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NAS Fort Worth JRB, Texas
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WEAPONS STORAGE AREA BACKGROUND STUDY

JANUARY 1998

By:

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ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Environmental Excellence
ASTM	American Society for Testing and Materials
C	Celsius
cm/s	centimeters per second
DER	Duplicate Error Ratio
DOI	U.S. Department of the Interior
DQO	data quality objective
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
FWS	U.S. Fish and Wildlife Service
Jacobs	Jacobs Engineering Group Inc.
LCS	laboratory control sample/spike
LCSD	laboratory control sample duplicate
MDL	method detection limit
mg/L	milligrams per liter
mL/L	milliliters per liter
MS	matrix spikes
MSD	matrix spike duplicate
NAS	Naval Air Station
ND	nondetect
NIST	National Institute of Standards and Technology
pCi/g	picocuries per gram
pCi/L	picocuries per liter
ppm	parts per million
PQL	practical quantitation limit
PVC	polyvinyl chloride
QC	quality control
Radian	Radian Corporation
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment

ACRONYMS AND ABBREVIATIONS

RPD	relative percent difference
%RSD	percent relative standard deviation
SDG	sample delivery group
SOP	standard operating procedures
SWMU	solid waste management unit
TCE	trichloroethene
TDPW	Texas Department of Parks and Wildlife
TFH	total fuel hydrocarbons
TI	tolerance interval
TNRCC	Texas Natural Resource Conservation Commission
TPH	total petroleum hydrocarbons
TPU	total propagated uncertainty
UTL	upper tolerance limit
$UTL_{95,95}$	upper tolerance limit with 95 percent confidence and 95 percent coverage
WSA	Weapons Storage Area
°	degree
>	greater than
≥	greater than or equal to
±	plus or minus
%	percent

EXECUTIVE SUMMARY

A background study was conducted at the Off-Site Weapons Storage Area (WSA) located approximately 5 miles west of Naval Air Station Fort Worth Joint Reserve Base, Carswell Field, Texas (referred to as NAS Fort Worth) to establish background concentrations of radium and total petroleum hydrocarbons (TPH) in surface soil, subsurface soil, and groundwater.

A total of 21 surface soil, 21 subsurface soil, and 15 groundwater samples were collected to characterize these media for background concentrations. Additionally, two groundwater samples were collected from each of the onsite water supply wells.

The Tolerance Interval (TI) method (U.S. Environmental Protection Agency [EPA] 1989, 1992) was used to estimate upper tolerance limits (UTLs) of the distribution of each constituent in the background data population. Table ES-1 presents the results of the WSA Background Study. The $UTL_{95,95}$ listed in the table is the value that we can say, with 95 percent confidence, will exceed 95 percent of the background data. Any analyte detected at a site with a concentration greater than the UTL has only a 5 percent probability of being drawn from the background data population and, thus, may indicate the presence of site-related contamination.

Table ES-1 also presents the maximum detected value for TPH, Radium-226, Radium-228, and total radium from the two samples collected from the onsite water supply wells. Comparison of these maximum values to the calculated UTLs indicates that the concentrations of radium detected in the onsite water supply wells are consistent with background concentrations and do not indicate site related contamination.

TABLE ES-1
Comparison of Maximum Detected Values in Supply Wells to Background UTL $_{95,95}$

Analyte in Groundwater	Background UTL $_{95,95}$	Maximum Concentration Detected in Supply Wells
TPH (mg/L)	ND at 0.444	ND at 0.444
Radium-226 (pCi/L)	13.06	9.82
Radium-228 (pCi/L)	2.61	1.39
Total Radium (pCi/L)	14.46	11.21

Notes:

mg/L milligrams per liter
pCi/L picocuries per liter
ND nondetect

TAB

Section 1

1.0 INTRODUCTION

This report describes field activities, summarizes analytical results, and presents background concentrations calculated for the Weapons Storage Area (WSA) background study. Jacobs Engineering Group Inc. (Jacobs) completed this work under Contract F41624-94-D-8046, Delivery Order 0021, issued by the Air Force Center for Environmental Excellence (AFCEE). The project consisted of sampling soil and groundwater, and calculating background concentrations for total petroleum hydrocarbons (TPH) and radium in each of these media.

This report is organized into six sections. Section 1.0 introduces the WSA background study, the history and physical setting of the site, project objectives, the general approach, and the rationale for the selection of sampling locations and the analytical suites. Section 2.0 describes the field sampling activities. Section 3.0 provides an overview of data quality. Section 4.0 presents the data analysis and statistical calculations of background concentrations for each of the media sampled. Section 5.0 summarizes the conclusions of this study. Section 6.0 is the list of references used to prepare this report. In addition to the six sections, this report includes the following six appendices:

- Appendix A - Preliminary Analytical Results
- Appendix B - Chain-of-Custody Records
- Appendix C - Soil Probe Boring Logs
- Appendix D - Monitoring Well Boring Logs, Construction Details, and Groundwater Sampling Data Sheets
- Appendix E - Statistical Calculations Support Tables
- Appendix F - Photographs.

1.1 LOCATION AND HISTORY OF WEAPONS STORAGE AREA

The WSA is located in north-central Texas, approximately 5 miles west of Naval Air Station (NAS) Fort Worth (Figure 1-1). The area surrounding the offsite WSA is

primarily rural, occupied mostly by ranches and farms although newer residential developments are located to the south and east of the WSA.

The WSA is a 247-acre site surrounded by a 264-acre buffer zone easement. The WSA is located between two forks of Live Oak Creek, which flows east and north to discharge into Lake Worth.

Opened in 1956, the site was historically used for munitions inspection, storage, and disposal. The facility includes two munitions inspection shops, 16 ordnance storage buildings, one entry-control building, an emergency power plant, an Explosive Ordnance Disposal range, a former radioactive waste storage facility, a water storage tank, and two water wells. The radioactive waste storage facility consisted of three waste burial wells, which were reportedly used for disposal of luminous instruments from dismantled or refurbished warplanes.

Contamination identified in previous investigations includes trichloroethene (TCE) in soil west of the Inspection Shop (Building 8503), and total radium in excess of the federal drinking water standards in the onsite potable water supply well.

The total radium detected in the onsite water supply well is the basis for the background study at the WSA. The background study was initiated to establish the naturally occurring concentrations of Radium-226 and -228 and determine the presence of TPH in groundwater and soil.

A 1989 Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) by A.T. Kearney, Inc. (A.T. Kearney, Inc. 1989) identified two solid waste management units (SWMUs) at the WSA: SWMU 60, the radium burial site and SWMU 65, the waste disposal site. Radian Corporation (Radian) collected soil and groundwater samples at the WSA in 1986 and in 1988 (Radian 1986, 1988). Based on these investigations, SWMU 65 was approved for no further action by the Texas Natural

Resource Conservation Commission (TNRCC) in 1991. In 1996 Metcalf & Eddy, Inc. removed the radioactive material at SWMU 60 (Metcalf & Eddy, Inc. 1996).

1.2 INSTALLATION ENVIRONMENTAL SETTING

The WSA is located in the Grand Prairie Section of the Central Lowlands Physiographic Province. The area is characterized by broad, gently to moderately sloping terraces of sedimentary rock mantled by a variable thickness of light brown to black loamy soil. The soil layer is thin to virtually nonexistent in some areas of the WSA. The Grand Prairie Section is typically grass-covered with isolated stands of upland timber.

In general, topography within the fenced area of the WSA consists of a gently eastward sloping surface with elevations ranging from approximately 720 feet above mean sea level along the east fence to approximately 770 feet above mean sea level near the western fence boundary of the site. The topography is more variable outside the fenced area. The stream valleys of Live Oak Creek and a tributary are found to the north and southeast of the WSA fenced area but within the WSA property boundary.

1.2.1 Demography

The WSA is located in north-central Tarrant County. Based on the 1990 census, the population of Tarrant County (which encompasses most of the Fort Worth metropolitan area) is approximately 1.17 million; approximately 447,600 people live in the City of Fort Worth. Numerous smaller communities represent the balance of the population. The community of White Settlement is approximately 3 miles to the east of the WSA. The Tarrant County/Parker County line is approximately 1.5 miles to west of the WSA.

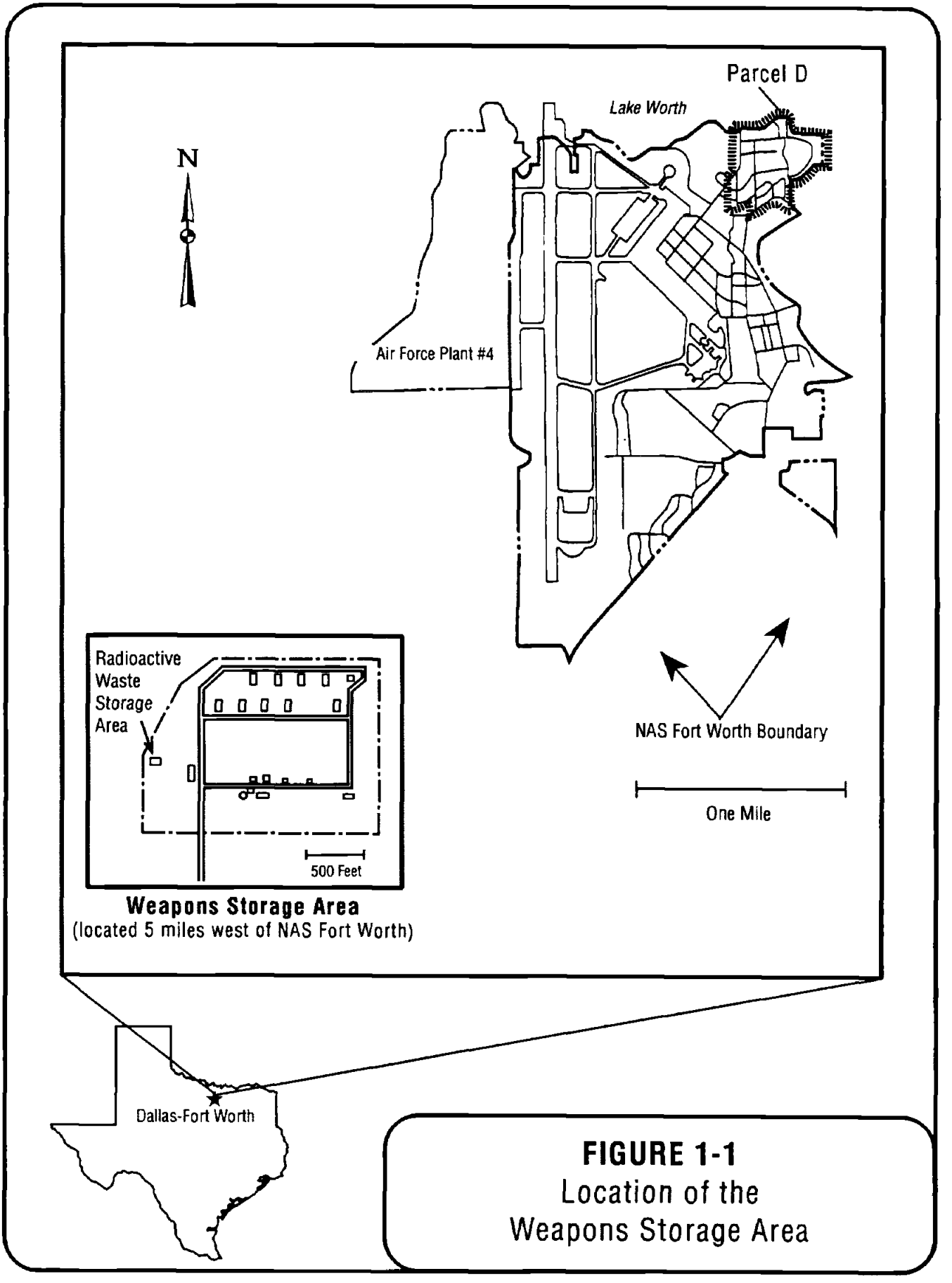

FIGURE 1-1
Location of the Weapons Storage Area

Land in the vicinity of the WSA is primarily rural and characterized by grazing and agricultural use. Currently, the area surrounding the WSA is relatively undeveloped; however, several small residential communities have recently been or are currently being built in the area.

1.2.2 Geology

The following sections discuss the regional geology and site-specific geology of the WSA.

1.2.2.1 Regional Geology

The geology of west-central Tarrant County consists of Early Cretaceous marine sedimentary rocks underlain by undifferentiated Paleozoic rocks. Unconsolidated thin alluvial deposits of the Quaternary period overlie bedrock along major stream and river valleys.

Sediments were deposited in the area during most of the Paleozoic era. Late in the Paleozoic era the area was uplifted, and extensive erosion during the Jurassic period produced a surface upon which early Cretaceous marine sediments were deposited as part of an oscillating shoreline. These marine sediments now exist as a southeast-thickening wedge extending into the East Texas basin. From the late Cretaceous period through the Tertiary period, the sea withdrew toward the Gulf of Mexico, and the land surface was eroded and shaped by streams. During the Quaternary period, the streams deposited alluvial sediments. The older sediments are represented by terrace deposits cut by the alluvial valleys of present streams.

Major structural features in the vicinity of Tarrant County include the Mexia-Talco fault system about 80 miles to the east, the leading edge of the Ouachita overthrust about 30 miles to the east, and the south end of the axis of the Fort Worth basin, located approximately 5 miles to the east of the site.

The generalized regional stratigraphic units in the vicinity of Tarrant County are presented in Table 1-1. Not all units are present at the WSA. The units present at the WSA are briefly described in the following paragraphs.

TABLE 1-1
Stratigraphic Units of Interest in the Vicinity of the Weapons Storage Area

Era	System	Series	Group	Stratigraphic Units
Cenozoic	Quaternary	Holocene		Fill Material Alluvium
		Pleistocene		Fluvial Terrace Deposits
Mesozoic	Cretaceous	Comanche	Washita	Duck Creek Limestone Kiamichi Formation
			Fredericksburg	Goodland Limestone Walnut Formation
			Trinity	Paluxy Formation Glen Rose Formation Twin Mountains Formation
Paleozoic				Paleozoic Undifferentiated

The fill materials consist of clay, silt, sand, gravel, and organic material generally due to farming related soil disturbance. The alluvial deposits fill present-day stream and river valleys and consist of sand, silt, clay, and gravel. The Terrace Alluvium, consisting of gravel, sand, silt, and clay, represent older floodplain sediments and occur above and are generally cut by the present stream valleys.

The Cretaceous rocks of the Comanche Series (the Washita, Fredericksburg, and Trinity Groups) all dip gently to the east-southeast at a rate of approximately 37 feet per mile (Leggat 1957). Units of the Washita Group (the Duck Creek Limestone and Kiamichi) do not occur at the site, but do occur to the south and east of NAS Fort Worth (McGowen et al. 1988).

The Fredericksburg Group, which consists of the Goodland Limestone and the Walnut Formation, underlie most of the area and occasionally crop out. The Goodland Limestone is composed of white, chalky, fossiliferous, dense, thinly to massively bedded limestone interbedded with gray to yellow-brown stiff clay and marl (Hargis + Associates 1989). The formation is extensively jointed and ranges from 0 to 130 feet thick in Tarrant County. The Walnut Formation, which averages 300 feet in thickness, is a fossiliferous limestone and shell coquinite, and consists of interbedded brown sandy clay, thinly bedded fossiliferous clay, fissile clay, and iron-stained limestone (Leggat 1957).

Rocks of the Trinity Group, consisting of the Paluxy, Glen Rose, and Twin Mountains Formations, underlie and often crop out at the WSA. The Paluxy Formation consists of sandstone and siltstone interbedded with sandy to silty, calcareous, waxy clay, and shale (Nordstrom 1982). The sandstone is composed of fine- to coarse-grained, well-sorted, poorly consolidated, and cross-bedded white quartz. The thickness of the Paluxy Formation in Tarrant County is approximately 140 to 190 feet (Leggat 1957). Underlying the Paluxy Formation is the Glen Rose Formation consisting of sandstone, claystone, limestone, and anhydrite. In the vicinity of Lake Worth, the Glen Rose Formation is approximately 250 feet thick.

Underlying the Glen Rose Formation is the Twin Mountains Formation. The Twin Mountains Formation grades upward from a chert and quartz conglomerate to a fine- to coarse-grained sandstone interbedded with shale and clay, and is approximately 250 feet thick in the vicinity of Lake Worth. Undifferentiated Paleozoic deposits underlie the Twin Mountains Formation and consist of shales, sandstones, and limestones 6,000 to 7,000 feet thick.

1.2.2.2 Geology of the Weapons Storage Area

The stratigraphy of the WSA consists of, in descending order, the following:

- Goodland Limestone;
- Walnut Formation;
- Paluxy Formation; and
- Glen Rose Formation.

The surficial materials at the WSA consist mostly of moderately to highly weathered outcrops of Goodland Limestone and Walnut Formation; very little, if any, fill or soil exists within the fenced boundaries of the site. Soil exists in some areas to the west, northwest, and east of the site. Alluvial materials are found only along the stream channels of Live Oak Creek and its tributary, which are located outside the boundary fence of the site.

Goodland Limestone outcrops to the west of the WSA property boundary, while weathered Walnut Formation outcrops over most of the area inside the fenced boundary of the WSA (Barnes 1972/1988). The Walnut Formation is composed of shell-agglomerate limestone with varying amounts of clay and shale. The limestone is usually fractured and contains considerable jointing and flaking. The Walnut Formation encountered in the two background wells was approximately 26 to 30 feet thick. Terrace Alluvium was not encountered at the WSA.

Underlying the Walnut Formation is the Paluxy Formation. The Paluxy is exposed only along Live Oak Creek and tributary, and in a quarry south of the WSA. The Paluxy is principally composed of sand with lesser amounts of clay, sandy clay, shale, and lignite. The Paluxy Formation encountered in the two background wells was approximately 170 to 190 feet thick.

1.2.3 Hydrogeology of the Weapons Storage Area

The hydrogeology of the WSA consists of three primary units:

1. the Walnut Formation aquitard, consisting primarily of dry limestone with some locally perched groundwater in shallow weathered zones;
2. the Paluxy Aquifer; and
3. the Glen Rose Formation aquitard.

Walnut Formation Aquitard. The Walnut Formation aquitard is composed of varying amounts of clay and shale layers interbedded with shell-agglomerate limestone strata. The Walnut Formation is typically dry and is not a source of groundwater in the area. Observations during the investigation indicated that water was found within the Walnut Formation only after heavy rains via surface infiltration. The Walnut Formation was found to be between 26 and 30 feet thick in areas west and northwest of the WSA.

Paluxy Aquifer. The Paluxy Aquifer is the principal source of groundwater in the vicinity of the WSA. The Paluxy Formation consists predominantly of sands separated by thin, discontinuous shale and claystone layers. The lower part of the Paluxy Formation is generally coarser grained than the upper part. The Paluxy can exist under unconfined or semiconfined conditions, depending on depth of encounter and the local stratigraphic sequence. Most of the water wells in the area are completed in the lower, coarser-grained and higher-permeable section of the Paluxy Aquifer.

Most recharge to the Paluxy occurs where the formation crops out west and north of the WSA along the Clear Fork of the Trinity River and along tributaries to the West Fork and South Fork of the Trinity River. The amount of recharge via outcrops along Live Oak Creek is not known. Regional groundwater flow in the Paluxy is southeastward in the direction of the regional dip.

The Paluxy Aquifer is an important source of potable groundwater for the Fort Worth area. Many individuals and communities surrounding the WSA draw their water from the Paluxy Aquifer. Groundwater is also used by many of the surrounding farms and ranches for agricultural and livestock purposes.

Three samples were collected from the Paluxy Aquifer and submitted for effective porosity and hydraulic conductivity analysis. The results are shown in Table 1-2.

TABLE 1-2
Summary of Geotechnical Results
for Paluxy Aquifer Samples

Sample ID	Sample Depth (feet)	Effective Porosity (%)	Average Hydraulic Conductivity (cm/s)
WJEPX925-A	195 to 196	28.66	2.29×10^{-3}
WJEPX925-B	249 to 250	28.91	3.47×10^{-3}
WJEPX925-C	161 to 162	1.6	9.1×10^{-8}

Notes:
cm/s centimeters per second
% percent

Glen Rose Aquitard. Below the Paluxy are the fine-grained limestone, shale, marl, and sandstone beds of the Glen Rose Formation. Although the sands in the Glen Rose yield small amounts of water to wells in Fort Worth and western Tarrant County, the relatively impermeable limestone is an aquitard, and restricts water movement between the Paluxy Aquifer above and the Twin Mountains Aquifer below.

1.2.4 Surface Water

The primary surface-water features in the vicinity of the WSA are Live Oak Creek, located approximately 400 feet south of the WSA boundary, and an unnamed

ephemeral tributary to Live Oak Creek located immediately outside the boundary north of the WSA. Live Oak Creek flows east-northeast from the WSA, entering Lake Worth approximately 3 miles west of NAS Fort Worth. Portions of the WSA fall within the 100-year floodplain of Live Oak Creek.

1.2.5 Climatology/Meteorology

The WSA is located at approximately 32 degrees north latitude and 97 degrees west longitude, in north-central Texas. The climate of the site is typified by hot summers and cool, relatively dry winters.

1.2.5.1 Precipitation

Mean annual precipitation is 31.6 inches, with the highest mean precipitation occurring in April and May (3.8 and 4.4 inches), and in September and October (3.2 and 3.6 inches). Mean monthly precipitation amounts are lowest from November through February (1.8 inches or less), and during August (1.9 inches). Most precipitation occurs as rain; snowfall accounts for appreciable amounts of precipitation only during the months of January and February.

1.2.5.2 Temperature

Historical meteorological data from NAS Fort Worth during the years 1942 through 1990 indicate the mean annual temperature is 66 degrees Fahrenheit (° F). Mean monthly temperatures range from a high of 86° F (July) to a low of 45° F (January). High and low extreme temperatures were 110 and 0° F, respectively, during the record-keeping period.

1.2.5.3 Wind

During most of the year, the predominant wind direction is from the south at a speed of 6 to 8 knots. Typically, the wind blows from the north only during December through February, at a speed of 7 to 8 knots.

1.2.6 Biological Resources

An ecological study has not been completed at the WSA; however, because of the proximity to Live Oak Creek, a wide variety of species would be expected to inhabit the buffer zone. Animals expected to inhabit this area include mice, gophers, squirrels, rabbits, granivorous and insectivorous birds, lizards, snakes, skunks, and higher predators such as hawks, owls, and foxes.

The U.S. Fish and Wildlife Service (FWS) and the Texas Department of Parks and Wildlife (TDPW) have identified 12 bird, two reptile, and one sensitive plant species that are threatened and endangered species and are potentially occurring in Tarrant County. The two federal-listed candidate reptile species that could inhabit Tarrant County are the Texas horned lizard, which lives on grassy hillsides, and the Texas garter snake, which inhabits prairie seeps and wet grassy swales.

However, no state- or federal-listed threatened or endangered species are known to live on the WSA property. The closest sensitive habitat to the sites is the great blue heron rookeries to the north of NAS Fort Worth, across Lake Worth.

1.2.7 Cultural or Archaeological Resources

No significant archaeological or prehistoric sites have been identified within the boundary of the WSA. Fossils are present in outcrops at the WSA, but have not been identified as a significant paleontological resource.

1.3 PROJECT OBJECTIVES

The objectives of the WSA background study are as follows:

- Establish background concentrations of Radium-226 and -228 and TPH in groundwater immediately upgradient of the WSA.

- Establish background concentrations of Radium-226 and -228 and TPH in surface and subsurface soils surrounding the WSA.
- Determine whether concentrations of radium previously detected in WSA supply wells can be attributed to site-related sources or to natural background sources.

1.4 GENERAL APPROACH AND RATIONALE

The approach and rationale for the background study at the WSA were developed to generate chemical compound constituent populations for pertinent media. The following discusses the approach and rationale used to select media and chemical analyses.

1.4.1 Media Classification

The media selected for determining background concentrations are surface soils, subsurface soils, and groundwater. The surface and subsurface soils were designated in the field as Horizons A and B, respectively, for identification purposes and do not refer to soil horizons used in the pedological classification system (U.S. Department of the Interior [DOI] 1980). Surface water from a small pond within the buffer zone northwest of the WSA was also sampled to provide an indication of naturally occurring concentrations; however, a single sample is not sufficient for establishing a background concentration. Additionally, the surface water sample was collected and analyzed to investigate if the source of radium in the supply wells was surface water infiltrating along the well casing and into the groundwater.

Surface soils, Horizon A, are defined as the first-encountered soil type at the ground surface to a depth of 2 feet. This soil type varies from a sandy clay to clay with varying amounts of silt and fine subrounded gravel and is dark grayish brown to dark gray in color. This soil type is the predominant surface soil at the WSA, and has been observed up to depths of 4 feet below ground surface. However, in some locations this soil type is not found on the surface because of erosional effects.

Subsurface soils, Horizon B, are defined as the second encountered soil type below the organically rich surface soil. The subsurface soil is a sandy clay with varying amounts of fine subrounded limestone clasts, reddish brown to strong brown.

1.4.2 Chemical Analyses

All media were analyzed for total alpha-emitting radium (Method SW9315), Radium-228 (Method SW9320), and TPH (Method E418.1). Because radium is naturally occurring in soils and groundwater in various concentrations, this study is concerned with the background concentrations as a means of comparison to concentrations found in the water supply wells.

1.4.3 Background Study

The analytical results were used to calculate background concentrations for TPH and radium in soils and groundwater. A total of 21 surface soil, 21 subsurface soil, and 15 groundwater samples were collected to characterize these media for background concentrations. The Tolerance Interval (TI) method (U.S. Environmental Protection Agency [EPA] 1989, 1992) was used to estimate background concentrations in site media. The TI method is used to estimate the concentration of a given constituent in a given medium and is expressed as an appropriate upper tolerance limit (UTL) of the distribution of the constituent in the background data population.

Section 4.0 discusses the process by which the UTLs were developed and reports the results for radium and TPH by medium.

TAB

Section 2

2.0 BACKGROUND SAMPLING PROGRAM

The following sections describe the numbers of samples collected, sample locations, and sampling procedures utilized during the background study.

2.1 SAMPLING LOCATIONS

Sampling locations meant to represent background concentrations of radium and TPH in soils and groundwater were chosen away from the WSA facility in areas believed to be unaffected by activities at the site. The two new groundwater monitoring wells were located upgradient from onsite wells XU3212-901 and XU3212-902. The third background well is a private well located southwest, or approximately cross-gradient, from the onsite wells. The surface water sample location was selected because it is upgradient from the WSA and because it is a catchment for a large area of runoff. Sample locations are illustrated on Plate 1.

2.1.1 Soil Sampling

Twenty-four soil probes were driven to collect samples of surface and subsurface soils (Horizons A and B, respectively). Locations were selected based on the presence of soil and the absence of potential source areas. If possible, samples were collected at both depths at each location. In some cases Horizon A and B samples were not collocated either because soil Horizon A or B was not encountered or because the sampling tool encountered shallow refusal.

Sample locations were adjusted from the planned locations described in the Work Plan (Jacobs 1996a) to adjust to field conditions and circumstances. Plate 1 shows the locations of the soil probes and the horizons sampled at each location.

The purpose of collecting surface-soil samples is to establish windblown or fall-out constituent background concentrations. The purpose of collecting subsurface soil

samples is to detect any contaminants that have leached from the surface into the vadose zone via infiltration.

2.1.2 Groundwater Sampling

To establish background concentrations, two monitoring wells were installed upgradient of the WSA to sample groundwater unaffected by activities at the WSA. Each of the two new wells and an existing private well were sampled five times over a 10-week period. Additionally, to confirm the previously detected radium concentrations in the onsite water supply wells and to allow for a snapshot comparison of site concentrations to background concentrations, the two onsite water supply wells were each sampled twice.

The Work Plan also called for sampling shallow groundwater. Several attempts were made to locate shallow groundwater in the areas upgradient and downgradient from the waste storage area, and immediately upgradient from water supply well XU3212-902. In each case a Geoprobe® was driven to refusal at depths from 4.0 to 7.5 feet without encountering groundwater. Boring BJETA930, originally driven to refusal to 7.5 feet with the Geoprobe® was continued using the hollow-stem auger rig, where refusal was again reached at 12 feet without encountering groundwater.

2.1.3 Surface Water Sampling

One surface water sample was collected from a small pond located within the buffer zone as shown on Plate 1. The purpose of the surface water sample was to investigate whether the source of radium in the supply wells was surface water infiltrating along the well casing and into the groundwater, and to provide an indication of naturally occurring concentrations; however, a single sample is not sufficient for establishing a background concentration.

2.2 SAMPLING AND DATA COLLECTION

Sampling and data collection activities were performed in accordance with the Work Plan (Jacobs 1996a) and the Sampling and Analysis Plan (Jacobs 1996b) with minor variations. Surface soil, subsurface soil, and Paluxy aquifer groundwater samples were collected to determine background concentrations in these media. A single surface water sample was also collected. Field activities are described in the following sections.

2.2.1 Soil Probe and Borehole Logging

During soil probe, hollow-stem auger, and rotary borehole drilling, drilling information, sample intervals, and sample descriptions were recorded on borehole logs (Appendix C).

Where soil core recoveries were adequate, samples of unconsolidated soils were described continuously using the Unified Soil Classification System according to the American Society for Testing and Materials (ASTM) procedure D2488-93 (ASTM 1996). When bedrock was encountered, the lithology was described according to standard professional nomenclature (Jacobs 1996b).

2.2.2 Soil Probe Sampling

Soil samples were collected at the locations illustrated on Plate 1 using a truck-mounted direct-push soil probe rig. Soil samples were collected from soil probes for submittal to Paragon Analytics, Inc. and EMAX Laboratories, Inc., to determine concentrations of radium and TPH, respectively. Drive probes were completed by hydraulically pushing and hammering samplers into the ground. A 4-foot-long by 2-inch-diameter sampler fitted with a plastic liner was used to collect the samples. Three-foot-long drive rods were added to the drive string as necessary to reach the target depth for each probe.

The plastic liner was removed from the sampler with the soil core inside the liner. The soil was examined to determine whether the Horizon A was intersected. The soil representing the Horizon A to the 2-foot depth was removed from the plastic liner, logged, and placed in a stainless steel bowl. In some drive probes, Horizon A was less than 2 feet thick. In these cases, the Horizon A was collected to its total depth. Additionally, the thickness of the Horizon A occasionally was not adequate to provide enough sample volume for the analyses, and a second probe within 6 inches of the original was necessary to provide enough sample volume. After an adequate amount of sample was collected, the soil was then mixed in the bowl, and large pieces of gravel were removed. The soil samples collected for radium and TPH analyses were placed in 8-ounce and 4-ounce jars, respectively, labeled, and placed in an iced cooler.

After the Horizon A soils were collected, the remaining core in the first 4 feet was examined to determine whether the Horizon B had been encountered. If Horizon B had not been encountered, or there was not a sufficient amount of material for a Horizon B sample, a second 4-foot-long sample probe was driven. If the Horizon B was encountered in the soil probe, a soil sample was collected for radium and TPH analysis as previously described.

Soil probe horizons sampled, sample depths, and analyses performed are depicted in Table 2-1. Photographs in Appendix F show some aspects of the soil probe activities.

2.2.3 Groundwater Monitoring Well Installation

Two Paluxy aquifer groundwater monitoring wells were installed for background sampling. The wells, WJEPX925 and WJEPX926, were installed to the west of the WSA boundary fence as depicted on Plate 1. Both wells were drilled with a Gardner Denver 1500 mud rotary rig with a 7 7/8-inch drill bit. During drilling, a coring tool was used to collect rock core whenever the rock was competent enough for core recovery. Samples from three intervals were submitted to Enviro Tech Services, Inc. for geotechnical analyses, as presented in Section 1.2.3. The boreholes were drilled to the top of the Glen Rose Formation.

TABLE 2-1
Summary of Sample Locations, Intervals, and Analyses Performed
Weapons Storage Area Background Study

Sample Location	Soil Horizon A		Soil Horizon B		Groundwater	Surface Water
	Sample Interval (feet)	Analyses	Sample Interval (feet)	Analyses		
BJETA901	0 - 2	Radium & TPH				
BJETA902	0 - 2	Radium & TPH	2 - 4	Radium & TPH		
BJETA903	0 - 2	Radium & TPH	2 - 3	Radium & TPH		
BJETA904	0 - 2	Radium & TPH				
BJETA905	0 - 2	Radium & TPH	5.5 - 7	Radium & TPH		
BJETA906	0 - 1.5	Radium & TPH	1.5 - 3	Radium & TPH		
BJETA907	0 - 1	Radium & TPH	3 - 4	Radium & TPH		
BJETA908	0 - 1	Radium & TPH	3 - 4	Radium & TPH		
BJETA909	0 - 1	Radium & TPH	3 - 4	Radium & TPH		
BJETA910	0 - 1	Radium & TPH	4 - 6	Radium & TPH		
BJETA911			3 - 4	Radium & TPH		
BJETA912	0 - 0.6	Radium & TPH	3 - 4	Radium & TPH		
BJETA913	0 - 1.1	Radium & TPH	6 - 8	Radium & TPH		
BJETA914	0 - 0.68	Radium & TPH	2 - 4	Radium & TPH		
BJETA915	0 - 0.85	Radium Only	2 - 4	Radium & TPH		
BJETA916	0 - 0.85	Radium & TPH				
BJETA917	0 - 1	Radium & TPH	4 - 6.3	Radium & TPH		
BJETA918	0 - 0.5	Radium & TPH	2 - 3.5	Radium & TPH		
BJETA919	0 - 0.75	Radium & TPH	0.75 - 2	Radium & TPH		
BJETA920	0 - 0.4	Radium & TPH	0.4 - 1.5	Radium & TPH		
BJETA921			2 - 3	Radium & TPH		
BJETA922	0 - 1	Radium & TPH	2 - 3	Radium & TPH		
BJETA923			2 - 3	Radium & TPH		
BJETA924	0 - 1	Radium & TPH	1.5 - 2.5	Radium & TPH		
RUDYSWELL [1]					Radium & TPH [2]	
WJETA925					Radium & TPH [2]	
WJETA926					Radium & TPH [2]	
XU3212-901					Radium & TPH [3]	
XU3212-902					Radium & TPH [3]	
RUDYSPOND						Radium & TPH

Notes:

[1] = private well owned by Rudy Lambert

[2] = background wells sampled five times - twice with bailer, three times with bladder pump

[3] = Weapons Storage Area water supply wells sampled twice

Radium = Radium-226 and -228 (Methods SW9315 and SW9320, respectively)

TPH = total petroleum hydrocarbons (Method E418.1)

Wells were then constructed using clean 4-inch schedule 40 polyvinyl chloride (PVC) riser and screen with 0.020-inch slots. Centralizers were placed near the top of each 20-foot section of casing before placement into the borehole. After the well screen and riser was inserted in the borehole, a 16/30 graded sand was placed in the annular space between the inside of the hole and the well casing from the bottom of the borehole to a depth approximately 4 feet above the top of the screen. As the sand was placed, measurements were made to ensure the sand was not bridging to reduce void development. After the sand was placed, the well was surged for 10 minutes to compact the sand pack and eliminate any possible bridging. The top of the sand level was measured after surging and more sand was added as necessary.

After the sand pack was placed, a bentonite seal at least 6 feet thick was placed above the top of the sand pack. The remainder of the annular space was filled with a bentonite-cement grout pumped from the top of the seal to the surface. To complete the well construction, a 6-foot by 6-inch protective casing was installed and a 3-foot by 3-foot by 4-inch concrete pad was constructed. Appendix D presents well construction diagrams, which show the details of each well constructed. Additionally, photographs of the drilling and the well installation process are provided in Appendix F.

2.2.4 Monitoring Well Development

Well development was initiated within approximately 24 hours after well completion. The wells were developed using air lift. In air-lift development, air is injected into the well by way of a pipe lowered to the bottom of the well. Air is pumped through the pipe by a compressor on the surface, raising the water column. When the water column reaches the surface, the air supply is shut off, allowing the water column to fall. This procedure effectively uses the column of water as a surge block, inducing pressure changes within the well and groundwater movement through the screen and sandpack. Occasionally, the air supply was kept on so that the water column was

forced out of the well, allowing recharge from the aquifer. Well development continued on each well until the following criteria were met:

- The sediment content of the water was less than 0.75 milliliter per liter (mL/L), as measured in an Imhoff cone in accordance with Method E160.5.
- The turbidity remained within a range of about 10 nephelometric turbidity units for at least 30 minutes.
- The stabilization criteria for pH, temperature, and conductivity were met. (Stabilization is defined as temperature plus or minus [±] one degree Celsius [1° C], pH ± 0.1, and conductivity ± 5 percent).

After well development activities were completed, approximately 72 hours passed before the new monitoring wells were sampled.

2.2.5 Groundwater Sampling

Groundwater was sampled using two methods. The first method employed was to rapidly purge three well volumes of water from the well and collect a groundwater sample with a bailer. The second method employed was a low-stress sampling protocol (EPA 1996) for the collection of groundwater samples. The first method only was used to collect both samples from the onsite water supply wells. Both methods were used to collect samples from the newly installed background monitoring wells. The private background well was purged and sampled via the dedicated pump installed in the well.

The method used for the background wells was changed from purge and bail to a low-stress method when it was calculated that it would be necessary to wait nearly 90 days between samples to obtain an independent sample. The parameters necessary to calculate an accurate groundwater velocity (survey data, effective porosity, and hydraulic conductivity) were not available until after the second round of sampling. The sampling method was changed to a low-stress method so that all samples could be collected within a

reasonable amount of time. Using the low-stress method, it was determined that two weeks between samples would be adequate to obtain independent samples.

2.2.5.1 Sampling Groundwater Using Bailer Technique

Before beginning to purge the well, a total depth of the well was measured using a sounding device used for groundwater level measurements. The casing volume was calculated to determine the proper purge volume. Three casing volumes of water were then removed from the well using a Grundfos® RediFlo II submersible pump. After each purge volume was removed, groundwater quality measurements were collected. When three casing volumes had been removed and the water quality parameters stabilized as defined in Section 2.2.4, samples were collected for analyses of radium and TPH according to procedures detailed in the Sampling and Analysis Plan (Jacobs 1996b). Field parameter measurements for bailer-collected samples are given in Table 2-2.

2.2.5.2 Low-Stress Aquifer Sampling

The EPA guidance for low-stress sampling (EPA 1996) was followed to sample groundwater for rounds 3, 4, and 5 at background wells WJEPX925 and WJEPX926. A dedicated bladder pump was used to perform the low-stress purging and sampling.

The bladder pump was constructed of PVC and was fitted with polyethylene tubing using compression fittings where necessary. The bladder itself was made of Teflon™, which aided decontamination procedures. The appropriate length of tubing was measured before inserting the pump into the well. The pump was slowly and carefully lowered to the target depth. To aid future sampling, the installation included a well cap with a compressed air inlet, a groundwater discharge tube, and a "freeze protection" inlet that allows for evacuating the top 10 feet of tubing. After the

TABLE 2-2
Summary of Water Quality Parameter Measurements
Weapons Storage Area Background Study

Location	Round	Sample Date	Type Sample	Purge Volume (gallons)	pH	Temperature (°C)	Specific Conductance (mmho/cm)	Turbidity (NTU)
RUDYSWELL	1	3/4/97	Purge and Sample	300	7.10	20.5	520	32
	2	3/19/97	Purge and Sample	300	7.50	19.5	515	0
	3	4/2/97	Purge and Sample	500	7.10	19.9	510	0
	4	4/17/97	Purge and Sample	300	6.50	19.9	520	0
	5	5/13/97	Purge and Sample	300	7.30	19.8	582	0
WJEPX925	1	3/4/97	Purge and Bail	300	7.20	21.1	446	0
	2	3/19/97	Purge and Bail	300	7.20	19.9	443	0
	3	4/3/97	Low-Stress	3.00	7.10	19.2	457	0
	4	4/17/97	Low-Stress	2.20	5.80	19.9	453	0
	5	5/13/97	Low-Stress	3.00	6.92	20.3	505	0
WJEPX926	1	3/5/97	Purge and Bail	240	7.30	20.5	550	0
	2	3/20/97	Purge and Bail	249	7.40	20.5	563	0
	3	4/4/97	Low-Stress	1.00	7.30	19.2	555	0
	4	4/17/97	Low-Stress	4.50	7.20	19.4	617	0
	5	5/13/97	Low-Stress	3.00	6.80	20.6	616	0
XU3212-901	1	3/6/97	Purge and Bail	420	7.40	20.5	583	0
	3	4/3/97	Purge and Bail	420	7.50	20.8	581	0
XU3212-902	1	3/5/97	Purge and Bail	420	7.30	19.9	584	0
	3	4/3/97	Purge and Bail	414	7.40	20.9	589	0

Notes:

°C = degrees Celsius
mmho/cm = Millimho per centimeter
NTU = nephelometric turbidity units
Purge and Sample = Purge and sample well with dedicated submersible pump.
Purge and Bail = Purge well with Grundfos® pump and sample with bailer.
Low-Stress = Purge and sample well with bladder pump.

The final, stabilized parameter measurements are presented.

pump was placed at the target depth (approximately 30 feet into the groundwater), the well was left to equilibrate at least 24 hours before sampling.

To sample the wells, either a gas powered compressor or bottled compressed nitrogen, flowing through a control box, was used to activate the bladder pump. The pump was turned on and the flow rate was adjusted. Flow rates for purging were generally set at approximately 200 milliliters per minute. Purge rates were dictated primarily by the amount of drawdown observed in each well. Drawdown was not allowed to exceed 0.31 foot. While purging was being performed, groundwater quality parameters were collected using a Horiba® Water Checker U-10. The parameters of pH, temperature, conductivity, dissolved oxygen, and turbidity were measured. Samples were collected after these parameters stabilized as defined by the following:

- The temperature did not vary more than ±1° C.
- The pH did not vary more than ±0.1 units.
- Conductivity did not vary more than ±5 percent.

These groundwater quality parameter results are presented in Table 2-2. Samples were collected through the tubing end at the surface by decreasing the pumping rate to less than 100 mL per minute. Then the sampler filled sample bottles from the tubing, being careful to minimize sample disturbance. Photographs in Appendix F illustrate aspects of the low-stress groundwater sampling set-up.

2.2.6 Surface Water Sampling

The single surface water sample was collected in accordance with the procedures in the Sampling and Analysis Plan (Jacobs 1996b). Surface water was collected from a small pond located northwest of the WSA just outside of the buffer zone easement (Plate 1). The sample was collected from the east end of the pond near a small outlet.

Water was collected in a polypropylene beaker and transferred to the appropriate sample bottles. Samples were submitted to the appropriate laboratories for analyses of radium and TPH. The purpose of the surface water sample was to investigate if the source of radium in the supply wells was surface water infiltrating along the well casing and into the groundwater, and to provide an indication of naturally occurring concentrations; however, a single sample is not sufficient for establishing a background concentration.

2.3 CHEMICAL ANALYSES

Samples of soil and groundwater were analyzed to provide data for characterization of background concentrations of radium and TPH at the WSA.

2.3.1 Radium

Radium analyses included total alpha-emitting radium (SW9315) and Radium-228 (SW9320). Method SW9315 measures Radium-226 after correcting for ingrowth of Radium-226 daughters between the time of separation and counting. Because radium is naturally occurring, the development of background concentrations will be useful in determining the disposition of the water supply wells.

2.3.2 Total Petroleum Hydrocarbons

The background sampling also included analyses for total petroleum hydrocarbons (Method E418.1).

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TAB

Section 3

3.0 DATA QUALITY

This section summarizes the quality of analytical and radiochemistry results derived from samples taken for this background study. Definitive data were produced in accordance with the documented and approved methods described in the Sampling and Analysis Plan (Jacobs 1996b). The data were managed within the following data packages, or sample delivery groups (SDGs), produced by Paragon Analytics, Inc., Fort Collins, Colorado (radiochemistry) and EMAX Laboratories, Inc., Torrance, California:

Organic Chemistry (TPH) packages -- EMAX

96K042	96K047
96K065	97C025
97C075	97D029
97D132	97E078

Radiochemistry (alpha-emitting radium and Radium-228) packages -- Paragon

96-11-057	96-11-073
96-11-097	97-02-125
97-03-046	97-03-133
97-04-046	97-04-213
97-05-132	

Cumulatively, the stated packages consisted of approximately 62 environmental samples (soil and water) plus associated field and laboratory quality control (QC) samples. The samples were collected at the WSA from November 1996 through May 1997 and shipped to the aforementioned laboratories for the following contaminant analyses (methods): TPH (EPA E418.1), alpha-emitting radium isotopes (SW9315), and Radium-228 (SW9320).

A combination of hard copies and digital data, which make up the data package in total, were compared against the data validation criteria stated in the project-specific Sampling and Analysis Plan (Jacobs 1996b: Section 7.0 and Appendix A). The validation criteria generally included the following controls, with variations depending on whether the package covered radiochemistry or organic chemistry:

ACCURACY

- Calibrations — initial and continuing
- Laboratory Control Samples/Spikes (LCS)
- Matrix Spikes (MS)
- Relative Standard Deviation (%RSD)
- Blanks (method, equipment)
- Chemical Yield (radionuclides)
- Counting Time (radionuclides)
- Sensor Efficiency (radionuclides)
- Correction for Ingrowth Daughters (radionuclides)

PRECISION

- Laboratory Replicates (radionuclides)
- MS Duplicates (MSD)
- Field Duplicates

REPRESENTATIVENESS

- Sample Chain of Custody
- Holding Times and Preservation
- Work Plans

COMPARABILITY

- Standard Operating Procedures (SOPs)
- established analytical methods

COMPLETENESS

- samples (environmental, QC)
- Data Packages (forms, run logs, extraction logs, etc.)

Validation criteria also invoked EPA Level III quality requirements (EPA 1994a and b), particularly with respect to evaluating blank data, where the industry standard "5x" (5 times) and "10x" (10 times) rules are defined for assessing whether blank contamination is significant.

Validation criteria were evaluated with respect to both frequency and acceptability of the test measures. Checklists were composed and compiled with the data package hard copies to document details of the validation process. Additional backup documentation included in the original data packages provided by the laboratories, but not included in this report's appendices, consist of raw data, bench sheets, run logs, calibrations (initial and continuing), and daily instrument checks.

The following discussions of the data quality are categorized by the type of analytical method, which serves as the title for each section. General quality issues are addressed, with references to specific data packages, samples, and analytes as needed. For those sample results that do not meet all QC criteria, validation qualifiers are assigned (data points are "flagged"); these qualifications of the data ensure that data users are aware of the data's limitations.

All data referenced by this report should be considered valid and usable for this WSA background study, with qualifications described in the narrative that follows and the validation qualifiers ("flags") applied within the digital data files.

3.1 TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (EPA METHOD E418.1)

The hydrocarbons analyzed by EPA Method E418.1 are also referred to as "Total Fuel Hydrocarbons" (TFH) in the associated electronic data deliverable (EDD).

3.1.1 Accuracy

In general, calibration results were within the required frequencies and tolerances. Initial calibrations were established with five-point curves and continuing calibrations implemented every 10 samples. The initial and continuing calibrations performed were adequate based on percent relative standard deviation and percent difference values within tolerances of less than10 percent, respectively, with one exception noted below. These QC measures differ slightly from the AFCEE flagging criteria, which specify a minimum correlation coefficient (greater than or equal to [$\geq$] 0.995) for the initial calibration and a maximum (10 percent) difference relative to changes in the response factor; nonetheless, calibrations for the method are adequate based on the controls provided by the laboratory.

Exceptions to the calibration criteria noted above were constituted by samples in SDG 97E078, where continuing calibrations yielded percent difference values from 11 to 12 percent (on the high side of the standard). Whereas these calibration results might possibly bias results to higher than actual values, there was no impact on sample results because results for the affected samples (CR-A163101, CR-A163102, and CF-A163301) were all nondetects.

LCS (or blank spike) results were satisfactory based on adequate frequency of performance and percent recoveries within QC tolerances for both soil and water matrices (approximately 101 percent $\pm$ 40 percent for water, 101 percent $\pm$ 50 percent for soil).

MS results, which are used to reflect bias due to matrix effects, were adequate based on frequency of performance and values within specified QC tolerances (as above).

No contaminants were detected above practical quantitation limits (PQLs) in blank samples; therefore, cross-contamination of equipment or false positives are not a concern for this study.

3.1.2 Precision

Precision results were determined by comparisons within the following pair-groupings: LCS/LCSD (LCS duplicates), MS/MSDs, and field duplicate values. All input values were calculated and compared against relative percent difference (RPD) tolerances, and all RPD values were within tolerance. MS/MSD comparisons using RPD values are less than 30 percent for waters and less than 50 percent for soils. Field duplicate pairs yielded nondetects, therefore, RPD values are not applicable, but the results are reproducible.

3.1.3 Representativeness

Chain of custody was intact for all samples based on completed custody forms and intact sample packages received, documented, and maintained by the offsite laboratory.

Preservation and analysis was satisfactory with respect to required holding times.

Sample locations were in accordance with the project-specific Sampling and Analysis Plan and associated standard operating procedures (Jacobs 1996b). Therefore, samples are representative of the media and locations described in the Sampling and Analysis Plan.

3.1.4 Completeness

The data set for TPH achieves the completeness goals of greater than 90 percent for soils/sediments and greater than 95 percent for waters based on no rejection of data results provided by the laboratory, as well as collection of all samples specified in the Sampling and Analysis Plan (Jacobs 1996b).

Quality records produced from this analytical method are contained within the data packages and provide adequate documentation for the validation process described herein. The records are complete with respect to the validation criteria, with the

exceptions of calibration records for SDG 96K065, which were not submitted by the laboratory.

3.1.5 Sensitivity

Method detection limits (MDLs) were well below the required PQLs listed in the project-specific Sampling and Analysis Plan (Jacobs 1996b: 1 part per million [ppm] for waters, 30 ppm for soils). Reporting limits by the laboratory were equivalent with AFCEE requirements (1 ppm for waters, 30 ppm for soils [normalized to dry weight]), with the exception of packages 96K042, 96K047, and 96K065, where PQLs were 2.0 milligrams per liter (mg/L) for water.

3.2 RADIUM, TOTAL (EPA METHOD SW9315)

3.2.1 Accuracy

Calibrations were performed as daily instrument checks on the gas flow proportional counting equipment, specifically in determining instrument efficiencies, using a Radium-226 standard traceable to the National Bureau of Standards (now National Institute of Standards and Technology [NIST]). The same type and mass of barium carrier ($BaSO_4$) was used for each calibration, as directed in Method SW9315. Chemical recoveries for the Barium precipitate were consistently greater than 50 percent, with final results corrected for percent recovery and progeny ingrowth (as a function of time between final precipitation and initiation of counting time).

LCS analyses were performed at adequate frequencies ($\geq$1:10 ratio of LCS to environmental samples) and with adequate percent recoveries (within two standard deviations of the reference, as defined through laboratory-specific control charting). Although spike values were greater than 30 times the reporting limits (0.5 picocurie per gram [pCi/g] for soils and 1 picocurie per liter [pCi/L] for waters), values measured near the reporting limit are not believed to be significantly biased.

MS samples, which are used to reflect bias due to matrix effects, were sampled and analyzed within laboratory QC tolerances; quality control limits for MSs were not required nor specified in the Field Sampling Plan (Jacobs 1996b).

Total alpha-emitting radium was not detected above the required reporting limits (or minimum detectable activities, stated above) in any of the blank samples.

3.2.2 Precision

Precision results were determined by comparing the results of replicate (or duplicate) values within a "Duplicate Error Ratio" (DER), which invokes statistical measures of error in the comparison, in contrast to a RPD value, which is poorly suited for measuring radiochemistry (stochastic) precision. The equation for DER is given below, where the critical value separating acceptance or rejection is 1.42. The QC limit of 1.42 is an empirical value based on laboratory-specific control-charting within 2 sigma (σ) (equivalent to a confidence level of approximately 95 percent, as to whether the compared results are statistically the same [<1.42] or different [>1.42]).

$$DER = \frac{|S - D|}{2\sqrt{(\sigma_S^2+\sigma_D^2)}}$$

where:

S = Sample activity

D = Duplicate (or Replicate) activity

σ_S = Total Propagated Uncertainty of the sample

σ_D = Total Propagated Uncertainty of the duplicate (or replicate)

Precision results and analysis frequencies for both laboratory replicates (reflecting precision in the analytical process) and field duplicates (reflecting overall project precision) were satisfactory, based on DER calculations for seven field duplicate pairs and nine laboratory replicate pairs.

3.2.3 Representativeness

Chain of custody was maintained for all samples based on completed custody forms and laboratory receipt inspection forms. Preservation of samples was satisfactory based on the use of required preservatives and temperatures and analyses within required holding times. Sample locations were in accordance with the project-specific Sampling and Analysis Plan and associated standard operating procedures (Jacobs 1996b). Therefore, samples are representative of the media and locations described in the Sampling and Analysis Plan.

3.2.4 Completeness

No sample results were rejected and all samples were collected and analyzed at the required frequencies. Therefore, data quality objectives (DQOs) for the project's completeness were achieved: $\geq$95 percent for water and $\geq$90 percent for soils.

Quality records produced from this analytical method(s) are contained within the data package and provide adequate documentation for the validation process described above. The records are complete with respect to the validation criteria.

3.2.5 Sensitivity

Reporting limits, also known as PQLs (or Minimum Detectable Activity [MDAs] for radionuclides), were at or below the required PQLs listed in the project-specific Sampling and Analysis Plan (Jacobs 1996b), given a basis of a 1x dilution factor and dry weight for soils. Generically, increase in moisture content (soils or sediment) can raise detection limits for soil/sediment matrices, whereas dilution factors greater than 1 will increase detection limits for any matrix type.

3.3 RADIUM (RADIUM-228), (EPA METHOD SW9320)

This isotope of Radium-226 was analyzed by gas-proportional counting. Method E901.1, a gamma spectroscopy technique, was used for only two samples, where

confirmation was desired for samples in SDG 97-02-125, based on problems with the original sample precipitates. The original sample results were confirmed.

3.3.1 Accuracy

Calibrations were performed as daily instrument checks on the gas-flow proportional counting equipment, specifically in determining instrument efficiencies, using a Strontium-89 standard traceable to NIST. Self-absorption curves were not necessary based on an estimated maximum beta attenuation correction (over the full range of potentially observable precipitate masses) of less than 3 percent; further, the total propagated uncertainty (TPU) value encompasses this and other sources of calibration uncertainty in the method.

LCS analyses were performed at adequate frequencies (≥1:10 ratio of LCS to environmental samples) and with adequate percent recoveries (within two standard deviations of the reference, as defined through laboratory-specific control charting) with the exceptions noted below. Although spike values were slightly greater than 30 times the reporting limits (0.5 pCi/g for soils and 1 pCi/L for waters), values measured near the reporting limit are not believed to be significantly biased.

Four samples were rejected (qualifier "R") due to low LCS recoveries:

CR-A157507 (equipment blank, water);
CR-A157508 (equipment blank, water);
CR-A157907 (equipment blank, water); and
CR-A157706 (soil sample, environmental, and matrix spike).

For environmental samples associated with the rejected blanks, there is no quality impact when the results of the environmental samples are nondetects, as the blank samples control potential positive bias (alpha error), not negative bias (beta error). The greatest value of any associated environmental samples was 1.5 pCi/g, a relatively minor quantity at only three times the reporting limit (0.5 pCi/g). Any unquantified

blank contamination resulting from the rejected blank data would not have biased environmental samples by more than 1.5 pCi/g. Also worth emphasizing is that Radium-228 blank contamination was not detected in any other equipment blanks or laboratory blanks, suggesting that processes in place to control cross-contamination were satisfactory. Therefore, environmental sample results (with detections) associated with the blanks in question were not qualified as estimates, but are listed below.

Sample ID	Result (pCi/g)	Sample ID	Result (pCi/g)
CR-A159001	1.47	CR-A158007	1.03
CR-A159002	1.17	CR-A158101	1.45
CR-A158001	1.11	CR-A158102	1.16
CR-A158002	0.90	CR-A158104	0.60
CR-A157606	0.55	CR-A158105	1.39
CR-A157704	1.24	CR-A158106	0.78
CR-A157501	0.51	CR-A157901	1.35
CR-A157505	0.82	CR-A157903	1.03
CR-A157506	0.7	CR-A157904	1.21
CR-A158003	1.04	CR-A157905	1.10
CR-A158004	0.87	CR-A157906	1.08
CR-A158006	0.59		

MS samples, which are used to reflect bias due to matrix effects, were sampled and analyzed within laboratory QC tolerances; QC limits for MSs were not required nor specified in the Sampling and Analysis Plan (SAP) (Jacobs 1996b).

3.3.2 Precision

Precision results were determined by comparing the results of replicate (or duplicate) values within a DER, which invokes statistical measures of error in the comparison, in contrast to a RPD value, which is poorly suited for measuring radiochemistry (stochastic) precision. The equation for DER is given in Section 3.2.2, where the critical value separating acceptance or rejection is 1.42. The QC limit of 1.42 is an

empirical value based on laboratory-specific control-charting within 2 sigma (equivalent to a confidence level of approximately 95 percent, as to whether the compared results are statistically the same [<1.42] or different [>1.42]).

Precision results and analysis frequencies for both laboratory replicates (reflecting precision in the analytical process) and field duplicates (overall project precision) were satisfactory, based on DER calculations for six field duplicate pairs and seven laboratory replicate pairs.

3.3.3 Representativeness

Chain of custody was maintained for all samples based on completed custody forms, laboratory receipt inspection forms, and tamper seals on shipping containers. Preservation of samples was satisfactory based on the use of required preservatives and temperatures and analyses within required holding times. Sample locations were in accordance with the project-specific Sampling and Analysis Plan and associated standard operating procedures (Jacobs 1996b). Therefore, samples are, representative of the media and locations described in the Sampling and Analysis Plan.

3.3.4 Completeness

Although one environmental sample result and three QC sample results were rejected due to inadequate blank spike recoveries, the overall completeness of the data set for Radium-228 is satisfactory. Loss of one environmental sample reduces the completeness of the environmental data set from 100 percent to 98 percent (45 of 46 samples) for soils, which is satisfactory. Environmental water samples were 100 percent complete.

All QC samples were complete except equipment blanks, where three of eight (37 percent) were rejected. As discussed in Section 3.3.1, this disparity does not impact environmental samples with nondetect values (values at less than the reporting limit), and the potential impact on positive detections is relatively minor (<1.5 pCi/g).

Therefore, although a significant portion of equipment blanks were rejected, the impact on the environmental sample results is minimal.

Quality records produced from this analytical method(s) are contained within the data package, and provide adequate documentation for the validation process described herein. The records are complete with respect to the validation criteria.

3.3.5 Sensitivity

Reporting limits, also known as PQLs (or MDAs for radionuclides), were at or below the required PQLs listed in the project-specific Sampling and Analysis Plan (Jacobs 1996b), given a basis of a 1x dilution factor and dry weight for soils. Generically, increase in moisture content (soils or sediment) can raise detection limits for soil/sediment matrices, whereas dilution factors greater than 1 will increase detection limits for any matrix type.

TAB

Section 4

4.0 BACKGROUND CHARACTERIZATION

To assess whether the concentrations of total radium detected in onsite wells XU3212-901 (located within Building 8504) and XU3212-902 (located within Building 8502) are attributable to site activities at the WSA or are naturally occurring background concentrations, it is necessary to compare the concentrations detected in site groundwater with the concentrations in background samples. The TI method was used to estimate reasonable background concentrations. According to the TI method (EPA 1989, 1992), the concentration of a given constituent in a given medium is expressed as an appropriate UTL of the distribution of the constituent in the background data population. A UTL is generally expressed in terms of confidence and coverage levels, so that it can be said with a specified level of confidence that the UTL indicates the concentration of the constituent below which a specified proportion of the background data distribution will occur. Thus, a UTL with 95 percent confidence and 95 percent coverage ($UTL_{95,95}$) is the value that we can say, with 95 percent confidence, will exceed 95 percent of the background data. Any site value greater than the UTL has only a 5 percent probability of being drawn from the background data population, and thus may indicate the presence of site-related constituents.

UTLs (and other statistical properties) were determined for Radium-226, -228, total radium, and TPH for groundwater as well as surface and subsurface soil. The purpose of sampling surface soil is to establish windblown or fallout background concentrations, while the purpose of sampling subsurface soil is to detect contaminants that may leach from the surface soils via infiltration.

A total of 21 surface soil, 21 subsurface soil, and 15 groundwater samples were collected to characterize these media for background concentrations. Additionally, each of the onsite water supply wells were sampled to confirm the earlier radium detections, and to allow for a snapshot comparison of site concentrations to background concentrations.

The 15 groundwater samples were collected by sampling the three background wells five times over a 10-week period. As mentioned in Section 2.2.5, the method used to sample the background wells was changed from purge and bail to a low-stress method when it was calculated that it would be necessary to wait nearly 90 days between samples to obtain an independent sample. It was determined that, using the low-stress method, two weeks between samples would be adequate to obtain independent samples. Subsequent review of the results indicates that there is no reason to reject any of the data because the distribution of the data does not indicate any lack of independence between sampling rounds.

4.1 STATISTICAL PARAMETERS OF BACKGROUND DATA SETS

The following statistical parameters were defined for each constituent:

- Frequency of Detection – The frequency of detection is reported.
- Range – Minimum and maximum observed values are reported.
- Mean – The arithmetic mean is reported.
- Standard Deviation – The sample standard deviation is reported.
- Upper Tolerance Limit – The $UTL_{95,95}$ value is reported.
- Outlier Identification – Potential outlier values are identified but not removed from the data set unless rejected by the data validation process.

The statistical analyses applied were drawn from the following references:

- *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities: Interim Final Guidance* (EPA 1989);
- *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities: Addendum to Interim Final Guidance* (EPA 1992); and
- *Manual for Conducting Radiological Surveys in Support of License Termination.* (U.S. Nuclear Regulatory Commission 1992).

4.2 PROCEDURES

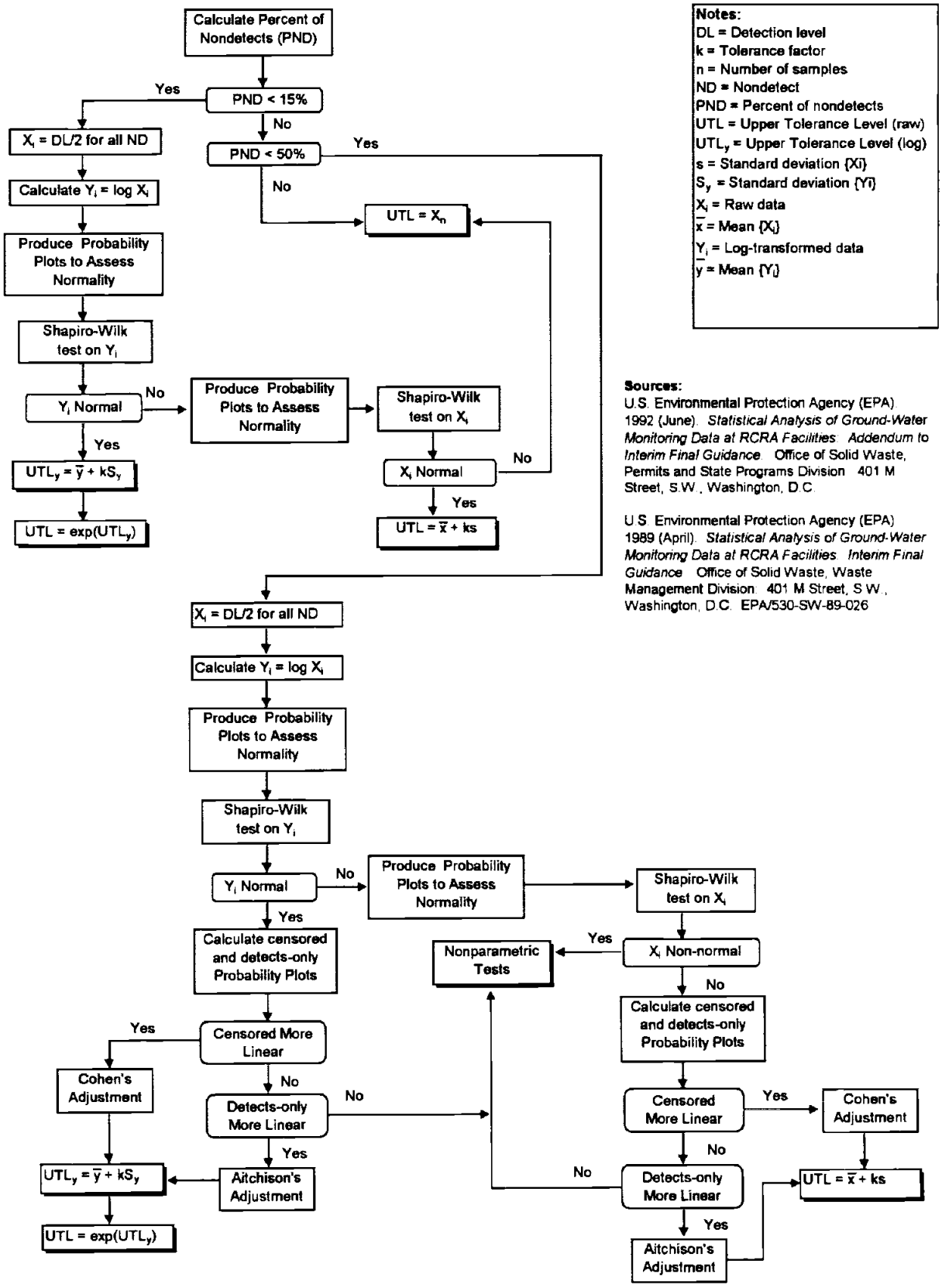
The data for a given constituent were analyzed according to the procedure outlined in Figure 4-1. The frequency of nondetects in the data set was calculated first. Unless the frequency of nondetects exceeded 50 percent, lognormality and normality of the data set were tested using graphical and formal calculation tests. Various statistical parameters were then calculated using formulas appropriate for the apparent distribution of the data set. In particular the $UTL_{95,95}$ was calculated as the value that we can say, with 95 percent confidence, will exceed 95 percent of the background data. If the frequency of nondetects exceeded 50 percent, or the distribution of the data set could not be demonstrated to be either normal or lognormal, then nonparametric estimates of the UTL were determined (typically the highest value in the data set). If the frequency of nondetects was between 15 and 50 percent, appropriate adjustments to the calculated statistical parameters were used to account for the nondetects.

The following sections discuss in greater detail the methods used to calculate UTLs and other statistical properties of background data sets.

4.2.1 Nondetects

Data that were reported at less than a detection level (i.e., nondetects) were treated differently depending on the frequency of nondetects. If the frequency of nondetects was less than 15 percent, the nondetects were replaced by one-half of the analytical method detection limit (EPA 1989, 1992), statistics were calculated, and statistical tests conducted using the data set with these replacement values. If the frequency of nondetects exceeded 50 percent, but was less than 100 percent, the nonparametric UTL was selected as the highest value in the data set (EPA 1989, 1992). In cases where the highest value was identified as a potential outlier, the second highest value was chosen as the UTL. If the frequency of nondetects was 100 percent, then the UTL was designated as the nondetect with the highest detection limit.

FIGURE 4-1
Weapons Storage Area Background Study
Flowchart of Data Analyses



Notes:
DL = Detection level
k = Tolerance factor
n = Number of samples
ND = Nondetect
PND = Percent of nondetects
UTL = Upper Tolerance Level (raw)
UTL_y = Upper Tolerance Level (log)
s = Standard deviation {Xi}
S_y = Standard deviation {Yi}
X_i = Raw data
$\bar{x}$ = Mean {X_i}
Y_i = Log-transformed data
$\bar{y}$ = Mean {Y_i}

Sources:
U.S. Environmental Protection Agency (EPA) 1992 (June). *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities: Addendum to Interim Final Guidance*. Office of Solid Waste, Permits and State Programs Division 401 M Street, S.W., Washington, D.C.

U.S. Environmental Protection Agency (EPA) 1989 (April). *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities: Interim Final Guidance*. Office of Solid Waste, Waste Management Division 401 M Street, S.W., Washington, D.C. EPA/530-SW-89-026

If the frequency of nondetects was between 15 and 50 percent, then the calculated statistics were adjusted for the presence of nondetects. Two adjustments are possible, depending on whether it appeared that the nondetects more likely represent zero values (i.e., the constituent is not present in the sample), or represent the presence of the constituent but at values less than the detection level. These adjustments are discussed further in Section 4.2.4.

Since total radium was calculated by adding the Radium-226 result and the Radium-228 result, the frequency of nondetects for total radium was assumed to be 0 percent.

4.2.2 Normality

The calculation of statistical parameters, and in particular the UTL, is affected significantly by the population distribution of the data set. Both formal and graphical statistical tests have been applied to assess normality. The general process is outlined in Figure 4-1.

To assess the population distribution of the data sets, each set was first addressed using a formal test for normality. Probability plots of the raw and log-transformed data were generated for some analytes to provide a graphical indication of whether the data distribution was normal or lognormal.

For the calculated statistical test of normality, it was first assumed that the data were lognormally distributed (EPA 1989, 1992). This assumption is based on the observation that environmental data are commonly distributed lognormally (i.e., logarithms of the observed data are distributed normally). This may be because environmental data are bounded by zero (i.e., negative constituent concentrations are not possible), so the data sets are often skewed to the right, which is characteristic of a lognormal distribution. Consequently, logarithms of the data were calculated before the tests for normality were performed.

Let x_i represent the raw data, and let $y_i = ln(x_i)$, where ln is the natural or Naperian logarithm. Let n be the statistical sample size (i.e., the number of data in the data set). If $n \leq 50$, then normality of the distribution of y_i was tested by the Shapiro-Wilk test (EPA 1989, 1992). If $n \geq 50$, then the alternate Shapiro-Francia test was applied (EPA 1992). In each case for the WSA background study, the statistical sample size n was less than 50, and the Shapiro-Wilk test of normality was applied.

The Shapiro-Wilk test is described in EPA (1992). To test for normality of the data, a test statistic W is calculated as:

$$W = \left[\frac{b}{s\sqrt{n-1}} \right]^2$$

where:

$$b = \sum_{i=1}^{k} a_{n-i+1} (x_{(n-i+1)} - x_{(i)}) = \sum_{i=1}^{k} b_i$$

and x_i is the ith smallest ordered value;

a_i is a coefficient dependent on the sample size (n);

s is the standard deviation;

n is the number of samples; and

k is the greatest integer less than or equal to $\frac{n}{2}$

The null hypothesis of normality of the logs of the data was rejected if W was less than the appropriate critical value (dependent on n) (EPA 1992: Appendix A). If normality of the natural logs of the data was rejected, the test was repeated using the raw data x_i and the standard deviation s of the raw data. If the null hypothesis of normality was also rejected for the raw data, then probability plots of the raw and log-transformed data were examined to determine whether the data distribution was more nearly normal or lognormal. When a reasonable choice between normality and lognormality could still not be made, then a nonparametric test is recommended to compare site data with background data, rather than comparing site data to a background a single UTL.

4.2.3 Statistical Parameters

The following statistical parameters were calculated:

- frequency of detection;
- range;
- mean;
- standard deviation;
- UTL; and
- potential outlier statistic.

The calculation of these various parameters depends in part on whether the data set has been judged to be normally or lognormally distributed.

The frequency of detection is a simple ratio of the number of values greater than the MDL to the total number of samples in the data set. The range of the background data set for a given constituent is reported as the minimum and maximum observed values in the data set. These values do not depend on the shape of the distribution.

The mean $\bar{x}$ was calculated as the arithmetic mean of the data set

$$\bar{x} = (\Sigma_i x_i)/ n.$$

The standard deviation s was calculated as the sample standard deviation of the data set

$$s = \{[n \Sigma_i x_i^2 - (\Sigma_i x_i)^2]/[n (n - 1)]\}^{1/2}.$$

The $UTL_{95,95}$ was calculated as

$$UTL_{95,95} = \bar{x} + k s.$$

where k is the tolerance factor for a one-sided normal (or lognormal) tolerance interval with a minimum of 95 percent coverage, a 95 percent probability, and n background observations.

For distributions that were determined to be lognormal rather than normal, the UTL was calculated in the same fashion except that $\bar{x}$ was replaced by $\bar{y}$ (the mean of the logarithms of the x_i) and s was replaced by S_y (the standard deviation of the logarithms of the x_i). The resultant value of the UTL (designated UTLy) is the UTL of the log-transformed data. The UTL for the raw data was then calculated as the exponential function of the UTLy of the log-transformed data; i.e., UTL = exp(UTLy).

4.2.4 Adjustment for Nondetects

If the frequency of nondetects for a given data set was between 15 and 50 percent, appropriate adjustments to the calculated statistical parameters were used to account for the nondetects. Either Cohen's adjustment or Aitchison's adjustment was used, as outlined in EPA (1992) and excerpted below:

> Cohen's adjustment ... assumes that all the data (detects and nondetects) come from the same Normal or Lognormal population, but that nondetect values have been "censored" at their detection limits. This implies that the [constituent] of concern is present in nondetect samples, but the analytical equipment is not sensitive to concentrations lower than the detection limit. Aitchison's adjustment ... is constructed on the assumption that nondetect samples are free of contamination, so that all nondetects may be regarded as zero concentrations...
>
> To decide which approach is more appropriate ..., two separate Probability Plots can be constructed. In [the first] method, the combined set of detects and nondetects is ordered (with nondetects being

given arbitrary but distinct ranks). ...Normal quantiles ... are then computed for the data set ... However, only the detected values and their associated Normal quantiles are actually plotted. If the shape of the Censored Probability Plot is reasonably linear, then Cohen's assumption that nondetects have been "censored" at their detection limit is probably acceptable ... If the Censored Probability Plot has significant bends and curves ..., one might consider Aitchison's procedure instead.

To test the assumptions of Aitchison's method, a Detects-Only Probability Plot may be constructed. [N]ondetects are completely ignored and a standard Probability Plot is constructed using only the detected measurements. ... Thus, ... Normal quantiles are computed only for the ordered detected values. ... If the Detects-Only Probability Plot is reasonably linear, then the assumptions underlying Aitchison's adjustment (i.e., that "nondetects" represent zero concentrations ...) are probably reasonable.

Cohen's Adjustment. If it was determined that Cohen's adjustment was appropriate, the sample mean $\bar{x}_d$ and sample variance s_d^2 for only the data greater than the detection limit were first calculated. Then two parameters h and γ were computed as

$$h = (n - l)/n$$

and

$$\gamma = s_d^2/(\bar{x}_d - MDL)^2,$$

where l is the number of observations greater than the detection level, and MDL is the method detection limit. Based on the values of h and γ, a value λ was determined from a table in Appendix B of EPA (1989), and corrected values of the mean $\bar{x}$ and standard deviation s were calculated by

$$\bar{x} = \bar{x}_d - \lambda (\bar{x}_d - MDL)$$

and

$$s = [s_d^2 + \lambda (\bar{x}_d - MDL)^2]^{1/2}.$$

If the distribution appeared to be lognormal rather than normal, the adjustment was made using the mean and standard deviation of the logarithms of the detected values, rather than $\bar{x}_d$ and s_d^2.

Aitchison's Adjustment. If it was determined that Aitchison's adjustment is appropriate, the sample mean $\bar{x}_d$ and sample variance s_d^2 for only the data greater than the method detection limit were first calculated. Let $d = n - l$ be the number of nondetects. Then the adjusted mean $\bar{x}$ and standard deviation s are given by

$$\bar{x} = (1 - d/n) \ \bar{x}_d$$

and

$$s = \{[n - (d + 1)] \ s_d^2 /(n - 1) + [d(n - d) \ \bar{x}_d^2]/[n(n - 1)]\}^{1/2}.$$

If the distribution appeared to be lognormal rather than normal, then the adjustment was made using the mean and standard deviation of the logarithms of the detected values, rather than $\bar{x}_d$ and s_d^2.

4.2.5 Outlier Identification

The highest value (x_n) in each data set with a frequency of detection greater than 50 percent was subjected to a formal test as an outlier (EPA 1989). The mean $\bar{x}$ and standard deviation s of the entire data set were first calculated. A test statistic T_n was then calculated

$$T_n = (x_n - \bar{x})/s.$$

T_n was then compared to a critical value (dependent on n) (EPA 1989: Appendix B). If T_n was greater than the tabulated critical value, this provided evidence that x_n was a statistical outlier and not truly a member of the background data set. However, x_n was not rejected, modified, or otherwise excluded from the data set solely on this basis. Only if the data validation process or other review of the data indicated some problem with the datum (such as a transcription error or failure to account for dilution) was any change made to the data set. The test for outliers merely identified those data that might be outliers and for which additional data review may be warranted.

4.3 BACKGROUND CONCENTRATIONS

Results of the background study, including percent of samples below the detection limit, number of detects, minimum, maximum, mean, standard deviation, UTL, and outlier identification, are listed in Table 4-1. The following sections briefly explain the process by which background values were calculated for each medium based on the Figure 4-1 flowchart for each analyte.

4.3.1 Soils

Surface (Horizon A) and subsurface (Horizon B) soils were evaluated separately.

4.3.1.1 Horizon A Soils

Radium-226, Radium-228, and Total Radium. Radium-226 was detected in 21 of 21 samples, and Radium-228 was detected in 11 of 21 samples. Because total radium was calculated by adding the Radium-226 and Radium-228 results, the frequency of

TABLE 4-1
Summary of Background UTLs with Comparison to Maximum Concentration Detected in WSA Supply Wells
Weapons Storage Area Background Study

Analyte	Matrix	Units	% Non detects	Detects/ Total	Minimum	Maximum	Mean	Standard Deviation	UTL $_{95,95}$	Potential Outlier?	Maximum Detected Concentration in WSA Supply Wells
TPH	Surface Soil	mg/kg	80	4/20	<5.3	8.0	nc	nc	8.0	------	------
	Subsurface Soil	mg/kg	95	1/21	<4.87	6.0	nc	nc	6.0	------	------
	Groundwater	mg/L	100	0/15	<0.44	<0.44	nc	nc	ND at 0.444	------	ND at 0.444
	Surface Water	mg/L	100	0/1	<0.44	<0.44	nc	nc	nc	------	------
Radium-226	Surface Soil	pCi/g	0	21/21	0.48	1.47	1.01	0.29	2.00	No	------
	Subsurface Soil	pCi/g	0	21/21	0.59	1.56	1.01	0.29	1.96	No	------
	Groundwater	pCi/L	0	15/15	1.62	10.3	5.62	2.90	13.06	No	9.82
	Surface Water	pCi/L	100	0/1	<0.18	<0.18	nc	nc	nc	------	------
Radium-228	Surface Soil	pCi/g	48	11/21	<0.3261	1.25	0.54	0.37	2.24	No	------
	Subsurface Soil	pCi/g	70	6/20	<0.3320	1.10	nc	nc	1.10	------	------
	Groundwater	pCi/L	27	11/15	<1.1	2.55	1.15	0.57	2.61	Yes	1.39
	Surface Water	pCi/L	100	0/1	<0.923	<0.923	nc	nc	nc	------	------
Total Radium	Surface Soil	pCi/g	0 *	------	0.48	2.29	1.44	0.62	4.05	No	------
	Subsurface Soil	pCi/g	0 *	------	0.6	2.17	1.22	0.45	2.84	No	------
	Groundwater	pCi/L	0 *	------	1.79	12.03	6.63	3.05	14.46	No	11.21
	Surface Water	pCi/L	100	0/1	nc	nc	nc	nc	nc	------	------

Notes:

* = Assumed to be 0 percent due to addition of Radium-226 and Radium-228 results.
------ = not applicable
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
nc = not calculated
ND = not detected
Outlier? = Result of test to determine if maximum value is potential outlier.
pCi/g = picocuries per gram
pCi/L = picocuries per liter
TPH = total petroleum hydrocarbons
UTL $_{95,95}$ = Upper Tolerance Level (95% confidence and 95% coverage)
WSA = Weapons Storage Area

nondetects for total radium was assumed to be 0 percent. Based on the Shapiro-Wilk test, the null hypothesis of normality was accepted for the log-transformed data for both analytes (Appendix E). The mean and standard deviation are listed in Table 4-1 for the raw data. Because the null hypothesis of log-normality was accepted, a UTLy based on the mean and standard deviation of the log-transformed data was calculated, and the UTL was calculated as exp(UTLy). No outliers were identified based on the formal test of the log-transformed data.

Total Petroleum Hydrocarbons. TPH was detected in surface soil in 4 of 20 samples, for a frequency of nondetects of 80 percent. For this analyte, the minimum value is a nondetect at the lowest detection limit and the maximum value is the maximum detected value. Mean and standard deviation were not calculated because data were insufficient. The UTL was established as the highest detected value. No test for outliers was performed because of the high number of nondetects.

4.3.1.2 Horizon B Soils

Radium-226 and Total Radium. Radium-226 was detected in 21 of 21 samples. Since total radium was calculated by adding the Radium-226 and -228 results, the frequency of nondetects for total radium was assumed to be 0 percent. Based on the Shapiro-Wilk test, the null hypothesis of normality was accepted for the log-transformed data for both analytes (Appendix E). The mean and standard deviation listed in Table 4-1 are for the raw data. Because the null hypothesis of log-normality was accepted, a UTLy based on the mean and standard deviation of the log-transformed data was calculated, and the UTL was calculated as exp(UTLy). No outliers were identified based on the formal test of the log-transformed data.

Radium-228 and Total Petroleum Hydrocarbons. Radium-228 was detected in 6 of 20 samples and TPH was detected in 1 of 21 samples, for frequency of nondetects of 70 and 95 percent, respectively. For these analytes, the minimum value is a nondetect at the lowest detection limit and the maximum value is the maximum detected value.

Mean and standard deviation were not calculated because data were insufficient. The UTL was established as the highest detected value. No test for outliers was performed because of the high number of nondetects.

4.3.2 Groundwater

Radium-226, Radium-228, and Total Radium. Radium-226 was detected in 15 of 15 samples, and Radium-228 was detected in 11 of 15 samples. Because total radium was calculated by adding the Radium-226 and -228 results, the frequency of nondetects for total radium was assumed to be 0 percent. Based on the Shapiro-Wilk test, the null hypothesis of normality was rejected for the log-transformed data but accepted for the raw data for these analytes (Appendix E). The mean and standard deviation are listed in Table 4-1 for the raw data. The highest value for Radium-228 was identified as a possible outlier, though it failed the outlier test by only a small margin (test statistic of 2.46 versus critical value of 2.41).

Total Petroleum Hydrocarbons. TPH was not detected in 15 groundwater samples. Therefore, the minimum and maximum values in Table 4-1 are reported as less than the minimum and maximum detection limits, respectively. Mean and standard deviation were not calculated because data were insufficient. The UTL was established as the highest ranked value, or in this case a nondetect at a given detection limit. No test for outliers was performed because they were all nondetects.

4.3.3 Surface Water

Radium-226, -288, and TPH were not detected in the single surface water sample collected. One sample is not sufficient to calculate background concentrations.

TAB

Section 5

5.0 CONCLUSIONS

The background study conducted at the WSA was initiated to establish background concentrations of radium and TPH in surface soil, subsurface soil, and groundwater.

A total of 21 surface soil, 21 subsurface soil, 15 groundwater samples were collected to characterize these media for background concentrations. Additionally, two groundwater samples were collected from each of the onsite water supply wells.

Table 5-1 presents the maximum detected value for Radium-226, Radium-228, and total radium from the two samples collected from the onsite water supply wells. Comparison of these maximum values to the calculated UTLs indicates that the concentrations of radium detected in the onsite water supply wells are consistent with background concentrations and do not indicate site-related contamination.

TABLE 5-1

Comparison of Maximum Detected Values in Supply Wells to Background UTL $_{95,95}$

Analyte in Groundwater	Background $UTL_{95,95}$	Maximum Concentration Detected in Supply Wells
TPH (mg/L)	ND at 0.444	ND at 0.444
Radium-226 (pCi/L)	13.06	9.82
Radium-228 (pCi/L)	2.61	1.39
Total Radium (pCi/L)	14.46	11.21

(intentionally blank)

TAB

Section 6

6.0 REFERENCES

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TAB

Appendix A

APPENDIX A

Preliminary Analytical Results

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511 ◆ (970) 490-1511 ◆ FAX (970) 490-1522

February 14, 1997

Ms. Lynn Schuetter
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RECEIVED
FEB 18 1997
JE - Denver

RE: PAI Workorder: 96-11-073
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Ms. Schuetter:

Twelve soil samples and one water sample were received from Jacobs Engineering Group under the above referenced workorder on November 12, 1996. The samples were scheduled for Radium-228 and Total Radium Alpha Emitters analysis according SW-846 Methods 9320 and 9315 respectively. The results for the Total Radium were reported on December 24, 1996. The results for Radium-228, as well as original custody documentation, are included in this package.

Please consult the individual data packages for case narratives specific to each method.

Paragon Analytics, Inc. apologizes for the delay in the delivery of this data. Should you have any questions, please call.

Sincerely,

Lori Pacheco

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

Paragon Analytics, Inc.

Radiochemistry Case Narrative
^{228}Radium by Method 9320

EMAX

Jacobs / Carswell AFB / (DO 21)

Paragon ID	Date Analyzed	Prep Batch ID	Paragon ID	Date Analyzed	Prep Batch ID
96-11-073-01	1/29/97	11073R6.XL1	96-11-073-B3	1/29/97	11073R6.XL1
96-11-073-02	1/29/97	11073R6.XL1	96-11-073-SB	2/13/97	11073R6.XL3
96-11-073-03	1/29/97	11073R6.XL1	96-11-073-BB	2/13/97	11073R6.XL3
96-11-073-04	1/29/97	11073R6.XL1	96-11-073-B4	1/29/97	11073R6.XL1
96-11-073-05	1/29/97	11073R6.XL1	96-11-073-D1	1/29/97	11073R6.XL1
96-11-073-06	1/29/97	11073R6.XL1	96-11-073-D2	1/3/97	11073R68.XLS
96-11-073-07	1/29/97	11073R6.XL1	96-11-073-M1	1/2/97	11073R68.XLS
96-11-073-08	1/29/97	11073R6.XL1	96-11-073-M2	1/29/97	11073R6.XL1
96-11-073-09	1/29/97	11073R6.XL1	96-11-073-S1	1/2/97	11073R68.XLS
96-11-073-10	1/29/97	11073R6.XL1	96-11-073-S2	1/2/97	11073R68.XLS
96-11-073-11	2/13/97	11073R6.XL3	96-11-073-S3	1/29/97	11073R6.XL1
96-11-073-12	2/13/97	11073R6.XL3	96-11-073-S4	1/29/97	11073R6.XL1
96-11-073-13	1/3/97	11073R68.XLS	96-11-073-SA	2/13/97	11073R6.XL3
96-11-073-B1	1/2/97	11073R68.XLS	96-11-073-BA	2/13/97	11073R6.XL3
96-11-073-B2	1/2/97	11073R68.XLS			

1. This report consists of 12 soil and 1 water samples received by Paragon on 11/12/96.

2. These samples were prepared according to SW-846 Method 9320. The samples were analyzed for the presence of Ra-228 by low background gas flow proportional counting of the ingrown progeny of radium-228, Actinium-228. The analyses were completed on 02/06/97.

3. The following deviations from the requested method were noted:

   a) Method 9320 makes no reference to the analysis of soil samples. The soil samples from this work order were initially leached in concentrated nitric acid. The leachate was then processed as a water sample according to the method.

b) Due to laboratory error, preparation of water sample CR-A157706 (PAI 96-11-073-13) was initiated with an aliquot of 4 liters according to the in-house method for Radium-226/228. The error was noted following the initial barium sulfate precipitation. The precipitate was subsequently dissolved in basic EDTA as per procedure and split into portions for analysis according to Method 9315 (Total Alpha Emitting Radium Isotopes) and Method 9320 (Radium-228). Although chemical preparation was carried out by requested methods, the QC batch in which the sample was analyzed failed to meet QC acceptance criteria for blank spikes (outside limits, low). The suspected cause for the failure was an inaccurate estimation (high) of the chemical yield resulting from inadequate washing of the precipitate. Reanalysis was not possible since sample volumes were depleted. Reported results are qualified "reject" due to the failure to meet QC criteria.

4. Blank spike 96-11-073-S6 (associated with prep batch 11073R6.XL2) showed recoveries outside control limits (high). This batch was sent back for reextraction. Reanalysis was completed on 2/13/97. Results met all QC criteria and are submitted.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Robert Shannon — 2/13/97
Radiochemistry Technical Manager — Date

Radiochemistry Final Data Review — 2/13/97
Date

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/09/96

Client Name: EMAX

Date Analyzed : 01/29/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 555 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
CR-A157801	11-073-01	0.61 ± 0.26	0.40
CR-A157802	11-073-02	0.37 ± 0.26	0.41
CR-A157803	11-073-03	0.49 ± 0.24	0.37
CR-A157804	11-073-04	0.61 ± 0.29	0.45
CR-A157805	11-073-05	0.43 ± 0.27	0.43
CR-A157807	11-073-06	0.52 ± 0.27	0.42
CR-A157806	11-073-07	0.14 ± 0.24	0.40
CR-A157701	11-073-08	-0.01 ± 0.26	0.44
CR-A157702	11-073-09	0.43 ± 0.32	0.52
CR-A157704	11-073-10	0.38 ± 0.26	0.42
CR-A157705	11-073-11	0.36 ± 0.17	0.25
CR-A157706	11-073-12	0.40 ± 0.17	0.26

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/09/96

Client Name: EMAX

Date Analyzed : 01/03/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 96-11-073

Count Duration: 360 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/L)	MDA
CR-A157706	11-073-13	-0.19 ± 0.51	0.87

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ)
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

PARAGON ANALYTICS, INC.

Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 360 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-073-B1	0.08 ± 0.24	0.40

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 360 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-073-B2	0.22 ± 0.27	0.45

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ)
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/20/97

Client Name: EMAX

Date Analyzed : 01/29/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 555 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-073-B3	-0.02 ± 0.26	0.44

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/20/97

Client Name: EMAX

Date Analyzed : 01/29/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 555 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-073-B4	-0.11 ± 0.26	0.45

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/10/97

Client Name: EMAX

Date Analyzed : 02/13/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 294 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-073-BA	0.14 ± 0.13	0.20

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/10/97

Client Name: EMAX

Date Analyzed : 02/13/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 294 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-073-BB	0.16 ± 0.14	0.23

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/09/96

Client Name: EMAX

Date Analyzed : 01/29/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 555 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Duplicate -01	11-073-D1	0.50 ± 0.32	0.51

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Remarks:

Sample 96-11-073-D1 is a duplicate of 96-11-073-01.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/09/96

Client Name: EMAX

Date Analyzed : 02/13/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 294 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Duplicate -11	11-073-DB	0.16 ± 0.16	0.25

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Remarks:

Sample 96-11-073-DB is a duplicate of 96-11-073-11.

RADIUM-228 MATRIX SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/11/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 360 Min.

Lab Sample ID	Ra-228 Known Value	Ra-228 Rep't Value	Ra-228 Recovery	Flag
96-11-073-M1	18.7 ± 8.13	17.4 ± 1.85	92.9%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-073-M1 is a matrix spike of sample 96-11-073-05.

RADIUM-228 MATRIX SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/11/96

Client Name: EMAX

Date Analyzed : 01/29/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 555 Min.

Lab Sample ID	Ra-228 Known Value	Ra-228 Rep't Value	Ra-228 Recovery	Flag
96-11-073-M2	18.7 ± 8.15	18.9 ± 1.98	101%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-073-M2 is a matrix spike of sample 96-11-073-05.

RADIUM-228 MATRIX SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/09/96

Client Name: EMAX

Date Analyzed : 02/13/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 294 Min.

Lab Sample ID	Ra-228 Known Value	Ra-228 Rep't Value	Ra-228 Recovery	Flag
96-11-073-MB	18.7 ± 8.15	15.8 ± 1.63	84.4%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-073-MB is a matrix spike of sample 96-11-073-12.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 360 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-S1	18.1	7.83 ±0.915	43.2%	Fail

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 360 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-S2	18.1	4.84 ±0.628	26.7%	Fail

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-073-S2 is a blank spike duplicate.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/20/97

Client Name: EMAX

Date Analyzed : 01/29/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 555 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-S3	17.9	18.0 ± 1.87	100%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ).
See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-073-S2 is a blank spike duplicate.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/20/97

Client Name: EMAX

Date Analyzed : 01/29/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 555 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-S4	17.9	21.4 ± 2.22	119%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-073-S2 is a blank spike duplicate.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/10/97

Client Name: EMAX

Date Analyzed : 02/13/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 294 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-SA	17.8	16.0 ± 1.65	90.2%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ).
See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/10/97

Client Name: EMAX

Date Analyzed : 02/13/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 294 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-SB	17.8	16.5 ± 1.70	92.7%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511 ◆ (970) 490-1511 ◆ FAX (970) 490-1522

December 24, 1996

RECEIVED
DEC 26 1996
JT - Denver

Mr. Dan Schultz
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: PAI Workorder: 96-11-073
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Mr. Schultz:

Twelve soil samples and one water sample were received from Jacobs Engineering Group under the above referenced workorder on November 12, 1996. The samples were scheduled for Radium-228 and Total Radium Alpha Emitters analysis according SW-846 Methods 9320 and 9315 respectively. The results for the Total Radium analyses as well as original custody documentation are contained in the enclosed report. The results for Radium-228 will be forwarded to you as they are completed.

Please consult the individual data packages for case narratives specific to each method.

Thank you for your confidence in Paragon Analytics, Inc. Should you have any questions, please call.

Sincerely,

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

An Employee Owned Small Business

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Total Radium by SW-846 Method 9315

EMAX

Jacobs / Carswell AFB (DO 21) 05G47900

Client ID	Paragon ID	Client ID	Paragon ID
CR-A157801	96-11-073-01	CR-A157705	96-11-073-11
CR-A157802	96-11-073-02	CR-A157706	96-11-073-12
CR-A157803	96-11-073-03	CR-A157706 WA	96-11-073-13
CR-A157804	96-11-073-04		
CR-A157805	96-11-073-05		
CR-A157807	96-11-073-06		
CR-A157806	96-11-073-07		
CR-A157701	96-11-073-08		
CR-A157702	96-11-073-09		
CR-A157704	96-11-073-10		

1. This report consists of 12 soil samples and 1 equipment rinsate blank received by Paragon on 11/12/96.

2. These samples were prepared according to SW-846 Method 9315 (modified). The corresponding Paragon Analytics, Inc. procedure is PAI SOP712R3. The following modifications to the method were necessary due to the matrix of the sample. The solid samples were digested in nitric acid, and the digestate processed as a water sample according to SW-846 Method 9315. Due to laboratory error, the entire volume of equipment rinsate supplied was prepared with water samples from a batch of samples being analyzed for radium-226/228. The affected samples were split from the batch following the initial barium sulfate precipitation and prepared parallel to solid samples in these work orders. Thus a dedicated blank spike was not analyzed with the water sample. The blank spike samples prepared in association with the solid samples indicate satisfactory method performance.

3. The samples were analyzed by low background gas proportional counting for the presence of total alpha emitting radium isotopes according to Paragon Analytics, Inc. procedure PAI SOP724R4. The analyses were completed on 12/19/96.

4. The presence of alpha emitting radium isotopes other than Radium-226 (e.g. Ra-224, Ra-223) is a known interference to the determination of Radium-226 using the requested methodology. A separate measurement can be conducted to specifically determine the Radium-226 activity of these samples. If necessary, the measurement should be conducted within four weeks of preparation of these samples.

5. No problems were encountered with either the client samples or the associated quality control samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Robert Shannon Radiochemistry Technical Manager	12/24/96 Date
Radiochemistry Final Data Review	12/24/96 Date

RADIOCHEMISTRY DATA PACKAGE CONTENTS

PARAGON ANALYTICS, INC.

LOW BACKGROUND GAS FLOW PROPORTIONAL ANALYSIS

Section 1	Sample Results Summary
Section 2	QC Results Summary
Section 3	Individual Sample Results
Section 4	Raw Data
	Mass Documentation Mass-Efficiency Calibration (m, b values) Sample, Blank, LCS, Background Data
Section 5	Quality Assurance Summary Reports
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Section 6	Laboratory Bench Sheets
Section 7	Standard Traceability Documents
	Certificates and Dilution Records Carrier Reagent Documentation
Section 8	Chain of Custody
Section 9	Additional Supporting Documentation
	Instrument Performance Checks

Cross-talk documentation is not applicable for this analysis.

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

RECEIVED
DEC 26 1996
at Denver

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc. Date Collected: 11/09/96

Client Name: EMAX Date Analyzed : 12/19/96

Client Project ID: Jacobs/Carswell AFB Sample Matrix : Soil

Lab Sample ID Series: 96-11-073 Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/g)
CR-A157801	11-073-01	0.69 ± 0.11
CR-A157802	11-073-02	1.24 ± 0.21
CR-A157803	11-073-03	1.01 ± 0.15
CR-A157804	11-073-04	1.56 ± 0.26
CR-A157805	11-073-05	1.38 ± 0.17
CR-A157807	11-073-06	1.41 ± 0.19
CR-A157806	11-073-07	1.36 ± 0.22
CR-A157701	11-073-08	0.80 ± 0.11
CR-A157702	11-073-09	1.32 ± 0.16
CR-A157704	11-073-10	0.98 ± 0.16
CR-A157705	11-073-11	0.82 ± 0.13
CR-A157706	11-073-12	0.84 ± 0.11
CR-A157706 WA	11-073-13	< 0.12(BDL)
Blank	11-073-B1	< 0.18(BDL)
Blank	11-073-B2	< 0.17(BDL)
Duplicate	11-073-D1	1.32 ± 0.16
Duplicate	11-073-D2	0.70 ± 0.10

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Remarks:

Sample 96-11-073-D1 is a duplicate of 96-11-073-01.
Sample 96-11-073-D2 is a duplicate of 96-11-073-12.

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/09/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID: Jacobs / Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 96-11-073

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
CR-A157706 WA	11-073-13	< 0.12(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ)
See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/04/96

Client Name: EMAX

Date Analyzed : 12/24/96

Client Project ID: Jacobs / Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 96-11-194

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
Blank	11-194-B1	< 0.03(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

2

PARAGON ANALYTICS, INC.

Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc. Date Collected: 12/08/96

Client Name: EMAX Date Analyzed : 12/13/96

Client Project ID: Jacobs/Carswell AFB Sample Matrix : Soil

Lab Sample ID Series: 96-11-073 Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/g)	Rep't Activity (pCi/g)	Spike Recovery
96-11-073-S1	67.1 ± 16.78	61.50 ± 6.41	91.6
96-11-073-S2	67.1 ± 16.78	64.65 ± 6.71	96.3

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/08/96

Client Name: EMAX

Date Analyzed : 12/13/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/g)	Rep't Activity (pCi/g)	Spike Recovery
96-11-073-M1	68.8 ± 17.20	34.06 ± 3.62	49.5

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

96-11-073-M1 is a matrix spike of 96-11-073-05.

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/08/96

Client Name: EMAX

Date Analyzed : 12/13/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/g)	Rep't Activity (pCi/g)	Spike Recovery
96-11-073-M2	68.1 ± 17.02	50.46 ± 5.21	74.1

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

96-11-073-M2 is a matrix spike of 96-11-073-11.

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511 ◆ (970) 490-1511 ◆ FAX (970) 490-1522

February 5, 1997

RECEIVED
FEB 6 1997
JE • Denver

Ms. Lynn Schuetter
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: PAI Workorder: 96-11-097
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Ms. Schuetter:

Eighteen soil samples and one water sample were received from Jacobs Engineering Group under the above referenced workorder on November 14, 1996. The samples were scheduled for Radium-228 and Total Radium Alpha Emitters analysis according SW-846 Methods 9320 and 9315 respectively. The results for the Total Radium were reported on December 24, 1996. The results for Radium-228, as well as original custody documentation, are included in this package.

Please consult the individual data packages for case narratives specific to each method.

Paragon Analytics, Inc. apologizes for the delay in the delivery of this data. Should you have any questions, please call.

Sincerely,

Lori Pacheco

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

Paragon Analytics - Fort Collins, Colorado

CONDITION OF SAMPLE UPON RECEIPT

CLIENT: Emax SHIPPING CONTAINER #: Cooler

WORKORDER NO. 96-11-047 INITIALS: DB DATE: 11/14/96

1.	Does this project require special handling according to NEESA. Level 3, or CLP protocols? If yes, complete a. and b. a. Cooler Temperature_____ b. Lot No's._____ c. Airbill Number _____		Yes	No
2.	Are custody seals on the cooler intact? If so, how many 2	N/A	Yes	No
3.	Are custody seals on sample containers intact?	N/A	Yes	No
4.	Is there a Chain of Custody (COC) or other representative documents, letters or shipping memos?		Yes	No
5.	Is the COC complete? Relinquished: Yes ✓ No__ Requested Analysis: Yes ✓ No__		Yes	No
6.	Is the COC in agreement with the samples received? No. of Samples: Yes ✓ No__ Sample ID's: Yes ✓ No__ Matrix: Yes ✓ No__ No. of Containers: Yes ✓ No__		Yes	No
7.	Are the samples preserved correctly?	N/A	Yes	No
8.	Is there enough sample? If so, are they in the proper containers?		Yes	No
9.	Are all samples within holding times for the requested analyses?		Yes	No
10.	Were the sample received on ice?	N/A	Yes	No
11.	Were all sample containers received intact? (not broken or leaking, etc.)		Yes	No
12.	Are samples requiring no headspace, headspace free?	N/A	Yes	No
13.	Do the samples require quarantine?		Yes	No
14.	Do samples require ATI disposal?		Yes	No
15.	Did the client return any unused bottles?		Yes	No

Describe "NO" items (except No's 1, 13, &14): (2) - 8mL HNO3 added to water sample upon Receipt

Was the client contacted? Yes____ No____

If yes, Date:_____ Name of person contacted:_____

Describe actions taken or client instructions:_____

Group Leader's Signature:_____ Date:_____

Cooler Temperature: 11°

ATI FRM 201FC5 (2/21/96)

FedEx USA Airbill

Tracking Number 9298823693

Recipient's Copy

1 From

Date 11/13/96

Sender's Name Mike Johnson Phone 303 575-8855

Dept./Floor/Suite/Room

Company Jacobs

Address 600 17th St. Ste. 1100N

City Denver State CO Zip 80202

2 Your Internal Billing Reference Information

3 To

Recipient's Name Tom Baily Phone 800 443-1511

Dept./Floor/Suite/Room

Company Paragon Analytics Inc.

Address 225 Commerce Drive

(To HOLD at FedEx location, print FedEx address here)

City Fort Collins State Co Zip 80524

For HOLD at FedEx Location check here

- [ ] Hold Weekday (Not available with FedEx First Overnight)
- [ ] Hold Saturday (Not available at all locations) (Not available with FedEx First Overnight or FedEx Standard Overnight)

For Saturday Delivery check here

- [ ] (Extra Charge. Not available to all locations) (Not available with FedEx First Overnight or FedEx Standard Overnight)

9 2 9 8 8 2 3 6 9 3

4 Service Delivery commitment may be later in some areas

- [ ] FedEx Priority Overnight (Next business morning)
- [x] FedEx Standard Overnight (Next business afternoon)
- [ ] FedEx 2Day* (Second business day)
- [ ] FedEx Govt. Overnight (Authorized user only)
- [ ] FedEx Overnight Freight
- [ ] FedEx 2Day Freight

(For packages over 150 pounds. Call for delivery schedule.)

- [ ] NEW FedEx First Overnight (Earliest next business morning delivery to select locations) (Higher rates apply)

*FedEx Letter Rate not available. Minimum charge: One pound FedEx 2Day rate

5 Packaging

- [ ] FedEx Letter*
- [ ] FedEx Pak*
- [ ] FedEx Box
- [ ] FedEx Tube
- [x] Other Packaging

(Declared value limit $500)

6 Special Handling

Does this shipment contain dangerous goods?

- [ ] Yes (As per attached Shipper's Declaration)
- [ ] Yes (Shipper's Declaration not required)
- [ ] Dry Ice — Dry Ice, 9, UN 1845 ... kg 904 (Dangerous Goods Shipper's Declaration not required)
- CA [ ] Cargo Aircraft Only

7 Payment

- [ ] Obtain Recipient FedEx Account No.

Bill to:

- [x] Sender (Account no. in section 1 will be billed)
- [ ] Recipient
- [ ] Third Party
- [ ] Credit Card
- [ ] Cash/Check

(Enter FedEx account no. or Credit Card no. below)

Total Packages	Total Weight	Total Declared Value*	Total Charges
1	43	$ .00	$

*When declaring a value higher than $100 per package, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY section for further information.

Credit Card Auth.

8 Release Signature

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

232

FORM ID NO. 0200

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Paragon Analytics, Inc.

Radiochemistry Case Narrative
$^{226/228}$Radium by Method 9320

EMAX

Jacobs / Carswell AFB / (DO 21)

Paragon ID	Date Analyzed	Prep Batch ID	Paragon ID	Date Analyzed	Prep Batch ID
96-11-097-01	12/20/96	11097R28.XLS	96-11-097-B2	12/20/96	11097R28.XLS
96-11-097-02	12/20/96	11097R28.XLS	96-11-097-B3	1/27/97	11097R6.XL1
96-11-097-03	12/20/96	11097R28.XLS	96-11-097-B4	1/27/97	11097R6.XL1
96-11-097-04	12/23/96	11097R28.XLS	96-11-097-D1	12/20/96	11097R28.XLS
96-11-097-05	12/20/96	11097R28.XLS	96-11-097-D2	12/20/96	11097R28.XLS
96-11-097-06	12/23/96	11097R28.XLS	96-11-097-D3	1/27/97	11097R6.XL1
96-11-097-07	12/20/96	11097R28.XLS	96-11-097-M1	12/23/96	11097R28.XLS
96-11-097-08	1/3/97	11057R68.XLX	96-11-097-M2	1/27/97	11097R6.XL1
96-11-097-09	1/27/97	11097R6.XL1	96-11-097-S1	12/20/96	11097R28.XLS
96-11-097-10	1/27/97	11097R6.XL1	96-11-097-S2	12/20/96	11097R28.XLS
96-11-097-11	1/27/97	11097R6.XL1	96-11-097-S3	1/27/97	11097R6.XL1
96-11-097-12	12/20/96	11097R28.XLS	96-11-097-S4	1/27/97	11097R6.XL1
96-11-097-13	12/20/96	11097R28.XLS	96-11-057-B3	1/6/97	11057R68.XLX
96-11-097-14	12/20/96	11097R28.XLS	96-11-057-B4	1/6/97	11057R68.XLX
96-11-097-15	12/20/96	11097R28.XLS	96-11-057-S3	1/6/97	11057R68.XLX
96-11-097-16	1/27/97	11097R6.XL1	96-11-057-S4	1/6/97	11057R68.XLX
96-11-097-17	1/27/97	11097R6.XL1	96-11-073-B1	1/2/97	11073R68.XLS
96-11-097-18	1/27/97	11097R6.XL1	96-11-073-B2	1/2/97	11073R68.XLS
96-11-097-19	1/2/97	11073R68.XLS	96-11-073-S1	1/2/97	11073R68.XLS
96-11-097-B1	12/20/96	11097R28.XLS	96-11-073-S2	1/2/97	11073R68.XLS

1. This report consists of 18 soil and 1 water sample received by Paragon on 11/14/96.

2. These samples were prepared according to SW-846 Method 9320. The samples were analyzed for the presence of Ra-228 by low background gas flow proportional counting of the ingrown progeny of radium-228, Actinium-228. The analyses were completed on 01/27/97.

3. The following deviations from the requested method were noted:

a) Method 9320 makes no reference to the analysis of soil samples. The soil samples from this work order were initially leached in concentrated nitric acid. The leachate was then processed as a water sample according to the method.

b) Due to suspected matrix interference, low chemical yield was noted for several samples upon inital analysis of these samples. Individual samples showing low chemical yield which thus failed to meet requested detection limits were reprepared and reanalyzed. Time delay between separation and counting (and thus decay) were minimized to improve the sensitivity of the measurements.

c) Submitted results either show activity greater the the requested MDA or meet the requested MDA's for all samples. The above table provides a cross reference of sample ID's and prep batch designation for submitted results.

d) Due to laboratory error, preparation of water sample CR-A157907 (PAI 96-11-097-19) was initiated with an aliquot of 4 liters according to the in-house method for Radium-226/228. The error was noted following the inital barium sulfate precipitation. The precipitate was subsequently dissolved in basic EDTA as per procedure and split into portions for analysis according to Method 9315 (Total Alpha Emitting Radium Isotopes) and Method 9320 (Radium-228). Although chemical preparation was carried out by requested methods, the QC batch in which the sample was analyzed failed to meet QC acceptance criteria for blank spikes (outside limits, low). The suspected cause for the failure was an inaccurate estimation (high) of the chemical yield resulting from indequate washing of the precipitate. Reanalysis was not possible since sample volumes were depleted. Reported results are qualified "reject" due to the failure to meet QC criteria.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Robert Shannon
Radiochemistry Technical Manager

1/31/97
Date

Radiochemistry Final Data Review

1/31/97
Date

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/12/96

Client Name: EMAX

Date Analyzed : 12/20/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-097

Count Duration: 180 Min.

Analyzed by: DCB

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
CR-A159001	11-097-01	1.11 ± 0.46	0.68
CR-A159002	11-097-02	0.85 ± 0.39	0.59
CR-A158001	11-097-03	0.85 ± 0.46	0.70
CR-A158002	11-097-04	0.13 ± 0.23	0.38
CR-A158003	11-097-05	1.25 ± 0.63	0.96
CR-A158004	11-097-06	0.08 ± 0.22	0.36
CR-A158006	11-097-07	1.10 ± 0.58	0.89
CR-A158007	11-097-08	0.07 ± 0.27	0.44
CR-A158101	11-097-09	0.31 ± 0.21	0.33
CR-A158102	11-097-10	0.50 ± 0.20	0.30
CR-A158104	11-097-11	0.12 ± 0.21	0.35
CR-A158105	11-097-12	0.80 ± 0.47	0.73
CR-A158106	11-097-13	1.06 ± 0.45	0.66
CR-A157901	11-097-14	0.94 ± 0.39	0.57
CR-A157903	11-097-15	1.13 ± 0.52	0.78
CR-A157904	11-097-16	0.06 ± 0.23	0.39
CR-A157905	11-097-17	0.27 ± 0.20	0.33
CR-A157906	11-097-18	0.01 ± 0.20	0.33
Duplicate of -01	11-097-D1	1.01 ± 0.48	0.75

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Remarks:

Sample 96-11-097-D1 is a duplicate of 96-11-097-01.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/12/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 96-11-097

Count Duration: 360 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
CR-A157907	11-097-19	-0.01 ± 0.81	0.62

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/12/96

Client Name: EMAX

Date Analyzed : 01/27/97

Client Project ID: Jacobs / Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-097

Count Duration: 450 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Duplicate -09	11-097-D3	0.35 ± 0.19	0.30

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Remarks:

Sample 96-11-097-D3 is a duplicate of 96-11-097-09.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/12/96

Client Name: EMAX

Date Analyzed : 12/20/96

Client Project ID: Jacobs / Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-097

Count Duration: 330 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Duplicate -10	11-097-D2	0.88 ± 0.54	0.86

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ)
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Remarks:

Sample 96-11-097-D2 is a duplicate of 96-11-097-10.

2

PARAGON ANALYTICS, INC.

Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/12/96

Client Name: EMAX

Date Analyzed : 12/20/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-097

Count Duration: 180 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-097-B1	0.40 ± 0.38	0.61

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/12/96

Client Name: EMAX

Date Analyzed : 12/20/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-097

Count Duration: 180 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-097-B2	0.55 ± 0.85	1.4

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/22/97

Client Name: EMAX

Date Analyzed : 01/27/97

Client Project ID: Jacobs / Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-097

Count Duration: 450 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-097-B3	-0.13 ± 2.0	0.32

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/22/97

Client Name: EMAX

Date Analyzed : 01/27/97

Client Project ID: Jacobs / Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-097

Count Duration: 450 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-097-B4	0.02 ± 0.19	0.32

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ)
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/12/96

Client Name: EMAX

Date Analyzed : 12/20/96

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-097

Count Duration: 180 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-097-S1	18.1	24.6 ± 2.64	136%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/12/96

Client Name: EMAX

Date Analyzed : 12/20/96

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-097

Count Duration: 180 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-097-S2	18.1	20.2 ± 2.15	112%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2
See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/22/97

Client Name: EMAX

Date Analyzed : 01/27/97

Client Project ID : Jacobs / Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-097

Count Duration: 450 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-097-S3	17.9	20.4 ± 2.09	114%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc. Date Collected: 01/22/97

Client Name: EMAX Date Analyzed : 01/27/97

Client Project ID : Jacobs / Carswell AFB Sample Matrix : Soil

Lab Workorder Number : 96-11-097 Count Duration: 450 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-097-S4	17.9	19.7 ± 2.02	110%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (. See PAI SOP 743FC f r details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

RADIUM-228 MATRIX SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/11/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-097

Count Duration: 300 Min.

Lab Sample ID	Ra-228 Known Value	Ra-228 Rep't Value	Ra-228 Recovery	Flag
96-11-097-M1	17.9 ± 7.80	15.3 ± 1.62	85.6%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-097-M1 is a matrix spike of sample 96-11-097-06.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/26/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 360 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-S1	18.0	7.47 ±0.873	41.4%	Fail

Reported Uncertainties are the Estimated Total Propagated Uncertainties (
See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/26/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 360 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-S2	18.0	4.60 ±0.596	25.5%	Fail

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/26/96

Client Name: EMAX

Date Analyzed : 01/06/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 375 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-057-S3	18.0	12.6 ± 1.31	69.6%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2
See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/31/96

Client Name: EMAX

Date Analyzed : 01/06/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 375 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-057-S4	18.0	16.0 ± 1.67	88.6%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511 ◆ (970) 490-1511 ◆ FAX (970) 490-1522

RECEIVED
DEC 26 1996
JE • Denver

December 24, 1996

Mr. Dan Schultz
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: PAI Workorder: 96-11-097
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Mr. Schultz:

Eighteen soil samples and one water sample were received from Jacobs Engineering Group under the above referenced workorder on November 14, 1996. The samples were scheduled for Radium-228 and Total Radium Alpha Emitters analysis according SW-846 Methods 9320 and 9315 respectively. The results for the Total Radium analyses as well as original custody documentation are contained in the enclosed report. The results for Radium-228 will be forwarded to you as they are completed.

Please consult the individual data packages for case narratives specific to each method.

Thank you for your confidence in Paragon Analytics, Inc. Should you have any questions, please call.

Sincerely,

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

An Employee Owned Small Business

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Total Radium by SW-846 Method 9315

EMAX

Jacobs / Carswell AFB (DO 21)

Client ID	Paragon ID	Client ID	Paragon ID
CR-A159001	96-11-097-01	CR-A158104	96-11-097-11
CR-A159002	96-11-097-02	CR-A158105	96-11-097-12
CR-A158001	96-11-097-03	CR-A158106	96-11-097-13
CR-A158002	96-11-097-04	CR-A157901	96-11-097-14
CR-A158003	96-11-097-05	CR-A157903	96-11-097-15
CR-A158004	96-11-097-06	CR-A157904	96-11-097-16
CR-A158006	96-11-097-07	CR-A157905	96-11-097-17
CR-A158007	96-11-097-08	CR-A157906	96-11-097-18
CR-A158101	96-11-097-09	CR-A157907	96-11-097-19
CR-A158102	96-11-097-10		

1. This report consists of 18 soil samples and 1 equipment rinsate blank received by Paragon on 11/14/96.

2. These samples were prepared according to SW-846 Method 9315 (modified). The corresponding Paragon Analytics, Inc. procedure is PAI SOP712R3. The following modifications to the method were necessary due to the matrix of the sample. The solid samples were digested in nitric acid, and the digestate processed as a water sample according to SW-846 Method 9315. Due to laboratory error, the entire volume of equipment rinsate supplied was prepared with water samples from a batch of samples being analyzed for radium-226/228. The affected samples were split from the batch following the initial barium sulfate precipitation and prepared parallel to solid samples in these work orders. Thus a dedicated blank spike was not analyzed with the water sample. The blank spike samples prepared in association with the solid samples indicate satisfactory method performance.

3. The samples were analyzed by low background gas proportional counting for the presence of total alpha emitting radium isotopes according to Paragon Analytics, Inc. procedure PAI SOP724R4. The analyses were completed on 12/16/96.

4. The presence of alpha emitting radium isotopes other than Radium-226 (e.g. Ra-224, Ra-223) is a known interference to the determination of Radium-226 using the requested methodology. A separate measurement can be conducted to specifically determine the Radium-226 activity of these samples. If necessary, the measurement should be conducted within four weeks of preparation of these samples.

5. No problems were encountered with either the client samples or the associated quality control samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Robert Shannon — 12/24/96
Radiochemistry Technical Manager — Date

Radiochemistry Final Data Review — 12/24/96
Date

RADIOCHEMISTRY DATA PACKAGE CONTENTS

PARAGON ANALYTICS, INC.

LOW BACKGROUND GAS FLOW PROPORTIONAL ANALYSIS

Section 1	Sample Results Summary
Section 2	QC Results Summary
Section 3	Individual Sample Results
Section 4	Raw Data
	Mass Documentation Mass-Efficiency Calibration (m, b values) Sample, Blank, LCS, Background Data
Section 5	Quality Assurance Summary Reports
	Non-Compliance Reports (If Applicable)
Section 6	Laboratory Bench Sheets
Section 7	Standard Traceability Documents
	Certificates and Dilution Records Carrier Reagent Documentation
Section 8	Chain of Custody
Section 9	Additional Supporting Documentation
	Instrument Performance Checks

Cross-talk documentation is not applicable for this analysis.

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

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DEC 26 1996

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc. Date Collected: 11/12/96

Client Name: EMAX Date Analyzed : 12/16/96

Client Project ID: Jacobs/Carswell AFB Sample Matrix : soil

Lab Sample ID Series: 96-11-097 Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/g)
CR-A159001	11-097-01	1.47 ± 0.22
CR-A159002	11-097-02	1.17 ± 0.17
CR-A158001	11-097-03	1.11 ± 0.12
CR-A158002	11-097-04	0.90 ± 0.16
CR-A158003	11-097-05	1.04 ± 0.15
CR-A158004	11-097-06	0.87 ± 0.16
CR-A158006	11-097-07	0.59 ± 0.11
CR-A158007	11-097-08	1.03 ± 0.17
CR-A158101	11-097-09	1.45 ± 0.21
CR-A158102	11-097-10	1.16 ± 0.18
CR-A158104	11-097-11	0.60 ± 0.07
CR-A158105	11-097-12	1.39 ± 0.19
CR-A158106	11-097-13	0.78 ± 0.11
CR-A157901	11-097-14	1.35 ± 0.19
CR-A157903	11-097-15	1.03 ± 0.11
CR-A157904	11-097-16	1.21 ± 0.19
CR-A157905	11-097-17	1.10 ± 0.16
CR-A157906	11-097-18	1.08 ± 0.12
Blank	11-097-B1	< 0.15(BDL)
Duplicate	11-097-D1	1.05 ± 0.17
Duplicate	11-097-D2	1.50 ± 0.22

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Remarks:

96-11-097-D1 is a duplicate of 96-11-097-01.
96-11-097-D2 is a duplicate of 96-11-097-10.

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/12/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID: Jacobs / Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 96-11-097

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
CR-A157907	11-097-19	< 0.11(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ)
See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc. Date Collected: 12/04/96

Client Name: EMAX Date Analyzed : 12/24/96

Client Project ID: Jacobs / Carswell AFB Sample Matrix : Water

Lab Sample ID Series: 96-11-194 Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
Blank	11-194-B1	< 0.03(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

PARAGON ANALYTICS, INC.

Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/09/96

Client Name: EMAX

Date Analyzed : 12/16/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : soil

Lab Sample ID Series: 96-11-097

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/g)	Rep't Activity (pCi/g)	Spike Recovery
96-11-097-S1	67.1 ± 16.77	56.67 ± 5.93	84.5
96-11-097-S2	67.1 ± 16.77	56.80 ± 5.88	84.6

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/09/96

Client Name: EMAX

Date Analyzed : 12/16/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : soil

Lab Sample ID Series: 96-11-097

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/g)	Rep't Activity (pCi/g)	Spike Recovery
96-11-097-M1	68.0 ± 16.99	56.28 ± 5.77	82.8

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ) See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

96-11-097-M1 is a matrix spike of 96-11-097-06

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/09/96

Client Name: EMAX

Date Analyzed : 12/16/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : soil

Lab Sample ID Series: 96-11-097

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/g)	Rep't Activity (pCi/g)	Spike Recovery
96-11-097-M2	68.1 ± 17.03	60.75 ± 6.21	89.2

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

96-11-097-M2 is a matrix spike of 96-11-097-15

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511◆ (970) 490-1511 ◆ FAX (970) 490-1522

April 9, 1997

RECEIVED
APR 1 0 1997

Ms. Lynn Schuetter
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: PAI Workorder: 97-03-046
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Ms. Schuetter:

Seven water samples were received from Jacobs Engineering Group under the above referenced workorder on March 7, 1997. The samples were scheduled for Radium-228 (Method 9320) and Total Radium Alpha Emitters (Method 9315) analysis. Results for these analyses are contained in this package. Additionally, due to the presence of excessive solids, one sample, CR-A158701 was also analyzed for Radium-226 by gamma spectroscopy. This approach was approved by the client on April 3, 1997.

This data is being shipped concurrently to Mr. Tom Dabney of EMAX. The Electronic Disc Deliverable for this data will be sent via E-mail directly to Mr. Chris Skinner of Jacobs Engineering Group.

Thank you for your confidence in Paragon Analytics, Inc. Should you have any questions, please call.

Sincerely,

Lori Pacheco

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

97-03-046

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1586 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: EMAX Inc.
PROJECT NUMBER: 05G47900
630 Maple Avenue
Pg 1 of 2
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A158601	3/4/97	12:20	DDS	1	1 Gal Poly	~~4 deg C~~ None BN	W	SW9315 SW9320		01
CR-A158602	3/5/97	15:30	DDS ~~BN~~	1	1 Gal Poly	~~4 deg C~~ None BN	W	SW9315 SW9320		02
CR-A 158603	3/5/97	17:30	BN	1	1 Gal Poly	~~4°C~~ None BN	W	SW9315 SW9320		03

DDS

COMMENTS:

17°-

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
Dan Schultz	3/6/97	16:00	

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
FOX	/ /	:	FOX	/ /	:
[illegible]	3/7/97	10:00			

RECORD RETURNED BY	DATE	TIME
	/	:

SHIPPING NUMBER: FEDEX 929882 3656

Paragon Analytics, Inc. - Fort Collins, Colorado

CONDITION OF SAMPLE UPON RECEIPT

CLIENT: Emax SHIPPING CONTAINER #: Cooler

WORKORDER NO. 97-03-046 INITIALS: [illegible] DATE: 3/7/97

1.	Does this project require special handling according to NEESA, Level 3, or CLP protocols? If yes, complete a. and b. a. Cooler Temperature_____ b. Lot No's._____ c. Airbill Number _____		Yes	No
2.	Are custody seals on the cooler intact? If so, how many 2	N/A	Yes	No
3.	Are custody seals on sample containers intact?	N/A	Yes	No
4.	Is there a Chain of Custody (COC) or other representative documents, letters or shipping memos?		Yes	No
5.	Is the COC complete? Relinquished: Yes ✓ No___ Requested Analysis: Yes ✓ No___	N/A	Yes	No
6.	Is the COC in agreement with the samples received? No. of Samples: Yes ✓ No___ Sample ID's: Yes ✓ No___ Matrix: Yes ✓ No___ No. of Containers: Yes ✓ No___		Yes	No
7.	Are the samples requiring acid preservation preserved correctly?	N/A	Yes	No
8.	Is there enough sample? If so, are they in the proper containers?		Yes	No
9.	Are all samples within holding times for the requested analyses?		Yes	No
10.	Were the sample received on ice?	N/A	Yes	No
11.	Were all sample containers received intact? (not broken or leaking, etc.)		Yes	No
12.	Are samples requiring no headspace, headspace free?	N/A	Yes	No
13.	Do the samples require quarantine?		Yes	No
14.	Do samples require Paragon disposal?		Yes	No
15.	Did the client return any unused bottles?		Yes	No

Describe "NO" items (except No's 1, 13, &14):_____

Was the client contacted? Yes____ No____

If yes, Date:_____ Name of person contacted:_____

Describe actions taken or client instructions:_____

Group Leader's Signature:_____ Date:_____

Cooler Temperature: 10°C

FRM 201FC6 (24/1/97)

Paragon Analytics, Inc.

Radiochemistry Case Narrative
^{228}Radium by Method 9320

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APR 1 5 1997

EMAX

Jacobs / Carswell AFB (DO 21) / 05G47900

PAI WO 97-03-046

1. This report consists of 7 water samples received by Paragon on 03/07/97.

2. These samples were prepared according to SW-846 Method 9320. The samples were analyzed for the presence of Ra-228 by low background gas flow proportional counting of the ingrown progeny of radium-228, actinium-228. The analyses were completed on 03/14/97.

3. All quality control criteria were met. No anomalous situations were noted during the preparation and analysis of these samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Robert Shannon
Radiochemistry Technical Manager

3/18/97
Date

Radiochemistry Final Data Review

3/18/97
Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9703046-1	CR-A158601	Water	03/04/97
9703046-2	CR-A158602	Water	03/05/97
9703046-3	CR-A158603	Water	03/05/97
9703046-4	CR-A158701	Water	03/04/97
9703046-5	CR-A158702	Water	03/04/97
9703046-6	CR-A158703	Water	03/05/97
9703046-7	CR-A158704	Water	03/06/97

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/04/97

Client Name: EMAX

Date Analyzed : 03/14/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-03-046

Count Duration: 300 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
CR-A158601	03-046-01	1.62 ± 0.53	0.78
CR-A158602	03-046-02	1.05 ± 0.51	0.79
CR-A158603	03-046-03	0.31 ± 0.40	0.65
CR-A158701	03-046-04	0.82 ± 0.43	0.66
CR-A158702	03-046-05	0.37 ± 0.53	0.87
CR-A158703	03-046-06	1.31 ± 0.55	0.83
CR-A158704	03-046-07	0.89 ± 0.54	0.86

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

2

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/10/97

Client Name: EMAX

Date Analyzed : 03/14/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-02-125

Count Duration: 300 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
Blank	02-125-B1	0.44 ± 0.46	0.75

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

Remarks:

Shared QC for w.o. 97-02-125 and 97-03-046.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/10/97

Client Name: EMAX

Date Analyzed : 03/14/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Water

Lab Workorder Number : 97-02-125

Count Duration: 74 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-02-125-S1	52.8	45.6 ± 5.11	86.3%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Shared QC for w.o. 97-02-125 an d 97-03-046.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/10/97

Client Name: EMAX

Date Analyzed : 03/14/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Water

Lab Workorder Number : 97-02-125

Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-02-125-S2	52.8	40.0 ± 4.19	75.7%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 97-02-125-S2 is a blank spike duplicate.
Shared QC for w.o. 97-02-125 and 97-03-046.

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Total Radium

RECEIVED
APR 1 0 1997

EMAX

Jacobs / Carswell / AFB (DO 21)/ 05G47900
PAI 97-03-046

1. This report consists of 7 water samples received by Paragon on 03/07/97.

2. These samples were prepared according to Paragon Analytics, Inc. procedure PAI SOP712R3.

3. The samples were analyzed for the presence of total radium according to Paragon Analytics, Inc. procedure PAI SOP724R4. The analyses were completed on 03/20/97.

4. The samples were initially prepared for analysis on 03/12/97. Due to a high % yield, samples CR-A158602 and CR-A158701 (PAI IDs 97-03-046-02 and 97-03-046-04) were prepared for reanalysis on 03/19/97. The results from the second analysis for these samples are included in this data package. Due to chemical interferences, sample CR-A158701 (PAI ID 97-03-046-04) showed an elevated yield. One of the blank spikes for this analytical batch (97-03-046-S4) failed normal control limits for spike recovery. The lower control limit for spike recovery is 75.0%. This blank spike showed 68.9% recovery. The other blank spike for this analytical batch (97-03-046-S3) passed normal control limits for spike recovery. This blank spike showed 78.6% recovery.

5. There was some concern that the high residual mass for sample CR-A158701 (PAI ID 97-03-046-04) could have caused increased sample self-absorption and underestimated activity concentration results. To address this concern, the sample from the initial preparation was recounted, along with the batch quality control samples, using a high purity germanium detector system. These counts were performed according to procedure PAI SOP713R4. Although this detection method lacks the sensitivity of the gas flow proportional counting method, the results obtained duplicate the original results within the total propagated uncertainty reported. Documentation for this reanalysis is included in the Additional Supporting Documentation section of the data package.

6. No further problems were encountered with either the client samples or the associated quality control samples. All other quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Renee Gallegos — 4/7/97
Renee Gallegos
Radiochemistry Instrumentation Technician
Date

Radiochemistry Final Data Review — 4/8/97
Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9703046-1	CR-A158601	Water	03/04/97
9703046-2	CR-A158602	Water	03/05/97
9703046-3	CR-A158603	Water	03/05/97
9703046-4	CR-A158701	Water	03/04/97
9703046-5	CR-A158702	Water	03/04/97
9703046-6	CR-A158703	Water	03/05/97
9703046-7	CR-A158704	Water	03/06/97

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc. Date Collected: 03/04/97

Client Name: EMAX Date Analyzed : 03/19/97

Client Project ID: Jacobs/Carswell AFB Sample Matrix : Water

Lab Sample ID Series: 97-03-046 Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
CR-A158601	03-046-01	1.62 ± 0.23
CR-A158602	03-046-02	5.73 ± 0.83
CR-A158603	03-046-03	< 0.12(BDL)
CR-A158701	03-046-04	4.23 ± 0.61
CR-A158702	03-046-05	< 0.08(BDL)
CR-A158703	03-046-06	7.24 ± 0.85
CR-A158704	03-046-07	3.27 ± 0.41
Blank	03-046-B1	< 0.21(BDL)
Blank	03-046-B2	< 0.30(BDL)
Duplicate of -01	03-046-D1	1.91 ± 0.28

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Remarks:

Sample 97-03-046-D1 is a duplicate of 97-03-046-01.

2

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/12/97

Client Name: Shared QC

Date Analyzed : 03/14/97

Client Project ID: Blank

Sample Matrix : Water

Lab Sample ID Series: 97-03-046

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/l)	Rep't Activity (pCi/l)	Spike Recovery
97-03-046-S1	67.1 ± 16.77	52.24 ± 5.61	77.9
97-03-046-S2	67.1 ± 16.77	53.83 ± 5.79	80.2
97-03-046-S3	67.1 ± 16.77	52.74 ± 5.78	78.6
97-03-046-S4	67.1 ± 16.77	46.23 ± 5.12	68.9

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511◆ (970) 490-1511 ◆ FAX (970) 490-1522

June 5, 1997

Mr. Brian Neely
Jacobs Engineering Group, Inc.
600 17th Street, Suite 1100N
Denver, CO 80202

RE: Paragon Workorder: 97-04-046
Client Project Name: Jacobs/Carswell AFB (DO21)
Client Project Number: 05G47900

Dear Mr. Neely:

Seven water samples were received from Jacobs Engineering Group under the above referenced workorder on April 5, 1997. The samples were scheduled for Radium-228 (Method 9320) and Total Radium Alpha Emitters (Method 9315) analysis. Results for these analyses were mailed on May 6, 1997.

Per your request a copy of the data is being resubmitted. The Electronic Disc Deliverable for this data was sent via E-mail directly to Mr. Chris Skinner of Jacobs Engineering Group.

Thank you for your confidence in Paragon Analytics, Inc. Should you have any questions, please call.

Sincerely,

Lori Pacheco

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

LP/jjc
Enclosure: Report

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

97-04-046

CR-A1618 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)

PROJECT NUMBER: 05G47900

WBS CODE: 505-01

SUBCONTRACT / D.O. No.

LABORATORY NAME & ADDRESS: Paragon
225 Commerce Dr.
Ft. Collins CO

Original to EMAX
Copy to Jacobs

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE		QC	CONDITION ON RECEIPT
CR-A161801	4/3/97	18:35	BN	1	1 Gal Poly	NONE	W	S		01
CR-A161802	4/4/97	08:25	MJ	1	1 Gal Poly	NONE	W	S1		02
CR-A161803	4/2/97	19:05	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		03
CR-A161804	4/3/97	12:30	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		04
CR-A161805	4/3/97	12:58	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		05
CR-A 161806	4/4/97	0905	MJ	1	1 gal Poly	NONE	W	SW9315 SW9320		06
CR-A 161807	4/4/97	1200	MJ	1	1 gal Poly	NONE	W	SW9315 SW9320		07

COMMENTS:

COLLECTED / RELEASED BY	DATE	TIME	TURNAROUND TIME
[signature]	4/4/97	1500	17 DAYS.

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
[signature] VIA FEDX	4/5/97	10:00		/ /	:

RECORD RETURNED BY	DATE	TIME
	/ /	:

SHIPPING NUMBER:

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511◆ (970) 490-1511 ◆ FAX (970) 490-1522

May 6, 1997

Ms. Lynn Schuetter
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: PAI Workorder: 97-04-046
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Ms. Schuetter:

Seven water samples were received from Jacobs Engineering Group under the above referenced workorder on April 5, 1997. The samples were scheduled for Radium-228 (Method 9320) and Total Radium Alpha Emitters (Method 9315) analysis. Results for these analyses are contained in this package.

This data is being shipped concurrently to Dr. Kam Pang of EMAX. The Electronic Disc Deliverable for this data will be sent via E-mail directly to Mr. Chris Skinner of Jacobs Engineering Group.

Thank you for your confidence in Paragon Analytics, Inc. Should you have any questions, please call.

Sincerely,

Lori Pacheco

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

Paragon Analytics, Inc. - Fort Collins, Colorado

CONDITION OF SAMPLE UPON RECEIPT

CLIENT: ZMAX SHIPPING CONTAINER #: 14 / 20002

WORKORDER NO. 97-04-046 INITIALS: RB DATE: 4/5/97

1.	Does this project require special handling according to NEESA, Level 3, or CLP protocols? If yes, complete a. and b. a. Cooler Temperature_____ b. Lot No's._____ c. Airbill Number		Yes	No
2.	Are custody seals on the cooler intact? If so, how many	N/A	Yes	No
3.	Are custody seals on sample containers intact?	N/A	Yes	No
4.	Is there a Chain of Custody (COC) or other representative documents, letters or shipping memos?		Yes	No
5.	Is the COC complete? Relinquished: Yes ✓ No__ Requested Analysis: Yes ✓ No	N/A	Yes	No
6.	Is the COC in agreement with the samples received? No. of Samples: Yes ✓ No__ Sample ID's: Yes__ No ✓ Matrix: Yes ✓ No__ No. of Containers: Yes ✓ No		Yes	No
7.	Are the samples requiring acid preservation preserved correctly?	N/A	Yes	No
8.	Is there enough sample? If so, are they in the proper containers?		Yes	No
9	Are all samples within holding times for the requested analyses?		Yes	No
10.	Were the sample received on ice?	N/A	Yes	No
11.	Were all sample containers received intact? (not broken or leaking, etc.)		Yes	No
12.	Are samples requiring no headspace, headspace free?	N/A	Yes	No
13.	Do the samples require quarantine?		Yes	No
14.	Do samples require Paragon disposal?		Yes	No
15.	Did the client return any unused bottles?		Yes	No

Describe "NO" items (except No's 1, 13, &14): ~~02 + 06~~ 2 bottles are labeled "CR-A161802" - one computer gen. & one handwritten. Need to clarify w/client (Times match)

Was the client contacted? Yes ✓ No____

If yes, Date: 4/7/97 Name of person contacted: Mike Johnson @ 11:05

Describe actions taken or client instructions: Resolved according times, per the chain of custody.

Group Leader's Signature: [signature] Date: 4/7/97

Cooler Temperature: 15°C / 15°C

FRM 201FC6 (24/1/97)

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

97-CM-046

CR-A1618 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: Paragon
PROJECT NUMBER: 05G47900
225 Commerce Dr.
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
Ft. Collins CO

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A161801	4/3/97	18:35	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		01
CR-A161802	4/4/97	08:25	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		02
CR-A161803	4/4/97	19:05	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		03
CR-A161804	4/3/97	12:30	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		04
CR-A161805	4/3/97	12:58	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		05
CR-A 161806	4/4/97	0905	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		06
CR-A 161807	4/4/97	1200	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		07

COMMENTS:

COLLECTED / RELEASED BY	DATE	TIME	TURNAROUND TIME	DATE	TIME
	4/4/97	15:00	17 DAYS.		
RECEIVED BY: VIA FEDX	4/5/97	10:00	RELINQUISHED BY		
RECORD RETURNED BY	DATE	TIME	SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Total Radium

EMAX

Jacobs / Carswell AFB (DO 21) / 054G7900
PAI Workorder 97-04-046

1. This report consists of 7 water samples received by Paragon on 04/05/97.

2. These samples were prepared according to Paragon Analytics, Inc. procedure PAI SOP712R3.

3. These samples were tested for the presence of Total Alpha Emitting Radium Isotopes according to Paragon Analytics, Inc. procedure PAI SOP724R4. This test is a screen for Radium-226 and will show high bias in sample results if other alpha emitting isotopes of radium are contained in the sample (esp. Ra-224 and Ra-223). Reanalysis of the sample following a several week period to allow for decay of the shorter lived interfering isotopes of radium will provide a more accurate measurement of the Radium-226 concentration of the sample.

4. The analyses were completed on 04/25/97.

5. The samples were initially prepared for analysis on 04/04/97. The blank spike for this analytical batch (97-04-016-S1) failed normal control limits for spike recovery. The upper control limit for spike recovery is 125.0%. This blank spike showed 131.1% recovery. The samples were prepared for reanalysis on 04/24/97. The results from the second analysis are included in this data package.

6. No further problems were encountered with either the client samples or the associated quality control samples. All other quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Renee Gallegos — 5/5/97
Renee Gallegos
Radiochemistry Instrument Technician
Date

Radiochemistry Final Data Review — 5/6/97
Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9704046-1	CR-A161801	Water	04/03/97
9704046-2	CR-A161802	Water	04/04/97
9704046-3	CR-A161803	Water	04/02/97
9704046-4	CR-A161804	Water	04/03/97
9704046-5	CR-A161805	Water	04/03/97
9704046-6	CR-A161806	Water	04/04/97
9704046-7	CR-A161807	Water	04/04/97

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 04/03/97

Client Name: EMAX

Date Analyzed : 04/25/97

Client Project ID: Jacobs/Carswell AFB (D

Sample Matrix : Water

Lab Sample ID Series: 97-04-046

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
CR-A161801	04-046-01	2.36 ± 0.71
CR-A161802	04-046-02	10.33 ± 2.32
CR-A161803	04-046-03	7.15 ± 1.67
CR-A161804	04-046-04	5.42 ± 1.32
CR-A161805	04-046-05	9.82 ± 2.18
CR-A161806	04-046-06	8.88 ± 2.03
CR-A161807	04-046-07	< 0.36(BDL)
Blank	04-046-B2	< 0.55(BDL)
Duplicate-07	04-046-D1	< 0.53(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

2

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 04/24/97

Client Name: Blank

Date Analyzed : 04/25/97

Client Project ID: Shared QC

Sample Matrix : Water

Lab Sample ID Series: 97-04-046

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
Blank	04-046-B2	< 0.55(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Remarks:

Blank for workorders 97-04-046 and 04-016.

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 04/24/97

Client Name: EMAX

Date Analyzed : 04/25/97

Client Project ID: Jacobs/Carswell AFB (D

Sample Matrix : Water

Lab Sample ID Series: 97-04-046

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/l)	Rep't Activity (pCi/l)	Spike Recovery
97-04-046-S3	67.2 ± 16.80	73.74 ±14.72	109.7
97-04-046-S4	67.2 ± 16.80	66.32 ±13.27	98.7

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Blank Spike for workorders 97-04-046 and 04-016.

Paragon Analytics, Inc.

Radiochemistry Case Narrative
^{228}Radium by Method 9320

EMAX

Jacobs/Carswell AFB (DO 21)/05G47900

PAI W.O. 97-04-046

1. This report consists of 7 water samples received by Paragon on 04/05/97.

2. These samples were prepared according to SW-846 Method 9320. The samples were analyzed for the presence of Ra-228 by low background gas flow proportional counting of the ingrown progeny of radium-228, actinium-228. The analyses were completed on 04/14/97.

3. All quality control criteria were met. No anomalous situations were noted during the preparation and analysis of these samples.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Renee Gallegos — 4/17/97
Renee Gallegos — Date
Radiochemistry Instrument Technician

Radiochemistry Final Data Review — 4/18/97
Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9704046-1	CR-A161801	Water	04/03/97
9704046-2	CR-A161802	Water	04/04/97
9704046-3	CR-A161803	Water	04/02/97
9704046-4	CR-A161804	Water	04/03/97
9704046-5	CR-A161805	Water	04/03/97
9704046-6	CR-A161806	Water	04/04/97
9704046-7	CR-A161807	Water	04/04/97

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 04/03/97

Client Name: EMAX

Date Analyzed : 04/14/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-04-046

Count Duration: 300 Min.

Analyzed by: RG

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
CR-A161801	04-046-01	1.22 ± 0.63	0.98
CR-A161802	04-046-02	1.73 ± 0.62	0.93
CR-A161803	04-046-03	0.90 ± 0.52	0.81
CR-A161804	04-046-04	0.90 ± 0.51	0.80
CR-A161805	04-046-05	1.39 ± 0.58	0.88
CR-A161806	04-046-06	1.50 ± 0.54	0.81
CR-A161807	04-046-07	-0.07 ± 0.61	1.0
Blank	04-046-B1	0.14 ± 0.51	0.85
Duplicate-01	04-046-D1	0.61 ± 0.43	0.69

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

Remarks:

Sample 97-04-046-D1 is a duplicate of 97-04-046-01.

2

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 04/08/97

Client Name: EMAX

Date Analyzed : 04/14/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Water

Lab Workorder Number : 97-04-046

Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-04-046-S1	52.3	51.4 ± 5.32	98.2%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 04/08/97

Client Name: EMAX

Date Analyzed : 04/14/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Water

Lab Workorder Number : 97-04-046

Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-04-046-S2	52.3	55.5 ± 5.72	106%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 97-04-046-S2 is a blank spike duplicate.

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511 ◆ (970) 490-1511 ◆ FAX (970) 490-1522

December 24, 1996

RECEIVED
DEC 26 1996
JE - Denver

Mr. Dan Schultz
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: PAI Workorder: 96-11-057 ✓
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Mr Schultz:

Sixteen soil samples and two water sample were received from Jacobs Engineering Group under the above referenced workorder on November 9, 1996. The samples were scheduled for Radium-228 and Total Radium Alpha Emitters analysis according SW-846 Methods 9320 and 9315 respectively. The results for the Total Radium analyses as well as original custody documentation are contained in the enclosed report. The results for Radium-228 will be forwarded to you as they are completed.

Please consult the individual data packages for case narratives specific to each method

Thank you for your confidence in Paragon Analytics, Inc. Should you have any questions, please call.

Sincerely,

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure Report

An Employee Owned Small Business

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Total Radium by SW-846 Method 9315

EMAX

Jacobs / Carswell AFB (DO 21) 05G47900

Client ID	Paragon ID	Client ID	Paragon ID
CR-A157401	96-11-057-01	CR-A157507	96-11-057-11
CR-A157403	96-11-057-02	CR-A157508	96-11-057-12
CR-A157404	96-11-057-03	CR-A157601	96-11-057-13
CR-A157405	96-11-057-04	CR-A157602	96-11-057-14
CR-A157406	96-11-057-05	CR-A157603	96-11-057-15
CR-A157501	96-11-057-06	CR-A157604	96-11-057-16
CR-A157503	96-11-057-07	CR-A157605	96-11-057-17
CR-A157504	96-11-057-08	CR-A157606	96-11-057-18
CR-A157505	96-11-057-09		
CR-A157506	96-11-057-10		

1. This report consists of 16 soil samples and 2 equipment rinsate blanks received by Paragon on 11/09/96.

2. These samples were prepared according to SW-846 Method 9315 (modified). The corresponding Paragon Analytics, Inc. procedure is PAI SOP712R3. The following modifications to the method were necessary due to the matrix of the sample. The solid samples were digested in nitric acid, and the digestate processed as a water sample according to SW-846 Method 9315. Due to laboratory error, the entire volume of equipment rinsate supplied was prepared with water samples from a batch of samples being analyzed for radium-226/228. The affected samples were split from the batch following the initial barium sulfate precipitation and prepared parallel to solid samples in these work orders. Thus a dedicated blank spike was not analyzed with the water sample. The blank spike samples prepared in association with the solid samples indicate satisfactory method performance.

3. The samples were analyzed by low background gas proportional counting for the presence of total alpha emitting radium isotopes according to Paragon Analytics, Inc. procedure PAI SOP724R4. The analyses were completed on 12/13/96.

4. The presence of alpha emitting radium isotopes other than Radium-226 (e.g. Ra-224, Ra-223) is a known interference to the determination of Radium-226 using the requested methodology. A separate measurement can be conducted to specifically determine the Radium-226 activity of these samples. If necessary, the measurement should be conducted within four weeks of preparation of these samples.

5. No problems were encountered with either the client samples or the associated quality control samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

David Burns
Radiochemistry Technical Manager

12/24/96
Date

Radiochemistry Final Data Review

12/24/96
Date

RADIOCHEMISTRY DATA PACKAGE CONTENTS

PARAGON ANALYTICS, INC.

LOW BACKGROUND GAS FLOW PROPORTIONAL ANALYSIS

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	Instrument Performance Checks

Cross-talk documentation is not applicable for this analysis.

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

RECEIVED
DEC 26 1996
JE - Denver

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 12/13/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/g)
CR-A157401	11-057-01	0.77 ± 0.15
CR-A157403	11-057-02	0.87 ± 0.10
CR-A157404	11-057-03	0.63 ± 0.07
CR-A157405	11-057-04	0.97 ± 0.11
CR-A157406	11-057-05	0.01 ± 0.00
CR-A157501	11-057-06	1.22 ± 0.13
CR-A157503	11-057-07	0.89 ± 0.15
CR-A157504	11-057-08	1.43 ± 0.22
CR-A157505	11-057-09	1.47 ± 0.17
CR-A157506	11-057-10	1.08 ± 0.17
CR-A157601	11-057-13	0.80 ± 0.09
CR-A157602	11-057-14	0.71 ± 0.11
CR-A157603	11-057-15	0.57 ± 0.09
CR-A157604	11-057-16	0.64 ± 0.10
CR-A157605	11-057-17	0.48 ± 0.10
CR-A157606	11-057-18	1.09 ± 0.19
Blank	11-057-B1	< 0.16(BDL)
Blank	11-057-B2	< 0.19(BDL)
Duplicate	11-057-D1	0.98 ± 0.12
Duplicate	11-057-D2	1.08 ± 0.16

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Remarks:

96-11-057-D1 is a duplicate of sample 96-11-057-01.
96-11-057-D2 is a duplicate of sample 96-11-057-10.

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID: Jacobs / Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 96-11-057

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
CR-A157507	11-057-11	< 0.11(BDL)
CR-A157508	11-057-12	< 0.09(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ
See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/04/96

Client Name: EMAX

Date Analyzed : 12/24/96

Client Project ID: Jacobs / Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 96-11-194

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
Blank	11-194-B1	< 0.03(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

2

PARAGON ANALYTICS, INC.

Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/06/96

Client Name: EMAX

Date Analyzed : 12/13/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration : 90 Min.

Lab Sample ID	Known Activity (pCi/g)	Rep't Activity (pCi/g)	Spike Recovery
96-11-057-S1	55.5 ± 13.88	44.33 ± 4.65	79.9
96-11-057-S2	55.5 ± 13.88	48.15 ± 5.00	86.8

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 12/13/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration : 90 Min.

Lab Sample ID	Known Activity (pCi/g)	Rep't Activity (pCi/g)	Spike Recovery
96-11-057-M1	56.7 ± 14.18	49.31 ± 5.14	86.9

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ)
See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

96-11-057-M1 is a matrix spike of 96-11-057-06.

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 12/13/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration : 90 Min.

Lab Sample ID	Known Activity (pCi/g)	Rep't Activity (pCi/g)	Spike Recovery
96-11-057-M2	56.1 ± 14.02	43.27 ± 4.54	77.2

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

96-11-057-M2 is a matrix spike of 96-11-057-15.

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511◆ (970) 490-1511 ◆ FAX (970) 490-1522

February 5, 1997

RECEIVED
FEB 6 1997
IF - Denver

Ms. Lynn Schuetter
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: PAI Workorder: 96-11-057
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Mr. Schuetter:

Sixteen soil samples and two water sample were received from Jacobs Engineering Group under the above referenced workorder on November 9, 1996. The samples were scheduled for Radium-228 and Total Radium Alpha Emitters analysis according SW-846 Methods 9320 and 9315 respectively. The results for the Total Radium were reported on December 24, 1996. The results for Radium-228, as well as original custody documentation, are included in this package.

Please consult the individual data packages for case narratives specific to each method.

Paragon Analytics, Inc. apologizes for the delay in the delivery of this data. Should you have any questions, please call.

Sincerely,

Lori Pacheco

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

CONDITION OF SAMPLE UPON RECEIPT

CLIENT: Jacobs Eng. SHIPPING CONTAINER #: Cooler

WORKORDER NO. 9611057 INITIALS: KCD DATE: 11/9/96

1.	Does this project require special handling according to NEESA, Level 3, or CLP protocols? If yes, complete a. and b. a. Cooler Temperature_____ b. Lot No's._____ c. Airbill Number _____		Yes	(No)
2.	Are custody seals on the cooler intact? If so, how many 2	N/A	(Yes)	No
3.	Are custody seals on sample containers intact?	(N/A)	Yes	No
4.	Is there a Chain of Custody (COC) or other representative documents, letters or shipping memos?		(Yes)	No
5.	Is the COC complete? Relinquished: Yes ✓ No__ Requested Analysis: Yes ✓ No__		(Yes)	No
6.	Is the COC in agreement with the samples received? No. of Samples: Yes ✓ No__ Sample ID's: Yes ✓ No__ Matrix: Yes ✓ No__ No. of Containers: Yes ✓ No__		(Yes)	No
7.	Are the samples preserved correctly?	N/A	Yes	(No)
8.	Is there enough sample? If so, are they in the proper containers?		(Yes)	No
9.	Are all samples within holding times for the requested analyses?		(Yes)	No
10.	Were the sample received on ice?	(N/A)	Yes	No
11.	Were all sample containers received intact? (not broken or leaking, etc.)		(Yes)	No
12.	Are samples requiring no headspace, headspace free?	(N/A)	Yes	No
13.	Do the samples require quarantine?		Yes	(No)
14.	Do samples require ATI disposal?		(Yes)	No
15.	Did the client return any unused bottles?		Yes	(No)

Describe "NO" items (except No's 1, 13, &14): (7) - 8 mL HNO_3 Added to Water Samples upon Receipt.

Was the client contacted? Yes X No 1

If yes, Date: 11/13 Name of person contacted: Dan Schultz

Describe actions taken or client instructions: Via fassimile

Group Leader's Signature: [signature] Date: 11/13/96

Cooler Temperature: 12°c

FedEx USA Airbill

Tracking Number 2149885791

Recipient's Copy

103 500 63942051 6254

1 From

Date 11/8/96

Sender's Name Mike Johnson Phone (303)595-8555

Dept./Floor/Suite/Room

Company JACOBS ENGINEERING

Address 600 17TH ST, STE 1100 N

City DENVER State Zip 80202

2 Your Internal Billing Reference Information 056 [illegible] 47900

3 To

Recipient's Name Tori Bailey Phone 800 443-1511

Dept./Floor/Suite/Room

Company Paragon Analytics, Inc.

Address 225 [illegible] Drive

(To "HOLD" at FedEx location, print FedEx address here)

City Fort Collins State CO Zip 80524

For HOLD at FedEx Location check here

- [ ] Hold Weekday (Not available with FedEx First Overnight)
- [ ] Hold Saturday (Not available at all locations) (Not available with FedEx First Overnight or FedEx Standard Overnight)

For Saturday Delivery check here

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2 1 4 9 8 8 5 7 9 1

4a Express Package Service *Packages under 150 lbs.* Delivery commitment may be later in some areas.

- [ ] FedEx Priority Overnight (Next business morning)
- [ ] FedEx Standard Overnight (Next business afternoon)
- [ ] FedEx 2Day* (Second business day)
- [ ] NEW FedEx First Overnight (Earliest next business morning delivery to select locations) (Higher rates apply)

* FedEx Letter Rate not available. Minimum charge: One pound FedEx 2Day rate.

4b Express Freight Service *Packages over 150 lbs.* Delivery commitment may be later in some areas.

- [ ] FedEx Overnight Freight (Next business day service for any distance)
- [ ] FedEx 2Day Freight (Second business day service for any distance)
- [ ] FedEx Express Saver Freight (Up to 3 business-day service based upon distance)

(Call for delivery schedule. See back for detailed descriptions of freight products.)

5 Packaging

- [ ] FedEx Letter (Declared value limit $500)
- [ ] FedEx Pak
- [ ] FedEx Box
- [ ] FedEx Tube
- [x] Other Pkg.

6 Special Handling

Does this shipment contain dangerous goods?

- [ ] Yes (As per attached Shipper's Declaration)
- [ ] Yes (Shipper's Declaration not required)
- [ ] Dry Ice — Dry Ice, 9, UN 1845 III ____ x ____ kg. 904 (Dangerous Goods Shipper's Declaration not required)
- CA [ ] Cargo Aircraft Only

7 Payment

Bill to:

- [x] Sender (Account no. in section 1 will be billed)
- [ ] Recipient
- [ ] Third Party
- [ ] Credit Card
- [ ] Cash/Check

(Enter FedEx account no. and credit card no. below)

[redacted]

Total Packages	Total Weight	Total Declared Value	Total Charges
1	46	.00	

* When declaring a value higher than $100 per shipment, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY section for further information.

Credit Card Auth.

8 Release Signature

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

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Questions?
Call 1·800·Go·FedEx
(1-800-463-3339)

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Paragon Analytics, Inc.

Radiochemistry Case Narrative
^{228}Radium by Method 9320

EMAX

Jacobs / Carswell AFB / (DO 21)

Paragon ID	Date Analyzed	Prep Batch ID	Paragon ID	Date Analyzed	Prep Batch ID
96-11-057-01	12/23/96	11057R68.XL4	96-11-057-B3	01/06/97	11057R68.XLX
96-11-057-02	12/23/96	11057R68.XL4	96-11-057-B4	01/06/97	11057R68.XLX
96-11-057-03	12/23/96	11057R68.XL4	96-11-057-B5	01/28/97	11057R6.XL1
96-11-057-04	12/23/96	11057R68.XL4	96-11-057-B6	01/28/97	11057R6.XL1
96-11-057-05	12/23/96	11057R68.XL4	96-11-057-D1	01/06/97	11057R68.XLX
96-11-057-06	01/28/97	11057R6.XL1	96-11-057-D2	01/06/97	11057R68.XLX
96-11-057-07	01/28/97	11057R6.XL1	96-11-057-D3	01/28/97	11057R6.XL1
96-11-057-08	01/28/97	11057R6.XL1	96-11-057-M1	12/23/96	11057R68.XL4
96-11-057-09	01/03/97	11057R68.XLX	96-11-057-M2	01/06/97	11057R68.XLX
96-11-057-10	01/03/97	11057R68.XLX	96-11-057-M3	01/28/97	11057R6.XL1
96-11-057-11	01/03/97	11073R68.XLS	96-11-057-S1	12/23/96	11057R68.XL4
96-11-057-12	01/03/97	11073R68.XLS	96-11-057-S2	12/23/96	11057R68.XL4
96-11-057-13	01/03/97	11057R68.XLX	96-11-057-S3	01/06/97	11057R68.XLX
96-11-057-14	01/28/97	11057R6.XL1	96-11-057-S4	01/06/97	11057R68.XLX
96-11-057-15	01/06/97	11057R68.XLX	96-11-057-S5	01/28/97	11057R6.XL1
96-11-057-16	01/06/97	11057R68.XLX	96-11-057-S6	01/28/97	11057R6.XL1
96-11-057-17	01/28/97	11057R6.XL1	96-11-073-B1	01/02/97	11073R68.XLS
96-11-057-18	01/06/97	11057R68.XLX	96-11-073-B2	01/02/97	11073R68.XLS
96-11-057-B1	12/23/96	11057R68.XL4	96-11-073-S1	01/02/97	11073R68.XLS
96-11-057-B2	12/23/96	11057R68.XL4	96-11-073-S2	01/02/97	11073R68.XLS

1. This report consists of 16 soil and 2 water samples received by Paragon on 11/09/96.

2. These samples were prepared according to SW-846 Method 9320. The samples were analyzed for the presence of Ra-228 by low background gas flow proportional counting of the ingrown progeny of radium-228, actinium-228. The analyses were completed on 01/28/97.

3. The following deviations from the requested method were noted:

a) Method 9320 makes no reference to the analysis of soil samples. The soil samples from this work order were initially leached in concentrated nitric acid. The leachate was then processed as a water sample according to the method.

b) Due to suspected matrix interference, low chemical yield was noted for several samples upon initial analysis of these samples. Individual samples showing low chemical yield which thus failed to meet requested detection limits were reprepared and reanalyzed. Time delay between separation and counting (and thus decay) were minimized to improve the sensitivity of the measurements.

c) The above table provides a cross reference of sample ID's and prep batch designation for submitted results. Submitted results either show activity greater the requested MDA or meet the requested MDA's for all samples, except those listed below.

CR-A157501	PAI 96-11-057-06
CR-A157503	PAI 96-11-057-07
CR-A157602	PAI 96-11-057-14
CR-A157604	PAI 96-11-057-16
CR-A157605	PAI 96-11-057-17

The initial analysis for these samples resulted in a higher MDA than the client requested. The samples were prepared for reanalysis, which again resulted in an elevated MDA.

d) Due to laboratory error, preparation of water samples CR-A157507 (PAI 96-11-057-11) and CR-A157508 (PAI 96-11-057-12) were initiated with an aliquot of 4 liters according to the in-house method for Radium-226/228. The error was noted following the initial barium sulfate precipitation. The precipitate was subsequently dissolved in basic EDTA as per procedure and split into portions for analysis according to Method 9315 (Total Alpha Emitting Radium Isotopes) and Method 9320 (Radium-228). Although chemical preparation was carried out by requested methods, the QC batch in which the samples were analyzed failed to meet QC acceptance criteria for blank spikes (outside limits, low). The suspected cause for the failure was an inaccurate estimation (high) of the chemical yield resulting from inadequate washing of the precipitate. Reanalysis was not possible since sample volumes were depleted. Reported results are qualified "reject" due to the failure to meet QC criteria.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Robert Shannon
Radiochemistry Technical Manager

2/4/97
Date

Radiochemistry Final Data Review

2/4/97
Date

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 300 Min.

Analyzed by: DCB

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
CR-A157401	11-057-01	-0.03 ± 0.28	0.47
CR-A157403	11-057-02	0.09 ± 0.26	0.44
CR-A157404	11-057-03	0.19 ± 0.24	0.39
CR-A157405	11-057-04	0.25 ± 0.22	0.35
CR-A157406	11-057-05	0.30 ± 0.26	0.43
CR-A157501	11-057-06	0.51 ± 0.46	0.75
CR-A157503	11-057-07	0.45 ± 0.42	0.68
CR-A157504	11-057-08	0.33 ± 0.42	0.69
CR-A157505	11-057-09	0.82 ± 0.43	0.67
CR-A157506	11-057-10	0.70 ± 0.33	0.51
CR-A157704	11-057-13	1.24 ± 0.50	0.76
CR-A157602	11-057-14	0.42 ± 0.47	0.78
CR-A157603	11-057-15	-0.21 ± 0.31	0.52
CR-A157604	11-057-16	-0.11 ± 0.39	0.67
CR-A157605	11-057-17	0.10 ± 0.34	0.56
CR-A157606	11-057-18	0.55 ± 0.28	0.44

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 01/03/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 96-11-057

Count Duration: 360 Min.

Analyzed by: DCB

Client Sample ID	Lab Sample ID	(pCi/L)	MDA
CR-A157507	11-057-11	0.51 ± 0.34	0.54
CR-A157508	11-057-12	0.17 ± 0.27	0.44

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2 σ).
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

2

PARAGON ANALYTICS, INC.

Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 300 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-057-B1	0.15 ± 0.23	0.38

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 300 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-057-B2	0.20 ± 0.27	0.44

Reported Uncertainties are the Estimated Total Propagated Uncertainties (
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

DCB

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/26/96

Client Name: EMAX

Date Analyzed : 01/06/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 375 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-057-B3	-0.08 ± 0.23	0.38

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/26/96

Client Name: EMAX

Date Analyzed : 01/06/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 375 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-057-B4	-0.14 ± 0.23	0.39

Reported Uncertainties are the Estimated Total Propagated Uncertainties (
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/22/97

Client Name: EMAX

Date Analyzed : 01/28/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 600 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-057-B5	-0.05 ± 0.39	0.66

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/22/97

Client Name: EMAX

Date Analyzed : 01/28/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 600 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-057-B6	0.20 ± 0.32	0.53

Reported Uncertainties are the Estimated Total Propagated Uncertainties (
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-057-S1	18.1	17.9 ± 1.86	98.6%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-057-S2	18.1	18.4 ± 1.93	101%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/26/96

Client Name: EMAX

Date Analyzed : 01/06/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 375 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-057-S3	18.0	12.6 ± 1.31	69.6%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/26/96

Client Name: EMAX

Date Analyzed : 01/06/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 375 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-057-S4	18.0	16.0 ± 1.67	88.6%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/22/97

Client Name: EMAX

Date Analyzed : 01/28/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 600 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-057-S5	17.9	17.5 ± 1.82	97.9%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 01/22/97

Client Name: EMAX

Date Analyzed : 01/28/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 600 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-057-S6	17.9	24.5 ± 2.57	137%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/07/96

Client Name: EMAX

Date Analyzed : 01/06/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 375 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Duplicate -06	11-057-D1	-0.34 ± 0.59	1.0

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Remarks:

Sample 96-11-057-D1 is a duplicate of 96-11-057-06.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/07/96

Client Name: EMAX

Date Analyzed : 01/06/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 375 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Duplicate -15	11-057-D2	0.53 ± 0.44	0.71

Reported Uncertainties are the Estimated Total Propagated Uncertainties (.
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Remarks:

Sample 96-11-057-D2 is a duplicate of 96-11-057-15.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 01/28/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-057

Count Duration: 600 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Duplicate -06	11-057-D3	0.49 ± 0.52	0.86

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Remarks:

Sample 96-11-057-D3 is a duplicate of 96-11-057-06.

RADIUM-228 MATRIX SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 12/23/96

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 300 Min.

Lab Sample ID	Ra-228 Known Value	Ra-228 Rep't Value	Ra-228 Recovery	Flag
96-11-057-M1	19.2 ± 8.34	16.7 ± 1.75	87.1%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-057-M1 is a matrix spike of sample 96-11-057-09.

RADIUM-228 MATRIX SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 01/06/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 375 Min.

Lab Sample ID	Ra-228 Known Value	Ra-228 Rep't Value	Ra-228 Recovery	Flag
96-11-057-M2	19.2 ± 8.34	27.2 ± 2.84	142%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-057-M2 is a matrix spike of sample 96-11-057-09.

RADIUM-228 MATRIX SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 11/06/96

Client Name: EMAX

Date Analyzed : 01/28/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-057

Count Duration: 600 Min.

Lab Sample ID	Ra-228 Known Value	Ra-228 Rep't Value	Ra-228 Recovery	Flag
96-11-057-M3	18.8 ± 8.18	26.2 ± 2.71	139%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 96-11-057-M3 is a matrix spike of sample 96-11-057-07.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 360 Min.

Analyzed by: DCB

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-073-B1	0.08 ± 0.24	0.40

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/13/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Sample ID Series: 96-11-073

Count Duration: 360 Min.

Analyzed by: DCB

Client Sample ID	Lab Sample ID	(pCi/g)	MDA
Blank	11-073-B2	0.22 ± 0.27	0.45

Reported Uncertainties are the Estimated Total Propagated Uncertainties (
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP721FC and PAI SOP717FC
and analyzed using PAI SOP724FC.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/26/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 360 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-S1	18.0	7.47 ±0.873	41.4%	Fail

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-223 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/26/96

Client Name: EMAX

Date Analyzed : 01/02/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Soil

Lab Workorder Number : 96-11-073

Count Duration: 360 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
96-11-073-S2	18.0	4.60 ±0.596	25.5%	Fail

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Paragon Analytics, Inc.

Radiochemistry Case Narrative
^{228}Radium by Method 9320

RECEIVED
MAR 2 1997
JE - Denver

EMAX

Jacobs / Carswell AFB (DO 21) / 05G47900

PAI WO 97-02-125

1. This report consists of 1 water sample received by Paragon on 02/21/97.

2. These samples were prepared according to SW-846 Method 9320. The samples were analyzed for the presence of Ra-228 by low background gas flow proportional counting of the ingrown progeny of radium-228, actinium-228. The analyses were completed on 03/14/97.

3. All quality control criteria were met. No anomalous situations were noted during the preparation and analysis of these samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Robert Shannon
Radiochemistry Technical Manager

3/18/97
Date

Daniel Burns
Radiochemistry Final Data Review

3/19/97
Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9702125-1	CR-A 161301	Liquid	02/14/97
9702125-2	CR-A 161302	Water	02/14/97
9702125-3	CR-A 161303	Liquid	02/16/97

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/14/97

Client Name: EMAX

Date Analyzed : 03/14/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-02-125

Count Duration: 300 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
CR-A 161302	02-125-02	0.46 ± 0.55	0.89
Blank	02-125-B1	0.44 ± 0.46	0.75
Duplicate of -02	02-125-D1	0.10 ± 0.50	0.83

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

Remarks:

Sample 97-02-125-D1 is a duplicate of 97-02-125-02.

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PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/10/97

Client Name: EMAX

Date Analyzed : 03/14/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Water

Lab Workorder Number : 97-02-125

Count Duration: 74 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-02-125-S1	52.8	45.6 ± 5.11	86.3%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Shared QC for w.o. 97-02-125 an d 97-03-046.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/10/97

Client Name: EMAX

Date Analyzed : 03/14/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Water

Lab Workorder Number : 97-02-125

Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-02-125-S2	52.8	40.0 ± 4.19	75.7%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ).
See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 97-02-125-S2 is a blank spike duplicate.
Shared QC for w.o. 97-02-125 and 97-03-046.

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Total Radium

RECEIVED
MAR 2 1997

EMAX

Jacobs/Carswell AFB (DO 21)/05G47900
PAI Workorder 97-02-125

1. This report consists of 1 water sample received by Paragon on 02/21/97.

2. The sample was prepared according to Paragon Analytics, Inc. procedure PAI SOP712R3.

3. The sample was analyzed for the presence of total radium according to Paragon Analytics, Inc. procedure PAI SOP724R4. The analyses were completed on 03/14/97. 903.0

4. No problems were encountered with either the client samples or the associated quality control samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Renee Gallegos — Date 3/20/97
Radiochemistry Instrumentation Technician

Radiochemistry Final Data Review — Date 3/20/97

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9702125-1	CR-A 161301	Liquid	02/14/97
9702125-2	CR-A 161302	Water	02/14/97
9702125-3	CR-A 161303	Liquid	02/16/97

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PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/14/97

Client Name: EMAX

Date Analyzed : 03/14/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-02-125

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
CR-A 161302	02-125-02	< 0.22(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/12/97

Client Name: Shared QC

Date Analyzed : 03/14/97

Client Project ID: Blank

Sample Matrix : Water

Lab Sample ID Series: 97-03-046

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
Blank	03-046-B1	< 0.21(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Remarks:

Blank for work orders 97-03-046, 03-032, and 02-125.

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/12/97

Client Name: Shared QC

Date Analyzed : 03/14/97

Client Project ID: Blank

Sample Matrix : Water

Lab Sample ID Series: 97-03-046

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/l)	Rep't Activity (pCi/l)	Spike Recovery
97-03-046-S1	67.1 ± 16.77	52.24 ± 5.61	77.9
97-03-046-S2	67.1 ± 16.77	53.83 ± 5.79	80.2

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ)
See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Blank spike for work orders 97-03-046, 03-032, and 02-125.

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Radium-226/228

EMAX

Jacobs/Carswell AFB (DO 21) / 05G47900

RECEIVED
MAR 2 7 1997

Paragon Work Order 9702125

1. This report consists of 2 liquid samples received by Paragon on 02/21/97.

2. These samples were prepared according to Paragon Analytics, Inc. procedure PAI SOP739R2.

3. The samples were analyzed for the presence of Ra-226 and Ra-228 by gamma spectroscopy. Ra-226 was quantified, via the gamma emissions of the ingrown progeny Bi-214 and Pb-214, according to Paragon Analytics, Inc. procedure PAI SOP713R2. Since it was not known to what degree equilibrium had been established between Ra-226 and its progeny, the samples were held for 21 days to ensure greater than 97.8% ingrowth prior to analysis. Radium-228 was quantified via the gamma emissions of the ingrown progeny Actinium-228. The analyses were completed on 03/18/97.

4. No problems were encountered with either the client samples or the associated quality control samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Michael E. Goodwill — 03 19 97
Radiochemistry Instrument Technician — Date

Radiochemistry Final Data Review — 3/19/97
Date

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

A summary report is not provided.
Please refer to the individual sample results data in section 3.

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PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/24/97 12:00

Client Name: EMAX

Date Analyzed: 03/18/97 18:07

Lab Sample ID: 97-02-125-BA

Sample Matrix: Soil

Client Sample ID: Blank

Count Duration: 600 Min.

Nuclide	Activity (pCi/Gram)	% Uncertainty
Pb-214	< 0.064	BDL
Ra-226	< 0.095	BDL
Bi-214	< 0.095	BDL

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See ATI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Data stored in file \gdr\prt\S02125BA.97P

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/24/97 12:00

Client Name: EMAX

Date Analyzed: 03/18/97 18:07

Lab Sample ID: 97-02-125-BA

Sample Matrix: Soil

Client Sample ID: Blank

Count Duration: 600 Min.

Nuclide	Activity (pCi/Gram)	% Uncertainty
Ra-228	< 0.105	BDL

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ).
See ATI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Data stored in file \gdr\prt\S02125BA.97P

GAMMA SPECTROMETRY QA RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 10/01/95 10:00

Client Name: EMAX

Date Analyzed : 03/17/97 11:31

Lab Sample ID: 97-02-125-S1

Sample Matrix : Soil

Client Sample ID: Lab Control

Count Duration: 30 Min.

Nuclide	Reported Activity	Known Value	Percent Recovery	Flag
Am-241	454	460	98.7	Pass
Cd-109	6540	6320	104	Pass
Co-57	142	145	97.9	Pass
Cs-137	189	185	102	Pass
Co-60	282	286	98.6	Pass

ATI sets control limits for gamma spectroscopy as follows :
Control Limits = Known ± 15%

Data stored in file \gdr\prt\S02125S1.97P

GAMMA SPECTROMETRY QA RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 12/11/95 10:00

Client Name: EMAX

Date Analyzed : 03/17/97 12:09

Lab Sample ID: 97-02-125-S2

Sample Matrix : Soil

Client Sample ID: Lab Control

Count Duration: 30 Min.

Nuclide	Reported Activity	Known Value	Percent Recovery	Flag
Ra-226	459	473	97.0	Pass

ATI sets control limits for gamma spectroscopy as follows :
Control Limits = Known ± 15%

Data stored in file \gdr\prt\S02125S2.97P

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PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 3

INDIVIDUAL SAMPLE RESULTS

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/14/97 12:20

Client Name: EMAX

Date Analyzed: 03/17/97 16:45

Lab Sample ID: 97-02-125-01

Sample Matrix: Soil

Client Sample ID: CR-A 161301

Count Duration: 600 Min.

Nuclide	Activity (pCi/gram)	% Uncertainty
Pb-214	< 0.068	BDL
Ra-226	< 0.099	BDL
Bi-214	< 0.099	BDL

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See ATI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Data stored in file \gdr\prt\S0212501.97P

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GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/14/97 12:20

Client Name: EMAX

Date Analyzed: 03/17/97 16:45

Lab Sample ID: 97-02-125-01

Sample Matrix: Soil

Client Sample ID: CR-A 161301

Count Duration: 600 Min.

Nuclide	Activity (pCi/gram)	% Uncertainty
Ra-228	< 0.119	BDL

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See ATI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Data stored in file \gdr\prt\S0212501.97P

MO

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/14/97 12:20

Client Name: EMAX

Date Analyzed: 03/17/97 16:46

Lab Sample ID: 97-02-125-D1

Sample Matrix: Soil

Client Sample ID: Duplicate

Count Duration: 600 Min.

Nuclide	Activity (pCi/Gram)	% Uncertainty
Pb-214	< 0.051	BDL
Ra-226	< 0.066	BDL
Bi-214	< 0.066	BDL

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See ATI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Remarks: Sample 97-02-125-D1 is a duplicate of 97-02-125-01.

Data stored in file \gdr\prt\S02125D1.97P

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/14/97 12:20

Client Name: EMAX

Date Analyzed: 03/17/97 16:46

Lab Sample ID: 97-02-125-D1

Sample Matrix: Soil

Client Sample ID: Duplicate

Count Duration: 600 Min.

Nuclide	Activity (pCi/Gram)	% Uncertainty
Ra-228	< 0.091	BDL

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See ATI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Remarks: Sample 97-02-125-D1 is a duplicate of 97-02-125-01.

Data stored in file \gdr\prt\S02125D1.97P

MT

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/16/97 15:47

Client Name: EMAX

Date Analyzed: 03/17/97 16:48

Lab Sample ID: 97-02-125-03

Sample Matrix: Soil

Client Sample ID: CR-A 161303

Count Duration: 600 Min.

Nuclide	Activity (pCi/Gram)	% Uncertainty
Pb-214	< 0.065	BDL
Ra-226	< 0.083	BDL
Bi-214	< 0.083	BDL

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See ATI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Data stored in file \gdr\prt\S0212503.97P

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 02/16/97 15:47

Client Name: EMAX

Date Analyzed: 03/17/97 16:48

Lab Sample ID: 97-02-125-03

Sample Matrix: Soil

Client Sample ID: CR-A 161303

Count Duration: 600 Min.

Nuclide	Activity (pCi/Gram)	% Uncertainty
Ra-228	< 0.095	BDL

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See ATI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Data stored in file \gdr\prt\S0212503.97P

Paragon Analytics, Inc.

Radiochemistry Case Narrative
^{228}Radium by Method 9320

EMAX

Jacobs/Carswell AFB (DO 21)

PAI W.O. 97-05-132

1. This report consists of 3 water samples received by Paragon on 05/16/97.

2. These samples were prepared according to SW-846 Method 9320. The samples were analyzed for the presence of Ra-228 by low background gas flow proportional counting of the ingrown progeny of radium-228, actinium-228. The analyses were completed on 05/21/97.

3. All quality control criteria were met. No anomalous situations were noted during the preparation and analysis of these samples.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Renee Gallegos — 5/27/97
Renee Gallegos — Date
Radiochemistry Instrument Technician

Radiochemistry Final Data Review — 5/27/97
Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9705132-1	CR-A163201	Water	05/13/97
9705132-2	CR-A163202	Water	05/13/97
9705132-3	CR-A163203	Water	05/13/97

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc. Date Collected: 05/13/97

Client Name: EMAX Date Analyzed : 05/21/97

Client Project ID: Jacobs/Carswell AFB (DO 2 Sample Matrix : Water

Lab Sample ID Series: 97-05-132 Count Duration: 300 Min.

Analyzed by: RG

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
CR-A163201	05-132-01	1.29 ± 0.56	0.86
CR-A163202	05-132-02	0.94 ± 0.43	0.66
CR-A163203	05-132-03	0.83 ± 0.56	0.90
Blank	05-132-B1	-0.32 ± 0.58	0.98
Duplicate-01	05-132-D1	0.75 ± 0.44	0.69

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

Remarks:

Sample 97-05-132-D1 is a duplicate of 97-05-132-01.

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc. Date Collected: 05/18/97

Client Name: EMAX Date Analyzed : 05/21/97

Client Project ID : Jacobs/Carswell AFB (DO Sample Matrix : Water

Lab Workorder Number : 97-05-132 Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-05-132-S1	51.7	56.0 ± 5.77	108%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc. Date Collected: 05/18/97

Client Name: EMAX Date Analyzed : 05/21/97

Client Project ID : Jacobs/Carswell AFB (DO Sample Matrix : Water

Lab Workorder Number : 97-05-132 Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-05-132-S2	51.7	51.9 ± 5.34	100%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 97-05-132-S2 is a blank spike duplicate.

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511 ◆ (970) 490-1511 ◆ FAX (970) 490-1522

May 27, 1997

RECEIVED
MAY 28 1997

Ms. Lynn Schuetter
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: Paragon Workorder: 97-05-132
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Ms. Schuetter:

Three water samples were received from Jacobs Engineering Group under the above referenced workorder on May 16, 1997. The samples were scheduled for Radium-228 (Method 9320) and Total Radium Alpha Emitters (Method 9315) analysis. Results for these analyses are contained in this package.

This data is being shipped concurrently to Dr. Kam Pang of EMAX. The Electronic Disc Deliverable for this data will be sent via E-mail directly to Mr. Chris Skinner of Jacobs Engineering Group.

Thank you for your confidence in Paragon Analytics, Inc. Should you have any questions, please call.

Sincerely,

Lori Pacheco

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Total Radium

EMAX

Jacobs/Carswell AFB (DO 21)
PAI Workorder 97-05-132

1. This report consists of 3 water samples received by Paragon on 05/16/97.

2. These samples were prepared according to Paragon Analytics, Inc. procedure PAI SOP712R3.

3. These samples were tested for the presence of Total Alpha Emitting Radium Isotopes according to Paragon Analytics, Inc. procedure PAI SOP724R4. This test is a screen for Radium-226 and will show high bias in sample results if other alpha emitting isotopes of radium are contained in the sample (esp. Ra-224 and Ra-223). Reanalysis of the sample following a several week period to allow for decay of the shorter lived interfering isotopes of radium will provide a more accurate measurement of the Radium-226 concentration of the sample.

4. The analyses were completed on 05/19/97.

5. No problems were encountered with either the client samples or the associated quality control samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Renee Gallegos — 5/23/97
Renee Gallegos — Date
Radiochemistry Instrument Technician

5/23/97
Radiochemistry Final Data Review — Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9705132-1	CR-A163201	Water	05/13/97
9705132-2	CR-A163202	Water	05/13/97
9705132-3	CR-A163203	Water	05/13/97

1

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 05/13/97

Client Name: EMAX

Date Analyzed : 05/19/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-05-132

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
CR-A163201	05-132-01	2.64 ± 0.76
CR-A163202	05-132-02	8.74 ± 1.97
CR-A163203	05-132-03	7.91 ± 1.83
Blank	05-132-B1	< 0.57 (MDL)
Duplicate-02	05-132-D1	13.60 ± 2.98

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 05/18/97

Client Name: EMAX

Date Analyzed : 05/19/97

Client Project ID: Blank

Sample Matrix : Water

Lab Sample ID Series: 97-05-132

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
Blank	05-132-B1	< 0.57(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 05/18/97

Client Name: EMAX

Date Analyzed : 05/19/97

Client Project ID: Blank

Sample Matrix : Water

Lab Sample ID Series: 97-05-132

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/l)	Rep't Activity (pCi/l)	Spike Recovery
97-05-132-S1	67.0 ± 16.74	60.64 ±12.17	90.5
97-05-132-S2	67.0 ± 16.74	69.74 ±13.98	104.1

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ)
See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

PARAGON ANALYTICS, INC.
225 Commerce Drive ◆ Fort Collins, CO 80524 ◆ (800) 443-1511 ◆ (970) 490-1511 ◆ FAX (970) 490-1522

April 4, 1997

Ms. Lynn Schuetter
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: PAI Workorder: 97-03-133
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Ms. Schuetter:

Six water samples were received from Jacobs Engineering Group under the above referenced workorder on March 21, 1997. The samples were scheduled for Radium-228 (Method 9320) and Total Radium Alpha Emitters (Method 9315) analysis. Results for these analyses are contained in this package.

This data is being shipped concurrently to Mr. Tom Dabney of EMAX. The Electronic Disc Deliverable for this data will be sent via E-mail directly to Mr. Chris Skinner of Jacobs Engineering Group.

Thank you for your confidence in Paragon Analytics, Inc. Should you have any questions, please call.

Sincerely,

Lori Pacheco

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Total Radium

EMAX

Jacobs / Carswell AFB (DO 21) / 05G47900
PAI 97-03-133

1. This report consists of 6 water samples received by Paragon on 03/21/97.

2. These samples were prepared according to Paragon Analytics, Inc. procedure PAI SOP712R3.

3. The samples were analyzed for the presence of total radium according to Paragon Analytics, Inc. procedure PAI SOP724R4. The analyses were completed on 04/03/97.

4. No problems were encountered with either the client samples or the associated quality control samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Renee Gallegos — 4/4/97
Radiochemistry Instrument Technician — Date

Radiochemistry Final Data Review — 4/4/97
Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9703133-1	CR-A161601	Water	03/19/97
9703133-2	CR-A161602	Water	03/20/97
9703133-3	CR-A161603	Water	03/19/97
9703133-4	CR-A161604	Water	03/20/97
9703133-5	CR-A161605	Water	03/19/97
9703133-6	CR-A161606	Water	03/19/97

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

RECEIVED
APR 9 1997
JE - Denver

Section 1

SAMPLE RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/19/97

Client Name: EMAX

Date Analyzed : 04/01/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-03-133

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
CR-A161601	03-133-01	1.79 ± 0.47
CR-A161602	03-133-02	8.86 ± 1.84
CR-A161603	03-133-03	5.97 ± 1.27
CR-A161604	03-133-04	< 0.18(BDL)
CR-A161605	03-133-05	5.40 ± 1.28
CR-A161606	03-133-06	< 0.33(BDL)
Blank	03-133-B1	< 0.26(BDL)
Duplicate	03-133-D1	< 0.23(BDL)

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

2

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/25/97

Client Name: EMAX

Date Analyzed : 04/01/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-03-133

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/l)	Rep't Activity (pCi/l)	Spike Recovery
97-03-133-S1	66.1 ± 16.52	58.41 ±11.75	88.4
97-03-133-S2	66.1 ± 16.52	70.52 ±14.12	106.7

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Paragon Analytics, Inc.

Radiochemistry Case Narrative
^{228}Radium by Method 9320

EMAX

Jacobs/Carswell AFB (DO 21) 05G47900

PAI W.O. 97-03-133

1. This report consists of 6 water samples received by Paragon on 03/21/97.

2. These samples were prepared according to SW-846 Method 9320. The samples were analyzed for the presence of Ra-228 by low background gas flow proportional counting of the ingrown progeny of radium-228, actinium-228. The analyses were completed on 03/28/97.

3. All quality control criteria were met. No anomalous situations were noted during the preparation and analysis of these samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Robert Shannon
Technical Manager

4/1/97
Date

Radiochemistry Final Data Review

4/1/97
Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9703133-1	CR-A161601	Water	03/19/97
9703133-2	CR-A161602	Water	03/20/97
9703133-3	CR-A161603	Water	03/19/97
9703133-4	CR-A161604	Water	03/20/97
9703133-5	CR-A161605	Water	03/19/97
9703133-6	CR-A161606	Water	03/19/97

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PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/19/97

Client Name: EMAX

Date Analyzed : 03/28/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-03-133

Count Duration: 300 Min.

Analyzed by: DCB

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
CR-A161601	03-133-01	0.19 ± 0.55	0.91
CR-A161602	03-133-02	1.49 ± 0.63	0.96
CR-A161603	03-133-03	0.87 ± 0.69	1.1
CR-A161604	03-133-04	0.71 ± 0.57	0.92
CR-A161605	03-133-05	1.89 ± 0.79	1.2
CR-A161606	03-133-06	0.22 ± 0.62	1.0

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/25/97

Client Name: EMAX

Date Analyzed : 03/28/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-03-133

Count Duration: 300 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
Blank	03-133-B1	0.06 ± 0.54	0.90

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/25/97

Client Name: EMAX

Date Analyzed : 03/28/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-03-133

Count Duration: 300 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
Blank	03-133-B2	0.37 ± 0.54	0.88

Reported Uncertainties are the Estimated Total Propagated Uncertainties (?
See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/19/97

Client Name: EMAX

Date Analyzed : 03/28/97

Client Project ID: Jacobs/Carswell AFB

Sample Matrix : Water

Lab Sample ID Series: 97-03-133

Count Duration: 300 Min.

Analyzed by: RTS

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
Duplicate -01	03-133-D1	1.08 ± 0.67	1.1

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

Remarks:

Sample 97-03-133-D1 is a duplicate of 97-03-133-01.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/25/97

Client Name: EMAX

Date Analyzed : 03/28/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Water

Lab Workorder Number : 97-03-133

Count Duration: 34 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-03-133-S1	52.6	49.9 ± 5.89	94.9%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (
See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/25/97

Client Name: EMAX

Date Analyzed : 03/28/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Water

Lab Workorder Number : 97-03-133

Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-03-133-S3	52.6	68.5 ± 7.09	130%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 97-03-133-S2 is a blank spike duplicate.

RADIUM-228 MATRIX SPIKE RESULTS

Lab Name: Paragon Analytics, Inc.

Date Collected: 03/20/97

Client Name: EMAX

Date Analyzed : 03/28/97

Client Project ID : Jacobs/Carswell AFB

Sample Matrix : Water

Lab Workorder Number : 97-03-133

Count Duration: 300 Min.

Lab Sample ID	Ra-228 Known Value	Ra-228 Rep't Value	Ra-228 Recovery	Flag
97-03-133-M1	54.2 ± 23.6	44.8 ± 4.80	82.7%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228

Acceptance Range for matrix spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 97-03-133-M1 is a matrix spike of sample 97-03-133-02.

PARAGON ANALYTICS, INC.
225 Commerce Drive • Fort Collins, CO 80524 • (800) 443-1511 • (970) 490-1511 • FAX (970) 490-1522

May 16, 1997

RECEIVED
MAY 19 1997
JE Denver

Ms. Lynn Schuetter
Jacobs Engineering Group
600 17th Street, Suite 1100N
Denver, CO 80202

RE: Paragon Workorder: 97-04-213
Client Project Name: Jacobs/Carswell AFB (DO 21)
Client Project Number: 05G47900

Dear Ms. Schuetter:

Four water samples were received from Jacobs Engineering Group under the above referenced workorder on April 26, 1997. The samples were scheduled for Radium-228 (Method 9320) and Total Radium Alpha Emitters (Method 9315) analysis. Results for these analyses are contained in this package.

This data is being shipped concurrently to Dr. Kam Pang of EMAX. The Electronic Disc Deliverable for this data will be sent via E-mail directly to Mr. Chris Skinner of Jacobs Engineering Group.

Thank you for your confidence in Paragon Analytics, Inc. Should you have any questions, please call.

Sincerely,

Lori Pacheco

Paragon Analytics, Inc.
Lori Pacheco
Project Manager

Enclosure: Report

Paragon Analytics, Inc. - Fort Collins, Colorado

CONDITION OF SAMPLE UPON RECEIPT

CLIENT: JacobsCo/EMAX SHIPPING CONTAINER #: 221

WORKORDER NO. 97-04-213 INITIALS: TB DATE: 4/26/97

1.	Does this project require special handling according to NEESA, Level 3, or CLP protocols? If yes, complete a. and b. a. Cooler Temperature_____ b. Lot No's._____ c. Airbill Number_____		Yes	(No)
2.	Are custody seals on the cooler intact? If so, how many 1	N/A	(Yes)	No
3.	Are custody seals on sample containers intact?	(N/A)	Yes	No
4.	Is there a Chain of Custody (COC) or other representative documents, letters or shipping memos?		(Yes)	No
5.	Is the COC complete? Relinquished: Yes ✓ No__ Requested Analysis: Yes ✓ No__	N/A	(Yes)	No
6.	Is the COC in agreement with the samples received? No. of Samples: Yes ✓ No__ Sample ID's: Yes ✓ No__ Matrix: Yes ✓ No__ No. of Containers: Yes ✓ No__		(Yes)	No
7.	Are the samples requiring acid preservation preserved correctly?	N/A	Yes	(No)
8.	Is there enough sample? If so, are they in the proper containers?		(Yes)	No
	Are all samples within holding times for the requested analyses?		(Yes)	No
9.	Were the sample received on ice?	(N/A)	Yes	No
11.	Were all sample containers received intact? (not broken or leaking, etc.)		(Yes)	No
12.	Are samples requiring no headspace, headspace free?	(N/A)	Yes	No
13.	Do the samples require quarantine?		Yes	(No)
14.	Do samples require Paragon disposal?		(Yes)	No
15.	Did the client return any unused bottles?		~~Yes~~	(No)

Describe "NO" items (except No's 1, 13, &14): Samples not preserved.

Was the client contacted? Yes____ No____

If yes, Date:_____ Name of person contacted:_____

Describe actions taken or client instructions:_____

Group Leader's Signature:_____ Date:_____

Cooler Temperature: 17°C

FRM 201FC6 (24/1/97)

Paragon Analytics, Inc.

Radiochemistry Case Narrative
^{228}Radium by Method 9320

EMAX

Jacobs/Carswell AFB (DO21) / 05G47900
PAI 97-04-213

1. This report consists of 4 water samples received by Paragon on 04/26/97.

2. These samples were prepared according to SW-846 Method 9320. The samples were analyzed for the presence of Ra-228 by low background gas flow proportional counting of the ingrown progeny of radium-228, actinium-228. The analyses were completed on 05/12/97.

3. All quality control criteria were met. No anomalous situations were noted during the preparation and analysis of these samples.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Renee Gallegos — 5/14/97
Renee Gallegos — Date
Radiochemistry Instrument Technician

5/14/97
Radiochemistry Final Data Review — Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9704213-1	CR-A162001	Water	04/17/97
9704213-2	CR-A162002	Water	04/24/97
9704213-3	CR-A162003	Water	04/17/97
9704213-4	CR-A162004	Water	04/24/97

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PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

Ra-228 ANALYSIS RESULTS SUMMARY

Lab Name: Paragon Analytics, Inc. Date Collected: 04/17/97

Client Name: EMAX Date Analyzed : 05/12/97

Client Project ID: Jacobs/Carswell AFB (DO 2Sample Matrix : Water

Lab Sample ID Series: 97-04-213 Count Duration: 300 Min.

Analyzed by: RG

Client Sample ID	Lab Sample ID	(pCi/l)	MDA
CR-A162001	04-213-01	1.49 ± 0.80	1.3
CR-A162002	04-213-02	2.6 ± 1.0	1.5
CR-A162003	04-213-03	1.10 ± 0.89	1.4
CR-A162004	04-213-04	1.29 ± 0.93	1.5
Blank	04-213-B1	0.29 ± 0.86	1.4
Blank	04-213-B2	0.21 ± 0.78	1.3

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

These samples were prepared using PAI SOP707FC and analyzed using PAI SOP724FC.

2

PARAGON ANALYTICS, INC.

Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc. Date Collected: 05/05/97

Client Name: EMAX Date Analyzed : 05/12/97

Client Project ID : Jacobs/Carswell AFB (DO Sample Matrix : Water

Lab Workorder Number : 97-04-213 Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-04-213-S1	51.9	61.5 ± 6.53	119%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Ra-228 BLANK SPIKE RESULTS

Lab Name: Paragon Analytics, Inc. Date Collected: 05/05/97

Client Name: EMAX Date Analyzed : 05/12/97

Client Project ID : Jacobs/Carswell AFB (DO Sample Matrix : Water

Lab Workorder Number : 97-04-213 Count Duration: 300 Min.

Lab Sample ID	Known Value	Rep't Value	Recovery	Flag
97-04-213-S2	51.9	48.8 ± 5.13	94.1%	Pass

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of TPU determinations.

Control Limits = Known ± 43% for Ra-228.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

Remarks:

Sample 97-04-213-S2 is a blank spike duplicate.

Paragon Analytics, Inc.

Radiochemistry Case Narrative
Total Radium

EMAX

Jacobs/Carswell AFB (DO21) / 05G47900
PAI 97-04-213

1. This report consists of 4 water samples received by Paragon on 04/26/97.

2. These samples were prepared according to Paragon Analytics, Inc. procedure PAI SOP712R3.

3. These samples were tested for the presence of Total Alpha Emitting Radium Isotopes according to Paragon Analytics, Inc. procedure PAI SOP724R4. This test is a screen for Radium-226 and will show high bias in sample results if other alpha emitting isotopes of radium are contained in the sample (esp. Ra-224 and Ra-223). Reanalysis of the sample following a several week period to allow for decay of the shorter lived interfering isotopes of radium will provide a more accurate measurement of the Radium-226 concentration of the sample.

4. The analyses were completed on 05/12/97.

5. No problems were encountered with either the client samples or the associated quality control samples. All quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, Paragon Analytics, Inc. certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Renee Gallegos — 5/14/97
Renee Gallegos — Date
Radiochemistry Instrument Technician

5/14/97
Radiochemistry Final Data Review — Date

Paragon Analytics, Inc.

SAMPLE NUMBER(S) CROSS-REFERENCE TABLE

Client Name: EMAX

Client Project ID: Jacobs/Carswell AFB (DO 21) 05G47900

PAI-ID	Client ID	MATRIX	DATE SAMPLED
9704213-1	CR-A162001	Water	04/17/97
9704213-2	CR-A162002	Water	04/24/97
9704213-3	CR-A162003	Water	04/17/97
9704213-4	CR-A162004	Water	04/24/97

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PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 04/17/97

Client Name: EMAX

Date Analyzed : 05/12/97

Client Project ID: Jacobs/Carswell AFB (D

Sample Matrix : Water

Lab Sample ID Series: 97-04-213

Count Duration: 60 Min.

Client Sample ID	Lab Sample ID	Total Radium (pCi/l)
CR-A162001	04-213-01	2.50 ± 0.74
CR-A162002	04-213-02	7.68 ± 1.75
CR-A162003	04-213-03	6.86 ± 1.62
CR-A162004	04-213-04	8.45 ± 1.92
Blank	04-213-B1	< 0.54(BDL)
Duplicate-01	04-213-D1	2.04 ± 0.65

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

2

PARAGON ANALYTICS, INC.
Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

TOTAL ALPHA-EMITTING RADIUM QA ANALYSIS RESULTS SUMMARY

Method 903.0 (Modified)

Lab Name: Paragon Analytics, Inc.

Date Collected: 05/09/97

Client Name: EMAX

Date Analyzed : 05/12/97

Client Project ID: Jacobs/Carswell AFB (D

Sample Matrix : Water

Lab Sample ID Series: 97-04-213

Count Duration : 60 Min.

Lab Sample ID	Known Activity (pCi/l)	Rep't Activity (pCi/l)	Spike Recovery
97-04-213-S1	67.0 ± 16.74	78.19 ±15.64	116.8
97-04-213-S2	67.0 ± 16.74	67.22 ±13.45	100.4

Reported Uncertainties are the Estimated Total Propagated Uncertainties (2σ). See PAI SOP 743FC for details of the TPU determination.

PAI sets control limits for Total Radium measurements as follows :

Control Limits = Known (μ) ± 0.25 * μ.

Acceptance Range for blank spike samples is the known value ± the control limits stated above. The reported value, without the uncertainty, should be compared to that range.

LABORATORY REPORT FOR

JACOBS ENGINEERING GROUP, INC.

CARSWELL AFB / 05G47900

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

SDG#: 96K042

DECEMBER 09, 1996

LAB CHRONICLE 11-13-199612:07:0

Method: EPA 418.1
Client: Jacobs Engineering Group
PROJECT: Carswell AFB / 05G47900
SDG/Batch No.: 96K042
Matrix: Soil

SAMPLE ID	CONT NO	%H2O	FILE ID	EXT DATE/BATCH	ANL DATE/BATCH	REMARKS
CR-A156601	K042-29	15.3		11/13	11/14	
CR-A156603	K042-30	16.4				
CR-A156604	K042-31	10.1				
CR-A156605	K042-32	17.5				
CR-A156606	K042-33	10.0				
CR-A156701	K042-36	19.9				
CR-A156704	K042-38	8.6				
CR-A156705	K042-39	23.8				
CR-A156706	K042-40	7.8				
CR-A156801	K042-41	20.1				
CR-A156802	K042-42	7.9				
-A156803	K042-43	23.5				
CR-A156804	K042-44	13.7				
CR-A156805	K042-45	17.6				
CR-A156806	K042-46	16.8				
CR-A156703	K042-37	20.3				

TRK003SB
SL
SC
K042-31M
-31S

LAB CHRONICLE 11-13-199612:07:0

Method: EPA 418.1
Client: Jacobs Engineering Group

PROJECT: Carswell AFB / 05G47900
SDG/Batch No.: 96K042
Matrix: Water

SAMPLE ID	CONT NO	%H2O	FILE ID	EXT DATE/BATCH	ANL DATE/BATCH	REMARKS
CR-A156607	K042-34	NA	11/13		11/18	
CR-A156608	K042-35	NA	11/13		11/18	

TR K042 WB
WC
WL

CASE NARRATIVE

CLIENT: JACOBS ENGINEERING GROUP, INC.

PROJECT: CARSWELL AFB / 05G47900

SDG: 96K042

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Two (2) water and sixteen (16) soil samples were received on 11/09/96 to be analyzed for total recoverable petroleum hydrocarbon (TRPH) in accordance with EPA Method 418.1 in EPA-600/4-79-020 (1983) and EMAX SOP AP-2013.

1. Holding Time

   Analytical holding time was met.

2. Method Blank

   Method blanks were free of contamination.

3. Matrix Spike/Matrix Spike Duplicate

   All recoveries and RPD were within QC limits for soil. No MS/MSD was designated for water.

4. Lab Control Sample/Lab Control Sample Duplicate

   All recoveries and RPD were within QC limits.

5. Calibration

   Initial calibration was at five-point and continuing calibration were carried out at 10-samples interval. All QC requirements were met.

6. Sample Analysis

   All sample analyses were done within QC requirements.

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	11/06/96
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	11/09/96
BATCH NO.:	96K042	DATE EXTRACTED:	11/13/96 17:00
MATRIX:	SOIL	INSTRUMENT ID:	T-018
CAL REF:	TRK010	PREP BATCH:	TRK003S

SAMPLE ID	CONTROL NO	RESULT (mg/kg)	DL FACTOR	MOIST (%)	PQL (mg/kg)	MDL (mg/kg)	ANALYZED DATETIME
CR-A156601	K042-29	ND	1	15.3	35.4	5.35	11/14/96 09:00
CR-A156603	K042-30	7.0F	1	16.4	35.9	5.42	11/14/96 09:05
CR-A156604	K042-31	ND	1	10.1	33.4	5.04	11/14/96 08:30
CR-A156604	K042-31M	202	1	10.1	33.4	5.04	11/14/96 08:35
CR-A156604	K042-31S	205	1	10.1	33.4	5.04	11/14/96 08:40
CR-A156605	K042-32	6.0F	1	17.5	36.4	5.49	11/14/96 09:10
CR-A156606	K042-33	ND	1	10.0	33.3	5.03	11/14/96 09:15
CR-A156701	K042-36	ND	1	19.9	37.5	5.65	11/14/96 09:20
CR-A156703	K042-37	6.0F	1	20.3	37.6	5.68	11/14/96 09:25
CR-A156704	K042-38	6.0F	1	8.6	32.8	4.95	11/14/96 09:30
CR-A156705	K042-39	8.0F	1	23.8	39.4	5.94	11/14/96 09:40
CR-A156706	K042-40	ND	1	7.8	32.5	4.91	11/14/96 09:45
CR-A156801	K042-41	ND	1	20.1	37.5	5.67	11/14/96 09:50
CR-A156802	K042-42	ND	1	7.9	32.6	4.92	11/14/96 09:55
CR-A156803	K042-43	ND	1	23.5	39.2	5.92	11/14/96 10:00
CR-A156804	K042-44	ND	1	13.7	34.8	5.25	11/14/96 10:05
CR-A156805	K042-45	ND	1	17.6	36.4	5.5	11/14/96 10:10
CR-A156806	K042-46	ND	1	16.8	36.1	5.44	11/14/96 10:15
MBLK1S	TRK003SB	ND	1	NA	30	4.53	11/14/96 08:05
LCS1S	TRK003SL	179	1	NA	30	4.53	11/14/96 08:10
LCD1S	TRK003SC	173	1	NA	30	4.53	11/14/96 08:15

PQL: Practical Quantitation Limit
F : Estimated value
CAL REF: TRK009, for K042-29, 30, 32, 33, 36, 37 and 38
TRK008, for TRK003SB, L, C, 31, 31M and 31S
AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: SOIL
% MOISTURE: NA

BATCH NO.: 96K042
SAMPLE ID: LCS1S/LCD1S
CONTROL NO.: TRK003SL/C

DATE RECEIVED: NA
DATE EXTRACTED: 11/13/96 17:00
DATE ANALYZED: 11/14/96 08:05

ACCESSION: 96K042

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	150.00	179.00	119	150.00	173.00	115	3	50-140	50

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: SOIL
% MOISTURE: 10.1

BATCH NO.: 96K042
SAMPLE ID: CR-A156604
CONTROL NO.: K042-31

DATE RECEIVED: 11/09/96
DATE EXTRACTED: 11/13/96 17:00
DATE ANALYZED: 11/14/96 08:30

ACCESSION: 96K042

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	167.00	202.00	121	167.00	205.00	123	1	50-140	50

AFCEE Ver. 1.0

900

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	11/06/96
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	11/09/96
BATCH NO.:	96K042	DATE EXTRACTED:	11/13/96 17:00
MATRIX:	WATER	INSTRUMENT ID:	T-018
CAL REF:	TRK005	PREP BATCH:	TRK002W

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	PQL (mg/L)	MDL (mg/L)	ANALYZED DATETIME
CR-A156607	K042-34	1.8J	1	2	.44	11/13/96 17:50
CR-A156608	K042-35	1.9J	1	2	.44	11/13/96 17:55
MBLK1W	TRK002WB	ND	1	2	.44	11/13/96 17:30
LCS1W	TRK002WL	6.2	1	2	.44	11/13/96 17:35
LCD1W	TRK002WC	6.2	1	2	.44	11/13/96 17:40

PQL: Practical Quantitation Limit
J : Estimated value
AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 96K042
SAMPLE ID: LCS1W/LCD1W
CONTROL NO.: TRK002WL/C

DATE RECEIVED: NA
DATE EXTRACTED: 11/13/96 17:00
DATE ANALYZED: 11/13/96 17:30

ACCESSION: 96K042

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	6.16	123	5.00	6.16	123	0	60-130	30

LABORATORY REPORT FOR

JACOBS ENGINEERING GROUP, INC.

CARSWELL AFB / 05G47900

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

SDG#: 96K047

DECEMBER 11, 1996

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

CASE NARRATIVE

CLIENT: JACOBS ENGINEERING GROUP, INC.

PROJECT: CARSWELL AFB / 05G47900

SDG: 96K047

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

One (1) water and eleven (11) soil samples were received on 11/12/96 to be analyzed for total recoverable petroleum hydrocarbon (TRPH) in accordance with EPA Method 418.1 in EPA-600/4-79-020 (1983) and EMAX SOP AP-2013.

1. Holding Time

   Analytical holding time was met.

2. Method Blank

   Method blanks were free of contamination.

3. Matrix Spike/Matrix Spike Duplicate

   All recoveries and RPD were within QC limits for soil. No MS/MSD was designated for water.

4. Lab Control Sample/Lab Control Sample Duplicate

   All recoveries and RPD were within QC limits.

5. Calibration

   Initial calibration was at five-point and continuing calibration were carried out at 10-samples interval. All QC requirements were met.

6. Sample Analysis

   All sample analyses were done within QC requirements.

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

LAB CHRONICLE 11-18-199612:17:1

Method: EPA 418.1
Client: Jacobs Engineering Group
PROJECT: Carswell AFB / 05G47900
SDG/Batch No.: 96K047
Matrix: Soil

SAMPLE ID	CONT NO	%H2O	FILE ID	EXT DATE/BATCH	ANL DATE/BATCH	REMARKS
CR-A156901	K047-47	17.3		11/13	11/14	
CR-A156902	K047-48	15.2				
CR-A156904	K047-49	7.0				
CR-A156905	K047-50	21.5				
CR-A156906	K047-51	8.7				
CR-A157001	K047-52	23.8				
CR-A157002	K047-53	16.5				
CR-A157003	K047-54	22.6				
CR-A157004	K047-55	17.3				
-A157006	K047-56	16.1				
CR-A157007	K047-57	16.8				
MBLKS	TRK004SB					
LCS1	SL					
LCS2	SC					
	K047-56M					
	S					

LAB CHRONICLE 11-18-199612:17:1

Method: EPA 418.1
Client: Jacobs Engineering Group

PROJECT: Carswell AFB / 05G47900
SDG/Batch No.: 96K047
Matrix: Water

SAMPLE ID	CONT NO	%H2O	FILE ID	EXT DATE/BATCH	ANL DATE/BATCH	REMARKS
CR-A152606	K047-09	NA		11/13	11/14	
MBLK W	TRK002WB			↓	↓	
LCS1	TRK002WL					
LCS2	WC					

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	11/09/96
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	11/12/96
BATCH NO.:	96K047	DATE EXTRACTED:	11/13/96 11:00
MATRIX:	SOIL	INSTRUMENT ID:	T-018
CAL REF:	TRK011	PREP BATCH:	TRK003S

SAMPLE ID	CONTROL NO	RESULT (mg/kg)	DL FACTOR	MOIST (%)	PQL (mg/kg)	MDL (mg/kg)	ANALYZED DATETIME
CR-A156901	K047-47	ND	1	17.3	36.3	5.48	11/14/96 11:00
CR-A156902	K047-48	ND	1	15.2	35.4	5.34	11/14/96 11:05
CR-A156904	K047-49	ND	1	7.0	32.3	4.87	11/14/96 11:10
CR-A156905	K047-50	ND	1	21.5	38.2	5.77	11/14/96 11:15
CR-A156906	K047-51	ND	1	8.7	32.9	4.96	11/14/96 11:20
CR-A157001	K047-52	ND	1	23.8	39.4	5.94	11/14/96 11:25
CR-A157002	K047-53	ND	1	16.5	35.9	5.42	11/14/96 11:30
CR-A157003	K047-54	ND	1	22.6	38.8	5.85	11/14/96 11:35
CR-A157004	K047-55	ND	1	17.3	36.3	5.48	11/14/96 11:40
CR-A157006	K047-56	ND	1	16.1	35.8	5.4	11/14/96 11:45
CR-A157006	K047-56M	200	1	16.1	35.8	5.4	11/14/96 09:37
CR-A157006	K047-56S	216	1	16.1	35.8	5.4	11/14/96 09:42
CR-A157007	K047-57	ND	1	16.8	36.1	5.44	11/14/96 11:50
MBLK1S	TRK004SB	ND	1	NA	30	4.53	11/14/96 09:13
LCS1S	TRK004SL	174	1	NA	30	4.53	11/14/96 08:20
LCD1S	TRK004SC	182	1	NA	30	4.53	11/14/96 08:24

PQL: Practical Quantitation Limit
CAL REF: TRK009, for K047-56, 56M, 56S and 57
TRK010, for K047-47
AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: SOIL
% MOISTURE: NA

BATCH NO.: 96K047
SAMPLE ID: LCS1/LCD1S
CONTROL NO.: TRK004SL/C

DATE RECEIVED: NA
DATE EXTRACTED: 11/13/96 11:00
DATE ANALYZED: 11/14/96 09:13

ACCESSION: 96K047 96K055

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	150.00	174.00	116	150.00	182.00	121	4	50-140	50

003

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: SOIL
% MOISTURE: 16.1

BATCH NO.: 96K047
SAMPLE ID: CR-A157006
CONTROL NO.: K047-56

DATE RECEIVED: 11/12/96
DATE EXTRACTED: 11/13/96 11:00
DATE ANALYZED: 11/14/96 11:45

ACCESSION: 96K047 96K055

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	179.00	200.00	112	179.00	216.00	121	7	50-140	50

006

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	11/09/96
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	11/12/96
BATCH NO.:	96K047	DATE EXTRACTED:	11/13/96 10:00
MATRIX:	WATER	INSTRUMENT ID:	T-018
CAL REF:	TRK005	PREP BATCH:	TRK002W

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	PQL (mg/L)	MDL (mg/L)	ANALYZED DATETIME
CR-A152606	K047-09	ND	1	2	.44	11/13/96 17:42
MBLK1W	TRK002WB	ND	1	2	.44	11/13/96 17:30
LCS1W	TRK002WL	6.2	1	2	.44	11/13/96 17:35
LCD1W	TRK002WC	6.2	1	2	.44	11/13/96 17:40

PQL: Practical Quantitation Limit
AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 96K047
SAMPLE ID: LCS1W/LCD1W
CONTROL NO.: TRK002WL/C

DATE RECEIVED: NA
DATE EXTRACTED: 11/13/96 10:00
DATE ANALYZED: 11/13/96 17:30

ACCESSION: 96K047 96K042 96K021

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	6.16	123	5.00	6.16	123	0	60-130	30

008

EMAX
LABORATORIES, INC.
630 Maple Ave.
Torrance, CA 90503
Telephone: (310) 618-8889
Fax: (310) 618-0818

RECEIVED
DEC 13 1996
JE - Denve

Date: 12-11-1996
EMAX Batch No.: 96K065

Attn: Lynn Schuetter

Jacobs Engineering Group
600 17th. Street, STe. 1100N
Denver CO 80202

Subject: Laboratory Report
Project: Carswell AFB / 05G47900

Enclosed is the Laboratory report for samples received on 11/14/96. The data reported include :

Sample ID	Control #	Col Date	Matrix	Analysis
CR-A157101	K065-01	11/11/96	Soil	EPA 418.1
CR-A157103	K065-02	11/11/96	Soil	EPA 418.1
CR-A157104	K065-03	11/11/96	Soil	EPA 418.1
CR-A157104MS	K065-03M	11/11/96	Soil	EPA 418.1
CR-A157104MSD	K065-03S	11/11/96	Soil	EPA 418.1
CR-A157105	K065-04	11/11/96	Soil	EPA 418.1
CR-A157106	K065-05	11/11/96	Soil	EPA 418.1
CR-A157201	K065-06	11/11/96	Soil	EPA 418.1
CR-A157202	K065-07	11/11/96	Soil	EPA 418.1
CR-A157203	K065-08	11/11/96	Soil	EPA 418.1
CR-A157204	K065-09	11/11/96	Soil	EPA 418.1
CR-A157206	K065-10	11/11/96	Soil	EPA 418.1
CR-A157207	K065-11	11/11/96	Soil	EPA 418.1
CR-A157301	K065-12	11/12/96	Soil	EPA 418.1
CR-A157301MS	K065-12M	11/12/96	Soil	EPA 418.1
CR-A157301MSD	K065-12S	11/12/96	Soil	EPA 418.1
CR-A157302	K065-13	11/12/96	Soil	EPA 418.1
CR-A157302MS	K065-13M	11/12/96	Soil	EPA 418.1
CR-A157302MSD	K065-13S	11/12/96	Soil	EPA 418.1
CR-A157304	K065-14	11/12/96	Soil	EPA 418.1
CR-A157305	K065-15	11/12/96	Soil	EPA 418.1
CR-A157306	K065-16	11/12/96	Soil	EPA 418.1
CR-A159101	K065-17	11/12/96	Soil	EPA 418.1
CR-A159102	K065-18	11/12/96	Soil	EPA 418.1
CR-A159103	K065-19	11/12/96	Water	EPA 418.1

The results are summarized on the following pages.

Please feel free to call if you have any questions concerning these results.

Sincerely yours,

K. Y. Pang

Kam Y. Pang, Ph.D.
Laboratory Director

P.S. - All analyses requested for the above referenced project have been completed. Therefore, unless instructed, the remaining portions of the samples will be disposed after fifteen (15) days from the date of this report.

SAMPLE RECEIPT FORM

CONTROL NO.	96K0 65
CLIENT	9 ~~OHM~~ JACOBS CNH
PROJECT	Carswell AFB

DATE	11- 14 -96
TIME	10:00
RECIPIENT	T. PATEL

SAMPLE TRANSPORTATION TO EMAX LABORATORY:		BY	ON(DATE)	AT(TIME)	FROM(SITE/CO.)	COMMENTS
PICKED-UP BY EMAX COURIER						
DELIVERED BY CLIENT ✓						
SHIPPED/AIRBILL NO:	FEDEX APTN: 2149885850	SEE AIRBILL				

SAMPLE BATCH PACKAGING/SEALING UPON RECEIPT:			✓ INTACT	___DAMAGED	✓ SEALED	___NOT SEALED	___NO CONTAINER
CONTAINER:	INSIDE TEMPERATURE (4°C ± 2 °C)	2° °C		CUSTODY SEAL		LOCATION	NUMBER
✓ COOLER	PACKAGING	TYPE	SUFFICIENCY	✓ INTACT	___DAMAGED	FRONT CLOSURE	1
___BOX	INSULATION:		OK	NAME:	SEE COC	REAR CLOSURE	1
___OTHER:	ICE/COOLANT:	REGULAR		DATE:			
_____	PACKING MATERIAL:	BUBBLEPAK, POPCORN		TIME:			

SAMPLE DOCUMENTATION/CHAIN-OF-CUSTODY(COC)	___SEALED	✓ ENCLOSED	___HANDCARRIED	___FAXED	___MAILED

SAMPLE LOG-IN:	CRITERIA	COMMENTS	DISCREPANCY
SAMPLE CUSTODY SEAL	EVERY SAMPLE	NONE	
CONTAINER TYPE/MATERIAL	APPROPRIATE	OK	
SAMPLE AMOUNT	ENOUGH		
HOLDING TIME	SUFFICENT		
SAMPLE PRESERVATION (For appropriate preservative see GP-0001 Appendix I)	NaOH preserved samples pH ≥ 12 HNO_3 / H_2SO_4 preserved samples pH ≤ 2		
HEADSPACE/BUBBLES	ZERO/NONE		
SAMPLE LABEL INFORMATION	SUFFICIENT		
CHAIN-OF-CUSTODY INFORMATION	SUFFICIENT		

SAMPLE INFO.:	SAMPLE ID ✓	DATE ✓	TIME ✓	SIGNATURE ✓	ANALYSES ✓	PRESERVATIVE	CONTAINER ✓

INDIVIDUAL SAMPLE CONTAINER:	___NONE	✓ SEALED PLASTIC BAG	___CAN	___OTHER(SPECIFY): _____

SAMPLE NUMBER	CLIENT ID	DISCREPANCY	ACTION

CLIENT SERVICES COPY RECEIVED BY	[illegible] 11/14/96	DATE		TIME	

LABORATORY REPORT FOR

JACOBS ENGINEERING GROUP

CARSWELL AFB / 05G47900

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

SDG#: 96K065

DECEMBER 11, 1996

CASE NARRATIVE

CLIENT: JACOBS ENGINEERING GROUP

PROJECT: CARSWELL AFB / 05G47900

SDG: 96K065

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

One (1) water and eighteen (18) soil samples were received on 11/14/96 to be analyzed for total recoverable petroleum hydrocarbon in accordance with "Methods for the Chemical Analysis of Water and Wastes".

1. Holding Time

   Analytical holding time was met.

2. Method Blank

   Method blanks were free of contamination.

3. Matrix Spike/Matrix Spike Duplicate

   All recoveries and RPDs were within QC limits.

4. Lab Control Sample

   All recoveries were within QC limits.

5. Calibration

   Initial calibration was at five-point and continuing calibration were carried out at 10-samples interval. All QC requirements were met.

6. Sample Analysis

   All sample analyses were done within QC requirements.

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

11/27/1996 09:35

LAB CHRONICLE
EPA 418.1

CLIENT: Jacobs Engineering Group
PROJECT: Carswell AFB / 05G47900

SDG/BATCH NO.: 96K065
MATRIX: Soil

SAMPLE ID	CONTROL NO	%H2O	PREPARATION BATCH/DATE/TIME	ANALYTICAL BATCH/DATE/TIME	CALIB REF	FILE ID
CR-A157101	K065-01	19.8	11/19	11/20		
CR-A157103	K065-02	20.9				
CR-A157104	K065-03	10.9				
CR-A157104MS	K065-03M	10.9				
CR-A157104MSD	K065-03S	10.9				
CR-A157105	K065-04	17.1				
CR-A157106	K065-05	13.3				
CR-A157201	K065-06	14.5				
CR-A157202	K065-07	15.0				
CR-A157203	K065-08	15.8				
CR-A157204	K065-09	15.3				
CR-A157206	K065-10	14.4				
CR-A157207	K065-11	15.3				
CR-A157301	K065-12	24.0				
CR-A157301MS	K065-12M	24.0				
CR-A157301MSD	K065-12S	24.0				
CR-A157302	K065-13	17.5				
CR-A157302MS	K065-13M	17.5				
CR-A157302MSD	K065-13S	17.5				
CR-A157304	K065-14	11.4				
CR-A157305	K065-15	21.4				
-A157306	K065-16	14.2				
CR-A159101	K065-17	22.3				
CR-A159102	K065-18	15.8				

K065 - EPA 418.1

THBLK01	TRK005 SW	11/19	11/20
LCS1	SL		
LCD1	SC		
THBLK02	TRK006 SW		
LCS2	SL		
LCD2	SC		

11/27/1996 09:35

LAB CHRONICLE
EPA 418.1

CLIENT: Jacobs Engineering Group
PROJECT: Carswell AFB / 05G47900

SDG/BATCH NO.: 96K065
MATRIX: Water

SAMPLE ID	CONTROL NO	%H2O	PREPARATION BATCH/DATE/TIME	ANALYTICAL BATCH/DATE/TIME	CALIB REF	FILE ID
CR-A159103	K065-19	NA	11/23	11/23		
	TRK008 WB					
	WL					
	WC					

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	11/11/96
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	11/14/96
BATCH NO.:	96K065	DATE EXTRACTED:	11/19/96 15:00
MATRIX:	SOIL	INSTRUMENT ID:	T-018
CAL REF:	TRK013-1	PREP BATCH:	TRK005S

SAMPLE ID	CONTROL NO	RESULT (mg/kg)	DL FACTOR	MOIST (%)	PQL (mg/kg)	MDL (mg/kg)	ANALYZED DATETIME
CR-A157101	K065-01	ND	1	19.8	37.4	5.65	11/20/96 09:00
CR-A157103	K065-02	ND	1	20.9	37.9	5.72	11/20/96 09:05
CR-A157104	K065-03	ND	1	10.9	33.7	5.08	11/20/96 09:10
CR-A157104MS	K065-03M	179	1	10.9	33.7	5.08	11/20/96 09:18
CR-A157104MSD	K065-03S	179	1	10.9	33.7	5.08	11/20/96 09:20
CR-A157105	K065-04	ND	1	17.1	36.2	5.46	11/20/96 09:15
CR-A157106	K065-05	ND	1	13.3	34.6	5.22	11/20/96 09:30
CR-A157201	K065-06	ND	1	14.5	35.1	5.3	11/20/96 09:35
CR-A157202	K065-07	ND	1	15.0	35.3	5.33	11/20/96 09:40
CR-A157203	K065-08	ND	1	15.8	35.6	5.38	11/20/96 09:45
CR-A157204	K065-09	ND	1	15.3	35.4	5.35	11/20/96 09:50
CR-A157206	K065-10	ND	1	14.4	35	5.29	11/20/96 09:55
CR-A157207	K065-11	ND	1	15.3	35.4	5.35	11/20/96 10:00
CR-A157301	K065-12	ND	1	24.0	39.5	5.96	11/20/96 10:05
CR-A157301MS	K065-12M	234	1	24.0	39.5	5.96	11/20/96 10:08
CR-A157301MSD	K065-12S	236	1	24.0	39.5	5.96	11/20/96 10:11
CR-A157302	K065-13	ND	1	17.5	36.4	5.49	11/20/96 11:25
CR-A157302MS	K065-13M	196	1	17.5	36.4	5.49	11/20/96 11:27
CR-A157302MSD	K065-13S	204	1	17.5	36.4	5.49	11/20/96 11:29
CR-A157304	K065-14	ND	1	11.4	33.9	5.11	11/20/96 11:00
CR-A157305	K065-15	ND	1	21.4	38.2	5.76	11/20/96 11:05
CR-A157306	K065-16	ND	1	14.2	35	5.28	11/20/96 11:10
CR-A159101	K065-17	ND	1	22.3	38.6	5.83	11/20/96 11:15
CR-A159102	K065-18	ND	1	15.8	35.6	5.38	11/20/96 12:00
MBLK1S	TRK005SB	ND	1	NA	30	4.53	11/20/96 08:30
LCS1S	TRK005SL	172	1	NA	30	4.53	11/20/96 08:32
LCD1S	TRK005SC	173	1	NA	30	4.53	11/20/96 08:35
MBLK2S	TRK006SB	ND	1	NA	30	4.53	11/20/96 11:17
LCS2S	TRK006SL	162	1	NA	30	4.53	11/20/96 11:18
LCD2S	TRK006SC	163	1	NA	30	4.53	11/20/96 11:20

PQL: Practical Quantitation Limit
AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: SOIL
% MOISTURE: 10.9

BATCH NO.: 96K065
SAMPLE ID: CR-A157104
CONTROL NO.: K065-03

DATE RECEIVED: 11/14/96
DATE EXTRACTED: 11/19/96 15:00
DATE ANALYZED: 11/20/96 09:10

ACCESSION: 96K065

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	168.35	178.45	106	168.35	178.45	106	0	50-140	50

AFCEE Ver. 1.0

900

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: SOIL
% MOISTURE: 24.0

BATCH NO.: 96K065
SAMPLE ID: CR-A157301
CONTROL NO.: K065-12

DATE RECEIVED: 11/14/96
DATE EXTRACTED: 11/19/96 15:00
DATE ANALYZED: 11/20/96 10:05

ACCESSION: 96K065

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	197.37	223.68	113	197.37	235.53	119	5	50-140	50

AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: SOIL
% MOISTURE: 17.5

BATCH NO.: 96K065
SAMPLE ID: CR-A157302
CONTROL NO.: K065-13

DATE RECEIVED: 11/14/96
DATE EXTRACTED: 11/19/96 15:00
DATE ANALYZED: 11/20/96 11:25

ACCESSION: 96K065 K021 K021A K028 K037

PARAMETER	SMPL RSLT (mg/kg)	SPIKE AMT (mg/kg)	MS RSLT (mg/kg)	MS % REC	SPIKE AMT (mg/kg)	MSD RSLT (mg/kg)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	181.82	196.36	108	181.82	203.64	112	4	50-140	50

AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: SOIL
% MOISTURE: NA

BATCH NO.: 96K065
SAMPLE ID: LCS1S/LCS1SD
CONTROL NO.: TRK005SL/C

DATE RECEIVED: NA
DATE EXTRACTED: 11/19/96 15:00
DATE ANALYZED: 11/20/96 08:30

ACCESSION: 96K065 K021 K021A K028 K037

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	150.00	172.00	115	150.00	173.00	115	1	50-140	50

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: SOIL
% MOISTURE: NA

BATCH NO.: 96K065
SAMPLE ID: LCS2S/LCS2SD
CONTROL NO.: TRK006SL/C

DATE RECEIVED: NA
DATE EXTRACTED: 11/19/96 15:00
DATE ANALYZED: 11/20/96 11:17

ACCESSION: 96K065 K021 K021A K028 K037

PARAMETER	BLNK RSLT (mg/kg)	SPIKE AMT (mg/kg)	BS RSLT (mg/kg)	BS % REC	SPIKE AMT (mg/kg)	BSD RSLT (mg/kg)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	150.00	162.00	108	150.00	163.00	109	1	50-140	50

10

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	11/12/96
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	11/14/96
BATCH NO.:	96K065	DATE EXTRACTED:	11/23/96 08:00
MATRIX:	WATER	INSTRUMENT ID:	T-018
CAL REF:	TRK018-1	PREP BATCH:	TRK008W

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	PQL (mg/L)	MDL (mg/L)	ANALYZED DATETIME
CR-A159103	K065-19	ND	1	2	.44	11/23/96 13:00
MBLK1W	TRK008WB	ND	1	2	.44	11/23/96 12:10
LCS1W	TRK008WL	4.84	1	2	.44	11/23/96 12:15
LCD1W	TRK008WC	5.06	1	2	.44	11/23/96 12:20

PQL: Practical Quantitation Limit
AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 96K065
SAMPLE ID: LCS1W/LCS1WD
CONTROL NO.: TRK008WL/C

DATE RECEIVED: NA
DATE EXTRACTED: 11/23/96 08:00
DATE ANALYZED: 11/23/96 12:10

ACCESSION: 96K065

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	4.84	97	5.00	5.06	101	4	60-130	30

EMAX
LABORATORIES, INC.
630 Maple Ave.
Torrance, CA 90503
Telephone: (310) 618-8889
Fax: (310) 618-0818

Date: 03-10-1997
EMAX Batch No.: 97C025

Attn: Lynn Schuetter

Jacobs Engineering Group
600 17th. Street, Ste. 1100N
Denver CO 80202

Subject: Laboratory Report
Project: Carswell AFB / 05G47900

Enclosed is the Laboratory report for samples received on 03/07/97. The data reported include :

Sample ID	Control #	Col Date	Matrix	Analysis
CR-A158301	C025-01	03/04/97	Water	EPA 418.1
CR-A158301MS	C025-01M	03/04/97	Water	EPA 418.1
CR-A158301MSD	C025-01S	03/04/97	Water	EPA 418.1
CR-A158302	C025-02	03/05/97	Water	EPA 418.1
CR-A158303	C025-03	03/05/97	Water	EPA 418.1
CR-A158304	C025-04	03/06/97	Water	EPA 418.1
CR-A158401	C025-05	03/04/97	Water	EPA 418.1
CR-A158402	C025-06	03/04/97	Water	EPA 418.1
CR-A158403	C025-07	03/05/97	Water	EPA 418.1

The results are summarized on the following pages.

Please feel free to call if you have any questions concerning these results.

Sincerely yours,

Kam Y. Pang, Ph.D.
Laboratory Director

P.S. - All analyses requested for the above referenced project have been completed. Therefore, unless instructed, the remaining portions of the samples will be disposed after fifteen (15) days from the date of this report.

FedEx USA Airbill — Tracking Number 9298823645

97 COLS
3-7-97
10:00 AM

Recipient's Copy

1 From

Date 3/6/97 [redacted]

Sender's Name DAN SCHULTZ Phone (303) 620-8410

Dept./Floor/Suite/Room

Company JACOBS ENGINEERING

Address 600 17TH ST. STE. 1100N

City DENVER State CO Zip 80202

2 Your Internal Billing Reference Information 05G47900-50501

3 To

Recipient's Name SAMPLE RECEIVING Phone (310) 618-8889

Dept./Floor/Suite/Room

Company EMAX LABS INC

Address 630 MAPLE AVE.

(To "HOLD" at FedEx location, print FedEx address here)*

City TORRANCE State CA Zip 90503

For HOLD at FedEx Location check here

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9 2 9 8 8 2 3 6 4 5

4 Service Delivery commitment may be later in some areas.

- [ ] FedEx Priority Overnight (Next business morning)
- [ ] FedEx Standard Overnight (Next business afternoon)
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- [ ] FedEx Overnight Freight
- [ ] FedEx 2Day Freight

(For packages over 150 pounds. Call for delivery schedule.)

- [ ] NEW FedEx First Overnight (Earliest next business morning delivery to select locations) (Higher rates apply)

*FedEx Letter Rate not available. Minimum charge: One pound FedEx 2Day rate

5 Packaging

- [ ] FedEx Letter*
- [ ] FedEx Pak*
- [ ] FedEx Box
- [ ] FedEx Tube
- [x] Other Packaging

Declared value limit $500

6 Special Handling

Does this shipment contain dangerous goods?

- [ ] Yes (As per attached Shipper's Declaration)
- [ ] Yes (Shipper's Declaration not required)
- [ ] Dry Ice — Dry Ice, 9, UN 1845 III, ____ kg, 904 (Dangerous Goods Shipper's Declaration not required)
- CA [ ] Cargo Aircraft Only

7 Payment

Bill to:

- [x] Sender (Account no. in section 1 will be billed)
- [ ] Recipient
- [ ] Third Party
- [ ] Credit Card
- [ ] Cash/Check

(Enter FedEx account no. or Credit Card no. below)

- [ ] Obtain Recipient FedEx Account No.

[redacted]

Total Packages	Total Weight	Total Declared Value	Total Charges
1	54	$ .00	$

*When declaring a value higher than $100 per package, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY section for further information.

Credit Card Auth.

8 Release Signature

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

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FORM ID NO. 0200

Rev. Date 10/95 • PART #147382
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GOFE 1/96

SAMPLE RECEIPT FORM

CONTROL NO.	97C025
CLIENT	JACOBS ENG.
PROJECT	CARSWELL AFB D021

DATE	03-07-97
TIME	10:00 AM
RECIPIENT	I. PATEL

3-7-97

SAMPLE TRANSPORTATION TO EMAX LABORATORY:		BY	ON(DATE)	AT(TIME)	FROM(SITE/CO.)	COMMENTS
PICKED-UP BY EMAX COURIER						
DELIVERED BY CLIENT ✓						
SHIPPED/AIRBILL NO:	FEDEX APTN: 9298823645	SEE AIRBILL				

SAMPLE BATCH PACKAGING/SEALING UPON RECEIPT:			✓ INTACT	___ DAMAGED	✓ SEALED	___ NOT SEALED	___ NO CONTAINER
CONTAINER:	INSIDE TEMPERATURE (4°C ± 2 °C) 4° °C			CUSTODY SEAL		LOCATION	NUMBER
✓ COOLER	PACKAGING	TYPE	SUFFICIENCY	✓ INTACT	___ DAMAGED	FRONT CLOSURE	1
___ BOX	INSULATION:			NAME:	SEE COC	REAR CLOSURE	1
___ OTHER:	ICE/COOLANT:	REGULAR	OK	DATE:			
	PACKING MATERIAL:	STYRO, BUBBLEPAK		TIME:			

SAMPLE DOCUMENTATION/CHAIN-OF-CUSTODY(COC)	___ SEALED	✓ ENCLOSED	___ HANDCARRIED	___ FAXED	___ MAILED

SAMPLE LOG-IN:		CRITERIA	COMMENTS			DISCREPANCY	
SAMPLE CUSTODY SEAL		EVERY SAMPLE	NONE				
CONTAINER TYPE/MATERIAL		APPROPRIATE	OK				
SAMPLE AMOUNT		ENOUGH					
HOLDING TIME		SUFFICENT					
SAMPLE PRESERVATION (For appropriate preservative see GP-0001 Appendix I)		NaOH preserved samples pH ≥ 12 HNO_3 / H_2SO_4 preserved samples pH ≤ 2					
HEADSPACE/BUBBLES		ZERO/NONE					
SAMPLE LABEL INFORMATION		SUFFICIENT					
CHAIN-OF-CUSTODY INFORMATION		SUFFICIENT	SEE BELOW				
SAMPLE INFO.:	SAMPLE ID ✓	DATE ✓	TIME ✓	SIGNATURE ✓	ANALYSES ✓	PRESERVATIVE ✓	CONTAINER ✓

INDIVIDUAL SAMPLE CONTAINER: ___ NONE ✓ SEALED PLASTIC BAG ___ CAN ___ OTHER(SPECIFY): ___

SAMPLE NUMBER	CLIENT ID	DISCREPANCY	ACTION
-1	CR-A158301	REC'D (2) 1 LAMBER CONTAINERS	✓
		BUT COC SAYS (1) — MS/MSD	

Claudia 3/7/97

CLIENT SERVICES	RECEIVED BY		DATE		TIME	

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

LABORATORY REPORT FOR

JACOBS ENGINEERING GROUP, INC.

CARSWELL AFB / 05G47900

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

SDG#: 97C025

MARCH 10, 1997

CASE NARRATIVE

CLIENT: JACOBS ENGINEERING GROUP, INC.

PROJECT: CARSWELL AFB / 05G47900

SDG: 97C025

EPA 418.1
TRPH

Seven (7) water samples were received on 03/07/97 to be analyzed for total recoverable petroleum hydrocarbon in accordance with "Methods for the Chemical Analysis of Water and Wastes".

1. Holding Time

   Analytical holding time was met.

2. Method Blank

   Method blank was free of contamination.

3. Matrix Spike/Matrix Spike Duplicate

   All recoveries and RPD were within QC limits.

4. Lab Control Sample/Lab Control Sample Duplicate

   All recoveries were within QC limits.

5. Calibration

   Initial calibration was at five-point and continuing calibration were carried out at 10-samples interval. All QC requirements were met.

6. Sample Analysis

   All sample analyses were done within QC requirements.

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

03/10/1997 11:04

LAB CHRONICLE
EPA 418.1

CLIENT: Jacobs Engineering Group
PROJECT: Carswell AFB / 05G47900

SDG/BATCH NO.: 97C025
MATRIX: Water

SAMPLE ID	CONTROL NO	%H2O	PREPARATION BATCH/DATE/TIME	ANALYTICAL BATCH/DATE/TIME	CALIB REF	FILE ID
CR-A158301	C025-01	NA	TRC004DC 03/07/97 12:00	TRC008C 03/07/97 13:30	TR010CC	NA
CR-A158301MS	C025-01M	NA			13:35	
CR-A158301MSD	C025-01S	NA			13:40	
CR-A158302	C025-02	NA			13:45	
CR-A158303	C025-03	NA			13:50	
CR-A158304	C025-04	NA			13:55	
CR-A158401	C025-05	NA			14:30 TRC010CC	
CR-A158402	C025-06	NA			14:00 TRC010CC	
CR-A158403	C025-07	NA			14:05	
	~~C025-01W~~		FY 3/7/97			
	~~-01S~~					
	TRC004WB				13:00	
	WL				13:05 TRC004CC	
	WC				13:10	

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	03/04/97
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	03/07/97
BATCH NO.:	97C025	DATE EXTRACTED:	03/07/97 12:00
MATRIX:	WATER	INSTRUMENT ID:	T-018
CAL REF:	TRC010CC	PREP BATCH:	TRC004W

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	PQL (mg/L)	MDL (mg/L)	ANALYZED DATETIME
CR-A158301	C025-01	ND	1	1	.44	03/07/97 13:30
CR-A158301MS	C025-01M	5.79	1	1	.44	03/07/97 13:35
CR-A158301MSD	C025-01S	6.10	1	1	.44	03/07/97 13:40
CR-A158302	C025-02	ND	1	1	.44	03/07/97 13:45
CR-A158303	C025-03	ND	1	1	.44	03/07/97 13:50
CR-A158304	C025-04	ND	1	1	.44	03/07/97 13:55
CR-A158401	C025-05	ND	1	1	.44	03/07/97 14:30
CR-A158402	C025-06	ND	1	1	.44	03/07/97 14:00
CR-A158403	C025-07	ND	1	1	.44	03/07/97 14:05
MBLK1W	TRC004WB	ND	1	1	.44	03/07/97 13:00
LCS1W	TRC004WL	4.83	1	1	.44	03/07/97 13:05
LCD1W	TRC004WC	5.23	1	1	.44	03/07/97 13:10

PQL: Practical Quantitation Limit
CAL REF: TRC012CC, for C025-05
TRC009CC, for TRC004WL and C

AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97C025
SAMPLE ID: CR-A158301
CONTROL NO.: C025-01

DATE RECEIVED: 03/07/97
DATE EXTRACTED: 03/07/97 12:00
DATE ANALYZED: 03/07/97 13:30

ACCESSION: 97C025

PARAMETER	SMPL RSLT (mg/L)	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	5.79	116	5.00	6.10	122	5	60-130	30

AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97C025
SAMPLE ID: LCS1W/LCD1W
CONTROL NO.: TRC004WL/C

DATE RECEIVED: 03/07/97
DATE EXTRACTED: 03/07/97 12:00
DATE ANALYZED: 03/07/97 13:00

ACCESSION: 97C025

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	4.83	97	5.00	5.23	105	8	60-130	30

EMAX
LABORATORIES, INC.
630 Maple Ave.
Torrance, CA 90503
Telephone: (310) 618-8889
Fax: (310) 618-0818

Date: 03-24-1997
EMAX Batch No.: 97C075

Attn: Lynn Schuetter

Jacobs Engineering Group
600 17th. Street, Ste. 1100N
Denver CO 80202

Subject: Laboratory Report
Project: Carswell AFB / 05G47900

Enclosed is the Laboratory report for samples received on 03/21/97. The data reported include :

Sample ID	Control #	Col Date	Matrix	Analysis
CR-A161501	C075-01	03/19/97	Water	EPA 418.1
CR-A161502	C075-02	03/20/97	Water	EPA 418.1
CR-A161503	C075-03	03/19/97	Water	EPA 418.1
CR-A161504	C075-04	03/20/97	Water	EPA 418.1
CR-A161505	C075-05	03/19/97	Water	EPA 418.1
CR-A161506	C075-06	03/19/97	Water	EPA 418.1
CR-A161503MS	C075-03M	03/19/97	Water	EPA 418.1
CR-A161503MSD	C075-03S	03/19/97	Water	EPA 418.1

The results are summarized on the following pages.

Please feel free to call if you have any questions concerning these results.

Sincerely yours,

Kam Y. Pang, Ph.D.
Laboratory Director

P.S. - All analyses requested for the above referenced project have been completed. Therefore, unless instructed, the remaining portions of the samples will be disposed after fifteen (15) days from the date of this report.

SAMPLE RECEIPT FORM

CONTROL NO.	97C 075
CLIENT	Jacobs
PROJECT	Carswell AFB

DATE	03-21-97
TIME	10:00
RECIPIENT	IP

G 3-24-97

SAMPLE TRANSPORTATION TO EMAX LABORATORY:	BY	ON(DATE)	AT(TIME)	FROM(SITE/CO.)	COMMENTS
PICKED-UP BY EMAX COURIER					
DELIVERED BY CLIENT					
SHIPPED/AIRBILL NO: Fedex see airbill 9298823623 SEE AIRBILL					

SAMPLE BATCH PACKAGING/SEALING UPON RECEIPT:			✓ INTACT	___ DAMAGED	✓ SEALED	___ NOT SEALED	___ NO CONTAINER
CONTAINER:	INSIDE TEMPERATURE (4°C ± 2 °C)		2 °C	CUSTODY SEAL		LOCATION	NUMBER
✓ COOLER	PACKAGING	TYPE	SUFFICIENCY	✓ INTACT	___ DAMAGED	FRONT closure	2
___ BOX	INSULATION:			NAME:	see coc		
___ OTHER:	ICE/COOLANT:	regular	OK	DATE:			
_____	PACKING MATERIAL:	none		TIME:			

SAMPLE DOCUMENTATION/CHAIN-OF-CUSTODY(COC)	___ SEALED	✓ ___ ENCLOSED	___ HANDCARRIED	___ FAXED	___ MAILED

SAMPLE LOG-IN:	CRITERIA	COMMENTS	DISCREPANCY
SAMPLE CUSTODY SEAL	EVERY SAMPLE	OK	
CONTAINER TYPE/MATERIAL	APPROPRIATE		
SAMPLE AMOUNT	ENOUGH		
HOLDING TIME	SUFFICENT		
SAMPLE PRESERVATION (For appropriate preservative see GP-0001 Appendix I)	NaOH preserved samples pH ≥ 12 HNO_3 / H_2SO_4 preserved samples pH ≤ 2		
HEADSPACE/BUBBLES	ZERO/NONE		
SAMPLE LABEL INFORMATION	SUFFICIENT		
CHAIN-OF-CUSTODY INFORMATION	SUFFICIENT		

SAMPLE INFO.:	SAMPLE ID	DATE	TIME	SIGNATURE	ANALYSES	PRESERVATIVE	CONTAINER

INDIVIDUAL SAMPLE CONTAINER:	___ NONE	___ SEALED PLASTIC BAG	___ CAN	___ OTHER(SPECIFY): _____

SAMPLE NUMBER	CLIENT ID	DISCREPANCY	ACTION

CLIENT SERVICES COPY RECEIVED BY	Ceilie 3/21/97	DATE		TIME	

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

FedEx *USA Airbill*

Tracking Number 9298823623

97C075
3-21-97
10:00 AM

Recipient's Copy

1 From

Date 3/20/97

Sender's Name Mike Johnson Phone 303 575-8825

Dept./Floor/Suite/Room

Company Jacobs Engineering

Address 600 17th St Suite 1100N

City Denver State Co Zip 80202

2 Your Internal Billing Reference Information

3 To

Recipient's Name Cecilia Chavez Phone 310 618-8889

Dept./Floor/Suite/Room

Company EMAX

Address 630 Maple Ave
(To "HOLD" at FedEx location, print FedEx address here)

City Torrance State Ca Zip 90503

For HOLD at FedEx Location check here

☐ Hold Weekday (Not available with FedEx First Overnight)

☐ Hold Saturday (Not available at all locations) (Not available with FedEx First Overnight or FedEx Standard Overnight)

For Saturday Delivery check here

☐ (Extra Charge. Not available to all locations) (Not available with FedEx First Overnight or FedEx Standard Overnight)

9 2 9 8 8 2 3 6 2 3

4 Service Delivery commitment may be later in some areas

☐ FedEx Priority Overnight (Next business morning)

☒ FedEx Standard Overnight (Next business afternoon)

☐ FedEx 2Day* (Second business day)

☐ FedEx Govt. Overnight (Authorized user only)

☐ (Next business day)

☐ FedEx Overnight Freight ☐ FedEx 2Day Freight
(For packages over 150 pounds. Call for delivery schedule.)

☐ NEW FedEx First Overnight (Earliest next business morning delivery to select locations) (Higher rates apply)

*FedEx Letter Rate not available. Minimum charge: One pound FedEx 2Day rate

5 Packaging

☐ FedEx Letter* ☐ FedEx Pak* (Declared value limit $500) ☐ FedEx Box ☐ FedEx Tube ☒ Other Packaging

6 Special Handling

Does this shipment contain dangerous goods?

☐ Yes (As per attached Shipper's Declaration) ☐ Yes (Shipper's Declaration not required)

☐ Dry Ice — Dry ice, 9, UN 1845 III ____ x ____ kg 904 (Dangerous Goods Shipper's Declaration not required)

CA ☐ Cargo Aircraft Only

7 Payment

Bill to: ☒ Sender (Account no. in section 1 will be billed) ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

(Enter FedEx account no. or Credit Card no. below)

☐ Obtain Recipient FedEx Account No.

Total Packages	Total Weight	Total Declared Value*	Total Charges
1	5	$ .00	$

*When declaring a value higher than $100 per package, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY section for further information.

Credit Card Auth.

8 Release Signature

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

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FORM ID NO 0200

Rev. Date 10/95 • PART #147382
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GBFE 1/96

LABORATORY REPORT FOR

JACOBS ENGINEERING GROUP, INC.

CARSWELL AFB / 05G47900

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

SDG#: 97C075

MARCH 24, 1997

CASE NARRATIVE

CLIENT: JACOBS ENGINEERING GROUP, INC.

PROJECT: CARSWELL AFB / 05G47900

SDG: 97C075

EPA 418.1
TRPH

Six (6) water samples were received on 03/21/97 to be analyzed for total recoverable petroleum hydrocarbon in accordance with "Methods for the Chemical Analysis of Water and Wastes".

1. Holding Time

   Analytical holding time was met.

2. Method Blank

   Method blank was free of contamination.

3. Matrix Spike/Matrix Spike Duplicate

   All recoveries and RPD were within QC limits.

4. Lab Control Sample/Lab Control Sample Duplicate

   All recoveries were within QC limits.

5. Calibration

   Initial calibration was at six-point and continuing calibration were carried out at 10-samples interval. All QC requirements were met.

6. Sample Analysis

   All sample analyses were done within QC requirements.

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

03/24/1997 11:06

LAB CHRONICLE
EPA 418.1

CLIENT: Jacobs Engineering Group
PROJECT: Carswell AFB / 05G47900

SDG/BATCH NO.: 97C075
MATRIX: Water

SAMPLE ID	CONTROL NO	%H2O	PREPARATION BATCH/DATE/TIME	ANALYTICAL BATCH/DATE/TIME	CALIB REF	FILE ID
CR-A161501	C075-01	NA	TRC011WB 03/24/97 9:00	TRC030WB 03/24/97 12:10	TRC030CC	NA
CR-A161502	C075-02	NA		12:15		
CR-A161503	C075-03	NA		12:20		
CR-A161504	C075-04	NA		12:35		
CR-A161505	C075-05	NA		12:40		
CR-A161506	C075-06	NA		12:55	TRC030CC	
CR-A161503MS	C075-03M	NA		12:25	TRC030CC	
CR-A161503MSD	C075-03S	NA		12:30		
MBLK1W	TRC011WB			11:55	TRC030CC	
LCS1W		WC		12:00		
LCD1W		WC		12:05		

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	03/19/97
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	03/21/97
BATCH NO.:	97C075	DATE EXTRACTED:	03/24/97 09:00
MATRIX:	WATER	INSTRUMENT ID:	T-018
CAL REF:	TRC030CC	PREP BATCH:	TRC011W

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	PQL (mg/L)	MDL (mg/L)	ANALYZED DATETIME
CR-A161501	C075-01	ND	1	1	.44	03/24/97 12:10
CR-A161502	C075-02	ND	1	1	.44	03/24/97 12:15
CR-A161503	C075-03	ND	1	1	.44	03/24/97 12:20
CR-A161504	C075-04	ND	1	1	.44	03/24/97 12:35
CR-A161505	C075-05	ND	1	1	.44	03/24/97 12:40
CR-A161506	C075-06	ND	1	1	.44	03/24/97 12:55
CR-A161503MS	C075-03M	4.97	1	1	.44	03/24/97 12:25
CR-A161503MSD	C075-03S	5.42	1	1	.44	03/24/97 12:30
MBLK1W	TRC011WB	ND	1	1	.44	03/24/97 11:55
LCS1W	TRC011WL	5.42	1	1	.44	03/24/97 12:00
LCD1W	TRC011WC	5.09	1	1	.44	03/24/97 12:05

PQL: Practical Quantitation Limit
CAL REF: TRC031CC, for C075-06
AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97C075
SAMPLE ID: CR-A161503
CONTROL NO.: C075-03

DATE RECEIVED: 03/21/97
DATE EXTRACTED: 03/24/97 09:00
DATE ANALYZED: 03/24/97 12:20

ACCESSION: 97C075

PARAMETER	SMPL RSLT (mg/L)	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	4.97	99	5.00	5.42	108	9	60-130	30

AFCEE Ver. 1.0

004

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97C075
SAMPLE ID: LCS1W/LCD1W
CONTROL NO.: TRC011WL/C

DATE RECEIVED: NA
DATE EXTRACTED: 03/24/97 09:00
DATE ANALYZED: 03/24/97 11:55

ACCESSION: 97C075

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	5.42	108	5.00	5.09	102	6	60-130	30

005

EMAX
LABORATORIES, INC.
630 Maple Ave.
Torrance, CA 90503
Telephone: (310) 618-8889
Fax: (310) 618-0818

RECEIVED
APR 17 1997

Date: 04-14-1997
EMAX Batch No.: 97D029

Attn: Lynn Schuetter

Jacobs Engineering Group
600 17th. Street, Ste. 1100N
Denver CO 80202

Subject: Laboratory Report
Project: Carswell AFB / 05G47900

Enclosed is the Laboratory report for samples received on 04/05/97. The data reported include :

Sample ID	Control #	Col Date	Matrix	Analysis
CR-A161701	D029-01	04/03/97	Water	EPA 418.1
CR-A161702	D029-02	04/04/97	Water	EPA 418.1
CR-A161703	D029-03	04/02/97	Water	EPA 418.1
CR-A161704	D029-04	04/03/97	Water	EPA 418.1
CR-A161705	D029-05	04/03/97	Water	EPA 418.1
CR-A161706	D029-06	04/04/97	Water	EPA 418.1
CR-A161707	D029-07	04/04/97	Water	EPA 418.1

The results are summarized on the following pages.

Please feel free to call if you have any questions concerning these results.

Sincerely yours,

Kam Pang

Kam Y. Pang, Ph.D.
Laboratory Director

P.S. - All analyses requested for the above referenced project have been completed. Therefore, unless instructed, the remaining portions of the samples will be disposed after fifteen (15) days from the date of this report.

97D029 H1

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1617

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: EMAX LABORATORIES, INC.
PROJECT NUMBER: 05C47900
630 Maple Avenue
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
1 CR-A161701	4/3/97	18:35	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		T=2°C
2 CR-A161702	4/4/97	0825	MJ	~~1~~ 2	1 L Amber Glass	4C H2SO4	W	E418.1	MS/MSD	
3 CR-A161703	4/2/97	19:01	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		
4 CR-A161704	4/3/97	12:30	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		
5 CR-A161705	4/3/97	12:58	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		
6 CR-A 161706	4/4/97	0905	MJ	1	1 L Am Glass	4C H2SO4	W	E418.1		
7 CR-A 161707	4/4/97	1200	MJ	1	1 L Am Glass	4C H2SO4	W	E418.1		

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
[signature]	4/4/97	15:00	17 DAY

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
[signature]	4/5/97	10:00 AM		/ /	:

RECORD RETURNED BY	DATE	TIME	SHIPPING NUMBER:
	/ /	:	

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

SAMPLE RECEIPT FORM

CONTROL NO.	97D029
CLIENT	JACOBS ENG
PROJECT	CARSWELL AFB D021

DATE	04-05-97
TIME	10:00 AM
RECIPIENT	I. PATEL

15 4-5-97

SAMPLE TRANSPORTATION TO EMAX LABORATORY:		BY	ON(DATE)	AT(TIME)	FROM(SITE/CO.)	COMMENTS
PICKED-UP BY EMAX COURIER						
DELIVERED BY CLIENT ✓						
SHIPPED/AIRBILL NO:	FEDEX APTN: 2946027792	SEE AIRBILL				

SAMPLE BATCH PACKAGING/SEALING UPON RECEIPT:			✓ INTACT	___DAMAGED	___SEALED	✓ NOT SEALED	___NO CONTAINER
CONTAINER:	INSIDE TEMPERATURE (4°C ± 2 °C)	2° °C		CUSTODY SEAL		LOCATION	NUMBER
✓ COOLER	PACKAGING	TYPE	SUFFICIENCY	___INTACT	___DAMAGED		
___BOX	INSULATION:		OK	NAME:			
___OTHER:	ICE/COOLANT:	REGULAR		DATE:			
	PACKING MATERIAL:	BUBBLEPAK		TIME:			

SAMPLE DOCUMENTATION/CHAIN-OF-CUSTODY(COC)	___SEALED	✓ ENCLOSED	___HANDCARRIED	___FAXED	___MAILED

SAMPLE LOG-IN:	CRITERIA	COMMENTS	DISCREPANCY
SAMPLE CUSTODY SEAL	EVERY SAMPLE	NONE	
CONTAINER TYPE/MATERIAL	APPROPRIATE	OK	
SAMPLE AMOUNT	ENOUGH		
HOLDING TIME	SUFFICENT		
SAMPLE PRESERVATION (For appropriate preservative see GP-0001 Appendix I)	NaOH preserved samples pH ≥ 12 HNO_3 / H_2SO_4 preserved samples pH ≤ 2		
HEADSPACE/BUBBLES	ZERO/NONE		
SAMPLE LABEL INFORMATION	SUFFICIENT		
CHAIN-OF-CUSTODY INFORMATION	SUFFICIENT		

SAMPLE INFO.:	SAMPLE ID	DATE	TIME	SIGNATURE	ANALYSES	PRESERVATIVE	CONTAINER

INDIVIDUAL SAMPLE CONTAINER:	___NONE	✓ SEALED PLASTIC BAG	___CAN	___OTHER(SPECIFY): BUBBLE BAG

SAMPLE NUMBER	CLIENT ID	DISCREPANCY	ACTION

CLIENT SERVICES / RECEIVED BY [illegible] DATE TIME

EMAX LABORATORIES INC. 630 Maple Ave. Torrance CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

FedEx. *USA Airbill* Tracking Number 2946027792

97D029
4-5-97 10:00 AM

Recipient's Copy

1 From

Date 4/4/97

Sender's Name Mike Johnson Phone (303) 620-8468

Dept./Floor/Suite/Room

Company Jacobs Eng

Address 600 17th St Suite 1100N

City Denver State Co Zip 80202

2 Your Internal Billing Reference Information

3 To

Recipient's Name Cecilia Chavez Phone (310) 618-8889

Dept./Floor/Suite/Room

Company EMAX Laboratories

Address 630 Maple Ave.
(To "HOLD" at FedEx location, print FedEx address here)

City Torrance State Ca Zip 90503

For HOLD at FedEx Location check here
- [ ] Hold Weekday (Not available with FedEx First Overnight)
- [ ] Hold Saturday (Not available at all locations) (Not available with FedEx First Overnight or FedEx Standard Overnight)

For Saturday Delivery check here
- [x] (Extra Charge. Not available to all locations) (Not available with FedEx First Overnight or FedEx Standard Overnight)

4a Express Package Service *Packages under 150 lbs.* Delivery commitment may be later in some areas
- [x] FedEx Priority Overnight (Next business morning)
- [ ] FedEx Standard Overnight (Next business afternoon)
- [ ] FedEx 2Day* (Second business day)
- [ ] NEW FedEx First Overnight (Earliest next business morning delivery to select locations) (Higher rates apply)

* FedEx Letter Rate not available. Minimum charge: One pound FedEx 2Day rate.

4b Express Freight Service *Packages over 150 lbs.* Delivery commitment may be later in some areas
- [ ] FedEx Overnight Freight (Next business day service for any distance)
- [ ] FedEx 2Day Freight (Second business day service for any distance)
- [ ] FedEx Express Saver Freight (Up to 3 business day service based upon distance)

(Call for delivery schedule. See back for detailed descriptions of freight products.)

5 Packaging
- [ ] FedEx Letter
- [ ] FedEx Pak
  Declared value limit $500
- [ ] FedEx Box
- [ ] FedEx Tube
- [x] Other Pkg.

6 Special Handling

Does this shipment contain dangerous goods?
- [ ] Yes (As per attached Shipper's Declaration)
- [ ] Yes (Shipper's Declaration not required)
- [ ] Dry Ice — Dry Ice, 9, UN 1845 III ____ x ____ kg. 904 (Dangerous Goods Shipper's Declaration not required)
- [ ] CA Cargo Aircraft Only

7 Payment

Bill to:
- [x] Sender (Account no. in section 1 will be billed)
- [ ] Recipient
- [ ] Third Party
- [ ] Credit Card
- [ ] Cash/Check

(Enter FedEx account no. or Credit Card no. below)

- [ ] Obtain Recipient FedEx Account No.

Total Packages	Total Weight	Total Declared Value*	Total Charges
1	50	$ .00	$

* When declaring a value higher than $100 per shipment, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY section for further information

Credit Card Auth.

8 Release Signature

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims

Questions?
Call 1-800-Go-FedEx
(1-800-463-3339)

272

2946027792

Rev. Date 6/96
PART #14795
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GREY/BLUE

LABORATORY REPORT FOR

JACOBS ENGINEERING GROUP

CARSWELL AFB / 05G47900

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

SDG#: 97D029

APRIL 14, 1997

CASE NARRATIVE

CLIENT: JACOBS ENGINEERING GROUP

PROJECT: CARSWELL AFB / 05G47900

SDG: 97D029

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Seven (7) water samples were received on 04/05/97 to be analyzed for total recoverable petroleum hydrocarbon in accordance with "Methods for the Chemical Analysis of Water and Wastes".

1. Holding Time

   Analytical holding time was met.

2. Method Blank

   Method blank was free of contamination.

3. Matrix Spike/Matrix Spike Duplicate

   All recoveries and RPD were within QC limits.

4. Lab Control Sample

   All recoveries were within QC limit.

5. Calibration

   Initial calibration was at six-point and continuing calibration were carried out at 10-samples interval. All QC requirements were met.

6. Sample Analysis

   All sample analyses were done within QC requirements.

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

04/11/1997 10:50

LAB CHRONICLE
EPA 418.1

CLIENT: Jacobs Engineering Group
PROJECT: Carswell AFB / 05G47900

SDG/BATCH NO.: 97D029
MATRIX: Water

SAMPLE ID	File ID	CONTROL NO	%H2O	PREPARATION BATCH/DATE/TIME	ANALYTICAL BATCH/DATE/TIME	CALIB REF	FILE ID
CR-A161701	TRD017-6	D029-01	NA	TRD006 WB 04-11-97 8:00	TRD017C 04-11-97	12:25	Cal. file TRD017CC
CR-A161702	-7	D029-02	NA			12:30	
CR-A161703	-10	D029-03	NA			12:45	
CR-A161704	-11	D029-04	NA			12:50	
CR-A161705	-14	D029-05	NA			13:05	TRD018CC
CR-A161706	-15	D029-06	NA			13:10	
CR-A161707	16	D029-07	NA			13:17	
	-8	D029-02M				12:~~4~~35 EY 4-11-97	TRD017CC
	-9	-02S				12:40	
	-3	TRD006	WB			12:10	
	-4		WL			12:15	
	-5		WC			12:20	

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	04/03/97
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	04/05/97
BATCH NO.:	97D029	DATE EXTRACTED:	04/11/97 08:00
MATRIX:	WATER	INSTRUMENT ID:	T-018
CAL REF:	TRD017CC	PREP BATCH:	TRD006W

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	PQL (mg/L)	MDL (mg/L)	ANALYZED DATETIME
CR-A161701	D029-01	ND	1	1	.44	04/11/97 12:25
CR-A161702	D029-02	ND	1	1	.44	04/11/97 12:30
CR-A161702MS	D029-02M	5.80	1	1	.44	04/11/97 12:35
CR-A161702MSD	D029-02S	5.99	1	1	.44	04/11/97 12:40
CR-A161703	D029-03	ND	1	1	.44	04/11/97 12:45
CR-A161704	D029-04	ND	1	1	.44	04/11/97 12:50
CR-A161705	D029-05	ND	1	1	.44	04/11/97 13:05
CR-A161706	D029-06	ND	1	1	.44	04/11/97 13:10
CR-A161707	D029-07	ND	1	1	.44	04/11/97 13:17
MBLK1W	TRD006WB	ND	1	1	.44	04/11/97 12:10
LCS1W	TRD006WL	5.42	1	1	.44	04/11/97 12:15
LCD1W	TRD006WC	5.80	1	1	.44	04/11/97 12:20

PQL: Practical Quantitation Limit
AFCEE Ver. 1.0

CAL REF: TRD018CC for D028-05 thru D028-07.

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97D029
SAMPLE ID: CR-A161702
CONTROL NO.: D029-02

DATE RECEIVED: 04/05/97
DATE EXTRACTED: 04/11/97 08:00
DATE ANALYZED: 04/11/97 12:30

ACCESSION:

PARAMETER	SMPL RSLT (mg/L)	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	5.80	116	5.00	5.99	120	3	60-130	30

AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97D029
SAMPLE ID: LCS1W/LCD1W
CONTROL NO.: TRD006WL/C

DATE RECEIVED: 04/11/97
DATE EXTRACTED: 04/11/97 08:00
DATE ANALYZED: 04/11/97 12:10

ACCESSION:

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	5.42	108	5.00	5.80	116	7	60-130	30

EMAX
LABORATORIES, INC.
630 Maple Ave.
Torrance, CA 90503
Telephone: (310) 618-8889
Fax: (310) 618-0818

Date: 05-01-1997
EMAX Batch No.: 97D132

Attn: Lynn Schuetter

Jacobs Engineering Group
600 17th. Street, Ste. 1100N
Denver CO 80202

Subject: Laboratory Report
Project: Carswell AFB / 05G47900

Enclosed is the Laboratory report for samples received on 04/26/97. The data reported include :

Sample ID	Control #	Col Date	Matrix	Analysis
CR-A161901	D132-01	04/17/97	Water	EPA 418.1
CR-A161902	D132-02	04/24/97	Water	EPA 418.1
CR-A161903	D132-03	04/17/97	Water	EPA 418.1
CR-A161904	D132-04	04/24/97	Water	EPA 418.1
CR-A161902MS	D132-02M	04/24/97	Water	EPA 418.1
CR-A161902MSD	D132-02S	04/24/97	Water	EPA 418.1

The results are summarized on the following pages.

Please feel free to call if you have any questions concerning these results.

Sincerely yours,

Kam Y. Pang, Ph.D.
Laboratory Director

P.S. - All analyses requested for the above referenced project have been completed. Therefore, unless instructed, the remaining portions of the samples will be disposed after fifteen (15) days from the date of this report.

97D132

JE JACOBS ENGINEERING GROUP INC. G3
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1619 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)	LABORATORY NAME & ADDRESS: EMAX LABORATORIES, INC.
PROJECT NUMBER: 05G47900	630 Maple Avenue
WBS CODE: 505-01 / SUBCONTRACT / D.O. No.	Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
1	CR-A161901	4/17/97	11:30	MJ	1	1 L Amber Glass	4C H2SO4	W	E418.1		T=2°C
2	CR-A161902	4/24/97	10:30	MJ	2	1 L Amber Glass	4C H2SO4	W	E418.1	MS MSD	
3	CR-A161903	1 1	14:38	MJ	1	1 L Amber Glass	4C H2SO4	W	E418.1		
4	CR-A161904	4/24/97	10:45	MJ	1	1L Amber	4C H_2SO_4	W	E418.1		
	161904										

4/25/97

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
	4/25/97	17:00	17 DAY

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	4/26/97	9:45A		/ /	:

RECORD RETURNED BY	DATE	TIME	
	/ /	:	SHIPPING NUMBER:

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

FedEx SA airbill 2149887176 97D132 9:45 A8.
4-28-97 241 500 63942051 6254M

4/25/97 Sender's FedEx Account Number 1605-0792-6

MIKE JOHNSON 303-595-8855

JACOBS ENGINEERING

600 17TH ST TE 1100 N

DENVER CO 80202

05647900 505-01

SAMPLE RECEIVING 310 618-8889

EMAX LABORATORIES INC

630 MAPLE AVE

TORRANCE CA 90503

45

2 1 4 9 8 8 7 1 7 6

272

Rev Date 6/96
PART #147956

SAMPLE RECEIPT FORM

CONTROL NO.	97D132
CLIENT	JACOBS ENG.
PROJECT	CARSWELL AFB D021

DATE	04-26-97
TIME	9:45 A.
RECIPIENT	I. PATEL

SAMPLE TRANSPORTATION TO EMAX LABORATORY:		BY	ON(DATE)	AT(TIME)	FROM(SITE/CO.)	COMMENTS
PICKED-UP BY EMAX COURIER						
DELIVERED BY CLIENT ✓						
SHIPPED/AIRBILL NO:	FEDEX APTN: 2149887176	SEE AIRBILL				

SAMPLE BATCH PACKAGING/SEALING UPON RECEIPT:			✓ INTACT	___ DAMAGED	✓ SEALED	___ NOT SEALED	___ NO CONTAINER
CONTAINER:	INSIDE TEMPERATURE (4°C ± 2 °C)	2° °C		CUSTODY SEAL		LOCATION	NUMBER
✓ COOLER	PACKAGING	TYPE	SUFFICIENCY	✓ INTACT	___ DAMAGED	FRONT CLOSURE	1
___ BOX	INSULATION:			NAME:	SEE COC	REAR CLOSURE	1
___ OTHER:	ICE/COOLANT:	REGULAR	OK	DATE:			
	PACKING MATERIAL:	STYRO, BUBBLEPAK		TIME:			

SAMPLE DOCUMENTATION/CHAIN-OF-CUSTODY(COC)	___ SEALED	✓ ENCLOSED	___ HANDCARRIED	___ FAXED	___ MAILED

SAMPLE LOG-IN:	CRITERIA	COMMENTS	DISCREPANCY
SAMPLE CUSTODY SEAL	EVERY SAMPLE	NONE	
CONTAINER TYPE/MATERIAL	APPROPRIATE	OK	
SAMPLE AMOUNT	ENOUGH		
HOLDING TIME	SUFFICENT		
SAMPLE PRESERVATION (For appropriate preservative see GP-0001 Appendix I)	NaOH preserved samples pH ≥ 12 HNO_3 / H_2SO_4 preserved samples pH ≤ 2		
HEADSPACE/BUBBLES	ZERO/NONE		
SAMPLE LABEL INFORMATION	SUFFICIENT	SEE BELOW	
CHAIN-OF-CUSTODY INFORMATION	SUFFICIENT		

SAMPLE INFO.:	SAMPLE ID	DATE	TIME	SIGNATURE	ANALYSES	PRESERVATIVE	CONTAINER

INDIVIDUAL SAMPLE CONTAINER:	___ NONE	✓ SEALED PLASTIC BAG	___ CAN	___ OTHER(SPECIFY): BUBBLE BAG

SAMPLE NUMBER	CLIENT ID	DISCREPANCY	ACTION
-3	CR-A161903	S. DATE 4-17-97 ON THE CONTAINER LABEL	→ w/ log-in date on the label.
-4	CR-A161904	NO. S. DATE ON THE CONTAINER LABEL	→ w/ follow up in the COC.

CLIENT SERVICES COPY RECEIVED BY	Cecilia 4/28/97	DATE		TIME	

EMAX LABORATORIES INC. 770 MONTE ALTO TORRANCE CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

LABORATORY REPORT FOR

JACOBS ENGINEERING GROUP

CARSWELL AFB / 05G47900

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

SDG#: 97D132

MAY 01, 1997

CASE NARRATIVE

CLIENT: JACOBS ENGINEERING GROUP

PROJECT: CARSWELL AFB / 05G47900

SDG: 97D132

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

Four (4) water samples were received on 04/26/97 to be analyzed for total recoverable petroleum hydrocarbon in accordance with "Methods for the Chemical Analysis of Water and Wastes".

1. Holding Time

   Analytical holding time was met.

2. Method Blank

   Method blank was free of contamination.

3. Matrix Spike/Matrix Spike Duplicate

   All recoveries and RPD were within QC limits.

4. Lab Control Sample/Lab Control Sample Duplicate

   All recoveries were within QC limit.

5. Calibration

   Initial calibration was at six-point and continuing calibration were carried out at 10-samples interval. All QC requirements were met.

6. Sample Analysis

   All sample analyses were done within QC requirements.

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

04/29/1997 19:37

LAB CHRONICLE
EPA 418.1

CLIENT: Jacobs Engineering Group
PROJECT: Carswell AFB / 05G47900

SDG/BATCH NO.: 97D132
MATRIX: Water

SAMPLE ID	CONTROL NO	%H2O	PREPARATION BATCH/DATE/TIME	ANALYTICAL BATCH/DATE/TIME	CALIB REF	FILE ID
CR-A161901	D132-01	NA	TRD010W 04-29-97 12:00	TRD024C 04-29-97 14:40		TRD025CC
CR-A161902	D132-02	NA			14:45	
CR-A161903	D132-03	NA			15:10	TRD026CC
CR-A161904	D132-04	NA			15:15	
CR-A161902MS	D132-02M	NA			14:50	TRD025CC
CR-A161902MSD	D132-02S	NA			14:55	TRD025CC
	TRD010WB				14:25	TRD025CC
		WL			14:30	
		WC			1435	

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	04/17/97
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	04/26/97
BATCH NO.:	97D132	DATE EXTRACTED:	04/29/97 12:00
MATRIX:	WATER	INSTRUMENT ID:	T-018
CAL REF:	TRD025CC	PREP BATCH:	TRD010W

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	PQL (mg/L)	MDL (mg/L)	ANALYZED DATETIME
CR-A161901	D132-01	ND	1	1	.44	04/29/97 14:40
CR-A161902	D132-02	ND	1	1	.44	04/29/97 14:45
CR-A161903	D132-03	ND	1	1	.44	04/29/97 15:10
CR-A161904	D132-04	ND	1	1	.44	04/29/97 15:15
CR-A161902MS	D132-02M	6.48	1	1	.44	04/29/97 14:50
CR-A161902MSD	D132-02S	5.99	1	1	.44	04/29/97 14:55
MBLK1W	TRD010WB	ND	1	1	.44	04/29/97 14:25
LCS1W	TRD010WL	6.14	1	1	.44	04/29/97 14:30
LCD1W	TRD010WC	5.91	1	1	.44	04/29/97 14:35

PQL: Practical Quantitation Limit
AFCEE Ver. 1.0

CAL REF: TRD026CC for D132-03 & D132-04

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97D132
SAMPLE ID: CR-A161902
CONTROL NO.: D132-02

DATE RECEIVED: 04/26/97
DATE EXTRACTED: 04/29/97 12:00
DATE ANALYZED: 04/29/97 14:45

ACCESSION:

PARAMETER	SMPL RSLT (mg/L)	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	6.48	130	5.00	5.99	120	8	60-130	30

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97D132
SAMPLE ID: LCS1W/LCD1W
CONTROL NO.: TRD010WL/C

DATE RECEIVED: 04/29/97
DATE EXTRACTED: 04/29/97 12:00
DATE ANALYZED: 04/29/97 14:25

ACCESSION:

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	6.14	123	5.00	5.91	118	4	60-130	30

EMAX
LABORATORIES, INC.
630 Maple Ave.
Torrance, CA 90503
Telephone: (310) 618-8889
Fax: (310) 618-0818

MAY 27 1997

Date: 05-21-1997
EMAX Batch No.: 97E078

R

Attn: Lynn Schuetter

Jacobs Engineering Group
600 17th. Street, Ste. 1100N
Denver CO 80202

Subject: Laboratory Report
Project: Carswell AFB / 05G47900

Enclosed is the Laboratory report for samples received on 05/16/97. The data reported include :

Sample ID	Control #	Col Date	Matrix	Analysis
CR-A163101	E078-01	05/13/97	Water	EPA 418.1
CR-A163102	E078-02	05/13/97	Water	EPA 418.1
CR-A163102MS	E078-02M	05/13/97	Water	EPA 418.1
CR-A163102MSD	E078-02S	05/13/97	Water	EPA 418.1
CR-A163301	E078-03	05/13/97	Water	EPA 418.1

The results are summarized on the following pages.

Please feel free to call if you have any questions concerning these results.

Sincerely yours,

Kam Y. Pang, Ph.D.
Laboratory Director

P.S. - All analyses requested for the above referenced project have been completed. Therefore, unless instructed, the remaining portions of the samples will be disposed after fifteen (15) days from the date of this report.

G1

97E078

JE JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1631 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)	LABORATORY NAME & ADDRESS: EMAX LABORATORIES, INC.
PROJECT NUMBER: 05G47900	630 Maple Avenue
WBS CODE: 505-01 / SUBCONTRACT / D.O. No.	Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT T=2°C
1 ✓	CR-A163101	05/13/97	11:30	BH	1	1 L Amber Glass	4C H2SO4	W	E418.1		
2 ✓	CR-A163102	5/13/97	14:30	MN	~~1~~ 2	1 L Amber Glass	4C H2SO4	W	E418.1	MS/MSD	

5/15/97

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
[signature]	5/15/97	11:00	7 day		
RECEIVED BY M. [signature]	DATE 5/16/97	TIME 10:00	RELINQUISHED BY	DATE / /	TIME :
RECORD RETURNED BY	DATE / /	TIME :			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

97ED78 G1

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1633 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
PROJECT NUMBER: 05G47900
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
LABORATORY NAME & ADDRESS: EMAX LABORATORIES, INC.
630 Maple Avenue
Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT T=2°C
3 CR-A163301	5/13/97	04:00	MJ	1	1 L Amber Glass	4C H2SO4	W	E418.1		

5/15/97

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
	5/15/97	11:00	7 Day

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
M. Dyer	5/16/97	10:00		/ /	:

RECORD RETURNED BY	DATE	TIME
	/ /	:

SHIPPING NUMBER:

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

FedEx *USA Airbill* Tracking Number **2652824764**

97E078
05-16-97
10:00 ML

Recipient's Copy

1 From

Date 5/15/97 [redacted]

Sender's Name Mike Johnson Phone (303) 595-8855

Dept./Floor/Suite/Room

Company Jacobs Engineering

Address 6600 17th St. Ste 1100N

City Denver State CO Zip 80202

2 Your Internal Billing Reference Information 05674700 505-01

3 To

Recipient's Name [illegible] Phone ( )

Dept./Floor/Suite/Room

Company EMAX Laboratories

Address 630 Maple Ave

(To "HOLD" at FedEx location, print FedEx address here)

City Torrance State CA Zip 90503

For HOLD at FedEx Location check here

☐ **Hold Weekday** (Not available with FedEx First Overnight)

☐ **Hold Saturday** (Not available at all locations) (Not available with FedEx First Overnight or FedEx Standard Overnight)

For Saturday Delivery check here

☐ (Extra Charge. Not available to all locations) (Not available with FedEx First Overnight or FedEx Standard Overnight)

4a Express Package Service *Packages under 150 lbs.* Delivery commitment may be later in some areas

☐ FedEx Priority Overnight (Next business morning)

☒ FedEx Standard Overnight (Next business afternoon)

☐ FedEx 2Day* (Second business day)

☐ NEW FedEx First Overnight (Earliest next business morning delivery to select locations) (Higher rates apply)

* FedEx Letter Rate not available. Minimum charge. One pound FedEx 2Day rate

4b Express Freight Service *Packages over 150 lbs.* Delivery commitment may be later in some areas

☐ FedEx Overnight Freight (Next business day service for any distance)

☐ FedEx 2Day Freight (Second business day service for any distance)

☐ FedEx Express Saver Freight (Up to 3 business day service based upon distance)

(Call for delivery schedule. See back for detailed descriptions of freight products.)

5 Packaging ☐ FedEx Letter ☐ FedEx Pak (Declared value limit $500) ☐ FedEx Box ☐ FedEx Tube ☒ Other Pkg

6 Special Handling

Does this shipment contain dangerous goods? ☐ Yes (As per attached Shipper's Declaration) ☐ Yes (Shipper's Declaration not required)

☐ Dry Ice (Dry Ice, 9, UN 1845 III) _____ x _____ kg 904 (Dangerous Goods Shipper's Declaration not required)

CA ☐ Cargo Aircraft Only

7 Payment

Bill to: ☒ Sender (Account no. in section 1 will be billed) ☐ Recipient ☐ Third Party ☐ Credit Card ☐ Cash/Check

(Enter FedEx account no. or Credit Card no. below)

[redacted]

Total Packages	Total Weight	Total Declared Value*	Total Charges
1	4	$ .00	$

*When declaring a value higher than $100 per shipment, you pay an additional charge. See SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY section for further information.

Credit Card Auth.

8 Release Signature

Your signature authorizes Federal Express to deliver this shipment without obtaining a signature and agrees to indemnify and hold harmless Federal Express from any resulting claims.

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Questions?
Call 1·800·Go·FedEx
(1-800-463-3339)

Rev. Date 8/96
PART #147957
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2652824764

SAMPLE RECEIPT FORM

CONTROL NO.	97E 078
CLIENT	Jacobs
PROJECT	Caswell

DATE	05-16-97
TIME	10:00
RECIPIENT	ML

SAMPLE TRANSPORTATION TO EMAX LABORATORY:		BY	ON(DATE)	AT(TIME)	FROM(SITE/CO.)	COMMENTS
PICKED-UP BY EMAX COURIER						
DELIVERED BY CLIENT						
SHIPPED/AIRBILL NO:	Fedex fee airbill 2652824764					

SAMPLE BATCH PACKAGING/SEALING UPON RECEIPT:			✓ INTACT	DAMAGED	✓ SEALED	NOT SEALED	NO CONTAINER
CONTAINER:	INSIDE TEMPERATURE (4°C ± 2°C)		2°C				
✓ COOLER	PACKAGING	TYPE	SUFFICIENCY	CUSTODY SEAL		LOCATION	NUMBER
BOX	INSULATION:			✓ INTACT	DAMAGED	Front Closure	
OTHER:	ICE/COOLANT:			NAME:	Fee coc		
	PACKING MATERIAL:			DATE:			
				TIME:			

SAMPLE DOCUMENTATION/CHAIN-OF-CUSTODY(COC)	SEALED	✓ ENCLOSED	HANDCARRIED	FAXED	MAILED

SAMPLE LOG-IN:		CRITERIA	COMMENTS			DISCREPANCY	
SAMPLE CUSTODY SEAL		EVERY SAMPLE	OK				
CONTAINER TYPE/MATERIAL		APPROPRIATE					
SAMPLE AMOUNT		ENOUGH					
HOLDING TIME		SUFFICENT					
SAMPLE PRESERVATION (For appropriate preservative see GP-0001 Appendix I)		NaOH preserved samples pH ≥ 12 HNO_3 / H_2SO_4 preserved samples pH ≤ 2					
HEADSPACE/BUBBLES		ZERO/NONE					
SAMPLE LABEL INFORMATION		SUFFICIENT					
CHAIN-OF-CUSTODY INFORMATION		SUFFICIENT					
SAMPLE INFO.:	SAMPLE ID ✓	DATE ✓	TIME ✓	SIGNATURE ✓	ANALYSES ✓	PRESERVATIVE ✓	CONTAINER ✓

INDIVIDUAL SAMPLE CONTAINER: NONE SEALED PLASTIC BAG CAN OTHER(SPECIFY):

SAMPLE NUMBER	CLIENT ID	DISCREPANCY	ACTION
2	CR-A163102	not enough water to do MS/MSD	

CLIENT SERVICES RECEIVED BY Carlie S. DATE TIME

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-9810

LABORATORY REPORT FOR

JACOBS ENGINEERING GROUP, INC.

CARSWELL AFB / 05G47900

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

SDG#: 97E078

MAY 21, 1997

CASE NARRATIVE

CLIENT: JACOBS ENGINEERING GROUP

PROJECT: CARSWELL AFB / 05G47900

SDG: 97E078

EPA 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (TRPH)

Three (3) water samples were received on 05/16/97 to be analyzed for TRPH in accordance with SW846 method 418.1.

1. **Holding Time**

   Analytical holding time was met.

2. **Method Blank**

   A method blank was free of contamination.

3. **Matrix Spike/Matrix Spike Duplicate**

   All recoveries and RPDs were within QC limit. Due to insufficient amount of sample, only 500 ml of sample was used for analysis.

4. **Lab Control Sample/Lab Control Duplicate**

   All recoveries were within QC limits.

5. **Calibration**

   Continue calibration were carried out at 10 samples interval. All QC requirements were met.

6. **Sample Analysis**

   Sample analyses met QC requirements.

EMAX LABORATORIES, INC., 630 Maple Ave., Torrance, CA 90503 TEL: (310) 618-8889 FAX: (310) 618-0818

05/19/1997 18:36

LAB CHRONICLE
EPA 418.1

CLIENT: Jacobs Engineering Group
PROJECT: Carswell AFB / 05G47900

SDG/BATCH NO.: 97E078
MATRIX: Water

SAMPLE ID	CONTROL NO	%H2O	PREPARATION BATCH/DATE/TIME	ANALYTICAL BATCH/DATE/TIME	CALIB REF	FILE ID
CR-A163101	E078-01	NA	TRE006W 05/19/97 12:00	TRE018CC 5/19/97 16:25	TRE018CC-1	~~NA~~ TRE018C -6
CR-A163102	E078-02	NA		16:30		-7
CR-A163102MS	E078-02M	NA		16:35		-8
CR-A163102MSD	E078-02S	NA		16:40		-9
CR-A163301	E078-03	NA		16:45		-10
	TRE006WB			16:10		-3
		WL		16:15		-4
		WC		16:20		-5

Jun 18 1997

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	JACOBS ENGINEERING GROUP	DATE COLLECTED:	05/13/97
PROJECT:	CARSWELL AFB / 05G47900	DATE RECEIVED:	05/16/97
BATCH NO.:	97E078	DATE EXTRACTED:	05/19/97 12:00
MATRIX:	WATER	INSTRUMENT ID:	T-018
CAL REF:	TRE018CC-1	PREP BATCH:	TRE006W

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	PQL (mg/L)	MDL (mg/L)	ANALYZED DATETIME
CR-A163101	E078-01	ND	1	1	.44	05/19/97 16:25
CR-A163102	E078-02	ND	1	1	.44	05/19/97 16:30
CR-A163102MS	E078-02M	5.05	1	1	.44	05/19/97 16:35
CR-A163102MSD	E078-02S	5.42	1	1	.44	05/19/97 16:40
CR-A163301	E078-03	ND	1	1	.44	05/19/97 16:45
MBLK1W	TRE006WB	ND	1	1	.44	05/19/97 16:10
LCS1W	TRE006WL	4.36	1	1	.44	05/19/97 16:15
LCD1W	TRE006WC	4.61	1	1	.44	05/19/97 16:20

PQL: Practical Quantitation Limit
AFCEE Ver. 1.0

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97E078
SAMPLE ID: CR-A163102
CONTROL NO.: E078-02

DATE RECEIVED: 05/16/97
DATE EXTRACTED: 05/19/97 12:00
DATE ANALYZED: 05/19/97 16:30

ACCESSION: 97E078

PARAMETER	SMPL RSLT (mg/L)	SPIKE AMT (mg/L)	MS RSLT (mg/L)	MS % REC	SPIKE AMT (mg/L)	MSD RSLT (mg/L)	MSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	5.05	101	5.00	5.42	108	7	60-130	30

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: JACOBS ENGINEERING GROUP
PROJECT: CARSWELL AFB / 05G47900
METHOD: EPA 418.1
MATRIX: WATER
% MOISTURE: NA

BATCH NO.: 97E078
SAMPLE ID: LCS1W/LCD1W
CONTROL NO.: TRE006WL/C

DATE RECEIVED: 05/19/97
DATE EXTRACTED: 05/19/97 12:00
DATE ANALYZED: 05/19/97 16:10

ACCESSION: 97E078

PARAMETER	BLNK RSLT (mg/L)	SPIKE AMT (mg/L)	BS RSLT (mg/L)	BS % REC	SPIKE AMT (mg/L)	BSD RSLT (mg/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
TRPH	ND	5.00	4.36	87	5.00	4.61	92	6	60-130	30

TAB

Appendix B

APPENDIX B

Chain-of-Custody Records

96K042 F5/F6/R6B3

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1566

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)

LABORATORY NAME & ADDRESS: [illegible] Inc.

PROJECT NUMBER: 05647900

630 Maple Avenue

WBS CODE: 505-01

SUBCONTRACT / D.O. No.

Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
29	CR-A156601	11/6/96	11:00	BN	1	4 oz. Jar	4 deg C	S	E418.1		T=2C
	~~CR-A156602~~	~~/ /~~	~~:~~		~~1~~	~~4 oz. Jar~~	~~4 deg C~~	~~S~~	~~E418.1~~		BN
30	CR-A156603	11/6/96	13:20	BN	1	4 oz. Jar	4 deg C	S	E418.1		T=2C
31	CR-A156604	11/6/96	13:30	BN	1	4 oz. Jar	4 deg C	S	E418.1		
32	CR-A156605	11/6/96	13:50	BN	1	4 oz. Jar	4 deg C	S	E418.1		
33	CR-A156606	11/6/96	13:58	BN	1	4 oz. Jar	4 deg C	S	E418.1		
34	CR-A156607	11/6/96	16:45	DDS	1	1-L amber	H_2SO_3	W	E418.1		
35	CR-A156608	11/7/97	16:30	DDS	1	1-L amber	H_2SO_3	W	E418.1		

11/8/96

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
	11/5/96	1800			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	11/9/96	10:[illegible]		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/ /	:			
			SHIPPING NUMBER: 2149885814		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96K042 F5/F6/R6B3

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1567 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: EMAX Inc.
PROJECT NUMBER: V5047900
630 Maple Avenue
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
36	CR-A156701	11/6/96	14:45	BN	1	4 oz. Jar	4 deg C	S	E418.1		T=2C-r
	~~CR-A156702~~	/ /	:		~~1~~	~~4 oz. Jar~~	~~4 deg C~~	~~S~~	~~E418.1~~		BN
37	CR-A156703	11/6/96	15:15	BN	1	4 oz. Jar	4 deg C	S	E418.1		T=2C-r
38	CR-A156704	11/6/96	16:05	BN	1	4 oz. Jar	4 deg C	S	E418.1		
39	CR-A156705	11/6/96	16:40	BN	1	4 oz. Jar	4 deg C	S	E418.1		
40	CR-A156706	11/6/96	16:55	BN	1	4 oz. Jar	4 deg C	S	E418.1		

11/8/96

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
	11/8/96	1800			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	11/9/96	10 AM		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/	:	SHIPPING NUMBER: 2147885814		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96K042 F5/F6/R6B3

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1568 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: EMAX Inc.
PROJECT NUMBER: 95647900
630 Maple Avenue
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
41	CR-A156001	11/7/96	13:00	BN	1	4 oz. Jar	4 deg C	S	E418.1		T=2C✓
42	CR-A156002	11/7/96	13:10	BN	1	4 oz. Jar	4 deg C	S	E418.1		
43	CR-A156003	11/7/96	14:00	BN	1	4 oz. Jar	4 deg C	S	E418.1		
44	CR-A156004	11/7/96	14:10	BN	1	4 oz. Jar	4 deg C	S	E418.1		
45	CR-A156005	11/7/96	14:50	BN	1	4 oz. Jar	4 deg C	S	E418.1		
46	CR-A156006	11/7/96	15:00	BN	1	4 oz. Jar	4 deg C	S	E418.1		

11/8/96

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
	11/8/96	10:00			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	11/9/96	10:00		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/ /	:	SHIPPING NUMBER: 2449885814		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96K047 L4/L5 R6 C4

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1569 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: KMX Inc.
PROJECT NUMBER: 05647900
630 Maple Avenue
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED T=2°C	QC	CONDITION ON RECEIPT
CR-A156901	11/9/96	8:32	BN	1	4 oz. Jar	4 deg C	S	E418.1		47
CR-A156902	11/9/96	8:47 8:32 MJ	BN	1	4 oz. Jar	4 deg C	S	E418.1		48
~~CR-A156903~~	~~11/9/96~~	~~9:32~~		~~1~~	~~4 oz. Jar~~	~~4 deg C~~	~~S~~	~~E418.1~~		
CR-A156904	11/9/96	9:32	MJ	1	4 oz. Jar	4 deg C	S	E418.1		49
CR-A156905	11/9/96	10:30	MJ	1	4 oz. Jar	4 deg C	S	E418.1		50
CR-A156906	11/9/96	10:30	MJ	1	4 oz. Jar	4 deg C	S	E418.1		51

11/11/96

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
	11/11/96	18:00			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
M. Dyer	11/12/96	10:00		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/	:			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96K047 L4/L5/R6C4

JE JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1570 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21) LABORATORY NAME & ADDRESS: EMAX Inc.

PROJECT NUMBER: 05G47900 630 Maple Avenue

WBS CODE: 505-01 SUBCONTRACT / D.O. No. Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED T=2°C	QC	CONDITION ON RECEIPT
CR-A157001	11 19 96	11:16	MJ	1	4 oz. Jar	4 deg C	S	E418.1		√2
CR-A157002	11 19 96	11:27	MJ	1	4 oz. Jar	4 deg C	S	E418.1		√3
CR-A157003	11/11/96	8:36	MJ	1	4 oz. Jar	4 deg C	S	E418.1		√4
CR-A157004	11/11/96	8:52	MJ	1	4 oz. Jar	4 deg C	S	E418.1		√5
~~CR-A157005~~	~~/ /~~	~~/~~		~~1~~	~~4 oz. Jar~~	~~4 deg C~~	~~S~~	~~E418.1~~ MJ		
CR-A157006	11/11/96	9:55	MJ	1	4 oz. Jar	4 deg C	S	E418.1		√6
CR-A 157007	11/11/96	8:55	MJ	1	4 oz Jar	4°	S	E418.1		√7
					MJ	11/11/96				T=1.6°C

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
[signature]	11/11/96	18:00			
RECEIVED BY M. [signature]	11/12/96	10:00	RELINQUISHED BY	DATE / /	TIME :
RECORD RETURNED BY	DATE / /	TIME :			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96K065 EG

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1571 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: EMAX Inc.
PROJECT NUMBER: 05G47900
630 Maple Avenue
WBS CODE: 505-01
SUBCONTRACT / D.D. No.
Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
1	CR-A157101	11/1/96	10:42	MJ	1	4 oz. Jar	4 deg C	S	E418.1		T=2°C
	~~CR-A157102~~	/ /	:		1	4 oz. Jar	4 deg C	S	E418.1		
2	CR-A157103	11/1/96	11:09	MJ	1	4 oz. Jar	4 deg C	S	E418.1		
3	CR-A157104	11/1/96	11:32	MJ	~~1~~ 2	4 oz. Jar	4 deg C	S	E418.1	MS/MSD	
4	CR-A157105	11/1/96	13:42	MJ	1	4 oz. Jar	4 deg C	S	E418.1		
5	CR-A157106	11/1/96	13:54	MJ	1	4 oz. Jar	4 deg C	S	E418.1		
	~~CR-A157107~~	~~11/1/96~~	~~11~~								

10/13/96

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
	11/13/96	1600			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	11/14/96	10:20		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/ /	:	SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96K065 E6

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1572 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: EMAX Inc.
PROJECT NUMBER: 95C47900
630 Maple Avenue
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
6	CR-A157201	11/1/96	14:31	MJ	1	4 oz. Jar	4 deg C	S	E418.1		T=2°C
7	CR-A157202	11/1/96	14:47	MJ	1	4 oz. Jar	4 deg C	S	E418.1		
8	CR-A157203	11/1/96	15:11	MJ	1	4 oz. Jar	4 deg C	S	E418.1		
9	CR-A157204	11/1/96	15:20	MJ	1	4 oz. Jar	4 deg C	S	E418.1		
	~~CR-A157205~~	~~11/1/96~~	~~15:50~~	~~BN~~	~~1~~	~~4 oz. Jar~~	~~4 deg C~~	~~S~~	~~E418.1~~ BN 11/1/96		
10	CR-A157206	11/1/96	15:50	BN	1	4 oz. Jar	4 deg C	S	E418.1		
11	CR-A 157207	11/1/96	14:33	MJ	1	4 oz Jar	4°	S	E418.1		

MJ 11/13/96

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
MJ	11/13/96	16:00			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
J. Blake	11/14/96	10:00 AM		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/ /	:			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96K065 E6

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1573 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: KMAX Inc.
PROJECT NUMBER: 05G47900
630 Maple Avenue
WBS CODE: 505-41
SUBCONTRACT / D.O. No.
Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
12	CR-A157301	11/12/96	08'25	BN	2	4 oz. Jar	4 deg C	S	E418.1	M	T=2°C
13	CR-A157302	11/12/96	09'00	BN	2	4 oz. Jar	4 deg C	S	E418.1	M	
	~~CR-A157303~~	/ /	:		~~1~~	~~4 oz. Jar~~	~~4 deg C~~	~~S~~	~~E418.1~~ BN		
14	CR-A157304	11/12/96	09'40	BN	1	4 oz. Jar	4 deg C	S	E418.1		
15	CR-A157305	11/12/96	09'55	BN	1	4 oz. Jar	4 deg C	S	E418.1		
16	CR-A157306	11/12/96	10'10	BN	1	4 oz. Jar	4 deg C	S	E418.1		
	~~CR-A157307~~	/ /	:		~~1~~	~~4 oz. Jar~~	~~4 deg C~~	~~S~~	~~E418.1~~		
	~~CR-A157308~~	/ /	:		~~1~~	~~4 oz. Jar~~	~~4 deg C~~	~~S~~	~~E418.1~~		
					11/12/96						

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
	11/13/96	16:00			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	11/14/96	10:00 AM		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/ /	:	SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96-11-057

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1574 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)

PROJECT NUMBER: 05G47900

WBS CODE: 505-01

SUBCONTRACT / D.O. No.

LABORATORY NAME & ADDRESS: ~~[illegible]~~ Paragon ~~630 Maple Avenue~~ 225 Commerce Dr. ~~Torrance CA 90503~~ Ft. Collins, Co 80524

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A157401	11/6/96	11:00	BN	~~1~~ 2	~~8~~ 4 oz. Jar	4 deg C	S	SW9315 SW9320		01
~~CR-A157402~~	~~/ /~~	~~:~~		~~1~~	~~8 oz. Jar~~	~~4 deg C~~	~~S~~	~~SW9315 SW9320~~		BN
CR-A157403	11/6/96	13:20	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		02
CR-A157404	11/6/96	13:30	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		03
CR-A157405	11/6/96	13:50	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		04
CR-A157406	11/6/96	13:58	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		05

COMMENTS:

Pg 1 of 3

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
[signature]	11/8/96	1800			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
FAX [signature]	/ /	:	FAX	/ /	:
	11/9/96	930			
RECORD RETURNED BY	DATE	TIME			
	/ /	:	SHIPPING NUMBER: 2149885791		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96-11.057

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1575 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
PROJECT NUMBER: 05G47900
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
LABORATORY NAME & ADDRESS: ~~MKI Inc.~~ Paragon ~~620 Maple Avenue Torrance CA 90503~~ 225 Commerce Dr. Ft Collins, Co 80524

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESER-VATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A157501	11/6/96	14:45	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		06
~~CR-A157502~~	~~/ /~~	~~:~~		~~1~~	~~8 oz. Jar~~	~~4 deg C~~	~~S~~	~~SW9315 SW9320~~		BN
CR-A157503	11/6/96	15:15	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		07
CR-A157504	11/6/96	16:05	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		08
CR-A157505	11/6/96	16:40	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		09
CR-A157506	11/6/96	16:55	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		10
CR-A157507	11/6/96	18:45	DSS	1	1-gal. cube	none	W	SW9315, SW9320		11
CR-A157508	11/7/96	18:30	DSS	1	1-gal cube	none	W	SW9315, SW9320		12

11/8/96

COMMENTS:

Pg 2 of 3

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
	11/8/96	18:00	1

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
FDX	/ /	:	FDX	/ /	:
	11/9/96	930			

RECORD RETURNED BY	DATE	TIME	SHIPPING NUMBER:
	/ /	:	2149885791

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

9611.057

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1576 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)

PROJECT NUMBER: 05647900

WBS CODE: 505-01

SUBCONTRACT / D.O. No.

LABORATORY NAME & ADDRESS: ~~KWAI Inc.~~ PARAGON
~~630 Maple Avenue~~ 225 Commerce Dr.
~~Torrance CA 90503~~ Ft. Collins, Co 80524

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A157601	11/7/96	13:00	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		13
CR-A157602	11/7/96	13:10	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		14
CR-A157603	11/7/96	14:00	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		15
CR-A157604	11/7/96	14:10	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		16
CR-A157605	11/7/96	14:50	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		17
CR-A157606	11/7/96	15:00	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		18

11/8/96

COMMENTS:

Pg 3 of 3

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
	11/8/96	1800			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
FDX	/ /	:	FDX	/ /	:
	11/9/96	950			
RECORD RETURNED BY	DATE	TIME			
	/ /	:	SHIPPING NUMBER: 2149885791		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

9611.073

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1577 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

Pg 2 of 2

PROJECT NAME: CARSWELL AFB (DO 21)	LABORATORY NAME & ADDRESS: ~~[illegible] Inc.~~ Paragon
PROJECT NUMBER: 05647900	MJ ~~630 Maple Avenue~~ 225 Commerce Dr.
WBS CODE: 505-01	SUBCONTRACT / D.O. No. MJ ~~Torrance CA 90502~~ Ft. Collins, Co 80524

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
✓ CR-A157701	11/9/96	08:32	BW	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		08
✓ CR-A157702	11/9/96	8:47	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		09
~~CR-A157703~~	~~11/9/96~~	~~9:32~~	~~MJ~~	~~1~~	~~8 oz. Jar~~	~~4 deg C~~	~~S~~	~~SW9315 SW9320~~ MJ		
✓ CR-A157704	11/9/96	9:32	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		10
✓ CR-A157705	11/9/96	10:30	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		11
✓ CR-A157706	11/9/96	10:30	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		12
✓ CR-A 157706 MJ	11/9/96	16:59	MJ	1	4 oz Plastic	←	W	SW9315 SW9320		13
					MJ	11/11/96				

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
[signature]	11/11/96	18:00			
RECEIVED BY FDX	DATE / /	TIME :	RELINQUISHED BY FDX	DATE / /	TIME :
[signature]	11/12/96	2:30			
RECORD RETURNED BY	DATE / /	TIME :			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

JE JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

9611.073

CR-A1578 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

pg 1 of 2

PROJECT NAME: CARSWELL AFB (DO 21)	LABORATORY NAME & ADDRESS: ~~[illegible]~~ Paragon
PROJECT NUMBER: 05G47900	~~[illegible]~~ 225 Commerce
WBS CODE: 505-01 SUBCONTRACT / D.O. No.	~~Torrance CA 90503~~ Fort Collins Co

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
✓ CR-A157801	11/19/96	11:14	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		01
✓ CR-A157802	11/19/96	11:24	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		02
✓ CR-A157803	11/11/96	8:38	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		03
✓ CR-A157804	11/11/96	8:46	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		04
✓ CR-A157805	11/11/96	9:46	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		05
~~CR-A157806~~	~~/ /~~	~~/~~		~~1~~	~~8 oz. Jar~~	~~4 deg C~~	~~S~~	~~SW9315 SW9320~~ MJ		
✓ CR-A 157807	11/11/96	8:50	MJ	1	8 oz Jar	4°	S	SW9315 SW9320		06
✓ CR-A 157806	11/11/96	9:52	MJ	1	8 oz Jar	4°	S	SW9315 SW9320		07
					MJ 11/11/96					

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
[signature]	11/11/96	8:00			
RECEIVED BY FDX	DATE / /	TIME :	RELINQUISHED BY FDX	DATE / /	TIME :
[signature]	11/12/96	2:30			
RECORD RETURNED BY	DATE / /	TIME :			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

9611097

JE JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1579 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

Pg 4 of 4

PROJECT NAME: CARSWELL AFB (DO 21)	LABORATORY NAME & ADDRESS: MJ ~~DAI Inc.~~ Paragon
PROJECT NUMBER: 05G47900	~~630 Maple Avenue~~ MJ 225 Commerce Dr.
WBS CODE: 505-01	SUBCONTRACT / D.O. No. MJ ~~Torrance CA 90503~~ Ft Collins, Co

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A157901	11/11/96	1043	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		14
~~CR-A157902~~	~~11/11/96~~	~~11:07~~	~~MJ~~	~~1~~	~~8 oz. Jar~~	~~4 deg C~~	~~S~~	~~SW9315 SW9320~~ MJ		
CR-A157903	11/11/96	11:07	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		15
CR-A157904	11/11/96	11:36	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		16
CR-A157905	11/11/96	13:43	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		17
CR-A157906	11/11/96	13:49	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		18
CR-A 157907	11/12/96	18:10	MJ	1	4 l Plastic	4°C	W	SW9315 SW9320		19
					MJ 11/13/96					

COMMENTS:

COLLECTED & RELEASED BY MJ	DATE 11/13/96	TIME 1600	TURNAROUND TIME		
RECEIVED BY [signature]	DATE 11/14/96	TIME 09:30	RELINQUISHED BY	DATE / /	TIME :
RECORD RETURNED BY	DATE / /	TIME :			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

96-11-097-704

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1580 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

Pg 2 of 4

PROJECT NAME: CARSWELL AFB (DO 21)

LABORATORY NAME & ADDRESS: ~~EMX Inc.~~ Paragon
~~630 Maple Avenue~~ 225 Commerce Dr.
~~Torrance CA 90503~~ Ft Collins, Co.

PROJECT NUMBER: 05G47900

WBS CODE: 505-01

SUBCONTRACT / D.O. No.

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A158001	11/1/96	14:35	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		03
CR-A158002	11/1/96	14:45	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		04
CR-A158003	11/1/96	15:13	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		05
CR-A158004	11/1/96	15:18	MJ	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		06
~~CR-A158005~~	/ /	:		~~1~~	~~8 oz. Jar~~	~~4 deg C~~	~~S~~	~~SW9315 SW9320~~ 11/1/96 BN		
CR-A158006	11/1/96	15:50	BN	1	8 oz. Jar	4 deg C	S	SW9315 SW9320		07
CR-A 158007	11/1/96	1437	MJ	1	8oz Jar	4°	S	SW9315 SW9328		08
								11/13/96		

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
	11/13/96	16:00			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	11/14/96	09:30		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/ /	:	SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

97C025 JS

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1583 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: EMAX Inc.
PROJECT NUMBER: 05G47900
630 Maple Avenue
WBS CODE: 505-01
SUBCONTRACT / D.D. No.
Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
✓1	CR-A158301	3/4/97	12:20	DDS	1	1 L Amber Glass	4C H2SO4	W	E418.1 (MS/MSD)	M	T=4°C
✓2	CR-A158302	3/5/97	15:30	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		
✓3	CR-A 158303	3/5/97	17:30	BN	1	1L Amber	H_2SO_4	W	E418.1		
✓4	CR-158304	3/6/97	11:50	DDS	1	1-L amber	H_2SO_4	W	E418.1		

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
Dan Schmitz	3/6/97	16:00			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
[signature]	3/7/97	10:00		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/ /	:	SHIPPING NUMBER: FEDEX 9298823645		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

97C025 JS

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1584 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: HRAI Inc.
PROJECT NUMBER: 05C47900
630 Maple Avenue
WBS CODE: 505-01
SUBCONTRACT / D.D. No.
Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
5 CR-A158401	3/4/97	15:35	DOS	1	1 L Amber Glass	4C H2SO4	W	E418.1		T=4°C
6 CR-A 158402	3/4/97	17:50	BV	1	1L Amber	H2SO4	W	E418.1		
7 CR-A 158403	3/5/97	11:00	BV	1	1L Amber	H2SO4	W	E418.1		

DOS

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
Dan Schultz	3/6/97	16:00			
RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
[signature]	3/7/97	10:00		/ /	:
RECORD RETURNED BY	DATE	TIME			
	/ /	:			
			SHIPPING NUMBER: FEDEX 9298823645		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

97-03-046

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1586 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
PROJECT NUMBER: 05G47900
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
LABORATORY NAME & ADDRESS: KMAI Inc.
630 Maple Avenue
Torrance CA 90503-

PO 1 of 2

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A158601	3/4/97	12:20	DDS	1	1 Gal Poly	~~4 deg C~~ None	W	SW9315 SW9320		01
CR-A158602	3/5/97	15:30	DDS ~~BN~~	1	1 Gal Poly	~~4 deg C~~ None	W	SW9315 SW9320		02
CR-A 158603	3/5/97	17:30	BN	1	1 Gal Poly	~~4°C~~ None	W	SW9315 SW9320		03

DDS

COMMENTS:

17°-

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
Dan Schultz	3/6/97	16:00	

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
FOX	/ /	:	FOX	/ /	:
[illegible]	3/7/97	1000			

RECORD RETURNED BY	DATE	TIME
	/ /	:

SHIPPING NUMBER: FEDEX 929882 3656

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1587

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)

PROJECT NUMBER: 05C47900

WBS CODE: 505-01

SUBCONTRACT / D.D. No.

LABORATORY NAME & ADDRESS: [illegible] Inc.
630 Maple Avenue
Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR A158701	3/4/97	15:35	DAS	1	1 Gal Poly	~~4 deg C~~ DAS none	W	SW9315 SW9320		
~~CR-A 158701~~ BN								BN 3/4/97		
CR-A 158702	3/4/97	17:50	BN	1	1 Gal Poly	none ~~4°C~~	W	SW9315 SW9320		
CR-A 158703	3/5/97	11:00	BN	1	1 Gal Poly	4°C	W	SW9315 SW9320		
CR-A158704	3/6/97	11:50	DAS	1	1-gal Poly	4°C DAS	W	SW9315 SW9320	DAS	

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
Don Schultz	3/6/97	16:00	

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	/ /	:		/ /	:

RECORD RETURNED BY	DATE	TIME
	/ /	:

SHIPPING NUMBER: FEDEX 9798823656

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

CR-1590 96 11 09 7

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK pg 1 of 4

PROJECT NAME: Carswell AFB (J021)
PROJECT NUMBER: 05 CH7900
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
LABORATORY NAME & ADDRESS: Paragon
225 Commerce Dr
Fort Collins, Co.

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A 159001	11/12/96	0825	BN	1	8oz jar	4°C	S	SW9315 SW9320		01
CR-A 159002	11/12/96	0900	BN	1	8oz jar	4°C	S	SW9315 SW9320		02

11/12/96

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME		
[signature]	11/13/96	16:00			
RECEIVED BY [signature]	11/14/96	09:30	RELINQUISHED BY	DATE / /	TIME :
RECORD RETURNED BY	DATE / /	TIME :			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

JACOBS ENGINEERING GROUP INC. CR-A1591 96K065 E6

600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (0021)
PROJECT NUMBER: 05647900
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
LABORATORY NAME & ADDRESS: EMAX Inc. 630 Maple Ave. Torrance, CA 90503

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT T=2°C
17 CR-A159101	11/12/96	08:25	BN	1	4oz. jar	4°C	S	E418.1		
18 CR-A159102	11/12/96	09:00	BN	1	4oz. jar	4°C	S	E418.1		
19 CR-A159103	11/12/96	18:17	BN	1	1 l Amber	H_2SO_4	W	E418.1		
~~CR-A159104~~										

11/12/96

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME	DATE	TIME
[signature]	11/13/96	16:00			
RECEIVED BY [signature]	11/14/96	10:00 am	RELINQUISHED BY		
RECORD RETURNED BY	DATE	TIME			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1[illegible]
TELEPHONE (303) 595 - 0855 FAX (303) [illegible] - 8057
NVER, COLORADO 80202

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: NASFW BACKGROUND STUDY
PROJECT NUMBER: 05647900
WBS CODE:
SUBCONTRACT / D.O. No.

LABORATORY NAME & ADDRESS: PARAGON ANALYTICS, INC.
225 COMMERCE DRIVE
FORT COLLINS, CO 80524

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A 161301	2/14/97	1220	MJ	1	1 Gal. Cube	None	WQ	Radium 226/228 by Gamma		01
CR-A 161302	2/14/97	1226	MJ	1	1 Gal Cube	None	WQ	Radium 226/228 by Gamma		02
CR-A 161303	2/16/97	1547	MJ	1	1 Gal. Cube	None	WQ	Radium 226/228 by Gamma		03

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
[signature]	2/20/97	14:57	30 Day

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
[signature] TDY	/ /	:	TDY	/ /	:
[signature]	2/21/97	250			

RECORD RETURNED BY	DATE	TIME
	/ /	:

SHIPPING NUMBER: 9218823600

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

000027

CR-A16 14

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: NASFW Background Study
PROJECT NUMBER: 05647900
WBS CODE:
SUBCONTRACT / D.O. No.
LABORATORY NAME & ADDRESS: ENVIRO TECH SERVICES, 361 North Ohio Street, Salina Kansas 67401

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A 161401	2/24/97	1500	MN	1	1 Plastic Bag	—	R	Hydraulic Cond. ASTM 2434 Effective Porosity Grain Size ASTM D422		
CR-A 161402	2/24/97	1515	MN	1	1 Plastic Bag	—	R	Hydraulic Cond. ASTM 2434 Effective Porosity Grain Size ASTM 422		
CR-A 161403	2/24/97	1530	MN	1	1 Plastic Bag	—	R	Hyd. Cond. ASTM 2434 Eff. Porosity Grain Size ASTM 422		

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
	2/26/97	17:00	

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	/ /	:		/ /	:

RECORD RETURNED BY	DATE	TIME	SHIPPING NUMBER:
	/ /	:	

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

97C075 G1

CR-A1615 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
PROJECT NUMBER: 05C47900
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
LABORATORY NAME & ADDRESS: MAX LABORATORIES, INC. 630 Maple Avenue Torrance CA 90503-

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
1	CR-A161501	3/19/97	10:45	MJ	1	1 L Amber Glass	4C H2SO4	W	E418.1		T=2°C
2	CR-A161502	3/20/97	10:25	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		
3	CR-A161503	3/19/97	14:10	BN	~~1~~ 2	1 L Amber Glass	4C H2SO4	W	E418.1	M	
	CR-A161504	3/20/97	09:10 ~~11:10~~	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1	MW	
5	CR-A 161505	3/19/97	1420	BN	1	1L Amber	H_2SO_4	W	E418.1		
6	CR-A 161506	3/19/97	16:45	BN	1	1L Amber	H_2SO_4	W	E418.1		

COMMENTS:

	DATE	TIME			
COLLECTED & RELEASED BY	3/20/97	1600	TURNAROUND TIME: 7 day TAT		
RECEIVED BY	3/21/97	10:00	RELINQUISHED BY	DATE	TIME
RECORD RETURNED BY	DATE	TIME			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

97-03133

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1616 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: Paragon
225 Commerce Dr.
Ft. Collins CO -
PROJECT NUMBER: 05G47900
WBS CODE: 505-01
SUBCONTRACT / D.O. No.

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A161601	3/19/97	10:50	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		01
CR-A161602	3/20/97	10:25 ~~14:10~~	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		02
CR-A161603	3/19/97	14:10	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		03
CR-A161604	3/20/97	09:10 ~~14:10~~	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		04
CR-A 161605	3/19/97	1420	BN	1	1 Gal Poly	none	W	SW9315 SW9320		05
CR-A 161606	3/19/97	16:45	BN	1	1 Gal Poly	none	W	SW9315 SW9320		06

COMMENTS:

RELEASED BY	DATE	TIME	TURNAROUND TIME: 17 day TAT	DATE	TIME
	3/20/97	1600			
RECEIVED BY: FDX	DATE	TIME	RELINQUISHED BY: FDX	DATE	TIME
	3/21/97	230 pm			
RECORD RETURNED BY	DATE	TIME	SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

JACOBS ENGINEERING GROUP INC. 97D029 H1

600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1617 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)

LABORATORY NAME & ADDRESS: EMAX LABORATORIES, INC.
630 Maple Avenue
Torrance CA 90503-

PROJECT NUMBER: 05G47900

WBS CODE: 505-01

SUBCONTRACT / D.O. No.

	SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
1	CR-A161701	4/3/97	18:35	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		T=2°C
2	CR-A161702	4/4/97	0825	MJ	2	1 L Amber Glass	4C H2SO4	W	E418.1	MS/MSD	
3	CR-A161703	4/2/97	19:00	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		
4	CR-A161704	4/3/97	12:30	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		
5	CR-A161705	4/3/97	12:58	BN	1	1 L Amber Glass	4C H2SO4	W	E418.1		
6	CR-A 161706	4/4/97	0905	MJ	1	1 L Am Glass	4C H2SO4	W	E418.1		
7	CR-A 161707	4/4/97	1200	MJ	1	1 L Am GLASS	4C H2SO4	W	E418.1		

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
[signature]	4/4/97	15:00	17 DAY

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
[signature]	4/5/97	10:00		/ /	:

RECORD RETURNED BY	DATE	TIME	SHIPPING NUMBER:
	/ /	:	

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1618

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: Paragon
PROJECT NUMBER: 05647900
225 Commerce Dr.
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
Ft. Collins CO

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A161801	4/3/97	18:35	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		01
CR-A161802	4/4/97	08:25	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		02
CR-A161803	4/3/97	19:05	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		03
CR-A161804	4/3/97	12:30	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		04
CR-A161805	4/3/97	12:58	BN	1	1 Gal Poly	NONE	W	SW9315 SW9320		05
CR-A161806	4/4/97	0905	MJ	1	1 gal Poly	NONE	W	SW9315 SW9320		06
CR-A161807	4/4/97	1200	MJ	1	1 gal Poly	NONE	W	SW9315 SW9320		07

COMMENTS:

COLLECTED / RELEASED BY	DATE	TIME	TURNAROUND TIME
	4/9/97	1500	17 DAYS.

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
VIA FEDX	4/5/97	10:00		/ /	

RECORD RETURNED BY	DATE	TIME	SHIPPING NUMBER:
	/ /	:	

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

97D132 G3

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1619

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)

PROJECT NUMBER: 05647900

WBS CODE: 505-01

SUBCONTRACT / D.D. No.

LABORATORY NAME & ADDRESS: EKAI LABORATORIES, INC.
630 Maple Avenue
Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A161901	4/17/97	11:30	MJ	1	1 L Amber Glass	4C H2SO4	W	E418.1	T=2°C	
CR-A161902	4/24/97	10:30	MJ	1	1 L Amber Glass	4C H2SO4	W	E418.1	MS MSD	
CR-A161903	1 1	14:38	MJ	1	1 L Amber Glass	4C H2SO4	W	E418.1		
CR-A161904	4/24/97	1045	MJ	1	1L Amber	4C H2SO4	W	E418.1		
161904										

4/25/97

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
	4/25/97	17:00	17 DAY

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	4/26/97	9:45A		/ /	:

RECORD RETURNED BY	DATE	TIME
	/ /	:

SHIPPING NUMBER:

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

97-04-213

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8856 FAX (303) 595 - 8857

CR-A1620

CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
PROJECT NUMBER: 05G47900
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
LABORATORY NAME & ADDRESS: Paragon
225 Commerce Dr.
Ft. Collins CO

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A162001	4/17/97	11:30	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		01
CR-A162002	4/24/97	10:30	MJ	3	1 Gal Poly	NONE	W	SW9315 SW9320		02
CR-A162003	4/17/97	14:38	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		03
CR-A 162004	4/24/97	1045	MJ	1	1 Gal Poly	NONE	W	SW9315 SW 9320		04

4/25/97

COMMENTS:

VIA FEDX Sat Del.

COLLECTED or RELEASED BY	DATE	TIME	TURNAROUND TIME
	4/25/97	1700	17 DAY

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
	4/26/97	09:30		/ /	:

RECORD RETURNED BY	DATE	TIME
	/ /	:

SHIPPING NUMBER:

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - AS REQUIRED PINK - DATA MANAGEMENT / GOLDENROD - FIELD

G1

97E078

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1631 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
PROJECT NUMBER: 05G47900
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
LABORATORY NAME & ADDRESS: EMAX LABORATORIES, INC.
630 Maple Avenue
Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT T=2°C
CR-A163101	05/13/97	11:30	BH	1	1 L Amber Glass	4C H2SO4	W	E418.1		
CR-A163102	5/13/97	14:30	MN	~~1~~ 2	1 L Amber Glass	4C H2SO4	W	E418.1	MS/MSD	

5/15/97

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
[signature]	5/15/97	11:00	7 day

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
M. [signature]	5/16/97	10:00		/ /	:

RECORD RETURNED BY	DATE	TIME	
	/ /	:	SHIPPING NUMBER:

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

9705.132

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1632 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)
LABORATORY NAME & ADDRESS: Paragon
PROJECT NUMBER: 05G47900
225 Commerce Dr.
WBS CODE: 505-01
SUBCONTRACT / D.O. No.
Ft. Collins CO

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT
CR-A163201	5/13/97	~~9:00~~ 11:30	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		01
CR-A163202	5/13/97	14:30	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		02
CR-A163203	5/13/97	09:00	MJ	1	1 Gal Poly	NONE	W	SW9315 SW9320		03

5/15/97

COMMENTS:

COLLECTED & RELEASED BY	DATE	TIME	TURNAROUND TIME
	5/15/97	11:00	7 DAY

RECEIVED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
FAX	/ /	:	FAX	/ /	:
	5/16/97	930			

RECORD RETURNED BY	DATE	TIME
	/ /	:

SHIPPING NUMBER:

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

411 421

97E078

C1

JACOBS ENGINEERING GROUP INC.
600 SEVENTEENTH STREET, SUITE 1100N DENVER, COLORADO 80202
TELEPHONE (303) 595 - 8855 FAX (303) 595 - 8857

CR-A1633 CHAIN OF CUSTODY RECORD

USE A BALLPOINT PEN, BLACK INK, AND PRESS FIRMLY. INSTRUCTIONS ARE ON THE BACK

PROJECT NAME: CARSWELL AFB (DO 21)	LABORATORY NAME & ADDRESS: EMAX LABORATORIES, INC.
PROJECT NUMBER: 05G47900	630 Maple Avenue
WBS CODE: 505-01 SUBCONTRACT / D.O. No.	Torrance CA 90503-

SAMPLE NUMBER	COLLECTION DATE	COLLECTION TIME	SAMPLER'S INITIALS	NUMBER OF CONTAINERS	CONTAINER SIZE AND TYPE	PRESERVATIVE	MATRIX CODE	ANALYSES REQUESTED	QC	CONDITION ON RECEIPT T=2°C
CR-A163301	5/13/97	09:00	MJ	1	1 L Amber Glass	4C H2SO4	W	E418.1		

5/15/97

COMMENTS:

COLLECTED & RELEASED BY	DATE 5/15/97	TIME 11:00	TURNAROUND TIME 7 Day		
RECEIVED BY	DATE 5/16/97	TIME 10:00	RELINQUISHED BY	DATE / /	TIME :
RECORD RETURNED BY	DATE / /	TIME :			
			SHIPPING NUMBER:		

DISTRIBUTION: WHITE - PROJECT FILE / CANARY - LAB RECEIPT / PINK - DATA MANAGEMENT / GOLDENROD - FIELD

TAB

Appendix C

APPENDIX C

Soil Probe Boring Logs

BORING LOG

Borehole ID: BJETA901
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Esenhart	Ground Elevation	Total Drilled Depth: 2.0 ft.	
Drilling Equipment	Drilling Method: Geoprobe	Borehole Diameter: 2 in.	Date/Time Drilling Started: 11/6/96 10:15	Date/Time Total Depth Reached: 11/6/96 11:05
Type of Sampling Device: Geoprobe 1" x 2' w/liners			Water Level (bgs) First: None	Final: None
Sample Hammer Type	Driving Wt.	Drop	Hydrogeologist: B. Neely	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1			NA	Sandy clay (CL) - Dark gray (10YR 4/1) clay with medium and coarse sand. Weathered limestone fragments 1/32 to 1/4 in. diameter	CL		D	Collect BJETA901-A
2				Bottom of boring at 2.0 ft.				
3								
4								
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA902
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 3.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Geoprobe / Borehole Diameter: 1 5/8 in.		Date/Time Drilling Started: 11/6/96 13:05	Date/Time Total Depth Reached: 11/6/96 13:35	
Type of Sampling Device: 1"x2' w/ SS liners		Water Level (bgs): First —	Final —	
Sample Hammer: Type / Driving Wt. / Drop		Hydrogeologist: B. Neely	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Silty Sandy Clay (CL) - Dark gray (10YR 4/1) clay with 5-10% sand and 20-30% silt. Weathered limestone fragments 1/32 to 1/8 in.	CL		Dry to Moist	Collect BJETA902-A
				1.5				
2				Clayey Silt (ML) - Very pale brown (10YR 7/3) silt with 15-25% clay. Moderately cohesive when hydrated.	ML		Dry	Collect BJETA902-B
3				3.0				
				Bottom of boring at 3.0 ft.				
4								
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA903
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Dary Isenhart	Ground Elevation	Total Drilled Depth: 3.2 ft. bgs	
Drilling Equipment: Geoprobe	Drilling Method: Direct Push	Borehole Diameter	Date/Time Drilling Started: 11/6/96 13:45	Date/Time Total Depth Reached: 11/6/96 14:05
Type of Sampling Device: 1"x2' w/ SS sleeves.		Water Level (bgs) First —	Final —	
Sample Hammer Type — Driving Wt. — Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Sandy Clay (CL) - Dark grayish brown (10YR 4/2) clay with 5-10% fine sand and 10-20% limestone fragments.	CL		Dry to Moist	Collect BJETA903-A
				0.8				
2				Sandy Silt with clay (SM) - Light gray (10YR 7/2) silt with 25% fine sand and 25% weathered limestone fragments.	SM		Dry	Collect BJETA903-B
3				3.2 Bottom of boring at 3.2 ft.				
4								
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA904
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe	Drilling Method: Direct Push	Borehole Diameter	Date/Time Drilling Started: 11/6/96 14:35	Date/Time Total Depth Reached: 11/6/96 15:00
Type of Sampling Device: ~~2"x~~ 1"x2' ca/SS sleeves.		Water Level (bgs) First —	Final —	
Sample Hammer Type — Driving Wt. — Drop —		Hydrogeologist: B. Neely	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Silty Clay (CL) - Dark grayish brown (10YR 4/2) clay with silt and weathered limestone fragments.	CL		Moist	Collected A horizon sample only. (BJETA904-A)
2								
3				3.0 — Weathered Limestone	LS		Dry	
4				Bottom of boring at 4.0 ft				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA905
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth	
Drilling Equipment: Geoprobe	Drilling Method: Direct Push	Borehole Diameter	Date/Time Drilling Started: 11/6/96 15:05	Date/Time Total Depth Reached: 11/6/96 16:15
Type of Sampling Device: 1"x2' with SS Sleeves		Water Level (bgs) First ———	Final ———	
Sample Hammer Type Driving Wt. Drop		Hydrogeologist: B. Neely	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0–5.0				Silty Clay (CL) - Very dark grayish brown (10YR 3/2) clay with 5-15% silt and 10% weathered limestone fragments, roots to 6 in. deep. NOTE: Soil slowly transitions to brown (10YR 4/3) silty clay with increasing amount of limestone fragments.	CL		Moist / Dry	Collect BJETA905-A
5.0–7.0				Sandy Clayey Silt (ML) - Light gray (10YR 7/2) silt with sand and clay. 10% unweathered limestone fragments 1/10 to 1/4 in. in size.	ML		Dry	Collect BJETA905-B
7.0				Bottom of boring at 7.0 ft. Refusal				

BORING LOG

Borehole ID: BJETA906
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 3.0 ft. bgs	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter		Date/Time Drilling Started: 11/6/96 16:30	Date/Time Total Depth Reached: 11/6/96	
Type of Sampling Device: 1" x 2' w/ SS sleeves		Water Level (bgs): First —	Final —	
Sample Hammer: Type — Driving Wt. — Drop —		Hydrogeologist: B. Neely	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				[redacted], Silty Clay (CL) - Dark grayish brown (10YR 4/2) clay with 5-15% silt. Roots to 3 in. deep	CL			Collect BJETA906-A
2				1.5 Silt (ML) - Light gray (10YR 7/2) silt with <5% clay, 10-20% unweathered limestone fragments.	ML			Collect BJETA906-B
3				3.0 Refusal at 3.0 ft. bgs				
4								
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA907
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe	Drilling Method: Direct Push	Borehole Diameter: 2 in.	Date/Time Drilling Started: 11/7/96 13:00	Date/Time Total Depth Reached: 11/7/96 13:30
Type of Sampling Device: 2" x 4' w/ Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type —	Driving Wt. —	Drop —	Hydrogeologist: B. Neely	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Silty Clay (CL) - Dark ~~[illegible]~~ grayish brown (10YR 4/2) clay with silt and <5% fine sand. Roots to 6 in. deep.	CL		Sl. Moist	Collect BJETA907-A
				(TRANSITIONAL CHANGE)				
2				Clayey Silt (ML) - Light gray (10YR 7/2) silt with clay. Only slightly cohesive when hydrated. 10% weathered limestone fragments 1/32 to 1/8 in diameter.	ML		Dry	Collect BJETA907-B
3								
4				Bottom of boring at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA908
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter: 2 in		Date/Time Drilling Started: 11/7/96 14:05	Date/Time Total Depth Reached: 11/7/96 14:10	
Type of Sampling Device: 2" x 4' w/ Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type — Driving Wt. — Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Clay (CL) - Very dark gray (7.5YR 3/1) clay. Highly plastic when hydrated. <5% silt and fine sand. Clay continues to 4.0 ft. with color change to mottled brown (7.5YR 4/4) and white (7.5YR 8/1).	CL		Sl. Moist	Collect BJETA908-A
2								
3								Collect BJETA908-B
4				Bottom of push at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA909
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05E47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push	Borehole Diameter: 2 in.	Date/Time Drilling Started: 11/7/96 14:50	Date/Time Total Depth Reached: 11/7/96 15:00	
Type of Sampling Device: 2" x 4' with Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type — Driving Wt. — Drop —		Hydrogeologist: B. Neely	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1, 2				Clay (CL) - Dark reddish brown (5YR 3/2) clay with silt and <5% fine sand. Roots to 4 in. deep and occasional mottled zones of reddish brown (5YR 5/3) clay.	CL		Sl. Moist	Collect BJETA909-A
				2.5 Goodland Shale (Walnut?) - Moderately weathered shale, yellowish red (5YR 4/6). Horizontal partings - very brittle, breaks into powder with hands.			Dry	Collect BJETA909-B
4, 5, 6, 7, 8, 9				Bottom of boring at 4.0 ft.				

BORING LOG

Borehole ID: BJETA910
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 7.2 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter: 2 in.		Date/Time Drilling Started: 11/9/96 08:10	Date/Time Total Depth Reached: 11/9/96 09:00	
Type of Sampling Device: 2"x4' w/ Plastic Sleeves		Water Level (bgs): First —	Final —	
Sample Hammer: Type Auto / Driving Wt. — / Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1, 2				Clay (CL) - Dark grayish brown (10YR 4/2) clay with 20-30% silt. Roots to 4 in. deep. Moderately plastic. 1.2	CL		Sl. Moist	Collect sample from 0-1 ft. (BJETA910-A)
3, 4, 5				Clay (CL) - Mottled brownish yellow (10YR 6/6), gray (10YR 5/1) and bluish gray (gley 6/1) clay with occasional subrounded limestone fragments. Not as plastic as above clay. 6.2	CL		Sl. Moist	Collect sample from 4-6 ft. (BJETA910-B)
6, 7				Claystone (Goodland Marl) - Light gray (2.5Y 7/2) claystone. Very brittle, breaks along horizontal bedding planes.	CL		Dry	
8, 9				Bottom of probe at 7.2 ft. Refusal at 7.2 ft.				

BORING LOG

Borehole ID: BJETA911
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 7 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter: 2 in.		Date/Time Drilling Started: 11/9/96 09:10	Date/Time Total Depth Reached: 11/9/96 09:45	
Type of Sampling Device: 2"x4' w/ Plastic Sleeve		Water Level (bgs) First —	Final —	
Sample Hammer Type: Auto Driving Wt. — Drop —		Hydrogeologist: B. Neely	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1, 2				Interval skipped- location for collection of deep sample only.				
3, 4				Clay (CL) - Mottled brownish yellow (10YR 6/6) and gray (10YR 5/1) clay. Moderately hard, very brittle. Breaks into angular to subangular fragments	CL		Sl. Moist	Collect sample from 3-4 ft. (BJETA911-B)
4.2				Claystone (Goodland Marl) - Light gray clay (2.5YR 7/2). Iron staining along fracture planes. Hard but brittle.				No sample collected.
5, 6, 7				Bottom of probe at 7 ft.				
8, 9								

BORING LOG

Borehole ID: BJETA912
Sheet 1 of 1

			Location WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4 ft	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter: 2 in.		Date/Time Drilling Started: 11/9/96 10:00	Date/Time Total Depth Reached: 11/9/96	
Type of Sampling Device: 2" w/ Plastic Sleeve		Water Level (bgs) First —	Final —	
Sample Hammer Type: Auto Driving Wt. — Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				0.6 Clay (CL) - Very dark grayish brown (10YR 3/2) clay with 20%-30% silt and roots to 4 in. Moderately plastic.	CL		Moist	Collect sample from 0-0.6 (BJETA912-A)
2, 3				Clay (CL) - Pale yellow (2.5YR 8/4) clay mottled with yellow (2.5YR 7/6) clay, with silt and 10% fine gravel sized limestone fragments. Moderately to poorly plastic.	CL		Sl. Moist	Collect sample from
4, 5, 6, 7, 8, 9				Bottom of probe at 4 ft.				

BORING LOG

Borehole ID: BJETA913
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05E47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 8 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push	Borehole Diameter: 2in.	Date/Time Drilling Started: 11/9/96 11:00	Date/Time Total Depth Reached: 11/9/96 11:45	
Type of Sampling Device: 2" w/ Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type Auto	Driving Wt. — Drop —	Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook): Along west fenceline (Rudy's property line fence)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1 2 3 4 5				Clay (CL) - Very dark gray (10YR 3/1) clay with sand and silt. Sand is fine with occasional medium and coarse. Up to 30% silt. Moderately cohesive in upper zone, grading to highly cohesive in lower zones with decreasing amounts of silt. Top 1.1 ft. is topsoil horizon with greatest percentage of organic matter. Roots to 6in. deep. 4.5	CL		Sl. Moist	3.7 ft. recovery Collect sample from 0-1.1 (BJETA913-A)
6 7				Sandy Clay (CL) - Pale yellow (2.5Y 7/4) clay with 20-40% fine sand and silt. 10% coarse gravel sized limestone fragments. Fragments are subrounded to rounded.	CL			4 ft. recovery collect sample from 6-8 ft. (BJETA913-B)
8 9				Bottom of probe at 8 ft.				

BORING LOG

Borehole ID: BJETA914
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05E47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Probe	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter: 2 in.		Date/Time Drilling Started: 11/11/96 08:20	Date/Time Total Depth Reached: 11/11/96 08:35	
Type of Sampling Device: 2"x4' w/ Plastic Sleeves		Water Level (bgs): First —	Final —	
Sample Hammer: Type Auto / Driving Wt. — / Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
				Clay (CL) - Very dark grayish brown (10YR 3/2) clay, high organic content, plastic, Roots to 0.7 — 6 in. deep.	CL			HNU = 0 ppm Collect BJETA914-A
1				Clay with Sand (CL) - Brown (10YR 5/3) clay with 20-30% fine sand, occasional mottled zones of yellowish brown (10YR 5/8) clay. Moderately cohesive, soft.	CL			HNU = 0ppm Collect BJETA914-B and BJETA914-BFD
2								
3								
4				Bottom of probe at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA915
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push	Borehole Diameter: 2"	Date/Time Drilling Started: 11/11/96 09:30	Date/Time Total Depth Reached: 11/11/96 09:40	
Type of Sampling Device: 2"x4' w/ Plastic Sleeve		Water Level (bgs) First —	Final —	
Sample Hammer Type: Auto Driving Wt. — Drop —		Hydrogeologist: B. Nedy	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Clay (CL) - Very dark grayish brown (10YR 3/2) clay with fine sand and silt. High organic content. Soft and cohesive clay. 0.85	CL			HNU = 0 ppm Collect BJETA915-A
				NOTE: Limestone, probably float, from 0.85 to 2 ft.				
2				Sandy Clay (CL) - Yellowish brown (10YR 5/4) clay with fine sand. 20 to 40% unweathered limestone fragments 1/4 to 1.5 in. in diameter.	CL			HNU = 0 ppm Collect BJETA915-B
3								
4				Bottom of probe at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA916
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 3.0 ft.	
Drilling Equipment: Geoprobe	Drilling Method: Direct Push	Borehole Diameter: 2"	Date/Time Drilling Started: 11/11/96 10:30	Date/Time Total Depth Reached: 11/11/96 10:35
Type of Sampling Device: 2"x4' w/ Plastic Sleeve		Water Level (bgs) First —	Final —	
Sample Hammer Type: Auto	Driving Wt. —	Drop —	Hydrogeologist: B. Neely	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
				Sandy Clay (CL) - Brown (10YR 4/3) clay with fine sand, low cohesiveness, soft, Roots to 10 in.	CL			HNU = 0 ppm Collect BJETA916-A
				0.8				
1				Limestone - White to very pale brown (10YR 8/1 to 10YR 7/3) slightly weathered limestone. Breaks into disk shaped pieces in sampler. Hard with occasional iron staining along fracture planes.	CL			
2								
3				Probe refusal at 3.0 ft. in Limestone.				
4								
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA917
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 7.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter: 2"		Date/Time Drilling Started: 11/11/96 10:55	Date/Time Total Depth Reached: 11/11/96 11:00	
Type of Sampling Device: 2" x 4' w/ Plastic Sleeve		Water Level (bgs) First —	Final —	
Sample Hammer Type: Auto / Driving Wt. — / Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Clay (CL) - Very dark gray (10YR 3/1) clay with organic matter and fine sand, Roots to 8 in. deep.	CL		Slightly Moist	Hnu = 0 ppm Collect BJETA917-A
2, 3, 4, 5, 6				Clay with Limestone - Pale brown (10YR 6/3) clay with limestone fragments 1/4 to 1 in. in diameter. Limestone is unweathered to slightly weathered. Limestone fragments represent approx. 35% of total with remainder being clay matrix. NOTE: 3 in. wet zone at approx. 5.5 ft.	CL		Slightly Moist; Wet	Hnu = 0 ppm Collect BJETA917-B
7				Goodland Limestone (Marl) - Mottled clayey silt marl, soft, lt. gray, yellow & white	ML		Dry	
8, 9				Probe refusal at 7.0 ft. in Goodland Limestone (Marl)				

BORING LOG

Borehole ID: BJETA918
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe	Drilling Method: Direct Push	Borehole Diameter: 2"	Date/Time Drilling Started: 11/11/96 13:20	Date/Time Total Depth Reached: 11/11/96 13:40
Type of Sampling Device: 2" w/ Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type Auto	Driving Wt. —	Drop —	Hydrogeologist: B. Neely	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
				Clay (CL) - Very dark gray (10YR 3/1) clay with 10-15% fine sand, organic matter and silt, roots to 4 in. deep.	CL		Sl. Moist	Hnu = 0 ppm Collect BJETA918-A
1				0.5				
				Clayey Sand (SC) - Pale brown (10YR 6/3) fine to coarse sand with clay.	SC		Moist	Hnu = 0 ppm Collect BJETA918-B
2				1.8				
				Sandy Clay (CL) - Pale brown (10YR 6/3) clay with fine to medium sand, shells and moderately weathered limestone fragments. Soft and moderately cohesive.	CL		Wet / Sl. Moist	wet zone at 2.5 ft.
3								
4				Bottom of probe at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA919
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter: 2"		Date/Time Drilling Started: 11/11/96 14:10	Date/Time Total Depth Reached: 11/11/96 14:40	
Type of Sampling Device: 2" w/ Plastic Sleeve		Water Level (bgs) First —	Final —	
Sample Hammer Type: Auto Driving Wt. — Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				CLAY (CL) - Very dark grayish brown (10YR 3/2) clay with sand. Roots to 4 in. deep. Soft, plastic, high organic contents. 0.9	CL		Sl. Moist	Haw = 0 ppm Collect BJETA919-A and BJETA919-AFD
2				SANDY CLAY (CL) - Light gray (2.5Y 7/1) clay with 30-45% fine and coarse sand. Not very cohesive due to sand content. Vertical Roots. 2.0	CL		Moist	Haw = 0 ppm Collect BJETA919-B
3				Goodland Limestone (Marl) - Mottled light gray (2.5Y 7/1), white (2.5Y 8/1), and light yellowish brown (2.5Y 6/4) clays with fine sand and silt. Dry and brittle	CL		Dry	
4							Wet	wet zone at 3.8 ft.
				Bottom of probe at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA920
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe	Drilling Method: Direct Push	Borehole Diameter: 2"	Date/Time Drilling Started: 11/11/96 14:55	Date/Time Total Depth Reached: 11/11/96 15:10
Type of Sampling Device: 2" w/ Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type Auto	Driving Wt. —	Drop —	Hydrogeologist: B. Neely	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				0.4 Clayey Sand (SC) - Light olive brown (2.5Y 5/3) sand with clay. Non-cohesive to slightly cohesive. Roots	SC		Slightly Moist	HNU = 0 ppm Collect BJETA920-A
2				1.5 Clay (CL) - Light brownish gray (10YR 6/2) clay with fine sand. Moderately plastic, soft. No Roots.	CL		Moist	HNU = 0 ppm Collect BJETA920-B
3				Goodland Limestone (Marl) - Mottled light gray (2.5Y 7/1), white (2.5Y 8/1) and light yellowish brown (2.5Y 6/4) clays with fine sand and silt. Dry and brittle. Cohesive if hydrated.			Dry	
4				Bottom of probe at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA921
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter		Date/Time Drilling Started: 11/11/96 15:40	Date/Time Total Depth Reached: 11/11/96 15:55	
Type of Sampling Device: 2" w/ Plastic Sleeve		Water Level (bgs) First —	Final —	
Sample Hammer Type: Auto Driving Wt. — Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
				Clay (CL) - Dark grayish brown (10YR 4/2) clay with fine sand and silt. Roots to 0.4 m.	CL		Moist	No sample collected due to lack of depth
1				NOTE: Some portions of this zone were not collected due to rock in shoe.				
2				Sandy Clay (CL) - Yellow (2.5Y 7/6) clay with fine sand and silt. Approx. 10% medium sand. Soft and moderately to slightly cohesive.	CL		Moist	
3								
4				Bottom of probe at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA922
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe	Drilling Method: Direct Push	Borehole Diameter: 2"	Date/Time Drilling Started: 11/12/96 08:15	Date/Time Total Depth Reached: 11/12/96 08:40
Type of Sampling Device: 2" x 4' w/ Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type Auto	Driving Wt. —	Drop —	Hydrogeologist: B. Neely	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Clay (CL) - Very dark gray (10YR 3/1) clay with 30-40% fine sand, moderately cohesive and soft. Roots to 6 in. deep. High organic content.	CL		Moist	Hnu = 0ppm (MS/MSD) Collect BJETA922-A and BJETA922-AFD
2				Clayey Sand (SC) - Light gray (10YR 7/2) fine sand with 20-30% clay and 10% coarse sand. Slightly to non-cohesive. Wet zone at 3.7 ft has greater than 80% fine and medium sand. Soft.	SC		Moist / Wet	Hnu = 0ppm (MS/MSD) Collect BJETA922-B and BJETA922-BFD. Wet zone from 3.7 to 4.0 ft.
3								
4				Bottom of probe at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA923
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe	Drilling Method: Direct Push	Borehole Diameter: 2"	Date/Time Drilling Started: 11/12/96 09:10	Date/Time Total Depth Reached: 11/12/96 09:30
Type of Sampling Device: 2" x 4' w/ Plastic Sleeve		Water Level (bgs) First —	Final —	
Sample Hammer Type: Auto	Driving Wt. —	Drop —	Hydrogeologist: B. Neely	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Clay (CL) - Very dark grayish brown (10YR3/2) clay with fine sand and roots. Silt and cohesive with high organic content.	CL			No Sample Collected from A horizon in this boring.
2				Sandy Clay (CL) - Light gray (10YR7/2) clay with 20-30% fine and medium sand. Approx. 20% coarse sand and fine gravel - Angular to subangular - dispersed in clay matrix.	CL			HNU = 0 ppm Collect BJETA923-B
4				Bottom of probe at 4.0 ft.				
5								
6								
7								
8								
9								

BORING LOG

Borehole ID: BJETA924
Sheet 1 of 1

			Location: WSA	
Project Name: Background Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push	Borehole Diameter: 2"	Date/Time Drilling Started: 11/12/96 09:50	Date/Time Total Depth Reached: 11/12/96 10:10	
Type of Sampling Device: 2"x4' w/ Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type Auto, Driving Wt. —, Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1				Sandy Clay (CL) - Very dark gray (10YR 3/1) clay with 30-40% sand. Slightly cohesive and soft. Roots to 6in. deep.	CL			Hnu=0 ppm Collect BJETA924-A
				Limestone Gravel Layer - Angular limestone fragments 1/2 to 1 1/2 in. diameter.				
2				Clay (CL) - Mottled light gray (2.5Y 7/1), white (2.5Y 8/1), and light yellowish brown (2.5Y 6/4) clay. Very stiff and plastic.	CL			Hnu=0 ppm Collect BJETA924-B
3								
4				Bottom of probe at 4.0 ft.				
5								
6								
7								
8								
9								

BJETA930

Borehole ID (WSA Test Hole 1)
Sheet 1 of 2

BORING LOG

			Location: WSA-Test Hole 1	
Project Name: Radium Study	Project Number: OSG47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: Geo Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push / Borehole Diameter: 2"		Date/Time Drilling Started: 11/12/96 12:30	Date/Time Total Depth Reached: 11/12/96 12:50	
Type of Sampling Device: 2"x 4' w/ Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type Auto / Driving Wt. — / Drop —		Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook): SE of former Radium Dial Storage Tubes.

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
				Sandy Clay (CL) - Very dark gray (10YR 3/1) clay with fine sand.	CL			
				0.7				
1				Clay / Sandy Clay (CL) - Light gray (10YR 7/2), white (10YR 8/1) and light yellowish brown (10YR 6/4) clay. Stiff. Wet zone at 3.9 to 4.2 ft.	CL		Moist	
2								
3								
4							Wet	Wet Zone from 3.9 to 4.2 ft.
5							Moist	
6								
				6.5				
7				Claystone - Light gray (2.5Y 7/2) Claystone. Hard - breaks along horizontal partings. Brittle. (Goodland Marl)			Dry	
8				Bottom of probe at 7.5 ft. - Begin Drilling with 6¼" HSA. 8"				
9				Hard Competent Limestone, light gray 5Y 7/1			Dry	21 c/m

BORING LOG

Borehole ID: BJETA930
Sheet 2 of 2

			Location: BJETA930	
Project Name: Radium Study	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GeoProjects	Driller: Jose Landeros	Ground Elevation	Total Drilled Depth: 12'	
Drilling Equipment: CME 75	Drilling Method: HSA	Borehole Diameter: 8"	Date/Time Drilling Started: 11/20/96 0849	Date/Time Total Depth Reached: 11/20/96 0937
Type of Sampling Device: 5'L x 2.5" Dia split barrel		Water Level (bgs) First N/A	Final N/A.	
Sample Hammer Type NA	Driving Wt. -	Drop -	Hydrogeologist: M Johnson	Checked by/Date
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
11				Shale Light olive gray 5Y 7/2				Victoreen redding. 34 c/m
12				Refusal.				
13								

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BORING LOG

Borehole ID: BJETA931
Sheet 1 of 1

			Location: WSA-Test Hole 2	
Project Name: Radium Study	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 7.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push	Borehole Diameter: 2"	Date/Time Drilling Started: 11/12/96 13:55	Date/Time Total Depth Reached: 11/12/96 14:25	
Type of Sampling Device: 2"x4' w/ Plastic Sleeve		Water Level (bgs) First —	Final —	
Sample Hammer Type: Auto	Driving Wt. — Drop —	Hydrogeologist: B. Neely	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
1, 2				Clayey Sand (SC) - Very dark grayish brown (10YR3/2) fine sand and clay. Soft and not very cohesive due to high sand content. Roots to 6 in. deep.	SC		Dry	
3, 4, 5, 6				Sandy Clay (CL) - Olive Brown (2.5Y4/4) clay with 20-40% fine and medium sand. Hard and brittle. Approx. 5% highly weathered limestone fragments 1/32 to 1/4 in. in diameter.	CL		Dry	
				6.3 Goodland Marl - Weathered marl, mottled gray, white, and brown.				
7, 8, 9				Probe refusal at 7.0 ft.				

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BORING LOG

Borehole ID: BJETA932
Sheet 1 of 1

			Location: WSA-Test Hole 3	
Project Name: Radium Study	Project Number: 05E47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GEO Corp.	Driller: Doug Isenhart	Ground Elevation	Total Drilled Depth: 4.0 ft.	
Drilling Equipment: Geoprobe / Drilling Method: Direct Push	Borehole Diameter: 2"	Date/Time Drilling Started: 11/12/96 14:55	Date/Time Total Depth Reached: 11/12/96 ~~65~~ 15:10	
Type of Sampling Device: 2"x4' w/ Plastic Sleeve		Water Level (bgs): First —	Final —	
Sample Hammer: Type Auto / Driving Wt. — / Drop —		Hydrogeologist: B. Neely	Checked by/Date	
Location Description (include sketch in field logbook): 25 ft. north of water tower				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
				Clay (CL) - Very dark grayish brown (10YR 3/2) clay w/ fine sand and roots.	CL		Dry	
				0.7				
1				Clayey Sand (SC) - Light gray (10YR 7/2) fine sand with clay and silt. Approx. 10% medium sand. Zone of >30% medium sand between 2.8 and 3.7 ft. deep. Limestone fragments at 3.9 ft.	SC		Dry	
2								
3								
4				Probe Refusal at 4.0 ft.				
5								
6								
7								
8								
9								

TAB

Appendix D

APPENDIX D

Monitoring Well Boring Logs, Construction Details, and Groundwater Sampling Data Sheets

BORING LOG

Borehole ID: WIEPX925
Sheet 1 of 6

			Location: WIEPX925	
Project Name: NASFW Background	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GeoProjects	Driller: Lee Gebhart	Ground Elevation	Total Drilled Depth: 200'	
Drilling Equipment: GD 1500 / Drilling Method: Mud Rotary / Borehole Diameter: 7 7/8		Date/Time Drilling Started: 2/16/97 1338	Date/Time Total Depth Reached: 2/18/97 1300	
Type of Sampling Device: HX Core Barrel		Water Level (bgs) First 110	Final 110	
Sample Hammer Type / Driving Wt. / Drop		Hydrogeologist: M Johnson	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
				Weathered Limestone Lt yellowish Brn				recording highest reading on victoreen m.m.n.
				Very Competent.				
10								
				Shale, black, horizontal bedding.				
								50 c/min
20				Limestone, Hard, small fossils, gray 6/N				Logging cuttings. 1511 2/16/97 - Start drill.
				Shale, black, horizontal bedding				50/c/min
30				calcareous shale/marl, greasy, dark grey 4/N				81 c/min
35				soft calcareous marl, greenish grey 6/10Y				70 c/min
40				Limestone, hard, white 8/N				60 c/min
				Walnut - Shellglomerate				90 c/min
50				Same - but v. clayey. N 4/1 dark gray				

BORING LOG

Borehole ID: WWEPX925
Sheet 2 of 6

			Location: WWEPX925	
Project Name: NASFW Background	Project Number: 0547900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: Geoprobe	Driller: Lee Gebbert	Ground Elevation	Total Drilled Depth: 260'	
Drilling Equipment: GO 1500 / Drilling Method: Rotary / Borehole Diameter: 7 7/8		Date/Time Drilling Started: 2/16/97 1338	Date/Time Total Depth Reached: 2/18/97 1300	
Type of Sampling Device: HX Core Barrel		Water Level (bgs) First: 110	Final: 110	
Sample Hammer Type / Driving Wt. / Drop		Hydrogeologist: M Johnson	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, mineralogy, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
50								
				Fossiliferous Limestone - hard, smaller shell fragments than above, more matrix, ~~aphanitic~~. Gray N 6/1.				80 c/min
60								900 2/12/97 Start drill.
70				Top of Paluxy - Sand with Clay, v. fine soft, well sorted, greenish gray N 6/2				80 c/m
80				Sand, Fine, soft, well sorted with clay greenish gray N 6/2				75 c/m
				Sand, Fine, well sorted, friable lt. greenish gray N 7/2				
90				Same w/ ~10% coal (shimmers in sun like pigeon ore) Striated lengthwise on needles of coal				57 c/m
100				Same w/ 30-50% coal.				91 c/m

BORING LOG

Borehole ID: WWEPX925
Sheet 3 of 6

			Location: WWEPX925	
Project Name: NASFW Background	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GeoProjects	Driller: Lee Gabbert	Ground Elevation	Total Drilled Depth: 260	
Drilling Equipment: GD 1800 / Drilling Method: Rotary / Borehole Diameter: 7 7/8		Date/Time Drilling Started: 2/16/97 1338	Date/Time Total Depth Reached: 2/18/97 1300	
Type of Sampling Device: HX Core		Water Level (bgs) First 110	Final 110	
Sample Hammer Type / Driving Wt. / Drop		Hydrogeologist: M Johnson	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
100				~~Sandy~~				
				Sand, Fine, well sorted. H. gray N 7/				
110								73 c/m ▽ 110
				Same w/ Tr Pyrite				
120				Shale, greasy. stiff/hard (clay like) greenish Gray 10GY 6/1				81 c/m
130								60 c/m
				Clay - small amounts of fine Sand Shale or Claystone/mudstone. gray 7.5YR 5/1				
140								71 c/m
				Fine well sorted Sand interbedded with Shales/mudstones, siltstone.				
150								66 c/m

BORING LOG

Borehole ID: WJEPX925
Sheet 4 of 6

			Location: WJEPX925	
Project Name: NASFW Background	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: Geoprojects	Driller: Lee Gilbert	Ground Elevation	Total Drilled Depth: 260	
Drilling Equipment: GD 1500 / Drilling Method: Wet Rot / Borehole Diameter: 7 7/8		Date/Time Drilling Started: 2/16/9 1338	Date/Time Total Depth Reached: 2/18/97 1300	
Type of Sampling Device: HX Core		Water Level (bgs) First: 110	Final: 110	
Sample Hammer Type / Driving Wt. / Drop		Hydrogeologist: M Johnson	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
150								
160				Fine Sand, well sorted, limestone inclusions at 160'-160.5, also somewhat clayey at 160'. Weakly cemented, slight effervesces w/ HCl. Less cementation at 166'. greenish gray 10y 6/1				95 c/m core rate 1'/min
170								85 c/min
180				Shale/clay with sand (fine) greenish gray 10y 6/1				54 c/m
190				Fine, lt gray (7.5yr 7/1) well sorted sandstone w/ thin 1/4-3/8 in. interbeds of clay shale poorly to well cemented. Calcareous. Clay color is greenish gray 10y 7/1				67 c/m
200				Fine, lt gray (7.5yr 7/1) well sorted sandstone, rounded to subrnd w/ Tr of thin clay interbeds coarser than above.				

BORING LOG

Borehole ID: WIEPX925
Sheet 5 of 6

			Location: WIEPX925	
Project Name: WHSFW Background	Project Number: 05647500	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GeoProjects	Driller: Lee Gebhart	Ground Elevation	Total Drilled Depth: 260	
Drilling Equipment: GD 1500 / Drilling Method: Rotary / Borehole Diameter: 7 7/8		Date/Time Drilling Started: 2/16/97 1338	Date/Time Total Depth Reached: 2/18/97 1300	
Type of Sampling Device: Core HX		Water Level (bgs) First 110	Final 110	
Sample Hammer: Type / Driving Wt. / Drop		Hydrogeologist: M Johnson	Checked by/Date	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
200				~~Firm~~				
				Fine, well sorted, friable, sandstone w/ clay interbeds. rounded to subrounded.				Cuttings.
								75 c/min
210								
220				Clay color turns to brown.				
				→ v. hard. Shaley-black, clayey brown				
				Limestone chips noted in cuttings.				
230				Limestone Lt. grayish brown 10YR 6/2 Hard.				
				Sandstone, hard, fine, well cemented, calcareous. mottled green/gray. Dark gray Shale lense 0.4' thick noted @ ~~22.4~~ 229.-229.4 feet. soft				
240				Sandstone, soft, friable, non calcareous. gray				
				Fine sandstone interbedded with numerous thin claystones. Sand is gray claystones are greenish gray lignite at 238.5 ft. Cement (calcite) content varies throughout.				
250								

BORING LOG

Borehole ID: WIEPX925
Sheet 6 of 6

			Location: WIEPX925	
Project Name: NASFW Background	Project Number: 05G4P900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GeoProjects	Driller: Lee Gebbert	Ground Elevation	Total Drilled Depth: 260	
Drilling Equipment: GD 1500 / Drilling Method: Rotary / Borehole Diameter: 7 7/8		Date/Time Drilling Started: 2/16/97 1338	Date/Time Total Depth Reached: 2/18/97 1300	
Type of Sampling Device: HX Core		Water Level (bgs) First: 110	Final: 110	
Sample Hammer Type / Driving Wt. / Drop		Hydrogeologist: U Johnson	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
250				Fine well sorted sandstone with varying silt content and interbeds of black and green shale. Dense. Very hard at 258'				
260				EOB = 260'				

BORING LOG

Borehole ID: WJETA926
Sheet 1 of 5

			Location: WJETA926	
Project Name: NASFW Background	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: GeoProjects	Driller: Lee Gebbert	Ground Elevation	Total Drilled Depth: 236	
Drilling Equipment: GD 1500	Drilling Method: Air Rotary	Borehole Diameter: 7 7/8	Date/Time Drilling Started: 2/11/97 1505	Date/Time Total Depth Reached: 2/14/97 1545
Type of Sampling Device: HX Core Barrel		Water Level (bgs) First: 92	Final: 92	
Sample Hammer Type: — Driving Wt.: — Drop: —		Hydrogeologist: M Johnson	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology*	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
				Sandy Clay w/ gravel, soft plastic yellowish brown, 10YR 5/4.	CL		M	background c/min = 36 c/m
10				Limestone interbedded w/ shales 6-12" thick. Limestone - white to lt. grey N 8/N, 7/N with v. fine sand and tr. of shells. Grds from hard lmst. to soft marl throughout. Shales - dark grey N 4/N, soft, calcareous, horizontal bedding.			D	Core rate 1'/75s 90% recovery 42 c/min
20				~~Shale as above~~				Did not core 22' to 25'
				Shale as above			M	core rate 1'/90s
30				Fossiliferous Limestone - Walnut. V. hard tr. of euhedral pyrite. lt. grey 7/N to dark grey 4/N Shale lense - 7.5 inches 37'-37'10" shell conglomerate layer			W	52 c/min
40				Shell glomerate lt. grey to drk grey 7/N - 4/N				15 c/min Core rate 1'/65"
				fossiliferous limestone, grey N 6/, interbedded w/ thin ~~shells~~ shales.			D	26 c/min
50								

BORING LOG

Borehole ID: WNEPX926
Sheet 2 of 5

			Location: WNEPX 926	
Project Name: WNEPX BACKGROUND	Project Number: 05647900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: Geoprojects.	Driller: Lee Gebbert	Ground Elevation	Total Drilled Depth: 236	
Drilling Equipment: GD 1500 / Drilling Method: Air Rotary / Borehole Diameter: 7 7/8		Date/Time Drilling Started: 2/1/97 1505	Date/Time Total Depth Reached: 2/4/97 1545	
Type of Sampling Device: HX core barrel		Water Level (bgs) First 92	Final 92	
Sample Hammer Type — Driving Wt. — Drop —		Hydrogeologist: M Johnson	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
50								62 c/min
				Fossiliferous limestone thinly interbedded w/calcareous shale. 5% sand and pyrite. Fractured - horizontal to 55° from core axis.				
60				Paluxy - Fine sand, poorly well sorted 7.5YR w/1 gray				78/c/min
70								
80				Shales/silt with returns, brown, gray, plastic				51 c/min
				Shaley				▽ 92'
90				Cemented Sand.				
100								

BORING LOG

Borehole ID: WIEPX926
Sheet 3 of 5

			Location: WIEPX925	
Project Name: WDSFW BACKGROUND	Project Number: 05G4A900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: Geoproject	Driller: Lee Gelbert	Ground Elevation	Total Drilled Depth	
Drilling Equipment: GD 1500 / Drilling Method: Air Rotary / Borehole Diameter: 7 7/8		Date/Time Drilling Started: 2/11/97 1505	Date/Time Total Depth Reached: 2/14/97 1545	
Type of Sampling Device: HX Core Barrel		Water Level (bgs) First 92	Final 92	
Sample Hammer Type — Driving Wt. — Drop —		Hydrogeologist: M Johnson	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
100								32 c/min
110				Shaley/Silty				
120				No Returns - sand v. moist - does not convey to surface well				26 c/min
130				Sand Reddish Pink, well sorted, Fine				
140								
150								

BORING LOG

Borehole ID: _____
Sheet 4 of ___

			Location: WNEPX 926	
Project Name: NASFW Background	Project Number: 05G47900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: Geoprojects	Driller: Lee Gebbert	Ground Elevation	Total Drilled Depth: 236	
Drilling Equipment: GD 1500	Drilling Method: Air	Borehole Diameter: 7 7/8	Date/Time Drilling Started: 2/11/97 1505	Date/Time Total Depth Reached: 2/14/97 1545
Type of Sampling Device: HX Core Barrel		Water Level (bgs) First 92	Final 92	
Sample Hammer Type — Driving Wt. — Drop —		Hydrogeologist: M Johnson	Checked by/Date	
Location Description (include sketch in field logbook)				

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
150				Fine Sand Interbedded w/ thin shale lenses.				37 c/min
160				Clean fine Quartz Sand, well sorted, subrounded hard to soft, greenish gray 5GY 6/1				29 c/min.
170								
180				v. hard Sandstone				-180' end of 2/13/97 Start drill 2/14/97 - Hole caved to 130'
190								
200								

BORING LOG

Borehole ID: WWEPX926
Sheet 5 of 5

			Location: WWEPX926	
Project Name: NWFW Background	Project Number: 0547900	LTCCODE (IRPIMS)	Site ID	LPRCODE (IRPIMS)
Drilling Company: Geoprojects	Driller: Van Gilbert	Ground Elevation	Total Drilled Depth: 236	
Drilling Equipment: GD 1500	Drilling Method: Air Rotary	Borehole Diameter: 7 7/8	Date/Time Drilling Started: 2/11/97 1505	Date/Time Total Depth Reached: 2/14/97 1545
Type of Sampling Device: HX Core Barrel		Water Level (bgs) First: 52	Final: 52	
Sample Hammer Type:	Driving Wt.:	Drop:	Hydrogeologist: M. Johnson	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Symbol	Lithology	Water Content	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
200				Sandstone, tan ( ) well sorted rounded to sub rounded. v. hard				
				- softens				
210								
				- v. hard				
220								
230				Limestone clasts noted in cuttings.				
				TD = 236'				

WELL CONSTRUCTION DETAILS AND ABANDONMENT FORM

FIELD REPRESENTATIVE: M Johnson

DRILLING CONTRACTOR: GEOPROJECTS

DRILLING TECHNIQUE: MUD ROTARY
AUGER SIZE AND TYPE:

BOREHOLE IDENTIFICATION: LWIEPX 925
BOREHOLE DIAMETER: 7 7/8
WELL IDENTIFICATION: LWIEPX 925

WELL CONSTRUCTION START DATE: 2/18/97
WELL CONSTRUCTION COMPLETE DATE: 3/1/97

SCREEN MATERIAL: PVC SCH 40
SCREEN DIAMETER: 4"
STRATUM-SCREENED INTERVAL (FT):

CASING MATERIAL: PVC SCH40
CASING DIAMETER: 4"

TYPE OF FILTER PACK: Sand
GRADIATION: 16/30
AMOUNT OF FILTER PACK USED: 22 50# SKS

TYPE OF BENTONITE: 100% Wyo Ben
AMOUNT BENTONITE USED: 3 100# SKS

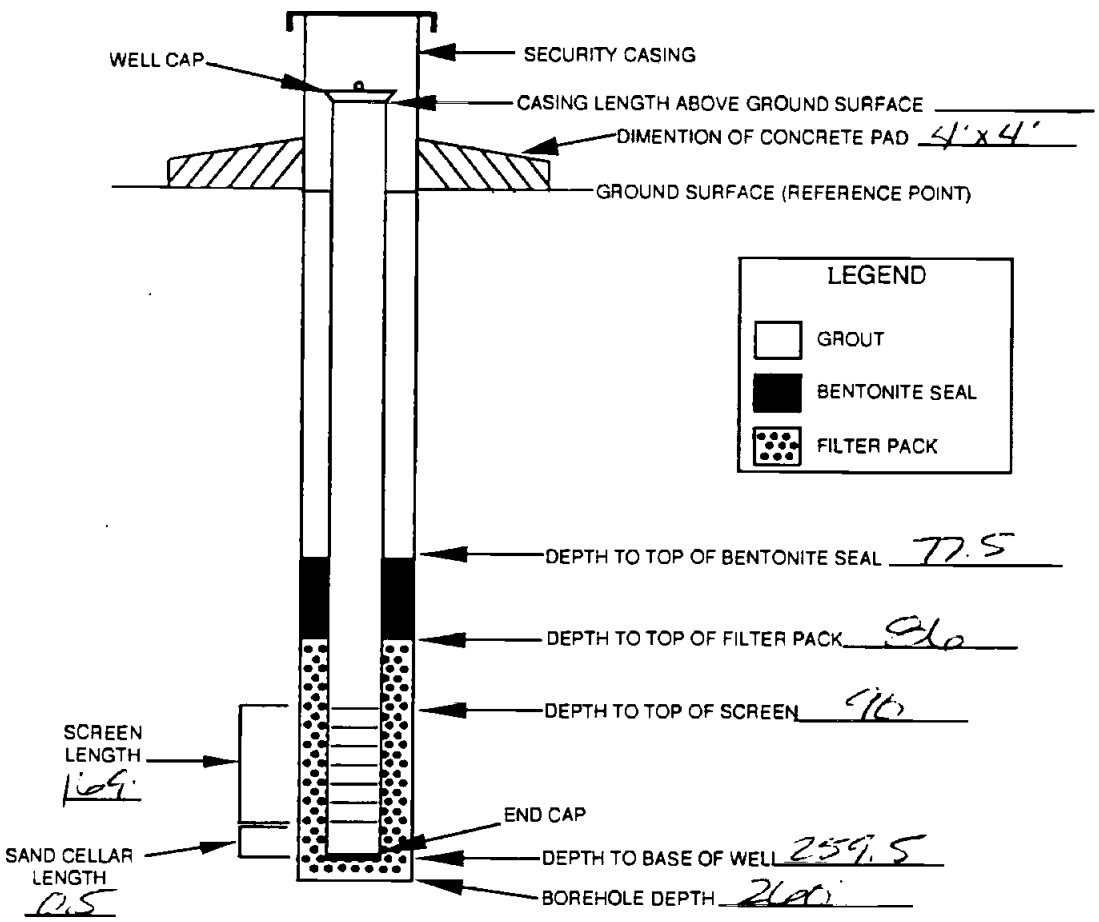
TYPE OF CEMENT: TYPE I/II
AMOUNT CEMENT USED: 15 100# SKS
GROUT MATERIALS USED: 75# Gel

DIMENSIONS OF SECURITY CASING: 22" x 6"

TYPE OF WELL CAP: J-PLUG
TYPE OF END CAP: THREADED

COMMENTS:

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Lee Gelbert
INSTALLATION OBSERVED BY: M Johnson

DISCREPANCIES: 8" Diameter Surface Casing Set to 20' bgs.

AFCEE FORM WAA.0

WELL CONSTRUCTION DETAILS AND ABANDONMENT FORM

FIELD REPRESENTATIVE: M. JOHNSON

DRILLING CONTRACTOR: GEOPROJECTS

DRILLING TECHNIQUE: AIR/FOAM ROTARY

AUGER SIZE AND TYPE:

BOREHOLE IDENTIFICATION: LWEPX926

BOREHOLE DIAMETER: 7 7/8

WELL IDENTIFICATION: LWEPX 926

WELL CONSTRUCTION START DATE: 2/16/97

WELL CONSTRUCTION COMPLETE DATE: 3/1/97

SCREEN MATERIAL: PVC SCH 40

SCREEN DIAMETER: 4" SCH 40

STRATUM-SCREENED INTERVAL (FT):

CASING MATERIAL: PVC SCH 40

CASING DIAMETER: 4"

TYPE OF FILTER PACK: SAND

GRADIATION: 16/30

AMOUNT OF FILTER PACK USED: 120 - 50# SACKS

TYPE OF BENTONITE: 100% WYO. BEN

AMOUNT BENTONITE USED: 4 SKS 100#

TYPE OF CEMENT: TYPE I/II

AMOUNT CEMENT USED: 25 100# SKS

GROUT MATERIALS USED: 1 100# BEN GEL

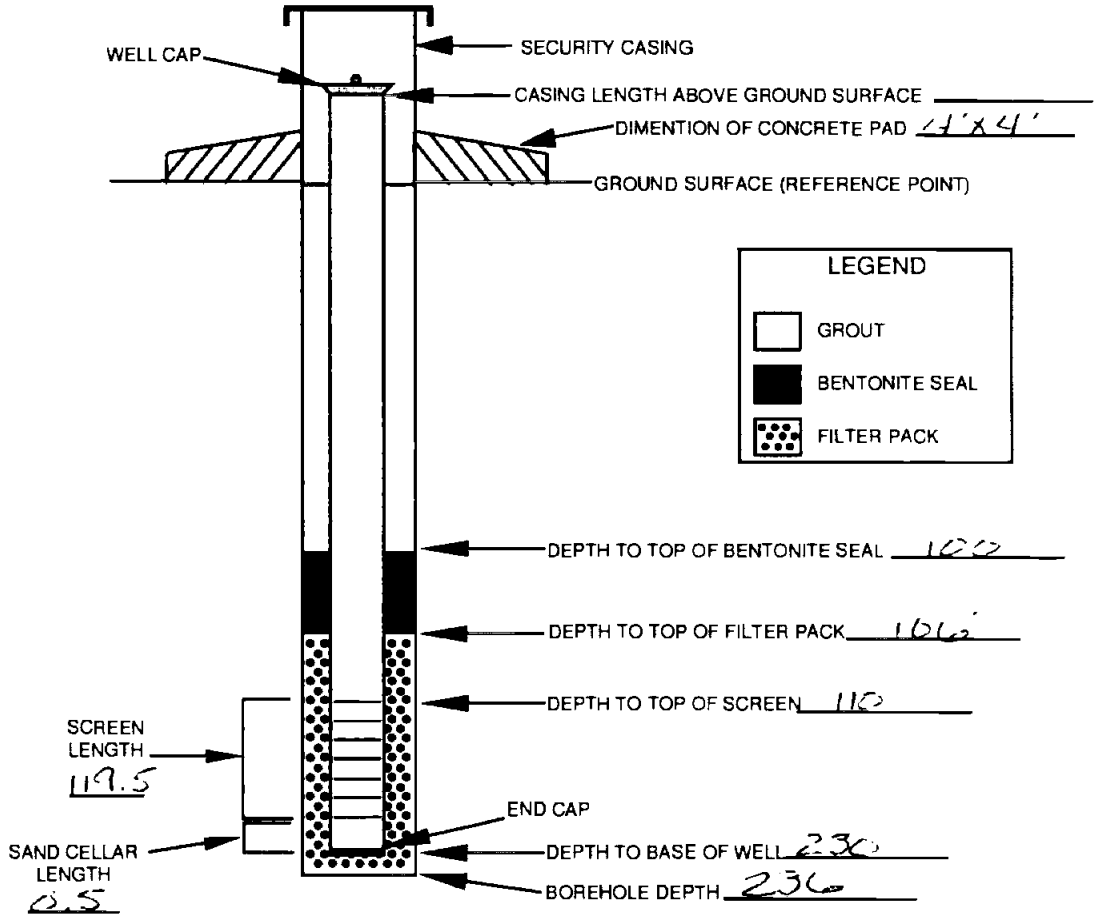
DIMENSIONS OF SECURITY CASING: 22" x 6"

TYPE OF WELL CAP: J-PLUG

TYPE OF END CAP: THREADED

COMMENTS: 8" dia surface casing (SCH 40 PVC) set to 20' bgs.

SPECIAL CONDITIONS
(describe and draw)



NOT TO SCALE

INSTALLED BY: Lee Corbert

INSTALLATION OBSERVED BY: M. Johnson

DISCREPANCIES:

AFCEE FORM WAA.0

November 1996 — GROUNDWATER SAMPLING DATA SHEET — Round 1

Carswell Background Study - 05G47900

Well Number: WJEPX925

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one): (PVC) St. Steel

Well Integrity: Good, new well

HNu Background: 0.8

HNu Wellhead: 0.8

HNu Breathing Zone: 0.8

Weather: Clear, light breeze, 60s

Sampled By: Schultz Neely

WELL PURGING

PURGE DATE: 3/4/97

PURGE VOLUME:

Casing Diameter (inches): 4 in. Sched 40

Water Depth (ft. BTOC): 112.81 (Keck) Slope Other Time: 0940

Casing Depth (ft. BTOC): 261.8 Keck Slope (Other) Field Notes from drilling

Casing Depth (corrected): (+.09 feet for Keck)

One Purge Volume: 97 Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 1027

Stop

Total elapsed minutes

PURGE METHOD:

1.88 - inch Teflon bailer

Bailer type:

X Grundfos

Dedicated Triloc

Other:

IMMISCIBLE PHASES: (Interface Probe Only)

None Detected ✓

DNAPL

LNAPL

Depth to Top (ft.)

Depth to Bottom (ft.)

Thickness (ft.)

FIELD PARAMETER MEASUREMENT

Time of last calibration: 1050

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
1057	100	21.1	7.17	0.450	0	1.30	none	none	Sd. = 0.01, W.L. = 119.4' BTOC
1122	100	21.0	7.15	0.447	0	1.77	none	none	Sd. = 0.01 W.L. = 119.7 BTOC
1147	100	21.1	7.17	0.446	0	1.43	none	none	Sd. = 0.01 W.L. = 119.95 BTOC
									Water level increased as soon
									as pump turned off.
	300	Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

X 1.88 - inch Teflon bailer

Dedicated Triloc pump

Other

Bottom-Emptying Device for VOC's? NA ~~Y~~ ~~N~~

Sample Date: 3/4/97

Sample Time: 12:20 Start: 12:25 Finish: 12:45

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A158601	1-gal. poly	SW9315/SW9320		WJEPX925-01		
CR-A158301	1-L glass	E418.1	H_2SO_4	WJEPX925-01	M	MS/MSD

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
rip Blank		

Additional comments: 30-sec. D.O. agitate
4.4 gal/min. purge rate
Photos 1,2 GF pump. Water level at 114.55
at 11:55 - water rising.

Recorded by: Schultz Neely

JACOBS ENGINEERING GROUP INC.

November 1996 GROUNDWATER SAMPLING DATA SHEET Round 1

Carswell Background Study - 05G47900

Well Number: WJEPX926

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one): (PVC) St. Steel

Well Integrity: Good, new well

HNu Background: 0

HNu Wellhead: 0

HNu Breathing Zone: 0

Weather: Clear, windy, 40s/50s

Sampled By: Schultz Neely

WELL PURGING

PURGE DATE: 3/5/97

PURGE VOLUME:

Casing Diameter (inches): 4

Water Depth (ft. BTOC): 113.17 (Keck) Slope Other _____ Time: 1330

Casing Depth (ft. BTOC): 230 Keck Slope Other Field Notes

Casing Depth (corrected): _____ (+.09 feet for Keck)

One Purge Volume: 76 Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 1352

Stop 1447

Total elapsed _____ minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type: _____

X Grundfos

___ Dedicated Triloc

___ Other: _____

IMMISCIBLE PHASES: (Interface Probe Only)

None Detected X

DNAPL _____

LNAPL _____

Depth to Top (ft.) _____

Depth to Bottom (ft.) _____

Thickness (ft.) _____

FIELD PARAMETER MEASUREMENT

Time of last calibration: 1405

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
1411	80	20.7	7.34	0.547	0	1.13	none	none	W.L = 121.52' Sal. = 0.02
1429	80	20.3	7.17	0.549	0	1.14	none	none	WL = 122.52 Sal. = 0.
1447	80	20.5	7.25	0.550	0	1.02	none	none	WL. = 122.93 Sal = 0.02
	240	Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

X 1.88 - Inch Teflon bailer

___ Dedicated Triloc pump

___ Other _____

Bottom-Emptying NA

Device for VOC's? Y N NDS

Sample Date: 3/5/97

Start: 15:15

Sample Time: 15.30 Finish: 15:30

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments: Purge at 5 gpm (400)

Recorded by: Schultz Neely

JACOBS ENGINEERING GROUP INC.

November 1996 GROUNDWATER SAMPLING DATA SHEET Round 1

Carswell Background Study - 05G47900

Well Number: XU-32-12-901

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one): PVC (St. Steel)

HNu Background: 0

HNu Wellhead: 0

HNu Breathing Zone: 0

Well Integrity: Good, old pump removed to sample well.

Weather: Clear, sl. cool, calm, 50s

Sampled By: Schulz Nely

WELL PURGING

PURGE DATE: 3/6/97

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE VOLUME:

Casing Diameter (inches): 6

Water Depth (ft. BTOC): 91.19 Keck Slope Other Time: 0905

Casing Depth (ft. BTOC): 186.7 Keck Slope Other Field Notes

Casing Depth (corrected): (+.09 feet for Keck)

One Purge Volume: 140 Gallons

PURGE TIME:

Start 0935 @ 4.9 gpm

Stop

Total elapsed minutes

PURGE METHOD:

- 1.88 - inch Teflon bailer
- Bailer type:
- X Grundfos
- Dedicated Triloc
- Other:

IMMISCIBLE PHASES: (Interface Probe Only)

None Detected: X

DNAPL:

LNAPL:

Depth to Top (ft.):

Depth to Bottom (ft.):

Thickness (ft.):

FIELD PARAMETER MEASUREMENT

Time of last calibration: 1018

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Sal.	Comments W.L.
1003	155	20.0	7.51	0.573	0	1.22	Dark gray	Sl. Hydrocarbon	0.02	98.53 (not calibr.)
1030	125	20.3	7.35	0.585	5	1.16	Dark gray	Sl. Hydrocarbon	0.02	99.30
1058	140	20.5	7.36	0.583	0	1.30	none	V. Sl. sulfur	0.02	99.73
	420	Total Purge Volume								

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

- X 1.88 - inch Teflon bailer
- Dedicated Triloc pump
- Other

Bottom-Emptying Device for VOC's? NDS Y N NA

Sample Date: 3/6/97

Sample Time: 1150

Start:

Finish:

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A15E304	1-1 Liter Amber	E418.1	H_2SO_4	XU32129 01-01		
CR-158704	1-1 gal poly	SW7315 SW9320	none	XU32129 01-01		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments: Small lines of product observed on purge water in bucket, probable lubricants from pump/shaft. Pump at 105' BTOC

Recorded by: Schulz

JACOBS ENGINEERING GROUP INC.

November 1996 GROUNDWATER SAMPLING DATA SHEET Round 1

Carswell Background Study - 05G47900

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one): PVC ~~Sl~~ (Steel)

Well Integrity: Good, old pump removed to sample well.

Weather: Clear, cold (30s/40s), breezy

Well Number: XU-32-12-902

HNu Background: 0.8

HNu Wellhead: 0.8

HNu Breathing Zone: 0.8

Sampled By: Schultz Neely

WELL PURGING

PURGE DATE: 3/5/97

PURGE VOLUME:

Casing Diameter (inches): 6

Water Depth (ft. BTOC): 92.49 (Keck) Slope Other Time: 08 40

Casing Depth (ft. BTOC): 186.6* Keck Slope Other Field Notes

Casing Depth (corrected): (+.09 feet for Keck) * Below ground surface

One Purge Volume: 138 Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 0857 @ 4.8 GPM

Stop 1037

Total elapsed ____ minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

X Grundfos

___ Dedicated Triloc

___ Other:

IMMISCIBLE PHASES: (Interface Probe Only)

None Detected X

DNAPL

LNAPL

Depth to Top (ft.)

Depth to Bottom (ft.)

Thickness (ft.)

FIELD PARAMETER MEASUREMENT

Time of last calibration: ____

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
0909	(40)	WL.	≈ 97.2	and dropping	@	~ 0.05' per minute			
0936 *	140	17.4	~~8~~ 7.02	0.588	0	0.88	none	V. Slight Sulfur	Sal. = 0.02/WL=97.7'/RATE
1005	140	20.1	7.32	0.583	0	0.93	none	V. Sl. Sulfur	Sal. = 0.02/WL=98.7
1037	140	19.9	7.29	0.584	0	1.01	none	V. Sl. Sulfur	Sal = 0.02/WL=99.08
	420	Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

X 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

___ Other

Bottom-Emptying Device for VOC's? NA ~~Y N~~ DPS

Sample Date: 3/5/97

Sample Time: 11:00 Start: 11:00 Finish: 11:20

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments: * 0936 start purge at 5.3 gpm
Purge rate at end, 5.1 - 5.2 gpm

Recorded by: Schultz Neely

JACOBS ENGINEERING GROUP INC.

November 1996 GROUNDWATER SAMPLING DATA SHEET Round 1

Carswell Background Study - 05G47900

Well Number: RVDYS

Well Type (circle one) Flushmount Stickup

Well Material (circle one): PVC St. Steel

Well Integrity: Good. Sample port rusted shut, no water level

Weather: 70°F, Clear, calm

HNu Background:

HNu Wellhead:

HNu Breathing Zone:

Sampled By: Schultz Neely

WELL PURGING

PURGE DATE: 3/4/97

PURGE VOLUME:

Casing Diameter (inches): 4" Sched 40

Water Depth (ft. BTOC): Keck Slope Other Time:

Casing Depth (ft. BTOC): Keck Slope Other

Casing Depth (corrected): ~200' (+.09 feet for Keck)

One Purge Volume: Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 1500

Stop

Total elapsed minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

___ Grundfos

___ Dedicated Triloc

X Other: Dedicated Submersible

IMMISCIBLE PHASES: (Interface Probe Only)

None Detected NA

DNAPL

LNAPL

Depth to Top (ft.)

Depth to Bottom (ft.)

Thickness (ft.)

FIELD PARAMETER MEASUREMENT

Time of last calibration:

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity ~~mg/L~~	D. O. (mg/L)	Color	Odor	Comments
1508	100	21.3	7.44	0.518	70	1.90	none	Sl. Sulfur	D.O. agitated
1515	100	20.8	7.19	0.513	35	3.70	none	Sl. Sulfur	Sal = 0.02
1525	100	20.5	7.08	0.520	32	2.84	None	V. Sl. Sulfur	Sal. = 0.02
	300	Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

___ 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

___ Other

Bottom-Emptying Device for VOC's? NA ~~Y N~~

Sample Date: 3/4/97

Start:

Sample Time: 1535 Finish:

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A158401		E418.1				
CR-A158701		SW9315 SW9320				

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments:

Recorded by:

JACOBS ENGINEERING GROUP INC.

March 1997 | GROUNDWATER SAMPLING DATA SHEET | Round 2

Carswell Background Study - 05G47900

Well Number: WJEPX925

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one): (PVC) St. Steel

Well Integrity: Good

HNu Background: 0.4

HNu Wellhead: 0.4

HNu Breathing Zone: 0.4

Weather: Cloudy, windy, 44°F

Sampled By: Neely Johnson

WELL PURGING

PURGE DATE: 3/19/97

PURGE VOLUME:

Casing Diameter (inches): 4

Water Depth (ft. BTOC): 108.24 (Keck) Slope Other _____ Time: 0850

Casing Depth (ft. BTOC): 259.5 Keck Slope Other _____

Casing Depth (corrected): _____ (+.09 feet for Keck)

One Purge Volume: 98 Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 0900

Stop 1015

Total elapsed 75 minutes

PURGE METHOD:

~~X~~ 1.88 - inch Teflon bailer

___ Bailer type: _____

X Grundfos

___ Dedicated Triloc

___ Other: _____

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected X

DNAPL

LNAPL

Depth to Top (ft.)

Depth to Bottom (ft.)

Thickness (ft.)

FIELD PARAMETER MEASUREMENT

Time of last calibration: 0905

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
0920	100	19.4	7.13	0.458	1	2.25	Clear	None	W.L. 117.5' btoc
0945	100	19.8	7.13	0.446	0	2.38	Clear	None	W.L. 118.26 btoc
1010	100	19.9	7.15	0.443	0	2.53	Clear	None	W.L. 118.60 btoc

300 Total Purge Volume

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

X 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

___ Other _____

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 3/19/97

Sample Time: 1045 Start: 1040 Finish: 1055

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A161501	1x1 Liter	E418.1	H_2SO_4	WJEPX925-02		
CR-A161601	1x1 Gal. Poly	SW9315 SW9320	—	WJEPX925-02		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments: _____

Recorded by: Neely Johnson

JACOBS ENGINEERING GROUP INC.

Carswell Background Study - 05G47900

Well Number: WJEPX926

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one): (PVC) St. Steel

Well Integrity: Good

HNu Background: 0.5

HNu Wellhead: 0.5

HNu Breathing Zone: 0.5 (ppm)

Weather: Clear, calm, 52°F

Sampled By: Johnson Neely

WELL PURGING

PURGE DATE: 3/20/97

PURGE VOLUME:

Casing Diameter (inches): 4

Water Depth (ft. BTOC): 111.90 (Keck) Slope Other Time: 8:26

Casing Depth (ft. BTOC): 230 Keck Slope (Other) Records

Casing Depth (corrected): (+.09 feet for Keck)

One Purge Volume: 77 Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 0835

Stop 0941

Total elapsed 66 minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

X Grundfos

___ Dedicated Triloc

___ Other:

IMMISCIBLE PHASES: (Interface Probe Only)

None Detected X

DNAPL

LNAPL

Depth to Top (ft.)

Depth to Bottom (ft.)

Thickness (ft.)

FIELD PARAMETER MEASUREMENT

Time of last calibration: 0850

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
0853	77	19.9	7.40	0.560	0	1.01	Clear	NONE	WL = 121.85 btoc
0917	100.8	20.3	7.40	0.557	0	1.03	Clear	NONE	WL = 122.43 btoc
0934	71.4	20.5	7.36	0.563	0	1.20	Clear	NONE	WL = 122.74 btoc

249.2 Total Purge Volume

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

X 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

___ Other

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 3/20/97

Sample Time: 1025 Start: 1020 Finish: 1030

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A161502	1x1L Amber	E418.1	H_2SO_4	WJEPX926-02		
CR-A161602	1x1gal poly	SW9315 SW9320	—	WJEPX926-02		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank	-	
Duplicate	-	
Equipment Blank	-	
Trip Blank	-	

Additional comments: Purge @ 4.2 gal/min

Recorded by: Johnson Neely

March 1997

GROUNDWATER SAMPLING DATA SHEET

Round 2

Carswell Background Study - 05G47900

Well Number: RUDYSWELL

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one): (PVC) St. Steel

Well Integrity: Good

HNu Background: —

HNu Wellhead: —

HNu Breathing Zone: —

Weather: Partly cloudy, light breeze

Sampled By: Neely Johnson

WELL PURGING

PURGE DATE: 3/19/97

PURGE VOLUME:

Casing Diameter (inches): 4

Water Depth (ft. BTOC): — Keck Slope Other _____ Time: _____

Casing Depth (ft. BTOC): — Keck Slope Other _____

Casing Depth (corrected): — (+.09 feet for Keck)

One Purge Volume: 100 Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 1331

Stop _____

Total elapsed _____ minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type: _____

___ Grundfos

___ Dedicated Triloc

X Other: Hose

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected _____

DNAPL _____

LNAPL _____

Depth to Top (ft.) _____

Depth to Bottom (ft.) _____

Thickness (ft.) _____

FIELD PARAMETER MEASUREMENT

Time of last calibration: _____

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
1341	100	19.2	7.30	0.526	75	1.72	Milky Gray	None	
1351	100	19.4	7.44	0.516	-10	1.99	Clear	NONE	
1401	100	19.5	7.52	0.515	-10	2.60	Clear	NONE	
	300	Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

_____ 1.88 - inch Teflon bailer

_____ Dedicated Triloc pump

X Other Hose

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 3/19/97

Sample Time: 1410 Start: 1405 Finish: 1415

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A161503	2x1L Amber	E418.1	H2SO4	RUDYSWELL	M	
CR-A161603	1x1Gal. Poly	SW9315 SW9320	None	RUDYSWELL		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate	RUDYSWELLCFD	CR-A1615, 1616
Equipment Blank		
Trip Blank		

Additional comments: _____

Recorded by: Neely Johnson

JACOBS ENGINEERING GROUP INC.

April 1997 | GROUNDWATER SAMPLING DATA SHEET | Round 3

Carswell Background Study - 05G47900 | **Well Number:** WJEPX925

Well Type (circle one) Flushmount Stickup

Well Material (circle one): PVC St. Steel

Well Integrity: good

HNu Background: —

HNu Wellhead: —

HNu Breathing Zone: —

Weather: Rain

Sampled By: MJ BN

WELL PURGING

PURGE DATE: 4/3/96

PURGE VOLUME:

Casing Diameter (inches): 4"

Water Depth (ft. BTOC): 104.45 Keck Slope Other _____ Time: _____

Casing Depth (ft. BTOC): _____ Keck Slope Other _____

Casing Depth (corrected): _____ (+.09 feet for Keck)

One Purge Volume: _____ Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 1735

Stop _____

Total elapsed _____ minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type: _____

___ Grundfos

___ Dedicated Triloc

X Other: Bladder Pump

IMMISCIBLE PHASES: (Interface Probe Only)

None Detected ✓

DNAPL _____

LNAPL _____

Depth to Top (ft.) _____

Depth to Bottom (ft.) _____

Thickness (ft.) _____

FIELD PARAMETER MEASUREMENT

Time of last calibration: 1700

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
1745	1 Liter	19.0	6.61	0.458	0	1.60	Clear	None	
1805	1 gal	19.3	6.88	0.457	1	1.28	"	"	
1825	1.5 gal	19.2	7.11	0.457	0	1.12	"	"	

3 gal Total Purge Volume

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

_____ 1.88 - inch Teflon bailer

_____ Dedicated Triloc pump

X Other Bladder Pump

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 4/3/97

Sample Time: 1835 Start: 1820 Finish: 1838

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A161701	1x 1L Amber	E418.1	H_2SO_4	WJEPX925-03		
CR-A161801	1x 1 gal poly	SW9315 SW9320	—	WJEPX925-03		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments: Slope indicator not working well. pH indicator out of calibration. Controller set @ 31/10.

Recorded by: _____

JACOBS ENGINEERING GROUP INC.

April 1997 | GROUNDWATER SAMPLING DATA SHEET | Round 3

Carswell Background Study - 05G47900

Well Number: WJEPX926

Well Type (circle one) Flushmount Stickup

Well Material (circle one): PVC St. Steel

Well Integrity:

Weather:

HNu Background:

HNu Wellhead:

HNu Breathing Zone:

Sampled By: Neely Johnson

WELL PURGING

PURGE DATE: 4/4/97

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE VOLUME:

Casing Diameter (inches): 4

Water Depth (ft. BTOC): 111.7 Keck (Slope) Other Time: 07:36

Casing Depth (ft. BTOC): 230 Keck Slope (Other) Records

Casing Depth (corrected): — (+.09 feet for Keck)

One Purge Volume: — Gallons

PURGE TIME:

Start 0750

Stop 0814

Total elapsed 24 minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

___ Grundfos

___ Dedicated Triloc

X Other: Bladder

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected NA

DNAPL

LNAPL

Depth to Top (ft.)

Depth to Bottom (ft.)

Thickness (ft.)

FIELD PARAMETER MEASUREMENT

Time of last calibration: 0745

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
0755	0.2	18.6	8.14	0.446	2	5.03	Clear	None	
0801	0.25	19.1	7.40	0.553	0	2.35	"	"	
0806	0.25	19.2	7.33	0.555	0	2.31	"	"	
0814	0.3	19.2	7.32	0.555	0	2.32	"	"	
	1.0	Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

___ 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

X Other Bladder

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 4/4/97

Sample Time: 0825 Start: 0815 Finish: 0900

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
				WJEPX926-03		
				WJEPX926-03		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate	WJEPX926-03FD	
Equipment Blank		
Trip Blank		

Additional comments: Field Duplicate Collected.

Recorded by: Neely Johnson

JACOBS ENGINEERING GROUP INC.

GROUNDWATER SAMPLING DATA SHEET

Carswell Background Study - 05G47900

Well Number: XU-32-12-901

Well Type (circle one) Flushmount Stickup

Well Material (circle one): PVC St. Steel - Steel

Well Integrity: good

HNu Background: —

HNu Wellhead: —

HNu Breathing Zone: —

Weather: Mostly Cloudy, 55-60°

Sampled By: Johnson Neely

WELL PURGING

PURGE DATE: 4/3/97

PURGE VOLUME:

Casing Diameter (inches):

Water Depth (ft. BTOC): 90.56 ~~Keck~~ Slope Other Time: 8:08

Casing Depth (ft. BTOC): 184. Keck Slope ~~Other~~ Records

Casing Depth (corrected): — (+.09 feet for Keck)

One Purge Volume: 137 Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 0819

Stop 0952

Total elapsed 93 minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type: ___

X Grundfos

___ Dedicated Triloc

___ Other: ___

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected ✓

DNAPL —

LNAPL —

Depth to Top (ft.) —

Depth to Bottom (ft.) —

Thickness (ft.) —

FIELD PARAMETER MEASUREMENT

Time of last calibration: 0842

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMho/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
0849	140	20.8	7.41	~~0.625~~ 581	0	1.43	Clear	None	
0920	140	20.8	7.46	0.581	0	1.38	Clear	sl. sulfur	
0948	140	20.8	7.47	0.581	0	1.31	Clear	sl. sulfur	
	420	Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

X 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

___ Other ___

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 4/3/97

Sample Time: 12:30 Start: 12:25 Finish: 12:32

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A161704	1x1 Liter	E418.1	H_2SO_4	XU-32-12-901-03		
CR-A161804	1x1 gal poly	SW9315 SW9320	—	XU-32-12-901-03		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments: Purge at 5 gal/min

Recorded by: Johnson Neely

Carswell Background Study - 05G47900

Well Number: XU-32-12-902

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one): PVC St. Steel – Steel

Well Integrity: good

HNu Background:

HNu Wellhead:

HNu Breathing Zone:

Weather: Mostly cloudy - 55°

Sampled By:

WELL PURGING

PURGE DATE: 4/3/97

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE VOLUME:

Casing Diameter (inches): 6

Water Depth (ft. BTOC): 92.74 (Keck) Slope Other Time:

Casing Depth (ft. BTOC): 186.6 Keck Slope (Other) Records

Casing Depth (corrected): (+.09 feet for Keck)

One Purge Volume: 138 Gallons

PURGE TIME:

Start 10:41

Stop 12:20

Total elapsed 99 minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

X Grundfos

___ Dedicated Triloc

___ Other:

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected

DNAPL

LNAPL

Depth to Top (ft.)

Depth to Bottom (ft.)

Thickness (ft.)

FIELD PARAMETER MEASUREMENT

Time of last calibration:

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
11:11	138	20.9	7.44	0.574	-10	3.52	Clear	Algal	
11:45	138	21.1	7.46	0.582	-10	3.61	Clear	None	
12:17	138	20.9	7.38	0.589	-10	2.42	Clear	None	
	414	Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

X 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

___ Other

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 4/3/97

Start: 12:55

Sample Time: 12:58 Finish: 12:59

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A161705	1x1 Liter	E418.1	HeSO4	XU-32-12-902-03		
CR-A161805	1x1 gal poly	SW9315 SW9320	—	XU-32-12-902-03		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments: Purge at 5gal/min

Recorded by:

April 1997 | GROUNDWATER SAMPLING DATA SHEET | Round 3

Carswell Background Study - 05G47900 | **Well Number:** RUDYSWELL

Well Type (circle one) Flushmount Stickup | HNu Background: —

Well Material (circle one): PVC St. Steel | HNu Wellhead: —

Well Integrity: Good, Domestic H2O Well | HNu Breathing Zone: —

Weather: Mostly Cloudy 65°F | Sampled By: M Johnson, B Neely

WELL PURGING

PURGE DATE: 4/2/97

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE VOLUME:

Casing Diameter (inches): —

Water Depth (ft. BTOC): — Keck Slope Other — Time: —

Casing Depth (ft. BTOC): — Keck Slope Other —

Casing Depth (corrected): — (+.09 feet for Keck)

One Purge Volume: 100 Gallons

PURGE TIME:

Start 1813

Stop

Total elapsed minutes

PURGE METHDD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

___ Grundfos

___ Dedicated Triloc

___ Other:

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected —

DNAPL —

LNAPL —

Depth to Top (ft.) —

Depth to Bottom (ft.) —

Thickness (ft.) —

FIELD PARAMETER MEASUREMENT

Time of last calibration: 1809

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
1823	100	20.1	7.35	0.515	-0	2.03	Clear	Sl. Sulfer	
1833	100	19.8	7.34	0.512	-0	3.06	Clear	Sl. Sulfer.	
1843	100	19.9	7.14	0.510	-0	3.18	Clear	"	
1853	100	19.9	7.04	0.502	-0	2.21	Clear	"	
1903	100	19.9	7.10	0.510	-0	1.97	Clear	"	
		Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

___ 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

✓ Other Dedicated Pump unknown

Bottom-Emptying Device for VOC's? Y N

Sample Date: 4/2/97

Sample Time: 1905 Start: 1903 Finish: 1906

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments:

Recorded by:

Mid April 1997 | GROUNDWATER SAMPLING DATA SHEET | Round 4

Carswell Background Study - 05G47900

Well Number: WJEPX925

Well Type (circle one) Flushmount Stickup

Well Material (circle one): PVC St. Steel

Well Integrity: Good

HNu Background: —

HNu Wellhead: —

HNu Breathing Zone: —

Weather: Partly Cloudy - 55° NE WIND

Sampled By: MN TB

WELL PURGING

PURGE DATE: 4/17/97

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE VOLUME:

Casing Diameter (inches): 4"

Water Depth (ft. BTOC): 107.35 Keck Slope Other Solinst Time: 1000

Casing Depth (ft. BTOC): 259.5 Keck Slope Other Records

Casing Depth (corrected): (+.09 feet for Keck)

One Purge Volume: Gallons

PURGE TIME:

Start 1011

Stop 1115

Total elapsed 65 minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

___ Grundfos

___ Dedicated Triloc

✓ Other: Dedicated Bladder

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected ✓

DNAPL

LNAPL

Depth to Top (ft.)

Depth to Bottom (ft.)

Thickness (ft.)

FIELD PARAMETER MEASUREMENT

Time of last calibration:

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
1026	2L	19.6	5.89	0.453	-8	0.83	None/Clr.	None	
1045	2L	19.8	5.86	0.453	-8	0.81	None/Clr	None	
1100	2L	19.9	5.82	0.453	-8	0.77	None/Clr	None	
1115	END								

10.5 Total Purge Volume Liters **Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

___ 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

___ Other

Bottom-Emptying Device for VOC's? Y N

Sample Date: 4/17/97

Sample Time: 11:30 Start: 1115 Finish: 1143

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A161901	1 x 1L Amber Glass	E418.1	H_2SO_4	WJEPX925-04		
CR-A162001	1 x 1 Gallon Poly	SW9315 SW9320	None	WJEPX925-04		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments:

Recorded by:

JACOBS ENGINEERING GROUP INC.

Mid April 1997 GROUNDWATER SAMPLING DATA SHEET Round 4

Carswell Background Study - 05G47900 **Well Number:** WJEPX926

Well Type (circle one) Flushmount Stickup

Well Material (circle one): PVC St. Steel

Well Integrity: GOOD

HNu Background:

HNu Wellhead:

HNu Breathing Zone:

Weather: PTLY CLDY 65° St. Breeze Sampled By: MJ TB

WELL PURGING

PURGE DATE: 4/17/97

PURGE VOLUME:

Casing Diameter (inches): 4"

Water Depth (ft. BTOC): 112.36 Keck Slope Other Solinst. Time:

Casing Depth (ft. BTOC): Keck Slope Other

Casing Depth (corrected): (+.09 feet for Keck)

One Purge Volume: Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME: 4/24/97

MJ Start ~~1215~~ 0935

Stop

Total elapsed minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

___ Grundfos

___ Dedicated Triloc

✓ Other: Ded. Bladder

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected

DNAPL

LNAPL

Depth to Top (ft.)

Depth to Bottom (ft.)

Thickness (ft.)

FIELD PARAMETER MEASUREMENT

Time of last calibration:

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
0954	4L	19.3	7.29	0.600	Erl				Horiba not work
1009	4L	19.3	7.30	0.606	-1L	0.33	Clear	None	well/Change bat.
1020	6L	19.2	7.16	0.621	0	0.68	Clear	None	After Battery Change
1027	8+L	19.4	7.19	0.617	-0	0.31	Clear	None	OK

22L Total Purge Volume **Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

___ 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

___ Other

Bottom-Emptying Device for VOC's? Y N

Sample Date: 4/24/97

Start: 1030

Sample Time: 1030 Finish:

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A161902	1 x 1L Amber Glass	E418.1	H_2SO_4	WJEPX926-04	MS/MSD	
CR-A162002	1 x 1 Gallon Poly	SW9315 SW9320	None	WJEPX926-04		
CR-A162004	1x1Gal Poly	SW9315 SW9320	None		FD	
CR-A1619004	1x1L Amber	E418.1	H_2SO_4		FD	

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments: Cycle = 36 second

Each Cycle = 200 ml.

Recorded by: [signature]

JACOBS ENGINEERING GROUP INC.

Mid April 1997 | GROUNDWATER SAMPLING DATA SHEET | Round 4

Carswell Background Study - 05G47900

Well Number: RUDYSWELL

Well Type (circle one) Flushmount Stickup

Well Material (circle one): PVC St. Steel

Well Integrity: GOOD

HNu Background: —

HNu Wellhead: —

HNu Breathing Zone: —

Weather: CLR - 70° Sl. Breeze

Sampled By: MJ TB

WELL PURGING

PURGE DATE: 4/17/97

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE VOLUME:

Casing Diameter (inches): .

Water Depth (ft. BTOC): . Keck Slope Other _____ Time: _____

Casing Depth (ft. BTOC): . Keck Slope Other _____

Casing Depth (corrected): . (+.09 feet for Keck)

One Purge Volume: 100 Gallons - from previous sampling

PURGE TIME:

Start 1404

Stop _____

Total elapsed _____ minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type: _____

___ Grundfos

___ Dedicated Triloc

✓ Other: Submersible

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected _____

DNAPL _____

LNAPL _____

Depth to Top (ft.) _____

Depth to Bottom (ft.) _____

Thickness (ft.) _____

FIELD PARAMETER MEASUREMENT

Time of last calibration: _____

Purge rate 10 gal/min

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
1414	100	20.5	6.49	0.528	233	3.22	clr	None	
1424	100	20.1	6.50	0.519	27	3.30	clr	None	
1434	100	19.9	6.49	0.520	0	3.04	clr	Sulfer	
		Total Purge Volume							

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

_____ 1.88 - inch Teflon bailer

_____ Dedicated Triloc pump

_____ Other _____

Bottom-Emptying Device for VOC's? Y N

Sample Date: 4/17/97

Sample Time: 1438 Start: 1434 Finish: 1444

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A161903	1 x 1L Amber Glass	E418.1	H_2SO_4	RUDYSWELL-04		
CR-A162003	1 x 1 Gallon Poly	SW9315 SW9320	None	RUDYSWELL-04		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank	-	
Duplicate	-	
Equipment Blank	-	
Trip Blank	-	

Additional comments: Not possible to sound well - domestic well.

Recorded by: [signature]

JACOBS ENGINEERING GROUP INC.

May 1997 | GROUNDWATER SAMPLING DATA SHEET | Round 5

Carswell Background Study - 05G47900

Well Number: WJEPX925

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one) (PVC) St. Steel

Well Integrity: Good

HNu Background: —

HNu Wellhead: —

HNu Breathing Zone: —

Weather: Clear, light wind, 60s

Sampled By: Johnson Neely

WELL PURGING

PURGE DATE: 5/13/97

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE VOLUME:

Casing Diameter (inches): 4

Water Depth (ft. BTOC): 107.20 Keck Slope (Other) Hazco Time: 1005

Casing Depth (ft. BTOC): 260 Keck Slope Other

Casing Depth (corrected): (+.09 feet for Keck)

One Purge Volume: 99.7 Gallons

PURGE METHOD: Purge Rate = 330 ml/minute

___ 1.88 - inch Teflon bailer

___ Bailer type:

___ Grundfos

___ Dedicated Triloc

X Other: Bladder Pump

PURGE TIME:

Start 1021

Stop

Total elapsed ___ minutes

IMMISCIBLE PHASES: (Interface Probe Only)

None Detected —

DNAPL —

LNAPL —

Depth to Top (ft.) —

Depth to Bottom (ft.) —

Thickness (ft.) —

FIELD PARAMETER MEASUREMENT

Time of last calibration: 0820

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
1038	5.6L	20.2	6.95	0.506	0	0.32	Clear	V.sl. sulfur	
1051	4.3L	20.2	6.93	0.505	0	0.43	"	"	
1109	5.0L	20.3	6.92	0.505	0	0.34	Clear		

14.9 Total Purge Volume Liters **Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

___ 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

X Other Bladder

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 5/13/97

Sample Time: 1130 Start: 1110 Finish: 1130

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A163101	1 x 1L Amber Glass	E418.1	H_2SO_4	WJEPX925-05		
CR-A163201	1 x 1 Gallon Poly	SW9315 SW9320	None	WJEPX925-05		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments:

Recorded by: Neely Johnson

JACOBS ENGINEERING GROUP INC.

Carswell Background Study - 05G47900

Well Number: WJEPX926

Well Type (circle one) Flushmount (Stickup)

Well Material (circle one): (PVC) St. Steel

Well Integrity: Good

HNu Background: —

HNu Wellhead: —

HNu Breathing Zone: —

Weather: Clear, light wind, 70s

Sampled By: Neely Johnson

WELL PURGING

PURGE DATE: 5/13/97

PURGE VOLUME:

Casing Diameter (inches): 4

Water Depth (ft. BTOC): 112.40 Keck Slope (Other) Hazco Time: 1325

Casing Depth (ft. BTOC): Keck Slope Other

Casing Depth (corrected): (+.09 feet for Keck)

One Purge Volume: Gallons

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE TIME:

Start 1340

Stop

Total elapsed minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

___ Grundfos

___ Dedicated Triloc

X Other: Bladder

IMMISCIBLE PHASES:

(Interface Probe Only)

None Detected —

DNAPL —

LNAPL —

Depth to Top (ft.) —

Depth to Bottom (ft.) —

Thickness (ft.) —

FIELD PARAMETER MEASUREMENT

Time of last calibration: 0820

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
1355	5.25L	21.0	6.89	0.613	0	0.09	Clear	None	
1411	5.25L	20.7	6.77	0.616	0	0.10	Clear		
1425	5.25	20.6	6.77	0.616	0	0.08	Clear		

Total Purge Volume

**Individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

___ 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

X Other Bladder

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 5/13/97

Sample Time: 1430 Start: Finish:

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A163102	1 x 1L Amber Glass	E418.1	H_2SO_4	WJEPX926-05		
CR-A163202	1 x 1 Gallon Poly	SW9315 SW9320	None	WJEPX926-05		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank		
Duplicate		
Equipment Blank		
Trip Blank		

Additional comments:

Recorded by:

Carswell Background Study - 05G47900

Well Number: RUDYSWELL

Well Type (circle one): (Flushmount) Stickup

Well Material (circle one): PVC (St. Steel)

Well Integrity: Good

HNu Background: ~0p

HNu Wellhead: —

HNu Breathing Zone: —

Weather: Clear, low 60s

Sampled By: Neely Johnson

WELL PURGING

PURGE DATE: 5/13/97

Conversion Factors
2" sched. 40 = .163 gal./ft.
4" sched 40 = .653 gal./ft.
4" sched. 80 = .574 gal./ft.
5" sched. 80 = .920 gal./ft.

PURGE VOLUME:

Casing Diameter (inches):

Water Depth (ft. BTOC): Keck Slope Other Time: 0827

Casing Depth (ft. BTOC): Keck Slope Other

Casing Depth (corrected): (+.09 feet for Keck)

One Purge Volume: 100 Gallons

PURGE TIME:

Start 0827

Stop

Total elapsed minutes

PURGE METHOD:

___ 1.88 - inch Teflon bailer

___ Bailer type:

___ Grundfos

___ Dedicated Triloc

X Other: Dedicated Pump

IMMISCIBLE PHASES: (Interface Probe Only)

None Detected —

DNAPL —

LNAPL —

Depth to Top (ft.) —

Depth to Bottom (ft.) —

Thickness (ft.) —

FIELD PARAMETER MEASUREMENT

Time of last calibration: 0820

Time of Measurement	Vol. ** Purged	Temp °C	pH	Cond. (ATC) (mMhos/cm)	Turbidity mg/L	D. O. (mg/L)	Color	Odor	Comments
0837	100	19.5	7.25	0.591	0	0.68	Clear	Sl. Sulfur	
0847	100	19.7	7.29	0.586	0	0.36	Clear	"	
0857	100	19.8	7.34	0.582	0	1.35	Clear	"	
	300	Total Purge Volume							

**individual volumes, not cumulative

WELL SAMPLING

SAMPLING METHOD (check one)

___ 1.88 - inch Teflon bailer

___ Dedicated Triloc pump

X Other Hose

Bottom-Emptying Device for VOC's? Y (N)

Sample Date: 5/13/97

Start: 0855

Sample Time: 0900 Finish: 0905

Sample No.	Volume/Cont.	Analysis Requested	Preserv.	Sample ID	QC?	Comments
CR-A163301	1 x 1L Amber Glass	E418.1	H_2SO_4	RUDYSWELL-05		
CR-A163203	1 x 1 Gallon Poly	SW9315 SW9320	None	RUDYSWELL-05		

QUALITY CONTROL SAMPLES

TYPE	SAMPLE ID	C-of-C
Ambient Blank	-	
Duplicate	-	
Equipment Blank	-	
Trip Blank	-	

Additional comments:

Recorded by: Johnson Neely

TAB

Appendix E

APPENDIX E

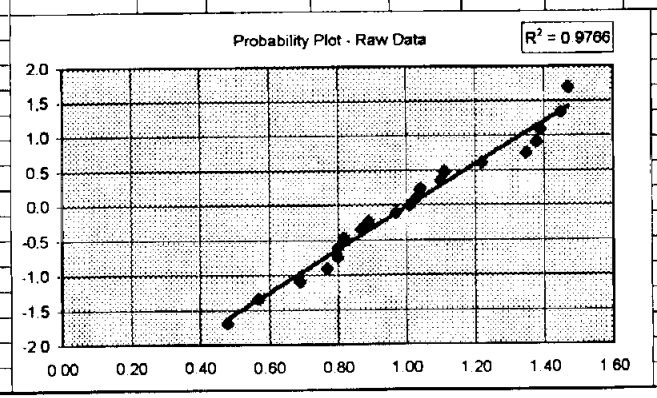
Statistical Calculations Support Tables

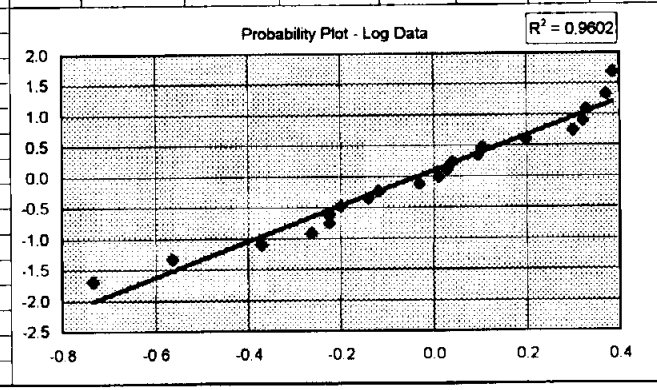
Total Petroleum Hydrocarbons (TPH) in Surface Soil

LOCATION	START_DEPT	END_DEPTH	SAMPLE_ID	UNITS	ANALYTE	VALUE	CALC	PARVQ	DETECT	PQUANT	LAB_QUAL
BJETA906	0.00	1.50	BJETA906-A	MG/KG	TFH	8.0000	8.0000	TR	5.9400	39.4000	F
BJETA902	0.00	2.00	BJETA902-A	MG/KG	TFH	7.0000	7.0000	TR	5.4200	35.9000	F
BJETA903	0.00	2.00	BJETA903-A	MG/KG	TFH	6.0000	6.0000	TR	5.4900	36.4000	F
BJETA905	0.00	2.00	BJETA905-A	MG/KG	TFH	6.0000	6.0000	TR	5.6800	37.6000	F
BJETA922	0.00	1.00	BJETA922-A	MG/KG	TFH	0.0000	2.9800	ND	5.9600	39.5000	U
BJETA913	0.00	1.10	BJETA913-A	MG/KG	TFH	0.0000	2.9700	ND	5.9400	39.4000	U
BJETA908	0.00	1.00	BJETA908-A	MG/KG	TFH	0.0000	2.9600	ND	5.9200	39.2000	U
BJETA914	0.00	0.68	BJETA914-A	MG/KG	TFH	0.0000	2.9250	ND	5.8500	38.8000	U
BJETA912	0.00	0.60	BJETA912-A	MG/KG	TFH	0.0000	2.8850	ND	5.7700	38.2000	U
BJETA924	0.00	1.00	BJETA924-A	MG/KG	TFH	0.0000	2.8800	ND	5.7600	38.2000	U
BJETA917	0.00	1.00	BJETA917-A	MG/KG	TFH	0.0000	2.8600	ND	5.7200	37.9000	U
BJETA907	0.00	1.00	BJETA907-A	MG/KG	TFH	0.0000	2.8350	ND	5.6700	37.5000	U
BJETA904	0.00	2.00	BJETA904-A	MG/KG	TFH	0.0000	2.8250	ND	5.6500	37.5000	U
BJETA916	0.00	0.85	BJETA916-A	MG/KG	TFH	0.0000	2.8250	ND	5.6500	37.4000	U
BJETA909	0.00	1.00	BJETA909-A	MG/KG	TFH	0.0000	2.7500	ND	5.5000	36.4000	U
BJETA910	0.00	1.00	BJETA910-A	MG/KG	TFH	0.0000	2.7400	ND	5.4800	36.3000	U
BJETA918	0.00	0.50	BJETA918-A	MG/KG	TFH	0.0000	2.7300	ND	5.4600	36.2000	U
BJETA920	0.00	0.40	BJETA920-A	MG/KG	TFH	0.0000	2.6900	ND	5.3800	35.6000	U
BJETA901	0.00	2.00	BJETA901-A	MG/KG	TFH	0.0000	2.6750	ND	5.3500	35.4000	U
BJETA919	0.00	0.75	BJETA919-A	MG/KG	TFH	0.0000	2.6500	ND	5.3000	35.1000	U
						% NDs	80%				
						Mean	3.61				
						Std Dev	1.66				
						UTL	8.0 (highest value)				

Radium-226 in Surface Soil

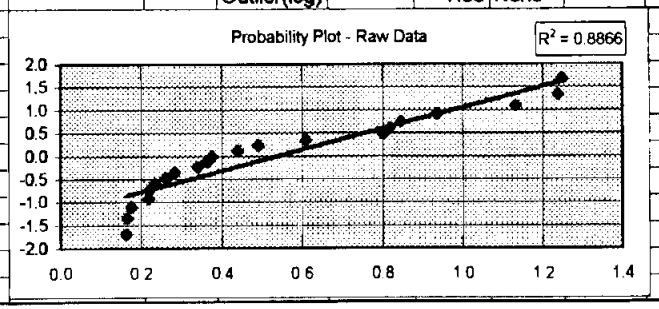
LOCATION	SAMPLE_ID	UNITS	ANALYTE	VALUE	CALC	CALC (Rev)	CALC (Rev) - CALC	$a_{(n-i+1)}$	b_i	LN(CALC)	LN CALC (Rev)	LN CALC (Rev) - LN CALC	$a_{(n-i+1)}$	b_i	R	i/(n+1)	mi	VQ	MDL	PQ	LQ	PUN
BJETA906	BJETA906-A	PCI/G	Ra-226	1.4700	1.4700	0.4800	-0.9900			0.3853	-0.7340	-1.1192			21	0.955	1.691	=	0.2100	0.2100		0.1700
BJETA922	BJETA922-A	PCI/G	Ra-226	1.4500	1.4500	0.5700	-0.8800			0.3716	-0.5621	-0.9337			20	0.909	1.335	=	0.1000	0.1000		0.2100
BJETA924	BJETA924-A	PCI/G	Ra-226	1.3900	1.3900	0.6900	-0.7000			0.3293	-0.3711	-0.7004			19	0.864	1.097	=	0.1300	0.1300		0.1900
BJETA915	BJETA915-A	PCI/G	Ra-226	1.3800	1.3800	0.7700	-0.6100			0.3221	-0.2614	-0.5834			18	0.818	0.908	=	0.1900	0.1900		0.1700
BJETA916	BJETA916-A	PCI/G	Ra-226	1.3500	1.3500	0.8000	-0.5500			0.3001	-0.2231	-0.5232			17	0.773	0.748	=	0.1300	0.1300		0.1900
BJETA904	BJETA904-A	PCI/G	Ra-226	1.2200	1.2200	0.8000	-0.4200			0.1989	-0.2231	-0.4220			16	0.727	0.605	=	0.2600	0.2600		0.1300
BJETA919	BJETA919-A	PCI/G	Ra-226	1.1100	1.1100	0.8200	-0.2900			0.1044	-0.1985	-0.3028			15	0.682	0.473	=	0.1700	0.1700		0.1200
BJETA918	BJETA918-A	PCI/G	Ra-226	1.1000	1.1000	0.8700	-0.2300			0.0953	-0.1393	-0.2346			14	0.636	0.349	=	0.1500	0.1500		0.1600
BJETA920	BJETA920-A	PCI/G	Ra-226	1.0400	1.0400	0.8900	-0.1500			0.0392	-0.1165	-0.1558			13	0.591	0.230	=	0.1400	0.1400		0.1500
BJETA917	BJETA917-A	PCI/G	Ra-226	1.0300	1.0300	0.9700	-0.0600			0.0296	-0.0305	-0.0600			12	0.545	0.114	=	0.2000	0.2000		0.1100
BJETA914	BJETA914-A	PCI/G	Ra-226	1.0100	1.0100	1.0100	0.0000	0.0000	0.0000	0.0100	0.0100	0.0000	0.0000	0.0000	11	0.500	0.000	=	0.2900	0.2900		0.1500
BJETA903	BJETA903-A	PCI/G	Ra-226	0.9700	0.9700	1.0300	0.0600	0.0263	0.0016	-0.0305	0.0296	0.0600	0.0263	0.0016	10	0.455	-0.114	=	0.2200	0.2200		0.1100
BJETA905	BJETA905-A	PCI/G	Ra-226	0.8900	0.8900	1.0400	0.1500	0.0530	0.0080	-0.1165	0.0392	0.1558	0.0530	0.0083	9	0.409	-0.230	=	0.1800	0.1800		0.1500
BJETA902	BJETA902-A	PCI/G	Ra-226	0.8700	0.8700	1.1000	0.2300	0.0804	0.0185	-0.1393	0.0953	0.2346	0.0804	0.0189	8	0.364	-0.349	=	0.1900	0.1900		0.1000
BJETA912	BJETA912-A	PCI/G	Ra-226	0.8200	0.8200	1.1100	0.2900	0.1092	0.0317	-0.1985	0.1044	0.3028	0.1092	0.0331	7	0.318	-0.473	=	0.1700	0.1700		0.1300
BJETA910	BJETA910-A	PCI/G	Ra-226	0.8000	0.8000	1.2200	0.4200	0.1399	0.0588	-0.2231	0.1989	0.4220	0.1399	0.0590	6	0.273	-0.605	=	0.1700	0.1700		0.1100
BJETA907	BJETA907-A	PCI/G	Ra-226	0.8000	0.8000	1.3500	0.5500	0.1736	0.0955	-0.2231	0.3001	0.5232	0.1736	0.0908	5	0.227	-0.748	=	0.1900	0.1900		0.0900
BJETA901	BJETA901-A	PCI/G	Ra-226	0.7700	0.7700	1.3800	0.6100	0.2119	0.1293	-0.2614	0.3221	0.5834	0.2119	0.1236	4	0.182	-0.908	=	0.1600	0.1600		0.1500
BJETA913	BJETA913-A	PCI/G	Ra-226	0.6900	0.6900	1.3900	0.7000	0.2578	0.1805	-0.3711	0.3293	0.7004	0.2578	0.1806	3	0.136	-1.097	=	0.1100	0.1100		0.1100
BJETA908	BJETA908-A	PCI/G	Ra-226	0.5700	0.5700	1.4500	0.8800	0.3185	0.2803	-0.5621	0.3716	0.9337	0.3185	0.2974	2	0.091	-1.335	=	0.1200	0.1200		0.0900
BJETA909	BJETA909-A	PCI/G	Ra-226	0.4800	0.4800	1.4700	0.9900	0.4643	0.4597	-0.7340	0.3853	1.1192	0.4643	0.5197	1	0.045	-1.691	=	0.1500	0.1500		0.1000
								b =	1.3				b =	1.3329								
				21																		
			% ND	0.0%			W	0.962				W	0.954									
			Range	0.48	1.47		W (crit)	0.908				W (crit)	0.908									
								Accept					Accept									
			Mean		1.01					-0.03												
			Std Dev		0.29					0.31		0.908	0.954		0.962							
			UTL (min)		1.69	0.48	1.47	1.01	0.29	2.00												
			UTL (ave)		1.52					1.66												
			Outlier(raw)		1.60	None																
			Outlier(log)		1.37	None																

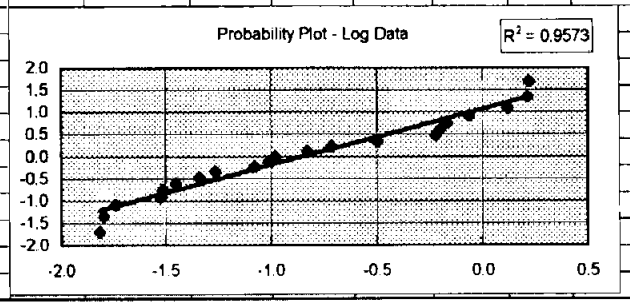




Radium-228 in Surface Soil

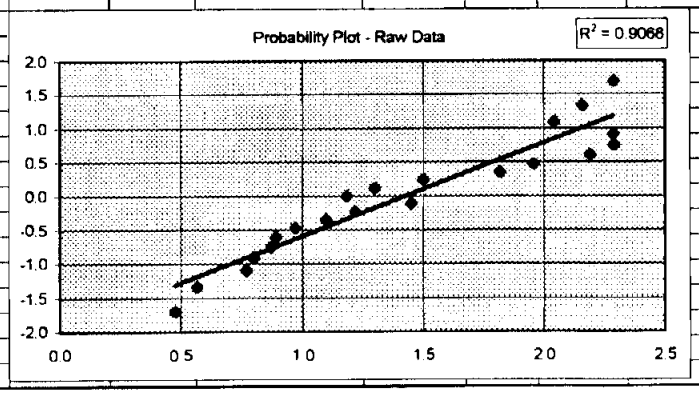
LOCATION	SAMPLE_ID	UNITS	ANALYTE	VALUE	CALC	CALC (Rev)	CALC (Rev) - CALC	$a_{(n-i+1)}$	b_i	LN(CALC)	LN CALC (Rev)	LN CALC (Rev) - LN CALC	$a_{(n+1)}$	b_i	R	i/(n+1)	mi	VQ	MDL	PQ	LQ	PUN
BJETA920	BJETA920-A	PCI/G	RA-228	1.2500	1.2500	0.1631	-1.0870			0.2231	-1.8137	-2.0368			21	0.955	1.691	=	0.9615	0.9615		0.6301
BJETA907	BJETA907-A	PCI/G	RA-228	1.2400	1.2400	0.1665	-1.0735			0.2151	-1.7928	-2.0079			20	0.909	1.335	=	0.7608	0.7608		0.4981
BJETA917	BJETA917-A	PCI/G	RA-228	1.1300	1.1300	0.1761	-0.9539			0.1222	-1.7367	-1.8589			19	0.864	1.097	=	0.7839	0.7839		0.5218
BJETA916	BJETA916-A	PCI/G	RA-228	0.9370	0.9370	0.2186	-0.7184			-0.0651	-1.5205	-1.4554			18	0.818	0.908	=	0.5696	0.5696		0.3854
BJETA919	BJETA919-A	PCI/G	RA-228	0.8460	0.8460	0.2203	-0.6258			-0.1672	-1.5130	-1.3458			17	0.773	0.748	=	0.7049	0.7049		0.4581
BJETA906	BJETA906-A	PCI/G	RA-228	0.8180	0.8180	0.2344	-0.5837			-0.2009	-1.4509	-1.2500			16	0.727	0.605	=	0.6743	0.6743		0.4306
BJETA924	BJETA924-A	PCI/G	RA-228	0.8010	0.8010	0.2624	-0.5386			-0.2219	-1.3379	-1.1160			15	0.682	0.473	=	0.7310	0.7310		0.4722
BJETA913	BJETA913-A	PCI/G	RA-228	0.6090	0.6090	0.2825	-0.3266			-0.4959	-1.2643	-0.7683			14	0.636	0.349	=	0.4028	0.4028		0.2600
BJETA914	BJETA914-A	PCI/G	RA-228	0.4910	0.4910	0.3403	-0.1507			-0.7113	-1.0779	-0.3666			13	0.591	0.230	=	0.3709	0.3709		0.2369
BJETA915	BJETA915-A	PCI/G	RA-228	0.4390	0.4390	0.3640	-0.0750			-0.8233	-1.0106	-0.1873			12	0.545	0.114	=	0.4252	0.4252		0.2662
BJETA904	BJETA904-A	PCI/G	RA-228	0.0000	0.3760	0.3760	0.0000	0.0000	0.0000	-0.9782	-0.9782	0.0000	0.0000	0.0000	11	0.500	0.000	ND	0.7520	0.7520	U	0.4615
BJETA912	BJETA912-A	PCI/G	RA-228	0.3640	0.3640	0.4390	0.0750	0.0263	0.0020	-1.0106	-0.8233	0.1873	0.0263	0.0049	10	0.455	-0.114	=	0.2541	0.2541		0.1662
BJETA905	BJETA905-A	PCI/G	RA-228	0.0000	0.3403	0.4910	0.1507	0.0530	0.0080	-1.0779	-0.7113	0.3666	0.0530	0.0194	9	0.409	-0.230	ND	0.6806	0.6806	U	0.4177
BJETA909	BJETA909-A	PCI/G	RA-228	0.0000	0.2825	0.6090	0.3266	0.0804	0.0263	-1.2643	-0.4959	0.7683	0.0804	0.0618	8	0.364	-0.349	ND	0.5649	0.5649	U	0.3392
BJETA908	BJETA908-A	PCI/G	RA-228	0.0000	0.2624	0.8010	0.5386	0.1092	0.0588	-1.3379	-0.2219	1.1160	0.1092	0.1219	7	0.318	-0.473	ND	0.5248	0.5248	U	0.3084
BJETA901	BJETA901-A	PCI/G	RA-228	0.0000	0.2344	0.8180	0.5837	0.1399	0.0817	-1.4509	-0.2009	1.2500	0.1399	0.1749	6	0.273	-0.605	ND	0.4687	0.4687	U	0.2787
BJETA910	BJETA910-A	PCI/G	RA-228	0.0000	0.2203	0.8460	0.6258	0.1736	0.1086	-1.5130	-0.1672	1.3458	0.1736	0.2336	5	0.227	-0.748	ND	0.4405	0.4405	U	0.2624
BJETA902	BJETA902-A	PCI/G	RA-228	0.0000	0.2186	0.9370	0.7184	0.2119	0.1522	-1.5205	-0.0651	1.4554	0.2119	0.3084	4	0.182	-0.908	ND	0.4372	0.4372	U	0.2631
BJETA903	BJETA903-A	PCI/G	RA-228	0.0000	0.1761	1.1300	0.9539	0.2578	0.2459	-1.7367	0.1222	1.8589	0.2578	0.4792	3	0.136	-1.097	ND	0.3522	0.3522	U	0.2184
BJETA922	BJETA922-A	PCI/G	RA-228	0.0000	0.1665	1.2400	1.0735	0.3185	0.3419	-1.7928	0.2151	2.0079	0.3185	0.6395	2	0.091	-1.335	ND	0.3330	0.3330	U	0.2081
BJETA918	BJETA918-A	PCI/G	RA-228	0.0000	0.1631	1.2500	1.0870	0.4643	0.5047	-1.8137	0.2231	2.0368	0.4643	0.9457	1	0.045	-1.691	ND	0.3261	0.3261	U	0.2026
								b =	1.5				b =	2.9894								
				21																		
			% ND	47.6%			W	0.864				W	0.928									
			Range	0.1631	1.25		W (crit)	0.908				W (crit)	0.908									
								Reject					Accept									
			Mean		0.5412					-0.84												
			Std Dev		0.37					0.69		0.908	0.928		0.864							
			UTL (min)		1.41	0.16	1.25	0.54	0.37	2.24												
			UTL (ave)		1.19					1.47												
			Outlier(raw)		1.93	None																
			Outlier(log)		1.53	None																

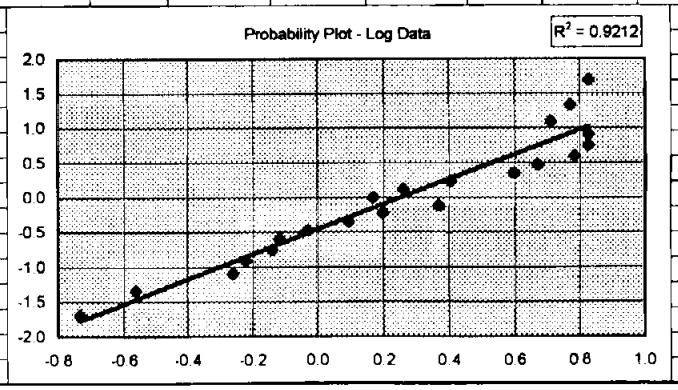




Total Radium in Surface Soil

LOCATION	SAMPLE_ID	UNITS	Ra-226	Ra-228	Total (Ra-226+226)	CALC	CALC (Rev)	CALC (Rev) - CALC	$a_{(n-i+1)}$	b_i	LN(CALC)	LN CALC (Rev)	LN CALC (Rev) - LN CALC	$a_{(n-i+1)}$	b_i	R	i/(n+1)	mi
BJETA920	BJETA920-A	PCI/G	1.0400	1.2500	2.2900	2.2900	0.4800	-1.8100			0.8286	-0.7340	-1.5625			21	0.955	1.691
BJETA917	BJETA917-A	PCI/G	1.0300	1.1300	2.1600	2.1600	0.5700	-1.5900			0.7701	-0.5621	-1.3322			20	0.909	1.335
BJETA907	BJETA907-A	PCI/G	0.8000	1.2400	2.0400	2.0400	0.7700	-1.2700			0.7129	-0.2614	-0.9743			19	0.864	1.097
BJETA916	BJETA916-A	PCI/G	1.3500	0.9370	2.2870	2.2870	0.8000	-1.4870			0.8272	-0.2231	-1.0504			18	0.818	0.908
BJETA906	BJETA906-A	PCI/G	1.4700	0.8180	2.2880	2.2880	0.8700	-1.4180			0.8277	-0.1393	-0.9669			17	0.773	0.748
BJETA924	BJETA924-A	PCI/G	1.3900	0.8010	2.1910	2.1910	0.8900	-1.3010			0.7844	-0.1165	-0.9009			16	0.727	0.605
BJETA919	BJETA919-A	PCI/G	1.1100	0.8460	1.9560	1.9560	0.9700	-0.9860			0.6709	-0.0305	-0.7014			15	0.682	0.473
BJETA915	BJETA915-A	PCI/G	1.3800	0.4390	1.8190	1.8190	1.1000	-0.7190			0.5983	0.0953	-0.5030			14	0.636	0.349
BJETA914	BJETA914-A	PCI/G	1.0100	0.4910	1.5010	1.5010	1.2200	-0.2810			0.4061	0.1989	-0.2073			13	0.591	0.230
BJETA913	BJETA913-A	PCI/G	0.6900	0.6090	1.2990	1.2990	1.4500	0.1510			0.2616	0.3716	0.1100			12	0.545	0.114
BJETA912	BJETA912-A	PCI/G	0.8200	0.3640	1.1840	1.1840	1.1840	0.0000	0.0000	0.0000	0.1689	0.1689	0.0000	0.0000	0.0000	11	0.500	0.000
BJETA922	BJETA922-A	PCI/G	1.4500	0.0000	1.4500	1.4500	1.2990	-0.1510	0.0263	-0.0040	0.3716	0.2616	-0.1100	0.0263	-0.0029	10	0.455	-0.114
BJETA904	BJETA904-A	PCI/G	1.2200	0.0000	1.2200	1.2200	1.5010	0.2810	0.0530	0.0149	0.1989	0.4061	0.2073	0.0530	0.0110	9	0.409	-0.230
BJETA918	BJETA918-A	PCI/G	1.1000	0.0000	1.1000	1.1000	1.8190	0.7190	0.0804	0.0578	0.0953	0.5983	0.5030	0.0804	0.0404	8	0.364	-0.349
BJETA903	BJETA903-A	PCI/G	0.9700	0.0000	0.9700	0.9700	1.9560	0.9860	0.1092	0.1077	-0.0305	0.6709	0.7014	0.1092	0.0766	7	0.318	-0.473
BJETA905	BJETA905-A	PCI/G	0.8900	0.0000	0.8900	0.8900	2.1910	1.3010	0.1399	0.1820	-0.1165	0.7844	0.9009	0.1399	0.1260	6	0.273	-0.605
BJETA902	BJETA902-A	PCI/G	0.8700	0.0000	0.8700	0.8700	2.2880	1.4180	0.1736	0.2462	-0.1393	0.8277	0.9669	0.1736	0.1679	5	0.227	-0.748
BJETA910	BJETA910-A	PCI/G	0.8000	0.0000	0.8000	0.8000	2.2870	1.4870	0.2119	0.3151	-0.2231	0.8272	1.0504	0.2119	0.2226	4	0.182	-0.908
BJETA901	BJETA901-A	PCI/G	0.7700	0.0000	0.7700	0.7700	2.0400	1.2700	0.2578	0.3274	-0.2614	0.7129	0.9743	0.2578	0.2512	3	0.136	-1.097
BJETA908	BJETA908-A	PCI/G	0.5700	0.0000	0.5700	0.5700	2.1600	1.5900	0.3185	0.5064	-0.5621	0.7701	1.3322	0.3185	0.4243	2	0.091	-1.335
BJETA909	BJETA909-A	PCI/G	0.4800	0.0000	0.4800	0.4800	2.2900	1.8100	0.4643	0.8404	-0.7340	0.8286	1.5625	0.4643	0.7255	1	0.045	-1.691
									b =	2.6				b =	2.0426			
				0	21													
				% Non-detect	0.0%			W	0.880				W	0.903				
				Range (Raw)	0.48	2.29		W (crit)	0.908				W (crit)	0.908				
									Reject					Reject				
				Mean		1.435					0.26			(Deemed to be log-normally distributed)				
				Std Dev		0.62					0.48		0.908	0.903		0.880		
				UTL (min 95)		2.90	0.48	2.29	1.44	0.62	4.05							
				UTL (ave 95)		2.53					3.03							
				Outlier Test (raw)		1.38	None											
				Outlier Test (log)		1.18	None											



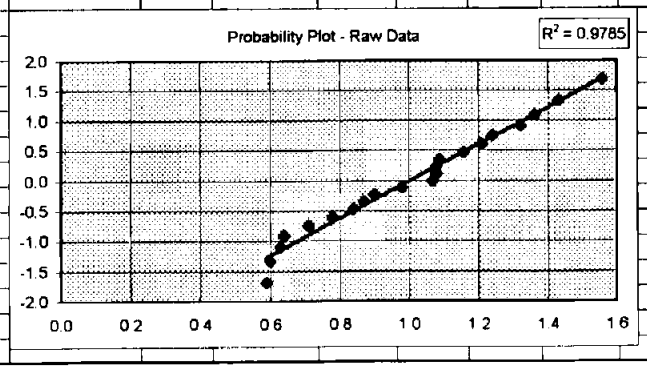


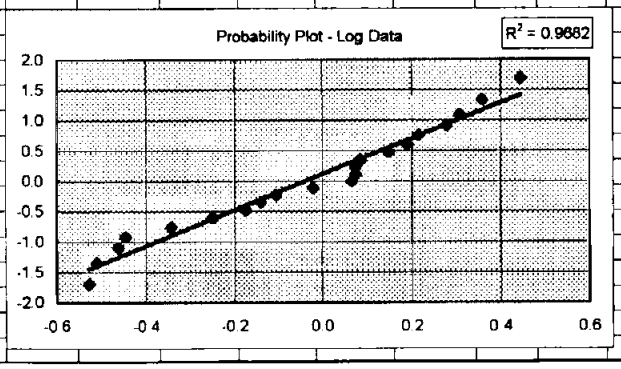
Total Petroleum Hydrocarbons (TPH) in Subsurface Soil

LOCATION	START_DEPT	END_DEPTH	SAMPLE_ID	UNITS	ANALYTE	VALUE	CALC	PARVQ	DETECT	PQUANT	LAB_QUAL
BJETA905	5.50	7.00	BJETA905-B	MG/KG	TFH	6.0000	6.0000	TR	4.9500	32.8000	F
BJETA922	2.00	3.00	BJETA922-B	MG/KG	TFH	0.0000	2.7450	ND	5.4900	36.4000	U
BJETA914	2.00	4.00	BJETA914-B	MG/KG	TFH	0.0000	2.7400	ND	5.4800	36.3000	U
BJETA909	3.00	4.00	BJETA909-B	MG/KG	TFH	0.0000	2.7200	ND	5.4400	36.1000	U
BJETA913	6.00	8.00	BJETA913-B	MG/KG	TFH	0.0000	2.7100	ND	5.4200	35.9000	U
BJETA915	2.00	4.00	BJETA915-B	MG/KG	TFH	0.0000	2.7000	ND	5.4000	35.8000	U
BJETA920	0.40	1.50	BJETA920-B	MG/KG	TFH	0.0000	2.6750	ND	5.3500	35.4000	U
BJETA910	4.00	6.00	BJETA910-B	MG/KG	TFH	0.0000	2.6700	ND	5.3400	35.4000	U
BJETA919	0.75	2.00	BJETA919-B	MG/KG	TFH	0.0000	2.6650	ND	5.3300	35.3000	U
BJETA921	2.00	3.00	BJETA921-B	MG/KG	TFH	0.0000	2.6450	ND	5.2900	35.0000	U
BJETA924	1.50	2.50	BJETA924-B	MG/KG	TFH	0.0000	2.6400	ND	5.2800	35.0000	U
BJETA908	3.00	4.00	BJETA908-B	MG/KG	TFH	0.0000	2.6250	ND	5.2500	34.8000	U
BJETA918	2.00	3.50	BJETA918-B	MG/KG	TFH	0.0000	2.6100	ND	5.2200	34.6000	U
BJETA923	2.00	3.00	BJETA923-B	MG/KG	TFH	0.0000	2.5550	ND	5.1100	33.9000	U
BJETA917	4.00	6.30	BJETA917-B	MG/KG	TFH	0.0000	2.5400	ND	5.0800	33.7000	U
BJETA902	2.00	4.00	BJETA902-B	MG/KG	TFH	0.0000	2.5200	ND	5.0400	33.4000	U
BJETA903	2.00	3.00	BJETA903-B	MG/KG	TFH	0.0000	2.5150	ND	5.0300	33.3000	U
BJETA912	3.00	4.00	BJETA912-B	MG/KG	TFH	0.0000	2.4800	ND	4.9600	32.9000	U
BJETA907	3.00	4.00	BJETA907-B	MG/KG	TFH	0.0000	2.4600	ND	4.9200	32.6000	U
BJETA906	1.50	3.00	BJETA906-B	MG/KG	TFH	0.0000	2.4550	ND	4.9100	32.5000	U
BJETA911	3.00	4.00	BJETA911-B	MG/KG	TFH	0.0000	2.4350	ND	4.8700	32.3000	U
						% NDs	95%				
						Mean	2.77				
						Std Dev	0.75				
						UTL	6.0 (highest value)				

Radium-226 in Subsurface Soil

LOCATION	SAMPLE_ID	UNITS	ANALYTE	VALUE	CALC	CALC (Rev)	CALC (Rev) - CALC	$a_{(n+1)}$	b_i	LN (CALC)	LN CALC (Rev)	LN CALC (Rev) - LN CALC	$a_{(n+1)}$	b_i	R	i/(n+1)	mi	VQ	MDL	PQ	LQ	PUN
BJETA914	BJETA914-B	PCI/G	Ra-226	1.5600	1.5600	0.5900	-0.9700			0.4447	-0.5276	-0.9723			21	0.955	1.691	=	0.1100	0.1100		0.1100
BJETA905	BJETA905-B	PCI/G	Ra-226	1.4300	1.4300	0.6000	-0.8300			0.3577	-0.5108	-0.8685			20	0.909	1.335	=	0.2000	0.2000		0.0700
BJETA915	BJETA915-B	PCI/G	Ra-226	1.3600	1.3600	0.6300	-0.7300			0.3075	-0.4620	-0.7695			19	0.864	1.097	=	0.2400	0.2400		0.0700
BJETA910	BJETA910-B	PCI/G	Ra-226	1.3200	1.3200	0.6400	-0.6800			0.2776	-0.4463	-0.7239			18	0.818	0.908	=	0.1500	0.1500		0.1000
BJETA913	BJETA913-B	PCI/G	Ra-226	1.2400	1.2400	0.7100	-0.5300			0.2151	-0.3425	-0.5576			17	0.773	0.748	=	0.1600	0.1600		0.1100
BJETA917	BJETA917-B	PCI/G	Ra-226	1.2100	1.2100	0.7800	-0.4300			0.1906	-0.2485	-0.4391			16	0.727	0.605	=	0.1100	0.1100		0.1100
BJETA922	BJETA922-B	PCI/G	Ra-226	1.1600	1.1600	0.8400	-0.3200			0.1484	-0.1744	-0.3228			15	0.682	0.473	=	0.2000	0.2000		0.1100
BJETA909	BJETA909-B	PCI/G	Ra-226	1.0900	1.0900	0.8700	-0.2200			0.0862	-0.1393	-0.2254			14	0.636	0.349	=	0.1200	0.1200		0.1600
BJETA906	BJETA906-B	PCI/G	Ra-226	1.0800	1.0800	0.9000	-0.1800			0.0770	-0.1054	-0.1823			13	0.591	0.230	=	0.1100	0.1100		0.1600
BJETA918	BJETA918-B	PCI/G	Ra-226	1.0800	1.0800	0.9800	-0.1000			0.0770	-0.0202	-0.0972			12	0.545	0.114	=	0.1400	0.1400		0.1600
BJETA903	BJETA903-B	PCI/G	Ra-226	1.0700	1.0700	1.0700	0.0000	0.0000	0.0000	0.0677	0.0677	0.0000	0.0000	0.0000	11	0.500	0.000	=	0.2900	0.2900		0.1100
BJETA911	BJETA911-B	PCI/G	Ra-226	0.9800	0.9800	1.0800	0.1000	0.0263	0.0026	-0.0202	0.0770	0.0972	0.0263	0.0026	10	0.455	-0.114	=	0.1600	0.1600		0.1700
BJETA919	BJETA919-B	PCI/G	Ra-226	0.9000	0.9000	1.0800	0.1800	0.0530	0.0095	-0.1054	0.0770	0.1823	0.0530	0.0097	9	0.409	-0.230	=	0.1600	0.1600		0.1200
BJETA920	BJETA920-B	PCI/G	Ra-226	0.8700	0.8700	1.0900	0.2200	0.0804	0.0177	-0.1393	0.0862	0.2254	0.0804	0.0181	8	0.364	-0.349	=	0.1600	0.1600		0.1900
BJETA912	BJETA912-B	PCI/G	Ra-226	0.8400	0.8400	1.1600	0.3200	0.1092	0.0349	-0.1744	0.1484	0.3228	0.1092	0.0352	7	0.318	-0.473	=	0.0900	0.0900		0.1800
BJETA924	BJETA924-B	PCI/G	Ra-226	0.7800	0.7800	1.2100	0.4300	0.1399	0.0602	-0.2485	0.1906	0.4391	0.1399	0.0614	6	0.273	-0.605	=	0.1100	0.1100		0.1900
BJETA907	BJETA907-B	PCI/G	Ra-226	0.7100	0.7100	1.2400	0.5300	0.1736	0.0920	-0.3425	0.2151	0.5576	0.1736	0.0968	5	0.227	-0.748	=	0.1400	0.1400		0.2100
BJETA908	BJETA908-B	PCI/G	Ra-226	0.6400	0.6400	1.3200	0.6800	0.2119	0.1441	-0.4463	0.2776	0.7239	0.2119	0.1534	4	0.182	-0.908	=	0.2000	0.2000		0.1600
BJETA902	BJETA902-B	PCI/G	Ra-226	0.6300	0.6300	1.3600	0.7300	0.2578	0.1882	-0.4620	0.3075	0.7695	0.2578	0.1984	3	0.136	-1.097	=	0.1300	0.1300		0.2200
BJETA923	BJETA923-B	PCI/G	Ra-226	0.6000	0.6000	1.4300	0.8300	0.3185	0.2644	-0.5108	0.3577	0.8685	0.3185	0.2766	2	0.091	-1.335	=	0.1900	0.1900		0.2200
BJETA921	BJETA921-B	PCI/G	Ra-226	0.5900	0.5900	1.5600	0.9700	0.4643	0.4504	-0.5276	0.4447	0.9723	0.4643	0.4514	1	0.045	-1.691	=	0.1500	0.1500		0.2600
								b =	1.3				b =	1.3037								
				21																		
			% ND	0.0%			W	0.961				W	0.948									
			Range	0.59	1.56		W (crit)	0.908				W (crit)	0.908									
								Accept					Accept									
			Mean		1.0067					-0.03												
			Std Dev		0.29					0.30		0.908	0.948		0.961							
			UTL (min)		1.69	0.59	1.56	1.01	0.29	1.96												
			UTL (ave)		1.52					1.64												
			Outlier(raw)		1.92	None																
			Outlier(log)		1.60	None																



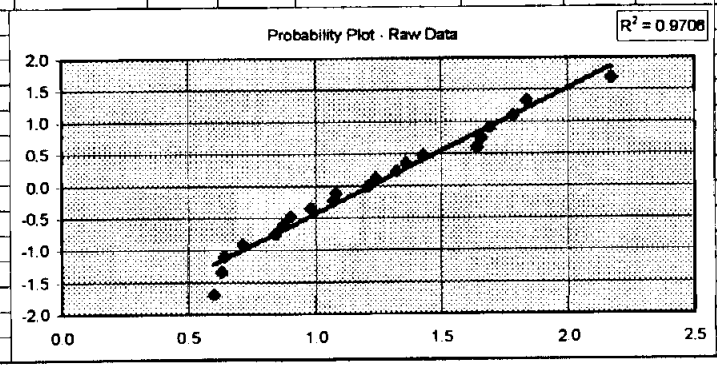


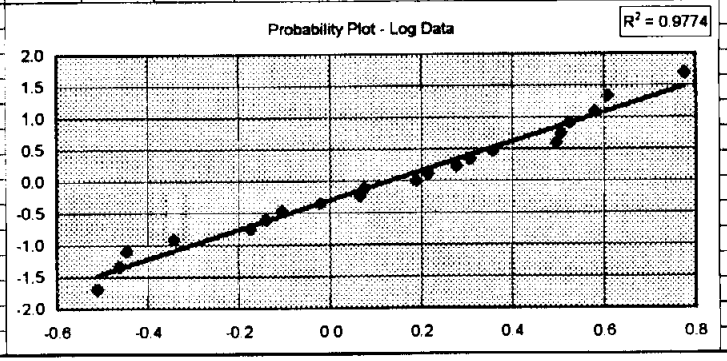
Radium-228 in Subsurface Soil

LOCATION	SAMPLE_ID	UNITS	ANALYTE	VALUE	CALC	CALC (Rev)	CALC (Rev) - CALC	$a_{(n+1)}$	b_i	LN (CALC)	LN CALC (Rev)	LN CALC (Rev) - LN CALC	$a_{(n+1)}$	b_i	R	i/(n+1)	mi	VQ	MDL	PQ	LQ	PUN
BJETA921	BJETA921-B	PCI/G	RA-228	1.1000	1.1000	0.1660	-0.9340			0.0953	-1.7958	-1.8911			20	0.952	1.668	=	0.8852	0.8852		0.5753
BJETA924	BJETA924-B	PCI/G	RA-228	1.0570	1.0570	0.1728	-0.8842			0.0554	-1.7556	-1.8111			19	0.905	1.309	=	0.6622	0.6622		0.4454
BJETA906	BJETA906-B	PCI/G	RA-228	0.7050	0.7050	0.1804	-0.5247			-0.3496	-1.7129	-1.3633			18	0.857	1.068	=	0.5055	0.5055		0.3276
BJETA914	BJETA914-B	PCI/G	RA-228	0.6140	0.6140	0.1900	-0.4241			-0.4878	-1.6610	-1.1732			17	0.810	0.876	=	0.4474	0.4474		0.2865
BJETA909	BJETA909-B	PCI/G	RA-228	0.5530	0.5530	0.1937	-0.3594			-0.5924	-1.6417	-1.0493			16	0.762	0.712	=	0.4420	0.4420		0.2826
BJETA922	BJETA922-B	PCI/G	RA-228	0.5000	0.5000	0.1944	-0.3056			-0.6931	-1.6378	-0.9447			15	0.714	0.566	=	0.3028	0.3028		0.1990
BJETA907	BJETA907-B	PCI/G	RA-228	0.0000	0.3887	0.1997	-0.1890			-0.9451	-1.6112	-0.6661			14	0.667	0.431	ND	0.7773	0.7773	U	0.4739
BJETA905	BJETA905-B	PCI/G	RA-228	0.0000	0.3447	0.2061	-0.1387			-1.0651	-1.5796	-0.5146			13	0.619	0.303	ND	0.6894	0.6894	U	0.4193
BJETA908	BJETA908-B	PCI/G	RA-228	0.0000	0.3329	0.2112	-0.1217			-1.0999	-1.5549	-0.4550			12	0.571	0.180	ND	0.6658	0.6658	U	0.3944
BJETA910	BJETA910-B	PCI/G	RA-228	0.0000	0.2575	0.2131	-0.0445			-1.3567	-1.5462	-0.1895			11	0.524	0.060	ND	0.5150	0.5150	U	0.3192
BJETA903	BJETA903-B	PCI/G	RA-228	0.0000	0.2131	0.2575	0.0445	0.0140	0.0006	-1.5462	-1.3567	0.1895	0.0140	0.0027	10	0.476	-0.060	ND	0.4261	0.4261	U	0.2640
BJETA911	BJETA911-B	PCI/G	RA-228	0.0000	0.2112	0.3329	0.1217	0.0422	0.0051	-1.5549	-1.0999	0.4550	0.0422	0.0192	9	0.429	-0.180	ND	0.4224	0.4224	U	0.2631
BJETA913	BJETA913-B	PCI/G	RA-228	0.0000	0.2061	0.3447	0.1387	0.0711	0.0099	-1.5796	-1.0651	0.5146	0.0711	0.0366	8	0.381	-0.303	ND	0.4121	0.4121	U	0.2567
BJETA915	BJETA915-B	PCI/G	RA-228	0.0000	0.1997	0.3887	0.1890	0.1013	0.0191	-1.6112	-0.9451	0.6661	0.1013	0.0675	7	0.333	-0.431	ND	0.3993	0.3993	U	0.2487
BJETA902	BJETA902-B	PCI/G	RA-228	0.0000	0.1944	0.5000	0.3056	0.1334	0.0408	-1.6378	-0.6931	0.9447	0.1334	0.1260	6	0.286	-0.566	ND	0.3888	0.3888	U	0.2375
BJETA917	BJETA917-B	PCI/G	RA-228	0.0000	0.1937	0.5530	0.3594	0.1686	0.0606	-1.6417	-0.5924	1.0493	0.1686	0.1769	5	0.238	-0.712	ND	0.3873	0.3873	U	0.2326
BJETA919	BJETA919-B	PCI/G	RA-228	0.0000	0.1900	0.6140	0.4241	0.2085	0.0884	-1.6610	-0.4878	1.1732	0.2085	0.2446	4	0.190	-0.876	ND	0.3799	0.3799	U	0.2304
BJETA920	BJETA920-B	PCI/G	RA-228	0.0000	0.1804	0.7050	0.5247	0.2565	0.1346	-1.7129	-0.3496	1.3633	0.2565	0.3497	3	0.143	-1.068	ND	0.3607	0.3607	U	0.2174
BJETA923	BJETA923-B	PCI/G	RA-228	0.0000	0.1728	1.0570	0.8842	0.3211	0.2839	-1.7556	0.0554	1.8111	0.3211	0.5815	2	0.095	-1.309	ND	0.3456	0.3456	U	0.2094
BJETA918	BJETA918-B	PCI/G	RA-228	0.0000	0.1660	1.1000	0.9340	0.4734	0.4422	-1.7958	0.0953	1.8911	0.4734	0.8952	1	0.048	-1.668	ND	0.3320	0.3320	U	0.1983
								b =	1.1				b =	2.4999								
				20																		
NOTE:			% ND	70.0%			W	0.721				W	0.818									
Radium 228 result for			Range	0.166	1.1		W (crit)	0.908				W (crit)	0.908									
BJETA912-B (CR-A157706) was								Reject					Reject									
rejected. Result eliminated for			Mean		0.389					-1.15												
calculating background.			Std Dev		0.29					0.62		0.908	0.818		0.721							
			UTL (min)		1.07	0.17	1.10	0.39	0.29	1.38												
			UTL (ave)		0.89					0.95												

Total Radium In Subsurface Soil

LOCATION	SAMPLE_ID	UNITS	Ra-226	Ra-228	Total (Ra-226+228)	CALC	CALC (Rev)	CALC (Rev) - CALC	$a_{(n-i+1)}$	b_i	LN (CALC)	LN CALC (Rev)	LN CALC (Rev) - LN CALC	$a_{(n-i+1)}$	b_i	R	i/(n+1)	mi
BJETA914	BJETA914-B	PCI/G	1.5600	0.6140	2.1740	2.1740	0.6000	-1.5740			0.7766	-0.5108	-1.2874			21	0.955	1.691
BJETA924	BJETA924-B	PCI/G	0.7800	1.0570	1.8370	1.8370	0.6300	-1.2070			0.6081	-0.4620	-1.0702			20	0.909	1.335
BJETA906	BJETA906-B	PCI/G	1.0800	0.7050	1.7850	1.7850	0.6400	-1.1450			0.5794	-0.4463	-1.0257			19	0.864	1.097
BJETA921	BJETA921-B	PCI/G	0.5900	1.1000	1.6900	1.6900	0.7100	-0.9800			0.5247	-0.3425	-0.8672			18	0.818	0.908
BJETA922	BJETA922-B	PCI/G	1.1600	0.5000	1.6600	1.6600	0.8400	-0.8200			0.5068	-0.1744	-0.6812			17	0.773	0.748
BJETA909	BJETA909-B	PCI/G	1.0900	0.5530	1.6430	1.6430	0.8700	-0.7730			0.4965	-0.1393	-0.6358			16	0.727	0.605
BJETA905	BJETA905-B	PCI/G	1.4300	0.0000	1.4300	1.4300	0.9000	-0.5300			0.3577	-0.1054	-0.4630			15	0.682	0.473
BJETA915	BJETA915-B	PCI/G	1.3600	0.0000	1.3600	1.3600	0.9800	-0.3800			0.3075	-0.0202	-0.3277			14	0.636	0.349
BJETA910	BJETA910-B	PCI/G	1.3200	0.0000	1.3200	1.3200	1.0700	-0.2500			0.2776	0.0677	-0.2100			13	0.591	0.230
BJETA913	BJETA913-B	PCI/G	1.2400	0.0000	1.2400	1.2400	1.0800	-0.1600			0.2151	0.0770	-0.1382			12	0.545	0.114
BJETA917	BJETA917-B	PCI/G	1.2100	0.0000	1.2100	1.2100	1.2100	0.0000	0.0000	0.0000	0.1906	0.1906	0.0000	0.0000	0.0000	11	0.500	0.000
BJETA918	BJETA918-B	PCI/G	1.0800	0.0000	1.0800	1.0800	1.2400	0.1600	0.0263	0.0042	0.0770	0.2151	0.1382	0.0263	0.0036	10	0.455	-0.114
BJETA903	BJETA903-B	PCI/G	1.0700	0.0000	1.0700	1.0700	1.3200	0.2500	0.0530	0.0133	0.0677	0.2776	0.2100	0.0530	0.0111	9	0.409	-0.230
BJETA911	BJETA911-B	PCI/G	0.9800	0.0000	0.9800	0.9800	1.3600	0.3800	0.0804	0.0306	-0.0202	0.3075	0.3277	0.0804	0.0263	8	0.364	-0.349
BJETA919	BJETA919-B	PCI/G	0.9000	0.0000	0.9000	0.9000	1.4300	0.5300	0.1092	0.0579	-0.1054	0.3577	0.4630	0.1092	0.0506	7	0.318	-0.473
BJETA920	BJETA920-B	PCI/G	0.8700	0.0000	0.8700	0.8700	1.6430	0.7730	0.1399	0.1081	-0.1393	0.4965	0.6358	0.1399	0.0889	6	0.273	-0.605
BJETA912	BJETA912-B	PCI/G	0.8400	0.0000	0.8400	0.8400	1.6600	0.8200	0.1736	0.1424	-0.1744	0.5068	0.6812	0.1736	0.1183	5	0.227	-0.748
BJETA907	BJETA907-B	PCI/G	0.7100	0.0000	0.7100	0.7100	1.6900	0.9800	0.2119	0.2077	-0.3425	0.5247	0.8672	0.2119	0.1838	4	0.182	-0.908
BJETA908	BJETA908-B	PCI/G	0.6400	0.0000	0.6400	0.6400	1.7850	1.1450	0.2578	0.2952	-0.4463	0.5794	1.0257	0.2578	0.2644	3	0.136	-1.097
BJETA902	BJETA902-B	PCI/G	0.6300	0.0000	0.6300	0.6300	1.8370	1.2070	0.3185	0.3844	-0.4620	0.6081	1.0702	0.3185	0.3408	2	0.091	-1.335
BJETA923	BJETA923-B	PCI/G	0.6000	0.0000	0.6000	0.6000	2.1740	1.5740	0.4643	0.7308	-0.5108	0.7766	1.2874	0.4643	0.5977	1	0.045	-1.691
									b =	2.0				b =	1.6856			
				0	21													
				% Non-detect	0.0%			W	0.957				W	0.959				
				Range (Raw)	0.6	2.174		W (crit)	0.908				W (crit)	0.908				
									Accept					Accept				
				Mean		1.2223					0.13							
				Std Dev		0.45					0.38		0.908	0.959		0.957		
				UTL (min 95)		2.29	0.60	2.17	1.22	0.45	2.84							
				UTL (ave 95)		2.02					2.25							
				Outlier Test (raw)		2.11	None											
				Outlier Test (log)		1.67	None											



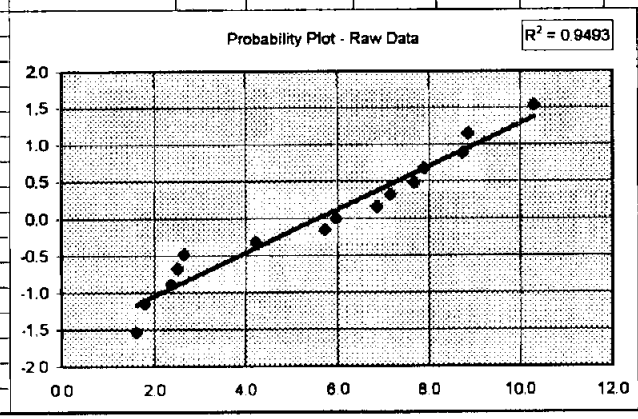


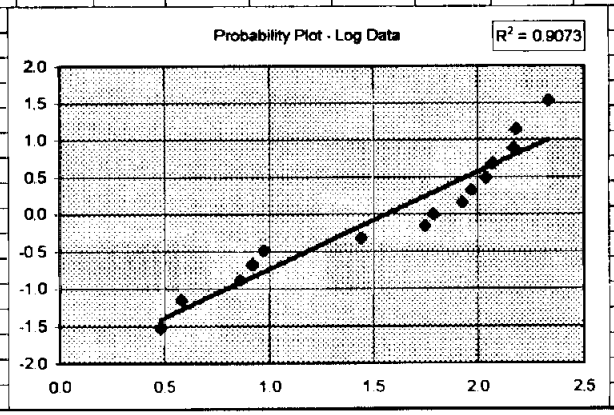
Total Petroleum Hydrocarbons (TPH) in Groundwater

LOCATION	SAMPLE_ID	UNITS	ANALYTE	VALUE	CALC	VQ	MDL	PQ	LQ
RUDYSWELL	RUDYSWELL-03	MG/L	TFH	0.0000	0.2220	ND	0.4440	1.0000	U
WJEPX925	WJEPX925-03	MG/L	TFH	0.0000	0.2220	ND	0.4440	1.0000	U
WJEPX926	WJEPX926-03	MG/L	TFH	0.0000	0.2220	ND	0.4440	1.0000	U
RUDYSWELL	RUDYSWELL-01	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
RUDYSWELL	RUDYSWELL-02	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
RUDYSWELL	RUDYSWELL-04	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
RUDYSWELL	RUDYSWELL-05	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
WJEPX925	WJEPX925-01	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
WJEPX925	WJEPX925-02	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
WJEPX925	WJEPX925-04	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
WJEPX925	WJEPX925-05	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
WJEPX926	WJEPX926-01	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
WJEPX926	WJEPX926-02	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
WJEPX926	WJEPX926-04	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
WJEPX926	WJEPX926-05	MG/L	TFH	0.0000	0.2200	ND	0.4400	1.0000	U
				% NDs	1.00				
				Mean	0.22				
				Std Dev	0.00				
				UTL	ND at 0.444				

Radium-226 in Groundwater

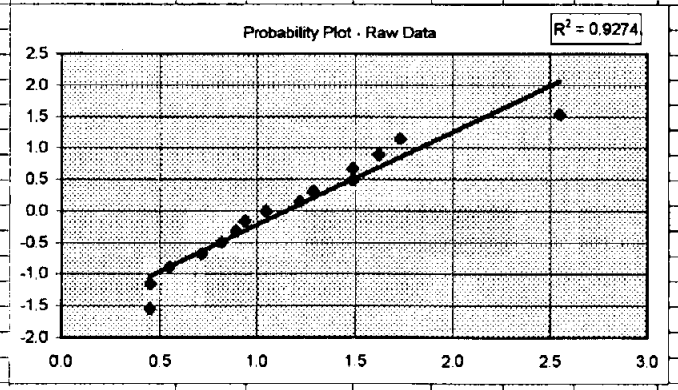
LOCATION	SAMPLE_ID	UNITS	ANALYTE	VALUE	CALC	CALC (Rev)	CALC (Rev) - CALC	$a_{(n-i+1)}$	b_i	LN (CALC)	LN CALC (Rev)	LN CALC (Rev) - LN CALC	$a_{(n-i+1)}$	b_i	R	i/(n+1)	mi	VQ	MDL	PQ	LQ	PUN
WJEPX926	WJEPX926-03	PCI/L	Ra-226	10.3000	10.3000	1.6200	-8.6800			2.3321	1.5644	-0.7677			15	0.938	1.534	=	0.5000	0.5000		2.3200
WJEPX926	WJEPX926-02	PCI/L	Ra-226	8.8600	8.8600	1.7900	-7.0700			2.1815	0.0000	-2.1815			14	0.875	1.150	=	0.1300	0.1300		1.8400
WJEPX926	WJEPX926-05	PCI/L	Ra-226	8.7400	8.7400	2.3600	-6.3800			2.1679	0.0000	-2.1679			13	0.813	0.887	=	0.2800	0.2800		1.9700
RUDYSWELL	RUDYSWELL-05	PCI/L	Ra-226	7.9100	7.9100	2.5000	-5.4100			2.0681	0.0000	-2.0681			12	0.750	0.674	=	0.4000	0.4000		1.8300
WJEPX926	WJEPX926-04	PCI/L	Ra-226	7.6800	7.6800	2.6400	-5.0400			2.0386	0.0000	-2.0386			11	0.688	0.489	=	0.3200	0.3200		1.7500
RUDYSWELL	RUDYSWELL-03	PCI/L	Ra-226	7.1500	7.1500	4.2300	-2.9200			1.9671	0.0000	-1.9671			10	0.625	0.319	=	0.4500	0.4500		1.6700
RUDYSWELL	RUDYSWELL-04	PCI/L	Ra-226	6.8600	6.8600	5.7300	-1.1300			1.9257	0.4824	-1.4433			9	0.563	0.157	=	0.4100	0.4100		1.6200
RUDYSWELL	RUDYSWELL-02	PCI/L	Ra-226	5.9700	5.9700	5.9700	0.0000	0.0000	0.0000	1.7867	0.5822	-1.2045	0.0000	0.0000	8	0.500	0.000	=	0.1500	0.1500		1.2700
WJEPX926	WJEPX926-01	PCI/L	Ra-226	5.7300	5.7300	6.8600	1.1300	0.0433	0.0489	1.7457	0.8587	-0.8871	0.0433	-0.0384	7	0.438	-0.157	=	0.2600	0.2600		0.8300
RUDYSWELL	RUDYSWELL-01	PCI/L	Ra-226	4.2300	4.2300	7.1500	2.9200	0.0880	0.2570	1.4422	0.9163	-0.5259	0.0880	-0.0463	6	0.375	-0.319	=	0.1600	0.1600		0.6100
WJEPX925	WJEPX925-05	PCI/L	Ra-226	2.6400	2.6400	7.6800	5.0400	0.1353	0.6819	0.9708	0.9708	0.0000	0.1353	0.0000	5	0.313	-0.489	=	0.3500	0.3500		0.7600
WJEPX925	WJEPX925-04	PCI/L	Ra-226	2.5000	2.5000	7.9100	5.4100	0.1878	1.0160	0.9163	1.4422	0.5259	0.1878	0.0988	4	0.250	-0.674	=	0.3100	0.3100		0.7400
WJEPX925	WJEPX925-03	PCI/L	Ra-226	2.3600	2.3600	8.7400	6.3800	0.2495	1.5918	0.8587	1.7457	0.8871	0.2495	0.2213	3	0.188	-0.887	=	0.3600	0.3600		0.7100
WJEPX925	WJEPX925-02	PCI/L	Ra-226	1.7900	1.7900	8.8600	7.0700	0.3306	2.3373	0.5822	1.7867	1.2045	0.3306	0.3982	2	0.125	-1.150	=	0.1900	0.1900		0.4700
WJEPX925	WJEPX925-01	PCI/L	Ra-226	1.6200	1.6200	10.3000	8.6800	0.5150	4.4702	0.4824	1.9257	1.4433	0.5150	0.7433	1	0.063	-1.534	=	0.1300	0.1300		0.2300
								b =	10.4				b =	1.3769								
				15																		
			% ND	0.0%			W	0.921				W	0.338									
			Range	1.62	10.3		W (crit)	0.881				W (crit)	0.881									
								Accept					Reject									
			Mean		5.6227					1.56												
			Std Dev		2.9					0.63		0.881	0.338		0.921							
			UTL (min)		13.06	1.62	10.30	5.62	2.90	24.25												
			UTL (ave)		10.89					15.12												
			Outlier(raw)		1.61	None																
			Outlier(log)		1.21	None																

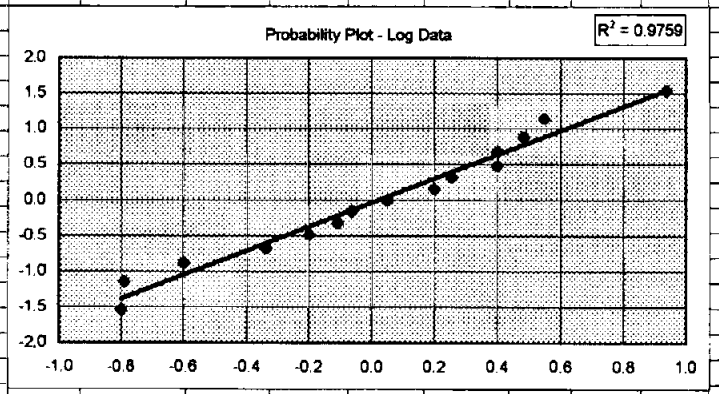




Radium-228 in Groundwater

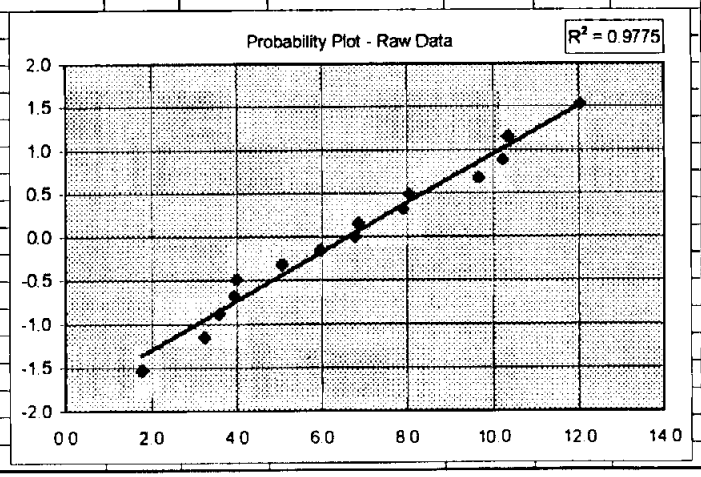
LOCATION	SAMPLE_ID	UNITS	ANALYTE	VALUE	CALC	CALC (Rev)	CALC (Rev) - CALC	$a_{(n-i+1)}$	b_i	LN(CALC)	LN CALC (Rev)	LN CALC (Rev) - LN CALC	$a_{(n-i+1)}$	b_i	R	i/(n+1)	mi	VQ	MDL	PQ	LQ	PUN
WJEPX926	WJEPX926-04	PCI/L	RA-228	2.5500	2.5500	0.4490	-2.1010			0.9361	-0.8007	-1.7368			15	0.938	1.534	=	1.5100	1.5100		0.9980
WJEPX926	WJEPX926-03	PCI/L	RA-228	1.7300	1.7300	0.4540	-1.2760			0.5481	-0.7897	-1.3378			14	0.875	1.150	=	0.9290	0.9290		0.6240
WJEPX925	WJEPX925-01	PCI/L	RA-228	1.6200	1.6200	0.5500	-1.0700			0.4824	-0.5978	-1.0803			13	0.813	0.887	=	0.7760	0.7760		0.5330
WJEPX925	WJEPX925-04	PCI/L	RA-228	1.4900	1.4900	0.7150	-0.7750			0.3988	-0.3355	-0.7342			12	0.750	0.674	=	1.2500	1.2500		0.8020
WJEPX926	WJEPX926-02	PCI/L	RA-228	1.4900	1.4900	0.8210	-0.6690			0.3988	-0.1972	-0.5960			11	0.688	0.489	=	0.9560	0.9560		0.6280
WJEPX925	WJEPX925-05	PCI/L	RA-228	1.2900	1.2900	0.8970	-0.3930			0.2546	-0.1087	-0.3633			10	0.625	0.319	=	0.8560	0.8560		0.5590
WJEPX925	WJEPX925-03	PCI/L	RA-228	1.2200	1.2200	0.9380	-0.2820			0.1989	-0.0640	-0.2629			9	0.563	0.157	=	0.9780	0.9780		0.6270
WJEPX926	WJEPX926-01	PCI/L	RA-228	1.0500	1.0500	1.0500	0.0000	0.0000	0.0000	0.0488	0.0488	0.0000	0.0000	0.0000	8	0.500	0.000	=	0.7940	0.7940		0.5130
WJEPX926	WJEPX926-05	PCI/L	RA-228	0.9380	0.9380	1.2200	0.2820	0.0433	0.0122	-0.0640	0.1989	0.2629	0.0433	0.0114	7	0.438	-0.157	=	0.6550	0.6550		0.4260
RUDYSWELL	RUDYSWELL-03	PCI/L	RA-228	0.8970	0.8970	1.2900	0.3930	0.0880	0.0346	-0.1087	0.2546	0.3633	0.0880	0.0320	6	0.375	-0.319	=	0.8120	0.8120		0.5160
RUDYSWELL	RUDYSWELL-01	PCI/L	RA-228	0.8210	0.8210	1.4900	0.6690	0.1353	0.0905	-0.1972	0.3988	0.5960	0.1353	0.0806	5	0.313	-0.489	=	0.6620	0.6620		0.4260
RUDYSWELL	RUDYSWELL-04	PCI/L	RA-228	0.0000	0.7150	1.4900	0.7750	0.1878	0.1455	-0.3355	0.3988	0.7342	0.1878	0.1379	4	0.250	-0.674	ND	1.4300	1.4300	U	0.8900
RUDYSWELL	RUDYSWELL-02	PCI/L	RA-228	0.0000	0.5500	1.6200	1.0700	0.2495	0.2670	-0.5978	0.4824	1.0803	0.2495	0.2695	3	0.188	-0.887	ND	1.1000	1.1000	U	0.6850
WJEPX925	WJEPX925-02	PCI/L	RA-228	0.0000	0.4540	1.7300	1.2760	0.3306	0.4218	-0.7897	0.5481	1.3378	0.3306	0.4423	2	0.125	-1.150	ND	0.9080	0.9080	U	0.5470
RUDYSWELL	RUDYSWELL-05	PCI/L	RA-228	0.0000	0.4490	2.5500	2.1010	0.5150	1.0820	-0.8007	0.9361	1.7368	0.5150	0.8945	1	0.063	-1.534	ND	0.8980	0.8980	U	0.5640
								b =	2.1				b =	1.8681								
				15																		
			% ND	26.7%			W	0.932				W	0.966									
			Range	0.449	2.55		W (crit)	0.881				W (crit)	0.881									
								Accept					Accept									
			Mean		1.1509					0.02												
			Std Dev		0.57					0.51		0.881	0.966		0.932							
			UTL (min)		2.61	0.45	2.55	1.15	0.57	3.78												
			UTL (ave)		2.19					2.58												
			Outlier(raw)		2.46	Outlier!																
			Outlier(log)		1.79	None																

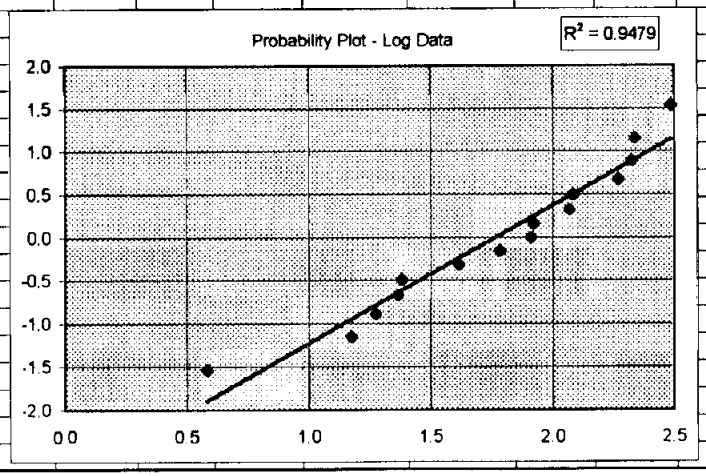




Total Radium in Groundwater

LOCATION	SAMPLE_ID	UNITS	Ra-226	Ra-228	Total	CALC	CALC (Rev)	CALC (Rev) - CALC	$a_{(n-i+1)}$	b_i	LN (CALC)	LN CALC (Rev)	LN CALC (Rev) - LN CALC	$a_{(n-i+1)}$	b_i	R	i/(n+1)	mi
WJEPX926	WJEPX926-03	PCI/L	10.3000	1.7300	12.0300	12.03	1.7900	-10.2400			2.4874	0.5822	-1.9052			15	0.938	1.534
WJEPX926	WJEPX926-02	PCI/L	8.8600	1.4900	10.3500	10.35	3.2400	-7.1100			2.3370	1.1756	-1.1614			14	0.875	1.150
WJEPX926	WJEPX926-04	PCI/L	7.6800	2.5500	10.2300	10.23	3.5800	-6.6500			2.3253	1.2754	-1.0500			13	0.813	0.887
WJEPX926	WJEPX926-05	PCI/L	8.7400	0.9380	9.6780	9.678	3.9300	-5.7480			2.2699	1.3686	-0.9012			12	0.750	0.674
RUDYSWELL	RUDYSWELL-03	PCI/L	7.1500	0.8970	8.0470	8.047	3.9900	-4.0570			2.0853	1.3838	-0.7015			11	0.688	0.489
RUDYSWELL	RUDYSWELL-05	PCI/L	7.9100	0.0000	7.9100	7.91	5.0510	-2.8590			2.0681	1.6196	-0.4485			10	0.625	0.319
RUDYSWELL	RUDYSWELL-04	PCI/L	6.8600	0.0000	6.8600	6.86	5.9700	-0.8900			1.9257	1.7867	-0.1390			9	0.563	0.157
WJEPX926	WJEPX926-01	PCI/L	5.7300	1.0500	6.7800	6.78	6.7800	0.0000	0.0000	0.0000	1.9140	1.9140	0.0000	0.0000	0.0000	8	0.500	0.000
RUDYSWELL	RUDYSWELL-02	PCI/L	5.9700	0.0000	5.9700	5.97	6.8600	0.8900	0.0433	0.0385	1.7867	1.9257	0.1390	0.0433	0.0060	7	0.438	-0.157
RUDYSWELL	RUDYSWELL-01	PCI/L	4.2300	0.8210	5.0510	5.051	7.9100	2.8590	0.0880	0.2516	1.6196	2.0681	0.4485	0.0880	0.0395	6	0.375	-0.319
WJEPX925	WJEPX925-04	PCI/L	2.5000	1.4900	3.9900	3.99	8.0470	4.0570	0.1353	0.5489	1.3838	2.0853	0.7015	0.1353	0.0949	5	0.313	-0.489
WJEPX925	WJEPX925-05	PCI/L	2.6400	1.2900	3.9300	3.93	9.6780	5.7480	0.1878	1.0795	1.3686	2.2699	0.9012	0.1878	0.1692	4	0.250	-0.674
WJEPX925	WJEPX925-03	PCI/L	2.3600	1.2200	3.5800	3.58	10.2300	6.6500	0.2495	1.6592	1.2754	2.3253	1.0500	0.2495	0.2620	3	0.188	-0.887
WJEPX925	WJEPX925-01	PCI/L	1.6200	1.6200	3.2400	3.24	10.3500	7.1100	0.3306	2.3506	1.1756	2.3370	1.1614	0.3306	0.3840	2	0.125	-1.150
WJEPX925	WJEPX925-02	PCI/L	1.7900	0.0000	1.7900	1.79	12.0300	10.2400	0.5150	5.2736	0.5822	2.4874	1.9052	0.5150	0.9812	1	0.063	-1.534
									b =	**11.2**				**b =**	**1.9368**			
				0	15													
				% Non-detect	0.0%			W	0.962				W	0.945				
				Range (Raw)	1.79	12.03		W (crit)	0.881				W (crit)	0.881				
									Accept					Accept				
				Mean		6.6291					1.77							
				Std Dev		3.05					0.53		0.881	0.945		0.962		
				UTL (min 95)		14.46	1.79	12.03	6.63	3.05	23.10							
				UTL (ave 95)		12.18					15.52							
				Outlier Test (raw)		1.77	None											
				Outlier Test (log)		1.34	None											



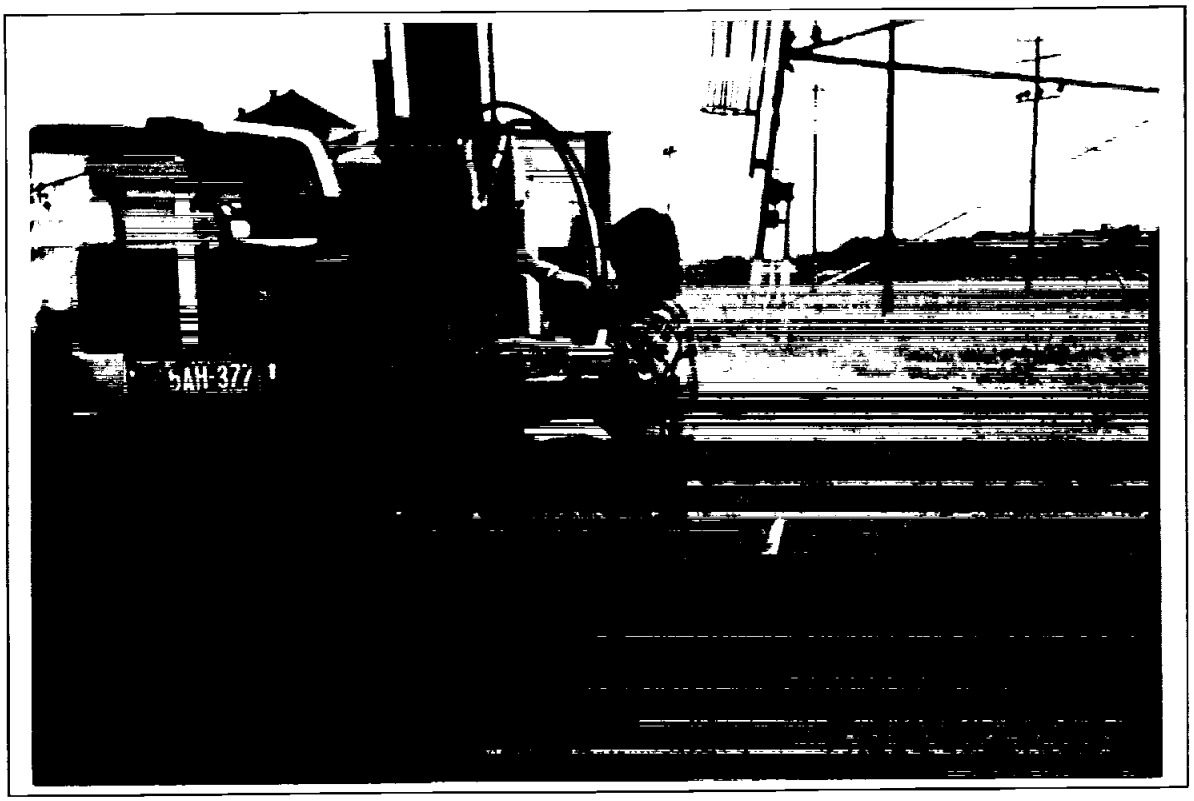


TAB

Appendix F

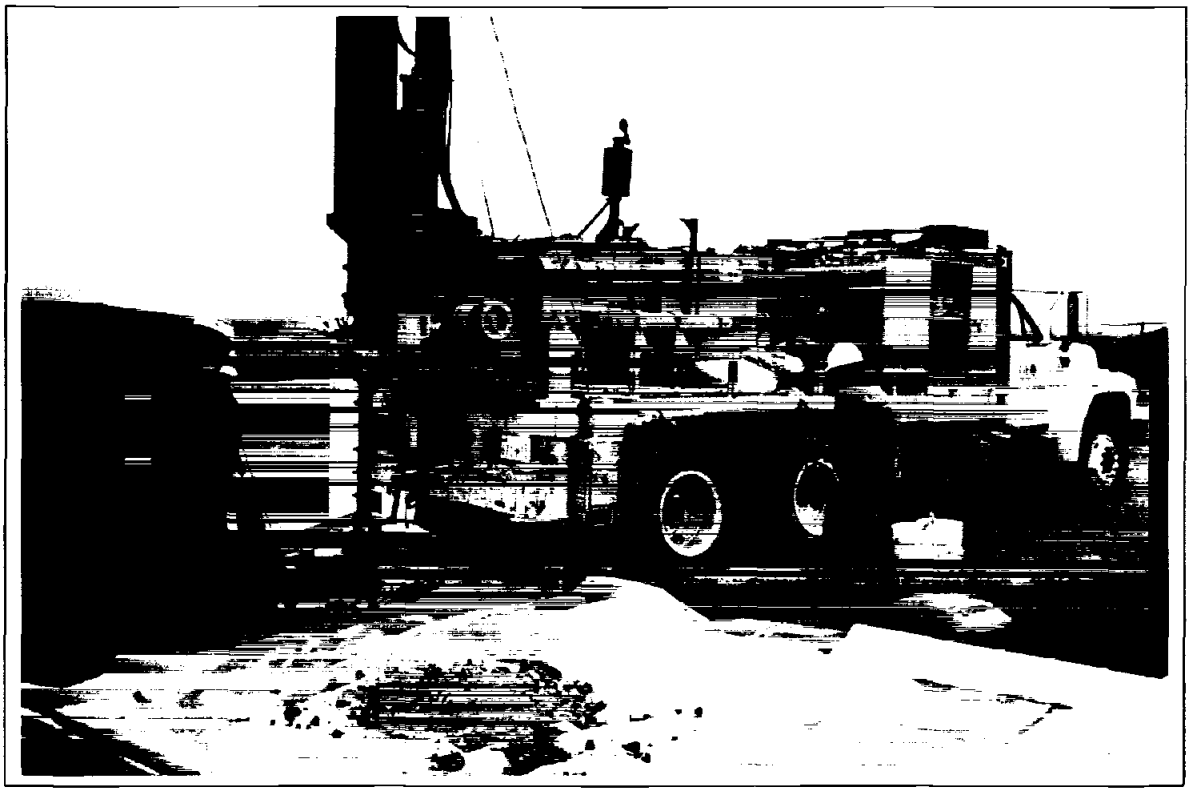
APPENDIX F
Photographs

Appendix F Photographs

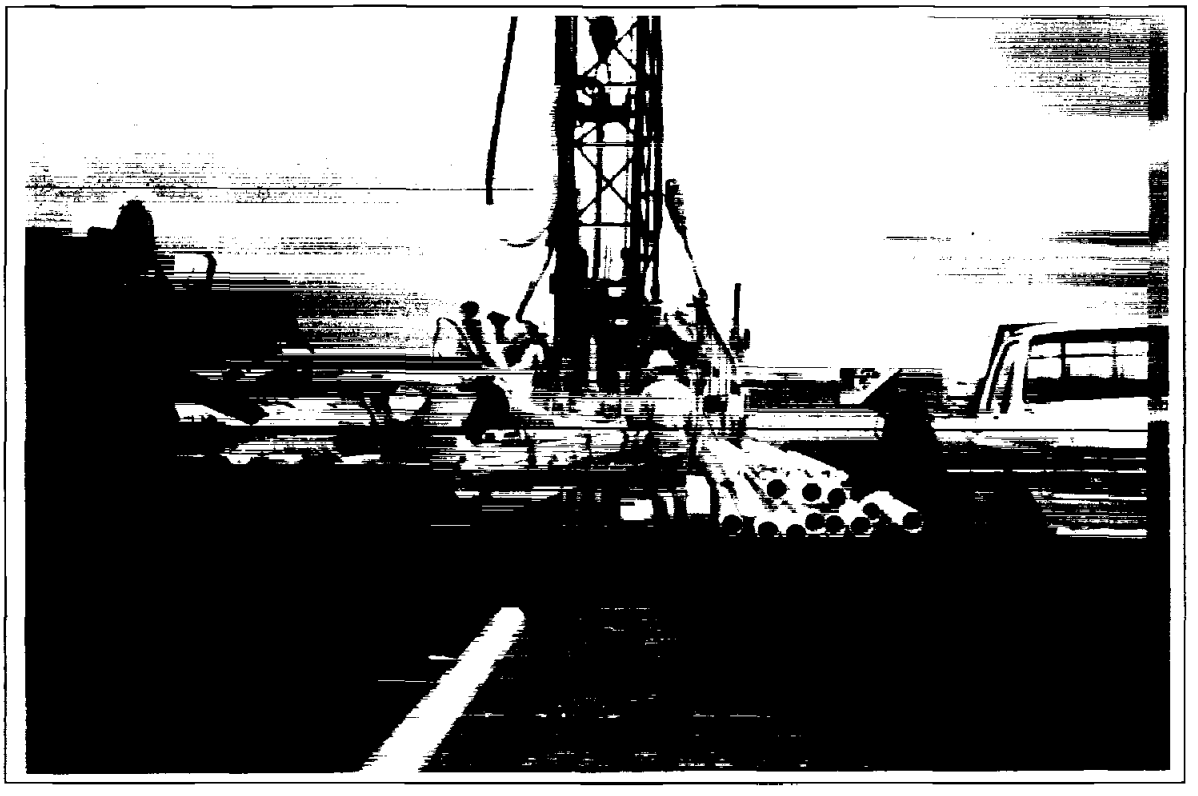


Direct push sampling at BJETA932. Water tower support is in background. (14:58, 11/12/96)

Soil sample from approximately 2 to 6 feet deep at BJETA913 showing transition from very dark gray Horizon A soil to pale yellow Horizon B soil. (11:29, 11/09/96)

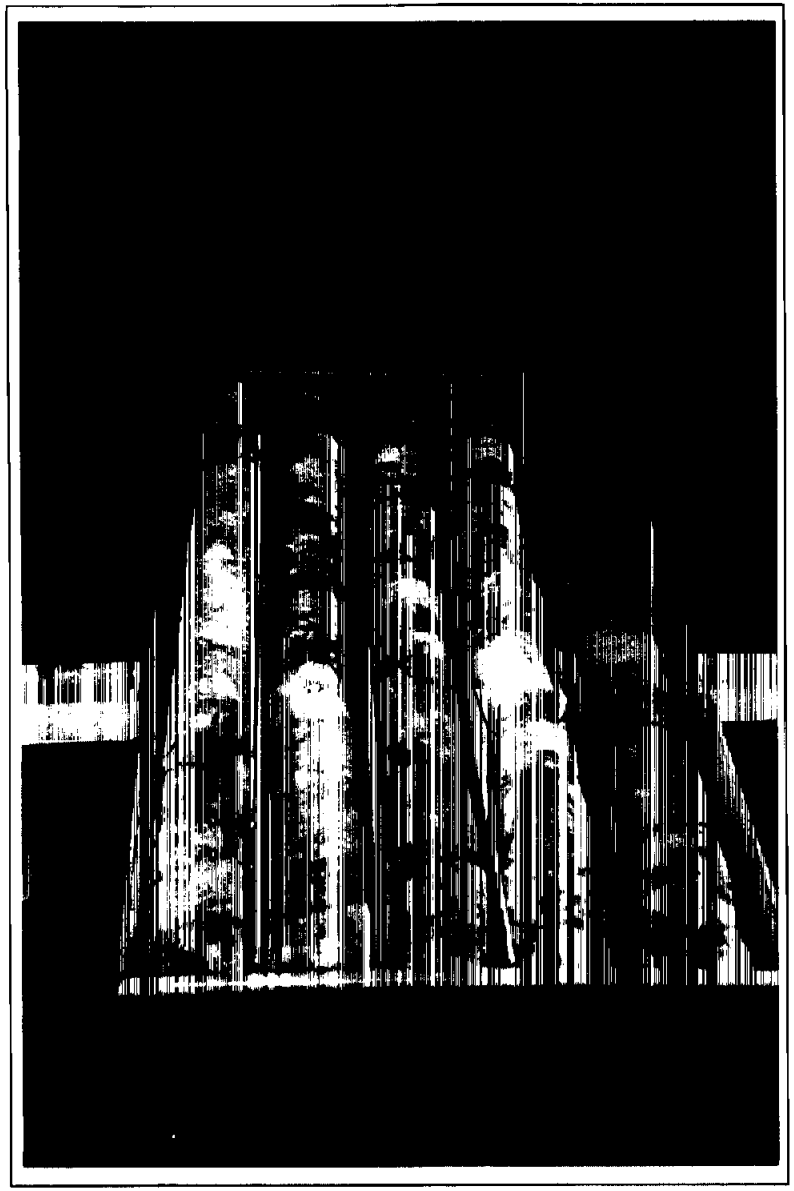


Drilling at BJETA930, southeast of the Radioactive Waste Storage Area. Refusal at 12 feet, no groundwater encountered. (10:14, 11/21/96)



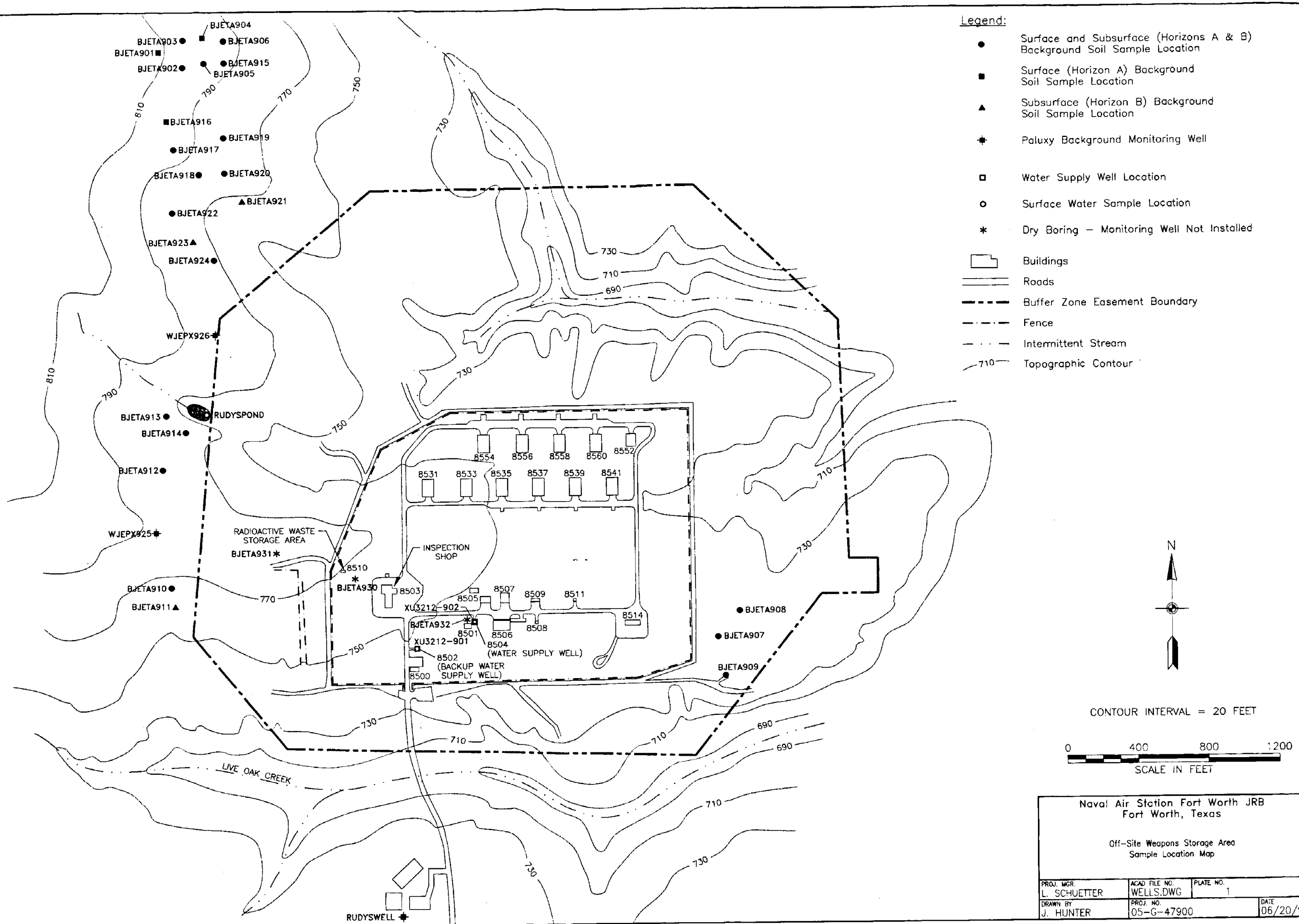
Preparing for well installation at WJEPX926. (15:54, 02/14/97)

Appendix F Photographs



Core from 45 to 55 feet from WJEPX926. (09:09, 02/13/97)

Bladder pump and tubing before installation in WJEPX925. Stainless steel pipe is to counteract buoyancy of pump and tubing. (09:30, 04/02/97)



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