GW - 107

REPORTS

YEAR(S):

1991 - 1990

El Paso Natural Gas Company
El Paso, Texas

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Groundwater Quality Assessment: El Paso Natural Gas Company Jal Number 4 Facility Jal, New Mexico

ENSR Consulting and Engineering
Document Number 2467-003

August, 1989

El Paso Natural Gas Company
El Paso, Texas

Groundwater Quality Assessment:
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1.0 INTRODUCTION

ENSR Consulting and Engineering (ENSR) was contracted by El Paso Natural Gas Company (EPNG) to conduct a groundwater assessment at the EPNG Jal No. 4 gas plant located in Jal, New Mexico. This report was prepared to satisfy the requirements of Contract No. 2467-003.

1.1 Purpose

The purpose of the field investigation was to obtain physical and analytical information regarding groundwater conditions beneath the facility. The principal client contact is Mr. John Bridges, El Paso Natural Gas.

1.2 Scope

On-site activities included drilling and construction of three monitoring wells. The monitoring wells were constructed beginning June 21 through July 8, 1989. Following the completion of the wells, groundwater samples were collected for chemical analysis. The purpose of the field program was to establish baseline data for characterization of the Ogallaha aquifer at the facility.

1.3 Project Personnel

ENSR personnel responsible for the satisfactory completion of the contract are:

- Mr. Samuel Nott, P.E., Project Manager
- Mr. Bryan Nelson, Senior Hydrogeologist
- Mr. Raymond Roblin, Project Hydrogeologist
- Mr. Bo Blankfield, Laboratory Manager
- Mr. Charles Vincent, Jr., E.I.T., Staff Engineer

Subcontracts were awarded for the monitoring well installation and the topographic survey. The three monitoring wells were constructed by Jim Winneck, Inc. of Tulsa, Oklahoma. The Winneck Company is a licensed water well driller in the state of New Mexico.

The topographic survey was completed by John West Engineering of Hobbs, New Mexico.

2.0 SITE CONDITIONS

2.1 Location

The Jal No. 4 plant is located approximately nine miles north of Jal, in Lea County, New Mexico. Figure 2-1 is a U.S.G.S. Topographic Map showing the Jal No. 4 plant location.

2.2 Environmental Setting

The environmental setting at the facility is within the Pecos Valley section of the Great Plains Physiographic Province in southeastern New Mexico. The surface and near subsurface soils are underlain by a hard caliche material and is almost entirely covered by aeolian dune sands. The surface topography in the immediate site is more subdued and irregular, owing to dune-sand cover and to dissection by numerous gullies and draws.

2.3 Geologic Profiles

The geologic profiles identified during the drilling program revealed that alluvial materials were present from the surface to approximately 45 feet. This alluvium consisted of intermixed sand, silt, and caliche materials. Between 45 and 65 feet below the surface, a very hard, recrystallized, carbonate cemented, fine sand was discovered. Below the recrystallized sand unit, a fine, poorly sorted, silty sand was revealed to the total depth of the boring. The stratigraphy found at the plant area is typical of the surficial geology of the Pecos Valley in southeast New Mexico.

The principal aquifers that supply potable groundwater in southern Lea County are the Tertiary Ogallaha formation, and Quaternary alluvium. Recharge to these aquifers is due entirely to precipitation, as the formations are topographically high and

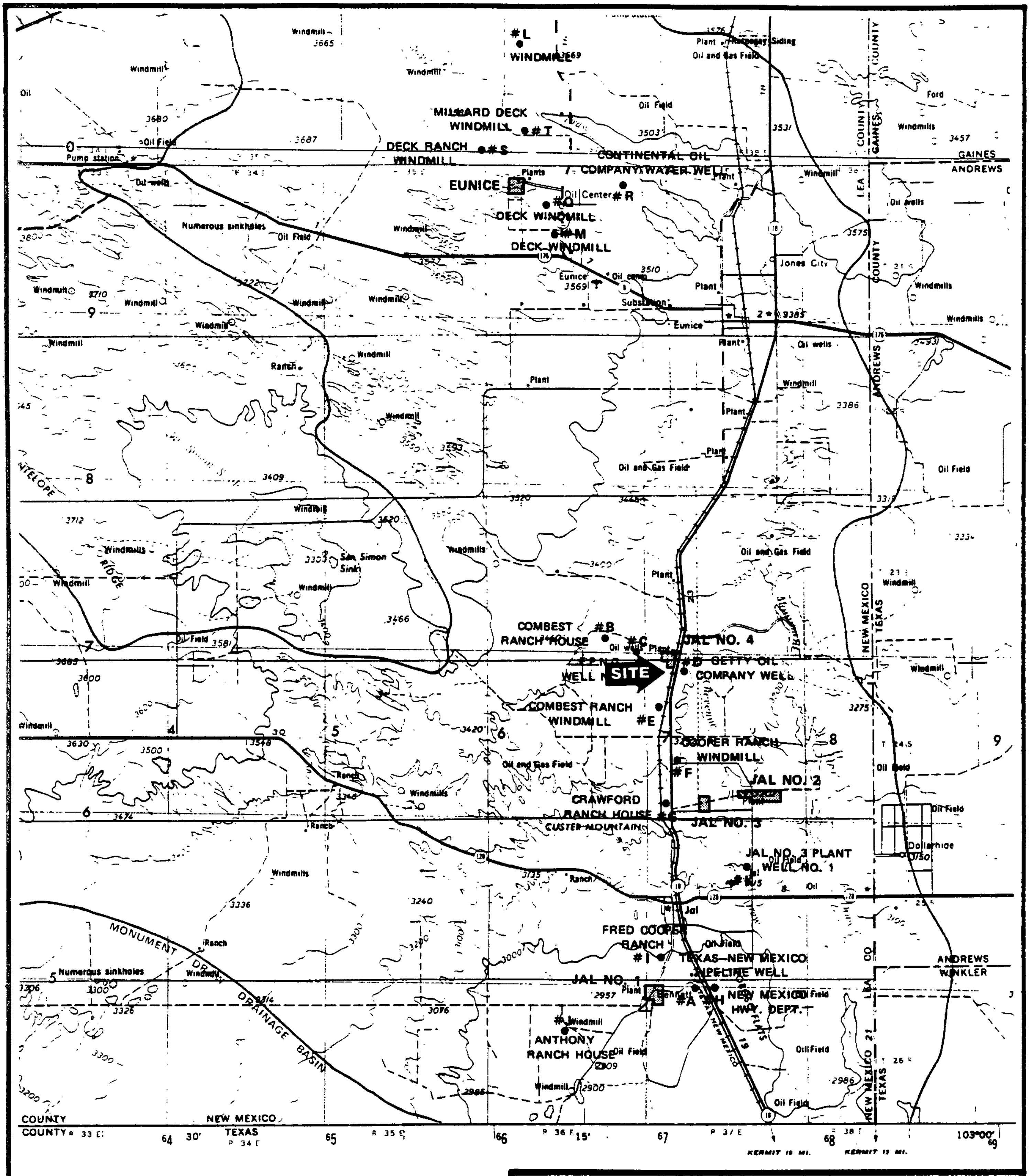

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FIGURE 2-1

SITE LOCATION MAP

DRAWN BY:	**DATE:**	**PROJECT NO.:**
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isolated. The geologic boundary between these two formations are vague, and tend to grade into each other at various stratigraphic levels.

3.0 FIELD ACTIVITIES

3.1 Operations

All monitoring equipment utilized during the field program was calibrated prior to use on-site. The method and frequency of calibration for each instrument was based on type of equipment, extent of use, degree of accuracy required and manufacturer's specifications. The monitoring wells were installed in accordance with ENSR's Standard Operating Procedures (SOP), unless described otherwise in Section 3.2. The standard operating procedures applicable to this activity are included as Appendix A and include: Borehole logging; monitor well construction and installation; monitor well development; decontamination; and rising-head/falling-head permeability testing.

Each groundwater sample collected was assigned a unique five character sample number. The sample number consists of a two-letter code designating the facility (EP-El Paso); monitoring well number (1); and a letter (A) to identify that these samples are the first analytical testing effort.

The groundwater samples were collected, packaged for shipment, and transported according to the Standard Operating Procedures included in Appendix B. The chain-of-custody documentation and analytical results are presented as Appendix C.

3.2 Decontamination

The drilling rig, tools, and well construction materials were decontaminated prior to the first boring and after each successive stage of well construction. The rig, and all associated tools were decontaminated with a steam-generating, high-pressure sprayer.

3.3 Monitor Well Construction

The monitoring well borings were advanced using air/rotary drilling methods utilizing a Failing type CF-15 rig. All drilling spoils were collected and placed into clean, 55-gallon drums, which were sealed, identified, and placed on pallets at the well locations.

The monitoring wells were constructed by installing eight-inch nominal PVC surface casing from the surface to 120 feet be. The surface casing was then grouted with "volclay" type grout between the borehole annulus and the surface casing to effectively seal the borehole. Figure 3-2 details a typical monitoring well design.

The wells were completed with four inch, Schedule 40, 0.010 inch slot PVC well screen and casing from approximately 150 feet to the surface. Each well has a five foot sump attached below the screen interval. The sump and the annulus of the screened interval were packed with 10-20 size clean silica sand, to a point within two to three feet above the top of the screen. A bentonite seal was installed above the sand pack. A "volclay" grout was then placed in the annular space above the bentonite seal, inside the surface casing, to ground level for installation of the steel security casing. The wells were developed by air lift methods until the water discharged was clear and its specific conductance, pH, and temperature stabilized.

3.4 Topographic Survey

After completion of the monitoring well construction and development of the wells, a detailed topographic survey was conducted to establish the ground elevation at the well locations to one hundredth of a foot. Figure 3-2 provided by John West Engineering, is a preliminary report of the established well elevations. Figure 3-3, an aerial photograph of the Jal No. 4 plant, is annotated to show appropriate locations of the wells.

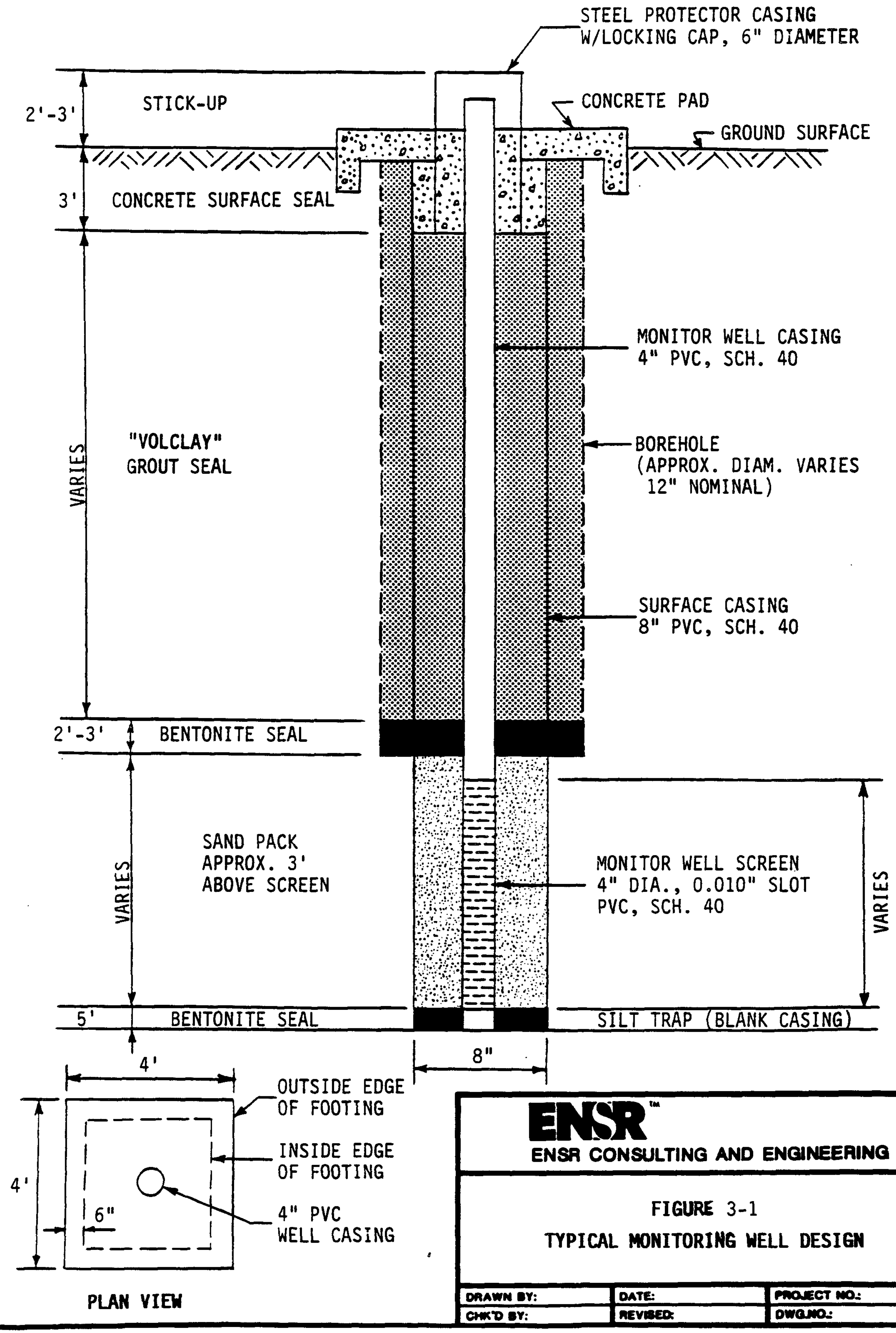

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FIGURE 3-1

TYPICAL MONITORING WELL DESIGN

DRAWN BY:	DATE:	PROJECT NO.:
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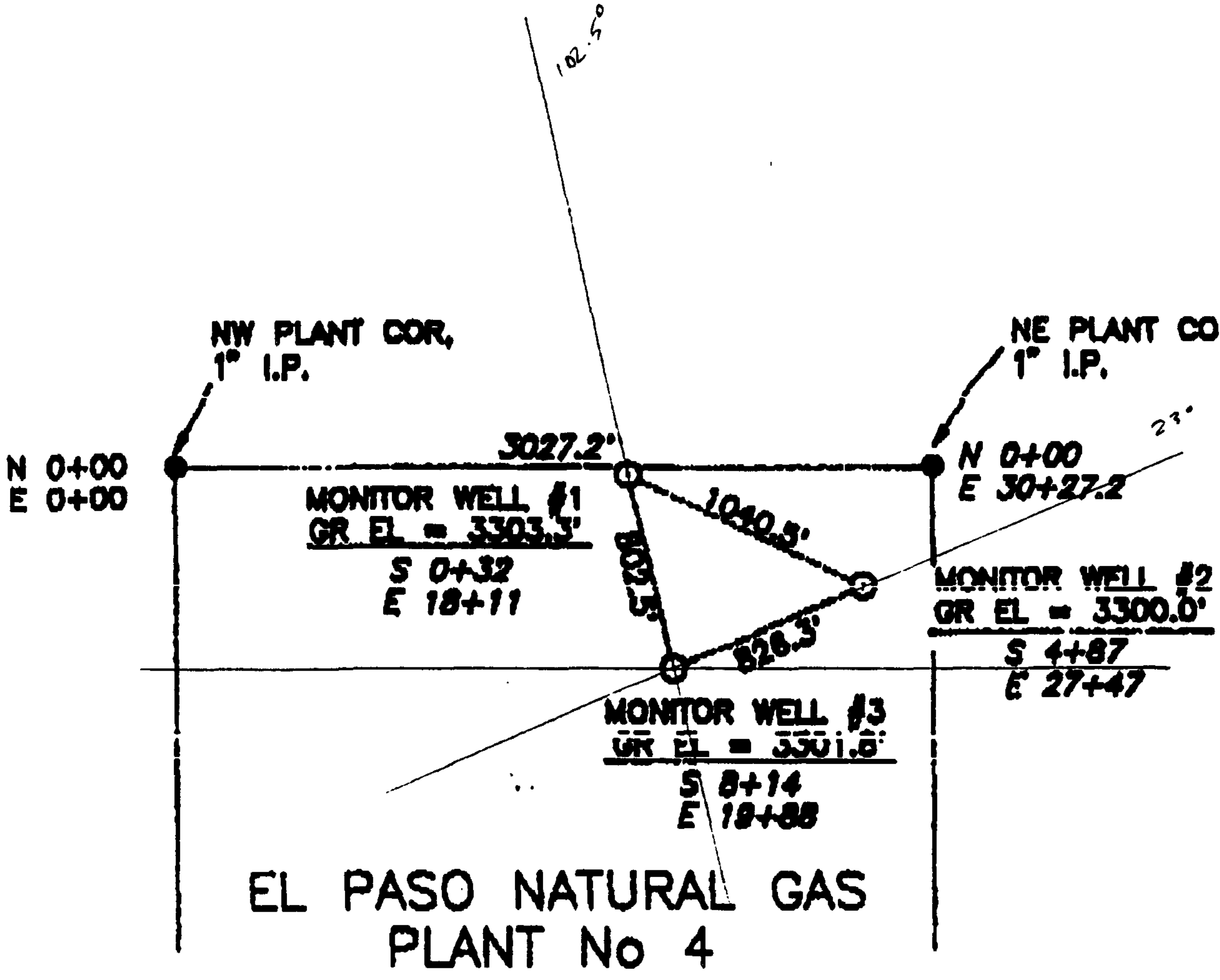
SECTION 31, TOWNSHIP 23 SOUTH, RANGE 37 EAS
LEA COUNTY,



SOURCE: JOHN WEST ENGINEERING

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FIGURE 3-2
MONITOR WELL ELEVATIONS

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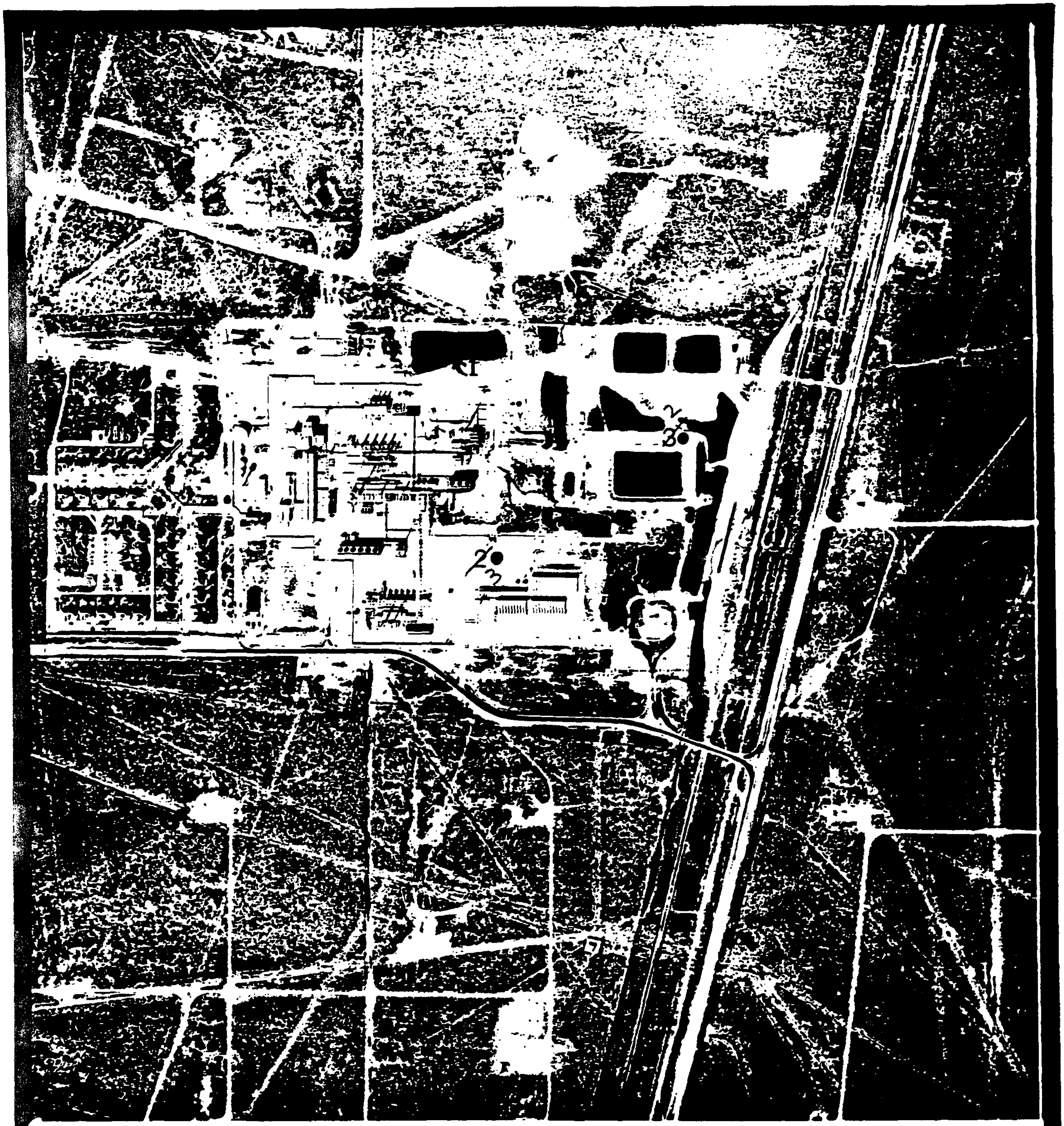

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FIGURE 3-3

APPROXIMATE WELL LOCATIONS

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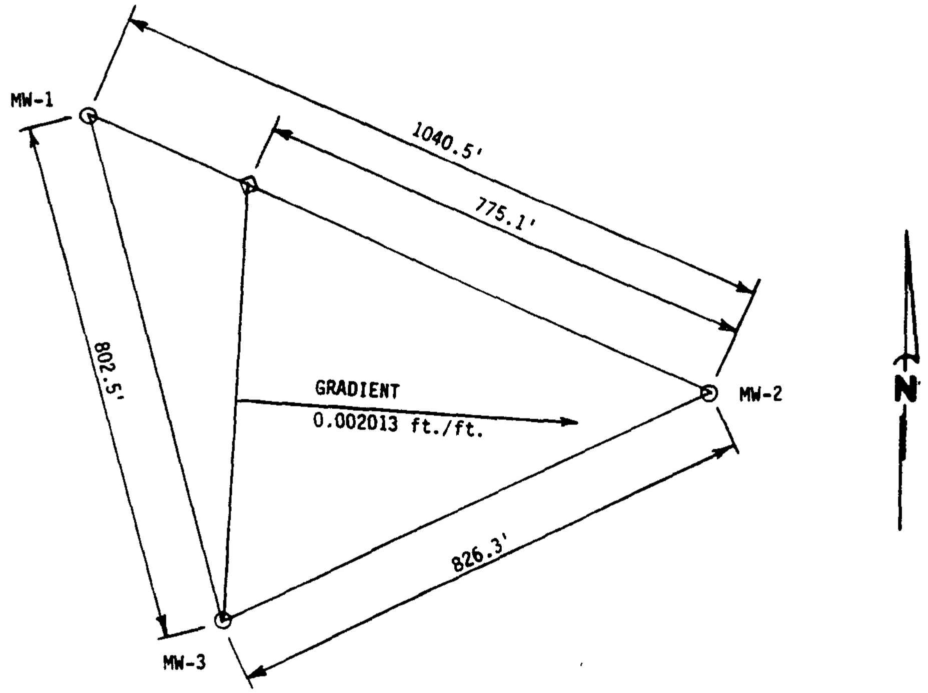
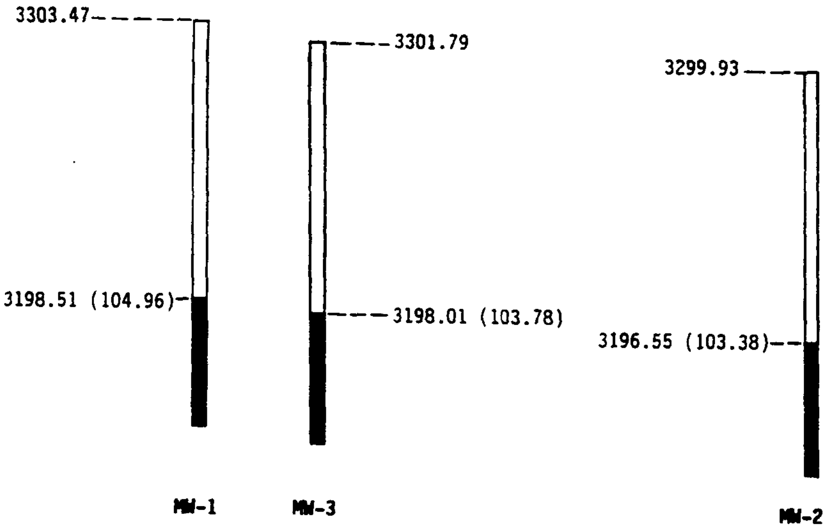


PLAN

SCALE: 1' = 300'



ELEVATION

NOTE: Water Level Elevations
Measured On 7/8/89.

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FIGURE 3-4

WELL CONFIGURATION

EPNG, JAL NUMBER 4

DRAWN BY:	DATE:	PROJECT NO.:
CHK'D BY:	REVISED:	DWG.NO.:

Using the exact elevations, water levels in the wells were measured with an electric sounding device to provide exact elevations of the water columns.

3.5 Groundwater Flow Direction

Static water levels in the monitoring wells indicate the groundwater flow direction to be in a east-southeast direction across the facility. The flow direction was calculated using a three point mathematical system described in Billings; Structural Geology 1972; Third Edition. Figure 3-4 shows the triangular configuration of the wells. The calculated hydraulic gradient is 0.002013 ft/ft.

3.6 Groundwater Sampling

Groundwater sampling was conducted to characterize the chemical quality of the aquifer. Samples were analyzed by ENSR Consulting and Engineering Laboratories for: Volatile organic compounds (VOC) EPA Method 624; semi-volatile organics EPA Method 625; Polychlorinated biphenols EPA Method 608; total petroleum hydrocarbons EPA Method 624; and chlorides Standard Method 407A,B. Prior to sample collection, the wells were purged of a minimum of three well volumes. During well evacuation, the discharged water was monitored for temperature, pH, and specific conductance. The water was purged by using a Grunfoes, redi-flow stainless steel pump and was containerized into clean steel drums. The samples were collected by use of a clean Teflon bailer and the water was placed directly into laboratory cleaned sample containers.

3.7 Sample Analysis

A table of parameters identified above detection limits is included on Table 3-1. The samples were then sealed, placed on ice for preservation, and chain-of-custody documentation was generated prior to shipment to ENSR's Houston, Texas and Wilmington, Massachusetts Laboratories.

TABLE 3-1

EL PASO NATURAL GAS
JAL NO. 4
DATA ANALYSIS FROM MONITORING WELLS

SAMPLE #	**EP-01-A**	**EP-02-A**	**REPLICATE EP-02-B**	**EP-03-A**
CHLORIDES	9700PPM	8900PPM	8500PPM	285PPM
ACETONE	24	81	80	23
CARBON DISULFIDE	BDL	22	24	BDL
2-BUTANONE (MEK)	BDL	29	30	BDL
BIS (2 ETHYLHEXYL) PHTHALATES	BDL	BDL	BDL	22
DI-N-BUYTL PHTHALATES	BDL	BDL	5.9	BDL
2,4 DIMETHYL PHENOL	16	7.5J	9.5J	BDL
METHYL NAPHTHALENE	6.0J	BDL	BDL	BDL
PENTACHLOROPHENOL	BDL	BDL	7.6	BDL
PCB	ND	ND	ND	ND

ALL FIGURES IN UG/L OR PPB

J = ESTIMATES

BDL = BELOW DETECTION LIMITS

A

APPENDIX A

Standard Operating Procedures

- Borehole Logging
- Monitor Well Construction & Installation
- Decontamination
- Rising Head/Falling Head
- Permeability Testing

Title: Borehole Logging

1.0 Applicability

This Standard Operating Procedure describes the methods used to document the information collected for classification of soil or rock samples from boreholes.

2.0 Responsibilities

The project geologist/hydrogeologist has the responsibility to document subsurface conditions in field notebooks when boreholes are advanced and to ensure that the proper records are maintained in the project files.

3.0 Supporting Materials

The list below identifies the material which may be used for a range of borehole logging applications. From this list, an equipment list will be selected based upon the project objectives, drilling methods, and anticipated conditions.

- pocket knife or small spatula
- hand lens
- bottle (5 percent) hydrochloric acid
- Munsell color chart
- five-foot scale
- core bags and boxes
- field notebook

4.0 General Methods

4.1 The geologist/hydrogeologist will record the information shown in Table 1 for each sample recovered. The items marked with an asterisk are optional.

4.2 The procedure for describing soil will follow ASTM Method D2488-84 entitled "Description and Identification of Soils (Visual-Manual Procedure)."

4.3 One complete core sample per pit, or per site where pits are closer together than 100 feet, will be preserved on site for examination by appropriate authorities until the completion of site characterization activities. Care will be taken in properly labelling and storing core samples.

5.0 Documentation

5.1 Field Logs

5.2 Relevant geologic and hydrologic data will be plotted on lithologic logs such as those shown in Figure 1.

Table 1: FIELD BORING LOG INFORMATION[a]

General

- o Project name
- o Hole name/number
- o Sheet number
- o Date started and finished
- o Geologist's name
- o Name of Drilling Firm
- o Hole locaton sketch map
- o Precipitation (yes/no)
- o Rig type, bit/auger size
- o Petrologic lithologic classification schemes, if used (e.g. Wentworth, unified soil classification system)
- o Static water level at completion

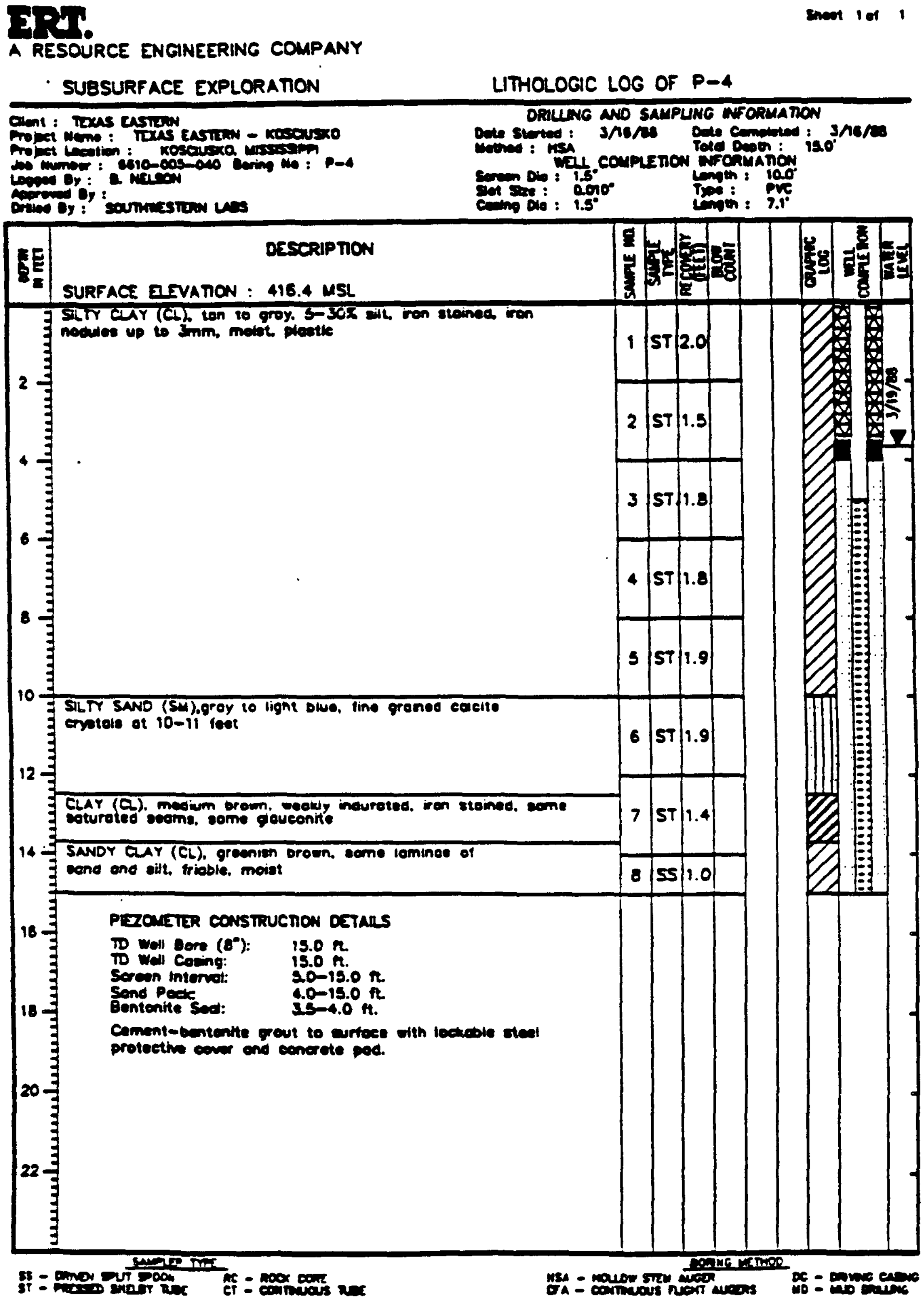
Sample Information

- o Depth
- o Sample location/number
- o Sample recovery, if split spoon or rock core samples are taken

Narrative Description

- o Geologic Observations (including depth)
  - soil/rock type
  - color and stain
  - friability*
  - moisture content*
  - degree of weathering*
  - presence of carbonate*
  - fractures or solution cavities (unless air rotary is used in unsaturated bedrock)
  - visible organic content
  - bedding, discontinuities, and fossils (if soil or rock core samples are taken)
  - depositional structures*
  - water bearing zones
- o Drilling Observations
  - blow counts and advance rate (if split spoons are used)
  - loss of circulation
  - advance rates*
  - rig chatter*
  - drilling difficulties*
  - changes in drilling method or equipment
  - detection equipment readings (if any)
  - estimated water yield or loss (during drilling at different depths)
  - types of liquids used
  - running sands
  - caving or hole instability
- o Other Remarks
  - equipment failures*
  - odor, if noted
  - visible presence of non-natural materials (describe)

Note a : Log notations made only for positive observations (i.e. absence of above data shall not be noted in the boring log). Asterisked items are optional, at the discretion of the Texas Eastern onsite geologist.



Sheet 1 of 1

ERT.
A RESOURCE ENGINEERING COMPANY

SUBSURFACE EXPLORATION

LITHOLOGIC LOG OF P-4

Client : TEXAS EASTERN
Project Name : TEXAS EASTERN – KOSCIUSKO
Project Location : KOSCIUSKO, MISSISSIPPI
Job Number : 6610-005-040 Boring No : P-4
Logged By : B. NELSON
Approved By :
Drilled By : SOUTHWESTERN LABS

DRILLING AND SAMPLING INFORMATION
Date Started : 3/16/88
Date Completed : 3/16/88
Method : HSA
Total Depth : 15.0'

WELL COMPLETION INFORMATION
Screen Dia : 1.5"
Length : 10.0'
Slot Size : 0.010"
Type : PVC
Casing Dia : 1.5"
Length : 7.1'

SURFACE ELEVATION : 416.4 MSL

DEPTH IN FEET	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	RECOVERY (FEET)	BLOW COUNT
0–10	SILTY CLAY (CL), tan to gray, 5–30% silt, iron stained, iron nodules up to 3mm, moist, plastic	1	ST	2.0	
		2	ST	1.5	
		3	ST	1.8	
		4	ST	1.8	
		5	ST	1.9	
10–12.5	SILTY SAND (SM), gray to light blue, fine grained calcite crystals at 10–11 feet	6	ST	1.9	
12.5–13.7	CLAY (CL), medium brown, weakly indurated, iron stained, some saturated seams, some glauconite	7	ST	1.4	
13.7–15	SANDY CLAY (CL), greenish brown, some laminae of sand and silt, friable, moist	8	SS	1.0	

PIEZOMETER CONSTRUCTION DETAILS

TD Well Bore (8"):	15.0 ft.
TD Well Casing:	15.0 ft.
Screen Interval:	5.0–15.0 ft.
Sand Pack:	4.0–15.0 ft.
Bentonite Seal:	3.5–4.0 ft.

Cement-bentonite grout to surface with lockable steel protective cover and concrete pad.

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
RC – ROCK CORE
CT – CONTINUOUS TUBE

BORING METHOD
HSA – HOLLOW STEM AUGER
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

Figure 1. Example Lithologic Log

Title: Monitoring Well Construction and Installation

1.0 Purpose and Applicability

This SOP establishes the method for installing ground water monitoring wells. These wells will be installed to monitor the depth to ground water, to measure aquifer properties, and to obtain samples of ground water for chemical analysis.

2.0 Definitions

Annulus: The space between the borehole wall and the outside of the well screen or riser pipe.

Filter Pack: A well-graded, clean sand or gravel placed around the well screen to prevent the entry of very fine soil particles.

Grout Plug: A cement/bentonite mixture use to seal a borehole that has been drilled to a depth greater than the final depth at which the monitoring well is to be installed.

Guard Pipe: A pipe, usually made of steel, placed around that portion of the well riser pipe that extends above the ground surface. As well as providing security to a well, it may provide a fixed elevation for surveying.

Riser Pipe: The section of unperforated well construction material used to connect the well screen with the ground surface. Frequently it is made of the same material and has the same diameter as the well screen.

Road Box: A man-hole set into the ground around a well installation. Usually constructed in areas where the monitoring well cannot extend above the ground surface for traffic or security reasons.

Tremie Pipe: A small diameter pipe that will fit in the annulus and is used to inject filter sands, seal materials, or cement/bentonite grout under pressure.

Well Screen: That portion of the well casing material that is perforated in some manner so as to provide a hydraulic connection to the aquifer. Typically a well screen has slots but holes, slits, louvers, and other perforations can, in some situations, be used.

3.0 Health and Safety Considerations

Monitoring well installation may involve chemical hazards associated with materials in the soil or aquifer being explored; and always

Some states have specific requirements regarding the construction of monitoring wells. It is the responsibility of the Project Manager to understand these regulations and any permitting requirements that may be necessary, and to ensure that the well installation program complies with all state and local requirements.

It is the responsibility of the Project Geologist or Engineer to directly oversee the construction and installation of the monitoring well by the subcontract driller to ensure that the well-installation specifications defined in the project work plan are adhered to and that all pertinent data are recorded on the approved forms.

6.0 Training/Qualifications

Each person designing monitoring wells for ENSR projects and overseeing their installation should be a degreed geologist or hydrogeologist with at least two years experience in ground water monitoring. Specific training and/or orientation will be provided for each project to ensure that personnel understand the objectives and special circumstances and requirements of that project.

7.0 Supporting Materials

The monitoring well shall consist of a commercially available well screen constructed of PVC, stainless steel, teflon, or fiberglass pipe of minimum 2-inch nominal diameter. The length of the screen and the size of the screen slots shall be determined by the inspecting geologist or specified in the project work plan depending upon the grain-size distribution of the aquifer materials. PVC, stainless steel, steel, teflon, or fiberglass riser pipe of minimum 2-inch nominal diameter shall be used to complete the monitoring well to ground surface. The riser pipe shall be connected by flush-threaded, coupled or welded watertight joints. No solvent or anti-sieze compound shall be used on the joints.

The section of riser pipe that sticks up above ground shall be protected by a steel guard pipe set at least 2 feet into a concrete surface seal. The top of the guard pipe shall have a vented lockable cap. Alternatively, a road box may be installed, if it satisfies the security requirements of the project. Road-box installations must use a watertight seal inside of the riser pipe to prevent surface water from entering the well.

8.2.3 The assembled screen and riser or its constituent parts shall be decontaminated with a detergent and water wash and triple deionized water rinse. Steam-cleaning also can be done to decontaminate the well materials. Decontaminated well components should be wrapped in plastic until installed in the boring. All personnel handling the decontaminated well components should exercise great care not to contaminate these components as they are installed in the borehole.

8.2.4 The well screen and riser pipe generally are assembled as they are lowered into the borehole. As the assembled well is lowered, care shall be taken to ensure that it is centered in the hole. In boreholes which are determined to be not plumb, centralizers should be used on the tail pipe below the screen and/or the midpoint and top of the screen. This will assure that the screened portion of the well is centrally located in the borehole with a uniform thickness of sand or filter pack between the screen and the borehole wall. In holes greater than 25 feet in depth, centralizers should be used.

8.2.5 The annular space surrounding the screened section of the monitoring well and at least 1 foot above the top of the screen shall be filled with an appropriately graded, clean sand or gravel. In no case shall the sand pack be longer than 1.5 times the length of the screen. A minimum 1-foot thick layer of very fine sand (i.e., sand-blasting sand) should be placed immediately above the well screen sand pack. This layer is designed to prevent the infiltration of sealing components (bentonite or grout) into the sand pack. As each layer is placed, a weighted tape should be lowered in the annular space to verify the depth to the top of the layer.

Depending on the depth of the well, the diameters of the borehole and well materials, and the depth to the static water level, satisfactory placement of the sand pack may require the use of a tremie pipe.

8.2.6 Bentonite seals, either pellets or slurry, a minimum of 2 feet thick shall be installed immediately above the artificial gravel pack in all monitoring wells. The purpose of the seal is to provide a barrier to vertical flow of water in the annular space between the borehole and

8.2.9 Measure the depth to the stabilized water level and record on the ground water monitoring well detail report (shown as Figure 1).

8.2.10 At some point after installation of a well and prior to use of the well for water level measurements or water quality samples, development of the well shall be undertaken in accordance with ENSR SOP 7221, Monitoring Well Development.

9.0 Quality Control Checks and Acceptance Criteria

- The borehole will be checked for total open depth, and extended by further drilling or shortened with a grout plug, if necessary, before any well construction materials are placed.
- Water level will be checked repeatedly during well installation to ensure that the positions of well screen, sand pack and seal, relative to water level, conform to project requirements.
- The depth to the top of each layer of packing (i.e., sand, bentonite, grout, etc.) will be verified and adjusted if necessary to conform to the requirements of this SOP and the QAPP before the next layer is placed.

10.0 Documentation

During installation of each monitoring well, a series of measurements shall be taken and recorded. These measurements shall include:

- length of tail pipe (if used)
- length of screen
- length of riser pipe
- total length of well
- depth to stabilized water level

Other data include the screen and riser pipe materials, diameters of the respective components, screen slot size, type and thickness of the sand pack, thicknesses and different types of grouting materials, and elevation of the top of the guard pipe, established measuring point, and ground surface after surveying is complete. If water or other drilling fluids have been introduced into the boring during drilling or

Figure 1

Project No: ____________ Client: ____________ Site: ____________

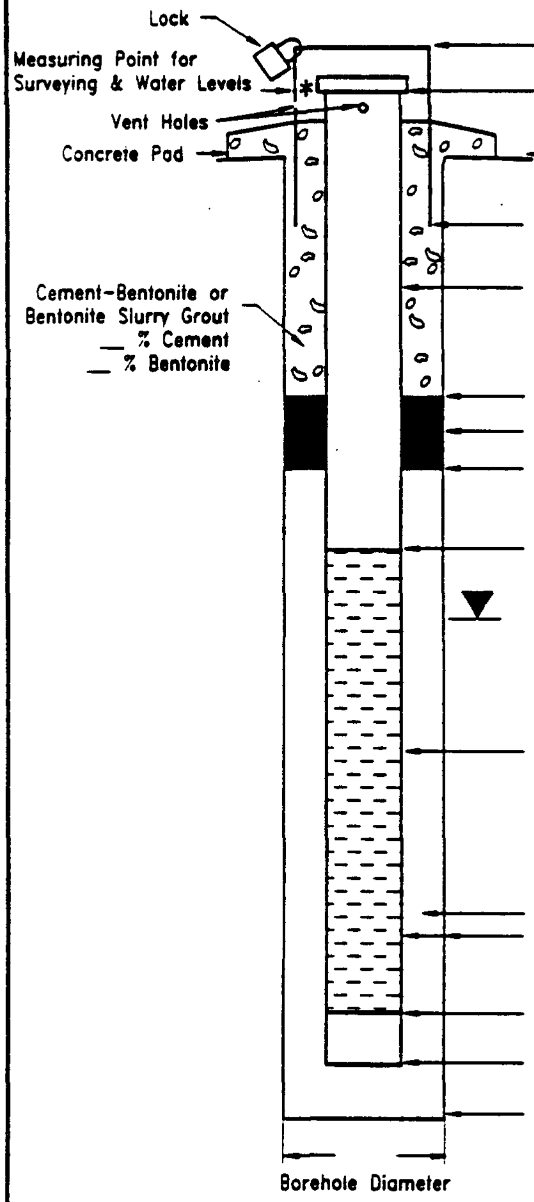
WELL No:

Well Location: ______________________________

Date Installed: __/__/__

Contractor: ____________ Method: ____________ Inspector: ____________

MONITORING WELL CONSTRUCTION DETAIL



		Depth from G.S. (feet)	Elevation (NGVD)
Top of Steel Guard Pipe		______	______
Top of Riser Pipe		______	______
Ground Surface (G.S.)		0.00	______
Bottom of Steel Guard Pipe		______	______
Riser Pipe:			
Length	______		
Inside Diameter (ID)	______		
Type of Material	______		
Top of Bentonite Seal		______	______
Bentonite Seal Thickness	______		
Top of Sand		______	______
Top of Screen		______	______
▼ Stabilized Water Level		______	______
Screen:			
Length	______		
Inside Diameter (ID)	______		
Slot Size	______		
Type of Material	______		
Type/Size of Sand	______		
Sand Pack Thickness	______		
Bottom of Screen		______	______
Bottom of Tail Pipe:		______	______
Length	______		
Bottom of Borehole		______	______

Approved:

* Describe Measuring Point: ______________________

______________ Signature

________ Date

STANDARD OPERATING PROCEDURE

Page: 1 of 13
Date: 2nd Qtr. 1989
Number: 7221
Revision: 0

Title: Monitoring Well Development

1.0 Purpose and Applicability

This SOP describes the methods used for developing monitoring wells after original installation and prior to use of the well for obtaining water level measurements or water quality samples. Development should not be confused with purging, the purpose of which is to evacuate the monitoring well system of stagnant water which may not be representative of the aquifer. For purging procedures refer to ENSR SOP No. 7130, Ground-Water Sample Collection from Monitoring Wells.

Monitoring well development and/or rehabilitation are necessary to ensure that complete hydraulic connection is made and maintained between the well and the aquifer material surrounding the well screen and packing materials. Development is necessary after original installation of a monitoring well to (1) reduce the compaction and inter-mixing of grain sizes produced during drilling; (2) to increase the porosity and permeability of the artificial filter pack by removing the finer grain-size fraction introduced near the screen by drilling and well installation; and (3) to remove any foreign drilling fluids that coat the borehole or that may have invaded the adjacent natural formation.

This procedure applies to monitoring wells in which siltation has been determined to have occurred. After a well has been installed for some period of time (ranging from months to years), siltation of the well may occur and rehabilitation will be necessary to re-establish complete hydraulic connection with the aquifer.

2.0 Definitions

Note: Equipment components are defined in Section 7.0 of this SOP.

Bridging: A condition within the filter pack outside the well screen whereby the smaller particles are wedged together in a manner that causes blockage of pore spaces.

Hydraulic Conductivity: A characteristic property of aquifer materials which describes the permeability of the material to a particular fluid (usually water).

Hydraulic Connection: A properly installed and developed monitoring well should have a complete hydraulic connection with the aquifer. The well screen and filter material should not provide any restriction to the flow of water from the aquifer to the well.

In addition, the following protective measures are always required:

- all persons within 50 feet of a drill rig must wear hard hats and safety shoes. Hearing protection should be provided during periods of excessive noise; and
- personnel who are not directly involved in overseeing, inspecting or performing the drilling and well installation will remain at least 100 feet away from the drill rig.

4.0 Quality Assurance Planning Considerations

The appropriate development method will be selected for each project on the basis of the circumstances, objectives and requirements of that project. Further, some states and EPA regions have promulgated comprehensive guidelines for ground water monitoring and subsurface investigation procedures. The provisions of this SOP will be adapted to these project-specific requirements in the Quality Assurance Project Plan (QAPP). Each QAPP will describe the specific method(s) to be used and the rationale, including trade-offs associated with the nature of the aquifer formation, chemical analytical objectives, and client or agency requirements.

5.0 Responsibilities

Development of new monitoring wells is the responsibility of the geologist or hydrogeologist involved in the original installation of the well. The geologist may, in fact, contract with the well driller to develop new wells under the geologist's guidance and oversight. Records of well development methods and results are to be kept by the geologist.

Any person using existing monitoring wells for any purpose is responsible for verifying the original well construction details and determining if a well requires rehabilitation.

6.0 Training/Qualifications

Each ENSR employee who develops a monitoring well for an ENSR project will have been trained by an experienced ENSR geologist in the specific procedure used.

7.4 Compressed Gas

Compressed gas, generally nitrogen, can be used to both surge and purge a monitoring well. A nitrogen tank is used to inject gas at the bottom of the water column, driving sediment-laden water to the surface. Compressed gas can also be used for "jetting" - a process by which the gas is directed at the slots in the well screen to cause turbulence (thereby disturbing fine materials in the adjacent filter pack). Compressed gas is not limited to any depth range.

The hose or pipe which will be installed in the well for jetting should be equipped with a horizontal (side) discharge nozzle and one or more small holes in the bottom of the hose to enhance the lifting of sediment during jetting.

Since the compressed gas will be used to "lift" water from the monitoring well, provisions must be made for controlling the discharge from contaminated wells. This is generally accomplished by attaching a "tee" discharge to the top of the casing and providing drums to contain the discharged water. Gas-lifting must never be done in contaminated wells without providing discharge control apparatus.

7.5 Decontamination Equipment

Standard equipment for decontaminating field apparatus in accordance with ENSR SOP 7600 will be used to decontaminate all equipment used to develop monitoring wells.

7.6 Purge Water and Sediment Disposal

The QAPP must specify the means for disposing of purged sediment-laden water. In most cases, disposal of this material will follow the methods used in the original installation of the borehole. If soil and/or ground water contamination conditions in a well have changed, it may be necessary to specify new disposal methods for wells that are being re-developed.

8.1.5 Generally, a permeability test as described in ENSR SOP 7720 is used to confirm that a reliable hydraulic connection has been established (or re-established) between the well and the surrounding aquifer material.

8.2 Selection of a Specific Procedure

The construction details of the well can be used to initially define the method of purging a well with due consideration being given to the level of contamination.

The criteria for selecting a well development method include well diameter, total well depth, static water depth, screen length, the likelihood and level of contamination, and the type of geologic formation adjacent to the screened interval.

The limitations, if any, of a specific procedure are discussed within each of the following procedures.

Methods that involve placing water into the well may be objectionable to some state and federal agencies. In such cases the surge block procedure may be preferable over the pumping procedure.

8.3 Specific Procedure: Surge Block

8.3.1 A surge block effectively develops most monitoring wells. If the geologic layering in the screened interval includes permeable and impermeable layers (e.g., gravels and clays), it is possible that surging could remove fines from the impermeable layers and force them into the permeable layers. This problem can be minimized by using fewer surging cycles, using a surge block which is looser fitting and/or increasing the purging volume or time of development.

8.3.2 Construct a surge block using the design in Figure 1 as a guide. Specific materials will depend upon the diameter of well to be developed. The diameter of the flexible rings must be sufficient to cause a tight seal within the well casing, and the rods must be of sufficient length to reach to the bottom of the monitoring well.

The water used to fill the monitoring well should be the same water removed from the well during the previous pumping cycle. The sediment previously pumped from the well must be removed from the water prior to re-introduction to the well. A steel drum can be used as a sediment-settling vessel.

8.4.5 Continue pumping water into and out from the well until sediment-free water is obtained.

8.5 Specific Procedure: Bailer

8.5.1 Lower the bailer into the screened interval of the monitoring well.

8.5.2 Using long, slow strokes, raise and lower the bailer in the screened interval simulating the action of a surge block.

8.5.3 Periodically bail standing water from the well to remove silt and clay particles drawn into the well.

8.5.4 Continue surging the well using the bailer and bailing water from the well until sediment-free water is obtained.

8.6 Specific Procedure: Compressed Gas (Nitrogen)

8.6.1 Although the equipment used to develop a well using this method is more difficult to handle and use, well development using compressed gas for jetting is considered to be a very effective method. This method also is the most generally applicable because it is not limited by well depth, well diameter or depth to static water, but caution must be exercised in highly permeable formations not to inject gas into the formation.

8.6.2 Lower the gas line from the gas cylinder into the well, setting it near the bottom of the screened interval. Install the discharge control equipment at the well head.

8.6.3 Set the gas flow rate to allow continuous discharge of water from the well. The discharge will contain suspended clay and silt material.

process. Any inability to return the well to the original specifications will be noted on the original copy of the Monitoring Well Construction Detail form and on the Monitoring Well Development Record (Figure 2).

All documentation will be retained in the project files following completion of the project.

Figure 2

ENSR

MONITORING WELL DEVELOPMENT RECORD

DATE: ______________________ WELL I.D.: ______________________

PROJECT NAME: ______________________ LOCATION: ______________________

PROJECT NUMBER: ______________________ DEVELOPER: ______________________

☐ ORIGINAL DEVELOPMENT ☐ REDEVELOPMENT ORIGINAL DEVELOPMENT DATE: __________

WELL DATA

Well Diameter		Geology at Screened Interval	
Total Well Depth			
Depth to Top of Screen		Likely Contaminants	
Depth to Bottom of Screen			
Depth to Static Water Level		Purge Water and Sediment Disposal Method	

DEVELOPMENT METHOD	PURGING METHOD	PERMEABILITY TEST RESULTS

ACCEPTANCE CRITERIA

Signature ______________________ Date __________

M890322

STANDARD OPERATING PROCEDURE

Title: Decontamination

Page of 4
Date: 1st Qtr 1984
Number: 7600
Revision: 1

1.0 General Applicability

This SOP describes the methods to be used for the decontaminization of all field equipment which becomes potentially contaminated during a sample collection task. The equipment may include split spoons, bailers, trowels, shovels, hand augers, or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross-contamination between samples and also helps to maintain a clean working environment for the safety of all field personnel involved, including the environment.

Decontamination is mainly achieved by rinsing with liquids which include: soap and/or detergent solutions, tap water, deionized water, and methanol. Equipment will be allowed to air dry after being cleaned or may be wiped dry with chemical free cloths or paper towels if immediate re-use is needed.

The frequency of equipment use, dictates that most decontamination be accomplished at each sampling site between collection points. Waste products produced by the decontamination procedures such as waste liquids, solids, rags, gloves, etc. will be collected and disposed of properly based on the nature of contamination. All cleaning materials and wastes should be stored in a central location so as to maintain control over the quantity of materials used and/or produced throughout the study.

2.0 Responsibilities

It is the primary responsibility of the site operations manager to assure that the proper decontamination procedures are followed and that all waste materials produced by decontamination are properly stored and disposed of.

It is the responsibility of the project safety officer to draft and enforce safety measures which provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of any subcontractors (i.e., drilling contractors) to follow the proper, designated decontamination procedures that are stated in their contracts and outlined in the Project Health and Safety Plan.

It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and to ensure that any contaminants are not negligently introduced to the environment.

3.0 Supporting Materials

- cleaning liquids: soap and/or detergent solutions, tap water, deionized water, methanol
- personal safety gear (defined in Project Health and Safety Plan)
- chemical-free paper towels
- disposable gloves
- waste storage containers: drums, boxes, plastic bags
- cleaning containers: plastic buckets, galvanized steel pans
- cleaning brushes

4.0 Methods or Protocol for Decontamination

4.1 General Procedures

4.1.1 The extent of known contamination will determine to what extent the equipment needs to be decontaminated. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated until enough data are available to allow assessment of the actual level of contamination.

4.1.2 Adequate supplies of all materials must be kept on hand. This includes all rinsing liquids and other materials listed in Section 3.0.

4.1.3 The standard procedures listed in the following section can be considered the procedure for full field decontamination. If different or more elaborate procedures are required for a specific project, they will be spelled out in the project work plan. Such variations in decontamination may include following all, just part, or an expanded scope of the decontamination procedure stated herein.

4.2 Standard Procedures

4.2.1 Remove any solid particles from the equipment or material by brushing and then rinsing with available tap water. This initial step is performed to remove gross contamination.

4.2.2 Wash equipment sampler with the soap or detergent solution.

4.2.3 Rinse with tap water

4.2.4 Rinse with deionized water

4.2.5 Rinse with methanol

4.2.6 Repeat entire procedure or any parts of the procedure if necessary

4.2.7 Allow the equipment or material to air dry before re-using

4.2.8 Dispose of any soiled materials in the designated disposal container

5.0 Specific Decontamination Procedures

5.1 Submersible Pump

5.1.1 Applicability

This procedure will be used to decontaminate submersible pumps between ground-water sample collection points and at the end of each day of use.

5.1.2 Materials

- plastic-nalgene upright cylinder
- 5-10 gallon plastic water storage containers
- methanol and dispenser bottle
- deionized water and dispenser bottle
- chemical free paper towels

5.1.3.1 During decontamination the submersible pump will be placed on a clean surface or held away from ground.

5.1.3.2 When removing the submersible pump from each well the power cord and discharge line will be wiped dry using chemical-free disposable towels.

5.1.3.3 Clean the upright plastic-nalgene cylinder with first a methanol and then a deionized water rinse, wiping the free liquids after each.

5.1.3.4 Reverse pump backwashing all removable residual water present in the pump tubing. The pump should be shut off as soon as intermittent flow is observed from the reverse discharge.

5.1.3.5 Rinse the stainless steel submersible down hole pump section with a liberal application of methanol and wipe dry.

5.1.3.6 Place the submersible pump section upright in the cylinder and fill the cylinder with tap water, adding 50-100 ml of methanol for every one liter of water.

5.1.3.7 Activate the pump in the forward mode withdrawing water from the cylinder.

5.1.3.8 Continue pumping until the water in the cylinder is pumped down and air is drawn through the pump. At this time air pockets will be observed in the discharge line. Shut off the pump immediately.

5.1.3.9 Remove the pump from the cylinder and place the pump in the reverse mode allowing that all removable water be discharged on to the ground surface as discussed in Step 2.

5.1.3.10 Using the water remaining in the cylinder, rinse the sealed portion of the power chord and discharge tube by pouring the water carefully over the coiled lines.

5.1.3.11 When reaching the next monitoring well place the pump in the well casing and wipe dry both the power and discharge lines with a clean paper towel as the pump is lowered.

5.1.4 Quality Assurance

To assure that decontamination is complete, field blank samples shall be collected using the cleaned submersible pump. These field blanks will be subsequently analyzed for the parameters of interest with respect to the ground water.

The procedure for collecting the field blanks will comprise using the pump to withdraw the tap water used for decontamination, from the plastic cylinder to sample containers. This field blank sample collection procedure shall only be performed after the materials to be used have been decontaminated.

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STANDARD OPERATING PROCEDURE

Title: Rising-Head/Falling-Head Permeability Testing

Page 1 of 3
Date: 1st Qtr 1984
Number: SOP 7720
Revision: 0

1.0 General Applicability

This SOP describes the procedures for conducting rising head and falling head permeability tests. Rising head/falling head tests are performed to determine the permeability of soil or rock within a test boring.

Falling head permeability tests are conducted in those boreholes that cannot be readily pumped or bailed for a rising head test. Two different methods for a falling head test may be used; one involves cleaning the casing completely to the bottom, the other involves back filling and pulling the casing above the bottom of the cleaned borehole.

2.0 Responsibilities

Permeability testing is generally conducted during boring programs and it is usually the responsibility of the contract driller to provide the necessary equipment. It is the responsibility of the ERT geologist or engineer to observe the performance of borehole permeability tests to ensure that all procedures are performed according to the SOP and to record all departures from the SOP. The geologist or engineer is also responsible for recording test data; and determining when tests will be performed, and duration of the test.

3.0 Supporting Materials

- measuring tape with sounding device
- stopwatch or other timing device
- bucket
- bailer
- centrifugal pump

4.0 Method or Protocol for Conducting Test

4.1 General Procedure

4.2.1 Borings designated for permeability tests shall be selected prior to drilling. These holes shall be cased and the use of drilling mud or recirculated drill water will not be allowed as this will affect the permeability of the surrounding material.

4.1.2 Once the desired testing depth is reached, as determined by the project geologist/engineer, the drilling operations shall be stopped and the casing properly seated at the depth of the drilling bit. The casing shall then be cleaned to remove all loose materials and drill rods withdrawn slowly to prevent loosening of the soil at the bottom of the boring.

4.1.3 Top of casing shall be the reference datum for all measurements. Elevation difference between top of casing and ground surface shall be documented.

4.2 Specific Procedures - Rising-Head Test

4.2.1 Once the casing has been seated and cleaned, the water level shall be allowed to stabilize for 10 to 15 minutes prior to testing.

4.2.2 After stabilization, the water level is then temporarily lowered with the use of a pump or by bailing.

4.2.3 Recovery measurements are then taken at a pre-selected time interval using the measuring tape and recorded on the permeability-test form. Reference datum shall be top casing.

4.2.4 The test may be repeated if necessary.

4.3 Specific Procedures: Falling-Head Test (Flush Bottom)

4.3.1 Once the casing has been seated and cleaned, the hole is then filled with water to a level within 5 feet from the top of the casing. This water level is maintained for 10 to 15 minutes, by adding water if necessary, to allow for development of a steady seepage rate.

4.3.2 When the water level has been adjusted for the last time, the initial test water-level shall be recorded.

4.3.3 The timing device shall then be started.

4.3.4 Proceed to take drawdown measurements at the selected time interval using the measuring tape until stabilization is reached. Reference datum shall be top of casing.

4.3.5 Record all values onto the permeability test form.

4.3.6 Repeat the test if necessary.

4.4 Specific Procedures: Falling-Head Test (Pulled-back Casing)

4.4.1 Utilize the same procedure as in section 4.2 except for the following:

4.4.2 The casing shall be backfilled with a clean, washed sand to a designated depth and the casing shall then be pulled back a designated amount.

4.4.3 Amount of backfill and length of pull-back will be determined by the geologist or engineer prior to testing.

4.5 Specific Procedures: Recorded Data

The following is a list of required data to be recorded on the test form:

- ground elevation
- reference elevation (top of casing)
- depth of test run
- casing diameter
- length of uncased borehole
- equipment identification

Other data to be recorded is listed on the included test report.

5.0 Documentation

A <u>permeability test report</u> shall be completed by the geologist or engineer for each test conducted.

All documentation shall be retained in the project files following completion of the project.

B

APPENDIX B

Standard Operating Procedures

- Groundwater Sample Collection
- Packaging and Shipment of Samples

STANDARD OPERATING PROCEDURE
Page: 1 of 17
Date: 1st Qtr. 1986
Number: 7130
Revision: 1

Title: Ground-Water Sample Collection from Monitoring Wells

1.0 Applicability

This Standard Operating Procedure (SOP) is concerned with the collection of valid and representative samples from ground-water monitoring wells. The scope of this document is limited to field operations and protocols applicable during ground-water sample collection.

2.0 Responsibilities

The site coordinator or his delegate will have the responsibility to oversee and ensure that all ground-water sampling is performed in accordance with the project-specific sampling program and this SOP. In addition, the site coordinator must ensure that all field workers are fully apprised of this SOP. The field team is responsible for proper sample handling as specified in SOP 7510, Handling and Storage of Samples.

3.0 Supporting Materials

The list below identifies the types of equipment which may be used for a range of ground water-sampling applications. From this list, a project-specific equipment list will be selected based upon project objectives, the depth to ground-water, purge volumes, analytical parameters and well construction. The types of sampling equipment are as follows:

- Purging/Sample Collection

  Bailers
  Centrifugal Pump
  Submersible Pump
  Peristaltic Pump

- Sample Preparation/Field Measurement

  pH Meter
  Specific Conductance Meter
  Filtration Apparatus
  Water-Level Measurement Equipment

Additional equipment to support sample collection and provide baseline worker safety will be required to some extent for each sampling task. The additional materials are separated into two primary groups: general equipment which is reusable for several samplings, and materials which are expendable.

- General

    Project-specific sampling program
    Deionized-water dispenser bottle
    Methanol-dispenser bottle
    Site-specific Health & Safety equipment (gloves, respirators, goggles)
    Field data sheets and/or log book
    Preservation solutions
    Sample containers
    Buckets and intermediate containers
    Coolers
    First-Aid kit

- Expendable Materials

    Bailer Cord
    Respirator Cartridges
    Gloves
    Water Filters
    Chemical-free paper towels
    Plastic sheets

Equipment checklists have been developed to aid in field trip organization and should be used in preparation for each trip.

4.0 Water-Level Measurement

4.1 Introduction

Prior to obtaining a water-level measurement, cut a slit in one side of the plastic sheet and slip it over and around the well, creating a clean surface onto which the sampling equipment can be positioned. This clean working area should be a minimum of eight feet square. Care will be taken not to kick, transfer, drop, or in any way let soil or other materials fall onto this sheet unless it comes from inside the well. Do not place meters, tools, equipment, etc. on the sheet unless they have been cleaned first with a clean rag.

After unlocking and/or opening a monitoring well, the first task will be to obtain a water-level measurement. Water-level measurements will be made using an electronic or mechanical device. Electronic measurement devices will be used in all wells wherein a clearly audible sound cannot be produced with a mechanical device.

4.2 Well Security

Unlock and/or open the monitoring well. Enter a description of condition of the security system and protective casing on the Ground-Water Sample Collection Record shown in Figure 1.

4.3 Measuring Point

Check for the measuring point for the well. The measuring point location should be clearly marked on the outermost casing or identified in previous sample collection records. If no measuring point can be determined, a measuring point should be established. Typically the top (highest point) of the protective or outermost well casing will be used as the measuring point. The measuring point location should be described on the Ground-Water Sample Collection Record and should be the same point used for all subsequent sampling efforts.

4.4. Measurement

To obtain a water-level measurement lower a clean steel, fiberglass tape into the monitoring well. Care must be taken to assure that the water-level measurement device hangs freely in the monitoring well and is not adhering to the wall of the well casing. The water-level measuring tape will be lowered into the well until the audible sound of the unit is detected or the light on an electronic sounder illuminates. At this time the precise measurement should be determined (to hundredth of a foot) by repeatedly raising and lowering the tape to converge on the exact measurement. The water-level measurement should be entered on the Ground-Water Sample Collection Record. As well point of measurement should be indicated; i.e., top of protective casing, top of pueriser, ground level.

4.5 Decontamination

The measurement device shall be decontaminated immediately after use with a methanol soaked towel. Generally only that portion of the tape which enters the water table should be cleaned. It is important that the measuring tape is never placed directly on the ground surface.

5.0 Purge-Volume Computation

All monitoring wells to be purged prior to sample collection. Depending upon the ease of purging, 3 to 10 volumes of ground water to be determined by hydrogeologing prior to sampling present in a well shall be withdrawn prior to sample collection or one volume if well can be purged dry. The volume of water present in each well shall be computed based on the length of water column and well casing diameter. The water volume shall be computed using Figure 2.

6.0 Well-Purging Methods

6.1 Introduction

Purging must be performed for all ground-water monitoring wells prior to sample collection in order to remove stagnant water from within the well casing and ensure that a representative sample is obtained. The following sections explain the proper procedures for purging and collecting water samples from monitoring wells.

Three general types of equipment are used for well purging: bailers, surface pumps, or down-well submersible pumps.

In all cases pH and/or specific conductance will be monitored during purging. Field parameter values will be entered on the Ground-Water Sample Collection Record along with the corresponding purge volume.

6.2 Bailing

In many cases bailing is the most convenient method for well purging. Bailers are constructed using a variety of materials; generally, PVC stainless steel, and Teflon®. Care must be taken to select a specific type of bailer that suits a study's particular needs. Teflon® bailers are generally most "inert" and are used most frequently. Keep in mind the diameter of each monitoring well so that the correct size bailers are taken to the site. It is preferable to use one bailer per well; however, field decontamination is a relatively simple task if required.

Bailing presents two potential problems with well purging. First, increased suspended solids may be present in samples as a result of the turbulence caused by raising and lowering the bailer through the water column. High solids concentrations may require that total suspended solids (TDS) and the chemical character of solids be evaluated during sample analyses. Second, bailing may not be feasible for wells which require that greater than twenty (20) gallons be removed during purging. Such bailing conditions mandate that long periods be spent during purging and sample collection or that centrifugal pumps be used. All ground-water collected from monitoring wells for subsequent volatile organic compound analyses shall be collected using bailers, regardless of the purge method.

6.3 Surface Pumping

Ground-water withdrawal using pumps located at the ground surface is commonly performed with centrifugal or peristaltic pumps.

All applications of surface pumping will be governed by the depth to the ground-water surface. Peristaltic and centrifugal pumps are limited to conditions where ground water need only be raised through approximately 20 feet of vertical distance. The lift potential of a surface pumping system will depend upon the net positive suction head of the pump and the friction losses associated with the particular suction line, as well as the relative percentage of suspended particulates.

Surface pumping can be used for many applications of well purging and ground-water sample collection. In all cases, pumping cannot be used for the collection of samples to be analyzed for volatile organic compounds (VOCs).

6.3.1 Peristaltic Pump

Peristaltic pumps provide a low rate of flow typically in the range of 0.02-0.2 gallons/min (75-750 ml/min). For this reason, peristaltic pumps are not particularly effective for well purging. Peristaltic pumps are suitable for purging situations where disturbance of the water column must be kept minimal for particularly sensitive analyses. Peristaltic pumps are most often used in conjunction with field filtering of samples and therefore can be used to obtain water samples for direct filtration at the wellhead.

6.3.2 Centrifugal Pump

Centrifugal pumps are designed to provide a high rate of pumping, in the range of 10-40 gallons per minute (gpm), depending on pump capacity. Discharge rates can also be regulated somewhat provided the pump has an adjustable throttle.

When centrifugal pumps are used, samples should be obtained from the suction (influent) line during pumping by an entrapment scheme as shown in Figure 3. Construction of this sampling scheme is relatively simple and will not be explained as part of this SOP. It is suggested that if samples cannot be obtained before going through the pump, that samples be obtained by using a bailer once pumping has ceased. Collecting samples from the pump discharge is not recommended.

6.3.3 Submersible Pump

Submersible pumps provide an effective means for well purging and in some cases sample collection. Submersible pumps are particularly useful for situations where the depth to water table is greater than twenty (20-30) feet and the depth or diameter of the well requires that a large purge volume be removed during purging.

ERT uses the Johnson-Keck pump model SP-81 which has a 1.75 inch diameter pump unit. The pump diameter restricts use to monitoring wells which have inside diameters equal to or greater than two (2) inches. As with other pump-type purge/sample collection methods, submersible pumps will not be used for the collection of samples for analyses of volatile organic compounds. Submersible pumps should never be used for well development as this <u>will</u> seriously damage the pump.

7.0 Sample Collection Procedures

7.1 Bailing

Obtain a clean/decontaminated bailer and a spool of polypropylene rope or equivalent bailer cord. Using the rope at the end of the spool tie a bowline knot or equivalent through the bailer loop. Test the knot for security and the bailer itself to ensure that all parts are intact prior to inserting the bailer into the well.

Remove the protective foil wrapping from the bailer, and lower the bailer to the bottom of the monitoring well and cut the cord at a proper length. Boiler rope should never touch the ground surface at any time during the purge routine.

Raise the bailer by grasping a section of cord using each hand alternately in a "rocking" action. This method requires that the samplers' hands be kept approximately 2-3 feet apart and that the bailer rope is alternately looped onto or off each hand as the bailer is raised and lowered.

Bailed ground water is poured from the bailer into a graduated bucket to measure the purged water volume.

For slowly recharging wells, the bailer is generally lowered to the bottom of the monitoring well and withdrawn slowly through the entire water column. Rapidly recharging wells should be purged by varying the level of bailer insertion to ensure that all stagnant water is removed. The water column should be allowed to recover to 70-90% of its static volume prior to collecting a sample. Water samples should be obtained from midpoint or lower within the water column.

Samples collected by bailing will be poured directly into sample containers from bailers which are full of fresh ground water. During sample collection, bailers will not be allowed to contact the sample containers.

7.2 Peristaltic Pump

Place a new suction and discharge line to the peristaltic pump. Silicon tubing must be used through the pump head. A second type of tubing may be attached to the silicon tubing to create the suction and discharge lines. Such connection is advantageous for the purpose of reducing tubing costs, but can only be done if airtight connections can be made. Tygon tubing will not be used when performing well purging or collecting samples for organic analysis. The suction line must be long enough to extend to the static ground-water surface and reach further should drawdown occur during pumping.

Measure the length of the suction line and lower it down the monitoring well until the end is in the upper 2-5 inches of the water column present in the well. Start the pump and direct the discharge into a graduated bucket.

Measure the pumping rate in gallons per minute by recording the time required to fill a selected volume of a bucket. Flow measurement shall be performed three times to obtain an average rate.

The pumping shall be monitored to assure continuous discharge. If drawdown causes the discharge to stop, the suction line will be lowered very slowly further down into the well until pumping restarts.

Measurements of pH and specific conductance will be made periodically during well purging. All readings will be entered on the Ground-Water Sample Collection Record.

Samples will be collected after the required purge volume has been withdrawn and the field parameters (pH and Specific Conductance) have stabilized.

When the sample bottles are prepared, each shall be filled directly from the discharge line of the peristaltic pump. Care will be taken to keep the pump discharge line from contacting the sample bottles. Ground-water samples requiring filtration prior to placement in sample containers, will be placed in intermediate containers for subsequent filtration or filtered directly using the peristatic pump.

At each monitoring point when use of the peristaltic pump is complete, all tubing including the suction line, pump head and discharge line must be disposed of. In some cases where sampling will be performed frequently at the same point, the peristaltic pump tubing may be retained between each use in a clean zip-lock plastic bag.

7.3 Centrifugal Pump

7.3.1 Direct Connection Method (Note: This method requires that the well casing be threaded at the top.)

Establish direct connection to the top of the monitoring well if possible using pipe connections, extensions, and elbows, with Teflon® tape wrapping on all threaded connections. If the centrifugal pump will subsequently be used for sample collection, a sample isolation chamber will be placed in the suction line configuration as shown in Figure 3.

Prime the pump by adding tap water to the pump housing until the housing begins to overflow.

Start the pump and direct the discharge into a graduated bucket or a bucket of known capacity (>2.5 gallons).

Start the pump and measure the pumping rate in gallons per minute by recording the time required to fill the graduated bucket. Flow measurement should be checked periodically to determine if pumping rates are continuous, fluctuating, or diminishing. If discharge stops, the pump will be throttled back to determine if pumping will restart at a lower rate. If pumping does not restart, the pump should be shut off to allow the well to recharge.

Measurements of pH and specific conductance will be made periodically during well purging. All readings will be entered on the Ground-Water Sample Collection Record. Samples will be collected after the required purge volume has been withdrawn and the field parameters (pH and Specific Conductance) have stabilized. Samples should be collected from an in-line discharge valve or with a bailer. The pump should be properly decontaminated between wells.

7.3.2 Down-Well Suction-Line Method

Lower a new suction line into the well. The suction line will have a total length great enough to extend to the water table and account for a minimum of five (5) feet of drawdown. Note should be made that drawdown may exceed the depth where pumping will terminate as a result of a limitation derived from suction-line conditions and the lift potential of the pump. All connections should be made using Teflon● ferrules and Teflon● thread wrapping tape. Run the pump as per Section 7.3.1.

At each monitoring well when use of a centrifugal pump is complete, all suction line tubing should be disposed of properly.

7.4 Submersible Pump

Prior to using a submersible pump, a check will be made of well diameter and alignment. A 1.75 inch diameter decontaminated cylindrical tube should be lowered to the bottom of each monitoring well to determine if the alignment or plumbness of a well is adequate to accommodate the submersible pump. All observations will be entered in the Ground-Water Sample Collection Record.

Slowly lower the submersible pump into the monitoring well taking notice of any roughness or restrictions within the riser.

Count the graduations on the pump discharge line and stop lowering when the stainless steel portion is below the uppermost section of the static water column within monitoring well. Secure the discharge line and power cord to the well casing.

Connect the power cord to the power source (i.e., rechargeable battery pack or auto battery monitor) and turn the pump on (forward mode). When running, the pump can usually be heard by listening near the well head.

Voltage and amperage meter readings on the pump discharge must be checked continuously. The voltage reading will decline slowly during the course of a field day representing the use of power from the battery. Amperage readings will vary depending upon the depth to water table. Amperage readings greater than 10 amps usually indicate a high solids content in the ground water which may cause pump clogging and serious damage. If a steady increase in amperage is observed, the pump should be shut off, allowed to stop, switched to the reverse mode, stopped again and then placed in forward mode. If high amperage readings persist, the pump should be withdrawn and checked using the large upright cylinder and tap water. Ground-water conditions such as high solids may require that an alternate purge/sample method be used.

Drawdown must also be monitored continuously by remaining near the well at all times and listening to the pump. When drawdown occurs, a metallic rotary sound will be heard as the pump intake becomes exposed and ceases to discharge water, but continues to run. The pump should be lowered immediately to continue pumping water within the uppermost section of the static water column. NOTE: The submersible pump cannot be allowed to run while not pumping for more than five seconds or the pump motor will burn out.

If drawdown continues to the extent that the well is pumped dry, the pump should be shut off and the well allowed to recharge. This on/off cycle may need to be repeated several times in order to purge the well properly.

Measurements of the pumping rate, pH, and specific conductance should be made periodically during well purging. All readings and respective purge volumes should be entered on the Ground-Water Sample Collection Record.

While pumping is on-going and when sample bottles are prepared, bottles will be filled directly from the discharge line of the pump taking care not to touch sample bottles to the discharge line.

At each monitoring well when use of the submersible pump is complete, the pump, discharge line and power cord shall be decontaminated according to the procedures contained in the SOP for Decontamination.

8.0 Sample Preparation

8.1 Introduction

Prior to sample transport or shipment, ground-water samples may require filtration and/or preservation dependent on the specific type of analysis required.

Specific preservation techniques are described in the EPA document, Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA-600/4-82-029). The EPA manual and laboratory manager should be consulted during the planning stage of the project. Project-specific sampling plans shall be assembled using the approved procedures obtained from the EPA manual.

8.2 Filtration

Ground-water samples collected for dissolved metals analyses will be filtered prior to being placed in sample containers. Ground-water filtration will be performed using a peristaltic pump and a 0.45 micron, water filter. Typically the water filters are 142 mm in diameter and are usually placed in 142 mm polycarbonate housings.

The filtration of ground-water samples shall be performed either directly from the monitoring well or from intermediate sample containers such as decontaminated buckets. In either case, well purging shall be performed first. Fresh ground water shall then be filtered and discharged from the filtration apparatus directly into sample containers. For most dissolved metal analyses, pH adjustment of the sample is also required and shall be performed after filling the sample bottles. This is generally accomplished using laboratory supplied compounds such as sulfuric or nitric acid and sodium hydroxide.

9.0 Documentation

A number of different documents must be completed and maintained as a part of ground-water sampling effort. The documents provide a summary of the sample-collection procedures and conditions, shipment method, the analyses requested and the custody history. The list of documents is:

- Ground-water sample collection record
- Sample labels
- Chain of custody forms and tape
- Shipping receipts

Sample labels shall be completed at the time each sample is collected and will include the information listed below. A sample label is shown in Figure 4.

- Client or project name
- Sample number
- Designation (i.e., identification of sample point no.)
- Analysis
- Preservative (e.g., filtration, acidified pH<2 HNO_3)
- Sample-collection date
- Sampler's name

Figure 5 displays the chain of custody record used by ERT. The chain of custody form is the record sample collection and transfer of custody. Information such as the sample collection date and time of collection, sample identification and origination, client or project name shall be entered on each chain of custody record. In accordance with 40 CFR 261.4(d) the following information must accompany all ground water samples which are known to be non-hazardous and to which U.S. Department of Transportation and U.S. Post Office regulations do not apply. Such information is:

- sample collector's name, mailing address and telephone number,
- analytical laboratory's name, mailing address and telephone number,
- quantity of each sample,
- date of shipment, and
- description of sample.

The chain of custody forms provide a location for entry of the above-listed information.

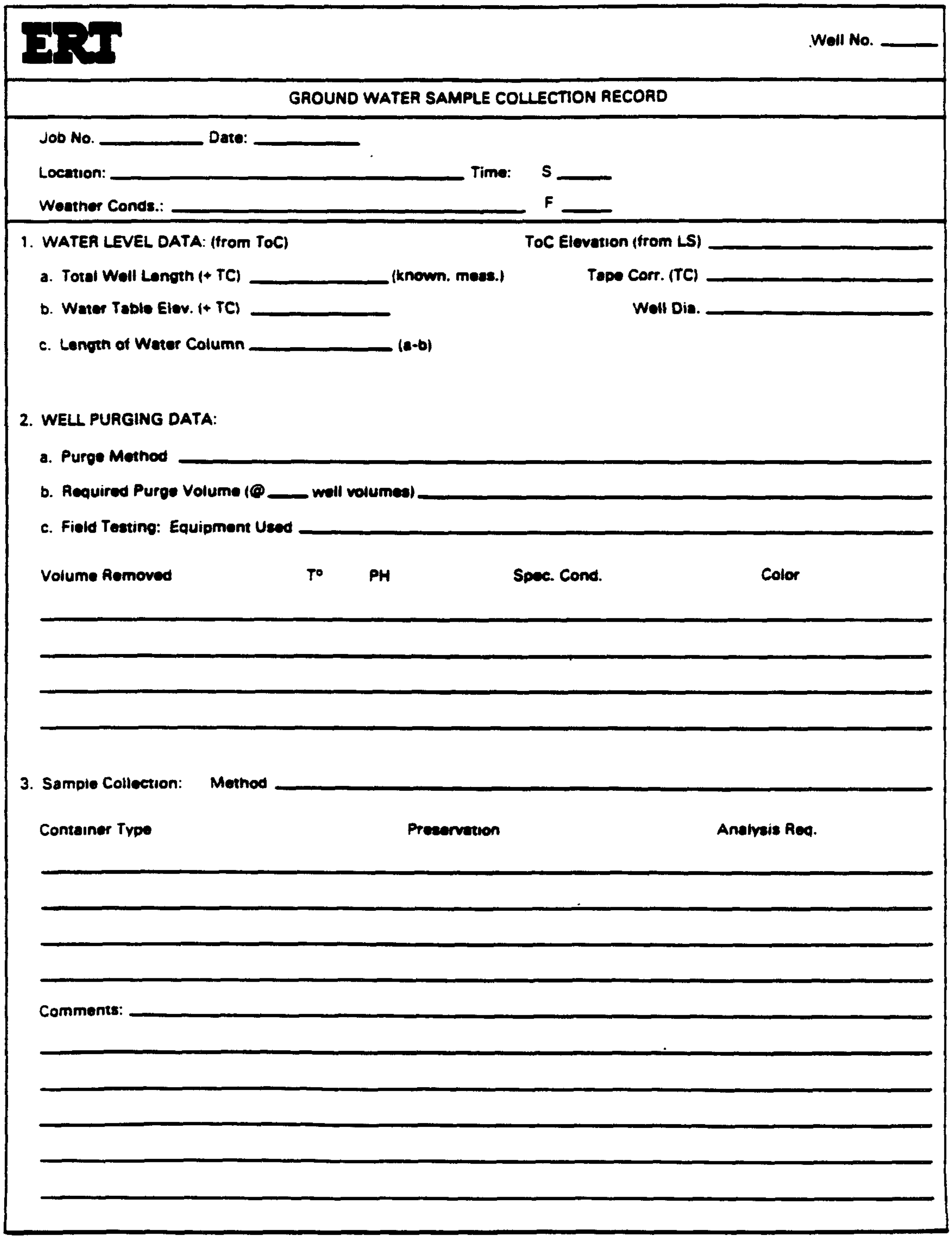
10.0 References

EPA, Handbook for Sampling and Sample Preservation of Water and Wastewater EPA-600/4-82-029, September 1982.

Geotrans, Inc. RCRA Permit Writer's Manual, Ground-Water Protection prepared for U.S. EPA. Contract No. 68-01-6464, October 1983.

Code of Federal Regulations, Chapter 40 (Section 261.4(d).

Figure 1



ERT Well No. ____

GROUND WATER SAMPLE COLLECTION RECORD

Job No. ____ Date: ____

Location: ____ Time: S ____

Weather Conds.: ____ F ____

1. WATER LEVEL DATA: (from ToC) ToC Elevation (from LS) ____
   a. Total Well Length (+ TC) ____ (known. meas.) Tape Corr. (TC) ____
   b. Water Table Elev. (+ TC) ____ Well Dia. ____
   c. Length of Water Column ____ (a-b)

2. WELL PURGING DATA:
   a. Purge Method ____
   b. Required Purge Volume (@ ____ well volumes) ____
   c. Field Testing: Equipment Used ____

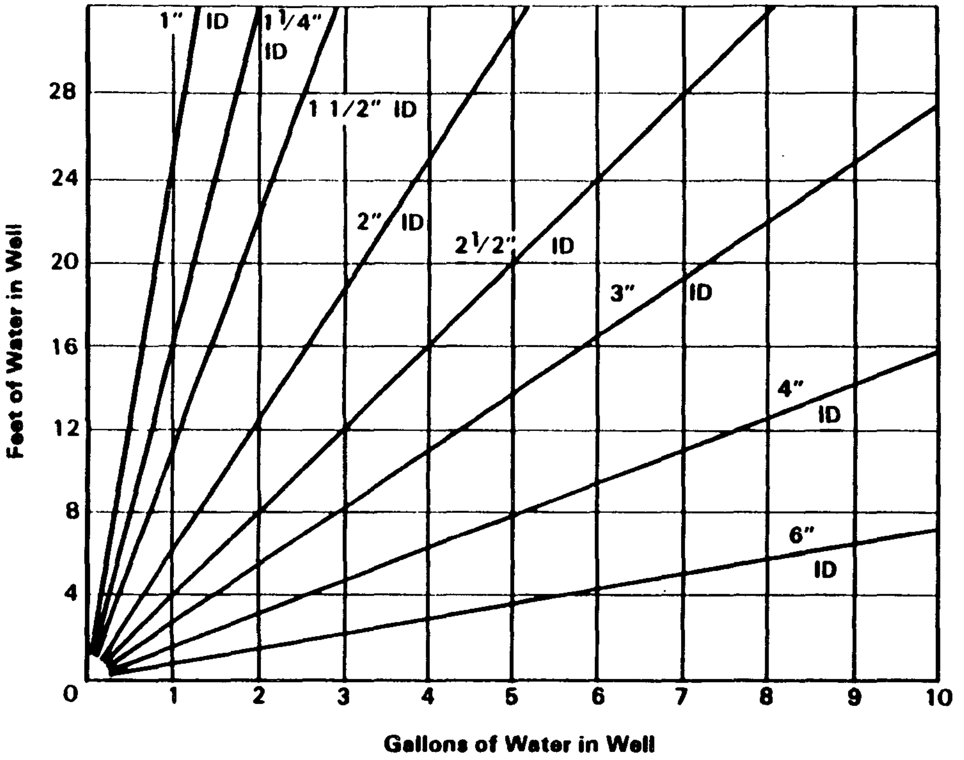
Volume Removed	T°	PH	Spec. Cond.	Color

3. Sample Collection: Method ____

Container Type	Preservation	Analysis Req.

Comments: ____

1995-12-84



(a) Graphical Explanation

Volume/Linear Ft. of Pipe		
ID(in)	Gal	Liter
1/4	0.003	0.010
3/8	0.006	0.022
1/2	0.010	0.039
3/4	0.023	0.087
1	0.041	0.154
2	0.163	0.618
3	0.367	1.39
4	0.653	2.47
6	1.47	5.56

(b) Volume Factors

Figure 2 Purge Volume Computation

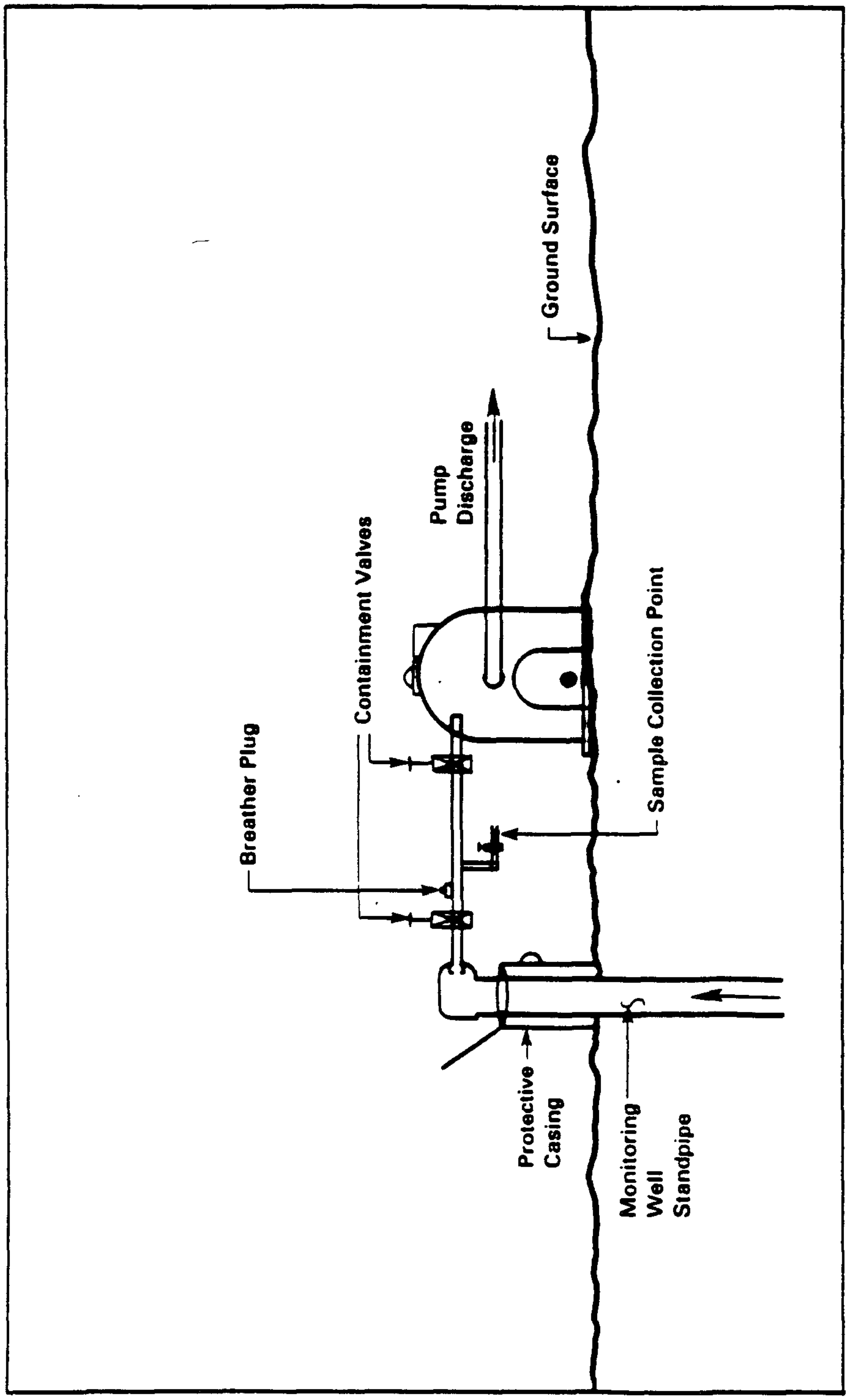
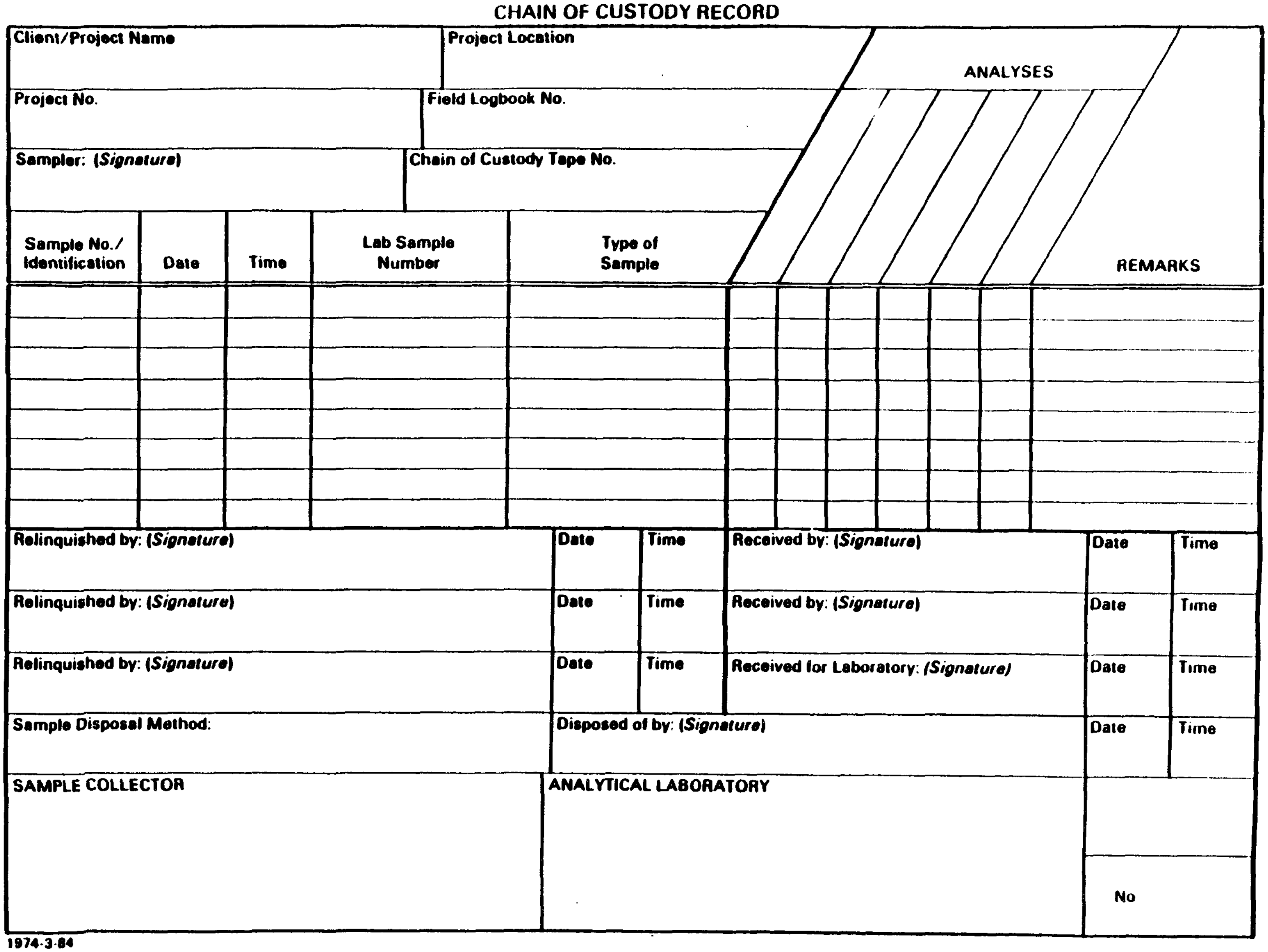


Figure 3 Down Well Suction Line Configuration

CLIENT ____________________
SAMPLE NO. ________________
DESIGNATION _______________
ANALYSIS __________________
PRESERVATIVE ______________
DATE __________ BY __________

Figure 4 Sample Container Label



CHAIN OF CUSTODY RECORD

Client/Project Name
Project Location
Project No.
Field Logbook No.
Sampler: (*Signature*)
Chain of Custody Tape No.

Sample No./ Identification	Date	Time	Lab Sample Number	Type of Sample	ANALYSES						REMARKS

Relinquished by: (*Signature*)	Date	Time	Received by: (*Signature*)	Date	Time
Relinquished by: (*Signature*)	Date	Time	Received by: (*Signature*)	Date	Time
Relinquished by: (*Signature*)	Date	Time	Received for Laboratory: (*Signature*)	Date	Time
Sample Disposal Method:	Disposed of by: (*Signature*)			Date	Time
SAMPLE COLLECTOR	ANALYTICAL LABORATORY			No	

1974-3-84

Figure 5 Sample Chain-of-Custody Record

STANDARD OPERATING PROCEDURE

Title: Packaging and Shipment of Samples

Page: 1 of 6
Date: 3rd Qtr. 1986
Number: 7510
Revision: 1

1.0 Applicability

This Standard Operating Procedure (SOP) is concerned with procedures associated with the packaging and shipment of samples. Two general categories of samples exist: environmental samples consisting of air, water and soil; and waste samples which include non-hazardous solid wastes and hazardous wastes as defined by 40 CFR Part 261.

2.0 Responsibilities

It is the responsibility of the project manager to assure that the proper packaging and shipping techniques are utilized for each project. The site operations manager shall be responsible for the enactment and completion of the packaging and shipping requirements outlined in the project specific sampling plan. The site operations manager shall be responsible to research, identify and follow all applicable U.S. Department of Transportation (DOT) regulations regarding shipment of materials classified as waste.

3.0 General Method

The objective of sample packaging and shipping protocol is to identify standard procedures which will minimize the potential for sample spillage or leakage and maintain field sampling program compliance with U.S. EPA and U.S. DOT regulations.

The extent and nature of sample containerization will be governed by the type of sample, and the most reasonable projection of the sample's hazardous nature and constituents. The EPA regulations (40 CFR Section 261.4(d)) specify that samples of solid waste, water, soil or air, collected for the sole purpose of testing, are exempt from regulation under the Resource Conservation and Recovery Act (RCRA) when all of the following conditions are applicable:

A. Samples are being transported to a laboratory for analysis;
B. Samples are being transported to the collector from the laboratory after analysis;
C. Samples are being stored (1) by the collector prior to shipment for analyses, (2) by the analytical laboratory prior to analyses, (3) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

Qualification for categories A and B above require that sample collectors comply with U.S. DOT and U.S. Postal Service (USPS) regulations or comply with the following items if U.S. DOT and USPS regulations are found not to apply:

The following information must accompany all samples and will be entered on a sample specific basis on chain of custody records:

- sample collector's name, mailing address and telephone number,
- analytical laboratory's name, mailing address and telephone number,
- quantity of sample,
- date of shipment,
- description of sample, and

in addition, all samples must be packaged so that they do not leak, spill or vaporize.

4.0 General Methods

4.1 Place plastic bubble wrap matting over the base and bottom corners of each cooler or shipping container as needed to manifest each sample.

4.2 Obtain a chain of custody record as shown in Figure 1 and enter all the appropriate information as discussed in Section 3.0 of this SOP. Chain of custody records will include complete information for each sample. One or more chain of custody records shall be completed for each cooler or shipping container as needed to manifest each sample.

4.3 Wrap each sample bottle individually and place standing upright on the base of the appropriate cooler, taking care to leave room for some packing material and ice or equivalent. Rubber bands or tape should be used to secure wrapping, completely around each sample bottle.

4.4 Place additional bubble wrap and/or styrofoam pellet packing material throughout the voids between sample containers within each cooler.

4.5 Place ice or cold packs in heavy duty zip-lock type plastic bags, close the bags, and distribute such packages over the top of the samples.

4.6 Add additional bubble wrap/styrofoam pellets or other packing materials to fill the balance of the cooler or container.

4.7 Obtain two pieces of chain of custody tape as shown in Figure 2 and enter the custody tape numbers in the appropriate place on the chain of custody form. Sign and date the chain of custody tape.

4.8 To complete the chain of custody form enter the type of analysis required for each sample, by container, under the "ANALYSES" section. Under the specific analysis enter the quantity/volume of sample collected for each corresponding analysis.

If shipping the samples where travel by air or other public transportation is to be undertaken, sign the chain of custody record thereby relinquishing custody of the samples. Relinquishing custody should only be performed when directly transmitting custody to a receiving party or when transmitting to a shipper for subsequent receipt by the analytical laboratory. Shippers should not be asked to sign chain of custody records.

4.9 Remove the last copy from the chain of custody record and retain with other field notes. Place the original and remaining copies in a zip-lock type plastic bag and place the bag on the top of the contents within the cooler or shipping container.

4.10 Close the top or lid of the cooler or shipping container and with another person rotate/shake the container to verify that the contents are packed so that they do not move. Improve the packaging if needed and reclose.

When transporting samples by automobile to the laboratory, and where periodic changes of ice are required, the cooler should only be temporarily closed so that reopening is simple. In these cases, chain of custody will be maintained by the person transporting the sample and chain of custody tape need not be used. If the cooler is to be left unattended, then chain of custody procedures should be enacted.

4.11 Place the chain of custody tape at two different locations on the cooler or container lid and overlap with transparent packaging tape. For coolers with hinged covers, if the hinges are attached with screws, chain of custody tape should also be used on the hinge side.

4.12 Packaging tape should be placed entirely around the sample shipment containers. A minimum of one to two full wraps of packaging tape will be placed at at least two places on the cooler. Shake the cooler again to verify that the sample containers are well packed.

4.13 If shipment is required, transport the cooler to an overnight express package terminal or arrange for pickup. Obtain copies of all shipment records as provided by the shipper.

4.14 If the samples are to travel as luggage, check with regular baggage.

4.15 Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain of custody form. The laboratory will verify that the chain of custody tape has not been broken previously and that the chain of custody tape number corresponds with the number on the chain of custody record. The analytical laboratory will then forward the back copy of the chain of custody record to the sample collector to indicate that sample transmittal is complete.

5.0 Documentation

As discussed in Section 4.0 the documentation for supporting the sample packaging and shipping will consist of chain of custody records and shipper's records. In addition a description of sample packaging procedures will be written in the field log book. All documentation will be retained in the project files following project completion.

CHAIN OF CUSTODY RECORD

Client/Project Name
Project Location
Project No.
Field Logbook No.
Sampler: (*Signature*)
Chain of Custody Tape No.

Sample No./ Identification	Date	Time	Lab Sample Number	Type of Sample	ANALYSES							REMARKS

Relinquished by: (*Signature*)	Date	Time	Received by: (*Signature*)	Date	Time
Relinquished by: (*Signature*)	Date	Time	Received by: (*Signature*)	Date	Time
Relinquished by: (*Signature*)	Date	Time	Received for Laboratory: (*Signature*)	Date	Time
Sample Disposal Method:	Disposed of by: (*Signature*)			Date	Time

SAMPLE COLLECTOR

ERT - A Resource Engineering Company
696 Virginia Road
Concord, MA 01742
617-369-8910

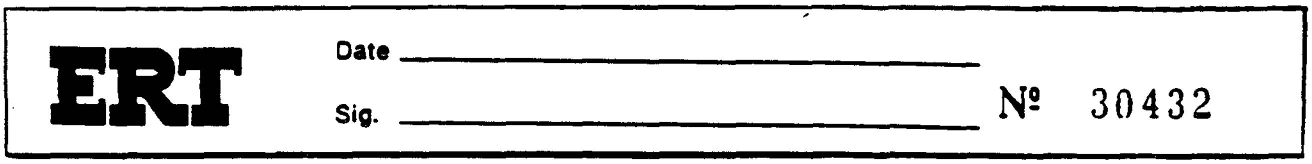
ANALYTICAL LABORATORY

ERT

Nº 1663

1974-3-84

Figure 1



ERT

Date ______________________

Sig. ______________________

№ 30432

Figure 2

C

APPENDIX C

Analytical Results and Chain-of-Custody Documentation

ENSR

Formerly ERT

ENSR Consulting
and Engineering

33 Industrial Way
Wilmington, MA 01887
(508) 657-4290

July 21, 1989

Mr. Sam Nott
ENSR Consulting and Engineering
12655 No. Central Expressway
Suite 706
Dallas, TX 75243

REFERENCE:	Project No. :	8500-089-117 (2467-003-000)
	Project Name :	El Paso Natural Gas
	Date Received:	July 8, 1989

Dear Mr. Nott:

Enclosed are the results of analyses performed at your request on the project submission referenced above. Please feel free to contact us if you have any questions concerning the enclosed data.

Sincerely yours,

Laurie H. Ekes
Laboratory Project Mgr.
(508) 657-4290

Karen M. McNamara for M.S.
Martha S. Sparlin
Laboratory QA Manager

Marilyn Hoyt
Marilyn Hoyt
Laboratory Manager

LABORATORY ANALYTICAL REPORT

I. INTRODUCTION

This report represents the results of analyses conducted on ENSR Project No. 8500-089-117 (2467-003-000), received by the Wilmington Laboratory on July 8, 1989. Upon receipt by the laboratory, the samples were inspected for condition, Chain of Custody field identification accountability, and individual sample analytical requirements. The submitted samples were entered into the computerized Laboratory Information Management data base and unique laboratory identification numbers were assigned to each sample. The sample I.D. number is subsequently used throughout the laboratory to provide positive sample accountability in accordance with recommended USEPA sample management protocol. Table I summarizes the field identification, laboratory sample numbers, and analytical methodologies performed for this project.

TABLE I.
Project Sample Summary

Project No. : 8500-089-117
Project Name: El Paso Natural Gas

Field Identification	Sample Number	Sample Matrix	Analytical Method and Reference
EP-03-A	71274	WATER	EPA METHOD 625
EP-01-A	71275	WATER	EPA METHOD 625
EP-02-A	71276	WATER	EPA METHOD 625
EP-02-B	71277	WATER	EPA METHOD 625

II. QUALITY ASSURANCE AND QUALITY CONTROL

As an indication of the overall quality of the data generated by the ENSR Laboratory for this report, one or more of the following types of Quality Control analyses may be included in this report as required by the analytical methodology referenced in the project summary contained in TABLE I.

1. Method Blanks (MB)
2. Sample Duplicate Analyses
3. Laboratory Control Samples (LCS)
4. Matrix Spikes and Duplicates (MS/MSD)
5. Surrogate Compound Recoveries

Results of the quality control and quality assurance samples analyzed concurrently with the submitted samples for this project were within acceptable ranges. Quality control analyses and criteria for all methodologies performed by this laboratory are established by regulatory agencies and are constantly monitored as part of the laboratory's formal QA/QC program. Appendix I contains descriptions of the various types of QA/QC requirements which may have been required in this project.

III. ANALYTICAL RESULTS AND DISCUSSION

The results of analyses included in this report have been reviewed by the appropriate analytical department managers, the Laboratory Quality Assurance Manager, and the Laboratory Project Manager for accuracy and completeness. Method descriptions and summaries of procedures used in this project are available upon request. Appendix II contains general references to analytical procedures used by this laboratory.

The Method Blank (MB) and Laboratory Control Spike (LCS) were within acceptable QA/QC ranges for the Semi-Volatile Organics analysis.

Samples EP-01-A and EP-02-A (ENSR#s 71275 and 71276) had low percent recoveries of acid surrogates due to emulsions which formed during the acidic extraction phase. The acid compounds results (noted by "@" on the report sheets), should be used as estimates only.

Samples EP-01-A, EP-02-A, and EP-02-B (ENSR#s 71275, 71276, and 71277) had results for certain compounds which were less than the method reporting limit (10 ug). The results for these compounds (noted by "J" on the report sheets), should also be used as estimates only.

METHODOLOGY SUMMARIES
AND
PROJECT DATA

ENSR CONSULTING AND ENGINEERING
SUMMARY OF ANALYTICAL RESULTS
SEMI-VOLATILE COMPOUNDS IN WATER

ENSR NO : MB890684
FLD ID : METHOD BLANK
CLIENT : EL PASO NATURAL GAS
SAMPLING SITE : ENSR,WILMINGTON,MA
PROJECT NO : 8500-089-117

DATE SAMPLED : 07/11/89
DATE RECEIVED : NOT APPLICABLE
DATE EXTRACTED : 07/11/89
DATE ANALYZED : 07/13/89

PARAMETER	RESULT (UG/L)	PARAMETER	RESULT (UG/L)
PHENOL	BDL	3-NITROANILINE	BDL#
ANILINE	BDL	ACENAPHTHENE	BDL
BIS(2-CHLOROETHYL)ETHER	BDL	2,4-DINITROPHENOL	BDL#
2-CHLOROPHENOL	BDL	4-NITROPHENOL	BDL#
1,3-DICHLOROBENZENE	BDL	DIBENZOFURAN	BDL
1,4-DICHLOROBENZENE	BDL	2,4-DINITROTOLUENE	BDL
BENZYL ALCOHOL	BDL	2,6-DINITROTOLUENE	BDL
1,2-DICHLOROBENZENE	BDL	DIETHYL PHTHALATE	BDL
2-METHYLPHENOL	BDL	4-CHLOROPHENYL PHENYLETHER	BDL
BIS(2-CHLOROISOPROPYL)ETHER	BDL	FLUORENE	BDL
4-METHYLPHENOL	BDL	4-NITROANILINE	BDL#
N-NITROSO-DI-N-PROPYLAMINE	BDL	4,6-DINITRO-2-METHYLPHENOL	BDL#
HEXACHLOROETHANE	BDL	N-NITROSODIPHENYLAMINE	BDL
NITROBENZENE	BDL	4-BROMOPHENYL PHENYL ETHER	BDL
ISOPHORONE	BDL	HEXACHLOROBENZENE	BDL
2-NITROPHENOL	BDL	PENTACHLOROPHENOL	BDL#
2,4-DIMETHYLPHENOL	BDL	PHENANTHRENE	BDL
BENZOIC ACID	BDL#	ANTHRACENE	BDL
BIS(2-CHLOROETHOXY)METHANE	BDL	DI-N-BUTYL PHTHALATE	BDL
2,4-DICHLOROPHENOL	BDL	FLUORANTHENE	BDL
1,2,4-TRICHLOROBENZENE	BDL	BENZIDINE	NA
NAPHTHALENE	BDL	PYRENE	BDL
4-CHLOROANILINE	BDL	BUTYL BENZYL PHTHALATE	BDL
HEXACHLOROBUTADIENE	BDL	3,3'-DICHLOROBENZIDINE	BDL
4-CHLORO-3-METHYLPHENOL	BDL	BENZO(A)ANTHRACENE	BDL
2-METHYLNAPHTHALENE	BDL	BIS(2-ETHYLHEXYL)PHTHALATE	BDL
HEXACHLOROCYCLOPENTADIENE	BDL	CHRYSENE	BDL
2,4,6-TRICHLOROPHENOL	BDL	DI-N-OCTYL PHTHALATE	BDL
2,4,5-TRICHLOROPHENOL	BDL#	BENZO(B&K)FLUORANTHENES	BDL
2-CHLORONAPHTHALENE	BDL	BENZO(A)PYRENE	BDL
2-NITROANILINE	BDL#	INDENO(1,2,3,CD)PYRENE	BDL
DIMETHYL PHTHALATE	BDL	DIBENZO(A,H)ANTHRACENE	BDL
ACENAPHTHYLENE	BDL	BENZO(G,H,I)PERYLENE	BDL

SURROGATE RECOVERY, %

2-FLUOROPHENOL	50	2-FLUOROBIPHENYL	76
PHENOL, D5	41	2,4,6-TRIBROMOPHENOL	71
NITROBENZENE,D5	77	TERPHENYL,D14	70

NA = NOT ANALYZED
ND = NOT DETECTED
* = OUTSIDE CONTROL LIMITS

BDL =< 10 UG/L
BDL#=< 50 UG/L

R VIEWED BY: UW

QC BY: K. M.

ENSR CONSULTING AND ENGINEERING
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
SEMI-VOLATILE COMPOUNDS IN WATER

ENSR NO : LCS890776	CLIENT : EL PASO NATURAL GAS
SAMPLE ID : LAB CONTROL SPIKE	PROJECT NO : 8500-089-117
EXTRACTION DATE : 07/11/89	ANALYSIS DATE : 07/13/89

COMPOUND	SPIKED CONC. (UG)	SAMPLE CONC. (UG)	% RECOVERY
PHENOL	200.0	83.1	42
2-CHLOROPHENOL	200.0	153.1	77
1,4-DICHLOROBENZENE	100.0	60.9	61
1,2,4-TRICHLOROBENZENE	100.0	58.3	58
N-NITROSO-DI-N-PROPLAMINE	100.0	87.7	88
4-CHLORO-3-METHYL PHENOL	200.0	146.0	73
ACENAPHTHENE	100.0	71.1	71
4-NITROPHENOL	200.0	59.6	30
2,4-DINITROTOLUENE	100.0	69.6	70
PENTACHLOROPHENOL	200.0	83.9	84
DI-N-BUTYL PHTHALATE	100.0	70.0	70
PYRENE	100.0	82.0	82

SURROGATE RECOVERY,%	
2-FLUOROPHENOL	46
PHENOL,D5	37
NITROBENZENE,D5	70
2-FLUOROBIPHENYL	69
2,4,6-TRIBROMOPHENOL	69
TERPHENYL,D14	73

NA = NOT ANALYZED
ND = NOT DETECTED
* = OUTSIDE CONTROL LIMITS

REVIEWED BY: ww

QC BY: K.M.

ENSR CONSULTING AND ENGINEERING
SUMMARY OF ANALYTICAL RESULTS
SEMI-VOLATILE COMPOUNDS IN WATER

ENSR NO : 71274
FLD ID : EP-03-A
CLIENT : EL PASO NATURAL GAS
SAMPLING SITE : JAL,NEW MEXICO
PROJECT NO : 8500-089-117

DATE SAMPLED : 07/07/89
DATE RECEIVED : 07/08/89
DATE EXTRACTED : 07/11/89
DATE ANALYZED : 07/13/89

PARAMETER	RESULT (UG/L)	PARAMETER	RESULT (UG/L)
PHENOL	BDL	3-NITROANILINE	BDL#
ANILINE	BDL	ACENAPHTHENE	BDL
BIS(2-CHLOROETHYL)ETHER	BDL	2,4-DINITROPHENOL	BDL#
2-CHLOROPHENOL	BDL	4-NITROPHENOL	BDL#
1,3-DICHLOROBENZENE	BDL	DIBENZOFURAN	BDL
1,4-DICHLOROBENZENE	BDL	2,4-DINITROTOLUENE	BDL
BENZYL ALCOHOL	BDL	2,6-DINITROTOLUENE	BDL
1,2-DICHLOROBENZENE	BDL	DIETHYL PHTHALATE	BDL
2-METHYLPHENOL	BDL	4-CHLOROPHENYL PHENYLETHER	BDL
BIS(2-CHLOROISOPROPYL)ETHER	BDL	FLUORENE	BDL
4-METHYLPHENOL	BDL	4-NITROANILINE	BDL#
N-NITROSO-DI-N-PROPYLAMINE	BDL	4,6-DINITRO-2-METHYLPHENOL	BDL#
HEXACHLOROETHANE	BDL	N-NITROSODIPHENYLAMINE	BDL
NITROBENZENE	BDL	4-BROMOPHENYL PHENYL ETHER	BDL
ISOPHORONE	BDL	HEXACHLOROBENZENE	BDL
2-NITROPHENOL	BDL	PENTACHLOROPHENOL	BDL#
2,4-DIMETHYLPHENOL	BDL	PHENANTHRENE	BDL
BENZOIC ACID	BDL#	ANTHRACENE	BDL
BIS(2-CHLOROETHOXY)METHANE	BDL	DI-N-BUTYL PHTHALATE	BDL
2,4-DICHLOROPHENOL	BDL	FLUORANTHENE	BDL
1,2,4-TRICHLOROBENZENE	BDL	BENZIDINE	NA
NAPHTHALENE	BDL	PYRENE	BDL
4-CHLOROANILINE	BDL	BUTYL BENZYL PHTHALATE	BDL
HEXACHLOROBUTADIENE	BDL	3,3'-DICHLOROBENZIDINE	BDL
4-CHLORO-3-METHYLPHENOL	BDL	BENZO(A)ANTHRACENE	BDL
2-METHYLNAPHTHALENE	BDL	BIS(2-ETHYLHEXYL)PHTHALATE	22
HEXACHLOROCYCLOPENTADIENE	BDL	CHRYSENE	BDL
2,4,6-TRICHLOROPHENOL	BDL	DI-N-OCTYL PHTHALATE	BDL
2,4,5-TRICHLOROPHENOL	BDL#	BENZO(B&K)FLUORANTHENES	BDL
2-CHLORONAPHTHALENE	BDL	BENZO(A)PYRENE	BDL
2-NITROANILINE	BDL#	INDENO(1,2,3,CD)PYRENE	BDL
DIMETHYL PHTHALATE	BDL	DIBENZO(A,H)ANTHRACENE	BDL
ACENAPHTHYLENE	BDL	BENZO(G,H,I)PERYLENE	BDL

SURROGATE RECOVERY, %

2-FLUOROPHENOL	38	2-FLUOROBIPHENYL	76
PHENOL, D5	29	2,4,6-TRIBROMOPHENOL	62
NITROBENZENE,D5	70	TERPHENYL,D14	85

NA = NOT ANALYZED
ND = NOT DETECTED
* = OUTSIDE CONTROL LIMITS

BDL =< 11 UG/L
BDL#=< 53 UG/L

R[illegible]VIEWED BY: MW QC BY: K.M.

ENSR CONSULTING AND ENGINEERING
SUMMARY OF ANALYTICAL RESULTS
SEMI-VOLATILE COMPOUNDS IN WATER

ENSR NO : 71275		DATE SAMPLED : 07/07/89	
FLD ID : EP-01-A		DATE RECEIVED : 07/08/89	
CLIENT : EL PASO NATURAL GAS		DATE EXTRACTED : 07/11/89	
SAMPLING SITE : JAL,NEW MEXICO		DATE ANALYZED : 07/13/89	
PROJECT NO : 8500-089-117			

PARAMETER	RESULT (UG/L)	PARAMETER	RESULT (UG/L)
PHENOL	BDL @	3-NITROANILINE	BDL#
ANILINE	BDL	ACENAPHTHENE	BDL
BIS(2-CHLOROETHYL)ETHER	BDL	2,4-DINITROPHENOL	BDL#@
2-CHLOROPHENOL	BDL @	4-NITROPHENOL	BDL#@
1,3-DICHLOROBENZENE	BDL	DIBENZOFURAN	BDL
1,4-DICHLOROBENZENE	BDL	2,4-DINITROTOLUENE	BDL
BENZYL ALCOHOL	BDL	2,6-DINITROTOLUENE	BDL
1,2-DICHLOROBENZENE	BDL	DIETHYL PHTHALATE	BDL
2-METHYLPHENOL	BDL @	4-CHLOROPHENYL PHENYLETHER	BDL
BIS(2-CHLOROISOPROPYL)ETHER	BDL	FLUORENE	BDL
4-METHYLPHENOL	BDL @	4-NITROANILINE	BDL#
N-NITROSO-DI-N-PROPYLAMINE	BDL	4,6-DINITRO-2-METHYLPHENOL	BDL#@
HEXACHLOROETHANE	BDL	N-NITROSODIPHENYLAMINE	BDL
NITROBENZENE	BDL	4-BROMOPHENYL PHENYL ETHER	BDL
ISOPHORONE	BDL	HEXACHLOROBENZENE	BDL
2-NITROPHENOL	BDL @	PENTACHLOROPHENOL	BDL @
2,4-DIMETHYLPHENOL	16 @	PHENANTHRENE	BDL
BENZOIC ACID	BDL#@	ANTHRACENE	BDL
BIS(2-CHLOROETHOXY)METHANE	BDL	DI-N-BUTYL PHTHALATE	BDL
2,4-DICHLOROPHENOL	BDL @	FLUORANTHENE	BDL
1,2,4-TRICHLOROBENZENE	BDL	BENZIDINE	NA
NAPHTHALENE	BDL	PYRENE	BDL
4-CHLOROANILINE	BDL	BUTYL BENZYL PHTHALATE	BDL
HEXACHLOROBUTADIENE	BDL	3,3'-DICHLOROBENZIDINE	BDL
4-CHLORO-3-METHYLPHENOL	BDL @	BENZO(A)ANTHRACENE	BDL
2-METHYLNAPHTHALENE	6.0 J	BIS(2-ETHYLHEXYL)PHTHALATE	BDL
HEXACHLOROCYCLOPENTADIENE	BDL	CHRYSENE	BDL
2,4,6-TRICHLOROPHENOL	BDL @	DI-N-OCTYL PHTHALATE	BDL
2,4,5-TRICHLOROPHENOL	BDL#@	BENZO(B&K)FLUORANTHENES	BDL
2-CHLORONAPHTHALENE	BDL	BENZO(A)PYRENE	BDL
2-NITROANILINE	BDL#	INDENO(1,2,3,CD)PYRENE	BDL
DIMETHYL PHTHALATE	BDL	DIBENZO(A,H)ANTHRACENE	BDL
ACENAPHTHYLENE	BDL	BENZO(G,H,I)PERYLENE	BDL

SURROGATE RECOVERY, %

2-FLUOROPHENOL	<10*	2-FLUOROBIPHENYL	68
PHENOL, D5	<10*	2,4,6-TRIBROMOPHENOL	17
NITROBENZENE,D5	69	TERPHENYL,D14	80

NA = NOT ANALYZED

BDL =< 10 UG/L

* = OUTSIDE CONTROL LIMITS

BDL#=< 52 UG/L

@ = ESTIMATED RESULTS DUE TO LOW ACID SURROGATE RECOVERIES

J = ESTIMATED VALUE-RESULTS < DETECTION LIMIT

REVIEWED BY: ______________ QC BY: K. M. ______________

ENSR CONSULTING AND ENGINEERING
SUMMARY OF ANALYTICAL RESULTS
SEMI-VOLATILE COMPOUNDS IN WATER

ENSR NO : 71276	DATE SAMPLED : 07/07/89
FLD ID : EP-02-A	DATE RECEIVED : 07/08/89
CLIENT : EL PASO NATURAL GAS	DATE EXTRACTED : 07/11/89
SAMPLING SITE : JAL,NEW MEXICO	DATE ANALYZED : 07/13/89
PROJECT NO : 8500-089-117	

PARAMETER	RESULT (UG/L)	PARAMETER	RESULT (UG/L)
PHENOL	BDL @	3-NITROANILINE	BDL#
ANILINE	BDL	ACENAPHTHENE	BDL
BIS(2-CHLOROETHYL)ETHER	BDL	2,4-DINITROPHENOL	BDL#@
2-CHLOROPHENOL	BDL @	4-NITROPHENOL	BDL#@
1,3-DICHLOROBENZENE	BDL	DIBENZOFURAN	BDL
1,4-DICHLOROBENZENE	BDL	2,4-DINITROTOLUENE	BDL
BENZYL ALCOHOL	BDL	2,6-DINITROTOLUENE	BDL
1,2-DICHLOROBENZENE	BDL	DIETHYL PHTHALATE	BDL
2-METHYLPHENOL	BDL @	4-CHLOROPHENYL PHENYLETHER	BDL
BIS(2-CHLOROISOPROPYL)ETHER	BDL	FLUORENE	BDL
4-METHYLPHENOL	BDL @	4-NITROANILINE	BDL#
N-NITROSO-DI-N-PROPYLAMINE	BDL	4,6-DINITRO-2-METHYLPHENOL	BDL#@
HEXACHLOROETHANE	BDL	N-NITROSODIPHENYLAMINE	BDL
NITROBENZENE	BDL	4-BROMOPHENYL PHENYL ETHER	BDL
ISOPHORONE	BDL	HEXACHLOROBENZENE	BDL
2-NITROPHENOL	BDL @	PENTACHLOROPHENOL	BDL @
2,4-DIMETHYLPHENOL	BDL @	PHENANTHRENE	BDL
BENZOIC ACID	BDL#@	ANTHRACENE	BDL
BIS(2-CHLOROETHOXY)METHANE	BDL	DI-N-BUTYL PHTHALATE	BDL
2,4-DICHLOROPHENOL	BDL @	FLUORANTHENE	BDL
1,2,4-TRICHLOROBENZENE	BDL	BENZIDINE	NA
NAPHTHALENE	BDL	PYRENE	BDL
4-CHLOROANILINE	BDL	BUTYL BENZYL PHTHALATE	BDL
HEXACHLOROBUTADIENE	BDL	3,3'-DICHLOROBENZIDINE	BDL
4-CHLORO-3-METHYLPHENOL	BDL @	BENZO(A)ANTHRACENE	BDL
2-METHYLNAPHTHALENE	BDL	BIS(2-ETHYLHEXYL)PHTHALATE	7.5 J
HEXACHLOROCYCLOPENTADIENE	BDL	CHRYSENE	BDL
2,4,6-TRICHLOROPHENOL	BDL @	DI-N-OCTYL PHTHALATE	BDL
2,4,5-TRICHLOROPHENOL	BDL#@	BENZO(B&K)FLUORANTHENES	BDL
2-CHLORONAPHTHALENE	BDL	BENZO(A)PYRENE	BDL
2-NITROANILINE	BDL#	INDENO(1,2,3,CD)PYRENE	BDL
DIMETHYL PHTHALATE	BDL	DIBENZO(A,H)ANTHRACENE	BDL
ACENAPHTHYLENE	BDL	BENZO(G,H,I)PERYLENE	BDL

SURROGATE RECOVERY, %

2-FLUOROPHENOL	<10*	2-FLUOROBIPHENYL	69
PHENOL, D5	<10*	2,4,6-TRIBROMOPHENOL	<10*
NITROBENZENE,D5	70	TERPHENYL,D14	82

NA = NOT ANALYZED
BDL =< 11 UG/L
* = OUTSIDE CONTROL LIMITS
BDL#=< 56 UG/L
@ = ESTIMATED RESULTS DUE TO LOW ACID SURROGATE RECOVERIES
J = ESTIMATED VALUE-RESULTS < DETECTION LIMIT

R VIEWED BY: MW

QC BY: K.M.

ENSR CONSULTING AND ENGINEERING
SUMMARY OF ANALYTICAL RESULTS
SEMI-VOLATILE COMPOUNDS IN WATER

ENSR NO : 71277
FLD ID : EP-02-B
CLIENT : EL PASO NATURAL GAS
SAMPLING SITE : JAL,NEW MEXICO
PROJECT NO : 8500-089-117

DATE SAMPLED : 07/07/89
DATE RECEIVED : 07/08/89
DATE EXTRACTED : 07/11/89
DATE ANALYZED : 07/13/89

PARAMETER	RESULT (UG/L)	PARAMETER	RESULT (UG/L)
PHENOL	BDL	3-NITROANILINE	BDL#
ANILINE	BDL	ACENAPHTHENE	BDL
BIS(2-CHLOROETHYL)ETHER	BDL	2,4-DINITROPHENOL	BDL#
2-CHLOROPHENOL	BDL	4-NITROPHENOL	BDL#
1,3-DICHLOROBENZENE	BDL	DIBENZOFURAN	BDL
1,4-DICHLOROBENZENE	BDL	2,4-DINITROTOLUENE	BDL
BENZYL ALCOHOL	BDL	2,6-DINITROTOLUENE	BDL
1,2-DICHLOROBENZENE	BDL	DIETHYL PHTHALATE	BDL
2-METHYLPHENOL	BDL	4-CHLOROPHENYL PHENYLETHER	BDL
BIS(2-CHLOROISOPROPYL)ETHER	BDL	FLUORENE	BDL
4-METHYLPHENOL	BDL	4-NITROANILINE	BDL#
N-NITROSO-DI-N-PROPYLAMINE	BDL	4,6-DINITRO-2-METHYLPHENOL	BDL#
HEXACHLOROETHANE	BDL	N-NITROSODIPHENYLAMINE	BDL
NITROBENZENE	BDL	4-BROMOPHENYL PHENYL ETHER	BDL
ISOPHORONE	BDL	HEXACHLOROBENZENE	BDL
2-NITROPHENOL	BDL	PENTACHLOROPHENOL	7.6 J
2,4-DIMETHYLPHENOL	BDL	PHENANTHRENE	BDL
BENZOIC ACID	BDL#	ANTHRACENE	BDL
BIS(2-CHLOROETHOXY)METHANE	BDL	DI-N-BUTYL PHTHALATE	5.9 J
2,4-DICHLOROPHENOL	BDL	FLUORANTHENE	BDL
1,2,4-TRICHLOROBENZENE	BDL	BENZIDINE	NA
NAPHTHALENE	BDL	PYRENE	BDL
4-CHLOROANILINE	BDL	BUTYL BENZYL PHTHALATE	BDL
HEXACHLOROBUTADIENE	BDL	3,3'-DICHLOROBENZIDINE	BDL
4-CHLORO-3-METHYLPHENOL	BDL	BENZO(A)ANTHRACENE	BDL
2-METHYLNAPHTHALENE	BDL	BIS(2-ETHYLHEXYL)PHTHALATE	9.5 J
HEXACHLOROCYCLOPENTADIENE	BDL	CHRYSENE	BDL
2,4,6-TRICHLOROPHENOL	BDL	DI-N-OCTYL PHTHALATE	BDL
2,4,5-TRICHLOROPHENOL	BDL#	BENZO(B&K)FLUORANTHENES	BDL
2-CHLORONAPHTHALENE	BDL	BENZO(A)PYRENE	BDL
2-NITROANILINE	BDL#	INDENO(1,2,3,CD)PYRENE	BDL
DIMETHYL PHTHALATE	BDL	DIBENZO(A,H)ANTHRACENE	BDL
ACENAPHTHYLENE	BDL	BENZO(G,H,I)PERYLENE	BDL

SURROGATE RECOVERY, %

2-FLUOROPHENOL	42	2-FLUOROBIPHENYL	75
PHENOL, D5	34	2,4,6-TRIBROMOPHENOL	71
NITROBENZENE,D5	66	TERPHENYL,D14	92

NA = NOT ANALYZED
* = OUTSIDE CONTROL LIMITS
J = ESTIMATED VALUE-RESULTS < DETECTION LIMIT

BDL =< 11 UG/L
BDL#=< 53 UG/L

REVIEWED BY: ww QC BY: R.M.

APPENDIX I

QUALITY CONTROL AND ASSURANCE PROCEDURES

1. Method Blanks (MB) - Analytical control consisting of all reagents, internal standards, and surrogate compounds carried through an analytical procedure to check for laboratory or instrumental contamination.

2. Surrogates - Isotope labelled compounds added to analyses used to evaluate analytical efficiency by measuring recovery.

3. Duplicate Analysis - A quality assurance check on the integrity of sample preparation as well as sample collection and shipping. Field duplicates and laboratory duplicates may be analyzed for each submission of samples when requested and where sample volumes permit. A laboratory duplicate is an aliquot of a field sample.

4. Laboratory Control Sample (LCS) - A standard control matrix spiked with a group of target compounds representative of the method analytes. The LCS is used to monitor the day-to-day accuracy of routine analytical methods within defined QC limits. An LCS has been established for most routine analytical methods. Control limits are defined by the most recent six months of LCS data for the appropriate methodology with an acceptable range for each analyte of the mean plus or minus 3 standard deviations.

5. Matrix Spike and Matrix Spike Duplicate (MS/MSD) - An aliquot of the sample matrix spiked with known quantities of specific compounds and subjected to the entire analytical procedure in order to evaluate the effect of sample matrix on measurable analyte recovery. The MSD is a duplicate analysis of the matrix used to measure method precision.

APPENDIX II

ANALYTICAL PROCEDURE REFERENCES

1. "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act", 40 CFR, Part 136; Federal Register, Vol.49, No.209, 1984.

2. US EPA. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. (SW 846) Washington, D.C., April, 1984.

3. US EPA. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020. Cincinnati, OH, March, 1983.

4. American Public Health Association, American Water Works Association, Water Pollution Control Federation. Standard Methods for the Examination of Water and Wastewater, 15th & 16th Ed., Washington, D.C., April, 1985.

5. 1984 Annual Book of ASTM Standards Section 4: Construction, Vol. 04.08: Soil & Rock; Building Stones.

6. 1984 Book of ASTM Standards, Part 31: Water.

7. Manuals of Soil Laboratory Testing, Vol. 1: Soil Classification and Compaction Tests, K.H. Head, 1980.

8. US EPA. Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water. Cincinnati, OH, Sep 1986.

9. Methods of Soil Analysis Agronomy No. 9, Part 2: Chemical and Microbiological Properties, 1965.

10. Current EPA Contract Laboratory Program (CLP) Invitation for Bid protocols for analysis of organic and inorganic hazardous substances.

11. ENSR/ERT developed and validated screening methods and specialized techniques for parameters not covered by published EPA protocols.

CHAIN OF CUSTODY SHEETS

AND

SAMPLE RECEIVING CHECKLISTS

Page 1 of 1

ENSR
LABORATORIES ©

CONSULTING AND ENGINEERING

2925 RICHMOND AVENUE HOUSTON, TX 77098 (713) 520-1495

Analysis Request and Chain of Custody Record

Project no. 2467-003

Client/Project Name El Paso Natural Gas

Project Location IAI N. Mexico

Lab ID No	Field Sample No./ Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid Sludge, Etc.)	Preservative	ANALYSIS REQUESTED	LABORATORY REMARKS
	EP-03-A	7/1/87 16:55	X		32 oz AM	H_2O	4°C	Semi-VOA	71274
	EP-01-A	11:10	X						71275
	EP-02-A	11:30	X						71276
	EP-02-B	11:30	X						71277

Samplers: *(Signature)*	Relinquished by: *(Signature)*	Date: 7/1/87 Time: 1400	Received by: *(Signature)* FED EX.	Date: Time:	COC Seal No. 31434
Affiliation ENSR C&E Dallas	Relinquished by: *(Signature)*	Date: Time:	Received by: *(Signature)*	Date: Time:	
	Relinquished by: *(Signature)*	Date: Time:	Received by [illegible] *(Signature)*	Date: 7/8	[illegible]
REMARKS:			1. [illegible] 2. [illegible]	[illegible]	[illegible]

ERT LABORATORIES
SAMPLE RECEIPT CHECKLIST

CLIENT El Paso Natural Gas PROJECT NO. 8500-059-117 AUTHORIZATION NUMBER 2467-003

1. ✓ shipped NOTES: Fed Ex 3071202470
______ hand-delivered

2. ✓ COC present on receipt NOTES:
______ no COC

3. ✓ COC tape on shipping container NOTES: 31434
______ no COC tape

4. ______ samples broken/leaking NOTES:
✓ samples intact of receipt
______ other, see notes

5. ______ ambient on receipt NOTES:
✓ chilled on receipt

6. ✓ samples preserved correctly NOTES:
______ improper preservatives
______ N/A, no recommended preservatives
______ other, see notes

7. ✓ received within holding time NOTES:
______ not received within holding times
______ N/A, no recommended holding time
______ other, see notes

8. ______ COC tapes on samples NOTES: in R5
✓ no COC tapes

9. ______ discrepancies between COC and sample labels NOTES:
✓ no discrepancies noted
______ N/A, no COC received

10. Storage Location R5
Additional comments:

Samples inspected and logged in by: Date/Time: 7/8/89
1010

ENSR

Formerly ERT

**ENSR Consulting
and Engineering**
2925 Richmond Avenue
Houston, TX 77098
(713) 520-1495

DATE: 08/02/89

TO: Ray Roblin

FROM: Bo Blankfield, Lab Director

PROJ. NO.: 2467-003 LAB NO.: A2555

Attached are reports of chemical analyses of samples received July 8, 1989. These analyses are:

Count	Test Code	Test Name	Test Method	Sampled	Matrix
4	1016 - -PCB-HOU	PCB AROCLOR 1016	EPA 600: 608, GAS CHROMATOGRAPHY	07/07/89	WATER
4	1221 - -PCB-HOU	PCB AROCLOR 1221	EPA 600: 608, GAS CHROMATOGRAPHY	07/07/89	WATER
4	1232 - -PCB-HOU	PCB AROCLOR 1232	EPA 600: 608, GAS CHROMATOGRAPHY	07/07/89	WATER
4	1242 - -PCB-HOU	PCB AROCLOR 1242	EPA 600: 608, GAS CHROMATOGRAPHY	07/07/89	WATER
4	1248 - -PCB-HOU	PCB AROCLOR 1248	EPA 600: 608, GAS CHROMATOGRAPHY	07/07/89	WATER
4	1254 - -PCB-HOU	PCB AROCLOR 1254	EPA 600: 608, GAS CHROMATOGRAPHY	07/07/89	WATER
4	1260 - -PCB-HOU	PCB AROCLOR 1260	EPA 600: 608, GAS CHROMATOGRAPHY	07/07/89	WATER
4	Cl- - - -HOU	CHLORIDE	16TH ED. SM:407A,B Ag, MERCURIC NO3	07/07/89	WATER
1	TPH - - -HOU	TOTAL PETROLEUM HYDROCARBONS	EPA 600: 418.1, IR SPEC	07/07/89	WATER
4	VOA - - -HOU	VOLATILE ORGANIC ANALYSES	EPA 600: 624, GC/MS	07/07/89	WATER

Data contained in this report reflect a full quality control review and have met all applicable standards established by ENSR. ENSR quality assurance protocols are in accordance with EPA guidelines.

Should you have any questions, do not hesitate to contact me at (713) 520-9900.

BB/lis

Enclosures: Analytical Summary, Analytical Report, Chain of Custody, Sample Receipt Checklist, Quality Control Logs, ENSR ID #A2555-1, ENSR ID #A2555-2, ENSR ID #A2555-3, ENSR ID #A2555-4, Billing Summary

cc: Sam Nott

LAB NO. A2555
PROJECT 2467-003 El Paso Natural Gas

ENSR Labs–Houston

Analytical Summary
08/02/89 13:24

Lab Number: A2555
Project: 2467-003
El Paso Natural Gas

Lab ID *Field ID* *Test /Matrix*	1 EP-03-A WATER	2 EP-01-A WATER	3 EP-02-A WATER	4 EP-02-B WATER	5 EP-TPH WATER
1016 - -PCB-HOU *(MDL)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	--
1221 - -PCB-HOU *(MDL)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	--
1232 - -PCB-HOU *(MDL)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	--
1242 - -PCB-HOU *(MDL)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	--
1248 - -PCB-HOU *(MDL)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	--
1254 - -PCB-HOU *(MDL)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	--
1260 - -PCB-HOU *(MDL)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	<1.0 µg/L *(1.0)*	--
Cl- - - -HOU *(MDL)*	285 MG/L *(5)*	9700 MG/L *(100)*	8900 MG/L *(100)*	8500 MG/L *(100)*	--

QAQC Approval: Dee Davis Date: 7-27-89

Mgr. Approval: Date: 8/2/89

***** CONTINUED *****

ENSR Labs—Houston

Analytical Summary
08/02/89 13:25

Lab Number: A2555
Project: 2467-003
El Paso Natural Gas

Lab ID *Field ID* *Test /Matrix*	1 EP-03-A WATER	2 EP-01-A WATER	3 EP-02-A WATER	4 EP-02-B WATER	5 EP-TPH WATER
TPH - - -HOU *(MDL)*	--	--	--	--	<4 MG/L *(4)*
VOA - - -HOU *(MDL)*	ATTACHED UG/L *()**	ATTACHED UG/L *()**	ATTACHED UG/L *()**	ATTACHED UG/L *()**	--

QAQC Approval: Dee Davis Date: 7-27-89

Mgr. Approval: Rhonda P. Date: 8/2/89

* Please see attached Analytical Report for remarks.

ENSR Labs—Houston

Analytical Report
08/02/89 13:19

El Paso Natural Gas	Field ID: EP-03-A	Date Sampled: 07/07/89
Proj. No.: 2467-003	Lab ID: 1	Time Sampled: 1055
Lab No.: A2555	Matrix: WATER (GRAB)	Date Received: 07/08/89

Parameter (Test Code) (Test Name) (Test Method)	Concen-tration	Units	Method Detection Limit	Date/Time Analysis Performed
1016 - -PCB-HOU PCB AROCLOR 1016 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1221 - -PCB-HOU PCB AROCLOR 1221 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1232 - -PCB-HOU PCB AROCLOR 1232 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1242 - -PCB-HOU PCB AROCLOR 1242 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1248 - -PCB-HOU PCB AROCLOR 1248 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1254 - -PCB-HOU PCB AROCLOR 1254 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1260 - -PCB-HOU PCB AROCLOR 1260 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
Cl- - - -HOU CHLORIDE 16TH ED. SM:407A,B Ag, MERCURIC NO3	285	MG/L	5	07/12/89 1000
VOA - - -HOU VOLATILE ORGANIC ANALYSES EPA 600: 624, GC/MS	ATTACHED *1	UG/L		07/08/89

*1 SEE ENSR ID #A2555-1

ENSR Labs-Houston

Analytical Report
08/02/89 13:19

El Paso Natural Gas	Field ID: EP-01-A	Date Sampled: 07/07/89
Proj. No.: 2467-003	Lab ID: 2	Time Sampled: 1110
Lab No.: A2555	Matrix: WATER (GRAB)	Date Received: 07/08/89

Parameter (Test Code) (Test Name) (Test Method)	Concentration	Units	Method Detection Limit	Date/Time Analysis Performed
1016 - -PCB-HOU PCB AROCLOR 1016 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1221 - -PCB-HOU PCB AROCLOR 1221 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1232 - -PCB-HOU PCB AROCLOR 1232 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1242 - -PCB-HOU PCB AROCLOR 1242 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1248 - -PCB-HOU PCB AROCLOR 1248 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1254 - -PCB-HOU PCB AROCLOR 1254 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1260 - -PCB-HOU PCB AROCLOR 1260 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
Cl- - - -HOU CHLORIDE 16TH ED. SM:407A,B Ag, MERCURIC NO3	9700	MG/L	100	07/12/89 1000
VOA - - -HOU VOLATILE ORGANIC ANALYSES EPA 600: 624, GC/MS	ATTACHED *1	UG/L		07/08/89

*1 SEE ENSR ID #A2555-2

ENSR Labs-Houston

Analytical Report
08/02/89 13:19

El Paso Natural Gas	Field ID: EP-02-A	Date Sampled: 07/07/89
Proj. No.: 2467-003	Lab ID: 3	Time Sampled: 1110
Lab No.: A2555	Matrix: WATER (GRAB)	Date Received: 07/08/89

Parameter (Test Code) (Test Name) (Test Method)	Concentration	Units	Method Detection Limit	Date/Time Analysis Performed
1016 - -PCB-HOU PCB AROCLOR 1016 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1221 - -PCB-HOU PCB AROCLOR 1221 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1232 - -PCB-HOU PCB AROCLOR 1232 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1242 - -PCB-HOU PCB AROCLOR 1242 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1248 - -PCB-HOU PCB AROCLOR 1248 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1254 - -PCB-HOU PCB AROCLOR 1254 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1260 - -PCB-HOU PCB AROCLOR 1260 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
Cl- - - -HOU CHLORIDE 16TH ED. SM:407A,B Ag, MERCURIC NO3	8900	MG/L	100	07/12/89 1000
VOA - - -HOU VOLATILE ORGANIC ANALYSES EPA 600: 624, GC/MS	ATTACHED *1	UG/L		07/08/89

*1 SEE ENSR ID #A2555-3

ENSR Labs—Houston

Analytical Report
08/02/89 13:20

El Paso Natural Gas	Field ID: EP-02-B	Date Sampled: 07/07/89
Proj. No.: 2467-003	Lab ID: 4	Time Sampled: 1110
Lab No.: A2555	Matrix: WATER (GRAB)	Date Received: 07/08/89

Parameter (Test Code) (Test Name) (Test Method)	Concentration	Units	Method Detection Limit	Date/Time Analysis Performed
1016 - -PCB-HOU PCB AROCLOR 1016 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1221 - -PCB-HOU PCB AROCLOR 1221 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1232 - -PCB-HOU PCB AROCLOR 1232 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1242 - -PCB-HOU PCB AROCLOR 1242 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1248 - -PCB-HOU PCB AROCLOR 1248 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1254 - -PCB-HOU PCB AROCLOR 1254 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
1260 - -PCB-HOU PCB AROCLOR 1260 EPA 600: 608, GAS CHROMATOGRAPHY	<1.0	µg/L	1.0	Ext.: 07/11/89 Anal.:07/12/89
Cl- - - -HOU CHLORIDE 16TH ED. SM:407A,B Ag, MERCURIC NO3	8500	MG/L	100	07/12/89 1000
VOA - - -HOU VOLATILE ORGANIC ANALYSES EPA 600: 624, GC/MS	ATTACHED *1	UG/L		07/08/89

*1 SEE ENSR ID #A2555-4

ENSR Labs-Houston

Analytical Report
08/02/89 13:20

El Paso Natural Gas	Field ID: EP-TPH	Date Sampled: 07/07/89
Proj. No.: 2467-003	Lab ID: 5	Time Sampled: 1200
Lab No.: A2555	Matrix: WATER (GRAB)	Date Received: 07/08/89

Parameter (Test Code) (Test Name) (Test Method)	Concen-tration	Units	Method Detection Limit	Date/Time Analysis Performed
TPH - - -HOU TOTAL PETROLEUM HYDROCARBONS EPA 600: 418.1, IR SPEC	<4	MG/L	4	07/15/89 900

Page 1 of 2

ENSR
LABORATORIES ©

CONSULTING AND ENGINEERING
2925 RICHMOND AVENUE HOUSTON, TX 77098 (713) 520-1495

Analysis Request and Chain of Custody Record

Project no. 2467-003	Client/Project Name El Paso Nat. Gas	Project Location Jal N. Mexico

Lab ID No	Field Sample No./ Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid Sludge, Etc.)	Preservative	ANALYSIS REQUESTED	LABORATORY REMARKS
1	EP-03-A	7/7/89 10:55	X		40ml	H2O	4°C	VOA	
1	EP-03-A	10:55	X		40ml			VOA	
2	EP-01-A	11:10	X		40ml			VOA.	
2	EP-01-A	11:10	X		40ml			VOA	
3	EP-02-A	11:30	X					VOA	
4 ~~3~~	EP-02-B	11.30	X					VOA	
3 ~~4~~	EP 02-A	11:30	X					VOA + next 10 peaks	per Sam Nott 10/3 PB
~~4~~	EP-02-B	11:30	✓					VOA	
~~5~~	EP-03-A	10:55	X		80oz			PCB + Chloride	✓ } Spare?
B ~~5~~	EP-03-A	10:55	X		80oz			PCB per R Robles 7.10.89	✓ } ~~Dups~~ Dups?

Samplers: (Signature) T Kill	Relinquished by: (Signature)	Date: 7/7/89 Time: 1400	Received by: (Signature) Fed Ex	Date: Time:	COC Seal No.
Affiliation ENSR C+E Dallas	Relinquished by: (Signature)	Date: Time:	Received by: (Signature)	Date: Time:	31435
	Relinquished by: (Signature)	Date: Time:	Received by Laboratory: (Signature) K Beeson	Date: 7-10-89 Time: 1005	Intact:
REMARKS:			Data Results To: 1. Roy Roslin 2. Sam Nott		Laboratory No. A2554

Page 2 of 2

ENSR LABORATORIES ©

CONSULTING AND ENGINEERING
2925 RICHMOND AVENUE HOUSTON, TX 77098 (713) 520-1495

Analysis Request and Chain of Custody Record

Project no.	Client/Project Name	Project Location
2467-C03	El Paso Nat Gas	Jal NMexico

Lab ID No	Field Sample No./ Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid Sludge, Etc.)	Preser-vative	ANALYSIS REQUESTED	LABORATORY REMARKS
2	EP-01-A	7/7/89 11:10	X		8oz			PCB & Chloride,	✓
2	EP-01-A	11:10	X		8oz			PCB per K Roblin 7-10-89	✓ spare?
3	EP-02A	11:10	X					PCB & Chloride	✓
3	EP-02A	11:10	X		[illegible]	[illegible]	[illegible]	PCB	✓ Spare
4	EP-02-B	11:10	X					PCB & Chloride	✓
4	EP-02B	11:10	X					PCB	✓ Spare?
6	EP-TPH	12:00	X		16oz		HCl	TPH	✓

Samplers: (Signature)	Relinquished by: (Signature)	Date: 7/7/89 Time: 1400	Received by: (Signature) FED EX	Date: Time:	COC Seal No.
R Reed	R Reed				31435
Affiliation	Relinquished by: (Signature)	Date: Time:	Received by: (Signature)	Date: Time:	
ENSR C&E Dallas	Relinquished by: (Signature)	Date: Time:	Received by Laboratory: (Signature) K Deason	Date: 7-10-89 Time: 1005	Intact:

REMARKS:

Data Results To:
1. Ray Roblin
2. Sam Nott

Laboratory No. A2555

ENSR LABORATORIES HOUSTON
SAMPLE RECEIPT CHECKLIST

CLIENT El Paso Natural Gas PROJ. NO. 2467-003 LAB NO. A2555

1. ✓ shipped NOTES: Fed Ex 3071202481 received at Helw Lab Sat 7.8.89 & logged in Mon 7.10.89

______ hand-delivered

2. ✓ COC present on receipt NOTES:

______ no COC

3. ✓ COC tape on shipping container NOTES: Intact #31435

______ no COC tape

4. ______ samples broken/leaking on receipt NOTES:

✓ samples intact on receipt

______ other, see notes

5. ______ ambient on receipt NOTES:

✓ chilled on receipt

6. ✓ samples preserved correctly NOTES:

______ improper preservatives

______ N/A, no recommended preservatives

______ other, see notes

7. ✓ received within holding times NOTES:

______ not received within holding times

______ N/A, no recommended holding times

______ other, see notes

8. ______ COC tapes on samples NOTES:

✓ no COC tapes

9. ______ discrepancies between COC and samples labels NOTES: Sampling time on #3 + #4 d
EP-C2-B and EP-C2-A pg 1 of
has Sampling time at 1130 pg. 2
COC has Sampling time at 1110. Ch
the bottles and it Says 1110 so w
logged in Sampling time at 1110

✓ no discrepancies noted

______ N/A, no COC received

Additional comments:

Samples inspected and logged in by: V Smith for K Beason Date/Time 7.10.89 1005

ENSR LABORATORIES

Quality Control Log

rameter: Chloride
thod of Analysis: SM: 407A,B

Matrix: Liquid
Date/Time: 7-12-89 1000

ab Numbers	Detection Limits
553-1	10 mg/l
553(2-6)	5 mg/l
555-1	5 mg/l
555(2-4)	100 mg/l

Calibration Standards/Blank	Absorbance

Comments:

Check Standards	Concentration Found/True
Sample Blank	
Method Blank	0.2nds
P.E.Std A987	49/52.1
Internal Std	490/500

Internal Quality Control Duplicates and Spikes

b No.- Sample ID	Sample Conc.	Duplicate Conc.	Range	% R.P.D.	Spiked Sample Result	Sample Result	Spike Added	Percent Recovery
A2553-1	950	950	0	0				
553-2					286.67	116.67	166.67	102%
A555-1	285	285	0	0	360	190	166.67	102%

nalyst: Karen K. Crockett

QAQC Approval: Dee Davis

ENSR LABORATORIES

Quality Control Log

meter: TPH on water
thod of Analysis: EPA 600: 418.1 I.R.

Matrix: Water
Date/Time: 7-15-89 0900

umbers	Detection Limits
558-1	2 mg/L
-2	2
-3	2
-4	2
-5	10
-6	10
-7	2
-8	3
555-5	4

Calibration Standards/Blank	Absorbance
2.0	0.0457
4.0	0.0826
8.0	0.1459
40.0	0.5980
Correlation Coefficient:	
	0.9997

Comments: Insufficient sample volume provided for further QC.

Check Standards	Concentration Found/True
Sample Blank	
Method Blank	Abs. 0.0006
P.E.Std.	
Internal Std	22.2/20.0

Internal Quality Control Duplicates and Spikes

b No.- Sample ID	Sample Conc.	Duplicate Conc.	Range	% R.P.D.	Spiked Sample Result mg	Sample Result mg	Spike Added mg	Percent Recovery
BLKSPK	—	—	—	—	19.7	<2	20.0	98%

nalyst:

QAQC Approval:

ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	ENSR LAB-Hou	Concentration:	LOW	Date Extracted:	07/08/89
Lab Sample ID:	A2555-1	Sample Matrix:	WATER	Date Analyzed:	07/08/89
Client Sample ID:	EP-03-A	Percent Moisture:	100.0	Dilution Factor:	1.0

VOLATILE COMPOUNDS

CAS Number		UG/L		CAS Number		UG/L
74-87-3	Chloromethane	10	<	78-87-5	1,2-Dichloropropane	5
74-83-9	Bromomethane	10	<	10061-02-6	Cis-1,3-Dichloropropene	5
75-01-4	Vinyl Chloride	10	<	79-01-6	Trichloroethene	5
75-00-3	Chloroethane	10	<	124-48-1	Dibromochloromethane	5
75-09-2	Methylene Chloride	5	<	79-00-5	1,1,2-Trichloroethane	5
67-64-1	Acetone	23		71-43-2	Benzene	5
75-15-0	Carbon Disulfide	5	<	10061-01-5	trans-1,3-Dichloropropene	5
75-35-4	1,1-Dichloroethene	5	<	110-75-8	2-Chloroethylvinylether	10
75-35-3	1,1-Dichloroethane	5	<	75-25-2	Bromoform	5
156-60-5	Trans-1,2-Dichloroethene	5	<	108-10-1	4-Methyl-2-Pentanone	10
67-66-3	Chloroform	5	<	591-78-6	2-Hexanone	10
107-06-2	1,2-Dichloroethane	5	<	127-18-4	Tetrachloroethene	5
78-93-3	2-Butanone	10	<	79-34-5	1,1,2,2-Tetrachloroethane	5
71-55-6	1,1,1-Trichloroethane	5	<	108-88-3	Toluene	5
56-23-5	Carbon Tetrachloride	5	<	108-90-7	Chlorobenzene	5
108-05-4	Vinyl Acetate	10	<	100-41-4	Ethylbenzene	5
75-27-4	Bromodichloromethane	5		100-42-5	Styrene	5
					Total Xylenes	5

The Lab ID for data on this page is A25551.

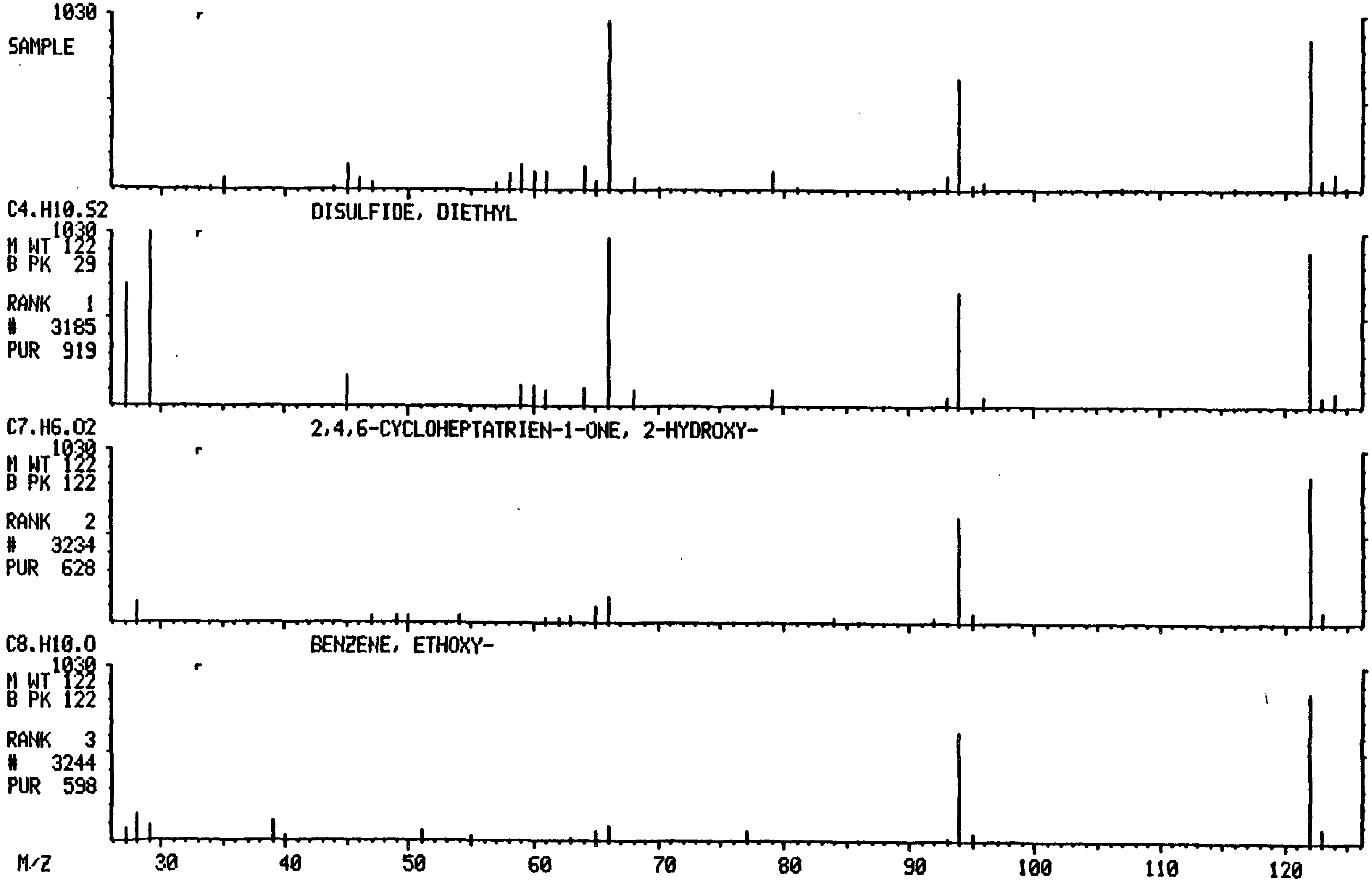
- Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

Form I

MID LIBRARY SEARCH (LIBRARYNB)
07/08/89 16:45:00 + 24:37
SAMPLE: EP-02-A
CONDS.: I50C
ENHANCED (S 15B 2N 0T)

DATA: EP02A # 985
CALI: EP02A # 3

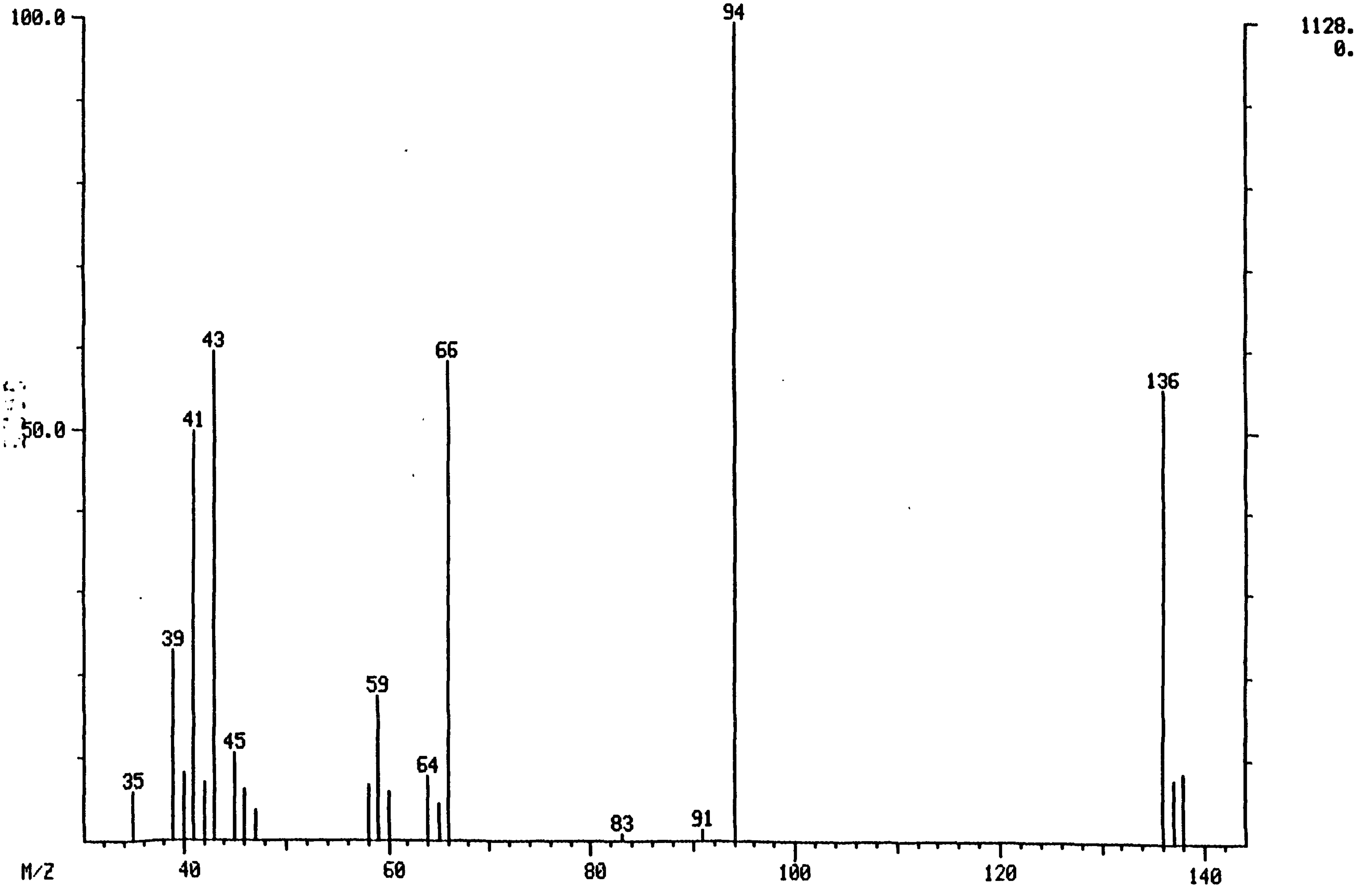
BASE M/Z: 66
RIC: 48064.



MASS SPECTRUM
07/08/89 16:45:00 + 28:21
SAMPLE: EP-02-A
CONDS.: I50C
TEMP: 225 DEG. C
ENHANCED (S 15B 2N 0T)

DATA: EP02A #1134
CALI: EP02A #3

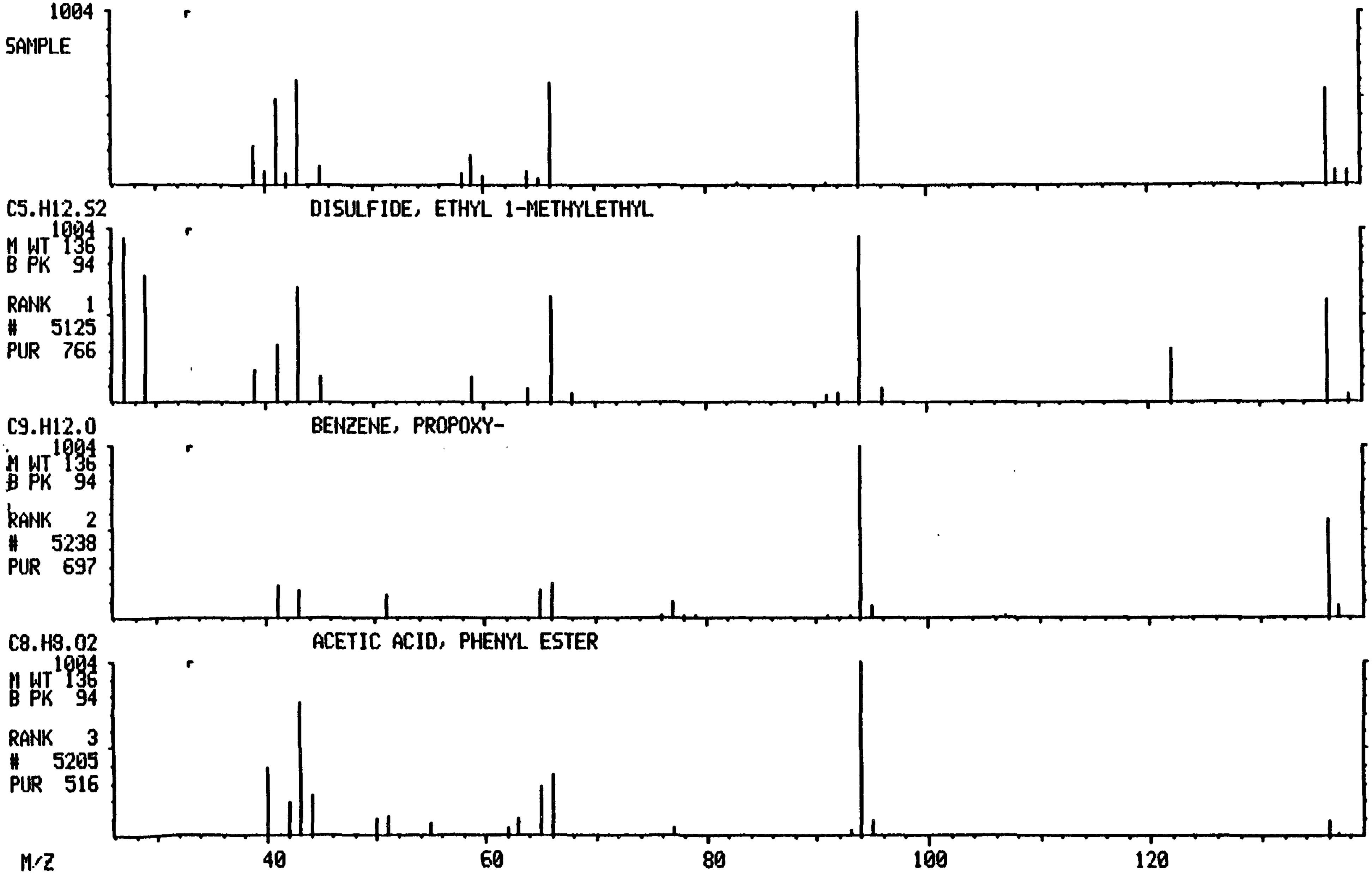
BASE M/Z: 94
RIC: 5056.



MID LIBRARY SEARCH (LIBRARYNB)
07/08/89 16:45:00 + 28:21
SAMPLE: EP-02-A
CONDS.: I50C
ENHANCED (S 15B 2N 0T)

DATA: EP02A #1134
CALI: EP02A # 3

BASE M/Z: 94
RIC: 4880.



ENSR Labs—Houston

Billing Summary
07/25/89 13:11

El Paso Natural Gas
Project No.: 2467-003 Lab Number: A2555

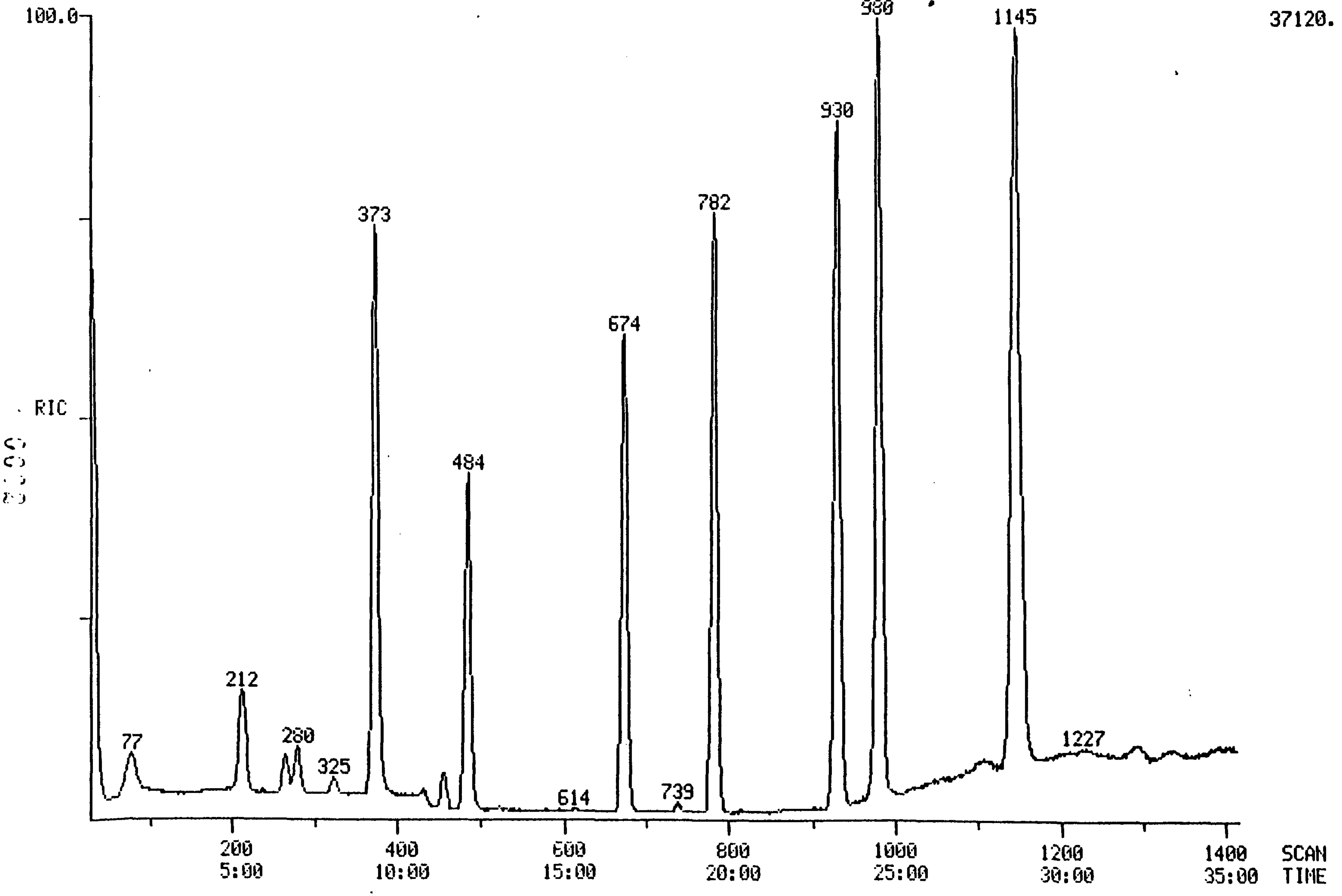
	Test Code	Description	Number	Cost	Total
1.	1016 - -PCB-HOU	PCB AROCLOR 1016	4	0.00	0.00
2.	1221 - -PCB-HOU	PCB AROCLOR 1221	4	0.00	0.00
3.	1232 - -PCB-HOU	PCB AROCLOR 1232	4	0.00	0.00
4.	1242 - -PCB-HOU	PCB AROCLOR 1242	4	0.00	0.00
5.	1248 - -PCB-HOU	PCB AROCLOR 1248	4	0.00	0.00
6.	1254 - -PCB-HOU	PCB AROCLOR 1254	4	0.00	0.00
7.	1260 - -PCB-HOU	PCB AROCLOR 1260	4	0.00	0.00
8.	Cl- - - -HOU	CHLORIDE	4	12.00	48.00
9.	PCB - - -HOU	*POLYCHLORINATED BIPHENYLS*	4	130.00	520.00
10.	TPH - - -HOU	TOTAL PETROLEUM HYDROCARBONS	1	30.00	30.00
11.	VOA - - -HOU	VOLATILE ORGANIC ANALYSES	3	230.00	690.00
			1	250.00	250.00
	Total:				1538.00

Billed 7-25-89

RIC
07/08/89 18:14:00
SAMPLE: EP-03-A
CONDS.: I50C
RANGE: G 1,1420 LABEL: N 0, 4.0 QUAN: A 0, 1.0 J 0 BASE: U 20, 3

DATA: EP03A #1
CALI: EP03A #3

SCANS 25 TO 1415



ORGANICS ANALYSIS DATA SHEET

Laboratory Name: ENSR LAB-Hou
Lab Sample ID: A2555-2
Client Sample ID: EP-01-A

Concentration: LOW
Sample Matrix: WATER
Percent Moisture: 100.0

Date Extracted: 07/08/89
Date Analyzed: 07/08/89
Dilution Factor: 1.0

VOLATILE COMPOUNDS

CAS Number		UG/L		CAS Number		UG/L
4-87-3	Chloromethane	10	<	78-87-5	1,2-Dichloropropane . . .	5
4-83-9	Bromomethane	10	<	10061-02-6	Cis-1,3-Dichloropropene .	5
75-01-4	Vinyl Chloride	10	<	79-01-6	Trichloroethene	5
5-00-3	Chloroethane	10	<	124-48-1	Dibromochloromethane . . .	5
5-09-2	Methylene Chloride	5	<	79-00-5	1,1,2-Trichloroethane . .	5
67-64-1	Acetone	24		71-43-2	Benzene	5
75-15-0	Carbon Disulfide	5	<	10061-01-5	trans-1,3-Dichloropropene	5
5-35-4	1,1-Dichloroethene	5	<	110-75-8	2-Chloroethylvinylether .	10
75-35-3	1,1-Dichloroethane	5	<	75-25-2	Bromoform	5
156-60-5	Trans-1,2-Dichloroethene .	5	<	108-10-1	4-Methyl-2-Pentanone . . .	10
7-66-3	Chloroform	5	<	591-78-6	2-Hexanone	10
107-06-2	1,2-Dichloroethane	5	<	127-18-4	Tetrachloroethene	5
78-93-3	2-Butanone	10	<	79-34-5	1,1,2,2-Tetrachloroethane	5
1-55-6	1,1,1-Trichloroethane . .	5	<	108-88-3	Toluene	5
6-23-5	Carbon Tetrachloride . . .	5	<	108-90-7	Chlorobenzene	5
108-05-4	Vinyl Acetate	10	<	100-41-4	Ethylbenzene	5
75-27-4	Bromodichloromethane . . .	5	<	100-42-5	Styrene	5
					Total Xylenes	5

The Lab ID for data on this page is A25552.

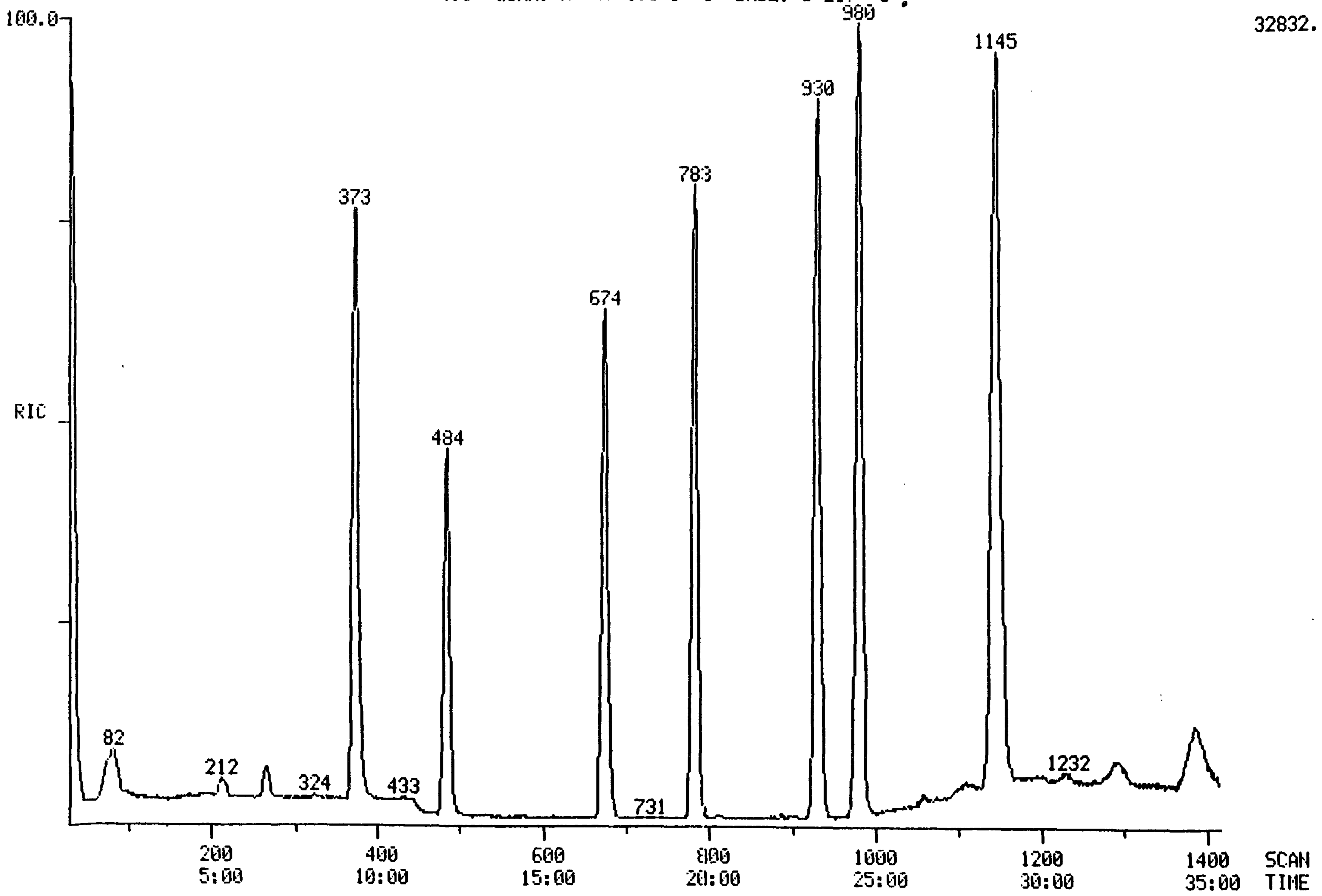
< - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

Form I

RIC
07/08/89 16:01:00
SAMPLE: EP-01-A
CONDS.: I50C
RANGE: G 1,1420 LABEL: N 0, 4.0 QUAN: A 0, 1.0 J 0 BASE: U 20, 3

DATA: EP01A #1
CALI: EP01A #3

SCANS 25 TO 1415



ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	ENSR LAB-Hou	Concentration:	LOW	Date Extracted:	07/08/89
Lab Sample ID:	A2555-3	Sample Matrix:	WATER	Date Analyzed:	07/08/89
Client Sample ID:	EP-02-A	Percent Moisture:	100.0	Dilution Factor:	1.0

VOLATILE COMPOUNDS

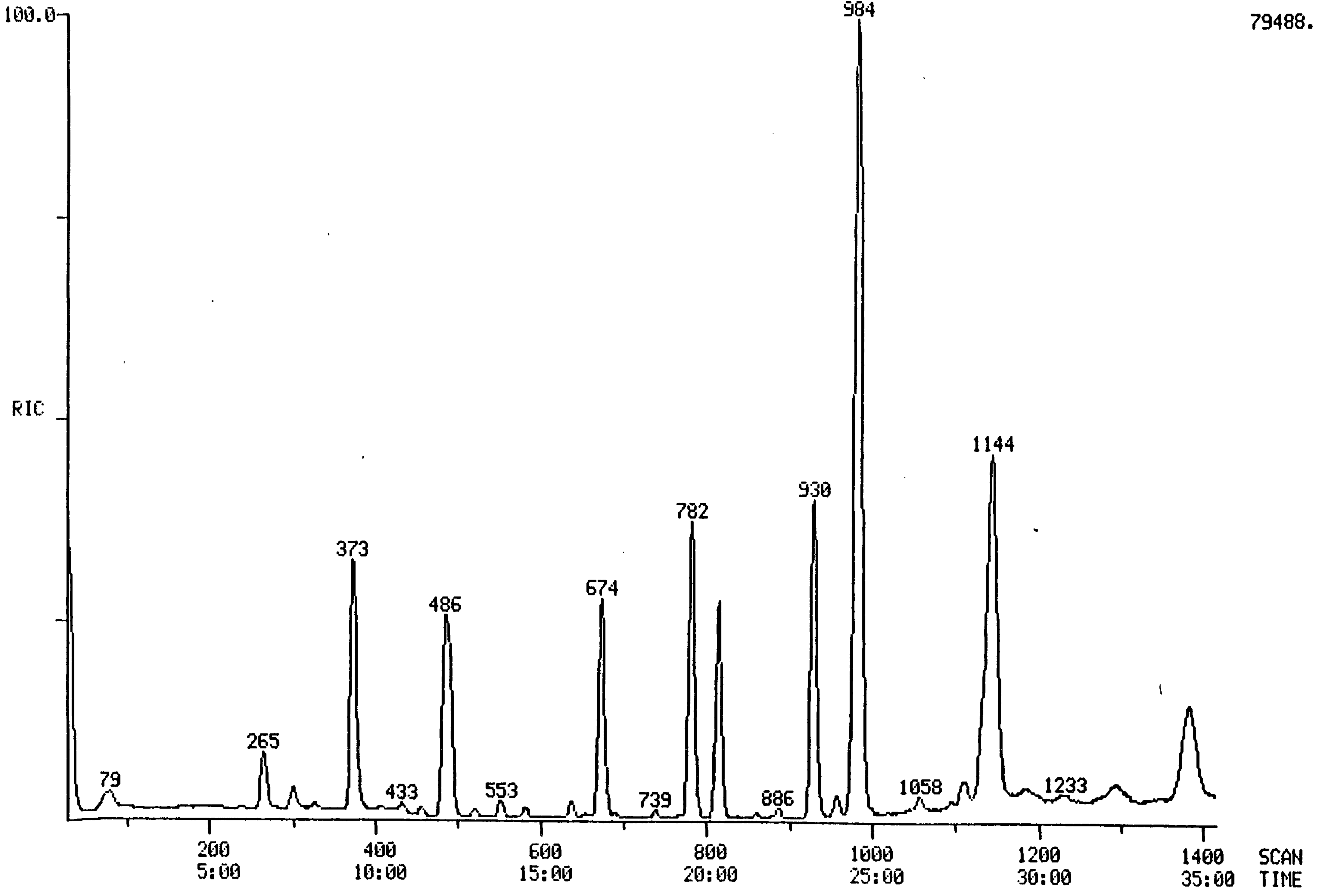
CAS Number		UG/L		CAS Number		UG/L
74-87-3	Chloromethane	10	<	78-87-5	1,2-Dichloropropane	5
74-83-9	Bromomethane	10	<	10061-02-6	Cis-1,3-Dichloropropene	5
75-01-4	Vinyl Chloride	10	<	79-01-6	Trichloroethene	5
75-00-3	Chloroethane	10	<	124-48-1	Dibromochloromethane	5
75-09-2	Methylene Chloride	5	<	79-00-5	1,1,2-Trichloroethane	5
67-64-1	Acetone	81		71-43-2	Benzene	5
75-15-0	Carbon Disulfide	22		10061-01-5	trans-1,3-Dichloropropene	5
75-35-4	1,1-Dichloroethene	5	<	110-75-8	2-Chloroethylvinylether	10
75-35-3	1,1-Dichloroethane	5	<	75-25-2	Bromoform	5
156-60-5	Trans-1,2-Dichloroethene	5	<	108-10-1	4-Methyl-2-Pentanone	10
67-66-3	Chloroform	5	<	591-78-6	2-Hexanone	10
107-06-2	1,2-Dichloroethane	5	<	127-18-4	Tetrachloroethene	5
78-93-3	2-Butanone	29		79-34-5	1,1,2,2-Tetrachloroethane	5
71-55-6	1,1,1-Trichloroethane	5	<	108-88-3	Toluene	5
56-23-5	Carbon Tetrachloride	5	<	108-90-7	Chlorobenzene	5
108-05-4	Vinyl Acetate	10	<	100-41-4	Ethylbenzene	5
75-27-4	Bromodichloromethane	5	<	100-42-5	Styrene	5
					Total Xylenes	5

The Lab ID for data on this page is A25553.

- Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

Form I

```
RIC                                        DATA: EP02A #1          SCANS   25 TO 1415
07/08/89 16:45:00                          CALI: EP02A #3
SAMPLE: EP-02-A
CONDS.: I50C
RANGE: G   1,1420  LABEL: N  0, 4.0  QUAN: A  0, 1.0 J  0  BASE: U 20,  3 .
```



ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	ENSR LAB-Hou	Concentration:	LOW	Date Extracted:	07/08/89
Lab Sample ID:	A2555-4	Sample Matrix:	WATER	Date Analyzed:	07/08/89
Client Sample ID:	EP-02-B	Percent Moisture:	100.0	Dilution Factor:	1.0

VOLATILE COMPOUNDS

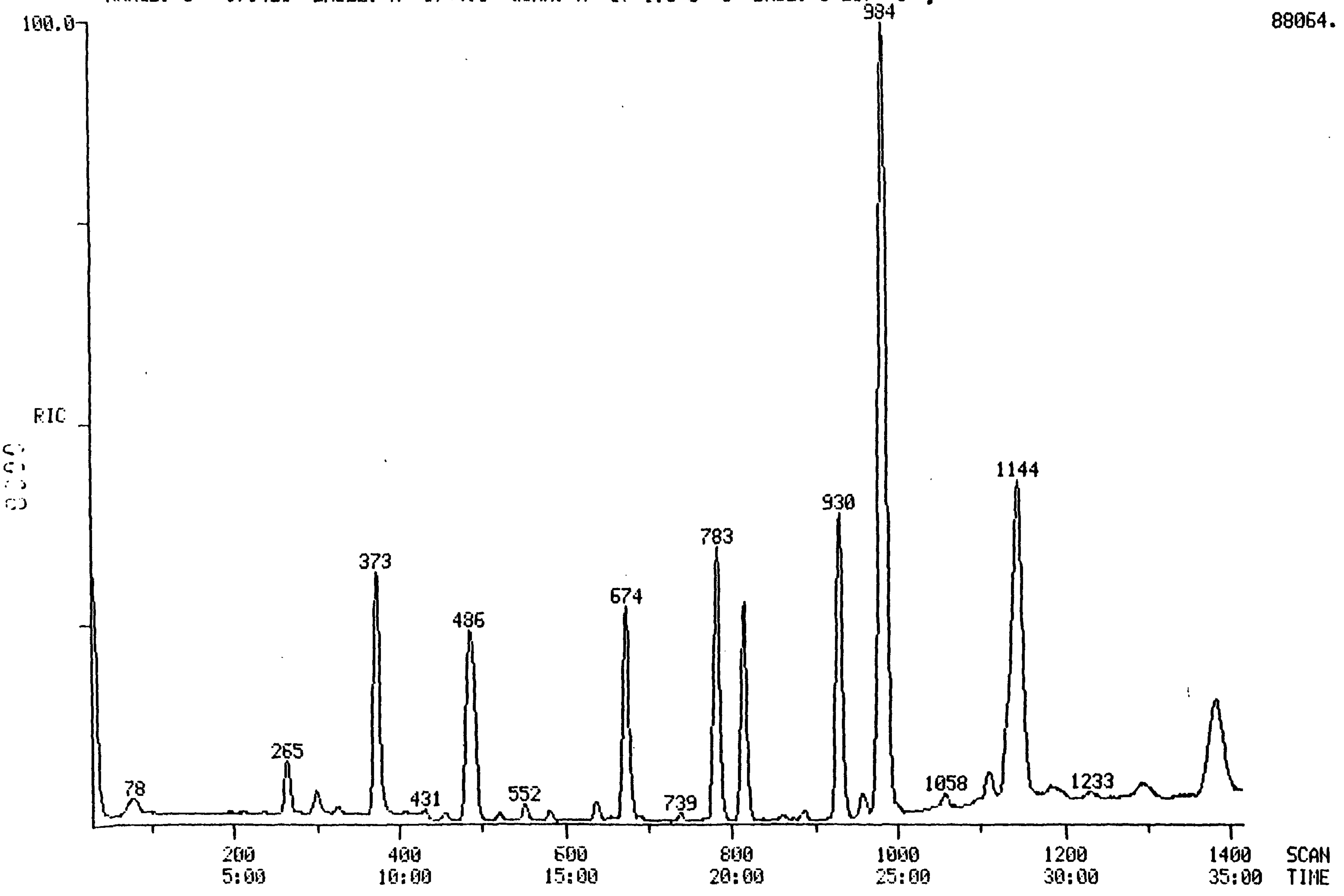
CAS Number		UG/L		CAS Number		UG/L
74-87-3	Chloromethane	10	<	78-87-5	1,2-Dichloropropane . . .	5
74-83-9	Bromomethane	10	<	10061-02-6	Cis-1,3-Dichloropropene .	5
75-01-4	Vinyl Chloride	10	<	79-01-6	Trichloroethene	5
75-00-3	Chloroethane	10	<	124-48-1	Dibromochloromethane . . .	5
75-09-2	Methylene Chloride	5	<	79-00-5	1,1,2-Trichloroethane . .	5
67-64-1	Acetone	80		71-43-2	Benzene	5
75-15-0	Carbon Disulfide	24		10061-01-5	trans-1,3-Dichloropropene	5
75-35-4	1,1-Dichloroethene	5	<	110-75-8	2-Chloroethylvinylether .	10
75-35-3	1,1-Dichloroethane	5	<	75-25-2	Bromoform	5
156-60-5	Trans-1,2-Dichloroethene .	5	<	108-10-1	4-Methyl-2-Pentanone . . .	10
67-66-3	Chloroform	5	<	591-78-6	2-Hexanone	10
107-06-2	1,2-Dichloroethane	5	<	127-18-4	Tetrachloroethene	5
78-93-3	2-Butanone	30		79-34-5	1,1,2,2-Tetrachloroethane	5
71-55-6	1,1,1-Trichloroethane . .	5		108-88-3	Toluene	5
56-23-5	Carbon Tetrachloride . . .	5	<	108-90-7	Chlorobenzene	5
108-05-4	Vinyl Acetate	10	<	100-41-4	Ethylbenzene	5
75-27-4	Bromodichloromethane . . .	5	<	100-42-5	Styrene	5
					Total Xylenes	5

The Lab ID for data on this page is A25554.

< - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

Form I

```
RIC                                      DATA: EP02B #1          SCANS   25 TO 1415
07/08/89 17:30:00                        CALI: EP02B #3
SAMPLE: EP-02-B
CONDS.: I50C
RANGE: G   1,1420  LABEL: N  0, 4.0  QUAN: A  0, 1.0 J  0  BASE: U 20,  3
```



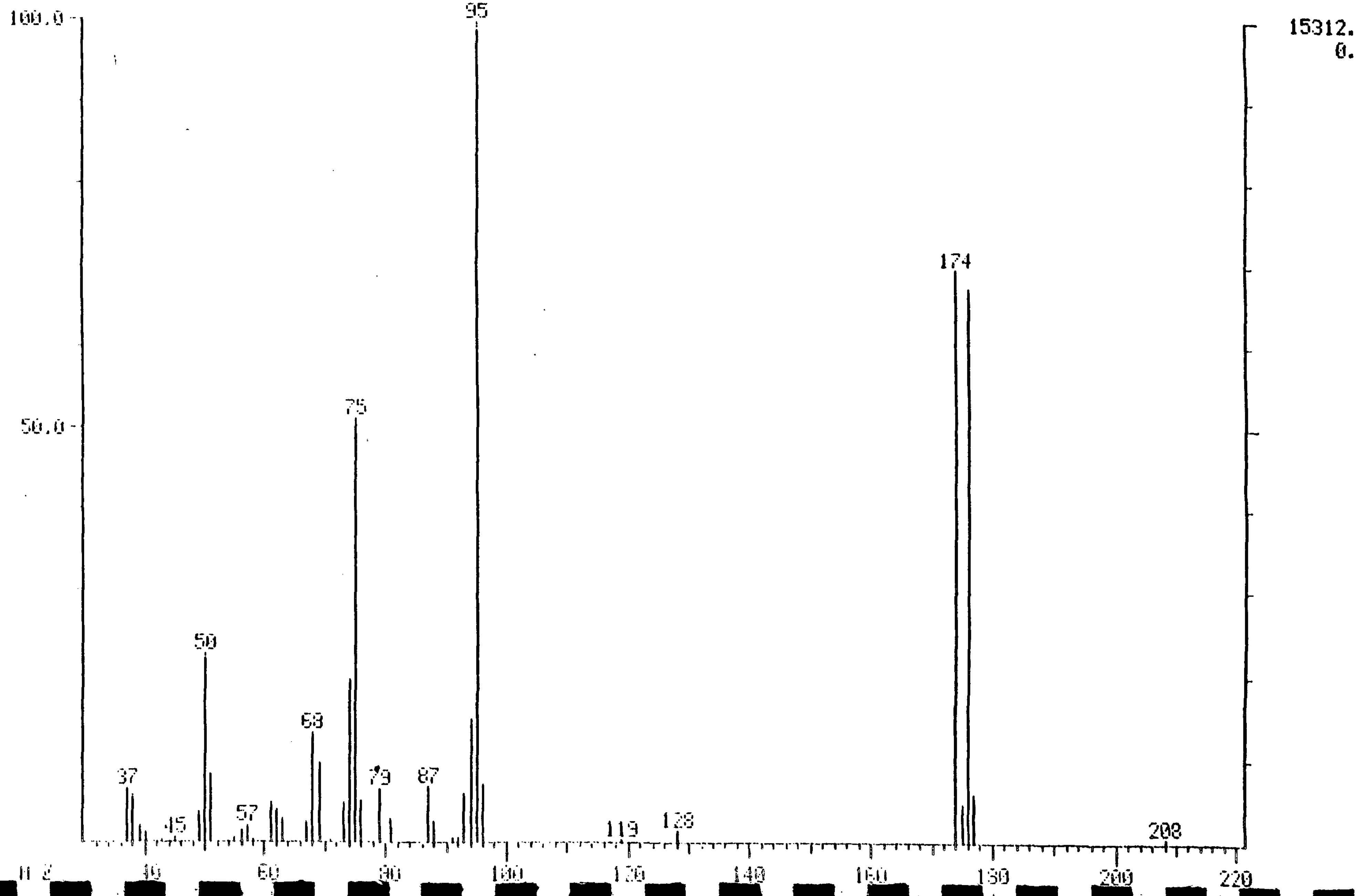
```
                        BROMOFLUOROBENZENE

Tuning Report                   Data: BF070889C1 # 417    Base m/z:   95
07/08/89 12:43:00 + 10:25       Cali: CALTAB #   3        RIC: -    71808.
Instrument: FINN                Analyst: BPB              Acct. No.: 8506-089
 #409 to #425 summed - #406 to #407 - #426 to #430
Case Number:                    Laboratory: ERT1 HOUSTON  Contract:

                                Ion Abundance Criteria
 m/z    Intensity      % RA     Min %    Max %    Mass    Actual    Status

  50        3408.      22.3     15.0     40.0      95      22.3      PASS
  75        7808.      51.0     30.0     60.0      95      51.0      PASS
  95       15312.     100.0    100.0     ---      ---     100.0      PASS
  96        1068.       7.0      5.0      9.0      95       7.0      PASS
 173           0.       0.0     ---       2.0     174       0.0      PASS
 174       10656.      69.6     50.0     ---       95      69.6      PASS
 175         723.       4.7      5.0      9.0     174       6.8      PASS
 176       10320.      67.4     95.0    101.0     174      96.8      PASS
 177         878.       5.7      5.0      9.0     176       8.5      PASS
```

MASS SPECTRUM
07/08/89 12:43:00 + 10:25
SAMPLE: BFB CALIBRATION
CONDS.: I50C
TEMP: 225 DEG. C
#409 TO #425 SUMMED - #406 TO #407 - #426 TO #430

DATA: BF070889C1 #417
CALI: CALTAB #3

BASE M/Z: 95
RIC: 71808.

0,00



```
Mass List                               Data: BF070889C1 # 417    Base m/z:    95
07/08/89 12:43:00 + 10:25               Cali: CALTAB #   3        RIC:      71808.
Sample: BFB CALIBRATION
Conds.: I50C
 #409 to #425 summed - #406 to #407 - #426 to #430

   37          0.00        0.    Minima  Min Inten:       0.
  208                            Maxima  #    0
 Mass          % RA     Inten.

   37?          6.48      992.
   38?          5.41      828.
   39?    S     1.80      276.
   40?    S     1.14      175.
   42?    S     0.18       27.
   43?    S     0.24       37.
   44?    S     0.40       61.
   45?    S     0.69      105.
   49?          3.71      568.
   50?    S    22.26     3408.
   51?          8.14     1246.
   55?    S     0.56       85.
   56?    S     1.35      207.
   57?    S     2.04      313.
   58?    S     0.37       57.
   61?          4.80      735.
   62?          3.87      592.
   63?          2.76      422.
   67?    S     2.51      385.
   68?    S    12.85     1968.
   69     S     9.44     1446.
   70           0.33       50.
   71     S     0.25       39.
   73     S     4.66      714.
   74     S    19.23     2944.
   75     S    50.99     7808.
   76           4.89      749.
   79           6.33      969.
   81     S     2.74      420.
   87           6.65     1018.
   88     S     2.88      441.
   91     S     0.59       91.
   92           0.71      108.
   93           5.86      898.
   94          14.52     2224.
   95     S   100.00    15312.
   96     S     6.97     1068.
  119           0.33       50.
  128     S     1.30      199.
  174     S    69.59    10656.
  175           4.72      723.
  176     S    67.40    10320.
  177           5.73      878.
  208           0.67      102.
```

```
Mass List                             Data: BF070889C1 # 417    Base m/z:    95
07/08/89 12:43:00 + 10:25             Cali: CALTAB #   3        RIC:       71808.
Sample: BFB CALIBRATION
Conds.: I50C
 #409 to #425 summed - #406 to #407 - #426 to #430

   37         0.00        0.   Minima  Min Inten:       0.
  208                          Maxima  #   0
 Mass         % RA    Inten.

   37?        6.48      992.
   38?        5.41      828.
   39?   S    1.80      276.
   40?   S    1.14      175.
   42?   S    0.18       27.
   43?   S    0.24       37.
   44?   S    0.40       61.
   45?   S    0.69      105.
   49?        3.71      568.
   50?   S   22.26     3408.
   51?        8.14     1246.
   55?   S    0.56       85.
   56?   S    1.35      207.
   57?   S    2.04      313.
   58?   S    0.37       57.
   61?        4.80      735.
   62?        3.87      592.
   63?        2.76      422.
   67?   S    2.51      385.
   68?   S   12.85     1968.
   69    S    9.44     1446.
   70         0.33       50.
   71    S    0.25       39.
   73    S    4.66      714.
   74    S   19.23     2944.
   75    S   50.99     7808
   76         4.89      749.
   79         6.33      969.
   81    S    2.74      420.
   87         6.65     1018.
   88    S    2.88      441.
   91    S    0.59       91.
   92         0.71      108.
   93         5.86      898.
   94        14.52     2224.
   95    S  100.00    15312.
   96    S    6.97     1068.
  119         0.33       50.
  128    S    1.30      199.
  174    S   69.59    10656.
  175         4.72      723.
  176    S   67.40    10320.
  177         5.73      878.
  208         0.67      102.
```

CONTINUING CALIBRATION CHECK
VOLATILE HSL COMPOUNDS

Case No: CALIB
Region:
Contractor: ENSR LAB-Hou
Contract No:
Instrument ID: FINN

Calibration Date: 07/08/89
Time: 14:24
Laboratory ID: CC070889C1
Initial Cali. Date: 06/06/89

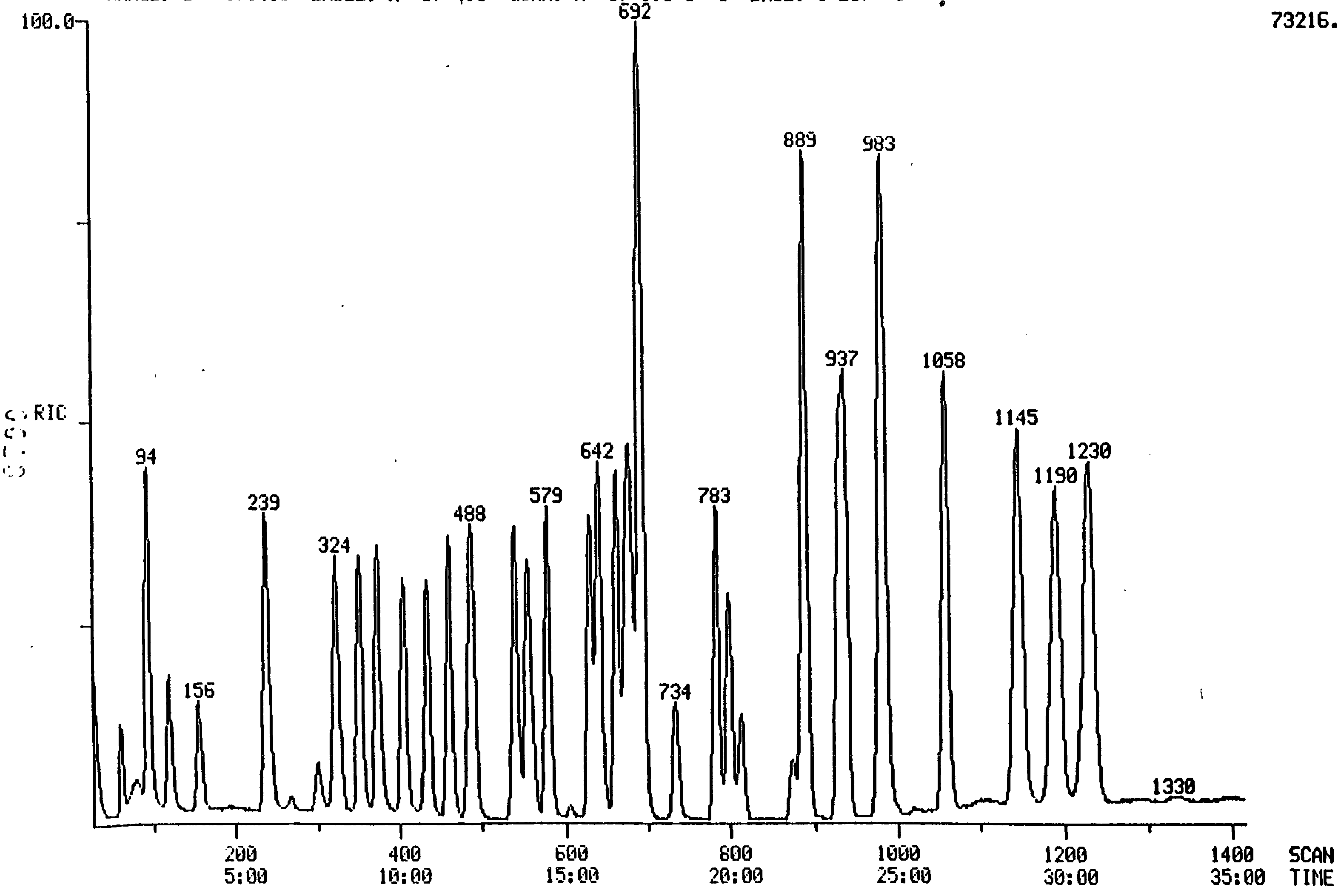
Minimum RF for SPCC is 0.300 (1)   Maximum %D for CCC is 25%

Compound	AVE RF	RF(50)	% D	CCC	SPCC
Chloromethane	1.025	1.043	-1.8		* *
Bromomethane	2.205	2.880	-30.6		
Vinyl Chloride	1.360	1.528	-12.4	*	
Chloroethane	1.028	1.287	-25.2		
Methylene Chloride	2.490	1.897	23.8		
Acetone	0.507	0.246	51.5		
Carbon Disulfide	1.291	1.116	13.6		
1,1-Dichloroethene	1.342	1.312	2.2	*	
1,1-Dichloroethane	3.029	3.096	-2.2		* *
Trans-1,2-Dichloroethene . . .	1.394	1.211	13.1		
Chloroform	3.570	2.967	16.9	*	
1,2-Dichloroethane	2.679	2.259	15.7		
2-Butanone	0.033	0.021	36.4		
1,1,1-Trichloroethane	0.685	0.726	-6.0		
Carbon Tetrachloride	0.590	0.534	9.5		
Vinyl Acetate	0.404	0.416	-3.0		
Bromodichloromethane	0.762	0.805	-5.6		
1,2-Dichloropropane	0.504	0.467	7.3	*	
Cis-1,3-Dichloropropene . . .	0.660	0.675	-2.3		
Trichloroethene	0.547	0.427	21.9		
Dibromochloromethane	0.711	0.707	0.6		
1,1,2-Trichloroethane	0.505	0.440	12.9		
Benzene	0.962	1.083	-12.6		
trans-1,3-Dichloropropene . .	0.574	0.518	9.8		
2-Chloroethylvinylether . . .	0.263	0.230	12.5		
Bromoform	0.563	0.469	16.7		* *
4-Methyl-2-Pentanone	0.436	0.348	20.2		
2-Hexanone	0.436	0.214	50.9		
Tetrachloroethene	0.535	0.421	21.3		
1,1,2,2-Tetrachloroethane . .	0.788	0.639	18.9		* *
Toluene	0.777	0.781	-0.5	*	
Chlorobenzene	1.067	1.070	-0.3		* *
Ethylbenzene	0.549	0.530	3.5	*	
Styrene	0.985	1.019	-3.5		
Total Xylenes	0.659	0.655	0.6		

RF(50) -	Response Factor from daily standard file at 50 ug/l
AVE RF -	Average Response Factor from initial calibration Form VI
%D - - -	Percent Difference
CCC - -	Calibration Check Compounds (*)
SPCC - -	System Performance Check Compounds (**)
(1) - -	Mininum RF for Bromoform is 0.250

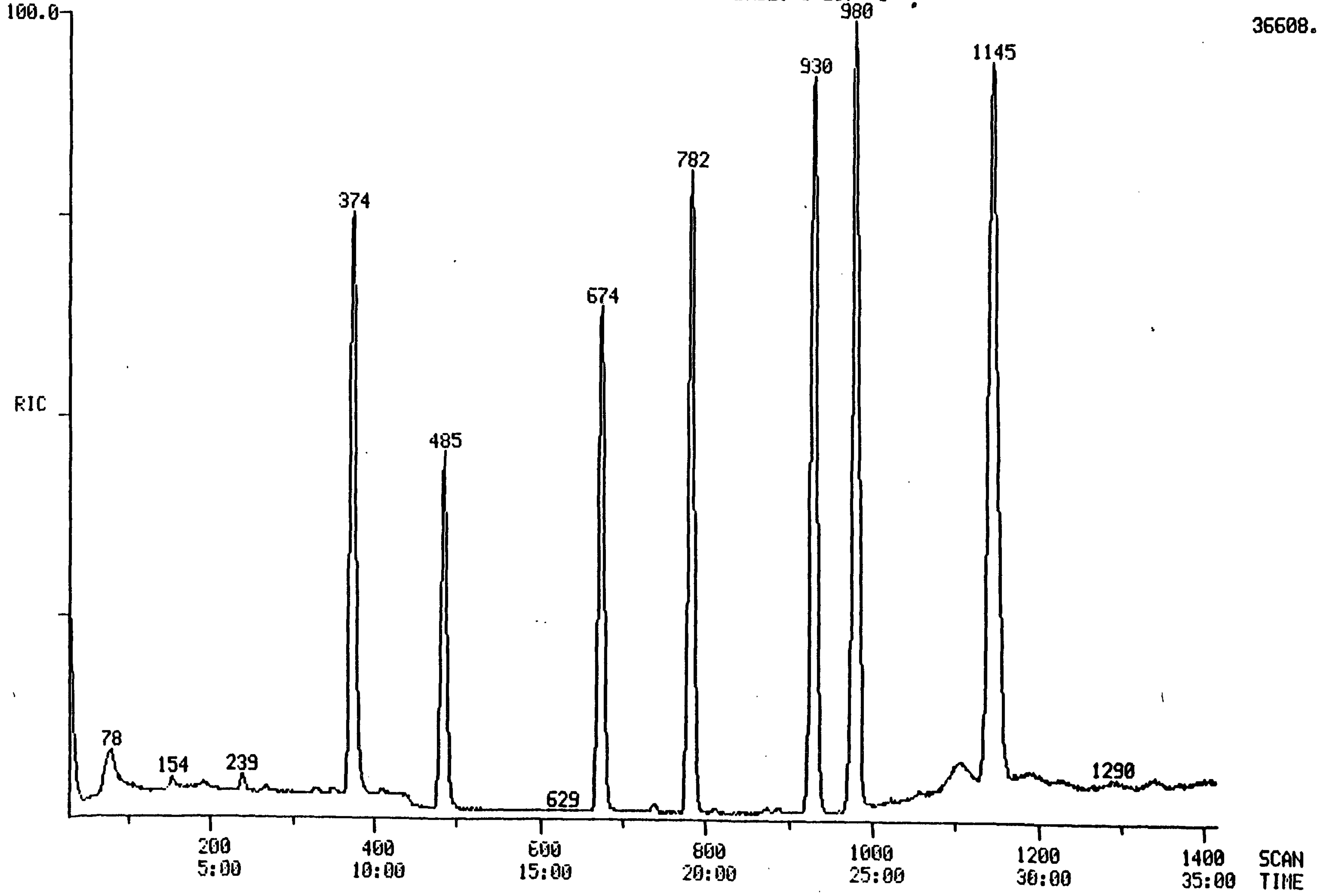
Form VII

```
RIC                                          DATA: CC070889C1 #1      SCANS   25 TO 1415
07/08/89 14:24:00                            CALI: CC070889C1 #3
SAMPLE: CONTINUING CALIBRATION WATER
CONDS.: I50C
RANGE: G   1,1415  LABEL: N  0, 4.0  QUAN: A  0, 1.0 J  0  BASE: U 20,  3
```



RIC
07/08/89 15:18:00
SAMPLE: METHOD BLANK WATER
CONDS.: I50C
RANGE: G 1,1420 LABEL: N 0, 4.0 QUAN: A 0, 1.0 J 0 BASE: U 20, 3

DATA: MB070889C1 #1 SCANS 25 TO 1415
CALI: MB070889C1 #3



WATER SURROGATE PERCENT RECOVERY SUMMARY
VOLATILE
(Page 1)

Case No. A2555 Contract Laboratory ENSR LAB-Hou Contract No.

	VOLATILE										
SMO TRAFFIC NO.	Toluene-d8	BFB	1,2-Dichloroethane-d4	BENZENE-D6							
	88	86	76	75							
	110	115	114	125							
EP-03-A	98	98	79	104							
EP-01-A	104	99	84	102							
EP-02-A	101	99	79	91							
EP-02-B	95	93	79	100							

* VALUES ARE OUTSIDE OF CONTRACT REQUIRED QC LIMITS

Volatiles: 0 out of 16; outside of QC limi
Semi-Volatiles: 0 out of 0; outside of QC limi
Pesticides: 0 out of 0; outside of QC limi

Comments:

FORM II

INITIAL CALIBRATION DATA
VOLATILE HSL COMPOUNDS

Case No: CALIB　　Region:　　Instrument ID: FINN
Contractor: ENSR LAB-Hou　　Calibration Date: 06/05/89
Contract No:

Min AVE RF for SPCC is 0.300 (1)　　Max %RSD for CCC is 30%

Laboratory ID	IC0605W020	CC060689C1	IC0605W100	IC0605W150	IC0605W200			CCC
Compound	RF(20)	RF(50)	RF(100)	RF(150)	RF(200)	AVE RF	% RSD	SPCC
Chloromethane	1.508	0.859	1.219	0.876	0.662	1.025	32.8	* *
Bromomethane	2.587	2.040	2.535	2.071	1.791	2.205	15.6	
Vinyl Chloride	1.798	1.230	1.627	1.193	0.953	1.360	25.3	*
Chloroethane	1.235	1.023	1.140	0.911	0.829	1.028	16.0	
Methylene Chloride	2.753	2.539	2.642	2.455	2.324	2.543	6.5	
Acetone	0.790	0.251	0.517	0.477	0.499	0.507	37.8	
Carbon Disulfide	1.318	0.890	1.604	1.406	1.236	1.291	20.3	
1,1-Dichloroethene	1.676	1.267	1.270	1.280	1.217	1.342	14.0	*
1,1-Dichloroethane	3.406	3.221	3.020	2.864	2.632	3.029	10.0	* *
Trans-1,2-Dichloroethene . . .	1.577	1.171	1.336	1.493	1.393	1.394	11.1	
Chloroform	3.982	4.037	3.789	3.149	2.891	3.570	14.5	*
1,2-Dichloroethane	2.773	2.733	2.867	2.620	2.402	2.679	6.7	
2-Butanone	0.031	0.026	0.039	0.034	0.037	0.033	15.4	
1,1,1-Trichloroethane	0.840	0.579	0.692	0.718	0.598	0.685	15.3	
Carbon Tetrachloride	0.682	0.619	0.540	0.580	0.529	0.590	10.6	
Vinyl Acetate	0.283	0.451	0.390	0.461	0.434	0.404	18.0	
Bromodichloromethane	0.786	0.777	0.851	0.748	0.650	0.762	9.6	
1,2-Dichloropropane	0.549	0.515	0.490	0.487	0.477	0.504	5.8	*
Cis-1,3-Dichloropropene . . .	0.692	0.686	0.729	0.641	0.554	0.660	10.2	
Trichloroethene	0.646	0.544	0.526	0.527	0.493	0.547	10.6	
Dibromochloromethane	0.668	0.726	0.819	0.707	0.637	0.711	9.7	
1,1,2-Trichloroethane	0.537	0.486	0.509	0.501	0.494	0.505	3.9	
Benzene	1.204	0.955	1.047	0.885	0.717	0.962	18.9	
trans-1,3-Dichloropropene . .	0.556	0.530	0.587	0.604	0.591	0.574	5.2	
2-Chloroethylvinylether . . .	0.272	0.248	0.267	0.257	0.271	0.263	3.9	
Bromoform	0.491	0.494	0.618	0.622	0.588	0.563	11.6	* *
4-Methyl-2-Pentanone	0.416	0.354	0.475	0.451	0.484	0.436	12.1	
2-Hexanone	0.167	0.354	0.475	0.451	0.484	0.386	34.4	
Tetrachloroethene	0.600	0.523	0.484	0.531	0.539	0.535	7.8	
1,1,2,2-Tetrachloroethane . .	0.736	0.776	0.830	0.833	0.764	0.788	5.4	* *
Toluene	0.897	0.706	0.773	0.796	0.715	0.777	9.9	*
Chlorobenzene	1.213	1.197	1.123	0.950	0.851	1.067	14.9	* *
Ethylbenzene	0.581	0.462	0.519	0.618	0.564	0.549	11.0	*
Styrene	0.912	1.040	1.099	0.954	0.921	0.985	8.2	
Total Xylenes	0.605	0.683	0.685	0.642	0.678	0.659	5.3	

Response Factor (number is the amount of ug/L)
AVE RF - Average Response Factor
%RSD - - Percent Relative Standard Deviation
CCC - - Calibration Check Compounds (*)
SPCC - - System Performance Check Compounds (**)
(1) - - Minimum AVE RF for Bromoform is 0.250

Form VI

ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	ENSR LAB-Hou	Concentration:	LOW	Date Extracted:	07/08/89
Lab Sample ID:	MB070889C1	Sample Matrix:	WATER	Date Analyzed:	07/08/89
Client Sample ID:	MB070889C1	Percent Moisture:	100.0	Dilution Factor:	1.0

VOLATILE COMPOUNDS

CAS Number		UG/L		CAS Number		UG/L	
74-87-3	Chloromethane	10	<	78-87-5	1,2-Dichloropropane . . .	5	<
74-83-9	Bromomethane	10	<	10061-02-6	Cis-1,3-Dichloropropene .	5	<
75-01-4	Vinyl Chloride	10	<	79-01-6	Trichloroethene	5	<
75-00-3	Chloroethane	10	<	124-48-1	Dibromochloromethane . . .	5	<
75-09-2	Methylene Chloride	5	<	79-00-5	1,1,2-Trichloroethane . .	5	<
67-64-1	Acetone	10	<	71-43-2	Benzene	5	<
75-15-0	Carbon Disulfide	5	<	10061-01-5	trans-1,3-Dichloropropene	5	<
75-35-4	1,1-Dichloroethene	5	<	110-75-8	2-Chloroethylvinylether .	10	<
75-35-3	1,1-Dichloroethane	5	<	75-25-2	Bromoform	5	<
156-60-5	Trans-1,2-Dichloroethene .	5	<	108-10-1	4-Methyl-2-Pentanone . . .	10	<
67-66-3	Chloroform	5	<	591-78-6	2-Hexanone	10	<
107-06-2	1,2-Dichloroethane	5	<	127-18-4	Tetrachloroethene	5	<
78-93-3	2-Butanone	10	<	79-34-5	1,1,2,2-Tetrachloroethane	5	<
71-55-6	1,1,1-Trichloroethane . .	5	<	108-88-3	Toluene	5	<
56-23-5	Carbon Tetrachloride . . .	5	<	108-90-7	Chlorobenzene	5	<
108-05-4	Vinyl Acetate	10	<	100-41-4	Ethylbenzene	5	<
75-27-4	Bromodichloromethane . . .	5	<	100-42-5	Styrene	5	<
					Total Xylenes	5	<

The Lab ID for data on this page is MB070889C1.

< - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

Form I

Additional Peaks

Sample ID: EP02A

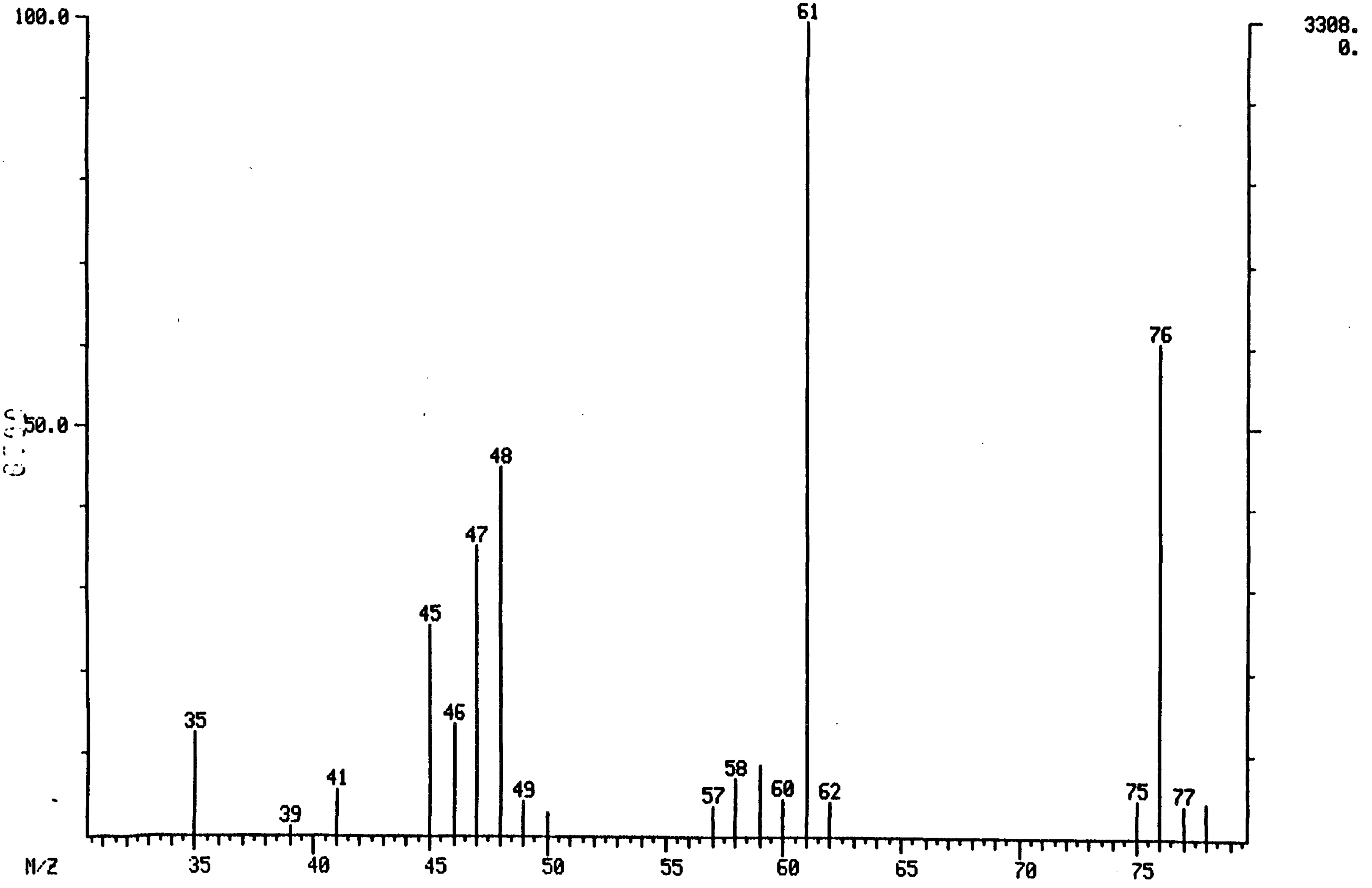
Date Analyzed: 7/08/89

Spectrum No.	Identity	Approx. Conc. (ug/L)
490	Methylthioethane (C_3H_8S)	30
815	Methylethyldisulfide ($C_3H_8S_2$)	25
985	Diethyldisulfide ($C_4H_{10}S_2$)	50
1134	Isopropylethyldisulfide ($C_5H_{10}S_2$)	15

MASS SPECTRUM
07/08/89 16:45:00 + 12:15
SAMPLE: EP-02-A
CONDS.: I50C
TEMP: 118 DEG. C
ENHANCED (S 15B 2N 0T)

DATA: EP02A #490
CALI: EP02A #3

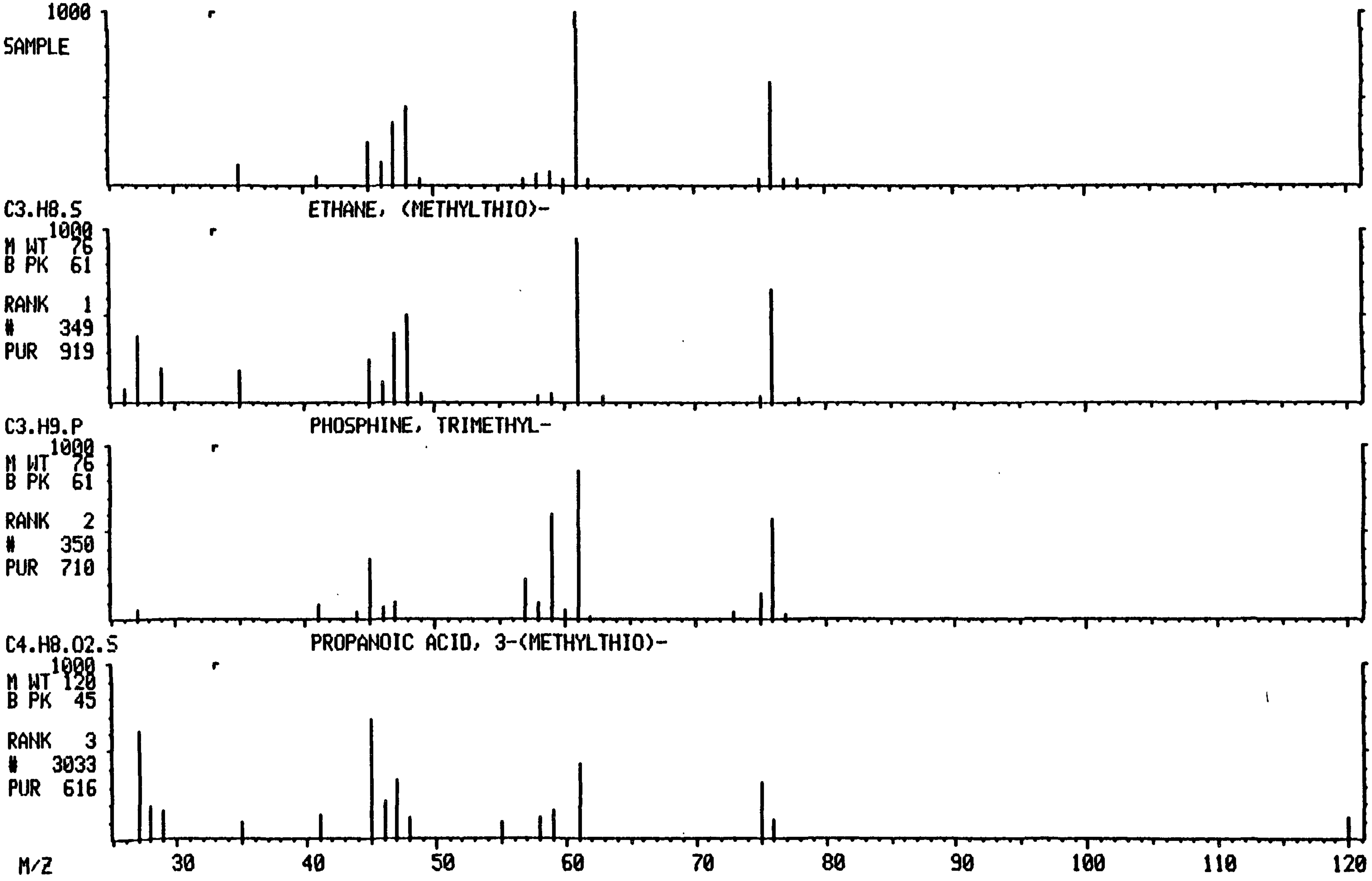
BASE M/Z: 61
RIC: 11456.



MID LIBRARY SEARCH (LIBRARYNB)
07/08/89 16:45:00 + 12:15
SAMPLE: EP-02-A
CONDS.: I50C
ENHANCED (S 15B 2N 0T)

DATA: EP02A # 490
CALI: EP02A # 3

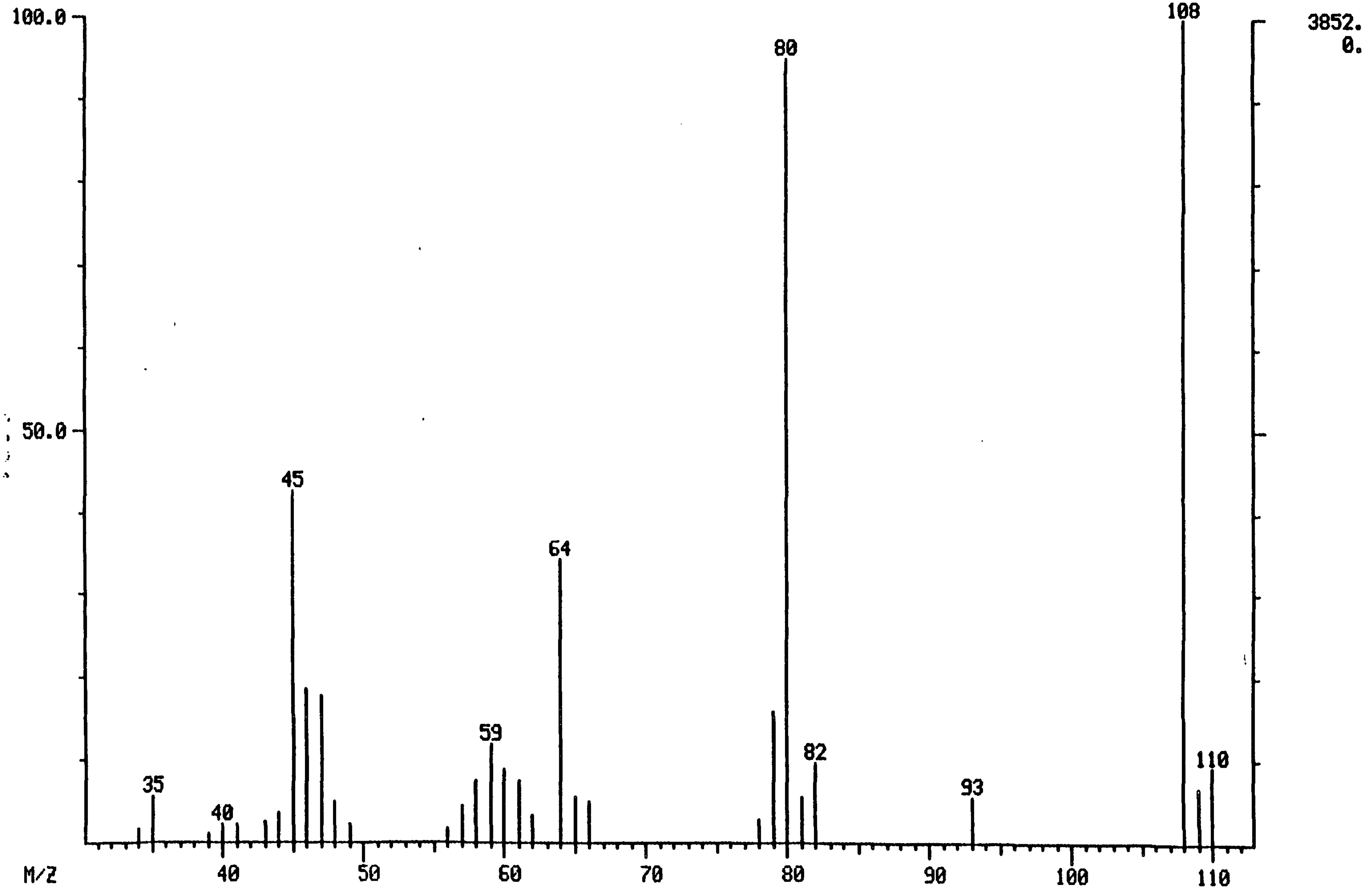
BASE M/Z: 61
RIC: 11328.



MASS SPECTRUM
07/08/89 16:45:00 + 20:22
SAMPLE: EP-02-A
CONDS.: I50C
TEMP: 183 DEG. C
ENHANCED (S 15B 2N 0T)

DATA: EP02A #815
CALI: EP02A #3

BASE M/Z: 108
RIC: 17152.



MID LIBRARY SEARCH (LIBRARYNB)
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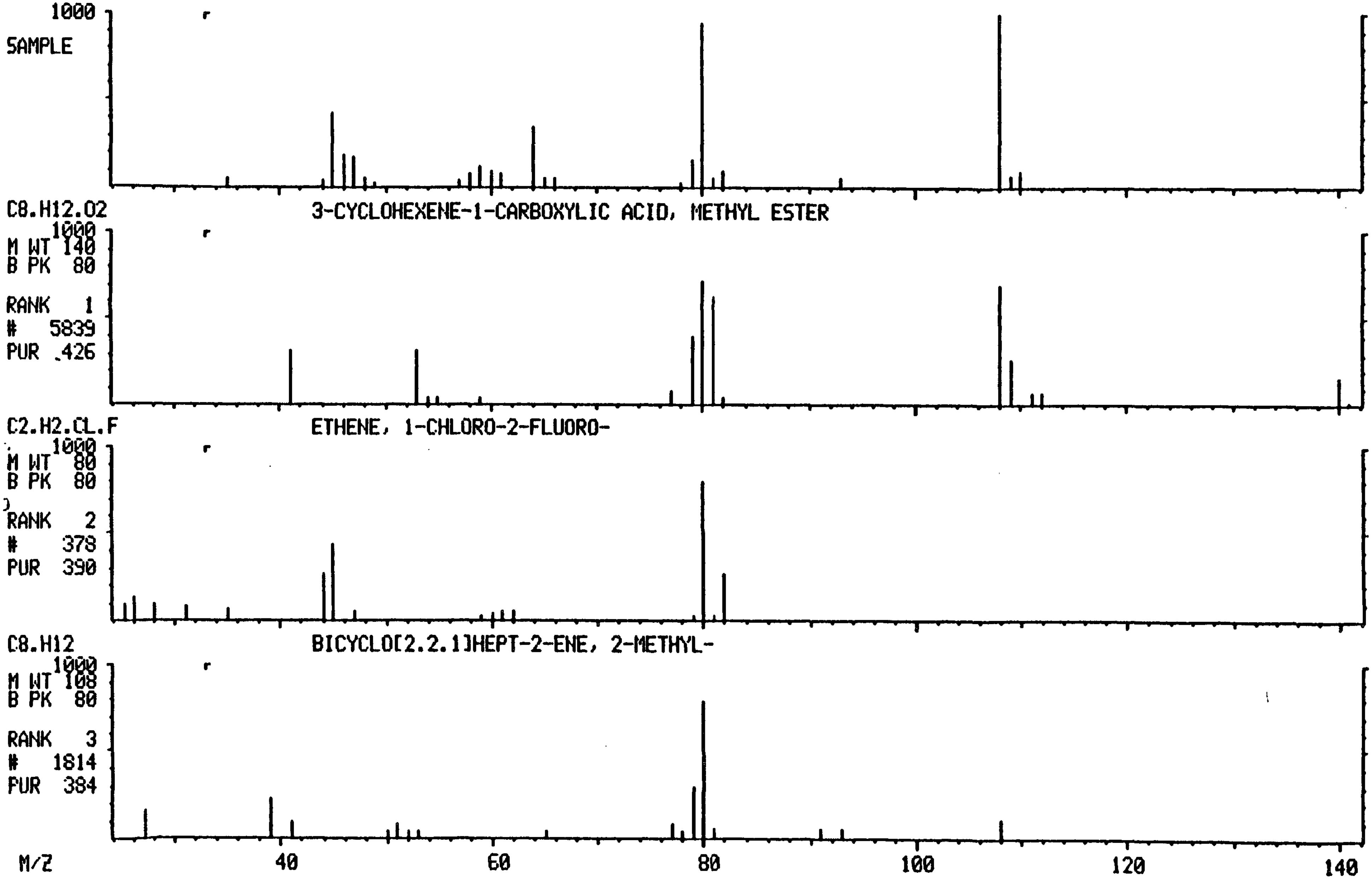

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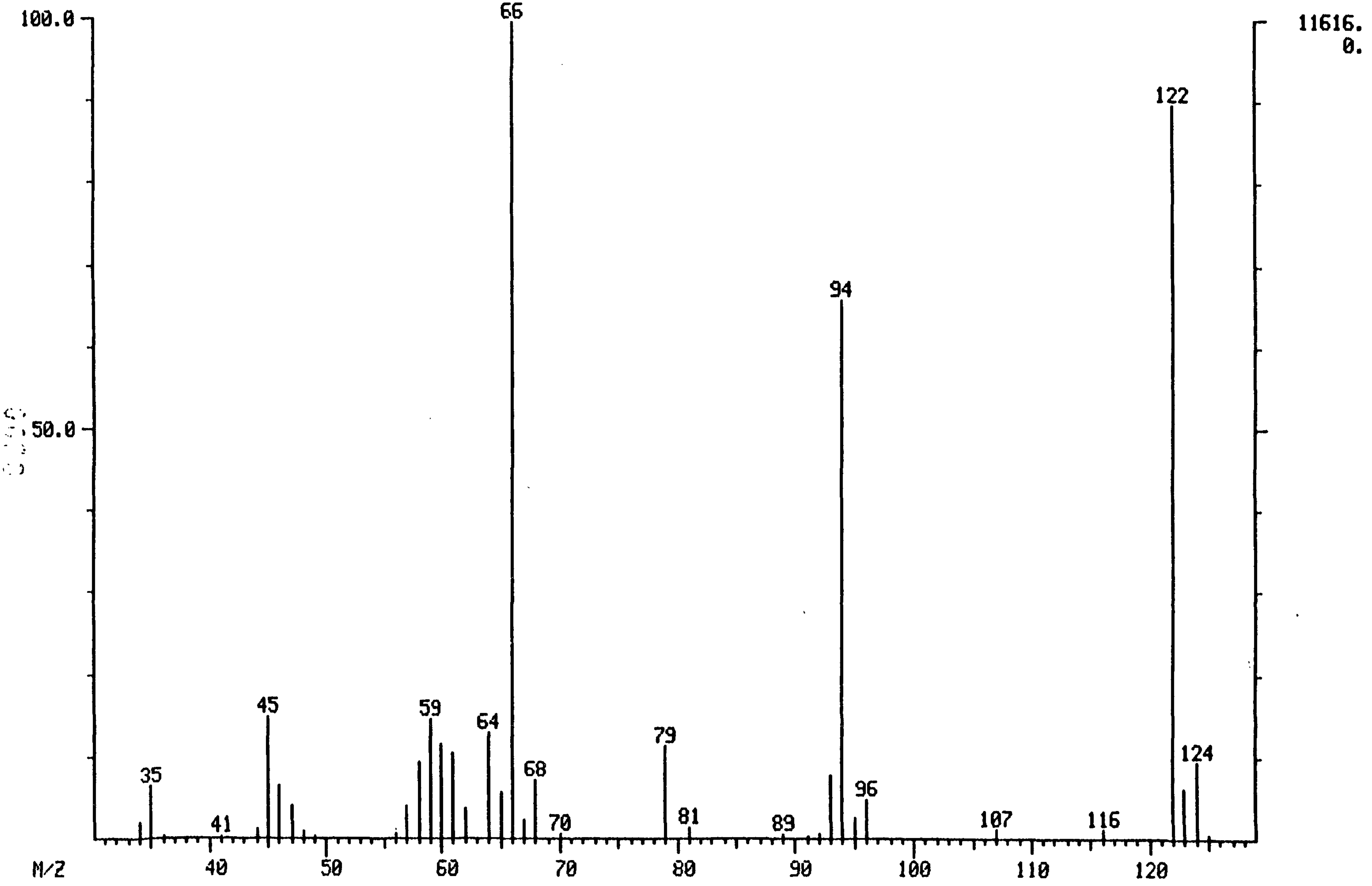

EXPANDED HYDROGEOLOGY STUDY FOR THE EL PASO NATURAL GAS COMPANY JAL 4 FACILITY

RECEIVED

JUN 20 1991

OIL CONSERVATION DIV.
SANTA FE

prepared for

El Paso Natural Gas Company
El Paso, Texas

prepared by

K. W. Brown & Associates, Inc.
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College Station, Texas 77845

August 1990

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1.0 CENTRAL FINDINGS AND RECOMMENDATIONS

The primary object of this work effort was to determine if a contaminant plume is present in the groundwater at the Jal 4 plant. To accomplish this objective, tasks were executed that included groundwater sampling, measuring the local groundwater gradient, determining the local groundwater flow direction, and interpreting groundwater quality data. Additionally, a groundwater model was employed to predict the configuration of a contaminant plume.

Groundwater at the site that is most vulnerable to contamination from surface sources occurs in two aquifers: the Ogallala and the Dockum Group. These two aquifers are virtually indistinguishable at the site. Depth-to-water at the site is approximately 100 to 110 feet from the ground surface. Groundwater at the site was determined to be present under unconfined conditions.

Groundwater contour maps constructed from site-specific data indicate the local groundwater gradient is 0.0018 ft/ft and the flow direction is to the southeast at an azimuth of N125°E. These findings are consistent with regional information and previous findings at the site.

Attempts to measure the hydraulic conductivity at the site were unsuccessful. An attempt to analyze data from a pumping stress test conducted on well EPNG-12 in 1965 was also unsuccessful. Therefore, the the hydraulic conductivity of the saturated zone is not known. It is estimated that the hydraulic conductivity for the local aquifer is on the order of 10^{-3} to 10^{-4} cm/sec. These estimates are based on field observations, geologic material identified at the site, and published hydraulic conductivity values.

Analytical data for the water wells and the monitoring wells indicate that a contaminant plume exists in an area that extends roughly from ENSR-1 toward ENSR-2 and an unknown distance to the southeast beyond ENSR-2. The contaminants detected include inorganic and organic constituents. The inorganics detected include sodium and chloride. The levels for these two constituents exceed 800 meq/L as compared to background concentrations on the order of 2 meq/L. Organic constituents detected above Water Quality Control Commission (WQCC) standards include benzene, naphthalene, and five phenolic compounds.

The configuration of the contaminant plume and the waste constituents detected suggest the source(s) for the contamination are the wastewater ponds that were operated at the site in the past. The available information lacked sufficient detail to identify which of the ponds were the source of the contamination. No evidence was discovered to suggest the source of contamination was the result of an offsite source.

Computer modeling, using the available data, suggests the plume has migrated to the southeast, past the eastern El Paso Natural Gas Company (EPNG) property line. The leading edge of the plume is estimated to be approximately 300 feet east of Highway 18.

It is recommended that Phase 2 of the investigation be implemented with several modifications. The modifications include the installation of additional monitoring wells and conducting a resistivity survey to identify the full extent of the plume. It is also recommended that a groundwater recovery system be considered to remediate the plume. Remediation of the contaminant plume will require the installation of recovery wells. It is recommended that five wells be employed. Of these, at least two will need to be pumped at the rate of 20 gallons per minute for a period of at least five years. Water pumped from these wells will need to be disposed via an underground injection well. The amount pumped daily will be approximately 57,600 gallons. Increasing the number of recovery wells and the pumping rate will improve the performance of the groundwater recovery system. Establishing the final configuration of the recovery system will be one of the main objectives of the Phase 2 effort.

2.0 SITE DESCRIPTION

The EPNG Jal 4 plant is located in the southeastern corner of Lea County, New Mexico. Specifically, the plant is located approximately 9 miles north of the city of Jal, New Mexico along Highway 18. Figure 1 illustrates the location of the facility as well.

The Jal 4 Plant was constructed in 1952 and consisted of a gasoline plant, a purification plant, a dehydration plant and appropriate compression facilities. The plant treated, compressed and transported natural gas to EPNG's main transmission line for consumption further west. The plant was upgraded in 1959 with the addition of a new fractionationing plant and underground storage wells. Other additions to the process have been added or deleted from time to time, but the plant function has not changed significantly since construction. (Sprester et al., 1983).

An 11.12 acre area of the eastern portion of the 181-acre plant site was dedicated for unlined ponds used for disposal of wastewater from 1952 to 1981. However, due to fluctuations in quantities of gas production and process changes, the location of ponds have shifted and ponds have been added or deleted; the total 11.12 acres were not used at any one time. In fact, about 8.35 acres were used for disposal of wastewater or to capture rainfall runoff. (Sprester et al., 1983).

Prior to installation of a disposal system, wastewater was disposed of in the unlined ponds. The largest ponds, Ponds 1 and 3, were in continuous service from 1952 to 1981. None of the ponds designed to receive wastewater have been totally free of oily wastes. Ponds 9, 10, and 11 are brine storage ponds related to the underground liquid hydrocarbon storage facility and are not considered wastewater disposal ponds. These three ponds are lined with a synthetic liner system. Ponds 6 and 7 were naturally occurring low areas that have received runoff water as well as overflow from the wastewater ponds; over time they were modified to become wastewater disposal ponds. (Sprester et al., 1983). [Refer to Figure 10 for the locations of the ponds.]

With the exception of the lined ponds, all ponds have been closed and capped for several years. The closure of these ponds was done in accordance with New Mexico Oil Conservation Commission approval. Plant operations at the Jal 4 facility were shutdown in 1987. (Sprester et al., 1983).

The following discussion presents information on the local climate, geology, and hydrology.

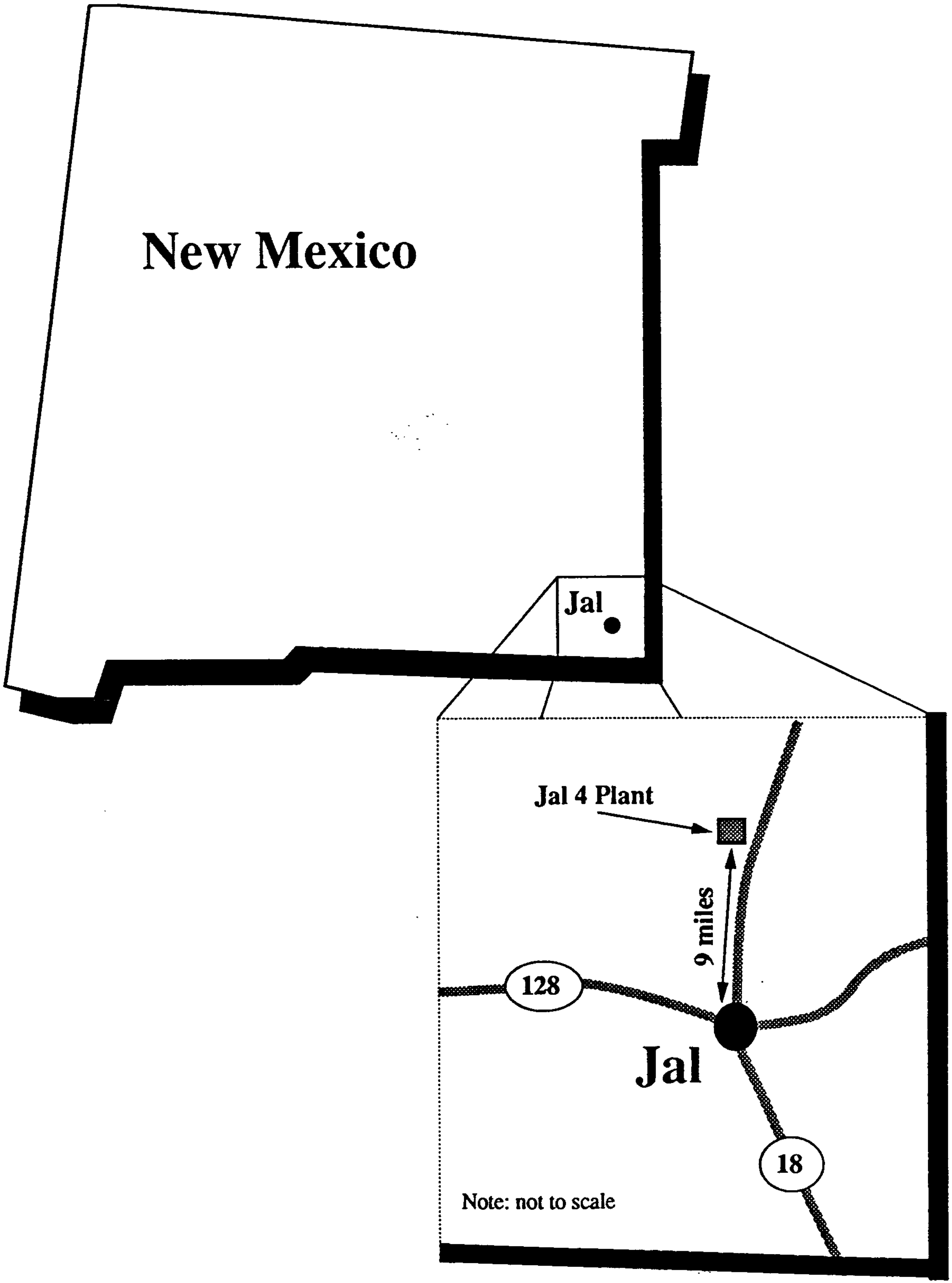


Figure 1. Site Map

2.1 CLIMATE

The climate of southern Lea County is characterized by low annual precipitation, low humidity, and high average temperature. The majority of the time the climate can be classified as marginal between semiarid and arid. The average annual precipitation is 8 inches in the southwestern corner to 14 inches in the northeastern corner (Reynolds, 1956). This precipitation occurs mostly as thundershowers between the months of October and May. The temperatures vary from greater than 100°F in summer to less than 0°F in the winter. The average annual lake evaporation is 79 inches per year using evaporation pan measurements that provide estimates of annual lake evaporation within 15% error.

2.2 GEOLOGY

The Jal 4 Plant is located in southeastern New Mexico in the Pecos Valley section of the Great Plains Physiographic Province within the Eunice Plain subdivision. The plant has a elevation of 3,310 feet above mean sea level (MSL). The relief in the plant area is no more than 22 feet while the total relief of the county is approximately 1,300 feet. The Eunice Plain is bounded on the north by the Llano Estacado portion of the High Plains; Mescalero Ridge marks the edge of the Llano Estacado. The Eunice Plain is bounded on the south by an irregular, low, south-facing scarp which is most prominent at Custer Mountain. Monument Draw traverses the east side of the Eunice Plain from north to south and is the only stream course in the area of significant extent. The Eunice Plain is bounded on the southeast by San Simon Ridge and Antelope Ridge. The westward extension of the Eunice Plain is the Gamma Ridge area.

The Eunice Plain is underlain by a hard caliche surface and is almost entirely covered by a reddish-brown dune sand. The sand cover is 2 to 5 feet thick over most of the area, but locally as deep as 20 feet, especially in the drift areas.

Southern Lea County includes part of a large subsurface feature known as the Permian basin. The oldest rocks exposed in the area are of Triassic age. Cretaceous rocks have been uncovered near Eunice but are of very limited extent. The only other rock units occurring at the surface are Tertiary and Quaternary in age.

Southern Lea County includes parts of the Delaware basin, the back-reef or shelf area, and the central basin platform of the Permian basin. The southwestern part of the county overlies the Delaware basin and the eastern part overlies the Central basin platform. Between the two areas is the back-reef or shelf area. These features were laid down about 250 million years ago when a huge inland sea covered what is now Texas and eastern New Mexico. The sea accumulated huge quantities of sediments and organic matter. Near the end of the Permian period, the sea waters evaporated leaving thick layers of gypsum, salt, anhydrite, and potash.

By the end of the Permian period, the basin received stream sediments from the higher surrounding areas. These sediments accumulated great thicknesses of nonmarine clays and sands. These layers are referred to in site drilling logs and elsewhere as "Red Beds." After the Permian period, the area was emergent and exposed to erosion during the early Triassic time. During the late Triassic time, deposition occurred once again. The formations laid down at this time are termed the Dockum Groups. Erosion occurred once again during the Jurassic period. During the Cretaceous period, the area was again submerged under a large inland sea subjected to sedimentation resulting in thick layers of rock being deposited. With the upthrusting of the Rocky Mountains, these layers, including some Triassic materials, were stripped off leaving an eroded, irregular surface. During Pliocene time, terrestrial deposits of the Ogallala formation were laid down which covered the uneven surface with the thick, even mantle of the High Plains. During the beginning of the Quaternary period, a new cycle of erosion began which continues to the present.

The Jal 4 site area is underlain by clastic and chemical sedimentary rocks ranging in age from Ordovician through Triassic, and by alluvial sediments of Quaternary age. According to the ENSR report (ENSR, 1989) the alluvial materials are present from the surface to approximately 45 feet. This alluvium consisted of intermixed sand, silt, and caliche. From approximately 45 to 65 feet a very hard, recrystalized carbonate-cemented sand was found. The Ogallala is a calcareous sand and this could possibly mark the top of the Ogallala aquifer. Below this unit a fine, poorly-sorted, silty sand was encountered to the total depth of the borings.

2.3 HYDROLOGY

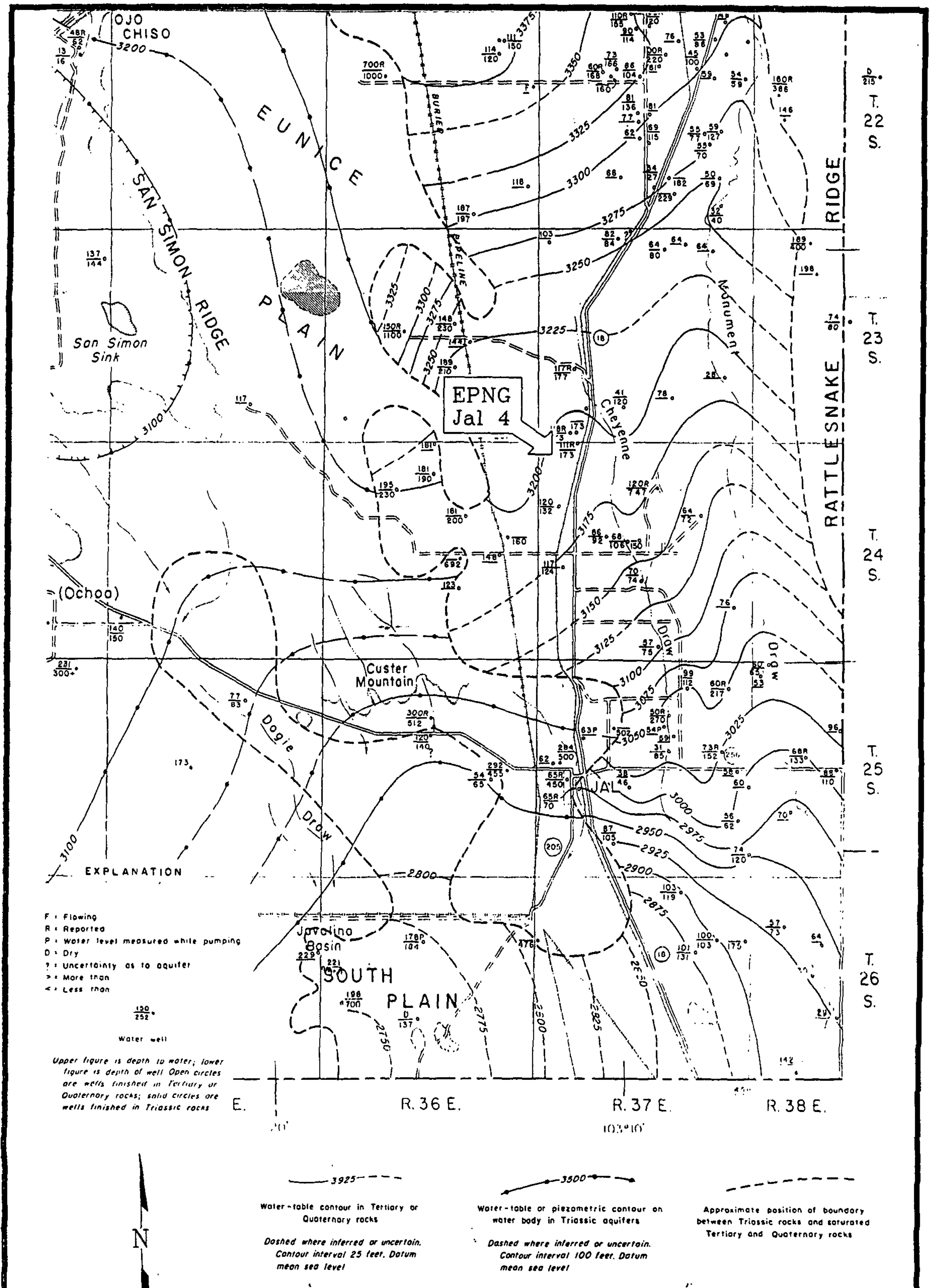
All the potable groundwater used in southern Lea County is derived from three principal geologic units, the Triassic Dockum Group, the Tertiary Ogallala, and the Quaternary alluvium. The chemical quality of the Ogallala and the Quaternary alluvium water is higher with greater yields than the water obtained from the Triassic formations. Therefore, the Tertiary Ogallala formation and the Quaternary alluvium are the principal sources of potable groundwater in the area for domestic and industrial users. The boundary between the Ogallala and the Alluvium beds is vague with one grading into the other at various stratigraphic levels. The Ogallala slopes to the southeast generally parallel with the underlying Chinile formation. The hydraulic gradient of about 10 to 12 feet per mile gives an easterly or southeasterly movement to the groundwater (Cronin, 1969). Pumping tests conducted in the 1960s indicate transmissivities ranging from 16,000 to 3,000 gallons per day per foot (ENSR, 1989).

The Ogallala overlies the relatively impermeable Triassic Chinile formation. It is the uppermost formation of the Dockum Group, characterized dominantly by red and green claystone. Below the Chinle, the Santa Rosa sandstone is found. The Santa Rosa is a principal aquifer in the western third of southern Lea County.

Southern Lea County is important as a recharge area, but little natural discharge takes place there. The aquifer beneath the High Plains is recharged mainly by infiltration from short drainage ways and from temporary lakes that form in shallow depressions after heavy rains. A small quantity of groundwater discharges to the atmosphere at Monument Springs and to the few small springs in the area, but most of the groundwater discharge is by pumping from wells.

The Ogallala receives its recharge as direct precipitation on the surface of the southern High Plains. This amounts to about 25,000 acre-feet per year for all of southern Lea County. The recharge area of the Triassic rocks is in the western part of southern Lea County and the eastern part of Eddy County. Some recharge is probably derived from the overlying Ogallala formation and the Quaternary alluvium where they overlie permeable beds of Triassic age in the subsurface (Nicholson & Clebsch, 1961).

Groundwater flow direction for southern Lea County, New Mexico, is typically south to southeast. A groundwater contour map compiled by Nicholson and Clebsch (1961) indicates the regional flow direction in the area near the Jal 4 facility is to the southeast (Figure 2).



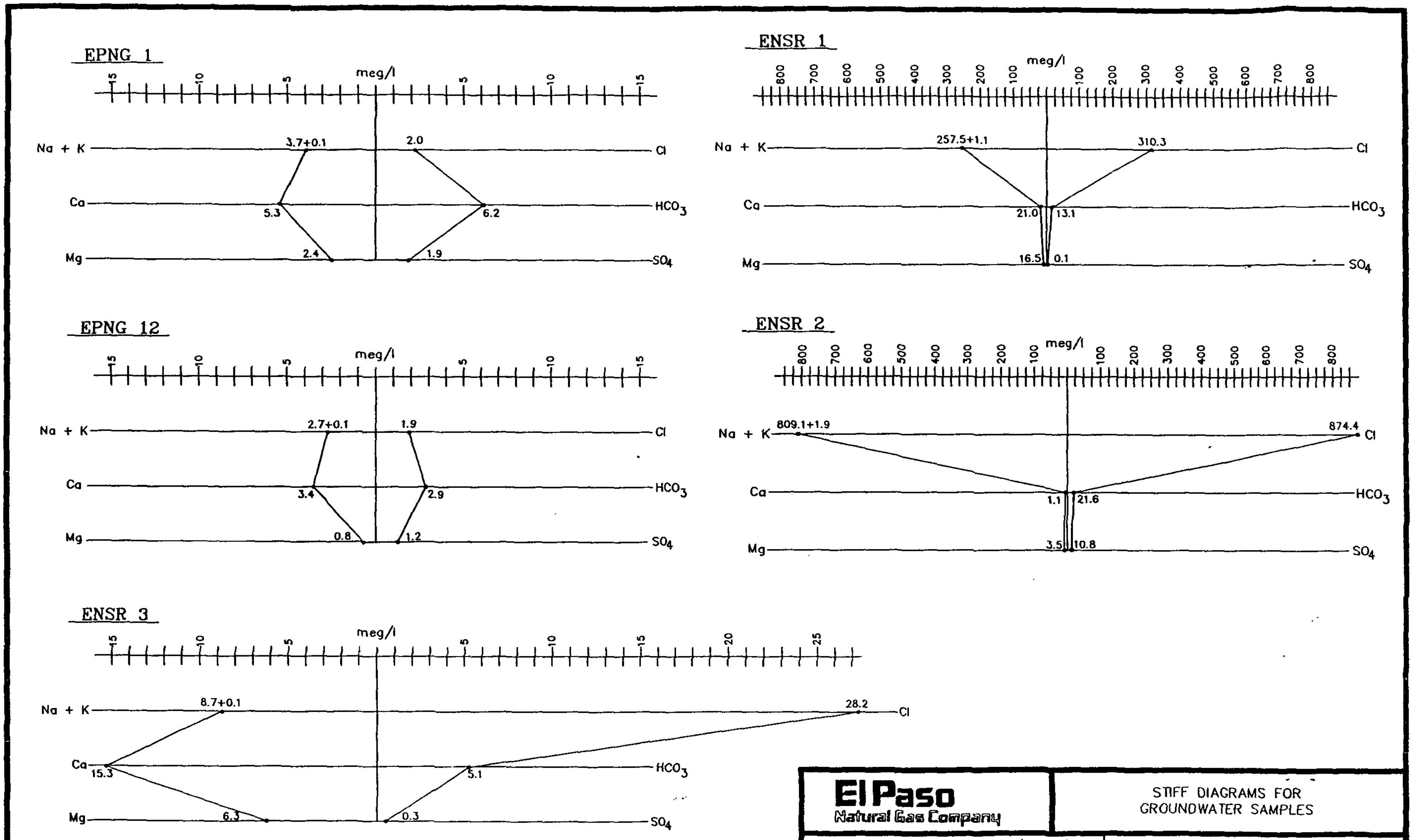
SCALE IN MILES
0 1 2 3 4 5

NICHOLSON AND CLEBSCH, 1961

El Paso Natural Gas Company

GROUNDWATER MAP OF SOUTHERN
LEA COUNTY, NEW MEXICO

PROJECT: EPNG 63724			LOCATION: LEA COUNTY, NM		
K.W. BROWN & ASSOCIATES, INC.				DATE:	06/01/90
APPR:			DRAWN BY:	RMM	SCALE: AS SHOWN
DATE:			DATE:	06/01/90	FIGURE: 2



El Paso
Natural Gas Company

STIFF DIAGRAMS FOR
GROUNDWATER SAMPLES

PROJECT: EPNG-JAL 63724 (JALGW)
LOCATION: LEA COUNTY, NM
K.W. BROWN & ASSOCIATES, INC.
DATE: 08/02/90
APPR:
DRAWN BY: RMM
SCALE: AS SHOWN
DATE:
DATE: 08/02/90
FIGURE: 3

3.0 GROUNDWATER SAMPLING

EPNG requested that water samples be collected from four of the existing monitoring wells at the site. These were EPNG water well numbers 1, 5, 6, and 12. Additionally, each of the ENSR monitoring wells were to be sampled. Upon arriving at the site it was determined that three of the EPNG wells were sealed. It was possible to remove the seal from EPNG-1, however, due to safety concerns, the seals at EPNG-5 and -6 were not removed.

3.1 SAMPLING METHODS

The initial water level in the wells was measured and recorded to the nearest 0.01-foot using an electronic probe. The depth-to-water was referenced to the top of the well casing and was measured from the same point each time. The wells were purged of the standard three bore volumes which amounted to 0.653 gallons per foot of water in the well for the 4-inch ENSR wells or approximately 45 gallons per monitoring well. Due to the larger casing diameters, it was necessary to purge approximately 4,400 gallons from EPNG-12 and 1,510 gallons from EPNG-1. The existing pump in EPNG-12 was used to purge and sample this well. K. W. Brown & Associates, Inc. (KWB&A) 3/4-horsepower submersible pump was used to purge EPNG-1 and the three ENSR monitoring wells.

During purging each of the wells, regular measurements of groundwater pH, electrical conductivity (EC), and temperature were made to determine the "stability" of the water being removed. Samples for laboratory analysis were not taken until the pH, EC, and temperature readings were stable. In accordance with groundwater collection protocols previously established, all of the water removed from the wells during purging was discharged to the soil surface near the well head.

With the exception of EPNG-12, each of the wells was sampled using a dedicated, disposable polypropylene bailer. As groundwater was retrieved, it was placed in the appropriate sample containers supplied by Analytical Technologies, Inc. (ATI) of Tempe, Arizona. Samples collected for metals analysis were filtered through a cellulosic, 0.45 micron filter before being placed in the sample containers. All samples were taken according to standard Environmental Protection Agency (EPA) field procedures in accordance with EPA-600/4-82-029 and RCRA "Subpart F."

All sampling equipment was decontaminated between each of the wells. The submersible pump was scrubbed with Liquinox laboratory soap then rinsed with clean water. It was then placed in a 18-gallon barrel of clean tapwater to which soap had been added. A hose loop was placed in the barrel so the soapy water would circulate through the pump. The pump was then turned on and allowed to run for 15 minutes. At the end of 15 minutes, the soapy water was removed and replaced with clean tapwater. Once again the pump was placed in the barrel and the water was allowed to circulated through the pump for 15 minutes. At the end of the clean water rinse, the pump was removed and allowed to air dry before being transported to the next monitoring well. Any other equipment associated with groundwater sampling that was reused was also scrubbed with laboratory soap, rinsed with distilled water, and allowed to air dry before reuse. Disposable items that were not reused (i.e., paper towels, bailers, gloves, etc...) were collected in plastic garbage bags and disposed in the trash containers at the EPNG Jal laboratory.

3.2 SAMPLE ANALYSIS

A total of five wells were sampled at the EPNG Jal 4 site. They included EPNG-1 and -12 and ENSR-1, -2, and -3. In addition to these three samples, two quality control (QC) samples were submitted. These two QC samples were designated at ENSR-4 and ENSR-5. ENSR-4 was a duplicate "set" of samples from monitoring well ENSR-1; ENSR-5 was a distilled water blank. In addition to these QC samples, trip blank samples were submitted for each well sampled.

Analytical testing included inorganic, organic, and physical parameters. Individual parameters tested, the analytical method used, and the method detection limits are listed in Tables 1 and 2.

3.3 ANALYTICAL RESULTS

Analytical data reported for the various wells at the site have been divided into two sections. The first discusses the inorganic and physical data and the second addresses the organic data. The raw laboratory data for all of the analyses have been included in Appendix A.

3.3.1 Inorganic and Physical Data

The inorganic and physical data for all of the wells have been summarized in Table 3. To illustrate similarities and differences in the inorganic data, Stiff diagrams for each well are included as Figure 3. From this figure, it is evident that the chemistry of the groundwater in wells ENSR-1 and -2 differs considerably from the surrounding groundwater. The most notable difference is the significant increase in the concentration of sodium and chloride. From these data, it is evident that the groundwater in the vicinity of the old wastewater ponds is skewed toward a system dominated by sodium chloride. Conversely, the geochemistry of the upgradient wells (EPNG-1 and -12) is more evenly balanced between minerals such as calcium sulfate (gypsum), calcium carbonate (calcite), calcium/magnesium carbonate (dolomite), and

Table 1. Detection Limits for Volatile, Semivolatile, and PNA Compounds

METHOD/ Analyzed Compounds	Detect. Limit ppb	Analyzed Compounds	Detect. Limit ppb
BETX Method: EPA 602			
Benzene	0.50	Ethylbenzene	0.50
Toluene	0.50	Xylenes	0.50
Semivolatile Method: EPA 625			
1,2,4-trichlorobenzene	10.00	Benzo(g,h,i)perylene	10.00
1,2-dichlorobenzene	10.00	Benzo(k)fluoranthene	10.00
1,3-dichlorobenzene	10.00	Benzoic Acid	10.00
1,4-dichlorobenzene	10.00	Benzyl Alcohol	10.00
2,4,5-trichlorophenol	50.00	Bis(2-chloroethoxy)methane	10.00
2,4,6-trichlorophenol	10.00	Bis(2-chloroethyl)ether	10.00
2,4-dichlorophenol	10.00	Bis(2-chloroisopropyl)ether	10.00
2,4-dimethylphenol	50.00	Bis(2-ethylhexyl)phthalate	10.00
2,4-dinitrophenol	50.00	Butylbenzylphthalate	10.00
2,4-dinitrotoluene	10.00	Chyrsene	10.00
2,5-dinitrotoluene	10.00	Di-n-butylphthalate	10.00
2-chloronaphthalene	10.00	Di-n-octylphthalate	10.00
2-chlorophenol	10.00	Dibenzo(a,h)anthracene	10.00
2-methylnaphthalene	10.00	Dibenzofuran	10.00
2-methylphenol	10.00	Diethylphthalate	10.00
2-nitroaniline	50.00	Dimethylphthalate	10.00
2-nitrophenol	10.00	Fluoranthene	10.00
3,3'-dichlorobenzidine	20.00	Fluorene	10.00
3-nitroaniline	50.00	Hexachlorobenzene	10.00
4,6-dinitro-2-methylphenol	50.00	Hexachlorobutadiene	10.00
4-bromophenyl-phenylether	10.00	Hexachlorocyclopentadiene	10.00
4-chloro-3-methylphenol	10.00	Hexachloroethane	10.00
4-chloroaniline	10.00	Indeno(1,2,3-cd)pyrene	10.00
4-chlorophenyl-phenylether	10.00	Isophorone	10.00
4-methylphenol	10.00	N-nitroso-di-n-propylamine	10.00
4-nitroaniline	50.00	N-nitrosodimethylamine	10.00
4-nitrophenol	50.00	N-nitrosodiphenylamine	10.00
Acenaphthene	10.00	Naphthalene	10.00
Acenaphthylene	10.00	Nitrobenzene	10.00
Aniline	10.00	Pentachlorophenol	50.00
Anthracene	10.00	Phenanthrene	10.00
Benzidine	100.00	Phenol	10.00
Benzo(a)anthracene	10.00	Pyrene	10.00
Benzo(b)fluoranthene	10.00		
Polynuclear Aromatics Method: EPA 610			
Acenaphthene	5.0	Dibenz(a,h)anthracene	5.0
Acenaphthylene	5.0	Fluoranthene	1.0
Anthracene	1.0	Fluorene	1.0
Benzo(a)anthrene	1.0	Indeno(1,2,3-cd)pyrene	1.0
Benzo(a)pyrene	1.0	Napthalene	5.0
Benzo(g,h,i)perylene	1.0	Phenanthrene	1.0
Benzo(k)fluoranthene	1.0	Pyrene	1.0

Table 2. Detection Limits for Organochlorines and PCBs Method : EPA 608

Analyzed Compounds	Detection Limits ppb						
	ENSR 1	ENSR 2	ENSR3	ENSR 4	ENSR5	EPNG 1	EPNG12
4,4'-DDD	0.10	0.50	2.00	0.10	0.10	0.10	0.10
4,4'-DDE	0.10	0.50	2.00	0.10	0.10	0.10	0.10
4,4'-DDT	0.10	0.50	2.00	0.10	0.10	0.10	0.10
Aldrin	0.05	0.25	1.00	0.05	0.05	0.05	0.05
Aldrin BHC	0.05	0.25	1.00	0.05	0.05	0.05	0.05
Aroclor 1016	0.50	2.50	10.00	0.50	0.50	0.50	0.50
Aroclor 1221	0.50	2.50	10.00	0.50	0.50	0.50	0.50
Aroclor 1232	0.50	2.50	10.00	0.50	0.50	0.50	0.50
Aroclor 1242	0.50	2.50	10.00	0.50	0.50	0.50	0.50
Aroclor 1248	0.50	2.50	10.00	0.50	0.50	0.50	0.50
Aroclor 1254	0.50	2.50	10.00	0.50	0.50	0.50	0.50
Aroclor 1260	0.50	2.50	10.00	0.50	0.50	0.50	0.50
Beta BHC	0.05	0.25	1.00	0.05	0.05	0.05	0.05
Chlordane	0.50	2.50	10.00	0.50	0.50	0.50	0.50
Delta BHC	0.05	0.25	1.00	0.05	0.05	0.05	0.05
Dieldrin	0.10	0.50	2.00	0.10	0.10	0.10	0.10
Endosulfan I	0.05	0.25	1.00	0.05	0.05	0.05	0.05
Endosulfan II	0.10	0.50	2.00	0.10	0.10	0.10	0.10
Endosulfan Sulfate	0.10	0.50	2.00	0.10	0.10	0.10	0.10
Endrin	0.10	0.50	2.00	0.10	0.10	0.10	0.10
Endrin Aldehyde	0.10	0.50	2.00	0.10	0.10	0.10	0.10
Endrin Ketone	0.10	0.50	2.00	0.10	0.10	0.10	0.10
Gamma BHC	0.05	0.25	1.00	0.05	0.05	0.05	0.05
Heptachlor	0.05	0.25	1.00	0.05	0.05	0.05	0.05
Heptachlor Epoxide	0.05	0.25	1.00	0.05	0.05	0.05	0.05
Methoxychlor	0.50	2.50	10.00	0.50	0.50	0.50	0.50
Toxaphene	1.00	5.00	20.00	1.00	1.00	1.00	1.00

Table 3. Inorganic and Physical Data.

Inorganic Ions	ENSR 1 ppm	ENSR 1 meq/L	ENSR 2 ppm	ENSR 2 meq/L	ENSR3 ppm	ENSR3 meq/L	ENSR 4 ppm	ENSR 4 meq/L	ENSR 5 ppm	EPNG 1 ppm	EPNG 1 meq/L	EPNG 12 ppm	EPNG 12 meq/L
Sodium	5,920.0	257.5	18,600.0	809.1	200.0	8.7	5,790.0	251.9	ND	85.7	3.7	61.9	2.7
Potassium	42.0	1.1	73.9	1.9	5.8	0.1	43.4	1.1	ND	5.5	0.1	3.4	0.1
Calcium	421.0	21.0	22.6	1.1	306.0	15.3	380.0	19.0	ND	106.0	5.3	68.6	3.4
Magnesium	200.0	16.5	42.2	3.5	76.2	6.3	118.0	9.7	ND	29.3	2.4	9.9	0.8
Chloride	11,000.0	310.3	31,000.0	874.4	1,000.0	28.2	11,000.0	310.3	ND	72.0	2.0	68.0	1.9
Bicarbonate	800.0	13.1	1,320.0	21.6	314.0	5.1	860.0	14.1	2.0	376.0	6.2	176.0	2.9
Sulfate	3.0	0.1	520.0	10.8	14.0	0.3	3.0	0.1	0.3	90.0	1.9	56.0	1.2
Total Alkalinity	800.0		1,320.0		314.0		860.0		2.0	376.0		176.0	

ND = No Detect

Physical	ENSR 1 Field	ENSR 1 Lab	ENSR 2 Field	ENSR 2 Lab	ENSR3 Field	ENSR3 Lab	ENSR 4 Field	ENSR 4 Lab	ENSR 5 Lab	EPNG 1 Field	EPNG 1 Lab	EPNG 12 Field	EPNG 12 Lab
pH (S.U.)	6.9	7.6	8.2	8.3	6.8	7.4	6.9	7.4	8.4	7.1	7.7	7.7	8.1
EC (umhos)	29,000.0	26,800.0	76,200.0	66,400.0	3,400.0	2,890.0	29,000.0	25,600.0	2.3	1,000.0	986.0	695.0	626.0
Temp (C°)	21.1	NA	20.7	NA	21.7	NA	21.1	NA	NA	21.3	NA	21.9	NA

NA = Not Analyzed

ENSR 4 is a duplicate of ENSR 1
ENSR 5 is a distilled water blank

sodium chloride (halite). The contrast in the inorganic chemistry of the wells suggests a localized source of sodium chloride in the area of monitoring wells ENSR-1 and -2.

Physical parameters measured for the groundwater samples collected include pH, EC, and temperature. Each of these parameters were measured in the field as the wells were sampled. Additionally, pH and EC were measured in the laboratory to confirm the field results.

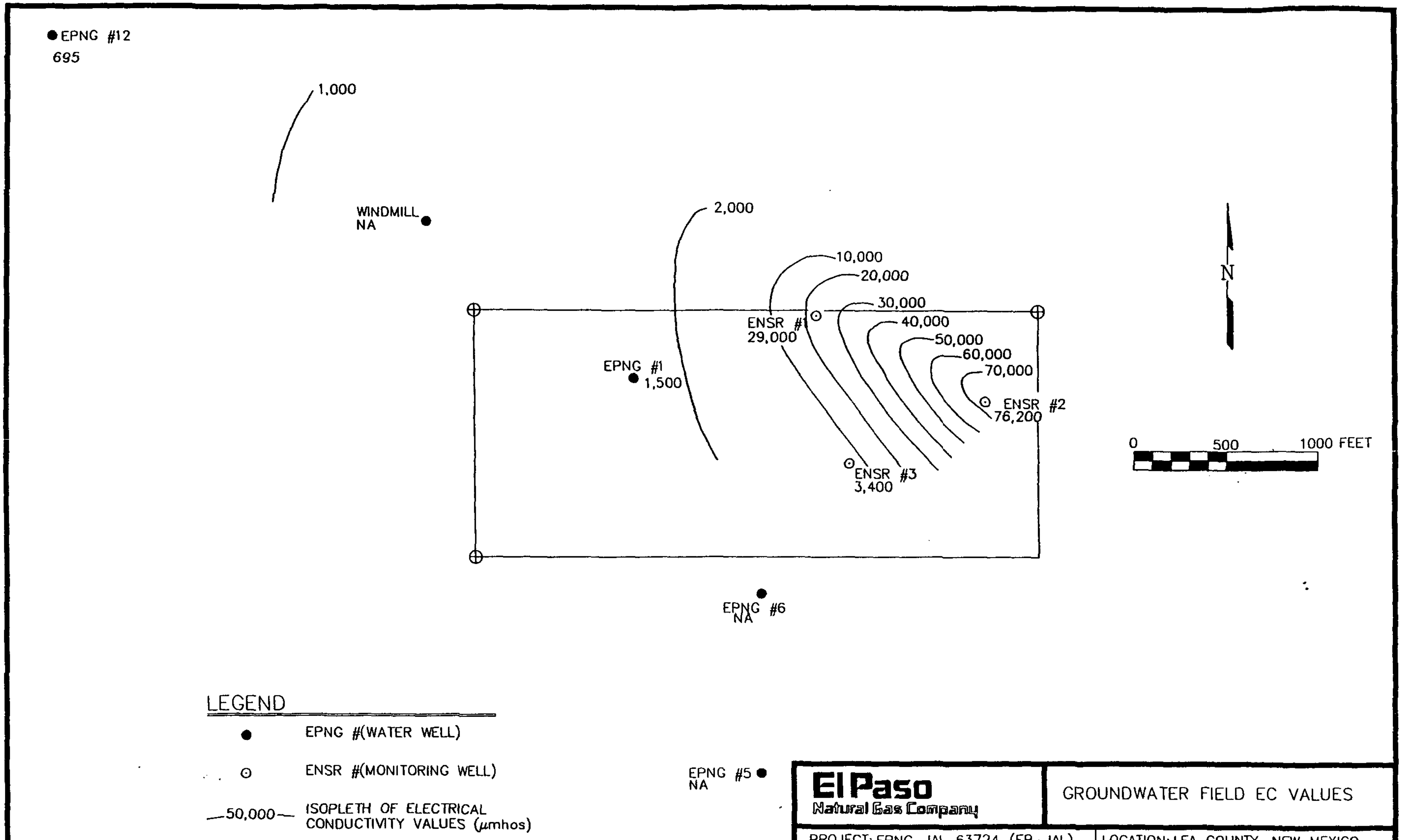
The field pH of the groundwater samples indicate the local groundwater varies from slightly acidic to moderately basic. Laboratory pH values indicate the groundwater is consistently basic. It is believed that the lab pH values are skewed to the basic side of the pH scale. This assessment is based on the distilled water blank (ENSR-5) which was reported to have a pH of 8.4. Normally, the pH of distilled water would be expected to be between 5.6 and 7.0. Although the discrepancy in the laboratory and field pH values raises some questions concerning actual pH of the local groundwater, it is reasonable to state that the groundwater in the area is generally neutral to slightly basic.

As would be expected, the EC of the groundwater samples correlates with the noted increases in salt concentrations. ENSR-1, which was determined to have the largest concentration of salt, also had the highest EC value (76,200 umhos @ field measurement; and 66,400 umhos @ lab measurement). Each of the ENSR wells exhibited relatively high EC values. By comparison, the upgradient wells, EPNG-1 and -12, had EC values which were equal to or less than 1,000 umhos. Figure 4 illustrates the EC isopleths as determined by field measurements. From this figure, it is evident that a localized zone of high EC water is situated in the area on the eastern portion of the Jal 4 site.

3.3.2 Organic Data

A summary of the organic constituents detected in the samples collected from the ENSR and EPNG wells is presented in Tables 4a and 4b. If a compound was not detected in any of the samples (e.g., PCBs), then it has been omitted from the table. In addition to presenting the analytical results, this table presents the WQCC standards for groundwater.

Each of the ENSR wells and one of the EPNG wells (EPNG-1) had at least one organic constituent present at levels above the method detection limit. However, the concentrations of the constituents were, by and large, below the stated groundwater standard (or there is no standard for comparison). There are, however, notable exceptions to the general trend. Benzene (90 ppb) and naphthalene (200 ppb) appear in ENSR-2 in concentrations which exceed the WQCC standards (10 and 30 ppb, respectively) . Also, phenolic compounds were detected above the 5 ppb "phenols" standard in ENSR-1, -2, and -3. Specific phenolic compounds detected include 2-dimethylphenol (54 ppb in ENSR-4 which is a duplicate sample from the ENSR-1 well), 2- and 4-methylphenol (14 and 22 ppb, respectively, in ENSR-2),



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GROUNDWATER FIELD EC VALUES

PROJECT: EPNG-JAL 63724 (EP-JAL)			LOCATION: LEA COUNTY, NEW MEXICO		
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DATE:			DATE:	7-11-90	FIGURE: 4

Table 4a. Organic Constituents Detected in Samples Collected June, 1990

Compound Detected	EPA Method	WQCC Standard ppb	ENSR1 Conc. ppb	ENSR2 Conc. ppb	ENSR3 Conc. ppb	ENSR4 Conc. ppb	ENSR5 Conc. ppb	EPNG1 Conc. ppb	EPNG12 Conc. ppb
Benzene	602	10	7.3	90.0	1.7	6.9	ND	0.5	ND
Ethylbenzene	602	750	1.0	21.0	ND	0.8	ND	ND	ND
Xylenes	602	620	2.1	30.0	ND	1.8	ND	ND	ND
Toluene	602	750	ND	71.0	ND	ND	ND	ND	ND
Naphthalene	610	30 *	ND	200.0	ND	ND	ND	ND	ND
1,2-dichlorobenzene	625	NS	16.0	ND	ND	13.0	ND	ND	ND
2-dimethylphenol	625	5 **	ND	ND	ND	54.0	ND	ND	ND
2-methylnaphthalene	625	30 *	10.0	ND	ND	TR	ND	ND	ND
Pentachlorophenol	625	5 **	ND	55.0	16.0	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	625	NS	ND	ND	190.0	ND	ND	ND	ND
2-methylphenol	625	5 **	ND	14.0	ND	ND	ND	ND	ND
4-methylphenol	625	5 **	ND	22.0	ND	ND	ND	ND	ND
Phenol	625	5 **	ND	430.0	ND	ND	ND	ND	ND
Fluorene	625	NS	ND	TR	ND	ND	ND	ND	ND

NS = No Standard; ND = Not Detected; TR = Trace

* Standard for naphthalene plus monomethylnaphthalenes

** Standard for "phenols"

ENSR 4 is a duplicate of ENSR 1

ENSR 5 is a distiled water blank

Table 4b. Organic Constituents Detected in Samples Collected July, 1989

Compound Detected	EPA Method	WQCC Standard ppb	ENSR1 Conc. ppb	ENSR2A Conc. ppb	ENSR2B Conc. ppb	ENSR3 Conc. ppb
Acetone	625	NS	24.0	81.0	80.0	23.0
Carbon Disulfide	625	NS	BDL	22.0	24.0	BDL
2-Butanone (MEK)	625	NS	BDL	29.0	30.0	BDL
Bis (2-ethylhexyl) phthalates	625	NS	BDL	7.5 J	9.5 J	22.0
Di-n-buytl phthalates	625	NS	BDL	BDL	5.9 J	BDL
2,4 Dimethyl phenol	625	5 **	16.0	BDL	BDL	BDL
Methyl naphthalene	625	30 *	6 J	BDL	BDL	BDL
Pentachlorophenol	625	5 **	BDL	BDL	7.6 J	BDL

NS = No standard; BDL = Below detection limit; J = Estimate

* Standard for naphthalene plus monomethylnaphthalenes

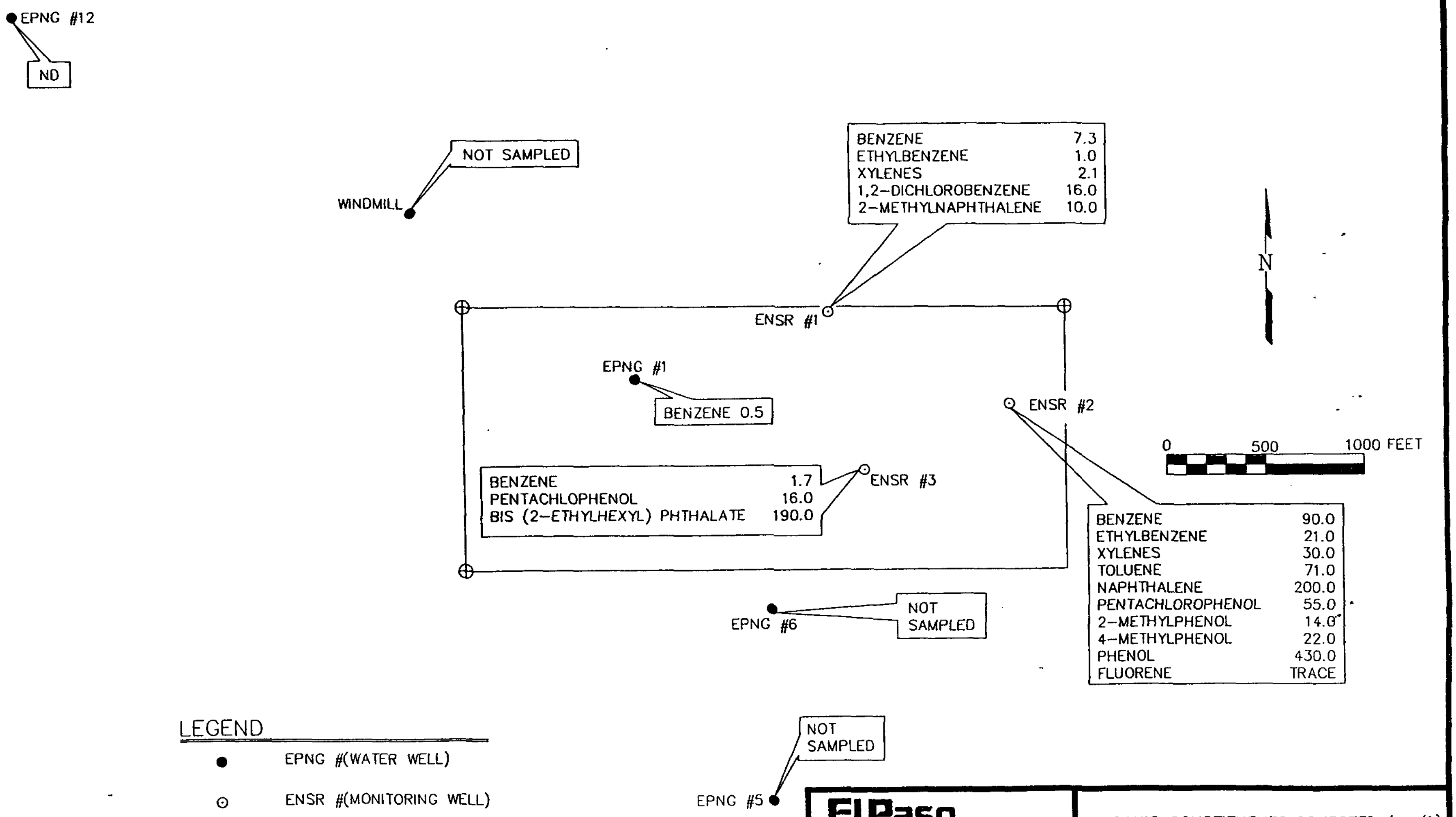
** Standard for "phenols"

ENSR 4 is a duplicate of ENSR 1

ENSR 5 is a distiled water blank

pentachlorophenol (55 and 16 ppb in ENSR-2 and -3, respectively), and phenol (430 ppb in ENSR-2).

In general terms, the wells sampled at the Jal 4 site can be ranked from clean (i.e., no organic constituents detected) to detecting ten separate organic constituents. Specifically, EPNG-12 was found to be free of organic constituents where as ENSR-2 contained nine quantified organic constituents and one suspected organic constituent. Figure 5 illustrates the organic constituents detected and the wells in which they were detected.



ENSR #1

BENZENE	7.3
ETHYLBENZENE	1.0
XYLENES	2.1
1,2-DICHLOROBENZENE	16.0
2-METHYLNAPHTHALENE	10.0

ENSR #3

BENZENE	1.7
PENTACHLOPHENOL	16.0
BIS (2-ETHYLHEXYL) PHTHALATE	190.0

ENSR #2

BENZENE	90.0
ETHYLBENZENE	21.0
XYLENES	30.0
TOLUENE	71.0
NAPHTHALENE	200.0
PENTACHLOROPHENOL	55.0
2-METHYLPHENOL	14.0
4-METHYLPHENOL	22.0
PHENOL	430.0
FLUORENE	TRACE

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ORGANIC CONSTITUENTS DETECTED (µg/l)

PROJECT: EPNG-JAL 63724 (EP-JAL)			LOCATION: LEA COUNTY, NEW MEXICO		
K.W. BROWN & ASSOCIATES, INC.					DATE: 8-9-90
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DATE:			DATE:	7-11-90	FIGURE: 5

4.0 AQUIFER CHARACTERISTICS

This section answers specific questions concerning the physical and chemical properties of the near-surface aquifer underlying the Jal 4 plant. Specific topics addressed include identifying the aquifers present, investigating the existence of a groundwater mound, establishing the local hydraulic gradient and groundwater flow direction, measuring hydraulic conductivity, identifying the presence of a contaminant plume, and evaluating the suitability of applying groundwater models to the current conditions.

4.1 *AQUIFER IDENTIFICATION*

As stated in Section 2.3, three principle aquifers exist in Southern Lea County: the Quaternary Alluvium, the Tertiary Ogallala, and the Triassic Dockum Group. Information presented on the EPNG and ENSR well logs suggests that only two of the aquifers, the Ogallala and the Dockum, are present at the site (Figures 6 and 7). The alluvial aquifer may be present, however, the alluvium is situated above the water table and, therefore, cannot be considered an aquifer in the area of the Jal 4 plant.

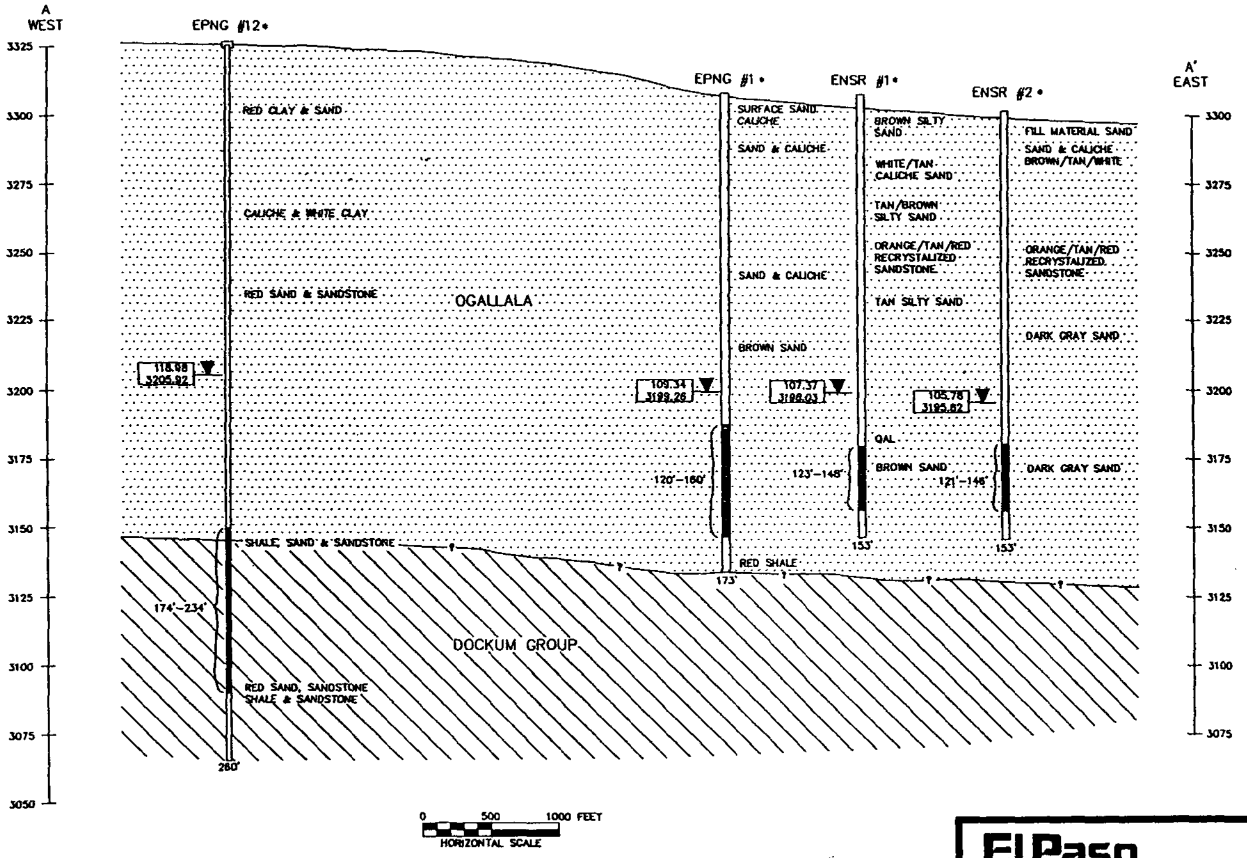
All of the EPNG and ENSR wells, with the exception of EPNG-12, appear to be completed in the Ogallala aquifer. EPNG-12 appears to be completed in the Dockum Group. This assessment is based on the descriptions offered in the ENSR report (1989) and a review of the EPNG water well logs.

Both of the aquifers identified at the site are considered to be unconfined. The geologic cross-sections illustrated in Figures 6 and 7 do not indicate the presence of a low permeability layer above the water table that could serve as an aquitard.

4.2 GROUNDWATER MOUND

It has been determined that a significant groundwater mound does not exist at the site. This assessment is based on Figure 8 which illustrates groundwater contours that are virtually linear and parallel. A slight inflection in the contour lines in the area of the ENSR monitoring wells is noticeable. This inflection has been attributed to the increase in well density in this area relative to the number and proximity of well elsewhere at the site. Having the three ENSR wells in a relatively small area gives greater control with respect to the EPNG wells. As such, the contour lines in the area of the ENSR wells can be drawn with greater accuracy.

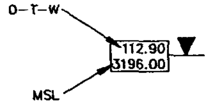
An additional argument against the presence of a groundwater mound is the permeability of the aquifer. Although a numerical permeability value has not been measured at the site (see Section 4.3), it was observed during sample collection that the water table



WELL #	CASING ELEV.	DEPTH TO WATER (feet) 6-20-90	GROUNDWATER ELEVATION (feet MSL)
ENSR 1	3305.40	107.37	3198.03
2	3301.60	105.78	3195.82
3	3303.80	106.30	3197.50
EPNG 1	3308.60	109.34	3199.26*
5	3308.90	112.90**	3196.08
6	3305.30	NA	NA
12	3324.90	118.98	3205.92

* DESCRIPTIONS FROM AVAILABLE WELL LOGS

** D-T-W VALUE CORRECTED FOR ANGLED ENTRY PORT.



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GEOLOGIC CROSS-SECTION A-A'

PROJECT: EPNG-JAL 63724 (JAL-SECA)		LOCATION: LEA COUNTY, NEW MEXICO	
K.W. BROWN & ASSOCIATES, INC.			DATE: 8-9-90
APPR:		DRAWN BY: RSW	SCALE: AS SHOWN
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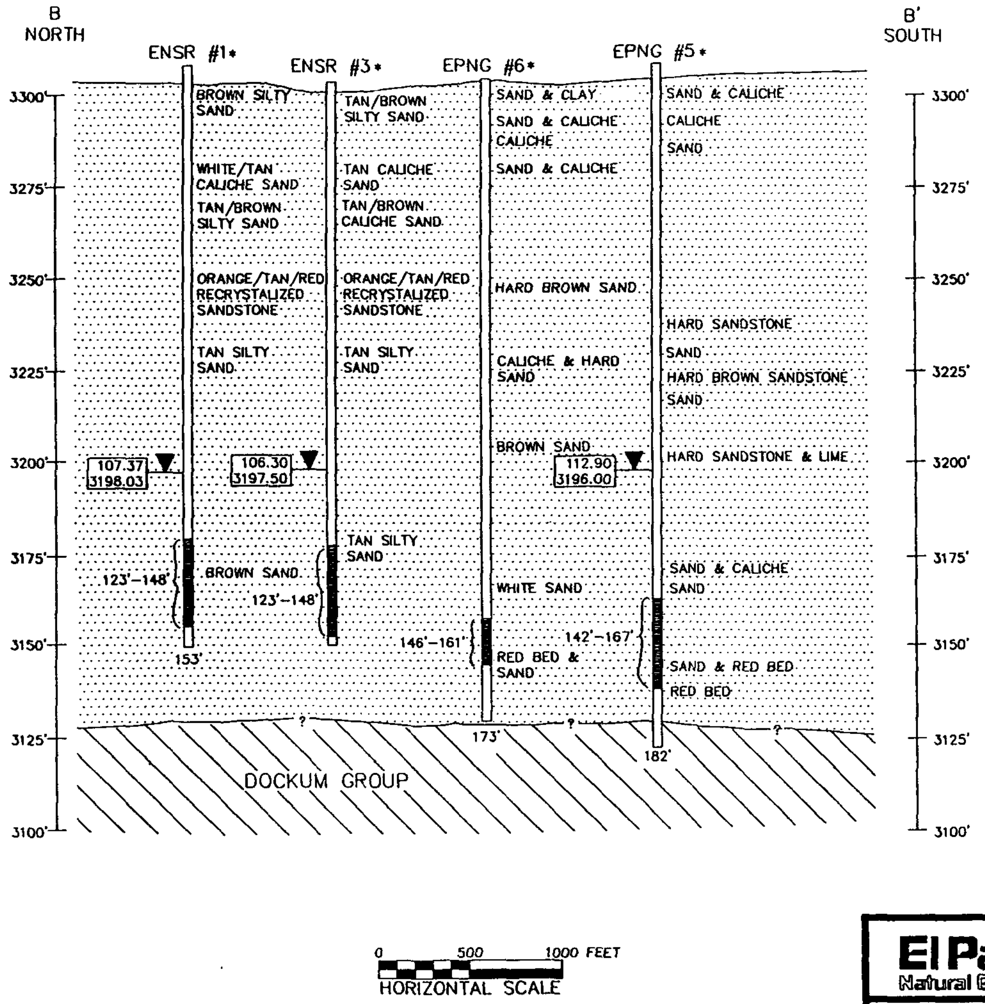
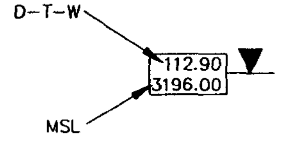


WELL #	CASING ELEV.	DEPTH TO WATER (feet) 6-20-90	GROUNDWATER ELEVATION (feet MSL)
ENSR 1	3305.40	107.37	3198.03
2	3301.60	105.78	3195.82
3	3303.80	106.30	3197.50
EPNG 1	3308.60	109.34	3199.26
5	3308.90	112.90**	3196.08
6	3305.30	NA	NA
12	3324.90	118.98	3205.92

* DESCRIPTIONS FROM AVAILABLE WELL LOGS

** D-T-W VALUE CORRECTED FOR ANGLED ENTRY PORT.



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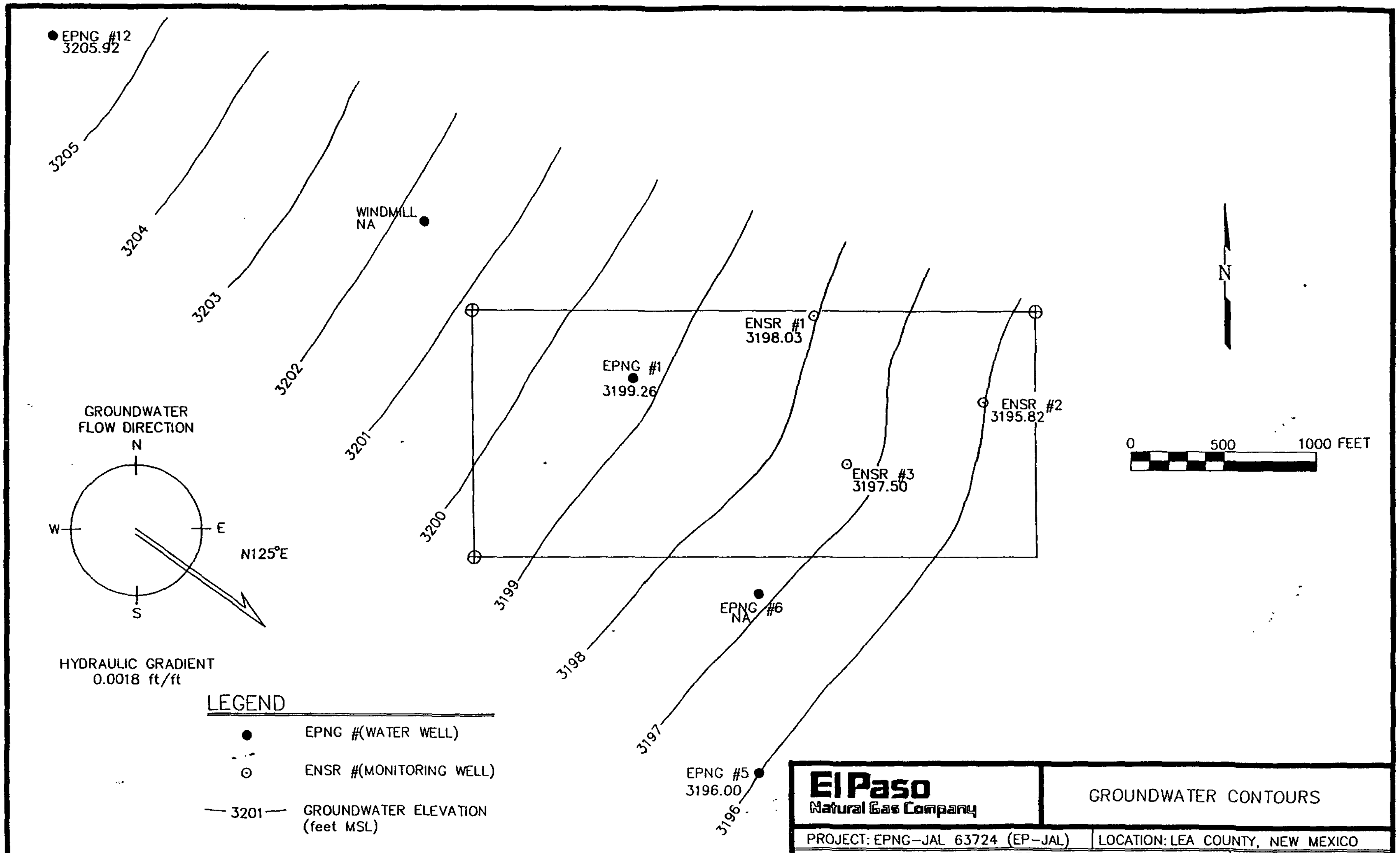
GEOLOGIC CROSS-SECTION B-B'

PROJECT: EPNG-JAL 63724 (JAL-SECB)		LOCATION: LEA COUNTY, NEW MEXICO			
K.W. BROWN & ASSOCIATES, INC.				DATE:	8-9-90
APPR:		DRAWN BY:	RSW	SCALE:	AS SHOWN
DATE:		DATE:	7-12-90	FIGURE:	7



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GROUNDWATER CONTOURS

PROJECT: EPNG-JAL 63724 (EP-JAL)		LOCATION: LEA COUNTY, NEW MEXICO		
K.W. BROWN & ASSOCIATES, INC.				DATE: 8-9-90
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DATE:		DATE:	7-11-90	FIGURE: 8

recovers quickly after pumping. This suggests that a relatively large amount of recharge would be needed to manifest a noticeable increase in the water table elevation.

Although the previous statements argue against the existence of a groundwater mound, the presence of a "small" mound cannot be totally discounted. There simply is not enough data to determine if the observed groundwater contour inflection is caused by localized recharge (seepage from a pond), or if the inflection is a function of the placement of the wells. However, from a practical standpoint, it can be stated that a significant groundwater mound does not exist. Significant, as it is used here to determine if a groundwater mound does indeed exist, means that based on the results of data development

1. radial flow (circular, closed contours) is not noted
2. disturbance of the groundwater contour lines is slight
3. the effective groundwater flow direction is unchanged.

4.3 HYDRAULIC GRADIENT AND FLOW DIRECTION

Determining the vertical hydraulic gradient would have required installation of a minimum of two piezometers; one to measure the hydraulic head near the surface of the aquifer and a second one to measure the hydraulic head near the base of the aquifer. Because a piezometer nest did not exist at the site, and because it was beyond the scope of this effort to install a piezometer nest, verifying the presence or absence of a vertical gradient was not possible.

Determining the horizontal hydraulic gradient required preparing a contour map that illustrates the MSL elevation of the water table surface as measured in the monitoring wells and water wells (refer to Figure 8). Elevation of the groundwater between these wells was then extrapolated, and equipotential lines (points of equal hydraulic head) were drawn. Once the contour lines were inplace, the groundwater flow direction was determined by drawing a line perpendicular to the contours. From this exercise, it was determined that the groundwater flow direction was to the southeast at an azimuth of N125°E.

Once the groundwater contours were drawn and the flow direction determined, it was possible to calculate the horizontal hydraulic gradient This was done by measuring the change in hydraulic head (*dh*) as a function of horizontal distance (*dl*) along the path of the groundwater flow direction. The distance from the 3,205 (feet MSL) contour and the 3,196 (feet MSL) contour was used for the calculation. This distance (*dl*) was determined to be approximately 4,975 feet. Using the difference in hydraulic head between these two contours ($dh = 9$ feet) and the specified horizontal distance ($dl = 4{,}975$ feet) yields a gradient of 0.0018 ft/ft (dh/dl). This value is consistent with regional information and the information presented in the initial ENSR report.

4.4 HYDRAULIC CONDUCTIVITY

The Request for Proposal (RFP) specified that hydrologic testing be conducted to measure the hydraulic conductivity of the aquifer. The response to the RFP specified that bail/slug tests would be performed as a means of determining the hydraulic conductivity. However, it was determined that the depth-to-water in the wells (>100 feet) and the diameter of the wells (4 inches for ENSR wells and 10 to 16 inches for the water wells) were such that bail/slug tests would not be effective. Moreover, it was noted that the recovery rate of the wells following purging was too rapid to accurately measure changes in water levels using a standard electronic depth-to-water meter. Hence, it was not possible to collect the necessary data to determine the hydraulic conductivity of the aquifer.

In an effort to quantify the hydraulic conductivity, an attempt was made to analyze data from a stress test performed on EPNG-12 in 1965. Conversion of the stress test data into a hydraulic conductivity value required using two equations and several conservative assumptions. The equations employed were the Weber Equation and the Thiem Equation.

Weber Equation:

$$r_2 = 2.45\sqrt{\frac{h_2 K t}{S}}$$

Thiem Equation:

$$Q = \frac{\pi K \left(h_2^2 - h_1^2\right)}{\ln\left(\frac{r_2}{r_1}\right)}$$

where:
h_1 = pumping water level
h_2 = static, nonpumping water level
r1 = radius of the well
r_2 = radius where h_2 occurs
K = hydraulic conductivity
S = storage coefficient
t = time required to reach steady state pumping

These equations were solved simultaneously by setting both equations equal to r_2. The resulting equation was then solved for K. However, to derive a numerical solution, it was necessary to make an assumption concerning the value for storativity (S) of the aquifer. Several S values were employed in the derivation. The results of this exercise indicated the aquifer's hydraulic conductivity was on the order of 10^{-8} cm/sec. Observations in the field regarding the recovery rates of the wells and documented yields (the ability of a well to deliver large quantities of water) for EPNG-12 suggest that this value is a gross underestimate. Therefore, at the conclusion of this effort, it was decided that the hydraulic conductivity of the aquifer could not be determined using the available data. And, because attempts to physically measure K in the field were unsuccessful, the numerical value of K remains unknown.

In the absence of site-specific data, it may reasonable to assume a hydraulic conductivity value based on the texture of the sediments, the documented yields from the wells, and the regional transmissivity for the aquifer. Using these criteria, it is estimated that K, for the local aquifers, is on the order of 10^{-3} to 10^{-5} cm/sec.

4.5 CONTAMINANT PLUME

From the information presented in previous sections, it is evident that contaminants have reached the groundwater. The most compelling evidence of contamination is the presence of elevated levels of salt in ENSR-1 and -2. This information is bolstered by the presence of low levels of organic constituents in five of the six wells sampled. When this information is interpreted concurrently, it is self-evident that local groundwater has been impacted. Moreover, the configuration of the contaminant plume (as illustrated by the EC isopleths; refer to Figure 4) is such that the source of the contamination appears to be associated with past activities at the Jal 4 plant.

At this time, it is not possible to define the overall lateral and vertical dimensions of the plume; there are simply too few data points in the study area to define the boundaries. However, it can be stated that the plume is oriented from the northwest and is trending to the southeast. Estimates on the lateral configuration of the plume, as predicted by a groundwater computer model, are presented in Section 4.5. The vertical configuration of the plume is unknown. The ENSR wells penetrate only the top portion of the saturated zone and there are no downgradient wells that sample the lower portion of the aquifer. Therefore, it is not possible to determine water quality at the base of the aquifer However, it would not be unreasonable to expect the water quality to be similar throughout the aquifer. There may be a salinity gradient which increases with depth because the more dense saltwater has a tendency to "sink." The presence of any kind of vertical gradient has not been documented.

4.6 GROUNDWATER MODELING

The scope-of-work requested that groundwater modeling be performed. However, to succeed with the modeling exercise, it was necessary to make several assumptions to supplement site-specific data. All assumptions made and the approach used are documented in the following sections.

4.6.1 Description of the Model

The mathematical model used to simulate groundwater flow and solute transport in the uppermost aquifer at the Jal 4 site is a two-dimensional finite-difference model that computes values of hydraulic head (sum of pressure and elevation heads) and reactive or nonreactive solute concentration on a rectangular grid having equal spacing between nodes. The model was written by Konikow and Bredehoeft (1978), and is typically referred to as the USGS Method of Characteristics (MOC) model. The program is capable of generating transient or steady-state solutions for the hydraulic head field.

In a review of mathematical models for the U.S. Nuclear Regulatory Agency (NRC), Thomas et al. (1982) state that MOC "... is a well-tested and well-documented code that would be well-suited for solving single-aquifer problems. Its high degree of acceptance makes it stand out among solute transport codes ..."

The model has undergone verification by comparison with several analytical models and has demonstrated excellent comparisons (Thomas et al., 1982). Field validation has been carried out for chloride movement at the Rocky Mountain Arsenal (Konikow, 1977), and for radionuclide transport at the National Reactor Testing Station (Robertson, 1974).

4.6.2 Model Assumptions

In order to effect a practical solution to complex hydrogeologic problems, a number of simplifying assumptions have been invoked by the model authors (Konikow and Bredehoeft, 1978); the following is a synopsis of those assumptions

1. Darcy's Law is valid and hydraulic head gradients are the only significant driving mechanism for fluid flow.
2. The porosity and hydraulic conductivity of the aquifer are constant in time, and porosity is uniform in space.
3. Gradients of fluid density, viscosity, and temperature do not affect the velocity distribution.
4. Ionic and molecular diffusion are negligible contributors to the total dispersive flux.
5. Vertical variations in head and concentration are negligible (i.e., computed values of head and concentration are averaged over the thickness of the aquifer).
6. The aquifer is homogeneous and isotropic with respect to the coefficients of longitudinal and transverse dispersivity.

There are no reasons to believe that Darcy's Law is not valid for description of the flow system at Jal 4. Factors governing the validity of Darcy's Law are: (1) fluid density, (2) pore fluid velocity, (3) average pore (grain size) diameter, and (4) dynamic fluid viscosity. Readers trained in the field of fluid mechanics will recognize these factors as those variables that define the Reynolds Number:

$$N_R = \frac{\rho V D}{\mu} \qquad (1)$$

Where: N_R = Reynolds Number
r = fluid density
V = pore fluid velocity
D = average pore (grain size) diameter
m = dynamic fluid viscosity

Most agree that the upper limit for the validity of Darcy's Law is when the N_R rises above the range 1 to 10. Thus, given the prevailing conditions at Jal 4, it is asserted that assumption (1) is met at both waste management areas.

Obviously, porosity and hydraulic conductivity are spatially-varying quantities for naturally-occurring aquifers. Without extensive field and laboratory measurements, the spatial distribution of the parameters remains unknown. The assignment of point estimates for porosity and hydraulic conductivity (transmissivity) represents a significant departure from reality, and the application of assumption (2) is questionable. Given the time limitations constraining the study, however, the approximation of the variables by point estimates is deemed acceptable.

The high levels of EC in the groundwater beneath the Jal 4 site (i.e., on the order of 70,000 mmhos/cm), suggest a significant concentration of dissolved salts. It is possible that the groundwater contains salt levels in sufficient quantities to affect its density and viscosity. Although groundwater temperature may remain fairly constant throughout the year, density and viscosity will probably vary as a function of position (laterally and vertically) within the aquifer, and assumption (3) may not be valid.

The dispersion coefficient is generally defined as follows (Freeze and Cherry, 1979):

$$D_l = \alpha_l v_l + D^* \quad \text{.......} \quad (2)$$

Where: D_l = coefficient of hydrodynamic dispersion
α_l = dispersivity along flow path l
v_l = average linear groundwater velocity
D^* = coefficient of molecular diffusion

For assumption (4) to be met, the first term in equation (2) must overshadow the second term; a quick calculation shows this to be the case:

Let α_l = 300 feet (selected through trial and error)
v_l = 9 feet/year (based on field data)
$D^* \approx 5 \times 10^{-9}$ ft^2/sec (Freeze and Cherry, 1979)
$\alpha_l v_l = 8.5 \times 10^{-5}$ ft^2/sec

Thus, the first term dominates the expression by four orders-of-magnitude, and the contribution to the dispersion coefficient by the diffusion coefficient is negligible.

With regard to assumption (5), where vertical gradients are absent, the variation of hydraulic head with depth is nonexistent. That is to say that, along a vertical line, the total head is constant, and this portion of assumption (5) is valid. The vertical variation of solute concentration with depth is much less known, and the viability of assumption (5) in this regard is in question. However, the small aquifer thickness at Jal 4 should aid in uniform mixing of solute.

Finally, it is generally recognized that dispersivity is a scale-dependent quantity. Molz et al. (1983) summarized the problematic nature of dispersivity measurement as follows: "... the greater the travel distance in a tracer test used to measure dispersivity, the larger the dispersivity value that is calculated." This phenomenon is largely attributed to vertical variations in aquifer hydraulic conductivity. Thus, at the current level of knowledge regarding dispersivity, precise spatial distributions for this parameter are very difficult to determine. Assumption (6) is considered to be reasonable in light of the absence of concrete methods with which to measure field values of longitudinal and transverse dispersivity.

4.6.3 Input Requirements

The principal data required by the model to generate a solution are given in Table 5. Table 6 lists all of the parameter values used during three model runs. The three model runs illustrate calibration of the model (Run 1), migration of a slug of contaminated groundwater (Run 2), and recovery of impacted groundwater (Run 3). Each of the three calculations are discussed below.

RUN 1: CALIBRATION

A limited number of data were available for calibrating the model. Hydraulic head contours were generated from water level measurements made in the existing wells on-site. There were only four wells where chemical data were available: ENSR-1, -2, -3, and EPNG-1.

The primary constituent focused on during calibration was EC. EC was used as the "contaminant" in the model, and the assumption was made that no adsorption processes would be simulated. That is, the modeled contaminant would move at the velocity of the groundwater.

The procedure generally involved identifying parameters with the least-known values, and utilizing those as the parameters that would be varied throughout the trial-and-error procedure. For this analysis, pond water EC, pond leakage rate, and longitudinal and transverse dispersivity were the most-unknown parameters available.

The remainder of the parameters, such as transmissivity, aquifer recharge, and porosity were estimated by the modelers based on experience and knowledge of the site.

Table 5. Input Requirements for the USGS MOC Solute Transport Model.

Parameter	Spatially[1] Varying?	Temporally[2] Varying?
Number of time steps	N/A	Yes
Simulation duration (Years)	N/A	N/A
Number of nodes in X-direction	N/A	No
Number of nodes in Y-direction	N/A	No
X-direction nodal spacing (Feet)	No	No
Y-direction nodal spacing (Feet)	No	No
Number of pumping or injection wells	Yes	N/A
Flow rate of pumping or injection wells (Ft3/sec)	Yes	Yes
Effective porosity	No	No
Longitudinal dispersivity (Feet)	No	No
Transverse dispersivity (Feet)	No	No
X-direction transmissivity (Ft2/sec)	Yes	No
Y-direction transmissivity (Ft2/sec)	Yes	No
Storage coefficient	No	No
Distribution coefficient (cm3/g)	No	No
Aquifer bulk density (g/cm3)	No	No
Half-life of solute (Seconds)	N/A	N/A
Saturated thickness of aquifer (Feet)	Yes	No
Diffuse discharge/recharge (Ft/sec)	Yes	No
Initial water table or piezometric surface elevation (Feet)	Yes	N/A
Initial solute concentration in aquifer (mg/L)	Yes	N/A
Vertical hydraulic conductivity of confining layer (Ft/sec)	Yes	No
Thickness of confining layer (Feet)	Yes	No
Source dimensions (Feet)	Yes	No
Source concentrations (mg/L)	Yes	No
Constant head boundaries (Feet)	Yes	No
No-flow boundaries	Yes	No

[1] Does the quantity vary in a horizontal plane?

[2] Does the quantity vary in time?

Table 6. Input Data: USGS MOC Groundwater Flow/Contaminant Transport Model.

	Run 1	Run 2*	Run 3*
	Calibration	Slug Migration	Groundwater Recovery
Parameter	Value	Value	Value
Number of columns	17	17	17
Number of rows	20	20	20
Column width (Feet)	200	200	200
Row height (Feet)	200	200	200
Max. no time steps	30	20	20
Duration (Years)	30	20	5
Storage coefficient	0	0	0
Porosity	0.2	0.2	0.2
Longitudinal dispersivity (Feet)	300	300	300
Transverse dispersivity (Feet)	90	90	90
Transmissivity (Feet^2/day)	184.25	184.25	184.25
Distribution coefficient (cm^3/g)	0	0	0
Aquifer thickness (Feet)	65	65	65
Hydraulic conductivity (cm/sec.)	1.00E-03	1.00E-03	1.00E-03
Aquifer recharge (In./Yr.)	0.1	0.1	0.1
Pond leakage rate (Feet/year)	22	0	0
Pond water EC (umhos/cm)	150,000	0	0
Number of pumping wells	0	0	2
Pumping rate (Gpm/well)	0	0	20

* Runs 2 and 3 were initiated following completion of run 1.

It was assumed that the ponds had leaked at a constant rate, with constant pond water EC, for a period of 30 years. Thus, Run 1 extended from 1952 through 1981. Figure 9 is a graph of observed versus computed EC for wells ENSR-1, -2, -3, and EPNG -1. For a good calibration, these data points should lie on a 45-degree line. As is apparent from an examination of Figure 1, all of these data points lie directly on a 45-degree line, or deviate slightly. The configuration of the plume at the end of the calibration run is illustrated in Figure 10. This figure is presented as an illustration of "current" conditions at the site.

RUN 2: MIGRATION OF SLUG

After the model had been calibrated, a 20-year simulation was made in which the ponds were allowed to dry, thereby removing the source of contaminants. Thus, the plume was modeled as a slug of contaminated water moving with the velocity of the groundwater. Table 7 contains a listing of the results of this run, which covers the period 1982 through 2001.

This period is marked by no water leakage from the ponds, no pumping or injection wells, and only steady migration of the plume with the bulk motion of the flowing groundwater.

From the end of the calibration run, which lasted for a period of 30 years, to the end of the slug migration, which lasted for 20 years, the maximum EC level decreased from 142,000 mmhos/cm to 44,000 mmhos/cm. The decrease in concentration is attributed to dilution and attenuation through dispersion.

RUN 3: GROUNDWATER RECOVERY

The third and final run consisted of turning on two pumping wells at the end of the calibration run, and letting them recover contaminant-laden groundwater for a period of 5 years. Well ENSR-2 was utilized as a pumping well, pumping at a steady rate of 20 gallons per minute (GPM). An additional (hypothetical) well, also pumping at 20 GPM, was positioned approximately 400 feet to the northwest of ENSR-2 and approximately 50 feet to the west-northwest of Highway 18.

Figure 11 is a plot of EC versus time as measured in each of the four wells (ENSR-1, -2, -~3, and EPNG-1) for the 5-year pumping period extending from 1990 to 1995. The curve for ENSR-1 is seen to rise sharply during the first few days of operation, indicating that a packet of heavily-contaminated water was drawn past this well's screen. The portion of the curve following the spike is seen to drop exponentially to below the estimated WQCC EC standard of 15,625 mmhos/cm (10,000 ppm TDS) after about 2 years of pumping. The remainder of the curves are fairly flat and show a gradual rise in EC levels versus time suggesting continued spreading of the plume laterally. The curve for ENSR-2, a pumping well, is seen to gradually

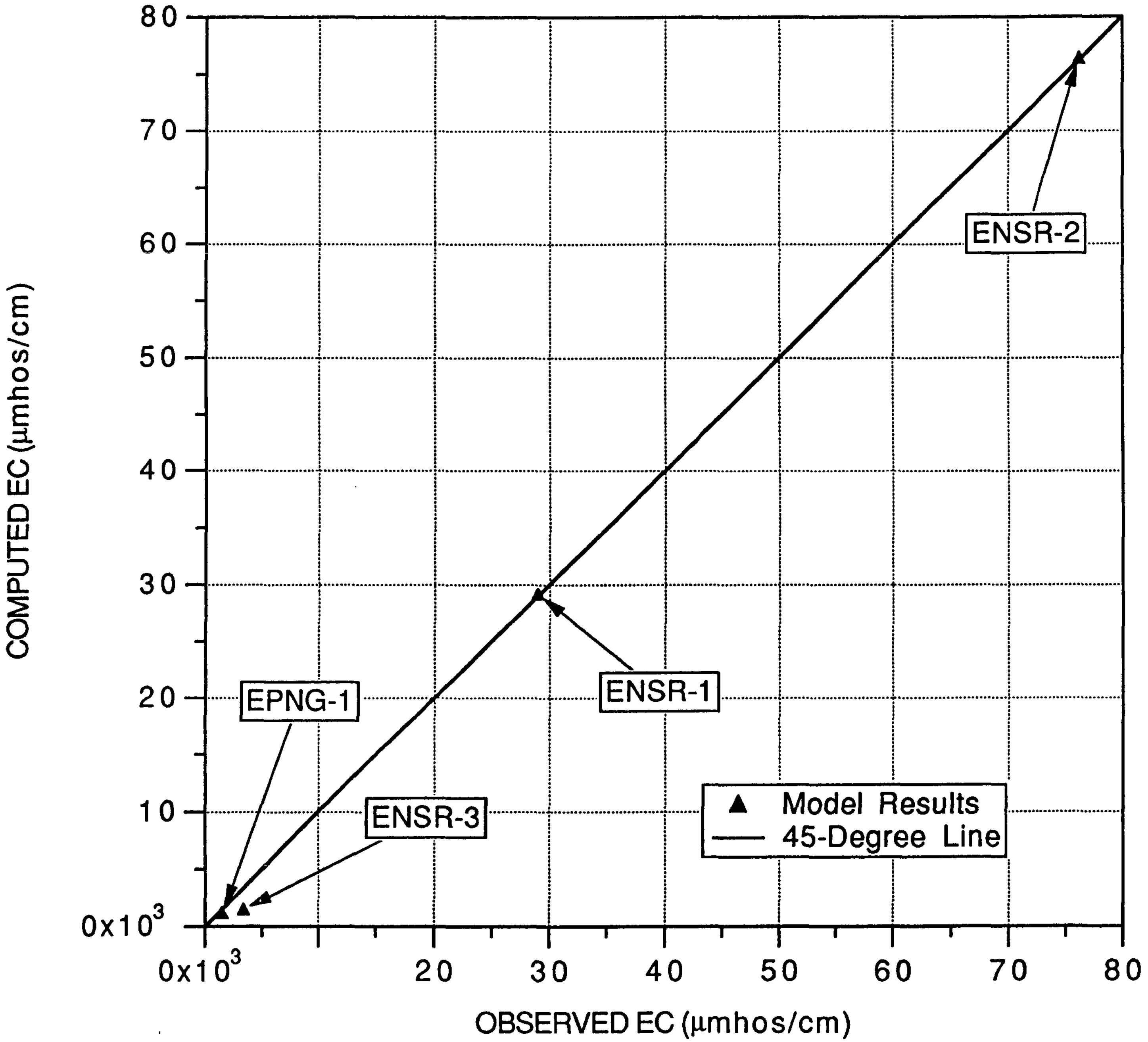
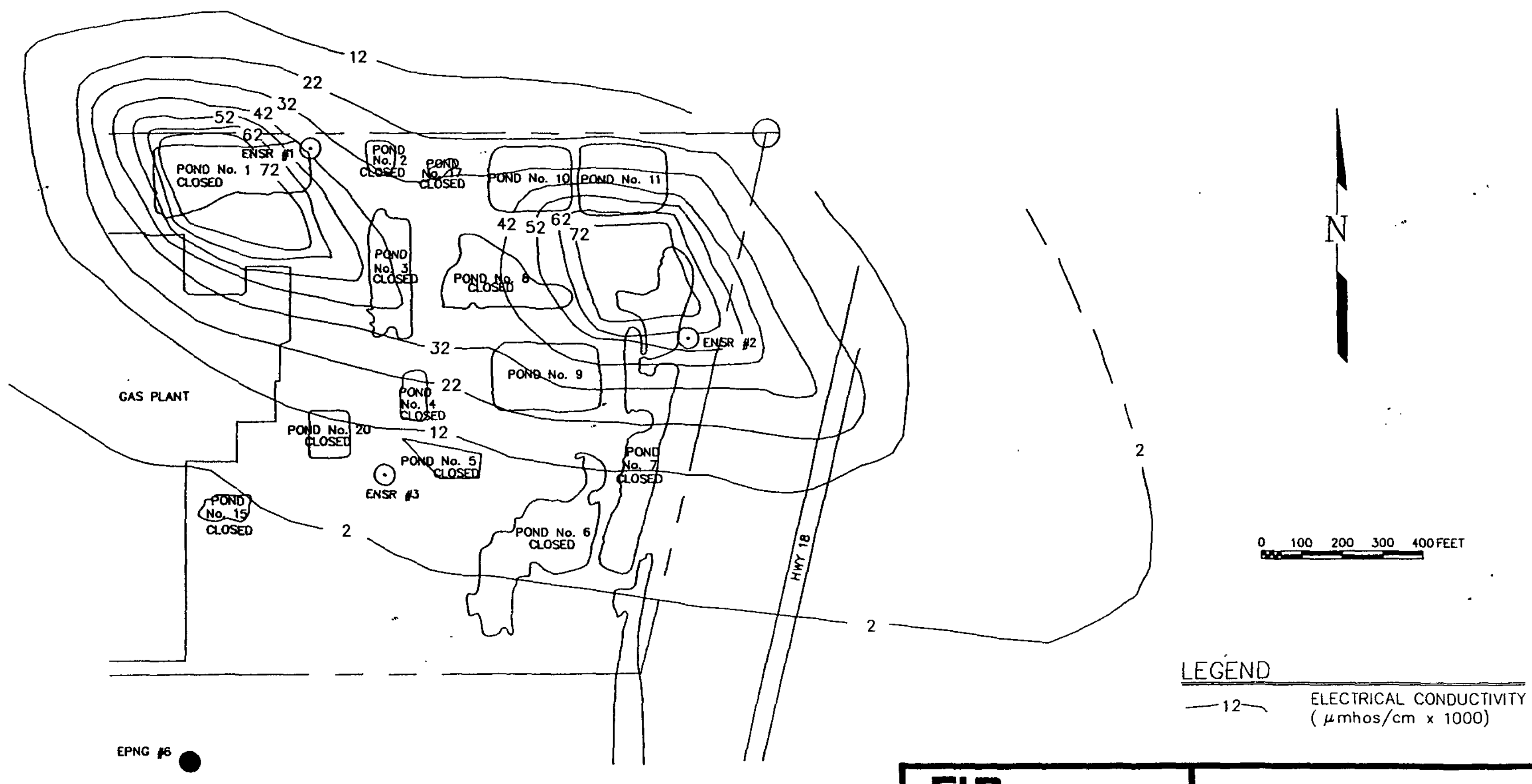


Figure 9. Correlation of Observed and Computed EC.



LEGEND

—12— ELECTRICAL CONDUCTIVITY
(μmhos/cm x 1000)

El Paso Natural Gas Company

PREDICTED EC CONCENTRATIONS

PROJECT: EPNG-JAL 63724 (EPJAL)			LOCATION: LEA COUNTY, NEW MEXICO	
K.W. BROWN & ASSOCIATES, INC.				DATE: 8-14-90
APPR:			DRAWN BY: RSW	SCALE: AS SHOWN
DATE:			DATE: 8-13-90	FIGURE: 10

Table 7. EC (umhos/cm /1,000) Values Computed by MOC for Run 2: Slug Migration.

	Column																
Row	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	0
3	0	2	3	4	3	2	1	1	1	1	1	1	1	1	1	1	0
4	0	3	5	8	5	2	1	1	1	1	1	1	1	1	1	1	0
5	0	5	8	13	8	4	2	1	1	1	1	1	1	1	1	1	0
6	0	7	14	22	12	6	2	1	1	1	1	1	1	1	1	1	0
7	0	10	20	34	20	9	4	2	1	1	1	1	1	1	1	1	0
8	0	12	24	36	25	15	6	2	1	1	1	1	1	1	1	1	0
9	0	11	23	27	29	20	9	3	1	1	1	1	1	1	1	1	0
10	0	9	18	28	29	25	13	5	2	1	1	1	1	1	1	1	0
11	0	6	12	21	28	32	18	7	2	1	1	1	1	1	1	1	0
12	0	4	8	16	28	44	24	9	3	1	1	1	1	1	1	1	0
13	0	3	5	13	28	37	27	10	3	1	1	1	1	1	1	1	0
14	0	2	4	10	22	29	22	10	3	1	1	1	1	1	1	1	0
15	0	1	3	7	15	22	16	7	3	1	1	1	1	1	1	1	0
16	0	1	2	4	9	13	9	5	2	1	1	1	1	1	1	1	0
17	0	1	1	2	5	7	5	3	1	1	1	1	1	1	1	1	0
18	0	1	1	1	2	3	3	2	1	1	1	1	1	1	1	1	0
19	0	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

rise from around 29,000 mmhos/cm to around 36,000 mmhos/cm during the 5-year pumping period. It is anticipated that this curve will reach a maximum at some point in the future as the well begins to pump better-quality groundwater from the upgradient fringes of the plume.

Table 8 is a listing of the results at the end of the 5-year period. From the end of the calibration run to the end of the recovery period, EC was seen to decrease from 142,000 mmhos/cm to 45,000 mmhos/cm. During this time, the total salt mass was estimated to have been reduced by 22%. Therefore, it is evident that pumping will, over time, improve the groundwater quality. Moreover, by increasing the efficiency of the groundwater recovery system, it will be possible to improve the rate at which the salt and trace organics are removed from the groundwater.

Although on the surface, groundwater recovery appears to be a less desirable option than simply letting the plume migrate, the overall mass of salt in the subsurface under the pumping scenario (at 5 years) is 78%that of the dissolved salt under the slug-migration scenario (at 20 years).

4.6.4 Groundwater Modeling Results

Information presented in this section is intended to provided qualitative predictions on the current status of groundwater conditions at the site. Because it was necessary to make assumptions to supplement the available site-specific data, the numerical values presented are not offered as quantitatively-precise results. Nevertheless, assumptions made to drive the model are considered to be representative and are founded on credible scientific evidence and experience. Therefore, the predictions presented are similarly considered representative of a future conditions at the site.

Results from the groundwater modeling exercise indicate the orientation of the plume is to the southeast along the axis of the groundwater flow direction. The area affected by the plume encompasses the majority of the plant which at one time was occupied by wastewater ponds as well as an area to the southeast of the EPNG eastern property line. The lateral extent of the plume, as predicted by the model, extends to the east beyond Highway 18 for a distance of approximately 900 feet.

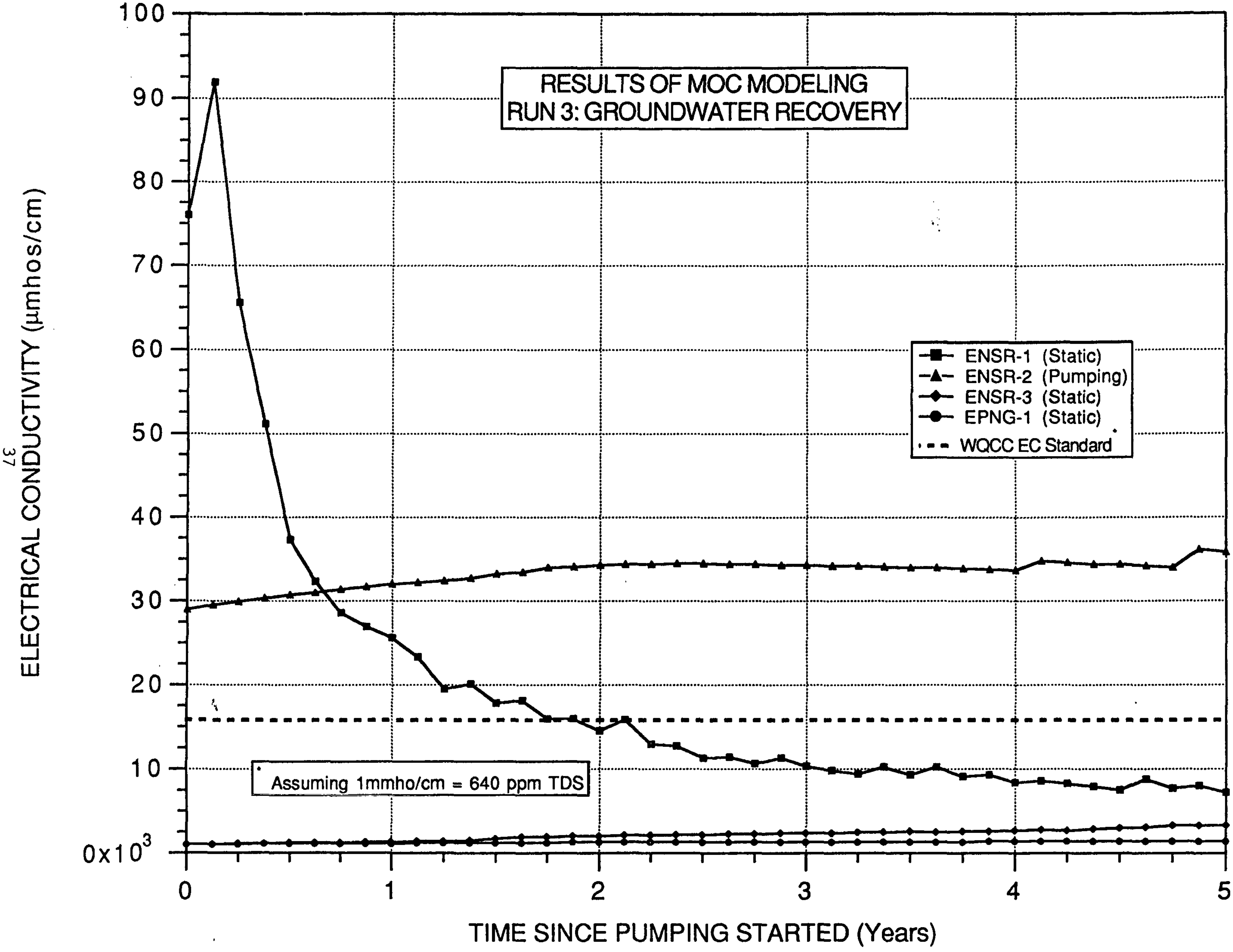


Figure 11. Results of MOC Modeling Run 3: Groundwater Recovery.

Table 8. EC (umhos/cm /1,000) Values Computed by MOC for Run 3: Groundwater Recovery.

	Column																
Row	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
3	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
4	0	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	0
5	0	2	3	3	3	2	2	1	1	1	1	1	1	1	1	1	0
6	0	4	5	5	4	3	2	1	1	1	1	1	1	1	1	1	0
7	0	11	9	11	8	5	3	2	1	1	1	1	1	1	1	1	0
8	0	13	11	7	11	10	5	2	1	1	1	1	1	1	1	1	0
9	0	11	11	5	12	15	7	2	1	1	1	1	1	1	1	1	0
10	0	10	17	18	21	22	10	3	1	1	1	1	1	1	1	1	0
11	0	6	12	19	26	32	17	5	2	1	1	1	1	1	1	1	0
12	0	3	7	16	32	45	26	8	2	1	1	1	1	1	1	1	0
13	0	2	5	13	36	43	31	9	3	1	1	1	1	1	1	1	0
14	0	1	3	10	29	32	28	9	3	1	1	1	1	1	1	1	0
15	0	1	2	6	17	34	18	6	2	1	1	1	1	1	1	1	0
16	0	1	1	3	9	18	10	4	1	1	1	1	1	1	1	1	0
17	0	1	1	2	4	8	5	2	1	1	1	1	1	1	1	1	0
18	0	1	1	1	2	3	2	1	1	1	1	1	1	1	1	1	0
19	0	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

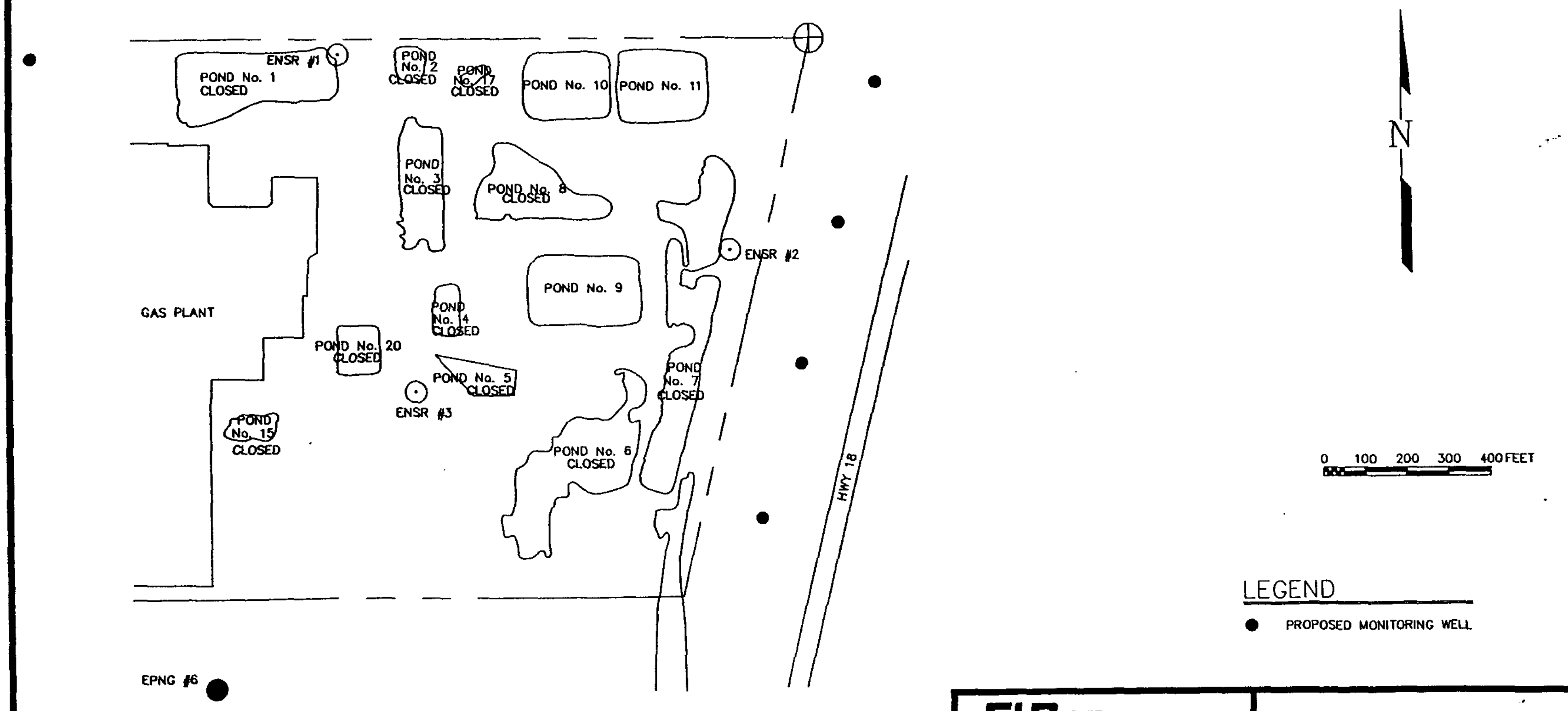
5.0 REMEDIATION

In preparing this discussion on a remedial action approach, it has been assumed that EPNG would prefer not to cross Highway 18 to conduct field activities. It has also been assumed that gaining access to the right-of-way along Highway 18 and the railroad tracks would be possible. Therefore, the remediation proposed will concentrate on activities that can be implemented on the western side of Highway 18.

Given the contamination at the site is characterized by relatively low levels of organics (ppb range) and high levels of salt, it is suggested that the contaminated groundwater be pumped out of the aquifer and disposed in an injection well. *In situ* treatment of the organics would be ineffective given the salinity of the water, and this type of treatment would do nothing to remove the inorganic contamination. Because the level of organic contamination appears to be relatively slight in comparison with the contamination resulting from salt, it is recommended that remediation focus on the recovery of saline groundwater. By assuming this posture, it will be possible to address both the problem of trace level organic contamination while removing induced salts. Moreover, this approach is consistent with the wishes of the New Mexico Oil Conservation Division.

The proposed remediation would involve the installation of the three additional monitoring wells as prescribed in the Phase 2 work assignment. The locations of the wells would be oriented parallel to Highway 18 and the wells would be installed as illustrated on Figure 12. Each of the wells would be 4 inches in diameter and would be on the order of 180 feet deep. Each well would receive a dedicated submersible pump. Initially, each well would be tested in the field to determine the EC of the groundwater to determine the position of the well relative to the contaminant plume. Ultimately, each well will be tested for the parameters that have been detected in the other monitoring wells.

It is recommended that a pump test be conducted during Phase 2 to determine the hydrologic properties of the aquifer. This information, along with the chemical data collected from the new wells, would aid greatly in optimizing a groundwater recovery system for the site.



El Paso
Natural Gas Company

PROPOSED MONITORING WELLS

PROJECT: EPNG–JAL 63724 (EPJAL)			LOCATION: LEA COUNTY, NEW MEXICO		
K.W. BROWN & ASSOCIATES, INC.					DATE: 8–14–90
APPR:			DRAWN BY:	RSW	SCALE: AS SHOWN
DATE:			DATE:	8–13–90	FIGURE: 12

6.0 SURVEY

A survey of the site was performed by John W. West Engineering Company of Hobbs, New Mexico. The location of the wells, the ground elevations at each well, and the elevations of the well casing were included in this survey. On the EPNG water production wells, the elevation of the concrete foundations was also determined. The results of this survey are included as Appendix B.

7.0 CONCLUSIONS AND RECOMMENDATIONS

In summary, it can be stated that a groundwater plume that contains high levels of salt and low levels of organic contaminants is present at the site. This assessment is based on groundwater data collected in 1989 and 1990 that clearly illustrates the presence of these constituents. Moreover, the available data suggest the source of the contaminant are the old wastewater ponds that were operated at the site from the 1950s until the 1980s.

The orientation of the plume is to the southeast which is concurrent with the groundwater flow direction at the site. The exact configuration of the plume is unknown due to the lack of monitoring wells downgradient of the suspected sources. Computer modeling, using available data and conservative assumptions, indicates the plume has extended eastward beyond the EPNG property line. It is estimated the leading edge of the plume is at least 900 feet to the east of Highway 18.

Remediation of the site is limited to recovery of the affected groundwater. Due to the high salinity of the water *in_situ* treatment of the groundwater to remove the organic constituents would not be effective. Moreover, *in_situ* treatment would not mitigate the inorganic contamination.

Background water quality is estimated to be near the 1,000 mg/L total dissolved solids (TDS) criteria established by the State of New Mexico. This estimation is based on the EC of the groundwater from EPNG-12 which, when converted to TDS, yields a value of 1,086 mg/L [where EC(umhos) ≈ TDS (mg/L) x 0.64)]. This indicates that recovering the saline groundwater such that the area is returned to background quality will be required by the state.

Recommendations for future work include the implementation of Phase 2 tasks with some modifications. Modifications to the Phase 2 effort would include increasing the number of monitoring wells installed from three to five. Also, it is recommended that a piezometer nest be installed which consists of two piezometers. The piezometer nest should be near a monitoring well for the purpose of conducting a pumping test and to determine whether a vertical hydraulic gradient exists. It is also recommended that Phase 2 allow for the design of a groundwater recovery system.

Additionally, it is recommended that consideration be given to conducting a resistivity survey from the area of the wastewater ponds to the southeast along the axis of the plume. The purpose of the resistivity survey would be to define the configuration of the plume prior to installing monitoring wells. It would also be possible to survey the land to the east of Highway 18 without having to disturb the surface.

It is envisioned that the ultimate remediation of the site will be to pump saline groundwater from the aquifer. This assessment is based on the level of salt contamination documented relative to the back groundwater water quality. The exact configuration of the recovery system that will ultimately be needed cannot be fully defined until Phase 2 has been initiated and the appropriate data collected and interpreted. Therefore, cost estimates on the remedial effort are not offered.

8.0 REFERENCES

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APPENDIX A

Laboratory Data

AnalyticalTechnologies, Inc. 2113 S. 48th Street Suite 107 Tempe, AZ 85282 (602) 438-1530

ATI I.D. 006781

July 26, 1990

K.W. Brown & Associates
6 Graham Road
College Station, TX 77845

Project Name/Number: EPNG Jal 4 63724

Attention: Sid Johnson

On 06/21/90, Analytical Technologies, Inc. received a request to analyze aqueous sample(s). The sample(s) were analyzed with EPA methodology or equivalent methods. The results of these analyses and the quality control data, which follow each set of analyses, are enclosed.

Method 610 analyses were performed by ATI, San Diego. On the original analysis, several 608 samples had low surrogate recoveries. Samples EPNG 1 and ENSR 2 have been confirmed to have matrix problems by re-extraction and re-analysis. Samples ENSR 4 and ENSR 1 had acceptable recoveries upon re-extraction. The original results are reported, with surrogate recoveries from the extraction of 07/03/90. For method 625, sample ENSR 3 has low surrogate recoveries confirmed by re-extraction and re-analysis.

If you have any questions or comments, please do not hesitate to contact us at (602)438-1530.

Elizabeth Proffitt

Elizabeth Proffitt
Project Manager

Robert V. Woods
Laboratory Manager

RVW:clf
Enclosure
90-21

Analytical**Technologies**, Inc.

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
DATE RECEIVED : 06/21/90
REPORT DATE : 07/26/90
ATI I.D. : 006781

ATI #	CLIENT DESCRIPTION	MATRIX	DATE COLLECTED
01	EPNG 1	AQUEOUS	06/19/90
02	ENSR 4	AQUEOUS	06/19/90
03	ENSR 3	AQUEOUS	06/18/90
04	ENSR 2	AQUEOUS	06/18/90
05	ENSR 1	AQUEOUS	06/19/90
06	EPNG 12	AQUEOUS	06/18/90
07	ENSR 5	AQUEOUS	06/20/90
08	TRIP BLANK	AQUEOUS	06/18/90
09	TRIP BLANK OF EPNG 1	AQUEOUS	06/19/90
10	TRIP BLANK OF ENSR 4	AQUEOUS	06/19/90
11	TRIP BLANK OF ENSR 3	AQUEOUS	06/18/90
12	TRIP BLANK OF ENSR 2	AQUEOUS	06/18/90
13	TRIP BLANK OF ENSR 1	AQUEOUS	06/19/90
14	TRIP BLANK OF EPNG 12	AQUEOUS	06/18/90
15	TRIP BLANK OF ENSR 5	AQUEOUS	06/20/90

----- TOTALS -----

MATRIX	# SAMPLES
AQUEOUS	15

ATI STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from th date of this report. If an extended storage period is required, please contac our sample control department before the scheduled disposal date.

AnalyticalTechnologies, Inc.

METALS - QUALITY CONTROL

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4

ATI I.D. : 006781

PARAMETER	UNITS	ATI I.D.	SAMPLE RESULT	DUP. RESULT	RPD	SPIKED SAMPLE	SPIKE CONC	% REC
CALCIUM	MG/L	00678107	<0.1	<0.1	NA	56.0	50.0	112
POTASSIUM	MG/L	00678107	<1.0	<1.0	NA	53.4	50.0	107
MAGNESIUM	MG/L	00678107	<0.1	<0.1	NA	26.0	25.0	104
MAGNESIUM	MG/L	00678105	200	210	5	2830	2500	105
SODIUM	MG/L	00678107	<0.1	<0.1	NA	54.7	50.0	109
SODIUM	MG/L	00678105	5920	6080	3	11100	5000	104

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative Percent Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 10$$

METALS RESULTS

ATI I.D. : 006781

CLIENT	: K.W. BROWN & ASSOCIATES	DATE RECEIVED	: 06/21/90
PROJECT #	: 63724		
PROJECT NAME	: EPNG JAL 4	REPORT DATE	: 07/26/90

PARAMETER	UNITS	01	02	03	04	05
CALCIUM	MG/L	106	380	306	22.6	421
POTASSIUM	MG/L	5.5	43.4	5.8	73.9	42.0
MAGNESIUM	MG/L	29.3	118	76.2	42.2	200
SODIUM	MG/L	85.7	5790	200.	18600	5920

METALS RESULTS

ATI I.D. : 006781

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4

DATE RECEIVED : 06/21/90

REPORT DATE : 07/26/90

PARAMETER	UNITS	06	07
CALCIUM	MG/L	68.6	<0.1
POTASSIUM	MG/L	3.4	<1.0
MAGNESIUM	MG/L	9.9	<0.1
SODIUM	MG/L	61.9	<0.1

AnalyticalTechnologies, Inc.

GENERAL CHEMISTRY RESULTS

ATI I.D. : 006781

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4

DATE RECEIVED : 06/21/90
REPORT DATE : 07/26/90

PARAMETER	UNITS	01	02	03	04	05
CARBONATE (CACO3)	MG/L	<1	<1	<1	<1	<1
BICARBONATE (CACO3)	MG/L	376	860	314	1320	800
HYDROXIDE (CACO3)	MG/L	<1	<1	<1	<1	<1
TOTAL ALKALINITY (AS CACO3)	MG/L	376	860	314	1320	800
CHLORIDE	MG/L	72	11000	1000	31000	11000
CONDUCTIVITY, (UMHOS/CM)		986	25600	2890	66400	26800
PETROLEUM HYDROCARBONS, IR	MG/L	3	2	8	3	2
PH	UNITS	7.7	7.4	7.4	8.3	7.6
SULFATE	MG/L	90	<3	14	520	<3

AnalyticalTechnologies, Inc.

GENERAL CHEMISTRY RESULTS

ATI I.D. : 006781

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4

DATE RECEIVED : 06/21/90
REPORT DATE : 07/26/90

PARAMETER	UNITS	06	07
CARBONATE (CACO3)	MG/L	<1	<1
BICARBONATE (CACO3)	MG/L	176	2
HYDROXIDE (CACO3)	MG/L	<1	<1
TOTAL ALKALINITY (AS CACO3)	MG/L	176	2
CHLORIDE	MG/L	68	<0.5
CONDUCTIVITY, (UMHOS/CM)		626	2.30
PETROLEUM HYDROCARBONS, IR	MG/L	<1	<1
PH	UNITS	8.1	8.4
SULFATE	MG/L	56	<0.3

GENERAL CHEMISTRY - QUALITY CONTROL

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
ATI I.D. : 006781

PARAMETER	UNITS	ATI I.D.	SAMPLE RESULT	DUP. RESULT	RPD	SPIKED SAMPLE	SPIKE CONC	% REC
CARBONATE	MG/L	00678105	<1	<1	NA	NA	NA	NA
BICARBONATE	MG/L		800	800	0	NA	NA	NA
HYDROXIDE	MG/L		<1	<1	NA	NA	NA	NA
TOTAL ALKALINITY	MG/L		800	800	0	NA	NA	NA
CARBONATE	MG/L	00680707	6	6	0	NA	NA	NA
BICARBONATE	MG/L		249	250	0.4	NA	NA	NA
HYDROXIDE	MG/L		<1	<1	NA	NA	NA	NA
TOTAL ALKALINITY	MG/L		255	256	0.4	NA	NA	NA
CHLORIDE	MG/L	00678107	<0.5	<0.5	NA	21.7	20.0	108
CONDUCTIVITY(UMHOS/CM)		00666202	4310	4360	1	NA	NA	NA
PETROLEUM HYDROCARBONS	MG/L	00678101	3	3	0	6	3	100
PH	UNITS	00678105	7.6	7.6	0	NA	NA	NA
SULFATE	MG/L	00678101	90	87	2	180	90	100

$$\% \text{ Recovery} = \frac{\text{(Spike Sample Result - Sample Result)}}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative Percent Difference)} = \frac{\text{(Sample Result - Duplicate Result)}}{\text{Average Result}} \times 100$$

AnalyticalTechnologies, Inc.

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678101

TEST : ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 608)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : EPNG 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/25/90
DATE ANALYZED : 06/28/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
ALDRIN	<0.05
ALPHA BHC	<0.05
BETA BHC	<0.05
GAMMA BHC (LINDANE)	<0.05
DELTA BHC	<0.05
CHLORDANE	<0.5
4,4'-DDD	<0.1
4,4'-DDE	<0.1
4,4'-DDT	<0.1
DIELDRIN	<0.1
ENDOSULFAN I	<0.05
ENDOSULFAN II	<0.1
ENDOSULFAN SULFATE	<0.1
ENDRIN	<0.1
ENDRIN ALDEHYDE	<0.1
ENDRIN KETONE	<0.1
HEPTACHLOR	<0.05
HEPTACHLOR EPOXIDE	<0.05
METHOXYCHLOR	<0.5
TOXAPHENE	<1.0
AROCLOR 1016	<0.5
AROCLOR 1221	<0.5
AROCLOR 1232	<0.5
AROCLOR 1242	<0.5
AROCLOR 1248	<0.5
AROCLOR 1254	<0.5
AROCLOR 1260	<0.5

SURROGATE PERCENT RECOVERIES

DBC (%)	-*

* Result out of limits due to sample matrix interference

AnalyticalTechnologies, Inc.

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678102

TEST : ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 608)

CLIENT	K.W. BROWN & ASSOCIATES	DATE SAMPLED	06/19/90
PROJECT #	63724	DATE RECEIVED	06/21/90
PROJECT NAME	EPNG JAL 4	DATE EXTRACTED	06/25/90
CLIENT I.D.	ENSR 4	DATE ANALYZED	06/28/90
SAMPLE MATRIX	AQUEOUS	UNITS	UG/L
		DILUTION FACTOR	1

COMPOUNDS	RESULTS
ALDRIN	<0.05
ALPHA BHC	<0.05
BETA BHC	<0.05
GAMMA BHC (LINDANE)	<0.05
DELTA BHC	<0.05
CHLORDANE	<0.5
4,4'-DDD	<0.1
4,4'-DDE	<0.1
4,4'-DDT	<0.1
DIELDRIN	<0.1
ENDOSULFAN I	<0.05
ENDOSULFAN II	<0.1
ENDOSULFAN SULFATE	<0.1
ENDRIN	<0.1
ENDRIN ALDEHYDE	<0.1
ENDRIN KETONE	<0.1
HEPTACHLOR	<0.05
HEPTACHLOR EPOXIDE	<0.05
METHOXYCHLOR	<0.5
TOXAPHENE	<1.0
AROCLOR 1016	<0.5
AROCLOR 1221	<0.5
AROCLOR 1232	<0.5
AROCLOR 1242	<0.5
AROCLOR 1248	<0.5
AROCLOR 1254	<0.5
AROCLOR 1260	<0.5
SURROGATE PERCENT RECOVERIES	
DBC (%)	67 *

*SURROGATE RECOVERY FROM EXTRACTION DATE 07/03/90.

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GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678103

TEST : ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 608)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 3
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/25/90
DATE ANALYZED : 07/03/90
UNITS : UG/L
DILUTION FACTOR : 20

COMPOUNDS	RESULTS
ALDRIN	<1.0
ALPHA BHC	<1.0
BETA BHC	<1.0
GAMMA BHC (LINDANE)	<1.0
DELTA BHC	<1.0
CHLORDANE	<10.0
4,4'-DDD	<2.0
4,4'-DDE	<2.0
4,4'-DDT	<2.0
DIELDRIN	<2.0
ENDOSULFAN I	<1.0
ENDOSULFAN II	<2.0
ENDOSULFAN SULFATE	<2.0
ENDRIN	<2.0
ENDRIN ALDEHYDE	<2.0
ENDRIN KETONE	<2.0
HEPTACHLOR	<1.0
HEPTACHLOR EPOXIDE	<1.0
METHOXYCHLOR	<10.0
TOXAPHENE	<20.0
AROCLOR 1016	<10.0
AROCLOR 1221	<10.0
AROCLOR 1232	<10.0
AROCLOR 1242	<10.0
AROCLOR 1248	<10.0
AROCLOR 1254	<10.0
AROCLOR 1260	<10.0

SURROGATE PERCENT RECOVERIES

DBC (%)	86

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GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678104

TEST : ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 608)

CLIENT	: K.W. BROWN & ASSOCIATES	DATE SAMPLED	: 06/18/90
PROJECT #	: 63724	DATE RECEIVED	: 06/21/90
PROJECT NAME	: EPNG JAL 4	DATE EXTRACTED	: 06/25/90
CLIENT I.D.	: ENSR 2	DATE ANALYZED	: 07/03/90
SAMPLE MATRIX	: AQUEOUS	UNITS	: UG/L
		DILUTION FACTOR	: 5

COMPOUNDS	RESULTS
ALDRIN	<0.25
ALPHA BHC	<0.25
BETA BHC	<0.25
GAMMA BHC (LINDANE)	<0.25
DELTA BHC	<0.25
CHLORDANE	<2.5
4,4'-DDD	<0.5
4,4'-DDE	<0.5
4,4'-DDT	<0.5
DIELDRIN	<0.5
ENDOSULFAN I	<0.25
ENDOSULFAN II	<0.5
ENDOSULFAN SULFATE	<0.5
ENDRIN	<0.5
ENDRIN ALDEHYDE	<0.5
ENDRIN KETONE	<0.5
HEPTACHLOR	<0.25
HEPTACHLOR EPOXIDE	<0.25
METHOXYCHLOR	<2.5
TOXAPHENE	<5.0
AROCLOR 1016	<2.5
AROCLOR 1221	<2.5
AROCLOR 1232	<2.5
AROCLOR 1242	<2.5
AROCLOR 1248	<2.5
AROCLOR 1254	<2.5
AROCLOR 1260	<2.5

SURROGATE PERCENT RECOVERIES

DBC (%)	-*

* Result out of limits due to sample matrix interference

Analytical**Technologies**, Inc.

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678105

TEST : ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 608)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/25/90
DATE ANALYZED : 06/28/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
ALDRIN	<0.05
ALPHA BHC	<0.05
BETA BHC	<0.05
GAMMA BHC (LINDANE)	<0.05
DELTA BHC	<0.05
CHLORDANE	<0.5
4,4'-DDD	<0.1
4,4'-DDE	<0.1
4,4'-DDT	<0.1
DIELDRIN	<0.1
ENDOSULFAN I	<0.05
ENDOSULFAN II	<0.1
ENDOSULFAN SULFATE	<0.1
ENDRIN	<0.1
ENDRIN ALDEHYDE	<0.1
ENDRIN KETONE	<0.1
HEPTACHLOR	<0.05
HEPTACHLOR EPOXIDE	<0.05
METHOXYCHLOR	<0.5
TOXAPHENE	<1.0
AROCLOR 1016	<0.5
AROCLOR 1221	<0.5
AROCLOR 1232	<0.5
AROCLOR 1242	<0.5
AROCLOR 1248	<0.5
AROCLOR 1254	<0.5
AROCLOR 1260	<0.5
SURROGATE PERCENT RECOVERIES	
DBC (%)	63 *

*SURROGATE RECOVERY OF 07/03/90.

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GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678106

TEST : ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 608)

CLIENT	: K.W. BROWN & ASSOCIATES	DATE SAMPLED	: 06/18/90
PROJECT #	: 63724	DATE RECEIVED	: 06/21/90
PROJECT NAME	: EPNG JAL 4	DATE EXTRACTED	: 6/25/90
CLIENT I.D.	: EPNG 12	DATE ANALYZED	: 06/28/90
SAMPLE MATRIX	: AQUEOUS	UNITS	: UG/L
		DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
ALDRIN	<0.05
ALPHA BHC	<0.05
BETA BHC	<0.05
GAMMA BHC (LINDANE)	<0.05
DELTA BHC	<0.05
CHLORDANE	<0.5
4,4'-DDD	<0.1
4,4'-DDE	<0.1
4,4'-DDT	<0.1
DIELDRIN	<0.1
ENDOSULFAN I	<0.05
ENDOSULFAN II	<0.1
ENDOSULFAN SULFATE	<0.1
ENDRIN	<0.1
ENDRIN ALDEHYDE	<0.1
ENDRIN KETONE	<0.1
HEPTACHLOR	<0.05
HEPTACHLOR EPOXIDE	<0.05
METHOXYCHLOR	<0.5
TOXAPHENE	<1.0
AROCLOR 1016	<0.5
AROCLOR 1221	<0.5
AROCLOR 1232	<0.5
AROCLOR 1242	<0.5
AROCLOR 1248	<0.5
AROCLOR 1254	<0.5
AROCLOR 1260	<0.5

SURROGATE PERCENT RECOVERIES

DBC (%)	100

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GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678107

TEST : ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 608)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 5
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/20/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 6/25/90
DATE ANALYZED : 06/28/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
ALDRIN	<0.05
ALPHA BHC	<0.05
BETA BHC	<0.05
GAMMA BHC (LINDANE)	<0.05
DELTA BHC	<0.05
CHLORDANE	<0.5
4,4'-DDD	<0.1
4,4'-DDE	<0.1
4,4'-DDT	<0.1
DIELDRIN	<0.1
ENDOSULFAN I	<0.05
ENDOSULFAN II	<0.1
ENDOSULFAN SULFATE	<0.1
ENDRIN	<0.1
ENDRIN ALDEHYDE	<0.1
ENDRIN KETONE	<0.1
HEPTACHLOR	<0.05
HEPTACHLOR EPOXIDE	<0.05
METHOXYCHLOR	<0.5
TOXAPHENE	<1.0
AROCLOR 1016	<0.5
AROCLOR 1221	<0.5
AROCLOR 1232	<0.5
AROCLOR 1242	<0.5
AROCLOR 1248	<0.5
AROCLOR 1254	<0.5
AROCLOR 1260	<0.5

SURROGATE PERCENT RECOVERIES

DBC (%)	95

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GAS CHROMATOGRAPHY - RESULTS

REAGENT BLANK

TEST : ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 608)

		ATI I.D.	: 006781
CLIENT	: K.W. BROWN & ASSOCIATES	DATE EXTRACTED	: 06/25/90
PROJECT #	: 63724	DATE ANALYZED	: 06/27/90
PROJECT NAME	: EPNG JAL 4	UNITS	: UG/L
CLIENT I.D.	: REAGENT BLANK	DILUTION FACTOR	: N/A

COMPOUNDS	RESULTS
ALDRIN	<0.05
ALPHA BHC	<0.05
BETA BHC	<0.05
GAMMA BHC (LINDANE)	<0.05
DELTA BHC	<0.05
CHLORDANE	<0.5
4,4'-DDD	<0.1
4,4'-DDE	<0.1
4,4'-DDT	<0.1
DIELDRIN	<0.1
ENDOSULFAN I	<0.05
ENDOSULFAN II	<0.1
ENDOSULFAN SULFATE	<0.1
ENDRIN	<0.1
ENDRIN ALDEHYDE	<0.1
ENDRIN KETONE	<0.1
HEPTACHLOR	<0.05
HEPTACHLOR EPOXIDE	<0.05
METHOXYCHLOR	<0.5
TOXAPHENE	<1.0
AROCLOR 1016	<0.5
AROCLOR 1221	<0.5
AROCLOR 1232	<0.5
AROCLOR 1242	<0.5
AROCLOR 1248	<0.5
AROCLOR 1254	<0.5
AROCLOR 1260	<0.5

SURROGATE PERCENT RECOVERIES

DBC (%)	103

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QUALITY CONTROL DATA

ATI I.D. : 006781

TEST : ORGANOCHLORINE PESTICIDES AND PCB'S (EPA 608)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
REF I.D. : 00799901

DATE ANALYZED : 06/27/90
SAMPLE MATRIX : AQUEOUS
UNITS : UG/L

COMPOUNDS	SAMPLE RESULT	CONC. SPIKED	SPIKED SAMPLE	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
GAMMA BHC	<0.05	2.0	2.0	100	2.0	100	0
HEPTACHLOR	<0.05	2.0	1.8	90	1.8	90	0
ALDRIN	<0.05	2.0	1.8	90	1.9	95	5
DIELDRIN	<0.1	2.0	2.1	105	2.1	105	0
ENDRIN	<0.1	2.0	2.2	110	2.2	110	0
DDT	<0.1	2.0	2.1	105	2.1	105	0

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Spiked Sample Result} - \text{Duplicate Spike Sample Result})}{\text{Average of Spiked Sample}} \times 100$$

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GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678101

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : EPNG 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 06/28/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
BENZENE	0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	78

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GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678102

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 4
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 06/27/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
BENZENE	6.9
TOLUENE	<0.5
ETHYLBENZENE	0.8
TOTAL XYLENES	1.8

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	76

Analytical **Technologies**, Inc.

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678103

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 3
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 06/27/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
BENZENE	1.7
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	66

AnalyticalTechnologies, Inc.

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678104

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 2
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 06/27/90
UNITS : UG/L
DILUTION FACTOR : 10

COMPOUNDS	RESULTS
BENZENE	90
TOLUENE	71
ETHYLBENZENE	21
TOTAL XYLENES	30

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	81

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GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678105

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 06/28/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
BENZENE	7.3
TOLUENE	<0.5
ETHYLBENZENE	1.0
TOTAL XYLENES	2.1

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	87

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678106

TEST : BTEX (8020)

CLIENT	K.W. BROWN & ASSOCIATES	DATE SAMPLED	06/18/90
PROJECT #	63724	DATE RECEIVED	06/21/90
PROJECT NAME	EPNG JAL 4	DATE EXTRACTED	N/A
CLIENT I.D.	EPNG 12	DATE ANALYZED	06/27/90
SAMPLE MATRIX	AQUEOUS	UNITS	UG/L
		DILUTION FACTOR	1

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	89

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GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678107

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 5
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/20/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 06/28/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	89

Analytical**Technologies**, Inc.

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678109

TEST : BTEX (8020)

CLIENT	: K.W. BROWN & ASSOCIATES	DATE SAMPLED	: 06/19/90
PROJECT #	: 63724	DATE RECEIVED	: 06/21/90
PROJECT NAME	: EPNG JAL 4	DATE EXTRACTED	: N/A
CLIENT I.D.	: TRIP BLANK OF EPNG 1	DATE ANALYZED	: 06/27/90
SAMPLE MATRIX	: AQUEOUS	UNITS	: UG/L
		DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5
SURROGATE PERCENT RECOVERIES	
TRIFLUOROTOLUENE (%)	89

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678110

TEST : BTEX (8020)

CLIENT	K.W. BROWN & ASSOCIATES	DATE SAMPLED	06/19/90
PROJECT #	63724	DATE RECEIVED	06/21/90
PROJECT NAME	EPNG JAL 4	DATE EXTRACTED	N/A
CLIENT I.D.	TRIP BLANK OF ENSR 4	DATE ANALYZED	06/27/90
SAMPLE MATRIX	AQUEOUS	UNITS	UG/L
		DILUTION FACTOR	1

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	93

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678111

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : TRIP BLANK OF ENSR 3
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 06/27/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	97

AnalyticalTechnologies, Inc.

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678112

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : TRIP BLANK OF ENSR 2
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 06/27/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	88

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GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678113

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : TRIP BLANK OF ENSR 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 06/27/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	80

AnalyticalTechnologies, Inc.

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678114

TEST : BTEX (8020)

CLIENT	: K.W. BROWN & ASSOCIATES	DATE SAMPLED	: 06/18/90
PROJECT #	: 63724	DATE RECEIVED	: 06/21/90
PROJECT NAME	: EPNG JAL 4	DATE EXTRACTED	: N/A
CLIENT I.D.	: TRIP BLANK OF EPNG 12	DATE ANALYZED	: 06/27/90
SAMPLE MATRIX	: AQUEOUS	UNITS	: UG/L
		DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	86

AnalyticalTechnologies, Inc.

GAS CHROMATOGRAPHY - RESULTS

ATI I.D. : 00678115

TEST : BTEX (8020)

CLIENT	K.W. BROWN & ASSOCIATES	DATE SAMPLED	06/20/90
PROJECT #	63724	DATE RECEIVED	06/21/90
PROJECT NAME	EPNG JAL 4	DATE EXTRACTED	N/A
CLIENT I.D.	TRIP BLANK OF ENSR 5	DATE ANALYZED	06/27/90
SAMPLE MATRIX	AQUEOUS	UNITS	UG/L
		DILUTION FACTOR	1

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	87

GAS CHROMATOGRAPHY - RESULTS

REAGENT BLANK

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : REAGENT BLANK

ATI I.D. : 006781
DATE EXTRACTED : 06/26/90
DATE ANALYZED : 06/26/90
UNITS : UG/L
DILUTION FACTOR : N/A

COMPOUNDS	RESULTS
BENZENE	<0.5
TOLUENE	<0.5
ETHYLBENZENE	<0.5
TOTAL XYLENES	<0.5

SURROGATE PERCENT RECOVERIES

TRIFLUOROTOLUENE (%)	114

AnalyticalTechnologies, Inc.

QUALITY CONTROL DATA

ATI I.D. : 006781

TEST : BTEX (8020)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
REF I.D. : 00699935

DATE ANALYZED : 06/26/90
SAMPLE MATRIX :
UNITS : UG/L

COMPOUNDS	SAMPLE RESULT	CONC. SPIKED	SPIKED SAMPLE	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
BENZENE	<0.5	10	11	110	10	100	10
TOLUENE	<0.5	10	12	120	11	110	9
ETHYLBENZENE	<0.5	10	11	110	10	100	10
XYLENES	<0.5	30	33	110	31	103	6

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Spiked Sample Result} - \text{Duplicate Spike Sample Result})}{\text{Average of Spiked Sample}} \times 100$$

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678101

TEST : POLYNUCLEAR AROMATICS (EPA 610)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : EPNG 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/29/90
DATE ANALYZED : 07/10/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
NAPHTHALENE	<5.0
ACENAPHTHYLENE	<5.0
ACENAPHTHENE	<5.0
FLUORENE	<1.0
PHENANTHRENE	<1.0
ANTHRACENE	<1.0
FLUORANTHENE	<1.0
PYRENE	<1.0
BENZO(A)ANTHRENE	<1.0
CHRYSENE	<1.0
BENZO(B)FLUORANTHENE	<1.0
BENZO(K)FLUORANTHENE	<1.0
BENZO(A)PYRENE	<1.0
DIBENZ(a,h)ANTHRACENE	<5.0
BENZO(g,h,i)PERYLENE	<1.0
INDENO(1,2,3-CD)PYRENE	<1.0

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678102

TEST : POLYNUCLEAR AROMATICS (EPA 610)

CLIENT	K.W. BROWN & ASSOCIATES	DATE SAMPLED	06/19/90
PROJECT #	63724	DATE RECEIVED	06/21/90
PROJECT NAME	EPNG JAL 4	DATE EXTRACTED	06/29/90
CLIENT I.D.	ENSR 4	DATE ANALYZED	07/10/90
SAMPLE MATRIX	AQUEOUS	UNITS	UG/L
		DILUTION FACTOR	1

COMPOUNDS	RESULTS
NAPHTHALENE	<5.0
ACENAPHTHYLENE	<5.0
ACENAPHTHENE	<5.0
FLUORENE	<1.0
PHENANTHRENE	<1.0
ANTHRACENE	<1.0
FLUORANTHENE	<1.0
PYRENE	<1.0
BENZO(A)ANTHRENE	<1.0
CHRYSENE	<1.0
BENZO(B)FLUORANTHENE	<1.0
BENZO(K)FLUORANTHENE	<1.0
BENZO(A)PYRENE	<1.0
DIBENZ(a,h)ANTHRACENE	<5.0
BENZO(g,h,i)PERYLENE	<1.0
INDENO(1,2,3-CD)PYRENE	<1.0

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678103

TEST : POLYNUCLEAR AROMATICS (EPA 610)

CLIENT	: K.W. BROWN & ASSOCIATES	DATE SAMPLED	: 06/18/90
PROJECT #	: 63724	DATE RECEIVED	: 06/21/90
PROJECT NAME	: EPNG JAL 4	DATE EXTRACTED	: 06/29/90
CLIENT I.D.	: ENSR 3	DATE ANALYZED	: 07/11/90
SAMPLE MATRIX	: AQUEOUS	UNITS	: UG/L
		DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
NAPHTHALENE	<5.0
ACENAPHTHYLENE	<5.0
ACENAPHTHENE	<5.0
FLUORENE	<1.0
PHENANTHRENE	<1.0
ANTHRACENE	<1.0
FLUORANTHENE	<1.0
PYRENE	<1.0
BENZO(A)ANTHRENE	<1.0
CHRYSENE	<1.0
BENZO(B)FLUORANTHENE	<1.0
BENZO(K)FLUORANTHENE	<1.0
BENZO(A)PYRENE	<1.0
DIBENZ(a,h)ANTHRACENE	<5.0
BENZO(g,h,i)PERYLENE	<1.0
INDENO(1,2,3-CD)PYRENE	<1.0

Analytical Technologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678104

TEST : POLYNUCLEAR AROMATICS (EPA 610)

CLIENT	: K.W. BROWN & ASSOCIATES	DATE SAMPLED	: 06/18/90
PROJECT #	: 63724	DATE RECEIVED	: 06/21/90
PROJECT NAME	: EPNG JAL 4	DATE EXTRACTED	: 06/29/90
CLIENT I.D.	: ENSR 2	DATE ANALYZED	: 07/10/90
SAMPLE MATRIX	: AQUEOUS	UNITS	: UG/L
		DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
NAPHTHALENE	200
ACENAPHTHYLENE	<5.0
ACENAPHTHENE	<5.0
FLUORENE	<1.0
PHENANTHRENE	<1.0
ANTHRACENE	<1.0
FLUORANTHENE	<1.0
PYRENE	<1.0
BENZO(A)ANTHRENE	<1.0
CHRYSENE	<1.0
BENZO(B)FLUORANTHENE	<1.0
BENZO(K)FLUORANTHENE	<1.0
BENZO(A)PYRENE	<1.0
DIBENZ(a,h)ANTHRACENE	<5.0
BENZO(g,h,i)PERYLENE	<1.0
INDENO(1,2,3-CD)PYRENE	<1.0

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678105

TEST : POLYNUCLEAR AROMATICS (EPA 610)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/29/90
DATE ANALYZED : 07/11/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
NAPHTHALENE	<5.0
ACENAPHTHYLENE	<5.0
ACENAPHTHENE	<5.0
FLUORENE	<1.0
PHENANTHRENE	<1.0
ANTHRACENE	<1.0
FLUORANTHENE	<1.0
PYRENE	<1.0
BENZO(A)ANTHRENE	<1.0
CHRYSENE	<1.0
BENZO(B)FLUORANTHENE	<1.0
BENZO(K)FLUORANTHENE	<1.0
BENZO(A)PYRENE	<1.0
DIBENZ(a,h)ANTHRACENE	<5.0
BENZO(g,h,i)PERYLENE	<1.0
INDENO(1,2,3-CD)PYRENE	<1.0

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678106

TEST : POLYNUCLEAR AROMATICS (EPA 610)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : EPNG 12
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/29/90
DATE ANALYZED : 07/11/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
NAPHTHALENE	<5.0
ACENAPHTHYLENE	<5.0
ACENAPHTHENE	<5.0
FLUORENE	<1.0
PHENANTHRENE	<1.0
ANTHRACENE	<1.0
FLUORANTHENE	<1.0
PYRENE	<1.0
BENZO(A)ANTHRENE	<1.0
CHRYSENE	<1.0
BENZO(B)FLUORANTHENE	<1.0
BENZO(K)FLUORANTHENE	<1.0
BENZO(A)PYRENE	<1.0
DIBENZ(a,h)ANTHRACENE	<5.0
BENZO(g,h,i)PERYLENE	<1.0
INDENO(1,2,3-CD)PYRENE	<1.0

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678107

TEST : POLYNUCLEAR AROMATICS (EPA 610)

CLIENT	K.W. BROWN & ASSOCIATES	DATE SAMPLED	06/20/90
PROJECT #	63724	DATE RECEIVED	06/21/90
PROJECT NAME	EPNG JAL 4	DATE EXTRACTED	06/29/90
CLIENT I.D.	ENSR 5	DATE ANALYZED	07/11/90
SAMPLE MATRIX	AQUEOUS	UNITS	UG/L
		DILUTION FACTOR	1

COMPOUNDS	RESULTS
NAPHTHALENE	<5.0
ACENAPHTHYLENE	<5.0
ACENAPHTHENE	<5.0
FLUORENE	<1.0
PHENANTHRENE	<1.0
ANTHRACENE	<1.0
FLUORANTHENE	<1.0
PYRENE	<1.0
BENZO(A)ANTHRENE	<1.0
CHRYSENE	<1.0
BENZO(B)FLUORANTHENE	<1.0
BENZO(K)FLUORANTHENE	<1.0
BENZO(A)PYRENE	<1.0
DIBENZ(a,h)ANTHRACENE	<5.0
BENZO(g,h,i)PERYLENE	<1.0
INDENO(1,2,3-CD)PYRENE	<1.0

AnalyticalTechnologies, Inc.

GCMS - RESULTS

REAGENT BLANK

TEST : POLYNUCLEAR AROMATICS (EPA 610)

CLIENT	: K.W. BROWN & ASSOCIATES	ATI I.D.	: 006781
PROJECT #	: 63724	DATE EXTRACTED	: 06/29/90
PROJECT NAME	: EPNG JAL 4	DATE ANALYZED	: 07/10/90
CLIENT I.D.	: REAGENT BLANK	UNITS	: UG/L
		DILUTION FACTOR	: N/A

COMPOUNDS	RESULTS
NAPHTHALENE	<5.0
ACENAPHTHYLENE	<5.0
ACENAPHTHENE	<5.0
FLUORENE	<1.0
PHENANTHRENE	<1.0
ANTHRACENE	<1.0
FLUORANTHENE	<1.0
PYRENE	<1.0
BENZO(A)ANTHRENE	<1.0
CHRYSENE	<1.0
BENZO(B)FLUORANTHENE	<1.0
BENZO(K)FLUORANTHENE	<1.0
BENZO(A)PYRENE	<1.0
DIBENZ(a,h)ANTHRACENE	<5.0
BENZO(g,h,i)PERYLENE	<1.0
INDENO(1,2,3-CD)PYRENE	<1.0

AnalyticalTechnologies, Inc.

QUALITY CONTROL DATA

ATI I.D. : 006781

TEST : POLYNUCLEAR AROMATICS (EPA 610)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
REF I.D. : 00799910

DATE ANALYZED : 07/11/90
SAMPLE MATRIX : AQUEOUS
UNITS : UG/L

COMPOUNDS	SAMPLE RESULT	CONC. SPIKED	SPIKED SAMPLE	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
ACENAPHTHENE	<5.0	90.0	64	71	61	68	5
PYRENE	<1.0	9.12	9.0	99	8.7	95	3

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Spiked Sample Result} - \text{Duplicate Spike Sample Result})}{\text{Average of Spiked Sample}} \times 100$$

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678101

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : EPNG 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/27/90
DATE ANALYZED : 07/06/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<10
PHENOL	<10
ANILINE	<10
BIS(2-CHLOROETHYL)ETHER	<10
2-CHLOROPHENOL	<10
1,3-DICHLOROBENZENE	<10
1,4-DICHLOROBENZENE	<10
BENZYL ALCOHOL	<10
1,2-DICHLOROBENZENE	<10
2-METHYLPHENOL	<10
BIS(2-CHLOROISOPROPYL)ETHER	<10
4-METHYLPHENOL	<10
N-NITROSO-DI-N-PROPYLAMINE	<10
HEXACHLOROETHANE	<10
NITROBENZENE	<10
ISOPHORONE	<10
2-NITROPHENOL	<10
2,4-DIMETHYLPHENOL	<10
BENZOIC ACID	<50
BIS(2-CHLOROETHOXY)METHANE	<10
2,4-DICHLOROPHENOL	<10
1,2,4-TRICHLOROBENZENE	<10
NAPHTHALENE	<10
4-CHLOROANILINE	<10
HEXACHLOROBUTADIENE	<10
4-CHLORO-3-METHYLPHENOL	<10
2-METHYLNAPHTHALENE	<10
HEXACHLOROCYCLOPENTADIENE	<10
2,4,6-TRICHLOROPHENOL	<10
2,4,5-TRICHLOROPHENOL	<50
2-CHLORONAPHTHALENE	<10
2-NITROANILINE	<50
DIMETHYLPHTHALATE	<10
ACENAPHTHYLENE	<10
3-NITROANILINE	<50
ACENAPHTHENE	<10
2,4-DINITROPHENOL	<50
4-NITROPHENOL	<50
DIBENZOFURAN	<10
2,4-DINITROTOLUENE	<10
2,6-DINITROTOLUENE	<10

(CONTINUED NEXT PAGE)

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678101

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

COMPOUNDS	RESULTS
DIETHYLPHTHALATE	<10
4-CHLOROPHENYL-PHENYLETHER	<10
FLUORENE	<10
4-NITROANILINE	<50
4,6-DINITRO-2-METHYLPHENOL	<50
N-NITROSODIPHENYLAMINE	<10
4-BROMOPHENYL-PHENYLETHER	<10
HEXACHLOROBENZENE	<10
PENTACHLOROPHENOL	<50
PHENANTHRENE	<10
ANTHRACENE	<10
DI-N-BUTYLPHTHALATE	<10
FLUORANTHENE	<10
BENZIDINE	<100
PYRENE	<10
BUTYLBENZYLPHTHALATE	<10
3,3'-DICHLOROBENZIDINE	<20
BENZO(a)ANTHRACENE	<10
BIS(2-ETHYLHEXYL)PHTHALATE	<10
CHRYSENE	<10
DI-N-OCTYLPHTHALATE	<10
BENZO(b)FLUORANTHENE	<10
BENZO(k)FLUORANTHENE	<10
BENZO(a)PYRENE	<10
INDENO(1,2,3-cd)PYRENE	<10
DIBENZO(a,h)ANTHRACENE	<10
BENZO(g,h,i)PERYLENE	<10

SURROGATE PERCENT RECOVERIES

NITROBENZENE-D5 (%)	103
2-FLUOROBIPHENYL (%)	85
TERPHENYL (%)	108
PHENOL-D5 (%)	59
2-FLUOROPHENOL (%)	70
2,4,6-TRIBROMOPHENOL (%)	110

Analytical Technologies, Inc.

QUALITY CONTROL DATA

ATI I.D. : 006781

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
REF I.D. : 00799909

DATE ANALYZED : 07/06/90
SAMPLE MATRIX : AQUEOUS
UNITS : UG/L

COMPOUNDS	SAMPLE RESULT	CONC. SPIKED	SPIKED SAMPLE	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
1,2,4-TRICHLOROBENZENE	<10	70	70	100	73	106	6
ACENAPHTHENE	<10	50	54	108	53	106	2
2,4-DINITROTOLUENE	<10	50	58	116	57	114	2
PYRENE	<10	50	62	124	57	114	8
N-NITROSO-DI-N-PROPYLAMINE	<10	50	44	88	50	100	13
1,4-DICHLOROBENZENE	<10	50	37	74	40	80	8
PENTACHLOROPHENOL	<50	100	142	142	130	130	9
PHENOL	<10	100	79	79	73	73	8
2-CHLOROPHENOL	<10	100	88	88	81	81	8
4-CHLORO-3-METHYLPHENOL	<10	100	80	80	72	72	11
4-NITROPHENOL	<50	100	123	123	108	108	13

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Spiked Sample Result} - \text{Duplicate Spike Sample Result})}{\text{Average of Spiked Sample}} \times 100$$

TR - Compound detected at an unquantifiable trace level

AnalyticalTechnologies, Inc.

QUALITY CONTROL DATA

ATI I.D. : 006781

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT	: K.W. BROWN & ASSOCIATES		
PROJECT #	: 63724	DATE ANALYZED	: 06/29/90
PROJECT NAME	: EPNG JAL 4	SAMPLE MATRIX	: AQUEOUS
REF I.D.	: 00799901	UNITS	: UG/L

COMPOUNDS	SAMPLE RESULT	CONC. SPIKED	SPIKED SAMPLE	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
1,2,4-TRICHLOROBENZENE	<10	70	61	61	61	61	0
ACENAPHTHENE	<10	50	46	92	42	84	9
2,4-DINITROTOLUENE	<10	50	41	82	36	72	13
PYRENE	<10	50	51	102	45	90	13
N-NITROSO-DI-N-PROPYLAMINE	<10	50	43	86	44	88	2
1,4-DICHLOROBENZENE	<10	50	37	74	37	74	0
PENTACHLOROPHENOL	<50	100	106	106	93	93	13
PHENOL	<10	100	77	77	82	82	6
2-CHLOROPHENOL	<10	100	80	80	84	84	5
4-CHLORO-3-METHYLPHENOL	<10	100	72	72	74	74	3
4-NITROPHENOL	<50	100	96	96	79	79	19

$$\text{\% Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Spiked Sample Result} - \text{Duplicate Spike Sample Result})}{\text{Average of Spiked Sample}} \times 100$$

AnalyticalTechnologies,Inc.
Phoenix, Arizona

Chain of Custody

DATE 6/20/90 PAGE 1 OF 1

PROJECT MANAGER: SID JOHNSON

COMPANY: K.W. BROWN
ADDRESS: 6 A GRAHAM RD
COLLEGE STATION, TX 77845

BILL TO: ~~[illegible]~~ K.W. BROWN
COMPANY: 6 Graham Rd.
ADDRESS: College Station, TX 77845

Ernest Hudson
SAMPLERS: (Signature)

(409) 690-9280
PHONE NUMBER

ANALYSIS REQUEST

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	Petroleum Hydrocarbons (418.1) 2.	Phenols 604 5.	(MOD 8015) Gas/Diesel	Diesel/Gasoline/BTXE (MOD 8015/8020)	BTXE (8020) 602 4.	Chlorinated Hydrocarbons (601/8010)	Aromatic Hydrocarbons (602/8020)	MTBE		~~Pesticides~~/PCB (608/8080) 6.	Herbicides (615/8150)	Dioxin 2,4,7,8 (625) 8.		Base/Neutral/Acid Compounds GC/MS (625/8270)	Volatile Organics GC/MS (624/8240)	PNAs (610) 7.	Trip Blank		SDWA Primary Standards	SDWA Secondary Standards	SDWA Volatiles (502.1/503.1)		The 13 Priority Pollutant Metals	The 8 EP Tox Metals by EP Tox Prep. (1310) "	The 8 EP Tox Metals by Total Digestion	The 8 EP Tox Metals by TCLP	METALS (Ca, Mg, Na, K) 1.	Cl, SO4, HCO3, pH, EC 3.	NUMBER OF CONTAINERS
EPNG 1	6/19		Water	1	X	X			X					X		X				X	X										X	X	14
ENSR 4	6/19		"	2	1	2			2					2		2				2	1										1	1	14
ENSR3	6/18		"	3	1	2			2					2		2				2	1										1	1	14
ENSR 2	6/18		"	4	1	2			2					2		2				2	1										1	1	14
ENSR1	6/19		"	5	1	2			2					2		1				2	1										1	1	13
EPNG 12	6/18		"	6	1	2			2					2		2				2	1										1	1	14
ENSR5	6/20		"	7	1	2			2					2		2				2	1										1	1	14
TRIP BLANK				8					✓																								

PROJECT INFORMATION

PROJECT NO.: ~~[illegible]~~ 63724
PROJECT NAME: EPNG Jal 4
P.O. NO.: 36925
VIA:
TAT: ☐ 24HR ☐ 48 HRS ☐ 1 WK ☐ 2 WKS

SAMPLE RECEIPT

TOTAL NO. OF CONTAINERS	97
CHAIN OF CUSTODY SEALS	N
INTACT?	Y
RECEIVED GOOD COND./COLD	Y
LAB NUMBER	006781

SAMPLE DISPOSAL INSTRUCTIONS

☒ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup (will call)

Comments: PQ # 330-020
1 Bottle broken ENSR5 - 608 (PCB)
2 Bottles " ~~[illegible]~~ Epng 1 - 625

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: SH Johnson Time: 10:30	Signature: Time:	Signature: Time:
Printed Name: SH Johnson Date 6/20/90	Printed Name: Date	Printed Name: Date
Company: KWB&A	Company:	Company:

RECEIVED BY: 1.	RECEIVED BY: 2.	RECEIVED BY: (LAB) 3.
Signature: Time:	Signature: Time:	Signature: Time: 12:00
Printed Name: Date:	Printed Name: Date:	Printed Name: Linda Eshelman Date: 6-21-90
Company:	Company:	Analytical Technologies, Inc.

ATI Labs: San Diego (619)458-9141 • Phoenix (602)438-1530 • Seattle (206)228-8335 • Pensacola (904)474-1001 DISTRIBUTION: White, Canary - ANALYTICAL TECHNOLOGIES, INC.• Pink - ORIGINATOR

APPENDIX B

Survey Data

ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

ATI I.D. : 00678101

COMPOUNDS	RESULTS
CAPROLACTAM	200
HEXADECANOIC ACID	20
OCTADECANOIC ACID	20

Analytical **Technologies**, Inc.

GCMS - RESULTS

ATI I.D. : 00678101

TEST : DIOXIN (2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN) EPA 625 SCREEN

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : EPNG 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 07/05/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
2,3,7,8-TETRACHLORO-DIBENZO-DIOXIN	NEG
2,3,7,8-TETRACHLORO-DIBENZO-FURAN	NEG

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678102

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 4
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/27/90
DATE ANALYZED : 06/29/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<10
PHENOL	<10
ANILINE	<10
BIS(2-CHLOROETHYL)ETHER	<10
2-CHLOROPHENOL	<10
1,3-DICHLOROBENZENE	<10
1,4-DICHLOROBENZENE	<10
BENZYL ALCOHOL	<10
1,2-DICHLOROBENZENE	13
2-METHYLPHENOL	<10
BIS(2-CHLOROISOPROPYL)ETHER	<10
4-METHYLPHENOL	<10
N-NITROSO-DI-N-PROPYLAMINE	<10
HEXACHLOROETHANE	<10
NITROBENZENE	<10
ISOPHORONE	<10
2-NITROPHENOL	<10
2,4-DIMETHYLPHENOL	54
BENZOIC ACID	<50
BIS(2-CHLOROETHOXY)METHANE	<10
2,4-DICHLOROPHENOL	<10
1,2,4-TRICHLOROBENZENE	<10
NAPHTHALENE	<10
4-CHLOROANILINE	<10
HEXACHLOROBUTADIENE	<10
4-CHLORO-3-METHYLPHENOL	<10
2-METHYLNAPHTHALENE	TR
HEXACHLOROCYCLOPENTADIENE	<10
2,4,6-TRICHLOROPHENOL	<10
2,4,5-TRICHLOROPHENOL	<50
2-CHLORONAPHTHALENE	<10
2-NITROANILINE	<50
DIMETHYLPHTHALATE	<10
ACENAPHTHYLENE	<10
3-NITROANILINE	<50
ACENAPHTHENE	<10
2,4-DINITROPHENOL	<50
4-NITROPHENOL	<50
DIBENZOFURAN	<10
2,4-DINITROTOLUENE	<10
2,6-DINITROTOLUENE	<10

TR - Compound detected at an unquantifiable trace level

Analytical Technologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678102

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

COMPOUNDS	RESULTS
DIETHYLPHTHALATE	<10
4-CHLOROPHENYL-PHENYLETHER	<10
FLUORENE	<10
4-NITROANILINE	<50
4,6-DINITRO-2-METHYLPHENOL	<50
N-NITROSODIPHENYLAMINE	<10
4-BROMOPHENYL-PHENYLETHER	<10
HEXACHLOROBENZENE	<10
PENTACHLOROPHENOL	<50
PHENANTHRENE	<10
ANTHRACENE	<10
DI-N-BUTYLPHTHALATE	<10
FLUORANTHENE	<10
BENZIDINE	<100
PYRENE	<10
BUTYLBENZYLPHTHALATE	<10
3,3'-DICHLOROBENZIDINE	<20
BENZO(a)ANTHRACENE	<10
BIS(2-ETHYLHEXYL)PHTHALATE	<10
CHRYSENE	<10
DI-N-OCTYLPHTHALATE	<10
BENZO(b)FLUORANTHENE	<10
BENZO(k)FLUORANTHENE	<10
BENZO(a)PYRENE	<10
INDENO(1,2,3-cd)PYRENE	<10
DIBENZO(a,h)ANTHRACENE	<10
BENZO(g,h,i)PERYLENE	<10

SURROGATE PERCENT RECOVERIES

NITROBENZENE-D5 (%)	58
2-FLUOROBIPHENYL (%)	46
TERPHENYL (%)	42
PHENOL-D5 (%)	44
2-FLUOROPHENOL (%)	41
2,4,6-TRIBROMOPHENOL (%)	60

ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

ATI I.D. : 00678102

COMPOUNDS	RESULTS
OCTANOIC ACID	50
CAPROLACTAM	100
DIMETHYL-NAPHTHALENES	40
DODECANOIC ACID	50
TETRADECANOIC ACID	20
HEXADECANOIC ACID	20
DODECANOIC ACID, ETHENYL ESTER	30

GCMS - RESULTS

ATI I.D. : 00678102

TEST : DIOXIN (2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN) EPA 625 SCREEN

CLIENT	K.W. BROWN & ASSOCIATES	DATE SAMPLED	06/19/90
PROJECT #	63724	DATE RECEIVED	06/21/90
PROJECT NAME	EPNG JAL 4	DATE EXTRACTED	N/A
CLIENT I.D.	ENSR 4	DATE ANALYZED	07/05/90
SAMPLE MATRIX	AQUEOUS	UNITS	UG/L
		DILUTION FACTOR	1

COMPOUNDS	RESULTS
2,3,7,8-TETRACHLORO-DIBENZO-DIOXIN	NEG
2,3,7,8-TETRACHLORO-DIBENZO-FURAN	NEG

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678103

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 3
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/27/90
DATE ANALYZED : 06/29/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<10
PHENOL	<10
ANILINE	<10
BIS(2-CHLOROETHYL)ETHER	<10
2-CHLOROPHENOL	<10
1,3-DICHLOROBENZENE	<10
1,4-DICHLOROBENZENE	<10
BENZYL ALCOHOL	<10
1,2-DICHLOROBENZENE	<10
2-METHYLPHENOL	<10
BIS(2-CHLOROISOPROPYL)ETHER	<10
4-METHYLPHENOL	<10
N-NITROSO-DI-N-PROPYLAMINE	<10
HEXACHLOROETHANE	<10
NITROBENZENE	<10
ISOPHORONE	<10
2-NITROPHENOL	<10
2,4-DIMETHYLPHENOL	<10
BENZOIC ACID	<50
BIS(2-CHLOROETHOXY)METHANE	<10
2,4-DICHLOROPHENOL	<10
1,2,4-TRICHLOROBENZENE	<10
NAPHTHALENE	<10
4-CHLOROANILINE	<10
HEXACHLOROBUTADIENE	<10
4-CHLORO-3-METHYLPHENOL	<10
2-METHYLNAPHTHALENE	<10
HEXACHLOROCYCLOPENTADIENE	<10
2,4,6-TRICHLOROPHENOL	<10
2,4,5-TRICHLOROPHENOL	<50
2-CHLORONAPHTHALENE	<10
2-NITROANILINE	<50
DIMETHYLPHTHALATE	<10
ACENAPHTHYLENE	<10
3-NITROANILINE	<50
ACENAPHTHENE	<10
2,4-DINITROPHENOL	<50
4-NITROPHENOL	<50
DIBENZOFURAN	<10
2,4-DINITROTOLUENE	<10
2,6-DINITROTOLUENE	<10

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GCMS - RESULTS

ATI I.D. : 00678103

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

COMPOUNDS	RESULTS
DIETHYLPHTHALATE	<10
4-CHLOROPHENYL-PHENYLETHER	<10
FLUORENE	<10
4-NITROANILINE	<50
4,6-DINITRO-2-METHYLPHENOL	<50
N-NITROSODIPHENYLAMINE	<10
4-BROMOPHENYL-PHENYLETHER	<10
HEXACHLOROBENZENE	<10
PENTACHLOROPHENOL	16
PHENANTHRENE	<10
ANTHRACENE	<10
DI-N-BUTYLPHTHALATE	<10
FLUORANTHENE	<10
BENZIDINE	<100
PYRENE	<10
BUTYLBENZYLPHTHALATE	<10
3,3'-DICHLOROBENZIDINE	<20
BENZO(a)ANTHRACENE	<10
BIS(2-ETHYLHEXYL)PHTHALATE	190
CHRYSENE	<10
DI-N-OCTYLPHTHALATE	<10
BENZO(b)FLUORANTHENE	<10
BENZO(k)FLUORANTHENE	<10
BENZO(a)PYRENE	<10
INDENO(1,2,3-cd)PYRENE	<10
DIBENZO(a,h)ANTHRACENE	<10
BENZO(g,h,i)PERYLENE	<10

SURROGATE PERCENT RECOVERIES

NITROBENZENE-D5 (%)	88
2-FLUOROBIPHENYL (%)	73
TERPHENYL (%)	73
PHENOL-D5 (%)	6
2-FLUOROPHENOL (%)	35
2,4,6-TRIBROMOPHENOL (%)	51

ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

ATI I.D. : 00678103

COMPOUNDS	RESULTS
OXYGENATED HYDROCARBONS C5	100
DECANOIC ACID	50
DODECANOIC ACID	80
TETRADECANOIC ACID	30
HEXADECANOIC ACID	30
METHYLATED HYDROCARBON C13	30

Analytical **Technologies,** Inc.

GCMS - RESULTS

ATI I.D. : 00678103

TEST : DIOXIN (2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN) EPA 625 SCREEN

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 3
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 07/05/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
2,3,7,8-TETRACHLORO-DIBENZO-DIOXIN	NEG
2,3,7,8-TETRACHLORO-DIBENZO-FURAN	NEG

Analytical **Technologies**, Inc.

GCMS - RESULTS

ATI I.D. : 00678104

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 2
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/27/90
DATE ANALYZED : 06/29/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<10
PHENOL	430
ANILINE	<10
BIS(2-CHLOROETHYL)ETHER	<10
2-CHLOROPHENOL	<10
1,3-DICHLOROBENZENE	<10
1,4-DICHLOROBENZENE	<10
BENZYL ALCOHOL	<10
1,2-DICHLOROBENZENE	<10
2-METHYLPHENOL	14
BIS(2-CHLOROISOPROPYL)ETHER	<10
4-METHYLPHENOL	22
N-NITROSO-DI-N-PROPYLAMINE	<10
HEXACHLOROETHANE	<10
NITROBENZENE	<10
ISOPHORONE	<10
2-NITROPHENOL	<10
2,4-DIMETHYLPHENOL	<10
BENZOIC ACID	<50
BIS(2-CHLOROETHOXY)METHANE	<10
2,4-DICHLOROPHENOL	<10
1,2,4-TRICHLOROBENZENE	<10
NAPHTHALENE	<10
4-CHLOROANILINE	<10
HEXACHLOROBUTADIENE	<10
4-CHLORO-3-METHYLPHENOL	<10
2-METHYLNAPHTHALENE	<10
HEXACHLOROCYCLOPENTADIENE	<10
2,4,6-TRICHLOROPHENOL	<10
2,4,5-TRICHLOROPHENOL	<50
2-CHLORONAPHTHALENE	<10
2-NITROANILINE	<50
DIMETHYLPHTHALATE	<10
ACENAPHTHYLENE	<10
3-NITROANILINE	<50
ACENAPHTHENE	<10
2,4-DINITROPHENOL	<50
4-NITROPHENOL	<50
DIBENZOFURAN	<10
2,4-DINITROTOLUENE	<10
2,6-DINITROTOLUENE	<10

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GCMS - RESULTS

ATI I.D. : 00678104

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

COMPOUNDS	RESULTS
DIETHYLPHTHALATE	<10
4-CHLOROPHENYL-PHENYLETHER	<10
FLUORENE	TR
4-NITROANILINE	<50
4,6-DINITRO-2-METHYLPHENOL	<50
N-NITROSODIPHENYLAMINE	<10
4-BROMOPHENYL-PHENYLETHER	<10
HEXACHLOROBENZENE	<10
PENTACHLOROPHENOL	55
PHENANTHRENE	<10
ANTHRACENE	<10
DI-N-BUTYLPHTHALATE	<10
FLUORANTHENE	<10
BENZIDINE	<100
PYRENE	<10
BUTYLBENZYLPHTHALATE	<10
3,3'-DICHLOROBENZIDINE	<20
BENZO(a)ANTHRACENE	<10
BIS(2-ETHYLHEXYL)PHTHALATE	<10
CHRYSENE	<10
DI-N-OCTYLPHTHALATE	<10
BENZO(b)FLUORANTHENE	<10
BENZO(k)FLUORANTHENE	<10
BENZO(a)PYRENE	<10
INDENO(1,2,3-cd)PYRENE	<10
DIBENZO(a,h)ANTHRACENE	<10
BENZO(g,h,i)PERYLENE	<10

SURROGATE PERCENT RECOVERIES

NITROBENZENE-D5 (%)	81
2-FLUOROBIPHENYL (%)	74
TERPHENYL (%)	70
PHENOL-D5 (%)	73
2-FLUOROPHENOL (%)	64
2,4,6-TRIBROMOPHENOL (%)	76

TR - Compound detected at an unquantifiable trace level

ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

ATI I.D. : 00678104

COMPOUNDS	RESULTS
DIETHYL-DISULFIDE	3000
OCTANOIC ACID	100
DODECANOIC ACID	400
TETRADECANOIC ACID	200
DECANOIC ACID	70
TOTAL EXTRACTABLE HYDROCARBONS C10-C14	20000

Analytical**Technologies**, Inc.

GCMS - RESULTS

ATI I.D. : 00678104

TEST : DIOXIN (2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN) EPA 625 SCREEN

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 2
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : N/A
DATE ANALYZED : 07/05/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
2,3,7,8-TETRACHLORO-DIBENZO-DIOXIN	NEG
2,3,7,8-TETRACHLORO-DIBENZO-FURAN	NEG

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678105

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 1
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/19/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/27/90
DATE ANALYZED : 06/29/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<10
PHENOL	<10
ANILINE	<10
BIS(2-CHLOROETHYL)ETHER	<10
2-CHLOROPHENOL	<10
1,3-DICHLOROBENZENE	<10
1,4-DICHLOROBENZENE	<10
BENZYL ALCOHOL	<10
1,2-DICHLOROBENZENE	16
2-METHYLPHENOL	<10
BIS(2-CHLOROISOPROPYL)ETHER	<10
4-METHYLPHENOL	<10
N-NITROSO-DI-N-PROPYLAMINE	<10
HEXACHLOROETHANE	<10
NITROBENZENE	<10
ISOPHORONE	<10
2-NITROPHENOL	<10
2,4-DIMETHYLPHENOL	<10
BENZOIC ACID	<50
BIS(2-CHLOROETHOXY)METHANE	<10
2,4-DICHLOROPHENOL	<10
1,2,4-TRICHLOROBENZENE	<10
NAPHTHALENE	<10
4-CHLOROANILINE	<10
HEXACHLOROBUTADIENE	<10
4-CHLORO-3-METHYLPHENOL	<10
2-METHYLNAPHTHALENE	10
HEXACHLOROCYCLOPENTADIENE	<10
2,4,6-TRICHLOROPHENOL	<10
2,4,5-TRICHLOROPHENOL	<50
2-CHLORONAPHTHALENE	<10
2-NITROANILINE	<50
DIMETHYLPHTHALATE	<10
ACENAPHTHYLENE	<10
3-NITROANILINE	<50
ACENAPHTHENE	<10
2,4-DINITROPHENOL	<50
4-NITROPHENOL	<50
DIBENZOFURAN	<10
2,4-DINITROTOLUENE	<10
2,6-DINITROTOLUENE	<10

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AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678105

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

COMPOUNDS	RESULTS
DIETHYLPHTHALATE	<10
4-CHLOROPHENYL-PHENYLETHER	<10
FLUORENE	<10
4-NITROANILINE	<50
4,6-DINITRO-2-METHYLPHENOL	<50
N-NITROSODIPHENYLAMINE	<10
4-BROMOPHENYL-PHENYLETHER	<10
HEXACHLOROBENZENE	<10
PENTACHLOROPHENOL	<50
PHENANTHRENE	<10
ANTHRACENE	<10
DI-N-BUTYLPHTHALATE	<10
FLUORANTHENE	<10
BENZIDINE	<100
PYRENE	<10
BUTYLBENZYLPHTHALATE	<10
3,3'-DICHLOROBENZIDINE	<20
BENZO(a)ANTHRACENE	<10
BIS(2-ETHYLHEXYL)PHTHALATE	<10
CHRYSENE	<10
DI-N-OCTYLPHTHALATE	<10
BENZO(b)FLUORANTHENE	<10
BENZO(k)FLUORANTHENE	<10
BENZO(a)PYRENE	<10
INDENO(1,2,3-cd)PYRENE	<10
DIBENZO(a,h)ANTHRACENE	<10
BENZO(g,h,i)PERYLENE	<10

SURROGATE PERCENT RECOVERIES

NITROBENZENE-D5 (%)	72
2-FLUOROBIPHENYL (%)	56
TERPHENYL (%)	48
PHENOL-D5 (%)	47
2-FLUOROPHENOL (%)	43
2,4,6-TRIBROMOPHENOL (%)	60

ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

ATI I.D. : 00678105

COMPOUNDS	RESULTS
DIMETHYL PHENOL	60
DIMETHYL-NAPHTHALENES	100
DODECANOIC ACID, ETHENYL ESTER	50
DODECANOIC ACID	20

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678105

TEST : DIOXIN (2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN) EPA 625 SCREEN

CLIENT	: K.W. BROWN & ASSOCIATES	DATE SAMPLED	: 06/19/90
PROJECT #	: 63724	DATE RECEIVED	: 06/21/90
PROJECT NAME	: EPNG JAL 4	DATE EXTRACTED	: N/A
CLIENT I.D.	: ENSR 1	DATE ANALYZED	: 07/05/90
SAMPLE MATRIX	: AQUEOUS	UNITS	: UG/L
		DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
2,3,7,8-TETRACHLORO-DIBENZO-DIOXIN	NEG
2,3,7,8-TETRACHLORO-DIBENZO-FURAN	NEG

GCMS - RESULTS

ATI I.D. : 00678106

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : EPNG 12
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/18/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/27/90
DATE ANALYZED : 06/29/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<10
PHENOL	<10
ANILINE	<10
BIS(2-CHLOROETHYL)ETHER	<10
2-CHLOROPHENOL	<10
1,3-DICHLOROBENZENE	<10
1,4-DICHLOROBENZENE	<10
BENZYL ALCOHOL	<10
1,2-DICHLOROBENZENE	<10
2-METHYLPHENOL	<10
BIS(2-CHLOROISOPROPYL)ETHER	<10
4-METHYLPHENOL	<10
N-NITROSO-DI-N-PROPYLAMINE	<10
HEXACHLOROETHANE	<10
NITROBENZENE	<10
ISOPHORONE	<10
2-NITROPHENOL	<10
2,4-DIMETHYLPHENOL	<10
BENZOIC ACID	<50
BIS(2-CHLOROETHOXY)METHANE	<10
2,4-DICHLOROPHENOL	<10
1,2,4-TRICHLOROBENZENE	<10
NAPHTHALENE	<10
4-CHLOROANILINE	<10
HEXACHLOROBUTADIENE	<10
4-CHLORO-3-METHYLPHENOL	<10
2-METHYLNAPHTHALENE	<10
HEXACHLOROCYCLOPENTADIENE	<10
2,4,6-TRICHLOROPHENOL	<10
2,4,5-TRICHLOROPHENOL	<50
2-CHLORONAPHTHALENE	<10
2-NITROANILINE	<50
DIMETHYLPHTHALATE	<10
ACENAPHTHYLENE	<10
3-NITROANILINE	<50
ACENAPHTHENE	<10
2,4-DINITROPHENOL	<50
4-NITROPHENOL	<50
DIBENZOFURAN	<10
2,4-DINITROTOLUENE	<10
2,6-DINITROTOLUENE	<10

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Analytical**Technologies**, Inc.

GCMS - RESULTS

ATI I.D. : 00678106

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

COMPOUNDS	RESULTS
DIETHYLPHTHALATE	<10
4-CHLOROPHENYL-PHENYLETHER	<10
FLUORENE	<10
4-NITROANILINE	<50
4,6-DINITRO-2-METHYLPHENOL	<50
N-NITROSODIPHENYLAMINE	<10
4-BROMOPHENYL-PHENYLETHER	<10
HEXACHLOROBENZENE	<10
PENTACHLOROPHENOL	<50
PHENANTHRENE	<10
ANTHRACENE	<10
DI-N-BUTYLPHTHALATE	<10
FLUORANTHENE	<10
BENZIDINE	<100
PYRENE	<10
BUTYLBENZYLPHTHALATE	<10
3,3'-DICHLOROBENZIDINE	<20
BENZO(a)ANTHRACENE	<10
BIS(2-ETHYLHEXYL)PHTHALATE	<10
CHRYSENE	<10
DI-N-OCTYLPHTHALATE	<10
BENZO(b)FLUORANTHENE	<10
BENZO(k)FLUORANTHENE	<10
BENZO(a)PYRENE	<10
INDENO(1,2,3-cd)PYRENE	<10
DIBENZO(a,h)ANTHRACENE	<10
BENZO(g,h,i)PERYLENE	<10

SURROGATE PERCENT RECOVERIES

NITROBENZENE-D5 (%)	85
2-FLUOROBIPHENYL (%)	75
TERPHENYL (%)	82
PHENOL-D5 (%)	30
2-FLUOROPHENOL (%)	69
2,4,6-TRIBROMOPHENOL (%)	68

ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

ATI I.D. : 00678106

COMPOUNDS	RESULTS
KETONES C7	30
OXYGENATED HYDROCARBONS C5	60

AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678106

TEST : DIOXIN (2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN) EPA 625 SCREEN

CLIENT	: K.W. BROWN & ASSOCIATES	DATE SAMPLED	: 06/18/90
PROJECT #	: 63724	DATE RECEIVED	: 06/21/90
PROJECT NAME	: EPNG JAL 4	DATE EXTRACTED	: N/A
CLIENT I.D.	: EPNG 12	DATE ANALYZED	: 07/05/90
SAMPLE MATRIX	: AQUEOUS	UNITS	: UG/L
		DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
2,3,7,8-TETRACHLORO-DIBENZO-DIOXIN	NEG
2,3,7,8-TETRACHLORO-DIBENZO-FURAN	NEG

Analytical**Technologies,** Inc.

GCMS - RESULTS

ATI I.D. : 00678107

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT : K.W. BROWN & ASSOCIATES
PROJECT # : 63724
PROJECT NAME : EPNG JAL 4
CLIENT I.D. : ENSR 5
SAMPLE MATRIX : AQUEOUS

DATE SAMPLED : 06/20/90
DATE RECEIVED : 06/21/90
DATE EXTRACTED : 06/27/90
DATE ANALYZED : 07/02/90
UNITS : UG/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<10
PHENOL	<10
ANILINE	<10
BIS(2-CHLOROETHYL)ETHER	<10
2-CHLOROPHENOL	<10
1,3-DICHLOROBENZENE	<10
1,4-DICHLOROBENZENE	<10
BENZYL ALCOHOL	<10
1,2-DICHLOROBENZENE	<10
2-METHYLPHENOL	<10
BIS(2-CHLOROISOPROPYL)ETHER	<10
4-METHYLPHENOL	<10
N-NITROSO-DI-N-PROPYLAMINE	<10
HEXACHLOROETHANE	<10
NITROBENZENE	<10
ISOPHORONE	<10
2-NITROPHENOL	<10
2,4-DIMETHYLPHENOL	<10
BENZOIC ACID	<50
BIS(2-CHLOROETHOXY)METHANE	<10
2,4-DICHLOROPHENOL	<10
1,2,4-TRICHLOROBENZENE	<10
NAPHTHALENE	<10
4-CHLOROANILINE	<10
HEXACHLOROBUTADIENE	<10
4-CHLORO-3-METHYLPHENOL	<10
2-METHYLNAPHTHALENE	<10
HEXACHLOROCYCLOPENTADIENE	<10
2,4,6-TRICHLOROPHENOL	<10
2,4,5-TRICHLOROPHENOL	<50
2-CHLORONAPHTHALENE	<10
2-NITROANILINE	<50
DIMETHYLPHTHALATE	<10
ACENAPHTHYLENE	<10
3-NITROANILINE	<50
ACENAPHTHENE	<10
2,4-DINITROPHENOL	<50
4-NITROPHENOL	<50
DIBENZOFURAN	<10
2,4-DINITROTOLUENE	<10
2,6-DINITROTOLUENE	<10

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AnalyticalTechnologies, Inc.

GCMS - RESULTS

ATI I.D. : 00678107

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

COMPOUNDS	RESULTS
DIETHYLPHTHALATE	<10
4-CHLOROPHENYL-PHENYLETHER	<10
FLUORENE	<10
4-NITROANILINE	<50
4,6-DINITRO-2-METHYLPHENOL	<50
N-NITROSODIPHENYLAMINE	<10
4-BROMOPHENYL-PHENYLETHER	<10
HEXACHLOROBENZENE	<10
PENTACHLOROPHENOL	<50
PHENANTHRENE	<10
ANTHRACENE	<10
DI-N-BUTYLPHTHALATE	<10
FLUORANTHENE	<10
BENZIDINE	<100
PYRENE	<10
BUTYLBENZYLPHTHALATE	<10
3,3'-DICHLOROBENZIDINE	<20
BENZO(a)ANTHRACENE	<10
BIS(2-ETHYLHEXYL)PHTHALATE	<10
CHRYSENE	<10
DI-N-OCTYLPHTHALATE	<10
BENZO(b)FLUORANTHENE	<10
BENZO(k)FLUORANTHENE	<10
BENZO(a)PYRENE	<10
INDENO(1,2,3-cd)PYRENE	<10
DIBENZO(a,h)ANTHRACENE	<10
BENZO(g,h,i)PERYLENE	<10

SURROGATE PERCENT RECOVERIES

NITROBENZENE-D5 (%)	110
2-FLUOROBIPHENYL (%)	96
TERPHENYL (%)	83
PHENOL-D5 (%)	92
2-FLUOROPHENOL (%)	72
2,4,6-TRIBROMOPHENOL (%)	50

ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

ATI I.D. : 00678107

COMPOUNDS	RESULTS
NO ADDITIONAL COMPOUNDS	<20

GCMS - RESULTS

ATI I.D. : 00678107

TEST : DIOXIN (2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN) EPA 625 SCREEN

CLIENT	: K.W. BROWN & ASSOCIATES	DATE SAMPLED	: 06/20/90
PROJECT #	: 63724	DATE RECEIVED	: 06/21/90
PROJECT NAME	: EPNG JAL 4	DATE EXTRACTED	: N/A
CLIENT I.D.	: ENSR 5	DATE ANALYZED	: 07/05/90
SAMPLE MATRIX	: AQUEOUS	UNITS	: UG/L
		DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
2,3,7,8-TETRACHLORO-DIBENZO-DIOXIN	NEG
2,3,7,8-TETRACHLORO-DIBENZO-FURAN	NEG

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GCMS - RESULTS

REAGENT BLANK

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

CLIENT	: K.W. BROWN & ASSOCIATES	ATI I.D.	: 006781
PROJECT #	: 63724	DATE EXTRACTED	: 06/27/90
PROJECT NAME	: EPNG JAL 4	DATE ANALYZED	: 06/29/90
CLIENT I.D.	: REAGENT BLANK	UNITS	: UG/L
		DILUTION FACTOR	: N/A

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<10
PHENOL	<10
ANILINE	<10
BIS(2-CHLOROETHYL)ETHER	<10
2-CHLOROPHENOL	<10
1,3-DICHLOROBENZENE	<10
1,4-DICHLOROBENZENE	<10
BENZYL ALCOHOL	<10
1,2-DICHLOROBENZENE	<10
2-METHYLPHENOL	<10
BIS(2-CHLOROISOPROPYL)ETHER	<10
4-METHYLPHENOL	<10
N-NITROSO-DI-N-PROPYLAMINE	<10
HEXACHLOROETHANE	<10
NITROBENZENE	<10
ISOPHORONE	<10
2-NITROPHENOL	<10
2,4-DIMETHYLPHENOL	<10
BENZOIC ACID	<50
BIS(2-CHLOROETHOXY)METHANE	<10
2,4-DICHLOROPHENOL	<10
1,2,4-TRICHLOROBENZENE	<10
NAPHTHALENE	<10
4-CHLOROANILINE	<10
HEXACHLOROBUTADIENE	<10
4-CHLORO-3-METHYLPHENOL	<10
2-METHYLNAPHTHALENE	<10
HEXACHLOROCYCLOPENTADIENE	<10
2,4,6-TRICHLOROPHENOL	<10
2,4,5-TRICHLOROPHENOL	<50
2-CHLORONAPHTHALENE	<10
2-NITROANILINE	<50
DIMETHYLPHTHALATE	<10
ACENAPHTHYLENE	<10
3-NITROANILINE	<50
ACENAPHTHENE	<10
2,4-DINITROPHENOL	<50
4-NITROPHENOL	<50
DIBENZOFURAN	<10
2,4-DINITROTOLUENE	<10
2,6-DINITROTOLUENE	<10
DIETHYLPHTHALATE	<10
4-CHLOROPHENYL-PHENYLETHER	<10

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AnalyticalTechnologies, Inc.

GCMS - RESULTS

REAGENT BLANK

ATI I.D. : 006781

TEST : SEMI-VOLATILE ORGANICS (EPA 625)

COMPOUNDS	RESULTS
FLUORENE	<10
4-NITROANILINE	<50
4,6-DINITRO-2-METHYLPHENOL	<50
N-NITROSODIPHENYLAMINE	<10
4-BROMOPHENYL-PHENYLETHER	<10
HEXACHLOROBENZENE	<10
PENTACHLOROPHENOL	<50
PHENANTHRENE	<10
ANTHRACENE	<10
DI-N-BUTYLPHTHALATE	<10
FLUORANTHENE	<10
BENZIDINE	<100
PYRENE	<10
BUTYLBENZYLPHTHALATE	<10
3,3'-DICHLOROBENZIDINE	<20
BENZO(a)ANTHRACENE	<10
BIS(2-ETHYLHEXYL)PHTHALATE	TR
CHRYSENE	<10
DI-N-OCTYLPHTHALATE	<10
BENZO(b)FLUORANTHENE	<10
BENZO(k)FLUORANTHENE	<10
BENZO(a)PYRENE	<10
INDENO(1,2,3-cd)PYRENE	<10
DIBENZO(a,h)ANTHRACENE	<10
BENZO(g,h,i)PERYLENE	<10

SURROGATE PERCENT RECOVERIES

NITROBENZENE-D5 (%)	84
2-FLUOROBIPHENYL (%)	76
TERPHENYL (%)	80
PHENOL-D5 (%)	49
2-FLUOROPHENOL (%)	74
2,4,6-TRIBROMOPHENOL (%)	78