02/04/88	1	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	-.04 +/- .47 pci/l	NR	<492 pci/l
5186	51-86-05-13-87	05/13/87	1	0.0 +/- 1.2 pc/l	NR	150 pc/l
5186	51-86-06-17-87	06/17/87	2	0.0 +/- 1.3 pci/l	NR	110 pci/l
5186	G518611860	11/07/86		-0.03 +/- 0.08 pci/l	NR	0.37 +/- 0.20 pci/ml
5186	51-86-12-10-87	12/10/87	4	0.00 +/- .19 pci/l	NR	.220 pci/l
5186	51-86-02-08-88	02/08/88	1	NR	NR	<210 pci/l

Notes: NR = Analyte not reported

INORGANICS

Groundwater Inorganic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	CO3=	HCO3-	Chloride	Sulfate	pH	Fluoride	Nitrate-Nitrite Nitrogen
West Spray Field Alluvial Wells										
1081	10-81-08-21-87	08/21/87	3	NR	39 mg/l	3.79 mg/l	21.0 mg/l	NR	NR	7.65 mg/l
1081	10-81-05-11-87	05/11/87	1	NR	28.0 mg/l	8.60 mg/l	20.0 mg/l	NR	NR	2.00 mg/l
1081	10-81-06-18-87	06/18/87	2	NR	36.9 mg/l	444 mg/l	22.0 mg/l	NR	NR	7.30 mg/l
1081	G108108860	08/08/86		21 mg/l	19 mg/l	5.7 mg/l	3 U mg/l	NR	NR	5.0 U mg/l
1081	10-81-01-12-88	01/12/88	4	NR	46.4 mg/l	5.69 mg/l	23.5 mg/l	NR	NR	6.10 mg/l
1081	10-81D-08-21-87	08/21/87	3	NR	40 mg/l	3.76 mg/l	18.0 mg/l	NR	NR	7.85 mg/l
1081	10-81D-01-12-88	01/12/88	4	NR	46.4 mg/l	5.69 mg/l	23.5 mg/l	NR	NR	6.10 mg/l
1081	10-81-02-04-88	02/04/88	1	NR	46.1 mg/l	3.15 mg/l	19.6 mg/l	NR	NR	5.98 mg/l
5186	51-86-08-20-87	08/20/87	3	NR	28.5 mg/l	4.75 mg/l	26.5 mg/l	NR	NR	5.15 mg/l
5186	51-86-05-13-87	05/13/87	1	NR	36.0 mg/l	5.70 mg/l	31.0 mg/l	NP	NR	4.65 mg/l
5186	51-86-06-17-87	06/17/87	2	NR	31.6 mg/l	5.00 mg/l	28.0 mg/l	NR	NR	4.60 mg/l
5186	G518611860	11/07/86		42 mg/l	3 U mg/l	7.3 mg/l	31 mg/l	NR	NR	NP
5186	51-86-12-10-87	12/10/87	4	NR	46.2 mg/l	5.20 mg/l	190 mg/l	NR	NR	3.45 mg/l
5186	51-86-02-08-88	02/08/88	1	NR	40.2 mg/l	8.86 mg/l	56.0 mg/l	NR	NR	4.91 mg/l
5086	G508610860	10/31/86		5 U mg/l	120 mg/l	7.6 mg/l	16 mg/l	NR	NR	NR
5086	G508610862	10/31/86		NR	NP	9.5 mg/l	16 mg/l	NR	NR	NP
5086	50-86-05-11-87	05/11/87	1	NR	95.0 mg/l	10.4 mg/l	28.0 mg/l	NR	NR	0.87 mg/l
5086	50-86-06-16-87	06/16/87	2	NR	92.5 mg/l	9.70 mg/l	13.5 mg/l	NR	NR	1.20 mg/l
5086	50-86-08-14-87	08/14/87	3	NR	95.7 mg/l	9.70 mg/l	12.5 mg/l	NR	NR	0.87 mg/l
5086	50-86-12-10-87	12/10/87	4	NR	119 mg/l	9.39 mg/l	27.4 mg/l	NR	NR	0.65 mg/l
4986	G498611860	11/24/86		45 mg/l	7.0 mg/l	30 mg/l	29 mg/l	NR	NR	NR
4986	49-86-04-08-87	04/08/87	1	NR	32.8 mg/l	20.2 mg/l	150 mg/l	NR	NR	9.10 mg/l
4986	49-86-06-18-87	06/18/87	2	NR	34.0 mg/l	25.7 mg/l	30.5 mg/l	NR	NR	16.3 mg/l
4986	49-86-08-25-87	08/25/87	3	NR	41 mg/l	30.6 mg/l	19.0 mg/l	NR	NR	12.6 mg/l
4986	49-86-12-14-87	12/14/87	4	NR	48.0 mg/l	13.3 mg/l	1340 mg/l	NR	NR	6.58 mg/l
4786	G478611860	11/07/86		88 mg/l	5.4 mg/l	2.9 mg/l	20 mg/l	NR	NR	NR
4786	G478611862	11/07/86		NR	NR	2.7 mg/l	18 mg/l	NR	NR	NR
4786	47-86-05-13-87	05/13/87	1	NR	76.0 mg/l	3.60 mg/l	7.80 mg/l	NR	NR	1.0 mg/l
4786	47-86-06-22-87	06/22/87	2	NR	76.5 mg/l	2.42 mg/l	1.0 U mg/l	NR	NR	1.10 mg/l
4786	47-86-08-14-87	08/14/87	3	NR	79.7 mg/l	1.96 mg/l	3.5 mg/l	NR	NR	1.2 mg/l
4786	47-86-10-05-87	10/05/87		NA	NA	NA	NA	NA	NA	NA
4786	47-86-10-05-87	10/05/87	4	NR	79.7 mg/l	2.4 mg/l	2.9 mg/l	NR	NR	1.15 mg/l
4786	47-86-02-08-88	02/08/88	1	NR	87.3 mg/l	5.90 mg/l	11.7 mg/l	NR	NR	1.05 mg/l
4586	G458610860	10/16/86		110 mg/l	12 mg/l	6.1 mg/l	14 mg/l	NR	NR	NR
4586	G458610862	10/16/86		5 U mg/l	4.9 mg/l	5.9 mg/l	13 mg/l	NR	NR	NR
4586	45-86-05-15-87	05/14/87	1	NR	22.0 mg/l	4.90 mg/l	24.5 mg/l	NR	NR	0.56 mg/l
4586	45-86-06-12-87	06/12/87	2	NR	18.4 mg/l	9.30 mg/l	19.0 mg/l	NR	NR	0.51 mg/l
4586	45-86-08-14-87	08/14/87	3	NR	39.1 mg/l	6.39 mg/l	14.5 mg/l	NR	NR	0.75 mg/l
4586	45-86-09-30-87	09/30/87		NA	NA	NA	NA	NA	NA	NA
4586	45-86-10-01-87	10/01/87	4	NA	NA	NA	NA	NA	NA	NA
4586	45-86-09-30-87	09/30/87	4	NR	45.1 mg/l	6.5 mg/l	17.5 mg/l	NR	NR	1.02 mg/l
5686	G568610860	10/02/86		120 mg/l	16 mg/l	15 mg/l	15 mg/l	NR	NR	5.0 U mg/l
5686	56-86-05-19-87	05/19/87	1	NR	105 mg/l	15.1 mg/l	19.0 mg/l	NR	NR	0.48 mg/l
5686	56-86-05-27-87	05/27/87	2	NR	121 mg/l	13.3 mg/l	1.0 U mg/l	NR	NR	0.2 U mg/l

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
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B : Present in laboratory blank

Groundwater Inorganic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Sulfide	Phosphate	Cyanide, Total	Hexavalent Chromium (Cr+6)	Total Dissolved Solids	Suspended Solids	% Solids
West Spray Field Alluvial Wells										
1081	10-81-08-21-87	08/21/87	3	NR	NR	1 U mg/l	NR	163 mg/l	NR	NR
1081	10-81-05-11-87	05/11/87	1	NR	NR	1.0 U mg/l	NR	123 mg/l	NR	NR
1081	10-81-06-18-87	06/18/87	2	NR	NR	1.0 U mg/l	NR	140 mg/l	NR	NR
1081	G108108860	08/08/86		NR	NR	0.0016 mg/l	10 U mg/l	128 mg/l	NR	NR
1081	10-81-01-12-88	01/12/88	4	NR	NR	NR	NR	152 mg/l	NR	NR
1081	10-81D-08-21-87	08/21/87	3	NR	NR	1 U mg/l	NR	138 mg/l	NR	NR
1081	10-81D-01-12-88	01/12/88	4	NR	NR	NR	NR	152 mg/l	NR	NR
1081	10-81-02-04-88	02/04/88	1	NR	NR	NR	NR	143 mg/l	NR	NR
5186	51-86-08-20-87	08/20/87	3	NR	NR	1 U mg/l	NR	149 mg/l	NR	NR
5186	51-86-05-13-87	05/13/87	1	NR	NR	1.0 U mg/l	NR	145 mg/l	NR	NR
5186	51-86-06-17-87	06/17/87	2	NR	NR	1.0 U mg/l	NR	141 mg/l	NR	NR
5186	G518611860	11/07/86		NR	NR	0.005 U mg/l	NR	277 mg/l	NR	NR
5186	51-86-12-10-87	12/10/87	4	NR	NR	NR	NR	126 mg/l	NR	NR
5186	51-86-02-08-88	02/08/88	1	NR	NR	NR	NR	163 mg/l	NR	NR
5086	G508610860	10/31/86		NR	NR	0.01 U mg/l	NR	200 mg/l	NR	NR
5086	G508610862	10/31/86		NR	NR	0.01 U mg/l	NR	210 mg/l	NR	NR
5086	50-86-05-11-87	05/11/87	1	NR	NR	1.0 U mg/l	NR	167 mg/l	NR	NR
5086	50-86-06-16-87	06/16/87	2	NR	NR	1.0 U mg/l	NR	171 mg/l	NR	NR
5086	50-86-08-14-87	08/14/87	3	NR	NR	1 U mg/l	NR	159 mg/l	NR	NR
5086	50-86-12-10-87	12/10/87	4	NR	NR	NR	NR	162 mg/l	NR	NR
4986	G498611860	11/24/86		NR	NR	0.005 U mg/l	NR	477 mg/l	NR	NR
4986	49-86-04-08-87	04/08/87	1	NR	NR	1.0 U mg/l	NR	264 mg/l	NR	NR
4986	49-86-06-18-87	06/18/87	2	NR	NR	1.0 U mg/l	NR	269 mg/l	NR	NR
4986	49-86-08-25-87	08/25/87	3	NR	NR	1 U mg/l	NR	201 mg/l	NR	NR
4986	49-86-12-14-87	12/14/87	4	NR	NR	NR	NR	309 mg/l	NR	NR
4786	G478611860	11/07/86		NR	NR	0.005 U mg/l	NR	264 mg/l	NR	NR
4786	G478611862	11/07/86		NR	NR	0.005 U mg/l	NR	290 mg/l	NR	NR
4786	47-86-05-13-87	05/13/87	1	NR	NR	1.0 U mg/l	NR	115 mg/l	NR	NR
4786	47-86-06-22-87	06/22/87	2	NR	NR	1.0 U mg/l	NR	119 mg/l	NR	NR
4786	47-86-08-14-87	08/14/87	3	NR	NR	1 U mg/l	NR	118 mg/l	NR	NR
4786	47-86-10-05-87	10/05/87		NA	NA	NA	NA	NA	NA	NA
4786	47-86-10-05-87	10/05/87	4	NR	NR	NR	NR	113 mg/l	NR	NR
4786	47-86-02-08-88	02/08/88	1	NR	NR	NR	NR	119 mg/l	NR	NR
4586	G458610860	10/16/86		NR	NR	0.01 U mg/l	NR	180 mg/l	NR	NR
4586	G458610862	10/16/86		NR	NR	0.01 U mg/l	NR	160 mg/l	NR	NR
4586	45-86-05-15-87	05/14/87	1	NR	NR	1.0 U mg/l	NR	143 mg/l	NR	NR
4586	45-86-06-12-87	06/12/87	2	NR	NR	1.0 U mg/l	NR	92.0 mg/l	NR	NR
4586	45-86-08-14-87	08/14/87	3	NR	NR	1 U mg/l	NR	124 mg/l	NR	NR
4586	45-86-09-30-87	09/30/87		NA	NA	NA	NA	NA	NA	NA
4586	45-86-10-01-87	10/01/87	4	NA	NA	NA	NA	NA	NA	NA
4586	45-86-09-30-87	09/30/87	4	NR	NR	NR	NR	125 mg/l	NR	NR
5686	G568610860	10/02/86		NR	NR	0.005 U mg/l	160 mg/l	210 mg/l	NR	NR
5686	56-86-05-19-87	05/19/87	1	NR	NR	1.0 U mg/l	NR	185 mg/l	NR	NR
5686	56-86-05-27-87	05/27/87	2	NR	NR	1.0 U mg/l	NR	202 mg/l	NR	NR

Notes: NR : Analyte not reported
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Groundwater Inorganic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	CO3=	HCO3-	Chloride	Sulfate	pH	Fluoride	Nitrate-Nitrite Nitrogen
West Spray Field Alluvial Wells										
5686	56-86-07-15-87	07/15/87	3	NR	124 mg/l	13.0 mg/l	15.9 mg/l	NR	NR	0.20 U mg/l
5686	56-86-09-30-87	09/30/87		NA	NA	NA	NA	NA	NA	NA
5686	56-86-10-01-87	10/01/87		NA	NA	NA	NA	NA	NA	NA
5686	56-86-09-30-87	09/30/87	4	NR	122 mg/l	19.6 mg/l	4.3 mg/l	NR	NR	0.20 U mg/l
5686	56-86-02-15-88	02/15/88	4	NR	91.7 mg/l	49.5 mg/l	39.5 mg/l	NR	NR	1.66 mg/l
0881	8-81-08-18-87	08/18/87	3	NR	50.3 mg/l	5.08 mg/l	19.5 mg/l	NR	NR	0.45 mg/l
0881	8-81-05-14-87	05/14/87	1	NR	131 mg/l	7.80 mg/l	19.0 mg/l	NR	NR	0.22 mg/l
0881	8-81-06-23-87	06/23/87	2	7.45 mg/l	109 mg/l	6.52 mg/l	32.0 mg/l	NR	NR	0.49 mg/l
0881	G088108860	08/18/86		NR	NR	8.6 mg/l	17 mg/l	NR	NR	NR
0881	8-81-01-14-88	01/14/88	4	NR	153 mg/l	6.64 mg/l	19.0 mg/l	NR	NR	0.21 mg/l
0881	8-81-01-14-88	01/14/88	4	NR	153 mg/l	6.64 mg/l	19.0 mg/l	NR	NR	0.21 mg/l
0981	9-81-08-18-87	08/18/87	3	NR	84.4 mg/l	52.6 mg/l	47.0 mg/l	NR	NR	0.20 U mg/l
0981	9-81-05-19-87	05/19/87	1	5.0 mg/l	102 mg/l	54.6 mg/l	49.5 mg/l	NR	NR	0.42 mg/l
0981	9-81-06-23-87	06/23/87	2	NR	71.5 mg/l	51.3 mg/l	48.0 mg/l	NR	NR	0.43 mg/l
0981	G098108860	08/14/86		85 mg/l	10 U mg/l	49 mg/l	55 mg/l	NR	NR	5.0 U mg/l
0981	9-81-01-13-88	01/13/88	4	NR	100 mg/l	51.6 mg/l	39.9 mg/l	NR	NR	0.02 U mg/l
0582	5-82-09-17-87	09/17/87	3	NR	38 mg/l	53.4 mg/l	62 mg/l	NR	NR	3.8 mg/l
0582	5-82-05-13-87	05/13/87	1	NR	43.0 mg/l	16.5 mg/l	60.0 mg/l	NR	NR	1.88 mg/l
0582	5-82-06-18-87	06/18/87	2	NR	33.7 mg/l	32.3 mg/l	49.0 mg/l	NR	NR	2.60 mg/l
0582	G058208860	08/13/86		NR	NR	55 mg/l	77 mg/l	NR	NR	32.4 mg/l
0582	5-82-01-07-88	01/07/88	4	NR	37.2 mg/l	43.1 mg/l	653 mg/l	NR	NR	3.38 mg/l
0682	6-82-08-18-87	08/18/87	3	NR	28.5 mg/l	3.70 mg/l	28.5 mg/l	NR	NR	0.28 mg/l
0682	6-82-05-12-87	05/12/87	1	NR	26.0 mg/l	2.80 mg/l	80.0 mg/l	NR	NR	0.20 U mg/l
0682	6-82-06-18-87	06/18/87	2	NR	29.4 mg/l	3.57 mg/l	37.5 mg/l	NR	NR	0.31 mg/l
0682	G068208860	08/18/86		NR	NR	3.3 mg/l	20 mg/l	NR	NR	5.0 U mg/l
0682	6-82-01-07-88	01/07/88	4	NR	32.1 mg/l	5.93 mg/l	90.2 mg/l	NR	NR	0.46 mg/l
0782	DRY	12/05/87	4	NA	NA	NA	NA	NA	NA	NA
0782	DRY	08/20/87		NA	NA	NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1	NA	NA	NA	NA	NA	NA	NA
0782	07-82-02-04-88	02/04/88	1	NA	NA	NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	NR	38.5 mg/l	4.75 mg/l	26.5 mg/l	NR	NR	5.15 mg/l
5186	51-86-05-13-87	05/13/87	1	NR	36.0 mg/l	5.70 mg/l	31.0 mg/l	NR	NR	4.65 mg/l
5186	51-86-06-17-87	06/17/87	2	NR	31.6 mg/l	5.00 mg/l	28.0 mg/l	NR	NR	4.60 mg/l
5186	G518611860	11/07/86		42 mg/l	3 U mg/l	7.3 mg/l	31 mg/l	NR	NR	NR
5186	51-86-12-10-87	12/10/87	4	NR	46.2 mg/l	5.20 mg/l	190 mg/l	NR	NR	3.45 mg/l
5186	51-86-02-08-88	02/08/88	1	NR	40.2 mg/l	8.86 mg/l	56.0 mg/l	NR	NR	4.91 mg/l

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Groundwater Inorganic Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Sulfide	Phosphate	Cyanide, Total	Hexavalent Chromium (Cr+6)	Total Dissolved Solids	Suspended Solids	% Solids
West Spray Field Alluvial Wells										
5686	56-86-07-15-87	07/15/87	3	NR	NR	1 U mg/l	NR	186 mg/l	NR	NR
5686	56-86-09-30-87	09/30/87		NA	NA	NA	NA	NA	NA	NA
5686	56-86-10-01-87	10/01/87		NA	NA	NA	NA	NA	NA	NA
5686	56-86-09-30-87	09/30/87	4	NR	NR	NR	NR	191 mg/l	NR	NR
5686	56-86-02-15-88	02/15/88	4	NR	NR	NR	NR	213 mg/l	NR	NR
0881	8-81-08-18-87	08/18/87	3	NR	NR	1 U mg/l	NR	150 mg/l	NR	NR
0881	8-81-05-14-87	05/14/87	1	NR	NR	1.0 U mg/l	NR	185 mg/l	NR	NR
0881	8-81-06-23-87	06/23/87	2	NR	NR	1.0 U mg/l	NR	213 mg/l	NR	NR
0881	G088108860	08/18/86		NR	NR	0.005 U mg/l	NR	10 U mg/l	NR	NR
0881	8-81-01-14-88	01/14/88	4	NR	NR	NR	NR	194 mg/l	NR	NR
0881	8-81-01-14-88	01/14/88	4	NR	NR	NR	NR	194 mg/l	NR	NR
0981	9-81-08-18-87	08/18/87	3	NR	NR	1 U mg/l	NR	286 mg/l	NR	NR
0981	9-81-05-19-87	05/19/87	1	NR	NR	1.0 U mg/l	NR	269 mg/l	NR	NR
0981	9-81-06-23-87	06/23/87	2	NR	NR	1.0 U mg/l	NR	277 mg/l	NR	NR
0981	G098108860	08/14/86		NR	2.4 mg/l	0.001 U mg/l	10 U mg/l	244 mg/l	NR	NR
0981	9-81-01-13-88	01/13/88	4	NR	NR	NR	NR	249 mg/l	NR	NR
0582	5-82-09-17-87	09/17/87	3	NR	NR	1 U mg/l	NR	210 mg/l	NR	NR
0582	5-82-05-13-87	05/13/87	1	NR	NR	1.0 U mg/l	NR	186 mg/l	NR	NR
0582	5-82-06-18-87	06/18/87	2	NR	NR	1.0 U mg/l	NR	228 mg/l	NR	NR
0582	G058208860	08/13/86		NR	NR	0.0010 U mg/l	10 U mg/l	245 mg/l	NR	NR
0582	5-82-01-07-88	01/07/88	4	NR	NR	NR	NR	232 mg/l	NR	NR
0682	6-82-08-18-87	08/18/87	3	NR	NR	1 U mg/l	NR	110 mg/l	NR	NR
0682	6-82-05-12-87	05/12/87	1	NR	NR	1.0 U mg/l	NR	365 mg/l	NR	NR
0682	6-82-06-18-87	06/18/87	2	NR	NR	1.0 U mg/l	NR	145 mg/l	NR	NR
0682	G068208860	08/18/86		NR	NR	0.005 U mg/l	10 U mg/l	500 mg/l	NR	NR
0682	6-82-01-07-88	01/07/88	4	NR	NR	NR	NR	192 mg/l	NR	NR
0782	DRY	12/05/87	4	NA	NA	NA	NA	NA	NA	NA
0782	DRY	08/20/87		NA	NA	NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1	NA	NA	NA	NA	NA	NA	NA
0782	07-82-02-04-88	02/04/88	1	NA	NA	NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	NR	NR	1 U mg/l	NR	149 mg/l	NR	NR
5186	51-86-05-13-87	05/13/87	1	NR	NR	1.0 U mg/l	NR	145 mg/l	NR	NR
5186	51-86-06-17-87	06/17/87	2	NR	NR	1.0 U mg/l	NR	141 mg/l	NR	NR
5186	G518611860	11/07/86		NR	NR	0.005 U mg/l	NR	277 mg/l	NR	NR
5186	51-86-12-10-87	12/10/87	4	NR	NR	NR	NR	126 mg/l	NR	NR
5186	51-86-02-08-88	02/08/88	1	NR	NR	NR	NR	163 mg/l	NR	NR

Notes: NR : Analyte not reported U : Analyzed but not detected B : Present in laboratory blank

METALS

Groundwater Metals Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Silver (Ag), total	Aluminum (Al), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Calcium (Ca), total	Cadmium (Cd), total	Cobalt (Co), total	Chromium (Cr), total	Cesium (Cs), total
West Spray Field Alluvial Wells														
1081	10-81-08-21-87	08/21/87	3	mg/l	0.0076 U	0.0400	0.005 U	0.1010	0.005 U	17.7583	0.001 U	0.0220 U	0.0144	0.02 U
1081	10-81-05-11-87	05/11/87	1	mg/l	0.0076 U	0.0433	0.01 U	0.1354	0.005 U	14.6231	0.005 U	0.0220 U	0.0100 U	0.2 U
1081	10-81-06-18-87	06/18/87	2	mg/l	0.0076 U	0.0290 U	0.01 U	0.0461	0.005 U	17.2256	0.005 U	0.0220 U	0.0100 U	0.2 U
1081	G1981088 60	08/08/86		ug/l	0.010 U	0.680	0.001 U	0.100 U	0.037	18.0	0.005 U	0.100	0.002 U	0.360
1081	10-81-01-12-88	01/12/88	4	mg/l	0.0076 U	0.0290 U	0.005	0.0698	0.002 J	15.4546	0.018	0.0220 U	0.0100 U	0.02 U
1081	10-81D-08-21-87	08/21/87	3	mg/l	0.0076 U	0.0509	0.005 U	0.1024	0.005 U	17.3812	0.001 U	0.0220 U	0.0100 U	0.02 U
1081	10-81D-01-12-88	01/12/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1081	10-81-02-04-88	02/04/88	1	mg/l	0.0076 U	0.0476	0.005 U	0.0866	0.005 U	16.2702	0.001 U	0.0220 U.	0.0100 U	0.02 U
5186	51-86-08-20-87	08/20/87	3	mg/l	0.0076 U	0.8289	0.005 U	0.1502	0.005 U	18.9247	0.001 U	0.0220 U	0.0173	0.02 U
5186	51-86-05-13-87	05/13/87	1	mg/l	0.0076 U	1.1942	0.0100 U	0.1220	0.005 U	23.0047	0.0050 U	0.0220 U	0.0100 U	0.2 U
5186	51-86-06-17-87	06/17/87	2	mg/l	0.0076 U	0.0290 U	0.01 U	0.0514	0.005 U	19.1503	0.005 U	0.0220 U	0.0100 U	0.2 U
5186	G518611860	11/07/86		mg/l	0.009 U	0.100 U	0.010 U	0.110	0.005 U	12.2	0.006	0.025 U	0.027	0.150 U
5186	51-86-12-10-87	12/10/87	4	mg/l	0.0076 U	0.0290 U	0.005 U	0.0745	0.005 U	15.8726	0.001 U	0.0220 U	0.0152	0.02 U
5186	51-86-02-08-88	02/08/88	1	mg/l	0.0076 U	0.0429	0.005 U	0.0997	0.005 U	15.6339	0.001 U	0.0220 U	0.0100 U	0.02 U
5086	G508610860	10/31/86		mg/l	0.010 U	0.190 U	0.010 U	0.190	0.005 U	30.000	0.005 U	0.025 U	0.010 U	0.150 U
5086	G508610862	10/31/86		mg/l	0.010 U	0.100 U	0.010 U	0.080	0.005 U	30.20	0.005 U	0.025 U	0.010 U	0.150 U
5086	50-86-05-11-87	05/11/87	1	mg/l	0.0076	0.0567	0.0100 U	0.1558	0.005 U	36.4507	0.0011	0.0220 U	0.1356	0.2 U
5086	50-86-06-16-87	06/16/87	2	mg/l	0.0076 U	0.0290 U	0.01 U	0.0597	0.005 U	34.4230	0.005 U	0.0220 U	0.0100 U	0.2 U
5086	50-86-08-14-87	08/14/87	3	mg/l	0.0076 U	0.0290 U	0.005 U	0.0822	0.005 U	31.0017	0.001 U	0.0220 U	0.0114	0.02 U
5086	50-86-12-10-87	12/10/87	4	mg/l	0.0076 U	0.5854	0.005 U	0.1007	0.005 U	30.4438	0.005 J	0.0220 U	0.0148	0.02 U
4986	G498611860	11/24/86		mg/l	0.009 U	0.100 U	0.010 U	0.116	0.005 U	35.200	0.005 U	0.020 U	0.010 U	0.150 U
4986	49-86-04-08-87	04/08/87	1	mg/l	0.0076 U	0.2107	0.0100 U	0.5163	0.005 U	34.7669	0.0050 U	0.0220 U	0.0100 U	0.2 U
4986	49-86-06-18-87	06/18/87	2	mg/l	0.0076 U	0.0290 U	0.01 U	0.0551	0.005 U	29.4858	0.005 U	0.0220 U	0.0100 U	0.2 U
4986	49-86-08-25-87	08/25/87	3	mg/l	0.0076 U	0.0392	0.005 U	0.1204	0.005 U	20.5711	0.001 U	0.0220 U	0.0100 U	0.02 U
4986	49-86-12-14-87	12/14/87	4	mg/l	0.0076 U	0.9473	0.005 U	0.1046	0.005 U	14.8498	0.001 U	0.0220 U	0.0100 U	0.02 U
4786	G478611860	11/07/86		mg/l	0.009 U	0.100 U	0.010 U	0.100	0.005 U	15.400	0.007	0.025 U	0.010 U	0.150 U
4786	G478611862	11/07/86		mg/l	0.009 U	0.100 U	0.010 U	0.100	0.005 U	16.30	0.008	0.025 U	0.027	0.150 U
4786	47-86-05-13-87	05/13/87	1	mg/l	0.0076 U	0.0290 U	0.01 U	0.0662	0.005 U	21.8236	0.005 U	0.0220 U	0.0100 U	0.2 U
4786	47-86-06-22-87	06/22/87	2	mg/l	0.0076 U	0.0290 U	0.01 U	0.0474	0.005 U	19.1714	0.005 U	0.0220 U	0.0100 U	0.2 U
4786	47-86-08-14-87	08/14/87	3	mg/l	0.0076 U	0.0290 U	0.005 U	0.1017	0.005 U	18.6199	0.001 U	0.0220 U	0.0100 U	0.02 U
4786	47-86-10-05-87	10/05/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4786	47-86-10-05-87	10/05/87	4	mg/l	0.0076 U	0.0290 U	0.005 U	0.0492	0.005 U	16.4384	0.001 U	0.0220 U	0.0100 U	0.02 U
4786	47-86-02-08-88	02/08/88	1	mg/l	0.0076 U	0.0290 U	0.005 U	0.0554	0.005 U	17.1793	0.001 U	0.0220 U	0.0100 U	0.02 U
4586	G458610860	10/16/86		mg/l	0.010 U	0.480	0.002 U	0.160	0.011	26.2	0.005 U	0.050 U	0.010 U	0.150 U
4586	G458610862	10/16/86		mg/l	0.010 U	0.550	0.002 U	0.150	0.007	25.5	0.005 U	0.050 U	0.010 U	0.150 U
4586	45-86-05-15-87	05/14/87	1	mg/l	0.0076 U	0.1786	0.0100 U	0.0308	0.005 U	11.5612	0.0050 U	0.0220 U	0.0100 U	0.2 U
4586	45-86-06-12-87	06/12/87	2	mg/l	0.0076 U	0.0405	0.01 U	0.0265	0.005 U	9.0966	0.005 U	0.0220 U	0.0100 U	0.2 U
4586	45-86-08-14-87	08/14/87	3	mg/l	0.0076 U	0.0727	0.005 U	0.0615	0.005 U	10.0692	0.001 U	0.0220 U	0.0115	0.02 U
4586	45-86-09-30-87	09/30/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4586	45-86-10-01-87	10/01/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4586	45-86-09-30-87	09/30/87	4	mg/l	0.0076 U	0.0336	0.005 U	0.0556	0.005 U	12.8262	0.001 U	0.0220 U	0.0100 U	0.02 U
5686	G568610860	10/02/86		mg/l	0.010 U	0.100 U	0.002 U	0.150 U	0.005 U	26.300	0.005 U	0.050 U	0.010 U	0.150 U
5686	56-86-05-19-87	05/19/87	1	mg/l	0.0076 U	0.0921	0.01 U	0.0668	0.005 U	30.7456	0.005 U	0.0220 U	0.0257	0.2 U
5686	56-86-05-27-87	05/27/87	2	mg/l	0.0076 U	0.3316	0.01 U	0.0599	0.005 U	25.8710	0.005 U	0.0220 U	0.0100 U	0.2 U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

Groundwater Metals Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Copper (Cu), total	Iron (Fe), total	Mercury (Hg), total	Potassium (K), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Molybdenum (Mo), total	Sodium (Na), total	Nickel (Ni), total
West Spray Field Alluvial Wells														
1081	10-81-08-21-87	08/21/87	3	mg/l	0.0099	0.0246	0.0002 U	1.0	NR	3.3620	0.0051 U	0.0220 U	14.4885	0.0370 U
1081	10-81-05-11-87	05/11/87	1	mg/l	0.0090	0.0282	0.0002 U	5.0 U	NR	2.7824	0.0051 U	0.0220 U	10.6409	0.0370 U
1081	10-81-06-18-87	06/18/87	2	mg/l	0.0063 U	0.0144	0.002 U	5.0 U	NR	2.9793	0.0051 U	0.0220 U	9.5838	0.0370 U
1081	G108108860	08/08/86		ug/l	0.020 U	0.270	0.0007	0.560	NR	6.6	0.010 U	0.510	11	0.077
1081	10-81-01-12-88	01/12/88	4	mg/l	0.0063 U	0.0317	0.0002	0.5	0.1 U	2.9601	0.0051 U	0.0220 U	10.0773	0.0370 U
1081	10-81D-08-21-87	08/21/87	3	mg/l	0.0066	0.0263	0.0002 U	0.8	NR	3.2901	0.0051 U	0.0220 U	13.9764	0.0370 U
1081	10-81D-01-12-88	01/12/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1081	10-81-02-04-88	02/04/88	1	mg/l	0.0063 U	0.0348	0.0002 U	0.5	0.1 U	3.3184	0.0051	0.0220 U	13.0288	0.0370 U
5186	51-86-08-20-87	08/20/87	3	mg/l	0.0063 U	0.5748	0.0002 U	0.6	NR	3.4800	0.0242	0.0220 U	16.3487	0.0370 U
5186	51-86-05-13-87	05/13/87	1	mg/l	0.0174 U	.0711	0.0002 U	5.0 U	NR	4.5871	0.0265	0.0220 U	14.6574	0.0370 U
5186	51-86-06-17-87	06/17/87	2	mg/l	0.0063 U	0.0069 U	0.0002 U	5.0 U	NR	3.3494	0.0065	0.0220 U	9.4233	0.0370 U
5186	G518611860	11/07/86		mg/l	0.023	0.075 U	0.0002 U	1.07	NR	0.00192	0.071	0.100 U	21.4 U	0.029
5186	51-86-12-10-87	12/10/87	4	mg/l	0.0141	0.0669	0.0002 U	0.5	0.1 U	2.9424	0.0051 U	0.0220 U	9.5898	0.0370 U
5186	51-86-02-08-88	02/08/88	1	mg/l	0.0063 U	0.0316	0.0002 U	0.8	0.1 U	3.1273	0.0051 U	0.0220 U	11.4788	0.0370 U
5086	G508610860	10/31/86		mg/l	0.020 U	0.181	0.0002 U	1.190	NR	5.430	0.347	0.100 U	12.100	0.020 U
5086	G508610862	10/31/86		mg/l	0.020 U	0.076	0.0002 U	2.160	NR	5.340	0.374	0.100 U	11.70	0.020 U
5086	50-86-05-11-87	05/11/87	1	mg/l	0.0261	0.5953	0.0002 U	5.0 U	NR	5.3889	0.1940	0.0220 U	12.9888	0.0701
5086	50-86-06-16-87	06/16/87	2	mg/l	0.0063 U	0.0069 U	0.0002 U	5.0 U	NR	5.1092	0.0051 U	0.0220 U	9.6210	0.0370 U
5086	50-86-08-14-87	08/14/87	3	mg/l	0.0063 U	0.0106	0.0002 U	0.8	NR	5.0253	0.0051 U	0.0220 U	10.7212	0.0370 U
5086	50-86-12-10-87	12/10/87	4	mg/l	0.0383	0.4740	0.0002 U	0.8	0.1 U	4.8416	0.0051 U	0.0220 U	10.2008	0.0370 U
4986	G498611860	11/24/86		mg/l	0.020 U	0.075 U	0.0002 U	1.900 U	NR	7.640	0.476	0.100 U	29.500	0.020 U
4986	49-86-04-08-87	04/08/87	1	mg/l	0.0063 U	0.0293	0.0002 U	5.0 U	NR	7.3621	0.2289	0.0220 U	36.0378	0.0370 U
4986	49-86-06-18-87	06/18/87	2	mg/l	0.0063 U	0.0078	0.0002 U	5.0 U	NR	5.6582	0.0248	0.0220 U	27.8577	0.0370 U
4986	49-86-08-25-87	08/25/87	3	mg/l	0.0084	0.0211	0.0002 U	1.2	NR	4.3797	0.0210	0.0220 U	26.6908	0.0370 U
4986	49-86-12-14-87	12/14/87	4	mg/l	0.0080	0.0406	0.0002 U	0.7	0.1 U	2.8133	0.0051 U	0.0220 U	21.2591	0.0370 U
4786	G478611860	11/07/86		mg/l	0.020 U	0.075 U	0.0002 U	1.000 U	NR	2.230	0.086	0.100 U	16.400	0.020 U
4786	G478611862	11/07/86		mg/l	0.020 U	0.075 U	0.0002 U	1.040	NR	1.990	0.093	0.100 U	14.700	0.020 U
4786	47-86-05-13-87	05/13/87	1	mg/l	0.0087	0.0069 U	0.0002 U	5.0 U	NR	3.8325	0.0325	0.0220 U	15.6347	0.0370 U
4786	47-86-06-22-87	06/22/87	2	mg/l	0.0063 U	0.0147	0.005	5.0 U	NR	3.1143	0.0263	0.0220 U	13.0281	0.0370 U
4786	47-86-08-14-87	08/14/87	3	mg/l	0.0068	0.0149	0.0002 U	0.5	NR	3.1834	0.0192	0.0220 U	17.2126	0.0370 U
4786	47-86-10-05-87	10/05/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4786	47-86-10-05-87	10/05/87	4	mg/l	0.0063 U	0.0069 U	0.0002 U	0.57	0.1 U	2.8904	0.0139	0.0220 U	13.2303	0.0370 U
4786	47-86-02-08-88	02/08/88	1	mg/l	0.0063 U	0.0162	0.0002 U	0.6	0.1 U	3.1210	0.0051 U	0.0220 U	13.0176	0.0370 U
4586	G458610860	10/16/86		mg/l	0.020 U	0.252	0.00021	0.623	NR	5.90	0.079	0.100 U	13.4	0.040 U
4586	G458610862	10/16/86		mg/l	0.020 U	0.242	0.0016	0.540	NR	5.40	0.091	0.100 U	13.9	0.040 U
4586	45-86-05-15-87	05/14/87	1	mg/l	0.0063 U	0.0948	0.0002 U	5.0 U	NR	2.6072	0.0141	0.0220 U	7.3332	0.0370 U
4586	45-86-06-12-87	06/12/87	2	mg/l	0.0063 U	0.0311	0.0002 U	5.0 U	NR	2.1295	0.0051 U	0.0220 U	6.5707	0.0370 U
4586	45-86-08-14-87	08/14/87	3	mg/l	0.0068 U	0.0495	0.0002 U	0.6	NR	2.3749	0.0062	0.0220 U	10.7756	0.0370 U
4586	45-86-09-30-87	09/30/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4586	45-86-10-01-87	10/01/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4586	45-86-09-30-87	09/30/87	4	mg/l	0.0063 U	0.0143	0.0002 U	0.67	0.1 U	3.2490	0.0051 U	0.0220 U	10.8467	0.0370 U
5686	G568610860	10/02/86		mg/l	0.020 U	0.075 U	0.0002 U	2.600	NR	6.210	0.340	0.100 U	17.800	0.040 U
5686	56-86-05-19-87	05/19/87	1	mg/l	0.0063 U	0.3115	0.0002 U	5.0 U	NR	6.8858	0.0481	0.0222	21.4615	0.0370 U
5686	56-86-05-27-87	05/27/87	2	mg/l	0.0071	0.3674	0.0002 U	5.0 U	NR	5.4196	0.0197	0.0220 U	19.2985	0.0370 U

Notes: NR = Analyte not reported
NA = Insufficient water in well for analysis
U = Analyzed but not detected
J = Present below detection limit
B = Present in laboratory blank

Groundwater Metals Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Lead (Pb), total	Antimony (Sb), total	Selenium (Se), total	Strontium (Sr), total	Thallium (Tl), total	Vanadium (V), total	Zinc (Zn), total
West Spray Field Alluvial Wells											
1081	10-81-08-21-87	08/21/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.0963	0.01 U	0.0240 U	0.1858
1081	10-81-05-11-87	05/11/87	1	mg/l	0.005 U	0.0600 U	0.0050 U	0.0832	0.01 U	0.0240 U	0.04
1081	10-81-06-18-87	06/18/87	2	mg/l	0.010	0.06 U	0.005 U	0.0908	0.01 U	0.0245	0.0200 U
1081	G108108860	08/08/86		ug/l	0.005 U	0.020 U	0.002 U	0.068	0.007	0.850	0.020
1081	10-81-01-12-88	01/12/88	4	mg/l	0.006	0.02 U	0.004 J	0.0845	0.01 U	0.0240 U	0.0398
1081	10-81D-08-21-87	08/21/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.0961	0.01 U	0.0240 U	0.1135
1081	10-81D-01-12-88	01/12/88	4		NA	NA	NA	NA	NA	NA	NA
1081	10-81-02-04-88	02/04/88	1	mg/l	0.005 U	0.02 U	0.005 U	0.0938	0.01 U	0.0240 U	0.0303
5186	51-86-08-20-87	08/20/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.0984	0.01 U	0.0240 U	0.0336
5186	51-86-05-13-87	05/13/87	1	mg/l	0.0050 U	0.06 U	0.005 U	0.1227	0.0100 U	0.0240 U	0.07
5186	51-86-06-17-87	06/17/87	2	mg/l	0.036	0.06 U	0.005 U	0.0913	0.01 U	0.0240 U	0.0200 U
5186	G518611860	11/07/86		mg/l	0.005 U	0.060 U	0.005 U	0.080 U	0.010 U	0.025 U	0.039
5186	51-86-12-10-87	12/10/87	4	mg/l	0.005 U	0.02 U	0.005 U	0.0929	0.01 U	0.0240 U	0.0200 U
5186	51-86-02-08-88	02/08/88	1	mg/l	0.005 U	0.02 U	0.005 U	0.0948	0.01 U	0.0240 U	0.1683
5086	G508611860	10/31/86		mg/l	0.054	0.060 U	0.005 U	0.164	0.010 U	0.025 U	0.063
5086	G508611860	10/31/86		mg/l	0.016	0.060 U	0.005 U	0.150	0.010 U	0.025 U	0.036
5086	50-86-05-11-87	05/11/87	1	mg/l	0.0050 U	0.06 U	0.005 U	0.1750	0.0100 U	0.0240 U	0.07
5086	50-86-06-16-87	06/16/87	2	mg/l	0.015	0.06 U	0.005 U	0.1768	0.01 U	0.0240 U	0.0200 U
5086	50-86-08-14-87	08/14/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.1791	0.01 U	0.0240 U	0.0237
5086	50-86-12-10-87	12/10/87	4	mg/l	0.005 U	0.02 U	0.005 U	0.1834	0.01 U	0.0240 U	0.0269
4986	G498611860	11/24/86		mg/l	0.005 U	0.055 U	0.005 U	0.205	0.010 U	0.025 U	0.020 U
4986	49-86-04-08-87	04/08/87	1	mg/l	0.0050 U	0.06 U	0.005 U	0.1843	0.0100 U	0.0240 U	0.49
4986	49-86-06-18-87	06/18/87	2	mg/l	0.020	0.06 U	0.005 U	0.1487	0.01 U	0.0240 U	0.0200 U
4986	49-86-08-25-87	08/25/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.1356	0.01 U	0.0240 U	0.0267
4986	49-86-12-14-87	12/14/87	4	mg/l	0.005 U	0.02 U	0.003 J	0.0771	0.01 U	0.0240 U	0.0200 U
4786	G478611860	11/07/86		mg/l	0.005 U	0.060 U	0.005 U	0.090 U	0.005 U	0.025 U	0.047
4786	G478611862	11/07/86		mg/l	0.005 U	0.060 U	0.005 U	0.080 U	0.010 U	0.025 U	0.054
4786	47-86-05-13-87	05/13/87	1	mg/l	0.005 U	0.0600 U	0.0050 U	0.1075	0.01 U	0.0240 U	0.02
4786	47-86-06-22-87	06/22/87	2	mg/l	0.036	0.06 U	0.005 U	0.0933	0.01 U	0.0275	0.0200 U
4786	47-86-08-14-87	08/14/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.0998	0.01 U	0.0240 U	0.0264
4786	47-86-10-05-87	10/05/87			NA	NA	NA	NA	NA	NA	NA
4786	47-86-10-05-87	10/05/87	4	mg/l	0.005 U	0.02 U	0.005 U	0.0902	0.01 U	0.0240 U	0.0200 U
4786	47-86-02-08-88	02/08/88	1	mg/l	0.005 U	0.02 U	0.005 U	0.1006	0.01 U	0.0240 U	0.1072
4586	G458610860	10/16/86		mg/l	0.005 U	0.050 U	0.002 U	0.190	0.010 U	0.025 U	0.006
4586	G458610862	10/16/86		mg/l	0.005 U	0.050 U	0.002 U	0.193	0.010 U	0.025 U	0.005 U
4586	45-86-05-15-87	05/14/87	1	mg/l	0.0050 U	0.06 U	0.005 U	0.0633	0.0100 U	0.0240 U	0.02 U
4586	45-86-06-12-87	06/12/87	2	mg/l	0.011	0.06 U	0.005 U	0.0550	0.01 U	0.0240 U	0.0200 U
4586	45-86-08-14-87	08/14/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.0617	0.01 U	0.0240 U	0.0498
4586	45-86-09-30-87	09/30/87			NA	NA	NA	NA	NA	NA	NA
4586	45-86-10-01-87	10/01/87	4		NA	NA	NA	NA	NA	NA	NA
4586	45-86-09-30-87	09/30/87	4	mg/l	0.002 J	0.011 J	0.005 U	0.0847	0.01 U	0.0334	0.0200 U
5686	G568610860	10/02/86		mg/l	0.010 U	0.050 U	0.002 U	0.080 U	0.010 U	0.025 U	0.005
5686	56-86-05-19-87	05/19/87	1	mg/l	0.005 U	0.0600 U	0.0050 U	0.1668	0.01 U	0.0240 U	0.02 U
5686	56-86-05-27-87	05/27/87	2	mg/l	0.018	0.06 U	0.005 U	0.1293	0.01 U	0.0240 U	0.0306

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

Groundwater Metals Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Silver (Ag), total	Aluminum (Al), total	Arsenic (As), total	Barium (Ba), total	Beryllium (Be), total	Calcium (Ca), total	Cadmium (Cd), total	Colbalt (Co), total	Chromium (Cr), total	Cesium (Cs), total
West Spray Field Alluvial Wells														
5686	56-86-07-15-87	07/15/87	3	mg/l	0.0076 U	0.0309	0.005 U	0.0847	0.005 U	31.0749	0.001 U	0.0220 U	0.0100 U	0.02 U
5686	56-86-09-30-87	09/30/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5686	56-86-10-01-87	10/01/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5686	56-86-09-30-87	09/30/87	4	mg/l	0.0076 U	0.0290 U	0.005 U	0.1029	0.005 U	27.0996	0.001 U	0.0220 U	0.0100 U	0.02 U
5686	56-86-02-15-88	02/15/88	4	mg/l	0.0076 U	0.0400	0.005 U	0.1220	0.005 U	27.4721	0.001 U	0.02204 U	0.0100 U	0.02 U
0881	8-81-08-18-87	08/18/87	3	mg/l	0.0076 U	0.0587	0.003 J	0.1143	0.005 U	45.0880	0.001 U	0.0220 U	0.0100 U	0.02 U
0881	8-81-05-14-87	05/14/87	1	mg/l	0.0076 U	0.0556	0.01 U	0.1228	0.005 U	36.2560	0.005 U	0.0220 U	0.0100 U	0.2 U
0881	8-81-06-23-87	06/23/87	2	mg/l	0.0076 U	0.0373	0.01 U	0.0762	0.005 U	49.8042	0.005 U	0.0220 U	0.0100 U	0.2 U
0881	G088108860	08/18/86		mg/l	0.010 U	0.100 U	0.002 U	0.100 U	0.080	73.3	0.005 U	0.050 U	0.013	0.100 U
0881	8-81-01-14-88	01/14/88	4	mg/l	0.0076 U	0.0564	0.006	0.0981	0.005 U	36.2776	0.008	0.0220 U	0.0100 U	0.02 U
0881	8-81-01-14-88	01/14/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0981	9-81-08-18-87	08/18/87	3	mg/l	0.0076 U	0.0546	0.005 U	0.0496	0.005 U	49.6003	0.001 U	0.0220 U	0.0100 U	0.02 U
0981	9-81-05-19-87	05/19/87	1	mg/l	0.0076 U	0.0386	0.01 U	0.0360	0.005 U	50.6558	0.005 U	0.0220 U	0.0100 U	0.2 U
0981	9-81-06-23-87	06/23/87	2	mg/l	0.0076 U	0.0364	0.01 U	0.0339	0.005 U	54.8688	0.005 U	0.0220 U	0.0100 U	0.2 U
0981	G098108860	08/14/86		mg/l	0.010 U	0.100 U	0.001 U	0.100 U	0.005 U	28.2	0.005 U	0.050 U	0.0075	0.100 U
0981	9-81-01-13-88	01/13/88	4	mg/l	0.0076 U	0.1024	0.006	0.0353	0.005 U	45.0152	0.0005 J	0.0220 U	0.0100 U	0.02 U
0582	5-82-09-17-87	09/17/87	3	mg/l	0.0076 U	0.2831	0.005 U	0.1056	0.005 U	29.7368	0.002	0.0220 U	0.0100 U	0.02 U
0582	5-82-05-13-87	05/13/87	1	mg/l	0.0076 U	0.2338	0.01 U	0.0903	0.005 U	19.3959	0.005 U	0.0220 U	0.0100 U	0.2 U
0582	5-82-06-18-87	06/18/87	2	mg/l	0.0076 U	0.0290 U	0.01 U	0.0668	0.005 U	29.8760	0.005 U	0.0220 U	0.0100 U	0.2 U
0582	G058208860	08/13/86		mg/l	0.010 U	0.100 U	0.002 U	0.150	0.005 U	36.2	0.005 U	0.050 U	0.005 U	0.100 U
0582	5-82-01-07-88	01/07/88	4	mg/l	0.0076 U	0.0290 U	0.005	0.0774	0.001 J	29.2540	0.0007 J	0.0220 U	0.0100 U	0.02 U
0682	6-82-08-18-87	08/18/87	3	mg/l	0.0076 U	0.2177	0.005 U	0.1270	0.005 U	11.4882	0.005 J	0.0220 U	0.0100 U	0.02 U
0682	6-82-05-12-87	05/12/87	1	mg/l	0.0076 U	1.8569	0.01 U	0.2237	0.005 U	11.1874	0.005 U	0.0220 U	0.0100 U	0.2 U
0682	6-82-06-18-87	06/18/87	2	mg/l	0.0076 U	0.1125	0.01 U	0.0403	0.005 U	12.7749	0.005 U	0.0220 U	0.0100 U	0.2 U
0682	G068208860	08/18/86		mg/l	0.010 U	0.100 U	0.002 U	0.290	0.040	8.70	0.005 U	0.050 U	0.022	0.100 U
0682	6-82-01-07-88	01/07/88	4	mg/l	0.0076 U	0.0831	0.006	0.0758	0.005 U	9.8562	0.006	0.0220 U	0.0124	0.02 U
0782	DRY	12/05/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	DRY	08/20/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	07-82-02-04-88	02/04/88	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	mg/l	0.0076 U	0.8289	0.005 U	0.1502	0.005 U	18.9247	0.001 U	0.0220 U	0.0173	0.02 U
5186	51-86-05-13-87	05/13/87	1	mg/l	0.0076 U	0.1042	0.0100 U	0.1330	0.005 U	23.0047	0.0050 U	0.0220 U	0.0100 U	0.2 U
5186	51-86-06-17-87	06/17/87	2	mg/l	0.0076 U	0.0290 U	0.01 U	0.0514	0.005 U	19.1503	0.005 U	0.0220 U	0.0100 U	0.2 U
5186	G518611860	11/07/86		mg/l	0.009 U	0.100 U	0.010 U	0.110	0.005 U	12.2	0.006	0.025 U	0.027	0.150 U
5186	51-86-12-10-87	12/10/87	4	mg/l	0.0076 U	0.0290 U	0.005 U	0.0745	0.005 U	15.8726	0.001 U	0.0220 U	0.0152	0.02 U
5186	51-86-02-08-88	02/08/88	1	mg/l	0.0076 U	0.0429	0.005 U	0.0997	0.005 U	15.6339	0.001 U	0.0220 U	0.0100 U	0.02 U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

Groundwater Metals Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Copper (Cu), total	Iron (Fe), total	Mercury (Hg), total	Potassium (K), total	Lithium (Li), total	Magnesium (Mg), total	Manganese (Mn), total	Molybdenum (Mo), total	Sodium (Na), total	Nickel (Ni), total
West Spray Field Alluvial Wells														
5686	56-86-07-15-87	07/15/87	3	mg/l	0.0127	0.0145	0.0002 U	2.9	NR	6.8215	0.0220	0.220 U	21.9101	0.0370 U
5686	56-86-09-30-87	09/30/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5686	56-86-10-01-87	10/01/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5686	56-86-09-30-87	09/30/87	4	mg/l	0.0063 U	0.0300	0.0002 U	2.4	0.1 U	6.4920	0.0196	0.0220 U	19.9013	0.0370 U
5686	56-86-02-15-88	02/15/88	4	mg/l	0.0063 U	0.0312	0.0002 U	1.7	0.1 U	6.8235	0.0071	0.0220 U	24.6484	0.0370 U
0881	8-81-08-18-87	08/18/87	3	mg/l	0.0063 U	0.0185	0.0002 U	1.8	NR	7.4774	0.0051 U	0.0220 U	20.8643	0.0370 U
0881	8-81-05-14-87	05/14/87	1	mg/l	0.0063 U	0.0136	0.0002 U	5.0 U	NR	7.9690	0.0107	0.0220 U	17.6824	0.0370 U
0881	8-81-06-23-87	06/23/87	2	mg/l	0.0063 U	0.0093	0.0002 U	5.0 U	NR	7.0867	0.0051 U	0.0220 U	18.9038	0.0370 U
0881	G088108860	08/18/86		mg/l	0.030	0.075 U	0.0002 U	0.010 U	NR	5.78	0.010 U	0.100 U	13.8	0.040 U
0881	8-81-01-14-88	01/14/88	4	mg/l	0.0193	0.0763	0.0002 U	2.3	0.1 U	8.8584	0.0051 U	0.0220 U	18.0305	0.0370 U
0881	8-81-01-14-88	01/14/88	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0981	9-81-08-18-87	08/18/87	3	mg/l	0.0063 U	0.0585	0.0002 U	1.4	NR	4.2665	0.0051 U	0.0220 U	25.8222	0.0370 U
0981	9-81-05-19-87	05/19/87	1	mg/l	0.0063 U	0.0307	0.0002 U	5.0 U	NR	3.5687	0.0051 U	0.0220 U	22.5516	0.0370 U
0981	9-81-06-23-87	06/23/87	2	mg/l	0.0063 U	0.0145	0.0002 U	5.0 U	NR	4.1392	0.0051 U	0.0220 U	22.6974	0.0370 U
0981	G098108860	08/14/86		mg/l	0.020 U	0.030 U	0.00022	5.88	NR	1.48	0.010 U	0.100 U	15.9	0.040 U
0981	9-81-01-13-88	01/13/88	4	mg/l	0.0065	0.0819	0.0002 U	1.4	0.1 U	3.5654	0.0101	0.0220 U	22.8651	0.0370 U
0582	5-82-09-17-87	09/17/87	3	mg/l	0.0099	0.2598	0.0002 U	0.95	NR	5.8898	0.0210	0.0220 U	25.5351	0.0370 U
0582	5-82-05-13-87	05/13/87	1	mg/l	0.0087	0.1632	0.0002 U	5.0 U	NR	3.7560	0.0091	0.0220 U	18.5408	0.0370 U
0582	5-82-06-18-87	06/18/87	2	mg/l	0.0063 U	0.0072	0.0003	5.0 U	NR	4.9821	0.0066	0.0220 U	20.5830	0.0431
0582	G058208860	08/13/86		mg/l	0.020 U	0.030 U	0.0012	15.5	NR	4.130	0.030	0.100 U	23.3	0.040 U
0582	5-82-01-07-88	01/07/88	4	mg/l	0.0094	0.0275	0.0002 U	0.8	0.1 U	5.2697	0.0134	0.0220 U	23.6020	0.0370 U
0682	6-82-08-18-87	08/18/87	3	mg/l	0.0088	0.1506	0.0002 U	1.0	NR	1.8879	0.0296	0.0220 U	9.9753	0.0370 U
0682	6-82-05-12-87	05/12/87	1	mg/l	0.0111	1.2989	0.0002 U	5.0 U	NR	2.1660	0.1355	0.0220 U	6.6292	0.0370 U
0682	6-82-06-18-87	06/18/87	2	mg/l	0.0063 U	0.0794	0.0002 U	5.0 U	NR	1.9752	0.2864	0.0220 U	2.9816	0.0485
0682	G068208860	08/18/86		mg/l	0.020 U	0.180	0.0002 U	0.010 U	NR	1.20	0.140	0.100 U	5.10	0.060
0682	6-82-01-07-88	01/07/88	4	mg/l	0.0137	0.0949	0.0002 U	1.3	0.1 U	1.9435	0.0565	0.0220 U	9.5266	0.0370 U
0782	DRY	12/05/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	DRY	08/20/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0782	07-82-02-04-88	02/04/88	1		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	mg/l	0.0063 U	0.5748	0.0002 U	0.6	NR	3.4800	0.0242	0.0220 U	16.3487	0.0370 U
5186	51-86-05-13-87	05/13/87	1	mg/l	0.0174 U	0.0711	0.0002 U	5.0 U	NR	4.5871	0.0265	0.0220 U	14.6574	0.0370 U
5186	51-86-06-17-87	06/17/87	2	mg/l	0.0063 U	0.0069 U	0.0002 U	5.0 U	NR	3.3494	0.0065	0.0220 U	9.4233	0.0370 U
5186	G518611860	11/07/86		mg/l	0.023	0.075 U	0.0002 U	1.07	NR	0.00192	0.071	0.100 U	21.4 U	0.029
5186	51-86-12-10-87	12/10/87	4	mg/l	0.0141	0.0669	0.0002 U	0.5	0.1 U	2.9424	0.0051 U	0.0220 U	9.5898	0.0370 U
5186	51-86-02-08-88	02/08/88	1	mg/l	0.0063 U	0.0316	0.0002 U	0.8	0.1 U	3.1273	0.0051 U	0.0220 U	11.4788	0.0370 U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

Groundwater Metals Results for WEST SPRAY FIELDS

ALLUVIAL Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Lead (Pb), total	Antimony (Sb), total	Selenium (Se), total	Strontium (Sr), total	Thallium (Tl), total	Vanadium (V), total	Zinc (Zn), total
West Spray Field Alluvial Wells											
5686	56-86-07-15-87	07/15/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.1740	0.01 U	0.0323	0.0373
5686	56-86-09-30-87	09/30/87			NA	NA	NA	NA	NA	NA	NA
5686	56-86-10-01-87	10/01/87			NA	NA	NA	NA	NA	NA	NA
5686	56-86-09-30-87	09/30/87	4	mg/l	0.002 J	0.02 U	0.005 U	0.1674	0.01 U	0.0240 U	0.0279
5686	56-86-02-15-88	02/15/88	4	mg/l	0.005 U	0.02 U	0.005 U	0.1697	0.01 U	0.0240 U	0.0261
0881	8-81-08-18-87	08/18/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.2981	0.01 U	0.0240 U	0.0200 U
0881	8-81-05-14-87	05/14/87	1	mg/l	0.005 U	0.0600 U	0.0050 U	0.2554	0.01 U	0.0240 U	0.02 U
0881	8-81-06-23-87	06/23/87	2	mg/l	0.019	0.06 U	0.005 U	0.2935	0.01 U	0.0398	0.0200 U
0881	G088108860	08/18/86		mg/l	0.010 U	0.010 U	0.0082	0.250	0.010 U	0.050 U	0.008 J
0881	8-81-01-14-88	01/14/88	4	mg/l	0.005 U	0.02 U	0.004 J	0.2996	0.01 U	0.0240 U	0.0200 U
0881	8-81-01-14-88	01/14/88	4		NA	NA	NA	NA	NA	NA	NA
0981	9-81-08-18-87	08/18/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.4518	0.01 U	0.0240 U	0.0268
0981	9-81-05-19-87	05/19/87	1	mg/l	0.005 U	0.0600 U	0.0050 U	0.4268	0.01 U	0.0240 U	0.02 U
0981	9-81-06-23-87	06/23/87	2	mg/l	0.018	0.06 U	0.005 U	0.4635	0.01 U	0.0302	0.0200 U
0981	G098108860	08/14/86		mg/l	0.006	0.020 U	0.002 U	0.350	0.019	0.005 U	0.090
0981	9-81-01-13-88	01/13/88	4	mg/l	0.002 J	0.02 U	0.004 J	0.4188	0.01 U	0.0240 U	0.0200 U
0582	5-82-09-17-87	09/17/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.1891	0.01 U	0.0240 U	0.1695
0582	5-82-05-13-87	05/13/87	1	mg/l	0.005 U	0.0600 U	0.0050 U	0.1089	0.01 U	0.0240 U	0.23
0582	5-82-06-18-87	06/18/87	2	mg/l	0.014	0.06 U	0.005 U	0.1578	0.01 U	0.0240 U	0.0786
0582	G058208860	08/13/86		mg/l	0.005 U	0.020 U	0.002 U	0.180	0.014	0.005 U	1.580
0582	5-82-01-07-88	01/07/88	4	mg/l	0.005 U	0.02 U	0.003 J	0.1720	0.01 U	0.0240 U	1.7771
0682	6-82-08-18-87	08/18/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.0609	0.01 U	0.0240 U	0.0590
0682	6-82-05-12-87	05/12/87	1	mg/l	0.005 U	0.0600 U	0.0050 U	0.0595	0.0100 U	0.0240 U	0.05
0682	6-82-06-18-87	06/18/87	2	mg/l	0.021	0.06 U	0.005 U	0.0564	0.01 U	0.0240 U	0.0200 U
0682	G068208860	08/18/86		mg/l	0.016	0.010 U	0.002 U	0.080 U	0.010 U	0.050 U	0.102
0682	6-82-01-07-88	01/07/88	4	mg/l	0.003 J	0.02 U	0.004 J	0.0524	0.01 U	0.0240 U	0.1000
0782	DRY	12/05/87	4		NA	NA	NA	NA	NA	NA	NA
0782	DRY	08/20/87			NA	NA	NA	NA	NA	NA	NA
0782	7-82-05-11-87	05/11/87	1		NA	NA	NA	NA	NA	NA	NA
0782	07-82-02-04-88	02/04/88	1		NA	NA	NA	NA	NA	NA	NA
5186	51-86-08-20-87	08/20/87	3	mg/l	0.005 U	0.02 U	0.005 U	0.0984	0.01 U	0.0240 U	0.0336
5186	51-86-05-13-87	05/13/87	1	mg/l	0.0050 U	0.06 U	0.005 U	0.1227	0.0100 U	0.0240 U	0.07
5186	51-86-06-17-87	06/17/87	2	mg/l	0.036	0.06 U	0.005 U	0.2913	0.01 U	0.0240 U	0.0200 U
5186	G518611860	11/07/86		mg/l	0.005 U	0.060 U	0.005 U	0.080 U	0.010 U	0.025 U	0.039
5186	51-86-12-10-87	12/10/87	4	mg/l	0.005 U	0.02 U	0.005 U	0.0929	0.01 U	0.0240 U	0.0200 U
5186	51-86-02-08-88	02/08/88	1	mg/l	0.005 U	0.02 U	0.005 U	0.0948	0.01 U	0.0240 U	0.1683

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

APPENDIX D-3

GROUND-WATER ANALYTICAL DATA
BEDROCK WELLS

VOLATILE ORGANICS

Groundwater Volatile Organic Results for WEST SPRAY FIELDS

BEDROCK Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Chloro methane	Bromo methane	Vinyl Chloride	Chloro ethane	Methylene Chloride	Acetone	Carbon Disulfide	1,1-Dichloro ethene	1,1-Dichloro ethane	Trans 1,2 Dichloro ethene
West Spray Field Bedrock Wells														
5286	52-86-05-13-87	05/13/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5286	52-86-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
5286	52-86-08-19-87	08/19/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
5286	52-86-10-02-86	10/02/86		ug/l	10 U	10 U	10 U	10 U	5 U	3 JB	5 U	5 U	5 U	5 U
5286	52-86-10-02-87	10/02/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5286	52-86D-10-02-87	10/02/87	4	ppb	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
5286	52-86-10-02-87	10/02/87	4	ppb	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
5286	52-86-02-08-88	02/08/88	1	ug/l	10 U	10 U	10 U	10 U	8	10 U	5 U	5 U	5 U	5 U
4886	48-86-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4886	48-86-08-25-87	08/25/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
4886	48-86-04-08-87	04/08/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4886	48-86-12-14-87	12/14/87	4	ug/l	10 U	10 U	10 U	10 U	7	4 J	5 U	5 U	5 U	5 U
4686	G468611860	11/13/86		ug/l	10 U	10 U	10 U	10 U	1 JB	8 J	1 J	5 U	5 U	5 U
4686	46-86-05-14-87	05/14/87	1	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4686	46-86-06-22-87	06/22/87	2	ug/l	NR	NR	NR	NR	NR	NR	NR	4 U	NR	4 U
4686	46-86-08-14-87	08/14/87	3	ug/l	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
4686	46-86-10-05-87	10/05/87		ug/l	10 U	10 U	10 U	10 U	5 U	4 JB	5 U	5 U	5 U	5 U
4686	46-86-10-06-87	10/06/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-05-87	10/05/87	4	ppb	NR	NR	NR	NR	NR	NR	NR	5 U	NR	5 U
4686	46-86-02-12-88	02/12/88	1	ug/l	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U

Notes: NR = Analyte not reported
NA = Insufficient water in well for analysis
U = Analyzed but not detected
J = Present below detection limit
B = Present in laboratory blank

Groundwater Volatile Organic Results for WEST SPRAY FIELDS

BEDROCK Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Chloroform	1,2-Dichloro ethane	2-Butanone	1,1,1-Trichloro ethane	Carbon Tetra chloride	Vinyl Acetate	Bromo dichloro methane	1,2-Dichloro propane	Trans-1,3-Dichloro propene	Trichloro ethene
West Spray Field Bedrock Wells														
5286	52-86-05-13-87	05/13/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5286	52-86-06-18-87	06/18/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
5286	52-86-08-19-87	08/19/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
5286	52-86-10-02-86	10/02/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
5286	52-86-10-02-87	10/02/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5286	52-86D-10-02-87	10/02/87	4	ppb	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
5286	52-86-10-02-87	10/02/87	4	ppb	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
5286	52-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4886	48-86-06-18-87	06/18/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4886	48-86-08-25-87	08/25/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
4886	48-86-04-08-87	04/08/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4886	48-86-12-14-87	12/14/87	4	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4686	G468611860	11/13/86		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4686	46-86-05-14-87	05/14/87	1	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4686	46-86-06-22-87	06/22/87	2	ug/l	4 U	4 U	NR	4 U	4 U	NR	NR	NR	NR	4 U
4686	46-86-08-14-87	08/14/87	3	ug/l	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
4686	46-86-10-05-87	10/05/87		ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
4686	46-86-10-06-87	10/06/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-05-87	10/05/87	4	ppb	5 U	5 U	NR	5 U	5 U	NR	NR	NR	NR	5 U
4686	46-86-02-12-88	02/12/88	1	ug/l	5 U	5 U	10 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

Groundwater Volatile Organic Results for WEST SPRAY FIELDS

BEDROCK Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Dibromo chloro methane	1,1,2-Trichloro ethane	Benzene	cis 1,3-Dichloro propene	2-Chloro ethylvinyl ether	Bromoform	4-Methyl-2-pentanone	2-Hexanone	Tetrachloro ethene	1,1,2,2-Tetrachloro ethane
West Spray Field Bedrock Wells														
5286	52-86-05-13-87	05/13/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5286	52-86-06-18-87	06/18/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
5286	52-86-08-19-87	08/19/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
5286	52-86-10-02-86	10/02/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
5286	52-86-10-02-87	10/02/87			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5286	52-86D-10-02-87	10/02/87	4	ppb	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
5286	52-86-10-02-87	10/02/87	4	ppb	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
5286	52-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4886	48-86-06-18-87	06/18/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4886	48-86-08-25-87	08/25/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
4886	48-86-04-08-87	04/08/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4886	48-86-12-14-87	12/14/87	4	ug/l	5 U	5 U	5 U	5 U	NR	5 U	10 U	10 U	5 U	5 U
4686	G468611860	11/13/86		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4686	46-86-05-14-87	05/14/87	1	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4686	46-86-06-22-87	06/22/87	2	ug/l	NR	4 U	NR	NR	NR	NR	NR	NR	4 U	NR
4686	46-86-08-14-87	08/14/87	3	ug/l	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
4686	46-86-10-05-87	10/05/87		ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
4686	46-86-10-06-87	10/06/87	4		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-05-87	10/05/87	4	ppb	NR	5 U	NR	NR	NR	NR	NR	NR	5 U	NR
4686	46-86-02-12-88	02/12/88	1	ug/l	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

Groundwater Volatile Organic Results for WEST SPRAY FIELDS

BEDROCK Wells at Rockwell (Rocky Flats)

Well Number	Field Sample Number	Date Sampled	Qtr.	Units	Toluene	Chloro benzene	Ethyl benzene	Styrene	Total Xylenes
West Spray Field Bedrock Wells									
5286	52-86-05-13-87	05/13/87	1	ug/l	NR	NR	NR	NR	NR
5286	52-86-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR
5286	52-86-08-19-87	08/19/87	3	ug/l	NR	NR	NR	NR	NR
5286	52-86-10-02-86	10/02/86		ug/l	5 U	5 U	5 U	5 U	5 U
5286	52-86-10-02-87	10/02/87			NA	NA	NA	NA	NA
5286	52-86D-10-02-87	10/02/87	4	ppb	NR	NR	NR	NR	NR
5286	52-86-10-02-87	10/02/87	4	ppb	NR	NR	NR	NR	NR
5286	52-86-02-08-88	02/08/88	1	ug/l	5 U	5 U	5 U	5 U	5 U
4886	48-86-06-18-87	06/18/87	2	ug/l	NR	NR	NR	NR	NR
4886	48-86-08-25-87	08/25/87	3	ug/l	NR	NR	NR	NR	NR
4886	48-86-04-08-87	04/08/87	1	ug/l	NR	NR	NR	NR	NR
4886	48-86-12-14-87	12/14/87	4	ug/l	5 U	5 U	5 U	5 U	5 U
4686	G468611B60	11/13/86		ug/l	1 J	5 U	5 U	5 U	5 U
4686	46-86-05-14-87	05/14/87	1	ug/l	NR	NR	NR	NR	NR
4686	46-86-06-22-87	06/22/87	2	ug/l	NR	NR	NR	NR	NR
4686	46-86-08-14-87	08/14/87	3	ug/l	NR	NR	NR	NR	NR
4686	46-86-10-05-87	10/05/87		ug/l	5 U	5 U	5 U	5 U	5 U
4686	46-86-10-06-87	10/06/87	4		NA	NA	NA	NA	NA
4686	46-86-10-05-87	10/05/87	4	ppb	NR	NR	NR	NR	NR
4686	46-86-02-12-88	02/12/88	1	ug/l	5 U	5 U	5 U	5 U	5 U

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis
U : Analyzed but not detected
J : Present below detection limit
B : Present in laboratory blank

RADIONUCLIDES

Groundwater Radiochemistry Results

for Regulated Units at Rocky Flats Plant

Well Number	Field Sample Number	Date Sampled	Qtr.	Gross Alpha	Gross Beta	Uranium 233, 234	Uranium 235	Uranium 238	Strontium 89, 90	Plutonium 239, 240
West Spray Field Bedrock Wells										
5286	52-86-05-13-87	05/13/87	1	36 +/- 29 pc/l	11 +/- 71 pc/l	.09 +/- .64 pc/l	0.0 +/- .28 pc/l	.31 +/- .46 pc/l	0.8 pc/l	.12 +/- .67 pc/l
5286	52-86-06-18-87	06/18/87	2	11 +/- 3 pci/l	-2 +/- 13 pci/l	0.0 +/- 0.5 pci/l	0.0 +/- 0.3 pci/l	0.2 +/- 0.4 pci/l	<1.0 pci/l	0.3 +/- 0.7 pci/l
5286	52-86-08-19-87	08/19/87	3	10 +/- 19 pci/l	38 +/- 46 pci/l	0.0 +/- 1.1 pci/l	0.1 +/- 0.4 pci/l	0.0 +/- 0.7 pci/l	<1.0 pci/l	1.8 +/- 1.3 pci/l
5286	52-86-10-02-86	10/02/86		NA	NA	NA	NA	NA	NA	NA
5286	52-86-10-02-87	10/02/87		NR	NR	0.074 +/- 0.150 pci/l	NR	0.053 +/- 0.058 pci/l	NR	-0.003 +/- 0.060 pci/l
5286	52-86D-10-02-87	10/02/87	4	NR	NR	0.407 +/- 0.177 pci/l	NR	0.307 +/- 0.084 pci/l	NR	-0.019 +/- 0.056 pci/l
5286	52-86-10-02-87	10/02/87	4	2 +/- 4 pci/l	-3 +/- 9 pci/l	.04 +/- .07 pci/l	0.00 +/- .02 pci/l	.05 +/- .05 pci/l	<1.0 pci/l	0.00 +/- .03 pci/l
5286	52-86-02-08-88	02/08/88	1	4 +/- 4 pci/l	11 +/- 12 pci/l	6.0 +/- 1.5 mg/l	0.25 +/- 0.25 pci/l	1.8 +/- 0.7 pci/l	NR	0.00 +/- 0.16 pci/l
4886	48-86-06-18-87	06/18/87	2	27 +/- 3 pci/l	67 +/- 22 pci/l	1.8 +/- 0.8 pci/l	0.06 +/- 0.32 pci/l	1.2 +/- 0.6 pci/l	<1.0 pci/l	0.03 +/- 0.63 pci/l
4886	48-86-08-25-87	08/25/87	3	9 +/- 18 pci/l	-6 +/- 37 pci/l	0.8 +/- 1.5 pci/l	-0.1 +/- 0.6 pci/l	0.0 +/- 1.5 pci/l	3.7 pci/l	-.32 +/- .78 pci/l
4886	48-86-04-08-87	04/08/87	1	-7 +/- 3 pci/l	11 +/- 2 pci/l	4.4 +/- 5.1 pci/l	0.0 +/- .52 pci/l	1.1 +/- 5.0 pci/l	NR	0.0 +/- 1.1 pci/l
4886	48-86-12-14-87	12/14/87	4	4 +/- 5 pci/l	8 +/- 9 pci/l	.27 +/- .17 pci/l	.05 +/- .04 pci/l	.42 +/- .13 pci/l	<1.0 pci/l	0.00 +/- .14 pci/l
4686	G468611860	11/13/86		NA	NA	NA	NA	NA	NA	NA
4686	46-86-05-14-87	05/14/87	1	184 +/- 33 pc/l	95 +/- 5 pc/l	5.7 +/- 1.2 pc/l	.50 +/- .42 pc/l	3.9 +/- 1.0 pc/l	5.04 pc/l	0.0 +/- .77 pc/l
4686	46-86-06-22-87	06/22/87	2	16 +/- 3 pci/l	4 +/- 17 pci/l	4.0 +/- 1.4 pci/l	0.5 +/- 0.6 pci/l	2.3 +/- 1.0 pci/l	<1.0 pci/l	0.0 +/- [illegible] pci/l
4686	46-86-08-14-87	08/14/87	3	23 +/- 22 pci/l	5 +/- [illegible] pci/l	3.9 +/- 1.6 pci/l	0.3 +/- 0.4 pci/l	7.5 +/- 1.7 pci/l	1.9 pci/l	01 +/- [illegible] pci/l
4686	46-86-10-05-87	10/05/87		NA	NA	NA	NA	NA	NA	NA
4686	46-86-10-06-87	10/06/87	4	NR	NR	4.244 +/- 0.669 pci/l	NR	2.306 +/- 0.330 pci/l	NR	0.034 +/- 0.038 pci/l
4686	46-86-10-05-87	10/05/87	4	NR	NR	2.6 +/- 0.4 pci/l	.09 +/- .06 pci/l	1.2 +/- 0.2 pci/l	<1.0 pci/l	0.00 +/- .07 pci/l
4686	46-86-02-12-88	02/12/88	1	7 +/- 4 pci/l	9 +/- 13 pci/l	1.9 +/- 0.6 pci/l	0.05 +/- 0.15 pci/l	1.3 +/- 0.4 pci/l	NR	0.02 +/- 0.14 pci/l

Notes: NR : Analyte not reported
NA : Insufficient water in well for analysis

APPENDIX E

1986 ANALYTICAL DATA
SOLAR PONDS 207B-NORTH, WEST SPRAY FIELD, BUFFER ZONE, AND INTERCEPTOR TRENCH PUMP HOUSE

APPENDIX 1

ROY F. WESTON, INC.
LABORATORY TEST RESULTS

SOLAR PONDS 207-A AND 207-B NORTH
WEST SPRAY FIELD,
BUFFER ZONE AND INTERCEPTOR
TRENCH PUMP HOUSE

INTRODUCTION

The results presented herein are for samples from Solar Evaporation Ponds 207-A and 207-B North, west spray field, buffer zone and interceptor trench pump house collected in April and May 1986 and resampling of the interceptor trench pump house in August 1986.

The samples are generally designated by a three character code. The last character designates the analytical sample code as shown in Table A. The remaining portion of the codes are as follows:

Soils and Sediment

Samples from the buffer zone and west spray field are designated by a three character code. The first character of the code indicates the composite sample number, 1, 2 or 3. The second character, A, B or C for the buffer zone or D, E or F for the spray field, indicates the sample depth, surface, 0 to 6 inches or 6 to 12 inches, in order.

For sediment from the interceptor trench pump house the first character, S, indicates a sediment sample. The second

TABLE A

ANALYTICAL SAMPLE CODE

Sample Type	Code	Designation
Soil/ Sediment	1	Volatiles
	2	Semi-Volatiles
	3	Metals and Cyanide
	4	RCRA Waste Characteristics
	5	Radiochemistry
Water	1	Volatiles
	2	Semi-Volatiles
	3	Metals
	4	Cyanide
	5	Phenolics
	6	RCRA Waste Characteristics
	7	Radiochemistry
	8	Tritium

character, A or B, indicates the initial or duplicate sample, respectively. In the resampling, the sample code has a prefix of ITPH.

Sediment from Pond 207-A is designated with a 207-A prefix and three character code. The first character, S, indicates a sediment sample. The second character, A, B or C indicates the location, north, center or south end, respectively, along the west side of the pond.

Water

For the interceptor trench pump house water sample the first character, L, indicates a liquid sample. The liquid was sampled in triplicate, A, B or C, designated by the second character. The zero or 0 second character indicates the field blank sample. In the resampling, the sample code has a prefix of ITPH.

The 207-A pond water is designated by a prefix of 207A and a two character code. The first character, A, B or C, indicates the sample location, north, center or south end, respectively, along the west side of the pond.

The 207-B North pond water is designated by a prefix 207B and a two character code. The first character of the code is the same as described for the 207-A pond samples.

EXPLANATION FOR ANALYSES DATA PACKAGE

NR	-	Not required by contract at this time
[ ]	-	The result is a value greater than or equal to the instrument detection limit but less than the contract required detection limit.
U	-	Indicated element was analyzed for but not detected. Report with the detection limit value (e.g., 1OU).
E	-	Indicates a value estimated or not reported due to the presence of interference. Explanatory note included on cover page.
s	-	Indicates value determined by Method of Standard Addition.
R	-	Indicates spike sample recovery is not within control limits.
*	-	Indicates duplicate analysis is not within control limits.
+	-	Indicates the correlation coefficient for method of standard addition is less than 0.995.

Solar Pond 207A liquor

VOLATILE COMPOUNDS

Compound ug/l	Sample Numbers A1	B1	C1
Chloromethane	1000U	100U	NA
Bromomethane	1000U	100U	
Vinyl Chloride	1000U	100U	
Chloroethane	1000U	100U	
Methylene Chloride	500U	50U	
Acetone	*260J	*100J	
Carbon Disulfide	500U	50U	
1,1 Dichloroethene	500U	50U	
1,1 Dichloroethane	500U	50U	
Trans-1,2- Dichloroethene	500U	50U	
Chloroform	500U	50U	
1,2 Dichloroethane	500U	50U	
2-Butanone	1000U	100U	
1,1,1-Trichloroethane	500U	50U	
Carbon Tetrachloride	500U	50U	
Vinyl Acetate	1000U	100U	
Bromodichloromethane	500U	50U	
1,2 Dichloropropane	500U	50U	
Trans-1,3-Dichloropropene	500U	50U	
Trichloroethene	500U	50U	
Dibromochloromethane	500U	50U	
1,1,2-Trichloroethane	500U	50U	
Benzene	500U	50U	
cis-1,3-Dichloropropene	500U	50U	
2-Chloroethylvinylether	1000U	100U	
Bromoform	500U	50U	
4-Methyl-2-Pentanone	1000U	100U	
2-Hexanone	1000U	100U	
Tetrachloroethene	500U	50U	
1,1,2,2-Tetrachloroethane	500U	50U	
Toluene	500U	50U	
Chlorobenzene	500U	50U	
Ethylbenzene	500U	50U	
Styrene	500U	50U	
Total Xylenes	500U	50U	

U - indicates that compound was analyzed for but not detected. The number associated with the letter U is the minimum detection limit attainable for the sample.

J - indicates an estimated value.

Solar Pond 207A Sediments

VOLATILE COMPOUNDS

Compound ug/Kg	Sample Number SA1	SB1	SC1
Chloromethane	3600U	36U	4000U
Bromomethane	3600U	36U	4000U
Vinyl Chloride	3600U	36U	4000U
Chloroethane	3600U	36U	4000U
Methylene Chloride	1800U	18U	2000U
Acetone	* 4680	* 5JB	*1600JB
Carbon Disulfide	1800U	18U	2000U
1,1 Dichloroethene	1800U	18U	2000U
1,1 Dichloroethane	1800U	18U	2000U
Trans-1,2- Dichloroethene	1800U	18U	2000U
Chloroform	1800U	18U	2000U
1,2 Dichloroethane	1800U	18U	2000U
2-Butanone	3600U	36U	4000U
1,1,1-Trichloroethane	1800U	18U	2000U
Carbon Tetrachloride	1800U	18U	2000U
Vinyl Acetate	3600U	36U	4000U
Bromodichloromethane	1800U	18U	2000U
1,2 Dichloropropane	1800U	18U	2000U
Trans-1,3-Dichloropropene	1800U	18U	2000U
Trichloroethene	1800U	18U	2000U
Dibromochloromethane	1800U	18U	2000U
1,1,2-Trichloroethane	1800U	18U	2000U
Benzene	1800U	18U	2000U
cis-1,3-Dichloropropene	1800U	18U	2000U
2-Chloroethylvinylether	3600U	36U	4000U
Bromoform	1800U	18U	2000U
4-Methyl-2-Pentanone	3600U	36U	4000U
2-Hexanone	3600U	36U	4000U
Tetrachloroethene	1800U	*200B	*1200JB
1,1,2,2-Tetrachloroethane	1800U	18U	2000U
Toluene	1800U	18U	2000U
Chlorobenzene	1800U	18U	2000U
Ethylbenzene	1800U	18U	2000U
Styrene	1800U	18U	2000U
Total Xylenes	1800U	18U	2000U

U - indicates compound was analyzed for but not detected. The number associated with the letter U is the minimum attainable detection limit for the sample.

J - indicates an estimated value.
B - analyte was found in blank as well as the sample; indicates possible blank contamination.

Solar Pond 207B liquor

VOLATILE COMPOUNDS

Compound ug/l	Sample Numbers A1	B1	C1	01
Chloromethane	10U	10U	10U	10U
Bromomethane	10U	10U	10U	10U
Vinyl Chloride	10U	10U	10U	10U
Chloroethane	10U	10U	10U	10U
Methylene Chloride	*28B	*35B	*19B	*71B
Acetone	10U	10U	10U	10U
Carbon Disulfide	5U	5U	5U	5U
1,1 Dichloroethene	5U	5U	5U	5U
1,1 Dichloroethane	5U	5U	5U	5U
Trans-1,2- Dichloroethene	5U	5U	5U	5U
Chloroform	5U	5U	5U	5U
1,2 Dichloroethane	5U	5U	5U	5U
2-Butanone	10U	10U	10U	*20
1,1,1-Trichloroethane	5U	5U	5U	5U
Carbon Tetrachloride	5U	5U	5U	5U
Vinyl Acetate	10U	10U	10U	10U
Bromodichloromethane	5U	5U	5U	5U
1,2 Dichloropropane	5U	5U	5U	5U
Trans-1,3-Dichloropropene	5U	5U	5U	5U
Trichloroethene	5U	5U	5U	5U
Dibromochloromethane	5U	5U	5U	5U
1,1,2-Trichloroethane	5U	5U	5U	5U
Benzene	5U	5U	5U	5U
cis-1,3-Dichloropropene	5U	5U	5U	5U
2-Chloroethylvinylether	10U	10U	10U	10U
Bromoform	5U	5U	5U	5U
4-Methyl-2-Pentanone	10U	10U	10U	10U
2-Hexanone	10U	10U	10U	10U
Tetrachloroethene	5U	5U	5U	5U
1,1,2,2-Tetrachloroethane	5U	5U	5U	5U
Toluene	5U	5U	5U	5U
Chlorobenzene	5U	5U	5U	5U
Ethylbenzene	5U	5U	5U	5U
Styrene	5U	5U	5U	5U
Total Xylenes	5U	5U	5U	5U

U - Indicates compound was analyzed for but not detected. The number associated with the letter U is the minimum attainable detection limit for the sample.

B - Analyte was found in the blank as well as the sample; indicates possible blank contamination.

Interceptor Trench Pump House Water

VOLATILE COMPOUNDS

Sample Numbers

Compound ug/l	LA1	LB1	LC1	L01
Chloromethane	10U	10U	10U	10U
Bromomethane	10U	10U	10U	10U
Vinyl Chloride	10U	10U	10U	10U
Chloroethane	10U	10U	10U	10U
Methylene Chloride	*3BJ	*10B	*14B	*99B
Acetone	10U	10U	10U	10U
Carbon Disulfide	5U	5U	5U	5U
1,1 Dichloroethene	5U	5U	5U	5U
1,1 Dichloroethane	5U	5U	5U	5U
Trans-1,2- Dichloroethene	5U	5U	5U	5U
Chloroform	*3J	*6	5U	3J
1,2 Dichloroethane	5U	5U	5U	5U
2-Butanone	10U	10U	10U	*110
1,1,1-Trichloroethane	5U	5U	5U	5U
Carbon Tetrachloride	*7	*6	*7	5U
Vinyl Acetate	10U	10U	10U	10U
Bromodichloromethane	5U	5U	5U	5U
1,2 Dichloropropane	5U	5U	5U	5U
Trans-1,3-Dichloropropene	5U	5U	5U	5U
Trichloroethene	*7	*8	*8	5U
Dibromochloromethane	5U	5U	5U	5U
1,1,2-Trichloroethane	5U	5U	5U	5U
Benzene	*1J	5U	5U	5U
cis-1,3-Dichloropropene	5U	5U	5U	5U
2-Chloroethylvinylether	10U	10U	10U	10U
Bromoform	5U	5U	5U	5U
4-Methyl-2-Pentanone	10U	10U	10U	10U
2-Hexanone	10U	10U	10U	10U
Tetrachloroethene	5U	5U	5U	5U
1,1,2,2-Tetrachloroethane	5U	5U	5U	5U
Toluene	5U	5U	5U	5U
Chlorobenzene	5U	5U	5U	5U
Ethylbenzene	5U	5U	5U	5U
Styrene	5U	5U	5U	5U
Total Xylenes	5U	5U	5U	5U

U - Indicates compound was analyzed for but not detected. The number associated with the letter U is the minimum attainable detection limit for the sample.

J - Indicates an estimated value.

B - Analyte was found in blank as well as the sample indicating possible blank contamination.

Interceptor Trench Pump House Sediments

VOLATILE COMPOUNDS

Compound ug/Kg	Sample Numbers SA1	SB1
Chloromethane	17U	16U
Bromomethane	17U	16U
Vinyl Chloride	17U	16U
Chloroethane	17U	16U
Methylene Chloride	*44B	*27B
Acetone	*23	*47
Carbon Disulfide	*3BJ	*5JB
1,1 Dichloroethene	8U	8U
1,1 Dichloroethane	8U	8U
Trans-1,2- Dichloroethene	8U	8U
Chloroform	8U	8U
1,2 Dichloroethane	8U	8U
2-Butanone	17U	16U
1,1,1-Trichloroethane	8U	8U
Carbon Tetrachloride	8U	8U
Vinyl Acetate	17U	16U
Bromodichloromethane	8U	8U
1,2 Dichloropropane	8U	8U
Trans-1,3-Dichloropropene	8U	8U
Trichloroethene	3J	*2J
Dibromochloromethane	8U	8U
1,1,2-Trichloroethane	8U	8U
Benzene	8U	8U
cis-1,3-Dichloropropene	8U	8U
2-Chloroethylvinylether	17U	16U
Bromoform	8U	8U
4-Methyl-2-Pentanone	17U	16U
2-Hexanone	17U	16U
Tetrachloroethene	8U	8U
1,1,2,2-Tetrachloroethane	8U	8U
Toluene	8U	*7J
Chlorobenzene	8U	8U
Ethylbenzene	8U	8U
Styrene	8U	8U
Total Xylenes	8U	8U

U - Indicates compound was analyzed for but not detected. The number associated with the letter U is the minimum detection limit attainable for the sample.

J - Indicates as estimated value.

B - Analyte was found in the blank as well as the sample indicating possible blank contamination.

West Spray Field - High Application Area Soils

VOLATILE COMPOUNDS

Compound ug/Kg	Composite 1 Sample Numbers surface scrape 1D1	0-6" 1E1	6-12" 1F1
Chloromethane	12U	13U	12U
Bromomethane	12U	13U	12U
Vinyl Chloride	12U	13U	12U
Chloroethane	12U	13U	12U
Methylene Chloride	*36B	*37B	*33B
Acetone	12U	13U	12U
Carbon Disulfide	6U	6U	6U
1,1 Dichloroethene	6U	6U	6U
1,1 Dichloroethane	6U	6U	6U
Trans-1,2- Dichloroethene	6U	6U	6U
Chloroform	6U	*2J	6U
1,2 Dichloroethane	6U	6U	6U
2-Butanone	12U	13U	12U
1,1,1-Trichloroethane	6U	6U	*2J
Carbon Tetrachloride	6U	6U	6U
Vinyl Acetate	12U	13U	12U
Bromodichloromethane	6U	6U	6U
1,2 Dichloropropane	6U	6U	6U
Trans-1,3-Dichloropropene	6U	6U	6U
Trichloroethene	6U	6U	6U
Dibromochloromethane	6U	6U	6U
1,1,2-Trichloroethane	6U	6U	*2J
Benzene	6U	6U	6U
cis-1,3-Dichloropropene	6U	6U	6U
2-Chloroethylvinylether	12U	13U	12U
Bromoform	6U	6U	6U
4-Methyl-2-Pentanone	12U	13U	12U
2-Hexanone	12U	13U	12U
Tetrachloroethene	6U	6U	6U
1,1,2,2-Tetrachloroethane	6U	6U	6U
Toluene	6U	6U	6U
Chlorobenzene	6U	6U	6U
Ethylbenzene	6U	6U	6U
Styrene	6U	6U	6U
Total Xylenes	6U	6U	6U

U - Indicates compound was analyzed for but not detected. The number associated with the letter U is the minimum attainable detection limit for the sample.

J - Indicates an estimated value.

B - Analyte was found in blank as well as the sample indicating possible blank contamination.

West Spray Field - High Application Area Soils

VOLATILE COMPOUNDS

Composite 2 - Sample Numbers

Compound ug/Kg	surface scrape 2D1	0-6" 2E1	6-12" 2F1
Chloromethane	14U	13U	12U
Bromomethane	14U	13U	12U
Vinyl Chloride	14U	13U	12U
Chloroethane	14U	13U	12U
Methylene Chloride	*29B	*70B	*33B
Acetone	*25B	*14B	6U
Carbon Disulfide	7U	6U	*2J
1,1 Dichloroethene	7U	6U	6U
1,1 Dichloroethane	7U	6U	6U
Trans-1,2- Dichloroethene	7U	6U	6U
Chloroform	7U	6U	*27
1,2 Dichloroethane	7U	6U	6U
2-Butanone	14U	13U	12U
1,1,1-Trichloroethane	7U	6U	6U
Carbon Tetrachloride	7U	6U	6U
Vinyl Acetate	14U	13U	12U
Bromodichloromethane	7U	6U	6U
1,2 Dichloropropane	7U	6U	6U
Trans-1,3-Dichloropropene	7U	6U	6U
Trichloroethene	7U	6U	6U
Dibromochloromethane	7U	6U	6U
1,1,2-Trichloroethane	7U	6U	6U
Benzene	7U	6U	6U
cis-1,3-Dichloropropene	7U	6U	6U
2-Chloroethylvinylether	14U	13U	12U
Bromoform	7U	6U	6U
4-Methyl-2-Pentanone	14U	13U	12U
2-Hexanone	14U	13U	12U
Tetrachloroethene	7U	6U	6U
1,1,2,2-Tetrachloroethane	7U	6U	6U
Toluene	*21	6U	*7
Chlorobenzene	7U	6U	6U
Ethylbenzene	7U	6U	6U
Styrene	7U	6U	6U
Total Xylenes	7U	6U	6U

U - Indicates compound was analyzed for but not detected. The number associated with the letter U is the minimum attainable detection limit for the sample.

J - Indicates an estimated value.

B - Analyte was found in blank as well as the sample indicating possible blank contamination.

West Spray Field - High Application Area Soils

VOLATILE COMPOUNDS

Composite 3 - Sample Numbers

Compound ug/Kg	surface scrape 3D1	0-6" 3E1	6-12" 3F1
Chloromethane	13U	13U	14U
Bromomethane	13U	13U	14U
Vinyl Chloride	13U	13U	14U
Chloroethane	13U	13U	14U
Methylene Chloride	*34B	*33B	*29B
Acetone	7U	6U	*29
Carbon Disulfide	*2BJ	*2BJ	* 2BJ
1,1 Dichloroethene	7U	6U	7U
1,1 Dichloroethane	7U	6U	7U
Trans-1,2- Dichloroethene	7U	6U	7U
Chloroform	7U	6U	7U
1,2 Dichloroethane	7U	6U	7U
2-Butanone	13U	13U	14U
1,1,1-Trichloroethane	7U	6U	7U
Carbon Tetrachloride	7U	6U	7U
Vinyl Acetate	13U	13U	14U
Bromodichloromethane	7U	6U	7U
1,2 Dichloropropane	7U	6U	7U
Trans-1,3-Dichloropropene	7U	6U	7U
Trichloroethene	7U	6U	7U
Dibromochloromethane	7U	6U	7U
1,1,2-Trichloroethane	7U	6U	7U
Benzene	7U	6U	7U
cis-1,3-Dichloropropene	7U	6U	7U
2-Chloroethylvinylether	13U	13U	14U
Bromoform	7U	6U	7U
4-Methyl-2-Pentanone	13U	13U	14U
2-Hexanone	13U	13U	14U
Tetrachloroethene	7U	6U	7U
1,1,2,2-Tetrachloroethane	7U	6U	7U
Toluene	*2J	*43	7U
Chlorobenzene	7U	6U	7U
Ethylbenzene	7U	6U	7U
Styrene	7U	6U	7U
Total Xylenes	7U	6U	7U

U - Indicates compound was analyzed for but not detected. The number associated with the letter U is the minimum attainable detection limit for the sample.

J - Indicates an estimated value.

B - Analyte was found in blank as well as the sample indicating possible blank contamination.

Buffer Zone Soils

VOLATILE COMPOUNDS

Composite 1 - Sample Numbers

Compound ug/Kg	surface scrape 1A1	0-6" 1B1	6-12" 1C1
Chloromethane	10U	13U	14U
Bromomethane	10U	13U	14U
Vinyl Chloride	10U	13U	14U
Chloroethane	10U	13U	14U
Methylene Chloride	5U	*46B	*39B
Acetone	10U	13U	*130
Carbon Disulfide	5U	*3BJ	*3BJ
1,1 Dichloroethene	5U	6U	7U
1,1 Dichloroethane	5U	6U	7U
Trans-1,2- Dichloroethene	5U	6U	7U
Chloroform	5U	6U	7U
1,2 Dichloroethane	5U	6U	7U
2-Butanone	10U	13U	*61
1,1,1-Trichloroethane	5U	6U	7U
Carbon Tetrachloride	5U	6U	7U
Vinyl Acetate	10U	13U	14U
Bromodichloromethane	5U	6U	7U
1,2 Dichloropropane	5U	6U	7U
Trans-1,3-Dichloropropene	5U	6U	7U
Trichloroethene	5U	6U	7U
Dibromochloromethane	5U	6U	7U
1,1,2-Trichloroethane	5U	6U	7U
Benzene	5U	6U	7U
cis-1,3-Dichloropropene	5U	6U	7U
2-Chloroethylvinylether	10U	13U	14U
Bromoform	5U	6U	7U
4-Methyl-2-Pentanone	10U	13U	14U
2-Hexanone	10U	13U	14U
Tetrachloroethene	5U	6U	7U
1,1,2,2-Tetrachloroethane	5U	6U	7U
Toluene	*1JB	6U	*3J
Chlorobenzene	5U	6U	7U
Ethylbenzene	5U	6U	7U
Styrene	5U	6U	7U
Total Xylenes	5U	6U	7U

U - Indicates compound was analyzed for but not detected. The number associated with the letter U is the minimum attainable detection limit for the sample.

J - Indicates an estimated value.

Field or lab

B - Analyte was found in blank as well as the sample indicating possible blank contamination.

Buffer Zone Soils

VOLATILE COMPOUNDS

Composite 2 - Sample Numbers

Compound	ug/Kg	surface scrape 2A1	0-6" 2B1	6-12" 2C1
Chloromethane		10U	13U	NA
Bromomethane		10U	13U	
Vinyl Chloride		10U	13U	
Chloroethane		10U	13U	
Methylene Chloride		5U	*32B	
Acetone		*10B	13U	
Carbon Disulfide		5U	*2BJ	
1,1 Dichloroethene		5U	6U	
1,1 Dichloroethane		5U	6U	
Trans-1,2- Dichloroethene		5U	6U	
Chloroform		5U	6U	
1,2 Dichloroethane		5U	6U	
2-Butanone		10U	13U	
1,1,1-Trichloroethane		5U	6U	
Carbon Tetrachloride		5U	6U	
Vinyl Acetate		10U	13U	
Bromodichloromethane		5U	6U	
1,2 Dichloropropane		5U	6U	
Trans-1,3-Dichloropropene		5U	6U	
Trichloroethene		5U	6U	
Dibromochloromethane		5U	6U	
1,1,2-Trichloroethane		5U	6U	
Benzene		5U	6U	
cis-1,3-Dichloropropene		5U	6U	
2-Chloroethylvinylether		10U	13U	
Bromoform		5U	6U	
4-Methyl-2-Pentanone		10U	13U	
2-Hexanone		10U	13U	
Tetrachloroethene		5U	6U	
1,1,2,2-Tetrachloroethane		5U	6U	
Toluene		*1JB	6U	
Chlorobenzene		5U	6U	
Ethylbenzene		5U	6U	
Styrene		5U	6U	
Total Xylenes		5U	6U	

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J - Indicates an estimated value.

B - Analyte was found in blank as well as the sample indicating possible blank contamination.

Buffer Zone Soils

VOLATILE COMPOUNDS

composite 3 - Sample Numbers

Compound ug/Kg	surface scrape 3A1	0-6" 3B1	6-12" 3C1
Chloromethane	10U	13U	13U
Bromomethane	10U	13U	13U
Vinyl Chloride	10U	13U	13U
Chloroethane	10U	13U	13U
Methylene Chloride	5U	*32B	*28B
Acetone	*10B	13U	*71
Carbon Disulfide	5U	*2BJ	6U
1,1 Dichloroethene	5U	7U	6U
1,1 Dichloroethane	5U	7U	6U
Trans-1,2- Dichloroethene	5U	7U	6U
Chloroform	5U	7U	6U
1,2 Dichloroethane	5U	7U	6U
2-Butanone	10U	*20	*26
1,1,1-Trichloroethane	5U	7U	6U
Carbon Tetrachloride	5U	7U	6U
Vinyl Acetate	10U	13U	13U
Bromodichloromethane	5U	7U	6U
1,2 Dichloropropane	5U	7U	6U
Trans-1,3-Dichloropropene	5U	7U	6U
Trichloroethene	5U	7U	6U
Dibromochloromethane	5U	7U	6U
1,1,2-Trichloroethane	5U	7U	6U
Benzene	5U	7U	6U
cis-1,3-Dichloropropene	5U	7U	6U
2-Chloroethylvinylether	10U	13U	13U
Bromoform	5U	7U	6U
4-Methyl-2-Pentanone	10U	13U	13U
2-Hexanone	10U	13U	13U
Tetrachloroethene	5U	7U	6U
1,1,2,2-Tetrachloroethane	5U	7U	6U
Toluene	*1JB	7U	6U
Chlorobenzene	5U	7U	6U
Ethylbenzene	5U	7U	6U
Styrene	5U	7U	6U
Total Xylenes	5U	7U	6U

U - Indicates compound was analyzed for but not detected. The number associated with the letter U is the minimum attainable detection limit for the sample.

J - Indicates an estimated value.

B - Analyte was found in blank as well as the sample indicating possible blank contamination.

Accu-Labs Research, Inc.
11485 W. 48th Avenue Wheat Ridge, Colorado 80033
(303) 423-2766

July 16, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail Street
Denver, CO 80215

RE: 9299-21884-6
Date Samples Rec'd 5-7-86
Project 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21884-6-5	9299-21884-6-6
Sponsor Designation	207A-B7 Solar Pond Depth ≈ 4" 5-7-86	207A-B8 Solar Pond Depth ≈ 4" 5-7-86
Determination: pCi/L		
Gross Alpha, ± counting error*	80000 ± 6000	--
Gross Beta, ± counting error*	40000 ± 2000	--
Plutonium-239, ± counting error*	660 ± 50	--
Americium-241, ± counting error*	45 ± 14	--
Uranium-233 + 234, ± counting error*	14000 ± 1000	--
Uranium-238, ± counting error*	21000 ± 1000	--
Tritium, ± counting error*	--	930 ± 260

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Bud Summers
Radiochemistry
Supervisor

BS/dh

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11485 W. 48th Avenue Wheat Ridge, Colorado 80033
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July 17, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail Street
Denver, CO 80215

RE: 9299-21856-6
Date Samples Rec'd 5-1-86
Project 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21856-6-5	9299-21856-6-6
Sponsor Designation	207A-A7 Solar Pond Northwest 5-1-86	207A-A8 Solar Pond Northwest 5-1-86
Determination: pCi/L		
Gross Alpha, dissolved, ± counting error*	46000 ± 4000	--
Gross Beta, dissolved, ± counting error*	37000 ± 2000	--
Plutonium-239, dissolved, ± counting error*	84 ± 16	--
Americium-241, dissolved, ± counting error*	-2.2 ± 3.6	--
Uranium-233 + 234, dissolved, ± counting error*	17000 ± 1000	--
Uranium-238, dissolved, ± counting error*	22000 ± 1000	--
Tritium, total, ± counting error*	--	610 ± 270

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Bud Summers
Radiochemistry
Supervisor

BS/dh dh

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11485 W. 48th Avenue Wheat Ridge, Colorado 80033
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July 17, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail Street
Denver, CO 80215

RE: 9299-21870-8
Date Samples Rec'd 5-6-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21870-8-5	9299-21870-8-6	9299-21870-8-7	9299-21870-8-8
Sponsor Designation	207A-SA7 Solar Pond NW Corner 5-5-86	207A-SA8 Solar Pond NW Corner 5-5-86	207A-SA9 Solar Pond NW Corner 5-5-86	207A-SA10 Solar Pond NW Corner 5-5-86
Determination: pCi/g (dry)				
Gross Alpha, ± counting error*	14000 ± 1000	--	7400 ± 200	--
Gross Beta, ± counting error*	560 ± 50	--	160 ± 20	--
Plutonium-239, ± counting error*	3700 ± 100	--	1500 ± 100	--
Americium-241, ± counting error*	4400 ± 100	--	2800 ± 100	--
Uranium-233 + Uranium-234, ± counting error*	200 ± 20	--	570 ± 30	--
Uranium-238, ± counting error*	130 ± 10	--	280 ± 20	--
Tritium, ± counting error*, pCi/L	--	9300 ± 800	--	12000 ± 1000
Air Dry Loss, %	--	76.7	--	73.2

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Bud Summers
Radiochemistry Supervisor

BS/dh

Accu-Labs Research, Inc.
11485 W. 48th Avenue Wheat Ridge, Colorado 80033
(303) 423-2766

July 17, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail Street
Denver, CO 80215

RE: 9299-21890-6
Date Samples Rec'd 5-8-86
Project 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21890-6-5	9299-21890-6-6
Sponsor Designation	207A-SB7 Solar Pond Center West 5-8-86	207A-SB8 Solar Pond Center West 5-8-86
Determination: pCi/g (dry)		
Gross Alpha, ± counting error*	4700 ± 200	--
Gross Beta, ± counting error*	190 ± 40	--
Plutonium-239, ± counting error*	3400 ± 100	--
Americium-241, ± counting error*	1400 ± 200	--
Uranium-233 + 234, ± counting error*	180 ± 20	--
Uranium-238, ± counting error*	210 ± 20	--
Tritium, ± counting error*, pCi/L	--	2400 ± 600
Air Dry Loss, %	--	78.3

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Bud Summers
Radiochemistry
Supervisor

BS/dh

Accu-Labs Research, Inc.
11485 W 48th Avenue Wheat Ridge, Colorado 80033
(303) 423-2766

July 21, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail Street
Denver, CO 80215

RE: 9299-21907-6
Date Samples Rec'd 5-12-86
Project 2029-13-03-01

CORRECTED REPORT

REPORT OF ANALYSIS

ALR Designation	9299-21907-6-5	9299-21907-6-6
Sponsor Designation	207A-SC7 Solar Pond SW Corner 5-12-86	207A-SC8 Solar Pond SW Corner 5-12-86
Determination: pCi/g (dry)		
Gross Alpha, ± counting error*	12000 ± 1000	--
Gross Beta, ± counting error*	1400 ± 100	--
Plutonium-239, ± counting error*	1700 ± 100	--
Americium-241, ± counting error*	3500 ± 100	--
Uranium-233 + 234, ± counting error*	120 ± 20	--
Uranium-238, ± counting error*	480 ± 30	--
Tritium, ± counting error*, pCi/L	--	1300 ± 500
Air Dry Loss, %	75.7	--

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

Bud Summers
Radiochemistry
Supervisor

BS/dh

Accu-Labs Research, Inc.
11485 W. 48th Avenue Wheat Ridge, Colorado 80033
(303) 423-2766

July 17, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail Street
Denver, CO 80215

RE: 9299-21907-6
Date Samples Rec'd 5-12-86
Project 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21907-6-5	9299-21907-6-6
Sponsor Designation	207A-SC7 Solar Pond SW Corner 5-12-86	207A-SC8 Solar Pond SW Corner 5-12-86
Determination: pCi/g (dry)		
Gross Alpha, ± counting error*	12000 ± 1000	--
Gross Beta, ± counting error*	1400 ± 100	--
Plutonium-239, ± counting error*	1000 ± 100	--
Americium-241, ± counting error*	2100 ± 100	--
Uranium-233 + 234, ± counting error*	71 ± 10	--
Uranium-238, ± counting error*	280 ± 20	--
Tritium, ± counting error*, pCi/L	--	1500 ± 600
Air Dry Loss, %	58.8	--

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

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July 17, 1986

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Denver, CO 80215

RE: 9299-21943-11
Date Samples Rec'd 5-15-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21943-11-5	9299-21943-11-6	9299-21943-11-10	9299-21943-11-11
Sponsor Designation	207A-C7 Solar Pond Southwest 5-15-86	207A-C8 Solar Pond Southwest 5-15-86	207A-07 Solar Pond Southwest 5-15-86	207A-08 Solar Pond Southwest 5-15-86
Determination: pCi/L				
Gross Alpha, ± counting error*	63000 ± 6000	--	32 ± 38	--
Gross Beta, ± counting error*	35000 ± 2000	--	-2 ± 83	--
Plutonium-239, ± counting error*	56 ± 16	--	2.9 ± 6.3	--
Americium-241, ± counting error*	11 ± 7	--	0.2 ± 5.2	--
Uranium-233 + Uranium-234, ± counting error*	20000 ± 1000	--	-2 ± 23	--
Uranium-238, ± counting error*	28000 ± 1000	--	4 ± 19	--
Tritium, ± counting error*, pCi/L	--	640 ± 190	--	240 ± 180

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

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July 2, 1986

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RE: 9299-21823-20
Date Samples Rec'd 4-28-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation Sponsor Designation	9299-21823-20-1 LA7 (ITPH) Sample A	9299-21823-20-2 LA8 (ITPH) Sample A	9299-21823-20-7 LB7 (ITPH) Sample B	9299-21823-20-8 LB8 (ITPH) Sample B	9299-21823-20-13 LC7 (ITPH) Sample C
Determination: pCi/L					
Gross Alpha, dissolved, ± counting error*	120 ± 40	--	120 ± 40	--	100 ± 40
Gross Beta, dissolved, ± counting error*	120 ± 40	--	75 ± 25	--	100 ± 30
Plutonium-239, dissolved, ± counting error*	0.16 ± 0.10	--	0.05 ± 0.08	--	0.06 ± 0.06
Americium-241, dissolved, ± counting error*	-0.01 ± 0.03	--	0.00 ± 0.04	--	0.02 ± 0.05
Uranium-233 + Uranium-234, dissolved, ± counting error*	66 ± 2	--	62 ± 2	--	66 ± 2
Uranium-238, dissolved, ± counting error*	44 ± 2	--	41 ± 2	--	40 ± 2
Tritium, total, ± counting error*	--	2700 ± 300	--	3400 ± 300	--

July 2, 1986

Mr. Mark Selman
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RE: 9299-21823-20
Date Samples Rec'd 4-28-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation Sponsor Designation	9299-21823-20-14 LC8 (ITPH) Sample C	9299-21823-20-19 L07 HPLC Distilled Water	9299-21823-20-20 L08 HPLC Distilled Water
Determination: pCi/L			
Gross Alpha, dissolved, ± counting error*	--	-1 ± 2	--
Gross Beta, dissolved, ± counting error*	--	-2 ± 4	--
Plutonium-239, dissolved, ± counting error*	--	0.01 ± 0.05	--
Americium-241, dissolved, ± counting error*	--	-0.01 ± 0.03	--
Uranium-233 + Uranium-234, dissolved, ± counting error*	--	0.05 ± 0.27	--
Uranium-238, dissolved, ± counting error*	--	-0.09 ± 0.24	--
Tritium, total, ± counting error*	3400 ± 300	--	40 ± 260

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

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RE: 9299-21843-6
Date Samples Rec'd 4-30-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21843-6-2	9299-21843-6-4	9299-21843-6-6
Sponsor Designation	207B-B7 Solar Pond North (Central) 4-30-86	207B-C7 Solar Pond North (Central) 4-30-86	207B-07 Solar Pond North (Central) 4-30-86
Determination: pCi/L			
Gross Alpha, dissolved, ± counting error*	93 ± 60	74 ± 58	16 ± 41
Gross Beta, dissolved, ± counting error*	25 ± 89	100 ± 92	-21 ± 84
Plutonium-239, diss., ± counting error*	-0.02 ± 0.11	-0.03 ± 0.06	0.05 ± 0.07
Americium-241, diss., ± counting error*	0.08 ± 0.08	-0.02 ± 0.04	0.08 ± 0.22
Uranium-233 + 234, dissolved, ± counting error*	51 ± 2	53 ± 2	0.10 ± 0.24
Uranium-238, dissolved, ± counting error*	32 ± 1	33 ± 1	-0.10 ± 0.21

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

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RE: 9299-21833-18
Date Samples Rec'd 4-29-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21833-18-5	9299-21833-18-6	9299-21833-18-10	9299-21833-18-14	9299-21833-18-18
Sponsor Designation	Solar Pond 207B-A7 North Northwest Corner 4-29-86	Solar Pond 207B-A8 North Northwest Corner 4-29-86	Solar Pond 207B-B8 North Central 4-29-86	Solar Pond 207B-C8 North Northeast 4-29-86	Solar Pond 207B-08 Field Blank 4-29-86
Determination: pCi/L					
Gross Alpha, dissolved, ± counting error*	120 ± 50	--	--	--	--
Gross Beta, dissolved, ± counting error*	56 ± 32	--	--	--	--
Plutonium-239, dissolved, ± counting error*	0.01 ± 0.06	--	--	--	--
Americium-241, dissolved, ± counting error*	-0.02 ± 0.04	--	--	--	--
Uranium-233 + Uranium-234, dissolved, ± counting error*	50 ± 2	--	--	--	--
Uranium-238, dissolved, ± counting error*	31 ± 1	--	--	--	--
Tritium, total, ± counting error*	--	1200 ± 300	1200 ± 300	1300 ± 300	-40 ± 260

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

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June 19, 1986

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RE: 9299-21732-9
Date Samples Rec'd 4-14-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21732-9-3	9299-21732-9-6	9299-21732-9-9
Sponsor Designation	1A5 (BZ) Composite 1 Surface Scrape	2A5 (BZ) Composite 2 Surface Scrape	3A5 (BZ) Composite 3 Surface Scrape
Determination: pCi/g (dry)			
Gross Alpha, ± counting error*	67 ± 17	71 ± 18	75 ± 18
Gross Beta, ± counting error*	55 ± 7	50 ± 7	56 ± 7
Plutonium-239, ± counting error*	0.10 ± 0.20	0.02 ± 0.10	0.02 ± 0.21
Americium-241, ± counting error*	-0.02 ± 0.03	-0.02 ± 0.03	0.00 ± 0.05
Uranium-233 + 234, ± counting error*	1.1 ± 0.2	1.2 ± 0.2	1.4 ± 0.2
Uranium-238, ± counting error*	0.89 ± 0.20	1.2 ± 0.2	1.2 ± 0.2
Tritium, ± counting error*, pCi/ml	0.09 ± 0.23	0.02 ± 0.22	-0.05 ± 0.22
Air Dry Loss, %	24.8	21.9	22.5

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

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June 10, 1986

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RE: 9299-21755-9
Date Samples Rec'd 4-17-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21755-9-3	9299-21755-9-6	9299-21755-9-9
Sponsor Designation	3D5 Com. 3 West Spray Field Surface Scrape	3E5 Com. 3 West Spray Field 0-6" depth	3F5 Com. 3 West Spray Field 6-12" depth
Determination: pCi/g (dry)			
Gross Alpha, ± counting error*	40 ± 14	32 ± 13	31 ± 13
Gross Beta, ± counting error*	34 ± 6	29 ± 6	29 ± 6
Plutonium-239, ± counting error*	0.04 ± 0.20	0.14 ± 0.21	0.01 ± 0.21
Americium-241, ± counting error*	0.02 ± 0.06	0.04 ± 0.06	-0.02 ± 0.03
Uranium-233 + 234, ± counting error*	1.2 ± 0.2	1.0 ± 0.2	0.83 ± 0.19
Uranium-238, ± counting error*	0.90 ± 0.20	0.82 ± 0.18	0.82 ± 0.19
Tritium, ± counting error*, pCi/ml	0.39 ± 0.23	0.11 ± 0.23	0.21 ± 0.23
Air Dry Loss, %	20.7	19.4	67.7

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

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July 7, 1986

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RE: 9299-21741-27
Date Samples Rec'd 4-15-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation Sponsor Designation	9299-21741-27-18 3C5 (BZ)	9299-21741-27-21 1D5 (BZ)	9299-21741-27-24 1E5 (BZ)	9299-21741-27-27 1F5 (BZ)
Determination: pCi/g (dry)				
Gross Alpha, ± counting error*	37 ± 14	52 ± 16	44 ± 15	21 ± 11
Gross Beta, ± counting error*	29 ± 6	40 ± 6	32 ± 6	29 ± 6
Plutonium-239, ± counting error*	0.05 ± 0.21	0.12 ± 0.21	0.07 ± 0.20	-0.08 ± 0.09
Americium-241, ± counting error*	-0.02 ± 0.03	0.01 ± 0.05	-0.02 ± 0.03	-0.02 ± 0.03
Uranium-233 + Uranium-234, ± counting error*	0.66 ± 0.16	1.1 ± 0.2	0.73 ± 0.17	0.59 ± 0.13
Uranium-238, ± counting error*	0.76 ± 0.18	1.2 ± 0.2	0.80 ± 0.18	0.61 ± 0.14
Tritium, ± counting error*, pCi/mL	0.28 ± 0.27	0.34 ± 0.23	0.34 ± 0.23	0.54 ± 0.24
Air Dry Loss, %	19.8	26.1	20.5	16.2

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

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June 10, 1986

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RE: 9299-21745-9
Date Samples Rec'd 4-16-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21745-9-3	9299-21745-9-6	9299-21745-9-9
Sponsor Designation	2D5 Com. 2	2E5 Com. 2	2F5 Com. 2
Determination: pCi/g (dry)			
Gross Alpha, ± counting error*	55 ± 16	43 ± 14	20 ± 11
Gross Beta, ± counting error*	37 ± 6	34 ± 6	29 ± 6
Plutonium-239, ± counting error*	0.15 ± 0.21	0.03 ± 0.19	0.04 ± 0.20
Americium-241, ± counting error*	0.01 ± 0.06	0.05 ± 0.08	-0.02 ± 0.03
Uranium-233 + 234, ± counting error*	1.0 ± 0.2	0.74 ± 0.18	0.73 ± 0.16
Uranium-238, ± counting error*	1.1 ± 0.2	1.0 ± 0.2	0.84 ± 0.20
Tritium, ± counting error*, pCi/ml	0.11 ± 0.23	-0.09 ± 0.22	-0.08 ± 0.22
Air Dry Loss, %	27.4	24.0	18.2

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

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RE: 9299-21741-27
Date Samples Rec'd 4-15-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation Sponsor Designation	9299-21741-27-3 1B5 (BZ)	9299-21741-27-6 1C5 (BZ)	9299-21741-27-9 2B5 (BZ)	9299-21741-27-12 2C5 (BZ)	9299-21741-27-15 3B5 (BZ)
Determination: pCi/g (dry)					
Gross Alpha, ± counting error*	46 ± 15	18 ± 11	47 ± 15	36 ± 13	35 ± 13
Gross Beta, ± counting error*	34 ± 6	31 ± 6	40 ± 7	28 ± 5	30 ± 6
Plutonium-239, ± counting error*	0.01 ± 0.10	0.05 ± 0.21	0.07 ± 0.21	0.03 ± 0.21	0.09 ± 0.22
Americium-241, ± counting error*	0.28 ± 0.16	0.01 ± 0.07	0.02 ± 0.06	0.07 ± 0.10	0.00 ± 0.08
Uranium-233 + Uranium-234, ± counting error*	0.77 ± 0.17	0.67 ± 0.17	0.86 ± 0.17	0.67 ± 0.15	0.89 ± 0.19
Uranium-238, ± counting error*	0.66 ± 0.16	0.62 ± 0.17	0.92 ± 0.18	0.84 ± 0.17	0.75 ± 0.18
Tritium, ± counting error*, pCi/mL	-0.07 ± 0.22	0.13 ± 0.23	0.04 ± 0.23	0.08 ± 0.23	0.20 ± 0.23
Air Dry Loss, %	22.3	28.2	21.6	20.1	22.8

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June 26, 1986

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RE: 9299-21884-6
Date Samples Rec'd 5-7-86
Project 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21884-6-1	9299-21884-6-3
Sponsor Designation	207A-B3 Solar Pond Depth ≈ 4" 5-7-86	207A-B5 Solar Pond Depth ≈ 4" 5-7-86
Determination: µg/L		
Aluminum, total	2640	--
Antimony, total	600U	--
Arsenic, total	150	--
Barium, total	200U	--
Beryllium, total	43	--
Cadmium, total	70	--
Calcium, total	[880]	--
Chromium, total	16700	--
Cobalt, total	200	--
Copper, total	1800	--
Iron, total	1600	--
Lead, total	50U	--
Magnesium, total	[1650]	--
Manganese, total	115	--
Mercury, total	0.2	--
Nickel, total	1900	--
Potassium, total	14,300,000	--
Selenium, total	50U	--
Silver, total	370	--
Sodium, total	42,900,000	--
Thallium, total	100U	--
Tin, total	13000	--
Vanadium, total	100	--
Zinc, total	780	--
Phenols	--	35

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June 26, 1986

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RE: 9299-21856-6
Date Samples Rec'd 5-1-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21856-6-1	9299-21856-6-3
Sponsor Designation	207A-A3 Solar Pond Northwest 5-1-86	207A-A5 Solar Pond Northwest 5-1-86
Determination: µg/L		
Aluminum, total	2420	--
Antimony, total	600U	--
Arsenic, total	150	--
Barium, total	200U	--
Beryllium, total	27	--
Cadmium, total	100	--
Calcium, total	[990]	--
Chromium, total	16300	--
Cobalt, total	200	--
Copper, total	1610	--
Iron, total	8000	--
Lead, total	50U	--
Magnesium, total	[1540]	--
Manganese, total	105	--
Mercury, total	0.2U	--
Nickel, total	1900	--
Potassium, total	13,200,000	--
Selenium, total	50U	--
Silver, total	310	--
Sodium, total	36,300,000	--
Thallium, total	100U	--
Tin, total	7000	--
Vanadium, total	120	--
Zinc, total	620	--
Phenols	--	13

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RE: 9299-21943-11
Date Samples Rec'd 5-15-86
Project 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21943-11-1	9299-21943-11-3
Sponsor Designation	207A-C3 Solar Pond Southwest 5-15-86	207A-C5 Solar Pond Southwest 5-15-86
Determination: µg/L		
Aluminum, total	2310	--
Antimony, total	600U	--
Arsenic, total	1000U	--
Barium, total	200U	--
Beryllium, total	39	--
Cadmium, total	150	--
Calcium, total	[770]	--
Chromium, total	13700	--
Cobalt, total	500	--
Copper, total	1750	--
Iron, total	1500	--
Lead, total	50U	--
Magnesium, total	[1540]	--
Manganese, total	95	--
Mercury, total	0.2U	--
Nickel, total	2000	--
Potassium, total	14,300,000	--
Selenium, total	50U	--
Silver, total	350	--
Sodium, total	38,500,000	--
Thallium, total	100U	--
Tin, total	13000	--
Vanadium, total	210	--
Zinc, total	690	--
Phenols	--	14

June 26, 1986

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RE: 9299-21943-11
Date Samples Rec'd 5-15-86
Project 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21943-11-7	9299-21943-11-8
Sponsor Designation	207A-03 Solar Pond Southwest 5-15-86	207A-05 Solar Pond Southwest 5-15-86
Determination: µg/L		
Aluminum, total	200U	--
Antimony, total	60U	--
Arsenic, total	10U	--
Barium, total	200U	--
Beryllium, total	5U	--
Cadmium, total	5U	--
Calcium, total	[440]	--
Chromium, total	5U	--
Cobalt, total	20U	--
Copper, total	[7]	--
Iron, total	[90]	--
Lead, total	11	--
Magnesium, total	[99]	--
Manganese, total	5U	--
Mercury, total	0.2U	--
Nickel, total	20U	--
Potassium, total	[1430]	--
Selenium, total	5U	--
Silver, total	5U	--
Sodium, total	15400	--
Thallium, total	10U	--
Tin, total	40U	--
Vanadium, total	5U	--
Zinc, total	57	--
Phenols	--	2

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June 27, 1986

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RE: 9299-21870-8
Date Samples Rec'd 5-6-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21870-8-1	9299-21870-8-3
Sponsor Designation	207A-SA3 Solar Pond NW Corner 5-5-86	207A-SA5 Solar Pond NW Corner 5-5-86
Determination: mg/kg dry wt.		
Aluminum, total	11300	--
Antimony, total	250U	--
Arsenic, total	42U	--
Barium, total	833U	--
Beryllium, total	309	--
Cadmium, total	1110	--
Calcium, total	24100	--
Chromium, total	1010	--
Cobalt, total	83U	--
Copper, total	425	--
Iron, total	3590	--
Lead, total	65	--
Magnesium, total	20400	--
Manganese, total	153	--
Mercury, total	7.5	--
Nickel, total	124	--
Potassium, total	59000	--
Selenium, total	21U	--
Silver, total	153	--
Sodium, total	154000	--
Thallium, total	42U	--
Tin, total	167U	--
Vanadium, total	208U	--
Zinc, total	248	--
Phenols, total	--	1.7U

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RE: 9299-21890-6
Date Samples Rec'd 5-8-86
Project 2029-13-03-0001

REPORT OF ANALYSIS

ALR Designation	9299-21890-6-1	9299-21890-6-3
Sponsor Designation	207A-SB3 Solar Pond Center West 5-8-86	207A-SB5 Solar Pond Center West 5-8-86
Determination: mg/kg dry wt.		
Aluminum, total	11000	--
Antimony, total	273U	--
Arsenic, total	45U	--
Barium, total	909U	--
Beryllium, total	668	--
Cadmium, total	10500	--
Calcium, total	50000	--
Chromium, total	1500	--
Cobalt, total	91U	--
Copper, total	1590	--
Iron, total	5550	--
Lead, total	455	--
Magnesium, total	21000	--
Manganese, total	595	--
Mercury, total	25	--
Nickel, total	1320	--
Potassium, total	50000	--
Selenium, total	23U	--
Silver, total	191	--
Sodium, total	130000	--
Thallium, total	45U	--
Tin, total	182U	--
Vanadium, total	227U	--
Zinc, total	595	--
Phenols, total	--	1.8U

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June 30, 1986

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RE: 9299-21907-6
Date Samples Rec'd 5-12-86
Project 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21907-6-1	9299-21907-6-3
Sponsor Designation	207A-SC3 Solar Pond SW Corner 5-12-86	207A-SC5 Solar Pond SW Corner 5-12-86
Determination: mg/kg dry wt.		
Aluminum, total	11900	--
Antimony, total	333U	--
Arsenic, total	56U	--
Barium, total	1110U	--
Beryllium, total	1570	--
Cadmium, total	1220	--
Calcium, total	19600	--
Chromium, total	19700	--
Cobalt, total	111U	--
Copper, total	879	--
Iron, total	6900	--
Lead, total	142	--
Magnesium, total	6110	--
Manganese, total	178	--
Mercury, total	10	--
Nickel, total	162	--
Potassium, total	65300	--
Selenium, total	28U	--
Silver, total	237	--
Sodium, total	166000	--
Thallium, total	56U	--
Tin, total	222U	--
Vanadium, total	278U	--
Zinc, total	227	--
Phenols, total	--	3.3

Cathy Cairns
Cathy Cairns
Water Laboratory
Supervisor

CC/dh

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June 12, 1986

Mr. Mark Selman
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938 Quail Street
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RE: 9299-21843-6
Date Samples Rec'd 4-30-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21843-6-1	9299-21843-6-3	9299-21843-6-5
Sponsor Designation	207B-B3 Solar Pond North (Center) 4-30-86	207B-C3 Solar Pond North (Center) 4-30-86	207B-03 Solar Pond North (Center) 4-30-86
Determination: µg/L			
Aluminum, total	200U	200U	200U
Antimony, total	60U	60U	60U
Arsenic, total	10U	10U	10U
Barium, total	200U	220	200U
Beryllium, total	5U	5U	5U
Cadmium, total	5U	5U	5U
Calcium, total	187000	176000	[990]
Chromium, total	5U	[9]	5U
Cobalt, total	20U	20U	20U
Copper, total	[6]	5U	5U
Iron, total	20U	20U	[20]
Lead, total	5U	5U	5U
Magnesium, total	67500	66400	[407]
Manganese, total	5U	5U	5U
Mercury, total	0.2U	0.2U	0.2U
Nickel, total	[30]	20U	20U
Potassium, total	62700	60500	[110]
Selenium, total	9	9	5U
Silver, total	[5]	[7]	5U
Sodium, total	374000	363000	[330]
Thallium, total	10U	10U	10U
Tin, total	400U	400U	40U
Vanadium, total	50U	50U	50U
Zinc, total	5U	5U	[11]

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June 26, 1986

Mr. Mark Selman
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RE: 9299-21833-18
Date Samples Rec'd 4-29-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21833-18-1	9299-21833-18-3	9299-21833-18-8
Sponsor Designation	Solar Pond 207B-A3 North Northwest Corner 4-29-86	Solar Pond 207B-A5 North Northwest Corner 4-29-86	Solar Pond 207B-B5 North Central 4-29-86
Determination: µg/L			
Aluminum, total	200U	--	--
Antimony, total	60U	--	--
Arsenic, total	10U	--	--
Barium, total	200U	--	--
Beryllium, total	5U	--	--
Cadmium, total	5U	--	--
Calcium, total	198000	--	--
Chromium, total	5U	--	--
Cobalt, total	20U	--	--
Copper, total	[14]	--	--
Iron, total	[90]	--	--
Lead, total	5U	--	--
Magnesium, total	72600	--	--
Manganese, total	15	--	--
Mercury, total	0.2U	--	--
Nickel, total	50	--	--
Potassium, total	56100	--	--
Selenium, total	9	--	--
Silver, total	5U	--	--
Sodium, total	451000	--	--
Thallium, total	10U	--	--
Tin, total	400U	--	--
Vanadium, total	50U	--	--
Zinc, total	22	--	--
Phenols	--	3	46

June 26, 1986

Mr. Mark Selman
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RE: 9299-21833-18
Date Samples Rec'd 4-29-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21833-18-12	9299-21833-18-16
Sponsor Designation	Solar Pond 2078-C5 North (Northeast) 4-29-86	Solar Pond 2078-05 Field Blank 4-29-86
Determination: µg/L		
Aluminum, total	--	--
Antimony, total	--	--
Arsenic, total	--	--
Barium, total	--	--
Beryllium, total	--	--
Cadmium, total	--	--
Calcium, total	--	--
Chromium, total	--	--
Cobalt, total	--	--
Copper, total	--	--
Iron, total	--	--
Lead, total	--	--
Magnesium, total	--	--
Manganese, total	--	--
Mercury, total	--	--
Nickel, total	--	--
Potassium, total	--	--
Selenium, total	--	--
Silver, total	--	--
Sodium, total	--	--
Thallium, total	--	--
Tin, total	--	--
Vanadium, total	--	--
Zinc, total	--	--
Phenols	3	4

Cathy Cairns

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May 30, 1986

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RE: 9299-21741-27
Date Samples Rec'd 4-15-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21741-27-1	9299-21741-27-4	9299-21741-27-7
Sponsor Designation	1B3 (BZ) Composite 1 0-6" depth	1C3 (BZ) Composite 1 6-12" depth	2B3 (BZ) Composite 2 0-6" depth
Determination: mg/kg, dry wt.			
Aluminum, total	8190	8640	6540
Antimony, total	38U	37U	38U
Arsenic, total	6.3U	10F	7.0
Barium, total	126U	123U	128U
Beryllium, total	3.2U	3.1U	3.2U
Cadmium, total	3.2U	3.1U	3.2U
Calcium, total	[1660]	[1100]	[1320]
Chromium, total	11	10	9.0
Cobalt, total	13U	[22]	[12]
Copper, total	[6.9]	[6.6]	[8.4]
Iron, total	9080	12400	9610
Lead, total	31	19	29
Magnesium, total	[1240]	[1030]	[997]
Manganese, total	274	293	247
Mercury, total	0.1U	0.1U	0.1U
Nickel, total	[13]	[16]	13U
Potassium, total	[1390]	[1100]	[1260]
Selenium, total	3.2U	3.1U	3.2U
Silver, total	3.2U	3.1U	3.2U
Sodium, total	63U	62U	64U
Thallium, total	6.3U	6.2U	6.4U
Tin, total	25U	25U	26U
Vanadium, total	32U	38	32U
Zinc, total	33	23	29
Phenols	0.3U	0.5	0.3U

May 30, 1986

Mr. Mark Selman
Roy F. Weston

RE: 9299-21741-27
Date Samples Rec'd 4-15-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21741-27-10	9299-21741-27-13	9299-21741-27-16
Sponsor Designation	2C3 (BZ) Composite 2 6-12" depth	3B3 (BZ) Composite 3 0-6" depth	3C3 (BZ) Composite 3 6-12" depth
Determination: mg/kg, dry wt.			
Aluminum, total	7640	6740	7200
Antimony, total	37U	38U	38U
Arsenic, total	6.1U	6.4	6.3U
Barium, total	122U	128U	125U
Beryllium, total	3.0U	3.2U	3.1U
Cadmium, total	3.0U	3.2U	3.1U
Calcium, total	[1440]	[1400]	[1020]
Chromium, total	9.6	5.7	5.6
Cobalt, total	12U	13U	25
Copper, total	[9.1]	[8.3]	[9.9]
Iron, total	10200	9580	10900
Lead, total	16	17	15
Magnesium, total	[1060]	[976]	[883]
Manganese, total	196	215	285
Mercury, total	0.1U	0.1U	0.1U
Nickel, total	[17]	[13]	13U
Potassium, total	[1250]	[1190]	[951]
Selenium, total	3.0U	3.2U	3.1U
Silver, total	3.0U	3.2U	3.1U
Sodium, total	61U	[68]	63U
Thallium, total	6.1U	6.4U	6.3U
Tin, total	24U	26U	25U
Vanadium, total	30U	32U	31U
Zinc, total	30	25	20
Phenols	0.2U	0.3U	0.3U

May 30, 1986

Mr. Mark Selman
Roy F. Weston

RE: 9299-21741-27
Date Samples Rec'd 4-15-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21741-27-19	9299-21741-27-22	9299-21741-27-25
Sponsor Designation	1D3 (BZ) Composite 1 Surface Scrape	1E3 (BZ) Composite 1 0-6" Core	1F3 (BZ) Composite 1 6-12" Core
Determination: mg/kg, dry wt.			
Aluminum, total	8330	7390	7010
Antimony, total	41U	38U	37U
Arsenic, total	9.2	6.7	6.1
Barium, total	137U	127U	122U
Beryllium, total	3.4U	3.2U	3.0U
Cadmium, total	3.4U	3.2U	3.0U
Calcium, total	[2060]	[1260]	[1070]
Chromium, total	11	8.6	11
Cobalt, total	[13]	13U	12U
Copper, total	[11]	[6.3]	[7.3]
Iron, total	10800	9240	11300
Lead, total	61	32	15
Magnesium, total	[1390]	[1090]	[922]
Manganese, total	295	289	240
Mercury, total	0.1U	0.1U	0.1U
Nickel, total	20	13U	12U
Potassium, total	[1840]	[1330]	[1200]
Selenium, total	3.4U	3.2U	3.0U
Silver, total	3.4U	3.2U	3.0U
Sodium, total	68U	63U	61U
Thallium, total	6.8U	6.3U	6.1U
Tin, total	27U	25U	24U
Vanadium, total	34U	32U	30U
Zinc, total	50	28	26
Phenols	0.3U	0.5	0.2U

Sylvia Hergenreder for CC
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Project Manager

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May 30, 1986

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RE: 9299-21732-9
Date Samples Rec'd 4-14-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21732-9-1	9299-21732-9-4	9299-21732-9-7
Sponsor Designation	1A3 (BZ) Composite 1 Surface Scrape	2A3 (BZ) Composite 2 Surface Scrape	3A3 (BZ) Composite 3 Surface Scrape
Determination: mg/kg, dry wt.			
Aluminum, total	8770	9140	9050
Antimony, total	40U	41U	41U
Arsenic, total	6.7U	6.8	6.8U
Barium, total	133U	135U	135U
Beryllium, total	3.3U	3.4U	3.4U
Cadmium, total	3.3U	3.4U	3.4U
Calcium, total	[1840]	[1930]	[1960]
Chromium, total	10	10	13
Cobalt, total	13U	14U	14U
Copper, total	[9.6]	[9.7]	[10]
Iron, total	11000	11400	12300
Lead, total	38	48	42
Magnesium, total	[1360]	[1490]	[1350]
Manganese, total	272	337	286
Mercury, total	0.1U	0.1U	0.1U
Nickel, total	13U	[13]	14U
Potassium, total	[1700]	[1860]	[1750]
Selenium, total	3.3U	3.4U	3.4U
Silver, total	3.3U	3.4U	3.4U
Sodium, total	67U	[217]	[140]
Thallium, total	6.7U	6.8U	6.8U
Tin, total	27U	27U	27U
Vanadium, total	33U	34U	34U
Zinc, total	41	49	44
Phenols	0.3U	0.3U	0.3U

Evda Hercenreder for CC
Cathy Cairns
Project Manager

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June 2, 1986

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RE: 9299-21745-9
Date Samples Rec'd 4-16-86
Project 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21745-9-1	9299-21745-9-4	9299-21745-9-7
Sponsor Designation	2D3 Composite 2 West Spray Field Surface Scrape	2E3 Composite 2 West Spray Field 0-6" depth	2F3 Composite 2 West Spray Field 6-12" depth
Determination: mg/kg, dry wt.			
Aluminum, total	7570	8760	8920
Antimony, total	42U	38U	38U
Arsenic, total	8.3	6.4U	6.3U
Barium, total	139U	128U	127U
Beryllium, total	3.5U	3.2U	3.2U
Cadmium, total	3.5U	3.2U	3.2U
Calcium, total	[2240]	[1310]	[1280]
Chromium, total	10	9.4	6.8
Cobalt, total	14U	13U	13U
Copper, total	[11]	[11]	[9.2]
Iron, total	10400	12500	9960
Lead, total	63	29	23
Magnesium, total	[1340]	[1240]	[1150]
Manganese, total	337	326	235
Mercury, total	0.1U	0.1U	0.1U
Nickel, total	14U	13U	13U
Potassium, total	[1750]	[1590]	[1490]
Selenium, total	3.5U	3.2U	3.2U
Silver, total	3.5U	3.2U	3.2U
Sodium, total	69U	64U	68
Thallium, total	6.9U	6.4U	6.3U
Tin, total	28U	26U	25U
Vanadium, total	35U	32U	32U
Zinc, total	52	36	29
Phenols	0.3U	0.3U	0.3U

Linda Hergenreder for cc
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Project Manager

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June 11, 1986

Mr. Mark Selman
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RE: 9299-21823-20
Date Samples Rec'd 4-28-86
Project 2023-13-03

REPORT OF ANALYSIS

ALR Designation Sponsor Designation	9299-21823-20-3 LB3 (ITPH) Sample B	9299-21823-20-5 LB5 (ITPH) Sample B	9299-21823-20-9 LC3 (ITPH) Sample C
Determination: µg/L			
Aluminum, total	200U	--	200U
Antimony, total	60U	--	60U
Arsenic, total	10U	--	10U
Barium, total	200U	--	220
Beryllium, total	5U	--	5U
Cadmium, total	5U	--	5U
Calcium, total	308000	--	319000
Chromium, total	[9]	--	[7]
Cobalt, total	20U	--	20U
Copper, total	5U	--	5U
Iron, total	20U	--	20U
Lead, total	5U	--	5U
Magnesium, total	76800	--	77400
Manganese, total	[12]	--	[13]
Mercury, total	0.5	--	0.4
Nickel, total	20U	--	20U
Potassium, total	73700	--	71500
Selenium, total	11	--	12
Silver, total	12	--	10
Sodium, total	451000	--	462000
Thallium, total	10U	--	10U
Tin, total	400U	--	400U
Vanadium, total	50U	--	50U
Zinc, total	24	--	30
Phenols, total	--	10	--

June 11, 1986

Mr. Mark Selman
Roy F. Weston

RE: 9299-21823-20
Date Samples Rec'd 4-28-86
Project 2023-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21823-20-11	9299-21823-20-15	9299-21823-20-17
Sponsor Designation	LC5 (ITPH) Sample C	L03 HPLC Distilled Water	L05 HPLC Distilled Water
Determination: µg/L			
Aluminum, total	--	200U	--
Antimony, total	--	60U	--
Arsenic, total	--	10U	--
Barium, total	--	200U	--
Beryllium, total	--	5U	--
Cadmium, total	--	5U	--
Calcium, total	--	[220]	--
Chromium, total	--	5U	--
Cobalt, total	--	20U	--
Copper, total	--	5U	--
Iron, total	--	[80]	--
Lead, total	--	5U	--
Magnesium, total	--	[66]	--
Manganese, total	--	5U	--
Mercury, total	--	0.2U	--
Nickel, total	--	20U	--
Potassium, total	--	[220]	--
Selenium, total	--	5U	--
Silver, total	--	5U	--
Sodium, total	--	[440]	--
Thallium, total	--	10U	--
Tin, total	--	40U	--
Vanadium, total	--	50U	--
Zinc, total	--	58	--
Phenols, total	2U	--	2

Linda Hergenreder for CC.
Cathy Cairns
Water Laboratory
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July 21, 1986

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RE: 9299-21884-6
Date Samples Rec'd 5-7-86
Project No. 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21884-6-2	9299-21884-6-4
Sponsor Designation	207A-B6 Solar Pond 207A	207A-B6 Solar Pond 207A
Reactivity, mg/L:		
Cyanide	--	19
Sulfide	--	*
Corrosivity-pH	--	9.9
Ignitability, °C	--	>100
Total Cyanide, mg/L	9.4	--
Hexavalent Chromium, mg/L	--	<0.01

*Not analyzed due to insufficient sample.

Michel A. Herzog
RCRA Analysis

MAH/dh

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July 21, 1986

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RE: 9299-21856-6
Date Samples Rec'd 5-1-86
Project No. 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21856-6-2	9299-21856-6-4
Sponsor Designation	207A-A4 Solar Pond 207A Northwest	207A-A6 Solar Pond 207A Northwest
Reactivity, mg/L:		
Cyanide	--	*
Sulfide	--	**
Corrosivity-pH	--	9.8
Ignitability, °C	--	>100
Total Cyanide, mg/L	11	--
Hexavalent Chromium, mg/L	--	<0.01

*Not analyzed due to insufficient sample.
**Not calculated due to interferences.

Michel A. Herzog
Soils and Overburden
Supervisor

MAH/dh

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July 23, 1986

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RE: 9299-21943-11
Date Samples Rec'd: 5-15-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation Sponsor Designation	9299-21943-11-2 207A-C4	9299-21943-11-4 207A-C6	9299-21943-11-9 207A-06
Determination: mg/L			
Reactivity:			
Cyanide	--	*	*
Sulfide	--	*	<10
Corrosivity-pH	--	9.8	6.6
Ignitability, °C	--	>100	>100
Total Cyanide	17	--	--
Hexavalent Chromium	--	0.02	<0.01

*Not analyzed due to insufficient sample.

Michel A. Herzog
RCRA Analysis

MAH/dh

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RE: 9299-21907-6
Date Samples Rec'd 5-12-86
Project No. 2029-13-03-01

REPORT OF ANALYSIS

ALR Designation	9299-21907-6-2	9299-21907-6-4
Sponsor Designation	207A-SC4 Solar Pond 207A SW Corner Sediment C-Composite	207A-SC6 Solar Pond 207A SW Corner Sediment C-Composite
RCRA EP Toxicity, mg/L:		
Arsenic	--	0.04
Barium	--	<0.2
Cadmium	--	4.5
Chromium	--	0.86
Lead	--	0.11
Mercury	--	0.001
Selenium	--	<0.005
Silver	--	<0.02
Reactivity, µg/g:		
Cyanide	--	6.3
Sulfide	--	*
Corrosivity-pH	--	9.0
Ignitability, °C	--	>100
Hexavalent Chromium, mg/L	--	0.01
Total Cyanide, µg/g	6.5	--

*Not calculated due to interferences.

Michel A. Herzog
RCRA Analysis

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RE: 9299-21833-18
Date Samples Rec'd 4-29-86
Project No. 2Q29-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21833-18-2	9299-21833-18-4	9299-21833-18-7	9299-21833-18-9	9299-21833-18-11
Sponsor Designation	207B-A4 Solar Pond 207B N-NW Corner	207B-A6 Solar Pond 207B N-NW Corner	207B-B4 Solar Pond 207B North (Central)	207B-B6 Solar Pond 207B North (Central)	207B-C4 Solar Pond 207B North (Northeast)
Reactivity, mg/L:					
Cyanide	--	<0.05	--	<0.05	--
Sulfide	--	<10	--	<10	--
Corrosivity-pH	--	8.0	--	7.9	--
Ignitability, °C	--	>100	--	>100	--
Total Cyanide, mg/L	<0.05	--	<0.05	--	<0.05
Hexavalent Chromium, mg/L	--	<0.01	--	<0.01	--

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Mr. Mark Selman
Roy F. Weston

RE: 9299-21833-18
Date Samples Rec'd 4-29-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21833-18-13	9299-21833-18-15	9299-21833-18-17
Sponsor Designation	207B-C6 Solar Pond 207B North (Northeast)	207B-04 Solar Pond 207B Field Blank	207B-06 Solar Pond 207B Field Blank
Reactivity, mg/L:			
Cyanide	<0.05	--	<0.05
Sulfide	<10	--	<10
Corrosivity-pH	8.1	--	7.1
Ignitability, °C	>100	--	>100
Total Cyanide, mg/L	--	<0.05	--
Hexavalent Chromium, mg/L	<0.01	--	<0.01

Michel A. Herzog
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July 21, 1986

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Denver, CO 80215

RE: 9299-21823-20
Date Samples Rec'd 4-28-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21823-20-4	9299-21823-20-6	9299-21823-20-10	9299-21823-20-12	9299-21823-20-16
Sponsor Designation	LB4 Interceptor Trench Pump House Sample B	LB6 Interceptor Trench Pump House Sample B	LC4 Interceptor Trench Pump House Sample C	LC6 Interceptor Trench Pump House Sample C	LD4 HPLC Distilled Water
Reactivity, mg/L:					
Cyanide	--	<0.05	--	<0.05	--
Sulfide	--	<10	--	<10	--
Corrosivity-pH	--	7.8	--	8.0	--
Ignitability, °C	--	>100	--	>100	--
Total Cyanide, mg/L	<0.05	--	<0.05	--	<0.05
Hexavalent Chromium, mg/L	--	<0.01	--	<0.01	--

23 1986

Mr. Mark Selman
Roy F. Weston

RE: 9299-21823-20
Date Samples Rec'd 4-28-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21823-20-18
Sponsor Designation	LB6-LC6-LD6 HPLC Distilled Water
Reactivity, mg/L:	
Cyanide	<0.05
Sulfide	<10
Corrosivity-pH	6.7
Ignitability, °C	>100
Total Cyanide, mg/L	--
Hexavalent Chromium, mg/L	<0.01

Michel A. Herzog
RCRA Analysis

MAH/dh

Accu-Labs Research, Inc.
11485 W. 48th Avenue Wheat Ridge, Colorado 80033
(303) 423-2766

May 16, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail St.
Denver, CO 80215

RE: 9299-21745-9
Date Samples Rec'd 4-16-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21745-9-1	9299-21745-9-2	9299-21745-9-4	9299-21745-9-5	9299-21745-9-7
Sponsor Designation	2D3 Composite 2 W. Spray Field Surface Scrape	2D4 Composite 2 W. Spray Field Surface Scrape	2E3 Composite 2 W. Spray Field 0"-6"	2E4 Composite 2 W. Spray Field 0"-6"	2F3 Composite 2 W. Spray Field 6"-12"
RCRA EP Toxicity, mg/L:					
Arsenic	--	0.09	--	0.09	--
Barium	--	<0.2	--	<0.2	--
Cadmium	--	<0.005	--	<0.005	--
Chromium	--	<0.01	--	0.02	--
Lead	--	<0.05	--	<0.05	--
Mercury	--	<0.001	--	<0.001	--
Selenium	--	<0.005	--	<0.005	--
Silver	--	<0.02	--	<0.02	--
Reactivity:					
Cyanide, µg/g	--	0.19	--	0.19	--
Sulfide, µg/g	--	<10	--	<10	--
Corrosivity-pH	--	5.7	--	5.6	--
Ignitability, °C	--	>100	--	>100	--
Hexavalent Chromium, mg/L	--	<0.01	--	<0.01	--
Total Cyanide, µg/g	0.21	--	0.19	--	0.08

May 16, 1986

Mr. Mark Selman
Roy F. Weston

RE: 9299-21745-9
Date Samples Rec'd 4-16-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21745-9-8
Sponsor Designation	2F4 Composite 2 W. Spray Field 6"-12"
RCRA EP Toxicity, mg/L:	
Arsenic	0.02
Barium	<0.2
Cadmium	0.005
Chromium	0.02
Lead	<0.05
Mercury	<0.001
Selenium	<0.005
Silver	<0.02
Reactivity:	
Cyanide, µg/g	0.09
Sulfide, µg/g	<10
Corrosivity-pH	5.6
Ignitability, °C	>100
Hexavalent Chromium, mg/L	0.01
Total Cyanide, µg/g	--

These samples are scheduled to be disposed of 45 days after the date of this report.

Michel A. Herzog
RCRA Analysis

MAH/dh

Accu-Labs Research, Inc.
11485 W. 48th Avenue Wheat Ridge, Colorado 80033
(303) 423-2766

May 16, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail St.
Denver, CO 80215

RE: 9299-21732-9
Date Samples Rec'd 4-14-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21732-9-1	9299-21732-9-3	9299-21732-9-4	9299-21732-9-5	9299-21732-9-7
Sponsor Designation	1A3 (BZ) Composite 1 Surface Scrape	1A4 (BZ) Composite 1 Surface Scrape	2A3 (BZ) Composite 2 Surface Scrape	2A4 (BZ) Composite 2 Surface Scrape	3A3 (BZ) Composite 3 Surface Scrape
RCRA EP Toxicity, mg/L:					
Arsenic	--	<0.005	--	<0.005	--
Barium	--	<0.2	--	<0.2	--
Cadmium	--	<0.005	--	0.006	--
Chromium	--	<0.01	--	0.01	--
Lead	--	<0.05	--	<0.05	--
Mercury	--	0.001	--	<0.001	--
Selenium	--	<0.005	--	<0.005	--
Silver	--	<0.02	--	<0.02	--
Reactivity:					
Cyanide, µg/g	--	0.11	--	0.11	--
Sulfide, µg/g	--	<10	--	<10	--
Corrosivity-pH	--	5.7	--	5.6	--
Ignitability, °C	--	>100	--	>100	--
Hexavalent Chromium, mg/L	--	<0.01	--	<0.01	--
Total Cyanide, µg/g	0.17	--	0.16	--	0.10

May 16, 1986

Mr. Mark Selman
Roy F. Weston

RE: 9299-21732-9
Date Samples Rec'd 4-14-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21732-9-8
Sponsor Designation	3A4 (BZ) Composite 3 Surface Scrape
RCRA EP Toxicity, mg/L:	
Arsenic	<0.005
Barium	<0.2
Cadmium	0.005
Chromium	0.02
Lead	<0.05
Mercury	<0.001
Selenium	<0.005
Silver	<0.02
Reactivity:	
Cyanide, µg/g	0.12
Sulfide, µg/g	<10
Corrosivity-pH	5.6
Ignitability, °C	>100
Hexavalent Chromium, mg/L	<0.01
Total Cyanide, µg/g	--

These samples are scheduled to be disposed of 45 days after the date of this report.

Michel A. Herzog
RCRA Analysis

MAH/dh

Accu-Labs Research, Inc.
11485 W. 48th Avenue Wheat Ridge, Colorado 80033
(303) 423-2766

May 16, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail St.
Denver, CO 80215

RE: 9299-21741-27
Date Samples Rec'd 4-15-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21741-27-1	9299-21741-27-2	9299-21741-27-4	9299-21741-27-5	9299-21741-27-7
Sponsor Designation	1B3 (BZ) Composite 1 0"-6"	1B4 (BZ) Composite 1 0"-6"	1C3 (BZ) Composite 1 6"-12"	1C4 (BZ) Composite 1 6"-12"	2B3 (BZ) Composite 2 0"-6"
RCRA EP Toxicity, mg/L:					
Arsenic	--	<0.005	--	<0.005	--
Barium	--	<0.2	--	<0.2	--
Cadmium	--	<0.005	--	<0.005	--
Chromium	--	<0.01	--	<0.01	--
Lead	--	<0.05	--	<0.05	--
Mercury	--	<0.001	--	<0.001	--
Selenium	--	<0.005	--	<0.005	--
Silver	--	<0.02	--	<0.02	--
Reactivity:					
Cyanide, µg/g	--	0.12	--	0.05	--
Sulfide, µg/g	--	<10	--	<10	--
Corrosivity-pH	--	5.7	--	5.7	--
Ignitability, °C	--	>100	--	>100	--
Hexavalent Chromium, mg/L	--	<0.01	--	<0.01	--
Total Cyanide, µg/g	0.10	--	0.05	--	0.08

May 16, 1986

Mr. Mark Selman
Roy F. Weston

RE: 9299-21741-27
Date Samples Rec'd 4-15-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21741-27-8	9299-21741-27-10	9299-21741-27-11	9299-21741-27-13	9299-21741-27-14
Sponsor Designation	2B4 (BZ) Composite 2 0"-6"	2C3 (BZ) Composite 2 6"-12"	2C4 (BZ) Composite 2 6"-12"	3B3 (BZ) Composite 3 0"-6"	3B4 (BZ) Composite 3 0"-6"
RCRA EP Toxicity, mg/L:					
Arsenic	<0.005	--	<0.005	--	<0.005
Barium	<0.2	--	<0.2	--	<0.2
Cadmium	<0.005	--	<0.005	--	0.005
Chromium	<0.01	--	<0.01	--	<0.01
Lead	<0.05	--	<0.05	--	<0.05
Mercury	<0.001	--	<0.001	--	<0.001
Selenium	<0.005	--	<0.005	--	<0.005
Silver	<0.02	--	<0.02	--	<0.02
Reactivity:					
Cyanide, µg/g	0.08	--	<0.05	--	0.06
Sulfide, µg/g	<10	--	<10	--	<10
Corrosivity-pH	5.7	--	5.5	--	5.7
Ignitability, °C	>100	--	>100	--	>100
Hexavalent Chromium, mg/L	<0.01	--	0.01	--	0.06
Total Cyanide, µg/g	--	0.05	--	0.09	--

May 16, 1986

Mr. Mark Selman
Roy F. Weston

RE: 9299-21741-27
Date Samples Rec'd 4-15-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21741-27-16	9299-21741-27-17	9299-21741-27-19	9299-21741-27-20	9299-21741-27-22
Sponsor Designation	3C3 (BZ) Composite 3 6"-12"	3C4 (BZ) Composite 3 6"-12"	1D3 Composite 1 Surface Scrape	1D4 Composite 1 Surface Scrape	1E3 Composite 1 0"-6" Core
RCRA EP Toxicity, mg/L:					
Arsenic	--	<0.005	--	<0.005	--
Barium	--	<0.2	--	<0.2	--
Cadmium	--	<0.005	--	<0.005	--
Chromium	--	<0.01	--	<0.01	--
Lead	--	<0.05	--	<0.05	--
Mercury	--	<0.001	--	<0.001	--
Selenium	--	<0.005	--	<0.005	--
Silver	--	<0.02	--	<0.02	--
Reactivity:					
Cyanide, µg/g	--	<0.05	--	0.13	--
Sulfide, µg/g	--	<10	--	<10	--
Corrosivity-pH	--	5.7	--	5.9	--
Ignitability, °C	--	>100	--	>100	--
Hexavalent Chromium, mg/L	--	0.02	--	0.02	--
Total Cyanide, µg/g	<0.05	--	0.13	--	0.07

May 16, 1986

Mr. Mark Selman
Roy F. Weston

RE: 9299-21741-27
Date Samples Rec'd 4-15-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21741-27-23	9299-21741-27-25	9299-21741-27-26
Sponsor Designation	1E4 Composite 1 0"-6" Core	1F3 Composite 1 6-12" Core	1F4 Composite 1 6"-12" Core
RCRA EP Toxicity, mg/L:			
Arsenic	<0.005	--	<0.005
Barium	<0.2	--	<0.2
Cadmium	0.007	--	0.011
Chromium	<0.01	--	0.01
Lead	<0.05	--	<0.05
Mercury	<0.001	--	<0.001
Selenium	<0.005	--	<0.005
Silver	<0.02	--	<0.02
Reactivity:			
Cyanide, µg/g	0.10	--	<0.05
Sulfide, µg/g	<10	--	<10
Corrosivity-pH	6.0	--	6.0
Ignitability, °C	>100	--	>100
Hexavalent Chromium, mg/L	<0.01	--	0.02
Total Cyanide, µg/g	--	<0.05	--

These samples are scheduled to be disposed of 45 days after the date of this report.

Michel A. Herzog
RCRA Analysis

MAH/dh

Accu-Labs Research, Inc.
11485 W. 48th Avenue Wheat Ridge, Colorado 80033
(303) 423-2766

May 28, 1986

Mr. Mark Selman
Roy F. Weston
938 Quail St.
Denver, CO 80215

RE: 9299-21755-9
Date Samples Rec'd 4-17-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21755-9-1	9299-21755-9-2	9299-21755-9-4	9299-21755-9-5	9299-21755-9-7
Sponsor Designation	3D3 Composite 3 W. Spray Field Surface Scrape	3D4 Composite 3 W. Spray Field Surface Scrape	3E3 Composite 3 W. Spray Field 0"-6" depth	3E4 Composite 3 W. Spray Field 0"-6" depth	3F3 Composite 3 W. Spray Field 6"-12" depth
RCRA EP Toxicity, mg/L:					
Arsenic	--	0.07	--	0.08	--
Barium	--	<0.2	--	<0.2	--
Cadmium	--	<0.005	--	<0.005	--
Chromium	--	0.02	--	<0.01	--
Lead	--	<0.05	--	<0.05	--
Mercury	--	<0.001	--	<0.001	--
Selenium	--	<0.005	--	<0.005	--
Silver	--	<0.02	--	<0.02	--
Reactivity:					
Cyanide, µg/g	--	0.15	--	0.12	--
Sulfide, µg/g	--	<10	--	<10	--
Corrosivity-pH	--	5.9	--	6.1	--
Ignitability, °C	--	>100	--	>100	--
Hexavalent Chromium, mg/L	--	0.02	--	<0.01	--
Total Cyanide, µg/g	0.41	--	0.11	--	0.07

Mr. Mark Selman
Roy F. Weston

RE: 9299-21755-9
Date Samples Rec'd 4-17-86
Project No. 2029-13-03

REPORT OF ANALYSIS

ALR Designation	9299-21755-9-8
Sponsor Designation	3F4 Composite 3 W. Spray Field 6"-12" depth
RCRA EP Toxicity, mg/L:	
Arsenic	0.02
Barium	<0.2
Cadmium	<0.005
Chromium	0.02
Lead	<0.05
Mercury	<0.001
Selenium	<0.005
Silver	<0.02
Reactivity:	
Cyanide, µg/g	0.06
Sulfide, µg/g	<10
Corrosivity-pH	6.3
Ignitability, °C	>100
Hexavalent Chromium, mg/L	<0.01
Total Cyanide, µg/g	--

These samples are scheduled to be disposed of 45 days after the date of this report.

Michel A. Herzog
RCRA Analysis

MAH/dh

WESTON

SEP 29 1986

VOA ORGANIC ANALYTICAL DATA PACKAGE FOR ROCKY FLATS

DATE RECEIVED: August 21, 1986

SAMPLE DESCRIPTION	WESTON ID R.F.W. NUMBER	DATE COLLECTED	VOA ANALYSIS
ITPH-LAI	8608-682-0070	8/19/86	9/01/86
ITPH-SAI	8608-682-0080	8/19/86	9/01/86
ITPH-LB1	8608-682-0240	8/19/86	9/01/86
ITPH-LC1	8608-682-0250	8/19/86	9/01/86
ITPH-SB1	8608-682-0260	8/19/86	9/01/86

WESTON ANALYTICS
GC/MS DATA SUMMARY
VOLATILE HAZARDOUS SUBSTANCE LIST COMPOUNDS

RFW Batch Number: 8608-682- Client: ROCKY FLATS

Sample Information	Cust ID:	ITPH-LAI	LAB DUP	MS	ITPH-SAI	ITPH-LBI	ITPH-LCI
	RFW#:	0070	0070	0070	0080	0240	0250
	Matrix:	Water	Water	Water	Water	Water	Water
	D.F.:	1	1	1	1	1	1
	Units:	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
		fl	fl	fl	fl	fl	fl
Chloromethane		1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane		1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride		1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane		1 U	1 U	1 U	1 U	1 U	1 U
Methylene Chloride		4 U	4 U	4 U	4 U	4 U	4 U
Acetone		2 U	2 U	2 U	2.5	2 U	2 U
Carbon Disulfide		1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene		1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane		1 U	1 U	1 U	1 U	1 U	1 U
Trans-1,2-Dichloroethene		1 U	1 U	1 U	1 U	1 U	1 U
Chloroform		1.2	1 U	89 %	6.9	1.4	1 U
1,2-Dichloroethane		1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone		1 U	1 U	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane		1 U	1 U	1 U	1 U	3.1	4.8
Carbon Tetrachloride		1 U	1 U	1 U	1 U	1.6	2.1
Bromodichloromethane		1 U	1 U	69 %	1 U	1 U	1 U
1,2-Dichloropropane		1 U	1 U	1 U	1 U	1 U	1 U
Trans-1,3-Dichloropropene		1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene		3.7	2.2	2.9	1 U	2.5	2.4
Dibromochloromethane		2 U	2 U	97 %	2 U	2 U	2 U
1,1,2-Trichloroethane		1 U	1 U	1 U	1 U	1 U	1 U
Benzene		1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene		1 U	1 U	1 U	1 U	1 U	1 U
2-Chloroethylvinylether		2 U	2 U	2 U	2 U	2 U	2 U
Bromoform		4 U	4 U	4 U	4 U	4 U	4 U
4-Methyl-2-pentanone		1 U	1 U	1 U	1 U	1 U	1 U

RFW Batch Number: 8608-682- Client: ROCKY FLATS

Cust ID:	ITPH-LAI	LAB DUP	MS	ITPH-SAI	ITPH-LBI	ITPH-LCI
RFW#:	0070	0070	0070	0080	0240	0250
	fl	fl	fl	fl	fl	fl
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U	1 U
Styrene	1 U	1 U	1 U	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
1,3-Dichlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dichlenzenes	1 U	1 U	1 U	1 U	1 U	1 U
Trichlorofluoromethane	1 U	1 U	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	1 U	1 U	1 U	1 U	1 U	1 U

U=Analyzed, not detected. B=Present in blank. NRP=Not Reported
J=Present at less than detection limit. NR=Not requested.

WESTON ..NALYTICS
GC/MS DATA SUMMARY
VOLATILE HAZARDOUS SUBSTANCE LIST COMPOUNDS

RFW Batch Number: 8608-682- Client: ROCKY FLATS

Sample Information	Cust ID:	ITPH-SB1	BLANK	BS
	RFW#:	0260	BLANK	BS
	Matrix:	Water	Water	Water
	D.F.:	1	1	1
	Units:	ug/l	ug/l	ug/l
Chloromethane		1 U	1 U	1 U
Bromomethane		1 U	1 U	1 U
Vinyl Chloride		1 U	1 U	1 U
Chloroethane		1 U	1 U	1 U
Methylene Chloride		4 U	4 U	4 U
Acetone		2.2	2 U	2 U
Carbon Disulfide		1 U	1 U	1 U
1,1-Dichloroethene		1 U	1 U	1 U
1,1-Dichloroethane		1 U	1 U	1 U
Trans-1,2-Dichloroethene		1 U	1 U	1 U
Chloroform		1 U	1 U	1 U
1,2-Dichloroethane		1 U	1 U	1 U
2-Butanone		1 U	1 U	1 U
1,1,1-Trichloroethane		1 U	1 U	1 U
Carbon Tetrachloride		29	1 U	1 U
Bromodichloromethane		1 U	1 U	1 U
1,2-Dichloropropane		1 U	1 U	1 U
Trans-1,3-Dichloropropene		1 U	1 U	1 U
Trichloroethene		1 U	1 U	1 U
Dibromochloromethane		2 U	2 U	2 U
1,1,2-Trichloroethane		1 U	1 U	1 U
Benzene		1 U	1 U	113 %
cis-1,3-Dichloropropene		1 U	1 U	1 U
2-Chloroethylvinylether		2 U	2 U	2 U
Bromoform		4 U	4 U	4 U
4-Methyl-2-pentanone		1 U	1 U	1 U

RFW Batch Number: 8608-682- Client: ROCKY FLATS

Cust ID:	ITPH-SB1	BLANK	BS			
RFW#:	0260	BLANK	BS			
Tetrachloroethene	1 U	1 U	1 U			
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U			
Toluene	1 U	1 U	1 U			
Chlorobenzene	1 U	1 U	1 U			
Ethylbenzene	1 U	1 U	1 U			
Styrene	1 U	1 U	1 U			
Total Xylenes	1 U	1 U	114 %			
1,2-Dichlorobenzene	1 U	1 U	1 U			
1,3-Dichlorobenzene	1 U	1 U	1 U			
1,4-Dichlenzenes	1 U	1 U	1 U			
Trichlorofluoromethane	1 U	1 U	1 U			
Dichlorodifluoromethane	1 U	1 U	1 U			

U=Analyzed, not detected. B=Present in blank. NRP=Not Reported
J=Present at less than detection limit. NR=Not requested.

APPENDIX 5

CEARP PHASE 2: IGMP HEALTH AND SAFETY PLAN

DEPARTMENT OF ENERGY
ALBUQUERQUE OPERATIONS OFFICE
ENVIRONMENT, SAFETY AND HEALTH DIVISION
ENVIRONMENTAL PROGRAMS BRANCH

COMPREHENSIVE ENVIRONMENTAL ASSESSMENT AND RESPONSE PROGRAM

PHASE 2:
ROCKY FLATS PLANT
INSTALLATION GENERIC MONITORING PLAN
(Comprehensive Source and Plume Characterization Plan)

HEALTH AND SAFETY PLAN

February 1987

DRAFT

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1. INTRODUCTION

CEARP Phase 2 Confirmation consists of CEARP Phase 2a, Monitoring Plan, and CEARP Phase 2b, Site Characterization (Remedial Investigation). This Health and Safety Plan is one component of the Monitoring Plan for Rocky Flats Plant. The Monitoring Plan consists of five parts: Synopsis, Sampling Plan, Technical Data Management Plan, Health and Safety Plan, and Quality Assurance/Quality Control Plan. Because of the Compliance Agreement made by the State of Colorado, Environmental Protection Agency, and Department of Energy (DOE), this Monitoring Plan also includes a Feasibility Study Plan. The Synopsis provides a discussion of the current situation and serves as an introduction to the other plans.

CEARP uses a three-tiered approach in the preparation of monitoring plans: the CEARP Generic Monitoring Plan (CGMP), the Installation Generic Monitoring Plan (IGMP), and the Site-Specific Monitoring Plans (SSMPs). This IGMP is the Comprehensive Source and Plume Characterization Plan required by the compliance agreement. Therefore, the acronym used to refer to this plan is IGMP/CSPCP.

This IGMP/CSPCP Health and Safety Plan incorporates the specific safety practices and procedural review requirements for Rocky Flats Plant.

The CGMP Health and Safety Plan provides generic guidance and establishes procedures for conducting site characterization (remedial investigation) activities under CEARP Phase 2. It outlines how the DOE-Albuquerque Operations Office will implement health and safety requirements under CEARP. Specifically, it provides generic guidelines and procedures that will be employed by Rocky Flats Plant and Los Alamos National Laboratory during CEARP Phase 2b site characterization (remedial investigation) activities to protect the health and safety of personnel involved in CEARP. Thus, the CGMP Health and Safety Plan becomes the foundation for the Rocky Flats Plant IGMP/CSPCP Health and Safety Plan and is incorporated, as appropriate, by reference.

2. POLICY AND STANDARDS

It is DOE's policy that its operations shall be conducted in a manner that will (1) limit risks to the health and safety of the public and employees, and (2) adequately protect property and the environment. As outlined in the CGMP Health and Safety Plan, DOE has responsibility for health, safety, and environmental protection programs at DOE-owned contractor-operated facilities. Consistent with this responsibility, this Health and Safety Plan includes the current health and safety policy and standards in effect at Rocky Flats Plant. It also includes provisions to implement external subcontractor policy and standards when the latter are determined to be more restrictive.

2.1. POLICY

The main tenet of this IGMP/CSPCP Health and Safety Plan is to keep human exposure to toxic materials and radiation at levels as low as reasonably achievable (ALARA). The ALARA review will demonstrate that all reasonable efforts have been made to minimize worker and public exposures to toxic and/or radioactive materials.

Specific ALARA procedures will include engineering controls, administrative controls, and the use of personal protective equipment. The length of time employees spend in areas with elevated levels of radioactive or toxic materials will be minimized. If conditions produce airborne contaminants, dust suppressant measures will be taken. General requirements for limiting exposures, and protective clothing and equipment necessary to protect personnel from contaminants are identified in the CGMP Health and Safety Plan and are specifically addressed in this IGMP/CSPCP Health and Safety Plan, Section 4.2.

2.2. STANDARDS AND REGULATIONS

The environmental, safety, and health protection requirements applicable to Rocky Flats Plant operations are set forth in DOE and DOE-Albuquerque Operations Office Orders. These orders require compliance with applicable Federal, State of Colorado, or local standards. This Rocky Flats Plant IGMP/CSPCP Health and Safety

Plan is based on these DOE Orders, Federal regulations, and other professional standards specified in Section 2 of the CGMP Health and Safety Plan.

2.3. PERMITS

Permits issued by Rocky Flats will be obtained as required for all land use activities (e.g., drilling, boring, samples, and entry), following the current health and safety policy and standards in effect at Rocky Flats Plant.

3. HEALTH AND SAFETY RESPONSIBILITIES

The line organizations conducting CEARP Phase 2b Site Characterizations (Remedial Investigations) are responsible for providing adequate precautions and protection to ensure the health and safety of employees and the public. The simplified organizational chart for health and safety at Rocky Flats Plant is presented in Figure 3.1.

3.1. GENERAL RESPONSIBILITIES

For site characterization (remedial investigation) activities conducted at Rocky Flats Plant, the Rockwell International CEARP Manager establishes requirements following guidelines specified in this IGMP/CSPCP Health and Safety Plan that are consistent with current health and safety requirements. The Subcontractor Site Manager is responsible for ensuring the health and safety of field team personnel during CEARP Phase 2b site characterization (remedial investigation) activities. The Subcontractor Site Health and Safety Coordinator provides guidance to the Subcontractor Site Manager regarding potential health hazards during characterization activities. The Subcontractor Site Health and Safety Coordinator has the authority to terminate field activities at specific sites if unsafe conditions develop.

3.2. INSTALLATION REQUIREMENTS

Primary health and safety responsibility at Rocky Flats Plant rests with Rockwell International Health, Safety and Environment Department Director. Representatives of the Rockwell International Health, Safety, and Environment Department, under direction of the Rockwell International CEARP Manager, will review and concur with the SSMP Health and Safety Plans prior to commencement of site characterizations (remedial investigations). The Rockwell International Health, Safety, and Environment Department will also provide guidance to the Subcontractor Project Manager for establishing health and safety requirements.

3.3. SPECIFIC RESPONSIBILITIES

Specific responsibilities assigned to the functional health and safety organization for the Rocky Flats Plant CEARP Phase 2b site characterizations (remedial investigations) are provided in the following sections.

3.3.1. Los Alamos National Laboratory

Because the site characterizations (remedial investigations) will be conducted by Rockwell International, Los Alamos National Laboratory does not have responsibility for implementing Health and Safety Plans.

3.3.2. Rockwell International CEARP Manager

The Rockwell International CEARP Manger shall

- ensure that the Rocky Flats Plant SSMP Health and Safety Plans are prepared, reviewed, and concurred with by the appropriate individuals within DOE-Albuquerque Operations Office and Rocky Flats Plant;
- concur in the selection of the Subcontractor Site Manager and Subcontractor Site Health and Safety Coordinator;
- ensure that personnel involved with CEARP Phase 2b site characterizations (remedial investigations) comply with the IGMP/CSPCP Health and Safety Plans;
- require periodic health and safety audits (at least once during each stage of sampling), review Health and Safety Audit Reports, and require responses to Health and Safety Audit Report findings and recommendations;
- act on employee concerns in accordance with the procedures outlined in DOE Orders and take appropriate action to correct violations;
- review and evaluate requests for variance from the Health and Safety plans; and
- ensure that the proper reports required by DOE and DOE-Albuquerque Operations Office orders are submitted, including accident investigation reports, as necessary.

3.3.3. Subcontractor Project Manager

The Subcontractor Project Manager shall

- assign a Subcontractor Site Manager (Section 3.3.4) who will be responsible for ensuring the health and safety of field team personnel during CEARP Phase 2b Site Characterization (Remedial Investigation) activities;

- assign a Subcontractor Site Health and Safety Coordinator (Section 3.3.5) to ensure implementation of the Rocky Flats Plant IGMP/CSPCP Health and Safety Plan and each SSMP Health and Safety Plan; and

- read, concur, and comply with the Rocky Flats Plant IGMP/CSPCP Health and Safety Plan.

3.3.4. Subcontractor Site Manager

The Subcontractor Site Manager shall

- submit requests for variance from the requirements of this plan to the Subcontractor Project Manager and Rockwell International CEARP Manager, when appropriate;

- assure that requirements specified in DOE and DOE-Albuquerque Operations Office Orders 5484.1 are recorded and reported for all employees;

- ensure that personnel involved with CEARP Phase 2b site characterizations (remedial investigations) comply with the IGMP/CSPCP Health and Safety Plans;

- monitor the performance of employees involved in site characterization (remedial investigation) activities to ensure compliance with health and safety requirements;

- be familiar with emergency response procedures and notification requirements, and implement them accordingly; and

- terminate work activities if unsafe conditions develop or when directed to do so by the Subcontractor Site Health and Safety Coordinator.

3.3.5. Subcontractor Site Health and Safety Coordinator

A Subcontractor Site Health and Safety Coordinator will be designated by the Subcontractor Project Manager for each stage of the Phase 2b site characterization

(remedial investigation) activities. The Rockwell International CEARP Manager shall concur in the selection of the Subcontractor Site Health and Safety Coordinator. The Subcontractor Site Health and Safety Coordinator is responsible for conducting a review of the proposed activities prior to commencement of operations, evaluating potential hazards, and recording the appropriate information on a Work Location, Personnel Protection, and Safety Evaluation Form (Appendix A). Activities that require special monitoring or certain personal protective equipment will be specified in the SSMP Health and Safety Plans. In addition to the duties outlined in Section 3.4 of the CGMP Health and Safety Plan, specific responsibilities of the Subcontractor Site Health and Safety Coordinator include the following:

- being present or having an acceptable alternate present when subcontractor work activities are being performed in areas requiring decontamination of personnel or equipment;

- advising the Rockwell International CEARP Manager, and the Subcontractor Site Manager of potential health and safety hazards during site characterization (remedial investigation) activities;

- conduct special monitoring, if necessary;

- evaluate potential modifications to work plans and personal protective equipment requirements to ensure employee safety;

- ensure that site characterization (remedial investigation) team members have been trained in the appropriate safety procedures for the activities they will conduct, have current medical certification that they are physically fit to perform required tasks; and have participated in all required dosimetry or bioassay training programs;

- contact the appropriate local emergency organizations (police, fire, ambulance, and hospital) to coordinate emergency response activities;

- require that the Subcontractor Field Team Leader terminate work activities if unsafe conditions develop, or an imminent hazard is perceived;

- prepare variances from the health and safety requirements if needed; and

- carry out health and safety audits and prepare health and safety audit reports as required by this IGMP/CSPCP Health and Safety Plan.

3.4. AUDITS

Health and safety audits will be conducted by the Subcontractor to ensure adequate implementation of the requirements of this IGMP/CSPCP Health and Safety Plan. Audits will be conducted by the Subcontractor Site Health and Safety Coordinator and documented in Health and Safety Audit Reports to be issued by the Subcontractor Project Manager. The Los Alamos National Laboratory CEARP Team Leader and the Rockwell International CEARP Manager will receive copies of these reports. Individuals responsible for health and safety deficiencies noted in the audit findings will provide written responses describing corrective actions that have been implemented to resolve the findings.

The Rockwell International Health, Safety, and Environment Department may also conduct health and safety audits, separately or concurrently, with subcontractor audits.

3.5. VARIANCES FROM HEALTH AND SAFETY REQUIREMENTS

Where special conditions exist, a written request for a variance from a specific health and safety requirement may be submitted by the Subcontractor Site Health and Safety Coordinator to the Subcontractor Project Manager. If the Subcontractor Project Manager agrees with the request, the request will be reviewed by the Rockwell International CEARP Manager and representatives of the Rockwell International Health, Safety, and Environment Department. The conditions of the request will be evaluated and, if appropriate, a variance specifying the conditions under which the requirement may be modified will be granted in writing. A copy of the variance will be retained in the field during work activities in which it is invoked.

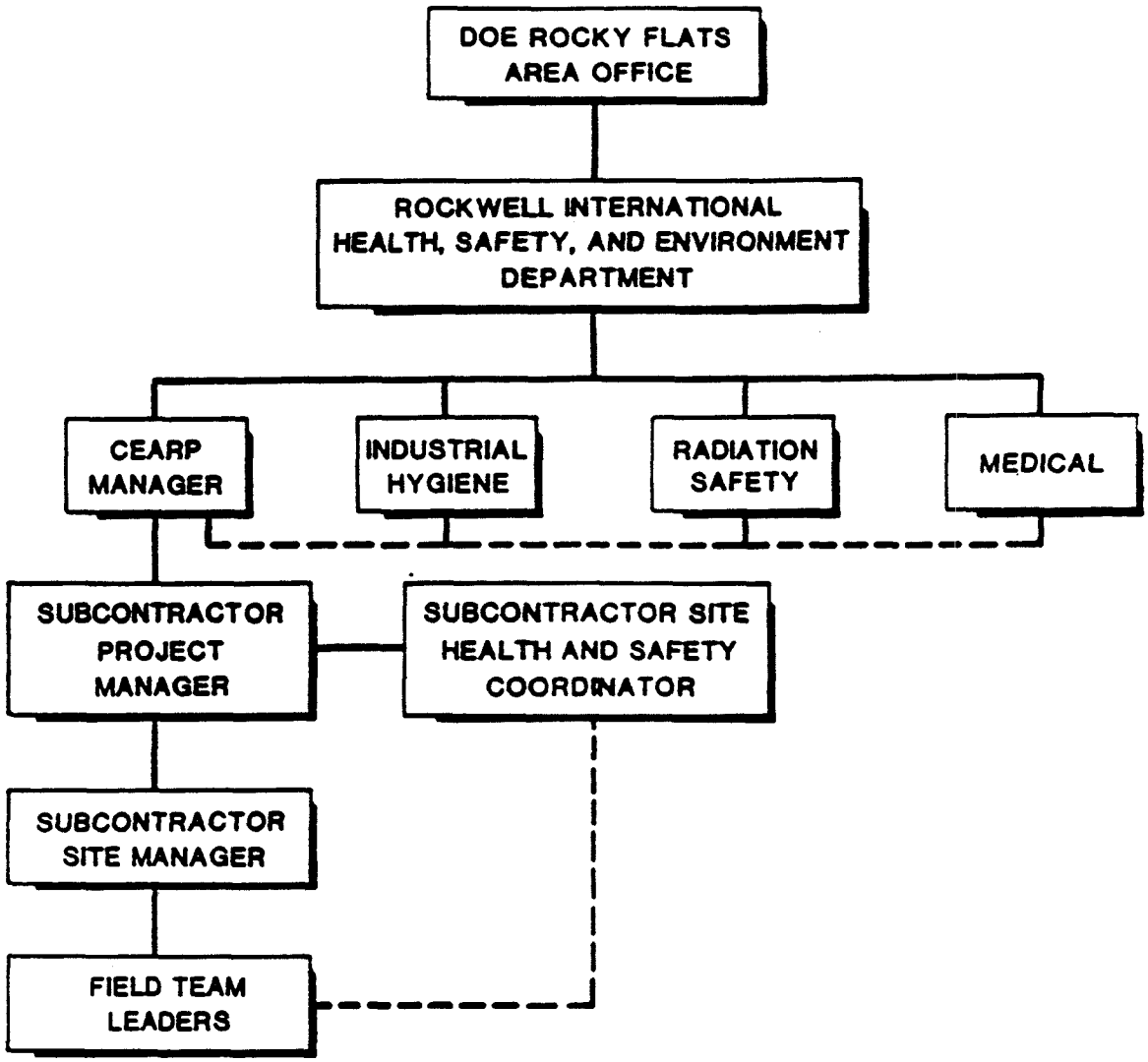

Figure 3.1. Simplified Health and Safety Organizational Chart for Rocky Flats Plant.

4. HAZARD ASSESSMENT AND PERSONNEL PROTECTION REQUIREMENTS

The following section provides a description of anticipated potential hazards anticipated at Rocky Flats Plant. The hazards description includes physical, chemical, radiological and biological hazards, followed by general requirements for limiting exposures, monitoring contaminant concentrations, and measuring employee exposure.

4.1. IDENTIFICATION OF POTENTIAL HAZARDS

4.1.1. Physical Hazards

The following physical hazards are anticipated at Rocky Flats Plant.

Heat Stress

The body's physiological processes fail to maintain a normal body temperature because of excessive heat. A number of physical reactions can occur, ranging from mild to fatal.

Heat-Related Problems

- Heat Rash, caused by continuous exposure to heat and humid air aggravated by chafing clothes. Decreases ability to tolerate heat and becomes a nuisance.

- Heat Cramps, caused by profuse perspiration with inadequate fluid intake and chemical replacements (especially salts). Signs: muscle spasm and pain in the extremities and abdomen.

- Heat exhaustion, caused by increased stress on various organs to meet increased demands to cool the body. Signs: shallow breathing; pale, cool, moist skin; profuse sweating; dizziness and lassitude.

- Heat stroke, the most severe form of heat stress. Body must be cooled immediately to prevent severe injury and/or death. Signs: red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong rapid pulse; coma.

Work/Rest Schedule

When working in level B or C protective clothing, the following guideline for calculating the work/rest schedule shall be used.

Calculate the adjusted temperature,

T(adjusted) = T(actual) + (13 x sunshine fraction)

100% sunshine =	no cloud cover	= 1.0
50% sunshine =	50% cloud cover	= 0.5
0% sunshine =	full cloud cover	= 0.0

Adjusted Temperature	Active Work Time (min./hr)
75 or less	50
80	40
85	30
90	20
95	10
100	0

Cold Exposure

Persons working outdoors in temperatures at or below freezing can become frostbitten. Exposure to extreme cold for short time periods can cause severe injury to the body surface or can result in profound generalized cooling, causing death. Body areas which have high surface-area-to-volume ratios (e.g., fingers, toes, and ears) are the most susceptible.

Cold Exposure-Related Problems

- Frost nip or incipient frostbite, characterized by sudden blanching or whitening of skin.
- Superficial frost bite, which causes skin to become waxy or white and superficially firm, but resilient beneath.
- Deep frostbite, characterized by cold, pale, solid skin tissues.
- Systemic hypothermia, caused by exposure to freezing or rapidly dropping temperature. Symptoms are usually exhibited in five stages: 1) shivering, 2) apathy, listlessness, sleepiness and (sometimes) rapid cooling of the body to less than 95°F, 3) unconsciousness, glassy stare, slow pulse and slow respiratory rate, 4) freezing of the extremities, and finally, 5) death.

Caution will be used to prevent cold exposure by wearing properly insulated garments beneath protective clothing and by taking frequent warm-up breaks.

Noise

When noise exceeds acceptable levels (limits specified in Department of Air Force Regulation 161-35 TLV's) administrative or engineering controls designed to reduce exposures will be utilized. If these controls are not sufficient, approved ear protection will be provided and its use mandated. Noise levels will be monitored when it becomes necessary to speak loudly under normal working conditions.

Standard Precautions for Equipment and Structures

Site characterizations (remedial investigations) at Rocky Flats Plant may require the use of shovels, drill rigs, portable augers, and backhoes. Prior to any surface disturbance the required permit will be obtained from Rocky Flats Plant. Heavy equipment will be operated according to OSHA recommendations and requirements.

- Only qualified and licensed personnel shall be allowed to operate this equipment.

- Heavy equipment shall be operated and maintained in conformance with established standards and inspected prior to use, as directed by Federal, State or OSHA regulations.

- Overhead electrical power lines shall be considered energized unless Rocky Flats Plant Utilities Manager has verified de-energization.

- While in use, drilling rigs shall maintain the following minimum distances from overhead power lines: 10 ft for 50 kv, 20 ft for 345 kv, and 34 ft for 750 kv.

  In transit, with the boom or derrick lowered, the closest approach to a powerline shall be 4 ft for 50 kv, 10 ft for 50-345 kv, and 16 ft for 345-750 kv.

Flammable and/or Combustible Materials

Several sites requiring characterization could contain flammable or combustible materials. The SSMP Health and Safety Plans will contain detailed information on the likelihood of encountering combustible materials and specific health and safety requirements for these areas.

4.1.2. Known Chemical Hazards

Known chemical hazards at Rocky Flats Plant include possible inhalation, ingestion, or dermal absorption of organic compounds, solvents, or other toxic materials. Specific properties of known chemical contaminants are provided in Appendix A. If it is determined that additional chemicals are present at Rocky Flats Plant, Appendix A will be amended. Levels or concentrations of these hazardous materials can be estimated from groundwater sampling results.

4.1.3. Known Radiological Hazards

Radionuclides are expected to be present at Rocky Flats Plant. The specific properties of the known radionuclides, including type of emission, half-life, maximum allowable concentrations, and body burdens are provided in Appendix A. The specific properties of the known radionuclides including type of emission, half-life, maximum allowable concentrations, and body burdens are provided in Appendix A.

There are three principal pathways by which individuals could be exposed to radioactivity during site characterizations (remedial investigations). These are (1) inhalation or ingestion, (2) dermal absorption, and (3) exposure to direct radiation from contaminated materials (see 4.2. for personnel protection requirements).

4.1.4. Biological Hazards

Certain biological hazards are anticipated at Rocky Flats Plant:

- insects, including ticks and mosquitoes;
- snakes of poisonous and nonpoisonous species; and
- rodents, including mice and rats.

If a worker is bitten by a rodent or snake, the Subcontractor Site Health and Safety Coordinator will be immediately notified. The Rocky Flats Plant installation medical center shall be contacted and appropriate medical care given.

4.2. PERSONNEL PROTECTION REQUIREMENTS

4.2.1. Protection Levels and Protective Clothing

As stated in the CGMP Health and Safety Plan, the U.S. Environmental Protection Agency (EPA) has established four levels of protection for personnel entering potentially hazardous sites. The work at Rocky Flats Plant is anticipated to be conducted in levels B, C, and D protection based upon known hazards. The SSMP Health and Safety Plan will define zones of contamination and identify which levels of protection will be required for each zone. All personnel entering a zone will be required to wear the attire designated for that zone.

4.2.2. Protective Equipment

As stated in the CGMP Health and Safety Plan, a variety of safety equipment will be used to protect personnel from safety hazards and minimize exposures to hazardous chemicals and radionuclides during Rocky Flats Plant site characterizations (remedial investigations). Portable monitors and meters will be used to determine exposures and measure air concentrations of radiological and chemical contaminants. The safety equipment used will include photoionization and organic vapor analyzers, air samplers, radiation survey meters, explosive gas concentration meters, detector tubes, and thermoluminescent dosimeters. This safety equipment is fully described in the CGMP Health and Safety Plan. The SSMP Health and Safety Plans will outline specific equipment to be used, and action levels to be taken for each type of measurement.

Cooling vests and warming equipment will be available to minimize stress from climatic conditions. As outlined in the CGMP Health and Safety Plan, emergency equipment including fire extinguishers, first aid kits, blankets, and eye wash kits will be available for emergency treatment.

4.2.3. General Safety Practices and Mitigation Measures

As stated in the CGMP Health and Safety Plan, some hazards can be minimized through the implementation of specific procedures, use of special equipment, training of personnel, or availability of emergency response equipment in the event of

an accident. The general requirements listed in the CGMP Health and Safety Plan will be observed during all Rocky Flats Plant site characterizations (remedial investigations).

Work that may involve resuspension of contaminants into the air will be suspended when the wind speed exceeds 15 miles per hour.

Morning meetings for all personnel involved in sampling will be held daily. These meetings will be used to express health and safety concerns related to the day's activities. Standard safe working practices, described in Section 4 of the CGMP Health and Safety Plan, will be followed. Appendix A provides a list of potential chemical and hazards radiological and their respective method of detection and Threshold Limit Value (TLV). A detailed description of hazards and hazardous materials which could be encountered at each site will be provided in each SSMP Health and Safety Plan. The SSMP Health and Safety Plans will also provide site-specific safety practices and mitigative measures.

4.3. SITE ACCESS CONTROL

4.3.1. Restricted Access Zones

As stated in the CGMP Health and Safety Plan, control zones will be established prior to commencement of work at contaminated sites to protect employees and the general public from unnecessary exposure to toxic materials and/or radiation, and to prevent inadvertent spread of contamination. The control (exclusion) zones will be designated in each SSMP Health and Safety Plan based on the nature, magnitude, and extent of contamination, and the potential for contaminant migration. Decontamination is required for personnel, equipment, and vehicles moving from an exclusion zone to a clean zone.

The decontamination of equipment and personnel will be conducted in steps starting at exclusion zones, proceeding through contamination reduction zones, and ending at clean zones. The size and number of contamination reduction zones will be determined on a site-specific basis and will be provided in each SSMP Health and Safety Plan. Exclusion criteria, protection requirements, contact person, and other relevant information will be posted at the access station of each exclusion zone.

4.3.2. Decontamination

At Rocky Flats Plant, decontamination will follow the general procedures described in Section 4 of the CGMP Health and Safety Plan. Each SSMP Health and Safety Plan will clearly define decontamination procedures for specific contaminants of concern.

Decontamination solutions used will be selected according to contaminants encountered on a site-specific basis. Radionuclides anticipated at Rocky Flats Plant can be removed from personnel and equipment using dilute soap and water solutions. Organic compounds and solvents will require use of slightly stronger detergents for effective removal. Following decontamination, verification measurements will be made to ensure that contaminants have been removed to safe levels. For articles or personnel contaminated by low energy beta emitters, swipe-samples will be collected and analyzed using liquid scintillation detectors. For alpha and high energy beta emitters, a survey meter will be used to evaluate decontamination. Following this "frisking," swipes will be collected and analyzed using a gross alpha/beta counting meter.

4.4. WORKER TRAINING

As described in the CGMP Health and Safety Plan, health and safety training will be conducted and documented for all members of site characterization (remedial investigation) field teams. The level of training for each team will be commensurate with job functions and potential hazards in work areas and comply with the RCRA part B Operating Permit Application, Section H. This will be in addition to completion of any surcontractor basic health and safety training, or the equivalent, that must be approved prior to site assignment. At least two field members of each field team will be required to have current certification in American Red Cross Multi-Media First Aid and Cardio Pulmonary Resuscitation (or the equivalent). In addition, training for all field team members will meet right-to-know requirements and will follow the outline in Appendix A, which includes

- radiological safety,
- hazard identification and recognition,
- potential health effects and symptoms of exposure,
- protective equipment requirements and proper use,
- decontamination procedures,

- controlled area restrictions, and
- emergency response requirements.

4.5. EMPLOYEE MEDICAL PROGRAM

As stated in the CGMP Health and Safety Plan, site characterization (remedial investigation), subcontractor field team members shall participate in an employee medical examination program. Their suitability for conducting field sampling activities (including possible respirator use) will be evaluated and documented by a physician. Medical programs must comply with requirements of DOE Order 5480.1A Chapter VIII.

4.6. RECORDS AND REPORTING REQUIREMENTS

Subcontractors will maintain health and safety records and submit reports, as required by DOE Orders, to the Subcontractor CEARP Project Manager. These will include the following:

- DOE Form 5484.3 Supplementary Record of Occupational Injuries and Illnesses
- DOE Form 5484.4 Tabulation of Property Damage Experience
- DOE Form 5485.5 Report of Property Damage or Loss
- DOE Form 5484.6 Annual Summary of Whole Body Exposures to Ionizing Radiation
- DOE Form 5484.7 Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials for CY
- DOE Form 5484.8 Termination Occupational Exposure Report
- DOE Form OSHA-200 Log of Occupational Injuries and Illness
- DOE Form EV-102A Summary of Department of Energy and Department of Energy Contractor Occupational Injuries and Illnesses
- DOE Form 5821.1 Unplanned Releases Form.

The Subcontractor Project Manager will distribute copies of the reports to Los Alamos National Laboratory, the DOE-Albuquerque Operations Office, and the

Rockwell International Health and Safety Department, as appropriate. Specific reporting responsibilities are given in the following subsection.

4.6.1. Exposure and Medical Records

Subcontractors will maintain confidential medical records for each field team member as indicated by the employee medical program. These records will identify individuals by name, date of birth, social security number, and additional identifiers as desired by the subcontractor. The employee's accident record and history of exposures and/or possible exposures to hazardous physical, chemical, or biological agents will be included with the medical records.

The Subcontractor Site Health and Safety Coordinator will prepare, and submit to the Subcontractor Project Manager and the Rockwell International CEARP Manager, radiation exposure reports as required in DOE Order 5484.1. Form 5484.8, "Termination Occupational Exposure Report," will be completed for any employee included in a radiation monitoring program upon termination of employment. Forms 5484.7, "Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials for CY 19XX," and 5484.6, "Annual Summary of Whole Body Exposures to Ionizing Radiation," will be submitted annually by March 31 for monitored employees. These reporting requirements are currently under revision by DOE, and the Subcontractor Site Health and Safety Coordinator shall comply with the new requirements when they become final.

4.6.2. Accident/Incident Reports

The Subcontractor Site Health and Safety Coordinator will notify the Subcontractor Project Manager and the Rockwell International CEARP Manager of any accidents or incidents that occur during site characterizations (remedial investigations) at Rocky Flats Plant. The Subcontractor Site Health and Safety Coordinator will also submit a completed DOE Form F 5484.X for any of the following incidents.

(1) "Recordable" occupational injuries or illnesses are defined below:

OCCUPATIONAL INJURY is any injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment.

NOTE: Conditions resulting from animal or insect bites, or one-time exposure to chemicals, are considered to be injuries.

OCCUPATIONAL ILLNESS of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases which may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.

(2) PROPERTY DAMAGE LOSSES of $1,000 or more are reported as follows: accidents which cause damage to DOE property, regardless of fault, or accidents wherein DOE may be liable for damage to a second party, are reportable if damage is $1,000 or more. Include damage to facilities, inventories, equipment, and properly parked motor vehicles. Exclude damage resulting from a DOE reportable vehicle accident.

(3) GOVERNMENT MOTOR VEHICLE ACCIDENTS resulting in damages of $250 or more, or involving an injury, are reported unless the Government vehicle is not at fault, damage of less than $250 is sustained by the Government vehicle, and no injury is inflicted on the Government vehicle occupants. Accidents are also reportable to DOE if

- damage to a Government vehicle, not properly parked, is greater than or equal to $250;
- damage to DOE property is greater than or equal to $250 and the driver of a Government vehicle is at fault;
- damage to any private property or vehicle is greater than or equal to $250 and the driver of a Government vehicle is at fault; and
- any person is injured and the driver of a Government vehicle is at fault.

4.7. EMPLOYEE INFORMATION

The Subcontractor Site Health and Safety Coordinator shall ensure that the following DOE forms are posted where field team members can easily read them:

- Form F 5480.2 Occupational Safety and Health Protection,
- Form F 5480.4 Occupational Safety and Health Complaint Form.

Also, the Rocky Flats Plant Health and Safety Standard concerning employee right-to-know shall be provided in each SSMP and appropriately posted.

5. EMERGENCY RESPONSE AND NOTIFICATION

This section provides guidelines for responses to emergency situations.

5.1. EMERGENCY CONTACTS

Names of persons to contact in case of emergencies will be provided in the format found in Figure 5.1. This emergency contact form will be copied and posted in prominent locations at the work sites. Additional contacts are given in the Safety Evaluation Form (Appendix A).

5.2. CONTINGENCY PLANS

Field team leaders, with assistance from the Subcontractor Site Health and Safety Coordinator, shall have responsibility and authority for coordinating all emergency response activities until proper authorities arrive and assume control. A copy of these plans shall be available at the work site at all times, and all personnel working on the site shall be familiar with the plans. Evacuation plans and routes shall be on a job-specific basis, and all personnel shall be familiar with them.

5.2.1. Fire/Explosion

Any fire emergency will be handled by immediately notifying the fire department. Only if the fire appears to be small and easily extinguishable will personnel attempt control with fire extinguishers available in the work area. Otherwise, immediate evacuation of the area is indicated.

If combustible gas/oxygen meters show explosive gas or oxygen concentrations approaching 25% of the lower explosive limits, all personnel will be evacuated and the fire department will be notified. In the event of an explosion, all personnel shall be evacuated and no one shall re-enter the area until it has been cleared by explosives safety personnel.

5.2.2. Personnel Injuries

In case of injuries to personnel, first aid treatment will be initiated immediately by trained personnel. In case of serious injuries, the victim will be transported to the Rocky Flats Plant medical center as soon as possible. Minor injuries may be treated onsite, but all injuries will be examined by trained medical personnel. Victims of serious bites or stings will be taken to the Rocky Flats Plant medical center. In the event that an injured person is contaminated with chemicals or radionuclides, the person shall be taken as soon as possible to the Rocky Flats Plant medical center. Decontamination shall be performed to prevent further exposure only if it will not aggravate the injury. Treatment of life threatening or serious injuries will always be considered first.

5.2.3. Accidental Releases of Radionuclides to the Environment

In case of releases of radionuclides to the environment (such as a spill of samples being transported for analysis), emergency response shall be in accordance with Rocky Flats Plant procedures. The Subcontractor Site Manager or Field Team Leader shall notify the Rockwell International CEARP Manager of such an event.

5.3. NOTIFICATION REQUIREMENTS

Reporting and notification of emergency situations shall be carried out in accordance with requirements in DOE Order 5484.1. The Field Team Leader shall notify the Subcontractor Site Manager. The Subcontractor Site Manager will notify appropriate emergency assistance personnel (e.g., fire, police, ambulance at ext. 2911), and the Rockwell International CEARP Manager. The responsibility of the Subcontractor Site Health and Safety Coordinator for Rocky Flats Plant is to implement notification and reporting requirements of DOE Order 5484.1.

Site Health and Safety Coordinator--

Name: Call: _____

Installation Health and Safety Officer--

Name: _____ Call: _____

24-Hour Installation Health/Safety Coordinator--

Call: _____

FIRE-- Call: _____

AMBULANCE-- Call: _____

POISON CENTER-- _____

SECURITY-- Call: _____

POLICE-- Call: _____

YOU ARE LOCATED AT: _____

_____

THE NEAREST TELEPHONE IS LOCATED AT:

_____

THE NEAREST EMERGENCY MEDICAL SERVICES ARE LOCATED AT:

_____

_____

Figure 5.1. Emergency Contacts

6. ENVIRONMENTAL MONITORING

Environmental impacts from CEARP site characterizations (remedial investigations) are expected to be negligible. Additional sampling to supplement Rocky Flats Plant routine monitoring activities is not considered necessary. Monitoring of air quality for personnel protection will provide data to re-evaluate the need for environmental monitoring. Additional guidance and detail regarding monitoring during site characterizations (remedial investigations) will be provided in SSMP Sampling Plans.