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300 Area Process Trench Sediment Analysis Report

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I. INTRODUCTION

This report describes the results of a sampling program for the sediments underlying the Process Trenches serving the 300 Area on the Hanford reservation. These Process Trenches were the subject of a Closure Plan(1) submitted to the Washington State Department of Ecology and to the U. S. Environmental Protection Agency in lieu of a Part B permit application on November 8, 1985. The closure plan described a proposed sampling plan for the underlying sediments and potential remedial actions to be determined by the sample analyses results. The results and proposed remedial action plan are presented and discussed in this report.

II. SUMMARY

The sediment sampling program for the 300 Area Process Trenches had two primary goals. These were:

> Determine contaminant levels in the sediments between the surface and groundwater caused by past disposal of hazardous materials in the process sewer system.
>
> Provide the basis for remedial action plans.

The sampling program achieved these goals. Shallow sediments in the trench bottoms were sampled every 100 feet at three depths and deeper sediments were sampled by drilling wells every 300 feet between the trenches. Contaminant levels above background were found for various metals including mercury, lead, nickel, chromium and uranium in the shallow sediments. No significant concentrations of hazardous materials were found in the deep sediments from the well samples. This concentration of metals in the shallow sediments is expected based on the chemistry of the process trench environment. The concentrations were not high enough to cause the shallow sediments themselves to be considered hazardous waste. The highest concentration is for uranium.

Remedial action is necessary to either remove the contamination or to stabilize the contamination in place. A reasonable technical argument can be made that the quantities of metals in the sediment cannot provide a significant hazard to the public or the environment. However, the removal or stabilization of the uranium to prevent possible dispersal is probably prudent. Removal or stabilization of the other metals may be necessary to satisfy the spirit of state and federal hazardous waste regulations. In the process of removing uranium, the other metals will probably also be removed to background levels.

Among the options considered, the preferred remedial action is to remove the contamination and continue to use the trenches for the disposal of non hazardous process water. This is the most economical action, except for the no action option, and provides other benefits. The contamination will be removed to a much more distant location from the river and the groundwater, and other trenches or ponds will not have to be excavated. Utilization of a leaching trench or pond instead of direct discharge to the river provides additional protection to the river and human drinking water intakes from acute effects of potential spills. The possibility of remedial action in response to a spill is also preserved.

The remedial action plan proposes the excavation of the contaminated trench sediments. The depth will be judged in the field from radiation measurements which detect uranium. Samples will then be taken and analyzed to verify that other contaminants have also been removed. Further excavation will be performed if necessary. The contamination level goal is based on the range of background concentrations of the contaminants in the localized area around the process trenches.

The schedule for the remedial action is proposed to be integrated with project 685. This project will provide spill protection and greatly reduce the uranium discharged from the fuel fabrication operations in the 300 Area. The remedial action would occur after project 685 was implemented. This means the remedial action should be scheduled after September 1988.

III. HISTORY AND BACKGROUND

The 300 Area Process Trenches serve as the discharge site for the Process Sewer system in the 300 Area on the Hanford Site. The trenches were constructed and put in operation in 1975 and are located north of the 300 Area. Each trench is about 1500 feet long, 15 feet deep and 10 feet wide. A concrete weirbox at the inlet, or south end, directs the water into the trenches. The trenches are shown in Figure III.1.

The trenches are operated alternately. Waste water is discharged from the Process Sewer system into one trench until the water rises to an operationally set level and then the discharge is switched to the other trench. Slowing of the infiltration rate causes the trench level to rise. The switching frequency may be anytime from 2 to 6 months. The trenches are inspected daily. An automatic sampler takes weekly composite samples which are analyzed for various chemical constituents and radioactivity.

Approximately 2.6 million gallons of water are discharged to the trenches each day. This water has been chlorinated by the water filter plant for the 300 Area and contains materials added to the water during use. The water discharged to the Process Sewer is primarily used for cooling purposes and is not modified. Other sources of discharges include steam condensate, janitorial solutions from washing and waxing of floors, water treatment (primarily salt), laboratories, process water from fuel fabrication and other aqueous solutions not designated as dangerous wastes by WAC-173-303. A major discharge to the process trenches is uranium from fuel fabrication operations. Quantities discharged are estimated at several hundred kilograms per year. The Process Sewer system is at risk for spills of various nonhazardous and hazardous chemicals which are not ordinarily discharged to the sewer.

Prior to 1985, small amounts of a wide variety of chemicals were discharged, or potentially discharged, to the sewer system which are presently regulated as dangerous wastes. These included a wide variety of chemicals from chemical and biological laboratories, fuel fabrication, photographic processing and maintenance operations. Two known spills of perchloroethylene totaling 120 gallons are documented. The intermittent

300 AREA PROCESS TRENCHES

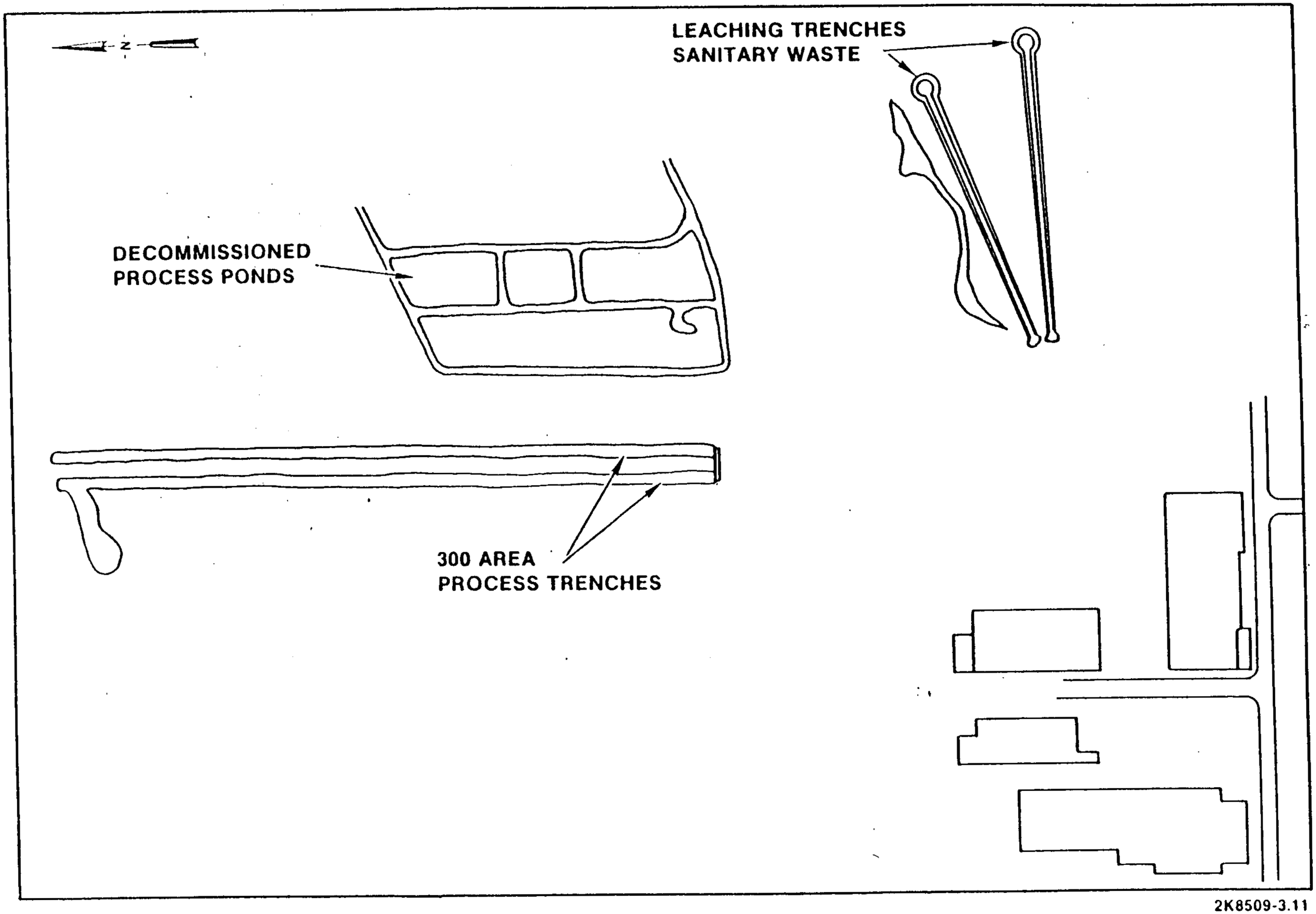

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Figure III.1

sampling prior to 1985 demonstrated that because of the dilution with process water, the influent to the Process Trenches generally was within drinking water standards. The primary chemicals discharged and quantity estimates are shown in Table III.1 and described in more detail in the Closure Plan.(1)

IV. CLOSURE PLAN SUMMARY (PART B)

A closure plan was submitted to the WDOE and the USEPA in lieu of a Part B application in November 8, 1985. This plan described the proposed sampling plan and the closure options. The options described were the clean out of contamination and continued use of the trenches or the stabilization of contamination in place using various cover materials and continuous monitoring. The appropriate sections of this closure plan are included in the Appendix A for reference.

V. SAMPLING STRATEGY

The sampling strategy was set up to complement the RCRA groundwater monitoring program for the 300 Area and to achieve the following goals:

> Determine contaminant levels in the sediments between the surface and groundwater caused by past disposal of hazardous materials in the process sewer system.
>
> Provide the basis for remedial action plans.

The chemical constituents which were analyzed for this project are the same as in the groundwater monitoring program with minor exceptions. These parameters are described in section VI. Only dioxin was not included for the sediment samples and was included for the groundwater samples. This was because US Testing was unable to perform a soil analysis for this constituent. No evidence of dioxin has been found in the groundwater and the quantities discharged would only have been a trace contaminant in the small amount of "chlorinated benzenes" discharged in the past. This is mentioned on Table III.1.

In order to achieve the goals it was necessary to discover the pattern of contamination in the trenches and sediments. In order to determine the contamination between the trench bottom and the groundwater, the sampling strategy included wells every 300 feet centered between the two trenches starting from the inlet end of the trench. The groundwater depth at the process trenches was estimated to be about 35 feet below grade. Therefore, the depth chosen for the wells was 40 feet and samples were planned to be taken every 5 feet in depth. This resulted in 6 wells and 48 samples. Since the wells were only to be used to obtain soil samples, the wells were to be filled in after sampling except the one nearest the inlet which was finished as a groundwater monitoring well. This sample pattern is shown in Figure V.1.

Table III.1

An Estimate of Chemicals Potentially Discharged to the 300 Area Process Trenches Prior to February 1, 1985

Intermittent Discharges

<Grams

Ammonium Bifluoride
Antimony
Arsenic
Barium
Cadmium
Dioxane
Dioxin[†]
Hydrocyanic Acid
Pyridine
Selenium and Compounds
Thiourea
Misc. Laboratory Chemicals

<kgs

Benzene
Carbon Tetrachloride
Chromium
Chlorinated Benzenes
Degreasing Solvents
Formaldehyde
Formic Acid
Hexachlorophene
Kerosene
Lead
Methyl Ethyl Ketone
Mercury
Napthalene
Nickel
Phenol
Silver
Sulfuric Acid
Tetrachloroethylene
  (Perchloroethylene)
Toluene
Tributylphosphate
  (Paraffin Hydrocarbon Solvents)
1,1,1 Trichloroethane
  (Methyl Chloroform)
Trichloroethylene
Xylene

Larger Discharges*

Larger Discharges*	
Copper	~ 30 kg/mo**
Detergents	≤ 30 kg/mo**
Ethylene Glycol	≤ 200 l/mo
Hydrofluoric Acid	~ 100 kg/mo
Nitrates	≤2000 kg/mo**
Nitric Acid	≤ 300 l/mo
Sodium Hydroxide	≤ 300 l/mo
Paint Solvents	≤ 100 l/mo
Photo Chemicals	≤ 700 l/mo**
Sodium Chloride	~ 75 ton/yr**
Uranium	~ 20 kg/mo**
2-Butoxyl Ethanol	~ 1200 l/yr
Perchloroethylene	~ 450 l ***
Heating Oil	~ 300 l ***

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† Included only because of the potential for Dioxin to exist as a trace impurity in Chlorinated Benzenes.
* These discharges were relatively continuous.
** These materials are still discharged.
*** Known spills.

In order to discover the pattern of contamination in the shallow sediments in the trench bottom, the sampling strategy included sample holes hand excavated every 100 feet from the inlet end of the trench. In each hole three samples were taken to represent the loose sediments washed into the trenches with the influent, the near surface trench bottom and 18 inches below the trench bottom. This resulted in about 16 holes and 48 samples per trench. The sample pattern is shown in Figure V.1.

The total number of samples which were planned to be collected was 144. In order to stay within the sample handling capabilites of US Testing and to reduce analytical costs while obtaining the necessary information, the following analytical stratagem was developed. Twenty per cent of the samples would be analyzed for all of the constituents and eighty per cent of the samples would be analyzed for a screening set of constituents. These analysis sets are described in Section VI. There would be a total of 29 full analysis samples and 115 screen analysis samples.

The screen set of analyses is designed primarily to detect the metals and provide an indication of organic chemicals such as chlorinated hydrocarbons through TOX and TOC analyses. Significantly larger TOX and TOC results than average for certain samples would indicate the need for a full analysis for the sample. The samples to undergo full analysis were chosen so as to include samples from all depths. The samples chosen for the full and screen analyses are shown in Figures V.2 and V.3.

A separate 250 ml sample was taken in addition to those required for the US Testing analyses. This sample is stored under refrigeration by Westinghouse Hanford Company and would be used for any further analyses which may be required.

VI. DESCRIPTION OF THE SAMPLING PROJECT

A. Plan Document

A Project Management Plan was prepared to describe the project management methods and controls to be used to manage the 300 area process trench soils characterization. The primary objective of the plan was to set up a project control structure for preparation, approval and administration of procedures to obtain soil samples and laboratory test results. The Project Management Plan (document #B83664-1) is contained in Appendix B.

B. Procedures

The shallow sediments in the trenches were acquired by manual digging at sample locations in the center of the east and west trench bottoms. Sample sites were at 100 foot intervals, throughout the length of the trench. At each location samples were taken at three levels: the loose sediments entering the trench with the influent, 4 inches below grade and 18 inches below grade. This would produce a maximum of 96 samples total from the shallow sediment sampling effort. The deep sediment samples were acquired from six wells drilled between the trenches to a depth of 40 feet to the ground water. Samples were taken at 5 foot intervals. This would produce a maximum of 48 samples from the total deep sediment sampling effort. The deep sampling was performed to evaluate contamination levels in

300 AREA PROCESS TRENCHES

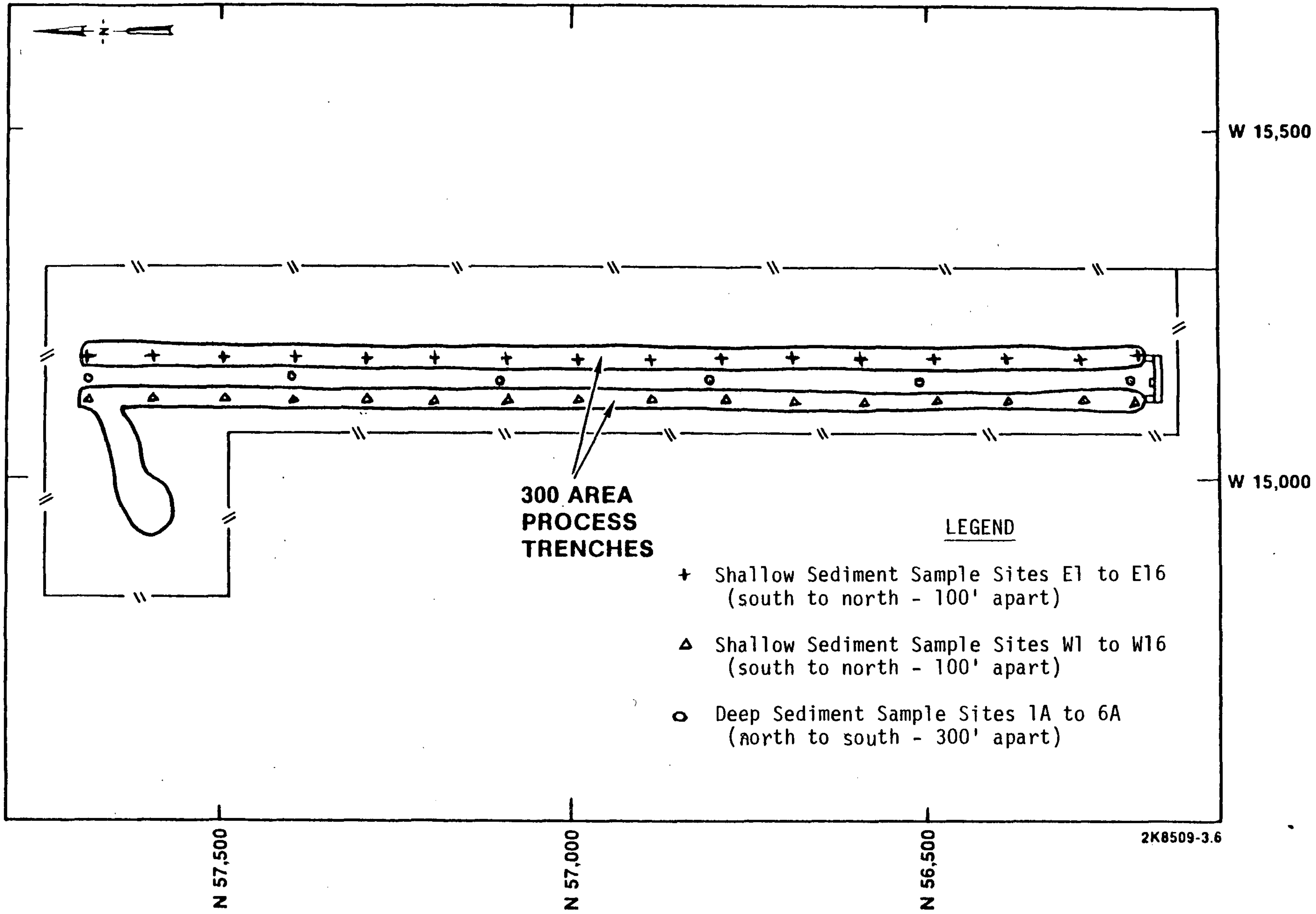


Figure V.1 Sediment Sample Locations

Figure V.2 Identification of Shallow Sediment Samples for Full and Screen Analysis

	Sample Site															
East Trench	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Loose Sediments	X	0	X	-	-	-	0	-	-	-	-	-	0	-	-	0
Shallow Sediments	0	X	0	0	X	0	0	0	0	X	0	0	0	0	0	X
Deep Sediments	0	X	-	-	-	-	X	0	0	0	0	0	0	X	0	-

Legend: X = Full Analysis
0 = Screen Analysis
\- = Not Taken

	Sample Site															
West Trench	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Loose Sediments	X	-	X	-	0	-	-	0	0	0	-	0	-	-	-	-
Shallow Sediments	0	X	0	0	X	0	0	0	0	X	0	0	-	-	-	X
Deep Sediments	0	X	0	0	0	0	X	0	0	0	0	0	-	-	-	-

Legend: X = Full Analysis
0 = Screen Analysis
\- = Not Taken

Figure V.3 Identification of Deep Sediment Samples for Full and Screen Analysis

Depth	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6
5	X	0	0	0	0	0
10	0	X	0	0	0	0
15	0	0	X	0	X	0
20	0	0	0	0	0	X
25	0	0	0	X	0	0
30	0	0	0	0	0	X
35	0	0	0	0	X	0
40	0	0	0	X	0	0

Legend: X = Full Analysis
0 = Screen Analysis

the sediments between the bottom of the trench and above groundwater. The Shallow Soils Sampling Procedure (document #B83664-2) and Deep Soils Sampling Procedure (document #B83664-3) are contained in Appendix C.

C. Quality Assurance/Quality Control

A QA plan was prepared by WHC for this project. The quality assurance program for the Process Trench Characterization was directed by WHC Quality Assurance in accordance with requirements in MG-100 Quality Assurance, the quality assurance program manual for WHC. The quality assurance program at WHC is in compliance with the requirements of ANSI/ASME NQA-1 Quality Assurance Program Requirements for Nuclear Facilities. The QA plan is included as a section of the project management plan in Appendix B.

An independent third party QC inspection was performed during the sample collection activities. This inspection was performed by Kaiser Engineers. It included witnessing of collection activities and verification that collection, sampling, storage and delivery of test samples was performed as required by the project procedures. Inspection reports documented these results. Sample third party inspection forms are provided in Appendix D and inspection findings are discussed later in this report.

D. Personnel

The sampling team consisted of a radiation protection technologist, an engineer and a technician. The sampling was directed by a chemical engineer who had attended a continuing education class entitled "Hazardous Waste: Monitoring and Sampling" as well as working in the hazardous waste field for several years. The course provided instruction in the practices and procedures for collecting multi-media hazardous substance samples for field or laboratory analysis per EPA guidelines. Instruction was also provided on various types of field instruments that are available for air, water and soil monitoring. Topics included the design of environmental sampling programs, sampling devices, sampling collection and sampling procedures, the regulations on shipment of samples and safety procedures for sample collection. The technician training included procedures for sample collection and transport in addition to three levels of hazardous waste training; generator, waste handler and treatment, storage and disposal facility operator. The radiation protection technologist training included the generator level of WHC hazardous waste training.

E. Analyses

US Testing-Richland Division (UST-RD) prepared technical and price proposals for the Process Trench Characterization effort. (See Appendix E for the proposal.) The general scheme of analysis consists of extraction of the analyte of interest in a suitable solvent followed by detection using appropriate analytical instrumentation. The proposal discussed the methods, the detection limits, the minimum sample sizes necessary, sample preservation and holding times, the impact on the routine program and the turn-around times for all of the requested analyses.

UST-RD adhered to the general quality control guidelines described in the various procedures used for analysis. Specifically, UST-RD performed reagent blank analysis with every batch of samples analyzed, 10% of all samples were spiked with the analytes of interest and analyzed to determine matrix effects, and sample extracts exhibiting results exceeding the highest calibration standard were appropriately diluted and re-analyzed. The US testing analysis procedures are in conformance with the EPA procedural and QA requirements as described in SW-846. US Testing, QA and QC procedures are described in references 3 and 4 respectively.

The sample analyses required to characterize the sediments and soils for the 300 area process trenches were split into 2 groups: the full analysis and the screen analysis. The full analysis was performed for 20% of the samples and included the same constituents analyzed for in the 300 area Process Trench groundwater monitoring program(2) for RCRA. The screen analysis was performed for the remaining 80 % of the samples. The analysis constituents are listed in Tables VI.1 and VI.2.

F. Cost and Schedule

Each full analysis cost approximately $3740 and each screen analysis cost approximately $480. The cost estimate for the shallow sediments sampling analyses was $123,020 and for the deep sediments sampling analyses was $87,640. The total cost estimate for the soils analyses including QA analyses was $225,660.

The deep sediment sampling was scheduled to begin in January and finish at the end of February. The shallow sediment sampling was scheduled to begin shortly after the completion of the deep sediment sampling dependent on available manpower, weather, etc. This schedule was much more flexible than the deep sampling because once the well driller was on site, the deep sediment samples had to be submitted in a relatively continuous and consistent manner. US Testing could not accept more than 15 samples per week.

VII. EXECUTION OF THE SAMPLING PROJECT

A. Well Sampling

The first deep sediment soil sample was taken on April 24, 1986. This start date was four months later than projected due to the time US Testing required to develop and implement the analysis procedures for soils. The drilling started on the north end of the center dike and moved southward. The drilling was accomplished with a cable tool drilling rig using hard tool method. The 8 inch casing was driven to the drilled depth and the hole was cleaned of all disturbed materials. A sample of the sediments was obtained from the bottom of the hole by means of a bailer. The samples were taken at five foot intervals. The wells were drilled with the addition of as little water as possible, to minimize leaching and dilution of any substances deposited on the sediments. Clean river water was used for this purpose. The deep sediment sampling was completed on May 23, 1986. The independent third party completed a "deep soil sampling third party inspection checklist" for every sample collected. No exceptions were noted.

Two samples of the river water used for drilling and cleaning of the sampling equipment were collected on May 7, 1986 and on May 16, 1986. These samples were analyzed by US Testing for the same constituents as the groundwater monitoring program samples. The water analysis results did not

Table VI.1

Full Analysis Parameters:	Coliform Bacteria
	Beta, radium and alpha
	ICP metals 6010 enhanced
	Method 8330 enhanced (Thiourea)
	Pesticides 8080 enhanced
	VOA method 8240 enhanced
	A/B/N 8270 enhanced
	Pesticides Method 8140
	Nitrate, Sulphate, ...(Anions)
	Direct aqueous injection
	Herbicide 8150 enhanced
	Arsenic
	Mercury
	Selenium
	Thallium
	Lead by GFAA
	TOX
	TOC
	Cyanide
	Perchlorate
	Sulfide
	Ammonium Ion
	Ethylene Glycol
	Citrus Red #2

Table VI.2

Screen Analysis Parameters:	Beta
	Alpha
	ICP metals 6010 enhanced
	Mercury
	Lead by GFAA
	TOX
	TOC

See Appendix E for the list of specific elements and compounds for the analytical methods listed above.

indicate any contamination. Two process trench water samples were taken during the drilling of two separate wells on May 7, 1986 and May 22, 1986. These samples were taken as the well drilling passed the 15-30 ft levels so we could see if any of the trench water components would be reflected in the soils composition at the same level. Trench water was encountered in the wells by the time the drill depth reached 10 feet. The analytical results for these samples indicate that there is no significant contamination of the soil sediments from the trench water. The analytical results are discussed in Section VIII.

There were 48 samples collected 9 of which were analyzed for full analysis and the remainder analyzed for the screen analysis. It took an average of 3-4 days to complete the sampling for each of the wells with more samples being available on the latter part of the third and fourth day. This indicates faster drilling rate in the layers below 15-20 feet. The samples were of a slurry consistency and most were screened through a USA #6 or #10 screen to develop a particle size consistency among the samples and to eliminate pebbles and chunks of rock.

The southern most well #6 was left installed for future groundwater sampling. The first five wells were drilled to an approximate depth of 40 feet. Then the casing was backpulled and the hole was sealed with bentonite mixture. The sixth well was drilled to an approximate depth of 45 feet. A 6 inch diameter, 20 slot stainless well screen was installed from 45' to 35' and a 6 inch well casing from 35' to 30" above the ground level was installed. The hole around was filled with a cement bentonite grout mixture around the casing. It was then capped and numbered for future use by the Groundwater Monitoring Program.

B. Shallow Sediment Sampling

The shallow sediment sampling effort began on June 16, 1986 and was completed on September 10, 1986. The three week time frame between the completion of the deep sampling and the start of the shallow sampling allowed for the trench bottom to dry out. Thirty-three samples were collected from each of the east and west process trenches. Forty-eight were expected from each trench but in the west trench 7 samples were not collected because the loose sediment layer was nonexistent and 9 in the east trench were not collected for the same reason. An additional 9 samples and 6 samples in the west and east trench respectively were not collected because of the presence of water cover. Efforts were made to try to clear these areas of water so they could be sampled but the water could not be cleared to any significant degree.

The approximately 3 month time frame to collect these shallow samples was due to the need to switch between the trenches and allow the bottom to dry out before attempting to collect more samples. Also, US Testing had a 15 sample per week limit so that their routine program would not be adversely impacted. Too long a wait after changeover resulted in seepage into the drained trench from the one being filled as water levels rose in the trench in use. Hence the samples had to be taken in some instances in the drained trench while some water still remained in pools in it. The geologists report "Exploration of the 300 area process water trenches" contains a description of these changing water levels and is included in the Appendix F.

The sampling sites were located at 100 ft intervals down the center of each trench bottom. Each sample location yielded a maximum of three separate samples. The first sample was taken from the middle of the loose sediments washed into the trench with the influent. The depth of these loose sediments varied depending on the distance from the weir. The second and third samples were taken at four inches below the loose sediments and at approximately 18 inches below the loose sediments. For seven and nine of the samples in the west and east trench respectively the loose sediments were so thin or nonexistent that not enough material could be collected for a sample. These conditions were logged and no samples of these sediments were taken. All of the shallow sediment samples were screened through a USA #6 or #10 mesh size sieve in an effort to achieve a uniform sample particle size and to eliminate pebbles and rocks.

Each sample site was hand dug with a shovel to a depth of at least 18 inches below the loose sediments. Then using a trowel, the sample materials were collected from the wall of the site after the walls were scraped of material that might have caused cross contamination of the sample. The samples were then sieved and placed in the sample bottles. The holes were filled back in after sampling was completed.

The independent third party completed the checklist for each sample. Exceptions from the procedure were noted in several instances for the cleaning of the sampling tools. The procedure called for cleaning the tools in river water and then rinsing them in distilled water. The river water was specified to limit the amount of distilled water required to be carried in from the labs every day of sampling. This quantity turned out to be minimal, readily available and easier to obtain than the river water so the tools were cleansed twice in the distilled water and not at all in the river water. This cleaning process still maintained the integrity of the sample and the intent of the procedure even though an exception from the procedure.

C. Sampling Documentation

1. General

The detailed procedures are in Appendix C.

Sample third party inspection forms and Chain of Custody forms are in Appendix D.

2. Logbooks

Several logbooks were kept for field notes while the sampling was in progress. Waste Systems Engineering kept a logbook for sample data per the sampling procedure recording the sample number, date and time of sampling, sample size, name of sample collectors, and a brief description of the sample.

A second logbook was compiled by the geologist. This contained information for the daily drilling log as well as field notes and observations on the shallow sediment samples. This notebook included drilling progress and characteristics, descriptions of samples and surrounding geology and process trench conditions.

3. Quality Assurance(QA)/Quality Control Records(QC)

The independent third party completed a checklist for the deep and shallow sediments sampling entitled "third party inspection checklist". The checklist denoted compliance with the sampling procedure for each set of samples. Samples are in Appendix D.

Analytical QA and QC records are maintained by US Testing and are described in references 3 and 4.

4. Chain of Custody

Chain of Custody documentation was prepared and accompanied all samples. Samples are in Appendix D.

D. Geological Report

The geologist issued a report entitled "Exploration of the 300 Area Process Water Trenches" in September 1986. It described the surrounding sediment formations and geology as well as the drilling and sampling programs and corresponding geologic analysis of the samples obtained, in conjunction with the behavior of the process trench water levels. (See Appendix F for the report.)

In summary, the geologists report states the following information. The trenches overlie an old Columbia River channel that is filled with the Pasco Gravels. The Ringold Formation sediments were not encountered because they lie at a depth of about 50 feet which is greater than the depth of the sampling wells. The Pasco Gravels continue down to this Ringold Formation level through the water table which is at around 30 feet. The nature of the Pasco Gravels is that they are the deposits of several catastrophic floods, rather than normal stream, shallow-lake and floodplain deposits as are the Ringold Formations. The Pasco Gravels consist of two identified graded sequences. The gravels range from basal cobble and boulder gravels, upward through finer gravels. Capping those gravels are clean and well-sorted deltaic, forest bedded gravels. Silts and fine sands are generally absent.

The general description of the sediment samples below is also derived from the geologists report.

1. Well Samples

Test Holes 1-5 physical findings can be summarized as follows:

0-15 ft: gravel 40%-60%, sand 40%-50% and silt 1-10%, poorly sorted gravel mostly <6"diameter but up to 18"diameter, caliche <1%

15-22 ft: gravel 30%-55%, sand 40%-60% and silt 1-5%, gravel is cobbles, no caliche

22-27 ft: gravel is pebbles <5mm diameter, little sand, trace silt

27-32 ft: gravel 65%, sand 35%, gravel is pebble to cobble, trace silt
32-40 ft: sand 65% - >90%, and gravel, silt 5%

Test Hole 6 was slightly different in physical nature from test holes 1-5 and can be summarized as follows:

0-14 ft: gravel 90% (pebble to cobble gravel), sand 10%, some caliche and silt

14-20 ft: gravel, sand and traces of silt

20-30 ft: gravel (granule to pebble size)

30-33 ft: sand 45%, gravel, pebbles and silt

33-37 ft: gravel (granule to pebble sized), sand, petrified wood

37-45 ft: gravel (pebble sized), sand, no silt

2. Shallow Sediment Samples

On the average the loose sediment sample could be described as sand or sandy/gravely for the south end of the trenches and humus towards the north end of the trenches.

Mostly the second layer sample, 4" below the loose sediments, could be described as eolian sand, clean granule to pebble and cobble gravel and some organic matter at the north end of the trench. One sample site contained a chunk of silt.

The deep sample, which was taken 18" below the bottom of the loose sediments layer, was sandy pebble to cobble gravel with no humus in most cases. One sample site had a clay chunk. Also, some boulder gravel was encountered in several sites.

In each case only the finer grained sediments were included in the sample. All samples were sieved through a USA #6 or #10 screen. Any contaminants present should be associated with the finer sediments and not the pebbles or cobbles.

VIII. DESCRIPTION OF ANALYTICAL RESULTS

All the results of the chemical analyses which were above detection level are listed in tabular form in Appendix E. These listings contain the deep well sample results, the shallow sediment sample results and the process trench and process water results. The numbering system used for the samples is explained in Appendix C. The only constituents which are significantly above background levels in the sediment are certain metals.

The analytical results for the constituents significant for the shallow and deep sediment samples are presented in Table VIII.1 and Figures VIII.1 and VIII.2. The table presents the peak values of these constituents anywhere in the shallow sediment samples and the peak values in the well samples. The uranium results were not measured directly but are inferred from the alpha counts. The alpha count is only a rough indicator to detect uranium contamination and there is a large uncertainty in the uranium concentrations; up to a factor of 2 or 3.

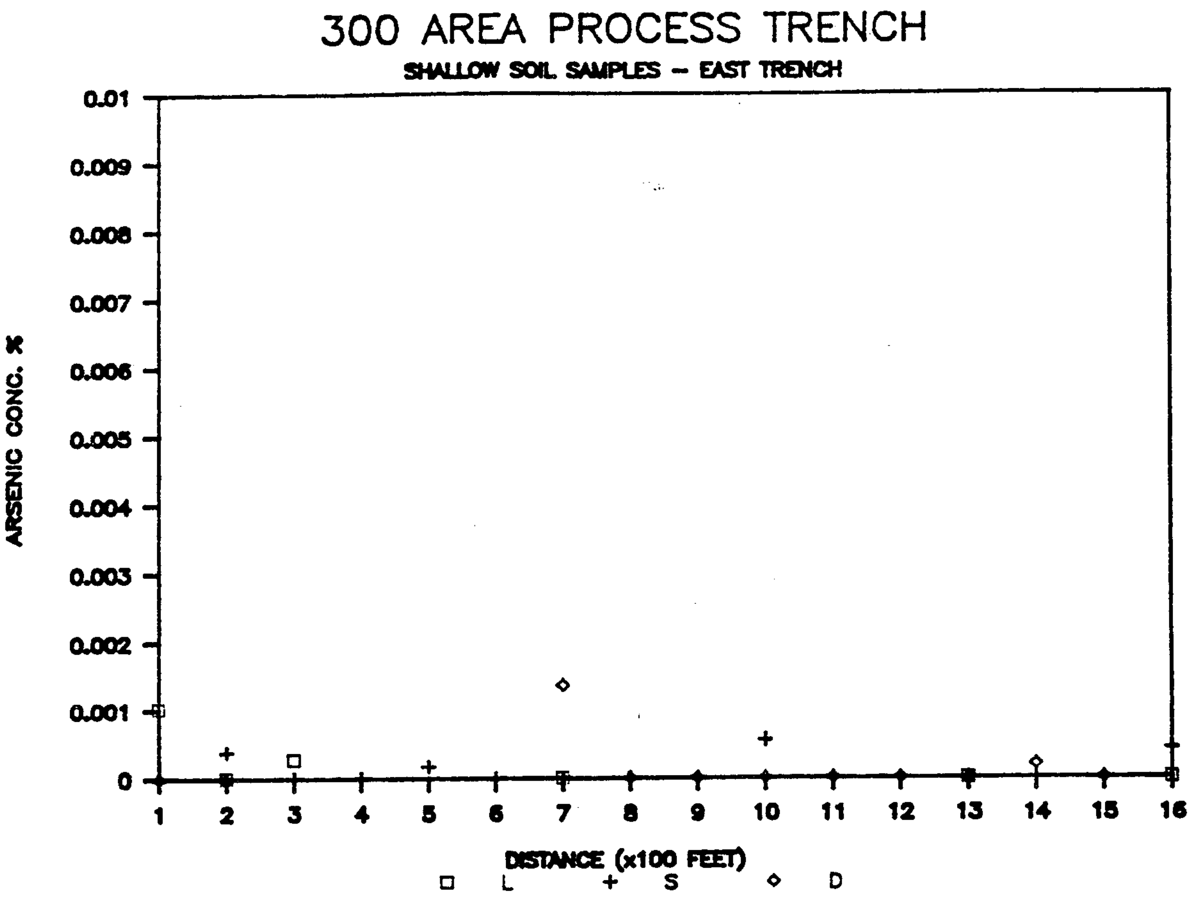
Table VIII.1

Concentration of Constituents
in Sediments
(ppm)

	Shallow Samples						Well Samples	
	Loose		Shallow (4")		Deep (18")			
Constituents	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak
Arsenic (As)	1.5	10	0.9	6	1	14	0.6	7
Cadmium (Cd)	2.4	20	1.8	5.4	1.3	2.9	0.49	0.9
Chromium (Cr)	274	551	59	319	30	131	6	10
Copper (Cu)	3550	7320	1109	8470	522	2230	18	42
Lead (Pb)	205	486	33	230	21	86	3	7
Mercury (Hg)	15	58	6	69	2	21	0	0.1
Nickel (Ni)	529	1550	306	4700	95	1030	5	11
Silver (Ag)	137	405	35	245	12	110	<1	<1
Uranium (U)	7400	20400	1200	6900	3400	27700	7.3	15.5

Figure VIII.1

Shallow Soil Sample Contaminant Concentrations in the 300 Area Process Trenches



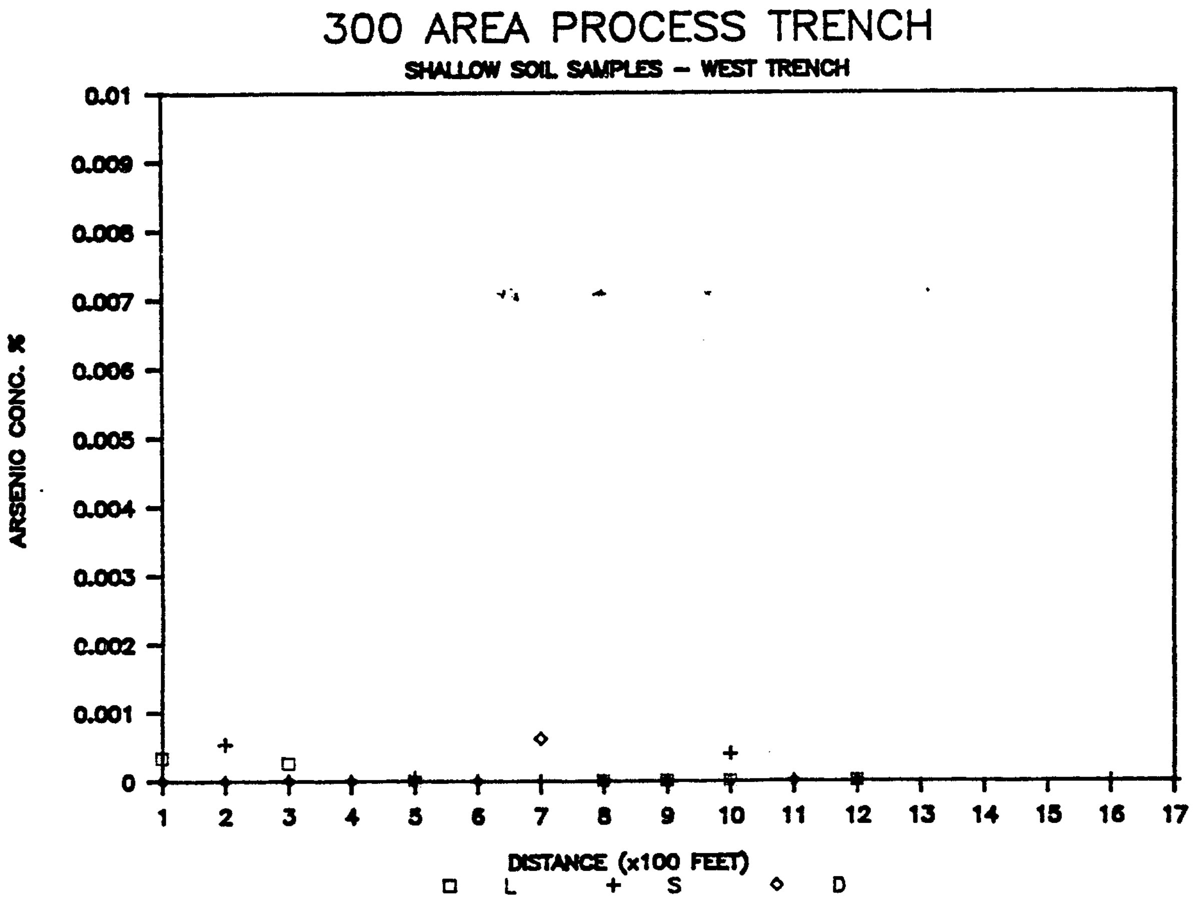
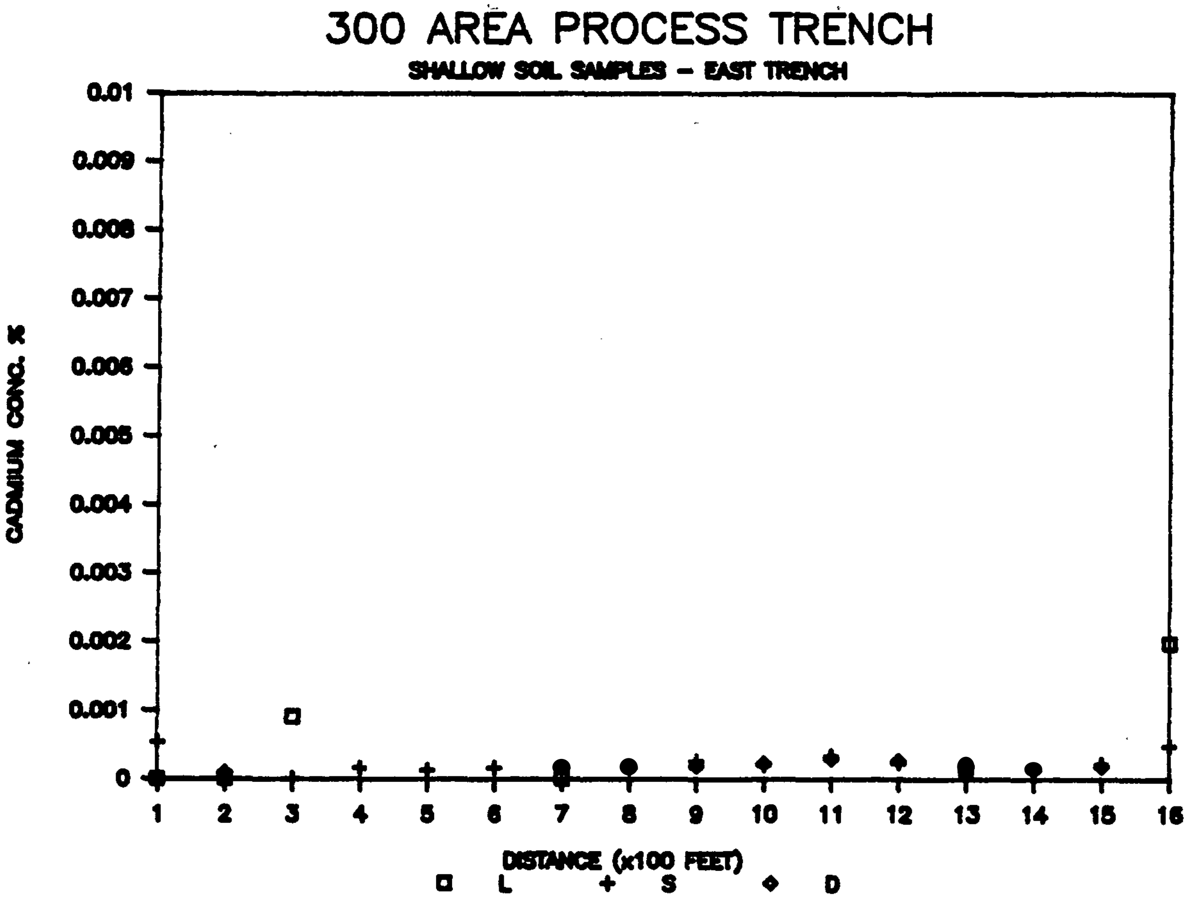


Figure VIII.1 (cont.)



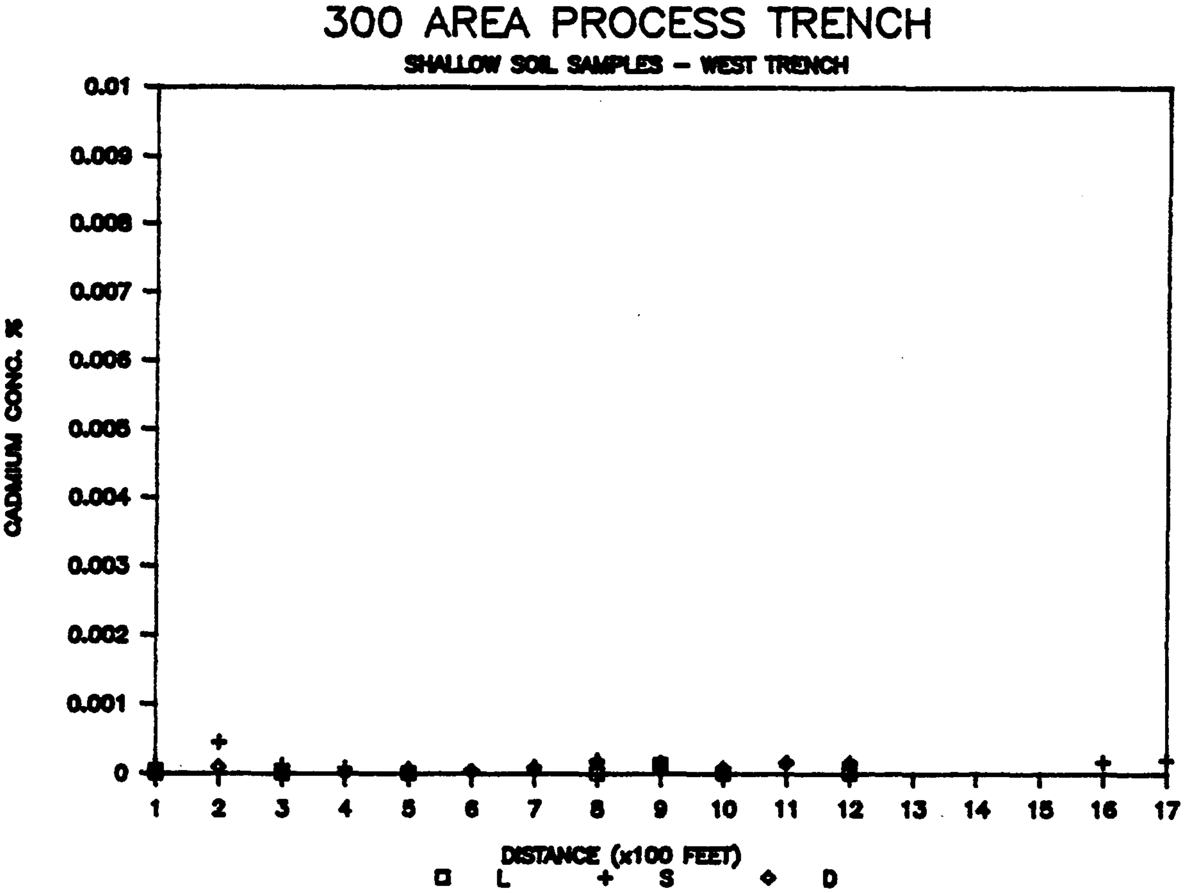
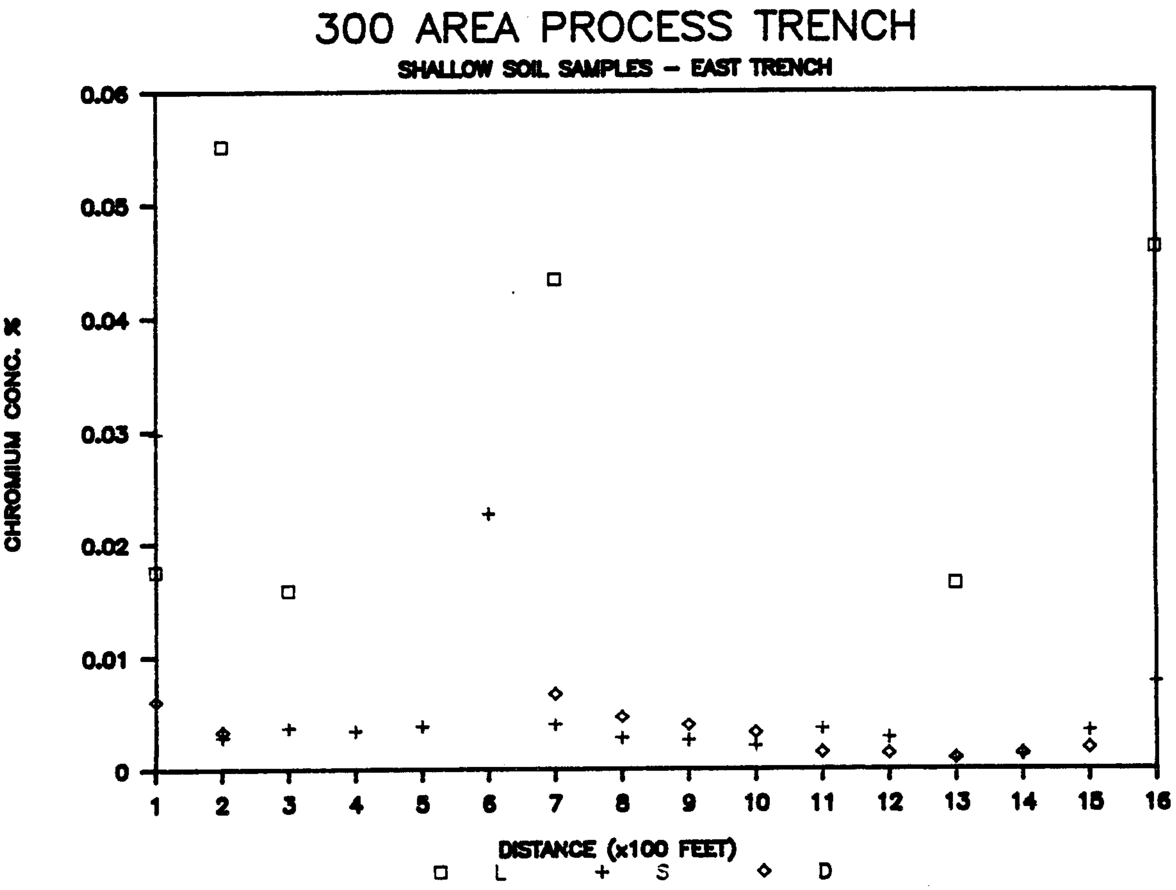


Figure VIII.1 (cont.)



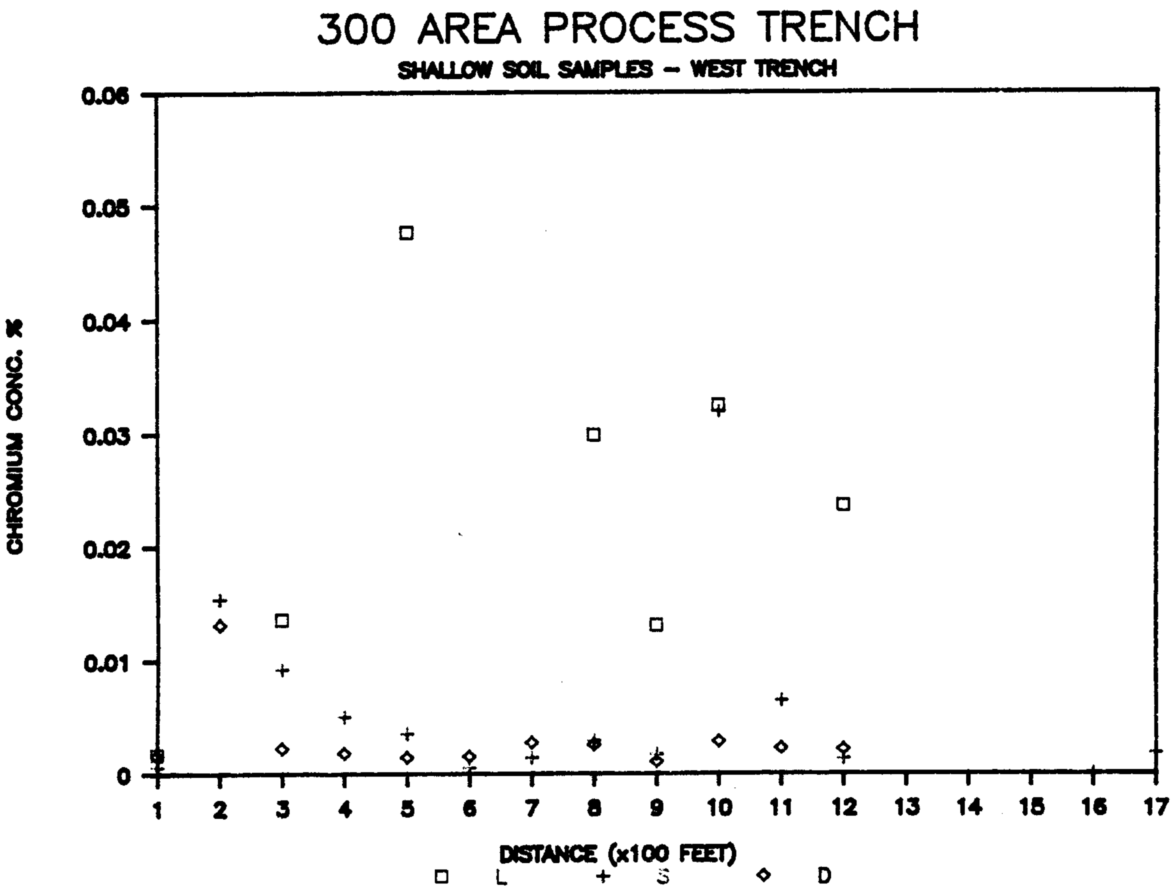
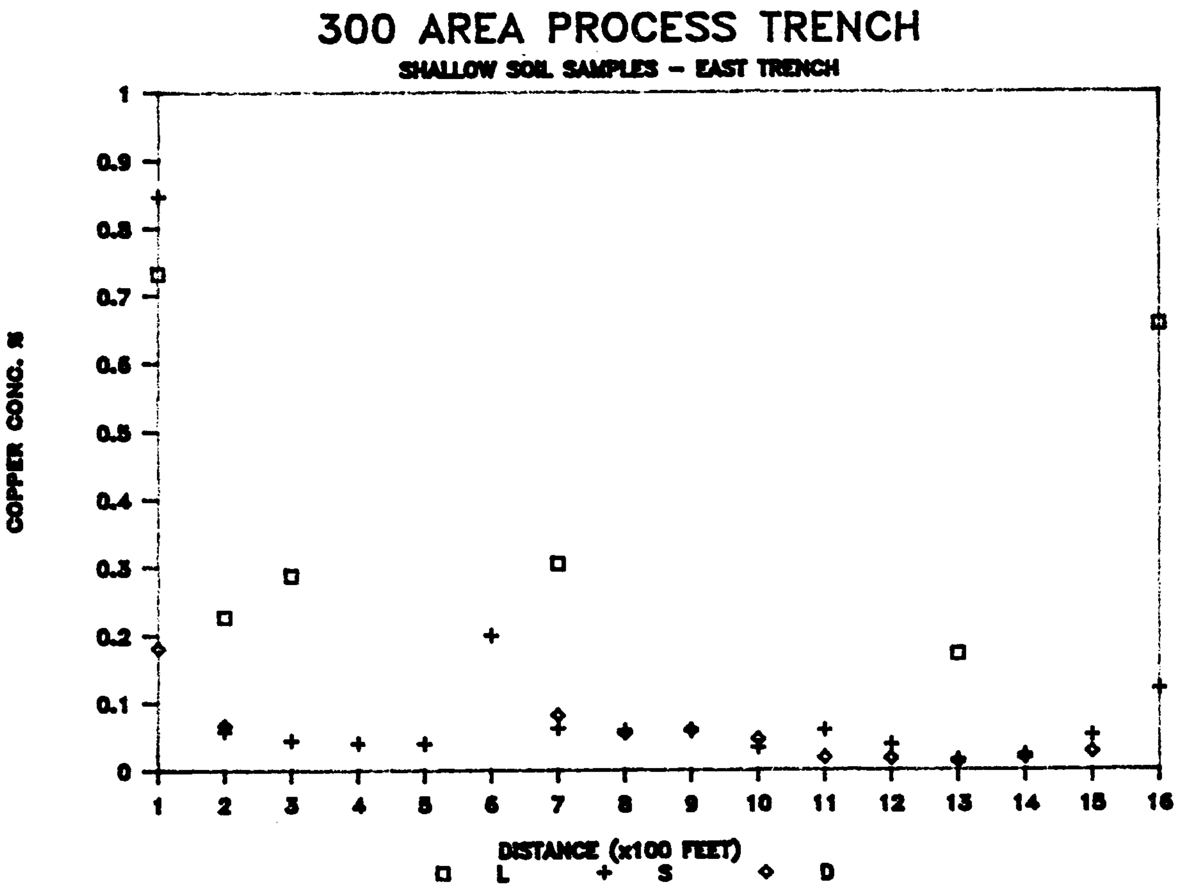
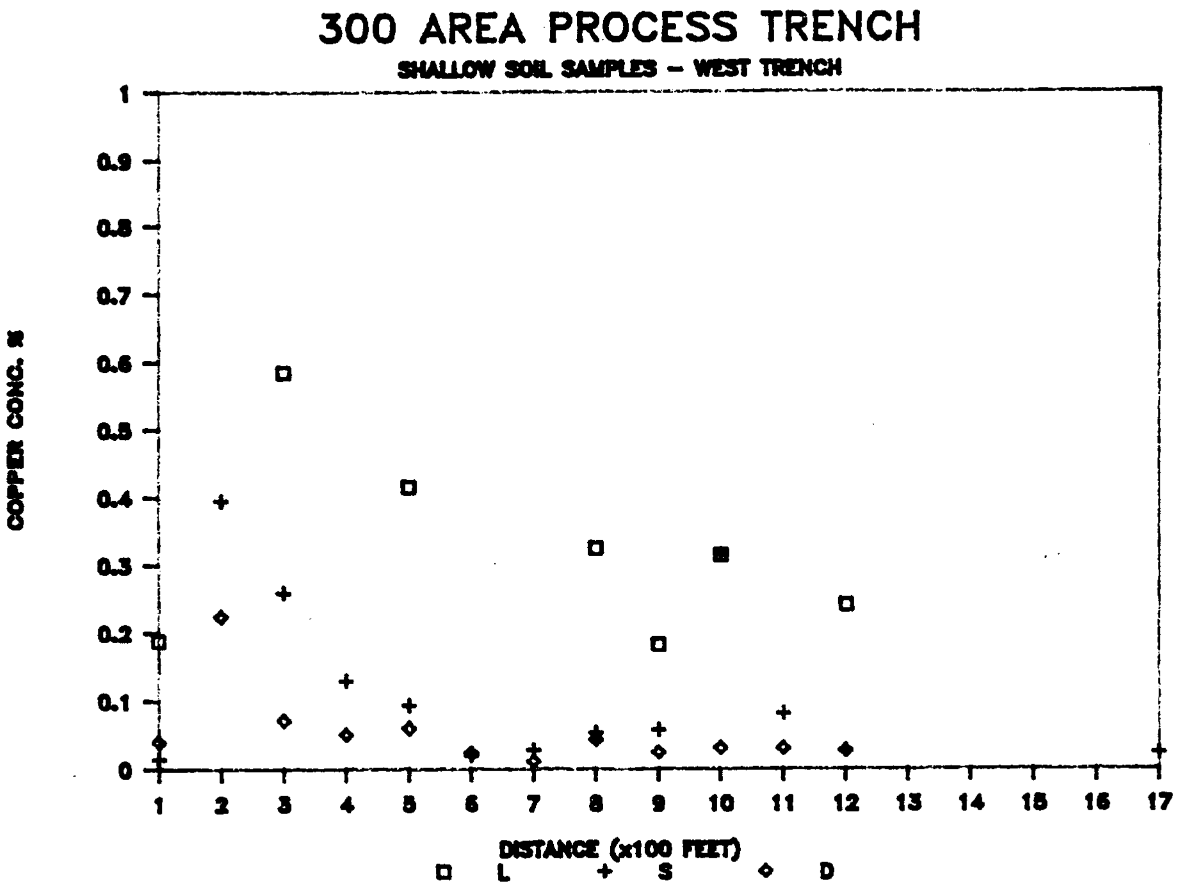


Figure VIII.1 (cont.)

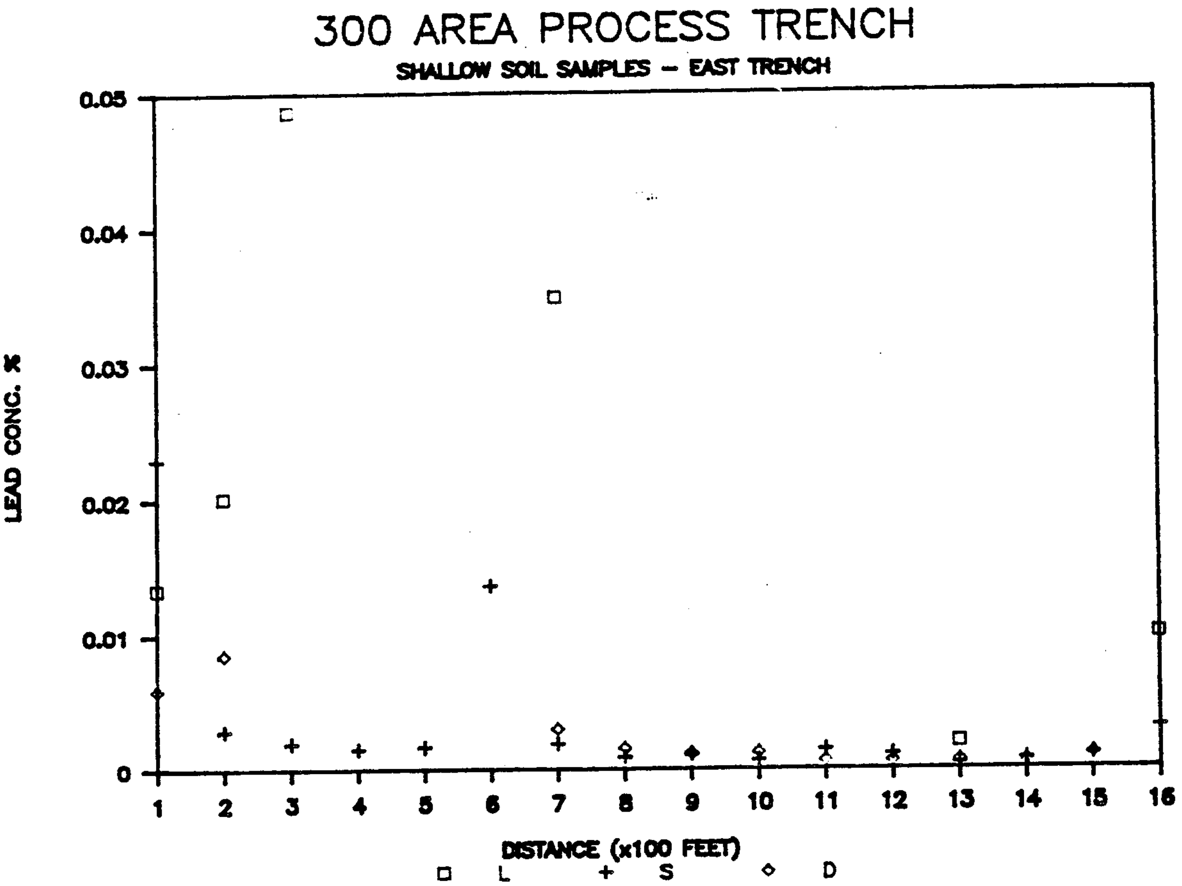

300 AREA PROCESS TRENCH

SHALLOW SOIL SAMPLES – EAST TRENCH


300 AREA PROCESS TRENCH

SHALLOW SOIL SAMPLES – WEST TRENCH

Figure VIII.1 (cont.)



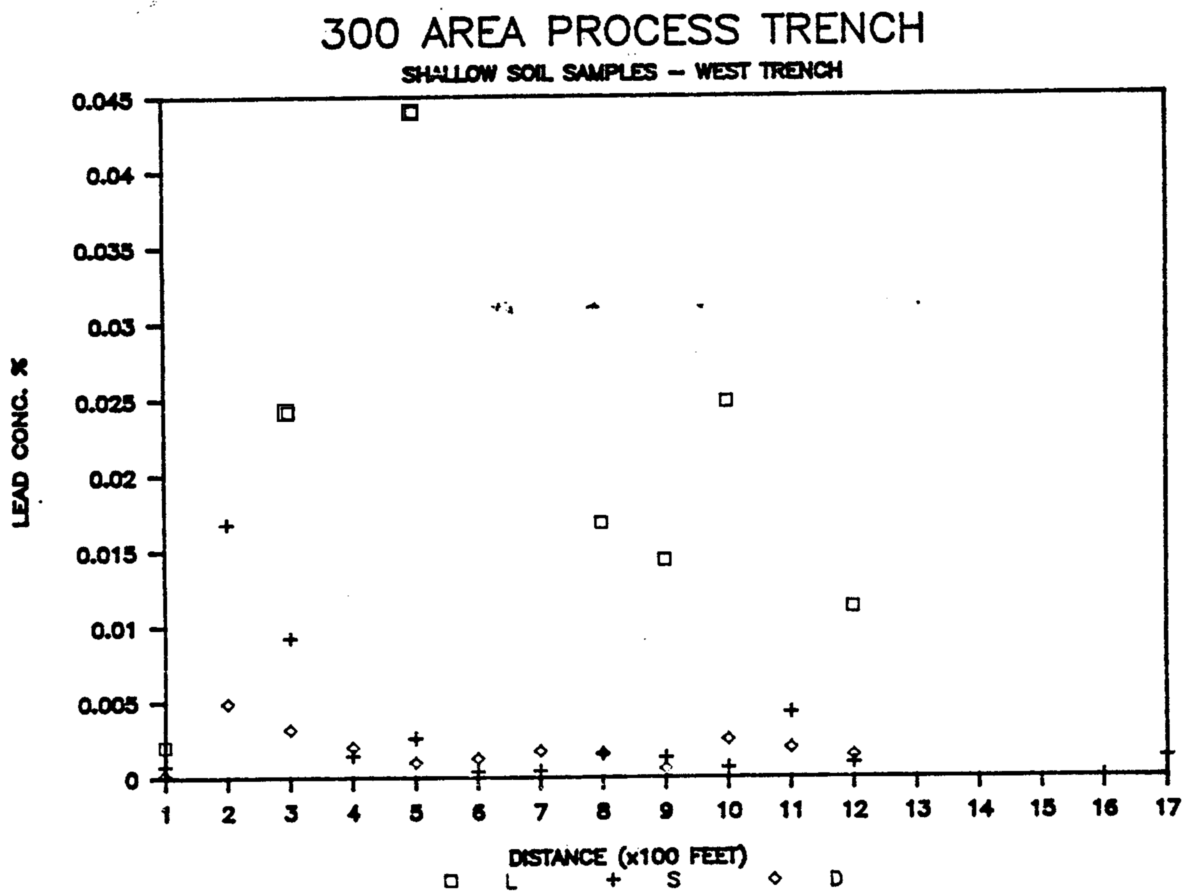
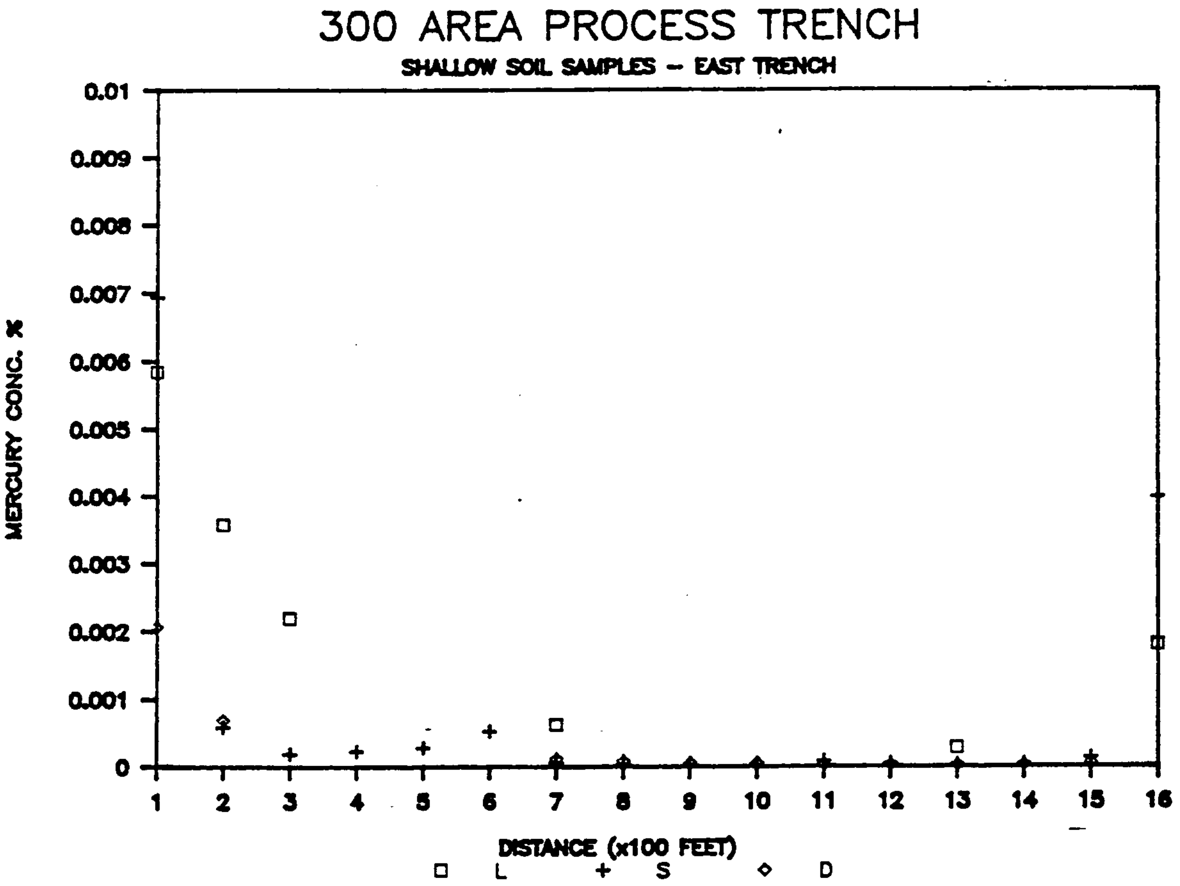


Figure VIII.1 (cont.)



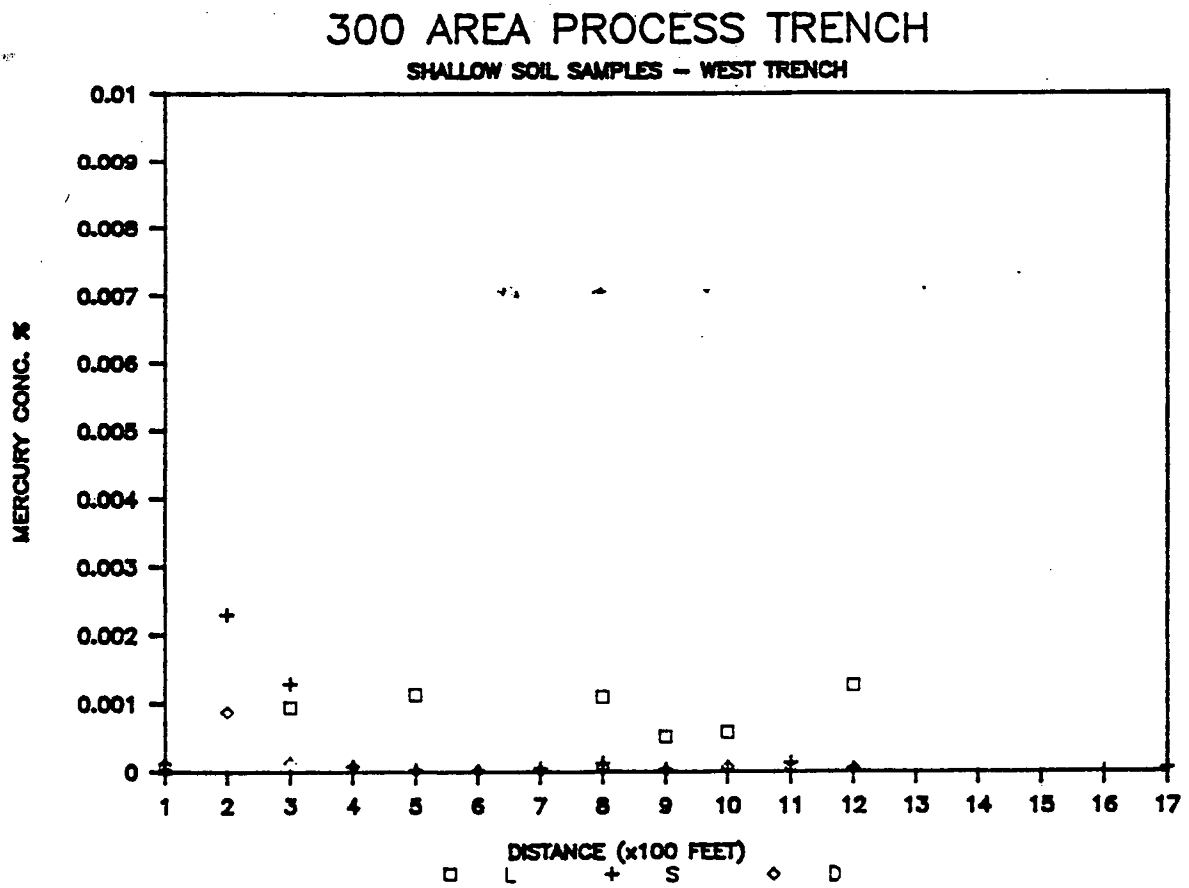
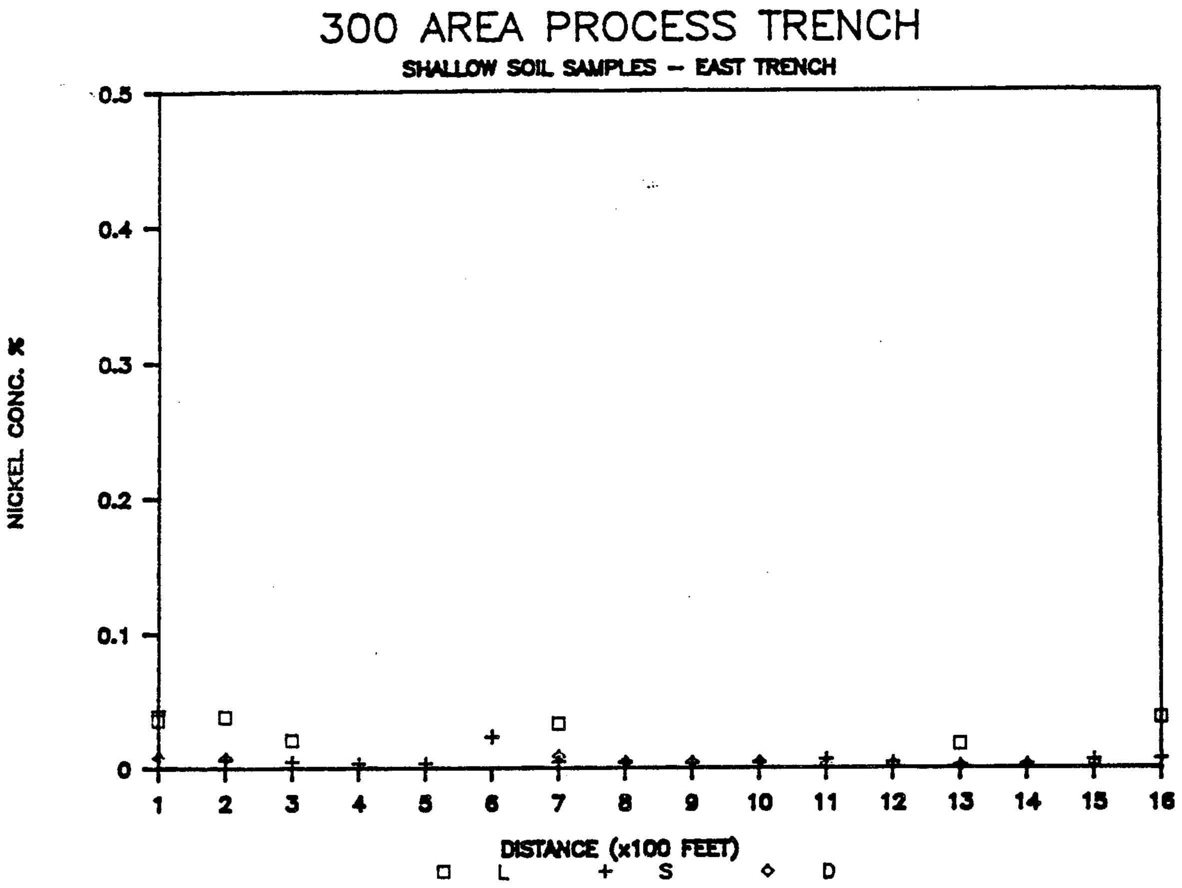


Figure VIII.1 (cont.)



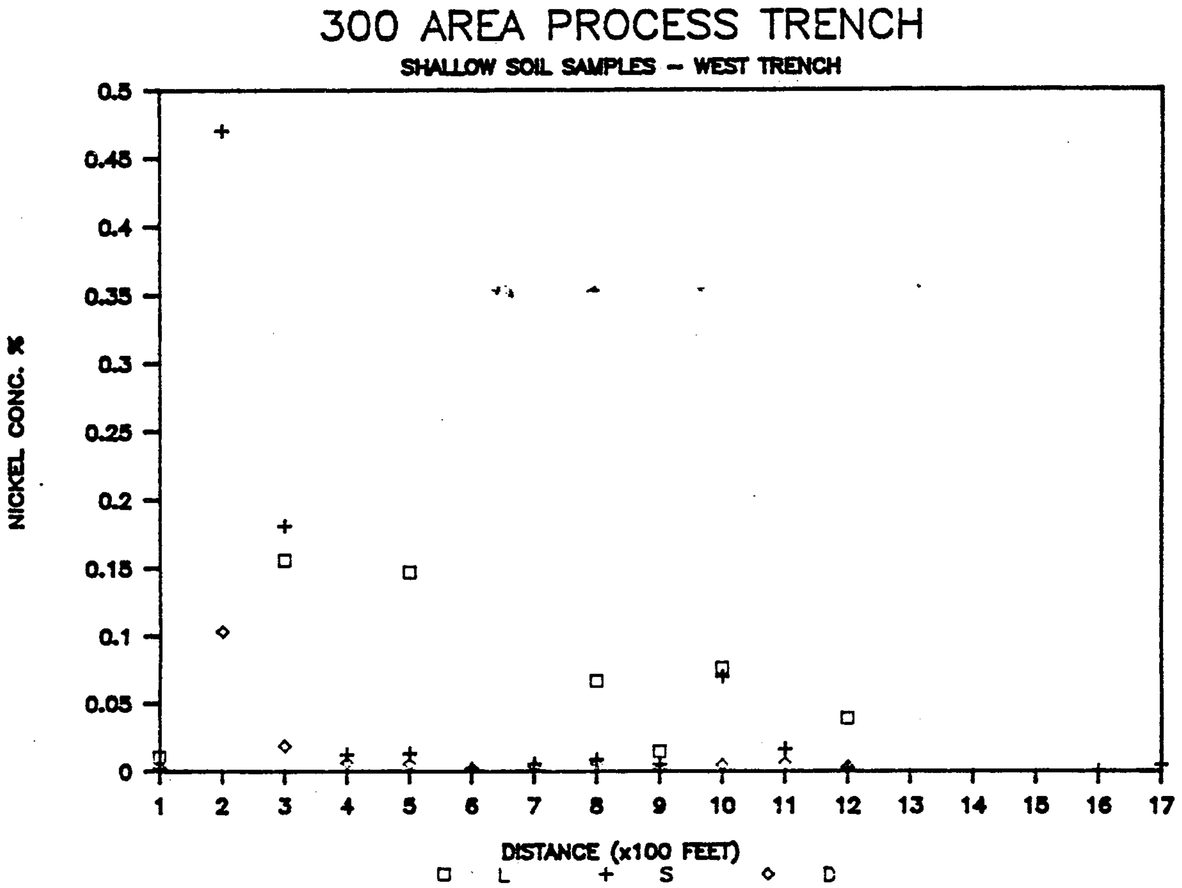
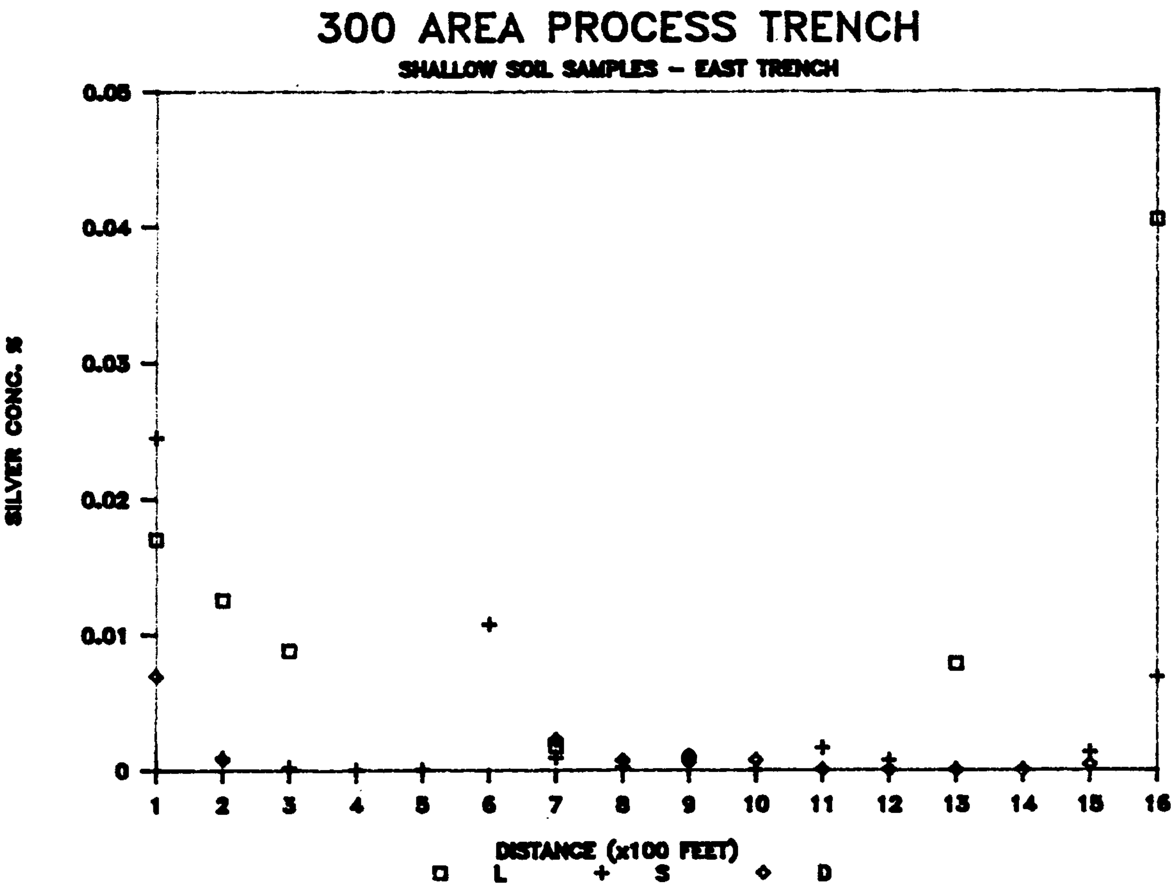
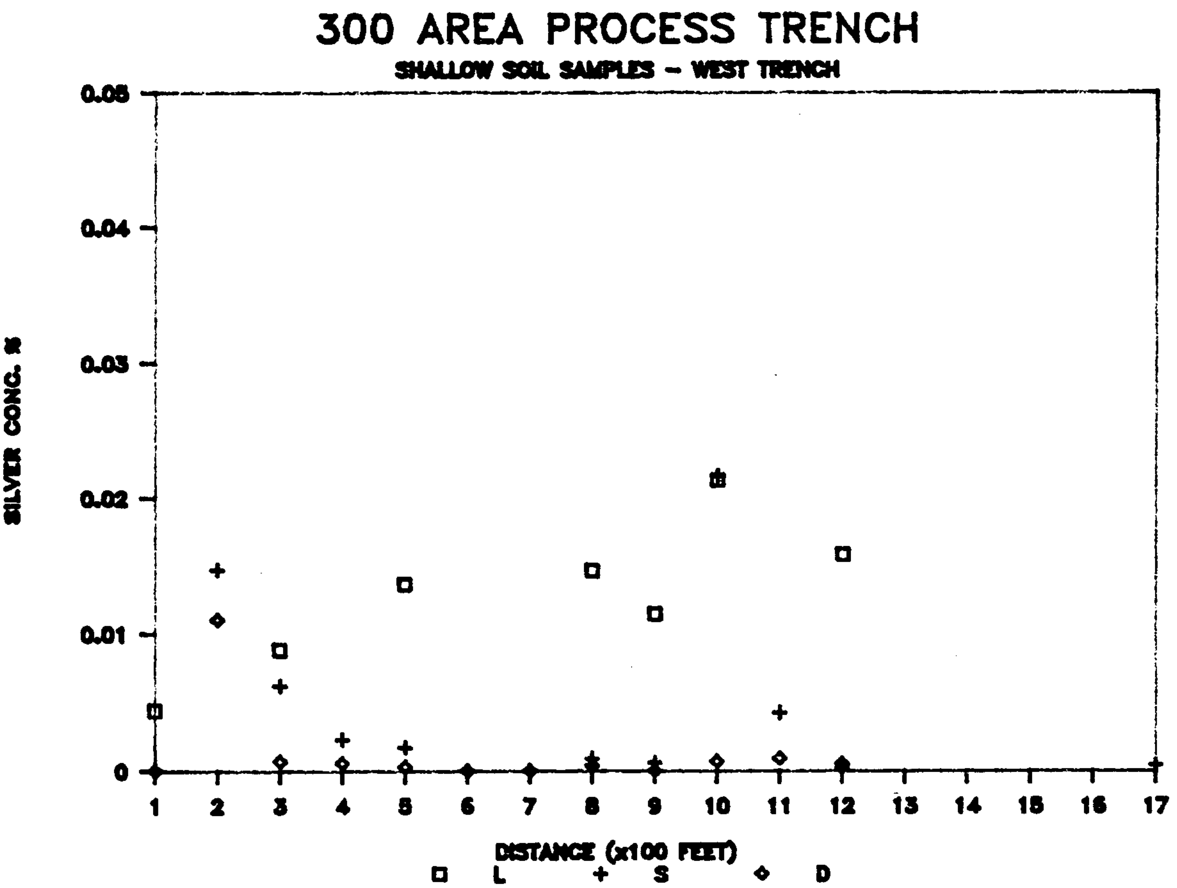


Figure VIII.1 (cont.)

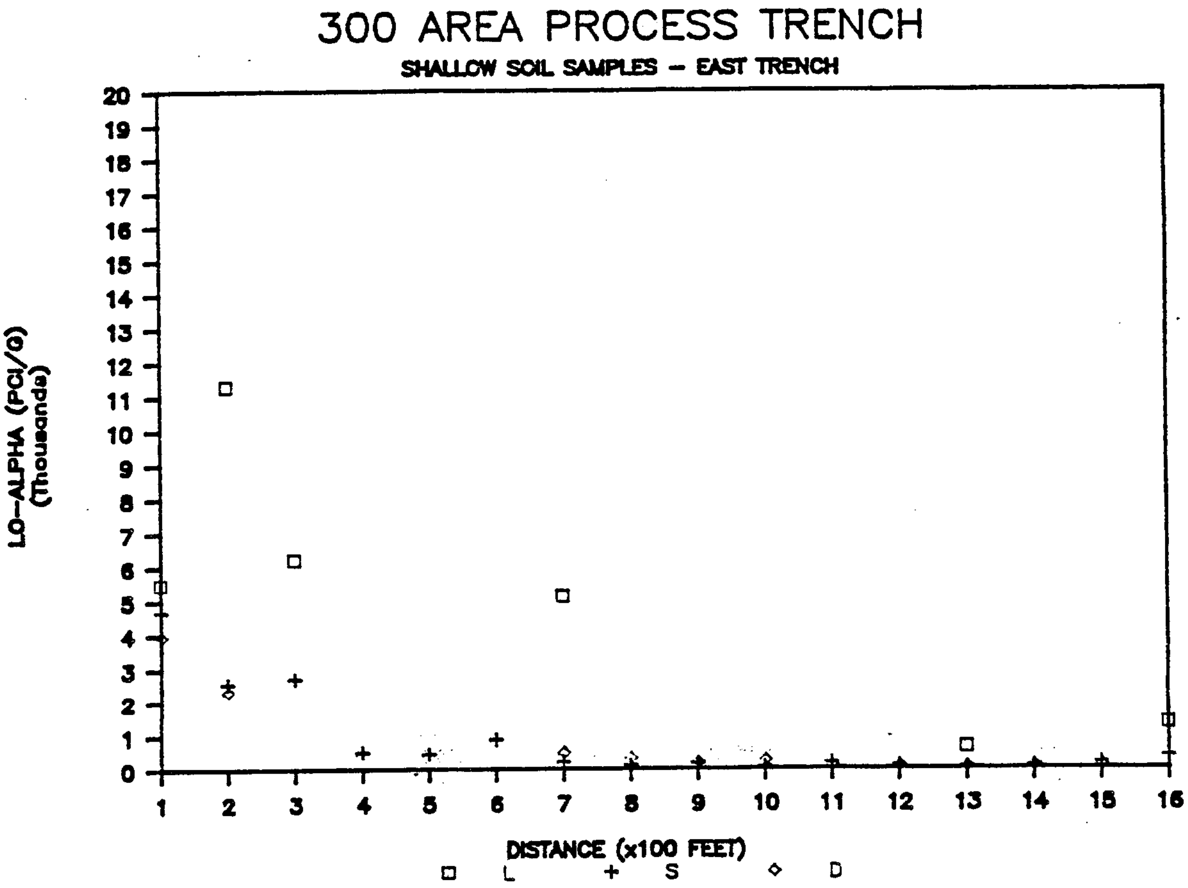

300 AREA PROCESS TRENCH

SHALLOW SOIL SAMPLES – EAST TRENCH


300 AREA PROCESS TRENCH

SHALLOW SOIL SAMPLES – WEST TRENCH

Figure VIII.1 (cont.)



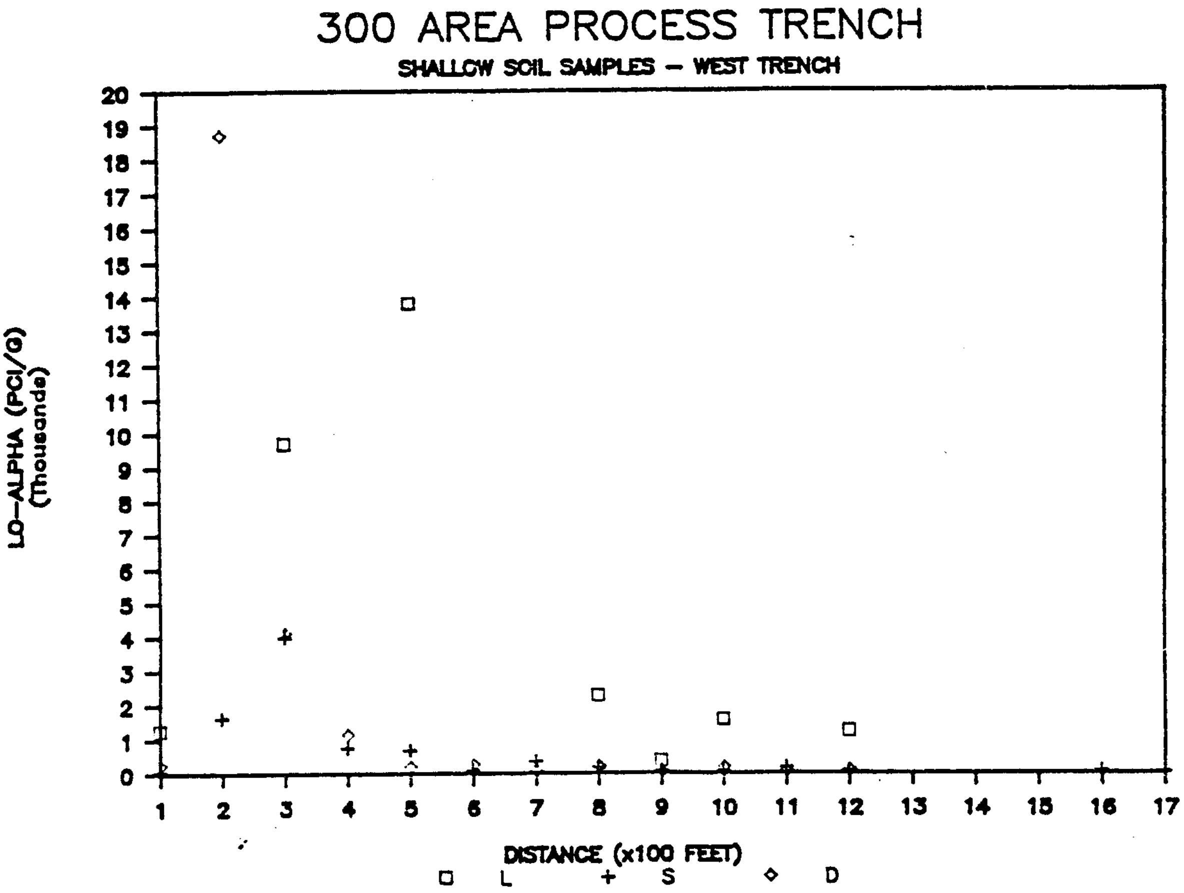


Figure VIII.2

Deep Soil Sample Contaminant Concentrations Under the 300 Area Process Trenches

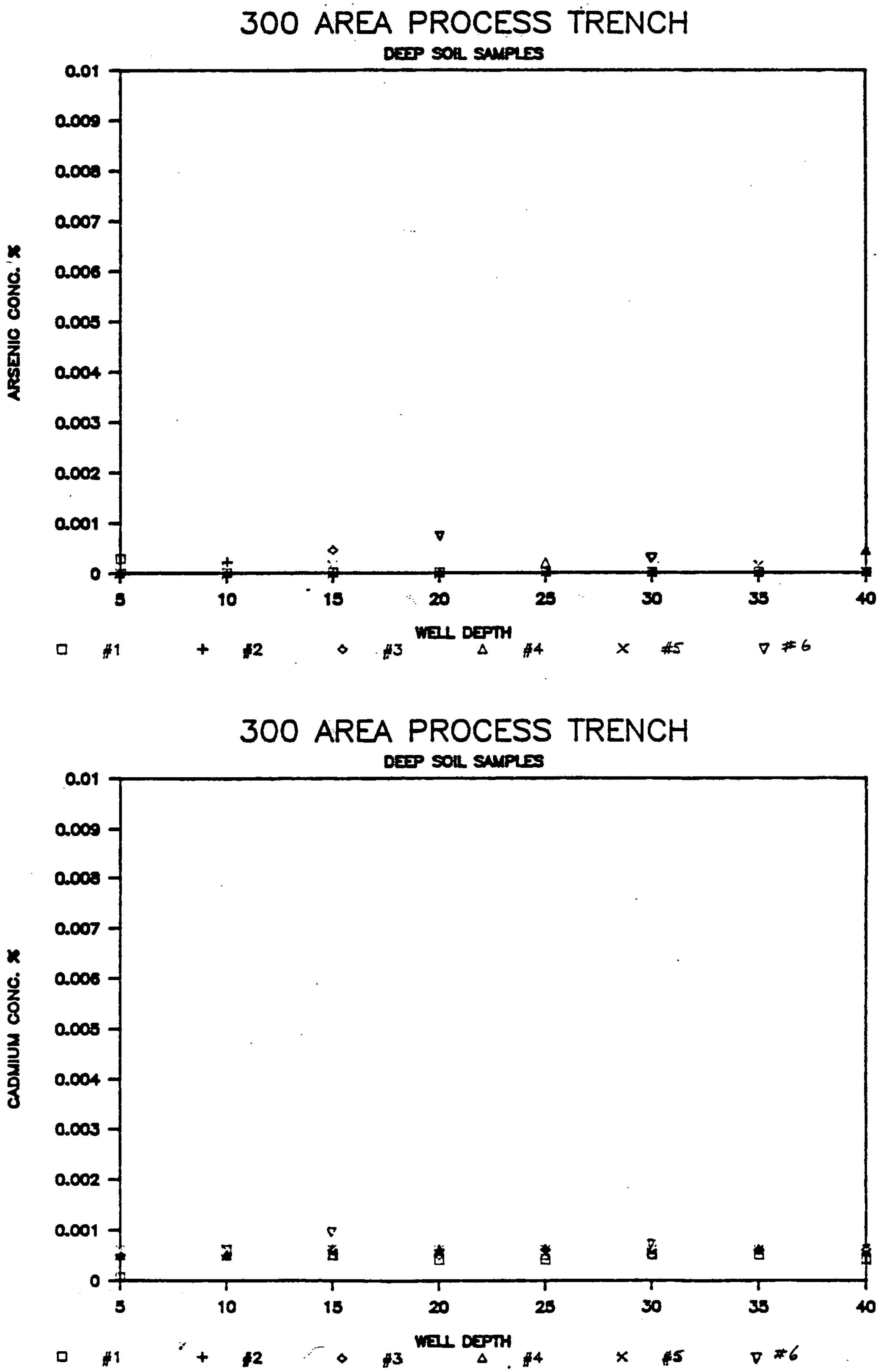
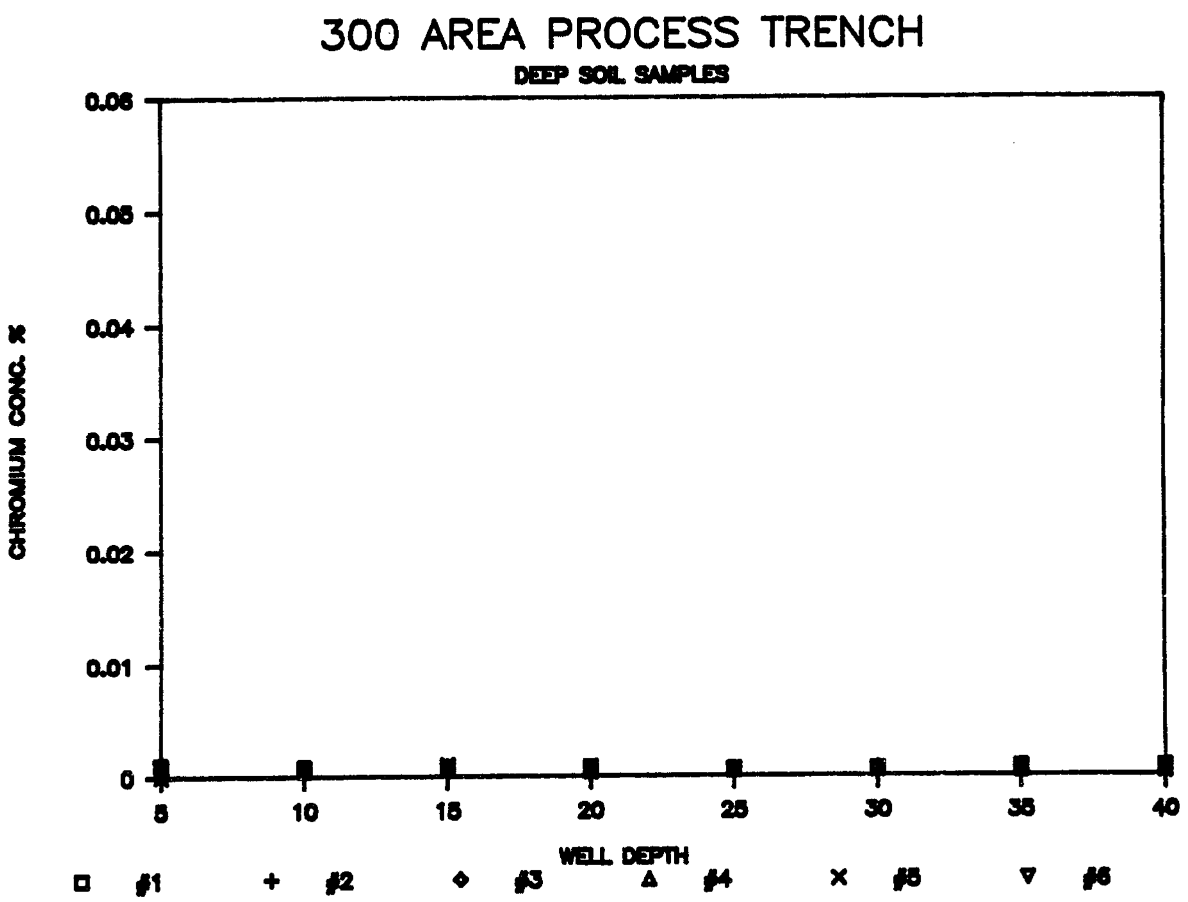


Figure VIII.2 (cont.)



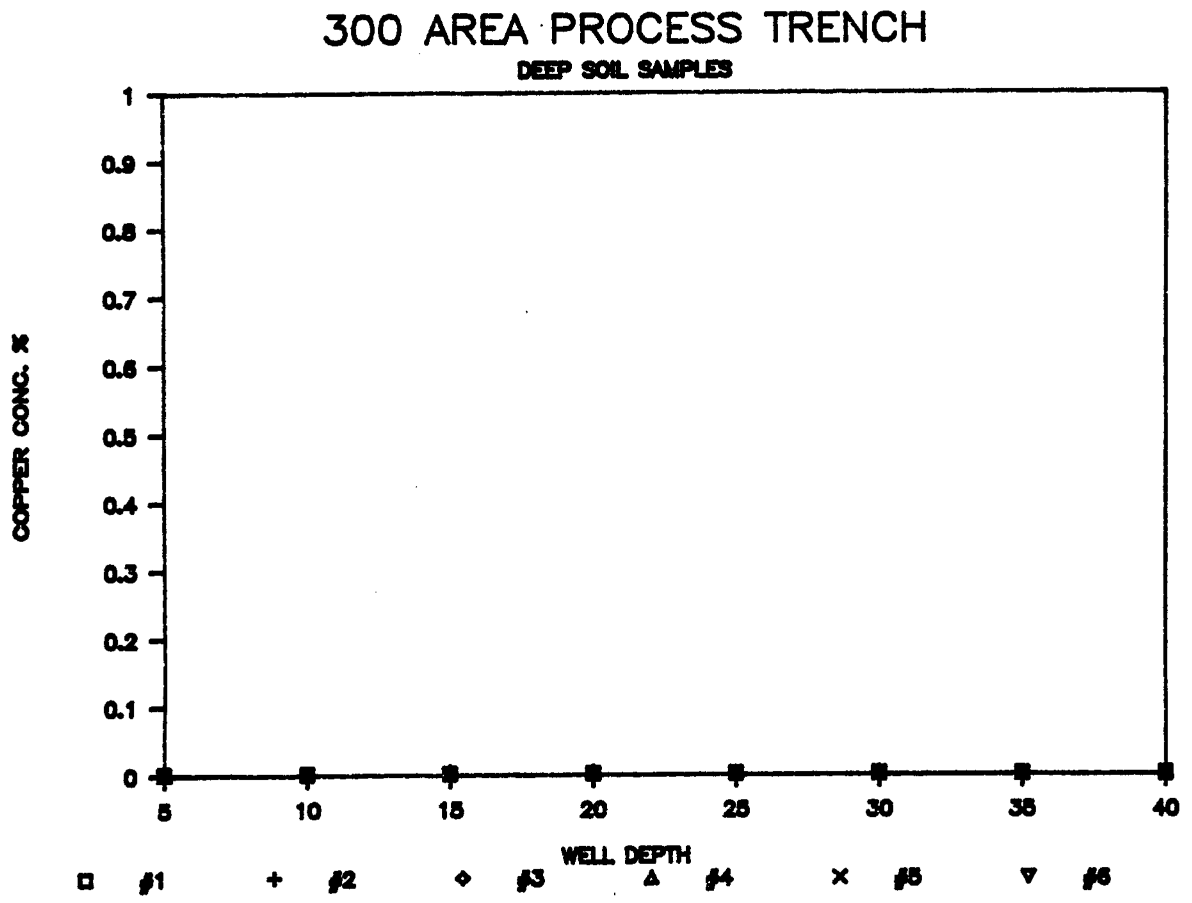
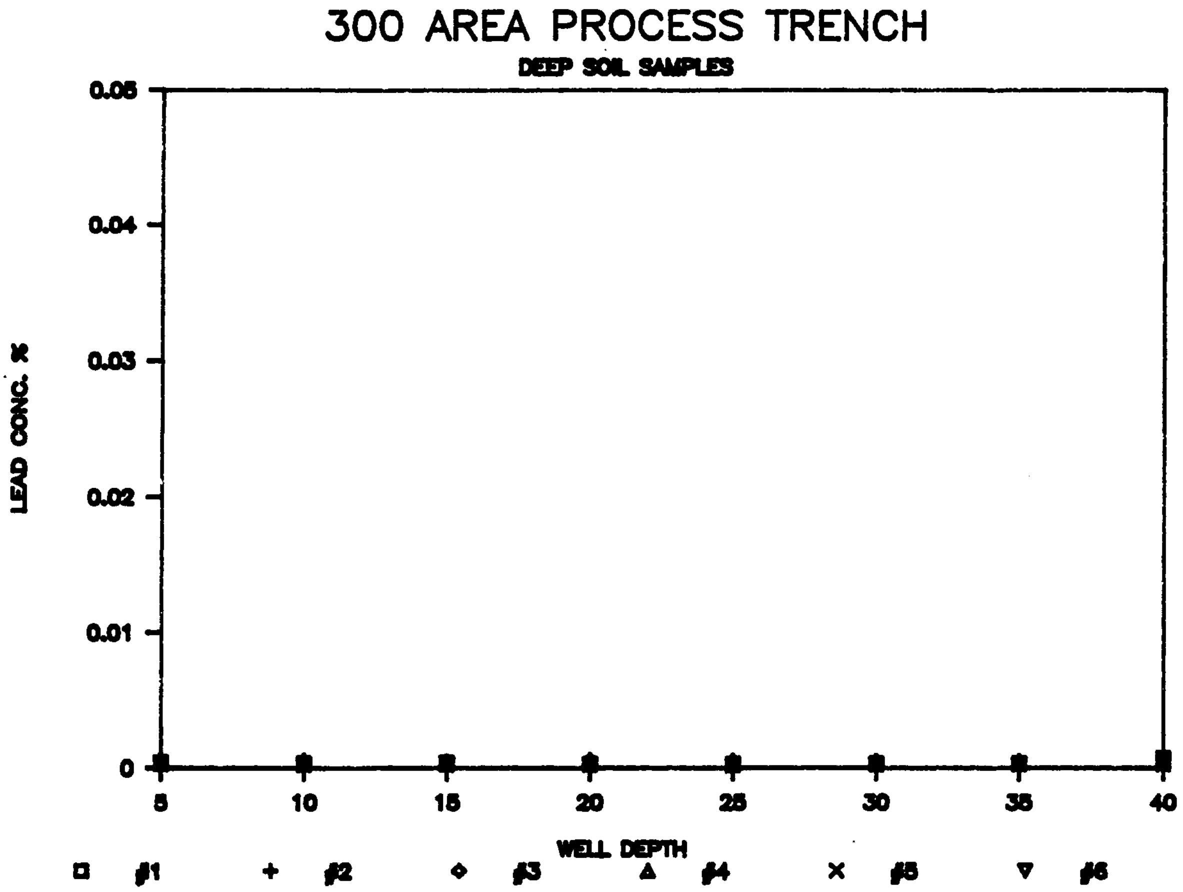


Figure VIII.2 (cont.)



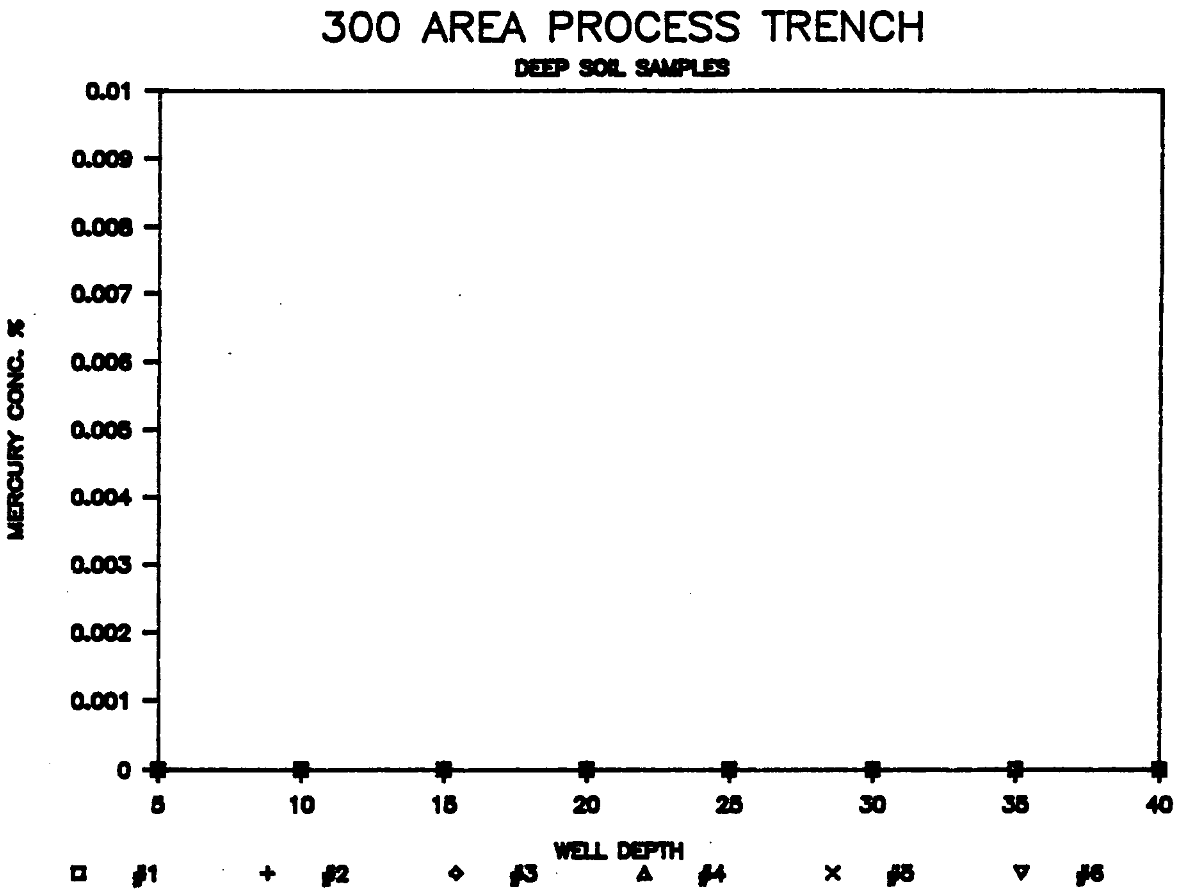
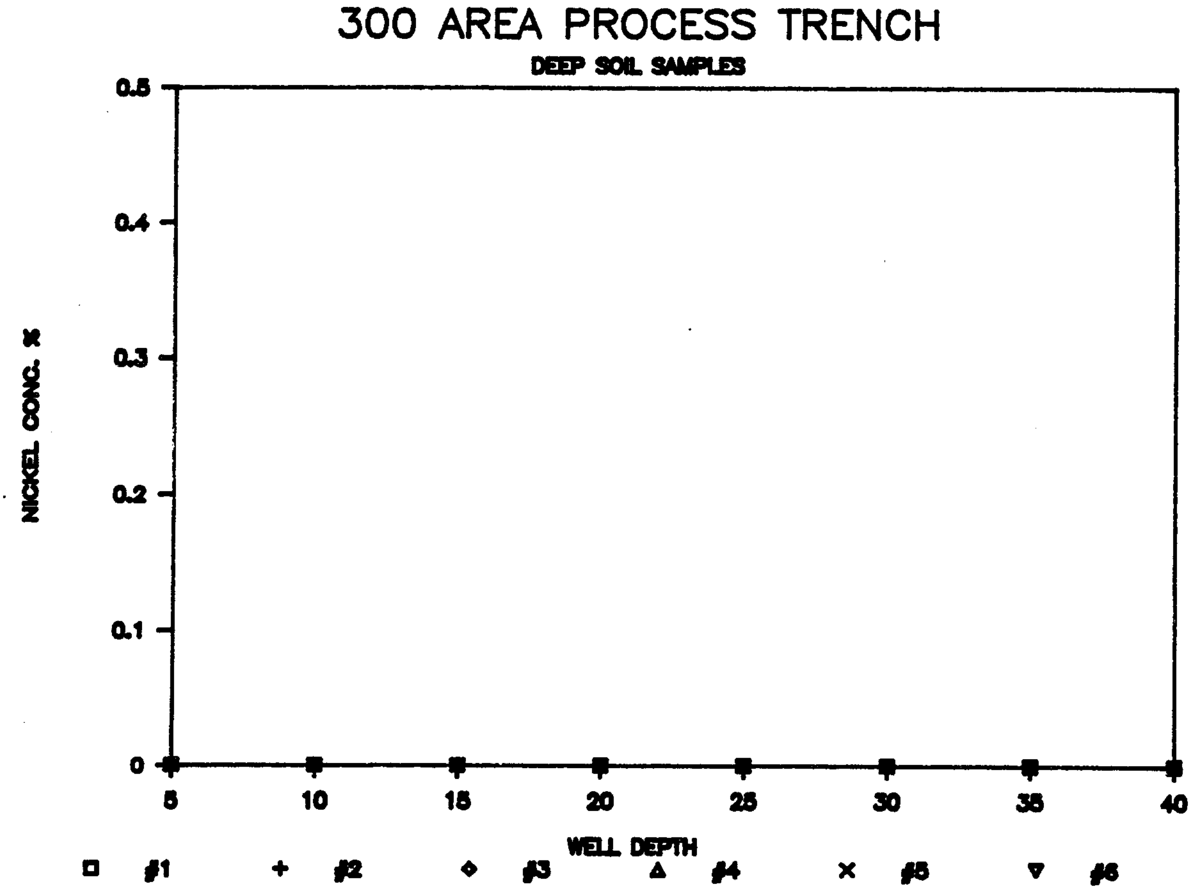


Figure VIII.2 (cont.)



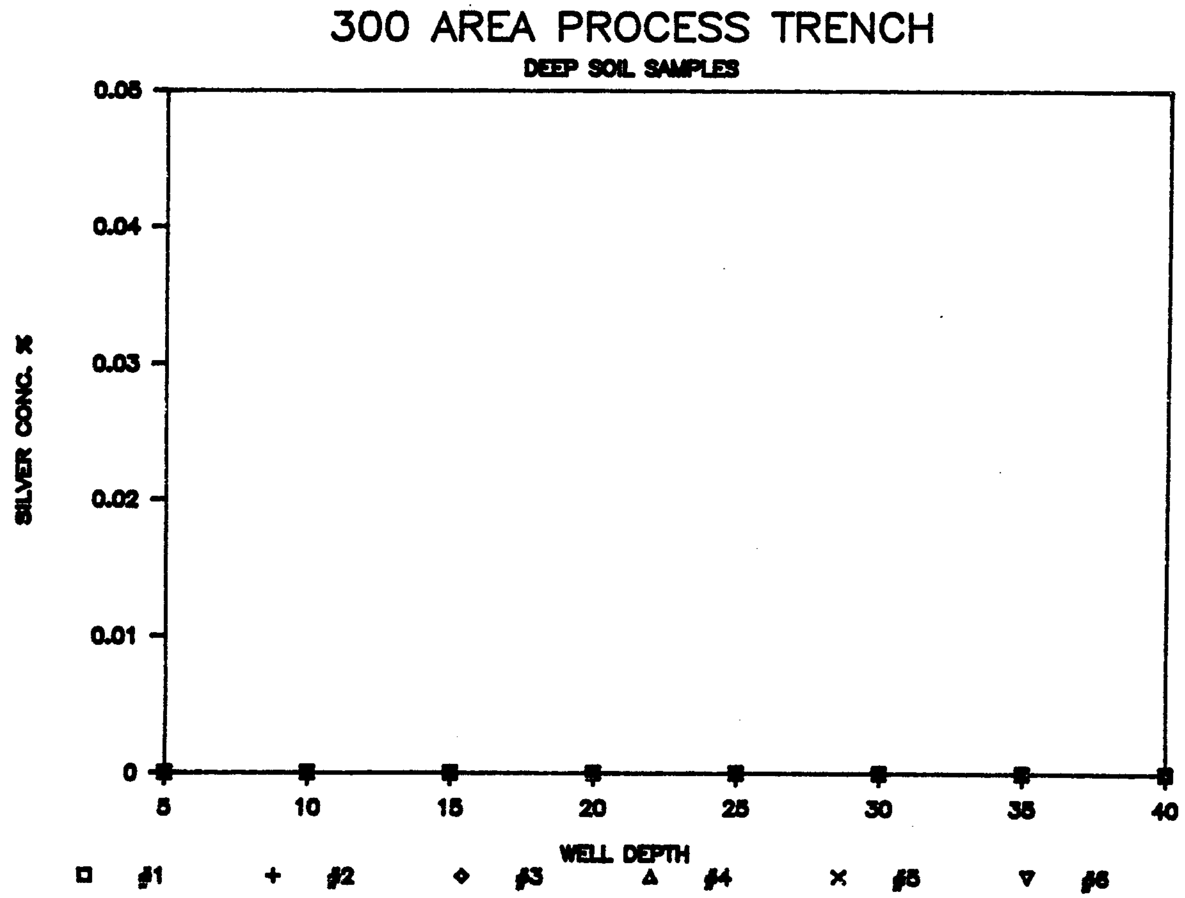
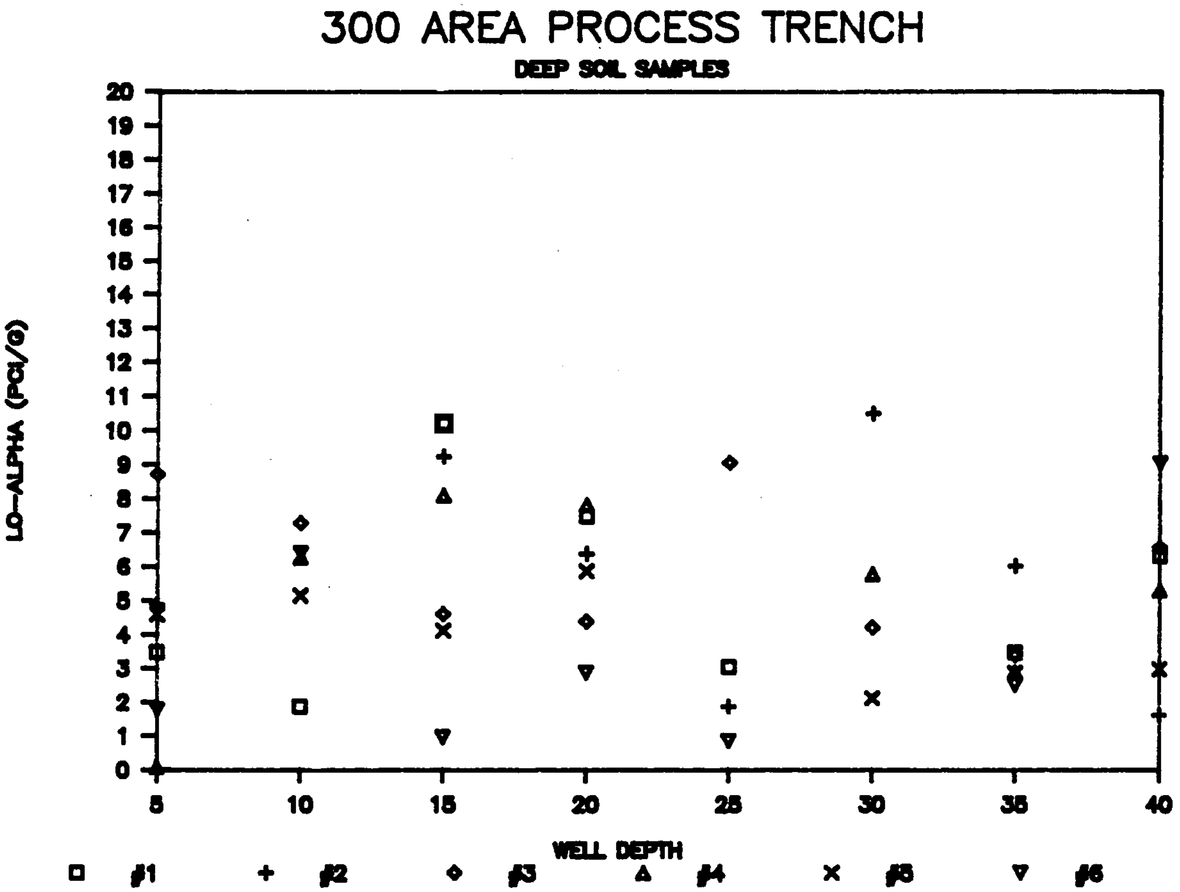


Figure VIII.2 (cont.)



The figures present plots of constituent concentrations as a function of sample depth and distance down the trenches away from the trench inlet for the shallow sediment samples. For the deep well sediment samples, the figures present plots of concentrations for each constituent and each well as a function of depth. The deep well constituents plotted are the same constituents plotted for the shallow sediments. The concentrations for the deep sediments are in many cases too low to differentiate from zero on the plots.

Four water sample analyses are presented in Appendix E. These analyses were taken during the trench sampling to evaluate the potential for cross contaminating the samples by process trench water or river water. The river water was used to clean the sampling tools between samples and was also used during the drilling process. River water was chosen because it had not been chlorinated and was not significantly contaminated with the constituents for which the samples were being analyzed. Two samples of river water used for tool cleaning and drilling were taken and analyzed. These are reported as samples R-1 and R-2. Two samples of the water in the process trenches were taken during the well sampling program for deep sediments. This was done because the well samples were saturated with water from the trenches at least by the ten foot sample. The process trench water samples permit the evaluation of the source of any contamination found in the samples from the wells. The process water samples are labeled P-1 and P-2.

IX. EVALUATION OF SAMPLING RESULTS

A. Discussion of Environmental and Regulatory Impact

The results described in Section VIII, "Description of Analytical Results," demonstrate that contamination above background levels exists in the process trenches but fails to detect contamination in the deeper well samples. The constituents found in the shallow sediments consist of the metals and compounds as described in the spill table of Appendix VIII of the RCRA regulations(5). The concentrations are too low to determine what the compounds actually are, but consideration of the environmental chemistry and the sources of some of the metals suggests the identity of the compounds. The compounds probably consist mostly of oxides and various salts such as phosphates, sulfates, chlorides, nitrates and fluorides. Based on the concentrations and the probable compounds, the trench sediments are not a hazardous waste as defined by the toxic mixture procedure of WAC 173-303(6). Six samples were chosen from the shallow sediment samples for an EP Toxic Leach analysis. The samples were chosen to represent the range of constituent concentrations from the most concentrated to the least. The results of the analyses are presented in Table IX.1. All of the results are below the levels which define a dangerous waste in WAC 173-303-090(8).

Recent EPA proposed amendments released on March 19, 1987(7) indicate that just because the contaminated material does not constitute a dangerous waste does not relieve the facility owner from cleanup requirements. No specific guidelines are given as to what constitutes constituent concentrations which require remedial action except that the goal is to remove or decontaminate all materials on site that could potentially contribute to future contamination problems.

Table IX.1

EP Toxic Leach Test Results

Analytical Results - EP Toxicity (ppm)

	W5LA	W10SA	W10DA	E1DA	E6SA	E2LA
Arsenic	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Barium	12	6.6	7.20	10.30	11.6	6.90
Cadmium	<0.01	<0.01	< .10	0.03	< .10	< .10
Chromium	0.02	<0.01	0.01	<0.01	0.06	0.02
Lead	0.46	<0.20	0.23	<0.20	<0.20	0.24
Mercury	0.10	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Silver	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

While these guidelines and goals are clear in a subjective sense, the problem is to determine what is required technically to comply with the requirements at a particular site and for particular constituents. To develop the technical goals, the following steps outline an appropriate approach:

1. Determine background levels of the contaminants found and compare with concentrations in the trench sediments.

2. Evaluate pathways to determine potential threats to human health.

    a. Leaching to groundwater and Columbia River
    b. Wind blown particulate
    c. Waterfowl

3. Determine remedial action steps

    a. No action
    b. Remove present contamination
    c. Stabilize contamination in place

B. Background Constituent Levels

The purpose of determining the background levels of constituents is to establish a cleanup goal for remedial actions. Background levels are established by taking and analyzing samples from areas near the 300 Area Process Trenches which have not been impacted by human activities. These background concentrations are shown in Table IX.2. The background samples came from the following locations:

Average of the Earths crust(10)

Geological samples from 10 and 15 foot depths from a well drilled in the 1950's before the Process Trenches were constructed and located approximately 20 feet west of the west trench; this is well 399-1-4 which is also part of the RCRA groundwater monitoring project.

Samples at depths of 10 and 15 feet from a new filter backwash pond about one half mile south of the trenches

Samples at 8 and 16 foot depths from the proposed location of a new sewage treatment plant northeast of the trenches

From this information, an average background concentration with uncertainties were calculated from the filter backwash pond and sewage treatment plant samples and a proposed goal concentration with uncertainties for the remedial activities is suggested in Table IX.3. The value of 104 ppm for Cr in the filter backwash pond 15 foot sample was not used to calculate the average in order not to bias the average background high. It is proposed that the goal of a cleanup be to achieve concentrations of constituents which do not exceed the average concentration plus uncertainty. The uncertainty is calculated as a concentration 30% greater than the peak background concentration. The exact percent varies because of round off errors. This goal should permit the detection of the background constituent level when all significant non-background contamination has been removed.

Table IX.2

Concentration of Constituents in Background Samples (ppm)

	Earth	Well-399-1-4		Filter Pond		New Sewage Plant		
Constituents	Crust	10 feet	15 feet	10 feet	15 feet	8 feet	8 feet	10 feet
Arsenic (As)	5	<91.7	<91.0	3.2	10	<0.8	<0.7	<0.7
Cadmium (Cd)	0.15	<1.3	<1.3	<0.2	0.5	1	<0.2	1
Chromium (Cr)	200	<2.6	<2.6	10	104	7	6	6
Copper (Cu)	70	<2.6	<2.6	12	22	15	8	16
Lead (Pb)	16	<91.7	<91.0	12	18	12	8	13
Mercury (Hg)	0.5	<26.2	<26.0	<0.2	<0.2	<1	<1	<1
Nickel (Ni)	80	<7.9	<7.8	6	9	7	5	6
Silver (Ag)	0.1	<1.2	<1.2	<1	<1	<1	<1	<1
Uranium (U)	4	<65	<65	7.9	6.4	0.9	0.6	1.1

Table IX.3

Average Background Concentrations and Proposed Goal
Remedial Action Concentrations
(ppm)

	Average Background		Proposed Goal	
Constituents	Concentration	Range	Concentration	Uncertainty
Arsenic (As)	3	<0.7-10	3	+13
Cadmium (Cd)	1	<0.2-1	1	+1.3
Chromium (Cr)	7.25	6-10	7	+13
Copper (Cu)	14.6	8-22	15	+29
Lead (Pb)	12.6	8-18	13	+23
Mercury (Hg)	<1	<0.2-<1.0	1	+1.3
Nickel (Ni)	6.6	5-9	7	+12
Silver (Ag)	<1	<1	1	+1.3
Uranium (U)	3.4	.6-8	4	+10

It is obvious by comparing the values in Table IX.3 with the values in Table VIII.1 that several of the constituents found in the trench sediments are already within the background range plus uncertainty presented in Table IX.3. Arsenic in the sediments is lower than the background concentrations. The average concentration of cadmium, lead and mercury are generally within the range of concentrations of the proposed goal. However, there are a few peaks in concentration in the shallow sediments which are significantly above background. The average and peak concentrations of chromium, copper, nickel and silver are significantly above background. The chromium is anticipated to be in the +3 ionic state rather than the more hazardous +6 (chromate) state. This is because most chromate (unlike Cr+3) compounds are soluble in water and would have been dissolved in the water flowing through the trenches. Also, the chemical environment in the trenches would probably tend to convert the Chromium +6 into Chromium +3. The average and peak uranium concentrations in the trench are much higher than background range. The conversion from the alpha counts, which was used to estimate uranium concentrations, is only accurate to within approximately a factor of two. It is also known from radiation measurements in the trenches that some surface uranium concentrations near the inlet to the trenches are much above background. The deep sediment or well sample concentrations are within the background range for all the constituents.

C. Pathways Discussion

The following potential pathways exist in the 300 Area Process Trench System which may impact human health:

1. Leaching to ground water and thence to the Columbia River, the Columbia river is used for drinking and irrigation water;

2. Windblown particulate when one of the trenches is allowed to dry out while the other trench is being used; and

3. Migratory waterfowl which may be hunted and consumed off the Hanford site.

There are no other known pathways. Crops are not grown around the trenches and public access is not permitted. The pathways which might impact public health must transport the hazardous constituents offsite. The primary pathway is the one to groundwater. Pacific Northwest Laboratory operates the RCRA groundwater monitoring program for the 300 Area Process Trenches. Groundwater monitoring results are reported to WDOE in quarterly reports(8). These results do not indicate groundwater concentrations above drinking water standards for the constituents found in significant concentrations in the process trench sediments. The gross radioactivity concentrations (alpha and beta) are sometimes above drinking water standards. However, if the activity due to uranium is subtracted as stated in the regulations, then the activity level is below the drinking water standards. There are also other potential sources for uranium contamination in the 300 Area from CERCLA sites. The primary source of the uranium is not clear at this time.

The constituents found in the drinking water of primary interest are chlorinated hydrocarbons. These include perchloroethylene, trichloroethylene and dichloroethylene (a breakdown product of the first two). These are sometimes detected above drinking water standards. The detections are intermittent and a defined plume of contamination has not yet been determined. These constituents are not detected in the process trench sediments. The source in the groundwater is probably from past operations, documented spills and trace amounts from solvent carryover in rinse water which is carried through the sediments in the process water. A project is presently funded and scheduled (Project 685) which will reduce or eliminate the only known sources of solvent carryover.

There is a finite potential that the constituents found in the sediments can be moved into the ground water. The sediments have been leached by large quantities of water (approximately 2.6 million gallons per day) since 1975. This water is generally neutral or basic up to a pH of 9. The fact that these constituents are still in place argues for the stability of the sediments in the present chemical environment. It can be postulated that should the trench influent become acidic, the metal constituents found in the sediments would become mobile. An acid spill large enough to move a significant amount of the constituents is not considered likely in the 300 Area because generally only small amounts of acid are used in the different laboratories. The N-Reactor fuel fabrication operation is the most likely source of a large spill. Several thousand gallons of concentrated acid or base are stored. There is some evidence from past spills that some constituents are mobilized(9). This is primarily based on increases in alpha counts in groundwater monitoring samples. A project is presently funded and scheduled (project 685) which will protect the process sewer from spills from the fuel fabrication operation.

There is a potential that the wind could blow particulate from the 300 Area Process Trench area. This could happen because the two trenches are operated alternately. One trench is allowed to dry out while the other is in use. Radiation surveys of the area have however demonstrated very little spread of uranium from the trench bottom. What contamination was found could more likely be explained by personnel tracking contamination out of the trenches during sampling and other operations. Other circumstances mitigating the potential for wind spread of constituents are the fact that the trench bottoms are about 15 feet below grade; thus being somewhat protected from the wind and large areas of the bottom of the unused trench generally remain wet because of crossover and seepage from the trench in use.

Waterfowl have been observed in the trench and presumably could feed and nest in the area. The constituents in the Process Water samples P-1 and P-2 discussed above would not be expected to impact the waterfowl, hunters or consumers of waterfowl. Bottom feeding could possibly be more of a problem. Very little information is presently available regarding this potential. The PNL environmental monitoring program may have sampled waterfowl from this area and contamination levels in waterfowl from this area may be available from the program. The information has not been obtained for this report.

D. Remedial Action Planning

The remedial action planning addresses a number of options which would address the potential risk to human health or the environment as a consequence of contaminants in the process trenches. The actions considered are as follows:

1. No Action

A reasonable case can be made for no action relative to all of the contaminants except the uranium. Even under worst case conditions, if all the contamination leached into the groundwater, no detectable effect on human health or the environment would be expected because the concentrations in the river would be so low. However, this may not satisfy the requirements of regulations to prevent accumulations of these contaminants in soils, their discharge to groundwaters and the potential for any environmental harm. Also, although the uranium concentrations do not present a significant health hazard, the concentrations are high enough that it would be prudent to remove or stabilize the sediments so that the potential for spread of contamination is eliminated. For these reasons the no action option is not considered to be viable.

Because of the dilution effect from the river, any constituents which presently enter the groundwater from the Process trenches are undetectable in the drinking water intakes downstream. The total amount of the metallic and uranium sediment constituents is estimated in Table IX.4. This is based on the concentrations found in the sediment samples.

2. Cleanout and Continued Use

This option consists of digging out the sediments containing constituents in concentrations greater than the goals set in Table IX.3. This would remove the potential for leaching of these constituents into the ground water in any greater concentration than from the natural soils. Since the potential for leaching of hazardous constituents into the groundwater would be removed, the trenches could continue to be used for disposal of non hazardous waste water. The sediments would be removed to an engineered disposal area protected from water and much further from groundwater and the river. The precise location has not been determined but it would probably be in the 200 Area disposal site for low level radioactive soils or gravel. Note that the sediments do not qualify as a dangerous waste but the uranium concentration may be high enough to qualify some of the sediments as low level radioactive waste.

The problem with this option is to be certain that the significant contamination above background has actually been removed. The sampling program was designed to provide the information necessary for this determination. The deep well samples demonstrate that the contamination has not progressed significantly beyond the shallow sediments in the trench. The shallow samples demonstrate that for most of the trench, the contamination can be removed by digging up the upper few inches to 24 inches of sediment. In the areas near the inlet, the samples indicated that the contamination may go deeper and more sediment will require excavation. The samples do generally indicate lesser concentrations with depth. These statements can be verified by studying the plots presented in Section VIII. Radiological measurements also indicate shallow uranium contamination up the sides of the trench near the inlet. This contamination seems to be associated with crust like deposits left at the water edge. This contamination would have to be scraped off.

Table IX.4

Estimated Total Amount of Constituents in the Sediment (kg)

Constituent	Shallow Sediments	Estimated Amount from Background
Arsenic (As) (1)	2	8
Cadmium (Cd)	3	3
Chromium (Cr)	341	19
Copper (Cu)	2261	30
Lead (Pb) (2)	108	33
Mercury (Hg) (2)	12.8	3
Nickel (Ni)	578	17
Silver (Ag)	74	3
Uranium (U)	720	9

(1) The arsenic is always within background range.

(2) The lead and mercury are within the range of background values except in some of the loose and shallow sediments.

The plan would be to excavate the sediments to a depth based on the sampling results. This depth would be deepest at the inlet and shallowest at the far end. In the field, the depth would be determined by portable radiation instruments used to indicate the presence of uranium. When the detectable radiation was near background levels, the excavation would stop and soil samples would be taken and analyzed for the metal contaminants of interest plus TOC and TOX. Any unusual results would be cause for further sampling and analyses. Based on these results, the excavation would continue or if the results were within the background range, the excavation would be considered complete. Clean gravel may be hauled in to fill holes.

The schedule for this project should be coordinated with the schedule for Project 685. This should be scheduled for implementation after project 685 is complete so that influent with the least potential for spills, uranium content or solvent carryover would enter the refurbished trench system.

3. Stabilize in Place

Another option is to stabilize the contamination in place. This process is described in detail in the Closure Plan submitted to WDOE and the USEPA in lieu of a Part B application in November 1985. This part of the submittal is enclosed in Appendix A. This primarily consists of filling and a series of covers such that the contamination is stabilized and cannot be leached into the groundwater. Continual groundwater monitoring would be required to verify the integrity of the stabilization process.

Another method for disposing of the nonhazardous waste water from the Process Sewer would be required. There are two viable options. These are to build another set of leaching trenches or to discharge directly to the river under an NPDES permit. New leaching trenches or ponds would probably be constructed north of the present trench location but a location has not been selected.

The other disposal option is to acquire an NPDES permit and discharge directly to the river. The present influent into the trenches especially after Project 685 is complete, does seem to meet the requirements for an NPDES permit. There are advantages to this option. This option is simpler in that no new trenches or their operation is required and it would be probably cheaper than new trenches because both options would probably require the laying of significant lengths of pipeline. The outfall structure may be a significant cost item. There are also disadvantages. One of the original purposes of the trench system was to protect the river from spills. With the present system, a spill is delayed and diluted considerably by the time it reaches the river. This reduces short term contamination levels in drinking water downstream of the 300 Area and in the Columbia River, thus preventing acute harm to biological systems or human health. The trench system also removes particles and less soluble materials from the water. The 300 Area sanitary water intake is at the south end of the 300 Area. Unless the discharge of the Process Sewer were directed south of this intake (an expensive project), it is possible that operations personnel could not react soon enough to prevent significant contamination of the 300 Area drinking water if a major spill occurred. Also, using process trenches provides some opportunity to clean up the spills before contaminants reach the river by pumping the appropriate monitoring wells.

Spills have in fact been very few, better controls have recently been instituted and better sampling systems are planned, however, this is still an important consideration.

4. Summary of Options

Considering both environmental protection and cost, the second option of cleaning out the trenches and continuing usage is preferable. Assuming that the contamination can confidently be removed from the trenches, this option provides all the environmental protection of the third option, does not require a new disposal facility and environmental monitoring systems are already in place. It is assumed that the no action option is not viable. If the contamination cannot economically be removed from the process trenches than the third option will probably have to be pursued. This will require a new disposal facility. New leaching trenches or ponds would be environmentally preferable. Any remedial actions should be coordinated with project 685.

X. OPERATION OF THE PROCESS SEWER SYSTEM

The operation of the process sewer system as a non hazardous waste system requires an integrated approach. This includes administrative procedures and training to prevent spills to the sewer system, physical systems to prevent accidental disposal to the system and measurement systems to verify that hazardous chemicals are not being disposed. The administrative procedures and training were implemented in 1985. A new monitoring system which provides better quality samples and is more reliable was installed in August 1987. This new sampling system takes a weekly composite sample and continuously monitor pH and conductivity at the inlet to the Process Trenches.

In addition another sampling system is presently being designed. This will consist of about 15 samplers which will collect weekly composite samples at different locations within the process sewer system. These samples will be analyzed when something unusual is detected in the trench inlet sample, to locate the source of the material detected or to verify a problem with the inlet sample or analysis. By being able to locate the discharge of material to a few buildings as opposed to the approximately 50 served by the process sewer, operations personnel will be able to locate the source of any unpermitable discharges and correct the situation. This sampling system is scheduled for installation by March 1988.

The influent to the trenches has been sampled weekly since 1975. The analysis parameters consisted of pH and a few heavy metals. In 1985, the Resource Conservation and Recovery Act regulations were applied to the trenches. Additional efforts were implemented at that time to prevent discharge of hazardous chemicals to the Process Sewer. In June, 1986, a more extensive weekly sampling effort of the influent to the trenches was implemented to verify compliance with operational procedures designed to prevent discharge of hazardous substances into the sewer and to detect spills.

A new and improved process trench influent sampler has been designed to provide for technically adequate and reliable control samples to verify operational compliance with DOE orders, state and federal hazardous waste regulations and complement the 300 area Groundwater Monitoring Program. The present sampler is located down in the trench area and is difficult to use. The new sampler will be relocated to the ground level area up above the present sampler which will make it safely accessible at all times. The new sampling station will include dual composite water samplers and continuously recorded pH and conductivity instruments. The station also has an existing flowmeter which is recorded continuously. The equipment will be located in an existing cabinet at ground level which also has freeze protection and electrical connections.

Presently one polyethylene sampling bottle is utilized for the weekly composite sample. The new system will collect approximately 8 samples per hour to form the weekly composite sample. Two samples will be drawn at the same time with the use of the dual pump heads and placed in separate sample containers - one glass and one polypropylene. This will eliminate the possibility of cross contamination of the samples from metals or organics leaching out of the container itself.

The weekly composite sample is analyzed for pH and conductivity. The new sampling system will continuously monitor and record the pH and conductivity at the trench influent point. This will allow for tracking fluctuations in these measurements.

This new sampling station will provide for better reliability and accuracy with a minimum of downtime and maintenance.

Presently, spill control measures such as catch tanks, leak detection devices, level controls, personnel awareness and weekly inspections of waste containers comprise the preventive measures for the spill control program. Primary reliance is on personnel training and awareness of the Washington State Dangerous Waste Regulations and their applicability to the process sewer and trenches to provide the disposal controls that are necessary to maintain compliance with the intended use of the 300 area process trenches for nonhazardous aqueous wastes.

References

1. U.S. Department of Energy, "Closure/Post-Closure Plan, 300 Area Process Trenches," November 1985.

2. U.S. Department of Energy, Richland Operations Office, "Revised Ground-Water Monitoring Compliance Plan for the 300 Area Process Trenches," September 1986.

3. U.S. Testing Co. Inc., Richland Division, "Quality Assurance Manual," UST-RD-QA-7-80, Rev. 7, March 25, 1986.

4. U.S. Testing Co, Inc., Richland Division, "Procedure Manual," UST-RD-PM-9-80, Rev. 3, March 1986.

5. Code of Federal Regulations, 40 CFR, Part 302.

6. Chapter 173-303 Washington Administrative Code, Dangerous Waste Regulations, Amended June 1986.

7. Code of Federal Regulations, 40 CFR Part 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities; Final Rule," March 19, 1987.

8. Pacific Northwest Laboratory, "Ground-Water Monitoring Compliance Project for Hanford Site Facilities," Quarterly Progress Reports, May 1987.

9. Weast, R. C., ed., "Handbook of Chemistry and Physics," 48th edition, The Chemical Rubber Co., 1967.

APPENDIX A

Part of the Closure Plan Submitted in Lieu of a Part B Application on November 8, 1985

6.0 CLOSURE AND POST-CLOSURE REQUIREMENTS

The 300 Area Process Trenches comprise a facility that received regulated waste in the past. However, effective February 1, 1985 new administrative controls were instituted which prevent discharge of hazardous materials into the trenches. The trenches currently receive non-hazardous, non-regulated aqueous solutions (for composition of discharge, see Section 3.0). All future discharges into the trenches will be non-hazardous. The purpose of this section is to demonstrate that the U.S. Department of Energy - Richland Operations Office (DOE-RL) is cognizant of the current and past practices relative to the 300 Area Process Trenches and that DOE-RL has a plan to administer the unit so that any future releases are within acceptable limits and will not harm the environment. The general closure plan involves several steps, some of which have already been initiated as a demonstration of DOE-RL's intent. The general steps are:

(1) Discontinue Discharges of Regulated Materials to Trenches (implemented 2/1/85)

(2) Sample Trench Area Soils
- Shallow Sampling (initiated 6/25/85)
- Deep Sampling (planned 2/28/86)

(3) Analyze Samples for Hazardous Components (initiated 7/26/85)

(4) Close Facility Under RCRA
- Decontaminate
- Alternate Closure Option

DOE-RL wishes to make clear that a commitment to close the facility under RCRA does not necessarily preclude the use of the facility in its current capacity (i.e., as a receiver of non-regulated solutions). The intent of DOE-RL is to operate the trenches while establishing that the trenches are not an environmental hazard. Should investigations reveal that significant and non-localized contamination is present at depth, then DOE-RL will begin immediately to initiate physical closure of the facilities or to take other appropriate actions that are consistent with RCRA. Should they become necessary, those activities will be conducted in accordance with common best engineering practices, under the direction of a registered engineer and with the approval of the cognizant regulatory authority; i.e., either:

Regional Administrator
Region X
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

or

Director
Washington Department of Ecology
Mail Stop PV-aa
Olympia, Washington 98504

Details of the 300 Area Process Trenches Closure/Post-Closure Plan are presented below. The locations of official copies of the Closure/Post-Closure Plan are given in Appendix H. The person responsible for storage and updating these copies is given in Appendix I. The certification of closure is found in Appendix J.

6.1 CLOSURE PLANS

6.1a Closure Performance Standard

The 300 Area Process Trenches will be closed in a manner that minimizes further maintenance and that minimizes post-closure escape of regulated waste to the extent necessary to protect human health or the environment. If necessary, a cover system will be designed for the trenches [see Section 6.1e(2)] which will prevent contaminant migration to groundwater. The vegetative cover will consist of two perennial wheatgrasses which are drought-tolerant and well suited to the local soils, thus minimizing maintenance at the site [Section 6.1e(4)].

6.1b Partial and Final Closure Activities

The DOE-RL does not anticipate any partial closure activities. Instead, DOE-RL will proceed to final closure of both trenches upon approval of this plan (expected in 1986). However, since two trenches are involved, it is possible that different closure alternatives may be indicated for each. It is therefore possible that one trench may be closed while detailed characterization of the other trench is proceeding. Thus, while all activities relate to final closure, final closure of the facility may occur in stages.

Characterization activities leading to final closure follow a logical progression of increasing detail. In the initial phase, shallow samples will be taken of the soil in the trench. The maximum depth of the samples will be two feet. Samples will be taken by soil augers or other suitable method and will be split so that representative samples of sediment, sediment/gravel interface, and rock/gravel interface are obtained from each hole. The regular sampling grid will consist of a single line down the axis of each trench with a sample spacing of 100 feet. These samples will be supplemented by samples taken at significant depressions and areas where field analytical instruments (e.g., field gas chromatograph or organic vapor analyzer) detect local "hot spots." In addition, paired samples will be taken at each end and at the middle of the trench to test for lateral heterogeneity. If significant levels of contamination are discovered by the initial sample grid, a more close-packed sampling array will be constructed to define its nature and extent.

To permit sampling, the trenches will continue their parallel operation. That is, sampling in one trench will be conducted while the other trench is receiving water. Once the sampling program in the first trench is finished, holes will be backfilled with native materials and that trench will receive process water so the other trench can be sampled.

Because of past practices, the remote possibility exists that regulated waste materials may have seeped into the ground in the past and may currently reside at some depth below the bottom of the trench and above groundwater. A deep sampling program will be conducted to establish the condition of the soil at depth. The DOE-RL will drill vertical holes between the two trenches. The distance between the two trenches is such that sediments in the zone of influence of the trenches will be sampled via these vertical holes. Samples will be taken at five-foot intervals and auger tailings will be monitored continuously with an organic vapor analyzer. These deep holes will be drilled at a spacing of 300 feet along a line that parallels the axis of the trench.

In addition to sampling soils, samples of the sludges at the inlet weir box will be taken. Those and all other samples will be collected according to procedures in SW-846 (Second Edition, Revised 1984). All sampling tools will be steam cleaned or washed with detergent and rinsed between samples. All samples will be labelled to indicate the trench, location, and depth from which they were taken. Samples will be logged in and preserved as they are taken and will be shipped for analysis at the end of each day.

Analyses will be performed in a manner that will ensure all analytical procedures and controls comply with EPA specifications. For quality assurance, unidentified blanks and five percent duplicate samples will accompany regular samples. In addition, five percent of all analyses will be confirmed by an independent laboratory. Proposed analytical parameters for the 300 Area Process Trenches are shown in Table 6-1. It is proposed that 20 percent of the samples be analyzed for the parameters in Table 6-1. The rest of the samples will be analyzed for metals and TOC. Any TOC results significantly above the average will require analysis for all parameters in Table 6-1.

All data generated by the sampling and analysis program will be evaluated to identify the most effective closure alternative. For example, if significant contamination is found and it is shallow or localized, then the contaminated sediments will be excavated, segregated into compatible groups as necessary, drummed, labeled, manifested, and transported for disposal at an authorized facility. If contaminated liquids are encountered in the trenches, the liquids will be removed using a vacuum truck. They will then be transferred to an authorized disposal site for solidification and disposal. If significant contamination is found at depth and is non-localized, then DOE-RL will take steps immediately to initiate closure of the trench (e.g., discontinue aqueous discharge into the trench, design and construct a cap containment structure).

6.1c Maximum Waste Inventory

The maximum waste inventory is currently unknown. It will be provided once the characterization activity for the trenches is complete.

6.1d Inventory Removal, Disposal or Decontamination of Equipment

If contamination is found, a variety of equipment will be used in the final closure of the 300 Area Process Trenches. These include:

- Tracked bulldozer
- Roadgrader
- Dump trucks
- Shovels, augers and rigs
- Water trucks (if needed)

All tools used in the sampling and final closure program will be assumed to be contaminated with regulated waste. They will be steam-cleaned prior to removal from the area. Cleaning will take place in a plastic-lined area where cleaning residues may be collected and analyzed for TOC and TOX. If cleaning residues contain hazardous constituents, the materials will be disposed of in a RCRA-regulated disposal facility at the Hanford Site.

6.1d(1) Closure of Containers

This section is not applicable to the 300 Area Process Trenches.

6.1d(2) Closure of Tanks

This section is not applicable to the 300 Area Process Trenches.

6.1d(3) Closure of Waste Piles

This section is not applicable to the 300 Area Process Trenches.

6.1d(4) Closure of Surface Impoundments

This section is not applicable to the 300 Area Process Trenches.

6.1d(5) Closure of Incinerators

This section is not applicable to the 300 Area Process Trenches.

6.1d(6) Closure of Land Treatment Facilities

This section is not applicable to the 300 Area Process Trenches.

6.1e Closure of Disposal Units

If contamination is extensive, the 300 Area Process Trenches will be closed as disposal units (i.e., contaminated materials will remain in place). The final cover and its expected performance is described in Section 6.1e(2).

6.1e(1) Disposal Impoundments

No preparation of wastes for final cover is expected to be required if the 300 Area Process Trenches are to be closed as disposal units.

6.1e(2) Cover Design

It is believed that any contamination found in the 300 Area Process Trenches, will be removable by excavation. As a result, no cover will be required. However, if deep, significant, and/or extensive contamination renders total excavation impractical, then a cover for the facility will be constructed as described below.

Final Cover General Design Description

A multilayer cover will be used for closure of the trenches. The cover will consist of 4 foot (1.2 meter) deep revegetated soil underlain by a woven synthetic geotextile fabric and 6 inches (15 centimeters) of gravel. The 4 foot (1.2 meter) depth of soil will provide storage for annual precipitation and support the establishment and growth of a perennial grass cover that will stabilize the surface and enhance soil-water removal. The geotextile will minimize the sifting of fines into the gravel interstices. The gravel layer will serve as a capillary barrier between the cover soil and waste zone, increasing the amount of water storage potential in the upper soil layer and maintaining greater levels of plant available moisture.

Concept and Function of the Multilayer Cover

Soil water moves in response to pressure-head differences. The pressure heads are positive in saturated soils because of hydrostatic forces and negative in unsaturated soils because of capillary forces. In unsaturated soil, water movement is influenced both by capillary forces and by gravity. For relatively salt-free soils, the combination of capillary and gravitational heads determines the total hydraulic head, usually expressed in terms of length (centimeters or meters) of an equivalent water column. Infiltration into either uniform or layered soils can be predicted by properly characterizing the gradient of hydraulic head and hydraulic conductivity. Another simple, yet basic, soil water concept is the soil water outflow law [Richards, L. A., 1950, "Law of Soil Moisture", Trans. Amer. Geophys. Union, 31 (5)]. This law states that water will not move from soil into an open cavity until the water pressure is atmospheric or greater. For layered soils, this means that water will not move from fine soil into very coarse soils until the soil at the boundary between the soil layers is virtually saturated [i.e., until the water pressure (capillary pressure) in the fine soil at the boundary is near or equal to zero]. This basic law is fundamental to understanding the concept of a multilayer cover.

The final cover intended for use at the trenches is based on the concept just described. The gravel layer underlying the cover soil serves as a capillary barrier. As moisture infiltrates the cover soil, a wetting front moves downward through the soil of relatively fine porosity to the point of contact with the large-pored (gravel) layer. The volume of pores capable of holding water at the tensions which exist at the wetting front and water-filled cross section is reduced. Before the wetting front can advance, the soil-water pressure at that point must increase until it is large enough to allow the pores to fill with water. The overlying soil will retain considerably more water at this point than would the same soil depth had a coarse (gravel) layer not been present.

Fine Soil for Final Cover

In order for a multilayer cover to be effective in eliminating drainage, it must be capable of storing at least the anticipated annual precipitation and, preferably, the maximum expected amount. The greatest annual amount of precipitation recorded at Hanford to date is approximately 11 inches (28 centimeters). There is a greater than 95 percent probability that the 11 inch total will not be exceeded (see Figure 6-1). This amount of precipitation has been established as a design criterion.

To meet the criteria of higher water-holding capacity and less permeability, the final cover soil will have to be obtained from selected sites outside of the immediate areas surrounding the trenches. The most promising soil identified thus far belongs to the Esquatzel series. Esquatzel series soils are typically deep and medium-textured, and exhibit moderate permeability and high water-holding capacity. Relatively uniform deposits of this soil type have been indicated approximately 10 miles (16 kilometers) northwest of the nonradioactive dangerous waste landfill; however, further investigations and soil analyses are planned to locate a source of suitable materials nearer the trenches.

In lieu of detailed soil data, the Benton County Soil Survey was used to obtain estimated properties of the Esquatzel series soils. These estimated properties are as follows:

- Textural class: fine sandy loam
- Unified class: ML
- Permeability: 2.0 - 6.0 centimeters per hour
- Water-holding capacity 0.16 - 0.20 centimeters per centimeter soil

Based on the estimated minimum water-holding capacity of 0.16 inches water per inch soil, a non-layered 4 feet (1.2 meters) deep soil profile will retain 7.8 inches (20 centimeters) of water.

Gravel for Final Cover

Materials ranging in size from coarse, washed sand to cobble-sized rock could be used to achieve the textural change necessary for the capillary barrier; however, 1/4 to 1/2 inch (6 to 12 millimeters) gravel is easily handled and provides a stable base over which the remainder of the barrier can be constructed. The gravel is also available on site at the excess concrete batch plant. The thickness of the gravel or capillary barrier will be at least 6 inches (15 centimeters). Barrier experience gained thus far has shown that this is the minimum thickness obtainable by use of heavy equipment during construction.

Geotextile for Final Cover

The distinctness of the textural change between the soil and the gravel layer will be maintained by use of a woven synthetic geotextile fabric. The geotextile is commonly used for load distribution and subgrade stabilization during roadway construction and offers excellent resistance to installation abuse. The product chosen is manufactured by Mirafi Construction Fabrics (Product No. 600X) which offers the tested properties shown in Table 6-2.

This product has been used in barrier construction at Hanford to prevent soil fines from sifting into the underlying gravel layer. This experience should prove useful during construction of the final cover at the trenches.

Vegetative Cover

Having established the ability of the final cover to safely store maximum annual precipitation, a mechanism for removal of the stored soil water must be provided. While estimates of annual evaporation closely approximate the annual precipitation, these estimates relate more accurately to total potential evaporation. Evaporation does account for the majority of the soil water removed; however, its effectiveness diminishes with soil depth.

To prevent the eventual accumulation of moisture and the possibility of drainage through the capillary barrier, a vegetative cover will be established to enhance soil water removal.

The two perennial wheatgrasses selected for revegetation of the final cover are Siberian wheatgrass (Agropyron sibericum) and thickspike wheatgrass (Agropyron dasytachyum), both of which have been used routinely with good success at Hanford. These species are drought tolerant and well suited to the medium- to coarse-textured local soils.

Once established, the vegetative cover will assure effective removal of available moisture (i.e., water held at less than -15 bars) throughout the 4 foot (1.2 meter) deep soil layer. The soil layer depth is sufficient to support and contain the rooting depth of the intended plant cover, and similar plant covers are known to be effective in exploiting soil-water to depths of at least four feet. Plant root penetration into the gravel layer is not expected to occur because of the gravel pore size and resultant lack of available moisture.

6.1e(3) Minimization of Liquid Migration

The primary objective of a cover system design is prevention of water infiltration into underlying waste zones where contact may leach contaminants into the groundwater. Most cover designs typically rely on impermeable barriers. An impermeable barrier as envisioned by the EPA at the present time would consist of clay and/or a synthetic liner. However, the use of clays in an arid environment is unacceptable because an optimum moisture content necessary to maintain the integrity and intended purpose of the clay liner cannot be assured. Eventual dessication will result in clay shrinkage and cracking with a subsequent loss of integrity. Synthetic liners would not be affected by the arid environment. However, their effectiveness depends heavily on the methods and care with which they are installed. Synthetic liners would be a barrier to both downward and upward moisture movement; but, over time, condensate would collect on the bottom side of the liner, which would act as a diverting mechanism for moisture to reenter the waste confinement zone. Therefore, neither clay nor synthetic material will fulfill the intent of the regulations, which are to prevent the entry of liquids into the closed waste containment area.

Recent research related to the long-term disposal of radioactive waste has shown that multilayer cover systems are effective in minimizing and preventing liquid migration into a buried waste zone in arid environments. Multilayer systems can use the natural material of rock and soil to provide a durable and long lasting cover system.

The basis for the multilayer approach is the soil water outflow law which states that water will not move from a fine-pore soil into much larger pores until the water is atmospheric or greater. For layered soils, this means that water will not move from fine soil into very coarse soils until the soil at the boundary between the soil layers approaches saturation. Field observations of layered soils indicate that significant increases in soil water storage can be attained when soils are underlain by coarse-textured materials. This is particularly true when the soil is moderately fine-textured. Table 6.3, (Miller, D. E., 1973, "Water Retention and Flow in Layered Soil Profiles", Field Soil Water Regime, R. R. Bruce, pp. 107-177, Soil Science Am. Special #5, Madison, Wisconsin) shows the effect of layering on water storage in an overlying soil.

The greater water retention is attributed to the textural differences between the upper soil and the capillary barrier. The coarser the underlying material, the less flow is expected until nearly saturated conditions prevail. The effectiveness of the multilayer cover to prevent or minimize liquid migration will thus be assured by:

- Highly nonlinear nature of unsaturated hydraulic conductivity across the fine soil/coarse gravel interface
- Water-holding capacity of the final cover soil
- Evapotranspiration of accumulated soil water

The soil of the multilayer cover system is a fine sandy loam. As a textural class, sandy loam is intermediate between loam and loamy sand. From Table 6-3, it can be inferred that moisture retention in a sandy loam soil underlain by coarse material (i.e., a capillary barrier) can be increased by a factor of at least 1.5. As stated previously in section 6.1e(2), a nonlayered 4 foot (1.2 meter) deep sandy loam soil profile will hold 7.8 inches (20 centimeters) of water, which is 2 inches (5 centimeters) more than the average annual precipitation and 3 inches (8 centimeters) less than the maximum recorded precipitation. Utilizing the above inferred increase in moisture retention capacity attributable to the presence of a capillary barrier, the estimated 7.8 inch total water retention capacity is increased to 11.7 inches (30 centimeters). Referring to Figure 6-1, the probability that annual precipitation will exceed this amount is estimated to be less than one percent. Further, assuming that evapotranspiration equals precipitation, the probability that precipitation will be great enough to penetrate the multilayer barrier can be estimated to be less than one percent.

6.1e(4) Maintenance Needs

Experience gained with Hanford Site surface stabilization (800 acres) since 1978 has shown that very little maintenance is required following the successful establishment of the vegetative cover. Successful establishment generally requires from two to three years. During this period, the straw mulch applied for initial stabilization and the natural emergence of cheatgrass (Bromus tectorum) which is ubiquitous in southeastern Washington, combine to protect the soil cover from erosion by wind. Also, trained personnel periodically evaluate seedling progress and recommend any necessary corrective actions. Herbicides are often used in the spring to selectively control annual broadleaf species which compete for available moisture and nutrients. Herbicide applications are discontinued following successful perennial grass establishment.

Fertilizer applications are sometimes needed after closure to stimulate plant vigor during the second or third year. Some instances of apparently increased small rodent activity have been discovered, primarily in the form of burrows in the trench cover side slopes. This potential problem has been practically eliminated by decreasing the side slope angles to three-to-one. The only other maintenance instituted as a result of periodic surveillance has been the manual removal of deep-rooted shrubs which might penetrate the soil cover. No additional backfilling has been required as a result of wind or water erosion to date. Maintenance of the final cover is not expected to be dissimilar from that experienced to date on other Hanford stabilization projects.

6.1e(5) Drainage and Erosion

No artificial drainage will be incorporated into the final cover system. Soil permeability and typical rainfall intensities are such that water erosion has not been a problem at Hanford. The greatest potential for erosion arises in the late winter when rapid snow melts may occur over frozen ground. No significant erosion has been recorded during routine surveillance of areas stabilized to date.

Initial erosion/abrasion protection will be provided by the application of a straw mulch. The entire cover and surrounding area disturbed during construction will be mulched at a rate of one ton of straw per acre. Mulching is an integral part of the revegetation process at Hanford and it has proven very successful in minimizing seedling damage and soil loss by winds. Once established, the perennial grasses will provide the protection necessary to minimize erosion over the long term. Little erosion has been recorded on other areas (800 acres) stabilized to date.

6.1e(6) Settlement and Subsidence

Localized settlement should not prove detrimental to the integrity of the multilayer cover. Significant subsidence events could disrupt the integrity of the final cover and reduce its effectiveness in preventing liquid migration. The geotextile will lend some support to the soil cover by providing load distribution should subsidence occur. Subsidence will be monitored through periodic surface measurements taken from permanent benchmarks and concrete perimeter posts. Possible maintenance actions are contained in the post-closure plan (6.2).

6.1e(7) Cover Permeability

Since no bottom liners (clay or synthetic) have been used at the trenches, the final cover system permeability need only be less than that of the underlying native soil. In lieu of detailed soils data, the Benton County Soil Survey was used to obtain estimated properties for Quincy series soils which correlate very closely to the Rupert series encountered at the trenches. These estimated properties are as follows:

- Textural class: loamy sand
- Unified class: SM
- Permeability: 25 centimeters per hour
- Water-holding capacity: 0.10 centimeters per centimeter soil

Referring to the estimated properties presented earlier for the Esquatzel series soils, the final cover soil has an estimated permeability of 0.8 to 2.5 inches per hour (6.0 centimeters per hour) compared to greater than 9.8 inches per hour (25.0 centimeters per hour) for the underlying native soil. Therefore, the permeability of the final cover soil (excluding the retarding effect of the cover system) is much less than that of the native soils at the trenches.

6.1f Continuance of Operations

During closure one trench will be in operation (i.e., receiving non-regulated aqueous solutions) while the other trench is characterized and remediated. Groundwater monitoring will continue as described in Section E.

6.1g Schedule for Closure

Closure will be initiated and all samples taken within 30 days of approval of the closure plan. All on-site waste will be removed by 90 days with final closure complete in 180 days. If a cover system is necessary, a detailed schedule for installation will be submitted to the regulating authority.

6.1h Extensions for Closure Time

If before or during the start of closure operations for the trenches it appears that closure may take more than 180 days, a demonstration will be made to the appropriate regulatory authority to explain the need to extend the 180 day closure time.

If the soil surrounding the trenches is contaminated and if extensive sampling and analysis are required, the removal of all the soil may take longer than 180 days. If this situation occurs, a demonstration will be made to the appropriate regulatory authority to explain the need to extend the 180-day closure time to protect human health and the environment.

6.2 POST-CLOSURE PLAN

If the contamination is extensive and the trenches are closed in place, the following post-closure plan will be implemented.

6.2a Inspection Plan

An engineer or scientist with experience in the construction and function of a multilayered cover system will perform the following monitoring activities semiannually for the first five years and annually for the remainder of the post-closure period:

a. Evaluation of settling/subsidence
b. Evaluation of vegetative cover
c. Evaluation of bench marks
d. Evaluation of security
e. Evaluation of rodent intrusion
f. Evaluation of erosion

The frequency of inspection is expected to be adequate to detect any serious problems with the cover system.

Maintenance action will be initiated within 90 days if the inspection reveals that the integrity of the final containment structure can potentially be breached.

A potential breach is defined below along with the possible maintenance action:

a. Settling/subsidence greater than three feet will initiate maintenance action. Maintenance action may include injecting a grout into identified void spaces and reestablishing the integrity of the multilayer cover system; or stabilizing the settling/subsidence area and relaying the multilayer system over the affected area. If, at the time of maintenance action, new products and/or information is available to perform the needed repair in a comparable manner to the actions listed above, those maintenance actions may be considered in lieu of the above proposed actions.

b. Vegetative cover less than ten percent after two years of closure (seeding) will initiate maintenance action. Maintenance action will include reseeding and possible fertilizer application.

c. Bench marks observed to be damaged or out of alignment will result in maintenance action. Maintenance action will include replacement of damaged bench marks and resurveying of bench marks found to be out of alignment.

d. Damage to the enclosing fences which allow access to the trenches will result in maintenance action. Maintenance action will include repair of the fence.

e. Rodent intrusion in densities that are judged to threaten the integrity of the multiliner system will result in maintenance action. Maintenance action might include the use of chemical deterrent and/or trapping.

f. Erosion damage that results in the loss of 0.5 meters of the fine soil top layer will result in maintenance action. Maintenance action will include replacement of the fine soil top layer at the affected area, reseeding, and performing other selected tasks that were performed during closure to insure a vigorous vegetative growth.

6.2b Monitoring Plan

During the post-closure care period, groundwater monitoring will be conducted as described in Section 5.7. There are no liners or leachate collection and removal systems at the 300 Area Process Trenches. All groundwater monitoring wells for the 300 Area Process Trenches are within a secured area of the Hanford Site. All wells will be routinely inspected to ensure proper operation.

6.2c Maintenance Plan

During the post-closure care period, the maintenance organizations are directed at maintaining the integrity of the waste containment system. Experience gained since 1978 with containment systems has shown that the waste containment system will remain intact if the vegetative cover is successfully established. Invading plants, primarily Russian thistle (Salsola Kali), with root systems that can extend into the waste zones, are the greatest potential problem. The active elimination of these invading species for two years after seeding will give the vegetative cover enough time to become firmly established.

Each Spring (generally between March 15, and April 15) for two to three years following closure, selective herbicides 2,4-D amine and dicamba (or their equivalent) will be applied to the closure area to minimize the establishment of deep rooting broadleaf annual plants that compete with the grasses for moisture and nutrients. Field application rates of 0.57 to 1.32 pounds per acre with 2,4-D amine and 0.19 to 0.44 pounds per acre with dicamba have proven effective in controlling undesirable broadleaf species. Selective herbicide applications will be discontinued following successful establishment of the perennial grass cover. Following establishment of the perennial grass cover, manual removal of deep rooting shrubs may be required periodically.

Soil permeabilities and rainfall intensities at Hanford are such that water erosion has proven to be practically nonexistent. However, the potential for wind erosion is possible, particularly during the period of vegetative establishment. Current mulching practices, which will be implemented during closure, have been quite effective at minimizing wind erosion. To date, there has been no need to import or provide additional backfill as a result of erosion.

Maintenance of bench marks has not been a problem to date. Vegetative growth is limited in the arid environment and bench marks are easily observable. Enough ground cover exists so that drifting sand does not overrun the bench marks. If a bench mark needs to be replaced, that action will be completed within 90 days of the original observation.

6.2d Land Treatment

This section is not applicable to the 300 Area Process Trenches.

6.3 NOTICE IN DEED

Notice to Local Land Authority

The DOE-RL will file, within 90 days after the start of post-closure care period, the following documents or similar documents to the local land use authority and the regulating authority. The land use authority is the Benton County Planning Department located at Courthouse Building, Prosser, Washington, 99350.

a. A survey plat indicating the location and dimensions of trenches to the extent the information exists and with respect to permanently surveyed bench marks will be submitted. This plat will be prepared by a certified professional land surveyor.

b. The following note is to accompany the survey plat: This plat describes real property in which hazardous wastes have been disposed and buried in accordance with requirements of 40 CFR Part 264 and/or WAC 173-303. Although this hazardous waste disposal facility is now closed, public health, environmental safety, and regulations issued by the EPA in 40 CFR 264.119 and/or the WDOE in WAC 173-303-610(9) require that post-closure use of the property never be allowed to disturb the integrity of the final cover unless it can be demonstrated that any proposed disturbance will not increase any risk to the human health or the environment.

c. A record of the type, location, and quantity of hazardous wastes disposed of within each trench to the extent that the information exists will be submitted. During the post-closure care period, any changes to this record will be submitted to the regulating authority.

Notice in Deed to Property

The DOE-RL will, in accordance with state law, sign, notarize, and attach the following notation to the deed of the 300 Area Process Trenches within 180 days of the start of the post-closure care period:

TO WHOM IT MAY CONCERN:

The U.S. Department of Energy-Richland Operations Office, an operations office of the U.S. Department of Energy, which is a Department of the United States Government, the undersigned, whose local address is the Federal Building, 825 Jadwin Avenue, City of Richland, County of Benton, State of Washington, hereby gives the following notice as required by 40 CFR 270.14(b)(14) and/or WAC 173-303-806(4)(a)(xiv).

a. The U.S. Department of Energy is, and since April 1943, has been in possession in fee simple of the following described lands (legal description).

b. Since November 19, 1980, the U.S. Department of Energy-Richland Operations Office has disposed of hazardous and/or dangerous waste under the terms of regulations promulgated by the United States Environmental Protection Agency and/or Washington Department of Ecology to the above-described land.

c. The future use of the above-described land is restricted under the terms of 40 CFR 264.117(c) and/or WAC 173-303-610(7).

d. Any and all future purchasers of this land should inform themselves of the requirements of the regulations and ascertain the amount and nature of wastes disposed on the above-described property.

e. U.S. Department of Energy-Richland Operation Office have filed a survey plat with the Benton County Planning Department and with the United States Environmental Protection Agency Region 10 and/or Washington Department of Ecology showing the location and dimensions of trenches and a record of the type, location and quantity of waste disposed within each area of the facility.

6.4 CLOSURE COST ESTIMATE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

6.5 FINANCIAL ASSURANCE MECHANISM FOR CLOSURE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

6.6 POST-CLOSURE COST ESTIMATE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

6.7 FINANCIAL ASSURANCE MECHANISM FOR POST-CLOSURE CARE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

6.8 LIABILITY REQUIREMENTS

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

TABLE 6-1

PROPOSED ANALYTICAL PARAMETERS FOR THE 300 AREA PROCESS TRENCHES SAMPLES

Required Constituents (Drinking Water Parameters)

Arsenic
Barium
Cadmium
Chromium
Fluoride
Lead
Mercury
Nitrate (as N)
Selenium
Silver
Endrin
Lindane
Methoxychlor
Toxaphene
2,4-D
2,4,5-TP Silvex
Radium
Gross alpha
Gross beta
Coliform bacteria

Site Specific Constituents

Hydrofluoric Acid	Listed
Hydrogen	Listed
Tetrachloromethane (Carbon tetrachloride)	Listed
Antimony	Listed
Benzene	Listed
Chlorinated Benzenes	Listed
Dioxane	Listed
Dioxin	Listed
Formaldehyde	Listed
Formic Adid	Listed
Hexachlorophene	Listed
Hydrazine	Listed
Hydrocyanic Acid	Listed(a)
Methyl Ethyl Ketone	Listed
Naphthalene	Listed
Nickel	Listed
Phenol	Listed
Pyridine	Listed
Selenium compound - Selenium Sulfide	Listed(a)

See footnotes at end of table.

TABLE 6-1
(Continued)

Site Specific Constituents (Continued)

Thiourea	Listed
Toluene	Listed
1,1,1-Trichloroethane (Methyl Chloroform)	Listed
Trichloroethane (Ethane 1,1,2-trichloro-)	Listed
Trichloroethene (Trichloroethylene)	Listed
Copper	Unlisted
Perchloroethylene	Listed
Nitric Acid	Unlisted(a)
Sulfuric Acid	Unlisted(a)
Sodium Hydroxide	Unlisted(a)
Ammonium Bifluoride	Unlisted(a)
Aluminum Nitrate	Unlisted(a)
Sodium Chloride	Unlisted(a)
Ethylene Glycol	Unlisted
Sodium Nitrate	Unlisted(a)
Xylene	Listed
Kerosene	Unlisted(a)
Tributylphosphate - Paraffin Hydrocarbon Solvents	Unlisted(b)
Degreasing Solvents	(b)
Detergents	(b)
Photochemicals	(b)

Additional constituents specifically required by EPA and State Regulations.

(a) No approved analytical method is currently available for this compound; components will be analyzed separately where possible.

(b) When listing the chemicals discharged at the facility, the facility operators indicated these general categories of chemicals as well as some specific chemicals. No analysis is currently planned, pending further guidance.

TABLE 6-2
PROPERTIES OF MIRAFI GEOTEXTILE

600X FABRIC	UNIT	TEST METHOD	TYPICAL VALUES
Grab Tensile Strength	lb	ASTM D-1682-64	300
Grab Tensile Elongation	%	ASTM D-1682-64	35 (Max)
Burst Strength	psi	ASTM D-3786-80	600
Trapezoid Test Strength	lb	ASTM D-1117-80	120
Puncture Resistance	lb	ASTM D-3787-80	130

TABLE 6-3

WATER RETENTION IN LAYERED SOIL PROFILES

SOIL MATERIAL	STORED WATER (cm Water/60 cm Soil) TEXTURE LOAMY SAND	LOAM	SILT LOAM
Soil underlain by sand layer (at 60 cm depth)	16.4	17.4	20.0
Uniformly deep soil with no layer	6.7	11.4	16.7
Ratio layered/uniform	2.5	1.5	1.2

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APPENDIX B

Project Management Plan
Trench Characterization

EDT NO. A-12447

TO: Approval List Project Management Plan 300 Area Process Trench Characterization ATTN:	FROM D. L. Pursley	PAGE 1 OF 1	SELLER CODE NA

PURCHASE ORDER/SUBCONTRACT NO.	DO NO.	MAJOR ASSY. DWG. NO.	EQ. PIECE NO.	HEDL RESP. ENGR.
NA	NA	NA	NA	D. L. Pursley

ORIGINATOR'S REMARKS

Please review the attached Project Management Plan for approval.
Note any comments on attached copy.

ADDRESSEE'S REMARKS

ORIGINATOR APPROVAL	DATE	RESPONSE REQ'D DATE	REF EDT NO	ERO NUMBER
DL Pursley	3/20/86	3/25/86	NA	NA

DATA TRANSMITTED

ITEM NO.	DOCUMENT NUMBER	SHEET NO.	REVISION	ADDEND. NO.	TITLE OR DESCRIPTION	A APPROVAL LEVEL	B REASON FOR SUBMITTAL	C DISPOSITION	D
1	W.O.B33644-1				Project Management Plan-Trench Characterization	2	1	2	
					RECEIVED				
					APR 15 1986				
					R.L. MARTIN				

USE "EDT" CONTINUATION PAGES FOR ADDITIONAL ITEMS

THE DISPOSITION PROVIDED HEREIN DOES NOT RELIEVE THE DESIGN CONTRACTOR OR SUPPLIER OF ANY OBLIGATION REQUIRED UNDER THE PURCHASE ORDER/SUBCONTRACT. THIS ENGINEERING DATA TRANSMITTAL CANNOT AUTHORIZE A CHANGE IN PURCHASE ORDER, PRICE, DELIVERY, SUBCONTRACT COST, FEE, OR DELIVERY.

DATE ____ AUTHORIZED REPRESENTATIVE FOR ADDRESSEE ____

DISPOSITION ACKNOWLEDGED & ACCEPTED ____ DATE ____

REASON FOR SUBMITTAL (COL B)
1. REQUEST APPROVAL
2. ISSUE RELEASED DOCUMENT
3. SUBMIT INFORMATION
4. IN PROGRESS REVIEW

DISPOSITION CODES (USE FOR COL. C & D)
1. APPROVED FOR RELEASE WITHOUT COMMENT.
2. APPROVED FOR RELEASE SUBJECT TO ATTACHED COMMENTS.
3. DISAPPROVED - COMMENTS ATTACHED.
4. REVIEWED - NO COMMENTS.
5. REVIEWED - COMMENTS ATTACHED.
6. RECEIPT OF SUBMITTAL ACKNOWLEDGED.

DOE DISPOSITION CODES (USE FOR COL "E")
11. APPROVED WITHOUT COMMENT.
12. APPROVED SUBJECT TO ATTACHED COMMENTS.
13. DISAPPROVED - COMMENTS ATTACHED.
14. REVIEWED - NO COMMENTS.
15. REVIEWED - COMMENTS ATTACHED.

RESP ENGR REQUESTS RESPONSE BY 3/25/86

ABBREVIATIONS USED BELOW
REVIEWER'S ACTION REQUIRED (RAR)
CON - CONCUR
C/C - CONCUR WITH COMMENT
NC/WC - NON CONCUR WITH COMMENT
A - APPROVE
R - REVIEW
I - INFORMATION

DOE DISPOSITION REQUESTED FROM
NAME NA DATE DUE ____

DOE DISPOSITION (COL. "E")
SIGNATURE NA DATE ____

APPROVAL NAME AND CODE NO.	RAR	CON	C/WC	NC/WC	SIGNATURE	DATE	APPROVAL NAME AND CODE NO.	RAR	CON	C/WC	NC/WC	SIGNATURE	DATE
CONSTRUCTION MGR ME Borgeson	A	X				3/[illegible]/86	[illegible] for RL Watts	A	X				
KG Toyoda	A	X				3/[illegible]/86	WJ McShane	I					
PLANT SAFETY JR Bell	A	X				4/1/86							
QUALITY ASSURANCE WH Caplinger	A	X											
GD Carpenter	A	X											
RESPONSIBLE ENGINEER MG Zimmerman	A	X											
RESPONSIBLE ENGINEERING MGR. RL Martin	A	X			R Martin	3/[illegible]/86	CCB ACTION ☐ APPROVED ☐ DISAPPROVED					COST ACT MGR NA	CCB LOG NO NA

BD 7400-172 (4-83)

EDT NO. A-12447

W. O. B83644-1
Project Management Plan

300 Area Process Trench Characterization
Revision 0

Prepared By: D. L. Pursley D.L. Pursley

Approved By:

Marvin E Borgeson
Manager, Project Engineering — Date 3/20/86

R L Martin
Manager, Waste Systems Engineering — Date 3/24/86

Manager, Engineering Services — Date 3/27/86

J R Bill
Manager, Industrial Safety & Fire Protection — Date 4/1/86

for R L Watts
Manager, Operational Health Physics — Date 4/3/86

Manager, Operational Safety — Date 4/3/86

R. O. Budd
Manager, Safety — Date 4/3/86

for WAC
Manager, Fuels Quality Engineering — Date 4/7/86

Project Management Plan

300 Area Process Trench Characterization

Revision 0
February 24, 1986

1.0 Introduction

This plan describes the Project Management methods and controls to be used to manage the 300 Area Process Trench soil characterization. This characterization is being completed to meet the requirements of the Closure/Post - Closure Plan, 300 Area Trenches, dated 11/85 submitted to the State of Washington by DOE. The 300 Area Process Trenches include two 1500 ft long leaching trenches, 45 ft apart, used for disposal of cooling water and nonregulated aqueous wastes generated in the 300 Area. These trenches have received regulated waste in the past and this characterization is part of the overall commitment by DOE to administer this facility and limit future releases to the environment within acceptable limits. Characterization will be accomplished by shallow soil sampling in the trench bottoms completed by WHC and deep soil sampling via wells drilled under JAJ subcontract in the area between the trenches.

2.0 Project Objective

The primary objective of this project is to set up a project control structure for preparation, approval, and administration of procedures to obtain soil samples and laboratory test results.

Schedule objectives are to make preparations and proceed as soon as Battelle/U.S. Testing can receive soil samples for laboratory testing. The present target date for acceptance of samples is April 15, 1986. (Short Term Planning Schedule attached.) Cost objectives are to meet a total project cost of 237,000 for the Short Term schedule items. Coordination of activities involved with sampling, transporting, testing and reporting are extremely important. This will require careful planning and coordination between PNL, RHO, JA Jones and WHC. The results of the short term sampling will determine the next step, which will be a final report to DOE on clean up and closure of the trenches.

3.0 Project Organizations

This project will involve interface between personnel of Battelle/U.S. Testing, RHO, JA Jones, a Third Party Inspector and WHC. See the attached project organizations chart.

3.1 RHO will provide coordination with JA Jones for preparation of a Fixed Price contract to drill the sampling wells. The drilling contractor will take the required samples and provide them to WHC Personnel at the test site.

3.2 JA Jones will prepare and manage a fixed price contract for drilling of the sampling wells.

3.3 WHC will provide overall project coordination, documentation control and cost control. WHC will also sample the trench bottoms and coordinate packaging, labeling and transport of these samples to Battelle/U.S. Testing. WHC will also receive samples from the drilling site and coordinate packaging, labeling and shipment to Battelle/U.S. Testing. WHC will also generate a final report. WHC will obtain a geologist for onsite services during the trench bottom sampling and the sample well drilling.

3.4 Battelle/U.S. Testing will schedule to complete laboratory testing as required and provide timely test results back to WHC. All testing will be completed under a procedure reviewed and approved by WHC Waste Systems Engineering and WHC Quality Assurance.

3.5 Third Party Inspection will provide overview inspection services for the sampling, storage and transportation of samples.

4.0 Project Participants Responsibilities and Authority

4.1 Westinghouse Hanford Company (WHC) will be responsible for overall technical direction and coordination of project efforts. WHC will provide a project file and set up project controls to obtain proper review and approval of all procedures & schedules and QA reviews and the timely update of project documents as new information becomes available. The project file will be set up to provide a traceable history of progress and allow final disposition and/or storage of project records.

WHC will issue excavation and/or drilling permits and welding and cutting permits for the fixed price work. WHC will provide Radiation Monitoring services at the drilling site and as required for the transported samples. WHC will provide any temporary badging and escort services as required to meet site security requirements. WHC will review and approve the Battelle/U.S. Testing Laboratory procedures.

WHC will notify the third party inspection personnel of trench bottom sampling. WHC will complete sampling of the trench bottoms and coordinate testing of these samples by Battelle/U.S. Testing. WHC will also coordinate with JA Jones and the drilling contractor for sampling during the drilling operation and coordinate testing of these samples by Battelle/U.S. Testing.

4.2 Rockwell Hanford Operations Company (RHO) will provide specific direction to JA Jones company to facilitate preparation of a fixed price contract for onsite drilling using the RHO regulated cable tool drilling rig and drilling equipment.

4.3 JA Jones Construction Company will provide construction management services to include:

1) Prepare bid packages and award construction fixed price subcontracts as required.

2) Provide orientation for construction subcontractors relative to policies and requirements applicable to contractors performing work at Hanford.

3) Provide subcontractor personnel badging and escorts required to meet site security requirements.

4) Review applicable project procedures and plans and provide comments.

5) Provide and update schedules as required.

6) Provide safety inspection for subcontract.

7) Participate in project kickoff meeting, planning meetings, and provide monthly progress reports.

8) Notify the Third Party Inspection personnel of planned well sampling.

4.4 Battelle/U.S. Testing will prepare to meet the soil sample laboratory testing schedule and provide timely reports of results to WHC.

4.5 Third Party Inspector will prepare an inspection plan for WHC review and approval and provide inspection personnel to cover the sampling activity.

4.6 Subcontractor responsibilities will be specified in contract documents.

5.0 Project Management Control System

5.1 This project will be controlled in accordance with Project Management System, of Engineering Services, Standard Engineering Practices, MG-200 and WHC QA requirements, MG-100. Approval of and any subsequent changes to the baselines, will be processed in accordance with these documents.

5.2 Project Baseline Documents

5.2.1 Closure/Post Closure Plan, 300 Area Trenches, dated 11/85

This plan includes the baseline requirements for both shallow and deep sampling of the 300 Area Trenches. This plan also includes effluent sampling and groundwater monitoring requirements being completed separately from this project. Final results from all sampling and testing will be compiled by WHC into a final report to DOE/EPA-STATE.

5.2.2 Procedure for Shallow Soil Sampling of 300 Area Process Trenches - W.O. B83644-2

This plan/procedure will describe/define methods used in taking samples from the bottom of the trenches and the inspection requirements required to meet the State and Federal regulatory compliance requirements. Packaging, labeling and transporting requirements will also be included in the plan/procedure.

5.2.3 Procedure for Deep Soil Sampling of 300 Area Process Trenches - W.O. B83644-3

This plan/procedure will describe/define methods of taking soil samples during the drilling operation and the inspection requirements required to meet the State and Federal regulatory compliance requirements. Packaging labeling and transporting will be included in the plan/ procedure.

5.2.4 Laboratory Analysis Plan for 300 Area Process Trench Soil Samples - W.O. B83644-4

This plan will describe the laboratory analysis to be performed on the soil samples and the QA controls used. This plan will also describe the handling differences between the regular samples and the 20% fully analyzed samples.

5.2.5 Schedule

The schedule is based on preparations by Battelle/ U.S. Testing to receive and handle the large numbers of samples and provide turnaround to meet the project requirements. Presently the schedule is based on Battelle/ U.S. Testing being ready to accept fifteen samples per week starting April 15, 1986. Twelve of the fifteen weekly samples will receive screen testing and three will receive a full analysis.

5.2.6 Cost Estimate

Shallow Sampling (96 Samples)

Physical sampling	$15,000
Analysis of regular samples (76)	36,480
Full analysis samples (20)	74,300
QA samples	10,000
Subtotal	$135,280

Deep Sampling (48 Samples)

Physical sampling	
Well drilling	$20,000
RHO support	12,000
Analysis of regular samples (38)	18,240
Full analysis samples (10)	37,400
QA samples	5,000
Subtotal	$92,640
Total	$228,920
Contingency (12%)	$26,310
	$255,230

6.0 Approval and Change Control

6.1 All documents prepared or changed under this project will be handled within WHC as Impact Level 2 with the concurrence of Battelle/U.S. Testing, RHO, the third party inspector or JAJ as required. These documents include but are not limited to those listed under Section 6.4. Approval organizations shall include, Project Engineering, Waste Systems Engineering, Industrial Safety and Fire Protection, Operational Health Physics, Environmental and Radiological Engineering and Fuels Quality Assurance.

6.2 Initial review and approval of project documents shall be transmitted and recorded via an Engineering Data Transmittal (EDT) form. Subsequent revision shall be handled by an Engineering Change Notice (ECN).

6.3 All documents prepared as part of this project will be handled per the WHC Management Guide 5-03 as detailed in the "WHC Records Management Guide," HEDL-MG-121 Rev. 1 Appendix C, Schedule 24, Item #9.

6.4 Project Documents

W.O. B83644-1, Project Management Plan
W.O. B83644-2, Procedure for Shallow Soil Sampling of 300 Area Process Trenches
W.O. B83644-3, Procedure for Deep Soil Sampling of the 300 Area Process Trenches
W.O. B83644-4, Laboratory Analysis Plan for 300 Area Process Trench Soil Samples

Soil Sample Log Sheets
Soil Sample Chain of Custody Sheets
Laboratory Test Result reports

7.0 Quality Assurance

The quality assurance program for the Process Trench Characterization will be directed by WHC Quality assurance in accordance with requirements in MG-100 Quality Assurance, the quality assurance program manual for WHC. The quality assurance program at WHC is in compliance with the requirements of ANSI/ASME NQA-I Quality Assurance Program Requirements for Nuclear Facilities. The following requirements as defined and implemented by the WHC quality assurance program have been applied to the Process Trench Characterization work.

7.1 Quality Assurance Program

The management, direction and definition of the WHC QA program is defined in MG-100. The Process Trench effort will be managed and controlled in accordance with procedures in this manual.

7.2 Instructions, Procedures and Drawings

The procedures described in Section 5 of this program plan will be prepared to define and control the activities that have a bearing on the validity of projects results. These activities include shallow sampling, deep sampling and laboratory analyses control. Existing WHC procedures will be used to control other activities such as supplier selection and evaluation, inspection and document preparation, review and approval. The existing procedures are found in MG-100 and MG-200 Standard Engineering Practices.

7.3 Document Control

Documents will be prepared, reviewed, approved and controlled as defined by Section 6.0 of this program plan.

7.4 Control of Purchased Items and Services

The significant procured items for this project are the sample testing services and the inspection overcheck services of the drilling and sample collection activities. WHC QA will assure through supplier evaluation and selection that the selected testing lab is capable of performance to the project requirements. The inspection overcheck services will be performed by the Third Party Inspector in accordance with an inspection plan approved by WHC quality and project personnel.

7.5 Identification and Control of Items

The procedures discussed in Section 5 of the plan will define the method to be used to assure that the test samples are identified and the identity is maintained until the completion of the test activity. The procedures will define the tagging, numbering, recording and tracking of sample containers throughout the testing process.

7.6 Control of Special Processes

The special processes that apply to this project are the activities to be performed by the test lab to analyze and control the test samples. WHC QA will assure that the selected testing facility has an established and documented system for control of their testing activities.

7.7 Inspection

Inspection activities for the project will occur during drilling, sample collection and testing of the collected samples. The inspection of the sample collection activity may be performed by WHC QA personnel or by a separate third party inspector. It will include witness of collection activities and verification that collection, sampling, storage and delivery of test samples is performed as required by the project procedures. The results of inspections will be documented on inspection reports. WHC QA will assure that appropriate inspections of the test analysis activity is performed by the quality organization of the test lab through overview of inprocess testing and review of supplier inspection records as appropriate.

7.8 Test Control

WHC QA will verify that the selected test lab has established and documented systems for the control of test activities and that objective evidence is available that these systems are followed during the performance of the work for this project.

7.9 Handling, Storage and Shipping

The handling, storage and shipping of the samples will be performed in accordance with the procedures developed as described in Section 5 of this plan. The procedures will define the methods to be used to assure the integrity of the samples throughout the process and until they are under the control of the test lab.

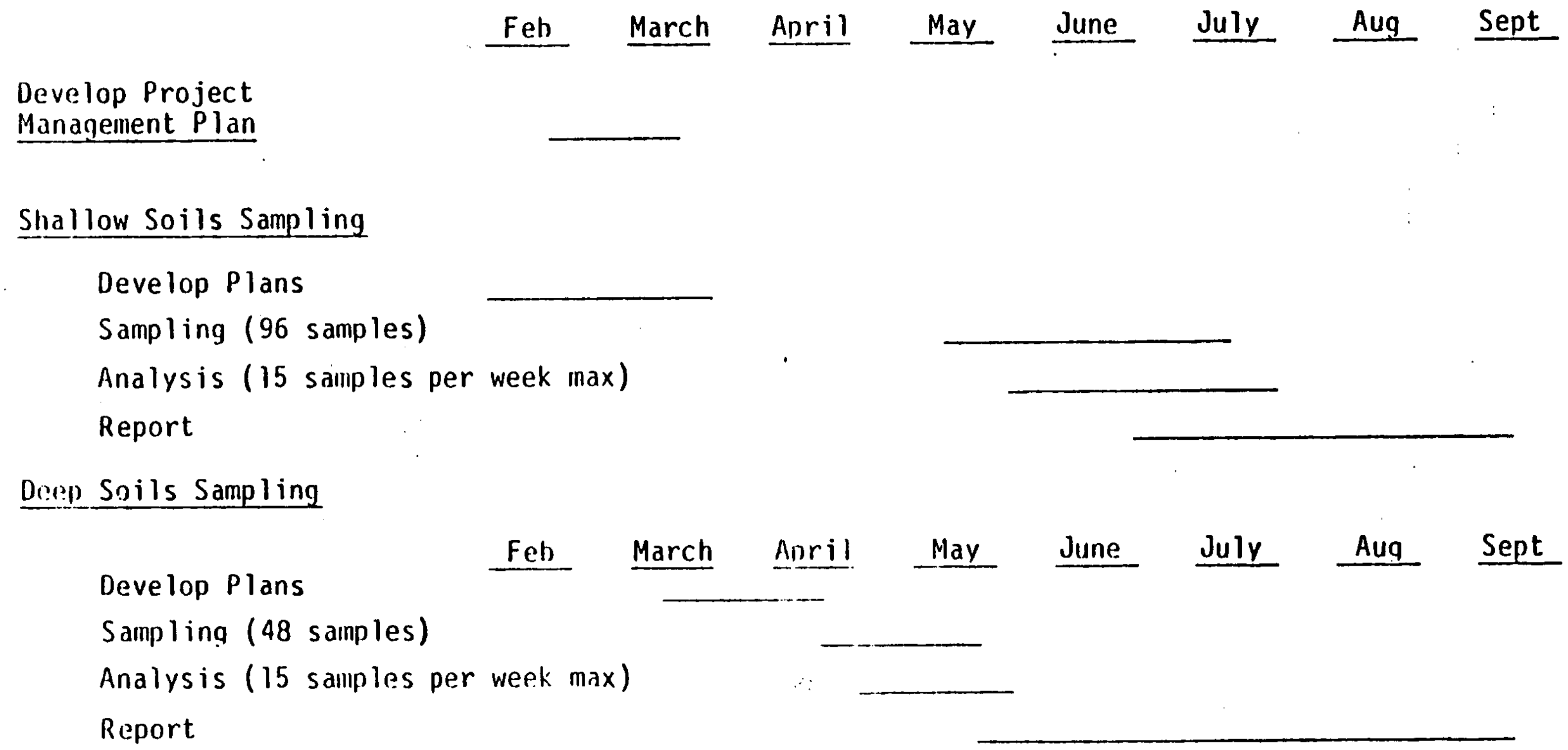
7.10 Control of Nonconformances

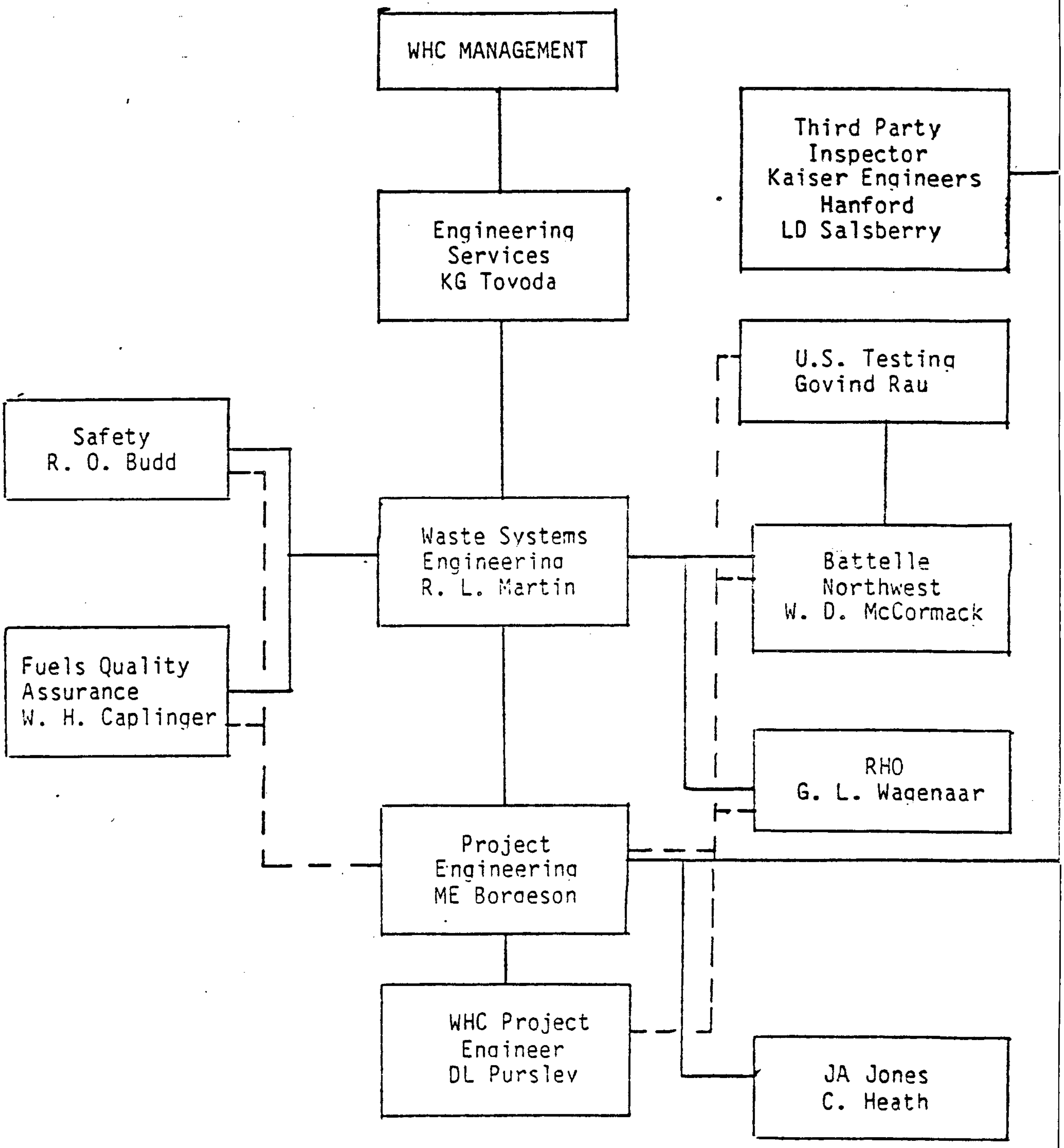
Nonconformances discovered during the performance of this project will be identified, documented, controlled and dispositioned in accordance with MG-100 Section 15 Nonconformance Control. Nonconforming items are identified and controlled with hold tags or other appropriate means, documented on nonconformance reporting forms and dispositioned by the responsible technical authority and quality assurance.

7.11 Records

The records that furnish evidence that sampling program was performed in accordance with the requirements of the project plan will be identified, collected, stored and maintained as defined in Section 6 of this project plan. Section 6 identifies the records to be collected, the storage location and the storage life of each record.

SHORT TERM PLANNING SCHEDULE





———————— Direct Organizational Responsibility

------------ Coordination Responsibility

300 AREA TRENCH CHARACTERIZATION

PROJECT ORGANIZATION

APPENDIX C

Shallow and Deep Soils Sampling Procedures

ENGINEERING DATA TRANSMITTAL

EDT NO. A12458

TO: Approval Personnel

ATTN:

FROM D. L. Pursley
Project Engineering

PAGE 1 OF 1

SELLER CODE NA

PURCHASE ORDER/SUBCONTRACT NO.	DO NO.	MAJOR ASSY. DWG. NO.	EQ. PIECE NO.	HEDL RESP. ENGR.
NA	NA	NA	NA	D. L. Pursley

ORIGINATOR'S REMARKS

Procedure for Approval

ADDRESSEE'S REMARKS

ORIGINATOR APPROVAL	DATE	RESPONSE REQ'D DATE	REF EDT NO	ERO NUMBER
D L Pursley	4/14/86	4/18/86	NA	NA

DATA TRANSMITTED

ITEM NO.	DOCUMENT NUMBER	SHEET NO.	REVISION	ADDEND. NO.	TITLE OR DESCRIPTION	A APPROVAL LEVEL	B REASON FOR SUBMITTAL	C DISPOSITION	D	E
1	B83664-2		0		Shallow Soils Sampling Procedure	2	1	1		

USE "EDT" CONTINUATION PAGES FOR ADDITIONAL ITEMS

THE DISPOSITION PROVIDED HEREIN DOES NOT RELIEVE THE DESIGN CONTRACTOR OR SUPPLIER OF ANY OBLIGATION REQUIRED UNDER THE PURCHASE ORDER/SUBCONTRACT. THIS ENGINEERING DATA TRANSMITTAL CANNOT AUTHORIZE A CHANGE IN PURCHASE ORDER, PRICE, DELIVERY, SUBCONTRACT COST, FEE, OR DELIVERY.

DATE ______ AUTHORIZED REPRESENTATIVE FOR ADDRESSEE ______

DISPOSITION ACKNOWLEDGED & ACCEPTED ______ DATE ______

REASON FOR SUBMITTAL (COL B)
1. REQUEST APPROVAL
2. ISSUE RELEASED DOCUMENT
3. SUBMIT INFORMATION
4. IN PROGRESS REVIEW

DISPOSITION CODES (USE FOR COL C & D)
1. APPROVED FOR RELEASE WITHOUT COMMENT.
2. APPROVED FOR RELEASE SUBJECT TO ATTACHED COMMENTS.
3. DISAPPROVED - COMMENTS ATTACHED.
4. REVIEWED - NO COMMENTS.
5. REVIEWED - COMMENTS ATTACHED.
6. RECEIPT OF SUBMITTAL ACKNOWLEDGED.

DOE DISPOSITION CODES (USE FOR COL "E")
11. APPROVED WITHOUT COMMENT.
12. APPROVED SUBJECT TO ATTACHED COMMENTS.
13. DISAPPROVED - COMMENTS ATTACHED.
14. REVIEWED - NO COMMENTS.
15. REVIEWED - COMMENTS ATTACHED.

RESP ENGR REQUESTS RESPONSE BY 4/18/86

ABBREVIATIONS USED BELOW
REVIEWER'S ACTION REQUIRED (RAR)
CON - CONCUR
C/C - CONCUR WITH COMMENT
NC/NC - NON CONCUR WITH COMMENT
A - APPROVE
R - REVIEW
I - INFORMATION

DOE DISPOSITION REQUESTED FROM
NAME NA DATE DUE ______

DOE DISPOSITION (COL. "E")
SIGNATURE NA DATE ______

APPROVAL NAME AND CODE NO.	RAR	CON	C/C	NC/NC	SIGNATURE	DATE
CONSTRUCTION MGR ME Borgeson	A	X				4/14/86
RL Watts	A					
PLANT SAFETY JR Bell	A					
QUALITY ASSURANCE DL Shugars	A	X			DL Shugars	4/16/86
GD Carpenter	A					
RESPONSIBLE ENGINEER DL Pursley	A	X			DL Pursley	4/14/86
RESPONSIBLE ENGINEERING MGR. RL Martin	A					

APPROVAL NAME AND CODE NO.	RAR	CON	C/C	NC/NC	SIGNATURE	DATE

[illegible] ACTION: APPROVED NA DISAPPROVED

[illegible] MGR: NA

[illegible] LOG NO: NA

Development Laboratory
A subsidiary of Westinghouse Electric Corporation
P. O. Box 1970 Richland, Wa 99352

PAGE 1 OF 1

PROCEDURE NUMBER	FACILITY	DATE
B83664-2	N/A	4/8/86

TITLE	REVISION NO.
300 Area Process Trenches - Shallow Soils Sampling Procedure	0

PREPARED BY	REVIEWED BY	APPROVED BY
D. L. Pursley 4/14/86	EDT A-12458	EDT A-12458

1.0 Purpose

This procedure defines the methods to be used in obtaining soil samples from the bottom of the two 300 Area Processes Trenches and for handling these samples from the field to the laboratory. All samples must be taken and controlled per EPA Publication SW-846, Second Edition, July 1982, "Test Methods for Evaluating Solid Waste," such that they are compatible with State and Federal regulatory compliance requirements.

2.0 General

2.1 Each of the two trenches will be sampled, at their center in 16 locations starting as close to the weir box as practicable and proceeding in 100 ft. intervals. Measurement of the distance from the weir box to the first sample station will be recorded. A stake will also be placed in the side of the trench at each sample station. Each sample location shall yield three separate samples. The first sample shall be taken from the loose sediments washed into the trench from the weir box. The depth of these loose sediments will vary depending on the distance from the weir. The second and third samples will be taken at four inches below the loose sediments and at approximately 18 inches below the loose sediments. The actual depth of each excavation will vary according to the thickness of the loose sediments. At some point away from the weir box the sediments may be so thin that not enough material can be collected for a sample. In these cases the condition will be logged and no sample of the sediments will be taken.

2.2 Each complete sample will consist of nine separate bottles of soil and the geologists sample. The geologists sample will include approximately one quart of material in a plastic bag labeled with the location. The sample bottles will include three 40 mL amber glass bottles, three 250 mL amber glass bottles and three 125 ml polyethylene bottles. Each bottle will be filled with soil leaving no head-space and then sealed tightly. Bottle caps must not be interchanged. A seal tape will be placed over each bottle lid and then the bottles will be packed in ice for transport to the laboratory. Each set of nine bottles will be pre-labeled to include the sample location code, a use designation code and an analysis code.

The following table indicates the information to be supplied on the labels.

Trench: E - East; W - West

100 ft markers: 1-16

Depth: L - Loose Sediments
S - 4" below Sediments
D - 18" below Sediments

Bottle Designation: A - Analysis at U.S. Testing
B - Backup Storage at 325 Bldg.

Analysis Type: VOA - X (Bottle 1-3)
ABN - Y (Bottle 1-2)
Metal - Z (Bottle 1-3)

Example: E1LAX1
East Trench
Marker at 0 ft. #1
Sediment Sample
Analysis at U.S. Testing
VOA Analysis, bottle #1

When the sample has been labeled and packed in ice in the transport cooler, a CHAIN-OF-CUSTODY form will be filled out (PNL Form #BC-1200-345 (7-85)). The sample information will then be entered on the "Sample Log Form" and a "Sample Analysis Request Form" will be filled out. Each sample will have eight of the nine bottles transported to U.S. Testing with one 250 ml sample kept by WHC in refrigeration at 325 Bldg. Separate coolers will be used for the U.S. Testing and WHC samples. For each delivery, the chain-of-custody forms will be signed by both the person relinquishing the samples and the person receiving the samples. See the sample of "Chain-Of-Custody," "Sample Log Form" and "Sample Analysis Request Form" in Appendix A.

2.3 Samples must include only fine materials without stones. If separation of the finer materials from gravel and cobbles becomes a problem screens will be used along with hand brushing of the finer materials from the larger materials. Three U.S. standard screens will be available with screen sizing of Tyler #6, #9 and #16. The sample will be dug and transferred directly to a screen and shaken into a bucket until sufficient material is available for the nine sample bottles.

Prior to first sampling of the day and between samples the tools will be cleansed. Each tool used will be washed in a bucket of river water and rinsed thoroughly with distilled water. This washing will stop cross contamination between samples. Equipment required will include shovels, a pick, trowels, U.S. standard screens, brush, five gallon cans of distilled water, river water, coolers, ice, sample bottles and empty buckets.

2.4 Personnel present for the sampling shall include as a minimum a Radiation Protection Technician (RPT), a Waste Systems Operations (WSO) Technician, a third party inspector and a Waste Systems Engineering (WSE) representative. A geologist will stop in at the site as needed to examine materials in the samples. The third party inspector will verify completion of specified steps during the sampling activity and record completion on the attached inspection checklist. The Waste Systems Engineering representative will fill out the "chain-of-custody" form, the "Sample Log Form" and the Sample Analysis Request Form. The WSE representative will also keep a log of all unusual happenings or deviations. The geologist will keep a log of sample descriptions.

2.5 The U.S. Testing laboratory can handle fifteen samples per week so field personnel obtaining the samples must be aware of the laboratory status so their limit is not exceeded. U.S. Testing must also be notified each morning that samples will be delivered that day. Delivery of samples will be made to the back door (North East side of Building) where lab personnel can be signaled by a bell. The cooler full of samples will be left and any empty coolers will be picked up.

2.6 Copies of each days sampling paperwork will be provided to Waste Systems Engineering at the end of the day. This will include copies of the "chain-of-custody" form, "Sample Log Form," "Sample Analysis Request Form," geologists log and the third party inspectors check sheets. All paperwork will be completed in ink.

2.7 All samples shall be transported in their coolers to the laboratory or to WHC storage by the end of the day the samples are taken.

3.0 Safety

Safety concerns are those typical hazards associated with an outdoor worksite. These include steep trench walls, potential tripping hazards slippery conditions and extreme weather conditions. Personnel must be aware of the conditions and plan accordingly. The trenches themselves contain uranium and standard radiological precautions must be observed so all work will be performed under a Radiation Work Procedure (RWP).

4.0 Prerequisites

4.1 The trench to be sampled must be dry enough to move around in and dig without problems with mud or surface water. Muddy conditions will affect the sampling procedure and cause cross contamination of samples. Ground water will affect the digging and wash away materials from the side of the excavation so that a sample will be impossible to obtain.

4.2 Radiological protection gear and clothing shall be available along with a copy of the applicable RWP.
Responsibilities: Radiological Clothing - Waste Systems Operations
RWP Copy: Project Engineering/JA Jones.

4.3 All tools shall be available for staking out the sample locations, digging, preparing the samples and transporting the samples.
Pre-labeled sample bottles, trowels, coolers with ice, distilled water, sieves, brush, plastic sheet, pen, clipboard, field logbook and proper forms.
Responsibilities:
Tools: Project Engineering/Waste Systems Engineering
Transporting Samples: Waste Systems Operations

4.4 Notify the testing laboratory that sampling is proceeding and verify the WHC sample storage area is available.
Responsibility: Waste Systems Engineering.

4.5 Notify the third party inspector.
Responsibility: Project Engineering.

5.0 Procedure

5.1 Select the first sample site at the center of the trench as close as practicable to the weir box. Record the distance from the weir box. Set a survey pin to the side of the sample site for location and measurement to the next site. Drive a stake labeled with the site location into the side of the trench above high water mark. This stake is for future reference. Select the set of prelabeled sample bottles for the first sample and set them out on the plastic sheet.

5.2 Using the survey pin for alignment, take the shovel and pick and dig a 2 1/2-3 ft long trench down through the loose sediments exposing a near vertical wall of material in excess of 18 inches below the loose sediment. Using a trowel, scrape some material from the wall at approximately 18 inches below the sediment. This will remove material that might cause cross contamination of the sample. With the trowel, sample the materials 18 inches below the sediments and transfer the material to a selected sieve. Shake the material through the sieve into a bucket and add more form the same location until enough material is available to fill nine sample bottles (approximately 1-1/2 liters). Take approximately one quart of material without sieving for the geologist sample, put it in a plastic bag and label it for location. Fill the nine pre-labeled sample bottles completely (no head space) from the sieved material in the bucket. Cap the bottles tightly as they are filled and place a seal tape over the cap. Bottle caps must not be interchanged. Place the eight sample bottles for U.S. Testing in the proper cooler and place the WHC backup sample in the proper cooler. Make sure all sample bottles are packed in ice.

5.3 Register the sample in the "sample log form" and provide any necessary or interesting disruptions or observations. Fill out the "Chain-Of-Custody" forms and a "Sample Analysis Request" form for the sample. Wash all tools in a bucket of river water and rinse with distilled water to prevent cross contamination between samples.

5.4 Select the next set of nine pre-labeled sample bottles. Scrape a small amount of soil from the side of the hole at approximately 4 inches below the sediment layer to remove material that may potentially cross contaminate the sample. Dig out and screen enough material into a clean bucket to provide a sample that will fill the nine bottles. Collect and label the geologists sample. Fill the nine sample bottles from the bucket, cap them tightly and place a seal tape on each cap. Place the bottles in the proper coolers for U.S. Testing and WHC and make sure they are packed in ice.

5.5 Register the sample in the "Sample Log Form" and provide any necessary or interesting disruptions or observations. Fill out the "Chain-Of-Custody" forms and a "Sample Analysis Request Form" for the sample. Wash all tools in the bucket of river water and rinse with distilled water.

5.6 Select the next set of nine pre-labeled sample bottles. Scrape some material from the wall of the excavation in the middle of the sediment layer to prevent sample cross contamination. Dig out and screen enough material into a clean bucket to fill the nine sample bottles. Collect and label the Geologists sample. Fill the nine sample bottles from the bucket, cap the bottles tightly and place a seal tape on each cap. Place the bottles in the proper coolers for U.S. Testing and WHC and make sure they are packed in ice.

5.7 Fill out "Chain-Of-Custody" forms and a "Sample Analysis Request Form" for the sample. Register the sample on the "Sample Log Form" and provide any observations. Wash all tools in the bucket of river water and rinse with distilled water.

5.8 Using the survey pin, measure 100 ft up the trench and set a new survey pin. Drive a stake labeled with the site location into the side of the trench above high water mark. This stake is for future reference.

5.9 Repeat steps 5.2 through 5.8, continue to sample the trench bottom until the sixteen sample locations have been completed.

NOTE: The testing laboratory can take 15 samples per week maximum. Laboratory requirements must be coordinated as the sampling proceeds. Do not begin a sample excavation unless all samples from the excavation can be handled by the laboratory within the shelf life of the sample for the type analysis to be completed. (Five days maximum)

5.10 Repeat the steps 5.1 through 5.9 on the second trench.

NOTE: Any deviations from this procedure will be noted in the WSE Representatives Log in detail.

Battelle
Pacific Northwest Laboratories
P.O. Box [illegible]
Richland, Washington 99352

CHAIN OF CUSTODY

Company Contact: ______________________ Telephone: ______________

Samples Collected by: ______________ Date: __________ Time: __________

Sample Location: ______________________________

Ice Chest No.: ______________________ Field Logbook Page No.: __________

Remarks: ______________________________

____

Method of Shipment: ______________________________

Sample Identification

CHAIN OF POSSESSION

Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time

Sample Log Form

Sample No.	Date	Time	Sample Size	Name of Collector	Signature	Description

SAMPLE ANALYSIS REQUEST

Westinghouse
W/B-46 / 337 Bldg. / WHC / 300 Area

United States Testing Company, In
2800 George Washington Way
Richland WA 99352

Collector ____________________

Date /Time Sampled ____________________

Company Contact Carolyn Dupuis 376-3318

Received by ____________________

Title ____________________

Date ____________ Time ____________

CHAIN OF CUSTODY NO. ____________________

SAMPLE ID ____________________

UST SAMPLE ID ____________________

☐ WATER ☒ SOIL ☐

☐ OTHER ____________________

COMMENTS

FULL ANALYSIS

	CODE	CONSTITUENT	(3) 40ml G	(2) 250ml G	(3) 125ml G			
1	725	ICP METALS 6010						
2	726	ICP METALS 6010 ENHANCED			X			
3	A20	ARSENIC			X			
4	A21	MERCURY			X			
5	A22	SELENIUM			X			
6	A23	THALLIUM			X			
7	A24	THIOUREA 8330						
8	727	METHOD 8330 ENHANCED		X				
9	A51	LEAD BY GFAA			X			
10	739	PCB						
11	728	PESTICIDES 8080						
12	729	PESTICIDES 8080 ENHANCED		X				
13	730	VOA METHOD 8240						
14	731	VOA METHOD 8240 ENHANCED	X					
15	732	A/B/N 8270						
16	733	A/B/N 8270 ENHANCED		X				
17	734	PESTICIDES METHOD 8140		X				
18	C68	TOX	X					
19	C69	TOC		X				
20	C70	CYANIDE			X			
21	735	NITRATE, SULPHATE,.... (IC)			X			
22	C77	PERCHLORATE			X			
23	C73	SULFIDE			X			
24	C80	AMMONIUM ION		X				
25	C81	ETHYLENE GLYCOL		X				
26	109	COLIFORM BACTERIA			X			
27	131	RADIUM			X			
28	212	ALPHA			X			
29	[illegible]	BETA			X			
30	[illegible]	DIOXIN		X				
31	C37	CITRUS RED #2			X			
32	[illegible]	CONDUCTIVITY						
33	[illegible]	PH						
34	[illegible]	DIRECT AQUEOUS INJECTION		X				
35	[illegible]	HERBICIDE 2,4-D, 2,4,5-TP SILVEX						
36	[illegible]	HERBICIDE 8150 ENHANCED						

DR2:(7,)156

SHALLOW SOILS SAMPLING

Third Party Inspection Checklist

Inspection Checklist	Sample Identification	Sample Identification	Sample Identification	Sample Identi catio
*Sample location identification				
*Measurement for sample location was correct. ________				
*Sample tools were cleaned before sampling. ________				
*Sample materials taken from the proper depth. ________				
*Proper sample bottles were used. ________				
*Sample bottles filled properly. ________				
*Seal tape applied to sample bottle caps. ________				
*Chain-Of-Custody Forms prepared. ________				
*Request for Analysis Form prepared. ________				
*Sample listed in the Sample Log Form. ________				

For comments put a 1 , 2 , 3 , ··· at the point the comment applies and write the comment on the back of this sheet.

CA Dupuis

ENGINEERING DATA TRANSMITTAL

EDT NO. A12459

TO: Approval Personnel	FROM D. L. Pursley Project Engineering	PAGE 1 OF 1 SELLER CODE NA

HASE ORDER/SUBCONTRACT NO.	DO NO.	MAJOR ASSY. DWG. NO.	EQ. PIECE NO.	MEDL RESP. ENGR.
NA	NA	NA	NA	D. L. Pursley

ORIGINATOR'S REMARKS

Procedure for Approval

ADDRESSEE'S REMARKS

ORIGINATOR APPROVAL	DATE	RESPONSE REQ'D DATE	REF EDT NO	ERO NUMBER
DL Pursley	4/14/86	4/18/86	NA	NA

DATA TRANSMITTED

ITEM NO.	DOCUMENT NUMBER	SHEET NO.	REVISION	ADDEND. NO.	TITLE OR DESCRIPTION	A APPROVAL LEVEL	B REASON FOR SUBMITTAL	C DISPOSITION	D	E
1	B83664-3		0		Deep Soils Sampling	2	1	1		

USE "EDT" CONTINUATION PAGES FOR ADDITIONAL ITEMS

THE DISPOSITION PROVIDED HEREIN DOES NOT RELIEVE THE DESIGN CONTRACTOR OR SUPPLIER OF ANY OBLIGATION REQUIRED UNDER THE PURCHASE ORDER/SUBCONTRACT. THIS ENGINEERING DATA TRANSMITTAL CANNOT AUTHORIZE A CHANGE IN PURCHASE ORDER, PRICE, DELIVERY, SUBCONTRACT COST, FEE, OR DELIVERY.

DATE ______ NA AUTHORIZED REPRESENTATIVE FOR ADDRESSEE

DL Pursley DISPOSITION ACKNOWLEDGED & ACCEPTED 4/24/86 DATE

REASON FOR SUBMITTAL (COL B)

1. REQUEST APPROVAL
2. ISSUE RELEASED DOCUMENT
3. SUBMIT INFORMATION
4. IN PROGRESS REVIEW

DISPOSITION CODES (USE FOR COL "C & D")

1. APPROVED FOR RELEASE WITHOUT COMMENT.
2. APPROVED FOR RELEASE SUBJECT TO ATTACHED COMMENTS.
3. DISAPPROVED - COMMENTS ATTACHED.
4. REVIEWED - NO COMMENTS.
5. REVIEWED - COMMENTS ATTACHED.
6. RECEIPT OF SUBMITTAL ACKNOWLEDGED.

DOE DISPOSITION CODES (USE FOR COL "E")

11. APPROVED WITHOUT COMMENT.
12. APPROVED SUBJECT TO ATTACHED COMMENTS.
13. DISAPPROVED - COMMENTS ATTACHED.
14. REVIEWED - NO COMMENTS.
15. REVIEWED - COMMENTS ATTACHED.

RESP ENGR REQUESTS RESPONSE BY 4/18/86

ABBREVIATIONS USED BELOW

REVIEWER'S ACTION REQUIRED (RAR)

CON - CONCUR

C/C - CONCUR WITH COMMENT

NC/NC - NON CONCUR WITH COMMENT

A - APPROVE

R - REVIEW

I - INFORMATION

DOE DISPOSITION REQUESTED FROM

NAME NA DATE DUE ______

DOE DISPOSITION (COL. "E")

SIGNATURE NA DATE ______

APPROVAL NAME AND CODE NO.	RAR	CON	C/WC	NC/WC	SIGNATURE	DATE	APPROVAL NAME AND CODE NO.	RAR	CON	C/WC	NC/WC	SIGNATURE	DATE
CONSTRUCTION MGR ME Borgeson	A	X			M E Borgeson	4/19/86							
RL Watts	A	X				4-23-86							
PLANT SAFETY JR Bell	A	X			JR Bell	4/22/86							
QUALITY ASSURANCE DL Shugars	A	X			DL Shugars	4/16/86							
GD Carpenter	A	X			GD Carpenter	4/24/86							
NSIBLE ENGINEER DL Pursley	A	X			DL Pursley	4/14/86							
RESPONSIBILE ENGINEERING MGR. RL Martin	A	X			R Martin	4/17/86	CCB ACTION ☐ APPROVED NA ☐ DISAPPROVED					COST ACT MGR NA	CCB LOG NO NA

BD-7400-172 (5-83)

RIDS: C-12, item 3e, 5 yrs after completion of project

EDT NO. A12459

DOE Richland, WA

INITIAL RELEASE AND CHANGE CONTROL RECORD

Hanford Engineering Development Laboratory

Westinghouse Hanford Company
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P.O. Box 1970, Richland, Wa. 99352

IDENTIFICATION NO. B83664-3

AUTHOR D. L. Pursley DL Pursley

TITLE 300 Area Process Trenches Deep Soils Sampling Procedure

APPROVAL EDT A-12459

DATE 4/14/86

CONTRACT NO. NA

REVISION	ADDENDUM	DATE	DESCRIPTION OF CHANGE - REPLACE, ADD, AND DELETE PAGES	APPROVALS FOR REV. OR A	
				COG ENGR	COG MGI
0	NA	--	Initial Release	A-12459	A-12459
1		4/23/86	Pen & Ink change Section 2.3 page 2of9. Well #1 to the <u>North</u>.	DLP, MSJ	4/2

A -7320-005

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Westinghouse Hanford Company
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P.O. Box 1970 Richland, Wa 99352

PAGE 1 OF 9

PROCEDURE NUMBER B83664-3	FACILITY N/A	DATE 4/8/86
TITLE 300 Area Process Trenches - Deep Soil Sampling		REVISION NO. 0
PREPARED BY D. L. Pursley	REVIEWED BY EDT A-12459	APPROVED BY EDT A-12459

1.0 Purpose

The purpose of this procedure is to provide deep soil samples from the area between the 300 Area process Trenches. These samples must be taken and controlled per EPA Manual SW-846, Second Edition , July 1982, "Test Methods for Evaluating Solid Waste," such that they are compatible with State and Federal regulatory compliance requirements.

2.0 General

2.1 Six wells will be drilled between the two process trenches as requested in letter G. L. Wagenaar/RHO to J. H. Mortimer/JA Jones "Characterization of the 300 Area Process Water Trenches," #RE54763. The drilling contractor will be under the direction of the RHO Drilling Engineer. Soil samples will be taken at five foot intervals down to forty feet. Soil samples will be provided to the WHC personnel in a bucket that can be moved away from the drilling site for handling.

2.2 The sample will be moved away from the drilling site and nine separate pre-labeled sample bottles including three 40 ml amber glass bottles, three 250 ml amber glass bottles and three 125 ml polyethylene bottles will be filled with sample material. The nine bottles will be capped tightly with a seal tape placed over the cap. Bottle caps must not be interchanged. The samples will then be packed in ice for transport to the testing laboratory and WHC storage. Only fine materials can be used for sample materials. If obtaining fine material becomes difficult, three different mesh sized standard screens will be available for use as needed along with brushes for hand brushing the fines from the larger materials. The materials will be screened into a clean bucket from which nine sample bottles will be filled.

A separate sample will be placed in a plastic bag and labeled for examination by the geologist. This sample will not be screened or modified in any way and will consist of approximately one quart of material.

2.3 The sample bottles will be pre-labeled to indicate the sampling location along with the following information.

Well No.: 1-6 (well #1 to the ~~south~~ North)
Sample Depth: 5,10,15,20,25,30,35 or 40 ft.

Bottle Designation: A - Analysis at U.S. Testing
B - Backup storage at 325 Building

Analysis type and Bottle #:
VOA - X (Bottle 1-3)
ABN - Y (Bottle 1-2)
Metal - Z (Bottle 1-3)

Example Label: 1A5X1
Well # - 1
Depth - 5 ft
Sample - Analysis at U.S. Testing
Analysis type and Bottle # - VOA #1

2.4 Each sample will be registered on a "Sample Log Form" and have a "sample analysis request form" and a "Chain-Of-Custody" form prepared. The samples will be transported in Ice Chests, packed in ice. Separate coolers will be used for the samples for U.S. Testing and WHC storage. Eight of the nine sample bottles go to U.S. Testing with one bottle placed in WHC storage at 325 Building. Only fifteen samples per week can be handled by U.S. Testing so careful scheduling is required. U. S. Testing must also be notified each morning that samples will be delivered that day. Delivery of samples will be made to the back door (Northeast side of Building) where lab personnel can be signaled by a bell. The cooler full of samples will be left and any empty coolers will be picked up.

2.5 The minimum personnel involved with the sampling will include a Radiation Protection Technician (RPT), a Waste Systems Operations (WSO) Technician, a third party inspector, a Waste Systems Engineering (WSE) representative and the well driller. A geologist and a RHO drilling supervisor will stop in at the site as needed. The geologist will examine the sampled materials and keep a log of his observations

The WSE representative will fill out the "Sample Log Forms", "Sample Analysis Request Forms," the "Chain-Of-Custody" forms and keep a field log book. The field log will be used for a list of personnel, personnel job assignments, field measurements taken, procedure deviation, etc. Information will also be logged on any unusual occurrences. The third party inspector will complete check off of the inspection points for each sample on copies of the Inspection check list attached to this procedure.

3.0 Safety

Safety will involve the normal safety concerns of a drilling operation. These include tripping hazards involved with equipment in the area of the well, overhead movement of drilling equipment and falling debris. Sampling personnel should avoid the area of the drilling operation except to obtain the samples from the driller. Hard hats will be required around the drilling equipment. All work at the site will be completed under Radiation Work Procedures and the special work procedures.

4.0 Prerequisites

4.1 Schedule the driller and brief him on the complete schedule including the number of samples per week and discuss procedure for obtaining the soil samples from the well and providing them to WHC personnel. Measure and mark locations for all six wells.
Responsibility: WHC Project Engineering/JA Jones.

4.2 Check out and prepare all equipment required for the sampling operation: Pre-labeled sample bottles, trowels, coolers with ice, distilled water, three sieves, brush, plastic sheet, pen, clipboard, field log books and proper forms.
Responsibility: Waste Systems Engineering/Project Engineering.

4.3 Verify the RWP requirements and check out the radiological protection gear and clothing.
Responsibility: Verify RWP requirements - WHC Project Engineering/JA Jones. Check out radiological protection gear - Waste Systems Operations.

4.4 Verify that U.S. Testing is ready to accept samples.
Responsibility: Waste Systems Engineering.

4.6 Verify sample capacity at U.S. Testing before each day's sampling and verify the WHC storage location is available for sample storage.
Responsibility: Waste Systems Engineering.

4.7 Notify Third Party Inspector.
Responsibility: Project Engineering.

5.0 Procedure

The drilling operation will proceed under the direction of the RHO Drilling Supervisor and samples from the correct well depths will be provided to the WHC personnel in a bucket. The bucket will be moved clear of the drilling site by the WSO Technician before filling of the sample bottles begins.

5.1 Verify the depth at which the sample will be taken prior to actual sampling. Record the date well depth and well number in the field log.

5.2 Obtain the sample from the driller in a bucket. The sample will require enough material to fill the nine sample bottles (approximately 1 1/2 quarts) and provide approximately one quart for the geologist examination.

5.3 Separate enough fine material from the sample to fill the nine sample bottles. This may require the use of the sieves or brushing of the larger materials. Fill the bottles full with no head space, cap tightly, and place a seal tape over the cap. Bottle caps must not be interchanged. Place the sample bottles in the correct cooler for either U.S. Testing or WHC storage and make sure they are packed in ice.

A separate sample will also be taken and placed in a plastic bag and labeled for examination by the geologist. This sample will not be screened or modified in any way and will consist of approximately one quart of material.

5.4 Log the sample on the "Sample Log Form", prepare a "Sample Analysis Request" Form and fill out a "Chain-Of-Custody" form for each cooler.

5.5 Wash the sample handling equipment with river water and rinse with distilled water prior to use with the next sample. This will prevent cross contamination between samples.

5.6 Repeat steps 5.1 through 5.5 until all sampling for the day is complete. Transport the two coolers with the sample bottles to U.S. Testing and to the 325 Building for storage. Samples for U.S. Testing are to be delivered to the North East door where a bell can be used to signal the laboratory personnel. The chain-of-custody forms must all be signed by the person delivering the sample and the person receiving the samples. Provide a copy of all chain-of- custody forms, sample analysis request forms, sample log forms, geologist log, third party inspection check lists and field log to Waste Systems Engineering at the end of each day.

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington 99352

CHAIN OF CUSTODY

Company Contact: ____________________ Telephone: ____________

Samples Collected by: ____________ Date: ____________ Time: ____________

Sample Location: ____________________

Ice Chest No.: ____________ Field Logbook Page No.: ____________

Remarks: ____________________

____

Method of Shipment: ____________________

Sample Identification

CHAIN OF POSSESSION

Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time

Sample Log Form

Sample No.	Date	Time	Sample Size	Name of Collector	Signature	Description

SAMPLE ANALYSIS REQUEST

Westinghouse
W/B-46 / 337 Bldg. / WHC / 300 Area

United States Testing Company,
2800 George Washington Way
Richland WA 99352

Collector ____________________

Date /Time Sampled ____________________

Company Contact Carolyn Dupuis 376-3318

Received by ____________________

Title ____________________

Date ____________ Time ________

CHAIN OF CUSTODY NO. ____________________

SAMPLE ID ____________________

UST SAMPLE ID ____________________

☐ WATER ☒ SOIL

☐ OTHER ____________________

COMMENTS

SCREEN ANALYSIS

	CODE	CONSTITUENT	(3) 40 ml G	(2) 250 ml G	(3) 125 ml P			
1	725	ICP METALS 6010						
2	726	ICP METALS 6010 ENHANCED			X			
3	A20	ARSENIC						
4	A21	MERCURY			X			
5	A22	SELENIUM						
6	A23	THALLIUM						
7	A24	THIOUREA 8330						
8	727	METHOD 8330 ENHANCED						
9	A51	LEAD BY GFAA			X			
10	739	PCB						
11	728	PESTICIDES 8080						
12	729	PESTICIDES 8080 ENHANCED						
13	730	VOA METHOD 8240						
14	731	VOA METHOD 8240 ENHANCED						
15	732	A/B/N 8270						
16	733	A/B/N 8270 ENHANCED						
17	734	PESTICIDES METHOD 8140						
18	C68	TOX	X					
19	C69	TOC		X				
20	C70	CYANIDE						
21	735	NITRATE, SULPHATE,.... (IC)						
22	C77	PERCHLORATE						
23	C78	SULFIDE						
24	C80	AMMONIUM ION						
25	C81	ETHYLENE GLYCOL						
26	109	COLIFORM BACTERIA						
27	131	RADIUM						
28	212	ALPHA			X			
29	111	BETA			X			
30	C36	DIOXIN						
31	C37	CITRUS RED #2						
32	191	CONDUCTIVITY						
33	199	pH						
34	736	DIRECT AQUEOUS INJECTION						
35	738	HERBICIDE 2,4-D, 2,4,5-TP SILVEX						
36	737	HERBICIDE 8150 ENHANCED						

DR2:[7,9]66

Deep Soil Sampling

Third Party Inspection Checklist

Inspections Checklist

*Sample Location Identification			
*Date/Time Sample taken			
*Well Depth of Sample			
*Were the nine sample Bottles filled?			
*Were the bottles sealed with a seal tape?			
*Were the bottles placed in a proper coolers?			
*Were the chain-of-custody and sample analysis request forms prepared?			
*Was the geologists samples taken?			
*Were the tools cleaned?			

For comments put a 1 , 2 , 3 , ... at the point the comment applies and write the comment on the back of this sheet.

APPENDIX D

Sample Forms

Third Party Inspection
and
Chain of Custody

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington 99352

CHAIN OF CUSTODY

1009

Company Contact: Carolyn Dupuis
Telephone: 376-3318

Samples Collected by: WC Skinner / CAD
Date: 5/1/86
Time: 2:20 pm

Sample Location: 300 Area Process Trenches Center Dike

Ice Chest No.: WHC-1
Field Logbook Page No.: 4.

Remarks: Sample Number 2A5 (well No. 2, depth 5 ft)

Method of Shipment: bottles in plastic bag inside ice chest

Sample Identification

(3) 40 ml G - C68 2A5-X1, 2A5-X2, 2A5-X3
(2) 250 ml G - C69 2A5-Y1, 2A5-Y2
(3) 125 ml P - 726, A21, A51, 212, 111 2A5-Z1, 2A5-Z2,
2A5-Z3

CHAIN OF POSSESSION

Relinquished by:	Received by:	Date/Time:
CA Dupuis		5-1-86 1455
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time:
Relinquished by:	Received by:	Date/Time

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington 99352

CHAIN OF CUSTODY

1122

Company Contact: Carolyn Dupuis
Telephone: 376-3318

Samples Collected by: WC Skinner/CAD
Date: 7/21/86
Time: 10:25A

Sample Location: 300 Area Process Trenches East Trench

Ice Chest No.: WHC- 1
Field Logbook Page No.: 44

Remarks: Sample Number E 14 DA

Method of Shipment: Bottles in plastic bag in an ice chest

Sample Identification

E14DA-X1, E14DA-X2, E14DA-X3 (3) 40 ml G - 731, C68
E14DA-Y1, E14DA-Y2 (2) 250 ml G - 727, 729, 733, 734, C69, C80, C81, C86, 736, 737
E14DA-Z1, E14DA-Z2, E14DA-Z3 (3) 125 ml P - 726, A20, A21, A22, A23, A51, C70, 735, C77, C78, 109, 181, 212, 111, C87

CHAIN OF POSSESSION

Relinquished by:	Received by:	Date/Time:
CADupuis		7-21-86 14:57

SHALLOW SOILS SAMPLING

Third Party Inspection Checklist

Inspection Checklist

*Sample location identification.	14D A+B	14S A+B	
*Date/Time sample taken.	10:25 AM 7-21-86	10:25 AM 7-21-8	
*Correct measurement for sample location.	Yes	Yes	
*Tools were cleaned before sampling.	Yes	Yes	
*Sample materials taken from the proper depth.	Yes	Yes	
*Seal tape applied to sample bottle caps.	Yes	Yes	
*Chain-Of-Custody Form and Analysis Request Form perpared.	Yes	Yes	
*Geologist sample taken.	Yes	Yes	

Deep Soil Sampling

Third Part Inspection Checklist

Inspections Checklist

*Sample Location Identification	Well #2 2A5 /2B5		
*Date/Time Sample taken	2:20pm 5-1-86		
*Well Depth of Sample	5'		
*Were the nine sample Bottles filled?	Yes		
*Were the bottles sealed with a seal tape?	Yes		
*Were the bottles placed in a proper coolers?	Yes		
*Were the chain-of-custody and sample analysis request forms prepared?	Yes		
*Was the geologists samples taken?	Yes		
*Were the tools cleaned?	Yes		

For comments put a 1 , 2 , 3 , ... at the point the comment applies and write the comment on the back of this sheet.

APPENDIX E

U.S. Testing
Technical and Price
Proposal

and

Analytical Method Group Codes

and

Hazardous Substance Constituent Codes

United States Testing Company, Inc.
Richland Division
2800 GEORGE WASHINGTON WAY
RICHLAND, WASHINGTON 99352 (509) 375-3131

RADIOCHEMISTRY
RADIATION DOSIMETRY
NUCLEAR SERVICES
BIOASSAY
AGRICULTURAL SERVICES
ANALYTICAL CHEMISTRY
ENGINEERING INSPECTION
POLLUTION CONTROL

WD McCormack
Chron
SPWA
Task w/o attachment
MG Zimmerman

February 19, 1986

cc:
RLM
RBH
G Meadows
MGZ/[illegible]

Dean H. Glazier
Subcontract Administrator
Pacific Northwest Laboratories
OSB Building
300 Area / Room 282

Dear Mr. Glazier:

Attached for PNL's review and consideration are UST-RD's technical and price proposals for Special Project Request for Price Proposal, SPRFFP 86-9.

If you have any questions regarding this proposal, please contact G.R. Rao for technical matters and V.H. Pettey for financial matters.

Sincerely,

UNITED STATES TESTING COMPANY, INC.

Neil H. Hembree for: V. H. Pettey

Van H. Pettey
Vice President - General Manager

VHP:lmm

Enclosure

xc: Govind Rao
File

RECEIVED
FEB 19 1986
SUB-CONTRACT

PROPOSAL 86-9

RECEIVED
FEB 19 1986
SUB-CONTRACT

86-9.1 Introduction

UST-RD has been performing analyses for organic and inorganic pollutants, primarily in ground water samples. The general scheme of analysis consists of extraction of the analyte of interest in a suitable solvent followed by detection using appropriate analytical instrumentation. The analysis of soil samples will follow the same general pattern. However, there are significant differences in the detailed application of the analytical procedures. These differences arise mainly in the extraction procedures, while detection techniques remain the same.

Documented extraction procedures are available for many of the specified analyses. For these cases, UST-RD will use the appropriate procedures. For cases where a definite extraction procedure is not available, UST-RD will use the aqueous extraction procedure described in Section 86-9.3. The aqueous extract will then be handled in a manner identical to that used for the analysis of aqueous samples. In either case, in the event that sample extracts are "dirty" (contain potentially troublesome interferences), UST-RD will dilute the extracts prior to analysis. Additional clean-up procedures that would require major capital equipment purchases will not be employed. The lower limit of detection for diluted extracts will be appropriately higher.

In subsequent sections we will discuss the methods, the detection limits, the minimum sample sizes necessary, sample preservation and holding times, the impact on the routine program and the turn-around times for all of the requested analyses except Dioxin. The analysis for Dioxin at UST-RD will have severe adverse impact on the routine program. Acquisition of major equipment will be necessary to offset such an impact. Non-radioactive soil samples can be analyzed by UST-Hoboken.

In preparing this proposal, UST-RD has the understanding that:

(a) The soil samples will either be non-radioactive or be only slightly radioactive so that UST-RD will not have to expend <u>considerable</u> effort in attempts to minimize radiation exposure to personnel as well as prevent contamination of its low-level radiochemistry laboratories;

(b) The turn-around times are contingent upon the timely acquisition of all of the new equipment and glassware identified in the proposal;

(c) The detection limits discussed in 86-9.5 are <u>a priori</u> limits and may be revised under certain circumstances; and

(d) Method verification studies performed <u>prior</u> to the analysis of samples may result in method modification.

(e) UST-RD will require at least 5 weeks from the time of acceptance of this proposal to prepare for the analysis of soil samples.

86-9.2 METHODS

In most cases, the methods described in SW846 procedures will be employed for analysis. In a few cases, methods for water and waste water analysis will be adapted to soil sample analysis. Instrument calibration and other instrument-related procedures will remain the same as used for the analysis of aqueous samples. The specific methods that will be used are enumerated below, along with variations if any, from the procedures. Detection limits and sample sizes are presented in Section 86-9.5.

86-9.2.1 ICP METALS - ENHANCED LIST

(a) Method 6010 of SW846[1] procedures will be used. The soil samples will be subjected to the acid digestion procedure described in Method 3050. Note: (i) Method 6010 does not explicitly address the analysis of Sr and Os. However, previous experience with these analytes has shown that reliable Sr results can be obtained for aqueous samples. There is some uncertainty regarding Os. (ii) Method 3050 is an acid digestion procedure that will be used to prepare soil samples for analysis by ICP. The method does not explicitly address the dissolution of Sodium, Aluminum, Manganese, Potassium, Iron, Osmium, Strontium, and Calcium. Preliminary indications suggest that Method 3050 will be applicable to all of the above metals except Osmium. UST-RD will investigate Osmium analysis further.

(b) A 1.0 g portion of sample will be used for each analysis. The digestate will be diluted to 100 mL with Type II (or better) water. The detection limits for the various metals in the digestate will be the same as in the analysis of aqueous samples.

86-9.2.2. Arsenic

(a) Method 7060[1] of SW846 procedures will be used. The soil samples will be subjected to the acid digestion procedure described in Method 3050[1].

(b) A 1.0 g portion of sample will be used for each analysis. The digestate will be diluted to 100 mL with Type II (or better) water. The detection limit for Arsenic in the digestate will be the same as in the analysis of aqueous samples.

86-9.2.3. Mercury

(a) Method 7471[1] of SW846 procedures will be used.

(b) A 0.2 g portion of dry sample will be used for each analysis. Each sample will be analyzed in triplicate. The average of the three determinations will be reported. The *a priori* detection limit for a 0.2 g sample will be equivalent to that in the analysis of aqueous samples.

86-9.2.4. Selenium

(a) Method 7740[1] of SW846 procedures will be used. The soil samples will be subjected to the acid digestion procedure described in Method 3050[1].

(b) A 1.0 g portion of sample will be used for each analysis. The digestate will be diluted to 100 mL with Type II (or better) water. The detection limit for Selenium in the digestate will be same as in the analysis of aqueous samples.

86-9.2.5. Thallium

(a) Method 7841[1] of SW846 procedures will be used. The soil samples will be subjected to the acid digestion procedure described in method 3050[1].

(b) A 1.0 g portion of the sample will be used for each analysis. The digestate will be diluted to 100 mL with Type II (or better) water. The detection limit for Thallium in the digestate will be the same as in the analysis of aqueous samples.

86-9.2.6 Thiourea Compounds - Enhanced List

(a) Thiourea compounds will be analyzed by HPLC by Method 8330[1] of SW846 procedures with the following variations:

(i) The thiourea compounds will be extracted in water according to the procedure described in 86-9.3.

(ii) The sample extract will be analysed by direct aqueous injection into a High Pressure Liquid Chromatograph.

(b) The detection limits for the thiourea compounds in the extract will be the same as in the analysis of aqueous samples.

86-9.2.7. Chlorinated Pesticides - Enhanced List

(a) Method 8080[1] of SW846 procedures will be used. The chlorinated pesticides will be extracted in hexane:acetone (1:1) by the Soxhlet extraction procedure (Method 3540[1]).

(b) A 10 g portion of sample will be used for each analysis. The sample extract will be concentrated to 10 mL and an aliquot will be analyzed by GC/ECD. The detection limits for the chlorinated pesticides will be 0.1 ug/g.

(c) Sample extract will be cleaned up by passing them through an alumina column. If the cleanup proves insufficient, the extract will be diluted appropriately before analysis by GC/ECD.

86-9.2.8. VOA - Enhanced List

(a) Method 8240[1] of SW846 procedures will be used. The volatile organics will be introduced into the gas chromatograph by the purge and trap method (Method 5030[1]).

(b) A 5.0 g portion of sample will be used for each analysis. The sample will be extracted in methanol and an aliquot of the extract will be analysed. Detection limits for the various compounds in the extract will be the same as for aqueous samples.

(c) Sample extracts that are "dirty" will be diluted appropriately before analysis. No additional cleanup will be attempted.

86-9.2.9. ABN - Enhanced List

(a) Method 8270[1] of SW846 procedures will be used. The semi-volatile organics will be extracted in methylene chloride by the Soxhlet extraction procedure (Method 3540[1]).

(b) A 10 g portion of the sample will be used for each analysis. The sample extract will be concentrated appropriately and analysed by a capillary GC/MS. Detection limits in the extract will be similar to that for aqueous samples.

(c) Sample extracts that are "dirty" will be diluted accordingly before analysis. No additional cleanup will be attempted.

86-9.2.10 Phosphorus Pesticides

(a) Method 8140[1] of SW846 procedures will be used. The phosphorus pesticides will be extracted in hexane:acetone (1:1) by the Soxhlet extraction procedure (Method 3540[1]).

(b) A 10 g portion of sample will be used for each analysis. The sample extract will be concentrated to 10 mL and analysed by GC/FPD. The detection limits in the extract will be same as that for aqueous samples.

(c) Sample extracts will be cleaned up by an alumina cleanup procedure. "Dirty" sample extracts will be diluted accordingly before analysis.

86-9.2.11 Extractable Organic Halide (EOX)

(a) The extractable organic halides will be extracted from a 1.0 g aliquot of sample in ethyl acetate by sonification as described in EPA Document 600/4-84-008 (see attachment)[2]. A 125 W ultrasonic bath will be used for sonification instead of a 220 W bath. The sonification time will be doubled. (Because of the smaller size of the 125 W ultrasonic baths, the effective power per square inch will be about the same).

(b) The extract will be analysed with a Dohrmann DX-20 TOX analyzer. An EOX sampling kit will be purchased from Dohrmann to permit analysis of the extract.

(c) Each sample will analyzed in duplicate in order to provide a measure of sample inhomogeneity. A minimum of 1.0 g of sample will be used for each analysis. Because the method detection limit can vary with instrument sensitivity and matrix effects, an *a priori* detection limit of 1.0 ug/g is proposed.

(d) Sample extracts that are "dirty" or that exceed the instrument capabilities will be re-analysed after appropriately diluting the extracts.

86-9.2.12 Total (Extractable) Organic Carbon (TOC)

(a) The extractable organic carbon will be extracted in water in accordance with the procedure described in 86-9.3.

(b) The sample extract will be analysed by an Ionics TOC analyzer in a manner identical to that used in the analysis of aqueous sample (Method 505A[3]).

(c) A minimum of 10.0 g of soil will be used for each analysis. The detection limit will depend upon sample homogeneity, matrix effects and instrumental sensitivity. An *a priori* detection limit of 10 ug/g is proposed with a 1.0 g portion of sample being analyzed. However, the actual detection limit may have to be revised upwards.

(d) Each sample will be analysed in duplicate in order to provide a measure of sample inhomogeneity.

(e) "Dirty" sample extracts will be diluted appropriately prior to analysis.

86-9.2.13 Cyanide

(a) The "extractable" cyanide will be extracted in water by the procedure described in 86-9.3.

(b) The aqueous extract will be analysed in a manner identical to the analysis of aqueous samples (Method 412D[3]).

(c) A minimum of 10.0 g of soil will be used for each analysis. The detection limit will depend upon several, as yet undetermined, factors. The sensitivity will be limited by matrix effects rather than by instrumental capabilities. An *a priori* estimate of 100 ug/g is proposed for the detection limit.

86-9.2.14 Lead by GFAA

(a) Method 7421[1] of SW846 procedures will be used. The soil samples will be subjected to the acid digestion procedure described in Method 3050.

(b) A 1.0 g portion of sample will be used for each analysis. The digestate will be diluted to 100 mL with Type II (or better) water. The detection limit for Lead in the digestate will be expected to be the same as that for aqueous samples.

86-9.2.15 Anions (Nitrate, Sulphate, ...)

(a) The anions will be extracted in water by the procedure described in 86-9.3.

(b) The extract will be analysed by Ion Chromatography in a manner identical to that used for aqueous samples.

(c) "Dirty" extracts will be diluted appropriately prior to analysis.

86-9.2.16 Perchlorate

(a) The same considerations as those for Anions (86-9.2.15) will be used.

86-9.2.17 Sulphide

(a) Sulphide will be extracted in water by the procedure described in 86-9.3

(b) The extract will be analyzed by titration.

86-9.2.18 Ammonium Ion

(a) Ammonium Ion will be extracted in Sodium acetate.

(b) The extract will be analyzed by Selective Ion Electrode in a manner identical to that used for aqueous samples.

86-9.2.19 Ethylene Glycol

(a) Ethylene glycol will be extracted in water by the procedure described in 86-9.3.

(b) The extract will be analysed by direct injection into a GC/FID in a manner identical to that used for aqueous samples.

(c) A minimum of 10.0 g of sample will be used for each analysis. An a priori detection limit of 3.0 ppm in the extract is proposed.

(d) "Dirty" extracts will be diluted appropriately.

86-9.2.20 Coliform Bacteria

(a) The soil samples will be subjected to the extraction procedure described in 86-9.3.

(b) The extract will be analysed for coliform bacteria in a manner identical to that used for aqueous samples (Method 908A[3]). The water used in the extraction procedure will be concurrently tested for coliform bacteria.

86-9.2.21 Radium (Total)

(a) Fifty grams of Soil will be leached with 8N Nitric Acid.

(b) The leachate will be analysed by procedure 20-RA-02 discribed in UST-RD's procedure manual, UST-RD-PM-2-86.

(c) Some developmental effort will be necessary.

86-9.2.22 Alpha

(a) Up to 100 mg of Soil will be directly counted in a proportional counter.

86-9.2.23 Beta

(a) Up to 1.0 g of Soil will be directly counted in a proportional counter.

86-9.2.24 Dioxin

UST-RD currently does not perform dioxin analysis in Richland. Non-radioactive samples will be sent to UST-Hoboken for analysis. The acquisition of the capability to analyze Dioxin in Richland is dependent on the following:

(i) Availability of surrogates and standards - EPA provides dioxin surrogates and standards free of charge only to contract laboratories approved for dioxin analysis. Surrogates and standards are commercially available but are quite expensive. It is our estimate that start-up and calibrations would cost around $10,000.

(ii) Availability of GC/MS - A more serious concern is the <u>severe adverse impact</u> dioxin analysis may have on the routine program. The GC/MS presently used for ABN analysis would have to be re-configured for dioxin analysis. During the dioxin analysis period, the GC/MS would <u>not</u> be available for ABN analyses. It is anticipated that at least 1 to 2 weeks would be required to set up and calibrate for Dioxin.

(iii) Training of Personnel - Because of the extreme hazard associated with handling Dioxin, additional training of personnel will be necessary prior to sample analysis.

86-9.2.25 <u>Citrus Red No. 2</u>

(a) Citrus Red No. 2 will be extracted in water by the procedure described in 86-9.3.

(b) The extract will be analysed in a manner identical to that used for aqueous samples. A Beckman UV/VIS spectrophotometer will be used.

86-9.2.26 <u>Direct Aqueous Injection</u>

(a) Direct aqueous injection compounds will be extracted in water by the procedure described in 86-9.3.

(b) An aliquot of the extract will be directly injected into the analytical instrument (GC/MS) in the same manner as that used in the analysis of aqueous samples.

(c) A minimum of 10.0 g of sample will be used for each analysis. The <u>a priori</u> detection limits in the extracts will be the same as those for aqueous samples (viz., 3 ppm).

(d) "Dirty" extracts will be diluted appropriately before analysis.

86-9.2.27 <u>Herbicides</u>

(a) Herbicides will be extracted in ether-acetone and analysed by GC/ECD according to the procedures described in Method 8150[1] of SW846 procedures.

(b) Fifty grams of soil will be used for each analysis. The sensitivity of the method depends upon the level of interferences rather than on instrumental capabilities. An <u>a priori</u> detection limit of 1.0 ug/g is proposed here.

(c) "Dirty" extracts will be diluted appropriately before analysis.

REFERENCES

1. SW846 Procedures: Test Methods for Evaluating Solid Waste, 2nd edition, 1984.
2. EPA-600/4-84-008, Development and Evaluation of Methods for Total Organic Halide and Purgeable Organic Halide in Waste Water, 1983.
3. Standard Methods for the Examination of Water and Waste Water, 16th Edition, 1985.

86-9.3 WATER EXTRACTION PROCEDURE

For those analyses that require a water extraction procedure, UST-RD will use the procedure described below:

(1) A weighed portion of the sample will be placed into a pre-cleaned container with a teflon lined lid.

(2) A measured volume of Type I water will be added to the bottle and the bottle will be capped.

(3) The constituents of interest will be extracted by continuously shaking the container in a reciprocating shaker for 30 minutes.

(4) The sample extract will then either be centrifuged or filtered to remove particulate matter.

(5) The extract will then be analysed for the intended analyte by the appropriate methods described in 86-9.2. If the analysis cannot be performed immediately, the extracts will be preserved until analysis. Table 1 summarizes the preservation of the extracts for the various analyses.

Typical aliquots that will be used in the extraction procedure are shown in Table 2 (86-9.5). The actual amounts used will depend upon data from preliminary analyses. We do not have *a priori* knowledge of the extraction efficiency, or of any potential problems that may be encountered. The extraction procedure will be modified appropriately if other, as yet unavailable, information makes it necessary.

Table 1.
Preservation of Aqueous Extracts

CODE	ANALYSIS	PRESERVATIVE
727	Thiourea Enh.	Cool to 4°C
C69	TOC	Cool to 4°C, H_2SO_4 to pH<2
C70	Cyanide	Cool to 4°C, NAOH to pH>12
735	Anions	Cool to 4°C
C77	Perchlorate	Cool to 4°C
C78	Sulphide	cool to 4°C, 0.5 mL Zinc Acetate plus NAOH to pH>9
C81	Ethylene Glycol	Cool to 4°C
109	Coliform Bacteria	Cool to 4°C
C87	Citrus Red No. 2	cool to 4°C
736	Direct Aqueous Injection	cool to 4°C

86-9.4 Quality Control

UST-RD will adhere to the general quality control guidelines described in the various procedures used for analysis. The following is intended to clarify the specific actions that UST-RD will take:

(a) UST-RD will analyze a minimum of four "blank" soil samples for all the analytes of interest as part of the start-up program and personnel training. At least two matrix spikes will be analyzed.

(b) With every batch of samples analyzed, UST-RD will perform reagent blank analysis to ensure that the reagents are free from interferences.

(c) Ten percent of all samples will be spiked with the analytes of interest and analyzed to determine matrix effects. Another aliquot of the same sample will be similarly spiked and analyzed. Data from the duplicate matrix spikes will be used to monitor the precision of the method. In certain cases (As, Se, Tl, Pb, NH_4^+, etc.), if matrix effects are consistently severe, UST-RD will determine the analytes of interest by the method of standard addition.

(d) Sample extracts exhibiting results exceeding the highest calibration standard will be appropriately diluted and re-analyzed. The re-analysis of dilutions will be billed at the negotiated unit prices.

86-9.5 Sample Size and Sample Preservation, Holding Times, and Detection Limits

86-9.5.1 Sample Size and Sample Preservation

Varying quantities of soil will be used for the different analyses. The typical quantities that will be used are shown in Table 2. The actual quantities used may have to be revised upwards or downwards after the first few analyses, if it is determined that better detection limits can be realized by using a larger aliquot of sample or that severe matrix interferences exist (hence, requiring that a smaller aliquot be used). In any event, sufficient sample must be collected to permit some variation in the sample aliquots analyzed. Additional sample will also be required for duplicate and matrix spike analysis. UST-RD recommends that a minimum of 1000 g of soil be collected for each sample.

Samples must be collected in several pre-cleaned containers that are appropriate for the various analyses. Table 3 shows the recommended containers and the analyses for which they are intended. All sample containers must be "iced" or refrigerated at 4°C from the time of collection until analysis. Special attention should be paid to the collection of samples intended for VOA and EOX analyses. These should be collected with no headspace in glass containers with open-top lids and teflon septa.

86-9.5.2 Holding Times

UST-RD will analyze the samples within the maximum holding times recommended in the procedures for the individual analysis. The samples will be refrigerated until analysis can be performed. The maximum holding times are listed in Table 4.

86-9.5.3 Detection Limits

A priori detection limits for the various analytes are presented in Table 5. The detection limits are based upon the assumption that the sample aliquots shown in Table (2) will be analyzed and that no matrix interferences exist. The actual detection limits will depend to a large extent upon matrix effects rather than upon instrumental capabilities. The detection limits have been calculated for the sample aliquots analyzed and the extraction volumes shown in Table (2). In general, the detection limits are higher than those for aqueous samples because much smaller aliquots of soil are analyzed as compared to water samples. For example, 1.0 g of soil is analyzed for metals, as compared to 100 mLs of water samples. So detection limits for metals will be at least a factor of 100 higher for soils. The detection limits shown in Table (5) may be revised under the following circumstances:

(a) Larger or smaller aliquot used for analysis - This may be necessitated either by very low levels of the analyte of interest in the soil, or by severe matrix interferences.

(b) Dilutions of "dirty" extracts - Sample extracts that are observed to contain extraneous material that would interfere with the determination of the analyte of interest, or that would pose a threat of potential damage to analytical instrumentation, will be diluted appropriately before analysis. Detection limits would increase appropriately.

(c) Method Limitations - If as yet undocumented limitations of the employed methods exist, the detection limit may be affected.

TABLE 2

Sample Aliquots Analyzed

Code	Analysis	Sample Weight (g)	Final Extract Volume (mL)
726	ICP Metals 6010 Enh.	1.0	100
A20	Arsenic	1.0	100
A21	Mercury	0.2 (3 times)	100
A22	Selenium	1.0	100
A23	Thallium	1.0	100
727	Thiourea 8330 Enh.	10.0	10
729	Pesticides 8080 Enh.	10.0	10
731	VOA Method 8240	2.0	-
733	A/B/N/ 8270 Enh.	10.0	10
734	Pesticides 8140	10.0	10
C68	EOX	1.0	
C69	TOC	10.0	100
C70	Cyanide	10.0	100
A51	LEAD BY GFAA	1.0	100
735	Anions	10.0	20
C77	Perchlorate	10.0	20
C78	Sulphide	10.0	100
C80	Ammonium Ion	10.0	100
C81	Ethylene Glycol	10.0	10
109	Coliforum Bacteria	10.0	100
181	Radium	50.0	to be determined
212	Alpha	0.1	-
111	Beta	1.0	-
C86	Dioxin	-	-
C87	Citrus Red No. 2	10.0	100
736	Direct Aqueous Injection	10.0	100
737	Herbicide 8150 Enh.	50.0	5

1. The Final Extract Volume is the volume of the extract after all concentrations or dilutions have been made. For example, the initial extract volume for A/B/N and pesticides is 300 mL. However this is concentrated down to 10 mL prior to analysis.

Table 3

Sample Containers(1),(2)

Analysis	Containes	Number of Containers
VOA (731), EOX (C68)	25 mL Amber glass with open-top lid and teflon septum. Sample should be collected with no head-space.	~~4~~ 3 25ml
ABN(733), 8080 Pesticides (729), 8140 Pesticides (734), Thiourea (727), Herbicides (737), Direct Aqueous Injection (736), Ethylene Glycol (C87), Dioxin (C86), Ammonium Ion (C80), TOC (C69)	125 mL Amber glass wide-mouth with teflon-lined lid.	~~4~~ 2 - 250 ml
Metals (726), Arsenic (A20), Mercury (A21), Selenium (A22), Thallium (A23), Lead (A51), Anions (735), Perchlorate (C77), Coliform Bacteria (109), Radium (181), Alpha (212), Beta (111), Sulphide (C78), Citrus Red (C87)	125 mL polyethylene wide mouth with teflon-lined lid	3

1. Pre-cleaned sample containers are available from I-Chem Research Inc., 23787 F Ficher Street, Hayward, CA 94545.
2. All samples must be refrigerated from the time of collection until analysis.

+ 1 for WNC

Table 4

Maximum Holding Times (1)

Code	Analysis	Extraction	Analysis
726	See Table 1	-	6 months
A20	"	-	6 months
A21	"	-	28 days
A22	"	-	6 months
A23	"	-	6 months
727	"	-	6 months
729	"	7 days	30 days
731	"	7 days	7 days
733	"	14 days	40 days
734	"	7 days	14 days
C68	"	-	-
C69	"	-	28 days *
C70	"	-	14 days *
A51	"	-	6 months
735	"	-	48 hours *
C77	"	-	- *
C78	"	-	7 days *
C80	"	-	28 days *
C81	"	-	- *
109	"	-	6 hours *
181	"	-	- *
212	"	-	- *
111	"	-	- *
C86	"	-	-
C87	"	-	- *
736	"	-	- *
737	"	7 days	23 days

1. The maximum holding times are maximum times for which samples can be held prior to extraction or analysis and still be considered valid. The "extraction" holding times apply from the time of receipt of the sample at UST-RD. The "analysis" holding times are also measured from the time of receipt of the sample at UST-RD.

* In those cases where the aqueous extraction procedure of Section 86-9.3 will be used, the sample extract will be analyzed within the holding times shown here. The times, in these cases, are measured from the time of extraction. From the time of extraction until analysis, the extracts will be appropriately preserved and cooled to 4°C. For the preservation of the extracts, see 86-9.3.

Table 5

Detection Limits

Code	Analysis	ug/g
726	ICP Metals 6010 Enh.	See footnote 1 below
A20	Arsenic	0.5
A21	Mercury	0.1
A22	Selenium	0.5
A23	Thallium	1.0
727	Thiourea 8330 Enh.	0.2
729	Pesticides 8080 Enh.	0.1
731	VOA Method 8240	0.01, 1.0 see footnote 2 below
733	A/B/N 8270 Enh.	1.0
734	Pesticides 8140	0.1
C68	EOX	1.0
C69	TOC	10.0
C70	Cyanide	1.0
A51	Lead by GFAA	0.5
735	Anions	see footnote 3 below
C77	Perchlorate	2 ug/g
C78	Sulphide	10.0
C80	Ammonium Ion	0.5
C81	Ethylene Glycol	10.0
109	Coliforum Bacteria	3 MPN/100 mL of extract
181	Radium	to be determined
212	Alpha	6 pCi/g
111	Beta	3 pCi/g
C86	Dioxin	-
C87	Citrus Red No. 2	10
736	Direct Aqueous Injection	3.0
737	Hebicide 8150 Enh.	0.1

Footnotes:

(1) The detection limits for the metals in soil will be 100 times higher than the corresponding limits for aqueous samples. For example, for Ba, the detection level will be 200 ppb which is equivalent to 0.2 ug/g. The other metals are similarly affected.

(2) The detection limit will depend upon whether the soil samples contain medium to high levels of organic compounds. The extraction/analysis procedure differs slightly for the low level and medium to high level soil samples. The detection limit for low level soils is expected to be 0.01 ug/g, whereas for higher level soils, it will be 1.0 ug/g. The actual detection limits will be established only after the first few soil samples have been analyzed.

(3) The detection limits for the anions will be twice those for aqueous samples.

86-9.6 Facilities, Equipment and Personnel

No major additional facilities will be required. Existing facilities will be used. The following equipment, glassware, etc. will be required:

(a) EOX analyzer kit for EOX (C68) determination

(b) Centrifuge (for EOX, etc.)

(c) Soxhlet extractors for the extraction of ABN's and pesticides

(d) Miscellaneous glassware, reagents, etc.

An additional person will be hired to handle the extra workload arising from the tedious, labor-intensive EOX (C68) and Herbicide (737) analyses.

86-9.7 Impact on the Routine Program

The major impact on the routine program will arise from the EOX (C68) and Herbicide (737) analyses, and from the additional aqueous extraction procedure (86-9.3). Appropriate steps will be taken to minimize any adverse impact on the routine program. As a minimum, these steps will consist of the following:

(a) Scheduling all or most of the effort under SPWA 86-9 to be performed on over-time and on weekends, if necessary;

(b) Hiring additional personnel;

(c) Acquiring an additional TOX analyzer.

86-9.8 Reports and Turn-around Times

UST-RD will provide data reports on hard copy only. Results can be provided on magnetic tape if additional funding is available for the necessary programming effort. The additional effort is required to convert the reporting units from ug/L to ug/g, etc. The effort is estimated to take at least 8 hours of programmer and data handling time on an overtime basis.

Hard copy reports will be provided within 35 business days of the receipt of samples.

86-9.9 Price Proposal

Code	Analysis	Unit Price
A20	Arsenic	$ 35.00
A21	Mercury	$ 85.00
A22	Selenium	$ 35.00
A23	Thallium	$ 35.00
A51	Lead by GFAA	$ 35.00
C68	EOX	$100.00
C69	TOC	$ 30.00
C70	Cyanide	$ 45.00
C77	Perchlorate	$ 90.00
C78	Sulfide	$ 45.00
C80	Ammonium Ion	$ 35.00
C81	Ethylene Glycol	$115.00
C86	Dioxin	- -*
C87	Citrus Red #2	$ 70.00
109	Coliform Bacteria	$ 20.00
111	Beta	$ 30.00
112	Alpha	$ 50.00
181	Radium	$155.00
726	ICP Metals 6010 Enhanced	$150.00
727	Method 8330 Enhanced	$360.00
729	Pesticides 8080 Enhanced	$280.00
731	VOA Method 8240 Enhanced	$500.00
733	A/B/N 8270 Enhanced	$600.00
734	Pesticides Method 8140	$165.00
735	Nitrate, Sulphate,....(IC)	$115.00
736	Direct Aqueous Injection	$315.00
737	Herbicide 8150 Enhanced	$245.00

* To be negotiated.

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June, 1983

USEPA Document 600/4/84-008
NTIS : PB.84-134337, $14.50

DEVELOPMENT AND EVALUATION OF METHODS FOR TOTAL ORGANIC HALIDE AND PURGEABLE ORGANIC HALIDE IN WASTEWATER

by

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Organic Analyses Section
Physical and Chemical Methods Branch
Environmental Monitoring and Support Laboratory
Cincinnati, Ohio 45268

Dohrmann P.N.	Description	Price
899-847	MC-1 Syringe Injection Kit	$700.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
26 WEST ST. CLAIR STREET
CINCINNATI, OHIO 45268

FOREWORD

Environmental measurements are required to determine the quality of ambient waters and the character of waste effluents. The Environmental Monitoring and Support Laboratory-Cincinnati conducts research to:

- Develop and evaluate methods to measure the presence and concentration of physical, chemical and radiological pollutants in water, wastewater, bottom sediments, and solid waste.
- Investigate methods for the concentration, recovery, and identification of viruses, bacteria and other microbiological organisms in water; and, to determine the responses of aquatic organisms to water quality.
- Develop and operate an Agency-wide quality assurance program to assure standardization and quality control of systems for monitoring water and wastewater.
- Develop and operate a computerized system for instrument automation leading to improved data collection, analysis, and quality control.

Under authority of Sections 304(h) and 501(a) of the Federal Water Pollution Control Act of 1972 and the Clean Water Act of 1977, the U.S. Environmental Protection Agency (U.S. EPA) is required to promulgate guidelines establishing test procedures for the analysis of pollutants. This report represents an evaluation of various procedures for the determination of organic halides in industrial wastewaters and solid samples as a group parameter.

Robert L. Booth, Acting Director
Environmental Monitoring and
Support Laboratory-Cincinnati

CONTENTS

Appendices

extracted organic halides (e.g., PCBs, chlorinated pesticides). However, this approach does not detect polar, nonextractable organic halides which are detected by the TOX carbon adsorption approach. This feature of the method is advantageous if the selective detection of nonpolar organic halides, such as the priority pollutants, is of interest, but undesirable if the TOX concentration is of interest.

- The EOX method for solids appears to work quite well for a variety of types of solids (e.g., soils, solid wastes, suspended solids contained in wastewater). However, because of the diversity of solid sample properties which are potentially of interest, the applicability of this approach to any specific sample needs to be evaluated before the surrogate method data can be used by itself with a high degree of confidence. Additional extraction solvents and other experimental parameters for this method should be explored before widespread use of the method occurs.

APPENDIX D

METHOD FOR EXTRACTABLE ORGANIC HALIDES (EOX) IN SOLIDS

1. Scope and Application 1.1

1.1 This method is to be used for the determination of extractable organic halides (EOX) as Cl^- in solids. EOX is defined as the sum of those organic halides which are extracted and detected by pyrolysis/microcoulometry under the conditions specified in this method. EOX includes but is not limited to the priority pollutant organic halides specified in EPA Method 624 and 625 (1,2). Extractable organic halides containing chlorine, bromine, or iodine are detected. However, fluorine containing species are not detected by this method.

1.2 This method has been evaluated for solid wastes, soils, and suspended solids isolated from industrial wastewater (2).

1.3 Any modification of this method, beyond those expressly permitted, shall be considered as a major modification subject to application and approval of alternate test procedures under 40 CFR 260.21.

1.4 This method is restricted to use by, or under the supervision of, analysts experienced in the operation of a pyrolysis microcoulometer and in the interpretation of the results.

1.5 Since this method does not identify individual components, it is advisable that compound specific techniques be employed to determine the individual components present in samples exhibiting significant EOX levels, unless the nature of the sample is already known.

2. Summary of Method 2.1

A 1-gram aliquot of a solid sample is extracted with ethyl acetate by sonification to isolate organic halides. A 25-μL aliquot of the extract is injected into a pyrolysis furnace using a stream of CO_2/O_2 and the hydrogen halide (HX) pyrolysis product is determined by microcoulometric titration.

as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current-awareness file of OSHA regulations regarding the safe handling of the chemicals used in this method. A reference file of material handling data sheets should also be made available to all personnel involved in the chemical analysis. Additional references to laboratory safety have been identified (4–6) for the information of the analyst.

4.2 Certain EOX compounds are tentatively classified as known or suspected human or mammaliam carcinogens. These include (but are not limited to) carbon tetrachloride, chloroform, 1,4-dichlorobenzene, vinyl chloride, polychlorinated biphenyls, α-BHC, β-BHC, δ-BHC, γ-BHC, and 4,4'-DDT. Primary standards of these compounds should be prepared in a hood. A NIOSH/MESA approved toxic gas respirator should be worn when the analyst handled high concentrations of these toxic compounds.

5. Apparatus and Materials (All specifications are suggested. Catalog numbers are included for illustration only.)

5.1 Sampling equipment, for discrete sampling.

5.1.1 Vial - 25-mL capacity or larger, equipped with a screw cap with hole in center (Pierce #13075 or equivalent). Detergent wash, rinse with tap and distilled water, and dry at 105°C before use.

5.1.2 Septum - Teflon-faced silicone (Pierce #12622 or equivalent). Detergent wash, rinse with tap and distilled water, and dry at 105°C for 1 hour before use.

5.2 Modified Dohrmann microcoulometric-titration system DX-20, or equivalent, containing the following components:

5.2.1 Solvent injection system

5.2.2 Pyrolysis furnace

5.2.3 Titration cell.

7. Calibration

7.1 Assemble the solvent injection/pyrolysis/microcoulometric titration apparatus shown in Figure 1 in accordance with the manufacturer's specifications and the modifications shown. Adjust the CO_2 flow to 300 mL/minute and the O_2 flow to 100 mL/minute using the auxiliary flow controllers (bypass the DX-20 flow controllers). The pyrolysis furnace should be set at 800 ± 10°C. Attach the titration cell to the pyrolysis tube outlet and fill with electrolyte (70% acetic acid).

7.2 Turn on the instrument and allow the gas flows and temperatures to stabilize. When the background current of the titration cell has stabilized the instrument is ready for use.

7.3 Calibrate the microcoulometric titration system for Cl- detection by injecting various amounts of the sodium chloride calibration standard directly into the titration cell and integrating the response using the POX integration mode. The range of sodium chloride amounts should cover the range of expected sample concentrations and should always be less than 80 µg Cl-. Over the range 1 - 80 µg Cl- the integrated response should read within 2% or 0.05 µg (whichever is larger) of the quantity injected. If this calibration requirement is not met then the instrument sensitivity parameters should be adjusted according to the manufacturer's specifications to achieve accurate response.

7.4 Check the performance of the entire analytical system by injecting three 25-uL aliquots of the trichlorobenzene calibrate standard into the furnace at a rate of 1 mL/second. The mean of these three analyses should be 2.2 - 2.8 µg Cl and the percent relative standard deviation should be 5% or less. If these criteria are not met the system should be checked as described in the instrument maintenance manual in order to isolate the problem.

7.5 Perform a blank ethyl acetate injection (25-uL) each day. If the integrated response is greater than 0.1 µg Cl-, then the system should be checked for sources of contamination.

8.2.3 Calculate the average percent recovery, (R), and the standard deviation of the percent recovery (S), for the results. Soil background corrections must be made before R and S calculations are performed.

8.2.4 Using the appropriate data from Table 2, determine the recovery and single operator precision expected for the method, and compare these results to the values measured in analyzed as described in Section 8.2. If the recovery for a particular parameter does not fall within the control limits for method performance, the results reported for that parameter in all samples processed as part of the same set must be qualified as described in Section 11.3. The laboratory should monitor the frequency of data so qualified to ensure that it remains at or below 5%.

8.5 Each day, the analyst must demonstrate, through the analysis of uncontaminated soil, that interferences from the analytical system are under control.

9. Sample Collection, Preservation, and Handling

9.1 All samples must be iced or refrigerated from the time of collection until analysis.

9.2 Grab samples must be collected in glass containers having a total volume of at least 25 mL. Fill the sample bottle as completely as possible to minimize headspace until time of analysis.

9.3 If the analysis is to be conducted on suspended solids from a wastewater sample, isolate the solids by centrifugation, weigh the wet solids, and analyze immediately. Determine the dry weight of a separate portion of the wet solids by heating overnight at 110°C.

10. Sample Analysis

10.1 Calibrate and check system performance daily as described in Section 7.

11.2 Report results in micrograms per gram. When duplicate and spiked samples are analyzed, report all data obtained with the sample results.

11.3 For samples processed as part of a set where the spiked sample recovery falls outside of the control limits which were established according to Section 8.3, data for the affected parameters must be labeled as suspect.

11.4 If the aqueous portion of a water sample, from which the suspended solids are being analyzed, is expected to contain high levels of organic halide, a 1-mL aliquot of the centrifuged sample should be analyzed. The solids data must then be corrected using the following equation:

$$\text{EOX (corrected)} = \text{EOX}_S - \text{EOX}_W \times \frac{W_S}{W_D}$$

where:

EOX_S = EOX in wet solids, μg/g as Cl

EOX_W = EOX in water sample, μg/g as Cl

W_S = Wet weight of solids, grams

W_D = Dry weight of solids, grams

12. Method Performance

12.1 The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. An MDL of 10 μg/g was obtained using injected ethyl acetate standards (3). The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

12.2 This method is recommended for use in the concentration range from the MDL up to 1000 x MDL.

12.3 In a single laboratory (Battelle Columbus Laboratories), using solid spiked at various levels, the average recoveries presented in Table 1 were obtained (3).

11.2 Report results in micrograms per gram. When duplicate and spiked samples are analyzed, report all data obtained with the sample results.

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where:

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EOX_W = EOX in water sample, μg/g as Cl

W_S = Wet weight of solids, grams

W_D = Dry weight of solids, grams

12. Method Performance

12.1 The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. An MDL of 10 μg/g was obtained using injected ethyl acetate standards (3). The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

12.2 This method is recommended for use in the concentration range from the MDL up to 1000 x MDL.

12.3 In a single laboratory (Battelle Columbus Laboratories), using solid spiked at various levels, the average recoveries presented in Table 1 were obtained (3).

US Testing

Analytical Method
Group Codes

HAZARDOUS SUBSTANCE ANALYSIS - U.S. TESTING 10/86

Commonly Called	Constituent	MDC,ppb	Constituent Code	Group Code	Sample Size	Method	FY 1987 Unit Price
ICP Metals (unfiltered/ filtered)	Zinc	5	A04/H18	725/740	1 ℓ P	SW-846, #6010	98
	Calcium	50	A05/H19				
	Barium	6	A06/H20				
	Cadmium	2	A07/H21				
	Chromium	10	A08/H22				
	Silver	10	A10/H23				
	Sodium	100	A11/H24				
	Nickel	10	A12/H25				
	Copper	10	A13/H26				
	Vanadium	5	A14/H27				
	Aluminum	150	A16/H28				
	Manganese	5	A17/H29				
	Potassium	100	A18/H30				
	Iron	50	A19/H31				
	Magnesium	50	A50/H32				
ICP Metals (Enhanced) (unfiltered/ filtered)	All ICP Metals (see above)						
	Beryllium	5	A01/H33	726/741	1 ℓ P	SW-846, #6010	100
	Osmium	300	A02/H34				
	Strontium	300	A03/H35				
	Antimony	100	A15/H36				
(unfilt/filt)	Lead	5	A51/H41		500 ml P	SW-846, #7421	22
(unfilt/filt)	Arsenic	5	A20/H37		500 ml P	SW-846, #7060	22
(unfilt/filt)	Mercury	0.1	A21/H38		500 ml G	SW-846, #7470	42
(unfilt/filt)	Selenium	5	A22/H39		500 ml P	SW-846, #7740	22
(unfilt/filt)	Thallium	10	A23/H40		500 ml P	SW-846, #7840	22

Commonly Called	Constituent	MDC,ppb	Constituent Code	Group Code	Sample Size	Method	FY 1987 Unit Price
	Endrin	1	A33				
Pesticides	Methoxyclor	1	A34	728	2 ℓ G	SW-846, #8080	112
	Toxaphene	1	A35				
	Lindane (and Isomers)	1	A36-A39				
	All Pesticides (see above)						
	4,4'-DDD	1	A40				
Pesticides	4,4'-DDE	1	A41	729	2 ℓ G	SW-846, #8080	190
(Enhanced)	4,4'-DDT	1	A42				
	Heptachlor	1	A43				
	Heptachlor epoxide	1	A44				
	Dieldrin	1	A46				
	Aldrin	1	A47				
	Chlordane	1	A48				
	Endosulfan I,II	1	A49,A52				
	Chlorobenzilate	100	C62				
	Polychlorinated Biphenyls	1	A54-A60	739	2 ℓ G	SW-846, #8080	126
Herbicides	2,4-D	1	H13	738	2 ℓ G	SW-846, #8150	112
	2,4,5-TP Silvex	1	H14				
Herbicides	All Herbicides (see above)			737	2 ℓ G	SW-846, #8150	116
(Enhanced)	2,4,5-T	1	H15				
	Tetraethylpyrophosphate	100	C61				
	Carbophenothion	2	C63				
Phosphorus	Disulfoton	2	C64	734	2 ℓ G	SW-846, #8140	112
Pesticides	Dimethoate	5	C65				
	Methyl Parathion	2	C66				
	Parathion	2	C67				

Commonly Called	Constituent	MDC,ppb	Constituent Code	Group Code	Sample Size	Method	FY 1987 Unit Price
Volatile Organics (VOA's)	Tetrachloromethane	10	A61	730	40 ml G	SW-846, #8240	169
	Methylethyl Ketone	10	A64				
	1,1,1-trichloroethane	10	A67				
	1,1,2-trichloroethane	10	A68				
	1,1,2-trichloroethylene	10	A69				
	Perchloroethylene	10	A70				
	Xylene	10	B14,A71				
	Chloroform	10	A80				
	Methylene Chloride	10	A93				
VOAs (Enhanced)	All Volatile Organics (see above)			731	40 ml G	SW-846, #8240	267
	Additional 9905 VOAs (see list attached)	10					
Acid/Base/ Neutrals (ABNs)	Hexachlorophene	10	C54	732	2 l G	SW-846, #8270	253
	Naphthalene	10	C55				
	Phenol	10	C57				
	Kerosene	10ppm	C79				
	Chlorinated Benzenes	10					
	1,2-dichlorobenzene		B61				
	1,3-dichlorobenzene		B62				
	1,4-dichlorobenzene		B63				
	hexachlorobenzene		B89				
	pentachlorobenzene		C26				
	1,2,4,5-tetrachlorobenzene		C37				
	1,2,4-trichlorobenzene		C43				
	1,2,3-trichlorobenzene		C56				
	1,3,5-trichlorobenzene		C58				
	1,2,3,4-tetrachlorobenzene		C59				
	1,2,3,5-tetrachlorobenzene		C60				
ABNs (Enhanced)	All Acid/Base/Neutrals (see above)			733	2 l G	SW-846, #8270	407
	Additional 9905 ABNs (see list attached)	10					
	Phenol	1	H57		3 l G	SW-846, #8040	63

Commonly Called	Constituent	MDC,ppb	Constituent Code	Group Code	Sample Size	Method	FY 1987 Unit Price
	Direct Aqueous Injection (see list attached)	3ppm	A97,A98,B19, C53,C88-C90, C94-H12	736	40 ml G	In-house	70
	Hydrazine	30	C53				112
	Thiourea	200	A24		50 ml G	SW-846, #8330 (modified)	49
Thiourea (Enhanced)	Thiourea	200	A24	727	50 ml G	SW-846, #8330 (modified)	225
	1-acetyl-2-thiourea	200	A25				
	1-(o-chlorophenyl)thiourea	200	A26				
	Diethylstilbesterol	200	A27				
	Ethylenethiourea	200	A28				
	1-napthyl-2-thiourea	200	A29				
	N-phenylthiourea	200	A32				
	Citrus Red #2	1ppm	C87		50 ml G	AOAC #34.015B	18
	Cyanide	10	C70		2 l P	SW-846, #9010	42
	Dioxin	0.1	C08		1 l G	EPA #613	302
	TOX (available 2 det. levels)	100	C68		500 ml G	SW-846, #9020	18
		20	H42		500 ml G	SW-846, #9020	70
	TOC	1ppm	C69		750 ml G	SM #505	18
	Total Carbon	2ppm	H16		750 ml G	SM #505	18
	Total Dissolved Solids		H17		500 ml P	SM #209D	18

Commonly Called	Constituent	MDC,ppb	Constituent Code	Group Code	Sample Size	Method	FY 1987 Unit Price
Ions	Nitrate	500	C72	735	125 mℓ P	In-house (Ion Chromatography)	70
	Sulfate	500	C73				
	Fluoride	500	C74				
	Chloride	500	C75				
	Phosphate	1ppm	C76				
	(NOTE - each ion available singly for $42)						
	Sulfide	1ppm	C78		1 ℓ P	SW-846, #9030	28
	Perchlorate	1ppm	C77		125 mℓ P	In-house (Ion Chromatography)	56
	Ammonium Ion	50	C80		350 mℓ G	SM #417E	22
	Ethylene Glycol	10ppm	C81		50 mℓ G	In-house	49
	Coliform Bacteria	2.2mpn	109		(2) 100 mℓ P	SM #908A	11
	Radium	1 pCi/ℓ	101		1 ℓ P	EPA Method #903.0	135
	Gross Alpha	4 pCi/ℓ	212		1 ℓ P	EPA Method 600/4-75-001	42
	Gross Beta	8 pCi/ℓ	111		1 ℓ P	EPA Method 600/4-75-001	25
	pH		199		50 mℓ		8
	Specific Conductance		191				8

Additional:

(a) For additional GC/MS searches, a charge of $10/peak will apply (unless additional peaks are provided for in the SOW or established procedures).

(b) For GC/MS confirmations of pesticides and/or herbicides, a surcharge of 20% will be applied.

(c) For any Hazardous Chemical analytical service required on a rapid basis, a factor of 2 is applied to the corresponding unit price; for priority processing, a factor of 1.5 is applied to the corresponding unit price.

US Testing

Hazardous Substance
Constituent Codes

HAZARDOUS WASTE CONSTITUENTS - GROUNDWATER MONITORING

Code	Code Name	Constituent
A01	berylam	berylliam
A02	osmium	osmium
A03	stronum	strontium
A04	zinc	zinc
A05	calcium	calcium
A06	barium	barium
A07	cadmium	cadmium
A08	chromum	chromium
A10	silver	silver
A11	sodium	sodium
A12	nickel	nickel
A13	copper	copper
A14	vanadum	vanadium
A15	antiony	antimony
A16	alumnum	aluminum
A17	mangese	manganese
A18	potasum	potassium
A19	iron	iron
A20	arsenic	arsenic
A21	mercury	mercury
A22	selenum	selenium
A23	thalium	thallium
A24	thioura	thiourea
A25	acetrea	1-acetyl-2-thiourea
A26	chlorea	1-(o-chlorophenyl) thiourea
A27	dietrol	diethylstilbesterol
A28	ethyrea	ethylenethiourea
A29	naphrea	1-naphthyl-2-thiourea
A30	nitrrea	N-nitroso-N-ethylurea
A31	nitrmet	N-nitroso-N-methylurea
A32	phenrea	N-phenylthiourea
A33	endrin	endrin
A34	methlor	methoxychlor
A35	toxaene	toxaphene
A36	a-BHC	alpha-BHC
A37	b-BHC	beta-BHC
A38	g-BHC	gamma-BHC
A39	d-BHC	delta-BHC
A40	DDD	DDD
A41	DDE	DDE
A42	DDT	DDT
A43	heptlor	heptachlor
A44	heptide	heptchlor epoxide
A46	dielrin	dieldrin
A47	aldrin	aldrin
A48	chloane	chlordane
A49	endofan	endosulfan
A50	magnes	magnesium
A51	leadgf	lead (graphite furmace)

A54	AR1016	Arochlor	1016
A55	AR1221	Arochlor	1221
A56	AR1232	Arochlor	1232
A57	AR1242	Arochlor	1242
A58	AR1248	Arochlor	1248
A59	AR1254	Arochlor	1254
A60	AR1260	Arochlor	1260
A61	tetrane	tetrachloromethane	
A62	benzene	benzene	
A63	dioxane	dioxane	
A64	methone	methyl ethyl ketone	
A65	pyridin	pyridine	
A66	toluene	toluene	
A67	1,1,1-t	1,1,1-trichloroethane	
A68	1,1,2-t	1,1,2-trichloroethane	
A69	tricene	trichloroethylene	
A70	percene	perchloroethylene	
A71	opxyle	xylene-o,p	
A72	acrolin	acrolein	
A73	acryile	acrylonitrile	
A74	bisther	bis(chloromethyl) ether	
A75	bromone	bromoacetone	
A76	methbro	methyl bromide	
A77	carbide	carbon disulfide	
A78	chlbenz	chlorobenzene	
A79	chlther	2-chloroethyl vinyl ether	
A80	chlform	chloroform	
A81	methchl	methyl chloride	
A82	chmther	chloromethyl methyl ether	
A83	crotona	crotonaldehyde	
A84	dibrchl	1,1-dibromo-3-chloropropane	
A85	dibreth	1,2-dibromoethane	
A86	dibrmet	dibromomethane	
A87	dibuten	1,4-dichloro-2-butene	
A88	dicdifm	dichlorodifluoromethane	
A89	1,1-dic	1,1-dichloroethane	
A90	1,2-dic	1,2-dichloroethane	
A91	trandce	trans-1,2-dichloroethene	
A92	dicethy	1,1-dichloroethylene	
A93	methych	methylene chloride	
A94	dicpane	1,2-dichloropropane	
A95	dicpene	1,3-dichloropropene	
A96	NNdiehy	N,N-diethylhydrazine	
A97	1,1-dim	1,1-dimethylhydrazine	
A98	1,2-dim	1,2-dimethylhydrazine	
A99	hydrsul	hydrogen sulfide	
B01	iodomet	iodomethane	
B02	methacr	methacrylonitrile	
B03	meththi	methanethiol	
B04	pentach	pentachloroethane	
B05	1112-tc	1,1,1,2-tetrachlorethane	
B06	1122-tc	1,1,2,2-tetrachlorethane	
B08	bromorm	bromoform	
B09	trcmeol	trichloromethanethiol	
B10	trcmflm	trichloromonofluoromethane	
B11	trcpane	trichloropropane	
B12	123-trp	1,2,3-trichloropropane	
B13	vinyide	vinyl chloride	

B14	m-xyle	xylene-m
B15	diethy	diethylarsine
B19	acetile	acetonitrile
B20	acetone	acetophenone
B21	warfrin	warfarin
B22	acefene	2-acetylaminofluorene
B23	aminoyl	4-aminobyphenyl
B24	amiisox	5-(aminomethyl)-3-isoxazolol
B25	amitrol	amitrole
B26	aniline	aniline
B27	aramite	aramite
B28	auramin	auramine
B29	benzcac	benz[c]acridine
B30	benzaan	benz[a]anthracene
B31	bendicm	benzene, dichloromethyl
B32	benthol	benzenethoil
B33	bendine	benzidine
B34	benzbfl	benzo[b]fluoranthene
B35	benzjfl	benzo[j]fluoranthene
B36	pbenzqu	p benzoquinone
B37	benzchl	benzyl chloride
B38	bis2chm	bis(2-chloroethoxy) methane
B39	bis2che	bis(2-chloroethyl) ether
B40	bis2eph	bis(2-ethylhexyl) phthalate
B41	brophen	4-bromophenyl phenyl ether
B42	butbenp	butyl benzyl phthalate
B43	butdinp	2-sec-butyl-4,6-dinitrophenol
B44	chaleth	chloroalkyl ethers
B45	chlanil	p-chloroaniline
B46	chlcres	p-chloro-m-cresol
B47	chlepox	1-chloro-2,3-epoxypropane
B48	chlnaph	2-chloronaphthalene
B49	chlphen	2-chlorophenol
B50	chrysen	chrysene
B51	cresols	cresols
B52	cychdin	2-cyclohexyl-4,6-dinitrophenol
B53	dibahac	dibenz[a,h]acridine
B54	dibajac	dibenz[a,j]acridine
B55	dibahan	dibenz[a,h]anthracene
B56	dibcgca	7H-dibenzo[c.g]carbazole
B57	dibaepy	dibenzo[a.e]pyrene
B58	dibahpy	dibenzo[a.h]pyrene
B59	dibaipy	dibenzo[a,i]pyrene
B60	dibphth	di-n-butyl phthalate
B61	12-dben	1,2-dichlorobenzene
B62	13-dben	1,3-dichlorobenzene
B63	14-dben	1,4-dichlorobenzene
B64	dichben	3,3'-dichlorobenzidine
B65	24-dchp	2,4-dichlorophenol
B66	26-dchp	2,6-dichlorophenol
B67	diephth	diethyl phthalate
B68	dihysaf	dihydrosafrole
B69	dimethb	3,3'-dimethoxybenzidine
B70	dimeamb	p-dimethylaminoazobenzene

B71	dimbenz	7,12-dimethylbenz[a]anthracene
B72	dimeylb	3,3'-dimethylbenzidine
B73	thionox	thiofanox
B74	dimpham	alpha,alpha-dimethylphenethylamine
B75	dimphen	2,4-dimethylphenol
B76	dimphth	dimethyl phthalate
B77	dinbenz	dinitrobenzene
B78	dincres	4,6-dinitro-o-cresol and salts
B79	dinphen	2,4-dinitrophenol
B80	24-dint	2,4-dinitrotoluene
B81	26-dint	2,6-dinitrotoluene
B82	diophth	di-n-octyl phthalate
B83	diphami	diphenylamine
B84	diphhyd	1,2-diphenylhydrazine
B85	diprnit	di-n-propylnitrosamine
B86	ethmine	ethyleneimine
B87	ethmeth	ethyl methanesulfonate
B88	fluoran	fluoranthene
B89	hexcben	hexachlorobenzene
B90	hexcbut	hexachlorobutadiene
B91	hexccyc	hexachlorocyclopentadiene
B92	hexceth	hexachloroethane
B93	indenop	indeno(1,2,3-cd)pyrene
B94	isosole	isosafrole
B95	maloile	malononitrile
B96	melphal	melphalan
B97	methapy	methapyrilene
B98	methnyl	metholonyl
B99	metazir	2-methylaziridine
C01	metchan	3-methylcholanthrene
C02	metbisc	4,4'-methylenebis(2-chloroaniline)
C03	metacto	2-methyllactonitrile
C04	metacry	methyl methacrylate
C05	metmsul	methyl methanesulfonate
C06	metprop	2-methyl-2-(methylthio) propionaldehyde-o-(methylcarbonyl)oxime
C07	methiou	methylthiouracil
C08	naphqui	1,4-naphthoquinone
C09	1-napha	1-naphthylamine
C10	2-napha	2-naphthylamine
C11	nitrani	p-nitroaniline
C12	nitbenz	nitrobenzine
C13	nitphen	4-nitrophenol
C14	nnibuty	N-nitrosodi-n-butylamine
C15	nnidiea	N-nitrosodiethanolamine
C16	nnidiey	N-nitrosodiethylamine
C17	nnidime	N-nitrosodimethylamine
C18	nnimeth	N-nitrosomethylethylamine
C19	nniuret	N-nitroso-N-methylurethane
C20	nniviny	N-nitrosomethylvinylamine
C21	nnimorp	N-nitrosomorpholine
C22	nninico	N-nitrosonornicotine
C23	nnipipe	N-nitrosopiperidine
C24	nitrpyr	nitrosopyrrolidine

C25	nitrtol	5-nitro-o-toluidine
C26	pentchb	pentachlorobenzene
C27	pentchn	pentachloronitrobenzene
C28	pentchp	pentachlorophenol
C29	phentin	phenacetin
C30	phenine	phenylenediamine
C31	phthest	phthalic acid esters
C32	picolin	2-picoline
C33	pronide	pronamide
C34	reserpi	reserpine
C35	resorci	resorcinol
C36	safrol	safrol
C37	tetrchb	1,2,4,5-tetrachlorobenzene
C38	TCDD	2,3,7,8-TCDD
C38	tetrchp	2,3,4,6-tetrachlorophenol
C40	thiuram	thiuram
C41	toludia	toluenediamine
C42	otolhyd	o-toluidine hydrochloride
C43	trichlb	1,2,4-trichlorobenzene
C44	245-trp	2,4,5-trichlorophenol
C45	246-trp	2,4,6-trichlorophenol
C46	triphos	O,O,O-triethyl phosphorothioate
C47	symtrin	sym-trinitrobenzene
C48	triphos	tris(2,3-dibromopropyl) phosphate
C49	benzopy	benzo[a]pyrene
C50	chlnaph	chlornaphazine
C51	bis2eth	bis(2-chloroisopropyl)ether
C52	hexaene	hexachloropropene
C53	hydrazi	hydrazine
C54	hexachl	hexachlorophene
C55	naphtha	naphthalene
C56	123tri	1,2,3-trichlorobenzene
C57	phenol	phenol
C58	135tri	1,3,5-trichlorobenzene
C59	1234te	1,2,3,4-tetrachlorobenzene
C60	1235te	1,2,3,5-tetrachlorobenzene
C61	tetepyr	tetraethylpyrophosphate
C62	chllate	chlorobenzilate
C63	carbpht	carbophenothion
C64	disulfo	disulfoton
C65	dimetho	dimethoate
C66	methpar	methyl parathion
C67	parathi	parathion
C68	TOX	total organic halogen
C69	TOC	total organic carbon
C70	cyanide	cyanide
C71	formaln	formalin
C72	nitrate	nitrate
C73	sulfate	sulfate
C74	fluorid	fluoride
C75	chlorid	chloride
C76	phospha	phosphate
C77	perchlo	perchlorate
C78	sulfide	sulfide

C79	kerosen	kerosene
C80	ammoniu	ammonium ion
C81	ethygly	ethylene glycol
109	colifrm	coliform bacteria
181	radium	radium
112	alpha	gross alpha
111	beta	gross beta
C86	dioxin	dioxin
C87	citrusr	citrus red
C88	cyanbro	cyanogen bromide
C89	cyanchl	cyanogen chloride
C90	paralde	paraldegyde
C91	strychn	strychnine
C92	malhydr	maleic hydrizide
C93	nicotin	nicotinic acid
C94	acryide	acrylamide
C95	allylal	allyl alcohol
C96	chloral	chloral
C97	chlacet	chloroacetaldehyde
C98	chlprop	3-chloropropionitrile
C99	cyanogn	cyanogen
H01	dicprop	dichloropropanol
H03	ethcarb	ethyl carbamate
H04	ethcyan	ethyl cyanide
H05	ethoxid	ethylene oxide
H06	ethmeth	ethyl methacrylate
H07	fluoroa	fluoroacetic acid
H08	glycidy	glycidylaldehyde
H09	isobuty	isobutyl alcohol
H10	metzine	methyl hydrazine
H11	propyla	n-propylamine
H12	propyno	2-propyn-1-ol
H13	2,4-D	2,4-D
H14	2,4,5TP	2,4,5-TP silvex
H15	2.4.5-T	2.4.5-T

9-12-8

New Constituent and Group Codes for Filtered Samples

Code	Code Name	Constituent	Group	
H18	fzinc	zinc	740	741
H19	fcalciu	calcium		
H20	fbarium	barium		
H21	fcadmiu	cadmium		
H22	fchromi	chromium		
H23	fsilver	silver		
H24	fsodium	sodium		
H25	fnickel	nickel		
H26	fcopper	copper		
H27	fvanadi	vanadium		
H28	falumin	aluminum		
H29	fmangan	manganese		
H30	fpotass	potassium		
H31	firon	iron		
H32	fmagnes	magnesium		
H33	fberyll	beryllium		
H34	fosmium	osmium		
H35	fstront	strontium		
H36	fantimo	antimony		
H37	farseni	arsenic		
H38	fmercur	mercury		
H39	fseleni	selenium		
H40	fthalli	thallium		
H41	flead	lead		

NOTE: Equivalencies for nonfiltered samples:

Filtered	Unfiltered
Group 740	Group 725
Group 741	Group 726
H37	A20
H38	A21
H39	A22
H40	A23
H41	A51

ADDITIONAL COMPOUND LIST

H16	TOTAL CARBON	TC
I01	ACETONE	ACETONE
I02	HEXANE	HEXANE
I03	METHYLCYCLOPENTANE	MECYPEN
I04	1,2 BENZENE DICARBOXYLIC ACID, BUTYL, 2 METHYLPROPYLESTER	MEBUPHT
I05	NITROMETHANE	NITROM
I06	ISOPHERONE	ISOPHER
I07	BUTANAL	BUTANAL
I08	3-BUTEN-2-ONE	BUTENON
I09	1-BUTANOL	BUTANOL
110	2-PROPANOL	PROPANOL
I11	1-H INDENE OCTAHYDRO	INDOCHY
I12	ETHYLMETHYL CYCLOHEXANE	CYCETME
I13	CYCLOHEXANE ISOMER	CYCISO1
I14	CYCLOHEXANE ISOMER	CYCISO2
I15	5-METHYL-4 NONENE	NONEME
I16	TRIMETHYL HEPTATRIENE	TMEHEPT
I17	1,2-OCTADIENE	OCTADIE
I18	N-METHOXYMETHANAMINE	MEOXAMI
I19	METHYLFORMATE	MEFORMT
I20	METHYLNITRATE	MENITRA
I21	TRIBUTYLPHOSPHORIC ACID	TRIBUPH
I22	HEXANOIC ACID	HEXACID
I23	2-BUTOXY ETHANOL	BUTOXET
I24	BENZALDEHYDE	BENZALD

I25	2-(2 BUTOXYETHOXY) ETHANOL	BUTOX2
I26	1,4 BUTANEDIOL, DINITRATE	14BDDN
I27	3,4-DICHLOROBENZOIC ACID	34DCBA
I28	TETRAHYDORFURAN	TAF
I29	ACENAPHTHENE	ACENAPH
I30	FLUORENE	FLRENE
I31	ANTHRACENE	ANTHRA
I32	PYRENE	PYRENE
I33	ETHYLBENZENE	ETHBENZ
I34	STYRENE	STYRENE
I35	1,1,3-TRIMETHYLCYCLOHEXANE	TMCYCH
I36	1,2,3-TRIMETHYLCYCLOHEXANE	12TMCYH
I37	3-ETHYLHEXANE	3ETHHEX
I38	1,3,5,7-CYCLOOCTATETRAENE	CYCTETR
I39	TRANS-1-ETHYL-4METHYL CYCLOHEXANE	ETMTCYC
I40	1,3 DIMETHYLBENZENE (M-XYLENE)	13DMBEN
I41	(1-METHYLETHYL)-BENZENE	MEBENZ
I42	BROMODICHLOROMETHANE	BDCM
I43	CHLORODIBROMOMETHANE	CDBM
I44	PROPYL BENZENE	PROBENZ
I45	1,4-DIMETHYL CYCLOOCTANE	14DMCYO
I46	CYCLO HEXANE	CYCLHEX
I47	METHYL CYCLOHEXANE	MECYCHE
I48	1-ETHYL-4-METHYL BENZENE	ETMTBEN
I49	3-METHYL HEPTANE	MEHEPT
I50	DECAHYDRONAPHTHALENE	DECANAP
I51	2-METHYL OCTANE	MEOCTA

I52	TRIMETHYL SILANOL	TMSILO
I53	DICHLOROFLUOROMETHANE	DCFM
I54	PENTENAL	PENTAL
I55	1-(1-PROPYNYL)-CYCLOHEXENE	PROCYEN
I56	2,3-DIMETHYL-2-HEXENE	DIMEHEX
I57	ETHENYL CYCLOPENTANE	ETHECYC
I58	1,3-DIMETHYLBUTYL CYCLOHEXANE	DMBCYCL
I59	2-METHYL BUTANE	METBUTA
I60	PENTANE	PENTANE
I61	2-PENTENE	2PENTEN
I62	2-METHYL HEXANE	2MEHEX
I63	2,6-BIS(1,1-DIMETHYLETHYL)-4-METHYL PHENOL	BHT
I64	2-NITROPHENOL	2NITPH
I65	2,4-DICHLORO-6-METHYLPHENOL	246DCMP
I66	2,4-DICHLORO-5-METHYLPHENOL	245DCMP
I67	ETHANOL	ETHANOL
I68	1,1,2-TRICHLORO-1,2,2-TRIFLOUROETHANE	TRECTRFE
I69	3-METHYL-2-BUTANONE	3M32BUT
I70	ISOOCTANOL	ISOCTOL
I71	2-ETHYL-1-HEXANOL	2ET1HOL
I72	TRANS-1,3-DIMETHYLCYCLOHEXANE	TDMECYC
I73	CIS-1,3-DIMETHYLCYCLOHEXANE	CDMECYC
I74	1-ETHYL-1-METHYLCYCLOHEXANE	1E1MCYC
I75	2-METHYLNAPHTHALENE	2MENAPH
I76	5-METHYLUNDECANE	2MEUNDE
I77	TRIDECANE	TRIDECA

I78	PENTADECANE	PENTDEC
I79	3-METHYL-5-PROPYLNONANE	NONMEP
I80	2,6,10,15-TETRAMETHYL HEPTADECANE	PHYTANE
I81	PENTATRIACONTANE	PENTRCO
I82	PHENANTHRENE	PHENANT
I83	NONANE	NONANE
I84	1-ETHYL-2-METHYLBENZENE	1E2MBEN
I85	1,2,4-TRIMETHYLBENZENE	124TMBE
I86	DECANE	DECANE
I87	2,6-DIMETHYLNONANE	26DMNON
I88	BUTYL CYCLOHEXANE	BUTCYCL
I89	4,5-DIMETHYLNONANE	45DMNON
I90	2-METHYL DECANE	2MEDECA
I91	UNDECANE	UNDECAN
I92	2,5,6-TRIMETHYL DECANE	256TMDE
I93	2-METHYL DECAHYDRO-NAPHTHALENE	2MEDECA
I94	PENTYL CYCLOHEXANE	PENTCYC
I95	DODECANE	DODECAN
I96	1,5-DIMETHYL NAPHTHALENE	15DMNAP
I97	UNKNOWN AROMATIC HC	UNKARO
I98	UNKNOWN ALIPHATIC HC	UNKALI
I99	UNKNOWN	

ADDITIONAL CMPND LIST (J)

J01	3-METHYL PENTANE	3MEPENT
J02	3-ETHYL-2,2-DIMETHYL PENTANE	3EDMPEN
J03	2,2,3-TRIMETHYLBUTANE	223TMBU
J04	3-METHYLHEXANE	3MEHEX
J05	ETHYL CYCLOHEXANE	ECYCHEX
J06	2-METHYL HEPTANE	2MEHEPT
J07	3,4,4-TRIMETHYL-2-HEXENE	5M2HEXE
J08	OCTANE	OCTANE
J09	3-METHYL OCTANE	3MEOCT
J10	(1-METHYLPROPYL)-BENZENE	1MPBENZ
J11	PROPYL CYCLOHEXANE	PRCYHEX
J12	2,4-DIMETHYL HEPTANE	24DMHEP
J13	1-ETHYL-2-METHYL BENZENE	132MBEN
J14	2,6-DIMETHYLUNDECANE	26DMUND
J15	2-ETHYL NAPHTHALENE	2ETNAPH
J16	2,6,10,14-TETRAMETHYL PENTADECANE	PRISTAN
J17	3,34-TRIMETHYL DECANE	3TMDECA
J18	5-METHYL NONANE	5MENONA
J19	1-ETHYL-2-METHYL CYCLOHEXANE	1E1MCYC
J20	3,5-DIMETHYL HEPTANE	35MHEP5
J21	3-METHYL NONANE	3MENONA
J22	3-ETHYL-2-METHYL HEPTANE	3E2MHEP
J23	1,2-DIMETHYL CYCLOHEXANE (TRANS)	12DMCYC
J24	1,3,5-TRIMETHYL CYCLOHEXANE	135MCYC
J25	BUTYL CYCLOPENTANE	BUTCYCP
J26	ETHYL CYCLOOCTANE	ETHCYCO

J27	4-METHYL NONANE	4MENONA
J28	1,2,3-TRIMETHYL CYCLOPENTANE	123MCYC
J29	2,3-DIMETHYL HEPTANE	23DMHEP
J30	2,3,7-TRIMETHYL OCTANE	5MEOCT
J31	5-ETHYL-2-METHYL HEPTANE	5E2MHEP
J32	2,3-DIHYDRO-IH-INDENE	DHYINDE
J33	4-(1-METHYLETHYL)-HEPTANE	41MEHEP
J34	2-METHYL TETRADECANE	2METDEC
J35	4,6-DIMETHYL UNDECANE	46DMUND
J36	1,2,3-TRIMETHYL BENZENE	1235MBE
J37	2,6,10 TRIMETHYL HEXADECANE	TMHEXAD
J38	DIMETHOXYMETHANE	DMOMTHN
J39	BUTYLNITRATE	BUTNITR
J40	N,4-DIMETHYL BENZENE SULFONAMIDE	N4DMBSA
J41	TETRADECANE	TETRADE
J42	2,4-DIMETHYL-1-DECENE	DMDECEN
J43	BENZYL ALCOHOL	BENZALC
J44	NONANOIC ACID	NONANAC
J45	2-METHYL-5-PROPYLNONANE	MEPRNON
J46	DODECANOIC ACID	DODECAC
J47	HEXADECANOIC ACID	HXDECAC
J48	1-(2-THIENYL) ETHANONE	THYETHA
J49	MOLECULAR SULFUR (S8)	MOLSULF
J50	HEXATHIEPANE	HEXTHIE
J51	1,2,4-TRITHIOLANE	TRITHIO
J52	HEXADECANE	NC16HC
J53	HEPTADECANE	NC17HC

J54	OCTADECANE	NC18HC
J55	NONADECANE	NC19HC
J56	EICOSANE	NC20HC
J57	HENEICOSANE	NC21HC
J58	DOCOSANE	NC22HC
J59	TRICOSANE	NC23HC
J60	HEPTACOSANE	NC27HC
J61	1,2-DIMETHYLNAPHTHALENE	DMNAPHT
J62	DOCOSANOIC ACID	DOCOACI
J63	HEXADECANAL	HXDECAL
J64	2-ETHYC HEXANOIC ACID	ETHHEXA
J65	2-(2-METHOXYETHOXY)ETHANOL	22MEETH
J66	2-[2-(2-METHOXYETHOXY)ETHOXY]ETHANOL	222METH
J67	2,5,8,11-TETRAOXADODECANE	TETDODE
J68	2-[2-(2-ETHOXYETHOXY)ETHOXY]ETHANOL	222ETHO
J69	2-HEXANONE	2HEXANO
J70	5-METHYL-2-HEXANONE	MEHEXON
*J71	BENZO(K)FLUORANTHENE	BNZKFLU

* ADDED 9/12/86

SURROGATE CODES AND DESCRIPTIONS

CODE	CODE NAME	CONSTITUENT
X01	2FLPHEN	2-FLOUROPHENOL
X02	PHEND6	PHENOL-D6
X03	NITBN2	NITROBENZENE D5
X04	2FLBIPH	2-FLOUROBIPHENYL
X05	246TRI	2,4,6-TRIBROMOPHENOL
X06	TERD14	TERPHENYL-D14
X07	12DCAD4	1-2-DICHLOROETHANE
X08	TOLUD8	TOLUENE-D8
X09	BFB	BFB
X10	DBC	DIBUTYLCHLORENDATE
X11	CHLOR37	CHLORINE-37

APPENDIX F

Geologist Report
for the
300 Area Process Trench
Sediment Sampling Project

cc:
RBH
CAD
RLM

EXPLORATION OF THE 300 AREA PROCESS WATER TRENCHES

By

Randall E. Brown
Geological Consultant

September 1986

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ILLUSTRATIONS

EXPLORATION OF THE 300 AREA PROCESS WATER TRENCHES

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Randall E. Brown
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September 1986

INTRODUCTION

This report summarizes the results of drilling and geological sampling of the sediments beneath and in the bottom of the 300 Area process water trenches, north of the 300 Area. It summarizes the geological analysis of the data obtained, such that the behavior of the waste waters, ground waters, and the contained waste materials can be better predicted and their behavior better explained.

The work was performed under a consultant agreement, order number Y6N-D44-20975, dated April 17, 1986.

SUMMARY AND CONCLUSIONS

The drilling program at the 300 Area process water trenches affirmed earlier conclusions. In no well or test hole there drilled on the just-completed project were the Ringold Formation sediments encountered in place. They there lie at a depth of about 50 feet, roughly 20 feet below the static water level (water table). To the east and west, only about 1000 feet away in each direction they lie above the water table and there markedly affect ground water behavior as described by Lindberg and Bond (1), At the trench site the Pasco Gravels lie down to about 20 feet below the water table , and ground water behavior reflects that presence.

The conclusion are affirmed that the trenches overlie an old Columbia River channel that is filled with the Pasco Gravels. The channel parallels and mirrors the current channel that lies just east of the buried channel.

It is important that the nature of the Pasco Gravels be understood, and their in-place properties recognized. They are the deposits of several catastrophic floods, rather than normal stream, shallow-lake and floodplain deposits as is the underlying Ringold Formation. Positive identification of the Pasco Gravels at the 300 Area trenches permits the judicious assignment of properties to those materials from other sites where their properties have been determined.

The sediments of the Pasco Gravels and of the Ringold Formation overlap in many of their characteristics from site to site. The samples as obtained by drilling have lost many of their important, in-place distinguishing properties. In addition in many sites the Pasco Gravels are merely reworked Ringold Formation sediments. However, the two formations can be appropriately distinguished from each other via samples from drilled wells or test holes, as later explained.

The Pasco Gravels at the 300 Area process water trenches consist of two identified graded sequences of gravelsoverlying the Ringold Formation. The graded gravels range from basal cobble and boulder gravels, that evidently are slurry-flood deposits characterized by a material   silt content, upward through finer gravels. Capping these gravels are clean and well-sorted deltaic, foreset-bedded gravels evidently dipping south to southeast. They were deposited in standing water, probably the result of backflooding of the Pasco Basin by floods or flood surges down the Snake River.

Silts and fine sands (the Touchet Beds) that elsewhere cap the gravels are here absent. They probably were eroded by a later flood whose graded deposits now extend to the ground surface. Those later graded gravels probably were capped by deltaic foreset-bedded gravels and the Touchet Beds, that were later eroded by a meltwater-swollen Columbia River.

DIFFERENTIATION OF THE PASCO GRAVELS AND THE RINGOLD FORMATION SEDIMENTS

Some of the earliest work on differentiating the two formations beneath the Hanford Reservation was by McHenry(2) in 1957. He used samples obtained from earlier drilled wells, and determined some of their chemical and physical properties. From those studies, the respective sediments were better characterized and identified.

Of special significance are the results he obtained on samples from well 399-1-2, between the process water trenches and the 300 Area. Among the tests he performed were the particle size distribution, the pH, the 15-atmosphere moisture content, the $CaCO_3$ content, and the cation exchange capacity. Those tests are particularly relevant to waste movement studies, and are later discussed.

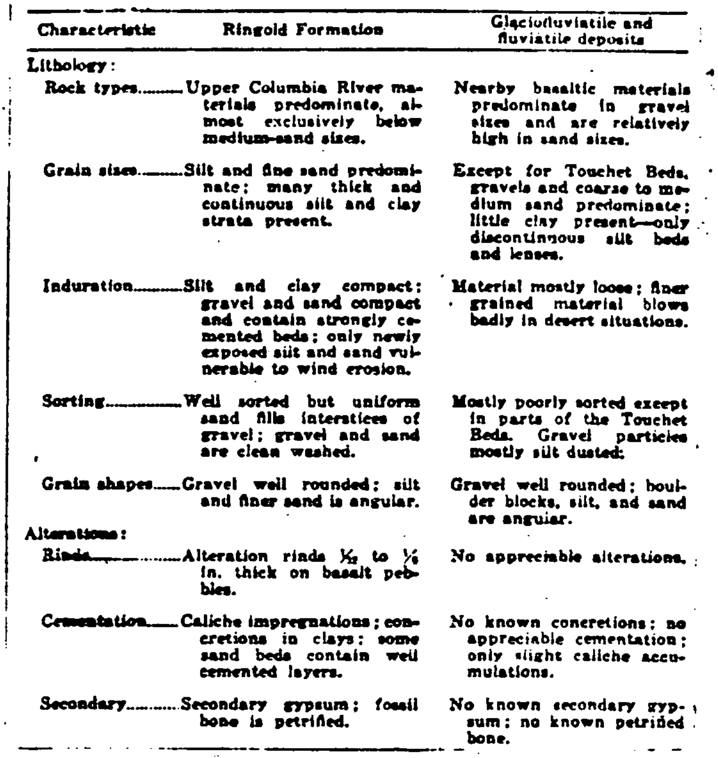
Newcomb, Strand and Frank in 1972(3) recognized that:

> " the distinction (especially in drill cuttings) between the Ringold Formation and the glaciofluviatile and fluviatile sediments is vital to the success of many ground-water developments and waste-disposal works..."

They felt at the time that the Pasco Gravels, which they called "glaciofluviatile and fluviatile deposits" were largely the deposits of glacial meltwaters and outwash. Subsequent research has shown clearly that although glacial meltwaters alone were repeatedly involved, much of the scouring and subsequent deposition of sediments was the result of numerous, unprecedented catastrophic floods. Many of the features formed as a result of that latter process rather than by normal though very large amounts of runoff. Recognition of that results in a better understanding of the deposits, and their impact on ground water flow and waste behavior.

Table 1 lists the differences between the Pasco Gravels and the Ringold Formation sediments, as cited by Newcomb, Strand and Frank(3). That table is followed by the properties herein recognized as distinguishing between the two formations.

Table 1



Characteristic	Ringold Formation	Glaciofluviatile and fluviatile deposits
Lithology:		
Rock types	Upper Columbia River materials predominate, almost exclusively below medium-sand sizes.	Nearby basaltic materials predominate in gravel sizes and are relatively high in sand sizes.
Grain sizes	Silt and fine sand predominate; many thick and continuous silt and clay strata present.	Except for Touchet Beds, gravels and coarse to medium sand predominate; little clay present—only discontinuous silt beds and lenses.
Induration	Silt and clay compact; gravel and sand compact and contain strongly cemented beds; only newly exposed silt and sand vulnerable to wind erosion.	Material mostly loose; finer grained material blows badly in desert situations.
Sorting	Well sorted but uniform sand fills interstices of gravel; gravel and sand are clean washed.	Mostly poorly sorted except in parts of the Touchet Beds. Gravel particles mostly silt dusted.
Grain shapes	Gravel well rounded; silt and finer sand is angular.	Gravel well rounded; boulder blocks, silt, and sand are angular.
Alterations:		
Rinds	Alteration rinds $\frac{1}{32}$ to $\frac{1}{8}$ in. thick on basalt pebbles.	No appreciable alterations.
Cementation	Caliche impregnations; concretions in clays; some sand beds contain well cemented layers.	No known concretions; no appreciable cementation; only slight caliche accumulations.
Secondary	Secondary gypsum; fossil bone is petrified.	No known secondary gypsum; no known petrified bone.

1. The Pasco Gravels in many sites occur in recognizably graded deposits, in which a specific sequence of materials was laid down by a single flood or flood surge. Commonly graded deposits consist of a basal boulder and cobble gravel, oftentimes highly silty, overlaid by progressively finer material, including pebble and granule gravel. Over them are coarse to fine sand and silt. The gravels and coarse sands are known as the Pasco Gravels, the sediments deposited in areas of high water velocity. The fine sands and silts, deposited in slackwater areas both in the basin center (as flood ponded) and on the basin margins are known as the Touchet Beds. Because of their fine-grained and unconsolidated nature they often were swept away by subsequent floods.

The total assemblage of flood deposits is known informally as the Hanford Formation. In contrast, the Ringold Formation sediments are stream, shallow-lake and floodplain deposits laid down over a considerable period of time.

2. The boulder and cobble gravels of the Pasco Gravels are extensive, with the coarsest gravels at sites where high water velocities occurred but where velocities were falling rapidly. Prime examples are at the mouth of the Snake River, and where the Columbia River emerges from its canyon just downstream from Priest Rapids Dam on to the Hanford Reservation.

Other boulder gravels occur in old, scoured-out stream channels on the Hanford Reservation such as at the 300 Area trenches. Water velocities decreased rapidly where the floods encountered backfloods from surges that entered the basin downstream of the boulder sites. Ringold Formation gravels, on the other hand, exist as a swath that extends through the basin from Sentinel Gap to Wallula Gap. They sjow gross facies changes from the main stream gravels along that swath to sands, silts and clays on the floodplain areas to the sides of the main stream as pointed out by Brown(4).

3. The Pasco Gravels cobble and boulder gravels commonly are very poorly sorted and heterogeneous. They are the deposits of roily floodwaters and locally of probably slurry floods that must have buoyed up the boulders. The sediments vary greatly in short distances. The Ringold Formation sediments, in contrast, are far more uniform, silty and sandy gravels, usually moderately well sorted, compact, and often cemented. (see Table 1).

4. The upper part of at least some of the Pasco Gravels graded deposits in some sites contain deltaic, foreset-bedded, well-sorted pebble gravels to coarse sands. Bretz, Smith and Neff(5) Observed many such deposits. Newcomb, Strand and Frank(3) discuss some of them elsewhere on the Hanford Reservation. They evidently were deposits in areas that were backflooded so that standing water, probably relatively clean, and at least some tens of feet deep at the site, was present. Their significance is that the fore-set bedding dips down-current at the time of deposition. The flow direction oftentimes varied in short distances or in time depending upon the impact of the flood surges that were varying the flow rate in time and place. The deltaic foreset beds, because of their well-sorted nature, have a high to a very high permeability.

Ground water flow directions and flow rates tend to be locally influenced by the bedding, both laterally and in depth. The Ringold Formation gravels are in flat-lying or very gently dipping beds without features that would be expected to cause a distinct rise or settling of the ground waters.

5. Great heterogeneity in short distances. The flood surges of each of the numerous major floods varied drastically in rates with time. In addition, surges down the many courses interacted with each other in a complex fashion. The Ringold Formation gravels tend to be relatively uniform over considerable distances.

6. The Pasco Gravels were deposited by a series of huge to catastrophic floods, at least some of them lasting a relatively few days. The Ringold Formation sediments on the other hand were deposited slowly over several million years. Caliche ($CaCO_3$) in the Pasco Gravels is generally only a thin coating, commonly only on the lower side of the gravel. Caliche in the Ringold Formation occurs as concretions and in beds where the Ringold Formation floodplain was exposed to the atmosphere and to evaporation. The Ringold Formation is much higher in caliche overall but where the beds were constanctly covered by water, caliche may be absent.

7. The pebbles and cobbles in the Ringold Formation commonly have a weathering rind (see Table 1) owing to their considerable age and to exposure in a then humid environment. Where those gravels were reworked, the rind was quickly worn off so that the Pasco Gravels pebbles and cobbles have a generally fresh surface. The presence of weathering rinds in the Pasco Gravels (see well logs) indicates deposition of that gravel a relatively short distance from the site of its scouring.

The criteria of Newcomb, Strand and Frank(3) in no way preclude catastrophic flood origin for the Pasco Gravels. Rather, the concept is a unifying concept, better explaining their criteria for differentiating the two sets of sediments. Most of the logs of the previously drilled 300 Area wells in fact show what evidently are graded sequences. They also are recognized at the FFTF site byLindberg(6). Numerous well logs included in Fecht and Lillie show what are probably graded sequences in many instances, and that may correlate to the 300 Area sequences, but have so far not been considered in that regard. If correlation is possible, a chronology of the flood history of the Pasco Basin could result.

The U.S. Geological Survey(3) did not identify graded gravels in well 10/28-10G1, only about a half mile southwest of the process water trenches (see log of well, page 57)(3). The proximity of that well to the process water trenches suggests that the graded gravels should be present. Probably the possible presence of graded gravels was not considered and evidence there for and against such a concept was not sought.

DESCRIPTION OF THE PASCO GRAVELS

Newcomb, Strand and Frank(3) summarize the properties and makeup of the Pasco Gravels, calling them the "glacio-fluviatile and fluviatile deposits". Their description follows:

LITHOLOGIC FEATURES

Gravel predominates in most facies of the glaciofluviatile and fluviatle deposits. It is a rudely bedded mixture of granule and pebble gravel with many cobbles and some boulders.

The gravels are loose, openwork materials. Cementation is generally absent, and only locally is a compacted, strong matrix filling present.

The gravel is made of well-rounded particles which in general are about 50 percent basalt of the Columbia River Group and 50 percent upriver rock types (quartzites, porphyrys, argillites, granitics, and other igneous rocks). The proportion of basalt to upriver exotic rock types varies from place to place and from one facies of the deposits to another. The scabland gravels are almost wholly basalt. The particles are relatively fresh rock and are devoid of weathering rinds. The granitic pebbles are sound and strong, in contrast to the decomposition found in many of the granitic pebbles of the Ringold Formation. Various amounts of secondary calcium carbonate coat parts of the gravels above the level of the water table. Some of the gravels contain considerable silt that occurs mostly as particle coating — indicating that the waters which deposited them were roily and silt laden. Some of the gravels indicate an influx of local material — those along the mountain fronts include local slope wash, and those near bedrock knobs or escarpments include trains of angular and subangular basalt boulder blocks.

Sand, predominantly coarse, occurs locally as an interstitial filling to the gravel, but it forms some separate beds and lenses within the glaciofluviatile and fluviatile deposits. Rare lenses and beds of silt occur irregularly within the principal current-laid deposits. Along with the finer sizes of sand, silt was the main deposit in the quiet-water facies of the Touchet Beds.

The sand, both that interstitial to the gravel and that in separate beds, differs in the percentage of the lithologic types in separate facies of the deposits. However, in general the siliceous upriver mineral and rock types predominate, in the common range of 60 percent quartzose and other exotic types to 40 percent basaltic types.

The percentages of rock and mineral types making up the grains in sand samples taken from the faces of the Gable Mountain quarry (NE¼ sec. 33, T. 13 N., R. 27 E.) and the concrete-mix plant aggregate pit (sec. 4, T. 12 N., R. 21 E.) are given below. Approximate percentages of mineral and rock types were determined from binocular microscopic examinations. (These quarries were located in the sandier parts of the glaciofluviatile and fluviatile deposits.)

Quarry	Grain size (Percent of total)	Rock and mineral types (percent)				
			Exotic types			
		Basalt	Rock	Quartz	Feldspar	Mica
Gable Mountain	Gravel (5)	60	40	......	......	......
	Sand:					
	Very coarse to medium (60)	10	40	49	1	......
	Medium to very fine (35)	5	30	64	1	......
	Silt and clay (0)					
Concrete-mix pit	Gravel (5)	60	35	......	5	......
	Sand:					
	Very-coarse to medium (59)	10	38	48	1	3
	Medium to very fine (29)	2	22	70	2	4
	Silt and clay (7)		10±	80±	10±	......

The gravel particles in these quarries are mostly well rounded, but the sand particles are more angular, the coarse sand being subrounded and the finest being angular. The sand is poorly sorted compared with the sand of most of the Ringold Formation.

As earlier noted, McHenry(2) determined some of the properties of the sediments beneath much of the Hanford Reservation, concentrating on those properties important to a determination of the probable behavior of radioactive wastes in ground waters.

He used the samples earlier obtained by drilling of wells. He had tests run that showed that drilling of the gravels resulted in crushing of pebbles, cobble and boulders down to a size ranging from about 5 to 10 mm in diameter. Relatively little crushing occurred in smaller-sized fractions. Accordingly he sieved the samples, recorded the weight of the fraction larger than 2 mm, then discarded it. As he noted, the greatest effect of the sediments was by the finer fractions which had the largest total surface area per unit weight, and that were most important in precluding waste migration. Those are the clay minerals.

His work showed that the Ringold Formation sediments tended to a lower gravel content, a higher sand, silt and clay content, a higher $CaCO_3$ content and a higher exchange capacity, reflecting largely the difference in clay content.

McHenry ran a profile on only one well in the southern part of the Hanford Reservation. It was well 399-1-2, between the waste trenches and the 300 Area. Hence it is in an ideal location for correlation to the samples obtained during the current drilling project. Of particular significance are the clay content, the $CaCO_3$ content, and the cation exchange capacity. The summarized data are shown on Table 2 (from McHenry).

Well Designation	Coordinates	Depth of Sample	Mechanical Analysis				pH	15-Atmosphere Moisture	CaCO$_3$	Cation Exchange Capacity
			Greater than 2-mm diameter	Less than 2-mm diameter						
				Sand	Silt	Clay				
399-1-2	N55, 772 E15, 134	feet	%	%	%	%		%	%	meq./100 g
		10	27.8	79.5	16.3	4.2	8.1	2.08	0.5	10.3
		25	35.2	84.6	13.7	1.7	8.2	1.39	0.2	7.4
		35	51.1	72 84.9	17.6	2.5	8.1	3.47	0.8	11.1
		50	58.0	94.2	2.5	0.3	8.5	1.23	0.1	8.1
		70	41.8	71.5	23.2	5.3	8.0	2.55	0.1	10.9
		80	9.9	74 93.6	6.4	0	7.5	0.45	0.3	6.8
		95	75.2	22.5 89.7	1.3 8.9	.55 1.4	-	2.74	-	-

Probable top of the Ringold Formation (this report)

Table 2 Characterization of samples from Well 399-1-2
(reproduced from McHenry, HW-53218)

Roedder in 1957 (7) determined the clay mineralogy of numerous samples, especially of the Pasco Gravels and the Touchet Beds, although at sites some miles from the 300 Area. However, the origin of the deposits argues that the data are applicable.

The silt fraction of the Pasco Gravels is an estimated 50% quartz and 40% feldspar. The clay fraction is an estimated 30% quartz, 20% feldspar, 20% chlorite, 10% mica, and 10% montmorillonite.

The silt fraction of the Touchet Beds is 50% quartz, 30% feldspar, and traces of mica and kaolinite. The clay fraction is 20% mica, 20% kaolinite, 10% montmorillonite, 10% chlorite, 10% mixed chlorite-montmorillonite, and traces of feldspar and kaolinite. Roedder concluded that the cation exchange capacity values "will fall rather close to values calculated by the expression

$$(1.1 \times \% \text{ montmorillonite} = 4) \text{ "}$$

thus emphasizing the importance of even small amounts of clay minerals, rather than merely clay-sized particles of quartz.

LITHOLOGIC COMPOSITION OF THE PASCO GRAVELS AT THE 300 AREA

The rock types present in the Pasco Gravels were derived from the entire drainage basin of the Columbia River and its tributaries. Consequently virtually every rock type durable enough to withstand transport to the Pasco Basin is there present. The most common rock types are those high in quartz, although basalt and related volcanic rocks, because of their toughness, locally are prominent.

The following rock types, in and near the 300 Area, were identified as follows. However, the gravel composition changes from site to site depending upon the characteristics of the individual floods and flood surges at a site locale.

32%	Quartzite, quartzose and quartz-rich rocks. They were derived in large part from the Belt Supergroup rocks of western Montana, northern Idaho and northeastern Washington. They include rocks such as gneisses that were not readily identifiable because of their small size.
19%	Basalt, in large part probably locally derived as indicated by the common angularity. In some instances the basalt flow from which they were stripped was identified. Often that flow was locally exposed.
18%	Old volcanic rocks, including rhyolites and andesites found in the Okanogan Highlands and in the north Cascades. They include the feldspar-rich rocks cited by Newcomb.
11%	Greenstone, largely chloritized volcanic rock, from numerous sources. Large amounts of greenstones would indicate sources in the Snake River canyon in Idaho, hence indicate that the gravel deposits were of a glacial Lake Bonneville flood.
9%	Gneiss, derived largely from the Okanogan Highlands.
4%	Chert and jasper
3%	Breccia, silicified, from the Okanogan Highlands.
2%	Caliche, locally derived. It is readily destroyed in transport hence must have had a local source.
1%	Petrified wood
1%	Granodiorite, diorite, gabbro. Derived from the Okanogan Highlands and the north Cascades. A large percentage of the granitic rocks evidently were ice rafted.
Traces	Clasts of Ringold Formation sediments, evidently saturated and frozen at the time of scouring and transport. Very local in origin.

THE DRILLING AND SAMPLING PROGRAM

Six wells first were drilled at the 300 Area waste trenches on the levee or berm between the two trenches. The first 5 wells were drilled 40 feet deep, the sixth, at the south end of the trenches at the weir boxes, was drilled 45 feet deep. A well screen was installed in the sixth well and the well was cased. That well permits routine ground water sampling. The casings in the first five wells were pulled and salvaged as the wells were drilled.

The wells were drilled with the addition of as little water as possible, to minimize leaching and dilution of any substances deposited on the sediments. The cuttings and bailed materials were checked by a radiation monitor, then examined and described by me. The materials were compared to those marerials exposed in the trench walls, and to the logs of nearby wells, previously drilled.

Samples from the wells were obtained at 5-foot intervals by bailing. Attempts were made to obtain samples that were as representative as possible Cobble and boulder gravels however are major constituents of much of the sediments and could not be included in the samples without crushing. Hence the sample descriptions were augmented by observations of the trenches near the respective wells.

The quartzites and quartzose pebble to cobble gravels almost universally are present as sub-rounded to well-rounded rocks, because of their wear during transport for long distances. Hence, when angular quartzite to quartzose granule and fine pebble gravel was present, especially in the five to ten-millimeter range of diameter, it was considered to have been broken in drilling. The well logs then reflect that observation.

Boulders and cobbles of course drilled with difficulty. Frequent discussions with the driller resulted in data on the size of the cobbles and boulders and whether other causes of difficult drilling were evident.

Following completion of the wells, samples were obtained from the trench bottoms. That sampling required that standing water not be present in order that the sediments be sampled and not the water. Hence sampling had to be coordinated with a changeover of effluent disposal from one trench to the other. Too long a wait after changeover resulted in seepage into the drained trench from the one being filled as water levels rose in the trench in use. Hence the samples had to be taken in some instances in the drained trench while some water still remained in pools in it.

Examination of the sediments sampled, and examination of the trench walls near the sampling site, showed that all the samples were typical of the highly heterogeneous materials previously drilled. They accordingly were not specifically described. Other reasons were (1) the sediments were sandy and silty pebble to boulder gravels which could not be included in the relatively small samples taken, (2) any contaminants present most likely would be associated with thefiner-grained sediments because of the larger surface area per unit weight or volume and the reaction of the clay minerals present.

That the fineness of the sediments is important, as noted by McHenry at well 399-1-2, was observed in several of the sampling pits. Blocks of silt, evidently saturated and frozen when transported and deposited, contained considerably higher levels of uranium contamination than adjacent coarser-grained material. In addition, the contamination fell off rapidly within an inch or two. Probably that was the result of several factors (1) the low permeability that precluded effective contact between the silt core and the uranium-bearing solutions, and (2) the lack of a steep enough concentration gradient to move the uranium deeper into the core of the block.

CHANGING WATER LEVELS IN THE TRENCHES

Water is discharged to one trench at a time of the two trenches. Rates range from less than 2000 to 3000 gpm or even more. Initially the water levels in the receiving trench remain low. With time, ordinarily a few weeks, the infiltration rate decreases and the water level in the trench slowly rises. Ultimately the water level rises to a few feet from the top of the berm or levee separating the trenches. Then the water is diverted to the other trench and the first trench is allowed to drain. The process is repeated.

Sampling of the sediments in the trench bottoms required that those sediments be no more than damp, in order that the sediments and not the water be sampled. Hence an understanding of the events occurring was desirable. The following description is an explanation that appears to satisfy the observed events and the nature of the materials beneath the trenches.

Initially the water seeps into the ground as a result of gravity and capillary forces. Where highly permeable sediments (clean gravels) are present, gravity flow predominates. Elsewhere capillary forces are important, and reach a maximum in fine-grained sediments where gravity flow is negligible. Generally a mix of the two processes occurs.

The wetted front, in uniformly fine-grained, low-permeability material is radially outward and downward from the trench bottom. It has the cross sectional profile of a semicircle (in uniform material). It spreads laterally and downward until a discontinuity is encountered, That may include the walls of the other trench, a change in the bedded sediments, or a significant change in the moisture content of the sediments. Those conditions provide a change in space in the magnitude of the capillary forces.

Significant flow across the discontinuity does not normally occur until the field capacity (specific retention) is exceeded such that gravity flow results. The flow rate then increases until saturated flow is achieved. Drainage across the discontinuity occurs, initially at a point, and the process is repeated until another discontinuity is encountered.

Ultimately, when the field capacity is exceeded to the water table, saturated flow occurs in the entire soil column. This may require a considerable period of time, perhaps many weeks. Gravity flow then occurs over a larger and larger area until its flow equals the inflow into the trench.

Once gravity flow is achieved, the water table becomes increasingly affected, and rises as the water flow to the water table increases. A higher water table, reflecting the increased recharge, means a reduced gradient is developed from the trench. Flow out of the trench is reduced. The water level in the trench then rises to create a higher head and a steeper gradient for water movement. Similarly, as the head is increased, capillary action induces water to rise to higher levels at the trench sides. Ultimately water is present in the walls of the adjacent trench above the floor of that trench. Water flow from one trench to the other does not occur, however, under unsaturated conditions until the field capacity is exceeded because of the discontinuity present at the trench wall. If adequately permeable gravels are present, saturated flow may occur. This was seen at several sites where vegetation grows in the trench walls.

Vegetation seemed to grow most abundantly at sites that indicated permeable gravels extend through the berm or levee.

The transmissivity of the Pasco Gravels in the Richland - North Richland area averages about 44,000 gpd/ft(4). Lindberg and Bond (1) cite a range of values from several tests on the 300 Area wells. Any of these values can be cited to show that flow rates of 2000 gpm will significantly raise the water table beneath the trenches. That rise is confirmed by measurements by Lindberg and Bond(1). (see Figure 3). Their work shows a static water level about 1.5 feet higher than what is probably normal.

The flow direction and flow rate of the ground waters obviously are significantly affected by trench operation.

GROUND WATER FLOW

Drilling, test pitting and sampling at the 300 Area trenches disclosed no data contra-indicating the results of earlier studies reported by Lindberg and Bond(1). In fact, the results fully corroborate those earlier findings, and provide additional detail on the nature and impact of the Pasco Gravels on ground water movement.

The 300 Area lies where, because of the Columbia River paleochannel, permeabilities of the Pasco Gravels are high over a moderately large area extending from north of the 300 Area into North Richland. Ground water flows into the current Columbia River is concentrated in that area.

Ground water gradients thus converge on the 300 Area from the southwest to northwest. From the southwest to west, waters from the losing Yakima River near the Horn abd downstream for a few miles move toward the area. From the northwest, waters from the southwestern part of the Hanford Reservation and the north face of the Rattlesnake

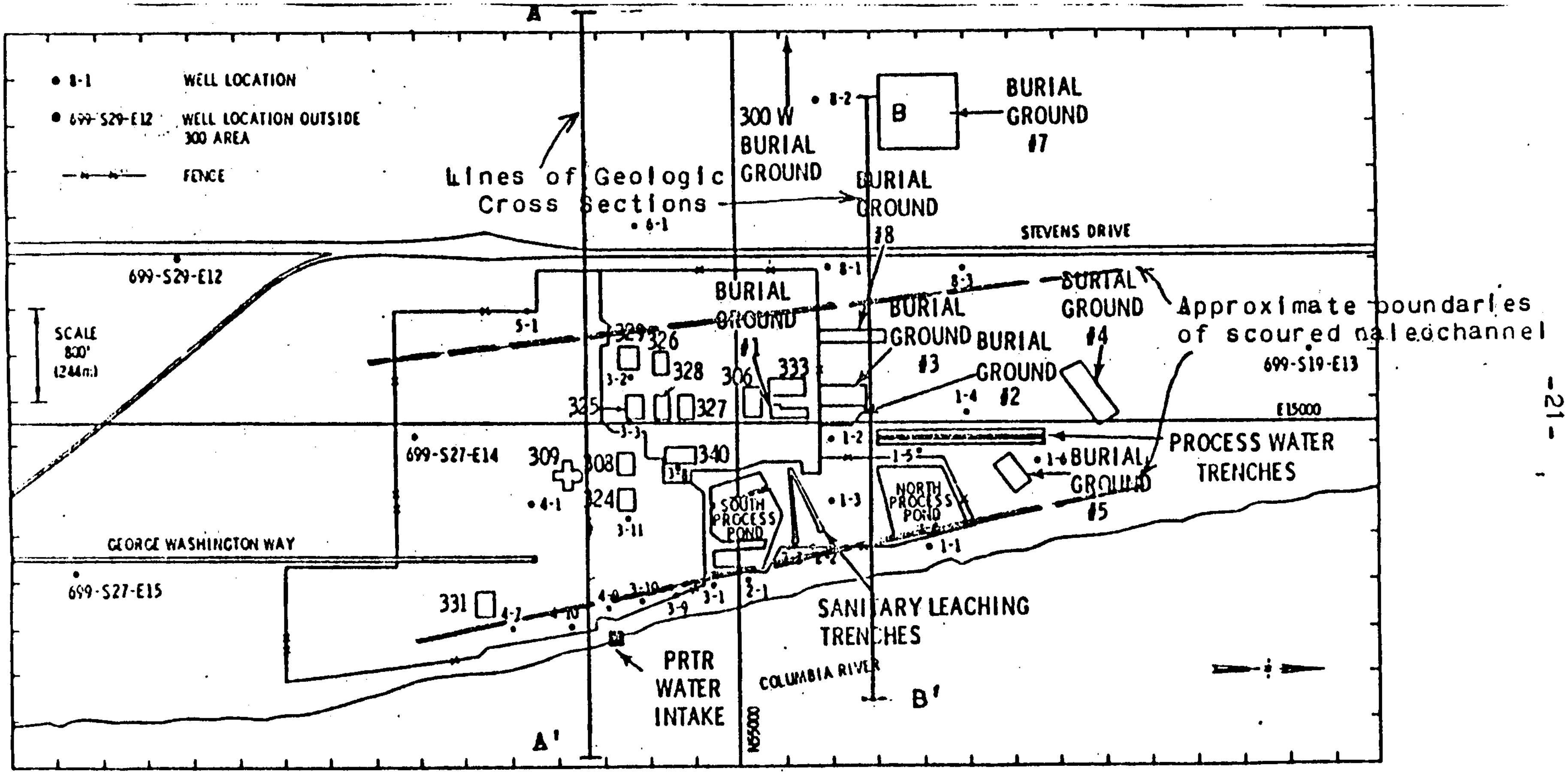
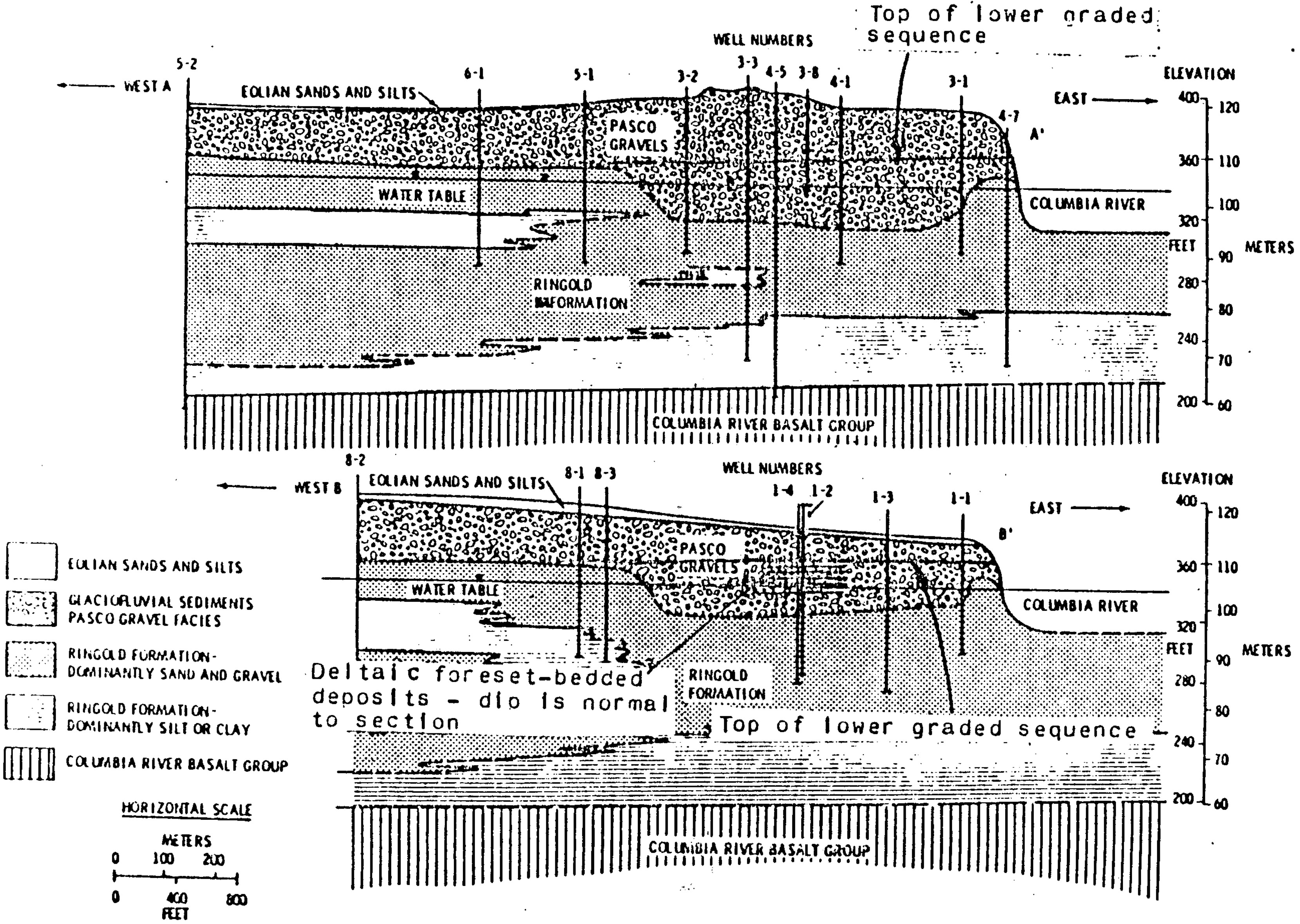


FIGURE 1. Location of 300 Area Wells, Burial Grounds, Buildings, Ponds and Trenches (modified from Lindberg and Bond, Fig. 4.4)



Top of lower graded sequence

Deltaic foreset-bedded deposits - dip is normal to section

Top of lower graded sequence

FIGURE 2 Geologic Cross Sections of 300 Area (modified from Lindberg and Bond)

Hills, and Dry Creek Valley move southeastward. At and near the 300 Area the waters mingle (see Figure 3), and enter the Columbia River largely downstream of the 300 Area.

The natural pattern of flow of ground waters is materially affected on by high spring rises of the Columbia River, when reversed gradients temporarily increase bank storage. As Lindberg and Bond point out, a significant impact now is rare owing to Columbia River regulation and the creation of the McNary Dam reservoir (Lake Wallula)

Any waste discharged to the trenches will of course move downward to the ground water table. In that path the waters will tend to move southward, following the direction of dip of the deltaic foreset-bedded deposits. At the water table the flow will tend to be radially outward because of the low ground water mound there created (see Figure 3). Flow then will be east-southeastward to and into the Columbia River.

The precise path of flow will depend upon a host of variables, however the ground waters and contained contaminants will disperse and be diluted laterally by movement through the highly heterogeneous gravels. Numerous wells in a generally downgradient direction will intercept those contaminants. Wells in that path include 399-1-2, 1-5, 1-3, 2-2, 2-3, 2-1, 3-1, 3-9, 3-10, 4-7, 4-9 and 4-10.

Downgradient flow also results in vertical dispersion and the resulting dilution. However, the top of the

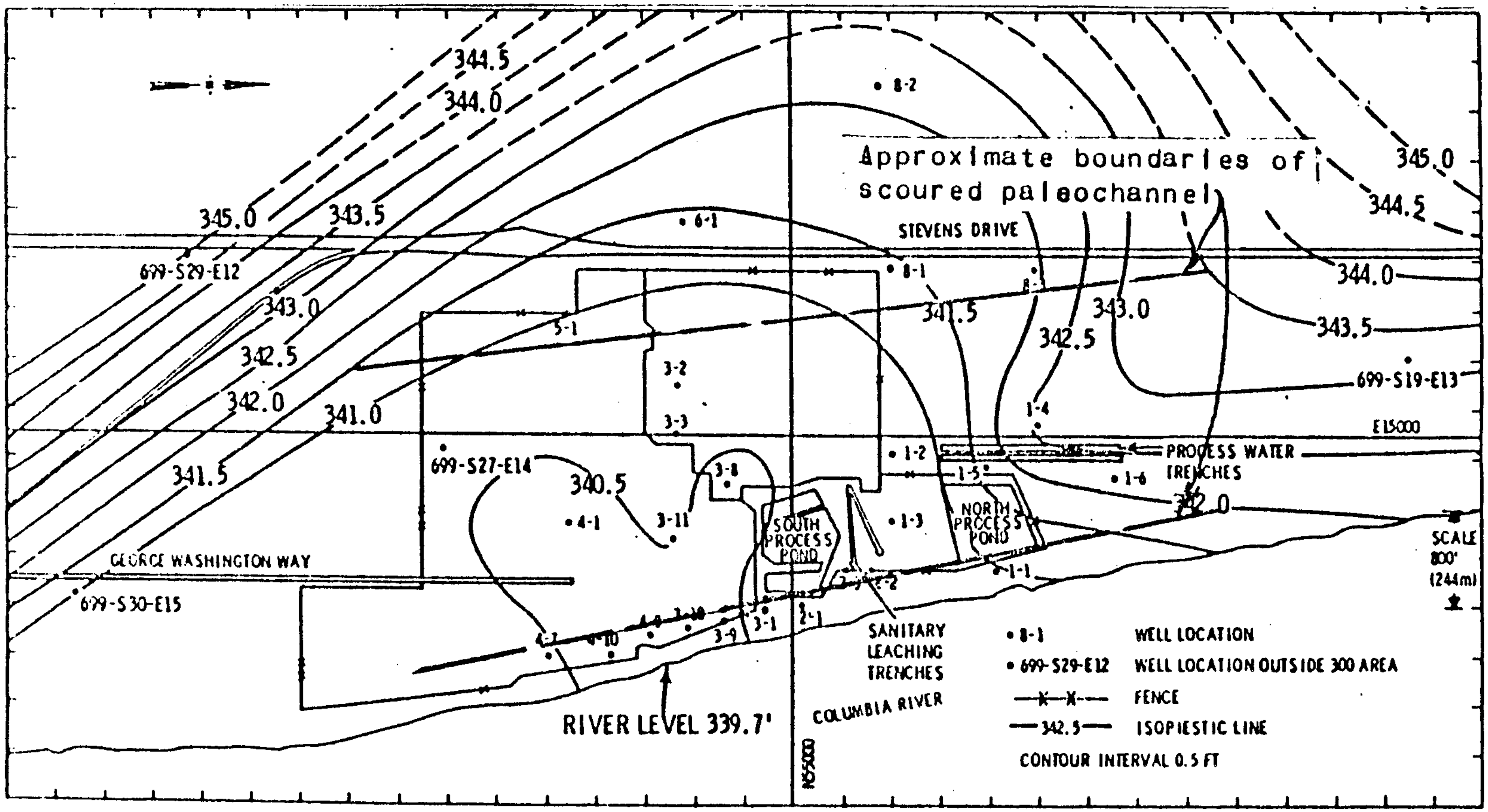


FIGURE 3: 300 Area Water-Table Map, July 1, 1977 (modified from Lindberg and Bond)

Ringold Formation at a depth of about 50 feet can be considered as the lower limit of concern in regard to contaminants. This is because of the low permeability of the Ringold Formation sediments compared to that of the Pasco Gravels, and the clay mineral content. They have, consequently, a higher affinity for contaminants than a comparable volume or weight of the oftentimes very clean Pasco Gravels.

RECOMMENDATIONS

The indicated ground water flow path from the trenches to the Columbia River is penetrated by a pattern of wells that virtually guarantees interception of contaminants. That interception is even more certain because of the spreading effect of the ground water mound beneath the trenches, and by the processes of dispersion that broaden the contaminant plume downgradient and vertically as well. Dispersion in addition dilutes the contaminant concentration, even prior to its dilution as the contaminants enter the Columbia River.

The question may be raised that contaminants are moving at depth, along the top of the Ringold Formation and beneath some wells that are less than fully penetrating of the aquifer. The concern appears groundless because of the shallow depth of the old channel (less than 30 feet) in which dispersion should distribute the contaminants uniformly.

Should concern still be present, a limited program of sampling of wells at depth could be begun. Conceivably it could be precededby the procurement of temperature profiles in key wells by the use of temperature probes. Such surveys

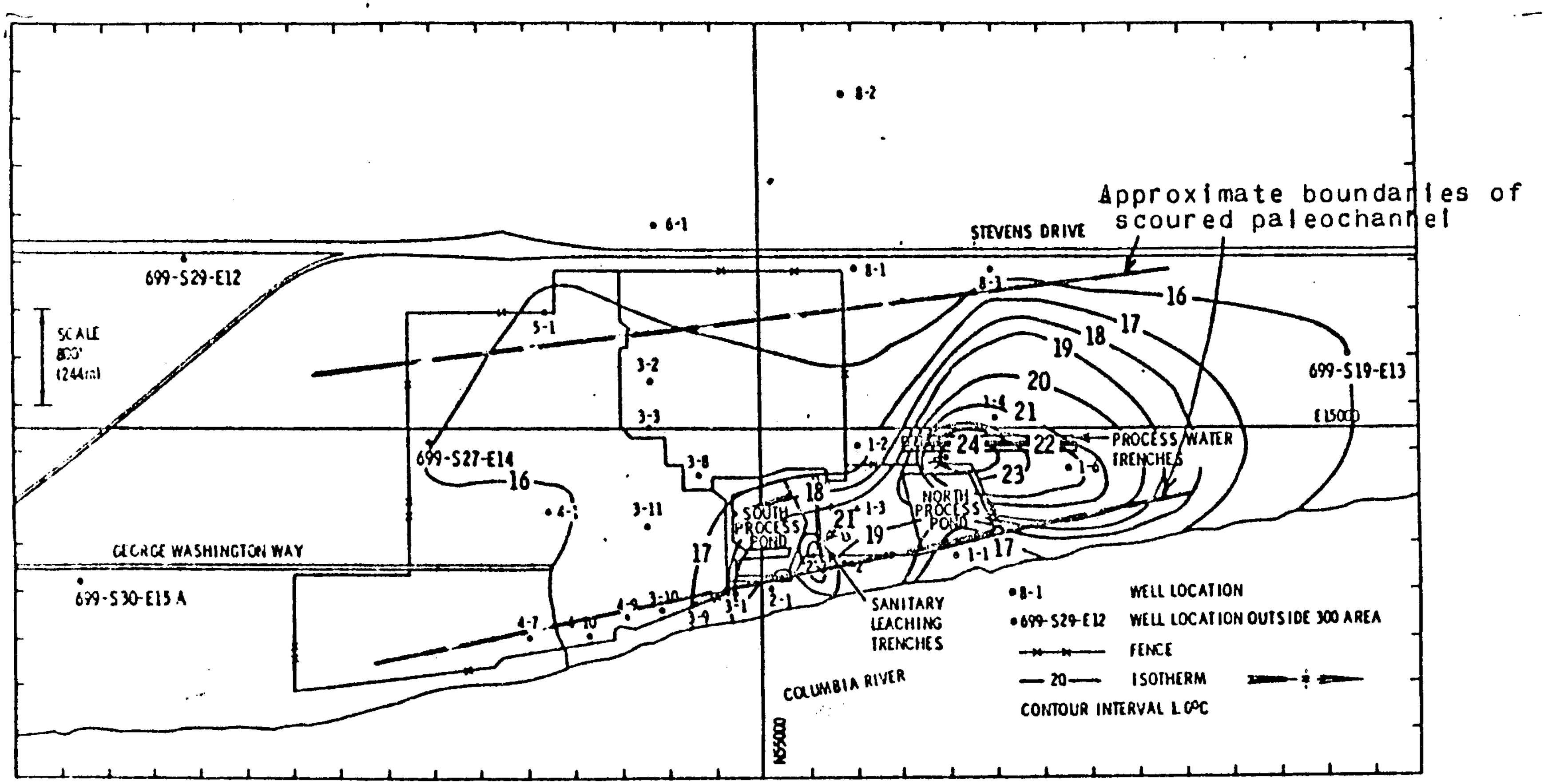


FIGURE 4 Temperature in the Unconfined Aquifer Under the 300 Area, September 1, 1977 (modified from Lindberg and Bond)

in past years, as noted by Lindberg and Bond(1) were highly effective in distinguishing between normal ground waters and colder river waters penetrating inland. Temperatures also distinguished effluent waters that were warmer than the ground waters in late summer and cooler than the ground waters in winter (see Lindberg and Bond, Figure 4.9, also Figure 4 of this report.

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APPENDIX

Logs of Wells and Test Holes

TEST HOLE NO. 1 (North end of trenches)

0 - 15 feet Gravel, sand and silt, poorly sorted. Gravel ranges from pebbles to boulders, dominantly less than 6 inches in diameter, but up to 18 inches in diameter. Boulders are basalt, evidently locally derived, cobbles are dominantly upriver exotic rock types. Those gravels in part may have been scoured from the Ringold Formation, the weathering rinds worn off and the gravels redeposited.

Silt is present as coatings on gravel, indicating roiled waters (slurry floods). Caliche (calcium carbonate) occurs as thin coatings on the underside of cobbles, and probably is appreciably less than 1% of the total sample. The gravels are uncemented, and cave into the hole. Casing must be frequently driven and water added to create a slurry for the support of the hole and for bailing of cuttings.

The cobble and boulder gravel indicate the probable base of a graded deposit.

15 - 22 feet Gravel, sand and silt. Gravel is dominantly cobbles, sand is coarse grained, silt is less than 5% of the sample. No caliche noted. Gravel is 50% basalt, 50% quartzite and quartzose rocks. The drilling rate in the interval after passing through the boulders in the higher interval. This is the probable top of a remnant of a graded gravel deposit below that in the 0 - 15 foot interval.

22 - 27 feet Gravel, dominantly pebbles of basalt. Clean, little sand, only traces of silt. Pebbles are less than 5 mm in diameter.

27 - 32 feet Gravel and sand, clean. Gravel is pebble to cobble in size, gravel is about 65% of the sample, sand is coarse grained and is about 35% of the sample. Silt is only a few percent of the total.

32 - 40 feet Sand and gravel, well sorted and clean. Sand is more than 90% of the sample, averages about 0.5 mm in diameter. Sand consists of sub rounded to well rounded quartz grains. Traces of mica are present. Sand flows into the well during bailing. Basalt constitutes about 30% of the total sample. Permeability of the materials is high.

From 22 feet downward the materials appears to be a deltaic, foreset-bedded deposit as seen in North Richland and on the east bank of the

Columbia River opposite the 300 area. There the deltaic deposits dip southward to southeastward, indicating that the depositing currents were from the north. In the south part of Richland, deltaic foreset bedding shows deposition by northward to northwestward-flowing currents, emanating from the Snake River.

The static water level on well completion was about 24 feet. The extent of mounding of the ground water table by percolation of waste waters is there not appreciable, but may be measurable.

TEST HOLE NO. 2

0 - 19 feet Gravel, sand and silt, poorly sorted, as in the No. 1 hole. Gravel included numerous boulders and totals to about 40% of the sample. Sand is 50% of the sample and silt is 10% of the sample. Clay and caliche were not noted but are probably present as in the No. 1 hole, in amounts less than about 1%. Basalt is dominant in all but the silt-sized fraction, as indicated by the dark gray to black color of the washed sample. This material appears to be the base of a graded gravel deposit.

19 - 23 feet Sand and gravel, clean. Sand is medium to coarse-grained and is largely basalt. Gravel is granule sized, less thsn about 5 mm in diameter, and is largely basalt. Silt is about 1% of the sample.

Particles dhow little evidence of breakage by drilling. The drilling rate increased as in the No. 1 hole. This material is probably the deltaic, foreset-bedded deposit at the top of a graded gravel sequence as elsewhere seen.

23 - 28 feet Gravel, sandy, only traces of silt. Well sorted and clean. Gravel is largely granule in size, sand is medium- to coarse grained in size and is largely basalt. Samples appears to be of an open-work gravel of high permeability.

28 - 33 feet Gravel, clean and well sorted. Only traces of silt. Gravel is largely pebbles, averaging about 2 cm in diameter. Samples is of an open-work gravel. Gravel is 60% basalt, 20% exotic rock types (volcanic), 20% quartzite and quartzose rocks. This gravel appears to be the base of the deltaic foreset-bedded gravels.

38 - 40 feet.	Sand, gravel and silt. Sand is medium- to coarse-grained , is 65% of sample and is largey basalt. Gravel is granule-sized, is 30% of the sample and is 50% basalt and 50% exotic rock types. Silt is 5% of the sample.

TEST HOLE NO. 3

0 - 10 feet	Gravel and sand. Gravel is less than 4 cm in diameter and is 60% of the sample. Sand is 40% of the sample. Silt is sparse, washes out of the sample easily.
10 - 21 feet	Sand, gravel and silt. Sand is 60% of the sample and is dominantly basalt. Gravel is dominantly pebble gravel with some cobbles and boulders, aggregates to 30% of the sample. Silt is largely quartz grains, with some feldspar
21 to 30 feet	Sand, little gravel and little silt. Sand is coarse grained. A few pebbles show weathering rinds, indicating scouring of the Ringold Formation nearby and redeposition. This material is probably the top of the deltaic foreset-bedded deposit.
30 to 35 feet	Gravel, only traces of sand and silt. Gravel is granule to pebble sized. Clean and well sorted
35 to 40 feet	Sand, clean and well sorted. Coarse to very coarse grained. Dominantly basalt.
40 feet	Sand, gravel and silt. Sand is 50% of the sample, is largely basalt. Gravel is 45% of the sample, silt is 5% of the sample. The total sample is about 50% tan quartz The sample appears to be from the base of the foreset-bedded deposit and probably is of a bottomset bed, or the top of a still deeper graded sequence.

TEST HOLE NO. 4

0 - 5 feet Gravel and sand. Gravel is less than about 6 cm in diameter, is 60% of the sample. Sand is about 40% of the sample. Caliche coating on gravel is present.

5 - 10 feet Sand, gravel and silt. Sand is 55% of the sample, is largely coarse grained and is dominnatly basalt. Gravel is 40% of the sample, is largely cobbles and boulders, is 50% basalt and 50% upriver exotic rock types. Silt is 5%. Caliche and clay were not noted but probably are present in amounts of a percent or so. No weathering rinds were seen. The sample is typical of roiled water deposits.

10 - 17 feet Gravel, sand and silt. Gravel is mixed pebble, cobble and boulder gravel, multicolored, largely of upriver exotic rock types. Sand is medium to coarse grained, is largely basalt. Fine sand and silt is subrounded to well rounded quartz grains. At 17 feet the test hole went out of the cobble and boulder gravel.

17 - 22 feet Gravel, sand and silt. Gravel is 55% of the sample, is 50% basalt, 50% exotic, upriver rock types. Sand is 40% of the sample, is largely basalt, grains are angular to subangular. Silt is 5%.

22 - 35 feet Gravel, sandy. Gravel is largely granule to pebble gravel, less than about 4 cm in diameter. Sand is only 10% of the sample, silt is in traces only. A limited pebble count at the 30-foot depth showed the following:

Basalt	60%
Quartzite	12%
Gneiss	10%
Volcanic rocks (other thsn basalt)	10%
Greenstone	4%
Chert	4%

The sample is typical of locally observed deltaic foreset-bedded deposits.

35 - 40 feet Gravel and sand. Gravel is granule to pebble-sized; sand is very coarse-grained. Sample is well sorted and clean. Gravel is 65% basalt, 35% exotic rock types. Small amounts of fine sands and silts are largely quartz.

40 feet Gravel, sand and silt. Gravel is pebble to cobble-dized, is largely quartzite and other exoti rock types. Sand is coarse grained, is angular. Fine sand is largely quartz and is subrounded. This is probably the top ofthe lower part of a graded deposit (bottomset beds).

TEST HOLE NO. 5

0 - 5 feet Gravel and sand. Gravel ranges in size from pebbles to boulders, up to 24 inches in diameter and that are angular to subangular. Clasts of Ringold Formation sediments are present in the trench walls. They are silts that must have been saturated and frozen at the time of the floods, in order to have been transported intact, even short distances. A fragment of caliche 10" x 5" x 3" also was noted and lies near the Ringold clasts. Gravel is 65% of the sample, boulders are 15% of the gravel. Sand is 30% of the sample with basalt dominant in the coarse sand fraction as angular to subangular grains. Fine sand and silt is 5% of the sample and is largely quartz grains, rounded to subrounded. The total sample is about 40% basalt, the remainder is upriver exotic rock types.

5 - 15 feet Sand and gravel and silt. Sand is largely angular to subangular basalt in the mdeium- to coarse-grained fraction. Fine sands and silt are largely quartz, rounded to subrounded. Silt is gray-green in color when wet, sample is dark gray to black whe washed, indicating dominance of basalt. No clay, caliche or weathering rinds were noted.

15 - 18 feet Sand and gravel. Sand is 50% of sample, very coars grained sand is basaltic, fine sand is largely quartz. Gravel is 35% of sample, quartzite and quartzose rocks are dominant. Numerous fragments (broken in drilling) show weathering rinds, hence they were scoured from the nearby Ringold Formatio and redeposited a short distance downstream.

18 - 32 feet Sand, gravel and a trace of silt. Poorly sorted. Sand is largely very coarse grained (about 30% of sample), fine to medium grained sand is 20% of the sample. Basalt is dominant in all but the fine to very fine grained sand. Gravel is 50% of the sample with 30% as granule gravel, and 20% as pebble gravel. Gravel is largely open-work. Most of the sample is 2 mm in diameter. Drilling accelerated at 21.5 feet, where the deltaic foreset-bedded deposits occur.

32 - 40 feet Sand, gravel and silt, poorly sorted. Sand is 50% of the sample, gravel is 45% of the sample, with about equal parts of granule and pebble gravel. Silt is about 5% of the sample, was difficult to wash from the sample. The 40-foot sample is 50% gravel (granule gravel is 10%, pebble gravel is 40%) sand is 40% and silt is 10% of the sample. Overall the sample is 50% basalt and 50% quartzite and other exotic rock types. Hard packed sand was encountered at 34 feet, Test hole encountered the deltaic foreset-bedded deposit.

TEST HOLE NO. 6 (South end oftrenches)

0 - 14 feet Gravel, sand and a little silt. Poorly sorted. Gravel is 90% of the sample, is a pebble to cobble gravel. Basalt predominates. Sand is 10% of the sample, largely basaltic. Silt is present in traces as a coating on gravel. Some caliche is present,

14 - 20 feet Gravel, sand and traces of silt, as above. Drilling rate increased significantly.

20 - 30 feet Gravel, well sorted and clean. Dominantly granule to pebble size. This material is of the deltaic foreset bedded deposit.

30 - 33 feet Sand, gravel and silt. Sand is in subangular grains, sand is 45% of the sample. Coarse sand is basalt-rich, fine sand is quartz-rich and consists of better rounded grains than coarser sand. Gravel is pebbles of quartzite that are well rounded, and basalt that is subangular.

33 - 37 feet Gravel and sand, well sorted,Gravel is granule to pebble sized, largely basalt. Sand is coarse grained, dominantly basalt.Some petrified wood is present. Weathering rinds occur on some gravel indicating a probable source in the nearby Ringold Formation sediments.

37 - 45 feet Gravel and traces of sand. Well sorted. Gravel is pebble sized, a maximum of about 2 cm in diameter. Sand is coarse to very coarse grained, increases in amount from 40 to 45 feet. Silt is absent. A pebble count showed the following:

Quartzite	40%
Basalt	18%
Gneiss	16%
Volcanic rocks other than basalt	10%
Greenstone	8%
Chert, jasper	3%

The samples indicate very high permeabilities. During bailing, perched water from the trench was heard entering and flowing down the well.

Coarse sand flows into the well to a depth of three feet.

The bottom ten feet of the well was screened, for sampling and test purposes.

This interval probably is the lower part of the deltaic foreset-bedded deposit.

APPENDIX G

Analytical Results

- Sample Numbering System
- Shallow Sediment Results
- Well Sediment Results
- Radioactivity Results
- EP Toxicity Results
- River and Process Trench Water Results

SAMPLE NUMBERING SYSTEM

DEEP SOILS SAMPLING

Well number: 1-6 (well #1 to the north)
Sample depth: 5, 10, 15, 20, 25, 30, 35 or 40 ft.

Bottle Designation: A - Analysis at US Testing
B - Backup storage at 325 Building

Analysis type and bottle #:
VOA - X (Bottle 1-3)
ABN - Y (Bottle 1-2)
Metal - Z (Bottle 1-3)

Example Label: 1A5X1
Well # - 1
Depth - 5 ft.
Sample - Analysis at US Testing
Analysis type and bottle # - VOA #1

SHALLOW SEDIMENTS SAMPLING

Trench: E - East; W - West

100 ft markers: 1-16

Depth: L - Loose Sediments
S - 4" below loose sediments
D - 18" below loose sediments

Bottle Designation: A - Analysis at US Testing
B - Backup storage at 325 Building

Analysis type and Bottle #:
VOA - X (Bottle 1-3)
ABN - Y (Bottle 1-2)
Metal - Z (Bottle 1-3)

Example: E1LAX1
East Trench
Marker at 0 ft. #1
Loose sediment sample
Analysis at US Testing
VOA Analysis, bottle #1

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	E1DA	SAMPLE DATE	E1LA	SAMPLE DATE	E1SA	SAMPLE DATE	E2DA
COLIFRM	MPN	2.20E+00			08/06/86	1.60E+01				
BERYLAM	UG/G	5.00E-01	08/06/86	8.00E-01	08/06/86	4.00E+00	08/06/86	3.00E+00		
STRONUM	UG/G	3.00E+01	08/06/86	4.60E+01	08/06/86	1.44E+02	08/06/86	1.43E+02	08/04/86	4.30E+01
ZINC	UG/G	5.00E-01	08/06/86	2.82E+02	08/06/86	6.64E+02	08/06/86	8.95E+02	08/04/86	1.99E+02
CALCIUM	UG/G	5.00E+00	08/06/86	6.22E+03	08/06/86	1.02E+04	08/06/86	1.42E+04	08/04/86	7.75E+03
BARIUM	UG/G	8.00E-01	08/06/86	1.47E+02	08/06/86	3.72E+02	08/06/86	4.60E+02	08/04/86	1.38E+02
CADMIUM	UG/G	2.00E-01	08/06/86	4.00E+00			08/06/86	1.70E+01	08/04/86	9.00E+00
CHROMUM	UG/G	1.00E+00	08/06/86	6.10E+01	08/06/86	1.75E+02	08/06/86	2.98E+02	08/04/86	3.20E+01
SILVER	UG/G	1.00E+00	08/06/86	6.90E+01	08/06/86	1.70E+02	08/06/86	2.45E+02	08/04/86	8.00E+00
SODIUM	UG/G	1.00E+01	08/06/86	2.85E+02	08/06/86	1.01E+03	08/06/86	7.96E+02	08/04/86	3.43E+02
NICKEL	UG/G	1.00E+00	08/06/86	8.60E+01	08/06/86	3.54E+02	08/06/86	4.26E+02	08/04/86	8.20E+01
COPPER	UG/G	1.00E+00	08/06/86	1.81E+03	08/06/86	7.32E+03	08/06/86	8.47E+03	08/04/86	6.51E+02
VANADUM	UG/G	5.00E-01					08/06/86	2.07E+02	08/04/86	3.60E+01
ANTIONY	UG/G	1.00E+01	08/06/86	3.10E+01	08/06/86	1.22E+02	08/06/86	6.40E+01		
ALUMNUM	UG/G	1.50E+01	08/06/86	5.92E+03	08/06/86	1.33E+04	08/06/86	1.38E+04	08/04/86	6.48E+03
MANGESE	UG/G	5.00E-01	08/06/86	2.20E+02	08/06/86	3.84E+02	08/06/86	5.66E+02	08/04/86	4.93E+02
POTASUM	UG/G	1.00E+01	08/06/86	5.89E+02	08/06/86	8.50E+02	08/06/86	7.69E+02	08/04/86	5.25E+02
IRON	UG/G	5.00E+00	08/06/86	1.74E+03	08/06/86	2.06E+04	08/06/86	3.55E+04	08/04/86	2.52E+04
ARSENIC	UG/G	5.00E-01			08/06/86	1.02E+01				
MERCURY	UG/G	1.00E-01	08/06/86	2.07E+01	08/06/86	5.84E+01	08/06/86	6.94E+01	08/04/86	6.96E+00
MAGNES	UG/G	5.00E+00	08/06/86	2.94E+03	08/06/86	3.41E+03	08/06/86	3.43E+03	08/04/86	4.71E+03
LEADGF	UG/G	5.00E-01	08/06/86	6.02E+01	08/06/86	1.34E+02	08/06/86	2.30E+02	08/04/86	8.55E+01
TOLUENE	UG/G	1.00E-02			08/06/86	2.00E-02				
OPXYLE	UG/G	1.00E-02			08/06/86	3.00E-02				
M-XYLE	UG/G	1.00E-02			08/06/86	2.00E-02				
TOX	UG/G	1.00E+00	08/06/86	6.20E+00	08/06/86	2.40E+00	08/06/86	1.72E+01	08/04/86	2.30E+00
TOC	UG/G	1.00E+01	08/06/86	2.41E+02	08/06/86	5.13E+02	08/06/86	4.79E+02	08/04/86	1.16E+02
NITRATE	UG/G	1.00E+00			08/06/86	5.89E+00				
SULFATE	UG/G	1.00E+00			08/06/86	6.63E+01				
FLUORID	UG/G	1.00E+00			08/06/86	3.18E+00				
CHLORID	UG/G	1.00E+00			08/06/86	2.52E+01				
SULFIDE	UG/G	1.00E+01			08/06/86	7.86E+01				
AMMONIU	UG/G	5.00E-01			08/06/86	1.40E+01				
ACETONE	UG/G	0.00E+00			08/06/86	1.70E-01				

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	E2LA	SAMPLE DATE	E2SA	SAMPLE DATE	E3LA	SAMPLE DATE	E3SA
COLIFRM	MPN	2.20E+00			08/04/86	1.60E+01	08/04/86	2.20E+00		
BERYLAM	UG/G	5.00E-01	08/04/86	3.00E+00			08/04/86	2.00E+00		
STRONUM	UG/G	3.00E+01	08/04/86	8.50E+01	08/04/86	3.50E+01	08/04/86	9.90E+01		
ZINC	UG/G	5.00E-01	08/04/86	1.27E+02	08/04/86	1.44E+02	08/04/86	1.87E+02	08/04/86	9.00E+01
CALCIUM	UG/G	5.00E+00	08/04/86	7.03E+03	08/04/86	6.96E+03	08/04/86	7.94E+03	08/04/86	5.99E+03
BARIUM	UG/G	6.00E-01	08/04/86	1.62E+02	08/04/86	1.16E+02	08/04/86	1.86E+02	08/04/86	9.60E+01
CADMIUM	UG/G	2.00E-01			08/04/86	8.00E+00	08/04/86	9.00E+00	08/04/86	9.00E+00
CHROMUM	UG/G	1.00E+00	08/04/86	5.51E+02	08/04/86	2.80E+01	08/04/86	1.58E+02	08/04/86	3.60E+01
SILVER	UG/G	1.00E+00	08/04/86	1.25E+02	08/04/86	9.00E+00	08/04/86	8.80E+01	08/04/86	2.00E+00
SODIUM	UG/G	1.00E+01	08/04/86	4.89E+02	08/04/86	3.06E+02	08/04/86	7.24E+02	08/04/86	3.58E+02
NICKEL	UG/G	1.00E+00	08/04/86	3.77E+02	08/04/86	6.50E+01	08/04/86	2.08E+02	08/04/86	4.70E+01
COPPER	UG/G	1.00E+00	08/04/86	2.26E+03	08/04/86	5.68E+02	08/04/86	2.87E+03	08/04/86	4.29E+02
VANADUM	UG/G	5.00E-01			08/04/86	3.30E+01	08/04/86	1.96E+02	08/04/86	4.20E+01
ANTIONY	UG/G	1.00E+01	08/04/86	1.28E+02			08/04/86	1.17E+02		
ALUMNUM	UG/G	1.50E+01	08/04/86	5.93E+03	08/04/86	5.70E+03	08/04/86	7.05E+03	08/04/86	5.94E+03
MANGESE	UG/G	5.00E-01	08/04/86	1.32E+02	08/04/86	5.90E+02	08/04/86	1.55E+02	08/04/86	2.39E+02
POTASUM	UG/G	1.00E+01	08/04/86	2.75E+02	08/04/86	5.14E+02	08/04/86	4.42E+02	08/04/86	5.00E+02
IRON	UG/G	5.00E+00	08/04/86	1.93E+04	08/04/86	2.24E+04	08/04/86	1.81E+04	08/04/86	2.79E+04
ARSENIC	UG/G	5.00E-01			08/04/86	3.96E+00	08/04/86	2.76E+00		
MERCURY	UG/G	1.00E-01	08/04/86	3.57E+01	08/04/86	5.92E+00	08/04/86	2.19E+01	08/04/86	1.87E+00
MAGNES	UG/G	5.00E+00	08/04/86	1.86E+03	08/04/86	4.53E+03	08/04/86	3.01E+03	08/04/86	5.60E+03
LEADGF	UG/G	5.00E-01	08/04/86	2.01E+02	08/04/86	2.85E+01	08/04/86	4.86E+02	08/04/86	1.92E+01
PERCENE	UG/G	1.00E-02			08/04/86	1.00E-02	08/04/86	1.00E-02		
BENZBFL	UG/G	1.00E+00					08/04/86	1.40E+01		
CHRYSEN	UG/G	1.00E+00					08/04/86	1.20E+01		
BENZOPY	UG/G	1.00E+00					08/04/86	2.50E+01		
TOX	UG/G	1.00E+00	08/04/86	1.20E+01	08/04/86	2.00E+00	08/04/86	2.66E+01	08/04/86	1.60E+00
TOC	UG/G	1.00E+01	08/04/86	5.27E+02	08/04/86	9.78E+01	08/04/86	4.55E+02	08/04/86	9.85E+01
NITRATE	UG/G	1.00E+00			08/04/86	1.40E+00				
SULFATE	UG/G	1.00E+00			08/04/86	1.63E+00	08/04/86	4.33E+00		
FLUORID	UG/G	1.00E+00			08/04/86	1.02E+00	08/04/86	1.48E+00		
CHLORID	UG/G	1.00E+00			08/04/86	1.13E+01	08/04/86	2.07E+01		
SULFIDE	UG/G	1.00E+01					08/04/86	3.10E+01		
AMMONIU	UG/G	5.00E-01			08/04/86	5.20E-01	08/04/86	2.09E+01		

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	E4SA	SAMPLE DATE	E5SA	SAMPLE DATE	E6SA	SAMPLE DATE	E7DA
COLIFRM	MPN	2.20E+00			08/04/86	1.60E+01				
BERYLAM	UG/G	5.00E-01					07/30/86	1.00E+00		
STRONUM	UG/G	3.00E+01					07/30/86	3.70E+01		
ZINC	UG/G	5.00E-01	08/04/86	7.30E+01	08/04/86	6.30E+01	07/30/86	2.39E+02	07/30/86	1.39E+02
CALCIUM	UG/G	5.00E+00	08/04/86	4.19E+03	08/04/86	5.90E+03	07/30/86	4.97E+03	07/30/86	4.42E+03
BARIUM	UG/G	6.00E-01	08/04/86	7.00E+01	08/04/86	9.10E+01	07/30/86	1.78E+02	07/30/86	1.10E+02
CADMIUM	UG/G	2.00E-01	08/04/86	1.10E+01	08/04/86	1.00E+01	07/30/86	1.30E+01	07/30/86	1.00E+01
CHROMUM	UG/G	1.00E+00	08/04/86	3.30E+01	08/04/86	3.70E+01	07/30/86	2.26E+02	07/30/86	6.70E+01
SILVER	UG/G	1.00E+00					07/30/86	1.07E+02	07/30/86	2.20E+01
SODIUM	UG/G	1.00E+01	08/04/86	3.09E+02	08/04/86	2.77E+02	07/30/86	2.89E+02	07/30/86	2.04E+02
NICKEL	UG/G	1.00E+00	08/04/86	3.30E+01	08/04/86	3.30E+01	07/30/86	2.32E+02	07/30/86	9.50E+01
COPPER	UG/G	1.00E+00	08/04/86	3.86E+02	08/04/86	3.82E+02	07/30/86	1.99E+03	07/30/86	8.07E+02
VANADUM	UG/G	5.00E-01	08/04/86	5.90E+01	08/04/86	4.30E+01	07/30/86	1.10E+02	07/30/86	4.70E+01
ALUMNUM	UG/G	1.50E+01	08/04/86	4.47E+03	08/04/86	4.82E+03	07/30/86	1.09E+04	07/30/86	7.68E+03
MANGESE	UG/G	5.00E-01	08/04/86	2.43E+02	08/04/86	2.78E+02	07/30/86	3.03E+02	07/30/86	3.11E+02
POTASUM	UG/G	1.00E+01	08/04/86	3.93E+02	08/04/86	3.96E+02	07/30/86	9.11E+02	07/30/86	6.99E+02
IRON	UG/G	5.00E+00	08/04/86	2.88E+04	08/04/86	2.79E+04	07/30/86	3.37E+04	07/30/86	2.67E+04
ARSENIC	UG/G	5.00E-01			08/04/86	1.76E+00			07/30/86	1.38E+01
MERCURY	UG/G	1.00E-01	08/04/86	2.27E+00	08/04/86	2.73E+00	07/30/86	5.23E+00	07/30/86	1.17E+00
MAGNES	UG/G	5.00E+00	08/04/86	4.81E+03	08/04/86	4.66E+03	07/30/86	5.03E+03	07/30/86	4.97E+03
LEADGF	UG/G	5.00E-01	08/04/86	1.48E+01	08/04/86	1.63E+01	07/30/86	1.36E+02	07/30/86	2.92E+01
TOX	UG/G	1.00E+00			08/04/86	1.00E+00	07/30/86	8.20E+00	07/30/86	1.78E+01
TOC	UG/G	1.00E+01	08/04/86	8.39E+01	08/04/86	8.89E+01	07/30/86	8.46E+01	07/30/86	1.52E+02
CYANIDE	UG/G	1.00E+00							07/30/86	1.30E+00
NITRATE	UG/G	1.00E+00			08/04/86	2.67E+00			07/30/86	1.65E+01
SULFATE	UG/G	1.00E+00			08/04/86	3.65E+00			07/30/86	6.81E+00
FLUORID	UG/G	1.00E+00			08/04/86	1.07E+00			07/30/86	1.03E+00
CHLORID	UG/G	1.00E+00			08/04/86	7.74E+00				
AMMONIU	UG/G	5.00E-01							07/30/86	6.20E-01

3.82E+02
4.30E+01 07/3
4.82E+03 07

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	E7LA	SAMPLE DATE	E7SA	SAMPLE DATE	E8DA	SAMPLE DATE	E8SA
BERYLAM	UG/G	5.00E-01	07/30/86	4.00E+00						
STRONUM	UG/G	3.00E+01	07/30/86	8.50E+01						
ZINC	UG/G	5.00E-01	07/30/86	2.85E+02	07/30/86	1.11E+02	07/30/86	9.30E+01	07/30/86	8.40E+01
CALCIUM	UG/G	5.00E+00	07/30/86	5.08E+03	07/30/86	4.43E+03	07/30/86	4.88E+03	07/30/86	4.18E+03
BARIUM	UG/G	6.00E-01	07/30/86	2.75E+02	07/30/86	8.20E+01	07/30/86	8.90E+01	07/30/86	8.60E+01
CADMIUM	UG/G	2.00E-01	07/30/86	6.00E+00	07/30/86	9.00E+00	07/30/86	1.10E+01	07/30/86	1.00E+01
CHROMUM	UG/G	1.00E+00	07/30/86	4.33E+02	07/30/86	3.90E+01	07/30/86	4.60E+01	07/30/86	2.70E+01
SILVER	UG/G	1.00E+00	07/30/86	1.70E+01	07/30/86	9.00E+00	07/30/86	7.00E+00	07/30/86	2.00E+00
SODIUM	UG/G	1.00E+01	07/30/86	3.17E+02	07/30/86	2.00E+02	07/30/86	2.79E+02	07/30/86	2.26E+02
NICKEL	UG/G	1.00E+00	07/30/86	3.29E+02	07/30/86	4.90E+01	07/30/86	4.90E+01	07/30/86	3.90E+01
COPPER	UG/G	1.00E+00	07/30/86	3.04E+03	07/30/86	6.06E+02	07/30/86	5.35E+02	07/30/86	5.80E+02
VANADUM	UG/G	5.00E-01			07/30/86	4.40E+01	07/30/86	6.40E+01	07/30/86	5.50E+01
ANTIONY	UG/G	1.00E+01	07/30/86	4.70E+01						
ALUMNUM	UG/G	1.50E+01	07/30/86	1.14E+04	07/30/86	4.67E+03	07/30/86	6.24E+03	07/30/86	5.74E+03
MANGESE	UG/G	5.00E-01	07/30/86	2.60E+02	07/30/86	2.33E+02	07/30/86	2.70E+02	07/30/86	2.91E+02
POTASUM	UG/G	1.00E+01	07/30/86	9.10E+02	07/30/86	5.53E+02	07/30/86	5.56E+02	07/30/86	5.81E+02
IRON	UG/G	5.00E+00	07/30/86	3.52E+04	07/30/86	1.95E+04	07/30/86	2.79E+04	07/30/86	2.61E+04
MERCURY	UG/G	1.00E-01	07/30/86	6.22E+00	07/30/86	5.70E-01	07/30/86	8.60E-01	07/30/86	2.90E-01
MAGNES	UG/G	5.00E+00	07/30/86	3.89E+03	07/30/86	3.47E+03	07/30/86	4.45E+03	07/30/86	4.63E+03
LEADGF	UG/G	5.00E-01	07/30/86	3.48E+02	07/30/86	1.83E+01	07/30/86	1.50E+01	07/30/86	8.66E+00
TOX	UG/G	1.00E+00	07/30/86	2.74E+01	07/30/86	6.40E+00	07/30/86	5.80E+00	07/30/86	4.50E+00
TOC	UG/G	1.00E+01	07/30/86	2.95E+02	07/30/86	9.18E+01	07/30/86	9.87E+01	07/30/86	1.05E+02

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	E9DA	SAMPLE DATE	E9SA	SAMPLE DATE	E10DA	SAMPLE DATE	E10SA
STRONUM	UG/G	3.00E+01							07/23/86	3.50E+01
ZINC	UG/G	5.00E-01	07/23/86	1.04E+02	07/23/86	8.80E+01	07/23/86	1.10E+02	07/23/86	1.05E+02
CALCIUM	UG/G	5.00E+00	07/23/86	4.54E+03	07/23/86	4.68E+03	07/23/86	4.47E+03	07/23/86	5.80E+03
BARIUM	UG/G	6.00E-01	07/23/86	8.20E+01	07/23/86	9.00E+01	07/23/86	9.00E+00	07/23/86	1.05E+02
CADMIUM	UG/G	2.00E-01	07/23/86	1.00E+01	07/23/86	1.10E+01	07/23/86	1.00E+01	07/23/86	1.10E+01
CHROMUM	UG/G	1.00E+00	07/23/86	3.80E+01	07/23/86	2.50E+01	07/23/86	3.10E+01	07/23/86	2.00E+01
SILVER	UG/G	1.00E+00	07/23/86	1.00E+01	07/23/86	6.00E+00	07/23/86	7.00E+00		
SODIUM	UG/G	1.00E+01	07/23/86	2.48E+02	07/23/86	2.32E+02	07/23/86	2.21E+02	07/23/86	2.29E+02
NICKEL	UG/G	1.00E+00	07/23/86	4.90E+01	07/23/86	3.30E+01	07/23/86	4.90E+01	07/23/86	3.90E+01
COPPER	UG/G	1.00E+00	07/23/86	5.82E+02	07/23/86	5.63E+02	07/23/86	4.43E+02	07/23/86	3.22E+02
VANADUM	UG/G	5.00E-01	07/23/86	4.70E+01	07/23/86	4.80E+01	07/23/86	4.80E+01	07/23/86	5.60E+01
ALUMNUM	UG/G	1.50E+01	07/23/86	6.25E+03	07/23/86	5.67E+03	07/23/86	6.11E+03	07/23/86	9.74E+03
MANGESE	UG/G	5.00E-01	07/23/86	2.68E+02	07/23/86	2.63E+02	07/23/86	2.67E+02	07/23/86	2.72E+02
POTASUM	UG/G	1.00E+01	07/23/86	5.76E+02	07/23/86	5.20E+02	07/23/86	5.83E+02	07/23/86	1.04E+03
IRON	UG/G	5.00E+00	07/23/86	2.45E+04	07/23/86	2.59E+04	07/23/86	2.44E+04	07/23/86	2.65E+04
ARSENIC	UG/G	5.00E-01							07/23/86	5.57E+00
MERCURY	UG/G	1.00E-01	07/23/86	5.80E-01	07/23/86	2.70E-01	07/23/86	5.30E-01	07/23/86	2.50E-01
THALIUM	UG/G	1.00E+00							07/23/86	1.38E+00
MAGNES	UG/G	5.00E+00	07/23/86	4.59E+03	07/23/86	4.62E+03	07/23/86	4.69E+03	07/23/86	5.49E+03
LEADGF	UG/G	5.00E-01	07/23/86	1.11E+01	07/23/86	1.04E+01	07/23/86	1.18E+01	07/23/86	6.23E+00
METHYCH	UG/G	1.00E-02							07/23/86	3.00E-02
BUTBENP	UG/G	1.00E+00							07/23/86	3.30E+00
TOX	UG/G	1.00E+00	07/23/86	1.18E+01	07/23/86	4.00E+00	07/23/86	5.10E+00	07/23/86	2.20E+00
TOC	UG/G	1.00E+01	07/23/86	1.02E+02	07/23/86	9.90E+01	07/23/86	9.05E+01	07/23/86	6.47E+01
NITRATE	UG/G	1.00E+00							07/23/86	8.94E+00
SULFATE	UG/G	1.00E+00							07/23/86	4.77E+00
FLUORID	UG/G	1.00E+00							07/23/86	1.40E+00

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	E11DA	SAMPLE DATE	E11SA	SAMPLE DATE	E12DA	SAMPLE DATE	E12SA
ZINC	UG/G	5.00E-01	07/23/86	9.70E+01	07/23/86	1.56E+02	07/23/86	7.90E+01	07/23/86	1.06E+02
CALCIUM	UG/G	5.00E+00	07/23/86	4.75E+03	07/23/86	4.77E+03	07/23/86	5.32E+03	07/23/86	4.97E+03
BARIUM	UG/G	6.00E-01	07/23/86	8.20E+01	07/23/86	9.50E+01	07/23/86	9.10E+01	07/23/86	9.10E+01
CADMIUM	UG/G	2.00E-01	07/23/86	1.10E+01	07/23/86	1.20E+01	07/23/86	1.10E+01	07/23/86	1.10E+01
CHROMUM	UG/G	1.00E+00	07/23/86	1.40E+01	07/23/86	3.50E+01	07/23/86	1.30E+01	07/23/86	2.70E+01
SILVER	UG/G	1.00E+00			07/23/86	1.60E+01			07/23/86	7.00E+00
SODIUM	UG/G	1.00E+01	07/23/86	2.24E+02	07/23/86	2.29E+02	07/23/86	2.67E+02	07/23/86	2.37E+02
NICKEL	UG/G	1.00E+00	07/23/86	2.70E+01	07/23/86	6.70E+01	07/23/86	2.80E+01	07/23/86	4.10E+01
COPPER	UG/G	1.00E+00	07/23/86	1.74E+02	07/23/86	5.79E+02	07/23/86	1.58E+02	07/23/86	3.64E+02
VANADUM	UG/G	5.00E-01	07/23/86	4.00E+01	07/23/86	6.10E+01	07/23/86	4.90E+01	07/23/86	5.00E+01
ALUMNUM	UG/G	1.50E+01	07/23/86	5.35E+03	07/23/86	7.20E+03	07/23/86	5.60E+03	07/23/86	6.98E+03
MANGESE	UG/G	5.00E-01	07/23/86	3.16E+02	07/23/86	3.08E+02	07/23/86	3.36E+02	07/23/86	3.06E+02
POTASUM	UG/G	1.00E+01	07/23/86	4.74E+02	07/23/86	6.72E+02	07/23/86	5.35E+02	07/23/86	6.79E+02
IRON	UG/G	5.00E+00	07/23/86	2.37E+04	07/23/86	2.74E+03	07/23/86	2.60E+04	07/23/86	2.58E+04
MERCURY	UG/G	1.00E-01	07/23/86	2.30E-01	07/23/86	7.70E-01	07/23/86	2.60E-01	07/23/86	4.40E-01
MAGNES	UG/G	5.00E+00	07/23/86	4.80E+03	07/23/86	4.89E+03	07/23/86	4.87E+03	07/23/86	5.08E+03
LEADGF	UG/G	5.00E-01	07/23/86	5.87E+00	07/23/86	1.37E+01	07/23/86	5.59E+00	07/23/86	1.05E+01
TOX	UG/G	1.00E+00	07/23/86	7.40E+00	07/23/86	1.44E+01	07/23/86	2.46E+01	07/23/86	1.86E+01
TOC	UG/G	1.00E+01	07/23/86	5.57E+01	07/23/86	1.32E+02	07/23/86	5.76E+01	07/23/86	1.21E+02

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	E13DA	SAMPLE DATE	E13LA	SAMPLE DATE	E13SA	SAMPLE DATE	E14DA
COLIFRM	MPN	2.20E+00							07/21/86	1.60E+01
BERYLAM	UG/G	5.00E-01			07/21/86	9.00E-01				
STRONUM	UG/G	3.00E+01			07/21/86	3.30E+01				
ZINC	UG/G	5.00E-01	07/21/86	7.00E+01	07/21/86	2.66E+02	07/21/86	8.00E+01	07/21/86	7.90E+01
CALCIUM	UG/G	5.00E+00	07/21/86	5.25E+03	07/21/86	4.10E+03	07/21/86	4.95E+03	07/21/86	4.83E+03
BARIUM	UG/G	6.00E-01	07/21/86	8.40E+01	07/21/86	1.46E+02	07/21/86	8.70E+01	07/21/86	8.80E+01
CADMIUM	UG/G	2.00E-01	07/21/86	1.00E+01	07/21/86	8.00E+00	07/21/86	1.00E+01	07/21/86	9.00E+00
CHROMUM	UG/G	1.00E+00	07/21/86	9.00E+00	07/21/86	1.64E+02	07/21/86	9.00E+00	07/21/86	1.30E+01
SILVER	UG/G	1.00E+00			07/21/86	7.80E+01				
SODIUM	UG/G	1.00E+01	07/21/86	2.74E+02	07/21/86	1.82E+02	07/21/86	2.95E+02	07/21/86	2.80E+02
NICKEL	UG/G	1.00E+00	07/21/86	1.70E+01	07/21/86	1.76E+02	07/21/86	2.00E+01	07/21/86	2.50E+01
COPPER	UG/G	1.00E+00	07/21/86	1.13E+02	07/21/86	1.71E+03	07/21/86	1.39E+02	07/21/86	1.71E+02
VANADUM	UG/G	5.00E-01	07/21/86	5.20E+01	07/21/86	4.50E+01	07/21/86	5.00E+01	07/21/86	4.60E+01
ALUMNUM	UG/G	1.50E+01	07/21/86	5.58E+03	07/21/86	7.91E+03	07/21/86	5.64E+03	07/21/86	6.14E+03
MANGESE	UG/G	5.00E-01	07/21/86	3.16E+02	07/21/86	1.82E+02	07/21/86	3.78E+02	07/21/86	3.26E+02
POTASUM	UG/G	1.00E+01	07/21/86	5.24E+02	07/21/86	7.65E+02	07/21/86	5.37E+02	07/21/86	6.04E+02
IRON	UG/G	5.00E+00	07/21/86	2.57E+04	07/21/86	2.12E+04	07/21/86	2.51E+04	07/21/86	2.34E+04
ARSENIC	UG/G	5.00E-01							07/21/86	2.00E+00
MERCURY	UG/G	1.00E-01	07/21/86	3.00E-01	07/21/86	2.80E+00	07/21/86	3.00E-01	07/21/86	3.00E-01
MAGNES	UG/G	5.00E+00	07/21/86	4.90E+03	07/21/86	4.08E+03	07/21/86	4.58E+03	07/21/86	4.86E+03
LEADGF	UG/G	5.00E-01	07/21/86	6.00E+00	07/21/86	1.92E+01	07/21/86	3.50E+00	07/21/86	5.70E+00
TOX	UG/G	1.00E+00	07/21/86	1.06E+01	07/21/86	1.54E+01	07/21/86	6.20E+00	07/21/86	8.50E+00
TOC	UG/G	1.00E+01	07/21/86	1.07E+02	07/21/86	4.47E+02	07/21/86	1.07E+02	07/21/86	1.60E+02
NITRATE	UG/G	1.00E+00							07/21/86	1.49E+01
SULFATE	UG/G	1.00E+00							07/21/86	3.41E+00
FLUORID	UG/G	1.00E+00							07/21/86	1.00E+00
CHLORID	UG/G	1.00E+00							07/21/86	1.78E+00

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	E14SA	SAMPLE DATE	E15DA	SAMPLE DATE	E15SA	SAMPLE DATE	E16LA
BERYLAM	UG/G	5.00E-01							08/08/86	1.50E+00
STRONUM	UG/G	3.00E+01							08/06/86	1.01E+02
ZINC	UG/G	5.00E-01	07/21/86	8.90E+01	07/21/86	1.09E+02	07/21/86	1.73E+02	08/06/86	1.16E+03
CALCIUM	UG/G	5.00E+00	07/21/86	4.23E+03	07/21/86	4.90E+03	07/21/86	5.32E+03	08/06/86	8.82E+03
BARIUM	UG/G	6.00E-01	07/21/86	8.60E+01	07/21/86	9.80E+01	07/21/86	1.07E+02	08/06/86	4.91E+02
CADMIUM	UG/G	2.00E-01	07/21/86	9.00E+00	07/21/86	1.00E+01	07/21/86	1.10E+01	08/06/86	2.80E+01
CHROMUM	UG/G	1.00E+00	07/21/86	1.20E+01	07/21/86	1.80E+01	07/21/86	3.30E+01	08/06/86	4.61E+02
SILVER	UG/G	1.00E+00			07/21/86	4.00E+00	07/21/86	1.30E+01	08/06/86	4.05E+02
SODIUM	UG/G	1.00E+01	07/21/86	2.17E+02	07/21/86	2.54E+02	07/21/86	2.82E+02	08/06/86	3.55E+02
NICKEL	UG/G	1.00E+00	07/21/86	2.70E+01	07/21/86	3.60E+01	07/21/86	6.60E+01	08/06/86	3.71E+02
COPPER	UG/G	1.00E+00	07/21/86	2.14E+02	07/21/86	2.61E+02	07/21/86	5.01E+02	08/06/86	6.55E+03
VANADUM	UG/G	5.00E-01	07/21/86	4.30E+01	07/21/86	4.40E+01	07/21/86	5.20E+01	08/06/86	6.20E+01
ALUMNUM	UG/G	1.50E+01	07/21/86	6.10E+03	07/21/86	6.58E+03	07/21/86	8.57E+03	08/06/86	1.35E+04
MANGESE	UG/G	5.00E-01	07/21/86	3.76E+02	07/21/86	3.15E+02	07/21/86	3.16E+02	08/06/86	1.21E+02
POTASUM	UG/G	1.00E+01	07/21/86	6.31E+02	07/21/86	6.53E+02	07/21/86	7.75E+02	08/06/86	6.99E+02
IRON	UG/G	5.00E+00	07/21/86	2.25E+04	07/21/86	2.45E+04	07/21/86	2.79E+04	08/06/86	2.47E+04
MERCURY	UG/G	1.00E-01	07/21/86	4.00E-01	07/21/86	6.00E-01	07/21/86	1.30E+00	08/06/86	1.80E+01
MAGNES	UG/G	5.00E+00	07/21/86	4.49E+03	07/21/86	5.02E+03	07/21/86	5.80E+03	08/06/86	2.95E+03
LEADGF	UG/G	5.00E-01	07/21/86	6.80E+00	07/21/86	1.04E+01	07/21/86	9.70E+00	08/06/86	1.00E+02
TOX	UG/G	1.00E+00	07/21/86	1.28E+01	07/21/86	5.20E+00	07/21/86	7.00E+00	08/06/86	2.00E+00
TOC	UG/G	1.00E+01	07/21/86	1.55E+02	07/21/86	1.69E+02	07/21/86	2.19E+02	08/06/86	7.31E+02

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	E16SA	SAMPLE DATE	W1DA	SAMPLE DATE	W1LA	SAMPLE DATE	W1SA
COLIFRM	MPN	2.20E+00	08/06/86	1.60E+01			06/16/86	2.40E+03		
STRONUM	UG/G	3.00E+01	08/06/86	3.00E+01			06/16/86	2.00E+00		
ZINC	UG/G	5.00E-01	08/06/86	2.82E+02			06/16/86	4.50E+01		
CALCIUM	UG/G	5.00E+00	08/06/86	5.58E+03	06/16/86	4.10E+01	06/16/86	2.42E+02		
BARIUM	UG/G	6.00E-01	08/06/86	1.35E+02	06/16/86	1.17E+02	06/16/86	9.30E+01	06/16/86	9.20E+01
CADMIUM	UG/G	2.00E-01	08/06/86	1.30E+01	06/16/86	6.44E+03	06/16/86	8.17E+03	06/16/86	4.00E+03
CHROMUM	UG/G	1.00E+00	08/06/86	7.80E+01	06/16/86	1.04E+02	06/16/86	2.22E+02	06/16/86	6.00E+01
SILVER	UG/G	1.00E+00	08/06/86	6.80E+01	06/16/86	8.00E+00			06/16/86	8.00E+00
SODIUM	UG/G	1.00E+01	08/06/86	2.69E+02	06/16/86	1.60E+01	06/16/86	1.70E+01	06/16/86	6.00E+00
NICKEL	UG/G	1.00E+00	08/06/86	7.40E+01			06/16/86	4.40E+01		
COPPER	UG/G	1.00E+00	08/06/86	1.19E+03	06/16/86	3.51E+02	06/16/86	5.63E+02	06/16/86	2.45E+02
VANADUM	UG/G	5.00E-01	08/06/86	4.80E+01	06/16/86	3.40E+01	06/16/86	1.05E+02	06/16/86	1.60E+01
ALUMNUM	UG/G	1.50E+01	08/06/86	7.13E+03	06/16/86	3.99E+02	06/16/86	1.87E+03	06/16/86	1.47E+02
MANGESE	UG/G	5.00E-01	08/06/86	2.13E+02	06/16/86	2.80E+01			06/16/86	4.50E+01
POTASUM	UG/G	1.00E+01	08/06/86	5.68E+02			06/16/86	9.60E+01		
IRON	UG/G	5.00E+00	08/06/86	2.53E+03	06/16/86	7.68E+03	06/16/86	5.22E+03	06/16/86	5.45E+03
ARSENIC	UG/G	5.00E-01	08/06/86	4.32E+00	06/16/86	3.19E+02	06/16/86	2.21E+02	06/16/86	1.96E+02
MERCURY	UG/G	1.00E-01	08/06/86	3.98E+01	06/16/86	8.25E+02	06/16/86	2.84E+02	06/16/86	5.52E+02
THALIUM	UG/G	1.00E+00	08/06/86	1.00E+00	06/16/86	2.50E+04	06/16/86	7.46E+03	06/16/86	2.11E+04
MAGNES	UG/G	5.00E+00	08/06/86	4.69E+03			06/16/86	3.40E+00		
LEADGF	UG/G	5.00E-01	08/06/86	2.98E+01	06/16/86	1.19E+00	06/16/86	4.08E-01	06/16/86	2.59E-01
METHYCH	UG/G	1.00E-02								
TOX	UG/G	1.00E+00			06/16/86	2.22E+00	06/16/86	2.04E+01	06/16/86	7.87E+00
TOC	UG/G	1.00E+01	08/06/86	1.98E+02	06/16/86	2.00E+00	06/16/86	7.47E+01		
NITRATE	UG/G	1.00E+00			06/16/86	8.88E+01	06/16/86	4.67E+02	06/16/86	4.41E+01
SULFATE	UG/G	1.00E+00	08/06/86	1.77E+01			06/16/86	1.05E+01		
FLUORID	UG/G	1.00E+00	08/06/86	1.19E+00			06/16/86	3.31E+01		
CHLORID	UG/G	1.00E+00	08/06/86	3.55E+00			06/16/86	2.80E+00		
SULFIDE	UG/G	1.00E+01					06/16/86	5.00E+02		
AMMONIU	UG/G	5.00E-01	08/06/86	2.10E+00			06/16/86	5.70E+02		
ACETONE	UG/G	0.00E+00					06/16/86	5.40E+02		
UNKNOWN	UG/G	0.00E+00					06/16/86	1.56E+03		
MOLSULF	UG/G									

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	W2DA	SAMPLE DATE	W2SA	SAMPLE DATE	W3DA	SAMPLE DATE	W3LA
COLIFRM	MPN	2.20E+00			06/23/86	4.00E+00	09/10/86	1.60E+01	09/10/86	1.60E+01
BERYLAM	UG/G	5.00E-01	06/23/86	1.00E+00	06/23/86	1.60E+00			09/10/86	3.00E+00
STRONUM	UG/G	3.00E+01	06/23/86	7.40E+01	06/23/86	1.58E+02	09/10/86	3.70E+01	09/10/86	2.28E+02
ZINC	UG/G	5.00E-01	06/23/86	3.96E+02	06/23/86	8.45E+02	09/10/86	1.55E+02	09/10/86	2.49E+02
CALCIUM	UG/G	5.00E+00	06/23/86	4.84E+03	06/23/86	9.34E+03	09/10/86	5.04E+03	09/10/86	7.50E+03
BARIUM	UG/G	6.00E-01	06/23/86	1.78E+02	06/23/86	4.65E+02	09/10/86	9.20E+01	09/10/86	2.96E+02
CADMIUM	UG/G	2.00E-01	06/23/86	8.00E+00	06/23/86	1.90E+01	09/10/86	6.00E+00		
CHROMUM	UG/G	1.00E+00	06/23/86	1.31E+02	06/23/86	1.54E+02	09/10/86	2.20E+01	09/10/86	1.36E+02
SILVER	UG/G	1.00E+00	06/23/86	1.10E+02	06/23/86	1.47E+02	09/10/86	7.00E+00	09/10/86	8.80E+01
SODIUM	UG/G	1.00E+01	06/23/86	5.29E+02	06/23/86	1.39E+03	09/10/86	3.34E+02	09/10/86	1.44E+03
NICKEL	UG/G	1.00E+00	06/23/86	1.03E+03	06/23/86	4.70E+03	09/10/86	1.86E+02	09/10/86	1.55E+03
COPPER	UG/G	1.00E+00	06/23/86	2.23E+03	06/23/86	3.94E+03	09/10/86	7.01E+02	09/10/86	5.84E+03
VANADUM	UG/G	5.00E-01	06/23/86	4.30E+01	06/23/86	8.00E-01	09/10/86	1.90E+01	09/10/86	7.00E+01
ANTIONY	UG/G	1.00E+01	06/23/86	1.80E+01	06/23/86	2.60E+01			09/10/86	6.40E+01
ALUMNUM	UG/G	1.50E+01	06/23/86	1.05E+04	06/23/86	1.76E+04	09/10/86	5.30E+03	09/10/86	1.69E+04
MANGESE	UG/G	5.00E-01	06/23/86	1.18E+03	06/23/86	6.74E+03	09/10/86	4.65E+02	09/10/86	1.70E+03
POTASUM	UG/G	1.00E+01	06/23/86	7.09E+02	06/23/86	7.27E+02	09/10/86	4.40E+02	09/10/86	6.46E+02
IRON	UG/G	5.00E+00	06/23/86	2.34E+04	06/23/86	4.56E+04	09/10/86	1.92E+04	09/10/86	2.30E+04
ARSENIC	UG/G	5.00E-01			06/23/86	5.40E+00			09/10/86	2.56E+00
MERCURY	UG/G	1.00E-01	06/23/86	8.78E+00	06/23/86	2.29E+01	09/10/86	1.31E+00	09/10/86	9.38E+00
SELENUM	UG/G	5.00E-01			06/23/86	6.50E+00			09/10/86	6.09E+00
MAGNES	UG/G	5.00E+00					09/10/86	3.47E+03	09/10/86	2.62E+03
LEADGF	UG/G	5.00E-01	06/23/86	4.90E+01	06/23/86	1.68E+02	09/10/86	3.15E+01	09/10/86	2.42E+02
PERCENE	UG/G	1.00E-02			06/23/86	8.50E+00	09/10/86	1.00E-02	09/10/86	1.10E-01
TRANDCE	UG/G	1.00E-02							09/10/86	4.00E-02
METHYCH	UG/G	1.00E-02							09/10/86	4.00E-02
TOX	UG/G	1.00E+00	06/23/86	9.60E+00	06/23/86	4.68E+01	09/10/86	1.20E+00	09/10/86	5.20E+00
TOC	UG/G	1.00E+01	06/23/86	9.05E+01	06/23/86	2.23E+02	09/10/86	4.85E+01	09/10/86	1.53E+02
CYANIDE	UG/G	1.00E+00			06/23/86	1.04E+00				
NITRATE	UG/G	1.00E+00			06/23/86	2.28E+01				
SULFATE	UG/G	1.00E+00			06/23/86	2.04E+01	09/10/86	4.70E+00	09/10/86	9.04E+00
FLUORID	UG/G	1.00E+00			06/23/86	3.58E+00			09/10/86	1.42E+00
CHLORID	UG/G	1.00E+00			06/23/86	8.06E+00	09/10/86	1.39E+00	09/10/86	6.30E+00
SULFIDE	UG/G	1.00E+01					09/10/86	2.60E+01	09/10/86	3.00E+01
AMMONIU	UG/G	5.00E-01			06/23/86	4.40E+00	09/10/86	5.00E-01	09/10/86	3.20E+00

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	W3SA	SAMPLE DATE	W4DA	SAMPLE DATE	W4SA	SAMPLE DATE	W5DA
BERYLAM	UG/G	5.00E-01	09/10/86	2.00E+00			09/10/86	6.00E-01		
STRONUM	UG/G	3.00E+01	09/10/86	9.40E+01						
ZINC	UG/G	5.00E-01	09/10/86	4.13E+02	09/10/86	1.00E+02	09/10/86	2.14E+02	09/10/86	1.10E+02
CALCIUM	UG/G	5.00E+00	09/10/86	8.38E+03	09/10/86	3.36E+03	09/10/86	4.22E+03	09/10/86	4.04E+03
BARIUM	UG/G	6.00E-01	09/10/86	2.50E+02	09/10/86	6.30E+01	09/10/86	9.70E+01	09/10/86	8.70E+01
CADMIUM	UG/G	2.00E-01	09/10/86	9.00E+00	09/10/86	6.00E+00	09/10/86	8.00E+00	09/10/86	7.00E+00
CHROMUM	UG/G	1.00E+00	09/10/86	9.20E+01	09/10/86	1.80E+01	09/10/86	5.00E+01	09/10/86	1.40E+01
SILVER	UG/G	1.00E+00	09/10/86	6.20E+01	09/10/86	6.00E+00	09/10/86	2.30E+01	09/10/86	3.00E+00
SODIUM	UG/G	1.00E+01	09/10/86	6.67E+02	09/10/86	1.67E+02	09/10/86	1.97E+02	09/10/86	2.06E+02
NICKEL	UG/G	1.00E+00	09/10/86	1.80E+03	09/10/86	6.20E+01	09/10/86	1.22E+02	09/10/86	5.20E+01
COPPER	UG/G	1.00E+00	09/10/86	2.58E+03	09/10/86	5.06E+02	09/10/86	1.29E+03	09/10/86	5.94E+02
VANADUM	UG/G	5.00E-01	09/10/86	5.00E+01	09/10/86	2.70E+01	09/10/86	1.18E+02	09/10/86	3.90E+01
ANTIONY	UG/G	1.00E+01	09/10/86	1.40E+01						
ALUMNUM	UG/G	1.50E+01	09/10/86	1.10E+04	09/10/86	4.22E+03	09/10/86	5.83E+03	09/10/86	4.77E+03
MANGESE	UG/G	5.00E-01	09/10/86	2.72E+03	09/10/86	1.93E+02	09/10/86	3.16E+02	09/10/86	1.85E+02
POTASUM	UG/G	1.00E+01	09/10/86	6.97E+02	09/10/86	3.92E+02	09/10/86	4.76E+02	09/10/86	4.50E+02
IRON	UG/G	5.00E+00	09/10/86	2.63E+04	09/10/86	1.70E+04	09/10/86	2.11E+04	09/10/86	2.09E+04
MERCURY	UG/G	1.00E-01	09/10/86	1.28E+01	09/10/86	8.10E-01	09/10/86	7.44E-01	09/10/86	1.98E-01
MAGNES	UG/G	5.00E+00	09/10/86	3.84E+03	09/10/86	3.08E+03	09/10/86	3.49E+03	09/10/86	3.61E+03
LEADGF	UG/G	5.00E-01	09/10/86	9.20E+01	09/10/86	2.00E+01	09/10/86	1.42E+01	09/10/86	9.90E+00
TOX	UG/G	1.00E+00	09/10/86	1.20E+00						
TOC	UG/G	1.00E+01	09/10/86	1.18E+02	09/10/86	5.97E+01	09/10/86	7.89E+01	09/10/86	5.58E+01

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	W5LA	SAMPLE DATE	W5SA	SAMPLE DATE	W6DA	SAMPLE DATE	W6SA
COLIFRM	MPN	2.20E+00			09/10/86	1.60E+01				
BERYLAM	UG/G	5.00E-01	09/10/86	3.00E+00						
STRONUM	UG/G	3.00E+01	09/10/86	1.75E+02						
ZINC	UG/G	5.00E-01	09/10/86	2.50E+02	09/10/86	1.60E+02	09/10/86	5.30E+01	09/10/86	4.90E+01
CALCIUM	UG/G	5.00E+00	09/10/86	4.79E+03	09/10/86	3.87E+03	09/10/86	4.20E+03	09/10/86	3.81E+03
BARIUM	UG/G	6.00E-01	09/10/86	2.34E+02	09/10/86	7.10E+01	09/10/86	6.00E+01	09/10/86	5.90E+01
CADMIUM	UG/G	2.00E-01			09/10/86	7.00E+00	09/10/86	7.00E+00	09/10/86	6.00E+00
CHROMUM	UG/G	1.00E+00	09/10/86	4.76E+02	09/10/86	3.50E+01	09/10/86	1.50E+01	09/10/86	5.00E+00
SILVER	UG/G	1.00E+00	09/10/86	1.36E+02	09/10/86	1.70E+01				
SODIUM	UG/G	1.00E+01	09/10/86	1.11E+03	09/10/86	1.83E+02	09/10/86	1.62E+02	09/10/86	1.60E+02
NICKEL	UG/G	1.00E+00	09/10/86	1.46E+03	09/10/86	1.26E+02	09/10/86	2.30E+01	09/10/86	1.50E+01
COPPER	UG/G	1.00E+00	09/10/86	4.14E+03	09/10/86	9.25E+02	09/10/86	2.32E+02	09/10/86	1.99E+02
VANADUM	UG/G	5.00E-01			09/10/86	4.20E+01	09/10/86	3.20E+01	09/10/86	3.40E+01
ANTIONY	UG/G	1.00E+01	09/10/86	8.70E+01						
ALUMNUM	UG/G	1.50E+01	09/10/86	1.74E+04	09/10/86	7.56E+03	09/10/86	4.38E+03	09/10/86	4.01E+03
MANGESE	UG/G	6.00E-01	09/10/86	2.92E+02	09/10/86	1.88E+02	09/10/86	2.22E+02	09/10/86	2.08E+02
POTASUM	UG/G	1.00E+01	09/10/86	6.09E+02	09/10/86	5.80E+02	09/10/86	3.70E+02	09/10/86	4.29E+02
IRON	UG/G	5.00E+00	09/10/86	2.22E+04	09/10/86	2.15E+04	09/10/86	2.17E+04	09/10/86	1.96E+04
ARSENIC	UG/G	5.00E-01			09/10/86	5.20E-01				
MERCURY	UG/G	1.00E-01	09/10/86	1.13E+01	09/10/86	2.00E-01	09/10/86	2.01E-01		
MAGNES	UG/G	5.00E+00	09/10/86	2.20E+03	09/10/86	4.23E+03	09/10/86	4.25E+03	09/10/86	3.60E+03
LEADGF	UG/G	5.00E-01	09/10/86	4.40E+02	09/10/86	2.57E+01	09/10/86	1.26E+01	09/10/86	3.80E+00
TOX	UG/G	1.00E+00	09/10/86	4.70E+00						
TOC	UG/G	1.00E+01	09/10/86	2.15E+02	09/10/86	3.93E+01	09/10/86	2.61E+01	09/10/86	1.40E+01
NITRATE	UG/G	1.00E+00			09/10/86	3.23E+00				
SULFATE	UG/G	1.00E+00			09/10/86	2.55E+00				
CHLORID	UG/G	1.00E+00			09/10/86	1.16E+00				
SULFIDE	UG/G	1.00E+01			09/10/86	2.49E+01				

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	W7DA	SAMPLE DATE	W7SA	SAMPLE DATE	W8DA	SAMPLE DATE	W8LA
COLIFRM	MPN	2.20E+00	06/25/86	2.10E+02						
BERYLAM	UG/G	5.00E-01							06/25/86	1.00E+00
STRONUM	UG/G	3.00E+01	06/25/86	3.20E+01					06/25/86	9.30E+01
ZINC	UG/G	5.00E-01	06/25/86	7.10E+01	06/25/86	5.30E+01	06/25/86	9.80E+01	06/25/86	3.14E+02
CALCIUM	UG/G	5.00E+00	06/25/86	1.00E+04	06/25/86	3.16E+03	06/25/86	4.83E+03	06/25/86	5.51E+03
BARIUM	UG/G	6.00E-01	06/25/86	1.03E+02	06/25/86	5.30E+01	06/25/86	9.40E+01	06/25/86	2.11E+02
CADMIUM	UG/G	2.00E-01	06/25/86	9.00E+00	06/25/86	6.00E+00	06/25/86	1.00E+01	06/25/86	6.00E+00
CHROMUM	UG/G	1.00E+00	06/25/86	2.70E+01	06/25/86	1.40E+01	06/25/86	2.50E+01	06/25/86	2.98E+02
SILVER	UG/G	1.00E+00					06/25/86	4.00E+00	06/25/86	1.46E+02
SODIUM	UG/G	1.00E+01	06/25/86	1.69E+02	06/25/86	1.94E+02	06/25/86	2.84E+02	06/25/86	5.43E+02
NICKEL	UG/G	1.00E+00	06/25/86	3.30E+01	06/25/86	5.00E+01	06/25/86	5.60E+01	06/25/86	6.60E+02
COPPER	UG/G	1.00E+00	06/25/86	1.04E+02	06/25/86	2.74E+02	06/25/86	4.25E+02	06/25/86	3.23E+03
VANADUM	UG/G	5.00E-01	06/25/86	3.70E+01	06/25/86	3.50E+01	06/25/86	6.00E+01	06/25/86	6.00E+01
ANTIONY	UG/G	1.00E+01							06/25/86	4.10E+01
ALUMNUM	UG/G	1.50E+01	06/25/86	1.85E+04	06/25/86	4.37E+03	06/25/86	5.93E+03	06/25/86	1.29E+04
MANGESE	UG/G	5.00E-01	06/25/86	4.43E+02	06/25/86	1.98E+02	06/25/86	2.77E+02	06/25/86	3.32E+02
POTASUM	UG/G	1.00E+01	06/25/86	1.87E+03	06/25/86	3.68E+02	06/25/86	5.31E+02	06/25/86	1.04E+03
IRON	UG/G	5.00E+00	06/25/86	2.70E+04	06/25/86	1.71E+04	06/25/86	2.74E+04	06/25/86	3.07E+04
ARSENIC	UG/G	5.00E-01	06/25/86	6.20E+00						
MERCURY	UG/G	1.00E-01	06/25/86	2.20E-01	06/25/86	5.30E-01	06/25/86	7.00E-01	06/25/86	1.09E+01
LEADGF	UG/G	5.00E-01	06/25/86	1.78E+01	06/25/86	4.40E+00	06/25/86	1.59E+01	06/25/86	1.68E+02
TOX	UG/G	1.00E+00	06/25/86	2.30E+00	06/25/86	1.20E+00	06/25/86	6.60E+00	06/25/86	1.78E+01
TOC	UG/G	1.00E+01	06/25/86	1.49E+01	06/25/86	5.88E+01	06/25/86	9.19E+01	06/25/86	2.73E+02
NITRATE	UG/G	1.00E+00	06/25/86	3.14E+00						
SULFATE	UG/G	1.00E+00	06/25/86	2.07E+00						
CHLORID	UG/G	1.00E+00	06/25/86	3.32E+00						

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	W8SA	SAMPLE DATE	W9DA	SAMPLE DATE	W9LA	SAMPLE DATE	W9SA
BERYLAM	UG/G	5.00E-01					06/16/86	1.00E+00		
STRONUM	UG/G	3.00E+01					06/16/86	4.80E+01		
ZINC	UG/G	5.00E-01	06/25/86	1.34E+02	06/16/86	8.00E+01	06/16/86	2.91E+02	06/16/86	1.20E+02
CALCIUM	UG/G	5.00E+00	06/25/86	4.61E+03	06/16/86	5.36E+03	06/16/86	6.93E+03	06/16/86	3.95E+03
BARIUM	UG/G	6.00E-01	06/25/86	1.02E+02	06/16/86	8.00E+01	06/16/86	1.76E+02	06/16/86	7.40E+01
CADMIUM	UG/G	2.00E-01	06/25/86	1.10E+01	06/16/86	9.00E+00	06/16/86	1.00E+01	06/16/86	9.00E+00
CHROMUM	UG/G	1.00E+00	06/25/86	2.90E+01	06/16/86	1.00E+01	06/16/86	1.30E+02	06/16/86	1.70E+01
SILVER	UG/G	1.00E+00	06/25/86	9.00E+00			06/16/86	1.14E+02	06/16/86	6.00E+00
SODIUM	UG/G	1.00E+01	06/25/86	2.76E+02	06/16/86	2.31E+02	06/16/86	3.09E+02	06/16/86	2.29E+02
NICKEL	UG/G	1.00E+00	06/25/86	8.50E+01	06/16/86	1.80E+01	06/16/86	1.43E+02	06/16/86	4.70E+01
COPPER	UG/G	1.00E+00	06/25/86	5.21E+02	06/16/86	2.40E+02	06/16/86	1.81E+03	06/16/86	5.68E+02
VANADUM	UG/G	5.00E-01	06/25/86	7.30E+01	06/16/86	4.70E+01	06/16/86	9.80E+01	06/16/86	5.00E+01
ANTIONY	UG/G	1.00E+01	06/25/86	1.30E+01						
ALUMNUM	UG/G	1.50E+01	06/25/86	6.30E+03	06/16/86	5.40E+03	06/16/86	9.91E+03	06/16/86	5.27E+03
MANGESE	UG/G	5.00E-01	06/25/86	3.01E+02	06/16/86	3.08E+02	06/16/86	2.83E+02	06/16/86	2.56E+02
POTASUM	UG/G	1.00E+01	06/25/86	5.46E+02	06/16/86	5.15E+02	06/16/86	9.78E+02	06/16/86	5.51E+02
IRON	UG/G	5.00E+00	06/25/86	2.70E+04	06/16/86	2.49E+04	06/16/86	2.75E+04	06/16/86	1.99E+04
MERCURY	UG/G	1.00E-01	06/25/86	1.26E+00	06/16/86	1.73E-01	06/16/86	5.14E+00	06/16/86	3.38E-01
LEADGF	UG/G	5.00E-01	06/25/86	1.51E+01	06/16/86	5.88E+00	06/16/86	1.43E+02	06/16/86	1.30E+01
TOX	UG/G	1.00E+00	06/25/86	2.20E+00	06/16/86	1.50E+00	06/16/86	5.05E+00	06/16/86	1.00E+00
TOC	UG/G	1.00E+01	06/25/86	1.12E+02	06/16/86	5.53E+01	06/16/86	1.54E+02	06/16/86	1.06E+02

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	W10DA	SAMPLE DATE	W10LA	SAMPLE DATE	W10SA	SAMPLE DATE	W11DA
BERYLAM	UG/G	5.00E-01	06/18/86	1.00E+00	06/18/86	2.00E+00	06/18/86	2.00E+00		
STRONUM	UG/G	3.00E+01			06/18/86	8.70E+01	06/18/86	8.30E+01		
ZINC	UG/G	5.00E-01	06/18/86	9.60E+01	06/18/86	4.08E+02	06/18/86	4.09E+02	06/18/86	1.30E+02
CALCIUM	UG/G	5.00E+00	06/18/86	5.48E+03	06/18/86	5.84E+03	06/18/86	5.74E+03	06/18/86	5.24E+03
BARIUM	UG/G	6.00E-01	06/18/86	9.30E+01	06/18/86	2.05E+02	06/18/86	2.04E+02	06/18/86	9.60E+01
CADMIUM	UG/G	2.00E-01	06/18/86	7.00E+00	06/18/86	6.00E+00	06/18/86	6.00E+00	06/18/86	9.00E+00
CHROMUM	UG/G	1.00E+00	06/18/86	2.80E+01	06/18/86	3.24E+02	06/18/86	3.19E+02	06/18/86	2.20E+01
SILVER	UG/G	1.00E+00	06/18/86	7.00E+00	06/18/86	2.13E+02	06/18/86	2.16E+02	06/18/86	9.00E+00
SODIUM	UG/G	1.00E+01	06/18/86	2.47E+02	06/18/86	4.90E+02	06/18/86	4.79E+02	06/18/86	2.55E+02
NICKEL	UG/G	1.00E+00	06/18/86	4.60E+01	06/18/86	7.52E+02	06/18/86	6.90E+02	06/18/86	5.90E+01
COPPER	UG/G	1.00E+00	06/18/86	3.06E+02	06/18/86	3.13E+03	06/18/86	3.13E+03	06/18/86	2.99E+02
VANADUM	UG/G	5.00E-01	06/18/86	3.70E+01	06/18/86	1.30E+01	06/18/86	1.50E+01	06/18/86	3.80E+01
ANTIONY	UG/G	1.00E+01			06/18/86	2.80E+01	06/18/86	2.60E+01		
ALUMNUM	UG/G	1.50E+01	06/18/86	9.00E+03	06/18/86	1.61E+04	06/18/86	1.57E+04	06/18/86	6.84E+03
MANGESE	UG/G	5.00E-01	06/18/86	2.60E+02	06/18/86	2.51E+02	06/18/86	2.36E+02	06/18/86	2.91E+02
POTASUM	UG/G	1.00E+01	06/18/86	1.22E+03	06/18/86	1.70E+03	06/18/86	1.62E+03	06/18/86	7.56E+02
IRON	UG/G	5.00E+00	06/18/86	2.10E+04	06/18/86	3.04E+04	06/18/86	3.04E+04	06/18/86	2.33E+04
ARSENIC	UG/G	5.00E-01					06/18/86	4.00E+00		
MERCURY	UG/G	1.00E-01	06/18/86	6.49E-01	06/18/86	5.74E+00	06/18/86	1.80E-01	06/18/86	5.13E-01
LEADGF	UG/G	5.00E-01	06/18/86	2.51E+01	06/18/86	2.48E+02	06/18/86	6.19E+00	06/18/86	1.94E+01
TOX	UG/G	1.00E+00			06/18/86	2.65E+00				
TOC	UG/G	1.00E+01	06/18/86	1.03E+02	06/18/86	4.12E+02	06/18/86	3.97E+01	06/18/86	1.38E+02
NITRATE	UG/G	1.00E+00					06/18/86	2.50E+00		
SULFATE	UG/G	1.00E+00					06/18/86	1.60E+00		
AMMONIU	UG/G	5.00E-01					06/18/86	1.30E+00		

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	W11SA	SAMPLE DATE	W12DA	SAMPLE DATE	W12LA	SAMPLE DATE	W12SA
BERYLAM	UG/G	5.00E-01					06/18/86	2.00E+00		
STRONUM	UG/G	3.00E+01					06/18/86	5.90E+01		
ZINC	UG/G	5.00E-01	06/18/86	2.51E+02	06/18/86	9.80E+01	06/18/86	2.74E+02	06/18/86	1.01E+02
CALCIUM	UG/G	5.00E+00	06/18/86	4.41E+03	06/18/86	5.67E+03	06/18/86	4.87E+03	06/18/86	4.86E+03
BARIUM	UG/G	6.00E-01	06/18/86	9.80E+01	06/18/86	9.10E+01	06/18/86	1.56E+02	06/18/86	8.60E+01
CADMIUM	UG/G	2.00E-01	06/18/86	1.00E+01	06/18/86	9.00E+00	06/18/86	4.00E+00	06/18/86	9.00E+00
CHROMUM	UG/G	1.00E+00	06/18/86	6.40E+01	06/18/86	2.10E+01	06/18/86	2.36E+02	06/18/86	1.30E+01
SILVER	UG/G	1.00E+00	06/18/86	4.20E+01	06/18/86	5.00E+00	06/18/86	1.58E+02	06/18/86	2.00E+00
SODIUM	UG/G	1.00E+01	06/18/86	2.57E+02	06/18/86	2.42E+02	06/18/86	3.04E+02	06/18/86	2.01E+02
NICKEL	UG/G	1.00E+00	06/18/86	1.60E+02	06/18/86	3.50E+01	06/18/86	3.85E+02	06/18/86	2.60E+01
COPPER	UG/G	1.00E+00	06/18/86	8.03E+02	06/18/86	2.64E+02	06/18/86	2.39E+03	06/18/86	2.71E+02
VANADUM	UG/G	5.00E-01	06/18/86	4.70E+01	06/18/86	4.30E+01	06/18/86	1.40E+01	06/18/86	3.80E+01
ANTIONY	UG/G	1.00E+01					06/18/86	1.70E+01		
ALUMNUM	UG/G	1.50E+01	06/18/86	8.64E+03	06/18/86	6.90E+03	06/18/86	1.13E+04	06/18/86	6.47E+03
MANGESE	UG/G	5.00E-01	06/18/86	2.56E+02	06/18/86	3.14E+02	06/18/86	1.68E+02	06/18/86	3.07E+02
POTASUM	UG/G	1.00E+01	06/18/86	8.35E+02	06/18/86	8.77E+02	06/18/86	9.69E+02	06/18/86	6.68E+02
IRON	UG/G	5.00E+00	06/18/86	2.30E+04	06/18/86	2.38E+04	06/18/86	2.13E+04	06/18/86	2.28E+04
MERCURY	UG/G	1.00E-01	06/18/86	1.25E+00	06/18/86	4.72E-01	06/18/86	1.26E+01	06/18/86	3.39E-01
LEADGF	UG/G	5.00E-01	06/18/86	4.25E+01	06/18/86	1.43E+01	06/18/86	1.12E+02	06/18/86	9.10E+00
TOX	UG/G	1.00E+00	06/18/86	2.50E+00	06/18/86	2.00E+00	06/18/86	1.45E+01		
TOC	UG/G	1.00E+01	06/18/86	2.45E+02	06/18/86	1.22E+02	06/18/86	1.92E+02	06/18/86	8.19E+01

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	W17SA
ZINC	UG/G	5.00E-01	06/18/86	1.92E+02
CALCIUM	UG/G	5.00E+00	06/18/86	5.39E+03
BARIUM	UG/G	8.00E-01	06/18/86	9.00E+01
CADMIUM	UG/G	2.00E-01	06/18/86	1.00E+01
CHROMUM	UG/G	1.00E+00	06/18/86	1.80E+01
SILVER	UG/G	1.00E+00	06/18/86	4.00E+00
SODIUM	UG/G	1.00E+01	06/18/86	2.50E+02
NICKEL	UG/G	1.00E+00	06/18/86	4.40E+01
COPPER	UG/G	1.00E+00	06/18/86	2.32E+02
VANADUM	UG/G	5.00E-01	06/18/86	4.50E+01
ALUMNUM	UG/G	1.50E+01	06/18/86	7.70E+03
MANGESE	UG/G	5.00E-01	06/18/86	2.74E+02
POTASUM	UG/G	1.00E+01	06/18/86	7.56E+02
IRON	UG/G	5.00E+00	06/18/86	2.60E+04
MERCURY	UG/G	1.00E-01	06/18/86	5.15E-01
LEADGF	UG/G	6.00E-01	06/18/86	1.31E+01
TOC	UG/G	1.00E+01	06/18/86	1.31E+02

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	1A5	SAMPLE DATE	1A10	SAMPLE DATE	1A15	SAMPLE DATE	1A20
COLIFRM	MPN	3.00E+00	04/24/86	9.00E+00						
STRONUM	UG/G	3.00E+01	04/24/86	3.10E+01						
ZINC	UG/G	5.00E-01	04/24/86	4.40E+01	04/25/86	4.40E+01	04/29/86	4.00E+01	04/30/86	3.30E+01
CALCIUM	UG/G	5.00E+00	04/24/86	6.71E+03	04/25/86	6.28E+03	04/29/86	6.82E+03	04/30/86	4.98E+03
BARIUM	UG/G	6.00E-01	04/24/86	9.80E+01	04/25/86	8.80E+01	04/29/86	8.90E+01	04/30/86	7.00E+01
CADMIUM	UG/G	2.00E-01	04/24/86	5.00E-01	04/25/86	6.00E+00	04/29/86	5.00E+00	04/30/86	4.00E+00
CHROMUM	UG/G	1.00E+00	04/24/86	1.00E+01	04/25/86	8.00E+00	04/29/86	7.00E+00	04/30/86	4.00E+00
SODIUM	UG/G	1.00E+01	04/24/86	7.47E+02	04/25/86	6.22E+02	04/29/86	5.35E+02	04/30/86	3.83E+02
NICKEL	UG/G	1.00E+00	04/24/86	6.00E+00	04/25/86	5.00E+00	04/29/86	5.00E+00	04/30/86	2.00E+00
COPPER	UG/G	1.00E+00	04/24/86	1.50E+01	04/25/86	1.80E+01	04/29/86	1.40E+01	04/30/86	1.20E+01
VANADUM	UG/G	5.00E-01	04/24/86	6.90E+01	04/25/86	7.00E+01	04/29/86	6.00E+01	04/30/86	4.80E+01
ALUMNUM	UG/G	1.50E+01	04/24/86	8.24E+03	04/25/86	6.99E+03	04/29/86	8.47E+03	04/30/86	4.65E+03
MANGESE	UG/G	5.00E-01	04/24/86	3.02E+02	04/25/86	3.10E+02	04/29/86	3.12E+02	04/30/86	2.44E+02
POTASUM	UG/G	1.00E+01	04/24/86	1.02E+03	04/25/86	8.92E+02	04/29/86	9.48E+02	04/30/86	5.62E+02
IRON	UG/G	5.00E+00	04/24/86	2.54E+04	04/25/86	2.49E+04	04/29/86	2.27E+04	04/30/86	1.95E+04
ARSENIC	UG/G	5.00E-01	04/24/86	2.80E+00						
LEADGF	UG/G	5.00E-01	04/24/86	3.09E+00	04/25/86	3.38E+00	04/29/86	3.58E+00	04/30/86	2.51E+00
TOX	UG/G	1.00E+00	04/24/86	4.95E+00						
TOC	UG/G	1.00E+01	04/24/86	2.50E+01	04/25/86	2.24E+01	04/29/86	2.33E+01		
SULFATE	UG/G	1.00E+00	04/24/86	9.86E+00						
FLUORID	UG/G	1.00E+00	04/24/86	2.02E+00						
CHLORID	UG/G	1.00E+00	04/24/86	8.43E+00						
AMMONIU	UG/G	5.00E-01	04/24/86	1.50E+00						

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	1A25	SAMPLE DATE	1A30	SAMPLE DATE	1A35	SAMPLE DATE	1A40
BERYLAM	UG/G	5.00E-01	04/30/86	4.00E+00	04/30/86	2.00E+00	04/30/86	4.00E+00	05/01/86	4.00E+00
ZINC	UG/G	5.00E-01	04/30/86	3.20E+01	04/30/86	3.80E+01	04/30/86	3.30E+01	05/01/86	2.90E+01
CALCIUM	UG/G	5.00E+00	04/30/86	5.03E+03	04/30/86	5.79E+03	04/30/86	5.14E+03	05/01/86	3.47E+03
BARIUM	UG/G	6.00E-01	04/30/86	6.90E+01	04/30/86	9.00E+01	04/30/86	8.30E+01	05/01/86	5.70E+01
CADMIUM	UG/G	2.00E-01	04/30/86	4.00E+00	04/30/86	5.00E+00	04/30/86	5.00E+00	05/01/86	4.00E+00
CHROMUM	UG/G	1.00E+00	04/30/86	5.00E+00	04/30/86	6.00E+00	04/30/86	4.00E+00	05/01/86	5.00E+00
SODIUM	UG/G	1.00E+01	04/30/86	6.33E+02	04/30/86	5.90E+02	04/30/86	4.44E+02	05/01/86	1.81E+02
NICKEL	UG/G	1.00E+00	04/30/86	3.00E+00	04/30/86	4.00E+00	04/30/86	3.00E+00	05/01/86	2.00E+00
COPPER	UG/G	1.00E+00	04/30/86	1.20E+01	04/30/86	1.60E+01	04/30/86	1.40E+01	05/01/86	8.00E+00
VANADUM	UG/G	5.00E-01	04/30/86	4.60E+01	04/30/86	5.70E+01	04/30/86	5.40E+01	05/01/86	6.60E+01
ALUMNUM	UG/G	1.50E+01	04/30/86	5.53E+03	04/30/86	5.89E+03	04/30/86	4.86E+03	05/01/86	4.28E+03
MANGESE	UG/G	5.00E-01	04/30/86	2.01E+02	04/30/86	2.49E+02	04/30/86	2.35E+02	05/01/86	1.67E+02
POTASUM	UG/G	1.00E+01	04/30/86	5.83E+02	04/30/86	7.14E+02	04/30/86	4.34E+02	05/01/86	6.12E+02
IRON	UG/G	5.00E+00	04/30/86	8.61E+03	04/30/86	2.31E+04	04/30/86	2.10E+04	05/01/86	1.62E+04
LEADGF	UG/G	5.00E-01	04/30/86	2.11E+00	04/30/86	2.69E+00	04/30/86	2.99E+00	05/01/86	2.87E+00
TOX	UG/G	1.00E+00			04/30/86	5.05E+00	04/30/86	2.50E+00	05/01/86	7.15E+00

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	2A5	SAMPLE DATE	2A10	SAMPLE DATE	2A15	SAMPLE DATE	2A20
COLIFRM	MPN	3.00E+00			05/02/86	1.10E+03				
BERYLAM	UG/G	5.00E-01			05/02/86	5.50E-01	05/05/86	6.00E-01		
ZINC	UG/G	5.00E-01	05/01/86	3.60E+01	05/02/86	4.00E+00	05/05/86	4.90E+01	05/05/86	4.80E+01
CALCIUM	UG/G	5.00E+00	05/01/86	7.55E+03	05/02/86	6.50E+03	05/05/86	7.96E+03	05/05/86	5.87E+03
BARIUM	UG/G	6.00E-01	05/01/86	8.40E+01	05/02/86	8.40E+01	05/05/86	8.50E+01	05/05/86	7.90E+01
CADMIUM	UG/G	2.00E-01	05/01/86	5.00E+00	05/02/86	5.00E+00	05/05/86	6.00E+00	05/05/86	6.00E+00
CHROMUM	UG/G	1.00E+00	05/01/86	8.00E+00	05/02/86	7.00E+00	05/05/86	8.00E+00	05/05/86	5.00E+00
SODIUM	UG/G	1.00E+01	05/01/86	4.79E+02	05/02/86	3.93E+02	05/05/86	4.80E+02	05/05/86	3.95E+02
NICKEL	UG/G	1.00E+00	05/01/86	6.00E+00	05/02/86	5.00E+00	05/05/86	1.10E+01	05/05/86	5.00E+00
COPPER	UG/G	1.00E+00	05/01/86	1.30E+01	05/02/86	1.60E+01	05/05/86	4.10E+01	05/05/86	2.20E+01
VANADUM	UG/G	5.00E-01	05/01/86	5.10E+01	05/02/86	4.80E+01	05/05/86	5.40E+01	05/05/86	5.20E+01
ALUMNUM	UG/G	1.50E+01	05/01/86	6.77E+03	05/02/86	5.66E+03	05/05/86	5.90E+03	05/05/86	4.55E+03
MANGESE	UG/G	5.00E-01	05/01/86	2.79E+02	05/02/86	2.69E+02	05/05/86	2.75E+02	05/05/86	2.47E+02
POTASUM	UG/G	1.00E+01	05/01/86	1.03E+03	05/02/86	9.17E+02	05/05/86	8.38E+02	05/05/86	5.80E+02
IRON	UG/G	5.00E+00	05/01/86	2.02E+04	05/02/86	2.04E+04	05/05/86	2.12E+04	05/05/86	1.99E+04
ARSENIC	UG/G	5.00E-01			05/02/86	2.18E+00				
LEADGF	UG/G	5.00E-01	05/01/86	2.87E+00	05/02/86	2.30E+00	05/05/86	3.00E+00	05/05/86	2.41E+00
TOX	UG/G	1.00E+00	05/01/86	3.15E+00	05/02/86	2.90E+00	05/05/86	3.50E+00		
TOC	UG/G	1.00E+01			05/02/86	1.05E+01	05/05/86	2.17E+01		
NITRATE	UG/G	1.00E+00			05/02/86	1.56E+00				
SULFATE	UG/G	1.00E+00			05/02/86	1.08E+01				
CHLORID	UG/G	1.00E+00			05/02/86	1.12E+00				
AMMONIU	UG/G	5.00E-01			05/02/86	2.42E+00				

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	2A25	SAMPLE DATE	2A30	SAMPLE DATE	2A35	SAMPLE DATE	2A40
BERYLAM	UG/G	5.00E-01	05/05/86	5.70E-01						
ZINC	UG/G	5.00E-01	05/05/86	4.20E+01	05/05/86	4.80E+01	05/06/86	3.80E+01	05/06/86	3.70E+01
CALCIUM	UG/G	5.00E+00	05/05/86	6.15E+03	05/05/86	6.43E+03	05/06/86	8.56E+03	05/06/86	5.95E+03
BARIUM	UG/G	6.00E-01	05/05/86	8.30E+01	05/05/86	9.00E+01	05/06/86	8.10E+01	05/06/86	7.70E+01
CADMIUM	UG/G	2.00E-01	05/05/86	6.00E+00	05/05/86	6.00E+00	05/06/86	6.00E+00	05/06/86	6.00E+00
CHROMUM	UG/G	1.00E+00	05/05/86	6.00E+00	05/05/86	8.00E+00	05/06/86	5.00E+00	05/06/86	4.00E+00
SODIUM	UG/G	1.00E+01	05/05/86	4.04E+02	05/05/86	5.46E+02	05/06/86	3.74E+02	05/06/86	4.56E+02
NICKEL	UG/G	1.00E+00	05/05/86	5.00E+00	05/05/86	5.00E+00	05/06/86	5.00E+00	05/06/86	4.00E+00
COPPER	UG/G	1.00E+00	05/05/86	2.10E+01	05/05/86	3.10E+01	05/06/86	1.80E+01	05/06/86	1.60E+01
VANADUM	UG/G	5.00E-01	05/05/86	5.30E+01	05/05/86	6.80E+01	05/06/86	6.10E+01	05/06/86	6.10E+01
ALUMNUM	UG/G	1.50E+01	05/05/86	4.81E+03	05/05/86	6.12E+03	05/06/86	4.56E+03	05/06/86	5.11E+03
MANGESE	UG/G	5.00E-01	05/05/86	3.04E+02	05/05/86	2.99E+02	05/06/86	3.00E+02	05/06/86	2.74E+02
POTASUM	UG/G	1.00E+01	05/05/86	4.90E+02	05/05/86	6.45E+02	05/06/86	5.05E+02	05/06/86	6.13E+02
IRON	UG/G	5.00E+00	05/05/86	2.37E+04	05/05/86	2.44E+04	05/06/86	2.49E+04	05/06/86	2.24E+04
LEADGF	UG/G	5.00E-01	05/05/86	2.25E+00	05/05/86	3.31E+00	05/06/86	1.55E+00	05/06/86	2.59E+00

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	3A5	SAMPLE DATE	3A10	SAMPLE DATE	3A15	SAMPLE DATE	3A20
ZINC	UG/G	5.00E-01	05/07/86	3.60E+01	05/08/86	3.80E+01	05/08/86	3.60E+01	05/09/86	4.30E+01
CALCIUM	UG/G	5.00E+00	05/07/86	6.46E+03	05/08/86	6.43E+03	05/08/86	5.53E+03	05/09/86	7.45E+03
BARIUM	UG/G	6.00E-01	05/07/86	8.10E+01	05/08/86	8.60E+01	05/08/86	7.20E+01	05/09/86	1.06E+02
CADMIUM	UG/G	2.00E-01	05/07/86	5.00E+00	05/08/86	5.00E+00	05/08/86	6.00E+00	05/09/86	5.00E+00
CHROMUM	UG/G	1.00E+00	05/07/86	7.00E+00	05/08/86	7.00E+00	05/08/86	6.00E+00	05/09/86	6.00E+00
SODIUM	UG/G	1.00E+01	05/07/86	3.09E+02	05/08/86	4.25E+02	05/08/86	4.87E+02	05/09/86	4.96E+02
NICKEL	UG/G	1.00E+00	05/07/86	6.00E+00	05/08/86	6.00E+00	05/08/86	5.00E+00	05/09/86	5.00E+00
COPPER	UG/G	1.00E+00	05/07/86	2.10E+01	05/08/86	1.80E+01	05/08/86	1.50E+01	05/09/86	1.70E+01
VANADUM	UG/G	5.00E-01	05/07/86	4.70E+01	05/08/86	5.00E+01	05/08/86	5.50E+01	05/09/86	6.60E+01
ALUMNUM	UG/G	1.50E+01	05/07/86	6.18E+03	05/08/86	6.18E+03	05/08/86	5.66E+03	05/09/86	6.67E+03
MANGESE	UG/G	5.00E-01	05/07/86	2.48E+02	05/08/86	2.74E+02	05/08/86	2.53E+02	05/09/86	3.13E+02
POTASUM	UG/G	1.00E+01	05/07/86	1.03E+03	05/08/86	9.14E+02	05/08/86	7.54E+02	05/09/86	8.80E+02
IRON	UG/G	5.00E+00	05/07/86	2.03E+04	05/08/86	2.11E+04	05/08/86	2.09E+04	05/09/86	2.48E+04
ARSENIC	UG/G	5.00E-01					05/08/86	4.65E+00		
LEADGF	UG/G	5.00E-01	05/07/86	5.99E+00	05/08/86	5.10E+00	05/08/86	4.23E+00	05/09/86	5.25E+00
TOX	UG/G	1.00E+00	05/07/86	5.65E+00	05/08/86	3.50E+00	05/08/86	2.80E+00	05/09/86	2.25E+00
TOC	UG/G	1.00E+01	05/07/86	4.37E+01	05/08/86	2.30E+01	05/08/86	1.04E+01	05/09/86	1.55E+01
NITRATE	UG/G	1.00E+00					05/08/86	1.05E+00		
SULFATE	UG/G	1.00E+00					05/08/86	2.12E+01		
FLUORID	UG/G	1.00E+00					05/08/86	1.22E+00		
CHLORID	UG/G	1.00E+00					05/08/86	2.04E+00		
AMMONIU	UG/G	5.00E-01					05/08/86	2.08E+00		

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	3A25	SAMPLE DATE	3A30	SAMPLE DATE	3A35	SAMPLE DATE	3A40
ZINC	UG/G	5.00E-01	05/09/86	4.20E+01	05/09/86	4.10E+01	05/09/86	3.90E+01	05/09/86	4.70E+01
CALCIUM	UG/G	5.00E+00	05/09/86	6.39E+03	05/09/86	5.03E+03	05/09/86	5.08E+03	05/09/86	7.21E+03
BARIUM	UG/G	6.00E-01	05/09/86	9.70E+01	05/09/86	8.20E+01	05/09/86	6.90E+01	05/09/86	9.50E+01
CADMIUM	UG/G	2.00E-01	05/09/86	6.00E+00	05/09/86	5.00E+00	05/09/86	6.00E+00	05/09/86	6.00E+00
CHROMUM	UG/G	1.00E+00	05/09/86	6.00E+00	05/09/86	6.00E+00	05/09/86	7.00E+00	05/09/86	7.00E+00
SODIUM	UG/G	1.00E+01	05/09/86	4.32E+02	05/09/86	3.22E+02	05/09/86	2.53E+02	05/09/86	5.52E+02
NICKEL	UG/G	1.00E+00	05/09/86	5.00E+00	05/09/86	4.00E+00	05/09/86	4.00E+00	05/09/86	4.00E+00
COPPER	UG/G	1.00E+00	05/09/86	1.50E+01	05/09/86	2.10E+01	05/09/86	1.80E+01	05/09/86	1.80E+01
VANADUM	UG/G	5.00E-01	05/09/86	6.70E+01	05/09/86	6.50E+01	05/09/86	6.30E+01	05/09/86	8.30E+01
ALUMNUM	UG/G	1.50E+01	05/09/86	5.66E+03	05/09/86	4.23E+03	05/09/86	4.34E+03	05/09/86	6.84E+03
MANGESE	UG/G	5.00E-01	05/09/86	2.98E+02	05/09/86	2.40E+01	05/09/86	2.64E+02	05/09/86	3.14E+02
POTASUM	UG/G	1.00E+01	05/09/86	6.83E+02	05/09/86	5.06E+02	05/09/86	2.70E+02	05/09/86	7.19E+02
IRON	UG/G	5.00E+00	05/09/86	2.71E+04	05/09/86	2.54E+04	05/09/86	2.56E+04	05/09/86	2.74E+04
LEADGF	UG/G	5.00E-01	05/09/86	4.70E+00	05/09/86	4.46E+00	05/09/86	4.37E+00	05/09/86	5.57E+00
TOX	UG/G	1.00E+00	05/09/86	4.40E+00			05/09/86	3.10E+00		
TOC	UG/G	1.00E+01	05/09/86	1.05E+01						

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	4A5	SAMPLE DATE	4A10	SAMPLE DATE	4A15	SAMPLE DATE	4A20
ZINC	UG/G	5.00E-01	05/12/86	3.70E+01	05/13/86	3.50E+01	05/13/86	4.60E+01	05/14/86	4.60E+01
CALCIUM	UG/G	5.00E+00	05/12/86	6.20E+03	05/13/86	5.09E+03	05/13/86	5.32E+03	05/14/86	5.76E+03
BARIUM	UG/G	6.00E-01	05/12/86	9.90E+01	05/13/86	8.00E+01	05/13/86	9.00E+01	05/14/86	9.00E+01
CADMIUM	UG/G	2.00E-01	05/12/86	5.00E+00	05/13/86	5.00E+00	05/13/86	5.00E+00	05/14/86	6.00E+00
CHROMUM	UG/G	1.00E+00	05/12/86	7.00E+00	05/13/86	5.00E+00	05/13/86	9.00E+00	05/14/86	7.00E+00
SODIUM	UG/G	1.00E+01	05/12/86	4.93E+02	05/13/86	3.83E+02	05/13/86	5.13E+02	05/14/86	5.19E+02
NICKEL	UG/G	1.00E+00	05/12/86	6.00E+00	05/13/86	5.00E+00	05/13/86	8.00E+00	05/14/86	7.00E+00
COPPER	UG/G	1.00E+00	05/12/86	1.50E+01	05/13/86	1.40E+01	05/13/86	4.20E+01	05/14/86	3.70E+01
VANADUM	UG/G	5.00E-01	05/12/86	5.30E+01	05/13/86	4.90E+01	05/13/86	5.80E+01	05/14/86	6.20E+01
ALUMNUM	UG/G	1.50E+01	05/12/86	7.13E+03	05/13/86	5.51E+03	05/13/86	5.62E+03	05/14/86	6.13E+03
MANGESE	UG/G	5.00E-01	05/12/86	2.77E+02	05/13/86	2.47E+02	05/13/86	2.75E+02	05/14/86	2.97E+02
POTASUM	UG/G	1.00E+01	05/12/86	8.85E+02	05/13/86	7.32E+02	05/13/86	7.90E+02	05/14/86	7.72E+02
IRON	UG/G	5.00E+00	05/12/86	2.21E+04	05/13/86	2.07E+04	05/13/86	2.33E+04	05/14/86	2.65E+04
MERCURY	UG/G	1.00E-01					05/13/86	1.06E-01	05/14/86	1.10E-01
LEADGF	UG/G	5.00E-01	05/12/86	3.31E+00	05/13/86	3.40E+00	05/13/86	3.80E+00	05/14/86	4.78E+00
TOX	UG/G	1.00E+00	05/12/86	5.90E+00			05/13/86	7.20E+00	05/14/86	4.70E+00
TOC	UG/G	1.00E+01							05/14/86	1.44E+01

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	4A25	SAMPLE DATE	4A30	SAMPLE DATE	4A35	SAMPLE DATE	4A40
COLIFRM	MPN	3.00E+00							05/14/86	7.00E+00
ZINC	UG/G	5.00E-01	05/14/86	3.20E+01	05/14/86	4.30E+01	05/14/86	3.60E+01	05/14/86	4.40E+01
CALCIUM	UG/G	5.00E+00	05/14/86	4.30E+03	05/14/86	5.53E+03	05/14/86	4.84E+03	05/14/86	5.84E+03
BARIUM	UG/G	6.00E-01	05/14/86	6.40E+01	05/14/86	1.04E+02	05/14/86	7.80E+01	05/14/86	9.30E+01
CADMIUM	UG/G	2.00E-01	05/14/86	5.00E+00	05/14/86	6.00E+00	05/14/86	6.00E+00	05/14/86	6.00E+00
CHROMUM	UG/G	1.00E+00	05/14/86	5.00E+00	05/14/86	7.00E+00	05/14/86	8.00E+00	05/14/86	8.00E+00
SODIUM	UG/G	1.00E+01	05/14/86	2.75E+02	05/14/86	6.24E+02	05/14/86	4.04E+02	05/14/86	4.45E+02
NICKEL	UG/G	1.00E+00	05/14/86	5.00E+00	05/14/86	5.00E+00	05/14/86	3.00E+00	05/14/86	4.00E+00
COPPER	UG/G	1.00E+00	05/14/86	1.90E+01	05/14/86	2.10E+01	05/14/86	1.60E+01	05/14/86	1.60E+01
VANADUM	UG/G	5.00E-01	05/14/86	4.80E+01	05/14/86	6.70E+01	05/14/86	6.00E+01	05/14/86	6.80E+01
ALUMNUM	UG/G	1.50E+01	05/14/86	4.02E+03	05/14/86	6.80E+03	05/14/86	4.98E+03	05/14/86	7.73E+03
MANGESE	UG/G	5.00E-01	05/14/86	2.41E+02	05/14/86	3.12E+02	05/14/86	2.69E+02	05/14/86	2.92E+02
POTASUM	UG/G	1.00E+01	05/14/86	4.49E+02	05/14/86	7.64E+02	05/14/86	5.57E+02	05/14/86	8.51E+02
IRON	UG/G	5.00E+00	05/14/86	2.31E+04	05/14/86	2.66E+04	05/14/86	2.64E+04	05/14/86	2.60E+04
ARSENIC	UG/G	5.00E-01	05/14/86	2.10E+00					05/14/86	4.51E+00
LEADGF	UG/G	5.00E-01	05/14/86	2.83E+00	05/14/86	4.04E+00	05/14/86	3.14E+00	05/14/86	4.17E+00
TOX	UG/G	1.00E+00	05/14/86	4.40E+00	05/14/86	4.00E+00	05/14/86	2.60E+00	05/14/86	3.90E+00
SULFATE	UG/G	1.00E+00	05/14/86	9.67E+00					05/14/86	1.67E+01
FLUORID	UG/G	1.00E+00							05/14/86	1.25E+00
CHLORID	UG/G	1.00E+00							05/14/86	1.06E+01
AMMONIU	UG/G	5.00E-01	05/14/86	6.00E+00					05/14/86	1.50E+01
N4DMBSA	UG/G	0.00E+00							05/14/86	2.50E+00

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	5A5	SAMPLE DATE	5A10	SAMPLE DATE	5A15	SAMPLE DATE	5A20
BERYLAM	UG/G	5.00E-01	05/15/86	6.00E-01	05/16/86	6.00E-01	05/19/86	6.00E-01		
ZINC	UG/G	5.00E-01	05/15/86	4.20E+01	05/16/86	4.00E+01	05/19/86	5.00E+01	05/19/86	4.30E+01
CALCIUM	UG/G	5.00E+00	05/15/86	6.83E+03	05/16/86	6.09E+03	05/19/86	7.57E+03	05/19/86	7.23E+03
BARIUM	UG/G	8.00E-01	05/15/86	1.07E+02	05/16/86	7.90E+01	05/19/86	8.00E+01	05/19/86	9.20E+01
CADMIUM	UG/G	2.00E-01	05/15/86	6.00E+00	05/16/86	6.00E+00	05/19/86	8.00E+00	05/19/86	6.00E+00
CHROMUM	UG/G	1.00E+00			05/16/86	7.00E+00	05/19/86	1.00E+01	05/19/86	5.00E+00
SODIUM	UG/G	1.00E+01	05/15/86	5.76E+02	05/16/86	6.12E+02	05/19/86	5.54E+02	05/19/86	5.92E+02
NICKEL	UG/G	1.00E+00	05/15/86	7.00E+00	05/16/86	6.00E+00	05/19/86	7.00E+00	05/19/86	4.00E+00
COPPER	UG/G	1.00E+00	05/15/86	1.60E+01	05/16/86	1.70E+01	05/19/86	1.60E+01	05/19/86	1.70E+01
VANADUM	UG/G	5.00E-01	05/15/86	6.60E+01	05/16/86	6.40E+01	05/19/86	6.30E+01	05/19/86	7.10E+01
ALUMNUM	UG/G	1.50E+01	05/15/86	7.70E+03	05/16/86	6.15E+03	05/19/86	5.56E+03	05/19/86	5.94E+03
MANGESE	UG/G	5.00E-01	05/15/86	3.14E+02	05/16/86	2.92E+02	05/19/86	2.92E+02	05/19/86	3.17E+02
POTASUM	UG/G	1.00E+01	05/15/86	1.00E+03	05/16/86	7.69E+02	05/19/86	6.78E+02	05/19/86	7.04E+02
IRON	UG/G	5.00E+00	05/15/86	2.48E+04	05/16/86	2.48E+04	05/19/86	2.44E+04	05/19/86	2.71E+04
ARSENIC	UG/G	5.00E-01					05/19/86	1.62E+00		
LEADGF	UG/G	5.00E-01	05/15/86	3.46E+00	05/16/86	2.46E+00	05/19/86	2.47E+00	05/19/86	2.47E+00
TOX	UG/G	1.00E+00	05/15/86	4.80E+00	05/16/86	1.90E+00	05/19/86	3.70E+00	05/19/86	6.10E+00
TOC	UG/G	1.00E+01	05/15/86	1.90E+01						
SULFATE	UG/G	1.00E+00					05/19/86	1.42E+01		
FLUORID	UG/G	1.00E+00					05/19/86	1.07E+00		
CHLORID	UG/G	1.00E+00					05/19/86	1.10E+00		

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	5A25	SAMPLE DATE	5A30	SAMPLE DATE	5A35	SAMPLE DATE	5A40
COLIFRM	MPN	3.00E+00					05/20/86	9.00E+00		
BERYLAM	UG/G	5.00E-01	05/19/86	8.00E+00	05/19/86	8.00E+00	05/20/86	5.00E-01	05/20/86	8.00E-01
ZINC	UG/G	5.00E-01	05/19/86	3.60E+01	05/19/86	3.70E+01	05/20/86	3.90E+01	05/20/86	3.00E+01
CALCIUM	UG/G	5.00E+00	05/19/86	5.43E+03	05/19/86	5.28E+03	05/20/86	5.53E+03	05/20/86	3.47E+03
BARIUM	UG/G	6.00E-01	05/19/86	6.80E+01	05/19/86	7.60E+01	05/20/86	9.50E+01	05/20/86	5.80E+01
CADMIUM	UG/G	2.00E-01	05/19/86	6.00E+00	05/19/86	6.00E+00	05/20/86	6.00E+00	05/20/86	4.00E+00
CHROMUM	UG/G	1.00E+00	05/19/86	5.00E+00	05/19/86	5.00E+00	05/20/86	5.00E+00	05/20/86	4.00E+00
SODIUM	UG/G	1.00E+01	05/19/86	3.43E+02	05/19/86	4.04E+02	05/20/86	5.00E+02	05/20/86	2.38E+02
NICKEL	UG/G	1.00E+00	05/19/86	5.00E+00	05/19/86	4.00E+00	05/20/86	4.00E+00	05/20/86	2.00E+00
COPPER	UG/G	1.00E+00	05/19/86	1.50E+01	05/19/86	1.40E+01	05/20/86	1.40E+01	05/20/86	8.00E+00
VANADUM	UG/G	5.00E-01	05/19/86	5.90E+01	05/19/86	6.70E+01	05/20/86	6.20E+01	05/20/86	5.20E+01
ALUMNUM	UG/G	1.50E+01	05/19/86	4.43E+03	05/19/86	4.28E+03	05/20/86	6.01E+03	05/20/86	3.89E+03
MANGESE	UG/G	5.00E-01	05/19/86	2.63E+02	05/19/86	2.68E+02	05/20/86	2.85E+02	05/20/86	1.94E+02
POTASUM	UG/G	1.00E+01	05/19/86	4.68E+02	05/19/86	5.34E+02	05/20/86	5.76E+02	05/20/86	4.98E+02
IRON	UG/G	5.00E+00	05/19/86	2.54E+04	05/19/86	2.39E+04	05/20/86	2.39E+04	05/20/86	1.71E+04
ARSENIC	UG/G	6.00E-01					05/20/86	1.42E+00		
LEADGF	UG/G	5.00E-01	05/19/86	2.60E+00	05/19/86	2.47E+00	05/20/86	2.87E+00	05/20/86	2.92E+00
TOX	UG/G	1.00E+00	05/19/86	2.00E+00	05/19/86	2.40E+00	05/20/86	2.70E+00	05/20/86	5.20E+00
SULFATE	UG/G	1.00E+00					05/20/86	1.60E+01		
FLUORID	UG/G	1.00E+00					05/20/86	1.54E+00		
CHLORID	UG/G	1.00E+00					05/20/86	2.16E+00		

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	6A5	SAMPLE DATE	6A10	SAMPLE DATE	6A15	SAMPLE DATE	6A20
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COLIFRM	MPN	3.00E+00							05/22/86	7.00E+00
ZINC	UG/G	5.00E-01	05/21/86	4.30E+01	05/21/86	4.20E+01	05/22/86	4.30E+01	05/22/86	4.10E+01
CALCIUM	UG/G	5.00E+00	05/21/86	7.33E+03	05/21/86	6.27E+03	05/22/86	6.68E+03	05/22/86	6.90E+03
BARIUM	UG/G	6.00E-01	05/21/86	9.80E+01	05/21/86	8.70E+01	05/22/86	1.18E+02	05/22/86	7.40E+01
CADMIUM	UG/G	2.00E-01	05/21/86	6.00E+00	05/21/86	6.00E+00	05/22/86	9.00E+00	05/22/86	6.00E+00
CHROMUM	UG/G	1.00E+00	05/21/86	8.00E+00	05/21/86	7.00E+00	05/22/86	6.00E+00	05/22/86	8.00E+00
SODIUM	UG/G	1.00E+01	05/21/86	6.73E+02	05/21/86	5.77E+02	05/22/86	5.82E+02	05/22/86	5.72E+02
NICKEL	UG/G	1.00E+00	05/21/86	7.00E+00	05/21/86	6.00E+00	05/22/86	5.00E+00	05/22/86	7.00E+00
COPPER	UG/G	1.00E+00	05/21/86	1.80E+01	05/21/86	1.70E+01	05/22/86	1.90E+01	05/22/86	1.80E+01
VANADUM	UG/G	5.00E-01	05/21/86	6.80E+01	05/21/86	6.50E+01	05/22/86	6.10E+01	05/22/86	6.80E+01
ALUMNUM	UG/G	1.50E+01	05/21/86	7.66E+03	05/21/86	5.94E+03	05/22/86	6.13E+03	05/22/86	5.34E+03
MANGESE	UG/G	5.00E-01	05/21/86	3.08E+02	05/21/86	3.02E+02	05/22/86	2.86E+02	05/22/86	2.74E+02
POTASUM	UG/G	1.00E+01	05/21/86	9.31E+02	05/21/86	7.17E+02	05/22/86	7.23E+02	05/22/86	6.19E+02
IRON	UG/G	5.00E+00	05/21/86	2.59E+04	05/21/86	2.39E+04	05/22/86	2.50E+04	05/22/86	2.53E+04
ARSENIC	UG/G	5.00E-01							05/22/86	7.13E+00
LEADGF	UG/G	5.00E-01	05/21/86	3.52E+00	05/21/86	2.54E+00	05/22/86	2.90E+00	05/22/86	2.27E+00
TOX	UG/G	1.00E+00	05/21/86	3.50E+00	05/21/86	4.00E+00	05/22/86	1.80E+00		
TOC	UG/G	1.00E+01	05/21/86	1.60E+01						
SULFATE	UG/G	1.00E+00							05/22/86	1.23E+01
FLUORID	UG/G	1.00E+00							05/22/86	1.03E+00

SOIL SAMPLE ANALYTICAL RESULTS ABOVE DETECTION LIMIT

CONSTITUENT NAME	UNITS	DETECTION LIMIT	SAMPLE DATE	6A25	SAMPLE DATE	6A30	SAMPLE DATE	6A35	SAMPLE DATE	6A40
ZINC	UG/G	5.00E-01	05/22/86	3.70E+01	05/22/86	4.20E+01	05/23/86	3.40E+01	05/23/86	4.30E+01
CALCIUM	UG/G	5.00E+00	05/22/86	6.32E+03	05/22/86	5.97E+03	05/23/86	4.62E+03	05/23/86	5.82E+03
BARIUM	UG/G	6.00E-01	05/22/86	9.00E+01	05/22/86	1.08E+02	05/23/86	8.10E+01	05/23/86	1.09E+02
CADMIUM	UG/G	2.00E-01	05/22/86	6.00E+00	05/22/86	7.00E+00	05/23/86	6.00E+00	05/23/86	6.00E+00
CHROMUM	UG/G	1.00E+00	05/22/86	6.00E+00	05/22/86	6.00E+00	05/23/86	8.00E+00	05/23/86	8.00E+00
SODIUM	UG/G	1.00E+01	05/22/86	5.42E+02	05/22/86	5.75E+02	05/23/86	3.33E+02	05/23/86	4.91E+02
NICKEL	UG/G	1.00E+00	05/22/86	5.00E+00	05/22/86	5.00E+00	05/23/86	7.00E+00	05/23/86	7.00E+00
COPPER	UG/G	1.00E+00	05/22/86	1.70E+01	05/22/86	1.80E+01	05/23/86	1.40E+01	05/23/86	1.90E+01
VANADUM	UG/G	5.00E-01	05/22/86	6.70E+01	05/22/86	7.20E+01	05/23/86	6.00E+01	05/23/86	6.20E+01
ALUMNUM	UG/G	1.50E+01	05/22/86	5.49E+03	05/22/86	6.69E+03	05/23/86	4.29E+03	05/23/86	7.18E+03
MANGESE	UG/G	5.00E-01	05/22/86	2.74E+02	05/22/86	3.44E+02	05/23/86	2.77E+02	05/23/86	3.46E+02
POTASUM	UG/G	1.00E+01	05/22/86	5.81E+02	05/22/86	6.67E+02	05/23/86	4.56E+02	05/23/86	8.27E+02
IRON	UG/G	5.00E+00	05/22/86	2.41E+04	05/22/86	2.70E+04	05/23/86	2.59E+04	05/23/86	2.44E+04
ARSENIC	UG/G	5.00E-01			05/22/86	2.60E+00				
LEADGF	UG/G	5.00E-01	05/22/86	2.57E+00	05/22/86	2.58E+00	05/23/86	2.11E+00	05/23/86	4.07E+00
TOX	UG/G	1.00E+00	05/22/86	2.20E+00	05/22/86	3.80E+00	05/23/86	2.10E+00	05/23/86	3.40E+00
SULFATE	UG/G	1.00E+00			05/22/86	1.21E+01				
FLUORID	UG/G	1.00E+00			05/22/86	1.31E+00				

US Testing Analytical Results - Radioactivity (pci/g)

	Total Radium	Beta	Lo-Alpha
W1LA	7.03	9140	1260
W2LA			
W3LA	2.09	11800	9710
W4LA			
W5LA		15400	13800
W6LA			
W7LA			
W8LA		7230	2280
W9LA		1050	345
W10LA		6120	1570
W11LA			
W12LA		4570	1220
W13LA			
W14LA			
W15LA			
W16LA			
W17LA			
W1SA		262	52.1
W2SA	6.76	5980	1630
W3SA		4800	4000
W4SA		746	748
W5SA	0.635	411	679
W6SA		117	101
W7SA		1480	332
W8SA		363	133
W9SA		223	54.8
W10SA	0.413	113	41.3
W11SA		488	153
W12SA		187	42.1
W13SA			
W14SA			
W15SA			
W16SA	0.813	361	54.6
W17SA		75.8	16.1
W1DA		1460	250
W2DA		6690	18700
W3DA	0.612	3320	4120
W4DA		828	1150
W5DA		378	195
W6DA		292	263
W7DA	1.64	192	58.6
W8DA		545	196
W9DA		127	18.3
W10DA		503	173
W11DA		198	40
W12DA		323	81
W13DA			
W14DA			
W15DA			
W16DA			
W17DA			

US Testing Analytical Results - Radioactivity (pci/g)

	Total Radium	Beta	Lo-Alpha
E1LA	1.43	13700	5480
E2LA		27600	11300
E3LA	11.4	20000	6210
E4LA			
E5LA			
E6LA			
E7LA		20800	5110
E8LA			
E9LA			
E10LA			
E11LA			
E12LA			
E13LA		747	644
E14LA			
E14LA			
E16LA		4530	1320
E1SA		13700	4690
E2SA	1.89	3050	2560
E3SA		4830	2710
E4SA		907	519
E5SA	0.764	875	456
E6SA		1970	876
E7SA		417	219
E8SA		221	116
E9SA		197	159
E10SA	1.66	121	54.6
E11SA		246	181
E12SA		196	94.4
E13SA		75.3	49.5
E14SA		110	66.3
E15SA		233	181
E16SA	9.47	683	365
E1DA		8500	3940
E2DA		3820	2320
E4DA			
E5DA			
E6DA			
E7DA	1.72	1070	488
E8DA		516	309
E9DA		427	179
E10DA		293	242
E11DA		128	74.6
E12DA		151	82.4
E13DA		106	44.5
E14DA	0.977	141	78.6
E15DA		105	102
E16DA			

US Testing Analytical Results - Radioactivity (pci/g)

	Total Radium	Beta	Lo-Alpha
1A5	0.325	13.2	3.47
1A10		14.1	1.87
1A15		13.7	10.2
1A20		15.4	7.48
1A25		17.2	3.03
1A30		15.3	
1A35		13.8	3.47
1A40		23.2	6.31
2A5		16.2	4.88
2A10	0.360	17.0	
2A15		20.2	9.24
2A20		14.7	6.38
2A25		14.0	1.86
2A30		14.9	10.5
2A35		14.3	6.02
2A40		15.6	1.61
3A5		18.1	8.71
3A10		15.6	7.28
3A15	0.446	14.1	4.61
3A20		15.1	4.38
3A25		16.0	9.06
3A30		14.3	4.20
3A35		14.8	3.39
3A40		17.2	6.56
4A5		15.8	0.0898
4A10		15.5	6.27
4A15		16.7	8.09
4A20		16.5	7.81
4A25	0.339	13.6	
4A30		15.2	5.78
4A35		13.7	2.88
4A40	0.562	18.7	5.30
5A5	0.487	17.1	4.60
5A10		15.2	5.15
5A15	0.868	14.4	4.11
5A20		10.7	5.86
5A25		11.8	
5A30		10.7	2.11
5A35	1.41	15.5	2.87
5A40		24.5	2.98
6A5		13.0	1.77
6A10		14.6	6.39
6A15		13.6	0.955
6A20	1.10	10.9	2.87
6A25		16.5	0.841
6A30	1.23	13.0	
6A35		14.6	2.51
6A40		18.8	9.03

US Testing Analytical Results - Radioactivity (pCi/~~D~~)

	Total Radium	Beta	Lo-Alpha
R-1	0.687	2.92	<0.304
R-2	<0.0108	1.29	<0.788

US Testing Analytical Results - Radioactivity (pCi/l)

	Total Radium	Beta	Lo-Alpha
R-1	0.687	2.92	<0.304
R-2	<0.0108	1.29	<0.788

Analytical Results - EP Toxicity (ppm)

	W5LA	W10SA	W10DA	E1DA	E6SA	E2LA
Arsenic	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Barium	12	6.6	7.20	10.30	11.6	6.90
Cadium	<0.01	<0.01	< .10	0.03	< .10	< .10
Chromium	0.02	<0.01	0.01	<0.01	0.06	0.02
Lead	0.46	<0.20	0.23	<0.20	<0.20	0.24
Mercury	0.10	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Silver	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

HAZARDOUS SUBSTANCE ANALYSIS REPORT

Results reported on 860613

SAMPLE TYPE	CUST#	ISOTOPE		RESULT	DIL #	C C	OVERALL ERROR	ANALYSIS SIZE	SAMPLE DATE	SAMPLE TIME	ANALYSIS DATE	H C	GROUP	UST#
WATER	P-1	D-BHC	A39	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860530	I	103	020018
WATER	P-1	LEAD	A51	* 5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860519	I	103	020018
WATER	P-1	12-DBEN	B61	● 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	13-DBEN	B62	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	14-DBEN	B63	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	HEXCBEN	B89	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	PENTCHB	C26	● 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	TETRCHB	C37	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	TRICHLB	C43	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	HEXACHL	C54	● 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	NAPHTHA	C55	● 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	123TRI	C56	● 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	PHENOL	C57	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	135TRI	C58	● 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	1234TE	C59	● 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	1235TE	C60	● 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	TOX	C68	2.60E+02 PPB			0.00E+00(S)	1.00E+00 G	860507	1400	860522	I	103	020018
WATER	P-1	TOC	C69	2.92E+03 PPB			0.00E+00(S)	2.50E+02 ML	860507	1400	860606	I	103	020018
WATER	P-1	TOC	C69	2.89E+03 PPB			0.00E+00(S)	2.50E+02 ML	860507	1400	860606	I	103	020018
** Duplicates														
WATER	P-1	NITRATE	C72	2.43E+04 PPB	1		0.00E+00(1S)	5.00E-02 ML	860507	1400	860602	I	103	020018
WATER	P-1	SULFATE	C73	1.77E+04 PPB			0.00E+00(S)	5.00E-02 ML	860507	1400	860602	I	103	020018
WATER	P-1	FLOURID	C74	9.07E+02 PPB			0.00E+00(S)	5.00E-02 ML	860507	1400	860602	I	103	020018
WATER	P-1	CHLORID	C75	3.76E+03 PPB			0.00E+00(S)	5.00E-02 ML	860507	1400	860602	I	103	020018
WATER	P-1	PHOSPHA	C76	* 1.00E+03 PPB			0.00E+00(S)	5.00E-02 ML	860507	1400	860602	I	103	020018
WATER	P-1	SULFIDE	C78	* 1.00E+03 PPB			0.00E+00(S)	2.00E+02 ML	860507	1400	860603	I	103	020018
WATER	P-1	KEROSEN	C79	* 1.00E+04 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	AMMONIU	C80	1.86E+02 PPB			0.00E+00(S)	1.00E+01 G	860507	1400	860602	I	103	020018
WATER	P-1	ETHYGLY	C81	● 1.00E+04 PPB			0.00E+00(S)	2.00E-03 ML	860507	1400	860516	I	103	020018
WATER	P-1	DIOXIN	C86	* 1.00E-01 PPB			0.00E+00(S)	0.00E+00 ML	860507	1400	860514	I	103	020018
WATER	P-1	2,4-D	H13	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860527	I	103	020018
WATER	P-1	2,4,5TP	H14	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860527	I	103	020018
WATER	P-1	2FLPHEN	X01	7.46E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	2FLPHEN	X01	8.16E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860520	I	103	020018
** Duplicates														
WATER	P-1	PHEND6	X02	6.53E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	PHEND6	X02	8.46E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860520	I	103	020018
** Duplicates														
WATER	P-1	NITBN2	X03	7.68E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	NITBN2	X03	9.24E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860520	I	103	020018
** Duplicates														
WATER	P-1	2FLBIPH	X04	7.96E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018
WATER	P-1	2FLBIPH	X04	8.90E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860520	I	103	020018
** Duplicates														
WATER	P-1	246TRI	X05	7.58E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103	020018

● Denotes a result less than the detection limit

UNITED STATES TESTING COMPANY INC.
2800 GEORGE WASHINGTON WAY, RICHLAND, WA
HAZARDOUS SUBSTANCE ANALYSIS REPORT
Results reported on 860613

SAMPLE TYPE	CUST#	ISOTOPE		RESULT	DIL #	C C	OVERALL ERROR	ANALYSIS SIZE	SAMPLE DATE	SAMPLE TIME	ANALYSIS DATE	H C	GROUP UST#
WATER	P-1	246TRI	X05	7.89E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860520	I	103 020018
** Duplicates													
WATER	P-1	TERD14	X06	6.96E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860519	I	103 020018
WATER	P-1	TERD14	X06	8.68E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860520	I	103 020018
** Duplicates													
WATER	P-1	DBC	X10	6.90E-01			0.00E+00(S)	1.00E+03 ML	860507	1400	860530	I	103 020018
WATER	P-1	CHLOR37	X11	1.10E+00			0.00E+00(S)	0.00E+00 ML	860507	1400	860514	I	103 020018
WATER	P-1	TETRANE	A61	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	BENZENE	A62	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	DIOXANE	A63	* 5.00E+02 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	METHONE	A64	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	PYRIDIN	A65	* 5.00E+02 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	TOLUENE	A66	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	1,1,1-T	A67	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	1,1,2-T	A68	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	TRICENE	A69	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	PERCENE	A70	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	OPXYLEN	A71	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	CHLFORM	A80	1.20E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	M-XYLE	B14	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	CYANIDE	C70	* 1.00E+01 PPB			0.00E+00(S)	5.00E+02 ML	860507	1400	860510	I	103 020018
WATER	P-1	FORMALN	C71	* 5.00E+02 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	ACETONE	I01	4.60E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	12DCAD4	X07	9.80E-01			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	TOLUD8	X08	1.00E+00			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	BFB	X09	9.40E-01			0.00E+00(S)	5.00E+00 ML	860507	1400	860512	I	103 020018
WATER	P-1	COLIFORM	109	2.30E+01 MPN			0.00E+00(S)	3.33E+01 ML	860507	1400	860507	I	103 020018
WATER	P-1	BARIUM	A06	4.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	CADMIUM	A07	* 2.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	CHROMUM	A08	* 1.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	SILVER	A10	* 1.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	SODIUM	A11	6.42E+03 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	NICKEL	A12	2.50E+01 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	COPPER	A13	5.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	VANADUM	A14	* 5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	ANTIONY	A15	* 1.00E+02 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	ALUMNUM	A16	4.18E+02 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	MANGESE	A17	1.80E+01 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	POTASUM	A18	1.45E+03 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	IRON	A19	7.54E+02 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860604	I	103 020018
WATER	P-1	ARSENIC	A20	* 5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860514	I	103 020018
WATER	P-1	MERCURY	A21	* 1.00E-01 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860609	I	103 020018
WATER	P-1	SELENUM	A22	* 5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860507	1400	860516	I	103 020018
WATER	P-1	THIOURA	A24	* 2.00E+02 PPB			0.00E+00(S)	2.00E-02 ML	860507	1400	860520	I	103 020018
WATER	P-1	ENDRIN	A33	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860530	I	103 020018
WATER	P-1	METHLOR	A34	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860530	I	103 020018
WATER	P-1	TOXAENE	A35	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860530	I	103 020018
WATER	P-1	A-BHC	A36	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860530	I	103 020018
WATER	P-1	B-BHC	A37	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860530	I	103 020018
WATER	P-1	G-BHC	A38	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1400	860530	I	103 020018

* Denotes a result less than the detection limit

2400 GEORGE WASHINGTON WAY, RICHLAND, WA

HAZARDOUS SUBSTANCE ANALYSIS REPORT

Results reported on 860731

SAMPLE TYPE	CUST#	ISOTOPE		RESULT	DIL #	C C	OVERALL ERROR	ANALYSIS SIZE	SAMPLE DATE	SAMPLE TIME	ANALYSIS DATE	H C	GROUP	UST#
WATER	P-2	12-DBEN	B61	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	13-DBEN	B62	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	14-DBEN	B63	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	HEXCBEN	B89	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	PENTCHB	C26	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	TETRCHB	C37	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	TRICHLB	C43	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	HEXACHL	C54	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	NAPHTHA	C55	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	123TRI	C56	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	PHENOL	C57	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	135TRI	C58	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	1234TE	C59	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	1235TE	C60	* 4.00E+01 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	KEROSEN	C79	* 4.00E+04 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	2FLPHEN	X01	6.77E-01			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	PHEND6	X02	5.80E-01			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	NITBN2	X03	8.60E-01			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	2FLBIPH	X04	7.34E-01			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	246TRI	X05	8.18E-01			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	TERD14	X06	7.60E-01			0.00E+00(S)	2.80E+02 ML	860522	1315	860714	I	103	020050
WATER	P-2	LEAD	A51	* 5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860702	I	103	020050
WATER	P-2	BARIUM	A06	3.40E+01 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	CADMIUM	A07	* 2.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	CHROMUM	A08	* 1.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	SILVER	A10	* 1.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	SODIUM	A11	5.31E+03 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	NICKEL	A12	* 1.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	COPPER	A13	3.70E+01 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	VANADUM	A14	* 5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	ANTIONY	A15	* 1.00E+02 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	ALUMNUM	A16	3.03E+02 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	MANGESE	A17	6.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	POTASUM	A18	9.86E+02 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	IRON	A19	1.73E+02 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860621	I	103	020050
WATER	P-2	MERCURY	A21	* 1.00E-01 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860623	I	103	020050
WATER	P-2	ENDRIN	A33	* 1.00E+00 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860623	I	103	020050
WATER	P-2	METHLOR	A34	* 1.00E+00 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860623	I	103	020050
WATER	P-2	TOXAENE	A35	* 1.00E+00 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860623	I	103	020050
WATER	P-2	A-BHC	A36	* 1.00E+00 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860623	I	103	020050
WATER	P-2	B-BHC	A37	* 1.00E+00 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860623	I	103	020050
WATER	P-2	G-BHC	A38	* 1.00E+00 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860623	I	103	020050
WATER	P-2	D-BHC	A39	* 1.00E+00 PPB			0.00E+00(S)	2.80E+02 ML	860522	1315	860623	I	103	020050
WATER	P-2	AMMONIU	C80	2.53E+02 PPB			0.00E+00(S)	1.00E+02 ML	860522	1315	860624	I	103	020050
WATER	P-2	ETHYGLY	C81	* 1.00E+04 PPB			0.00E+00(S)	2.00E-02 ML	860522	1315	860623	I	103	020050
WATER	P-2	DBC	X10	1.07E+00			0.00E+00(S)	2.80E+02 ML	860522	1315	860623	I	103	020050

*** Denotes a result less than the detection limit**

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24-Jun-06 08:46 AM                       UNITED STATES TESTING COMPANY INC.
                                    2800 GEORGE WASHINGTON WAY, RICHLAND, WA
                                       HAZARDOUS SUBSTANCE ANALYSIS REPORT
                                          Results reported on 860613

                                                  DIL   C     OVERALL     ANALYSIS          SAMPLE      ANALYSIS    H
SAMPLE TYPE    CUST#  ISOTOPE           RESULT     #    C      ERROR        SIZE          DATE  TIME       DATE     C GROUP UST#

WATER          P-2    ARSENIC  A20 * 5.00E+00 PPB           0.00E+00( S) 1.00E+02 ML     860522 1315      860603    I 103 020050
WATER          P-2    SELENUM  A22 ● 5.00E+00 PPB           0.00E+00( S) 1.00E+02 ML     860522 1315      860603    I 103 020050
WATER          P-2    TETRANE  A61 ● 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    BENZENE  A62 * 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    DIOXANE  A63 * 5.00E+02 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    METHONE  A64 ● 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    PYRIDIN  A65 * 5.00E+02 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    TOLUENE  A66 * 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    1,1,1-T  A67 * 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    1,1,2-T  A68 * 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    TRICENE  A69 * 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    PERCENE  A70 * 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    OPXYLEN  A71 * 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    CHLFORM  A80   1.50E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    M-XYLE   B14 * 1.00E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    TOX      C68   2.53E+02 PPB           0.00E+00( S) 1.00E+00 G      860522 1315      860610    I 103 020050
WATER          P-2    FORMALN  C71 ● 5.00E+02 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    NITRATE  C72   5.81E+04 PPB  1        0.00E+00(1S) 5.00E-02 ML     860522 1315      860602    I 103 020050
WATER          P-2    SULFATE  C73   1.75E+04 PPB           0.00E+00( S) 5.00E-02 ML     860522 1315      860602    I 103 020050
WATER          P-2    FLOURID  C74   9.02E+02 PPB           0.00E+00( S) 5.00E-02 ML     860522 1315      860602    I 103 020050
WATER          P-2    CHLORID  C75   2.96E+03 PPB           0.00E+00( S) 5.00E-02 ML     860522 1315      860602    I 103 020050
WATER          P-2    PHOSPHA  C76 * 1.00E+03 PPB           0.00E+00( S) 5.00E-02 ML     860522 1315      860602    I 103 020050
WATER          P-2    SULFIDE  C78 * 1.00E+03 PPB           0.00E+00( S) 2.00E+02 ML     860522 1315      860603    I 103 020050
WATER          P-2    ACETONE  I01   6.90E+01 PPB           0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    12DCAD4  X07   9.90E-01               0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    TOLUDB   X08   9.80E-01               0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    BFB      X09   9.50E-01               0.00E+00( S) 5.00E+00 ML     860522 1315      860602    I 103 020050
WATER          P-2    COLIFORM 109   4.00E+00 MPN           0.00E+00( S) 3.33E+01 ML     860522 1315      860522    I 103 020050
WATER          P-2    THIOURA  A24 ● 2.00E+02 PPB           0.00E+00( S) 2.00E-02 ML     860522 1315      860606    I 103 020050
WATER          P-2    TOC      C69   3.03E+03 PPB           0.00E+00( S) 2.50E+02 ML     860522 1315      860611    I 103 020050
WATER          P-2    TOC      C69   3.10E+03 PPB           0.00E+00( S) 2.50E+02 ML     860522 1315      860611    I 103 020050
** Duplicates
WATER          P-2    CYANIDE  C70 * 1.00E+01 PPB           0.00E+00( S) 5.00E+02 ML     860522 1315      860610    I 103 020050
WATER          P-2    DIOXIN   C86 * 1.00E-01 PPB           0.00E+00( S) 0.00E+00 ML     860522 1315      860606    I 103 020050
WATER          P-2    2,4-D    H13 * 1.00E+00 PPB           0.00E+00( S) 1.00E+03 ML     860522 1315      860613    I 103 020050
WATER          P-2    2,4,5TP  H14 * 1.00E+00 PPB           0.00E+00( S) 1.00E+03 ML     860522 1315      860613    I 103 020050
WATER          P-2    CHLOR37  X11   1.14E+00               0.00E+00( S) 0.00E+00 ML     860522 1315      860606    I 103 020050




● Denotes a result less than the detection limit
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                                                              Results reported on 860613

                                                         DIL   C      OVERALL       ANALYSIS             SAMPLE         ANALYSIS    H
SAMPLE TYPE      CUST#  ISOTOPE          RESULT           #    C       ERROR          SIZE            DATE   TIME        DATE      C GROUP UST#

WATER            R-1    COLIFORM 109    1.10E+01 MPN                0.00E+00( S) 3.33E+01 ML        860507 1100        860507     I 103 020017
WATER            R-1    BARIUM   A06    3.50E+01 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    CADMIUM  A07 ● 2.00E+00 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    CHROMUM  A08 ● 1.00E+01 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    SILVER   A10 * 1.00E+01 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    SODIUM   A11    2.55E+03 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    NICKEL   A12 * 1.00E+01 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    COPPER   A13 * 1.00E+01 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    VANADUM  A14 * 5.00E+00 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    ANTIONY  A15 * 1.00E+02 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    ALUMNUM  A16 ● 1.50E+02 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    MANGESE  A17    1.00E+01 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    POTASUM  A18    8.86E+02 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    IRON     A19    3.63E+02 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860604     I 103 020017
WATER            R-1    ARSENIC  A20 * 5.00E+00 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860514     I 103 020017
WATER            R-1    MERCURY  A21 ● 1.00E-01 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860609     I 103 020017
WATER            R-1    SELENUM  A22 * 5.00E+00 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860516     I 103 020017
WATER            R-1    THIOURA  A24 ● 2.00E+02 PPB                0.00E+00( S) 2.00E-02 ML        860507 1100        860520     I 103 020017
WATER            R-1    ENDRIN   A33 ● 1.00E+00 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860530     I 103 020017
WATER            R-1    METHLOR  A34 * 1.00E+00 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860530     I 103 020017
WATER            R-1    TOXAENE  A35 ● 1.00E+00 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860530     I 103 020017
WATER            R-1    A-BHC    A36 * 1.00E+00 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860530     I 103 020017
WATER            R-1    B-BHC    A37 * 1.00E+00 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860530     I 103 020017
WATER            R-1    G-BHC    A38 ● 1.00E+00 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860530     I 103 020017
WATER            R-1    D-BHC    A39 ● 1.00E+00 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860530     I 103 020017
WATER            R-1    LEAD     A51 * 5.00E+00 PPB                0.00E+00( S) 1.00E+02 ML        860507 1100        860519     I 103 020017
WATER            R-1    12-DBEN  B61 ● 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    13-DBEN  B62 * 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    14-DBEN  B63 ● 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    HEXCBEN  B89 ● 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    PENTCHB  C26 * 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    TETRCHB  C37 * 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    TRICHLB  C43 * 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    HEXACHL  C54 * 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    NAPHTHA  C55 * 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    123TRI   C56 ● 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    PHENOL   C57 ● 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    135TRI   C58 ● 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    1234TE   C59 ● 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    1235TE   C60 * 1.00E+01 PPB                0.00E+00( S) 1.00E+03 ML        860507 1100        860519     I 103 020017
WATER            R-1    TOX      C68    6.85E+02 PPB                0.00E+00( S) 1.00E+00 G         860507 1100        860522     I 103 020017
WATER            R-1    TOC      C69    1.98E+03 PPB                0.00E+00( S) 2.50E+02 ML        860507 1100        860606     I 103 020017
WATER            R-1    TOC      C69    2.06E+03 PPB                0.00E+00( S) 2.50E+02 ML        860507 1100        860606     I 103 020017
** Duplicates
WATER            R-1    NITRATE  C72 * 5.00E+02 PPB                0.00E+00( S) 5.00E-02 ML        860507 1100        860602     I 103 020017


● Denotes a result less than the detection limit
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2800 GEORGE WASHINGTON WAY, RICHLAND, WA
HAZARDOUS SUBSTANCE ANALYSIS REPORT
Results reported on 860619

SAMPLE TYPE	CUST#	ISOTOPE		RESULT	DIL #	C C	OVERALL ERROR	ANALYSIS SIZE	SAMPLE DATE	SAMPLE TIME	ANALYSIS DATE	H C	GROUP	UST#
WATER	R-1	TETRANE	A61	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	BENZENE	A62	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	DIOXANE	A63	* 5.00E+02 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	METHONE	A64	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	PYRIDIN	A65	* 5.00E+02 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	TOLUENE	A66	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	1,1,1-T	A67	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	1,1,2-T	A68	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	TRICENE	A69	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	PERCENE	A70	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	OPXYLEN	A71	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	M-XYLE	B14	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	CYANIDE	C70	* 1.00E+01 PPB			0.00E+00(S)	5.00E+02 ML	860507	1100	860510	I	103	020017
WATER	R-1	FORMALN	C71	* 5.00E+02 PPB			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	12DCAD4	X07	9.20E-01			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	TOLUD8	X08	9.80E-01			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	BFB	X09	9.10E-01			0.00E+00(S)	5.00E+00 ML	860507	1100	860512	I	103	020017
WATER	R-1	SULFATE	C73	1.13E+04 PPB			0.00E+00(S)	5.00E-02 ML	860507	1100	860602	I	103	020017
WATER	R-1	FLOURID	C74	* 5.00E+02 PPB			0.00E+00(S)	5.00E-02 ML	860507	1100	860602	I	103	020017
WATER	R-1	CHLORID	C75	9.54E+02 PPB			0.00E+00(S)	5.00E-02 ML	860507	1100	860602	I	103	020017
WATER	R-1	PHOSPHA	C76	* 1.00E+03 PPB			0.00E+00(S)	5.00E-02 ML	860507	1100	860602	I	103	020017
WATER	R-1	SULFIDE	C78	* 1.00E+03 PPB			0.00E+00(S)	2.00E+02 ML	860507	1100	860603	I	103	020017
WATER	R-1	KEROSEN	C79	* 1.00E+04 PPB			0.00E+00(S)	1.00E+03 ML	860507	1100	860519	I	103	020017
WATER	R-1	AMMONIU	C80	* 5.00E+01 PPB			0.00E+00(S)	1.00E+01 G	860507	1100	860602	I	103	020017
WATER	R-1	ETHYGLY	C81	* 1.00E+04 PPB			0.00E+00(S)	2.00E-03 ML	860507	1100	860516	I	103	020017
WATER	R-1	DIOXIN	C86	* 1.00E-01 PPB			0.00E+00(S)	0.00E+00 ML	860507	1100	860514	I	103	020017
WATER	R-1	2,4-D	H13	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1100	860527	I	103	020017
WATER	R-1	2,4,5TP	H14	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860507	1100	860527	I	103	020017
WATER	R-1	2FLPHEN	X01	7.01E-01			0.00E+00(S)	1.00E+03 ML	860507	1100	860519	I	103	020017
WATER	R-1	PHEND6	X02	5.63E-01			0.00E+00(S)	1.00E+03 ML	860507	1100	860519	I	103	020017
WATER	R-1	NITBN2	X03	5.56E-01			0.00E+00(S)	1.00E+03 ML	860507	1100	860519	I	103	020017
WATER	R-1	2FLBIPH	X04	5.90E-01			0.00E+00(S)	1.00E+03 ML	860507	1100	860519	I	103	020017
WATER	R-1	246TRI	X05	6.70E-01			0.00E+00(S)	1.00E+03 ML	860507	1100	860519	I	103	020017
WATER	R-1	TERD14	X06	8.92E-01			0.00E+00(S)	1.00E+03 ML	860507	1100	860519	I	103	020017
WATER	R-1	DBC	X10	6.70E-01			0.00E+00(S)	1.00E+03 ML	860507	1100	860530	I	103	020017
WATER	R-1	CHLOR37	X11	1.07E+00			0.00E+00(S)	0.00E+00 ML	860507	1100	860514	I	103	020017
WATER	R-1	CHLOR37	X11	1.07E+00			0.00E+00(S)	0.00E+00 ML	860507	1100	860514	I	103	020017

** Duplicates

* Denotes a result less than the detection limit

Results reported on 860714

SAMPLE TYPE	CUST#	ISOTOPE		RESULT	DIL #	C C	OVERALL ERROR	ANALYSIS SIZE	SAMPLE DATE	SAMPLE TIME	ANALYSIS DATE	H C	GROUP USR#
WATER	R-2	LEAD	A51	* 5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860702	I	103 020036
WATER	R-2	COLIFORM	109	4.00E+00 MPN			0.00E+00(S)	3.33E+01 ML	860516	1100	860516	I	103 020036
WATER	R-2	ARSENIC	A20	* 5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860603	I	103 020036
WATER	R-2	SELENUM	A22	* 5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860603	I	103 020036
WATER	R-2	THIOURA	A24	* 2.00E+02 PPB			0.00E+00(S)	2.00E-02 ML	860516	1100	860520	I	103 020036
WATER	R-2	ENDRIN	A33	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860530	I	103 020036
WATER	R-2	METHLOR	A34	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860530	I	103 020036
WATER	R-2	TOXAENE	A35	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860530	I	103 020036
WATER	R-2	A-BHC	A36	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860530	I	103 020036
WATER	R-2	B-BHC	A37	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860530	I	103 020036
WATER	R-2	G-BHC	A38	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860530	I	103 020036
WATER	R-2	D-BHC	A39	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860530	I	103 020036
WATER	R-2	TETRANE	A61	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	BENZENE	A62	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	DIOXANE	A63	* 5.00E+02 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	METHONE	A64	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	PYRIDIN	A65	* 5.00E+02 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	TOLUENE	A66	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	1,1,1-T	A67	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	1,1,2-T	A68	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	TRICENE	A69	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	PERCENE	A70	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	OPXYLEN	A71	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	M-XYLE	B14	* 1.00E+01 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	TOX	C68	5.31E+02 PPB			0.00E+00(S)	1.00E+00 G	860516	1100	860610	I	103 020036
WATER	R-2	FORMALN	C71	* 5.00E+02 PPB			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	NITRATE	C72	* 5.00E+02 PPB			0.00E+00(S)	5.00E-02 ML	860516	1100	860602	I	103 020036
WATER	R-2	SULFATE	C73	1.11E+04 PPB			0.00E+00(S)	5.00E-02 ML	860516	1100	860602	I	103 020036
WATER	R-2	FLOURID	C74	* 5.00E+02 PPB			0.00E+00(S)	5.00E-02 ML	860516	1100	860602	I	103 020036
WATER	R-2	CHLORID	C75	6.63E+02 PPB			0.00E+00(S)	5.00E-02 ML	860516	1100	860602	I	103 020036
WATER	R-2	PHOSPHA	C76	* 1.00E+03 PPB			0.00E+00(S)	5.00E-02 ML	860516	1100	860602	I	103 020036
WATER	R-2	SULFIDE	C78	* 1.00E+03 PPB			0.00E+00(S)	2.00E+02 ML	860516	1100	860603	I	103 020036
WATER	R-2	2,4-D	H13	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860527	I	103 020036
WATER	R-2	2,4,5TP	H14	* 1.00E+00 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860527	I	103 020036
WATER	R-2	12DCAD4	X07	9.70E-01			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	TOLUD8	X08	1.00E+00			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	BFB	X09	9.10E-01			0.00E+00(S)	5.00E+00 ML	860516	1100	860520	I	103 020036
WATER	R-2	DBC	X10	6.80E-01			0.00E+00(S)	1.00E+03 ML	860516	1100	860530	I	103 020036
WATER	R-2	12-DBEN	B61	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103 020036
WATER	R-2	13-DBEN	B62	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103 020036
WATER	R-2	14-DBEN	B63	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103 020036
WATER	R-2	HEXCBEN	B89	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103 020036
WATER	R-2	PENTCHB	C26	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103 020036
WATER	R-2	TETRCHB	C37	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103 020036
WATER	R-2	TRICHLB	C43	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103 020036
WATER	R-2	HEXACHL	C54	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103 020036
WATER	R-2	NAPHTHA	C55	* 1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103 020036

* Denotes a result less than the detection limit

UNITED STATES TESTING COMPANY INC.
2800 GEORGE WASHINGTON WAY, RICHLAND, WA
HAZARDOUS SUBSTANCE ANALYSIS REPORT
Results reported on 860619

SAMPLE TYPE	CUST#	ISOTOPE			RESULT	DIL #	C C	OVERALL ERROR	ANALYSIS SIZE	SAMPLE DATE	SAMPLE TIME	ANALYSIS DATE	H C	GROUP	UST#
WATER	R-2	123TRI	C56	*	1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	PHENOL	C57	*	1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	135TRI	C58	*	1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	1234TE	C59	*	1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	1235TE	C60	*	1.00E+01 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	TOC	C69		2.40E+03 PPB			0.00E+00(S)	2.50E+02 ML	860516	1100	860611	I	103	020036
WATER	R-2	TOC	C69		2.35E+03 PPB			0.00E+00(S)	2.50E+02 ML	860516	1100	860611	I	103	020036
** Duplicates															
WATER	R-2	CYANIDE	C70	*	1.00E+01 PPB			0.00E+00(S)	5.00E+02 ML	860516	1100	860610	I	103	020036
WATER	R-2	KEROSEN	C79	*	1.00E+04 PPB			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	DIOXIN	C86	*	1.00E-01 PPB			0.00E+00(S)	0.00E+00 ML	860516	1100	860605	I	103	020036
WATER	R-2	2FLPHEN	X01		8.61E-01			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	PHEND6	X02		7.55E-01			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	NITBN2	X03		7.36E-01			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	2FLBIPH	X04		7.88E-01			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	246TRI	X05		7.79E-01			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	TERD14	X06		9.42E-01			0.00E+00(S)	1.00E+03 ML	860516	1100	860612	I	103	020036
WATER	R-2	CHLOR37	X11		1.03E+00			0.00E+00(S)	0.00E+00 ML	860516	1100	860605	I	103	020036
WATER	R-2	BARIUM	A06		3.50E+01 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	CADMIUM	A07	*	2.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	CHROMUM	A08	*	1.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	SILVER	A10	*	1.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	SODIUM	A11		2.85E+03 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	NICKEL	A12	*	1.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	COPPER	A13	*	1.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	VANADUM	A14	*	5.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	ANTIONY	A15	*	1.00E+02 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	ALUMNUM	A16	*	1.50E+02 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	MANGESE	A17		9.00E+00 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	POTASUM	A18		8.53E+02 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	IRON	A19		1.23E+02 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860621	I	103	020036
WATER	R-2	MERCURY	A21	*	1.00E-01 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860623	I	103	020036
WATER	R-2	AMMONIU	C80	*	5.00E+01 PPB			0.00E+00(S)	1.00E+02 ML	860516	1100	860624	I	103	020036
WATER	R-2	ETHYGLY	C81	*	1.00E+04 PPB			0.00E+00(S)	2.00E-02 ML	860516	1100	860623	I	103	020036

*** Denotes a result less than the detection limit**

Distribution:

DOE/RL	EA Bracken	DOE/FED/628A/700A
	DM Collado	DOE/FED/666/700A
	RE Gerton	DOE/FED/618/700A
	JM Hennig	DOE/FED/690/700A
	RA Holten	DOE/FED/577/700A
	JR Hunter	DOE/FED/668/700A
	EC Norman	DOE/FED/667/700A
	OL Olson	DOE/FED/581/700A
	MW Shupe	DOE/FED/608/700A
	RK Stewart	DOE/FED/629/700A
PNL	WJ Bjorkland	PNL/3762/112/300
	MS Hanson	PNL/RO/1258/3000
	TJ McLaughlin	PNL/RTL-520/30/3000
	R. Schalla	PNL/SIGMA5/2621/3000
	DR Sherwood	PNL/SIGMA5/2305/3000
WHC	MR Adams	R2-78
	RW Bloom	N2-53
	ME Borgeson	N1-23
	JM Burks	L1-52
	GD Carpenter	R2-85
	FW Ellis	L6-53
	KA Gasper	R1-15
	EM Greager	L6-60
	ML Grygiel	N2-57
	RD Hensyel	L1-52
	KL Hoewing	A4-35
	RE Lerch	R2-53
	RL Martin	L1-52
	WJ McShane	L2-50
	DL Pursley	N1-23
	PS Schaus	R1-06
	FM Smith	L1-52
	KG Toyoda	N1-22
	WR Tucker	L3-52
	WJ Young	L1-52
	MG Zimmerman(6)	L1-52
	Central Files (2)	L8-04
	Documentation (2)	L8-15
	Microfilm Services	L8-15