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REPORTS

DATE:

Aug. 29, 1994

WORK PLAN/CLOSURE PLAN FOR ATOKA 1 COMPRESSOR STATION EDDY COUNTY, NEW MEXICO

TRANSWESTERN PIPELINE COMPANY

AUGUST 29, 1994

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Use or disclosure of data contained on this sheet is subject to the restriction specified at the beginning of this document.

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CHAPTER 1

INTRODUCTION

Transwestern Pipeline Company (Transwestern) operates the Atoka 1 Compressor Station in Eddy County, New Mexico (Figure 1). The facility covers approximately two acres and is located at Section 1, Township 18 South, Range 27 East. In a letter dated June 1, 1994, the New Mexico Oil Conservation Division (NMOCD) requested Transwestern to submit the following:

1) A work plan to complete the definition of the extent of soil and ground water contamination related to Transwestern's activities,

2) A closure plan for the formerly used concrete lined surface impoundment.

This Work Plan/Closure Plan was prepared for Transwestern to address the request made by the NMOCD. Prior to commencing work, all necessary permits will be acquired, and approval of the Work Plan/Closure Plan will be obtained from the NMODC. Work will commence within 30 days upon NMODC approval of this Work Plan/Closure Plan and right of access from the Bureau of Land Management (BLM).

Proposed Scope of Work

This Work Plan/Closure Plan was completed to perform the installation of five soil borings/monitor wells and the closure of a former concrete lined surface impoundment. The field methods used during the borehole/monitor well installation and the surface impoundment closure are discussed. A project schedule for the activities and the timely submittal of a report documenting the investigation and closure activities are included.

Project Objectives

The objectives of this project are to:

1) determine the vertical and horizontal extent of impacted soil and ground water on and adjacent to the Atoka 1 facility,

2) close the former concrete lined surface impoundment, and

3) collect soil and ground water data to select a remediation/closure alternative for impacted soil and ground water at the facility.

Regulatory Requirements of the NMOCD

This Work Plan/Closure Plan has been prepared to comply with the "Unlined Surface Impoundment Closure Guidelines" (February 1993), NMOCD. Field activities and procedures related to this Work Plan/Closure Plan will be conducted within these guidelines.

CHAPTER 2

SITE BACKGROUND

The Transwestern Atoka 1 Compressor Station (Atoka 1) is located in Eddy County, New Mexico, approximately ten miles east of Artesia. The facility is situated in the NE/4 NE/4 of Section 1, Township 18 South, Range 27 East, N. M. P. M., and is leased from the Bureau of Land Management (BLM).

Facility Description

The facility lies on approximately two acres of leased BLM land. A concrete-lined surface impoundment is located in the southeast corner of the property along the fenceline. It was used for the disposal of waste oil. The surface impoundment is approximately 30 feet by 30 feet at ground surface with inwardly sloping sides (Figure 2).

Interviews with plant personnel and site diagrams indicated that two bermed areas, containing pipeline liquid tanks, were located west of the lined surface impoundment. The berms were composed of native soil. These tanks were used for the disposal of pipeline liquid waste.

Geographic Settings

Atoka 1 is located in the Pecos Valley section of the Southern High Plains physiographic province. The area is characterized by broad plains and rolling hills with transecting bluffs and shallow river valleys. The site is situated atop Quaternary sedimentary deposits overlying flat lying formations of the Permian Artesia Group.

The Artesia Group is positioned stratigraphically above the San Andres Dolomite and is composed of carbonate, sandstone and evaporite strata (Figure 3). The units comprising the Artesia Group, from youngest to oldest, are the Transil Formation, Yates Sandstone, Seven Rivers Formation, Queen Sandstone, and the Grayburg Formation. Both the Artesia Group and the underlying San Andres Dolomite were deposited along the shelves associated with the Delaware Basin. Evaporite sequences were generally deposited along the distal portions of the shelves during the early Guadalupian and encroached toward the reefs associated with the basins during the late Guadalupian, denoting the impending end of the inland sea in the region.

CHAPTER 3

PREVIOUS ENVIRONMENTAL INVESTIGATION

During June and July of 1993, a preliminary subsurface investigation was conducted to assess potential impact from the concrete lined surface impoundment at the Atoka 1 Compressor Station. Brown & Root Environmental drilled 12 soil borings, subsequently, four were completed as monitoring wells. A site map displaying the borings and well locations is included as Figure 2.

Site Hydrogeology

Ground water levels and recharge rates in the wells varied. Ground water was encountered during drilling at depths ranging from 47 to 63 feet below ground surface (bgs). After well stabilization the levels varied significantly, ranging from 36 to 60 feet bgs or from 31.56 to 58.45 feet in elevation. The reason for the variance is currently unknown.

Ground water recharge also varied considerably. Three of the four monitoring wells were bailed dry. Monitoring wells MW-1 and MW-4 recharged very slowly, on the order of days, and monitoring well MW-3 required several hours to recharge. Monitoring well MW-2 could not be bailed dry.

Soil Impacts

Soil samples sent to the laboratory were analyzed for total petroleum hydrocarbons (TPH) using EPA Method 418.1. Soil samples collected from Borings AT1-1 though AT1-6 were analyzed for volatile organics using EPA Method 8240 and semivolatile organics using EPA Method 8270. Soil samples collected from borings AT1-7 though AT1-10 were analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) using EPA Method 8020.

The near surface (less than 20 feet bgs) soils near the historical bermed pipeline liquids tank area appear to be impacted. Subsurface soil samples collected from boring AT1-4 detected volatile organic constituents ethylbenzene, toluene, and xylene at concentrations of 6.2 mg/kg, 1 mg/kg, and 40 mg/kg, respectively. The detection limits on the other volatile organic constituents analyzed for, in that sample, were elevated due to the high concentrations observed. TPH was detected at 410 mg/kg and bis(2-Ethylhexyl)phthalate, a semivolatile compound, was detected at 1.5 mg/kg.

Deeper subsurface soil (greater than 20 feet bgs) impact is indicated from laboratory analytical and field screening results from soil samples collected from borings AT1-2 and AT1-7, located west of the concrete line surface impoundment. The sample collected from the 32 to 34 foot interval bgs in boring AT1-2 detected ethylbenzene, toluene, and xylenes at concentrations of 0.97 mg/kg, 30 mg/kg, and 40 mg/kg, respectively. The detection limits on the other volatile organic constituents analyzed for, in that sample, were elevated due to the high concentrations observed. The sample collected from the 47 to 48.5 foot bgs interval in boring AT1-7 detected benzene, toluene, ethylbenzene, and xylene at concentrations of 2 mg/kg, 1.7 mg/kg, 6.7 mg/kg, and 12.3 mg/kg, respectively. TPH was detected at concentrations of 4,400 mg/kg and 150 mg/kg, respectively.

Ground Water Impact

Ground water samples were analyzed for TPH by EPA Method 418.1 and total dissolved solids (TDS) using EPA Method 160.1. Ground water from monitor well MW-1 (AT1-2W) was sampled for volatile organics using EPA Method 8240 and semivolatile organics using EPA Method 8270. The other three wells were analyzed for the BTEX constituents only using EPA Method 8020.

Phase separated hydrocarbons (PSH) were observed in MW-1. Because of the PSH, TPH and benzene, toluene, ethylbenzene and xylene concentrations in ground water collected from that well were elevated. Ground water sample collected from monitor well MW-2 (boring AT1-7) detected TPH and benzene, toluene, ethylbenzene and xylene at concentrations of 12 mg/L, 3.6 mg/L, 0.4 mg/L, 9.8 mg/L, and 3.17 mg/L, respectively. Monitor well MW-4 (boring AT1-3), located west of the concrete lined surface impoundment, detected TPH and benzene, toluene, ethylbenzene and xylene at concentrations of 0.6 mg/L, 0.061 mg/L, 0.004 mg/L, 0.020 mg/L, and 0.068 mg/L, respectively. Monitor well MW-3 detected TPH, benzene, and toluene at concentrations of 1.1 mg/L, 0.007 mg/L, and 0.006 mg/L, respectively.

TDS concentrations ranged from 4,600 mg/L in monitor well MW-4 to 7,700 mg/L in the monitor well containing PSH (MW-1).

CHAPTER 4

SOIL ASSESSMENT PLAN

The following section outlines the procedures and methodologies that will be used to compete the soil assessment portion of the investigation.

Soil Sampling Strategy

Subsurface samples will be collected from monitor well boreholes to aid in determining the nature and extent of impact site activities have had on the subsurface environment. Proposed monitor well boring locations are presented in Figure 4. The proposed monitor well boring locations are the minimum number of boreholes to be drilled in this investigation. Based on soil and ground water analytical results from these borings, additional borehole locations may be required to determine the extent of the hydrocarbon impact. No boreholes are scheduled to be drilled in known areas with shallow impacted soil due to planned excavation of these impacted areas.

A minimum of two subsurface samples collected from each boring will be submitted for laboratory analysis. One sample will be collected from the interval displaying the most prominent evidence of impact as determined by field screening methods as outlined in this chapter. The second sample will be collected from the interval immediately above the saturated zone. Additional samples may be submitted for laboratory analysis at the discretion of the Brown and Caldwell geologist with concurrence from Transwestern. The additional samples would be selected from sample intervals representing major changes in lithology or exhibiting unusual physical characteristics (e.g. color, odor, texture, etc.).

Soil Sampling Procedures

Monitor well borings will be sampled, at a minimum, every ten feet from surface to total depth. It is anticipated that both hollow stem auger and air rotary drilling methods will be employed during this investigation. Initially, hollow stem augers will be utilized. When consolidated sediments, unsuitable for hollow stem augering are encountered, air rotary drilling methods will be used.

Samples will be collected using split spoon samplers or an NDX core barrel depending on the drilling method. Boring logs will be constructed for each monitor well boring. These logs will contain sample interval information, a physical description of recovered samples and field screening results.

Field screening will consist of a visual inspection and a headspace analysis of recovered samples. A portion of each recovered sample will be placed in a resealable plastic bag for headspace analysis. The remainder of the sample will be placed in a laboratory supplied jar, properly labeled and stored on ice.

Headspace analysis will consist of allowing the portion of the sample placed into a resealable plastic bag to stand for a minimum of five minutes. During this time period, the bag will be massaged or shaken to break up soil clods. One end of the bag will be opened and the probe of a flame ionization detector (FID)/photoionization detector (PID) will then be inserted into the bag. The plastic bag will be resealed around the probe to minimize the amount of vapors escaping from the bag. The instrument reading will be recorded on the boring log.

Samples selected for laboratory analysis will be packed on ice and shipped under Chain of Custody by overnight carrier to Terra Laboratories, Inc. (Terra) in League City, Texas for analysis. Samples will be selected by the Brown and Caldwell geologist based on field screening results, with concurrence from Transwestern.

Borehole Abandonment Procedures

Four monitor wells currently exist in the area included as part of this investigation. Five additional monitor wells will be installed during this investigation. After these wells have been installed, and sampled, all existing monitor well locations will be evaluated. Wells deemed unnecessary will be abandoned. Concurrence from Transwestern and NMOCD will be obtained prior to abandoning any monitor wells.

Abandonment procedures will include overdrilling the existing monitor wells with appropriate sized hollow stem augers or roller bit if air rotary methods are deemed appropriate. The resultant borehole will be grouted from the total depth of the borehole to the surface using a Portland cement/bentonite slurry.

Laboratory Analysis of Soil Samples

Soil samples will be packed on ice and shipped under Chain of Custody by overnight carrier to Terra for analysis. Soil samples will be analyzed for total petroleum hydrocarbons (TPH) using EPA Method 418.1 and benzene, toluene, ethylbenzene and xlyenes (BTEX) using EPA Method 8020.

Decontamination Procedures

The drill rig and downhole drilling and sampling equipment (e.g. augers, drill rod, bits, split spoons, core barrels, etc.) will be steam cleaned prior to the commencement of drilling activities and prior to demobilizing from the site. Downhole drilling and sampling equipment will also be steam cleaned between boring locations. In addition, all sampling equipment will be decontaminated prior to use at each boring location and between sample intervals using a phosphate free soap/potable water wash followed by a potable water rinse and then a distilled water rinse. Sampling equipment will be allowed to air dry before it is used.

Management of Investigation-Derived Wastes

Soil cuttings generated while drilling monitor well boreholes will be stockpiled on and covered with plastic sheeting. Separate stockpiles will be used for each boring location. Gloves and other potentially contaminated trash will be collected in plastic trash bags. At the end of each day, this trash will be placed in an appropriately marked drum.

Transwestern will be responsible for the proper disposition of all investigation derived wastes. It is anticipated that soils generated during drilling activities will be treated along with soils excavated during site remedial activities at a location selected by Transwestern with concurrence from NMOCD.

readings are within +/- 0.1 units for pH and +/- 10 percent for conductivity. A minimum of three well volumes will be purged from each well. Wells will then be sampled using a disposable polyethylene bailer and dedicated bailer rope.

Laboratory Analysis of Ground Water Samples

Ground water samples will be packed on ice and shipped under Chain of Custody by overnight carrier to Terra Laboratories, Inc. (Terra) in League City, Texas for analysis. Ground water samples will be analyzed for TPH using EPA Method 418.1 and BTEX using EPA Method 8020.

Aquifer Testing

Slug tests will be conducted on a minimum of one monitor well. After the five monitor wells are completed, the boring logs and well development and purging data will be evaluated to select the well(s) in which slug tests will be conducted.

Both slug-in (falling head) and slug-out (rising head) tests will be conducted on wells selected for slug testing. The size of the slug used will be dependent upon the height of the water column in each well. In general, the slug size will be selected to maximize the change in head within the well. Water level changes will be measured using a pressure transducer and recorded using a Hermit Datalogger. Slug test data will be analyzed using the AQTESOLVE software package to determine aquifer characteristics.

Decontamination Procedures

Bailers and pumps used to develop and purge monitor wells will be decontaminated prior to use at each monitor well. Non-dedicated bailers will be steam cleaned. The bailer will then be rinsed with a phosphate free/potable water wash and rinsed with potable water and then rinsed with distilled water. Pumps will be disassembled and cleaned using a phosphate free/potable water wash and rinsed with potable water and then rinsed with distilled water. Ground water samples will be obtained using a disposable polyethylene bailer. Dedicated bailer rope will be used.

Management of Investigation-Derived Wastes

Gloves, disposable bailers, and other potentially contaminated trash will be collected in plastic trash bags. At the end of each day, this trash will be placed in an appropriately marked drum. Development and purge water will be stored in properly labeled 55-gallon drums.

The method of disposal for development and purge water will be dependent upon ground water analytical results. Transwestern will be responsible for the proper disposition of all investigation derived wastes.

CHAPTER 6

QUALITY ASSURANCE PROJECT PLAN

Quality assurance can be defined as a management program of planned and systematic actions having the objective of providing adequate confidence that project activities are performed in accordance with standards of professional practice and regulatory requirements. Brown and Caldwell's quality assurance plan assigns quality assurance responsibilities to all staff members involved in the project. The quality assurance plan includes procedures for borehole drilling, monitor well installation, soil and ground water sampling and analytical methods and procedures are discussed in the following sections.

Borehole Drilling

Boreholes will be drilled by a New Mexico licensed drilling subcontractor using a truck mounted drilling rig capable of both hollow stem auger and air rotary drilling methods. Boreholes will be drilled and sampled to below the saturated zone (approximately 60 feet). To prevent cross contamination during drilling, all equipment will be steam cleaned prior to and between use at each borehole. Soil sampling and monitoring procedures during borehole drilling are described in Chapter 4, Soil Sampling Procedures.

Monitor Well Installation

Monitor Wells will be installed by a New Mexico licensed drilling subcontractor with the same drilling equipment used for borehole drilling. Monitor well installation and ground water sampling are described in Chapter 5.

Analytical Methods and Procedures

The collected soil and water samples will be analyzed for benzene, ethyl benzene, toluene and xylene (BETX) by EPA Method 8020 and total petroleum hydrocarbons (TPH) by Method 418.1.

Data Quality Objectives (DQOs)

DQOs are qualitative and quantitative statements which specify the quality of the data required to support decisions during cleanup activities. DQOs for this work plan were determined based on the end uses of the data collected. The intent is a work plan which details the chosen sampling and analysis procedures.

The type of samples to be collected include soil samples (shallow and deep), ground water samples, and miscellaneous Quality Assurance/Quality Control (QA/QC) water samples. The QA/QC water samples consist of trip blanks for samples to be analyzed for BETX. Trip blanks are used to identify contaminants introduced to the sample between the time the sample containers are shipped from the laboratory and the laboratory analyses are completed. They originate from analyte-free water in VOA vials shipped with the empty sample containers to the site and returned to the laboratory with the full sample containers to be analyzed for BETX. One trip blank will be returned to the laboratory for each sampling day in a cooler containing a sample to be analyzed for BETX.

Five soil borings are proposed with two samples from each boring. The soil samples will be collected with an appropriate sampling tool and placed into the laboratory cleaned sample containers.

One ground water sample will be collected from each monitor well. The ground water samples will collected using a disposable bailer and will be poured directly into the laboratory supplied sample containers.

Documentation

After the sample is collected in the field and the outside of the sample container properly decontaminated, documentation for sample shipment is completed. A Chain of Custody (COC) record will be prepared per sample cooler to maintain the legal transfer of the sample from the field to the laboratory. The COC lists each sample in that cooler. The COC record is used to record the custody of samples and will accompany samples at all times. The COC record will contain the following information:

- Project name,
- Signature of sampler,
- Sample number, date and time of collection, grab or composite sample designation, and a brief description of the type of sample and sampling location,
- Requested sample analysis,
- Signature(s) of individuals involved in sample transfer (i.e., relinquishing and accepting samples). Individuals receiving the samples will sign, date, and note the time that they received the samples on the form, and
- Sample matrix.

The analyses listed on the COC serve as an official communication to the laboratory of the particular analyses required for each sample and provide further evidence that the COC is complete.

Samples, other than those collected for field measurements or analyses, are identified by using a standard sample label which is attached to the sample container. The following information will be included on the sample label:

- Site name,
- Field identification or sample station number,
- Date and time of sample collection,
- Designation of the sample as a grab or composite,
- Type of sample (matrix) and a brief description of the sampling location,
- The signatures of the sampling team,
- Sample preservation and preservative used, and
- The general types of analyses to be conducted.

Shipping

The samples will be placed into ice chests with ice to cool the samples to 4 degrees Celsius, plus or minus 4 degrees. The empty spaces in the ice chest will be filled with packing, vermiculite if available. A COC will be placed in each ice chest and the ice chest will be sealed with strapping tape and shipped Federal Express for next day delivery to the laboratory.

Field Activities

Field activities will be directed on a day-to-day basis by an experienced field geologist. The field geologist will also be responsible for recording on the borehole logs or field notes all observations and measurements made during the site investigation and closure activities at the Atoka 1 facility. A Site Safety and Health Plan (SSHP) will be prepared for the site investigation and closure activities at the Atoka 1 facility. The field geologist will be responsible for implementing the guidelines established in the SSHP.

CHAPTER 7

SURFACE IMPOUNDMENT CLOSURE PLAN

Site Location

The concrete lined surface impoundment to be closed is located on the southeast corner of the property.

Remediation Goals

Near Surface Soils. Remediation goals for the near-surface soils apparently impacted by the concrete lined surface impoundment are proposed in accordance with NMOCD Unlined Surface Impoundment Closure Guidelines. For purposes of this closure plan, near surface soils are defined as those soils which can be excavated using conventional excavation equipment. The practical limit for such excavation is approximately 10 feet or the first consolidated layer encountered, whichever is shallower. As per Section II.A.2.a of the Guidelines, a ranking score was developed to determine soil cleanup criteria. Since ground water is present at a depth of less than 50 feet, a Ranking Score of 20 is assigned to this criterion. A water well search (included in the Appendices) indicated no wells were present within 1000 feet of the facility. The Wellhead Protection Area criterion is therefore assigned a score of zero. Because no surface water is located within 1000 feet of the site, the Distance to Surface Water Body criterion is also assigned a score of zero.

Therefore, a total Ranking Score of 20 is indicated for the near surface soils at this site. In accordance with Section II.A.2.b, the corresponding cleanup goals for soils under these conditions is:

- 10 mg/kg Benzene
- 50 mg/kg total BTEX
- 100 mg/kg TPH

Per Section III.B.2.b, it is requested that an alternate analytical method be approved for near surface soils. Immunoassay methods are proposed for these analysis. These field based-methods allow for accurate results within 30 minutes of sample collection. Two immunoassay methods will be used:

1) EPA Method 4030 for TPH

2) EPA Method 4031 for BTEX

Currently, there is no accepted BTEX immunoassay method in SW846. The method mentioned above, EPA Method 4031, has completed submission and field testing with EPA Region IV. It is anticipated that this product will be in the accepted stage within the next three months and will be assigned that method number. It is proposed that no separate analysis be performed for benzene, as no benzene has been detected in near-surface soil samples. Both immunoassay analytical methods are similar in that they are designed to give false positives as compared to their corresponding laboratory analytical methods. Therefore, the results from the immunoassay field analyses are conservative. Manufacturer's data on these test methods is included in the Appendices.

Deep Soils and Ground Water

Remediation goals for the deeper soils and impacted ground water on site will be developed after completion of delineation of the extent of soil and ground water impact on the site. Remediation goals for deep soils and ground water will be such that fresh waters, public health and the environment will not be impacted by remaining contaminants.

Remediation Procedures

Near-Surface Soils. Based on previous soil sampling activities on site, as described in the Brown & Root Environmental Subsurface Investigation Report dated October 20, 1993, some minor hydrocarbon impacts to soils may be due to the surface impoundment. Based on the field screening and the laboratory analysis of soil samples described in the Report, it appears that hydrocarbons migrated from the impoundment down through the surficial silts until they reached a caliche layer present 10-15 ft below grade. It should be noted that hydrocarbon impacts apparently due to the impoundment proper are minimal; samples analyzed from the boreholes adjacent to the impoundment are within the remediation goals described in this chapter. Therefore, the soils beneath the impoundment may be within the remediation goals.

The surface impoundment will be emptied of fluids using a vacuum truck. The concrete will then be steam cleaned to remove residual hydrocarbons. A vacuum truck will be used to remove fluids generated during the concrete cleaning. The concrete lining will then be demolished. A portion of the cleaned concrete will be analyzed for total recoverable petroleum hydrocarbons (TRPH) and buried on site, pending approval by BLM, after the excavation of impacted soil is completed. The remaining cavity will be visually inspected for highly contaminated soil as indicated by gross hydrocarbon staining in accordance with II.B of the guidelines. In the event that gross hydrocarbon staining is present, a sample will be taken no less than 3 feet into the undisturbed soil beneath the most grossly stained area with a backhoe. This sample, and all samples described in this section, will be analyzed for TPH and BTEX using immunoassay test methods, as described in this chapter. If the analysis determines that the sample does not meet the remediation goals of 50 mg/kg BTEX and 100 mg/kg TPH, the soils beneath and adjacent to the impoundment will be excavated until the grossly stained soil is removed. Samples will then be taken from each of the excavation sidewalls and the bottom to confirm that remediation goals have been met. If the analysis of confirmation samples yields TPH or BTEX levels in excess of the remediation goals, excavation will resume. Field screening with a PID will be used to determine when to stop excavation and take confirmation samples from the excavation sidewalls and bottom. This sequence will be repeated until:

1) Analysis of all confirmation samples indicates that the contaminated soils have been removed;

2) Consolidated material is encountered; or

3) A depth of 10 feet below grade is reached.

Note that under conditions 2 and 3, excavation will continue laterally until analyses of sidewall confirmation samples are below the remediation goals for BTEX and TPH. In the event that excavation stops because of depth or consolidated material, a sample will be collected for laboratory analysis for BTEX by EPA Method 8020. The data from this analysis will be used to perform a risk analysis in accordance with Section V.A. of the Guidelines. If the analysis indicates that the remaining soils pose an unacceptable risk to fresh water, public health or the environment, these soils will be remediated along with the remainder of the deep soils.

Once excavation of contaminated soils is complete, the excavation will be backfilled. The broken up concrete will be buried in one of the cavities generated by the excavation. If offsite backfill material is used, one composite sample of the fill material will be analyzed for BTEX by EPA Method 8020 and TPH by EPA Method 418.1, prior to placement. Offsite backfill material which exceeds the remediation goals will not be used as fill.

After excavation of contaminated soils associated with the impoundment is complete, contaminated soils in the vicinity of boring AT1-4 will be excavated. Grossly stained soils will be removed, and confirmation samples will be taken as described above. Excavation and sampling will continue as described above.

Soil Management. Treatment options for excavated affected soils will be evaluated following completion of the excavation activities. Four options for treatment/disposal of affected soil will be considered:

1) Transport soil to C&C Landfarm, Inc., in Lea County, New Mexico for treatment.

2) Transport soil to the Transwestern Yates Plant Landfarm for treatment.

3) Treat soil on BLM property adjacent to the Atoka 1 facility.

4) Treat soil on the Atoka 1 facility.

The final selection of one of the four treatment/disposal options will be based on the quantity of soil to treat, hydrocarbon concentrations in the soil, and land or facility access. Transwestern will request NMOCD approval prior to final disposition or treatment of affected soil.

Deep Soils. Remediation of deep soils and ground water will be addressed once the extent of hydrocarbon impact to soil and ground water has been delineated at the site.

CHAPTER 8

REPORT

A report documenting the site investigation and impoundment closure activities will be submitted to the New Mexico Oil Conservation Division (NMOCD) in accordance with the schedule discussed in Chapter 9, Schedule. The report will include a summary of the investigation and closure activities, a discussion of the local geology and hydrogeology, a description of field methods, field and laboratory analytical results, conclusions and recommendations, boring log/well completion diagrams, a sample location map, a boring/monitor well location map, and documentation for the disposition of materials related to the impoundment closure.

CHAPTER 9

PROJECT SCHEDULE

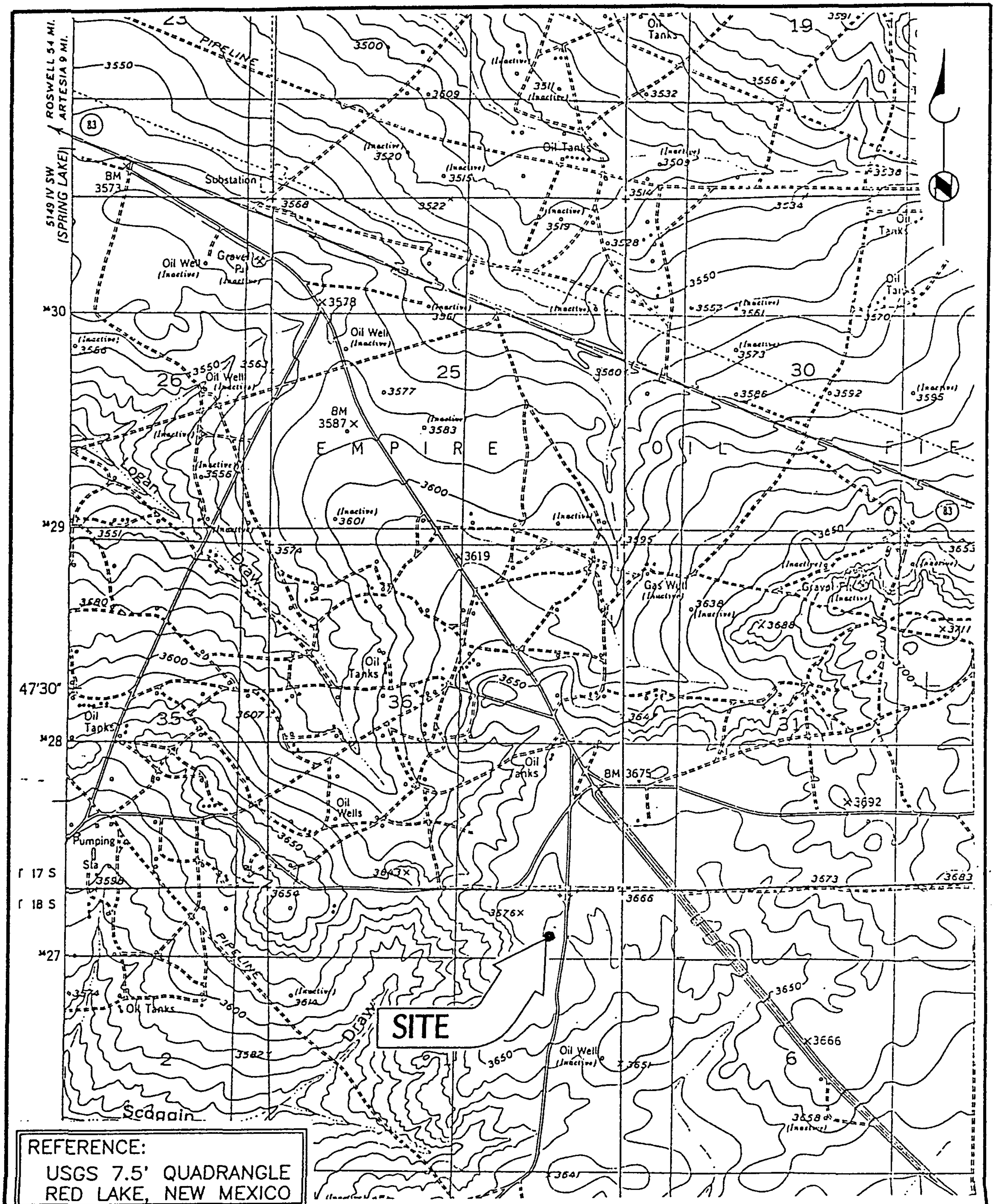
This section provides a schedule of the site investigation, surface impoundment closure and preparation of a report documenting the field activities.

Site Investigation and Impoundment Closure

Field activities will commence within 30 days of approval of the Work Plan/Closure Plan by the New Mexico Oil Conservation Division (NMOCD) and right of access from BLM. It is anticipated that the field investigation activities will be completed within 15 days of start-up. The closure of the concrete lined surface impoundment and excavation of near surface soils will be completed within 30 days of start-up (based on an estimated soil volume of less than 1000 loose cubic yards of soil requiring excavation).

Site Investigation and Closure Report

A report documenting the site investigation and closure of the concrete lined surface impoundment will be submitted to the NMODC within 60 days after field activities are completed.



REFERENCE:
USGS 7.5' QUADRANGLE
RED LAKE, NEW MEXICO

BROWN AND CALDWELL
HOUSTON, TEXAS

SUBMITTED: LYNN WRIGHT DATE:
PROJECT MANAGER

APPROVED: ROBERT JENNINGS, P.E. DATE:
BROWN AND CALDWELL

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DRAWN BY: DHD DATE 8/23
CHK'D BY: DG DATE 8/23
APPROVED: LMW DATE

TITLE
SITE LOCATION MAP

CLIENT
TRANSWESTERN PIPELINE COMPANY

SITE LOCATION ATOKA 1 COMPRESSOR STATION
ATOKA, NEW MEXICO

DATE
8/23/94

PROJECT NUMBER
1618

FIGURE NUMBER
1

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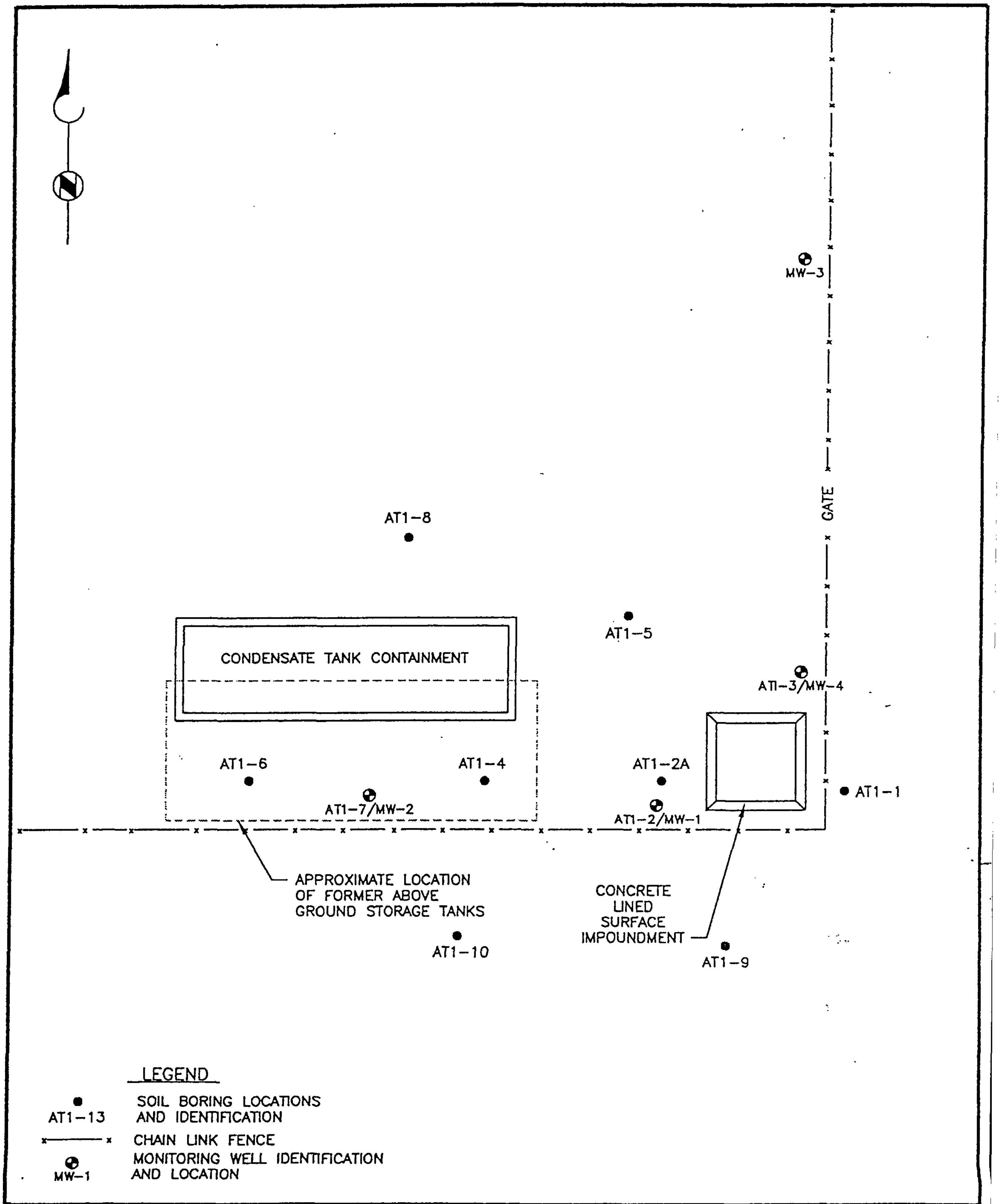

BROWN AND CALDWELL
HOUSTON, TEXAS
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APPROVED: ROBERT JENNINGS, P.E. BROWN AND CALDWELL DATE:

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CHK'D BY: DG DATE 8/23
APPROVED: LMW DATE

TITLE SITE PLAN WITH BORING/ MONITORING WELL LOCATIONS
DATE 8/29/94
CLIENT TRANSWESTERN PIPELINE COMPANY
PROJECT NUMBER 1618
SITE LOCATION ATOKA 1 COMPRESSOR STATION ATOKA, NEW MEXICO
FIGURE NUMBER 2

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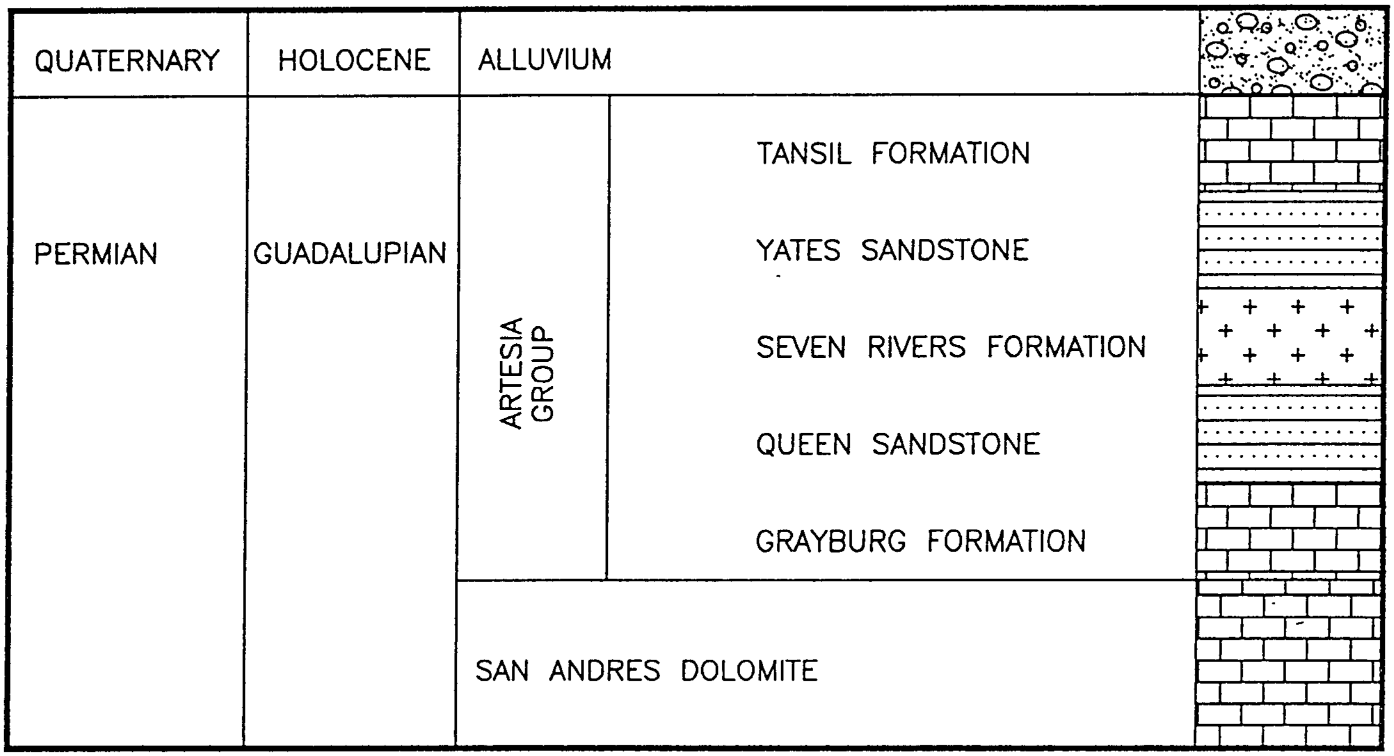
FIGURE 3
GENERALIZED STRATIGRAPHIC COLUMN
ARTESIA, NEW MEXICO



SYSTEM	SERIES		
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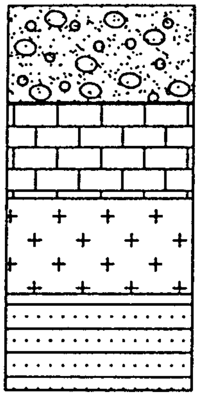
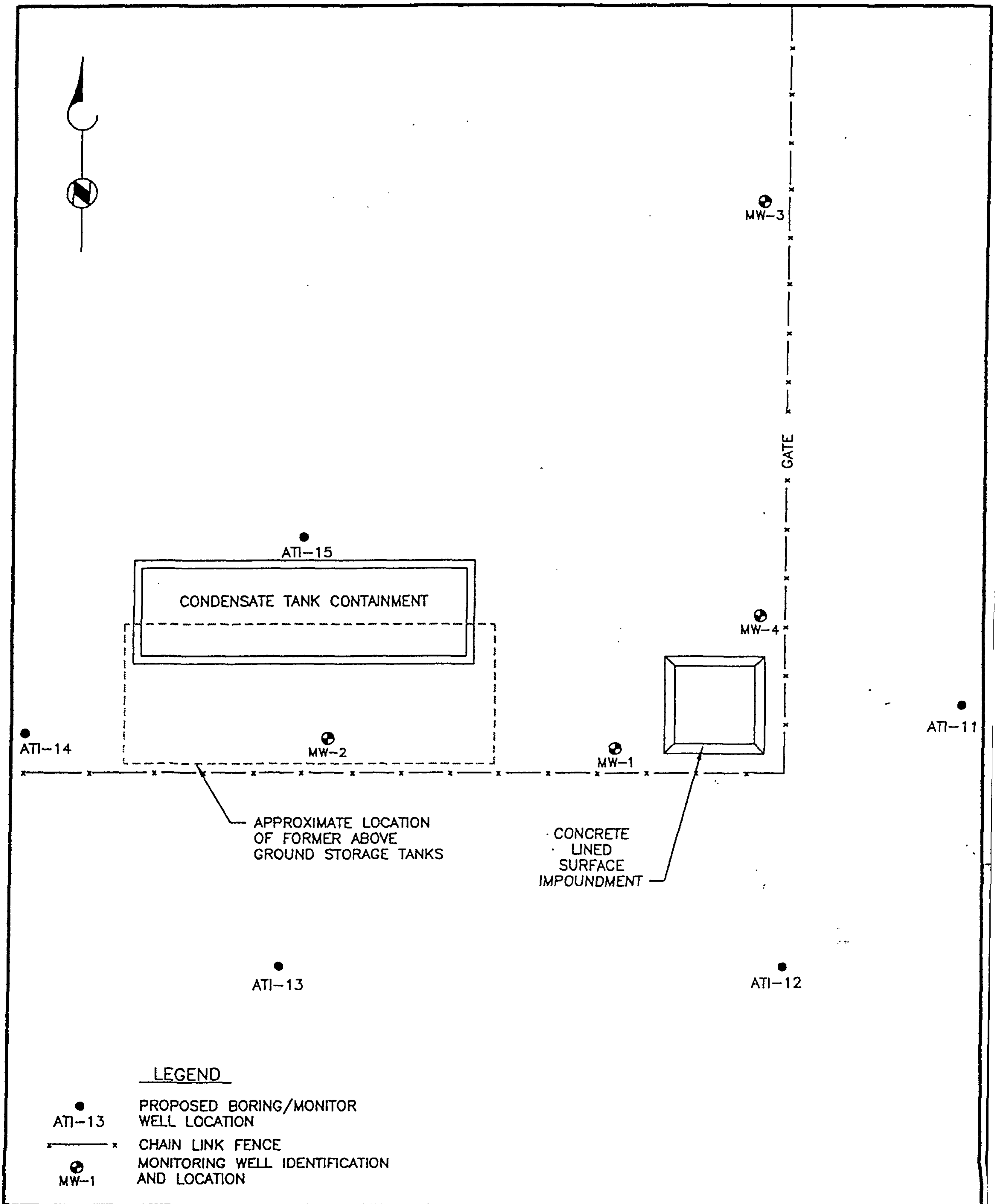
			GRAYBURG FORMATION
		SAN ANDRES DOLOMITE	

LEGEND





BROWN AND CALDWELL
HOUSTON, TEXAS
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APPROVED: ROBERT JENNINGS, P.E., BROWN AND CALDWELL DATE:

0 20 40
SCALE: 1" = 40'
DRAWN BY: DHD DATE 8/23
CHK'D BY: DG DATE 8/23
APPROVED: LMW DATE

TITLE PROPOSED BORING/ MONITORING WELL LOCATIONS
CLIENT TRANSWESTERN PIPELINE COMPANY
SITE LOCATION ATOKA 1 COMPRESSOR STATION
ATOKA, NEW MEXICO

DATE 8/29/94
PROJECT NUMBER 1618
FIGURE NUMBER 4

:\1618\1618-01

DANIEL B. STEPHENS & ASSOCIATES, INC.
ENVIRONMENTAL SCIENTISTS AND ENGINEERS

August 23, 1994

0947-4235-94

Mr. George Robinson
ENRON Environmental Affairs
1400 Smith St.
Suite #AC 3142
Houston, Texas 77002

Dear George:

Enclosed is a listing of wells in the Artesia area that were included in the USGS database. Only one of these wells (18S.28E.S7.43131) is within two miles of the compressor station (it is further than 1 mile from the station). Available water level data for this well is attached; no water quality data are available for the well.

We have also queried several State Engineer Office water rights compilations and found no wells within 2 miles of the station. Additionally, we reviewed a report called *Collection of Hydrologic Data, East Side Roswell Range EIS Area* and found no wells listed within 1 mile of the station. The report was prepared by Geohydrology Associates for the BLM in Denver, Colorado, in June 1978.

We believe that if wells are present in this area, they most likely would have been included in one of these sources. Based on discussions with the Roswell district personnel, it is unlikely that they would have wells listed in their files that are not included in one of the data bases that we queried. However, on occasion they do have some additional information, and you can examine the files in Roswell if you want to double check.

Please let me know if you need anything else.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Joanne Hilton

Joanne Hilton
Project Manager

JH/sd
Enclosure

4235\GC\ROBINSON.823

8/22/94 Standard Report Page 1

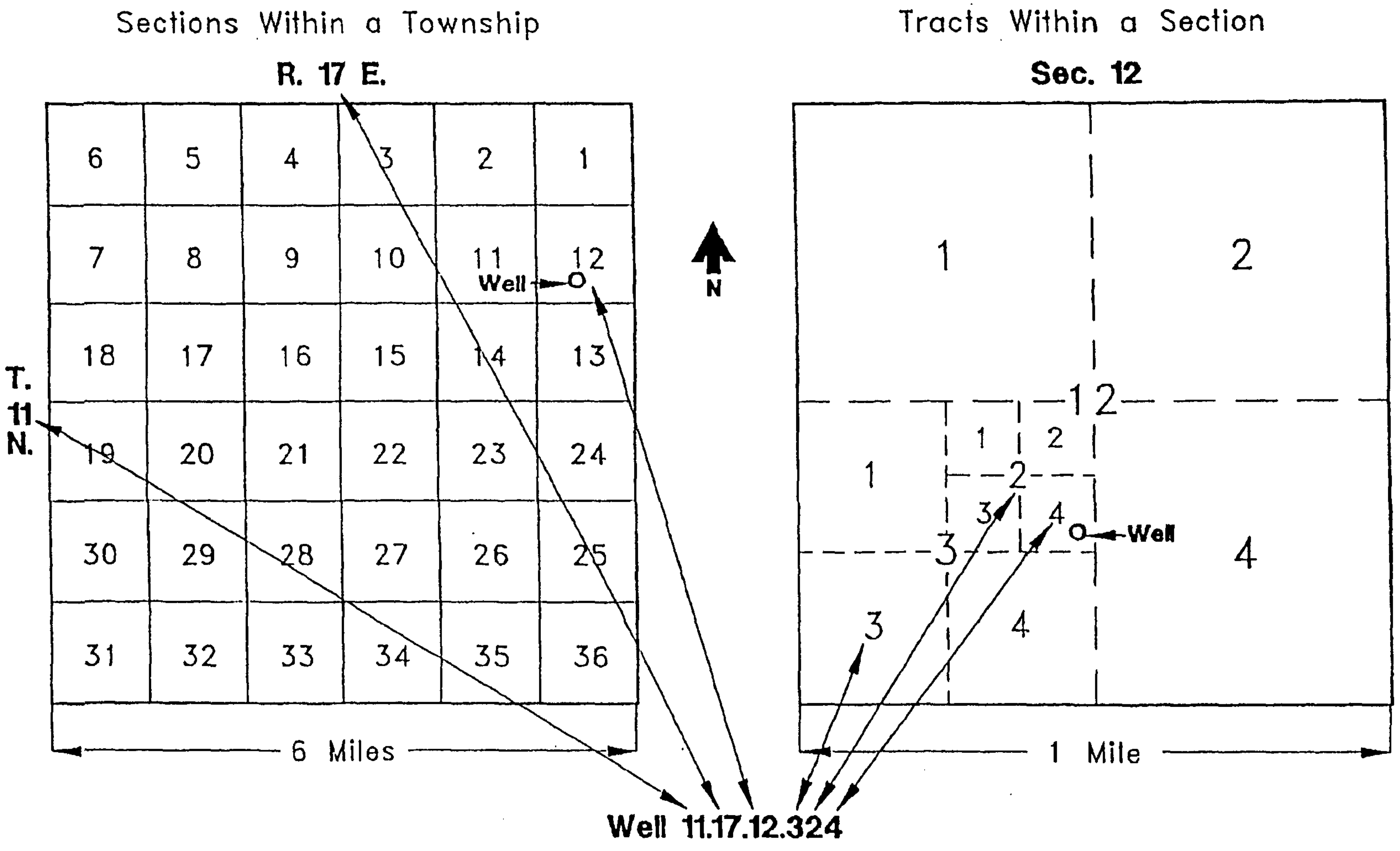
Siteid	Stat-type	Recd	Source	ProjNo	Dcode	Scode	Ccode	Latitude	Longitude	LLacc	Local well number	Land-net location	Name of location map	Map Scale	LSD_feet	LSDmeth	Al
325058104190301	NNNNNYN	U	USGS		35	35	15	325058.00	1041903.00		17S.27E.07.23 E.P.BLACK						
325100104190001	NNNNNYN	U	USGS	463527100	35	35	15	325100.00	1041900.00	T	17S.27E.07.233324	SWSWNES07 T17S R27E			3310		
325032104145701	NNNNNYN	U	USGS		35	35	15	325032.00	1041457.00		17S.27E.11.134						
325102104151401	NNNNNYN	U	USGS	463527100	35	35	15	325102.00	1041514.00	T	17S.27E.11.134232	SESWNWS11 T17S R27E			3401		
324943104171201	NNNNNYN	U	USGS	463527100	35	35	15	324943.00	1041712.00	T	17S.27E.16.34314	SWSESWS16 T17S R27E			3428		
324939104170001	NNNNNYN	U	USGS		35	35	15	324939.00	1041700.00		17S.27E.16.344 EMPIRE W.						
324952104174601	NNNNNYN	U	USGS		35	35	15	324952.00	1041746.00		17S.27E.17.423 RVRSD STA						
324939104183301	NNNNNYN	U	USGS		35	35	15	324939.00	1041833.00		17S.27E.18 E.P.BACH						
324847104152701	NNNNNYN	U	USGS		35	35	15	324847.00	1041527.00		17S.27E.23.33 OILTEST						
324715104180201	NNNNNYN	U	USGS	463527100	35	35	15	324715.00	1041802.00	T	17S.27E.32.32000	NESW S32 T17S R27E			3430		
324718104181201	NNNNNYN	U	USGS	463527100	35	35	15	324718.00	1041812.00	T	17S.27E.32.323234	SWNESWS32 T17S R27E			3430		
325141104082301	NNNNNYN	U	USGS	463527100	35	35	15	325141.00	1040823.00	T	17S.28E.02.424314	SENESES02 T17S R28E			3574		
325033104081801	NNNNNYN	U	USGS		35	35	15	325033.00	1040818.00		17S.28E.14.22 DIAMOND A						
324920104124101	NNNNNYN	U	USGS	463527100	35	35	15	324920.00	1041241.00	T	17S.28E.19.234233	SESWNES19 T17S R28E			3591		
324903104091901	NNNNNYN	U	USGS		35	35	15	324903.00	1040919.00		17S.28E.22.442 DIAMOND A						
324857104091901	NNNNNYN	U	USGS	463527100	35	35	15	324857.00	1040919.00	T	17S.28E.22.44244	NESESES22 T17S R28E			3579		
324858104091901	NNNNNYN	U	USGS	463527100	35	35	15	324858.00	1040919.00	T	17S.28E.22.442442	NESESES22 T17S R28E			3579		
324947104172901	NNNNNYN	U	USGS	463527100	35	35	15	324947.00	1041729.00	T	18S.27E.08.24422	SESENES08 T18S R27E			3510		
324603104155001	NNNNNYN	U	USGS	463527100	35	35	15	324603.00	1041550.00	T	18S.27E.10.213223	SWNWNES10 T18S R27E			3466		
324315104172401	NNNNNYN	U	USGS	463527100	35	35	15	324315.00	1041724.00	T	18S.27E.28.13323	SWSWNWS28 T18S R27E			3405		
324246104192801	NNNNNYN	U	USGS	463527100	35	35	15	324246.00	1041928.00	T	18S.27E.30.33334	SWSWSWS30 T18S R27E			3275		
324155104184601	NNNNNYN	U	USGS	463527100	35	35	15	324155.00	1041846.00	T	18S.27E.31.430	SWSE S31 T18S R27E			3277		
324633104105401	NNNNNYN	U	USGS	463527100	35	35	15	324633.00	1041054.00	T	18S.28E.04.32412	SENESWS04 T18S R28E			3661		
324627104110401	NNNNNYN	U	USGS		35	35	15	324627.00	1041104.00		18S.28E.04.341 IBEX OIL						
324532104125101	NNNNNYN	U	USGS	463527100	35	35	15	324532.00	1041251.00	T	18S.28E.07.43131	NWSWSES07 T18S R28E			3594		
324549104113501	NNNNNYN	U	USGS		35	35	15	324549.00	1041135.00		18S.28E.08.243 OIL TEST						
324523104121701	NNNNNYN	U	USGS	463527100	35	35	15	324523.00	1041217.00	T	18S.28E.17.111211	NWNWNWS17 T18S R28E			3599		
324523104121601	NNNNNYN	U	USGS	463527100	35	35	15	324523.00	1041216.00	T	18S.28E.17.111212	NWNWNWS17 T18S R28E			3599		
324339104131901	NNNNNYN	U	USGS	463527100	35	35	15	324339.00	1041319.00	T	18S.28E.30.111123	NWNWNWS30 T18S R28E			3562		

tacc	Toposet	HydroUnit	Drildate	SUse1	WUse1	WUse2	WUse3	Drildepth	Welldepth	Depthsrc	DTW	DTWdate	DTWsrce	DTWmeth	WLstat	AQUIFCODE	X	Y
									275								563866.63	-365387.50
				U	U				275		6	19601229.00				313SADR	563944.06	-365325.50
																313CKBF	570266.50	-366144.75
				W	S						18	19481201.00			P	313SADR	569818.00	-365224.00
				W	K				1042		153	19620104.00				313SADR	566767.31	-367678.50
																	567080.25	-367799.50
									100							313CKBF	565881.38	-367407.00
									247								564662.19	-367815.50
									625								569509.50	-369383.75
				U	C				400		84	19601229.00				313SADR	565497.75	-372244.75
				U	C				198		83	19590109.00				313SADR	565236.38	-372153.75
				W	S						28	19481203.00			P	313SADR	580491.75	-363942.00
																	580638.75	-366035.00
				W	S						224	19481202.00			P	313SADR	573818.88	-368336.00
																313CKBF	579075.13	-368819.00
				W	S						75	19830413.00				313SADR	579076.56	-369003.75
				U	U						46	19481201.00				313SADR	579076.31	-368973.25
				W	U				381		73	19620104.00				313ARTS	566324.44	-367557.75
				W	U				130		47	19611228.00				313ARTS	568946.81	-374438.00
				W	U				120		91	19601228.00				313ARTS	566535.38	-379628.00
				O	U				27		21	19720628.00				110AVMB	563312.94	-380542.50
				W	U				305		29	19860505.00				110AVMB	564417.13	-382105.50
				W	N						103	19850604.00				110AVMB	576641.06	-373457.50
																231SNRS	576381.69	-373644.50
				W	S						42	19830413.00				110AVMB	573611.06	-375359.25
									2359							313SADR	575584.56	-374820.75
				W	S						86	19830413.00				313ARTS	574497.88	-375629.75
				U	U						82	19481202.00				313ARTS	574523.63	-375629.50
				W	H						137	19481202.00			P	313ARTS	572907.63	-378844.25

8/23/94 WLE.db query Page 1

Local well number	Siteida	DTWDATE	Dacc	DTW	DTWstat	DTWmeth	DTWref	LSD_feet	HydroUnit	AQUIFCODE	X	Y	WLE
18S.28E.07.43131	324532104125101	19830413	0	42.20				3594.00		110AVMB	573611.06	-375359.25	3551.80
18S.28E.07.43131	324532104125101	19890222	D	44.81				3594.00		110AVMB	573611.06	-375359.25	3549.19

J/3300/3300W06.DWG



SANTA FE COUNTY INVENTORY

System of Numbering Wells and Springs in New Mexico

Figure 2

DANIEL B. STEPHENS & ASSOCIATES, INC.
7-94
JN 3300

- ~~Task 3 - Assimilate the technical information gathered during Task 2 and delineate the aquifer systems in the County for management purposes. This task included four components:~~
  - ~~Develop conceptual models of the various hydrologic systems.~~
  - ~~Describe the water quality, aquifer parameters, and water budget component estimates for each of the systems.~~
  - ~~Develop aquifer performance criteria for each of the aquifer systems.~~
  - ~~Evaluate the efficacy of the existing County Code~~
- ~~Task 4 - Summarize information and analysis gathered in the first three tasks and provide recommendations for future water resource management.~~

1.2 Well Numbering System

The system of numbering wells in this report is based on the common subdivision of land into townships, ranges, and sections in the Federal land-survey system. In land grants, well numbers are based on projection of the townships, ranges, and sections.

The well numbers based on townships, ranges, and sections consist of four parts separated by periods (Figure 2). The first part is the township number, the second part is the range number, and the third part is the section number. Since all the township blocks within the study area are north of the baseline and east of the principal meridian, the letters N and E, indicating direction, are omitted, as are the letters T for township and R for range. For example, the identifier 18.7.1 is assigned to any well located in T. 18 N., R. 7 E., Sec. 1.

The fourth part of the well number consists of three digits that denote within the section the particular 10-acre tract in which the well is located. The method of numbering the tracts within the section (Figure 2) is based on consecutive subdivision of the section into quarters, as follows:

- The section is first divided into four quarters, numbered 1 through 4 for the northwest, northeast, southwest, and southeast quarters, respectively, each of which is a tract of 160 acres. This 160-acre quarter section provides the first digit of the fourth part of the well number

- Each quarter section is then subdivided in the same manner into 40-acre tracts. This 40-acre sixteenth of a section provides the second digit of the fourth part of the well number.

- Finally, the 40-acre tract is divided into four 10-acre tracts; the third digit of the fourth part of the well number denotes one 10-acre tract (1/64 of a section)

Thus, well 18.7.1.224 is in the SE¼ of the NE¼ of the NE¼ of Section 1, T. 18 N., R. 7 E. (Figure 2).

IMMUNOASSAY ANALYSES

PETRO RISC™ TEST

ON-SITE TESTING FOR GASOLINE AND DIESEL FUEL IN SOIL

On-Site Decision-Making
Analyze four samples within 30 minutes on-site. Having reliable data available on-site reduces the time and cost of site assessments, remediation, and site closures.

Improved Data Quality - Reduced Risk
PETRO RISC™ allows for an increase in the number of samples. More data points provide better overall data quality, better selection of samples for lab analysis, and avoids missing hot spots. EnSys tests correctly identify more than 95% of contaminated samples.

Specific Detection Capability
PETRO RISC™ is designed to specifically detect gasoline and diesel fuel with minimal interference from non-petroleum organics.

Reliable State-of-the-Art Technology
Thousands of EnSys field tests are used every month. Our customers include many of the largest environmental consulting firms, the EPA*, DOD, and DOE.

*_Immunochemistry for Environmental Monitoring_, Gerlach, C. L., Van Emon, J. M., et al. EPA Environmental Monitoring Systems Laboratory, Las Vegas, 1991.

ENSYS INC.

EnSys, Inc.
P. O. Box 14063
Research Triangle Park
North Carolina 27709
(800) 242-7472

PETRO RISc™ TEST

Operating Characteristics

Detection Limits: 100 ppm for gasoline, diesel, and jet fuel
Detection Levels: 100 ppm and 1000 ppm
Temperature: Test can be used at 40° – 100°F
Shelf Life: 3 Months at room temperature

Gasoline and diesel fuel-free soil and soil containing 100 ppm of gasoline or diesel fuels were tested with the EnSys PETRO RISc analytical method. The method correctly identified 95% of these samples.

A sample that has developed less color than the standard is interpreted as positive. It contains gasoline or diesel fuels. A sample that has developed more color than the standard is interpreted as negative. It contains less than 100 ppm of gasoline or diesel fuel.

Validation Data – Underground Storage Tank
10 Samples Analyzed

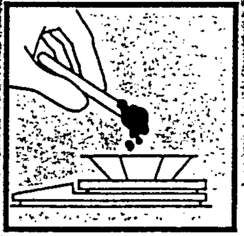
Sample ID	TRPH	PETRO RISc™ Interpretation		Correct
UST-01	< 20	< 100	< 1000	Yes
UST-02	520	≥ 100	< 1000	Yes
UST-03	1700	≥ 100	≥ 1000	Yes
UST-04	130	≥ 100	< 1000	Yes
UST-05	20	≥ 100	< 1000	—
UST-06	< 20	< 100	< 1000	Yes
UST-07	40	≥ 100	< 1000	—
UST-08	400	≥ 100	< 1000	Yes
UST-09	640	≥ 100	< 1000	Yes
UST-10	1600	≥ 100	≥ 1000	Yes

TRPH – Total Recoverable Petroleum Hydrocarbons SW846 Method 418.1

ENSYS INC

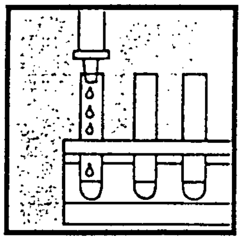
P.O. Box 14063
Research Triangle Park
North Carolina 27709
(800) 242-7472

How to Run the PETRO RISc™ Tes



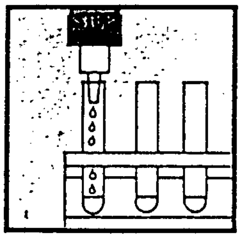
Sample Preparation

A soil sample is extracted with methanol, filtered and diluted.



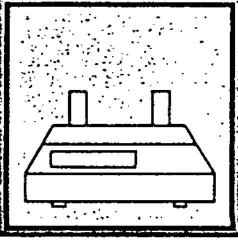
Sample Analysis

The prepared sample and an enzyme-labelled analyte are added to antibody-coated tubes where they compete to bind with the antibodies. If the concentration of gasoline/diesel is high, more sample molecules than enzyme molecules will bind with the antibodies.



Color Development

Coloring reagents are added to the solution which react with the enzyme to give a darker color; a higher concentration of Petroleum Hydrocarbons means fewer enzymes have attached to the antibodies giving a lighter color.



Interpretation of Results

A photometer compares the color development of the sample to a known standard at 100 and 1000 ppm detection levels.

ENSYS PROFILES

Site Assessment and Remediation at an Industrial Site Contaminated with Petroleum Hydrocarbons

SITE CHARACTERISTICS

The fifteen acre site was located in the center of a city. It had been leased to several tenants in the automotive service industry operating from warehouses. The site had been used for this purpose for up to 30 years and a wide range of Petroleum Hydrocarbon products were used by the auto shops.

The site owner retained a large environmental consultant to perform an environmental audit on the site which was required by the bank and the land buyer. The site owner told the consultant that an oil spill had occurred in the past. The release had to be located and cleaned up before the transaction could be completed. Local environmental regulations required that soils with over 200 ppm TPH be removed.

THE PROBLEM

The one month deadline for the impending real estate transaction, the size of the site, and the knowledge of at least one spill, required the consultant develop rapid data acquisition and remediation plans.

THE SOLUTION

The environmental consultant recommended the PETRO·RISc™ soil test for petroleum hydrocarbons to assess the extent of contamination. The use of on-site analytical testing was expected to minimize analytical delays and reduce the number of remobilizations. This allowed removal of contaminated soil in the time frame required.

Benefits of On–Site Petroleum Hydrocarbon Analysis

Project Quality

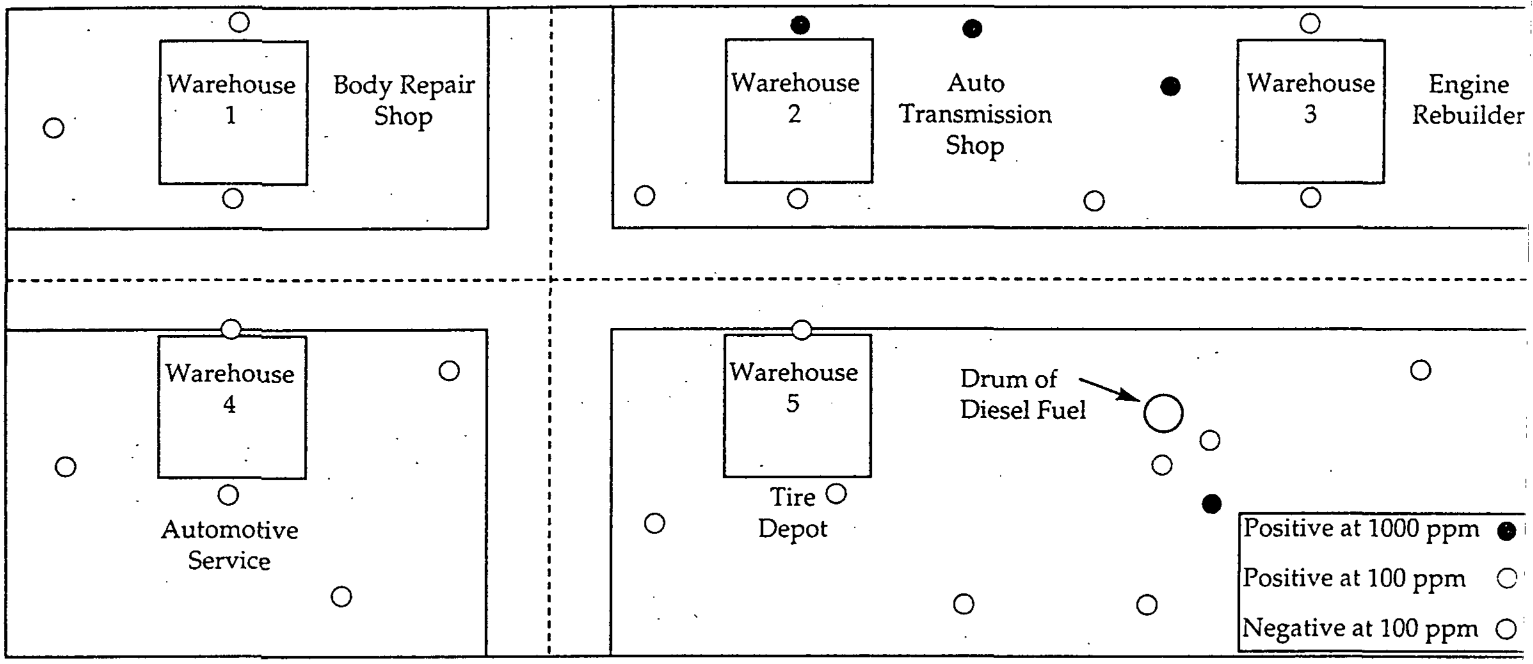
The use of the EnSys PETRO kit allowed for extensive sampling, which ensured reliable identification of hot spots. On-site testing continued during the remediation phase to confirm complete removal of contaminated soil.

Time

The land owner wanted the project to be completed in one month in order to complete the sale. Use of the EnSys method reduced crew/equipment downtime and allowed the consulting engineer to meet the deadline.

Costs

Project cost savings were $ 15,000, and a real estate deal valued at over $250,000 proceeded on schedule. Soil disposal cost was significantly reduced because proper identification of contamination levels was readily available through the use of EnSys PETRO test.



The site contained five warehouses in an inner-city location. The diagram is marked to show soil sampling points and "hot spots".

PROJECT QUALITY

Two consulting engineers worked on-site during the month-long project, carrying out the site assessment and managing subcontractors involved in excavation and soil removal. The engineers used the EnSys Petro RISc™ kit to get on-site data and improve their ability to control the project.

Soil samples were taken at several locations on the site, including areas around the warehouses, dumps, and near used drums. Samples were analyzed on-site at two detection levels, 100 and 1000 ppm. Selected site and QC samples were sent to the lab for confirmation.

"Hot spots" of contamination existed throughout the site. Diesel fuel had leaked from a drum behind one of the warehouses. Contamination was also discovered between an auto transmission and an engine rebuilding facility. The abilty to accuately locate and map "hot spots" within a large diverse site improved project quality.

Further on-site testing was carried out during the excavation and removal activity. The engineers tested soil samples to ensure that the area had been cleaned to below 200 ppm TPH. This procedure reduced the risk of future liability for the site owner.

The consultants were able to assure the client that the best possible professional practice had been used to complete the project. Project quality was maintained within a demanding time schedule through the use of reliable on-site analytical methods.

TIME

The consulting engineers were able to locate and map the contaminated areas during three days on-site. Six seperate mobilizations would have been necessary to complete this task if the team had relied solely on lab data. Reliable on-site data helped the engineeers reduce the time to complete the project from five to three weeks. The client was confident that the proposed sale would be completed on schedule.

MONEY

The use of EnSys PETRO RISc™ tests allowed the consultant to save the client at least $ 10,000 in soil disposal costs. Further savings of $ 5,000 were due to a reduction of crew/equipment costs.

FOR MORE INFORMATION CONTACT:
TECHNICAL SERVICES
(800) 242-7472

P. O. BOX 14063
RESEARCH TRIANGLE PARK
NORTH CAROLINA, 27709

National Environmental Technology Applications Corporation (412) 826-5511

NETAC ENVIRONMENTAL PRODUCT PROFILES

EnSys On-Site Analytical Test Kits

Process Description

- **▲ *Immunoassay/ Chromogenic Technique***

EnSys On-Site Analytical Test Kits provide "real time" analysis of soil and water samples under field conditions. The disposable, hand-held kits operate through the use of immunoassay (antibody reactions) and chromogenic (color generation) technologies orginally developed for the healthcare industry. Samples are tested using tubes coated with an antibody that is specific to an individual compound (e.g., a test for pentachlorophenol) or class of compounds (e.g., a test for PCBs). Reactions with the antibody result in a color change that is proportional to the concentration of the compound in the sample. The color change is then read by a comparative photometer to quantify contaminant concentrations. The test kits are most efficiently used to screen samples to determine the presence of the contaminant of interest. EnSys developed this technique as an alternative to current on-site analysis methods. According to a February 1991 report by the U.S. EPA Environmental Monitoring Systems Laboratory (Las Vegas, Nevada), advantages of the immunoassay method include speed and accuracy of analysis and relatively low cost. Table 1 lists the test kits that are currently available.

TABLE 1: AVAILABLE TEST KITS

Test Kit	Detection Limit
Petroleum fuels soil test	100 ppm
PCB soil test	5.0 ppm
PCB wipe test	10 ug per 100 cm^2
PCP soil test	0.5 ppm
PCP water test	5.0 ppb

Reprinted from *Environmental Technology and Product Profiles*, a NETAC publication featuring innovative and emerging environmental technologies.

Process Application

- **▲ *Soil***
- **▲ *Groundwater***
- **▲ *Wastewater***

- **▲ *Field Analysis and Screening***

- **▲ *PCP***
- **▲ *PCBs***
- **▲ *Petroleum Fuels***

The test kits can be used to determine contaminant concentrations in soil, groundwater, or wastewater samples. Typical applications include site assessment, contaminant mapping, evaluating the effectiveness of remediation, and groundwater and effluent monitoring at landfills, chemical spill areas, and underground storage tank sites. Specific applications for on-site water testing include effluent discharge permit compliance, wastewater treatment process control, and groundwater quality assessment. The company currently offers test kits that screen for pentachlorophenol, PCBs, or petroleum fuels. A unit that will test for polyaromatic hydrocarbons (PAHs) is currently under development. The pentachlorophenol test kit was evaluated under the U.S. EPA SITE Demonstration Program. This study showed that results obtained using the kit were comparable to GC/MS field results. Table 2 summarizes potential applications of the test kits.

TABLE 2: POTENTIAL APPLICATIONS

- Site assessment and monitoring
- Evaluation of remediation effectiveness
- Emergency response assessments
- Wastewater treatment process control
- Stormwater runoff discharge compliance
- Wastewater treatment discharge compliance

CONTACT: EnSys, Inc. P.O. Box 14063 Research Triangle Park, NC 27709 (800) 242-7472

ENVIRONMENTAL PRODUCT PROFILES

EnSys On-Site Analytical Test Kits

Process Operation

- ▲ ***Sample Acquisition***
- ▲ ***Preparation***
- ▲ ***Analysis***
- ▲ ***Interpretation***

The test kit is supplied with enough material for four complete tests. No special training is required to use the test kits as all reagents are premeasured. The basic steps involved in using the kits are listed in Table 3. Following acquistion of the samples, sample preparation is required. For aqueous samples, preparation consists of filtration. For soil samples, preparation includes weighing, extracting, filtering, buffering, and dilution. Following preparation, testing consists of adding the sample, standards, and reagents in a step-wise manner to the antibody coated tubes. The entire procedure takes approximately 20 minutes and results in a color change within each tube proportional to the concentration of the compound of interest. Concentration levels are determined by a comparative photometer that compares the color development in the sample with that in a standard.

TABLE 3: REQUIRED ACTIVITIES

1. Obtain and prepare sample
2. Test sample
   - a. Add standards and sample to coated tubes
   - b. Let stand for 10 minutes
   - c. Add color developing agent
   - d. Let stand for 2.5 minutes
   - e. Add stop reagent
3. Compare sample with standards and interpret results

Vendor Information

- ✓ ▲ ***Bench***
- ✓ ▲ ***Pilot***
- ✓ ▲ ***Commercial***

EnSys, Inc. is a privately-held corporation formed in 1987 by the Synertech Group, Inc., a North Carolina-based venture development group that specializes in starting biotechnology companies. The company specializes in the development and marketing of immunoassay test kits for the analysis of environmental samples. EnSys has worked in conjunction with various branches of the U.S. EPA, large environmental consulting firms, and numerous industrial companies. Two grants to help the company research and develop these kits were awarded by the North Carolina Biotechnology Center in 1988 and 1989. Immunoassay methods are approved by the Food and Drug Adminstration and have been used for over 30 years for medical diagnostics testing. Due to the nature of the test kit applications, extensive product validation studies have been conducted under laboratory and field conditions. Table 4 summarizes currently available validation studies. The company is currently seeking corporate relationships that can complement their technical and marketing skills.

TABLE 4: VALIDATION STUDIES

Product	Validated By	Date
PCB soil test	Gas Research Institute	July 1991
PCP soil test	Mississippi Forest Products Lab	June 1991
PCP water test	U.S. EPA	May 1991

Note: Validation studies currently are under way for the PCB wipe test and petroleum fuels soil test.

United States
Environmental Protection
Agency

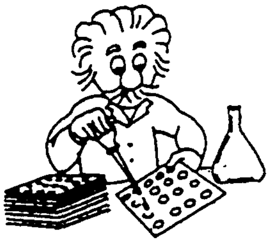
Environmental Monitoring
Systems Laboratory
P.O. Box 93478
Las Vegas NV 89193-3478

November 1991

TECHNOLOGY SUPPORT PROJECT

EPA

Immunochemistry for Environmental Monitoring



INTRODUCTION

The Environmental Monitoring Systems Laboratory - Las Vegas (EMSL-LV) is pioneering an investigation into the usefulness of several immunochemical techniques for monitoring the extent of contamination in various environmental and biological matrices. Immunochemistry includes all methods of sample preparation and analysis that incorporate antibodies that have been developed for specific analytes or groups of analytes. Enzyme-based immunochemical techniques have been in use since the '70s and more recent efforts have focused on their applicability to the complex matrices that face environmental scientists. The EMSL-LV has developed and demonstrated several immunochemical techniques and believes that these methods hold great promise for the quantitative analysis of target analytes for use in ground-water surveillance, *in situ* hazardous waste site monitoring, and assessment of human exposure. Current work involves the analysis of chemicals, like PCBs, nitroaromatics, and certain pesticides, that are difficult to analyze by other analytical methods.

BACKGROUND

Immunochemistry includes techniques such as immunoaffinity and immunoassay. Immunoaffinity is a sample preparation procedure that takes advantage of the attraction between an antibody and a specific analyte. Immunoaffinity preparations have great potential for cleanup of complex samples like dioxins. By rinsing a sample over an antibody-treated surface, scientists can isolate particular compounds in the sample that adhere to the antibody. The isolated compound is then eluted from the immobilized antibody and is ready for analysis by chromatography or immunoassay. One common immunoassay is the enzyme-linked immunosorbent assay (ELISA). The specificity of the antibody for the analyte and the resultant immune complex is the basis for the specificity of immunoassays. Most field immunoassays are colorimetric analytical methods that quantify compounds of interest. A sample is spiked with a known amount of a labelled analyte. The label is typically an enzyme. A *chromogenic substrate* is added to serve as an indicator of compound concentration in the sample. Laboratory-based immunoassays include fluorescent and radioactive methods that have greater sensitivity but are less portable.

FIELD USE

Immunoassays are portable, rugged, and inexpensive. Their use at hazardous waste sites has been investigated by the EMSL-LV. The results of Superfund Innovative Technology Evaluation (SITE) studies indicate a strong correlation between field immunoassays, laboratory immunoassays, and gas chromatography/mass spectrometry. The only equipment needed is a spectrophotometer, various microtiter plates or test tubes, precision pipets, and immunologic reagents. The 96-well microtiter plate is approximately 3" x 6" and has 96 depressions, each capable of holding about 250 μL liquid. Smaller microtiter strips are available that can be assembled to form modular sections for individual analytes. These plates and test tubes are available precoated with the antibody base.

Another field use of immunochemistry is being explored at the EMSL-LV. This use may revolutionize safety and exposure precautions used by workers who deal with hazardous chemicals. Dosimeter badges with an immunochemical twist are available for pentachlorophenol and nitroaromatics. These personal exposure monitors (PEMs) are lightweight, inexpensive, can be analyzed quickly, and provide real time indication of exposure. These badges employ a microdialysis tubing containing an immobilized antibody phase. Immediate identification of high exposure levels is critical to the conduct of safe site characterization.

ADVANTAGES AND LIMITATIONS

The use of immunochemical techniques is gaining acceptance in the area of environmental science. One need that is being addressed is that of specificity. Frequently, immunoassays are available for a class, like PCBs. Specific quantitation for each component would be difficult.

Advantages	Limitations
• Field portable • User friendly • Quick and inexpensive • Potential for wide range of analytes • Useful for many matrices • Low detection limits	• Separate immunoassay needed for each analyte • More complex analysis required for quantitation of specific analytes • Long development time for new antibodies and methods

PEMs are available for pentachlorophenol and are being developed for parathion and chlorpyrifos. The development of PEMs must address the question of diffusion of chemicals through the dialysis tubing, the optimum concentration of the antibody, detection limits and quantitation of the badge, the efficiency of the antibody in capturing the analyte, and the capacity of the device.

FUTURE

The EMSL-LV is active in the development of all immunochemical methods that have potential for Agency use. One new avenue of investigation is the use of antibody-coated fiber optic immunosensors. Another application is the integration of robotics capability for high sample throughput and a tiered analytical approach, i.e., biological and environmental samples, biomarkers, target analytes, and degradation products. This system of analytical procedures will enable scientists to measure contamination at the source, follow the fate and transport of residual amounts, and assess human exposure.

Multi-analyte immunoassays that can identify several analytes simultaneously are expected to expand the desirability of immunoassay technology for environmental use. Work in this area is already underway at the EMSL-LV.

REFERENCE

Immunochemical Methods for Environmental Analysis, J. M. Van Emon and Mumma, R. O., eds., ACS Symposium Series 442, ACS, Washington, DC, 1990, 229pp

FOR FURTHER INFORMATION

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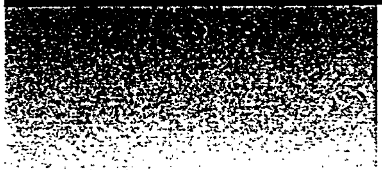
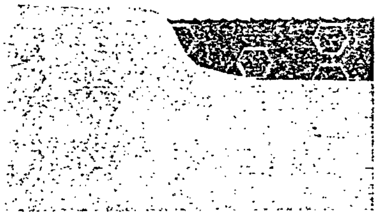
The Technology Support Center fact sheet series is developed and written by Clare L. Gerlach, Lockheed Engineering & Sciences Company, Las Vegas.



D TECH™ BTEX Field Test Kit



Benzene, toluene, ethylbenzene, and xylene (BTEX) make up between 20-40% of gasoline's composition. This makes BTEX the test of choice for investigating gasoline contamination of soil and water from underground storage tanks and spills. Screening soil and water samples for BTEX in the field has never been easier or faster. With the D TECH BTEX Field Test Kit, you can quickly and economically identify hot spots, map sites, monitor remediation, determine risk, and select samples for laboratory analysis. A complete test takes less than 25 minutes with ppb sensitivity and semiquantitative accuracy. In field tests D TECH BTEX test kit results show excellent correlation with EPA gas chromatography methods.

General Description

The D TECH BTEX Field Test Kit is based on an Enzyme Linked Immunosorbent Assay (ELISA), a technology recognized by the EPA as a valuable field screening tool. The test is specific for the toxic aromatic components of petroleum products including benzene, toluene, ethylbenzene and xylene, referred to collectively as BTEX.

The basic D TECH BTEX kit contains materials to test four (4) water or soil samples and is designed as an on-site workstation. Step-by-step instructions guide the user through the analysis procedure. No training or previous laboratory or field testing experience is required. Soil samples require prior extraction using the D TECH BTEX Soil Extraction Pac.

Methodology

For the D TECH BTEX Field Test Kit, antibodies specific to BTEX are linked to latex particles and then used to capture BTEX molecules present in the sample. The latex particles are collected on the membrane surface of a collection device and a color developing solution is added. The presence (or absence) of BTEX can then be quantitated with a hand-held DTECHTOR meter or, for quick screening, with the color comparison card supplied with the kit.

D TECH BTEX TEST KIT FEATURES.

Sensitive
- 600 ppb BTEX in water
- 2.5 ppm BTEX in soil

Fast
- Provides test results for water or soil samples in less than 25 minutes

Easy-to-use
- Requires no special training

Convenient
- Materials for testing water samples included in basic kit; prior extraction with D TECH BTEX Soil Extraction Pac (TK-1003S-1) required for soil samples
- Kit package is designed for use as on-site workstation

D TECH™
Environmental Detection Systems

Assay Range

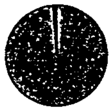
	Water	Soil
BTEX w/DTECHTOR	0.6-10 ppm	2.5-35 ppm
BTEX w/Color Card	0.6-10 ppm	2.5-35 ppm

Method Correlation

Based on 66 field and laboratory samples, the D TECH BTEX test kit with the DTECHTOR meter correlates to the EPA SW-846 gas chromatography method 8020. Correlation indicates that the methods agreed on the presence or absence of BTEX in the samples in the detectable range of the kit. The false positive and false negative results are interpreted according to the recommended EPA definitions.

Correlated values	99%
False positives	<1%
False negatives	<0.1%

(no false negatives recorded)



Interfering Substances

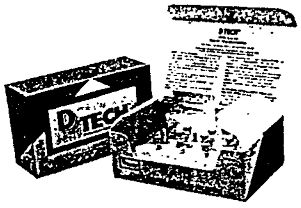
The D TECH BTEX test kit has been tested for cross reactivity with the following compounds:

Compound	MDL* (ppm)
0-Cresol	1.5
Chlorobenzene	1.8
Nitrobenzene	6.0
1, 2, Dichlorobenzene	6.0
2 Nitrophenol	7.0

*The Minimum Detection Limit (MDL) is defined as the lowest concentration of compound that yields a positive test result equivalent to 0.6 ppm BTEX.

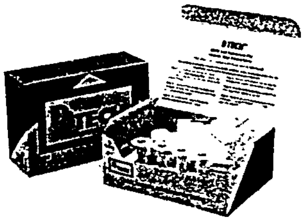
Soil Matrix Effects

The BTEX procedure has been tested using 32 different soil types. No significant matrix effects have been determined.



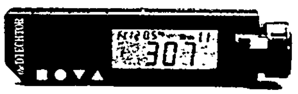
D TECH BTEX Field Test Kit

Order No. TK-1003-1
- Includes materials necessary to test four (4) samples
- Step-by-step instruction guide
- Color comparison card



D TECH BTEX Soil Extraction Pac

Order No. TK-1003S-1
- Includes materials necessary to perform four (4) sample extractions
- Step-by-step instruction guide



the DTECHTOR Environmental Field Test Meter

The D TECHTOR is a hand-held reflectometer for interpreting results of D TECH BTEX test samples. It is completely portable and powered with a 9-volt, plug-in battery. Operation is a simple push-button procedure that takes only one minute. Readings are displayed in a large, easy-to-read window, along with sample ID, date, and time of analysis. Results for up to 127 samples can be stored in memory. Size: 7" x 2" x 1.5" Weight: 170 gm (6 oz) with battery

Order No. TK-1001M-1
- Includes calibrators, protective cannisters, and meter cover
- Step-by-step instruction guide
- Maintenance and service manual

Ordering Information

D TECH Field Test Products can be ordered from EM Science by calling toll-free **1-800-222-0342** or by sending a fax to 1-800-336-4422.

D TECH Field Test Products currently available from EM Science are TNT (Quantitative), BTEX and PCB test kits, the D TECH Soil Extraction Pacs, and the DTECHTOR Environmental Field Test Meter.

For complete technical information on D TECH Field Test Products, call the EM Science Technical Support Group at **1-800-222-0342.**

D TECH™
Environmental Detection Systems

EM Science/Strategic Diagnostics Incorporated
480 Democrat Road
Gibbstown, NJ 08027
800-222-0342

D TECH™

BTEX TEST KIT INSTRUCTION GUIDE

TK-1003-1
800-222-0342

IMPORTANT

Read all instructions and handling procedures before using this kit. For assistance call the TECHNICAL SERVICE HOT LINE 1-800-222-0342.

INTENDED USE

The D TECH™ BTEX (Benzene, Toluene, Ethylbenzene and Xylene) on-site and laboratory test kit is designed to provide quick, semiquantitative and reliable test results for making environmental decisions.
The D TECH BTEX Test Kit can be used on-site for identifying "hot spots", site mapping, monitoring of remediation processes and selecting site samples for laboratory analysis.

PRINCIPLE

The D TECH system for analyzing trace amounts of BTEX is based on immunoassay technology.
An antibody specific for BTEX has been labeled with an enzyme.
This antibody is reacted with BTEX and solid particles forming a complex which is collected on the membrane of the cup assembly.
A color developing solution added to the surface of the cup assembly develops a color inversely proportional to the concentration of BTEX Equivalents in the sample (less color indicates more BTEX present in sample).
BTEX Equivalents are measured at parts per million (ppm) in soil and parts per billion (ppb) in water samples.

TEST KIT DESCRIPTION

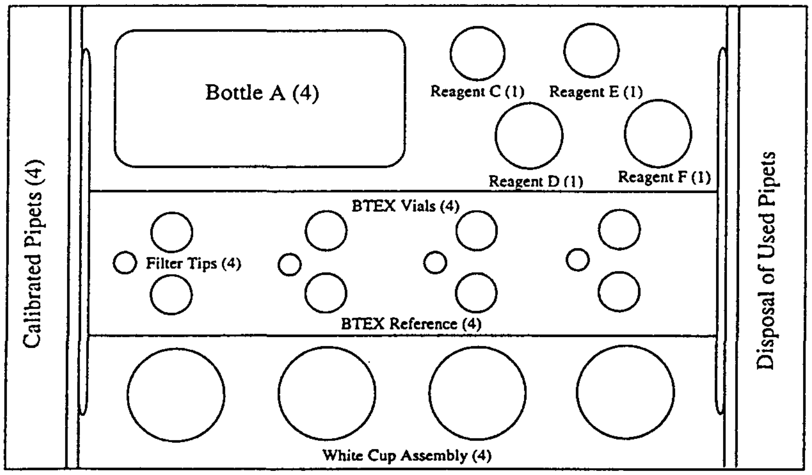
The D TECH BTEX Test Kit, Item #TK-1003-1, contains sufficient materials to perform four tests.
This kit can test water samples or be used with the D TECH BTEX Soil Extraction Pac, Item #TK-1003S-1, to test soil samples.
The BTEX Soil Extraction Pac contains only the materials needed to extract BTEX from soil for semiquantitation with this D TECH BTEX Test Kit. The results can be obtained by using the enclosed Color Card or the DTECHTOR Meter, Item #TK-1001M-1.

STORAGE/STABILITY

This kit has excellent stability at room temperature and under refrigeration. For expiration dating under these conditions, see the package label.

MATERIALS PROVIDED

See the tray diagram below. This diagram includes the kit component names and quantity of each item.



Not shown in diagram

Used Kit Label (1)

Instruction Guide (1)

Color Card (1)

Data Labels (4)
for Cup Assembly

Red Dot Labels (4)
for identifying used
Bottle A components

ACCESSORIES SUPPLIED BY USER

Timing Device (minutes)
D TECH BTEX Soil Extraction Pac, Item #TK-1003S-1 (if testing soil samples)
the DTECHTOR Meter, Item #TK-1001M-1 (optional)

D TECH™

BTEX TEST KIT INSTRUCTION GUIDE

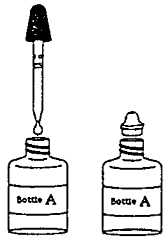
TK-1003-1
800-222-0342

This package is designed to serve as a WORK STATION. At the conclusion of the test, the components can be left in the package for proper disposal.
Important: Read all Health/Safety Comments on page 4 prior to use.

Step 1: Choose the corresponding sample source to determine the first step.

WATER SAMPLE: Using a clean calibrated pipet, transfer **1 mL** of sample to **Bottle A**. Snap a filter tip on **Bottle A**. Gently mix.

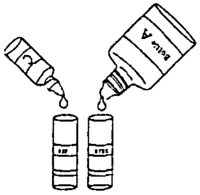
SOIL SAMPLE: Using a clean calibrated pipet, transfer **1 mL** of **Bottle 2** solution from the D TECH BTEX Soil Extraction Pac, (Item #TK-1003S-1) to **Bottle A**; snap a filter tip on **Bottle A**. Gently mix. Re-cap **Bottle 2** and set aside.



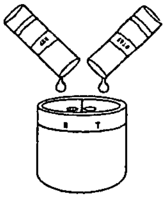
Note: The vials in the next two steps need to stand five (5) minutes after dispensing the liquid. The solutions in these vials will remain cloudy.

Step 2: Squeeze **Bottle A** filling the **BTEX Vial** to a level between the two lines (approximately 13-14 drops). Gently mix.

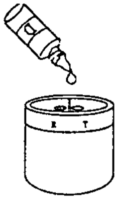
Step 3: Squeeze the contents of **Reagent C** (white cap) to fill the **BTEX Reference** vial to a level between the 2 lines. Gently mix.



Step 4: After 5 minutes, pour the contents of the **BTEX Vial** onto the T (test) side of the cup assembly. Pour the contents of the **Reference** vial onto the **R** side of the cup assembly. Allow the liquid to drain completely through on both sides.

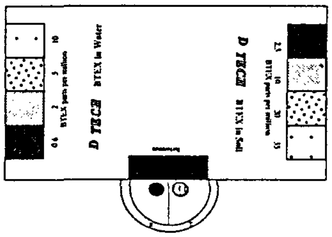


Step 5: Add approximately 10 drops of **Reagent D** solution (yellow cap) into each side of the cup assembly. Drain completely.



Step 6: Add approximately 5 drops of **Reagent E** solution (blue cap) to each side of the cup assembly. Be sure to add this solution immediately to the second well after addition to the first well. Drain completely.

Step 7: Read the results when the color of the **R** (left) side of cup assembly matches the color of the reference bar of the **Color Card**. (The color development time is approximately 10 minutes at 70°F. More time is required at lower temperatures and less time is required at higher temperatures.)



COLOR CARD: Match the color on the **T** side of the cup assembly to the **Color Card**.
and/or
the DTECHTOR: Quantitate the result using *the* DTECHTOR Meter (see Instrument Operator's Guide for complete instructions).

See Interpretation of the Test section (page 3) to determine concentration of BTEX Equivalents. Record the result on a **Cup Assembly** label and apply to the cup.

Note: To preserve the color for up to 4 hours (optional), add approximately 8 drops of Reagent F solution (red cap) into each side of the cup assembly. Drain completely.

the DTECHTOR Meter Set Up

the DTECHTOR light sources must be calibrated whenever the meter is turned on. Calibrators are provided with the meter for this purpose. The **Calibrator** must be clean and white to insure valid results.

Step 1: Insert **Calibrator** into the **Meter Head** and hold firmly in place. (ZERO)

Step 2: Press the Square Button 1 time. When calibration is complete the meter will display........ (SET)

Step 3: Remove **Calibrator** and return it to its protective cannister. Display remains............ (SET)

Step 4: Press the Square Button 1 time to select meter program #1 (Program to be used for this D TECH test kit). (SET #1)

Step 5: Insert Cup Assembly (test) into the Meter Head and firmly hold in place. (TEST #1)

Note: The #1 in the upper right corner of the display window in Steps 4 & 5 corresponds to the meter program number being used to obtain the meter reading.

Step 6: Press the Square Button 1 time. (- - -)
Obtain the meter reading.
For example............ (46%)

Use *the* DTECHTOR Table (see page 3) and the meter reading to determine the concentration of BTEX.

Note: If the meter displays "WAIT", remove the Cup Assembly. Allow the reference color to develop further and try again.

Step 7: Record the result then press the Square Button 1 time while holding the **Cup Assembly** in place. (- - - -)

Step 8: Key in a 4 digit Label. (Optional)

Step 9: Remove **Cup Assembly**. (SET #1)

Step 10: Insert the next **Cup Assembly** (test) and repeat Steps 5 - 9.

PERFORMANCE CHARACTERISTICS

INTERPRETATION OF THE TEST The results from the D TECH BTEX Test Kit can be interpreted using either the Color Card supplied with the kit or *the* DTECHTOR and the table provided below. If the color of the test does not exactly match a panel of the color card, user interpretation is required.

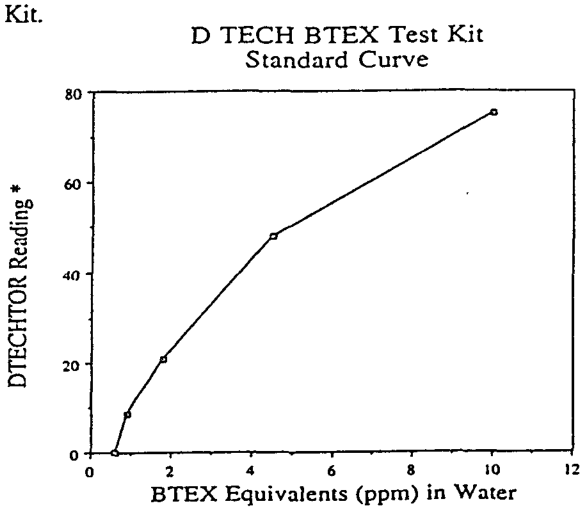
the DTECHTOR Table

Sample	*the* DTECHTOR Reading	BTEX Equivalents (ppm)
Water	LO	<0.6
	1 - 10	0.6 - 1.0
	10 - 25	1.0 - 2.5
	25 - 50	2.5 - 5.0
	50 - 75	5.0 - 10
	HI	>10
		(ppm)
Soil	LO	<2.5
	1 - 15	2.5 - 5.0
	15 - 35	5.0 - 10
	35 - 60	10 - 20
	60 - 75	20 - 35
	HI	>35

SENSITIVITY The D TECH BTEX Test Kit can be used to reliably measure BTEX in the following ranges:

Sample	*the* DTECHTOR	Color Card
Water (ppm)	0.6 - 10	0.6 - 10
Soil (ppm)	2.5 - 35	2.5 - 35

The Minimum Detection Limit (MDL) of the test for BTEX in a water sample is 600 ppb and in soil is 2.5 ppm. The graph below is a typical standard curve for the D TECH BTEX Test Kit.


D TECH BTEX Test Kit
Standard Curve

*Percent Reflectance Relative to Reference

SPECIFICITY The D TECH BTEX Test Kit has been tested for cross-reactivity with compounds having similiar structures to the BTEX group. The table below summarizes the cross-reactivity of these compounds in water samples using *the* DTECHTOR. A positive test result may be due to the presence of BTEX (BTEX Equivalents). Samples testing positive for BTEX should be confirmed by standard methods. The D TECH BTEX Test Kit has been designed to minimize the effect of environmental interferences. Sample pH does not effect test results.

Compound	IC_{50}[a] (ppm)	MDL[b] (ppm)	Cross-reactivity[c]
Benzene	12.6	1.2	+
Toluene	4.5	0.6	+
Ethylbenzene	4.3	0.6	+
Xylenes	4.3	0.6	+
O-Cresol	10.0	1.5	+
Chlorobenzene	14.0	1.8	+
1,2-Dichlorobenzene	21.0	6.0	+
Nitrobenzene	23.0	6.0	+
2-Nitrophenol	55	7.0	+
Methylcyclohexane	NA	100	-
cis 1,3-Dichloropropene	NA	200	-
Iso-octane	NA	NA	-
Benzoic Acid	NA	NA	-
Hexane	NA	NA	-

[a] The IC_{50} is defined as the concentration of compound required to produce a test response equivalent to 50% of the maximum response.

[b] The Minimum Detection Limit (MDL) is defined as the lowest concentration of compound that yields a positive test result.

[c] A compound is considered cross-reactive when a concentration 100 times the MDL of BTEX (60 ppm) yields a positive test result

NA - Not Applicable. Results could not be quantitated by the addition of 1000 ppm of analyte.

TESTING HIGHER BTEX CONCENTRATIONS

BTEX concentrations greater than the upper limit of the test may be determined by diluting the extract with a highly purified purge and trap grade methanol (such as EM Science Purge and Trap Grade Methanol, item number MX0482). For example, an extract from a 100 ppm soil sample, processed using the D TECH BTEX Soil Extraction Pac, may be diluted 1:10 in methanol and run in the D TECH BTEX Test Kit. The concentration of the undiluted sample (100 ppm) is determined by multiplying the BTEX concentration of the diluted sample (10 ppm) by the dilution factor (10). For further information, please call our technical service hot line 1-800-222-0342.

HEALTH/SAFETY

Material Safety Data Sheets (MSDS) have been supplied with the purchase of this product. The MSDS should be read before using this test. During the execution of the test, any excess BTEX is absorbed into the **Cup Assembly** absorbant plug. It is not retained on the surface of the **Cup Assembly**.
When all kit components have been used, apply the warning label to seal the box and set it aside for proper disposal. In this section, we have emphasized health and safety precautions that should be followed when handling these solutions.

PROTECT EYES WITH SAFETY GLASSES
PROTECT SKIN WITH PROTECTIVE GLOVES

Associated Hazards

May be irritating to skin, eyes, and mucous membranes.

Symptoms of Exposure

May be irritating on contact with skin, eyes, and mucous membranes.

First Aid Measures

GET MEDICAL ASSISTANCE FOR ALL CASES OF OVEREXPOSURE

Skin:	Wash thoroughly with soap and water.
Eyes:	Immediately flush with water for at least 15 minutes.
Inhalation:	Remove to fresh air; give artificial respiration if breathing has stopped.
Ingestion:	Get immediate medical attention; if conscious, give water freely.

QUALITY CONTROL

All D TECH Test Kits are thoroughly quality controlled and manufactured at Strategic Diagnostics Incorporated's GMP facility. All products undergo extensive validation and field testing to assure accuracy and reliability.
All lots of product are thoroughly quality controlled to consistently meet the published specification.

EM SCIENCE/Strategic Diagnostics Inc
480 Democrat Road
P.O. Box 70
Gibbstown, N.J. 08027
(800) 222-0342

VOLUME 1 ISSUE 1 WINTER 1992-93

Site D-TECHTOR

THE

QUICK,

ACCURATE,

RELIABLE

ON-SITE

TESTING

FREE LITERATURE AVAILABLE BY CALLING TOLL-FREE HOTLINE

Detailed literature on the D TECH Environmental Detection System is available by calling the EM Science Technical Service toll-free hotline at 1-800-222-0342. Find out how fast, accurate, economical, and easy on-site sample screening can be. ■

D TECH™
Environmental Detection Systems

EM Science
P.O. Box 70
480 Democrat Road
Gibbstown, NJ 08027

ENVIRONMENTAL DEMANDS FUEL DEVELOPMENT OF D TECH™ ENVIRONMENTAL DETECTION SYSTEM

The D TECH Environmental Detection System was developed to fulfill a critical need within the environmental engineering community for an accurate, low-cost, on-site test kit for the screening of soil and water contamination.

Field screening for contaminants is a relatively new concept that is gaining wide acceptance in the environmental sector as a quick, reliable method for on-site testing. The D TECH Environmental Detection System has reduced the sophisticated immunoassay technology to a very user-friendly format that can be used quickly and efficiently by personnel with little or no laboratory training.

Field testing has been used by the general chemical industry for several years. The environmental community, on the other hand, has been slow to capitalize on the concept because of the rigid, bureaucratic nature of the industry and the stringent state and federal guidelines governing environmental remediation.

Today, however, environmental engineers and related disciplines have realized that streamlining the analytical segment of their business with on-site field screening can save time and money by reducing the time required to define the extent of site contamination, identify hot spots, monitor the progress of remediation, and select samples for laboratory analysis.

"There were several key goals in the development of the D TECH Environmental Detection System," says D TECH Marketing Manager, Bruce Crane. "First, the product had to provide quick results and be simple and easy to use. Second, the kits had to provide accurate, reliable data conducive to making sound environmental decisions. And third, it had to be cost-effective. We have accomplished all of these goals with the D TECH Environmental Detection System."

The D TECH field analytical technique, when properly applied, is extremely specific, accurate, and precise. Test results can be obtained in a matter of minutes and the tests are not significantly affected by the composition of the sample (soil or water). Detection ranges were developed to correspond to environmental "action levels".

"The D TECH test essentially takes a Polaroid snapshot that enables environmental engineers to make immediate decisions", says Crane. "It eliminates the 2-4 week waiting period usually associated with laboratory analysis.

The D TECH Environmental Detection System is a tool you can work with immediately, and the system's 'cookbook' procedure allows the user to run as many samples as desired, without the technical skills required in the laboratory."

D TECH's Environmental Detection System's first generation of environmental detection systems includes the TNT/RDX Test Kit developed specifically for the detection of explosives-related contaminants in soil

(Continued on page 2)

FREE TRANSPORT PACK WITH D TECH PURCHASE

Take the D TECH Environmental Detection System into the field. Order any six boxes of D TECH test kits by December 31, 1993, and we'll give you a free transport pack. If you're not 100% satisfied with any of the D TECH products, we'll refund your money and you can keep the pack! ■

THE ADVANTAGES OF ON-SITE TESTING

Field screening has obvious benefits when attempting to characterize specific contaminants from a leak or spill, and proceeding with remedial action when time and schedule are critical and delays costly. D TECH detection systems significantly reduces delays in assessment and remediation caused by off-site sample shipment and analysis.

The immunoassay method of field screening will continue to grow in importance as government regulations become more stringent. D TECH kits will enable field personnel to have early information about potential contaminants, allowing companies to implement required health and safety measures. The test kits are also contaminant-specific, which precludes interference from other compounds.

Field screening technology is rapidly closing the gap in bringing analytical answers to a contaminated site in a cost-effective manner. The technology combines the specific binding properties of an antibody molecule with a read-out system for the purpose of detecting and quantifying compounds. All of this chemistry is accomplished in a few easy steps that are applied to the processed sample or dilution thereof.

The regulatory community has long recognized the potential savings in time and expense offered by the successful application of field screening to environmental samples.

The Environmental Protection Agency (EPA) recently concluded an investigation of the use of immunoassays for field analysis. The study helped clarify the advantages that the new technology can provide the environmental industry, including low detection limits, low cost, ease of use, speed of obtaining results, and field portability. The EPA encourages the development of technologies and commercial products for on-site work.

Additional features and benefits include:

- Real-time data in a manner of minutes.
- Field technicians can process between 50 and 100 samples per day.
- Site analytical costs can be reduced as much as 40 percent.
- Increased level of information with no increase in cost.
- Timely, in-process evaluation of soil as it is being excavated, removed, or remediated.
- Field tests can greatly shorten the elapsed time and operating costs associated with locating and defining ground water contamination.

These advantages and more make it very conducive for environmental companies to include field screening in their work plan as part of an overall sampling and analytical program. ■

TO ORDER, CALL OUR TOLL-FREE HOTLINE

D TECH Environmental Field Screening Products are as easy to order as they are to use. Simply place your order by calling our toll-free Customer Service Hotline at 1-800-222-0342 with your Purchase Order Number. You may also order by FAX at (609) 423-4389. For additional convenience, you may use your Visa or MasterCard.

PRODUCT	ORDER NUMBER	UNIT PRICE
TNT/RDX Explosives Test Kit *	TK-1001-1	$99.00
TNT/RDX Soil Extract Pac *	TK-1001S-1	$24.00
PCB's Test Kit *	TK-1002-1	$120.00
BTEX Test Kit *	TK-1003-1	$99.00
BTEX Soil Extract Pac	TK-1003S-1	$24.00
D-TECHTOR (Quantitative Instrument)	TK-1001M-1	$299.00

* Each kit contains material for four (4) tests.

D TECH is a registered trademark of EM Industries, Inc.

VISIT THE D TECH BOOTH AT LAS VEGAS SYMPOSIUM

The D TECH Environmental Detection System will be showcased at the Third International Symposium on Field Screening Methods for Hazardous Wastes and Toxic Chemicals February 24-26, 1993 at the Sands Hotel in Las Vegas, Nevada. Visit our booth for a demonstration, technical information, and a free sample. ■

D TECH CALENDER

The D TECH Environmental Detection System will be showcased at the following industry trade shows during the first half of 1993:

- Third Annual Symposium on Field Screening Methods for Hazardous Wastes and Toxic Chemicals, February 24-26, Sands Hotel, Las Vegas, NV.
- PittCon '93, March 8-11, Atlanta, GA.
- HAZMACON '93, April 6-8, San Jose Convention Center, San Jose, CA.
- Federal Environmental Restoration Conference, May 25-27, Sheraton Washington Hotel, Washington, D.C.
- International HazMat, June 9-11, Atlantic City Convention Center, Atlantic City, N.J. ■

Environmental Demands

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and ground-water at military installations. This product also has potential for use by forensic scientists conducting criminal investigations involving explosives.

The D TECH Environmental Detection System also offers a BTEX Test Kit developed specifically for testing petroleum and gasoline-based contaminants in soil and water. A third product is the PCB's Test Kit developed for detection of PCB contamination in soil.

In addition to these, there are a host of other environmentally useful kits scheduled to join these products. ■