018502

GROUND WATER MIGRATION MANAGEMENT
REMEDIAL INVESTIGATION

Sheridan Disposal Services Site
Hempstead, Texas

Volume I

ERM-Southwest, inc.

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In Partial Fulfillment of Consent Order Requirements
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REMEDIAL INVESTIGATION

Sheridan Disposal Services Site
Hempstead, Texas

Volume I

Prepared for:

The Sheridan Site Committee

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EXECUTIVE SUMMARY

The Sheridan Disposal Services Site, located in northern Waller County, Texas was a commercial waste disposal facility owned and operated by Mr. Duane Sheridan from the late 1950's until its closure in 1984. The facility consists of a main pond whose surface area varies from 12 to 15 acres (depending on water level), a 42 acre irrigation/evaporation system, and a 17 acre dike around the main pond. An inoperable incinerator and a group of nine treatment and storage tanks are located on the east side of the main pond.

Wastes brought to the site were disposed of by methods including separation, open pit burning and incineration. Ashes, residues and some liquid wastes were deposited in the main pond. These wastes and their impact on the ground water beneath the SDS site are the subject of this Groundwater Migration Management Remedial Investigation (GWRI) report.

Major conclusions reached in this report include:

1. There are two aquifers of concern under the SDS site. The shallow aquifer consists of the lower part of the Brazos River Alluvium and has been designated stratum B. This aquifer occurs under unconfined (water table) conditions. The deeper aquifer, referred to as stratum D, occurs under confined conditions at the site. Stratum D is part of the Fleming Formation. In this area, the Fleming Formation is designated as a part of the Evangeline Aquifer. These two aquifers are separated by 20-30 feet of clay, designated as stratum C and geologically part of the Fleming Formation.

2. Within a three-mile radius downgradient of the site there are no known wells being used that are screened in the Brazos River Alluvium. There are several wells potentially screened in the same zone as the confined aquifer under the site (stratum D) that are regionally downgradient of the site. However, ground water flow direction for stratum D in the area immediately around the SDS site has been in the opposite direction of regional flow due to localized influences of the Brazos River.

3. Ground water flow direction in stratum B changes with river stage. In general, the water flows north or northwest toward the Brazos River. When the river reaches and surpasses approximately 140 feet MSL at the site, the ground water begins to flow south, into the aquifer, and then west away from the site. The direction changes back to the north/northwest soon after the river drops below 140 feet. On an

annual basis the net movement of ground water is to the north. In stratum D, ground water flows to the northwest, toward the Brazos River, for the period of record (August 1987 through February 1988). During this time river stage has been relatively low (<135') and it is not known if this aquifer will change its flow direction when the river stage rises.

4. There is a difference in height (head) between the water elevations in the two aquifers. In general, for the period of record (November 1985 through February 1988), when the river stage is low, the confined aquifer (stratum D) has a higher head than the unconfined aquifer (stratum B) and the head potential is upward. When the river stage is high this trend is reversed. This situation is true at the site except away from the river at the well nest (see Figure 3-6). Here, head in the unconfined aquifer is higher than in the confined aquifer during prolonged low river stage. The head in the confined aquifer is higher than in the unconfined aquifer at the well nest when the river stage is high or when it has been fluctuating around 135-140 feet and above. On an annual basis, the net head potential flow direction is upward everywhere at the site, greatly decreasing the potential for downward constituent migration under the site from stratum B to stratum D.

5. Pumping test data were used to analyze the potential hydraulic connection between strata B and D by pumping on stratum D and monitoring changes in water level in both strata B and D. Using the Hantush-Jacob method of curve matching, a hydraulic conductivity on the order of 10^{-4} cm/sec was calculated. This large amount of "leakage", if coming from stratum B down through stratum C into stratum D during the pumping test, would cause some drawdown in the unconfined aquifer. A very small amount of decrease in the water level in stratum B was noted during the pumping test. Using this value as the amount of drawdown due to pumping, the hydraulic conductivity in stratum C was calculated to be on the order of 10^{-7} cm/sec. This permeability corresponds with the clayey soil type which comprises stratum C. The remainder of the leakage must be coming from below stratum D, that is, through stratum E from below.

6. Low levels of some volatile constituents, no PCBs and some trace metals have been detected in the shallow unconfined aquifer (stratum B) in a limited area to the north and northwest of the main pond. In the confined aquifer (stratum D) no levels of constituents above background values were found at the site.

GROUND WATER MIGRATION MANAGEMENT
REMEDIAL INVESTIGATION

SHERIDAN DISPOSAL SERVICES SITE
HEMPSTEAD, TEXAS

1 - INTRODUCTION

In accordance with the Administrative Order on Consent for the Sheridan Disposal Services site in Hempstead, Texas, a Ground Water Migration Management Remedial Investigation (herein referred to as GWRI) has been completed. The purpose of the GWRI, as part of the second operable unit RI/FS, is to define the hydrogeologic setting of the area and assess the impact, if any, of disposal activities on the ground water beneath and adjacent to the site. Previous investigations for the Source Control RI (first operable unit) defined the nature and extent of possible contamination in soil at and adjacent to the waste disposal facilities. The Source Control FS (first operable unit) has recommended remedial alternatives for site clean-up of waste areas.

Field studies supporting the GWRI include subsurface soil borings, installation of monitor wells, periodic water level measurements, aquifer testing and ground water sampling of the upper two aquifers that lie under the disposal site. Data utilized for this report were collected from January 1987 through the present. Information from the Source Control Remedial Investigation (referred to as SCRI) of July 1987 and Source Control FS (November 1988) is also used, where appropriate, to supplement the findings of this report. An additional ground water sampling event will take place when the Brazos River reaches a high water stage or by June 1989, whichever comes first. The results of that sampling will be presented as an addendum to this report.

1.1 Site History

1.1.1 Geographical Location

The Sheridan Disposal Services (SDS) site is located in Waller County, Texas approximately nine miles north-northwest of the City of Hempstead, Texas and two miles northwest of the intersection of Clark Bottom Road and Farm Road 1736 (Figure 1-1). The property is bounded on the east, south and west sides by farm and ranch lands, and on the north by the Brazos River. The site lies within the Gulf Coastal Plain Physiographic Province and is transitionally positioned between the Post Oak Savannah and Blackland Prairie Natural Regions of Texas. (SCRI, July 1987).

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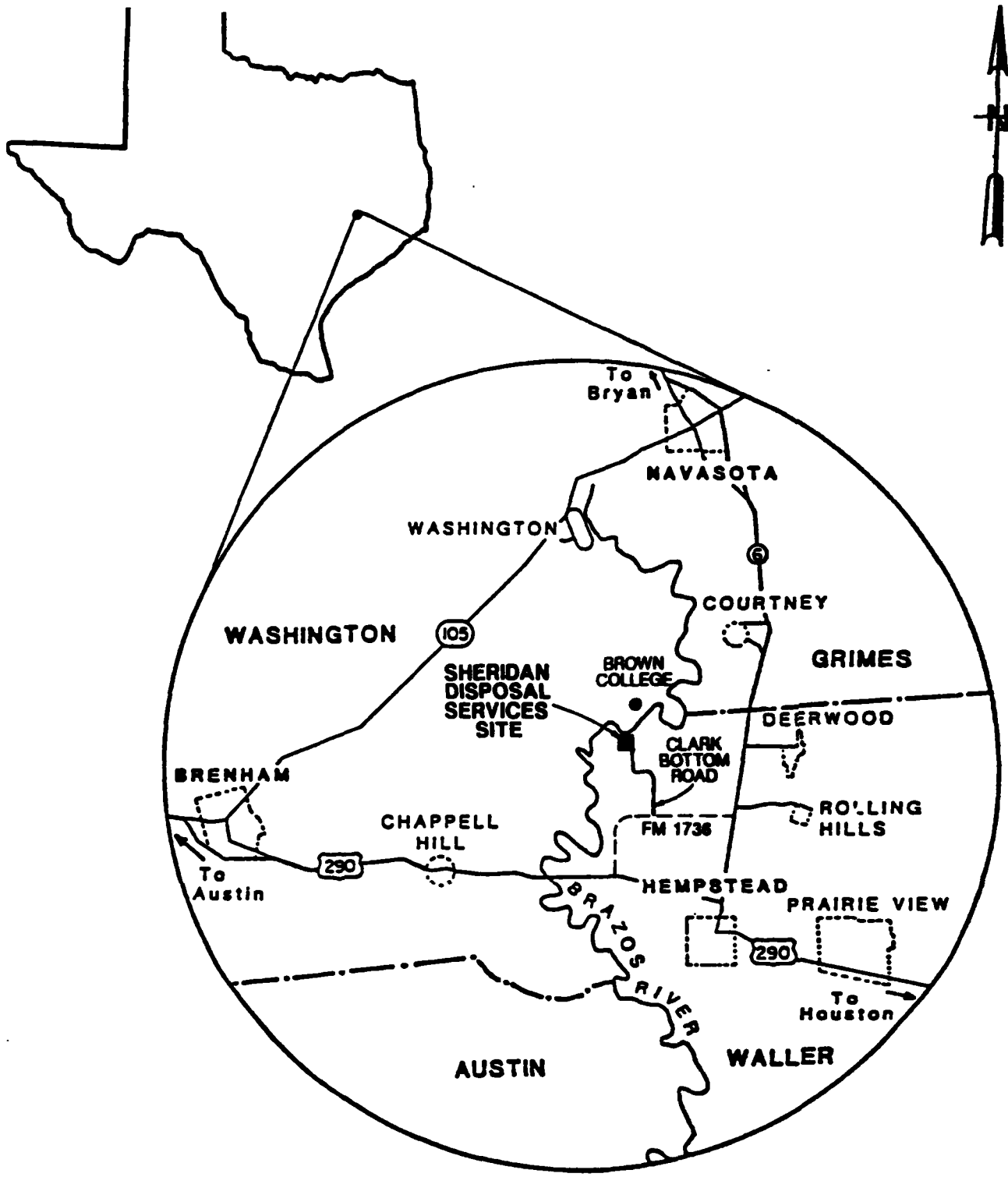

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SCALE (MILES)

SOURCE: REI, MARCH 1986

ERM-Southwest, Inc.
NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

DATE 12/30/88 | W.O.NO. 9115A007

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FIGURE 1-1

REGIONAL COMMUNITIES WITHIN A 12-MILE RADIUS

Sheridan Disposal Services
Hempstead, Texas

1.1.2 Facility Description

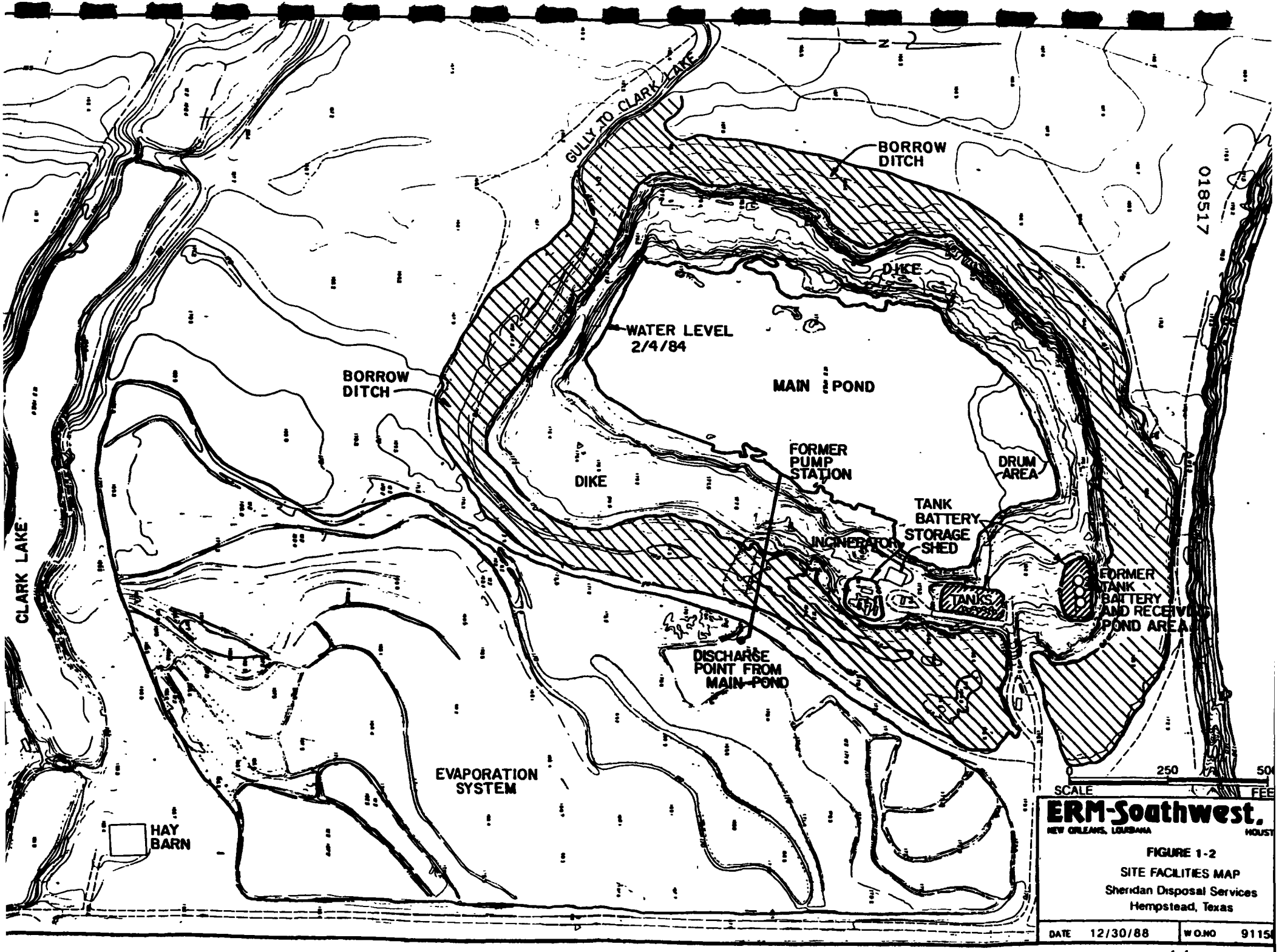
The facility currently occupies approximately 110 acres, and includes a 42 acre irrigation/evaporation system, a 12 acre main pond and a 17 acre dike area around the main pond (Figure 1-2). The area of the main pond and dike are based on a water surface elevation in the main pond of 170.5 feet (mean sea level); these areas will vary with changes in the main pond water level. An inoperable incinerator and a group of nine treatment and storage tanks are located on the east side of the main pond on the dike. The remaining acreage consists of borrow ditches excavated for construction of the dikes and other "buffer zone" acres inside the perimeter fence.

The main pond is located in a naturally occurring low-lying area that was gradually expanded to a maximum size of about 22 acres utilizing a system of levees. The main pond was used as a surface impoundment for material disposal and for open pit burning. The levee was built of native soils from around the pond and from combustion residuals from waste burning. Some sludges underlie parts of the levees. Over time, the levee height was increased using barrels, ash from the incinerator, and additional native soils. This mixture was also used to fill in part of the main pond as an attempt at closure. This partial closure activity reduced the size of the main pond to approximately 15 acres.

Water that accumulated in the main pond due to precipitation was pumped into the irrigation/evaporation system and allowed to evaporate. The tanks were used for the separation and treatment of oil/water emulsions and storage of solvents and fuel oils.

1.1.3 Chronological History of Site Management, Use and Modifications

The Sheridan Disposal Services site, owned and operated by Mr. Duane Sheridan of Hempstead, Texas, began accepting industrial wastes for disposal in the late 1950's. These wastes were disposed of by open pit burning and surface impoundment of ash residue in a naturally low-lying area on Mr. Sheridan's property. As the volume of material accepted at the site increased, a dike composed of native soils and combustion residuals from waste burning was constructed (sometime in late 1963) around the natural depression to form the main pond. This levee was completed such that some sludges were covered by the base of portions of the dikes. Native soils appear to have come from the borrow areas shown in Figure 1-2. These site management practices and facilities were used through 1971.


GULLY TO CLARK LAKE
BORROW DITCH
018517
DIKE
WATER LEVEL 2/4/84
BORROW DITCH
MAIN POND
FORMER PUMP STATION
DRUM AREA
DIKE
TANK BATTERY STORAGE SHED
INCINERATOR
TANKS
FORMER TANK BATTERY AND RECEIVING POND AREA
CLARK LAKE
DISCHARGE POINT FROM MAIN POND
EVAPORATION SYSTEM
HAY BARN
0
250
SCALE
ERM-Southwest.
NEW ORLEANS, LOUISIANA
FIGURE 1-2
SITE FACILITIES MAP
Sheridan Disposal Services
Hempstead, Texas
DATE 12/30/88
W.O.NO 9115

A group of storage and treatment tanks were constructed beginning in September 1971 in response to an order from the Texas Water Quality Board (TWQB), predecessor to the Texas Water Commission (TWC). These tanks were used for steam treating oil-water emulsions. Separated oils were used as fuel for a system of ground flares that was installed in 1972.

A smaller pond (approximately 400,000 gallons) was constructed in the northeast corner of the main pond levee. It was used to receive incoming materials. From there the wastes were generally pumped into the steam treatment system for emulsion treatment. Any recovered oils were either sold, burned in ground flares or used as boiler fuel. Leftover residues were disposed of in the main pond. Liquid wastes from the smaller pond were discharged directly into the main pond when the steam emulsion system was not working or was overloaded.

In November of 1972 a fire destroyed the oil burner (incinerator) system and the surface of the main pond was ignited, burning off the surface layer of oil. At this time, the volume of wastes disposed of in the main pond caused a freeboard problem. Twice during 1973 severe rainfall brought the height of liquids in the pond to within six inches of the top of the levee. The height of the levee was increased in 1975 to mitigate this type of occurrence.

During 1974 and 1975, several trial burns of new incinerators were performed by Sheridan Disposal Services. Permit approval was granted to SDS by the Texas Air Control Board (TACB) for a liquid waste burner (incinerator) that was designed and built by Mr. Sheridan. The incinerator was in use until June 1978 when a fire destroyed portions of the system.

In order to take care of the continuing problem of accumulated pond wastewater, a new facility -- the irrigation/evaporation system -- was built in 1976 adjacent to the main pond. This 42 acre impoundment received wastewater from the main pond into a series of small cells where it was allowed to evaporate.

SDS began closing the main pond with levee and other materials in October 1978. An initial closure plan was agreed to by SDS and the TWQB in 1979. This plan called for initial closure of the main pond, pumping of accumulated stormwater from the pond into the evaporation system, and maintenance of the pond levee. Pond water was transferred to the evaporation system and approximately seven acres of the main pond area including the receiving basin were covered with fill material.

A final closure plan was submitted to the Texas Department of Water Resources (now the Texas Water Commission (TWC)), by

Sheridan Disposal Services. It was rejected in January 1984, at which time the TDWR determined that SDS did not have the expertise or resources to properly close the site. At that time the TWC contacted certain companies whose waste may have been disposed of at the SDS site to request assistance in the site closure. The Sheridan Site Committee was formed in response to that request and has since worked with the Texas Water Commission and the Environmental Protection Agency to collect and analyze information necessary to evaluate appropriate closure alternatives.

The SDS site was proposed for inclusion on the National Priorities List pursuant to Section 105 of CERCLA on June 10, 1986.

1.2 Source Material Description

The major sources of organic and inorganic chemical constituents at the site are the main pond (water and sludges), affected pond subsoils and dike materials. There are very limited additional quantities of affected sludges and soils in the evaporation system. These source areas are discussed below. Manifest descriptions of some of the materials received for disposal at the site are listed in Table 1-1. A summary of representative concentrations and volumes of waste on-site is included in Table 1-2. This table is reproduced from the Baseline Risk Assessment (Table 9-2, dated November 1, 1988); references in this table refer to other tables in the Risk Assessment.

1.2.1 Main Pond

The current size of the main pond varies between 13 and 15 acres depending on water depth. The depth of accumulated rainwater varies between one and six feet between periods of accumulation and removal.

The main pond contents are stratified into a partial surface oil and emulsion layer, an aqueous phase and a heavy sludge layer. The surface oil layer (less than two inches in thickness) currently covers 15% or less of the pond surface and varies in location according to wind direction. During July/August 1987, the majority of the oil layer was removed from the main pond and placed in on-site storage tanks. The main pond water has been evaporated in the evaporation system in accordance with an Administrative Order issued by EPA.

Based on results from the analyses of 15 samples collected in June 1987, the main pond sludges vary in thickness from about 6 inches to about 24 inches with an average thickness of 12.4 inches. This depth contrasts with sludge thickness measurements of one foot to just over three feet in September 1984 (SCRI,

TABLE 1-1

Descriptions of Materials Listed on Manifests for Disposal at the SDS Site

Alcohol, organic phosphorus compounds, cobalt

Alkyl Benzenes

Ammonia Bromate, Water

Barge, RR Tank Car Washings, & Misc. Chemicals

Benzene, Ethers, Methylchloride

Butyl Acrylates

Calcium Arsenate

Caustic and Latex Polymer

Copper Chloride Powder Catalyst

Diethylene Glycol, Resin, w/Toluene

Drilling Muds

Drum Washing Residue

Fatty Acid Esters

Fatty Alcohols

Filter Cake Residue

Furfural, Butadiene Copolymer

Glycol Still Bottoms

Herbicides
Bottoms

Hydraulic Oils

Insecticides

B, S & W Oils

Kerosene & Grease

Kitchen Grease & Water

Methacrylate

Molasses & Water

Oily Wastewater

Organic Sludge, Skimming, Kerosene and Mineral Spirits

Phenol Formaldehyde

Pickling Acid

Polyethylene, Diatomaceous Earth

Process Wastewater

Soap

Sodium

Sodium Hydroxide

Sour Crude Oil

Spent Chlorinated Solvents

Spent Newspaper Inks and Solvents

Styrene & Ethylbenzene

Styrene Monomer w/Diesel

Vegetable Oils

Waste Chemicals

Water & Oil

TABLE 1-2

Summary of Representative Concentrations and Volumes for
Specific Waste Compartments and Receptors for the Sheridan Disposal Services Site

Parameter	Representative Water Concentrations (1)			Representative Concentrations for Soils/Sludges (1)					
					Dike Area		Evaporation Area		
	Main Pond Water (2) (Table 4-1&2)	Clark Lake Water (west end) (Table 8-7)	Brazos River Water Quality (Table 8-4)	Main Pond Sludges (2)	Averaged Soils (3)	Affected Soil	Soils	Sludges (2)	Background Soils (Tables 4-1&2)
Units	mg/l	mg/l	mg/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Area (acres)	19 (4)		Surficial	12	17	12	40.75	0 25	Surficial
Representative thickness (feet)	7.1 (5)		NA	1 5	11	5 5	0 5	0.5	NA
Approximate volume (cu.yds.)	217021		NA	30000	301693	114000	33000	200	NA
Density	1.0 g/cm3	1 0 g/cm3	1 0 g/cm3	1 1 g/cm3	1.6 g/cm3	1 3 g/cm3	1.6 g/cm3	1.3 g/cm3	1 6 g/cm3
Benzene	ND	ND	ND	1050	12	23	ND	42 95	ND
2,4-Dimethylphenol	ND	ND	ND	342	8	16	ND	24.7	ND
Ethylbenzene	ND	ND	ND	3267	6	11	ND	301	ND
Naphthalene	ND	ND	ND	257	6	12	ND	ND	0 135
Total PCBs (as Aroclor 1016)	ND	ND	ND	159	10	19	ND (6)	25	ND
Phenol	1 8	ND	ND	695	45	90	ND	757	ND
Tetrachloroethylene	0.26	ND	ND	121	ND	ND	ND	21 8	ND
Toluene	0 63	ND	ND	1225	10	19	ND	165 0	ND
Trichloroethylene	1 46	ND	ND	50	ND	ND	ND	ND	ND
Metals (as total constituent)									
Chromium	1 14	0 01	0 01	236	13	20	33 4	72.6	31 1
Lead	0.304	0 012	0 0235	404	149	290	45.7	164	11 6
Nickel	0 625	ND	0 005	67	12	14	17 6	31 5	17 2
Zinc	4.505	0.07	0 035	573	285	492	72.6	751	39 6

(1) Except for sludge samples, the representative concentration given is the average of [detected concentration(s) plus 1/2*(sample d.l.)] found for the waste compartment indicated

(2) Representative values for sludge samples are calculated as the average of all above-detection-limit concentrations or 1/2 of detected value if there is only one detection in the data base See Appendix E-1 for documentation These calculations provide worst-case levels for direct contact exposure and ground water models Representative values for Toluene and Zinc to not include outlier values of 36,600 and 13,800 mg/kg, respectively, because concentrations of that magnitude were not confirmed in 1987 samples

(3) Average dike soil concentration is calculated as the mean of all visually affected and unaffected soils data from the dike boring samples collected July 6-10, 1987 (see Appendix E-1 for documentation) These calculations provide data for dust emissions and direct exposure models

(4) Acreage given is based on the assumption that, if abandoned, the pond would fill to an elevation of 176 5 feet MSL and would decant over the lowest part of the dike at that elevation with each subsequent rainfall The low point appears to be located on the north dike, west of the former tank battery and receiving pond (Figure 2-2)

(5) Depth given is based on the average depth (3 6 feet) from the water surface to the sludge surface (see Table 3-5) as recorded in the June 17-18, 1987 sampling of pond sludges, plus the difference between the water elevation recorded on that date (173' MSL) and 176 5' MSL (a difference of 3 5')

(6) PCBs (as Aroclor 1248) were detected from 0 5-1' depth in evaporation system cells 3 and 15 at concentrations of 1600 ug/kg and 110 ug/kg, respectively (samples from February 1988 and December 1987 sampling events)

NA - Not Applicable
ND - Not Detected

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1987). An average pond depth of 18 inches is used for risk analysis and design calculations. These sludges are approximately 45% water, 40% oil and 15% solids by weight. Pond sludge composition was reported in the SCRI (Page 3-4) to be 50% water and volatile organics by weight, 30% non-volative organics by weight and 20% inorganics by weight based on samples collected in 1984. These are similar to the values reported herein from 1987 samples for water, oil and solids content, respectively.

No samples of pond subsoil were collected during the GWRI investigations due to the possibility of carry down of affected material contained in the sludge.

1.2.2 Pond Dike

The dike around the pond has a surface area of approximately 17 acres and was constructed primarily from surrounding clay and combustion residues from the incinerator. It is estimated that up to 10% of the levee material may consist of materials characterized as diatomaceous earth filter aid wetted with a petroleum oil. This filter cake material contains unspecified organometallic chemicals as well as insoluble barium and zinc salts.

Additionally, a number of drums have been incorporated into the levee structure in the north and west sections of the dike system. Soil borings conducted on the dikes in July 1987 indicate discrete sludge or other waste products varying in thickness from two to seven feet. These layers occur at depths consistent with pre-construction grade elevations of the natural depression utilized by Sheridan for disposal since the late 1950's.

When SDS began initial closure actions in 1979, approximately five acres of the pond in the northern section were covered with construction debris and dike material. In addition, another two acres of the southeastern portion of the pond were capped using fill materials and on-site soils. (These seven acres are included in the estimated dike area of 17 acres.) These actions have resulted in portions of the pond being covered with materials such as construction debris and soils that are different in composition from the remainder of the levee.

1.2.3 Evaporation Area Sludges and Soils

The evaporation system consists of 42 acres of water retention cells. The majority of organic compounds that were identified in the evaporation system occur in isolated sludge deposits at or near the point of pond discharge into the evaporation system. Trace amounts of PCBs (110 to 1800 ppb) were also detected in

cells adjacent to the pond discharge cell. Other concentrations of detected constituents in evaporation system soils and sludges are found in Table 1-2.

2 - REGIONAL GEOLOGY AND HYDROGEOLOGY

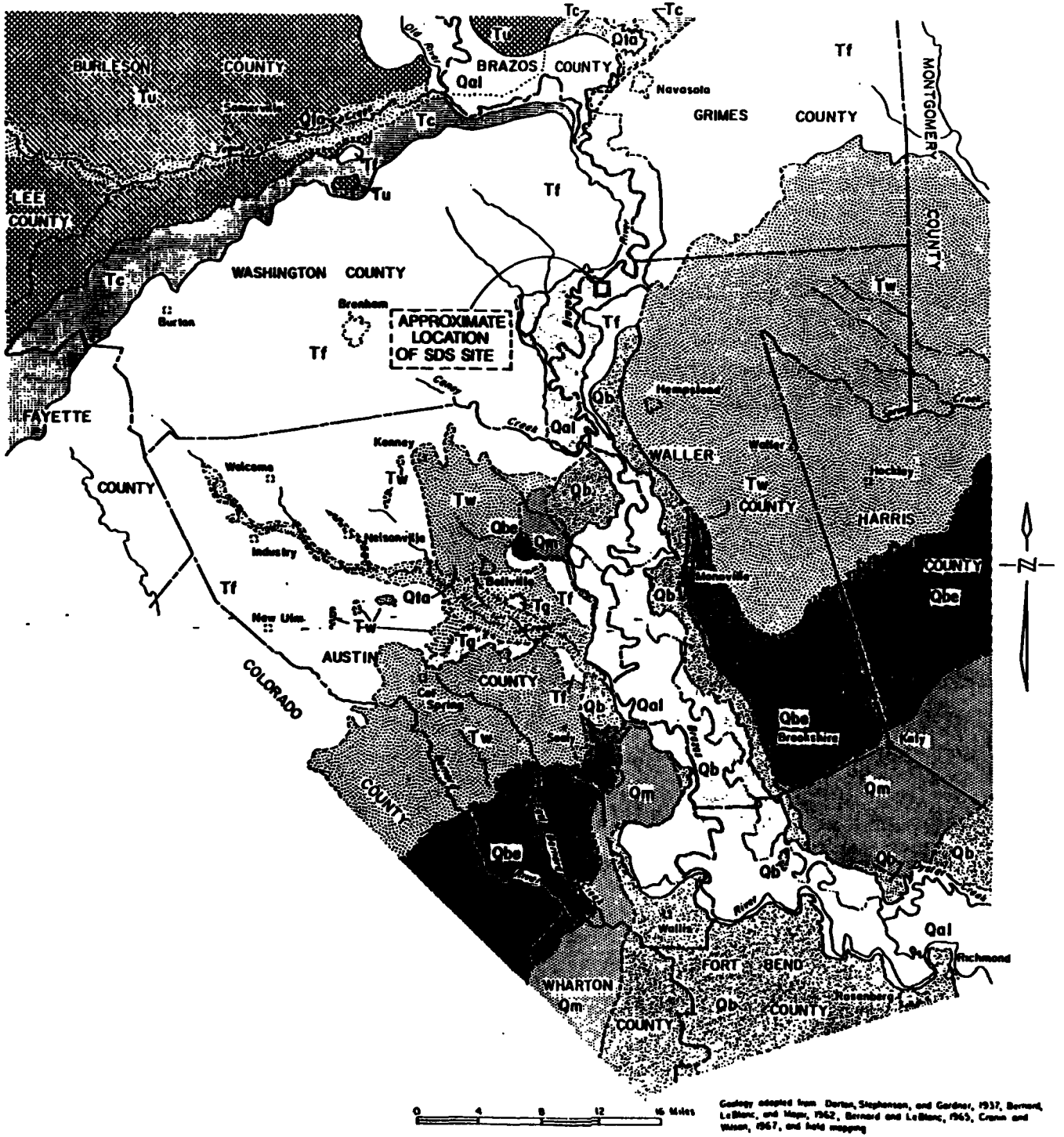
2.1 Regional Geology

The Sheridan Disposal Services (SDS) site is located in the Brazos River drainage basin. The Brazos River flows across central Texas toward the Gulf of Mexico. Near the SDS site it flows across the West Gulf Coast section of the Coastal Plain Province, and ultimately discharges into the Gulf of Mexico near Freeport, Texas.

Seven geologic formations are exposed at the surface between the SDS site and the Gulf of Mexico. These units, from oldest to youngest, include: the Fleming Formation, Goliad Sand, Willis Sand, Bentley Formation, Montgomery Formation, Beaumont Clay and the recent alluvium of the Brazos River. Geologic units older than the Fleming Formation outcrop northwest of the site (updip), and can be found between the site and the Gulf of Mexico, although at great depths. Figure 2-1 shows the site location and geologic map of the region around the SDS site. The site lies completely within the Brazos River alluvium which is approximately 55 feet thick at this location. It is underlain by the Fleming Formation (Miocene age). The surface between these units is unconformable.

The formations along the Gulf Coast in this region are composed of unconsolidated and interbedded sands, silts and clays that were deposited under both subaerial and subaqueous (marine) conditions. These regional depositional environments were primarily influenced by changes in relative sea level in the Gulf of Mexico. The formations have a regional dip to the south/southeast, with concurrent thickening and steepening of dip toward the Gulf of Mexico.

According to the Geologic Atlas of Texas, Austin sheet, there are no surface expressions of faulting in the area of northern Waller or Washington Counties. Subsurface sampling at the SDS site did not show any evidence of faulting. The only other structural features in the region are the Hockley escarpment, Hockley salt dome and the Millican fault zone. Neither the Hockley escarpment, 18 miles south of the site, nor the Millican fault zone, 20 miles north of the site, appear to have any structural or hydrologic influence on the SDS site.



EXPLANATION

Recent

Qal — Alluvium of Brazos River
Gravel, sand, silt, and clay

Qtq — Tributary stream alluvium
Gravel, sand, silt, and clay

Pleistocene — QUATERNARY

Qb — Beaumont Clay
Chiefly clay; contains lenses of sand and gravel

Qm — Montgomery Formation
Chiefly sand, silt, and clay

Qbe — Bentley Formation
Fine- to coarse-grained sand and clay

Pliocene(?) — TERTIARY(?)

Tw — Willis Sand
Sand and clay, some gravel

Pliocene — TERTIARY

Tg — Goliad Sand
Gravelly sand and sandstone, some clay

Miocene — TERTIARY

Tf — Fleming Formation
Clay and sand. Sand predominant in lower part

Tc — Catahoula Sandstone
Clay, tuff, and sand

Eocene

Tu — Shale and sandstone undifferentiated

Contact

Dashed where approximately located; dotted where inferred or concealed by alluvium

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FIGURE 2-1
GENERALIZED GEOLOGIC MAP
OF AUSTIN AND WALLER COUNTIE
AND ADJACENT AREAS
(FROM TWDB REPORT 68,1967)
Sheridan Disposal Services
Hempstead, Texas

W.O. NO.	9120B17	DATE	12/30/

2.2 Regional Hydrogeology

In the Southeast Texas region, ground water is a principal supplier for industrial, municipal, irrigation and domestic use. Fresh and slightly saline ground water is available throughout the area, with less saline formations found closer to the surface. The geologic formations that contain usable ground water include: the Catahoula Sandstone, Fleming Formation, Goliad Sand, Willis Sand, Bentley Formation, Montgomery Formation, Beaumont Formation and the recent alluvium of the Brazos River Basin. Because all of these formations are lithologically similar (interbedded sequences of sand, silt and clay) and often in hydrologic connection with each other, the formations have been divided into four hydrogeologic units. The units are: the Jasper Aquifer, Burkeville Aquiclude, Evangeline Aquifer, and the Brazos River Alluvium Aquifer. These are the four aquifer systems that could potentially be impacted by the SDS site.

The SDS site lies on the surficial sediments of the Brazos River Alluvium. Beneath the alluvium is the Fleming Formation, composed of alternating sand and clay layers. The complex nature of the Miocene stratigraphy and the vertical and horizontal variations in any of the Gulf Coast formations have led to the Fleming Formation being "pigeon-holed" into two different aquifer systems: the Evangeline Aquifer and the Jasper Aquifer, separated by the Burkeville Aquiclude. The classification of the Fleming Formation depends on its location and depth along the Gulf Coast. At the SDS site, the Fleming Formation is probably part of the Evangeline Aquifer, based on electric logs from the region.

Figure 2-2 shows a northeast-southwest hydrologic cross-section across Waller County that falls near the SDS site (Texas Water Development Board (TWDB) Report 68, 1967). This indicates that at a minimum, the base of the Evangeline Aquifer is at approximately 305 feet below mean sea level (MSL). An average elevation for the SDS site is 170 feet MSL, meaning that the base of the Evangeline is over 450 feet below the surface at the site. This is also shown on the geologic map (Figure 2-1) demonstrating that the site is located within the upper portion of the Fleming Formation. Table 2-1 shows that the upper portion of the Fleming Formation forms the lower part of the Evangeline Aquifer. The lower portion of the Fleming Formation may form parts of the Jasper Aquifer along portions of the Gulf Coast, as reported in TDWR Report 236, 1979, Table 1.

The Burkeville Aquiclude and the Jasper Aquifer are also found under the SDS site at approximate depths of 305 feet and 525 feet below MSL, respectively, and are water sources in the region.

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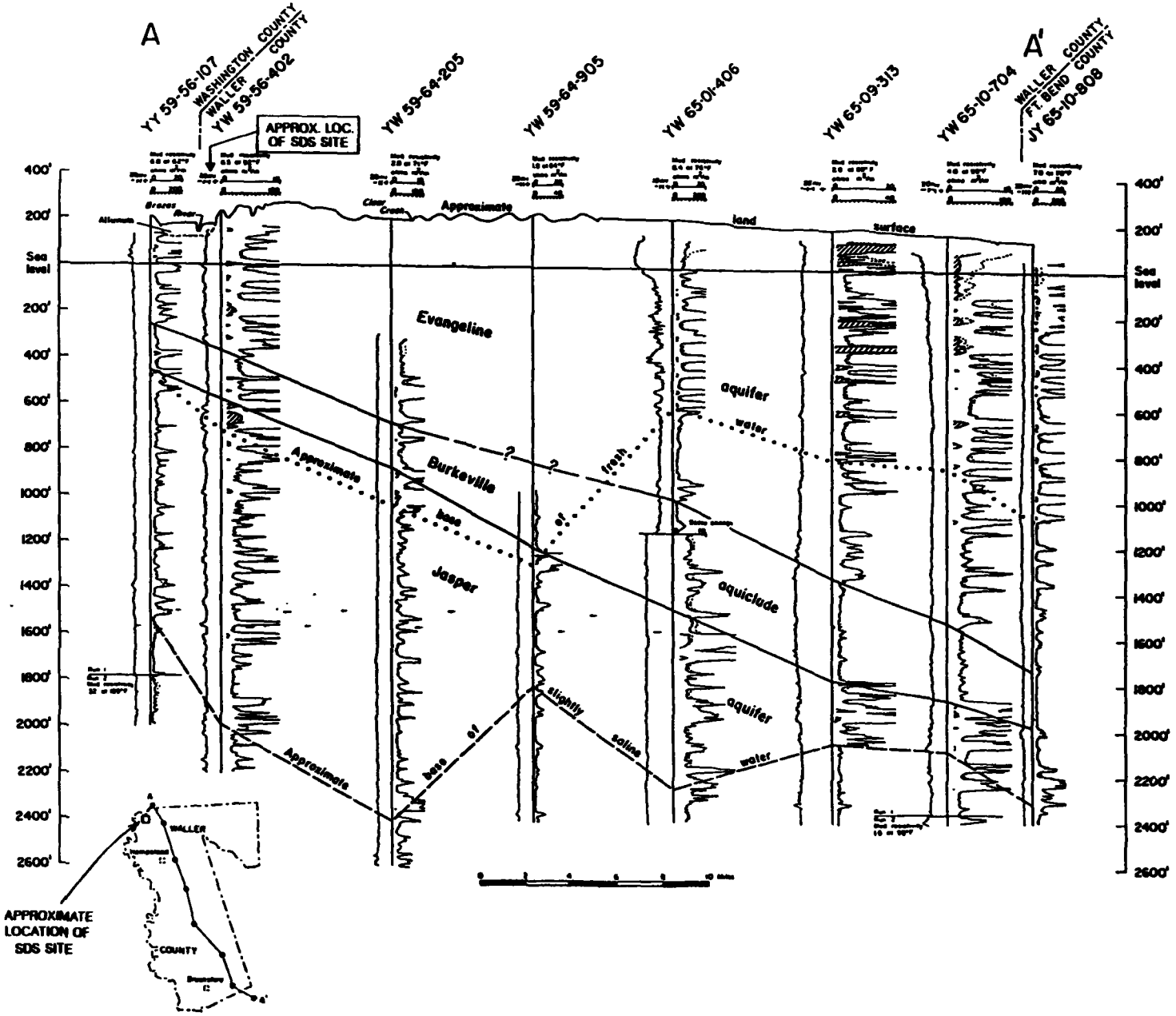

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FIGURE 2-2
CROSS-SECTION SHOWING HYDROLOGIC
ACROSS WALLER COUNTY, TEXAS
(FROM TWDB REPORT 68, 1967)
Sheridan Disposal Services
Hempstead, Texas

W.O. NO. 9120818 DATE 12/30/

System	Series	Stratigraphic unit	Estimated thickness in area (feet)	General composition in Austin and Waller Counties	Surface expressions	Water-bearing properties in Austin and Waller Counties	Hydrologic unit
Quaternary	Recent	Tributary alluvium and flood-plain alluvium of the Brazos River	0- 80	Unconsolidated gray, brown, and reddish-brown clay, silt, and sandy clay, commonly overlying light-colored sand or coarser-grained sand and gravel.	Occurs along the banks of smaller streams and in the flood plain of the Brazos River. Nearly flat plain. Forms reddish- to dark-brown and black soils.	Yields small to large amounts of fresh water in the flood plain of the Brazos River.	Alluvium of Brazos River
	Pleistocene	Beaumont Clay	0- 75	Mottled red, reddish-brown, brown and gray, dense clay with white calcareous nodules. May contain lenses of fine- and medium-grained sand or sand and gravel in places.	Occurs only along the fringes of the Brazos River flood plain. Forms nearly flat, narrow plain. Soils are gray to black, blocky.	Yields small to moderate amounts of water to scattered shallow wells less than 100 feet deep along the edge of the Brazos River flood plain.	Zone 7 Evangeline aquifer (0-1,840 ft) (May contain unidentifiable parts of basal Chicot aquifer along edges of Brazos River flood plain or along southern part of both counties.)
		Montgomery Formation	0- 407	Light gray to light brown, fine-grained sand, silt, and clay, probably grading with depth to darker-colored coarser sand and in places basal sand and gravel.	Nearly flat, featureless plain; soils are light colored, fine-grained sandy. Occurs only along southern edge of area.	Yields small amounts of water to scattered shallow wells.	
		Bentley Formation	0- 587	Alternating beds of reddish-brown to yellow and gray, mottled clay interbedded with grayish, fine- to coarse-grained sand and gravel lenses. Scattered lentils of lime-cemented sandstone. Clay, sandy clay, and fine sand predominate in the upper part, darker-colored, coarser sand and gravel in the lower part.	Forms flat plains in the southern one-third of the counties; most of the rice-growing area is on the outcrop. Forms light-colored sandy loamy soils.	Contributes small to moderate amounts of fresh water to domestic wells in the southern part of the area; probably represented by the uppermost sands screened in these wells.	
Tertiary(?)	Pliocene(?)	Willis Sand	0- 340?	Alternating beds of mottled red, yellow, brown, and gray clay and sand with scattered lenses of unsorted sand and quartz gravel. Ferruginous nodules common. Pocked and hard in fresh exposures. Basal part is usually a hard, gravelly sand and clay.	Forms the gently-rolling sand hills of northern Waller County and central Austin County. Most of the gravel pits in Austin County are in the basal Willis. Forms tan sandy soils.	Yields small to large amounts of fresh water to wells.	Zone 6 Zone 5 Zone 4 Zone 3 Zone 2 Burkeville aquiclude (0-480 ft) Zone 1 Jasper aquifer
Tertiary	Pliocene	Goliad Sand	0- 840?	White to gray, sticky, calcareous clay with interbedded lenses of light-colored, gravelly sand and lime-cemented sandstone. Black chert grains in the whitish sand give a salt and pepper effect.	Occurs as isolated surface exposures because the Goliad is overlapped by the Willis Sand or is easily removed by erosion. Forms gray, sticky soils. Usually occurs along valley bottoms and walls.	Yields large amounts of fresh water to wells.	
	Miocene	Fleming Formation	0-1,700	Interbedded clay and sand; clay predominantly in the upper part. The blocky, dense clay is various shades of gray, yellow, olive, and brown. White calcareous nodules are common. Sand is gray to brown, interbedded with gray clay. Sand is medium to fine grained and often cross-bedded.	Forms the rolling and dissected topography of northern Austin County. Forms gray to black loam and sandy loam soils.	Yields small to large amounts of fresh to slightly saline water.	
		Catahoula Sandstone	?	Alternating beds of gray clay, tuff, and sand. Lower sands may be hard, white, and have opaline appearance.	Does not crop out in Austin or Waller Counties. Difficult to distinguish from overlying Fleming Formation in both surface exposures and in well logs.	May yield small amounts of fresh water in the most northern part of Austin County. Generally water is at least slightly saline.	
	Eocene	Undifferentiated	--	Alternating beds of gray sand, sandstone, and shale.	Does not crop out in Austin or Waller Counties	Would yield only saline water.	

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TABLE 2-1

GEOLOGIC DESCRIPTION AND WATER-BEARING PROPERTIES OF THE GEOLOGIC UNITS FORMING THE AQUIFERS IN AUSTIN AND WALLER COUNTIES
(COPIED FROM TWDB REPORT 68, 1967)

2.2.1 Hydrologic Properties

There are limited published data available which document the hydrologic properties of the four aquifers which underlie the site. The only document which describes the properties of these aquifers in the vicinity of the site is the TWDB report No. 68 entitled "Ground-Water Resources of Austin and Waller Counties, Texas". The discussion which follows summarizes relevant data from that report.

The Jasper Aquifer is the deepest regional aquifer beneath the SDS location. Only a few large production wells currently use this aquifer. The only available data for this unit comes from pumping test data on one well; it yielded values of between 212 and 272 gpd/ft^2 (0.010 to 0.012 cm/sec). No other data are available for this aquifer.

Overlying the Jasper Aquifer is the Burkeville Aquiclude. This unit hydrologically separates the Jasper from the Evangeline Aquifer. The Burkeville is predominately clayey with some sand lenses within it that do produce measurable quantities of water. In the vicinity of the SDS site it has an average thickness of about 320 feet and is approximately 480 feet below the ground surface. A few domestic wells produce from the Burkeville, but no published data are available concerning its hydrologic properties.

The Evangeline Aquifer overlies the Burkeville Aquiclude. In the vicinity of the SDS site the Evangeline appears to have an approximate thickness of 420 feet (Figure 2-2) and occurs about 60 feet below ground surface. This aquifer is a primary producer of ground water in the area due to its proximity to the surface. Hydrologic properties calculated from 25 wells in Austin and Waller Counties yielded values of between 7900 and 99,000 gpd/ft for transmissivity. Hydraulic conductivity varied between 51 and 487 gpd/ft^2 (0.002 to 0.02 cm/sec), with an average of 215 gpd/ft^2 (0.01 cm/sec).

The uppermost aquifer at the site is the Brazos River Alluvium. It ranges in thickness from 0 to 75 feet in the region and is about 55 feet thick at the site. No pumping tests have been performed in Austin or Waller Counties on this aquifer, but data from Fall, Robertson, Brazos and Burleson Counties, where the alluvium is similar, have a range of transmissivity between 7300 to 208,000 gpd/ft, with an estimated average of 42,000 gpd/ft.

The primary source of ground water recharge is infiltration from precipitation. In this area of the Gulf Coast, ground water tends to flow downdip toward the Gulf of Mexico, although local variations do occur (for example, in an area where there is a

large amount of pumping). Therefore, most recharge would occur updip of the Sheridan site. The Brazos River Alluvium Aquifer may be different due to bank storage. The Brazos River is considered an effluent (gaining) stream in the region of the SDS site (TWDB Report 68, 1967). That is, the river gains water from local ground water drainage into the channel. This situation may reverse itself during periods of high river stage, when water will flow from the river into the alluvial aquifer. This situation can exist at the SDS site and will be discussed in more detail in Section 3.

2.2.2 Ground Water Uses

Ground water is used for municipal, industrial, irrigation and domestic purposes in the region. A record search of the Texas Water Development Board and Texas Water Commission was conducted to locate all registered wells within a three mile radius of the SDS site. Figure 2-3 shows the location of these wells in relation to the site. Two well classifications are listed in Tables 2-2 and 2-3: located wells and plotted wells. Located wells are those which have been verified on-site by the Texas Water Development Board (TWDB) or US Geological Survey staff. In some cases, samples for chemical analyses have been also taken from these wells. Plotted wells are those whose location is taken from a water well driller's log. The accuracy of these locations depends on the driller and has not been field checked.

Wells of primary concern within the three mile radius of the SDS site include those located to the south and southeast of the site, on the southern or eastern bank of the Brazos River. Wells north of the site would not be of concern because the regional gradient is to the south/southeast. These wells are therefore upgradient of the site. Also, any wells screened in the alluvium or possibly the upper portion of the Fleming Formation (that portion which is in hydrologic communication with the Brazos River) across the Brazos River from the site (either north or west) would not be of concern because of the dilution capacity of the river.

In the immediate vicinity of the SDS site, the ground water flow direction for the Brazos River Alluvium Aquifer is primarily to the north or northwest, toward the Brazos River. This direction changes only when the river is in high stage, at which time the flow changes to a south and then west direction. This southerly flow does not maintain itself for long periods of time or great distances away from the river bank and hence is not of concern for any significant constituent travel toward the south. Based on these flow patterns, a review of Figure 2-3 indicates that there are no wells screened in the alluvium that would be impacted by the SDS site. Well number 605, screened in the

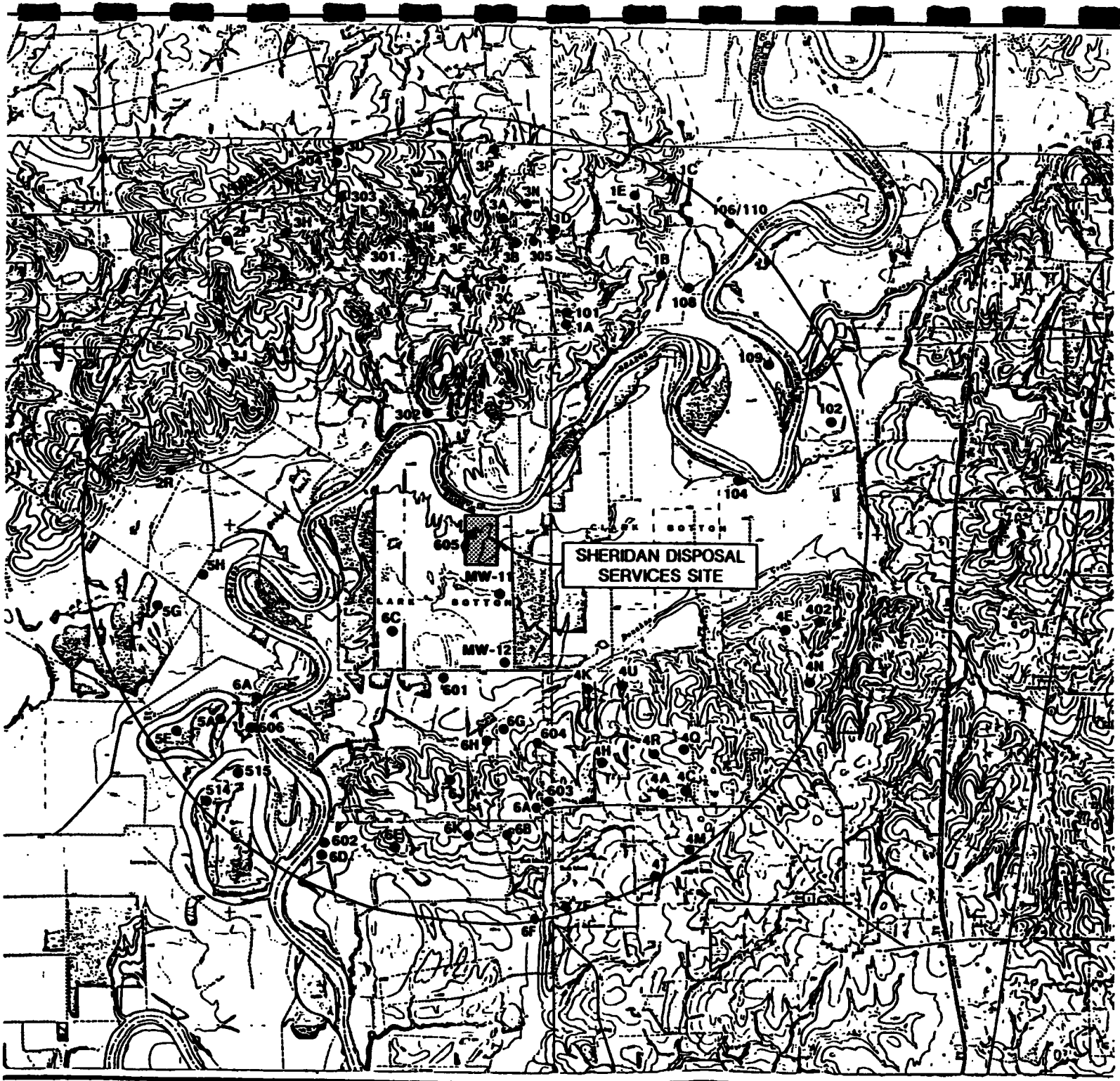

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FIGURE 2-3
REGISTERED WELLS WITHIN A THREE MILE RADIUS OF THE SDS SITE
HEMPSTEAD, TEXAS

W.O. NO. 9109B024	9/28/88

TABLE 2-2

Located Well Data within a Three Mile Radius
of the Sheridan Disposal Services Site

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Well No.	County	Aquifer	Use	Diameter of Well (in.)	Total Depth [a] (Ft)	Screened Interval (Ft.) [Depth Below Ground Surface]	Elevation (Ft. MSL)	Top of Casing (Ft.) [b]	Water Level (Ft.) [c]
59-55-601	Waller	Alluvium	Irrigation	18	64	36 ?	168	1 Above Surface	25.43
59-55-602	Waller	Evangeline	Stock	6	396	356-396	168	Unk.	Unk.
59-55-603	Waller	Evangeline	Domestic, Stock	3	106	91-106	215 ?	Ground	41
59-55-604	Waller	Evangeline	Stock	3	178	Unknown	197	--	Unk
59-55-605	Waller	Alluvium	Stock	4	60	30-60	170	1.5	40.65
59-56-102	Waller	Alluvium	Irrigation	14	73	60	170 ?	1.0	36.80
59-56-104	Waller	--	Stock	3.5	400	Unknown	178	1.0	32.05
59-56-402	Waller	(See Electric Log File Q-134) [d]							
59-56-106	Washington	Alluvium	Irrigation	16	71	Unknown	174	1.0	52 4
59-56-108	Washington	--	Stock	4	900	Unknown	177	Unk.	Unk.
59-56-109	Washington	--	Stock	4	900	Unknown	173	Unk.	Unk.
59-56-110	Washington	Alluvium	Irrigation	16	85	Unknown	174	1.5	36.15
59-55-301	Washington	Jasper	Stock	5	1049	1029-1049	180	2.0	27 25
59-55-302	Washington	--	Stock	4	1059	1049-1059	175	Unk.	24 Above LSD
59-55-303	Washington	--	Domestic	6	438	428-438	232	1.2	48.42
59-55-304	Washington	--	Unused	6	65	46-65	272	Unk.	53
59-55-305	Washington	--	Unused	36	46	Unknown	230	2.9	46 55
59-55-514	Washington	--	Stock	6	65	Unknown	166	1.0	26 07
59-55-515	Washington	--	Stock	2 5	365	Unknown	166	Unk.	Unk
59-55-606	Washington	Alluvium	Unused	6	105	Unknown	150	Ground	32.45
59-56-101	Washington	(See Electric Log File Q-19) [d]							

NOTES.

[a] Depth measured from ground surface.
[b] Measured above ground surface.
[c] Measured from top of casing
[d] Electric Log Files could not be located either at the TWC or TWDB

TABLE 2-3

Plotted Well Data Within a Three Mile Radius of the Sheridan Disposal Services Site

Well NO	County	Aquifer	Use	Diameter of Well (in.)	Total Depth [a] (Ft)	Screened Interval (Ft) [Depth Below Ground Surface]	Elevation (Ft MSL)	Top of Casing (Ft.) [b]	Water Level (Ft) [c]
59-55-6A1	Waller	Unk.	Ranch	4	136	130-136	Unk	Unk.	22
59-55-6A2	Waller	Unk.	Domestic	4 (0-188) 2.5 (188-203)	203	188-203	Unk.	Unk	80
59-55-6B1	Waller	Unk.	Domestic	4	133	127-133	Unk.	Unk.	Unk
59-55-6B2	Waller	Unk.	Domestic	2	159	153-159	Unk.	Unk.	Unk.
59-56-6C	Waller	Unk.	Domestic	4 (0-170) 2.5 (170-180)	180	170-180	Unk.	1 5	88
59-55-6D	Waller	Unk.	Industrial	4	249	207-249	Unk.	Unk.	55
59-55-6E	Waller	Unk.	Industrial	4	273	231-273	Unk.	Unk.	40
59-55-6F	Waller	Unk.	Domestic	4	160	154-160	Unk.	Unk.	32
59-55-6G	Waller	Unk.	Industrial	4	295	Unk.	Unk.	Unk.	45
59-55-6H	Waller	Unk.	Industrial	4	265	Unk.	Unk.	Unk.	55
59-55-6J	Waller	Unk.	Industrial	4	262	Unk.	Unk.	Unk.	42
59-55-6K	Waller	Unk.	Industrial	4	210	Unk.	Unk.	unk.	25
59-55-2P	Washington	Unk.	Domestic	4 (0-108) 2.5 (108-118)	123	108-118	Unk.	Unk.	Unk.
59-55-2R	Washington	Unk.	Domestic	4 (0-149) 2.5 (149-164)	165	149-164	Unk.	Unk.	98
59-55-3A1	Washington	Unk.	Domestic	4 (0-146) 2 5 (146-161)	161	146-161	Unk.	Unk.	66
59-55-3A2	Washington	Unk.	Domestic	4 (0-139) 2 (127-148)	148	127-148	Unk.	0.0	87
59-55-3B1	Washington	Unk.	Domestic	4 (0-119) 2 (112-138)	138	112-138	Unk.	0.0	71
59-55-3B2	Washington	Unk.	Domestic	4 (0-117) 2 (111-134)	134	111-134	Unk.	Unk.	68
59-55-3C1	Washington	Unk.	Domestic	4 (0-139) 2 (127-148)	148	127-148	Unk.	0.0	68
59-55-3C2	Washington	Unk.	Domestic	4 (0-175) 2.5 (175-190)	190	175-190	Unk.	Unk.	123
59-55-3C3	Washington	Unk.	Domestic	4 (0-142) 2 (126-157)	157	126-157	Unk.	0.0	79
59-55-3D	Washington	Unk.	Domestic	4 (0-147) 2 (140-161)	161	140-161	Unk.	0.0	91
59-55-3E1	Washington	Unk.	Domestic	4 (0-345) 2.5 (345-360)	379	345-360	Unk.	1.0	46
59-55-3E2	Washington	Unk.	Domestic	4 (0-228) 2 (211-253)	253	211-253	Unk.	Unk.	29
59-55-3F	Washington	Unk.	Domestic	4 (0-124) 2 (116-137)	137	116-137	Unk.	0.0	62
59-55-3H1	Washington	Unk.	Domestic	4 (0-105) 2.5 (105-113)	117	105-113	Unk.	0.0	73
59-55-3J	Washington	Unk	Domestic	4 (0-163) 2 5 (163-178)	183	163-178	Unk.	1.0	111
59-55-3L1	Washington	Unk.	Domestic	4 (0-118) 2 (111-132)	132	111-132	Unk.	Unk.	62
59-55-3L2	Washington	Unk.	Domestic	4 (0-124) 2 (114-146)	140	114-140	Unk.	Unk.	72

NOTES
[a] Depth measured from ground surface.
[b] Measured above ground surface.
[c] Measured from top of casing.

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TABLE 2-3 (Cont'd)

Plotted Well Data Within a Three Mile Radius of the Sheridan Disposal Services Site

Well NO	County	Aquifer	Use	Diameter of Well (in)	Total Depth (a) (Ft)	Screened Interval (Ft.) (Depth Below Ground Surface)	Elevation (Ft. MSL)	Top of Casing (Ft) (b)	Water Level (Ft) (c)
59-55-3M	Washington	Unk.	Domestic	4	181	161-181	Unk.	Unk.	76
59-55-3N	Washington	Unk.	Domestic	4 (0-152) 2.5 (152-167)	167	151-167	Unk.	Unk.	98
59-55-3P	Washington	Unk.	Domestic	4 (0-163) 2.5 (163-178)	178	163-178	Unk.	Unk.	105
59-55-5A	Washington	Unk.	Domestic	2	360	340-360	Unk.	Unk	0.0
59-55-5E	Washington	Unk.	Industrial	4	246	189-231	Unk.	Unk.	22
59-55-5G1	Washington	Unk.	Industrial	4	210	147-168 189-210	Unk.	Unk.	40
59-55-5G2	Washington	Unk.	Irrigation	12-3/4	130	39-58, 71-76, 79-75, 98-104	Unk.	Unk.	102
59-55-5H	Washington	Unk.	Industrial	4	215	170-215	Unk.	Unk.	30
59-55-6A1	Washington	Unk.	Industrial	4	246	180-215	Unk.	Unk.	25
59-55-6A2	Washington	Unk.	Industrial	4	286	189-210 231-252	Unk.	Unk.	22
59-55-6A3	Washington	Unk.	Industrial	4	210	168-210	Unk.	Unk.	25
59-56-4A1	Waller	Unk.	Farm	4	276	270-276	Unk.	Unk.	91
59-56-4A2	Waller	Unk.	Domestic	4	301	291-301	Unk.	0.0	105
59-56-4C	Waller	Unk.	Domestic	4 (0-170) 2.5 (165-200)	200	165-200	Unk.	Unk.	90
59-56-4E	Waller	Unk.	Domestic	4	165	155-165	Unk.	Unk.	87
59-56-4H1	Waller	Unk.	Domestic	2	115	109-115	Unk.	Unk.	30
59-56-4H2	Waller	Unk.	Domestic	4	106	Unk.	Unk.	Unk.	55
59-56-4H3	Waller	Unk.	Domestic	4	306	296-306	Unk.	Unk.	126
59-56-4K	Waller	Unk.	Domestic	4	202	182-202	Unk.	0.0	76
59-56-4M1	Waller	Unk.	Unknown	4 (0-128) 2 (120-141)	141	120-141	Unk.	0.0	50
59-56-4M2	Waller	Unk.	Domestic	4	141	136-141	Unk.	Unk.	63
59-56-4N	Waller	Unk.	Domestic	4 (0-135) 2 (126-153)	153	126-153	Unk.	0.0	69
59-56-4Q	Waller	Unk.	Industrial	4	265	168-210	Unk.	Unk.	45
59-56-4R	Waller	Unk.	Domestic	4	120	Unk.	Unk.	Unk.	58
59-56-4T	Waller	Unk.	Domestic	4 (0-250) 2.5 (250-260)	260	250-260	Unk.	Unk.	95
59-56-4U	Waller	Unk.	Oil Field/Supply	4	300	160-180	Unk.	Unk.	45
59-56-7F	Waller	Unk.	Domestic	4 (0-282) 2 (265-307)	307	265-307	Unk.	0.0	112
59-56-1A	Washington	Unk.	Domestic	4 (0-133) 2 (125-146)	146	125-146	Unk.	Unk.	70
59-56-1B	Washington	Unk.	Domestic	4 (0-158) 2.5 (158-173)	173	158-173	Unk.	Unk.	21
59-56-1C	Washington	Unk	Domestic	4 (0-95) 2.5 (95-110)	110	95-110	Unk.	Unk.	Unk.
59-56-1D	Washington	Unk.	Domestic	4 (0-149) 2.5 (149-164)	164	149-164	Unk.	Unk.	78
59-56-1E	Washington	Unk.	Domestic	4	139	Unk.	Unk.	Unk	60
59-55-3H2	Washington	Unk.	Domestic	4	192	152-172	Unk.	Unk.	72

NOTES:
[a] Depth measured from ground surface.
[b] Measured above ground surface.
[c] Measured from top of casing.

018534

alluvium, is also known as MW-5, a well just west of the main pond. It is used only for ground water monitoring purposes at the SDS site.

The only other regional aquifer of concern that could potentially be affected by the site is the first aquifer in the Fleming Formation (equivalent to stratum D). As mentioned above, this sand unit is probably a part of the Evangeline Aquifer.

Geologic cross-sections from Section 3 show that this unit is generally found between 90 and 60 feet MSL. The regional gradient of the Evangeline Aquifer is between 40 and 60 feet per mile in this region (TWDB Report 68, 1967). Based on existing data, flow at the site in stratum D is toward the Brazos River (N-NW). If, however, flow followed the regional gradient (S-SE) there is a potential for a hydraulic connection between stratum D and wells regionally downgradient of the site. Using this range of values and the estimated depths of screened intervals in wells downgradient of the SDS site along with their calculated downdip distance from the site, a comparison was made to see if the calculated depth of the aquifer would be the same as the screened interval in the downgradient wells. Results of these calculations are in Table 2-4 and indicate that wells 6A-2, 6D, 6E, 4A, 4K, 4T, 4U and 7F could potentially be completed in the Evangeline Aquifer in the same sand unit as Stratum D beneath the site. This list includes all wells that are screened even remotely close to the projected depth of the aquifer. Wells which are regionally downdip of the site for which the screened intervals are unknown (e.g., wells 402, 604, 4R, etc.) are not included in Table 2-4 since it is impossible to judge hydraulic connection if the screened interval is not known. Well 601 is not included in Table 2-4 because this well is screened in the alluvium (equivalent to stratum B) and is not in hydraulic connection with stratum D. Three other wells, 602, 6C and 4H-3, have the potential to be connected to stratum D via vertical migration down an open borehole into the screened interval. However, there are no data to support a hydrologic connection between the aquifer at the site and any of the wells listed above. A more detailed discussion of the ground water flow direction in this aquifer and its chemistry is found in Sections 3 and 4, respectively.

TABLE 2-4

Wells Regionally Downgradient of SDS Site
Potentially Screened in Evangeline Aquifer

018536

Well Number	Aquifer	Elevation (Known or Estimated) (Ft., MSL)	Screened Interval Below Ground Surface (Ft.)	Screened Interval (Ft . MSL)	Approximate Distance From SDS (Miles)[a]	Approx. Elevation (Ft., MSL) of 90 to 60° Sand Beneath SDS		Potential Connection with Stratum D Sand Under SDS Site
						40'/Mile Gradient	60'/Mile Gradient	
602	Evangeline	168	356-396	-188 to -228	1.5	30 to 0	0 to -30	Possible
603	Evangeline	215	91-106	124 to 109	2	10 to -20	-30 to -60	NO
6A-1	Unk.	209	130-136	79 to 73	2	10 to -20	-30 to -60	NO
6A-2	Unk.	209	188-203	21 to 6	2	10 to -20	-30 to -60	Yes
6B-1	Unk.	214	127-133	87 to 81	2 25	0 to -30	-45 to -75	NO
6B-2	Unk.	214	153-159	61 to 55	2.25	0 to -30	-45 to -75	NO
6C	Unk.	161	170-180	-9 to -19	0 31	77 to 47	70 to 40	Possible
6D	Unk.	165	207-249	-42 to -84	1 6	26 to -6	-6 to -36	Yes
6E	Unk.	195	231-273	-36 to -78	1.75	20 to -10	-15 to -45	Yes
6F	Unk.	176	154-160	22 to 16	2 7	-18 to -48	-72 to -102	NO
4A1	Unk.	240	270-276	-30 to -36	2.25	0 to -30	-45 to -75	Yes
4A2	Unk.	240	291-301	-51 to -61	2 25	0 to -30	-45 to -75	Yes
4C	Unk.	245	165-200	80 to 45	2 3	-2 to -32	-48 to -78	NO
4E	Unk.	230	155-165	75 to 65	1 54	28 to -2	-2.4 to -32.4	NO
4H-1	Unk.	211	109-115	102 to 96	1 9	14 to -16	-24 to -54	NO
4H-3	Unk.	211	296-306	-85 to -95	1 9	14 to -16	-24 to -54	Possible
4K	Unk.	180	182-202	-2 to -22	1.3	38 to 8	12 to -18	Yes
4M-1	Unk.	224	120-141	104 to 83	2 75	-20 to -50	-75 to -105	NO
4M-2	Unk.	224	136-141	88 to 83	2 75	-20 to -50	-75 to -105	NO
4N	Unk.	239	126-153	113 to 86	2	10 to -20	-30 to -60	NO
4Q	Unk.	261	168-210	93 to 51	2	10 to -20	-30 to -60	NO
4T	Unk.	225	250-260	-25 to -35	2.75	-20 to -50	-75 to -105	Yes
4U	Unk	212	160-180	52 to 32	1 4	34 to 4	6 to -26	Yes
7F	Unk.	205	265-307	-60 to -102	2 7	-18 to -48	-72 to -102	Yes

[a] Distance is measured along strike (SE) of regional dip

3 - SITE GEOLOGY AND HYDROGEOLOGY

3.1 Introduction

The subsurface geology and hydrogeology at the SDS site are closely interrelated. Information about the site has been collected through field studies primarily involving subsurface borings and monitor well installation. Previous site investigations for the Source Control RI (SCRI) and Interim FS provide the framework for the GWRI and some of the data collected for those documents are used and expanded upon in this report. Additional field investigations and data for the GWRI have been collected, including the completion of 11 new (1987) subsurface borings, installation of 11 monitor wells in these boreholes, aquifer testing and continued monitoring of the transmissive zones beneath the site.

3.2 Site Geology

The SDS site lies on the Brazos River Alluvium along the southern bank of the Brazos River. At this location the alluvium is approximately 55 feet thick and is composed of recent river bottom and overbank deposits. Sediment types range from clay to gravel. Two divisions of the alluvium have been designated in the SCRI: stratum A and stratum B. Stratum A extends from the surface to as much as 40 feet in depth, although it is generally 25-30 feet thick. It is composed of reddish brown interbedded sands, silts and clays. These vary in their lateral extent and composition depending on the distance from the river. For example, sediments near the river bank tend to be sandier with lenses of clay and have small lateral extents, whereas further south, away from the river, these sediments are much clayier. Correlations of individual beds within stratum A are difficult to make across the site due to the variable nature of stratum A.

Stratum B is the lower portion of the alluvium and can be distinguished from stratum A where sand becomes prevalent and continuous with depth. Stratum B is a typical alluvial fining-upward sequence for a meandering stream. The upper portion generally begins as a fine sand or silty sand that continuously grades downward into coarse sand or pebbles and sometimes gravel at or near its base. These sediments are reddish tan to brown and become grey with increasing grain size. They are poorly-to well-sorted and are composed primarily of quartz and chert grains with occasional shell fragments. This sequence is found all over the site, even though its thickness may vary.

Portions or all of stratum B are saturated and under unconfined conditions. This forms the uppermost aquifer (referred to as the unconfined or alluvial aquifer) under the SDS site. The locations of borings used to determine the relationships of both strata A and B are shown in Figure 3-1; cross-sections for the site are in Figures 3-2 through 3-5. Boring logs used to develop these cross-sections are in Appendix A. Selected soil samples from the 1987 field investigations were analyzed for various physical parameters. Table 3-1 shows the variation in the character of sediments in the alluvium.

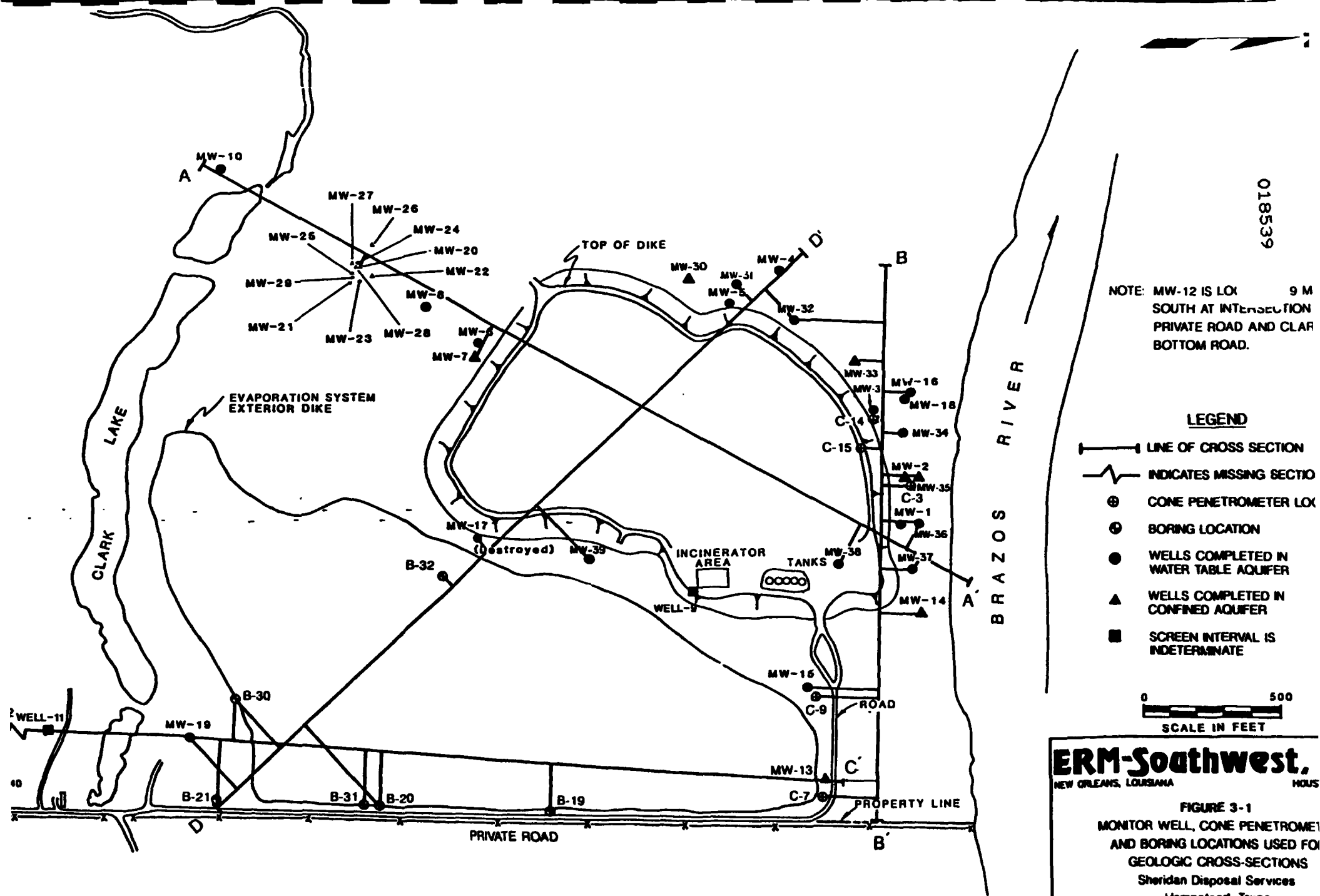
Underneath the alluvium is the Fleming Formation. At the site the zone of interest within the Fleming has been subdivided into three units: stratum C, stratum D and stratum E. Stratum C is generally a dense, hard olive green to grey clay which is laterally continuous under the site, usually found between 55 and 60 feet below grade. It often contains layers of clayey silt or clayey sand within it. These coarser-grained layers are up to 2 feet thick. South of Clark Lake at MW-40, approximately 1700 feet south of the southern edge of the main pond, stratum C is primarily a clayey or sandy silt.

The thickness of stratum C is quite variable, ranging from 12 feet at MW-40 to 37 feet at MW-14. Based on available data from boreholes drilled through October 1987, the average thickness of stratum C under the site is approximately 27 feet. This value differs from previous documents (e.g. SCRI, July 1987) due to additional data collected for this report.

Beneath this clay is stratum D, a sandy transmissive zone that is saturated and under confined conditions. It is the second aquifer underlying the site. Depending on location, stratum D is found between 65 and 95 feet below grade. Its thickness varies from 9.5 feet to 28 feet, with an average value of 16.5. These values vary from those previously reported (SCRI July 1987) due to additional field data collected for the GWRI. Stratum D is a reddish or brown to tan, fine to medium-grained sand that is silty or clayey in zones. In some areas this sand is very well cemented with calcareous cement, forming a hard sandstone layer near the top of the stratum.

Stratum E is beneath stratum D and is another very hard and stiff clay layer. It is grey with olive mottling and iron staining and has a similar appearance to stratum C. The lateral extent and thickness of stratum E under the site is unknown.

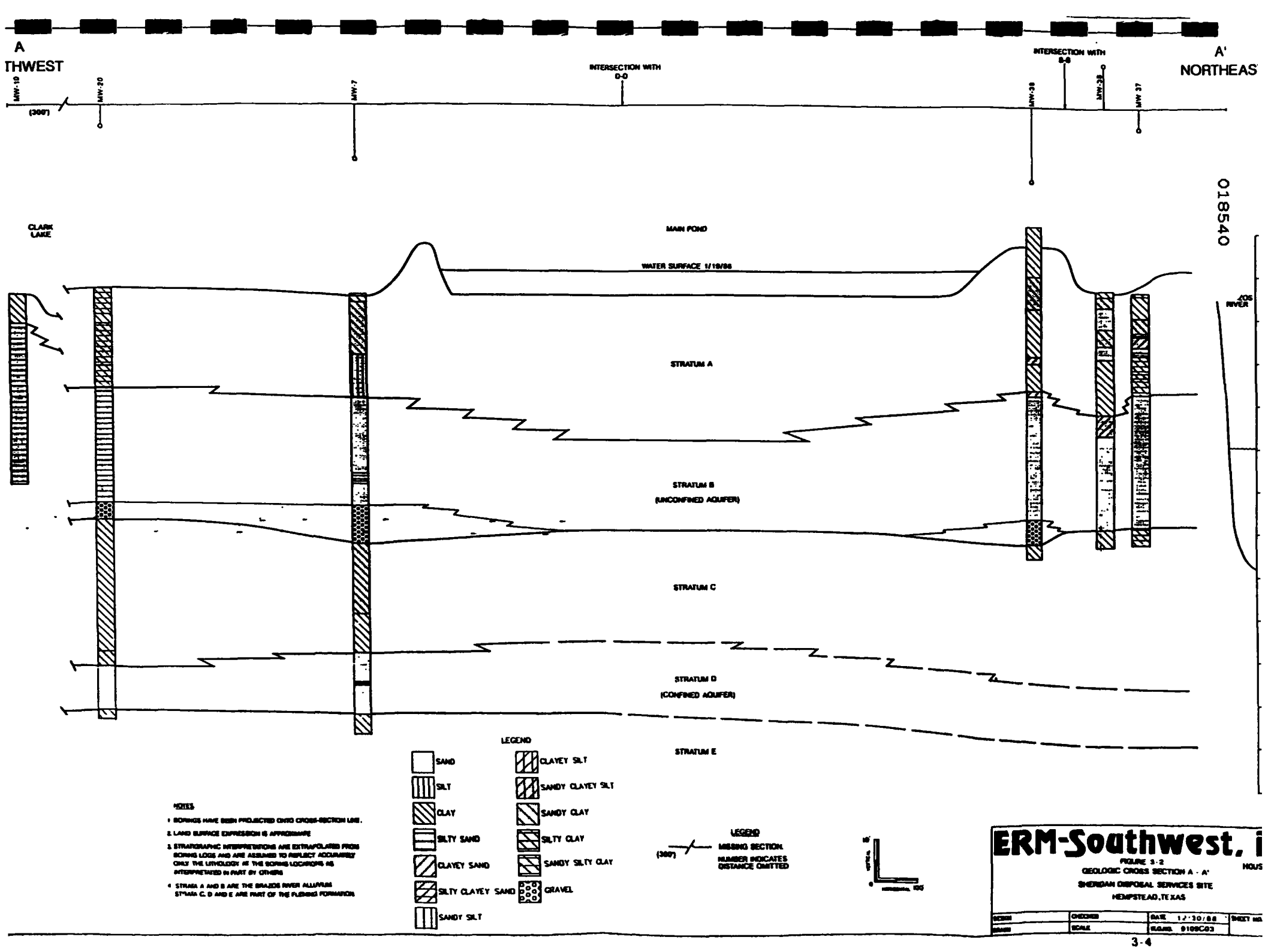
Cross-sections showing the lateral and vertical extent of strata C, D and E are shown in Figures 3-2 through 3-5. Physical parameters of soil samples for the Fleming Formation are in presented in Table 3-2.



ERM-Southwest.
NEW ORLEANS, LOUISIANA HOUS

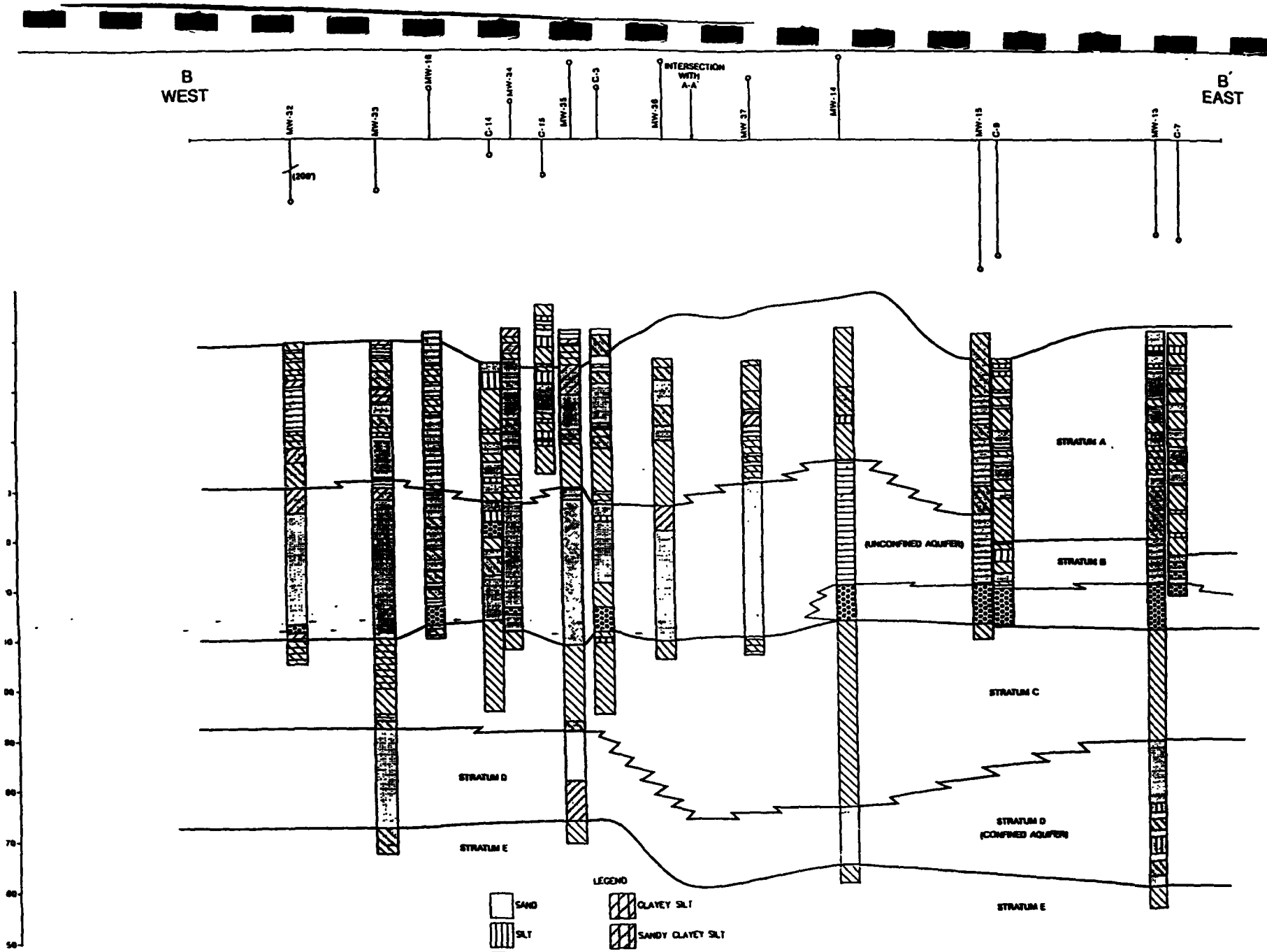
FIGURE 3-1
MONITOR WELL, CONE PENETROMET
AND BORING LOCATIONS USED FO
GEOLOGIC CROSS-SECTIONS
Sheridan Disposal Services
Hempstead, Texas

W.O. NO. 9120802 DATE 12/30/8


A
THWEST
A'
NORTHEAS
INTERSECTION WITH D-D
INTERSECTION WITH B-B
MW-19
MW-20
MW-7
MW-38
MW-36
MW 37
(300')
CLARK LAKE
MAIN POND
WATER SURFACE 1/19/88
STRATUM A
STRATUM B
(UNCONFINED AQUIFER)
STRATUM C
STRATUM D
(CONFINED AQUIFER)
STRATUM E
RIVER
LEGEND
SAND
SILT
CLAY
SILTY SAND
CLAYEY SAND
SILTY CLAYEY SAND
SANDY SILT
CLAYEY SILT
SANDY CLAYEY SILT
SANDY CLAY
SILTY CLAY
SANDY SILTY CLAY
GRAVEL
LEGEND
(300')
MISSING SECTION
NUMBER INDICATES DISTANCE OMITTED
NOTES
1. BORINGS HAVE BEEN PROJECTED ONTO CROSS-SECTION LINE.
2. LAND SURFACE EXPRESSION IS APPROXIMATE
3. STRATIGRAPHIC INTERPRETATIONS ARE EXTRAPOLATED FROM BORING LOGS AND ARE ASSUMED TO REFLECT ACCURATELY ONLY THE LITHOLOGY AT THE BORING LOCATIONS AS INTERPRETATED IN PART BY OTHERS
4. STRATA A AND B ARE THE BRAZOS RIVER ALLUVIUM STRATA C, D AND E ARE PART OF THE FLEMING FORMATION
ERM-Southwest, i
FIGURE 3-2
GEOLOGIC CROSS SECTION A - A'
SHERIDAN DISPOSAL SERVICES SITE
HEMPSTEAD, TEXAS
DATE 12/30/88
SCALE
9109C03

018540

018541



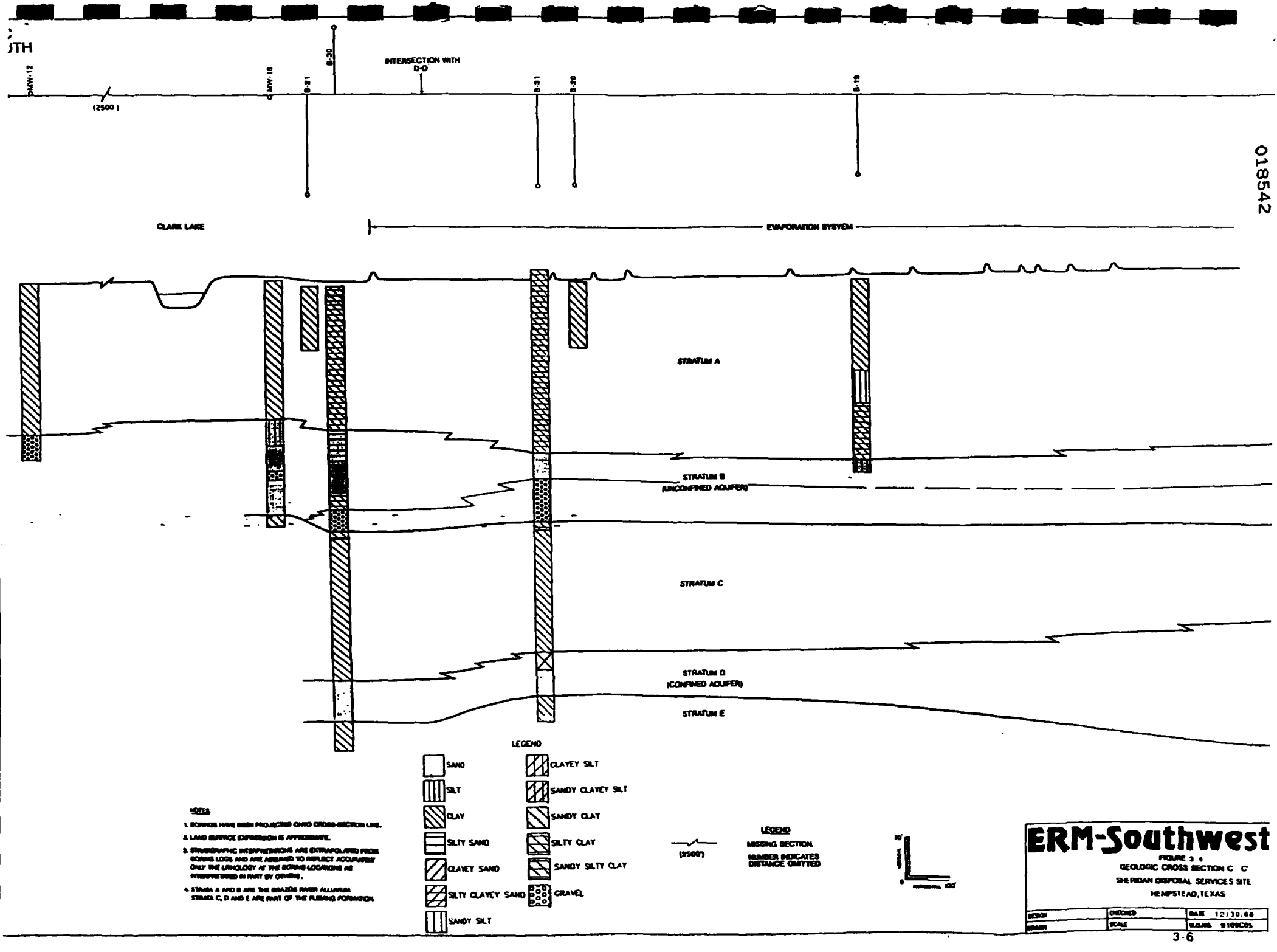
NOTES

1. BORINGS HAVE BEEN PROJECTED ONTO CROSS-SECTION LINE.
2. LAND SURFACE EXPRESSION IS APPROXIMATE.
3. STRATIGRAPHIC INTERPRETATIONS ARE EXTRAPOLATED FROM BORING LOGS AND ARE ASSUMED TO REFLECT ACCURATELY ONLY THE LITHOLOGY AT THE BORING LOCATIONS AS INTERPRETATED IN PART BY OTHERS.
4. STRATA A AND B ARE THE BRAZOS RIVER ALLUVIUM. STRATA C, D AND E ARE PART OF THE FLEMING FORMATION.

ERM-Southwest

FIGURE 3 3
GEOLOGIC CROSS SECTION B B'
SHERIDAN DISPOSAL SERVICES SITE
HEMPSTEAD, TEXAS

DESIGN	CHECKED	DATE 12 30/88
DRAWN	SCALE	W.O.NO. 9109C04

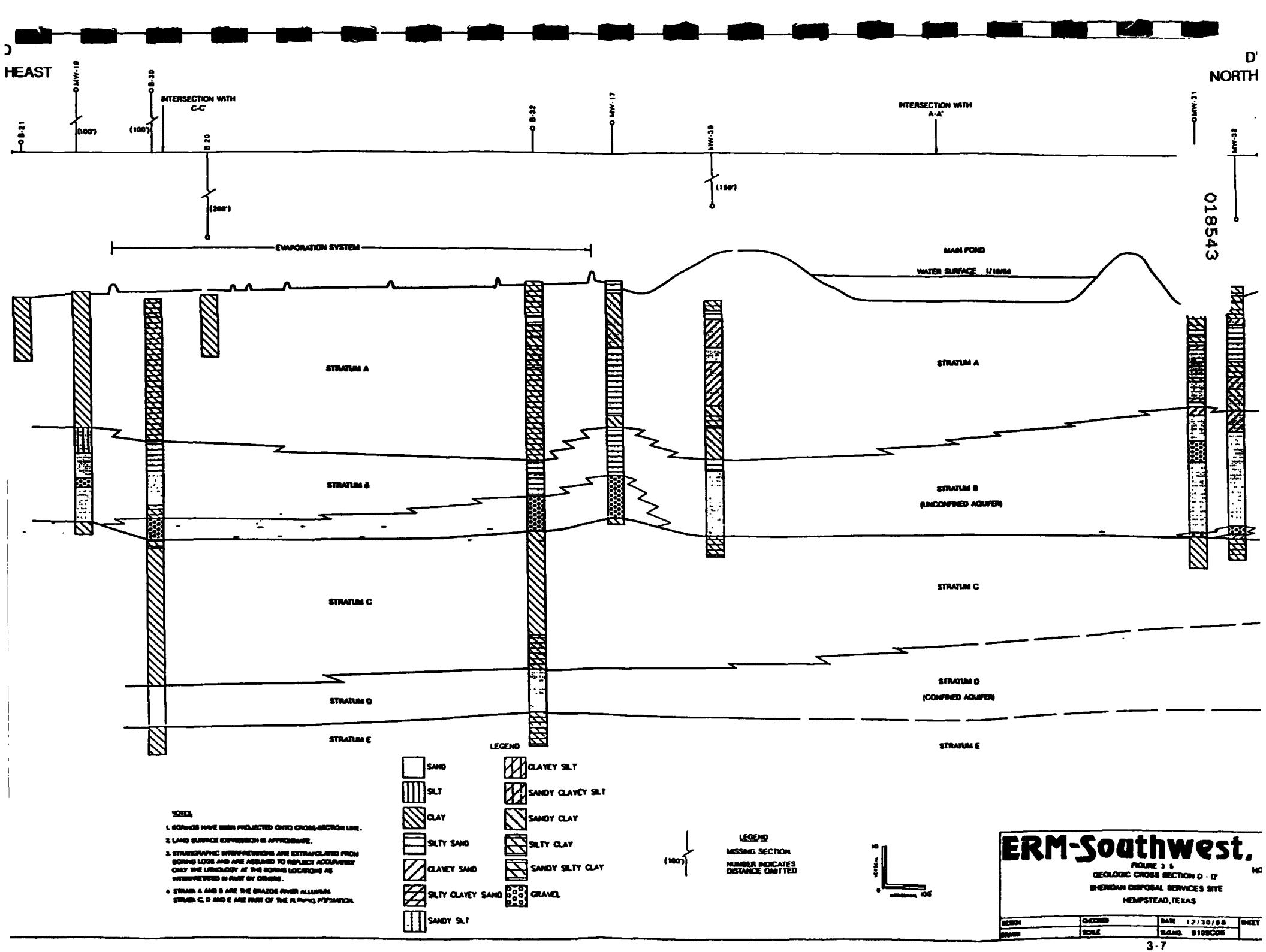


018542

ERM-Southwest

FIGURE 3 4
GEOLOGIC CROSS SECTION C C'
SHERIDAN DISPOSAL SERVICES SITE
HEMPSTEAD, TEXAS

DESIGN	CHECKED	DATE 12/30.88
DRAWN	SCALE	PROJ. NO. 0109C05


HEAST
D'
NORTH
B-21
MW-19
(100')
B-30
(100')
INTERSECTION WITH C-C'
B-20
(200')
B-32
MW-17
MW-39
(150')
INTERSECTION WITH A-A'
MW-31
MW-32
018543
EVAPORATION SYSTEM
MAIN POND
WATER SURFACE 1/1988
STRATUM A
STRATUM B
STRATUM C
STRATUM D
STRATUM E
STRATUM A
STRATUM B
(UNCONFINED AQUIFER)
STRATUM C
STRATUM D
(CONFINED AQUIFER)
STRATUM E
LEGEND
SAND
SILT
CLAY
SILTY SAND
CLAYEY SAND
SILTY CLAYEY SAND
SANDY SILT
CLAYEY SILT
SANDY CLAYEY SILT
SANDY CLAY
SILTY CLAY
SANDY SILTY CLAY
GRAVEL
NOTES
1. BORINGS HAVE BEEN PROJECTED ONTO CROSS-SECTION LINE.
2. LAND SURFACE EXPRESSION IS APPROXIMATE.
3. STRATIGRAPHIC INTERPRETATIONS ARE EXTRAPOLATED FROM BORING LOGS AND ARE ASSUMED TO REFLECT ACCURATELY ONLY THE LITHOLOGY AT THE BORING LOCATIONS AS INTERPRETED IN PART BY DRILLERS.
4. STRATA A AND B ARE THE BRAZOS RIVER ALLUVIUM. STRATA C, D AND E ARE PART OF THE FLEMING FORMATION.
(100')
LEGEND
MISSING SECTION
NUMBER INDICATES DISTANCE OMITTED
ERM-Southwest,
FIGURE 3.5
GEOLOGIC CROSS SECTION D - D'
SHERIDAN DISPOSAL SERVICES SITE
HEMPSTEAD, TEXAS
DESIGN
CHECKED
DATE 12/30/88
SHEET
DRAWN
SCALE
W.O.NO. 0109C05

C806

TABLE 3-1

Physical Characteristics of Selected Soil Samples from the Brazos River Alluvium (Strata A and B)

Sheridan Disposal Services

Sample Location	Depth (feet)	Stratum	Lab Description	Grain Size Analysis % Passing Sieve Size #10	#40	#200	Unconfined Compressive Strength (tsf)	Atterberg Limits Liquid Limit	Plastic Limit	Plasticity Index
MW-31	6.3-7.0	A	sandy clay	100	100	78	3.2	32	18	14
	34-39	B	sand	100	74	15				
	44-49	B	sand	100	96	1				
MW-32	8-9	A	sandy clay	100	100	63				
MW-33	24-25	A	silty clay w/ sand seam	100	100	71				
MW-34	7-9	A	sandy silt	100	100	66				
	49-54	B	silty sand	100	100	12				
MW-35	3-4	A	silty clay	100	100	97		47	21	26
MW-36	17-18	A	silty clay	100	100	100	0.9	54	26	28
	39-44	B	sandy clay	100	100	57				
MW-37	2 5-3.0	A	silty clay	100	100	99	0.6	67	31	36
	26-29	B	sandy silt	100	100	46				
MW-39	23-24	A	silty clay	100	99	91		41	22	19
	37.5-38	B	sandy clay	100	99	85	0 2	31	17	14
	49-54	B	silty sand	100	46	15				
MW-40	13 25-13 75	A	clay	100	99	96	1 2	68	19	49
	46.5-47	B	poorly graded sand	100	94	2				

Note

The following standard methods were used for the above determinations

Soil Classification ASTM D2487-85
Grain Size Analysis ASTM D422-63 (1972)
Unconfined Compressive Strength: ASTM D2166-85
Atterberg Limits. ASTM D4318-84

018544

C807

TABLE 3-2

Physical Characteristics of Selected Soil Samples from the Fleming Formation (Strata C, D and E)

Sheridan Disposal Services

Sample Location	Depth (feet)	Stratum	Soil Classification	Grain Size Analysis % Passing Sieve Size #10	#40	#200	Unconfined Compressive Strength (tsf)	Atterberg Limits Liquid Limit	Plastic Limit	Plasticity Index
MW-31	62-63	C	clay	100	100	95	1.5	63	26	37
MW-32	62-63	C	clay w/ silt seams	100	100	89	3.1	59	24	35
MW-33	79-81	D	sand w/ silt seams	98	93	15				
	100-100.6	E	sandy clay	100	100	87		54	23	31
MW-35	67-68	C	sandy clay	100	100	95	2.7	57	28	29
	78-79	C	silty clay	100	100	86	2.7	38	17	21
	82-83	D	silty sand	100	95	46				
MW-37	55-56	C	clay w/ silt seams	100	100	98	2.8	72	27	45
MW-39	57.5-58.3	C	silty clay w/ sand seams	100	100	97	6.3	52	20	32
MW-40	58-58.5	C	silty clay w/sand	100	99	86	1.2	37	19	18
	85-85.5	E	clay	100	98	76	0.64	36	12	24

Note

The following standard methods were used for the above determinations:

Soil Classification ASTM D2487-85
Grain Size Analysis: ASTM D422-63 (1972)
Unconfined Compressive Strength: ASTM D2166-85
Atterberg Limits: ASTM D4318-84

018545

3.3 Investigation of Site Hydrogeology

In order to understand the hydrogeology under the SDS site and the potential impact of the site on ground water, numerous monitor wells have been installed around the site over the past 25 years. Through 1985, 29 wells had been installed. Table 3-3 lists these wells and the aquifer they monitor. More details about these wells can be found in Section 4 of the SCRI (July 1987).

For the GWRI, eleven additional monitor wells were installed to better assess ground water flow directions and water quality beneath the site. Monitor well construction details for these wells are contained in Table 3-4. The following subsection describes the procedures followed for sampling each borehole and installing the eleven most recent monitor wells.

3.4 Field Procedures

3.4.1 Monitor Well Installation

Eleven additional wells were installed at the SDS site as part of the GWRI. Seven of these wells are screened in the shallow, unconfined aquifer and four are screened in the deeper, confined aquifer. Locations of these new wells and previously existing wells are shown in Figure 3-6.

All wells were installed with a CME 75 drilling rig using hollow stem auger techniques. Boreholes were continuously sampled where possible and described by a hydrogeologist. Detailed boring log descriptions are contained in Appendix A. Selected soil samples were retained for physical testing. These are described in Tables 3-1 and 3-2. In addition, extruded samples were field checked for contamination using an HNu meter. No indications of contamination were detected in any of the boreholes, except at MW-38 where surface contamination was noted during the installation of steel surface casing. Once this casing was installed, no further contamination was detected in the borehole.

A summary of well completion details is listed in Table 3-4. All wells are either two or four-inch diameter schedule 40 PVC, except that one two-inch well, MW-38, is 304 stainless steel. All wells have 0.01 inch slot size for the screened interval, with a 2 to 3 foot sump below the screen to collect fine particles and help keep the screen free of silt through time. A 20/40 washed silica sand pack was tremied around the screened interval to approximately two feet above the screen. Six to

TABLE 3-3

Details of Monitor Well Construction
Monitor and Other Wells Installed at SDS Through 1985

Well Number	Diameter (inches)	Total Depth (ft)	Screened Interval (ft)	Date Installed	Aquifer Monitored [a]	Description
MW-1	2	65	50-60	1983	1	EPA FIT Well, No. 3
MW-1 [b]	1	40.5	NA	1985	1	Resource Engineering
MW-2	4	114	94-106	1972	2	O'Malley & Clay (north well)
MW-3	2	65	53-63	1983	1	EPA FIT Well, No. 2
MW-4	4	69	55-61	1972	1	O'Malley & Clay (west well)
MW-5	4	60	54-60	1963	1	Old Windmill Well
MW-6	2	58	43-58	1983	1	EPA FIT Well, No. 1
MW-7	4	100	80-95	1984	2	Resource Engineering
MW-8	4	65	51-57	1972	1	O'Malley & Clay (south well)
MW-9	4	165 [c]	?	1963	1	Production Well for Boiler
MW-10	2	44.5	28-43	1984	1	Resource Engineering
MW-11	4	135 [c]	?	?	?	Domestic Well
MW-12	2	40	24-39	1984	1	Resource Engineering
MW-13	2	93	83-93	1984	2	Resource Engineering
MW-14	2	102	92-102	1984	2	Resource Engineering
MW-15	2	61	51-61	1984	1	Resource Engineering
MW-16	2	61	48-53	1984	1	Resource Engineering
MW-17	2	Accidentally Destroyed			1	Resource Engineering
MW-18	4	58.5	32-57	1984	1	Resource Engineering
MW-19	2	57	34-54	1984	1	Resource Engineering
MW-20	4	98	85-97.5	1985	2	Resource Engineering
MW-21	2	54	4-54	1985	1	Resource Engineering
MW-22	2	101	85-100	1985	2	Resource Engineering
MW-23	2	54	4-54	1985	1	Resource Engineering
MW-24	2	54	4-54	1985	1	Resource Engineering
MW-25	2	54	4-54	1985	1	Resource Engineering
MW-26	2	98.5	83.5-98.5	1985	2	Resource Engineering
MW-27	2	102	85-97	1985	2	Resource Engineering
MW-28	2	98	85.5-98	1985	2	Resource Engineering
MW-29	4	56	5-55	1985	1	Resource Engineering

NOTES.
[a] Aquifer Monitored 1 - Unconfined (water table) aquifer, 2 - Confined Aquifer.
[b] MW-1 became plugged with silt, it was reconstructed with open ended 1-inch PVC pipe.
[c] Total depth report by Duane Sheridan, not confirmed

Data from Source Control RI, July 1987

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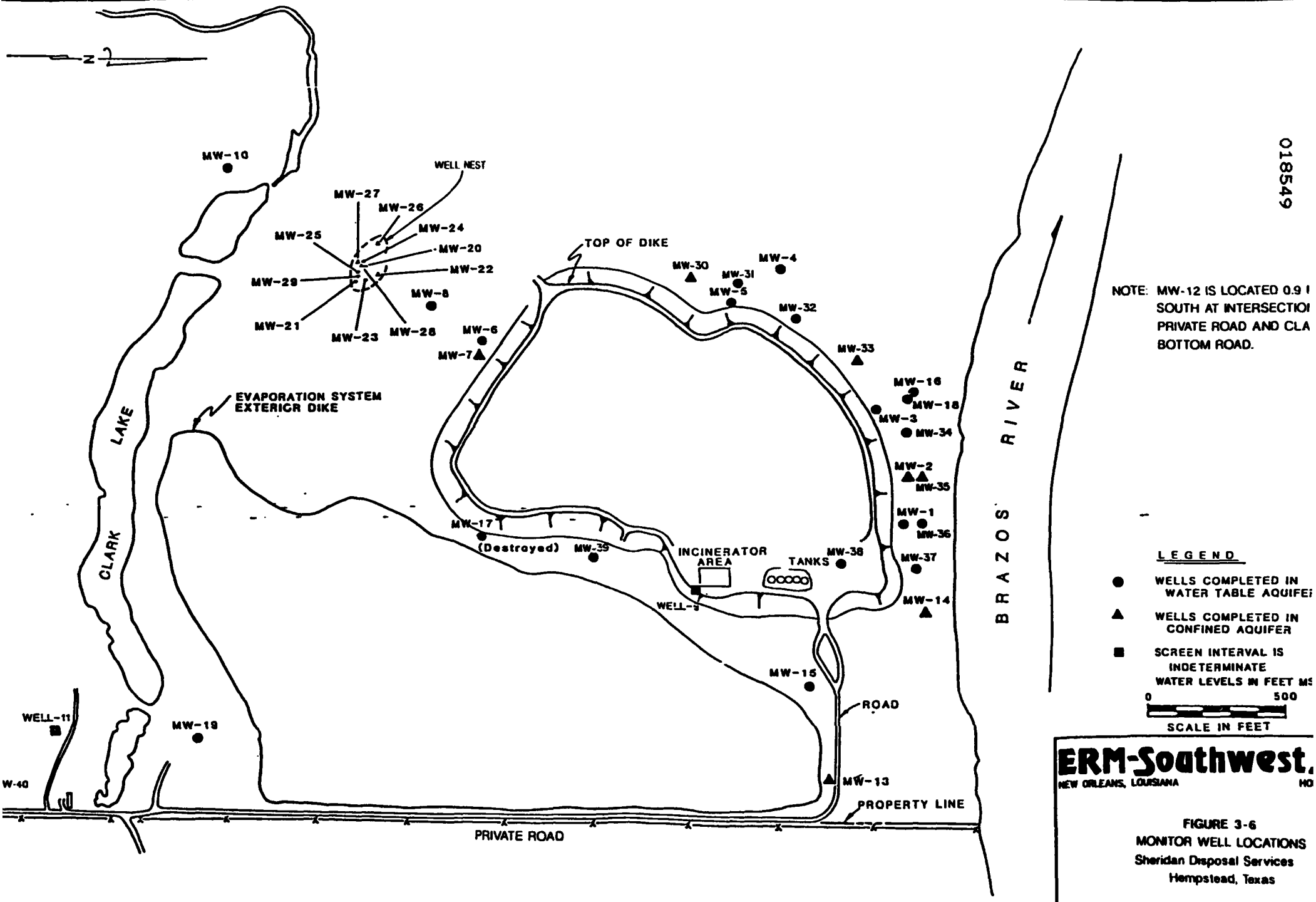
TABLE 3-4

Monitor Well Construction Details [a]
Wells Installed for CWRI

Sheridan Disposal Services Site

Well Number	Diameter (inches)	Total Depth (ft)	Screened Interval (ft)	Date Installed	Aquifer Monitored [b]	Description
MW-30	2	104	77-102	7/27/87	2	ERM (surface casing to 59')
MW-31	4	63	25-60	7/16/87	1	ERM
MW-32	4	63	25-60	7/20/87	1	ERM
MW-33	2	100	77-97	7/29/87	2	ERM (surface casing to 65)
MW-34	4	64	26-61	7/23/87	1	ERM
MW-35	2	103	80-100	8/6/87	2	ERM (surface casing to 68')
MW-36	4	60	27-57	8/7/87	1	ERM
MW-37	4	58	25-55	8/7/87	1	ERM
MW-38	2	78	31-76	7/30/87	1	ERM (surface casing to 26' stainless steel well)
MW-39	4	57	34-54	8/8/87	1	ERM
MW-40	4	85.5	65 5-83	10/10/87	2	ERM

[a] See Appendix A for boring logs.
[b] Aquifer Monitored: 1 - Unconfined (water table) Aquifer 2 - Confined Aquifer



018549

NOTE: MW-12 IS LOCATED 0.9 I
SOUTH AT INTERSECTIO
PRIVATE ROAD AND CLA
BOTTOM ROAD.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFE
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MS

0 500

SCALE IN FEET

ERM-Southwest,
NEW ORLEANS, LOUISIANA HO

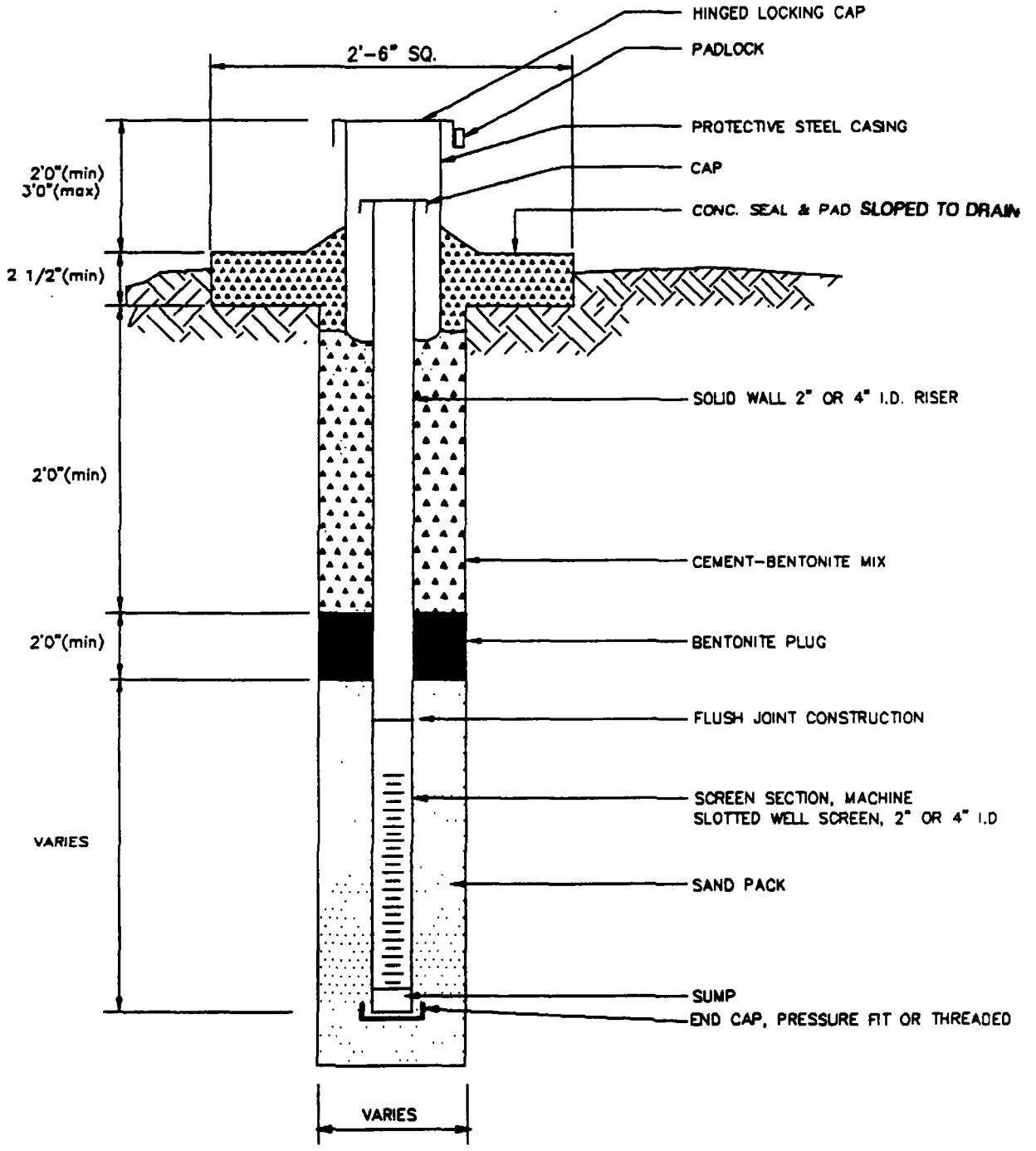
FIGURE 3-6
MONITOR WELL LOCATIONS
Sheridan Disposal Services
Hempstead, Texas

W.O. NO. 9120809 | DATE 12/30/

twelve inches of fine silica sugar sand (40/60) was tremied above the coarse sand pack. Two feet of bentonite pellets were placed above the sand pack. The bentonite was hydrated with clean water if no natural ground water was in the borehole at that depth. The bentonite was allowed to hydrate approximately one or more hours before completing the hole. A thick slurry of cement and bentonite (approximate 20:1 mixture by weight) was tremied down the annulus and filled to ground surface. Well completion details can be found in the boring log descriptions, Appendix A. A steel locking protective casing was placed around each well and cemented into the concrete pad. Pads are 2.5 feet by 2.5 feet in size and are sloped away from the well to preclude water from collecting around the well casing. Figure 3-7 illustrates general monitor well construction details.

In order to protect the integrity of the deep aquifer from potential surface contamination, steel surface casings were installed from the ground surface to a depth of three to five feet into the clay (stratum C) underlying the unconfined aquifer. This procedure was followed for the three wells screened in the deep aquifer that were installed along the west and north sides of the main pond (MW-30, MW-33 and MW-35). A surface casing was not installed in MW-40, a background well screened in the deep aquifer and located south of Clark Lake, as no indication of affected ground water was detected there and the location is well-removed from site activities. In addition, a shallow surface casing was installed in MW-38, the stainless steel well located at the top of the dike near the existing battery of tanks (Figure 3-6). Although this well screens the shallow aquifer, there is affected material in the dike soils and the surface casing lessens the possibility of carrying material down to the aquifer. The casing was installed to 26 feet below grade, the depth determined to be below any HNu detectable or visibly affected soil at that location.

Because of the unconsolidated nature of the uppermost aquifer, the boreholes would not remain open and surface casings had to be installed using mud rotary techniques. After the borehole had been sampled using hollow stem augers and the clay layer located, a Gardner-Denver drilling rig moved over the location and reamed the borehole to approximately 11.5 inches diameter. A minimal amount of bentonite or poly gel was added to the drilling fluid to insure stability of the borehole. The steel casing (8 inch inner diameter) was set a minimum of three feet into the clay with approximately one foot of open hole below the casing to allow the grout to move freely into the annulus. In each borehole the casing was set into place using pressure grouting techniques to ensure a good seal between the casing and the subsurface soil. The grout was allowed to set a minimum of



ERM-Southwest, inc.
HOUSTON, TEXAS

FIGURE 3-7
GENERAL WELL CONSTRUCTION DETAILS
SHERIDAN DISPOSAL SERVICES SITE

4/29/88 | W.O.NO. 9109A19D88

24 hours before the plug was drilled out and sampling of the borehole continued. Figure 3-8 illustrates these well completion details.

Upon completion of well installation all existing and accessible wells were surveyed to mean sea level by ERM-Southwest personnel to establish a datum for comparison of ground water elevations and site stratigraphy. The survey benchmark was established at MW-13, which had been previously surveyed to mean sea level for the Source Control RI (July 1987).

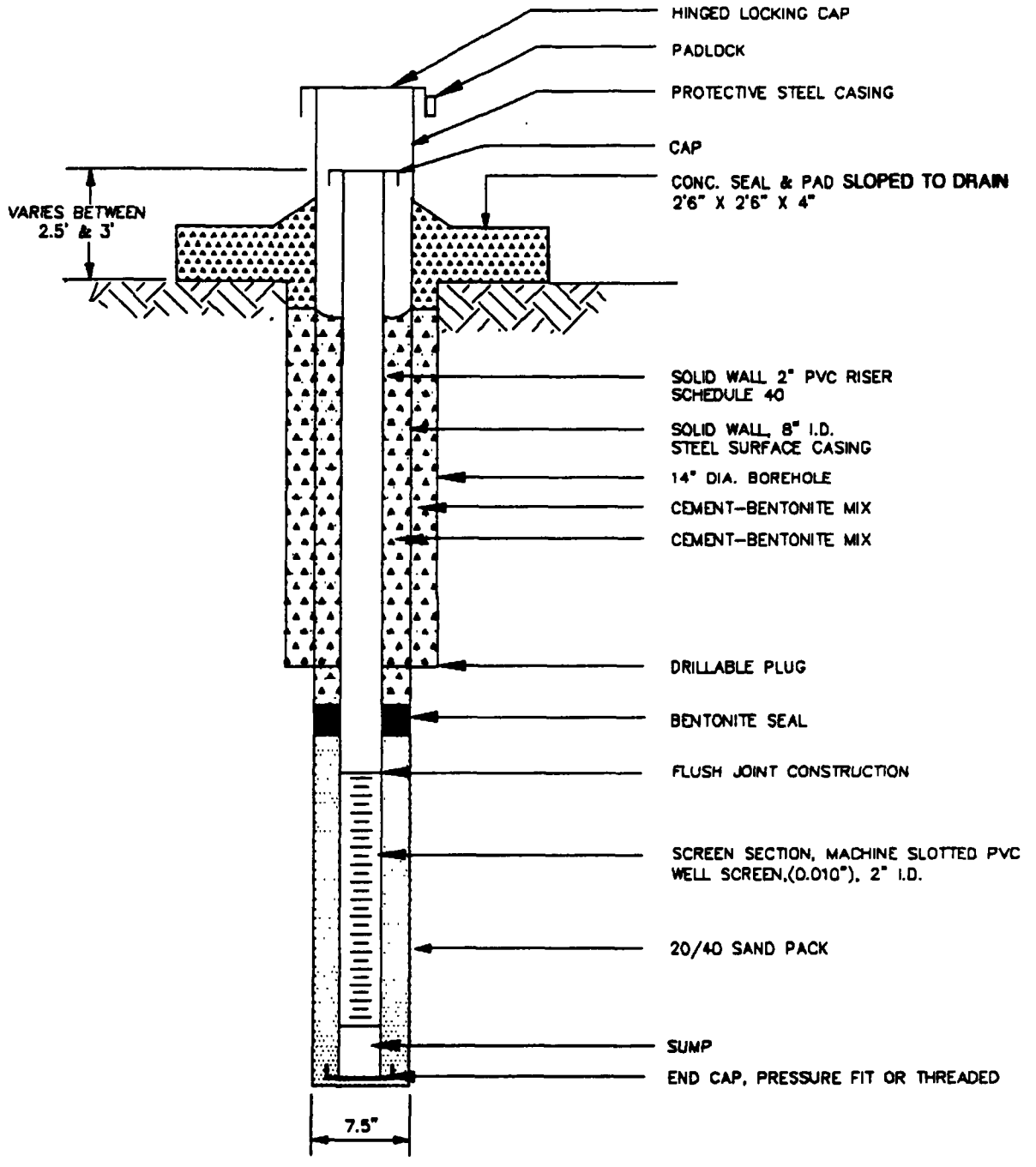
3.4.2 Decontamination Procedures

In order to keep on-site cross contamination to a minimum, all equipment used during drilling (augers, bits, Shelby tubes, flight rods) was steam cleaned between each boring location at the decontamination pad. If the back portion of the drilling rig was dirty it was also steam cleaned between locations. In addition, steel surface casings were steam cleaned before being grouted into place. Sections of monitor well casings (either blank pipe or screen) were steam cleaned if they had not been previously wrapped in plastic.

Cuttings (excess soil) generated during drilling were placed on plastic sheeting and later disposed of in the main pond. Water used for steam cleaning and for mixing with grout was obtained from Mr. Sheridan's water well behind his residence approximately 1.4 miles from the site. This well is screened about 400 feet below grade. An analysis of the water from this well was performed to confirm the chemical characteristics of this water. No compounds from the Priority Pollutant list (volatile, semivolatile, pesticide/PCBs and metals) were found above detection limits except trace concentrations of arsenic, copper and zinc. These concentrations are well below drinking water standards, as noted in Table 3-5. A copy of the complete analytical results is found in Appendix B.

3.4.3 Well Development

After installation, all 11 wells were developed to clear the screen of fine particles that can accumulate as a normal part of installation. The wells were developed until the pH and specific conductivity had stabilized, and the water was clear. The wells were developed using air lift techniques in which compressed air is put into the well through a tube and the air pressure lifts the standing water and fine sediment out of the well, allowing water to flow into the well through the screen, clearing it up. Before entering the well, the compressed air is passed through two separate filters that remove particles or oil that



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ERM-Southwest, inc.
HOUSTON, TEXAS

04/29/88	W.O.NO. 9109A020088

FIGURE 3-8
GENERAL CONSTRUCTION DETAILS FOR WELLS
SCREENED IN THE CONFINED AQUIFER
WITH SURFACE CASING
SHERIDAN DISPOSAL SERVICES SITE

C810

TABLE 3-5

Summary of Analytical Results for water
Used in Drilling and Decontamination

Chemical Constituents	
Volatile Organics	ND
Base/Neutral/Acid Extractable Organics	ND
Pesticides/PCBs	ND

Metals	Conc (mg/l)	Water Quality Standard
Arsenic	0 005 (0 003)	0.05 (MCL)
Copper	0.016 (0 006)	1 0 (AWC-H20)
Zinc	0 10 (0.01)	5 (AWC-H20)
All other metals	ND	---

Other Parameters		
pH	7 61 (0 01)	S U
Specific Conductance	604 (1)	(umhos/cm)

NOTES
ND - Not Detected
Values in parentheses represent detection limits
MCL - Maximum Contaminant Level
AWC-H2O - Ambient Water Quality Criteria for water
Values for MCL and AWC-H2O from Superfund Public Health
Evaluation Manual, OSWER Directive 9285 4-1, October 1986

may be ejected from the air compressor. All tubing or other apparatus coming in contact with formation water were thoroughly steam cleaned or new materials were used between each well.

All four inch diameter wells screened in the unconfined aquifer were also further developed with a submersible pump. This was done to aid in clearing up the water in these wells to reduce their continued turbidity. In many cases several thousand gallons of water were removed from the wells. Specific well development details are included in Appendix A.

Within the waste management area of the site, water removed during well development was pumped into the main pond for disposal. Water from wells outside the waste management area was pumped onto the ground.

3.5 Hydrology of the Unconfined Aquifer

3.5.1 Hydraulic Characteristics

The hydraulic characteristics of the unconfined aquifer were determined by three different methods: laboratory permeability tests, slug or bail tests, and pump tests. Laboratory tests on unconsolidated sands are recompacted permeabilities. They yield values that should approximate actual permeability at that location. Samples that are clayier had both horizontal and vertical permeability tests run on them. Results are presented in Table 3-6. The geometric mean coefficient of permeability of the samples from stratum B is 1.4E-04 cm/sec.

Slug and/or bail tests were completed in all newly installed PVC wells. This method uses the "instantaneous" removal or insertion of a volume or slug and the subsequent change in water level with time to determine the aquifer permeability (hydraulic conductivity) near the well being tested. Field procedures for these tests are described in Appendix C. The method of Bouwer and Rice (1976) was used to analyze the data. Detailed calculations are also provided in Appendix C. A summary of results shown in Table 3-7 indicate a range of hydraulic conductivity from 3.3E-03 to 1.4E-02 cm/sec, with a geometric mean value of 5.8E-03 cm/sec. These values are in the range for a silty sand to a sand as would be expected given the lithology of the aquifer. Transmissivity ranged from 1.5E+03 to 7.5E+03 gpd/ft, with a geometric mean value of 2.9E+03 gpd/ft.

As part of the Source Control RI, a thirteen-hour pump test was conducted on the unconfined aquifer beginning 12/18/85. Analy

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TABLE 3-6

Results of Laboratory Permeabilities for
Samples from the Brazos River Alluvium (Strata A and B)

Sample Number	Depth (ft)	Stratum	Soil Type	Coefficient of Permeability (cm/sec)		
				Vertical	Horizontal	Recompacted
MW-31	6-7	A	Sandy Clay	4 1 x 10-7	2 1 x 10-7	-
	34-39	B	Sand	-	-	3 2 x 10-4
	44-49	B	Sand	-	-	2.0 x 10-4
MW-32	8-9	A	Sandy Clay	-	-	1.8 x 10-4
MW-33	24-25	A	Silty Clay with Sand Seams	-	-	1.3 x 10-4
MW-34	7-9	A	Sandy Silt	-	-	1 0 x 10-4
	49-54	B	Silty Sand	-	-	9.8 x 10-4
MW-35	3-4	A	Silty Clay	2 1 x 10-8	4 3 x 10-9	-
MW-36	17-18	A	Silty Clay	4 3 x 10-9	7 8 x 10-9	-
	39-44	B	Sandy Clay	-	-	2 7 x 10-5
MW-37	2.5-3	A	Silty Clay	2 2 x 10-9	4.8 x 10-9	-
	26-29	B	Sandy Silt	-	-	2 4 x 10-5
MW-39	23-24	A	Silty Clay	1 7 x 10-8	2 6 x 10-9	-
	37.5-38	B	Sandy Clay	2 5 x 10-9	4 8 x 10-2	-
	49-54	B	Silty Sand	-	-	1 3 x 10-4
MW-40	13.2-13 7	A	Clay	9 9 x 10-9	8 9 x 10-9	-
	46.5-47	B	Poorly Graded Sand	-	-	2 4 x 10-4

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TABLE 3-7

Summary of Permeability and Transmissibility Values
from Slug/Ball Tests, Unconfined Aquifer

Well Number	K (cm/sec)	Average K	Aquifer Thickness (ft)	T
MW-31	1.5E-02 1 4E-02 1.3E-02	1.4E-02	25 7	7.5E+03 gpd/ft or 93.6 m2/day
MW-32	9.5E-03 9.5E-03	9.5E-03	25.0	5.0E+03 gpd/ft or 62.4 m2/day
MW-34	4.4E-03 4 5E-03	4.5E-03	20.2	1.9E+03 gpd/ft or 23 7 m2/day
MW-36	4 2E-03 3.7E-03	3 9E-03	20 4	1 7E+03 gpd/ft or 21 1 m2/day
MW-37	3 2E-03 3 3E-03	3 3E-03	21 1	1 5E+03 gpd/ft or 18 2 m2/day
MW-39	5 7E-03 5 0E-03	5 35E-03	23 9	2.7E+03 gpd/ft or 33 6 m2/day
	Mean K (geometric) = 5.8E-03		Mean T (geometric) =	2 8E+03 gpd/ft = 35 1 m2/day

sis of the data yielded an average transmissivity of 4.0E+03 gpd/ft, and hydraulic conductivity of 7.9E-03 cm/sec using a saturated thickness for the aquifer of 24 feet.

Comparison of the three sets of data show good agreement between the different methods of aquifer analysis. Permeability measurements from the laboratory are slightly lower than the field data, which may be a function of sample size and recompaction of the sample into the permeameter. Mean pump and slug test values for permeability and transmissivity are very close, given the variable nature of the methods (a localized test versus a more regional test) and the heterogeneity of the aquifer. These values characterize the unconfined aquifer in the vicinity of the site.

3.5.2 Ground Water Elevations and Movement

In order to assess the movement of ground water in the unconfined aquifer, water level measurements have been recorded at the site on a regular basis (monthly or more frequently) from November 1985 until February 1988. Values measured at each well have been converted to the same datum (mean sea level) so that relative comparisons of water level over the site can be made. Data collected for this time period from all accessible wells on the site are given in Table 3-8. A continuous water level recorder was installed in MW-16 and data from this instrument are to note relative changes in water level only.

Water elevations plotted on the site map show the direction of ground water flow. Representative flow directions for the site indicate that the primary flow direction is to the north or northwest, toward the Brazos River. The flow direction occasionally changes to that of south and west across portions of the site but only for relatively short periods of time. (Figures 3-9 to 3-11). These changes are related to the stage of the Brazos River and the relative amount of bank storage within the unconfined aquifer.

The height of the river at the site has been measured in several ways. A wooden staff gauge was installed along the bank in March 1987 and surveyed to mean sea level. Several measurements were recorded from this until the water level dropped below the base of the gauge. Several yellow blazes about one foot apart have been painted on a stationary pipe in the river. This pipe contains a pressure transducer that records relative changes in river level. These blazes have been surveyed to mean sea level, and visual estimates of the river level have been made. A final method used to estimate the height of the river at the site is to take the height recorded at the Hempstead station (#08111500) by the USGS and use a factor to estimate the height at the site.

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TABLE 3-8
(Page 1 of 3)

Ground Water Elevations in the Unconfined Aquifer (Stratum 8)

Sheridan Disposal Services Site

Date of Sample	Days from Start	River Stage - Hempstead (ft MSL)	River Stage at Site (meas)	River Stage at Site (calc)	Main Pond	Evaport'n System	Clark Lake	Elevation by Well Code (feet MSL) - Shallow Wells: MW-1	MW-3	MW-4	MW-5	MW-6	MW-8	MW-10	MW-12
Total Well Depth		N/A			N/A	N/A	N/A	65	65	69	60	58	65	44.5	40
Screened Interval		N/A			N/A	N/A	N/A	50-60	53-63	55-61	54-60	43-58	51-57	28-43	24-39
Top of Casing (REI)		N/A			N/A	N/A	N/A	167.84	167.92		172.36	168.16	169.25	168.34	169.61
Top of Casing (ERM)								167.83	167.33	169.76	172.39	167.41	169.29	167.28	168.87
REI Data															
11/22/85	1	122.9		132.1	no data	no data	no data	132.99	133.40		134.20	135.74	136.01	136.32	141.11
12/06/85	15	131.8		141.0	no data	no data	no data	138.50	136.64		139.85	137.15	136.70	136.64	141.93
12/13/85	22	140.9		150.1	no data	no data	no data	140.31	137.40		135.22	137.34	138.82	136.75	142.00
12/19/85	28	132.0		141.2	no data	no data	no data	139.40	137.71		135.60	137.88	137.31	136.96	141.59
1986															
01/03/86	43	124.6		133.8	no data	no data	no data	136.10	136.31		136.44	137.90	137.73	137.38	142.48
01/14/86	54	123.9		133.1	no data	no data	no data	135.06	135.54		136.28	137.48	137.43	137.43	-
02/07/86	78	144.0		153.2	no data	no data	no data	138.98	137.67		135.81	137.62	137.25	137.23	141.58
03/21/86	120	122.1		131.3	no data	no data	no data	-	135.05		136.39	137.33	137.08	137.94	141.82
04/24/86	154	121.0		130.2	no data	no data	no data	132.29	133.60		135.46	136.49	136.89	137.61	141.62
05/09/86	169	126.1		135.3	no data	no data	no data	135.34	135.20		-	137.28	137.23	137.56	141.79
06/11/86	202	137.0		146.2	no data	no data	no data	141.81	138.57		136.69	138.57	138.07	137.95	142.60
07/15/86	236	126.1		135.3	no data	no data	no data	136.14	136.86		137.51	138.55	138.50	138.30	142.59
08/18/86	270	121.2		130.4	no data	no data	no data	133.83	134.94		-	137.40	137.63	138.10	141.90
09/18/86	301	127.2		136.4	no data	no data	no data	135.32	135.55		-	137.54	137.57	137.95	141.90
10/27/86	340	132.0		141.2	no data	no data	no data	138.61	137.57		136.59	138.26	138.02	137.99	142.04
11/28/86	372	131.2		140.4	no data	no data	no data	137.37	137.05		136.79	138.17	137.98	138.13	142.09
1987															
01/02/87	407	133.7		142.9	no data	no data	no data	141.83	140.11		137.87	139.63	138.99	138.41	143.01
ERM-SW Data															
						(Staff gauges at site)									
01/22/87	427	128.9		138.1	no data	no data	no data	138.35	138.52	-	138.39	139.60	139.27	138.70	143.02
02/05/87	441	128.5		137.7	no data	no data	no data	137.68	138.04	137.84	138.31	139.41	139.21	138.70	142.87
02/23/87	459	128.0		137.2	no data	no data	no data	137.12	137.48	137.56	138.02	139.09	138.99	138.83	142.94
03/09/87	473	136.5	145.7	145.7	172.96	171.13	161.73	143.00	139.53	138.41	138.51	140.14	139.52	138.96	143.49
03/23/87	487	131.5	140.1	140.7	173.07	171.15	161.78	140.83	140.18	138.92	139.00	140.44	139.87	139.17	143.73
04/06/87	501	126.9		136.1	172.99	170.90	160.98	137.49	138.19	-	137.77	140.03	-	139.39	143.61
04/21/87	516	126.6		135.8	172.77	dry	160.43	137.31	138.02	138.36	138.83	139.81	139.71	139.48	143.47
05/05/87	530	122.5		131.7	171.12	dry	160.61	135.10	136.40	137.70	138.21	138.93	139.18	139.43	143.20
05/20/87	545	124.1		133.3	172.81	170.68	160.53	134.16	135.60	137.07	137.70	138.42	138.73	139.30	143.13
06/10/87	566	141.4	150.6	150.6	173.54	171.50	162.13	145.81	141.50	138.08	138.17	140.11	139.74	139.42	143.97
06/23/87	579	139.0	148.2	148.2	172.61	171.35	161.20	-	143.11	139.97	139.59	141.45	140.51	139.77	144.52
07/15/87	601	131.1		140.3	-	171.45	161.78	141.07	141.33	140.57	140.54	141.78	141.08	140.08	144.83
07/30/87	616	128.6		137.8	-	-	161.02	139.00	139.99	140.21	140.53	141.49	141.14	140.41	144.76
08/13/87	630	125.6		134.8	-	-	160.53	136.83	138.43	139.50	139.95	140.71	140.69	140.46	144.53
08/26/87	643	123.3		132.5	-	-	160.70	135.83	137.42	138.77	139.32	140.17	140.34	140.42	144.12
09/16/87	664	121.1		130.3	DRY	-	160.25	133.76	135.71	137.65	138.52	139.13	139.63	140.17	143.71
09/30/87	678	121.7		130.9	DRY	-	160.18	133.29	135.20	137.08	137.95	138.60	139.22	139.95	143.30
10/13/87	691	119.6		128.8	DRY	-	160.53	132.53	134.50	136.47	137.42	138.03	138.73	139.71	142.92
10/23/87	701	120.2		129.4	DRY	-	160.28	132.04	134.00	136.04	137.04	-	138.46	139.54	142.69
11/10/87	719	120.2	128.8	129.4	DRY	-	160.28	131.35	133.53	135.66	136.52	137.20	137.98	139.29	142.38
11/18/87	727	121.0	130.9	130.2	DRY	-	160.28	131.74	133.48	135.36	136.18	137.05	137.80	139.12	142.37
12/02/87	741	121.4	130.9	130.6	DRY	-	160.28	132.59	133.73	135.09	135.97	137.14	137.76	139.01	142.54
12/23/87	762	124.2	133.7	133.4	DRY	-	161.78	133.03	133.94	134.99	135.77	137.29	137.76	138.85	142.75
1988															
01/06/88	776	122.5	132.2	131.7	DRY	-	161.33	133.86	134.51	135.59	135.89	137.77	138.03	138.80	143.03
01/19/88	789	121.6	130.7	130.8	171.39	-	161.30	133.14	134.12	135.06	135.94	137.41	137.79	138.74	142.89
02/11/88	812		129.7		171.19	-	161.13	132.00	133.24	134.68	135.56	136.80	137.39	138.55	-
02/26/88	827		131.0		171.19	-	161.13	132.63	133.43	134.37	135.27	136.79	137.15	138.26	142.33

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TABLE 3-8 (Continued)
(Page 2 of 3)

Ground Water Elevations in the Unconfined Aquifer (Stratum B)

Sheridan Disposal Services Site

Date of Sample	Days from Start	River Stage - Hempstead (ft MSL)	River Stage at Site (meas)	River Stage at Site (calc)	Main Pond	Evaport'n System	Clark Lake	Elevation by Well Code (feet MSL) - Shallow wells: MW-15	MW-16	MW-18	MW-19	MW-21	MW-23	MW-24	MW-25
Total Well Depth		N/A			N/A	N/A	N/A	61	61	58 5	57	54	54	54	54
Screened Interval		N/A			N/A	N/A	N/A	51-61	48-53	32-57	34-54	4-54	4-54	4-54	4-54
Top of Casing (REI)		N/A			N/A	N/A	N/A	174 16	173.8	173 92	170 38	170 05	168 9	168 98	169 64
Top of Casing (ERA)								173 63	172.55	173.41	169.99	169 16	168 49	168 81	168 85
REI Data															
11/22/85	1	122.9		132 1	no data	no data	no data	135 32	132 89	132.98	138.40	no well			
12/06/85	15	131.8		141 0	no data	no data	no data	138.35	137.62	137.79	139 89	no well			
12/13/85	22	140 9		150.1	no data	no data	no data	139 73	138 17	138 30	139.84	138 50			'36 54
12/19/85	28	132.0		141.2	no data	no data	no data	139.28	138 49	138 70	140.40	137 00	136 95		-
1986															
01/03/86	43	124 6		133 8	no data	no data	no data	136 56	136 20	136.31	140 45	137 41	137 42	137 33	137 41
01/14/86	54	123 9		133 1	no data	no data	no data	135 85	135 12	135 16	140.17	137 29	137 27	137 23	137 29
02/07/86	78	144 0		153 2	no data	no data	no data	139.91	137.58	137 48	140.02	137 10	137 09	137 00	137 11
03/21/86	120	122 1		131.3	no data	no data	no data	134.91	134.26	134.27	139 95	137 68	-	137 61	-
04/24/86	154	121 0		130.2	no data	no data	no data	133.76	132 70	132 71	139 32	137 17	137 14	137 10	137 16
05/09/86	169	126 1		135 3	no data	no data	no data	136.58	134 98	135.09	140 01	137 29	137 26	137 15	137 26
06/11/86	202	137.0		146.2	no data	no data	no data	140.51	138 99	139 12	141 28	137.83	137 80	137 68	137 83
07/15/86	236	126 1		135 3	no data	no data	no data	137.24	136 51	136.57	140 80	138 44	138 42	138 17	138 39
08/18/86	270	121 2		130 4	no data	no data	no data	134 59	134 15	134 08	138 85	138 08	138 17	137 89	138 09
09/18/86	301	127 2		136 4	no data	no data	no data	136 75	-	-	139.95	137 92	137 95	137 68	137 87
10/27/86	340	132.0		141 2	no data	no data	no data	139 14	137 84	137.97	140 52	138 05	138.07	137 84	138 04
11/28/86	372	131 2		140.4	no data	no data	no data	138 51	136 84	136.88	140.45	138 16	138 17	138 05	138 15
1987															
01/02/87	407	133 7		142.9	no data	no data	no data	140 95	140 98	141 17	142 03	138 58	138 54	138 50	138 59
ERA-SW Data															
					I--(Staff gauges at site)-I										
01/22/87	427	128 9		138.1	no data	no data	no data	139 00	138 45	138.41	141 89	138 81	138 80	138 73	138 79
02/05/87	441	128 5		137.7	no data	no data	no data	138.48	137 80	137.76	141.70	138 83	138 84	138 75	138 85
02/23/87	459	128.0		137 2	no data	no data	no data	138 04	137 09	137 04	141 57	138 85	138 83	138 81	138 85
03/09/87	473	136 5	145 7	145.7	172.96	171.13	161 73	141.38	141.00	141 04	142 49	139 07	139 04	139 01	139 04
03/23/87	487	131 5	140 1	140.7	173.07	171 15	161.78	140 83	140 45	140 56	142 84	139 30	139 29	139 21	139 31
04/06/87	501	126.9		136.1	172 99	170.90	160.98	138 47	138 11	138 10	142 44	139 51	139 48	139 42	139 48
04/21/87	516	126 6		135.8	172.77	dry	160 43	138 15	137 65	137 82	142 19	139 47	139 45	139 43	139 47
05/05/87	530	122 5		131 7	171 12	dry	160 61	135 75	135.62	135 54	141 43	139 25	139.28	139 21	139 24
05/20/87	545	124 1		133.3	172.81	170.68	160.53	135 48	134 62	134 54	141.15	139 09	138 91	138 94	139 09
06/10/87	566	141 4	150 6	150 6	173.54	171 50	162.13	142.42	142.61	142.68	142 75	139 26	139 32	139 21	139 33
06/23/87	579	139.0	148.2	148.2	172.61	171.35	161.20	143.80	144.36	144.50	143.77	139.78	139 79	139 67	139 83
07/15/87	601	131.1		140.3	-	171.45	161.78	141.74	141.50	141 59	144.12	140 34	140.35	140 30	140 31
07/30/87	616	128 6		137.8	-	-	161 02	140.28	139.76	139.71	143 80	140 56	140 59	140 51	140 55
08/13/87	630	128.6		134.8	-	-	160.53	138.28	137.76	137.71	143.06	140 47	140.51	140 47	140 50
08/26/87	643	123.3		132.5	-	-	160.70	137.02	-	136.52	142.51	139 57	140 32	140 26	140 27
09/16/87	664	121.1		130.3	DRY	-	160.25	135.13	134 43	134.49	141 65	139 89	139 82	139 87	139 86
09/30/87	678	121.7		130.9	DRY	-	160.18	134.94	133 98	133.91	141.07	139.56	139 55	139 67	139 58
10/13/87	691	119.6		128.8	DRY	-	160.53	133.82	133.30	133.23	140 56	139 25	139 24	139 27	139 21
10/23/87	701	120.2		129.4	DRY	-	160 28	133.56	132.76	132.71	-	139 02	138 98	139 05	139 04
11/10/87	719	120.2	128.6	129.4	DRY	-	160.28	133.26	132 35	132 24	139.76	138.67	138.66	138 68	138 62
11/18/87	727	121.0	130.9	130.2	DRY	-	160.28	133.68	132.43	132.34	139.76	138.53	138 50	138 54	138 50
12/02/87	741	121.4	130 9	130.6	DRY	-	160.28	134.20	132 88	132.85	140 08	138.39	138 30	138 33	138 34
12/23/87	762	124.2	133.7	133.4	DRY	-	161.78	135.21	133.15	133 18	140.32	138.36	138 32	138 35	137 62
1988															
01/06/88	776	122 5	132.2	131 7	DRY	-	161.33	135 31	133.87	133 83	140 91	138 35	138 32	138 32	138 15
01/19/88	789	121.6	130 7	130 8	171.39	-	161.30	134 43	133.29	133 27	140 58	137 96	138 17	138 17	138 21
02/11/88	812		129 7		171.19	-	161.13	133 56	132.29	132.28	139 88	137 98	137.95	137 96	138 00
02/26/88	827		131 0		171 19	-	161.13	134 19	132 61	132.61	139.89	137 64	137 63	137 63	137 67

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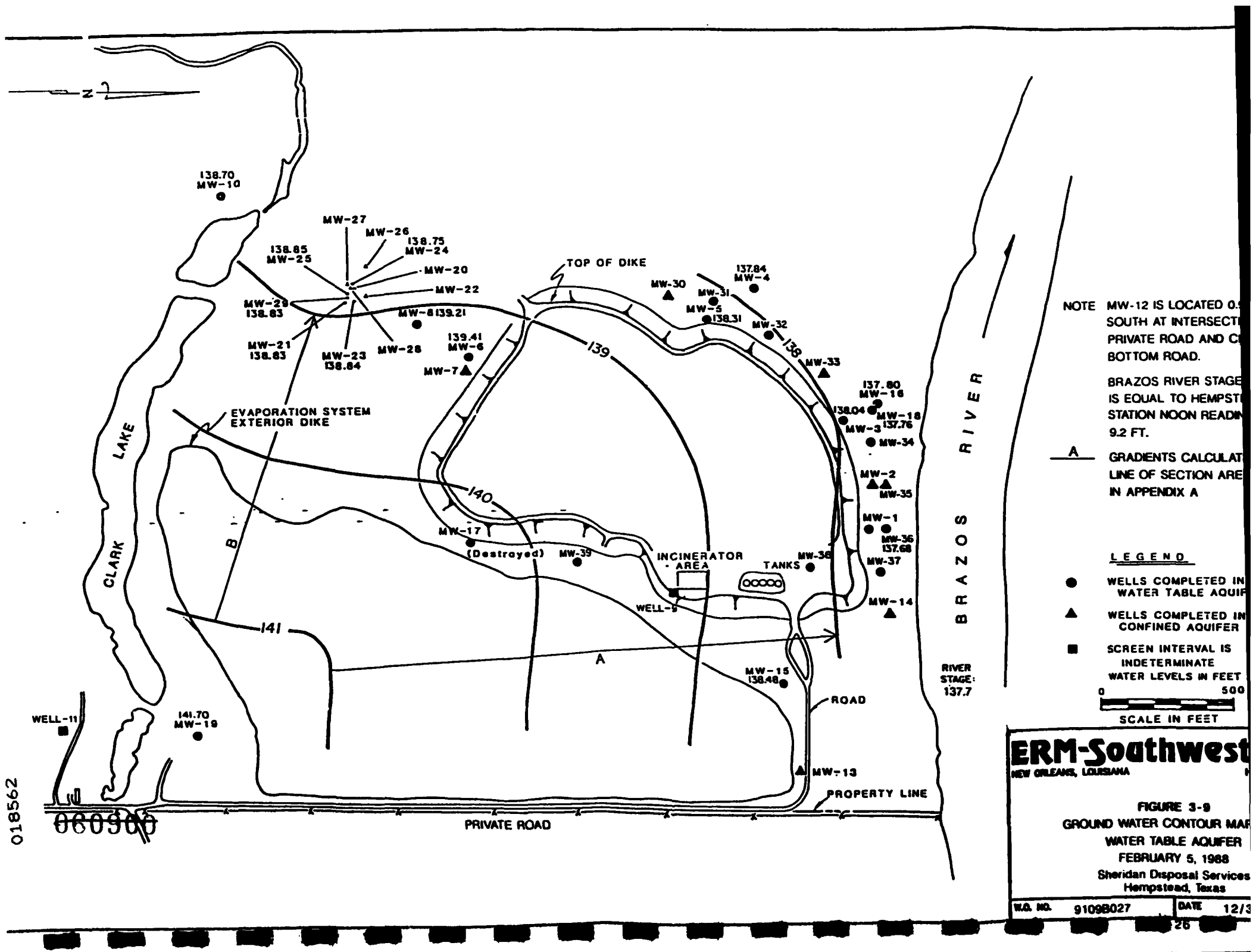
TABLE 3-8 (Continued)
(Page 3 of 3)

Ground Water Elevations in the Unconfined Aquifer (Stratum B)

Sheridan Disposal Services Site

Date of Sample	Days from Start	River Stage - Hempstead (ft MSL)	River Stage at Site (meas)	River Stage at Site (calc)	Main Pond	Evaport'n System	Clark Lake	Elevation by Well Code (feet MSL) - Shallow Wells							
								MW-29	MW-31	MW-32	MW-34	MW-36	MW-37	MW-38	MW-39
Total Well Depth		N/A			N/A	N/A	N/A	56	63	62	63	60	57	78	56
Screened Interval		N/A			N/A	N/A	N/A	5-55	25-60	25-60	26-61	27-57	25-55	31-76	34-54
Top of Casing (REI)		N/A			N/A	N/A	N/A	169 9	---	---	---	---	---	---	---
Top of Casing (ERM)								169.58	169.29	172.2	174 32	169 48	168.75	184 93	167 58
REI Data															
11/22/85	1	122.9		132.1	no data	no data	no data								
12/06/85	15	131 8		141.0	no data	no data	no data								
12/13/85	22	140.9		150.1	no data	no data	no data	136.57							
12/19/85	28	132.0		141.2	no data	no data	no data	137 00							
1986															
01/03/86	43	124 6		133 8	no data	no data	no data	137 43							
01/14/86	54	123.9		133.1	no data	no data	no data	137 28							
02/07/86	78	144 0		153.2	no data	no data	no data	134 12							
03/21/86	120	122 1		131.3	no data	no data	no data	-							
04/24/86	154	121 0		130.2	no data	no data	no data	137 18							
05/09/86	169	126.1		135.3	no data	no data	no data	137 24							
06/11/86	202	137 0		146 2	no data	no data	no data	137.78							
07/15/86	236	126 1		135.3	no data	no data	no data	138 25							
08/18/86	270	121 2		130 4	no data	no data	no data	137 78							
09/18/86	301	127 2		136 4	no data	no data	no data	137 70							
10/27/86	340	132 0		141 2	no data	no data	no data	137 82							
11/28/86	372	131.2		140.4	no data	no data	no data	137 97							
1987															
01/02/87	407	133 7		142.9	no data	no data	no data	138 48							
ERM-SW Data															
					(--(Staff gauges at site)-(										
01/22/87	427	128.9		138.1	no data	no data	no data	138 82							
02/05/87	441	128 5		137.7	no data	no data	no data	138 83							
02/23/87	459	128 0		137.2	no data	no data	no data	138 84							
03/09/87	473	136 5	145.7	145.7	172 96	171.13	161.73	139 05							
03/23/87	487	131.5	140 1	140.7	173 07	171 15	161 78	139 31							
04/06/87	501	126 9		136.1	172.99	170.90	160.98	139 50							
04/21/87	516	126 6		135 8	172 77	dry	160 43	139 51							
05/05/87	530	122 5		131 7	171 12	dry	160 61	139 28							
05/20/87	545	124 1		133 3	172.81	170.68	160.53	138 90							
06/10/87	566	141.4	150.6	150.6	173 54	171 50	162.13	139 30							
06/23/87	579	139.0	148.2	148.2	172.61	171.35	161 20	139.79							
07/15/87	601	131.1		140.3	-	171.45	161.78	140.33							
07/30/87	616	128.6		137.8	-	-	161.02	140.59							
08/13/87	630	129.6		134.8	-	-	160.93	140.52							
08/26/87	643	123.3		132.5	-	-	160.70	140.12							
09/16/87	664	121.1		130.3	DRY	-	160.25	139 87	138.56	137 81	134.08	132.07			
09/30/87	678	121.7		130.9	DRY	-	160.18	139.59	137 98	137.16	133.64	131.89			136 94
10/13/87	691	119.6		128.8	DRY	-	160.53	139.29	137 48	136.57	132.89	130.81	132.83		136 17
10/23/87	701	120.2		129.4	DRY	-	160.28	139.06	137.08	136.15	132.44	130.55	132.33		135 82
11/10/87	719	120.2	128.8	129.4	DRY	-	160.28	138.71	136.49	135 56	132.00	130 25	131.88	133 66	135 38
11/18/87	727	121 0	130.9	130.2	DRY	-	160.28	138.53	136.23	135.32	132.23	130 95	132.15	134 42	135 40
12/02/87	741	121.4	130.9	130.6	DRY	-	160.28	138.47	135 99	135 17	132.77	131 65	132 95	134 32	135 82
12/23/87	762	124 2	133.7	133.4	DRY	-	161 78	138 28	135.82	135.07	132.72	132 96	133 46	139 88	136 27
1988															
01/06/88	776	122.9	132 2	131.7	DRY	-	161 33	138 36	135.93	135.32	133.80	133 04	134 15	135 46	136 70
01/19/88	789	121.6	130 7	130.8	171.39	-	161.30	138.22	135.90	135 22	133.18	132.04	133 47	134 75	136 11
02/11/88	812		129 7		171.19	-	161.13	138 01	135.52	134 72	132.15	130 94	132 37	133 86	135 30
02/26/88	827		131 0		171.19	-	161.13	137 68	135 17	134 42	132 68	131 80	132 95	134 41	135 59



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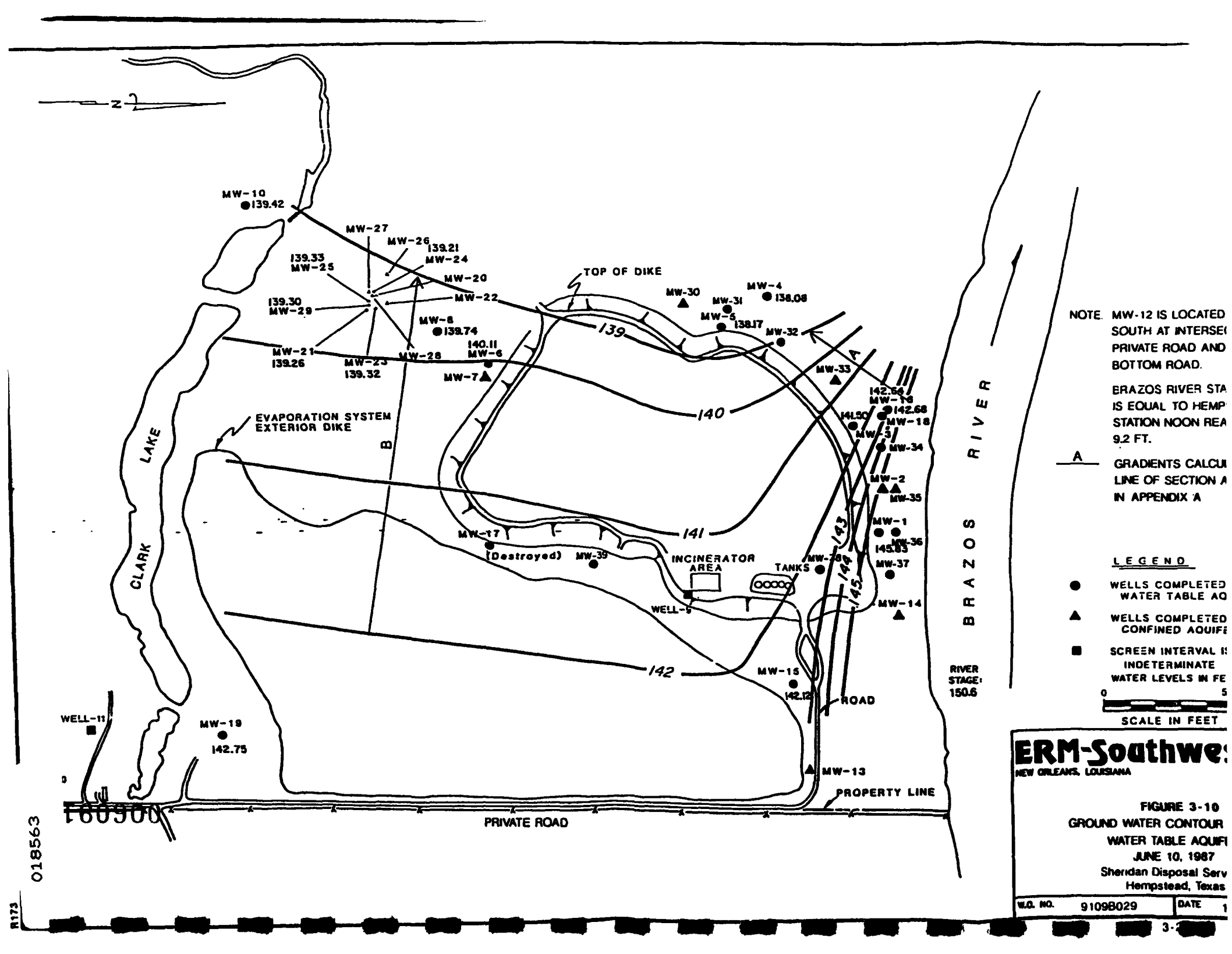
ERM-Southwest
NEW ORLEANS, LOUISIANA

FIGURE 3-9
GROUND WATER CONTOUR MAP
WATER TABLE AQUIFER
FEBRUARY 5, 1988
Sheridan Disposal Services
Hempstead, Texas

W.O. NO. 91098027 DATE 12/3



ERM-Southwes
NEW ORLEANS, LOUISIANA

FIGURE 3-10
GROUND WATER CONTOUR
WATER TABLE AQUIF
JUNE 10, 1987
Sheridan Disposal Serv
Hempstead, Texas

W.O. NO. 91098029 | DATE 1

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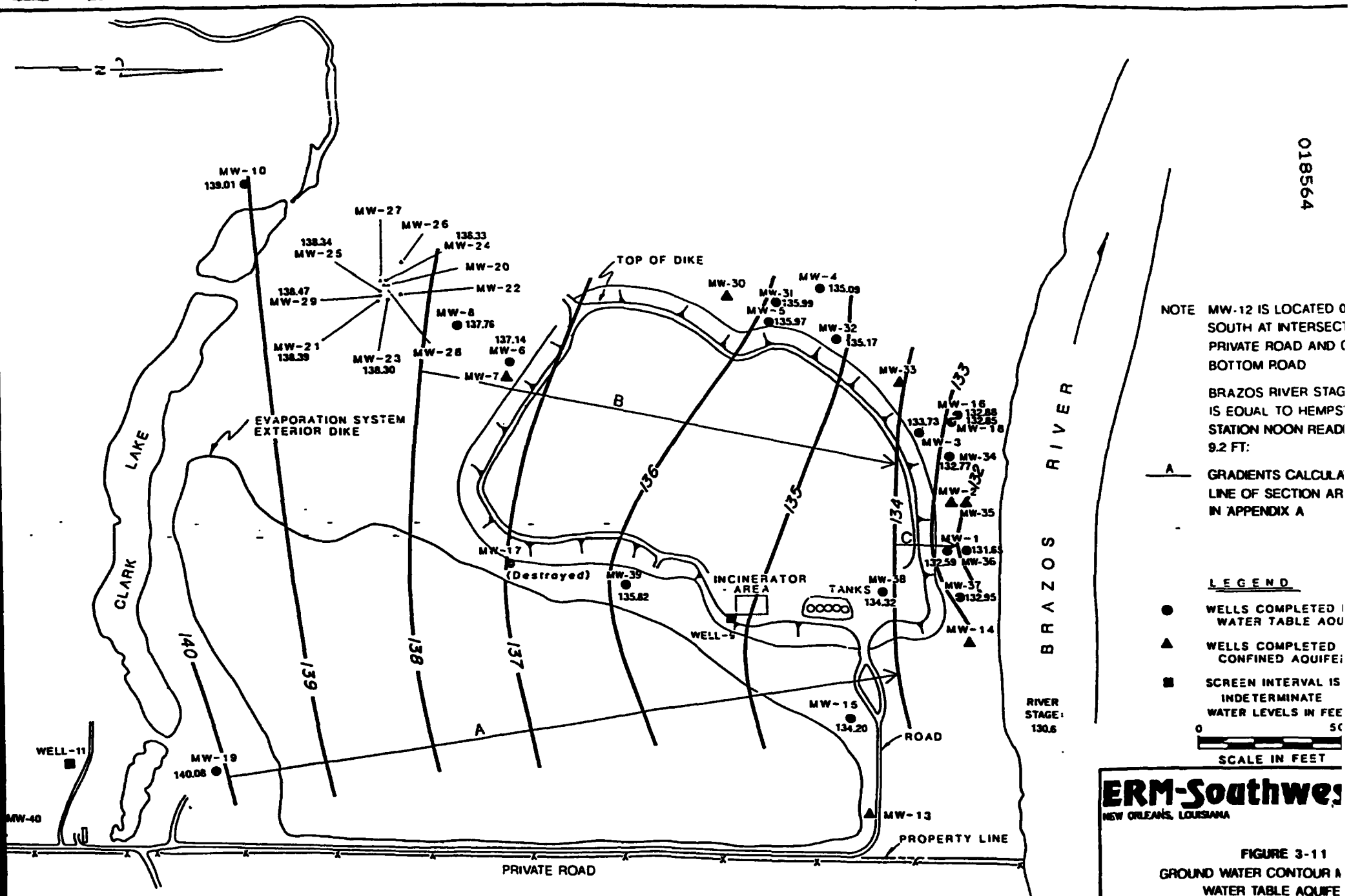

ERM-Southwes
NEW ORLEANS, LOUISIANA

FIGURE 3-11
GROUND WATER CONTOUR M
WATER TABLE AQUIFE
DECEMBER 2, 1987
Sheridan Disposal Serv
Hempstead, Texas

W.O. NO. 91098028 | DATE 12

A comparison of the known elevations at the site with data recorded at Hempstead shows that adding 9.2 feet to the reading at Hempstead yields a good estimate of the river height at the site.

Table 3-9 outlines these measurements and compares the actual value at the site and the value calculated using data from the USGS. While this method assumes that there is a linear relationship between river stage at the site and at Hempstead, which is probably not precisely the case, it does give reasonable estimates of the river height at the site. These estimates then can be used with water elevations to better understand and predict ground water flow directions.

Ground water in the unconfined aquifer generally flows either to the north, west or south in areas of the site. Careful inspection of a complete set of ground water contour maps in Appendix D-1 (data from 11/85 through 2/88) yields several trends or relationships. Of primary importance is the influence of the stage of the river on the ground water flow directions and gradients. By inspection of the available data and calculated river stage at the site, it was determined that when the river reaches a stage of approximately 140 feet MSL at the site, the ground water direction shifts from its typical flow toward the north to a southerly and westerly direction. The length of time that the flow stays in the southerly or westerly direction depends on such factors as the length of time the river is at a high stage and the previous water level (saturated thickness) in the unconfined aquifer.

Table 3-10 shows the river stage at the site, the direction of ground water flow, and the length of time the river has been at or above 140' or the amount of time since the river dropped below 140'. In most cases the water direction changes at about 140'. The flow toward the south and probably also the west would be considered bank storage, that is, water that is stored along a river's bank that drains back into the river once the water level decreases below a certain level. This is a common phenomenon along rivers or creeks that are cut into unconsolidated sediments which have the ability to store water in their pore spaces. This effect is also illustrated in Figures 3-12 to 3-14, which plot the calculated river stages against the measured water levels in selected wells screened in the unconfined aquifer. In MW-15, which is close to the river bank, the change in water level closely mimics the change in river stage. This effect is still seen, but is less pronounced, as the distance of the well from the river increases. This is illustrated at both MW-6, located on the south side of the main pond approximately 1800 feet from the river's edge, and at MW-24, located in the well nest about 2300 feet away from the river. The water eleva-

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TABLE 3-9

Measured and Calculated River Stage
at the Sheridan Disposal Services Site
Using USGS Data Recorded at Hempstead, Texas

Date of Sample	River Stage - Hempstead	River Stage at Site (meas)	Difference between Hempstead and Site	River Stage at Site (calc)
11/22/85	122 9			132 1
12/06/85	131 9			141 1
12/13/85	140 9			150 1
12/19/85	132.0			141 2
01/03/86	124.6			133.8
01/14/86	123.9			133.1
02/07/86	144 0			153.2
03/21/86	122.1			131 3
04/24/86	121 0			130 2
05/09/86	126.1			135.3
06/11/86	137 0			146 2
07/15/86	126 1			135.3
08/18/86	121 2			130 4
09/18/86	127.2			136 4
10/27/86	132 0			141 2
11/28/86	131 2			140 4
01/02/87	133.7			142 9
01/22/87	128 9			138 1
02/05/87	128 5			137 7
02/23/87	128 0			137 2
03/09/87	136.5	145 7	9 2	145 7
03/23/87	131.5	140 1	8.7	140 7
04/06/87	126.9			136 1
04/21/87	126 6	132 4 appr		135 8
05/05/87	122 5	128 4 appr		131 7
05/20/87	124 1	128 4 appr		133 3
06/10/87	141 4	150 6	9 2	150 6
06/23/87	139 0	148 2	9 2	148 2
07/15/87	131.1	140.4 appr	9 4	140 3
07/30/87	128 6	137 4 appr	8 8	137 8
08/13/87	125 6			134 8
08/26/87	123 3			132 5
09/16/87	121.1			130 3
09/30/87	121.7			130 9
10/13/87	119.6			128 8
10/23/87	120.2			129 4
11/10/87	120 2	128 8	8 7	129 4
11/18/87	121.0	130 9 appr	9 9	130 2
12/02/87	121.4	130.9 appr	9 5	130 6
12/23/87	124.2	133.7 appr	9 5	133 4
01/06/88	122.5	132.2 appr	9 7	131 7
01/19/88	121.6	130 7 appr	9.1	130.8
02/11/88		129.7 appr		
02/26/88		131.0 appr		

			Average	
			9 2	

Elevations are in feet relative to mean sea level.
Brazos River stage at Hempstead is taken from 12 noon reading
Calculated river stage at site is equal to Brazos River stage at Hempstead + 9 2 ft.

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TABLE 3-10

Comparison of River Stage and Flow Direction
in the Unconfined Aquifer

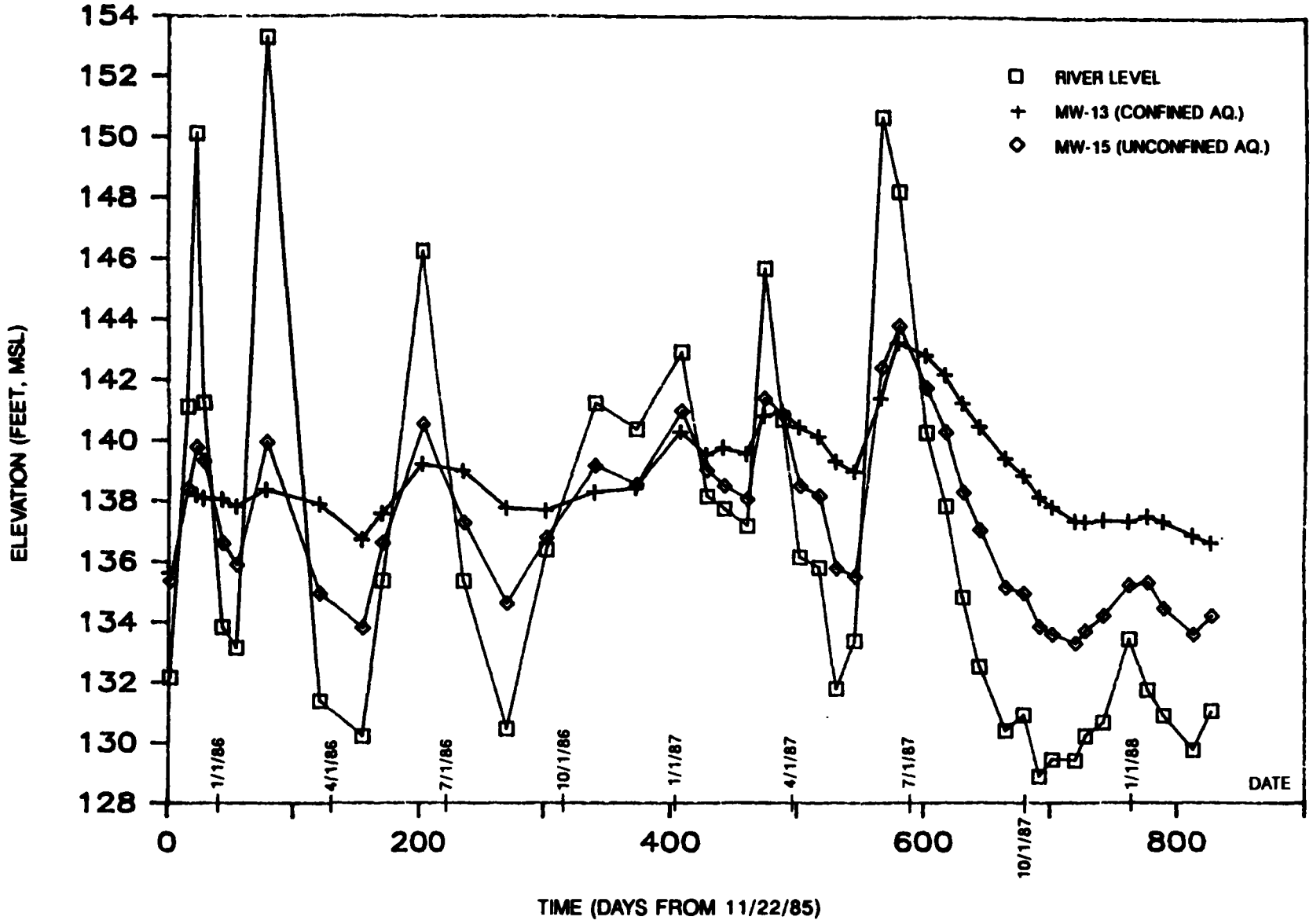
For River Stage >140'

Date of Water Level Measurement	River Stage [a]	Flow Direction at North End of Site	Date River Stage Surpassed 140'	Number of Consecutive Days Above 140'
12/19/85	141 2	S	12/13/85	6
02/07/86	153 2	S	02/05/86	2
06/11/86	146 2	S	06/08/86	3
10/27/86	141 2	S	10/25/86	2
01/02/87	142 9	S	12/16/87	17
03/09/87	145.7	S	02/26/87	11
03/23/87	140.7	S	02/26/87	24
06/10/87	150.6	S	05/31/87	10
06/23/87	148 2	S	05/31/87	23

For River Stage Between 135 and 140 5'

Date of Water Level Measurement	River Stage [a]	Flow Direction at North End of Site	Date River Level Dropped Below 140'	Number of Consecutive Days Since River Level Dropped Below 140'
05/09/86	135 3	NW	05/06/86	3
07/15/86	135 3	N	06/26/86	20
09/18/86 [b]	136 4	NW	06/26/86	85
11/28/86 [b]	140.4	N	---	2 Days Above 140'
01/22/87	138 1	NNW	01/08/87	14
02/05/87	137 7	N	01/08/87	28
02/23/87	137 2	NNW	01/08/87	45
04/06/87	136 1	N	03/24/87	13
04/21/87	135.8	N	03/24/87	28
07/15/87 [b]	140.3	N	---	2 Days Below 141'
07/30/87	137.8	N	07/22/87	8

[a] River stage as calculated for the date of water level measurement, using noon Hempstead reading and adding 9 2'
[b] Possible southerly component within 300' of river bank



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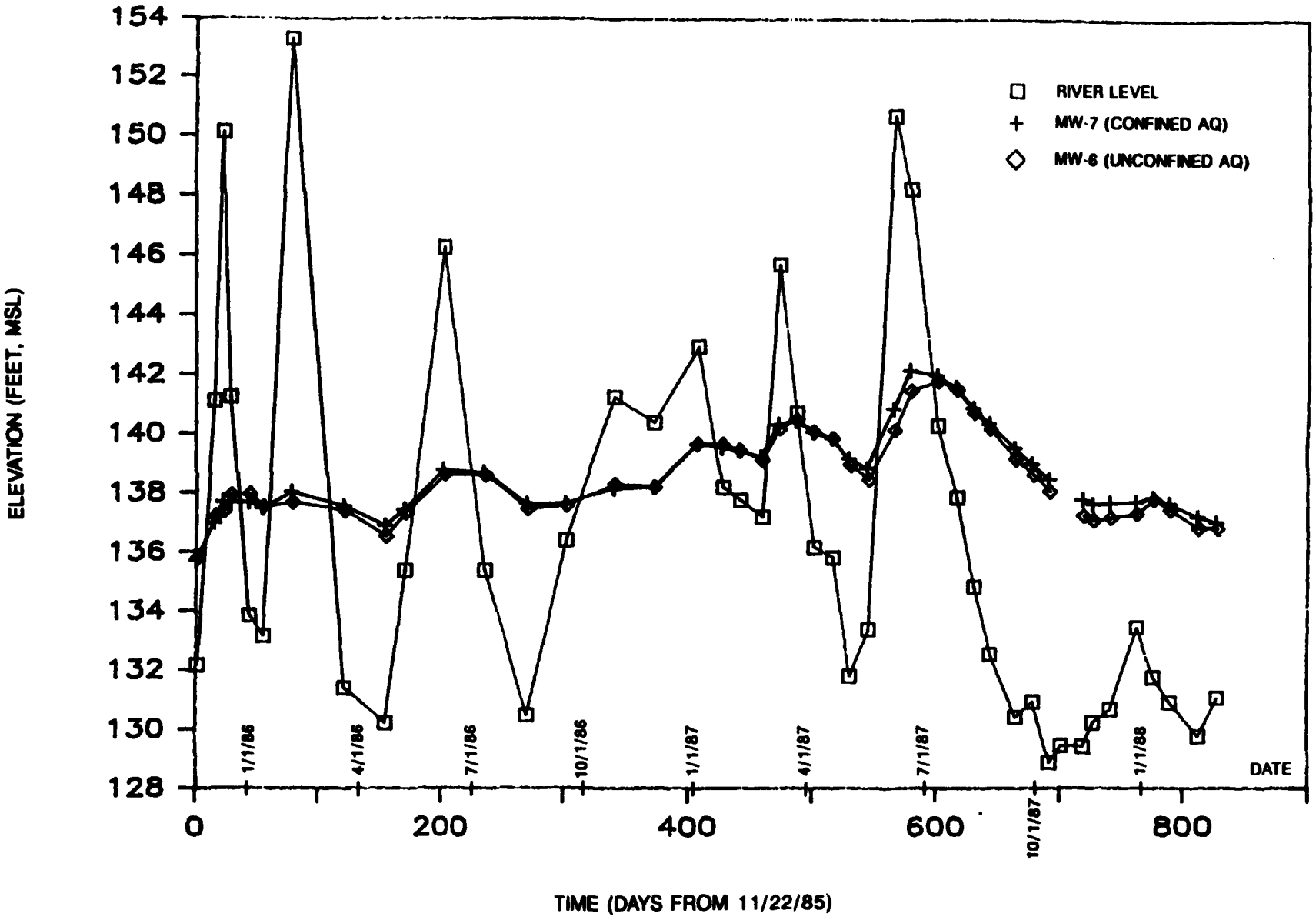
HOUSTON, TEXAS

4/27/88 | W.O.NO. 9109A13

FIGURE 3-12
RIVER LEVEL VERSUS ELEVATIONS IN MW-13 (CONFINED AQ)
AND MW-15 (UNCONFINED AQ) FROM 11/85 THROUGH 2/88
SHERIDAN DISPOSAL SERVICES SITE



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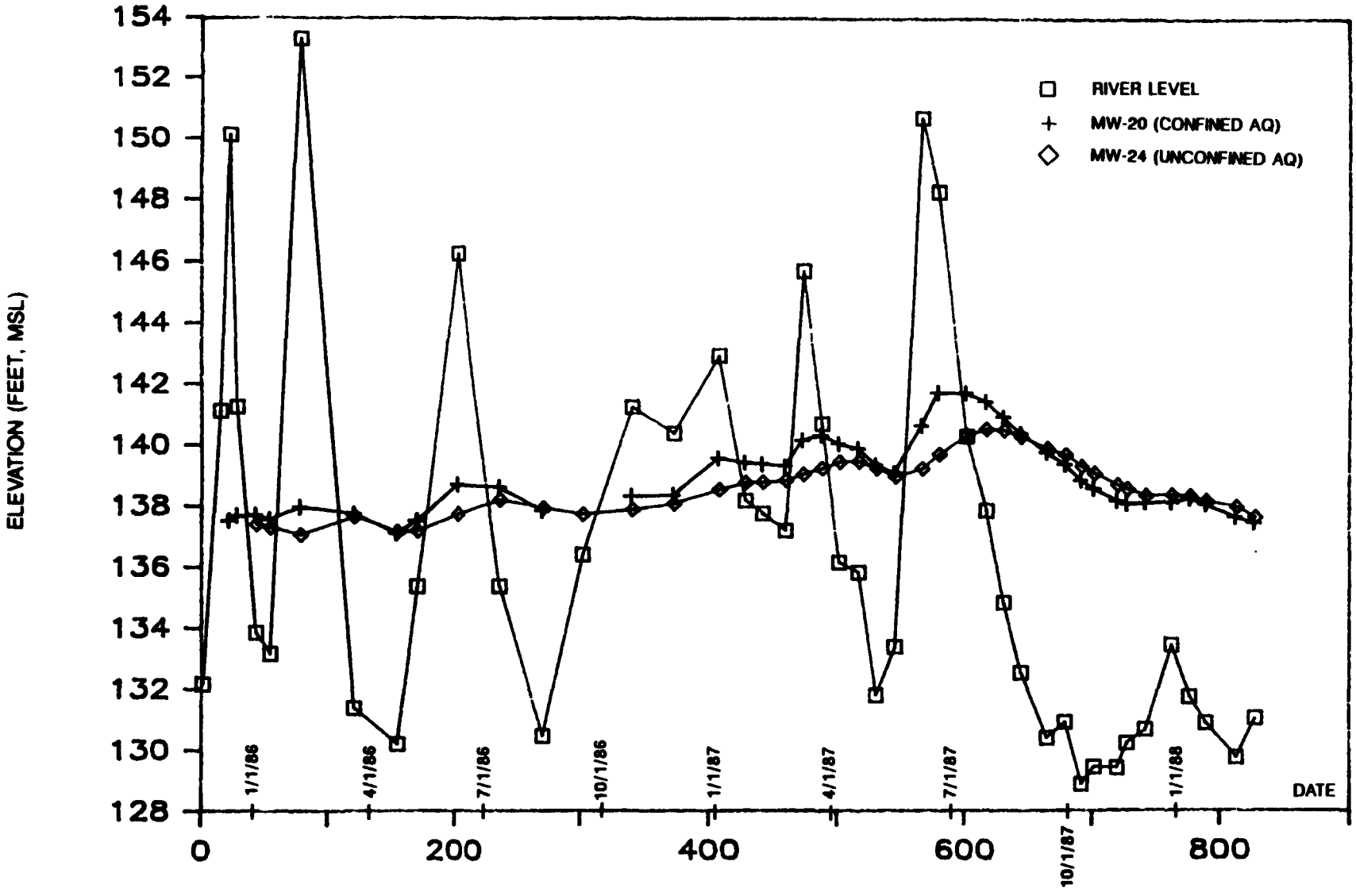
HOUSTON, TEXAS

4/27/88 | W.O.NO. 9109A14

FIGURE 3-13
RIVER LEVEL VERSUS ELEVATIONS IN MW-7 (CONFINED AQ)
AND MW-6 (UNCONFINED AQ) FROM 11/85 THROUGH 2/88
SHERIDAN DISPOSAL SERVICES SITE



ERM-Southwest, Inc.
HOUSTON, TEXAS

4/27/88 | W.O.NO. 9109A15

FIGURE 3-14
RIVER LEVEL VERSUS ELEVATIONS IN MW-20 (CONFINED AQ)
AND MW-24 (UNCONFINED AQ) FROM 11/85 THROUGH 2/88
SHERIDAN DISPOSAL SERVICES SITE

tion in each of these wells (and therefore the aquifer) is affected by changes in river stage.

In order to compare the relative amount of time the gradient is in any of the three general directions, data from the years 1986 and 1987 were compared. The northerly flow direction (including north/northeast to north/northwest) is prominent for this aquifer, that is, it occurs about 50% or more of the time. The westerly direction is next most common, occurring about 35% of the time. The remainder of flow occurs in the southerly direction 15% of the time. The percentage of time calculated here and in the following discussion assumes no change in flow direction between individual sampling events; the percentage is calculated as the number of occurrences of the event divided by the total number of occurrences.

For each of these directions an average gradient has been calculated and the data are summarized in Table 3-11. The average northerly gradient for 1986 and 1987 is 0.0023. In the westerly direction the gradient is 0.0018, and in the southerly direction it is 0.0058. The actual lines along which the gradients were calculated and their locations on the ground water contour maps are shown in Appendix D-1. Appendix D-2 contains the gradient calculations for this aquifer. The 1987 data, which was collected twice every month, is split apart into two segments: January through July and August through December. During the earlier part of 1987 precipitation was plentiful in the drainage basin and the river was high (>140 feet MSL) on several occasions. Severe rains during early July 1987 brought the river level up.

During January through July (1987) the northerly component of flow was reduced to only 35% of the time, the westerly direction accounted for 48% of those months and 17% of the time flow was to the south. Once the rains ended, water from bank storage and aquifer recharge was released from the aquifer and flow was primarily to the north (90% of the time from August through December 1987). Since the river did not rise above 140 feet from August through December 1987, there has been no component of flow to the south. This trend continued through the end of February 1988 (the time through which data was collected) since no significant precipitation has occurred over the drainage basin and the river has remained at a low stage.

While the 140 foot river level at the site usually signifies a change in ground water flow direction, this relationship also depends on the level of water already existing in the aquifer. That is, when the river level reaches 140 feet it does not necessarily always change flow directions. For example, on July 15, 1987, the river is at 140.3 feet but the flow is still to the north, probably due to the water previously stored in the

F740

TABLE 3-11

Average Gradient, Flow Direction and Percent of Time
for the Unconfined Aquifer (Stratum B)

Year or Month	Direction	Number of Occurrences [a]	% of Time [b]	Average Gradient
1986	N (NNW-NNE)	6	50	0 0018
	W (NW-W)	4 5	38	0 0017
	S (SW-S)	1.5	12	0 0042
1987	N	14	57	0 0028
	W	8	33	0 0018
	S	2 5	10	0 0074
Jan - July 1987	N	5	35	0 0020
	W	7	48	0 0018
	S	2 5	17	0 0074
Aug - Dec 1987	N	9	90	0 0038
	W	1	10	0 0014
	S	0	0	-
1988	N	4	100	0 0043

[a] Number of occurrences based on dates when flow is in indicated direction - Dates when flow is bidirectional are considered half of an occurrence for each of the directions

[b] The percentage of time calculated here assumes no change in flow direction and gradient between individual sampling events

aquifer from earlier abundant rains and bank storage (Table 3-11). Conversely, if the Brazos River has been low for an extended period of time (say 6 or more months), the direction may change before the river stage reaches 140 feet because the water level along the river is so low. The contour maps for the last months of 1987 and for 1988 (Appendix D-1) show how the aquifer has been draining into the river and the elevations in the wells along the river have been decreasing with time.

The gradients in the unconfined aquifer are also tied into the relationship between bank storage and river stage. This is most readily evident along the bank of the river. When the river has been at low stage for a long time without recharge from bank storage, the gradient near the river is steeper than the average gradient by about an order of magnitude. (See contour maps and gradients listed in Appendix D.) When the river stage comes up, if it quickly goes above 140 feet the southerly gradient is rather steep. If, however, the river only rises to around 140 feet or stays at 140 feet for any length of time, the gradient along the river flattens out. Again, this also depends on the head in the aquifer, such that if the head is relatively high and the river level comes up quickly, the gradient along the river would not tend to be as steep as if the head in the aquifer was lower at the beginning of the river rise.

While the existence of a southerly component of flow does occur at the site, the distance away from the river that this southerly direction continues is variable and depends on the river stage, its duration above 140 feet and the level of water in the aquifer. In general the higher the river stage or the longer its duration, the greater the distance the southerly component extends south of the river (Table 3-12). This is not, however, an absolute relationship and other factors such as the head in the aquifer would affect this relationship. It should be noted that no matter what the duration or river stage, the southerly flow direction does not extend beyond about 1000 to 1200 feet south of the bank. This is about 1/2 to 2/3 of the way across the main pond as measured toward the south. From there the flow direction changes toward the west in all cases. Evidently the subsurface configuration of the aquifer is such that there is some sort of barrier to continued southerly flow, possibly a hydraulic phenomenon or a facies change that might indicate the presence of a former channel of the Brazos River.

The change in flow direction and gradients in the unconfined aquifer cause the actual net movement of ground water to vary considerably with time. In all cases net measurement is calculated by taking an average flow rate in a given direction and multiplying it by an estimated duration of flow in that direction. Two different scenarios were examined in order to

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TABLE 3-12

Extent of Southerly Flow in the Unconfined Aquifer
During High River Stage

Sheridan Disposal Services Site

Date	River Stage (Feet/MSL)	Southerly Gradient	Extent of Influence South of Brazos River [a]
12/19/85	141.2	0.0045	800-1000
02/07/86	153.2	0 0043	900-1200
06/11/86	146.2	0.0055	700
10/27/86	141.2	0.0027	400-600
01/02/87	142 9	0.0047	600-900
03/09/87	145.7	0.0096	600-700
03/23/87	140.7	0.0036	700-800
06/10/87	150.6	0 0120	800
06/23/87	148.2	0.0070	600-800

[a] Distance in feet as measured from southern bank of the Brazos River

quantify the movement of ground water. First, for each year of record (1986 and 1987), ground water movement was examined across the entire site. In 1986, ground water flowed to the north 88% of the occurrences, with an average gradient of 0.0018. (88% is the sum of the northerly and westerly flow directions as indicated in Table 3-11, used because water flowing in these directions ultimately ends up in the Brazos River). Flow in the southerly direction occurs 12% of the total number of occurrences, at an average gradient of 0.0042. Using these values, net ground water flow across the site is 28 feet in a northerly direction for 1986. Utilizing the same reasoning for the 1987 data, the net flow of ground water is 49 feet in a northerly direction. (All calculations are in Appendix D-2.)

For the second scenario, ground water flow directions, durations and gradients were recalculated to examine ground water movement between the northern portion of the main pond and the Brazos River. This area of the site is where the most frequent changes in ground water flow direction take place due to its proximity to the river. As above, each year was calculated separately. In 1986, northerly flow occurred 55% of the time at an average gradient of 0.0028. Southerly flow occurred 27% of the measured dates, at an average gradient of 0.0058. The remainder of the time (18%) flow was neutral, neither in the northerly or southerly direction. This results in a net southerly flow of less than one foot for 1986. For 1987 data northerly flow occurred 79% of the measured dates at an average gradient of 0.0067. A southern gradient occurred 17% of the time with a gradient of 0.0055. "Neutral" flow occurred 4% of the time. These values result in a net northerly flow of 121 feet for 1987. (Calculations are found in Appendix D-2.)

What these data indicate is that during a "normal" year such as 1986, where ground water flow directions changed several times during the year, the net ground water movement was slightly to the south between the main pond and the river. Over the entire site, however, net ground water movement was to the north. During a drier year, such as 1987, net ground water flow was to the north both over the entire site and immediately adjacent to the river. While these conclusions are based on the number of measured occurrences at the site and not the actual duration of events, it is highly likely that the net overall ground water movement is to the north/northwest, towards the Brazos River. This can be demonstrated by the fact that volatile organic constituents have been detected in the ground water north and northwest of the site, while no constituents have been detected south of the site. Further details of ground water sampling are found in Section 4.

3.6 Hydrology of the Confined Aquifer

3.6.1 Hydraulic Characteristics

The hydraulic characteristics of the confined aquifer were determined the same way as for the unconfined aquifer, that is, through laboratory permeabilities, slug/bail tests and pump tests. Two samples from this aquifer were analyzed in the laboratory and the permeability averaged 8.8E-05 cm/sec (Table 3-13). Slug/bail tests were run on the four deep wells installed for the GWRI: MW-30, MW-33, MW-35, and MW-40. These data were analyzed using the methods of Bouwer and Rice (1976) and Papadopulos et al.(1973) (Appendix E). Results in Table 3-13 show fairly good agreement between different test runs on the same well and also between the two methods of analysis. Average transmissivity calculated from these methods was 1.8E+03 gpd/ft, with a mean hydraulic conductivity of 6.8E-03 cm/sec.

The lower hydraulic conductivity values for the laboratory permeability values is likely due to the fact that these samples were unconsolidated and had to be recompacted to run the test.

In order to determine hydraulic properties on a more regional scale, two separate pump tests were run on the confined aquifer. A pump and recovery test was completed in February 1986 as part of the SCRI. Wells screened in the deep aquifer within the well nest were monitored for approximately 25 hours. Results of this analysis, presented in section 4.5.2.1 of the SCRI (July 1987), yielded values of 5.8E-03 cm/sec for permeability, 1.4E+03 gpd/ft for transmissivity, and 7.6E-04 for storativity. In December 1987 a 65-hour pump and recovery test on the confined aquifer was completed on the wells in the well nest. Pump test data for this test, analyses and procedures are shown in Appendix F. Results of both pump and recovery tests, calculated using the Hantush-Jacob method (1955) and listed in Table 3-14, yield a mean hydraulic conductivity of 3.2E-03 cm/sec, transmissivity of 6.7E+02 gpd/ft, and storativity of 4.5E-04. These values are in very good agreement with those calculated from the previous pump test and the values from the slug tests. Overall these numbers are in the range for a coarse to fine sand, which correlates with the observed sediments at the site.

3.6.2 Ground Water Elevations and Movement

Ground water elevations for the confined aquifer have been measured at the same time intervals as for the unconfined aquifer (Table 3-15). Ground water contour maps have not been drawn for data collected before August 1987 because the nearly linear alignment of the early wells at the site (MWs-13,14,7, and the wells in the well nest) preclude accurate determination of flow

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TABLE 3-13

Results of Laboratory Permeabilities and Slug/Bail Test Permeabilities of the Confined Aquifer (Stratum D)

Laboratory Tests

Well Number	Depth (ft)	Soil Type	Recompacted Permeability (cm/sec)
MW-33	79-81	Sand with Silt Seams	8.5 x 10-5
MW-35	82-83	Silty Sand	9.0 x 10-5

Slug/Bail Tests

	Bouwer & Rice (1976)		Papadopulos, et al. (1973)	
Well Number	K (cm/sec)	T (gpd/ft)	K (cm/sec)	T (gpd/ft)
MW-30 #1	1 7 x 10-2	8.2 x 10+3	1.1 x 10-2	5.0 x 10+3
MW-33 #1	3.2 x 10-3	1.5 x 10+3	5.1 x 10-3	2.5 x 10+3
MW-33 #2	2.5 x 10-3	1.2 x 10+3		
MW-33 #3	3.9 x 10-3	1.9 x 10+3		
Xg	3.3 x 10-3	1.4 x 10+3		
MW-35 #0	1.6 x 10-2	7.9 x 10+3		
MW-35 #1	1.3 x 10-2	6.2 x 10+3		
MW-35 #3	1.5 x 10-2	7.2 x 10+3	2.4 x 10-2	1 2 x 10+4
Xg	1.5 x 10-2	6.5 x 10+3		
MW-40 #0	1 2 x 10-4	4.7 x 10+1		
MW-40 #1	7.4 x 10-5	2.8 x 10+1		
MW-40 #3	1 3 x 10-4	5.1 x 10+1	4 7 x 10-4	1 8 x 10+2
Xg	1.2 x 10-4	3.9 x 10+1		
Overall Geometric Mean	4.0 x 10-3	1.7 x 10+3		

NOTES.
Xg = geometric mean
Method ASTM D2434-68 (1974) was used to determine laboratory permeabilities

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TABLE 3-14

Results of 65-Hour Pump and Recovery Test
Using Hantush-Jacob (1955) Method of Analysis

Well Number		Transmissivity (gpd/ft)	Hydraulic Conductivity (cm/sec)	Storativity
MW-22	(P) 1	1,599	7.5 x 10-3	1.8 x 10-4
	(R) 2	668	3.2 x 10-3	1.8 x 10-4
MW-26	(P)	2,820	1.3 x 10-2	1.4 x 10-4
MW-27	(P)	268	1.3 x 10-3	2.5 x 10-4
	(R)	275	1.3 x 10-3	2.1 x 10-4
MW-28	(P)	265	1.3 x 10-3	1.3 x 10-3
	(R)	974	5.0 x 10-3	1.2 x 10-2
Mean	3	665	3.2 x 10-3	4.5 x 10-4

NOTES:
1 - P = Results calculated using pumping test data
2 - R = Results calculated using recovery test data
3 - Values calculated using geometric mean

TABLE 3-15

Ground Water Elevations in the Confined Aquifer (Stratum D)

Sheridan Disposal Services Site

Date of Sample	Days from Start	River Stage - Hempstead (ft MSL)	River Stage at Site (meas)	River Stage at Site (calc)	Main Evaporation Pond	System	Clark Lake	Elevation by Well Code (feet MSL) - Deep Wells											
								MW-7	MW-13	MW-14	MW-20	MW-22	MW-26	MW-27	MW-28	MW-30	MW-33	MW-35	MW-40
Well Depth		N/A			N/A	N/A	N/A	100	93	102	98	101	98.5	102	98	104	100	103	87.5
Screened Interval		N/A			N/A	N/A	N/A	80-95	83-93	92-102	85-97.5	85-100	83.5-98.5	85-97	85.5-98	77-102	77-97	80-100	65.5-83
Top of Casing (REI)		N/A			N/A	N/A	N/A	169.43	173.63	175.3	170.1	170.48	171.24	170.36	170.1	-----	-----	----	----
Top of Casing (ERM)								168.73	172.62	175.01	169.82	169.37	169.69	170.02	170.03	169.53	172.51	174.63	171.4
REI Data																			
11/22/85	1	122.9		132.1	no data	no data	no data	135.71	135.62	135.48									
12/06/85	15	131.8		141.0	no data	no data	no data	136.98	-	137.00									
12/13/85	22	140.9		150.1	no data	no data	no data	137.68	138.19	138.18	137.51				137.57				
12/19/85	28	132.0		141.2	no data	no data	no data	137.68	138.10	137.94	137.67	137.70	137.67		137.57				
1986																			
01/03/86	43	124.6		133.8	no data	no data	no data	137.68	138.05	137.87	137.70	137.74	137.73	137.80	137.66				
01/14/86	54	123.9		133.1	no data	no data	no data	137.47	137.82	-	137.54	137.60	137.58	137.68	137.57				
02/07/86	78	144.0		153.2	no data	no data	no data	138.02	138.39	138.24	137.96	138.03	137.98	137.98	137.90				
03/21/86	120	122.1		131.3	no data	no data	no data	137.54	137.90	137.67	137.75	137.70	-	137.99	-				
04/24/86	154	121.0		130.2	no data	no data	no data	136.88	136.70	136.83	137.10	137.07	137.07	137.19	137.04				
05/09/86	169	126.1		135.3	no data	no data	no data	137.43	137.58	137.36	137.53	137.53	137.50	137.60	137.47				
06/11/86	202	137.0		146.2	no data	no data	no data	138.78	139.23	139.07	138.70	138.74	138.67	138.73	138.65				
07/15/86	236	126.1		135.3	no data	no data	no data	138.68	139.01	138.91	138.63	138.63	138.60	138.71	138.48				
08/18/86	270	121.2		130.4	no data	no data	no data	137.63	137.78	137.61	137.84	137.74	137.98	137.89	137.76				
09/18/86	301	127.2		136.4	no data	no data	no data	137.65	137.70	137.59	-	137.73	137.96	137.90	137.69				
10/27/86	340	132.0		141.2	no data	no data	no data	138.16	138.31	138.24	138.33	138.21	138.40	138.30	138.12				
11/28/86	372	131.2		140.4	no data	no data	no data	138.19	138.46	138.42	138.37	138.26	138.39	138.37	138.18				
1987																			
01/02/87	407	133.7		142.9	no data	no data	no data	139.66	140.32	140.29	139.59	139.56	139.55	139.56	139.44				
ERM-SW Data																			
						(Staff gauges at site)													
01/22/87	427	128.9		138.1	no data	no data	no data	139.54	139.55	139.84	139.44	139.31	139.35	139.19	139.08				
02/05/87	441	128.5		137.7	no data	no data	no data	139.44	139.79	139.68	139.40	139.37	139.31	139.39	139.40				
02/23/87	459	128.0		137.2	no data	no data	no data	139.23	139.58	139.46	139.32	139.31	139.24	139.34	139.31				
03/09/87	473	136.5	145.7	145.7	172.96	171.13	161.73	140.34	140.84	140.74	140.18	140.22	140.11	140.19	140.22				
03/23/87	487	131.5	140.1	140.7	173.07	171.15	161.28	140.46	141.00	140.71	140.35	140.17	140.29	140.35	140.33				
04/06/87	501	126.9		136.1	172.99	170.90	160.98	140.06	140.47	140.35	140.06	140.05	139.97	140.05	140.06				
04/21/87	516	126.6		135.8	172.77	dry	160.43	139.85	140.16	140.01	139.90	139.87	139.77	139.89	139.80				
05/05/87	530	122.5		131.7	171.12	dry	160.61	139.18	139.35	139.20	139.37	139.28	138.24	139.38	139.37				
05/20/87	545	124.1		133.3	172.81	170.68	160.53	138.85	139.00	138.83	139.12	139.05	139.01	139.12	139.12				
06/10/87	566	141.4	150.6	150.6	173.54	171.50	162.13	140.89	141.45	141.37	140.67	140.76	140.68	140.66	140.74				
06/23/87	579	139.0	148.2	148.2	172.61	171.35	161.20	142.18	143.29	143.26	141.75	141.82	141.71	141.70	141.75				
07/15/87	601	131.1		140.3	-	171.45	161.78	141.99	142.86	142.79	141.73	141.89	141.65	141.71	141.73				
07/30/87	616	128.6		137.8	-	-	161.02	141.62	142.21	142.11	141.45	141.48	141.38	141.47	141.48				
08/13/87	630	125.6		134.8	-	-	160.53	140.90	141.28	141.17	140.94	140.94	-	140.96	140.93				
08/26/87	643	123.3		132.5	-	-	160.70	140.37	140.50	-	140.42	140.44	140.42	140.51	140.45	139.98	139.64	139.76	
09/16/87	664	121.1		130.3	DRY	-	160.25	139.54	139.45	139.36	139.79	139.71	139.70	139.85	139.80	139.04	138.48	138.46	
09/30/87	678	121.7		130.9	DRY	-	160.18	139.01	138.88	138.77	139.39	139.31	139.33	139.46	139.38	138.58	137.96	137.86	
10/13/87	691	119.6		128.8	DRY	-	160.53	138.49	138.16	138.04	138.87	138.81	138.83	138.99	138.90	137.98	137.28	137.23	
10/23/87	701	120.2		129.4	DRY	-	160.28	-	137.85	137.73	138.60	138.40	138.55	138.68	138.61	137.68	136.95	136.81	140.89
11/10/87	719	120.2	128.8	129.4	DRY	-	160.28	137.78	137.36	137.26	138.19	138.08	138.17	138.31	138.21	137.23	136.41	136.26	140.59
11/18/87	727	121.0	130.9	130.2	DRY	-	160.28	137.66	137.35	137.15	138.11	138.05	138.06	138.20	138.07	137.13	136.34	136.24	140.51
12/02/87	741	121.4	130.9	130.6	DRY	-	160.28	137.70	137.40	137.19	138.13	138.07	138.09	138.23	138.13	137.15	136.32	136.23	140.74
12/23/87	762	124.2	133.7	133.4	DRY	-	161.78	137.73	137.37	137.24	138.16	138.07	138.08	138.26	138.19	137.18	136.38	136.23	140.89
1988																			
01/06/88	776	122.5	132.2	131.7	DRY	-	161.33	137.87	137.54	137.35	138.29	138.19	138.24	138.34	138.30	137.28	136.48	136.33	141.30
01/19/88	789	121.6	130.7	130.8	171.39	-	161.30	137.67	137.35	137.17	138.09	138.02	138.01	138.17	138.10	137.07	136.24	136.09	141.16
02/11/88	812		129.7		171.19	-	161.13	137.22	136.89	136.65	137.67	137.57	137.60	137.74	137.67	136.60	135.73	135.57	140.68
02/26/88	827		131.0		171.19	-	161.13	137.03	136.66	136.45	137.48	137.39	137.42	137.55	137.49	136.43	135.57	135.42	140.50

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direction and gradient. The installation of MWs-30,33 and 35 for the GWRI along the west, northwest and north sides of the main pond in July and August 1987, plus the installation of background well MW-40 south of Clark Lake in October 1987 have eliminated this problem.

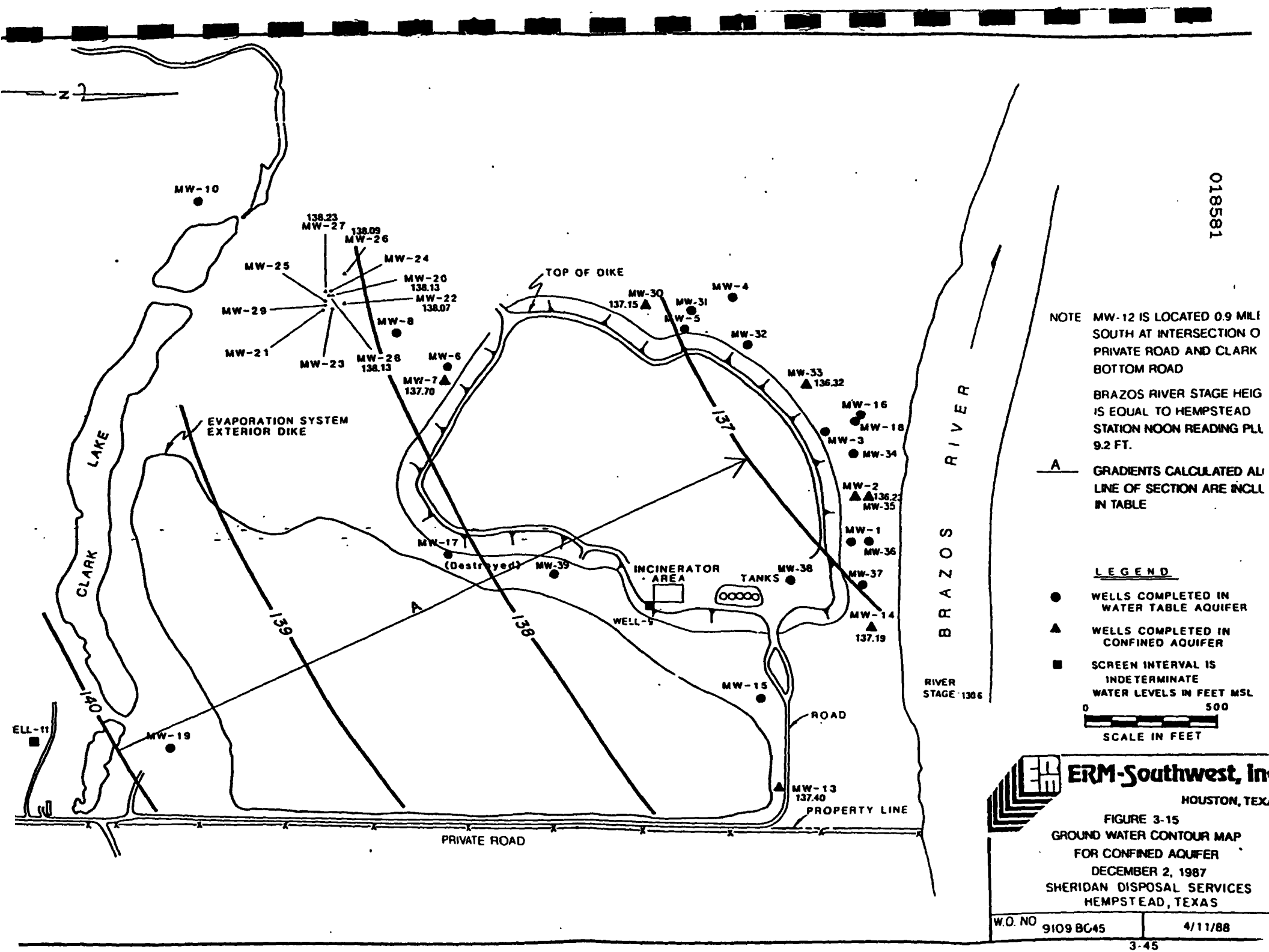
Contour maps for the confined aquifer are in Appendix G-1. Figure 3-15 shows the typical ground water flow direction from August 1987 through February 1988, which is to the northwest. The average gradient of this aquifer is about 0.001 feet/foot, as summarized in Table 3-16. Gradient calculations are shown in Appendix G-2.

During the August 1987 to February 1988 time period the river stage has remained low to very low and it is not known how this aquifer will react to high flow. However, Figures 3-12 to 3-14 show the response of selected wells screened in the confined aquifer with change in river stage. MW-13, close to the river bank, responds directly and quickly to changes in river level. MW-7, on the south side of the main pond, also reacts to these changes, but the response is slightly delayed and has a smaller magnitude of change. This is also true for MW-20, located southwest of the site in the well nest. These three figures show that in general the confined aquifer responds to river stage in the same manner as does the unconfined aquifer; that is, each aquifer increases its potentiometric head when the river stage comes up, and the wells closest to the river have the greatest magnitude of change. The magnitude of change decreases away from the river and the response is slightly delayed. As the river level drops, the heads decline.

3.7 Relationship Between the Unconfined and Confined Aquifers Beneath the SDS Site

The potential for hydraulic connection between the two aquifers beneath the SDS Site is of interest due to the potential for downward migration of constituents found at SDS. Chemical constituents have been detected in a limited area of the unconfined aquifer, with no measurable amounts found in the confined aquifer (a complete discussion of ground water quality is in Section 4).

Laboratory permeabilities were measured on seven selected samples from the confining clay (stratum C) between the unconfined and confined aquifers. In all cases the permeabilities varied between 10^{-8} and 10^{-9} cm/sec, both in the vertical and horizontal directions, even in samples containing silt and sand (Table 3-17). These values are indicative of dense, tight clays and correspond to observations in the field.



ERM-Southwest, In
HOUSTON, TEX

FIGURE 3-15
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
DECEMBER 2, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO	9109 BC45	4/11/88

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TABLE 3-16

Summary of Ground Water Flow Directions and Gradients in the Confined Aquifer

Year or Month	Flow Direction	Number of Occurrences	Percent of Time	Average Gradient
1987 Aug - Dec	NNW	6	60	0.00094
	NW	4	40	0.00103
		Average for 1987 Data -		0.00099
1988 Jan - Feb	NW	4	100	0.0013

TABLE 3-17

Results of Laboratory Permeabilities for
Soil Samples from Strata C and E

Sample Number	Stratum	Depth (ft)	Soil Type	Coefficient of Permeability (cm/sec)	
				Vertical	Horizontal
MW-31	C	62-63	Clay	8.2 x 10-9	9.2 x 10-9
MW-32	C	62-63	Clay with Silt Seams	5.1 x 10-9	1.0 x 10-8
MW-33	E	100-100.6	Sandy Clay	5.4 x 10-9	1.0 x 10-9
MW-35	C	67-68	Sandy Clay	8.8 x 10-9	6 8 x 10-9
	C	78-79	Silty Clay	5.6 x 10-8	4.9 x 10-9
MW-37	C	55-56	Clay with Silt Seams	1.4 x 10-9	6.4 x 10-9
MW-39	C	57.5-58.3	Silty Clay with Sand	2.4 x 10-9	5.5 x 10-9
MW-40	C	58-58.5	Silty Clay with Sand	4.9 x 10-8	7.4 x 10-8
	E	85-85.5	Clay	9 4 x 10-9	2.3 x 10-8

Stratum C - mean horizontal permeability = 9 7 x 10-9
- mean vertical permeability = 8.6 x 10-9

Stratum E - mean horizontal permeability = 4 8 x 10-9
- mean vertical permeability = 7.1 x 10-9

Notes: Method EM 1110-2-1906 (1970) was used to determine laboratory permeability
Mean calculated as a geometric mean.

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In order to test the properties of the aquifers and their potential for hydraulic interconnection on a more regional scale, pumping test data can be utilized for quantitative analysis. Data collected during the pumping test of December 1987 was analyzed by two different methods for leaky aquifer analysis: Hantush and Jacob (1955) and Modified Hantush (1960). These methods are similar because in each it is assumed that additional water is being supplied to the aquifer during the pumping test. This additional water is due to the confining clay aquitard being "leaky", that is, having the ability to transmit water through it, although at a rate much smaller than the surrounding aquifers. In the Hantush-Jacob analysis it is assumed that the water is coming from another aquifer either above or below the aquifer being pumped, and the clay aquitard through which the water passes contributes no water to the system (no change in storage in the aquitard). In the Modified Hantush analysis, additional water is not only supplied by one or more aquifers above or below the aquifer being tested, but also can come from dewatering the clay aquitard(s) in the system (change in storage in the aquitard).

Pumping test data from the Sheridan site showed that additional water was supplied to the aquifer during the pumping test, and so the above methods of analysis were used to try to assess the properties of the aquifer itself, as well as determine the relative permeability of the clay aquitards in the system.

Because the Modified Hantush method is a more generalized version of the Hantush-Jacob method and the Modified Hantush method could yield more information about the aquifer/aquitard system, it was the preferred method of analysis. However, results of the analysis did not meet all of the criteria necessary to have the numerical results be valid. That is, for the long time criteria there was not a unique curve fit, and for the early part of the curve the time criteria could not be met. Therefore a unique or even approximated value for the permeability of the stratum C and stratum E clays could not be calculated using the Modified Hantush method. Data could be analyzed using the Hantush-Jacob method since all the curve-matching and time criteria could be met. This analysis is presented below.

During the December 1987 pumping test on stratum D, stratum B (unconfined aquifer) was also monitored to see if the pumping test caused any drawdown in stratum B. Results in Table 3-18 show that the vertical hydraulic conductivity calculated using an average aquitard thickness of 30 feet varies from 4.6E-02 cm/sec to 6.4E-05 cm/sec, with a geometric mean value of 6.6E-04 cm/sec. (Calculations for these data are contained in Appendix F.)

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TABLE 3-18

"Leakage" through Stratum C Calculated
Using Hantush-Jacob Method

Well Number	Type of Test [a]	Leakage (cm/sec) [b]
MW-22	P	1.4 x 10-4
	R	3.6 x 10-4
MW-26	P	6.4 x 10-5
MW-27	P	3.9 x 10-4
	R	4.0 x 10-4
MW-28	P	2.5 x 10-3
	R	4.6 x 10-2

Mean Leakage = 6.6 x 10-4 cm/sec

NOTES:
[a] = P - Pumping test data results
R - Recovery test data results
[b] = Leakage calculated using a thickness of 30 feet for stratum C.
Mean calculated as a geometric mean

These values for hydraulic conductivity, if they apply to stratum C, are more representative of a silty formation than the hard, dense clay that was observed in the field. However, if the above value for hydraulic conductivity actually applies to the clay between the two aquifers, then the response, in terms of amount of drawdown, of the unconfined aquifer (stratum B) to the pumping in stratum D can be predicted using equation 5.83 in Walton (1985). The result of this calculation indicates that approximately 1.3 feet of drawdown would be expected in stratum B during the pumping test using the hydraulic conductivity of the aquitard calculated above. Details of this calculation are found in Appendix H-1.

The actual measured response of the four piezometers in the well nest that are screened in stratum B was negligible; the greatest amount of decrease from static was 0.07 feet. This amount is more likely due to changes in barometric pressure and in response to the tidal influence than due to pumping. Similar changes in water level on a daily basis were noted in MW-14 as recorded from the pressure transducer in that well. Data collected from October 14-22 shows these daily changes during a period of no rainfall and are provided in Appendix H-2.

If the high hydraulic conductivity values indicated above are not due to stratum C transmitting water from stratum B through to stratum D, two possibilities exist. One is that the "leakage" comes from below stratum D, that is, the water is coming from an aquifer beneath stratum E. Two samples from stratum E had mean laboratory values of 7.1E-09 cm/sec and 4.8E-09 cm/sec for vertical and horizontal permeability, respectively (Table 3-17). The hard, dense nature of the material observed in the field appears to have a very low hydraulic conductivity. However, this clay is not well defined and its thickness beneath the site is not known, so the potential exists that this clay is thin in areas and may transmit water from below. Water levels from wells screened in the Evangeline Aquifer are higher than water levels from wells screened in the Brazos River Alluvium in central Waller County (TWDB Report 68), indicating an upward flow potential.

The other possibility is that the "leakage" is not coming from above or below, but that the excess water that causes the time-drawdown pumping curve to flatten out is actually coming from the Brazos River. The river is acting as a constant head boundary that continuously supplies water to stratum D. The response of the confined aquifer to changes in water level in the river argues strongly for a hydraulic connection with the river, probably fairly close to the site. However, the head in the confined aquifer decreases in the direction of the river, so water would have to be drawn "upgradient" to reach the pumping

test area. This scenario is not likely, and effectively removes the river from being a direct source of water during the pumping test. Furthermore, the radius of influence of the pumping well probably did not extend to the river.

Assuming that there is leakage from stratum B to stratum D through the clay, the Hantush-Jacob method cannot distinguish between leakage from below or leakage from above the aquifer being pumped, and the values calculated could actually be a sum effect of leakages from two directions. If this is the case, the effect of leakage on stratum B would be a maximum drawdown of 0.07 feet, the maximum amount of water level decrease noted during the pump test in wells screened in the unconfined aquifer. Taking this value with the other aquifer parameters already discussed above, and substituting these back into equation 5.100 from Walton (1985), the effective permeability or leakage across stratum C can be calculated. When this exercise is completed, the estimated permeability of stratum C is on the order of 10^{-7} cm/sec, a value that is much more reasonable for a clay (Appendix H-3) and which is in closer agreement with other test data for stratum C. The remainder of the leakage would come from below stratum D. The amount of downward leakage from stratum B through stratum C into the confined aquifer is low, and the calculated hydraulic conductivity for stratum C can be used to calculate the travel time through stratum C into stratum D.

In order to calculate the travel time through the clay at the permeability of 10^{-7} cm/sec, there must be a downward head difference between the two aquifers to cause water to flow in that direction. At the SDS site the difference in head between the two aquifers changes with distance from the river and with river stage. By inspection, when the river stage is high (140 feet MSL or higher), the unconfined aquifer has a higher head than the confined aquifer and the direction of flow is downward. When the river stage is lower, the unconfined aquifer drains out rather rapidly and the head in the confined aquifer is higher than the head in the unconfined aquifer, resulting in an upward direction of flow. (See also Figures 3-12 through 3-14.) This relationship holds true near the river bank and as far south as MW-6 and MW-7 south of the main pond. At the well nest the pattern is nearly reversed, with the head showing an upward gradient when the river level is high or when there are many high stages close together (as in late 1985 and early 1986). The gradient becomes downward in direction when the river stage is low, especially since the level has remained low (around 130') for a longer period of time, as it has from September 1987 through February 1988. Tables 3-19 and 3-20 show the percent of time the head is in a downward direction and the average heads between the two aquifers, respectively, for four different pairs

TABLE 3-19

Percent of Occurrences Gradient Between the Confined and Unconfined Aquifers is in a Downward Direction

Date of Sample	River Stage at Site (calc)	Difference in water elevations between Deep and Shallow Aquifers (POSITIVE numbers indicate an UPWARD gradient) Well Nest - Deep minus Shallow	MW-7 minus MW-6	MW-13 minus MW-15	MW-14 minus MW-16	Number of readings indicating a DOWNWARD gradient (1 indicates downward gradient) Well Nest	MW7-MW6	MW13-MW15	MW14-MW16
11/22/85	132.1		-0.03	0.30	2 59		1	0	0
12/06/85	141.1		-0.17		-0 62		1	0	1
12/13/85	150.1	1.00	0.34	-1.54	0.01	0	0	1	0
12/19/85	141.2	0.67	-0.20	-1.18	-0.55	0	1	1	1
01/03/86	133.8	0.33	-0.22	1.49	1 67	0	1	0	0
01/14/86	133.1	0.32	-0.01	1.97		0	1	0	
02/07/86	153.2	1.49	0.40	-1.52	0.66	0	0	1	0
03/21/86	131.3	0.17	0.21	2.99	3.41	0	0	0	0
04/24/86	130.2	-0.05	0.39	2.94	4.13	1	0	0	0
05/09/86	135.3	0.29	0.15	1.00	2.38	0	0	0	0
06/11/86	146.2	0.91	0.21	-1.28	0 08	0	0	1	0
07/15/86	135.3	0.28	0.13	1.77	2.40	0	0	0	0
08/18/86	130.4	-0.16	0.23	3 19	3.46	1	0	0	0
09/18/86	136.4	0.00	0 11	0.95		1	0	0	
10/27/86	141.2	0.31	-0.10	-0.83	0.40	0	1	1	0
11/28/86	140.4	0.21	0.02	-0.05	1.58	0	0	1	0
01/02/87	142.9	1.00	0.03	-0 63	-0.69	0	0	1	1
01/22/87	138.1	0.48	-0.06	0.55	1.39	0	1	0	0
02/05/87	137.7	0.55	0.03	1.31	1.88	0	0	0	0
02/23/87	137.2	0.47	0.14	1.54	2.37	0	0	0	0
03/09/87	145.7	1.14	0.20	-0.54	-0.26	0	0	1	1
03/23/87	140.7	1.01	0.02	0.17	0.26	0	0	0	0
04/06/87	136.1	0.56	0 03	2.00	2.24	0	0	0	0
04/21/87	135.8	0.38	0 04	2.01	2.36	0	0	0	0
05/05/87	131.7	-0.12	0.25	3.60	3.58	1	0	0	0
05/20/87	133.3	0.10	0.43	3.52	4.21	0	0	0	0
06/10/87	150.6	1.42	0.78	-0.97	-1.24	0	0	1	1
06/23/87	148.2	1.97	0.73	-0.51	-1.10	0	0	1	1
07/15/87	140.3	1.42	0.21	1.12	1.29	0	0	0	0
07/30/87	137.8	0.89	0.13	1.93	2.35	0	0	0	0
08/13/87	134.8	0.45	0.19	3 00	3 41	0	0	0	0
08/26/87	132.5	0.34	0 20	3.48	0 00	0	0	0	0
09/16/87	130.3	-0.09	0.41	4.32	4.93	1	0	0	0
09/30/87	130.9	-0.22	0.41	3.94	4 78	1	0	0	0
10/13/87	128.8	-0.37	0.46	4.34	4.74	1	0	0	0
10/23/87	129.4	-0.46	0.00	4.29	4.97	1	0	0	0
11/10/87	129.4	-0.48	0 58	4.10	4.91	1	0	0	0
11/18/87	130 2	-0.42	0.61	3.67	4.72	1	0	0	0
12/02/87	130.6	-0.24	0.56	3.20	4 31	1	0	0	0
12/23/87	133.4	-0.03	0 44	2 16	4 09	1	0	0	0
01/06/88	131 7	-0.03	0 10	2 23	3 48	1	0	0	0
01/19/88	130.8	-0 07	0 26	2 92	3.88	1	0	0	0
02/11/88	129.7	-0 33	0.42	3 33	4.36	1	0	0	0
02/26/88	131 0	-0 18	0 24	2.47	3.84	1	0	0	0
					Total Number of Readings	42	44	44	42
					Percent of Occurrences Downward Gradient	38 1%	15.9%	22 7%	14 3%

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TABLE 3-20

Amount of Head Potential Between the Confined and Unconfined Aquifers

(POSITIVE numbers indicate an UPWARD head potential)

Date of Sample	River Stage at Site (calc)	Well Nest - Deep minus Shallow	MW-7 minus MW-6	MW-13 minus MW-15	MW-14 minus MW-16
11/22/85	132.1		-0.03	0 30	2 59
12/06/85	141.1		-0.17	-0 62	
12/13/85	150.1	1.00	0.34	-1.54	0 01
12/19/85	141.2	0.67	-0 20	-1 18	-0 55
01/03/86	133.8	0.33	-0.22	1 49	1.67
01/14/86	133.1	0.32	-0.01	1 97	
02/07/86	153.2	1.49	0.40	-1.52	0 66
03/21/86	131.3	0.17	0.21	2.99	3 41
04/24/86	130.2	-0.05	0.39	2.94	4.13
05/09/86	135.3	0.29	0.15	1.00	2.38
06/11/86	146.2	0.91	0.21	-1.28	0.08
07/15/86	135.3	0.28	0.13	1.77	2.40
08/18/86	130.4	-0.16	0.23	3.19	3.46
09/18/86	136.4	0.00	0.11	0.95	
10/27/86	141.2	0.31	-0.10	-0.83	0.40
11/28/86	140.4	0.21	0.02	-0.05	1.58
01/02/87	142.9	1.00	0.03	-0.63	-0.69
01/22/87	138.1	0.48	-0.06	0.55	1.39
02/05/87	137.7	0.55	0.03	1.31	1.88
02/23/87	137.2	0.47	0.14	1.54	2.37
03/09/87	145.7	1.14	0.20	-0.54	-0.26
03/23/87	140.7	1.01	0.02	0.17	0.26
04/06/87	136.1	0.56	0.03	2.00	2.24
04/21/87	135.8	0.38	0.04	2.01	2.36
05/05/87	131.7	-0.12	0.25	3 60	3.58
05/20/87	133.3	0.10	0.43	3.52	4.21
06/10/87	150.6	1.42	0.78	-0.97	-1.24
06/23/87	148.2	1.97	0.73	-0 51	-1.10
07/15/87	140.3	1.42	0.21	1.12	1 29
07/30/87	137.8	0.89	0.13	1 93	2.35
08/13/87	134.8	0.45	0.19	3.00	3.41
08/26/87	132.5	0.34	0.20	3.48	0.00
09/16/87	130.3	-0.09	0.41	4.32	4.93
09/30/87	130.9	-0.22	0.41	3.94	4.78
10/13/87	128.8	-0.37	0.46	4 34	4.74
10/23/87	129.4	-0.46	0.00	4.29	4.97
11/10/87	129.4	-0.48	0.58	4 10	4.91
11/18/87	130.2	-0.42	0.61	3.67	4.72
12/02/87	130.6	-0.24	0.56	3.20	4.31
12/23/87	133.4	-0.03	0.44	2.16	4.09
01/06/88	131.7	-0.03	0.10	2.23	3.48
01/19/88	130.8	-0.07	0.26	2.92	3.88
02/11/88	129.7	-0.33	0.42	3 33	4.36
02/26/88	131.0	-0.18	0.24	2.47	3.84

DOWNWARD head potential

Well Nest	MW7-MW6	MW13-MW15	MW14-MW16
	-0.03		
	-0.17		-0.62
		-1.54	
	-0 20	-1 18	-0.55
	-0 22		
	-0.01		
		-1 52	
-0.05			
		-1.28	
-0.16			
	-0.10	-0 83	
		-0 05	
		-0.63	-0.69
	-0.06		
		-0.54	-0.26
-0.12			
		-0.97	-1.24
		-0.51	-1.10
-0.09			
-0.22			
-0.37			
-0.46			
-0.48			
-0.42			
-0 24			
-0.03			
-0.03			
-0.07			
-0.33			
-0.18			
Average downward head potential			
-0.22	-0 11	-0.90	-0.74

UPWARD head potential

Well Nest	MW7-MW6	MW13-MW15	MW14-...
		0 30	2 59
1.00	0.34		0 01
0.67			
0.33		1.49	1 67
0.32		1.97	
1.49	0.40		0 66
0.17	0.21	2 99	3.41
	0.39	2 94	4.13
0 29	0.15	1.00	2 38
0.91	0.21		0 08
0.28	0.13	1 77	2 40
	0.23	3.19	3.46
	0.11	0.95	
0.31			0 40
0.21	0.02		1.58
1.00	0.03		
0.48		0.55	1.39
0.55	0.03	1.31	1 88
0.47	0.14	1.54	2.37
1.14	0.20		
1.01	0.02	0.17	0 26
0.56	0.03	2.00	2.24
0.38	0.04	2.01	2.36
	0 25	3.60	3 58
0.10	0 43	3.52	4 21
1.42	0.78		
1.97	0.73		
1.42	0.21	1.12	1.29
0.89	0.13	1.93	2.35
0.45	0.19	3.00	3.41
0.34	0.20	3.48	
	0 41	4.32	4 93
	0.41	3.94	4 78
	0 46	4.34	4.74
		4 29	4 97
	0.58	4.10	4 91
	0.61	3.67	4.72
	0.56	3.20	4 31
	0.44	2.16	4.09
	0.10	2.23	3.48
	0.26	2.92	3 88
	0.42	3.33	4 36
	0 24	2.47	3 84
Average upward head potential			
0.70	0.28	2.48	2.89

Note:
Average head potentials are calculated as the number of occurrences of the event divided by the total number of events. It is also assumed that the head potentials do not change between measuring events.

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of wells at the site: MWs-14 and 16, MWs-13 and 15, MWs-6 and 7, and an average of the shallow wells versus the deep wells in the well nest. The percentage of time the hydraulic head is in a downward (or upward) direction assumes no change in hydraulic head between individual sampling events and is calculated as the number of occurrences of an event divided by the total number of measurements. In each case there is a comparison between the head in the confined aquifer to the head in the unconfined aquifer.

Using the average amount of occurrences the head potential is in the downward direction (Table 3-19) with the maximum and average downward head at each well pair, along with the calculated permeability of stratum C, and assuming that the percentage of occurrences is equivalent to the percentage of time, the travel time across the clay from stratum B to D can be calculated using Darcy's Law:

$$v = \frac{k * I}{n_e}$$

where k is the permeability of the clay, I is the gradient across the clay [calculated as the head difference/thickness of clay, which is 30 feet, and n_e is the effective porosity of the clay, assumed to be 25% (0.25)]. These calculations, summarized in Table 3-21, yield travel times on the order of years, with the minimum amount of time being 162 years in the downward direction at MW-13 and 15 (See also Appendix H-4).

However, since there is generally an upward flow gradient from the deeper to shallower aquifer, an evaluation of net flow must take into account the upward gradient. Using the average upward and downward gradients, plus the percentage of time these gradients are in effect (again assuming that the percent of time is equivalent to the percentage of occurrences, which is measured here), the net distance traveled in a year is at least one order of magnitude greater in the upward direction than in the downward direction (Table 3-22). This occurs at all of the well pairs at the site. Since the overall head between the two aquifers is in an upward direction, the potential for downward migration of constituents from the site to stratum D is negligible.

In summary, the relationship between the unconfined and confined aquifers beneath the SDS site has been examined through the use of pumping test analysis. Using the Hantush-Jacob method and related equations, a permeability value on the order of 10^{-7} cm/sec was calculated for the stratum C clay.

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TABLE 3-21

Travel Times Across Stratum C
in a Downward Direction

Well Pair	Gradient		Percent of Time	Travel Time (Years) Across Stratum C Clay Using Maximum or Average Gradient	
	Maximum	Average		Maximum	Average
MW-13 MW-15	0.062	0.036	23	162	279
MW-14 MW-16	0.05	0.03	14	201	336
MW-6 MW-7	0.009	0.004	16	1,120	2,520
Well Nest Deep vs. Shallow	0.019	0.009	38	524	1,120

NOTES:

Thickness of Stratum C is assumed to be 25 feet. Vertical permeability of Stratum C is calculated from pumping test data to be is 1.7 x 10-3 ft/day or 6 x 10-7 cm/sec.

The percentage of time the gradient is in a given direction is calculated by counting the number of occurrences of the event and dividing by the total number of events. It is assumed that there is no change in flow direction between sampling events, and that the percentage of occurrences estimates the percentage of time the events occur.

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TABLE 3-22

Distance Traveled Across Stratum C
on an Annual Basis
Sheridan Disposal Services Site

Well Pair	Average Upward Gradient	Average Downward Gradient	Time for Upward Flow [a]	Time for Downward Flow [a]	Distance Traveled in One Year	Net Distance Traveled in One Year
MW 13/15	0.099	0.036	77% (281 days/year)	23% (84 days/year)	0.19 ft/year - upward 0.021 ft/year - downward	0.169 feet - upward
MW 14/16	0.116	0.03	86% (314 days/year)	14% (51 days/year)	0.248 ft/year - upward 0.017 ft/year - downward	0.231 feet - upward
MW 6/7	0.011	0.004	84% (307 days/year)	16% (58 days/year)	0.023 ft/year - upward 0.0016 ft/year - downward	0.021 feet - upward
Well Nest Shallow vs. Deep	0.028	0.009	62% (226 days/year)	38% (139 days/year)	0.043 ft/year - upward 0.009 ft/year - downward	0.034 feet - upward

[a] Data from 11/85 through 2/88; percentages based on individual measurements, not actual durations. It is assumed that the flow direction does not change between measurements, and that the percentage of occurrences for a given event is equivalent to the percentage of time that event occurs.

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While this value is indicative of a tight, competent clay, the pumping test data did indicate that another source of water was being supplied to the aquifer/aquitard system during the test.

The probable primary source of this water is the aquifer(s) below stratum E. This was concluded because:

1) The stratigraphy of the area around the SDS site is such that there are additional aquifers and aquitards beneath stratum E, although their specific thicknesses and properties under the SDS site are not known.

2) The thickness and lateral extent of stratum E under the site is not known, and it is possible that this clay layer is thin under or near the site, increasing the chance for leakage of water from below.

3) It has been documented (TWDB Report 68, 1967) that water levels from wells screened in the Evangeline Aquifer are higher than water levels from wells screened in the Brazos River Alluvium in central Waller County, indicating that an upward flow potential exists in the region of the SDS site.

Therefore it is plausible and likely that there could be a source of water from below stratum E that contributed water to the pumping test data.

While a concern for contaminant migration from stratum B through stratum C into stratum D exists, pumping test data has indicated a very tight clay aquitard (stratum C) exists between the two aquifers. It should also be noted that the net head potential between the two aquifers is always upward. This means that the possibility of downward migration of constituents from stratum B into stratum D is negligible.

4 - GROUND WATER QUALITY

As part of the GWRI, the ground water chemical quality was evaluated. Ground water quality data, for both the region within a three mile radius of the SDS site and in the immediate vicinity of the site, is very sparse. In addition, the historical chemical parameters evaluated are often different between wells or areas. Therefore direct comparisons are difficult to make. The quality of earlier analyses may also be suspect due to the lack of quality control data. Much of the data presented here comes from previously published and unpublished data that does not have any quality control and is included only to show general trends in water quality. Available data for the Brazos River water quality is also included because of the potential interconnection between the aquifers at the site and the river.

4.1 Regional Water Quality

All available water quality data for ground water wells within a three mile radius of the SDS site are included in Table 4-1. These data are from records of the Texas Water Development Board and Texas Water Commission. Samples for chemical analysis were analyzed by the Texas Department of Health, although it is not known which agency might have collected these samples, or if the water was sent in by the well owner. Of the seven wells and eight analyses available, only three are applicable to the SDS site because they are known to be screened in aquifers present at the site, that is, the Brazos River Alluvium and the Evangeline Aquifer. These wells are numbered 59-55-603, 59-55-604 and 59-55-605. The other analyses are for deeper aquifers (Jasper) or are from wells where the screened interval is not recorded.

All three wells listed above generally meet Secondary Drinking Water Standards (Table 4-2). Additional standards may be applicable. Exceptions to this include the iron and TDS values of #605, and the TDS value of #603. Both of these wells are screened in the alluvium. For these parameters, the water exceeds recommended Secondary Drinking Water Standards which are designed to protect aesthetic quality of water. The water from all three wells (603, 604 and 605) is considered very hard for both the alluvium and the Evangeline Aquifer, with values greater than 180 mg/l calcium carbonate hardness.

The water quality of the Brazos River has also been monitored on a sporadic basis, both upstream of the site (near College Station and other locations) and downstream near Richmond or Sealy. Data for available constituents are shown in Table 4-3.

TABLE 4-1

Ground Water Quality Parameters of
Wells within a 3-Mile Radius of
the SDS Site [a]
Hempstead, Texas

Well Number:		59-55-603 [b]	59-55-604 [b]	59-55-605 [b]	59-56-109	59-56-301		59-55-302	59-55-305
Aquifer:		Evangeline	Evangeline	Alluvium	Unknown	Jasper		Unknown	Unknown
County:		Waller	Waller	Waller	Washington	Washington		Washington	Washington
Date Sampled:		1/31/66	1/31/66	1/31/66	10/8/68	10/8/68	6/13/80	10/22/42	10/22/42
Parameter	Units								
pH	S.U.	7.0	7.1	6.9	7.6	8.0	8.2	-	-
Specific Conductivity	umhos/cm	948	-	882	976	754	696	-	-
Total Dissolved Solids	mg/l	510	-	510	-	489	496	361	514
Calcium	mg/l	108	-	108	-	21	21	104	146
Magnesium	mg/l	13	-	20	-	3	1	5	13
Sodium	mg/l	57	-	56	-	162	157	29	52
Potassium	mg/l	-	-	-	-	-	8.0	-	-
Iron (Total)	mg/l	-	-	2.6	-	-	0.91	-	-
Chloride	mg/l	168	36	61	65	34	4 1	30	169
Fluoride	mg/l	0.3	-	0.3	-	0.4	0.5	-	0.1
Sulfate	mg/l	14	17	36	-	22	15	3	11
Bicarbonate	mg/l	232	360	420	526	420	420	354	336
Silica	mg/l	28	-	19	-	40	53	-	-
Nitrate	mg/l	7.7	-	0.2	-	0.2	<0.1	15	8 0
Sodium Adsorption Ratio	S.U.	1.4	-	1.3	-	8.9	-	-	-
Sodium	%	28	-	26	-	85	-	-	-
Hardness (total as CaCO3)	mg/l	324	181	350	60	63	56	254	418

[a] Source: TWC and TWDB Records (Driller's Logs)
[b] Known to be screened in aquifer screened at the site.

018595

TABLE 4-2

Drinking Water Regulations

National Primary Drinking Water Regulations - 40CFR 141

Parameter	Maximum Contaminant Level
Arsenic	0.05 mg/l
Barium	1 mg/l
Cadmium	0.010 mg/l
Chromium	0.05 mg/l
Lead	0.05 mg/l
Mercury	0.002 mg/l
Nitrate (as N)	10 mg/l
Selenium	0.01 mg/l
Silver	0.05 mg/l
Fluoride	4 mg/l
Endrin	0.0002 mg/l
Lindane	0.004 mg/l
Methoxychlor	0.1 mg/l
Toxaphene	0.005 mg/l
2,4-D	0.1 mg/l
2,4,5 - TP Silvex	0.01 mg/l
Trihalomethanes (total)	0.10 mg/l
Turbidity	1-5 TU
Coliform (total)	< 1 col/100 ml
Radium 226 + 228	5 pCi/L
Gross Alpha	15 pCi/L
Beta Particle and photon radioactivity	4 mrem (annual dose equivalent)
Benzene	0.005 mg/l
Carbon Tetrachloride	0.005 mg/l
1,2-Dichloroethane	0.005 mg/l
1,1-Dichloroethylene	0.007 mg/l
para-Dichlorobenzene	0.075 mg/l
1,1,1-Trichloroethane	0.2 mg/l
Trichloroethylene	0.005 mg/l
Vinyl Chloride	0.002 mg/l

F805

TABLE 4-2 (Continued)

National Secondary Drinking Water Regulations - 40CFR 143.3

Parameter	Secondary Maximum Contaminant Levels
Chloride	250 mg/l
Color	15 color units
Copper	1 mg/l
Corrosivity	Non-corrosive
Fluoride	2.0 mg/l
Foaming agents	0.5 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Odor	3 threshold odor number
pH	6.5 - 8.5
Sulfate	250 mg/l
Total Dissolved Solids	500 mg/l
Zinc	5 mg/l

F805

TABLE 4-3

Available Specific Chemical and Water Quality Data for the Brazos River at College Station, TX (Upstream), Richmond, TX (Downstream), and Segment 1202 [a]

Parameter	Criteria for Segment 1202	At College Station (Mile 271 9)		At Richmond (Mile 92.0)				Segment 1202 [a]
		1981-1982	1983-1984	1981-1982	1983-1984	1984-1985	1985-1986	1981-1985
(Units in mg/l unless otherwise specified)								
Specific Conductance (umhos/cm)		251-1770	509-1500	204-1520	251-1410	172-1920	262-1170	NA
Temperature (deg. C)	<35	2-32	1-31.5	4-31	3-31	5-31	7-30	6-32
Hardness (as CaCO3)	-	220-310	160-260	160-300	93-270	87-310	180-260	
Calcium, dissolved	-	65-93	50-92	51-90	28-70	38-82	34-78	
Magnesium, dissolved	-	13-19	9 2-23	7.9-20	5.5-20	5.6-21	4.5-16	
Sodium, dissolved	-	74-180	49-190	36-170	17-140	22-150	16-140	
Potassium, dissolved	-	3.5-5.6	4.2-6.4	5.0-5.5	4.5-6.7	4.3-6.0	3.8-5.1	
Alkalinity (as CaCO3)	-	94-210	130-230	92-160	82-160	87-144	91-165	
Sulfate, dissolved	200 [b]	63-170	64-180	53-160	18-120	26-160	18-130	58-220
Chloride, dissolved	300 [b]	86-300	52-290	51-270	21-210	27-320	17-220	30-15175
TDS	750 [b]	433-814	320-870	280-811	150-670	153-911	150-650	335-963
pH	6.5-9.0	NA	NA	7.6-8.5	7.8-8.1	7.5-8.3	7.8-8.5	7.5-9.1
Turbidity (FTU)	-	NA	NA	4.2-200	9-530	26-350	4.2-890	
Dissolved Oxygen	>5.0	NA	NA	7-11.5	7.2-10.5	7.2-9.6	7.0-11.2	6.8-11.2
Dissolved Oxygen, % sat.	-	NA	NA	94-115	81-96	97-104	87-112	
BOD	-	NA	NA	1 6-4.5	1.2-8.1	1.5-2.6	1.2-3.6	
Coliform (cols/100 ml)	200	NA	NA	80-210	92-3400	88-650	20-7300	20-2000
Streptococci (cols./100 ml)	-	NA	NA	220-3300	80-8600	32-500	20-9100	
Sediment, suspended	-	NA	NA	19-4440	12-1430	20-4370	32-3140	
ORGANICS (Total in bottom material, in mg/kg)								
PCBs				0.0	NA	NA	NA	NA
DDD				0.0	NA	NA	NA	NA
DDE				0.3	NA	NA	NA	NA
DDT				0.0	NA	NA	NA	NA
Lindane				0.0	NA	NA	NA	NA

NOTES.
Samples were collected for SCRI (1987) immediately upstream and downstream of the site. No priority pollutant organics were detected in the samples. Metals analyses were not performed

[a] Brazos River Segment 1202 extending between Whitney Dam and the tidal limit; Water Quality Inventory, 8th Edition, Texas Water Commission, October 1986.

[b] Annual Average Not to Exceed.

[c] Metal concentrations are from two stations near Sealy for 1974-1975 (1202.0133 and 1202.0166), in Warshaw, S . Metals Concentrations in Water and Sediment of Texas, Report SR-4, Texas Water Quality Board, May 1976.

018598

TABLE 4-3 (Cont.)

Available Specific Chemical and Water Quality Data for the Brazos River at College Station, TX (Upstream), Richmond, TX (Downstream), and Segment 1202 [a]

Parameter	Criteria for Segment 1202	At College Station (Mile 271.9)		At Richmond (Mile 92.0)				Segment 1202 [a]
		1981-1982	1983-1984	1981-1982	1983-1984	1984-1985	1985-1986	1974-1975 [c]
(Units in ug/l unless otherwise specified)								
METALS								
Aluminum	-	NA	NA	NA	NA	NA	20-150	NA
Arsenic, total	-	NA	NA	2-4	NA	NA	NA	NA
dissolved		NA	NA	2-3	<1-7	1-5	2-3	NA
Barium, total	-	NA	NA	<100-200	NA	NA	NA	<100-200
dissolved		NA	NA	110-160	64-160	92-160	56-120	NA
Beryllium, total	-	NA	NA	NA	NA	NA	NA	NA
dissolved		NA	NA	NA	<0.5-<1.0	<0.5-2.0	<0.5	NA
Cadmium, total	-	NA	NA	<1-3	NA	NA	NA	<10
dissolved		NA	NA	<1-4	<1-1	<1-3	<1-4	NA
Chromium, total	-	NA	NA	<10-10	NA	NA	NA	<10-30
dissolved		NA	NA	<10	<1-1	<1-2	<1	NA
Cobalt, total	-	NA	NA	<1-3	NA	NA	NA	NA
dissolved		NA	NA	<1-<3	<3	<3	<3	NA
Copper, total	-	NA	NA	5-14	NA	NA	NA	<10-30
dissolved		NA	NA	3-7	2-4	2-7	1-5	NA
Iron, total	-	NA	NA	390-6800	NA	NA	NA	3620-5350
dissolved		NA	NA	5-27	<3-66	3-83	7-160	NA
Lead, total	-	NA	NA	2-45	NA	NA	NA	<50-120
dissolved		NA	NA	1-5	<1-3	<1-7	<5-2	NA
Manganese, total	-	NA	NA	80-240	NA	NA	NA	120-230
dissolved		NA	NA	2-3	<1-7	<1-18	2-4	NA
Mercury, total	-	NA	NA	0.1-0.2	NA	NA	NA	<2-250
dissolved		NA	NA	<0.1-0.3	<0.1	<0.1	<0.1-0.1	NA
Nickel, total	-	NA	NA	2-8	NA	NA	NA	20-140
dissolved		NA	NA	1-7	<1-4	<1-3	1-2	NA
Selenium, total	-	NA	NA	<1-1	NA	NA	NA	NA
dissolved		NA	NA	<1	<1-1	<1	<1-1	NA
Silver, total	-	NA	NA	<1	NA	NA	NA	<10
dissolved		NA	NA	<1	<1	<1	<1-1	NA
Vanadium, total	-	NA	NA	NA	NA	NA	NA	NA
dissolved		NA	NA	NA	<6-7	<6	<6	NA
Zinc, total	-	NA	NA	10-60	NA	NA	NA	10-400
dissolved		NA	NA	7-39	<3-10	9-19	10-23	NA

NOTES:
Samples collected for SCRI (1987) immediately upstream and downstream of the site. No priority pollutant organics were detected in the samples. Metals analyses were not performed

[a] Brazos River Segment 1202 extending between Whitney Dam and the tidal limit; Water Quality Inventory, 8th Edition, Texas Water Commission, October 1986.

[b] Annual Average Not to Exceed.

[c] Metal concentrations are from two stations near Sealy for 1974-1975 (1202.0133 and 1202.0166), in Warshaw, S., Metals Concentrations in Water and Sediment of Texas, Report SR-4, Texas Water Quality Board, May 1976.

018599

A comparison of similar parameters between the river data and wells 603, 604 and 605 show that most of the constituents in the aquifer fall in the range of values listed for the river. Calcium concentrations are somewhat higher and sulfate concentrations lower in the aquifers than in the river. Concentrations of particular constituents do not change appreciably from the upstream location (College Station) to the downstream location (Richmond or near Sealy).

4.2 Ground Water Quality at the SDS Site

Ground water quality has been periodically measured at the SDS site as part of facility operations and since operations have ceased. Data that have been collected include general water quality parameters from 1963 through 1984, a Priority Pollutant volatile and semi-volatile analysis in 1984 and 1985, indicator parameters (TOC and TOX) collected monthly from January through June, 1987, and one sampling event in October 1987 that analyzed for the Priority Pollutant list, pH, specific conductance, TOC, TOX, phenolics and cyanide. The data from 1963-1984 does not have complete QA/QC procedures included. The indicator parameters and the Priority Pollutant analyses of October 1987 were completed as part of the GWRI.

4.2.1 General Ground Water Quality: 1963-1984

The general water quality parameters for wells installed through 1984 are summarized in Table 4-4 for the unconfined aquifer and Table 4-5 for the confined aquifer. While most of the data was collected in 1984 shortly after well installation, wells MW-4 and MW-8 have data from 1972-1984, and MW-5 has data from 1963-1984, giving the best historical record of water quality changes with time during the operation of the site. Data from these three wells do show variations over time, especially in parameters of specific conductance and chloride, but these changes show no specific trends through time. (Table 4-6).

Historical data in Table 4-5 for the confined aquifer are from 1984 only and no background well data are available. The four wells sampled have similar ranges of values for the parameters tested. High specific conductivity readings in MW-2 and MW-7 were both detected on April 20, 1984, and could be a function of instrument error, since all readings taken on that date in both aquifers are unusually high (Appendix I), even compared to more recent and more frequent readings taken in 1987.

D131

TABLE 4-4

Summary of Ground Water Analyses for the Unconfined Aquifer Collected Between 1963 and 1984 at the SDS Site

Parameter	Units	MW-1 Range of Values	MW-1 Mean of Values	MW-3 Range of Values	MW-3 Mean of Values	MW-4 Range of Values	MW-4 Mean of Values	MW-5 Range of Values	MW-5 Mean of Values	MW-6 Range of Values	MW-6 Mean of Values
pH	s.u.	7.9	-	6.7-7.0	6.8	6.8-7.9	7.2	6.8-8.0	7.4	6.7-7.2	7.0
Specific Conductivity	umhos/cm	885	-	2840-4050	3282	1000-5800	1543	870-1793	1216	650-1385	905
Total Dissolved Solids	mg/l	-	-	-	-	632-1416	953	-	-	-	-
Hardness	mg/l	-	-	-	-	315-708	475	196-560	355	-	-
Total Alkalinity	mg/l	-	-	-	-	288-550	368	275-410	338	-	-
Sodium	mg/l	69	-	116-122	119	77-78	78	60-72	66	56-60	58
Calcium	mg/l	39	-	32-380	110	81-84	83	45-54	49	41-44	42
Magnesium	mg/l	23	-	47-49	48	26-29	28	21-26	23	16-20	18
Bicarbonate	mg/l	283	-	293-325	309	297-347	321	160-313	224	263-357	306
Carbonate	mg/l	-	-	<0.01	-	<0.01	-	<0.01	-	<0.01	-
Chlorides	mg/l	125	-	598-661	642	167-1060	231	159-183	171	77-91	84
Sulfates	mg/l	20	-	3-30	12	5-50	32	<1-5	2.2	5-30	15
Phenolics	mg/l	<0.01	-	<0.01-0.53	0.11	0.11-0.25	0.17	<0.01-0.24	0.05	<0.01-.23	0.04
TOC	mg/l	123	-	35-165	68	88-134	109	16-59	31	8-128	38
COD	mg/l	-	-	-	-	6.7-59	30.1	30-95	65	-	-
Year(s) Sampled (1)		1984 [1]		1984 [4]		1972 [13] 1973 [1] 1974 [4] 1978 [1] 1979 [1] 1984 [2]		1963 [1] 1965 [1] 1968 [2] 1970 [2] 1984 [4]		1984 [4]	

NOTES:

Mean was calculated as the geometric mean.

- Indicates no data was available or indicates the mean was not calculated because only one analysis was available.

(1) Number in brackets [ ] is the number of separate analyses completed in that year. Specific dates of those analyses are in Appendix I and Table 4-6.

018601

TABLE 4-4 (Continued)

Summary of Ground Water Analyses for the Unconfined Aquifer
Collected between 1963 and 1984 at the SDS Site

Parameter	Units	MW-8 Range of Values	MW-8 Mean of Values	MW-10 Range of Values	MW-10 Mean of Values	MW-12 Range of Values	MW-12 Mean of Values	MW-15 Range of Values	MW-15 Mean of Values	MW-16 Range of Values	MW-16 Mean of Values
pH	s.u.	6.6-7.6	7.2	6.8-7.3	7.0	6.6-7.5	7.2	6.7-6.9	6.8	6.6-6.8	6.7
Specific Conductivity	umhos/cm	794-3375	1158	220-1280	589	980-1765	1198	1170-1260	1214	1960-2640	2275
Total Dissolved Solids	mg/l	431-735	532	-	-	-	-	-	-	-	-
Hardness	mg/l	210-375	319	-	-	-	-	-	-	-	-
Total Alkalinity	mg/l	50-500	301	-	-	-	-	-	-	-	-
Sodium	mg/l	31-33	32	51-54	52	138-165	146	-	-	-	-
Calcium	mg/l	34-42	38	37-39	38	31-34	33	-	-	-	-
Magnesium	mg/l	10-15	12	12	12	11-21	17	-	-	-	-
Bicarbonate	mg/l	236-305	268	228-317	269	81-285	162	-	-	-	-
Carbonate	mg/l	<0.01	-	<0.01	-	<0.01	-	-	-	-	-
Chlorides	mg/l	19-92	65	64-90	74	101-125	112	205-208	206	494-521	507
Sulfates	mg/l	<1-29	13	35-73	50	64-328	137	9-38	18	76-98	86
Phenolics	mg/l	<0.01-.21	0.06	<0.01-0.39	0.04	<0.01-0.8	0.02	0.03-0.14	0.06	0.08-0.26	0.14
TOC	mg/l	13-82	36	21-142	54	5-95	28	5-36	13	34-46	40
COD	mg/l	<1-36	8	-	-	-	-	-	-	-	-
Year(s) Sampled (1)		1972 [14] 1973 [1] 1974 [6] 1984 [4]		1984 [4]		1984 [5]		1984 [2]		1984 [2]	

NOTES:

Mean was calculated as the geometric mean.

- Indicates no data was available or indicates the mean was not calculated because only one analysis was available.

(1) Number in brackets [ ] is the number of separate analyses completed in that year. Specific dates of those analyses are in Appendix I and Table 4-6.

018602

TABLE 4-5

Summary of Ground Water Analyses for the Confined Aquifer
Collected During 1984 at the SDS Site

Parameter	Units	MW-2 Range of Values	MW-2 Mean of Values	MW-7 Range of Values	MW-7 Mean of Values	MW-13 Range of Values	MW-13 Mean of Values	MW-14 Range of Values	MW-14 Mean of Values
pH	s.u.	6.8-7.4	7.1	6.8-7.5	7.2	7.3	7.3	7.2-7.3	7.3
Specific Conductivity	umhos/cm	415-1065	652	580-1025	742	603-680	649	540-700	615
Sodium	mg/l	81-86	83	89-90	90	-	-	-	-
Calcium	mg/l	27-29	28	26-44	34	-	-	-	-
Magnesium	mg/l	7	7	6-8	7	-	-	-	-
Bicarbonate	mg/l	285-289	287	218-253	235	-	-	-	-
Carbonate	mg/l	<0.01	-	<0.01	-	-	-	-	-
Chlorides	mg/l	46-65	58	58-65	60	68-74	70	65-70	67
Sulfates	mg/l	3-9	5	5-56	15	7-10	8	5	5
Phenolics	mg/l	<0.01-0.08	0.03	<0.01-0.21	0.03	0.02-0.04	0.03	0.03-0.06	0.04
TOC	mg/l	7-57	19	3-115	26	8-17	10	3-10	5
Number of Analyses		4		4		3		2	

NOTES:

Mean was calculated as the geometric mean.

- Indicates no data was available or indicates that the mean was not calculated because only one analysis was available

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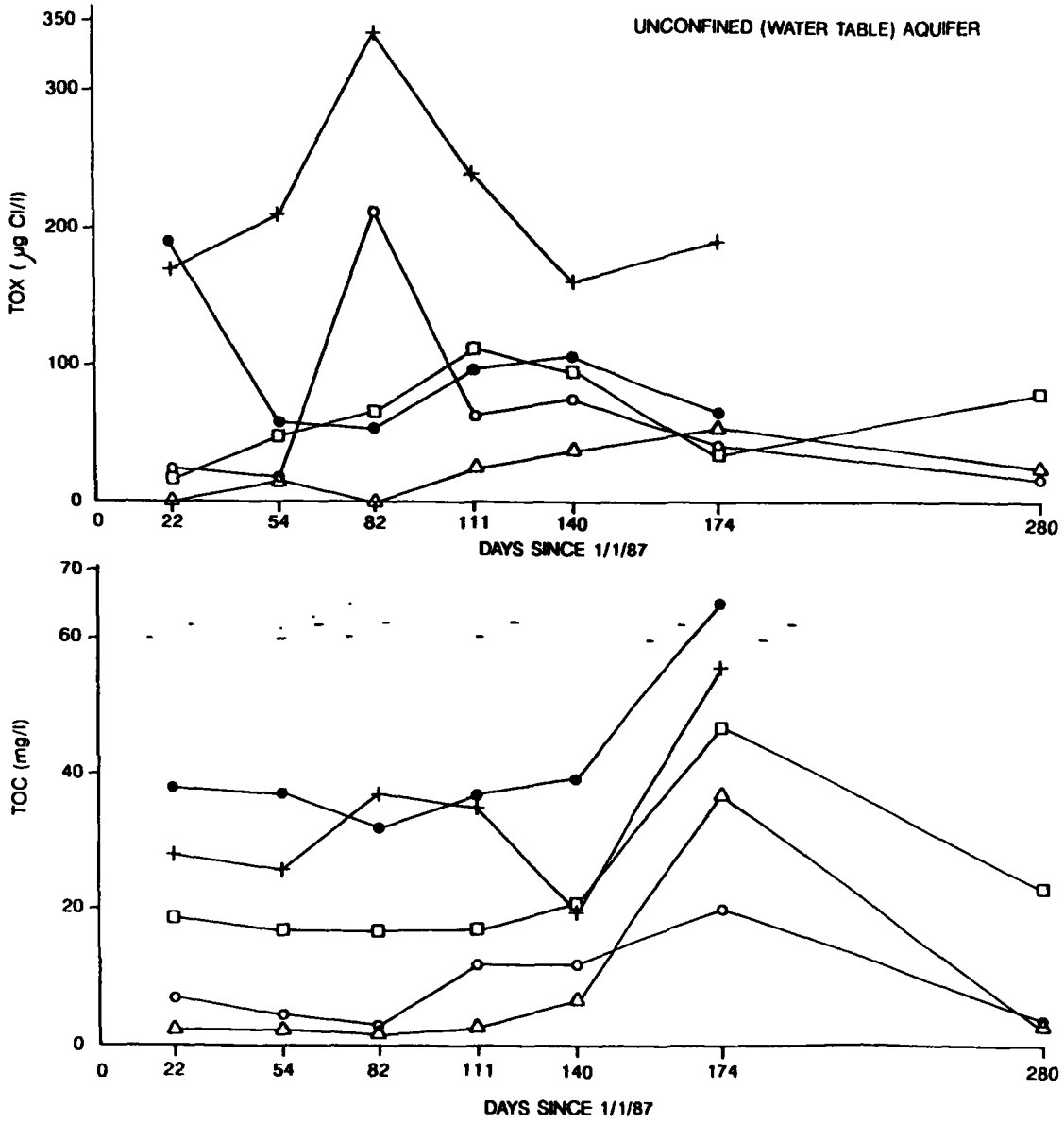
018610



NOTES

1. SAMPLING DATES ARE FOR THE SIX-MONTH INDICAT(PARAMETER STUDY, PLUS VALUES FROM THE OCTOE 1987 SAMPLING EVENT, AS APPROPRIATE.

2.

SAMPLING DATES	DAYS
1/22/87	22
2/23/87	54
3/23/87	82
4/21/87	111
5/20/87	140
6/23/87	174
10/87	280

006138

KEY

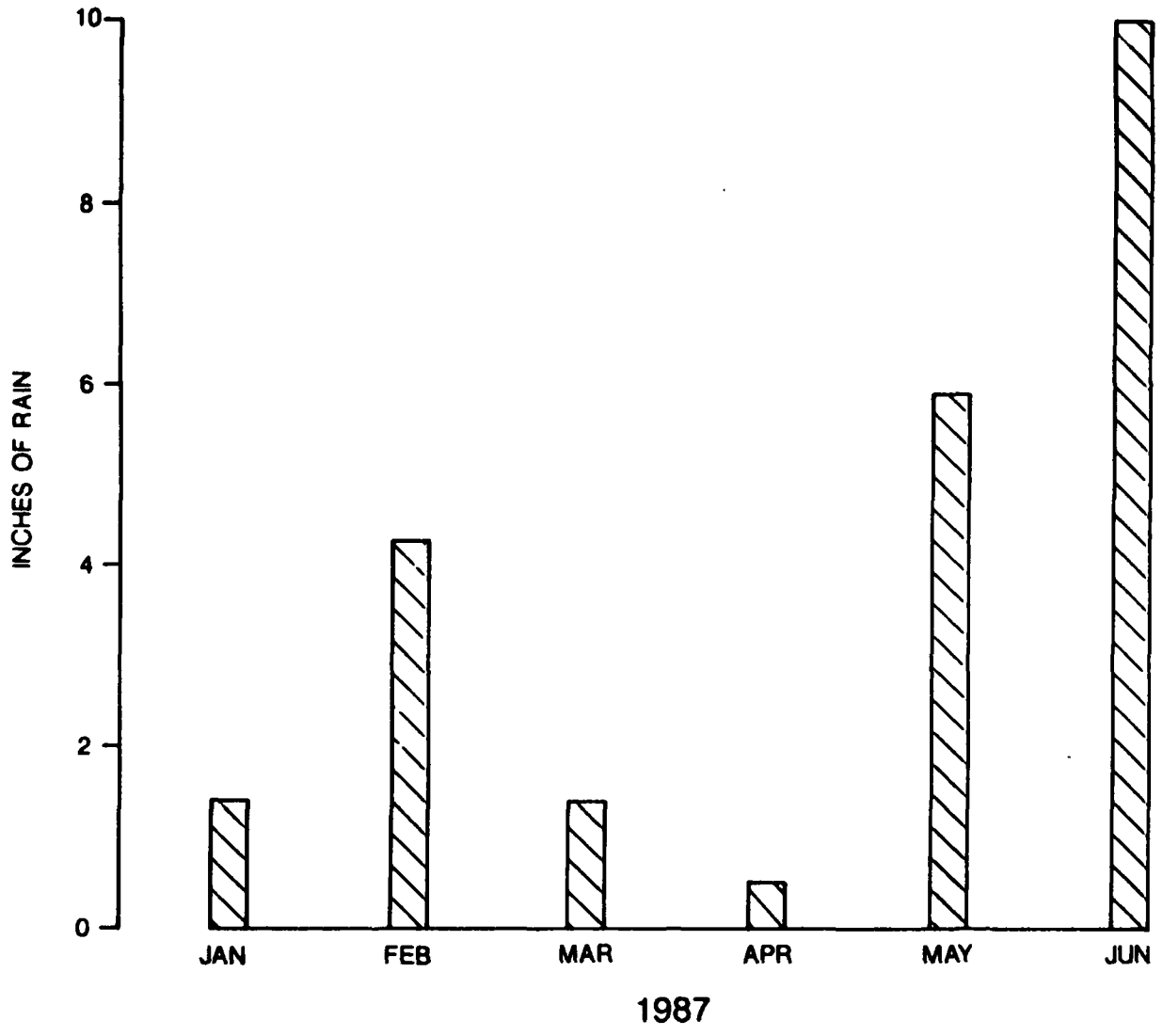
- ● MW-3
- ○ MW-6
- \+ MW-15
- □ MW-18
- △ MW-29

ERM-Southwest,
NEW ORLEANS, LOUISIANA HOUS

FIGURE 4-2

TOC AND TOX VALUES FOR THE UNCONFINED AQUIFER AS A FUNCTION O SHERIDAN DISPOSAL SERVICES SITE

W.O. NO. 91098022 9/27/88



NOTES:

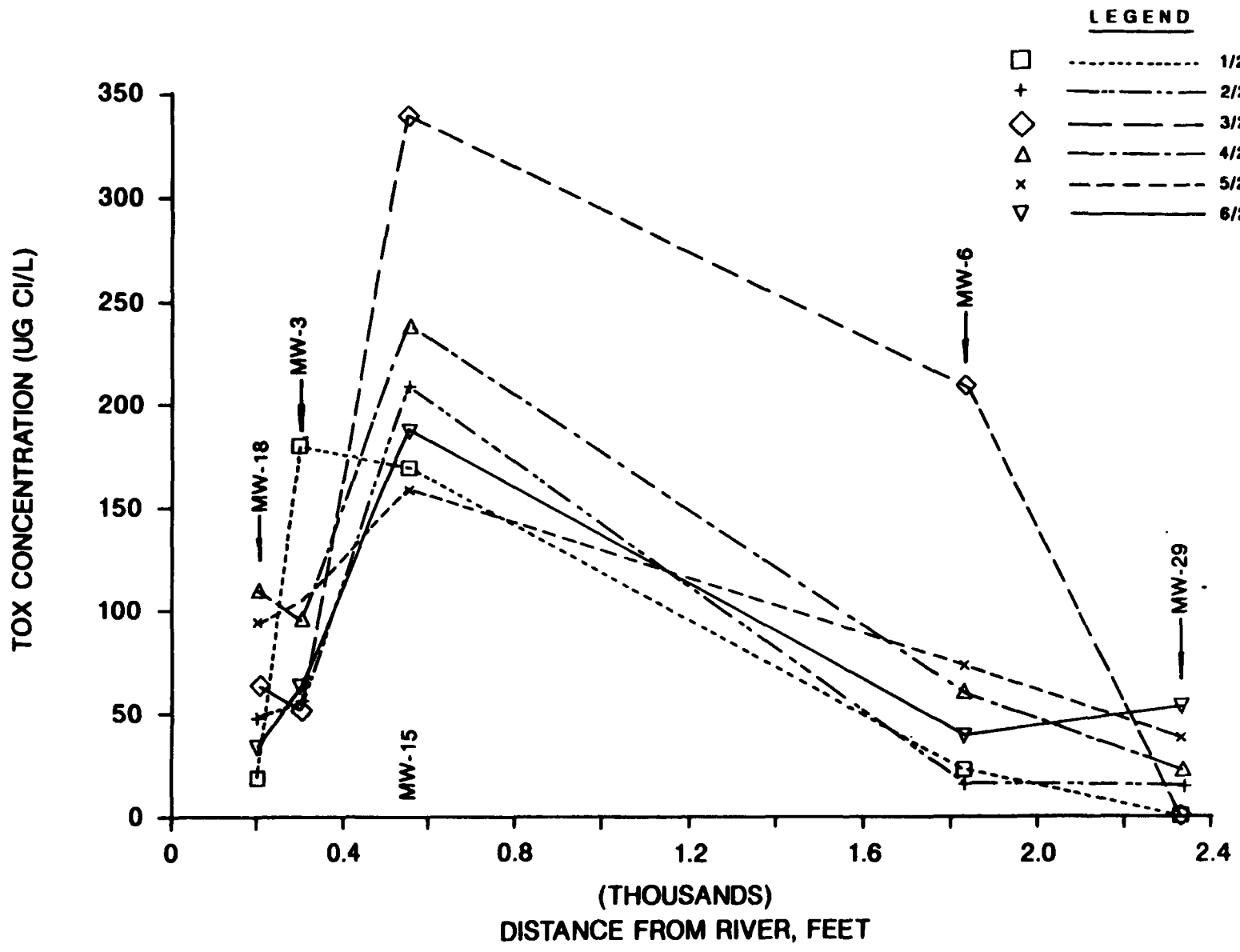
006139

1. DATA FROM MONTHLY CLIMATOLOGI DATA REPORTS FOR TEXAS; PUBLISHED BY NOAA.
2. DATA FOR THIS GRAPH WAS COMPILED AS THE GEOMETRIC MEAN OF VALUES FROM THE FOLLOWING STATIONS NEAR HEMPSTEAD, TEXAS :
   - BREHNAM
   - SEALY
   - SOMERVILLE DAM
   - WASHINGTON STATE PARK

ERM-Southwest, inc.
NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

DATE	9/27/88	W.O.NO.	9109A021

FIGURE 4-3
MONTHLY PRECIPITATION NEAR HEMPSTEAD, TX.,
DURING JANUARY THROUGH JUNE, 1987
SHERIDAN DISPOSAL SERVICES SITE



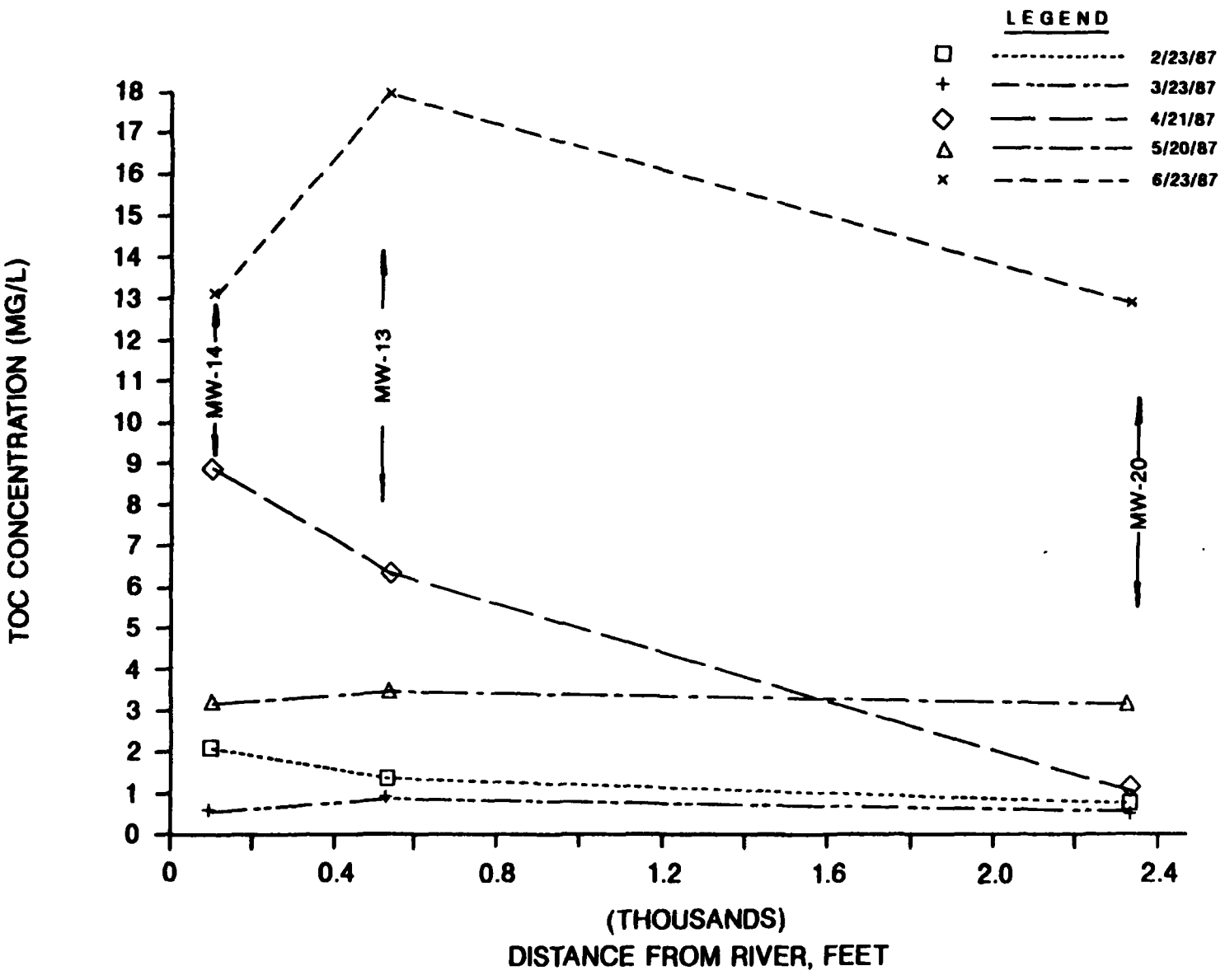
018612

4-19

ERM-Southwest, Inc.
NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

DATE 4/28/88 W.O.NO. 9109A10

FIGURE 4-4
TOX VALUES IN THE UNCONFINED AQUIFER FROM
JANUARY THROUGH JUNE, 1987
SHERIDAN DISPOSAL SERVICES SITE
HEMPSTEAD, TEXAS



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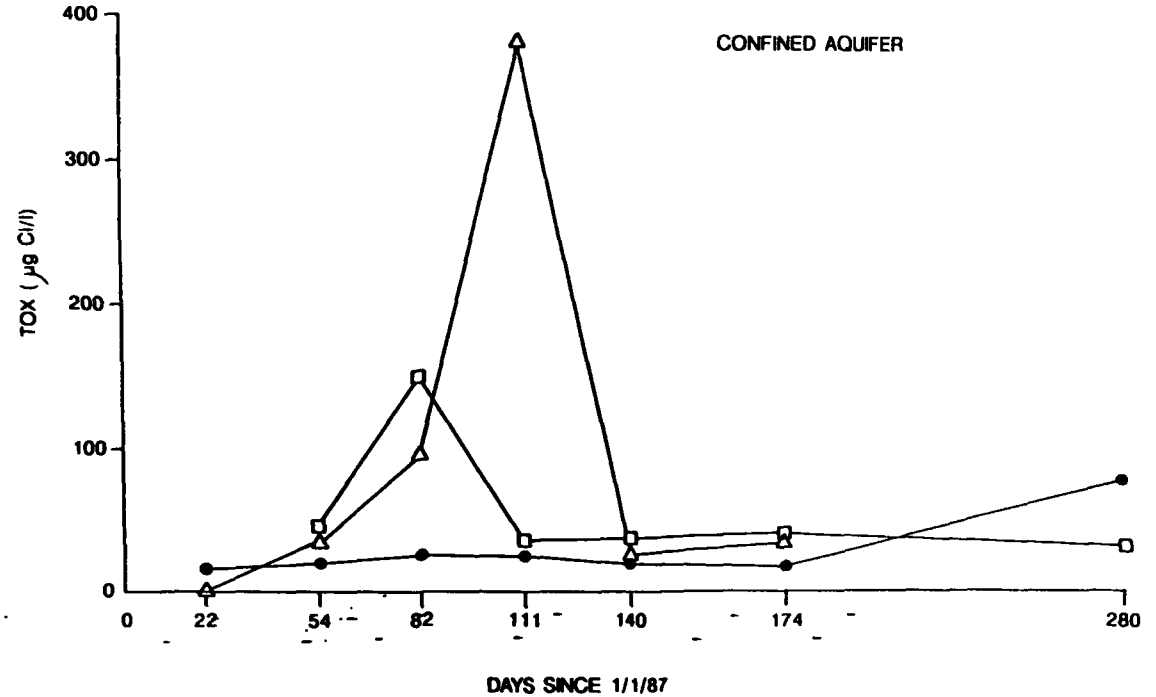
4-20

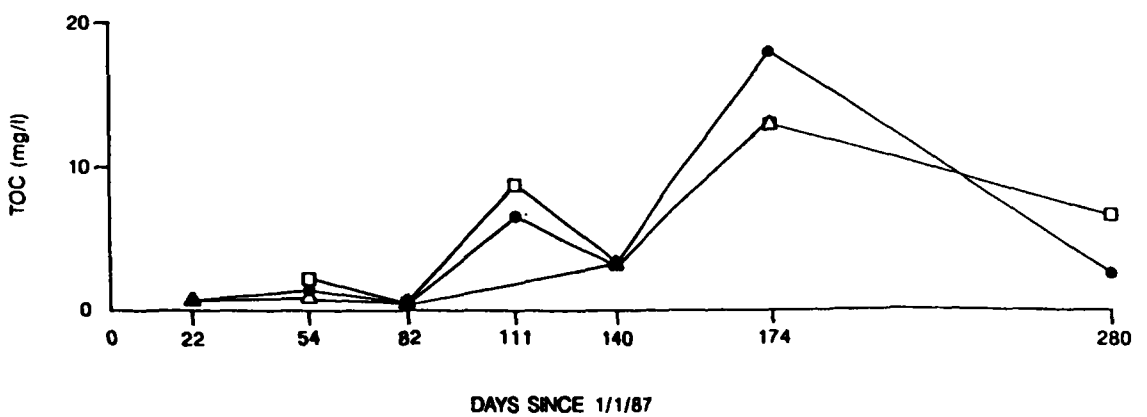
ERM-Southwest, inc.
NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

DATE 4/28/88 W.O.NO. 9109A11

FIGURE 4-5
TOC VALUES IN THE CONFINED AQUIFER FROM
JANUARY THROUGH JUNE, 1987
SHERIDAN DISPOSAL SERVICES SITE
HEMPSTEAD, TEXAS

018614





NOTES:

1. SAMPLING DATES ARE FOR THE SIX-MONTH II PARAMETER STUDY, PLUS VALUES FROM THE OCTC 1987 SAMPLING EVENT, AS APPROPRIATE.

2.

SAMPLING DATES	DAYS
1/22/87	22
2/23/87	54
3/23/87	82
4/21/87	111
5/20/87	140
6/23/87	174
10/87	280

000142

KEY

- ● MW-13
- □ MW-14
- △ MW-20

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FIGURE 4-6

TOC AND TOX VALUES FOR TH
CONFINED AQUIFER AS A FUNCTION
SHERIDAN DISPOSAL SERVICES

W.O. NO	9109B023	9/27.

TOX concentrations in the confined aquifer have less distinct patterns; values tend to remain constant or increase slightly away from the river (Figure 4-7). Values were elevated at MW-14 and MW-20 during March, but were low at that time at MW-13, a well that is closest to the disposal facilities compared to the other two (Figure 3-6). In April the TOX value at MW-20 increased over 3 times compared to any previous reading; no reasonable explanation can be found for this anomalous data point.

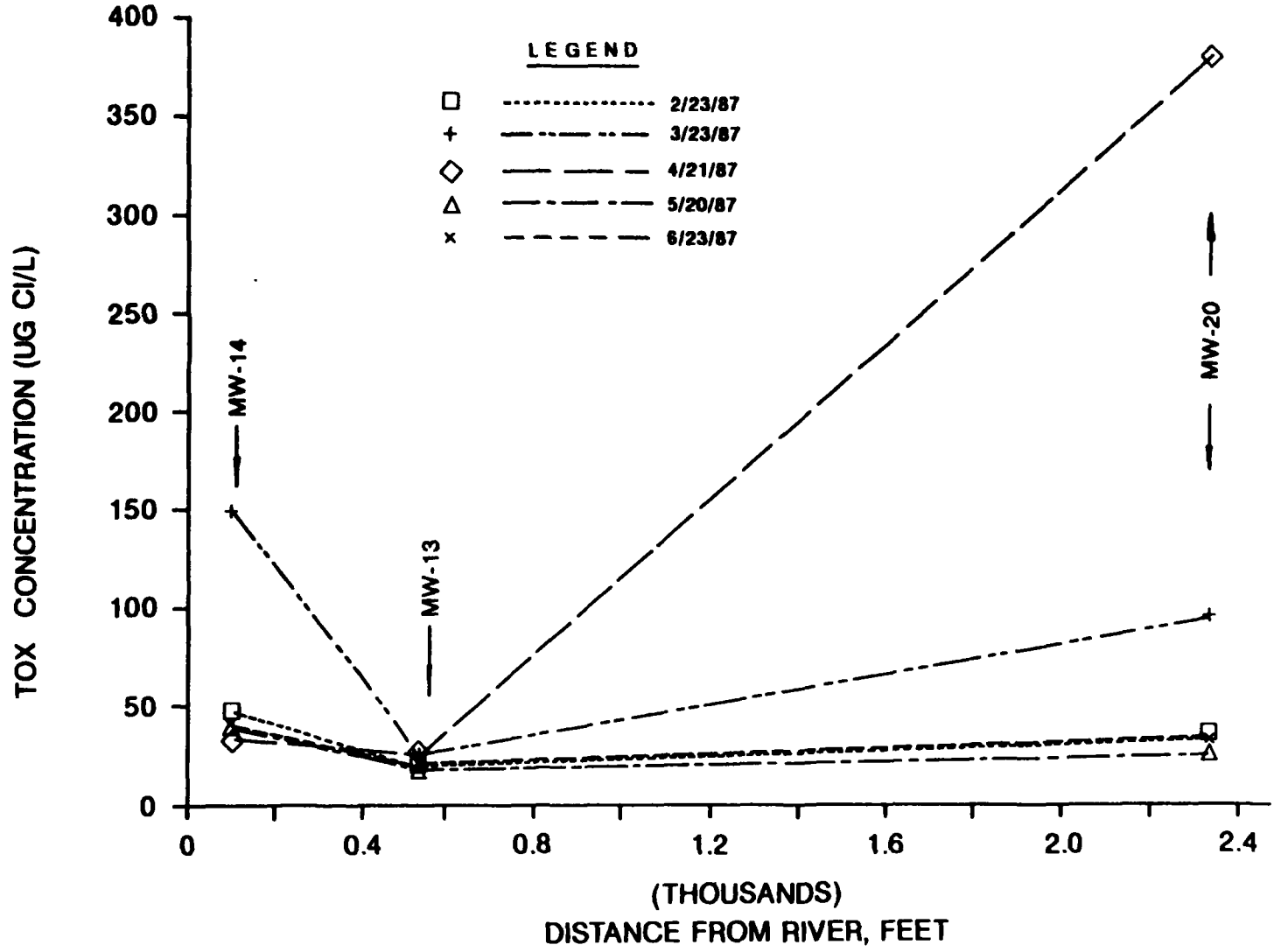
4.2.3 Priority Pollutant Sampling Events

As part of the Source Control RI, six monitoring wells were sampled for volatile and semi-volatile priority pollutant organic compounds. Three wells (MW-3, MW-6 and MW-16) screened in the unconfined aquifer were sampled. Results shown in Table 4-8 indicate that no compounds were above detection limits in either MW-6 and MW-16. In MW-3, low levels of trihalomethanes were detected (11-63 ppb), as was chloroform (60 ppb) and isophorone (30 ppb).

Three wells were also sampled in the confined aquifer (MW-2, MW-7 and MW-14) and analyzed for volatile and semi-volatile priority pollutant organic compounds. Compounds that were identified during analysis are probably laboratory contaminants (Table 4-8). Complete analytical reports for both aquifers are found in Appendix K.

The above data have been used qualitatively only, due to poor quality control, different sampling dates, and the lack of analyses for other constituents such as PCBs and metals. These data indicate that constituents from site activities are present in the shallow unconfined aquifer. No constituents were found in the deeper, confined aquifer.

In October 1987, twenty monitor wells around the SDS site were sampled for Priority Pollutant constituents, TOC, TOX, phenolics, and the field parameters of pH and specific conductivity. These include monitor wells 30 through 40, installed in 1987 for the GWRI, and wells 10, 12, 6, 18, 19, 29, 7, 13 and 14, installed during 1984-1985 for the SCRI. Before the sampling was begun, monitor wells installed before 1987 were redeveloped using air lift and/or submersible pump techniques to reduce turbidity that was present in some of the wells. Further details of well development are presented in Appendix A. Procedures for the removal of water and its disposal were discussed in Section 3.4. Details of water sampling procedures are in Appendix L.



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DATE 4/28/88 W.O.NO. 9109A12

FIGURE 4-7
TOX VALUES IN THE CONFINED AQUIFER FROM
JANUARY THROUGH JUNE, 1987
SHERIDAN DISPOSAL SERVICES SITE
HEMPSTEAD, TEXAS

F793

TABLE 4-8

Results of Priority Pollutant GC/MS
Analyses for the Source Control RI
Sheridan Disposal Services Site

Well Number:		MW-3	MW-6	MW-16	MW-2	MW-7	MW-14
Date Sampled		6/29/84	6/29/84	6/29/84	6/29/84	6/29/88	12/19/85
Aquifer		Unconfined	Unconfined	Unconfined	Confined	Confined	Confined
Parameter	Units						
Volatiles							
Chlorodibromomethane	ppb	11	ND	ND	ND	ND	ND
Chloroform	ppb	60	ND	ND	ND	ND	ND
Dichlorobromomethane	ppb	63	ND	ND	ND	ND	ND
Methylene Chloride	ppb	ND	ND	ND	BMDL (<10)	ND	5.2[1]
1,1,1-Trichloroethane	ppb	11	ND	ND	ND	ND	ND
Acid Extractable Fraction	ppb	ND	ND	ND	ND	ND	ND
Base/Neutral Extractable Fraction							
Bis (2-Ethylhexyl) Phthalate	ppb	BMDL (<10)	BMDL (<10)	BMDL (<10)	ND	10 [1]	ND
Isophorane	ppb	30	ND	BMDL (<10)	ND	ND	ND

NOTES:

ND = Not Detected.

BMDL = Tentatively identified at concentrations below method detection limits.

[1] = False positive results since laboratory blank sample analyzed positive for these compounds.

018617

Analytical results of the October 1987 sampling for the unconfined aquifer are presented in Table 4-9 (complete analytical results are in Appendix L). For all wells sampled in the unconfined aquifer no compounds were detected in the base/neutral, acid extractable group, the pesticide/PCB group or in the cyanide group. Phenolics concentrations were generally below detection limits (0.01 ppm), but increased to 0.04 ppm at MW-34. Total organic carbon (TOC) values ranged from 3.2 ppm at MW-12 (upgradient of site facilities) to 42 ppm at MW-34. Total organic halogen (TOX) values varied from 0.017 ppm at MW-10 (upgradient) and MW-6 (downgradient) to 1.1 ppm at MW-37. pH values were generally around background levels for all wells sampled. Specific conductance varied from approximately 875-1020 umhos/cm for background values to a maximum 2750 umhos/cm at MW-32.

Trace concentrations of dissolved metals were detected in several of the wells. These trace concentrations are probably due to natural variations as well as site activities. Constituent levels, however, are at or below their respective Maximum Contaminant Levels (MCLs) as listed in Table 4-2.

Four compounds were identified in the volatile fraction in levels above detection limits: benzene, tetrachloroethylene, trans-1,2-dichloroethene, and trichloroethene. These constituents were found in only three monitor wells, MW-34, MW-37 and MW-38. MW-34 and MW-37 are located north of the main pond, and MW-38 is found along the northeastern edge of the main pond on the inside of the dike (see Figure 3-6 for well locations). Concentrations ranged from just above detection limits (0.0052 ppm) to a maximum of 0.027 ppm for benzene in MW-34. No constituents were detected in MW-36, even though compounds were detected in wells immediately adjacent to MW-36 (MW-34 and MW-37). This may be attributed to spatial variability in porosity and permeability of the shallow aquifer, stratum B.

For the confined aquifer, analytical results from October 1987 are shown in Table 4-10. pH and specific conductance tended to be close to or below background values. The concentration of phenolics was slightly elevated in MW-30, but was at or below detection limits in all other wells. Total organic carbon values range from 1.2 to 25 ppm, while total organic halogens varied from 0.017 to 0.086 ppm over the site. However, priority pollutant analyses showed that no constituents were detected in any of these wells for the volatile, base/neutral, acid extractable, or pesticide/PCB fractions. As above, trace amounts of metals were detected in all wells sampled. These trace levels are attributed to natural background levels.

D133

TABLE 4-6

Historical Water Quality Parameters for MW-4, 5 and 8 [a]
Sheridan Disposal Services Site

Parameter (mg/l or as noted)	MW-4										
	1/7/72	1/28/72	2/4/72	2/28/72	3/24/72	3/30/72	5/4/72	5/17/72	5/18/72	6/22/72	8/21/72
pH (S.U.)	7.5	7.0	7.0	7.0	7.1	7.0	-	7.5	7.1	7.0	7.1
Total Dissolved Solids	640	1330	940	1140	632	820	940	947	-	-	739
Specific Conductivity (umhos/cm)	1076	-	5800	-	1250	-	-	-	1200	3225	1260
Hardness	469	-	540	-	488	-	-	500	-	-	468
Total Alkalinity	288	350	352	380	364	366	-	370	350	348	348
Chloride (Cl)	175	261	213	239	167	-	177	201	177	205	-
Sulfate (SO4)	45	-	37	-	39	26	39	-	37	26	30
Chemical Oxygen Demand	-	19	-	16	39	6.7	20	-	36	39	28

Parameter (mg/l or as noted)	9/15/72	10/6/72	3/2/73	5/7/74	8/13/74	10/24/74	11/20/74	12/14/78	4/27/79	4/5/84	4/20/84
pH (S.U.)	7.2	7.2	7.1	7.2	6.8	7.2	7.0	7.3	7.2	6.9	7.9
Total Dissolved Solids	944	1044	-	-	841	1131	1145	981	1416	-	-
Specific Conductivity (umhos/cm)	1260	1260	1400	1350	2000	1000	-	1300	1700	-	1328
Hardness	315	488	656	-	-	-	-	415	708	-	321
Total Alkalinity	348	350	346	360	450	550	460	340	336	-	-
Chloride (Cl)	195	192	1060	240	-	-	-	240	305	212	200
Sulfate (SO4)	39	37	-	50	-	-	55	47	48	15	5
Chemical Oxygen Demand	35	28	56	44	32	53	59	-	-	-	-

- Not Analyzed

[a] All data from July 1986 Draft of Source Control R.I.

018604

D133

TABLE 4-6 (Cont'd)

Historical Water Quality Parameters for MW-4, 5 and 8 [a]
Sheridan Disposal Services Site

Parameter (mg/l or as noted)	MW-5									
	6/3/63	12/8/65	10/10/68	7/3/68	2/18/70	6/10/70	4/5/84	4/20/84	7/2/84	7/20/84
(, U.)	7.3	7.3	7.3	7.1	7.7	7.7	7.8	8.0	7.0	6.8
Total Dissolved Solids	-	-	-	-	-	-	-	-	-	-
Specific Conductivity (umhos/cm)	870	925	-	-	1793	1782	-	1310	1100	1060
Hardness	-	338	-	425	525	560	196	241	-	-
Total Alkalinity	324	336	275	-	410	358				-
Chloride (Cl)	-	-	-	-	-	-	-	-	-	-
Sulfate (SO4)	-	-	-	-	-	-	-	-	-	-
Chemical Oxygen Demand	-	-	30	-	95	95	-	-	-	-

- Not Analyzed

[a] All data from July 1988 Draft of Source Control R.I.

018605

TABLE 4-6 (Cont'd)

Historical Water Quality Parameters for MW-4, 5 and 8 [a]
Sheridan Disposal Services Site

Parameter (mg/l or as noted)	MW-8									
	1/28/72	2/8/72	2/28/72	3/10/72	3/24/72	3/30/72	5/4/72	5/5/72	5/18/72	6/22/72
pH (S.U.)	7.0	7.2	7.0	7.2	7.3	7.0	7.5	-	7.1	7.3
Total Dissolved Solids	500	440	526	431	437	533	553	540	0	-
Specific Conductivity (umhos/cm)	-	3375	-	-	840	-	-	-	810	3030
Hardness	-	316	-	316	352	-	354	314	-	-
Total Alkalinity	306	322	343	322	330	320	320	-	314	-
Chloride (Cl)	57	52	46	55	68	92	87	76	76	80
Sulfate (SO4)	-	15	-	13	25	29	10	22	26	18
Chemical Oxygen Demand	1.6	-	2.5	-	16	<1	2.9	-	<10	12

Parameter (mg/l or as noted)	10/6/72	3/2/73	5/7/74	5/8/74	8/13/74	9/4/74	10/29/74	11/21/74	4/5/84	4/20/84
pH (S.U.)	7.4	7.0	7.2	-	6.8	6.9	7.2	7.2	7.3	7.6
Total Dissolved Solids	735	-	-	-	-	500	528	507	-	-
Specific Conductivity (umhos/cm)	1200	875	840	-	800	860	2000	2200	-	794
Hardness	328	-	-	375	-	-	-	-	-	-
Total Alkalinity	324	333	342	-	500	50	350	380	-	-
Chloride (Cl)	85	-	-	72	-	-	-	55	65	77
Sulfate (SO4)	21	-	-	17	-	-	-	-	5	5
Chemical Oxygen Demand	-	36	21	-	9	24	19	17	-	-

- Not Analyzed

[a] All data from July 1986 Draft of Source Control R I

018606

4.2.2 Six-Month Indicator Parameter Study: 1987

As part of the GWRI, water samples from selected wells were collected during the first six months of 1987 and were analyzed for the following parameters: pH, specific conductivity, total organic carbon (TOC) and total organic halogens (TOX). The purpose of this study was to collect more information concerning the significance of seasonal variations in ground water quality, to see if any contaminant plume(s) could be identified around the facility and aid in placement of 11 additional monitor wells installed for the GWRI. A summary of analytical results is shown in Table 4-7 (raw TOC and TOX data are provided in Appendix J).

For the unconfined aquifer, monitor wells 3,6,15,18 and 29 were selected for this study. TOC data were plotted as a function of distance from the river bank to see if there were any spatial trends across the site (Figure 4-1). In general, TOC increases from MW-18 to MW-3, decreases slightly at MW-15, and then decreases more substantially across the site toward the south. A graph of the same data, plotted versus time, show TOC values are fairly constant through time, except for an increase in June (Figure 4-2). The June values might be due to heavy rains that occurred between late May and June (Figure 4-3) that "flushed" organic constituents into the aquifer, or else the rise of the Brazos River, and change in flow direction had some effect on values. No TOC (or TOX) data are available for the river. Heavy rains in March, with an associated rise in river level, did not increase TOC values. This may be due to the fact that the amount of rain in June was 2 to 3 times as much as was recorded in February and March.

TOX values in the unconfined aquifer show similar trends to the TOC data in that TOX increases from MW-18 to MW-3 to MW-15, and then decreases away from the river (Figure 4-4). In March a large peak occurs at MW-15 and MW-6, instead of in June (Figure 4-2). All of the TOX data for June show no increase over the other data. River stage may have something to do with this phenomenon, but it is unusual that TOC would be elevated for one time period and TOX for another.

Three monitor wells screened in the deeper aquifer were sampled for the TOC/TOX study: MW-14, MW-13 and MW-20. Trends are not quite as distinctive in this zone, but TOC also decreases away from the river. (Figure 4-5). Again, TOC values from the June sampling are elevated for all three wells (Figure 4-6). Note that overall TOC in the confined aquifer is much lower than in the unconfined aquifer.

TABLE 4-7

Summary of Six-Month Indicator Parameter Study

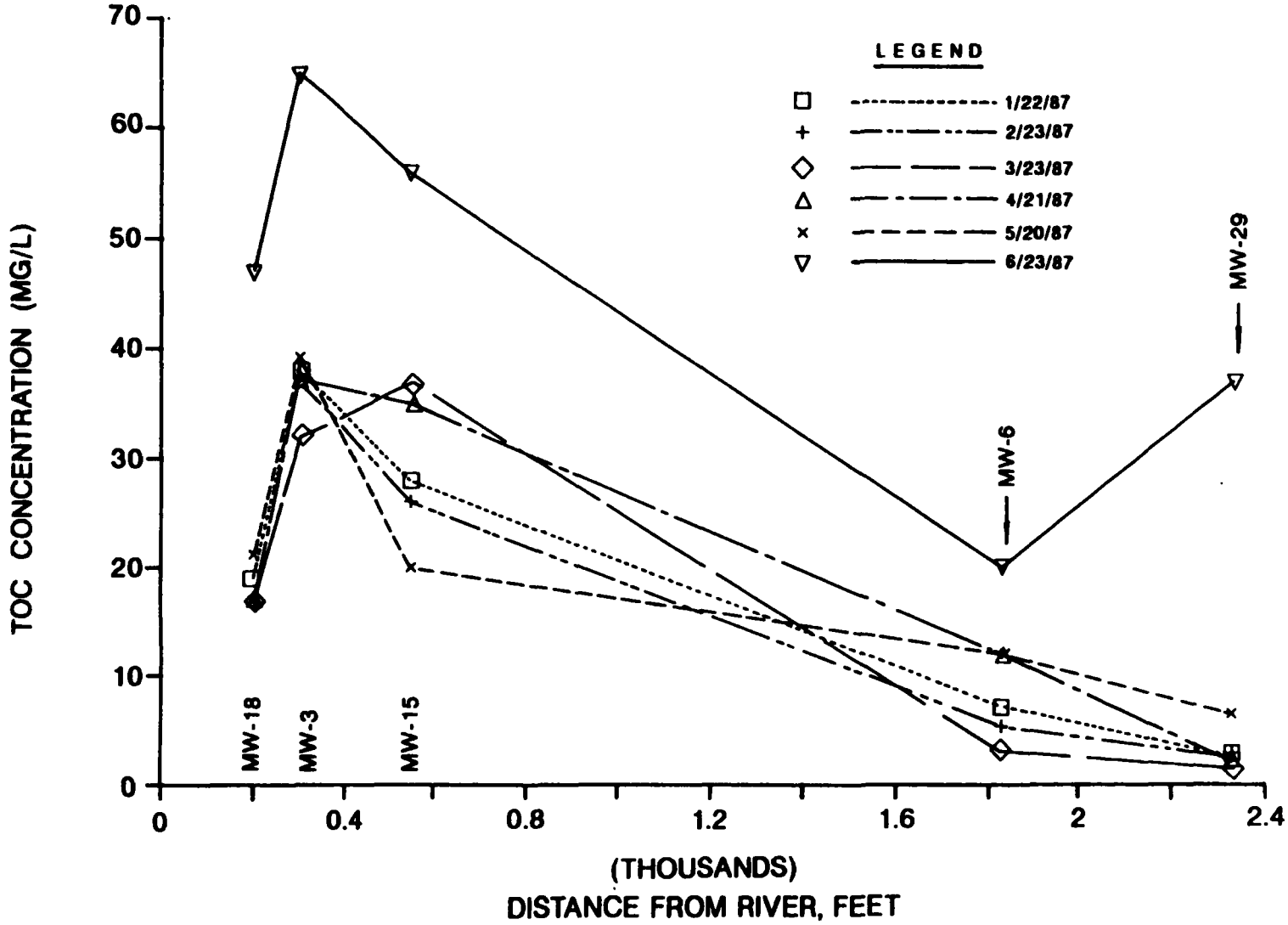
Sheridan Disposal Services Site
Hempstead, Texas

Sampling Date		MW-3	MW-6	MW-13	MW-14	MW-15	MW-18	MW-20	MW-29	FIELD BLANK	TRIP BLANK
1/22-23/87	pH (a)	6.87/6.99	6.70/6.88	7.30/7.26	NA	7.00/7.07	6.88/6.89	6.92/7.01	6.51/6.56	NA	NA
	SC (a)	2440/2510	1060/1080	875/880	NA	1820/1870	2000/1970	740/750	925/910	NA	NA
	TOC (mg/l) (b)	38(0.1)	7.2(0.1)	0.5(0.1)	NA	28(0.1)	19(0.1)	0.7(0.1)	2.5(0.1)	0.3(0.1)	NA
	TOX (ug Cl/l) (b)	180(5)	23(5)	16(5)	NA	170(5)	19(5)	ND(5)	ND(5)	ND(5)	NA
2/23/87	pH (a)	6.39/6.32	6.69/6.72	7.20/7.15	7.23/7.27	6.59/6.65	6.52/6.52	6.72/6.65	6.47/6.51	NA	NA
	SC (a)	1895/1895	1140/1133	810/802	768/772	1775/1740	1785/1765	778/762	958/956	NA	NA
	TOC (mg/l) (b)	37(0.11)	5.3(0.1)	(1.4)(0.1)	2.1(0.1)	26(0.1)	17(0.1)	0.8(0.1)	2.5(0.1)	0.5(0.1)	0.3(0.1)
	TOX (ug Cl/l) (b)	56(5)	17(5)	20(5)	48(5)	210(5)	49(5)	34(5)	16(5)	45(15) (c)	ND(15) (c)
3/23/87	pH (a)	6.83/6.76	6.82/6.76	6.95/6.95	7.12/7.15	6.50/6.50	6.62/6.70	6.77/7.15	6.96/6.96	NA	NA
	SC (a)	2360/2320	1120/1127	776/780	744/737	1991/1980	1918/1909	787/768	1014/1006	NA	NA
	TOC (mg/l) (b)	32(0.1)	3(0.1)	0.9(0.1)	0.6(0.1)	37(0.1)	17(0.1)	0.6(0.1)	1.5(0.1)	0.4(0.1)	0.4(0.1)
	TOX (ug Cl/l) (b)	52(5)	210(5)	26(5)	150(5)	340(5)	64(5)	95(5)	ND(5)	ND(10)	ND(5)
4/21/87	pH (a)	6.35/6.30	6.85/6.75	6.90/6.85	7.0/7.0	6.40/6.40	6.65/6.65	7.05/7.00	6.85/6.85	NA	NA
	SC (a)	2390/2360	1155/1137	770/770	742/738	1750/1750	1935/1925	715/716	933/932	NA	NA
	TOC (mg/l) (b)	37(0.1)	12(0.1)	6.4(0.1)	8.9(0.1)	35(0.1)	17(0.1)	1.1(0.1)	2.1(0.1)	0.2(0.1)	0.6(0.1)
	TOX (ug Cl/l) (b)	95(5)	61(5)	25(5)	34(5)	240(5)	110(5)	380(5)	23(5)	5(5)	10(5)
	Turbidity (NTU) (d)	52(0.1)	49(0.1)	NA	NA	NA	40(0.1)	NA	220(0.1)	NA	NA
5/20/87	pH (a)	6.64/6.59	6.86/6.81	7.25/7.20	7.38/7.20	6.64/6.65	6.46/6.40	7.23/7.25	6.82/6.77	NA	NA
	SC (a)	1800/1790	890/900	680/690	610/600	1250/1250	1750/1750	610/610	820/820	NA	NA
	TOC (mg/l) (b)	39(0.1)	12(0.1)	3.5(0.1)	3.2(0.1)	20(0.1)	21(0.1)	3.2(0.1)	6.4(0.1)	ND(0.1)	ND(0.1)
	TOX (ug Cl/l) (b)	105(5)	74(5)	20(5)	39(5)	160(5)	94(5)	26(5)	39(5)	6(5)	ND(5)
6/23/87	pH (a)	7.0/7.0	6.70/6.75	6.95/6.85	7.05/7.15	6.74/6.75	7.0/7.0	7.0/6.95	7.0/6.95	NA	NA
	SC (a)	1880/1840	962/977	962/688	660/649	1419/1410	1670/1673	645/651	842/847	NA	NA
	TOC (mg/l) (b)	65(0.5)	20(0.5)	18(0.5)	13(0.5)	56(0.5)	47(0.5)	13(0.5)	37(0.5)	1.2(0.5)	1.5(0.5)
	TOX (ug Cl/l) (b)	63(5)	40(5)	19(5)	40(5)	190(5)	34(5)	35(5)	54(5)	35(5)	13(5)

Notes: (a) pH and SC results are from field measurements. Duplicate test results are provided.
(b) RMAL Detection Limits for TOC and TOX are given in parentheses.
(c) The field and trip blanks were re-analyzed for TOX. The second set of results is reported here.
(d) Nephelometric Turbidity Units; detection limits given in parentheses.

NA = Not Analyzed
ND = Not Detected or Below Detection Limits

018608



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NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

DATE 4/28/88 W.O.NO. 9109A09

FIGURE 4-1
TOC VALUES IN THE UNCONFINED AQUIFER
FROM JANUARY THROUGH JUNE, 1987
SHERIDAN DISPOSAL SERVICES SITE
HEMPSTEAD, TEXAS

H654

TABLE 4-9
(Page 1 of 2)

Results of Ground Water Sampling
for Wells Screened in Unconfined Aquifer, October, 1987

Sheridan Disposal Services

RMAL #64874-			005	013	004	021	002	001	014	015
Well Number			MW-10	MW-12	MW-6	MW-18	MW-19	MW-29	MW-31	MW-32
Date Sampled			10/27/87	10/28/87	10/27/87	10/29/87	10/27/87	10/27/87	10/28/87	10/28/87
Constituents	Number of Compounds	Units	Upgradient	Upgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient
VOLATILE ORGANICS	27									
Benzene		ppb	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Tetrachloroethene		ppb	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
trans-1,2-Dichloroethene		ppb	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Trichloroethene		ppb	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
BASE/NEUTRAL/ACID EXTRACTABLE ORGANICS	55	ppb	ND	ND	ND	ND	ND	ND	ND	ND
PESTICIDES/PCBs	26	ppb	ND	ND	ND	ND	ND	ND	ND	ND
METALS (FILTERED)	13									
Arsenic		ppm	ND(0.003)	ND(0.003)	0.007(0.003)	ND(0.05)	ND(0.003)	0.005(0.003)	0.006(0.003)	ND(0.003)
Copper		ppm	ND(0.006)	0.012(0.006)	ND(0.006)	ND(0.006)	ND(0.006)	ND(0.006)	ND(0.006)	ND(0.006)
Selenium		ppm	ND(0.004)	ND(0.004)	ND(0.002)	ND(0.004)	ND(0.004)	ND(0.004)	ND(0.004)	ND(0.002)
Zinc		ppm	0.04(0.01)	0.06(0.01)	0.05(0.01)	0.07(0.01)	0.06(0.01)	0.02(0.01)	0.07(0.01)	0.05(0.01)
OTHER INORGANIC PARAMETERS										
Total Organic Carbon		ppm	4.7(0.1)	3.2(0.1)	3.8(0.1)	23 (0.1)	2.7(0.1)	2.5(0.1)	15(0.1)	16(0.1)
Total Organic Halogens		ugCl/L	17(5)	22(5)	17(5)	79(5)	36(5)	23(5)	120(5)	230(5)
Total Cyanide		ppm	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(.01)	ND(.01)	ND(0.01)	ND(0.01)
Phenolics		ppm	ND(0.01)	ND(0.01)	ND(0.01)	0.01(0.01)	ND(.01)	ND(.01)	ND(0.01)	ND(0.01)
FIELD MEASUREMENTS										
pH		S.U.	6.51/6.50	6.94/6.98	6.82/6.70	6.80/6.82	6.51/6.55	6.88/6.89	6.72/6.66	6.46/6.43
Specific Conductivity		umhos/cm	883/876	1018/1022	1061/1050	1918/1922	1058/1044	839/840	1376/1326	2760/2730
Temperature		C	22	21	22.5	21.5	22	22.5	23	22.5

Notes
ND = Not Detected
Detection Limits in Parentheses

018619

Hb54

TABLE 4-9 (Continued)
(Page 2 of 2)

Results of Ground Water Sampling
for Wells Screened in Unconfined Aquifer, October, 1987

Sheridan Disposal Services

018620

RMAL #64874-			020	017	018	024	012	008	022	003
Well Number			MW-34	MW-36	MW-37	MW-38	MW-39	MW-39	Field Blank	Trip Blank
Date Sampled			10/29/87	10/29/87	10/29/87	10/30/87	10/28/87	10/28/87	10/30/87	10/27/87
Constituents	Number of Compounds	Units	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Duplicate 1	Duplicate 3	
VOLATILE ORGANICS	27									
Benzene		ppb	27(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Tetrachloroethene		ppb	ND(5)	ND(5)	13(5)	21(5)	ND(5)	ND(5)	ND(5)	ND(5)
trans-1,2-Dichloroethene		ppb	25(5)	ND(5)	5.2(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
Trichloroethene		ppb	15(5)	ND(5)	ND(5)	13(5)	ND(5)	ND(5)	ND(5)	ND(5)
BASE/NEUTRAL/ACID EXTRACTABLE ORGANICS	55	ppb	ND	ND	ND	ND	ND	ND	ND	ND
PESTICIDES/PCBs	26	ppb	ND	ND	ND	ND	ND	ND	ND	ND
METALS (FILTERED)	13									
Arsenic		ppm	ND(0.003)	ND(0 003)	ND(0.003)	ND(0.003)	0 043(0.003)	0.048(0.003)	ND(0.003)	ND(0.003)
Copper		ppm	ND(0.006)	ND(0 006)	ND(0.006)	0.006(0.006)	ND(0 006)	ND(0.006)	0.026(0.006)	ND(0.006)
Selenium		ppm	ND(0.002)	0 010(0.004)	ND(0.004)	ND(0.004)	ND(0.004)	ND(0.004)	ND(0.002)	ND(0.002)
Zinc		ppm	0.06(0.01)	0.07(0.01)	0.04(0.01)	0 11(0.01)	0.04(0.01)	0.02(0.01)	0.03(0.01)	ND(0.01)
OTHER INORGANIC PARAMETERS										
Total Organic Carbon		ppm	42(0.1)	7.2(0.1)	16(0 1)	28(0.1)	39(0.1)	35(0.1)	0.7(0.1)	0 5(0 1)
Total Organic Halogens		ugCl/L	160(5)	20(5)	1100(5)	320(5)	310(5)	310(5)	7(5)	13(5)
Total Cyanide		ppm	ND(0 01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0 01)	ND(0.01)	ND(0.01)	ND(0.01)
Phenolics		ppm	0.04(0.01)	ND(0.01)	0.02(0.01)	ND(0.01)	0 01(0 01)	ND(0.01)	ND(0 01)	ND(0.01)
FIELD MEASUREMENTS										
pH		S U	6.79/6 78	6 51/6 40	6 70/6 62	6 91/6.83	6.77/6 64	---	---	---
Specific Conductivity		umhos/cm	1988/1996	1412/1405	1242/1235	1540/1530	1748/1755	---	---	---
Temperature		C	22	23	23	23	22	---	---	---

Notes:
ND = Not Detected
Detection Limits in Parentheses

TABLE 4-10

Results of Priority Pollutant Sampling, October 1987
for Wells Screened in Confined Aquifer

Sheridan Disposal Services

018621

RMAL #64874-			006	010	023	016	[illegible]	007	009	019	022	003
Well Number			MW-40	MW-7	MW-13	MW-14	MW-30	MW-33	MW-33	MW-35	Field Blank	Trip Blank
Date Sampled:			10/27/87	10/28/87	10/30/87	10/29/87	10/28/87	10/28/87	10/28/87	10/29/87	10/30/87	10/27/87
			Upgradient	Downgradient	Downgradient	Downgradient	Downgradient	Downgradient	Duplicate 2	Downgradient	Duplicate 3	
Constituents	Number of Compounds	Units										
VOLATILE ORGANICS	27	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BASE/NEUTRAL/ACID EXTRACTABLE ORGANICS	55	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PESTICIDES/PCBs	26	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
METALS (FILTERED)	13											
Arsenic		ppm	ND(0.003)	ND(0.003)	ND(0.003)	ND(0.003)	ND(0.003)	0.003(0.003)	ND(0.003)	ND(0.003)	ND(0.003)	ND(0.003)
Copper		ppm	ND(0.006)	ND(0.006)	ND(0.006)	ND(0.006)	0.01(0.006)	ND(0.006)	ND(0.006)	ND(0.006)	0.026(0.006)	ND(0.006)
Selenium		ppm	ND(0.004)	ND(0.004)	ND(0.002)	ND(0.002)	ND(0.004)	ND(0.002)	ND(0.002)	ND(0.002)	ND(0.002)	ND(0.002)
Zinc		ppm	0.04(0.01)	0.02(0.01)	0.06(0.01)	0.05(0.01)	0.04(0.01)	0.02(0.01)	0.04(0.01)	0.04(0.01)	0.03(0.01)	ND(0.01)
OTHER INORGANIC PARAMETERS												
Total Organic Carbon		ppm	1.2(0.1)	1.7(0.1)	2.6(0.1)	6.4(0.1)	25(0.1)	6.8(0.1)	3.0(0.1)	13(0.1)	0.7(0.1)	0.5(0.1)
Total Organic Halogens		ugCl/L	17(5)	72(5)	75(5)	31(5)	87(5)	80(5)	35(5)	86(5)	7(5)	13(5)
Total Cyanide		ppm	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)	ND(0.01)
Phenolics		ppm	ND(0.01)	0.01(0.01)	ND(0.01)	ND(0.01)	0.05(0.01)	ND(0.01)	ND(0.01)	0.01(0.01)	ND(0.01)	ND(0.01)
FIELD MEASUREMENTS												
pH		S.U.	7.10/7.07	7.37/7.25	7.16/7.15	7.22/7.06	6.81/6.78	6.94/6.88	---	7.27/7.20	---	---
Specific Conductivity		umhos/cm	730/731	710/706	721/722	682/682	609/603	677/674	---	679/674	---	---
Temperature		C	23.5	23	22	23	23	22	---	23	---	---

NOTES

ND = Not Detected
Detection Limits in Parentheses

5 - CONCLUSIONS

A Ground Water Migration Management Remedial Investigation report has been completed for the SDS site. Major conclusions reached in this report include:

1. There are two aquifers of concern under the SDS site. The shallow aquifer consists of the lower part of the Brazos River Alluvium and has been designated stratum B. This aquifer occurs under unconfined (water table) conditions. The deeper aquifer, referred to as stratum D, occurs under confined conditions at the site. Stratum B D is part of the Fleming Formation. In this area, the Fleming Formation is designated as a part of the Evangeline Aquifer. These two aquifers are separated by 20-30 feet of clay, designated as stratum C and geologically part of the Fleming Formation.

2. Within a three-mile radius downgradient of the site there are no known wells being used that are screened in the Brazos River Alluvium. There are several wells potentially screened in the same zone as the confined aquifer under the site (stratum D) that are regionally downgradient of the site. However, ground water flow direction for stratum D in the area immediately around the SDS site has been in the opposite direction of regional flow due to localized influences of the Brazos River.

3. Ground water flow direction in stratum B changes with river stage. In general, the water flows north or northwest toward the Brazos River. When the river reaches and surpasses approximately 140 feet MSL at the site, the ground water begins to flow south, into the aquifer, and then west away from the site. The direction changes back to the north/northwest soon after the river drops below 140 feet. On an annual basis the net movement of ground water is to the north. In stratum D, ground water flows to the northwest, toward the Brazos River, for the period of record (August 1987 through February 1988). During this time river stage has been relatively low (<135') and it is not known if this aquifer will change its flow direction when the river stage rises.

4. There is a difference in height (head) between the water elevations in the two aquifers. In general, for the period of record (November 1985 through February 1988), when the river stage is low, the confined aquifer (stratum D) has a higher head than the unconfined aquifer (stratum B) and the head potential is upward. When the river stage is high this trend is reversed. This situation is true at the site except away from the river at the well nest (See Figure 3-6). Here, head in the unconfined aquifer is higher than

in the confined aquifer during prolonged low river stage. The head in the confined aquifer is higher than in the unconfined aquifer at the well nest when the river stage is high or when it has been fluctuating around 135-140' and above. On an annual basis, the net head potential flow direction is upward everywhere at the site, greatly decreasing the potential for downward constituent migration under the site from stratum B to stratum D.

5. Pumping test data was used to analyze the potential hydraulic connection between strata B and D. Using the Hantush-Jacob method of curve matching, a hydraulic conductivity on the order of 10^{-4} cm/sec was calculated. This large amount of leakage, if coming from stratum B down through stratum C into stratum D during the pumping test, would probably cause some drawdown in the unconfined aquifer. A very small amount of decrease in the water level in stratum B was noted during the pumping test. Using this value as the amount of drawdown due to pumping, hydraulic conductivity of stratum C was calculated to be on the order of 10^{-7} cm/sec. This permeability corresponds with the clayey soil type which comprises stratum C. The remainder of the leakage must be coming from below stratum D, that is, through stratum E from below.

6. Results from the six-month indicator parameter study showed variable TOC and TOX concentrations in both time and space around the site. No definitive patterns or causal relationships could be tied to precipitation or river stage. Results from the October 1987 Priority Pollutant sampling show that low levels of some volatile constituents, no PCBs and some trace metals have been detected in the shallow unconfined aquifer (stratum B) in a limited area to the north and northwest of the main pond. In the confined aquifer (stratum D) no levels of constituents above background values were found at the site.

REFERENCES

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Hantush, M. S. and C. E. Jacobs, 1955, Nonsteady radial flow in an infinite leaky aquifer: American Geophysical Union Transactions, v. 36, no. 1, p. 95-100.

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1-11

GROUND WATER MIGRATION MANAGEMENT REMEDIAL INVESTIGATION

Sheridan Disposal Services Site
Hempstead, Texas

Volume II
Appendices A - E

ERM-Southwest, inc.

018627

GROUND WATER MIGRATION MANAGEMENT
REMEDIAL INVESTIGATION

Sheridan Disposal Services Site
Hempstead, Texas

Volume II
Appendices A - E

Prepared For:

The Sheridan Site Committee

W.O. #91-09

December 30, 1988

Prepared by:

ERM-SOUTHWEST, INC.
16000 Memorial Dr., Suite 200
Houston, Texas 77079
(713) 496-9600

H650

018628

APPENDIX A

Boring Logs, Symbols Used in Geologic Cross-Sections and Well Development Summary

018629

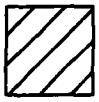
APPENDIX A

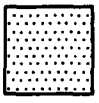
NOTE:

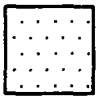
Graphic symbols are different for boring logs recorded by REI for the Source Control RI. However, the symbols have been changed in the cross-sections to be consistent with the symbols shown here, so, for example, a silty clay in one log has the same graphic symbol as a silty clay in another log.

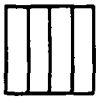
018630

1 SILTY

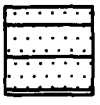
2  CLAYEY

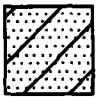
3  SAND

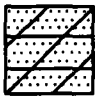
4  COARSE SAND

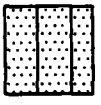
5  SILT

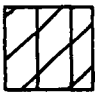
6 CLAY

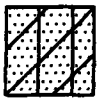
7  SILTY SAND

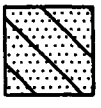
8  CLAYEY SAND

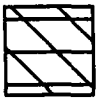
9  SILTY CLAYEY SAND

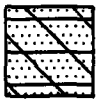
10  SANDY SILT

11  CLAYEY SILT

12  SANDY CLAYEY SILT

13  SANDY CLAY

14  SILTY CLAY

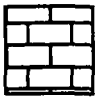
15  SANDY SILTY CLAY

16 FILL OR GROUND OR EARTH

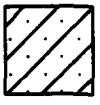
17 SHALE

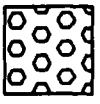
18 SILTSTONE

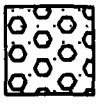
19 MUDSTONE OR CLAYSTONE

20  LIMESTONE

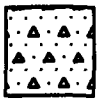
21 CONCRETE

22  SACCRETE

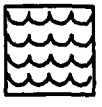
23  GRAVEL

24  SANDY GRAVEL OR GRAVELLY SAND

25 BENTONITE PLUG

26  GROUT

27 SLOT MARKINGS FOR MONITORING WELL SCREEN

28  PEAT

29 CUTTINGS

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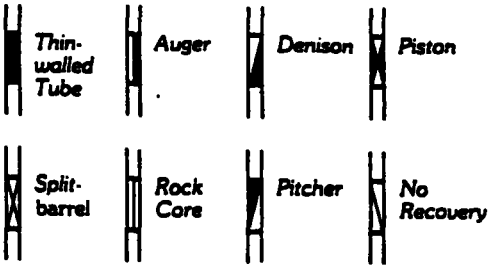
BORING LOG SYMBOLS

W.O.NO. STDA22

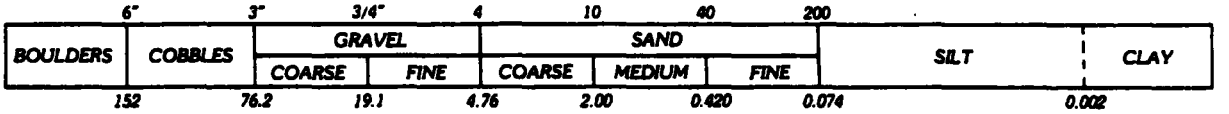
TERMS AND SYMBOLS USED ON BORING LOGS

SAMPLER TYPES



SOIL GRAIN SIZE

U.S. STANDARD SIEVE



SOIL GRAIN SIZE IN MILLIMETERS

STRENGTH OF COHESIVE SOILS [1]

Consistency	Undrained Shear Strength, Kips Per Sq Ft
Very Soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very Stiff	2.00 to 4.00
Hard	greater than 4.00

DENSITY OF GRANULAR SOILS [2,3]

Descriptive Term	*Relative Density, %
Very Loose	less than 15
Loose	15 to 35
Medium Dense	35 to 65
Dense	65 to 85
Very Dense	greater than 85

*Estimated from sampler driving record

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows Per Foot	Description
25	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows drove sampler 3 inches during initial 6-inch seating interval.

Note : To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

SOIL STRUCTURE [1]

Slickensided	Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along these planes.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.

REFERENCES :
(1) ASTM D 2488
(2) ASCE Manual 56 (1976)
(3) ASTM D 2049

Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the times and places indicated, and may vary with time, geologic condition or construction activity.

STDA25

018632

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/Well No. MW-30 (D-3) — Boring T.D. 104' — Boring Diam. 8"

Surface Elevation 167.09' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2" — Length 25'/2' SUMP — Slot Size 0.01"

Casing Dia. 2" — Length 77' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By D. Weidemann — Date Drilled 7/28/87

SKETCH MAP

NOTES

SURFACE CASING INSTALLED TO 59' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0				1.5	0–4	0–4	SLIGHTLY SILTY SAND: Reddish brown, somewhat stiff to very stiff, dry, roots at top, rootlets, calcium carbonate nodules and slickensides with depth (5YR 3/2 to 3/3).
				>4.5			
5				>4.5	4–9	4–6	SANDY CLAY: Dark brown, fine to very fine-grained, rootlets, dry, stiff (5YR 3/3).
				>4.5		6–9	SILTY CLAYEY SAND: Reddish brown, very fine-grained, few small areas of calcium carbonate; dry, stiff, friable (5YR 4/6).
10					9–14	9–10	SANDY CLAY: Dark reddish brown, dry, friable (5YR 5/6 to 4/6).
						10–18	SLIGHTLY CLAYEY SAND: Reddish brown, very fine to fine-grained, noncohesive, damp to dry; contains layer of dark reddish brown sandy clay from 14–14.5' (5YR 4/6 to 5/6).
15					14–19		
						18–19	SANDY CLAY: Reddish brown, very fine-grained (5YR 4/6).
20					19–24	19–21	SAND: Light reddish brown; fine to medium-grained; unconsolidated; moist to wet (5YR 6/6 to 5/6).
						21–22.5	SANDY CLAY: Reddish brown, fine to medium-grained; soft; very wet (5YR 4/6).
						22.5–24	SAND: Reddish brown to tan; medium-grained, very wet, lense of clay at base (7.5YR 4/4).
25					24–29	24–25	CLAYEY SAND: Reddish brown; very fine-grained; soft; moist; unconsolidated (5YR 5/6).

R173

018633

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation | Owner Sheridan

Location Hempstead, TX | W.O. NO. 091-06

Boring/ Well No. MW-30 (D-3) | Boring T.D. 104' | Boring Diam. 8"

Surface Elevation 167.09' | Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2" | Length 25'/2' SUMP | Slot Size 0.01"

Casing Dia. 2" | Length 77' | Type PVC Sch 40

Drilling Company Southwestern Labs | Drilling Method Hollow Stem Auger

Driller B. Christopher | Log By D. Weidemann | Date Drilled 7/28/87

SKETCH MAP

NOTES

SURFACE CASING INSTALLED TO 59' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25						25–54	SAND: Light reddish tan to brown, fine-grained; dry to damp; few clayey areas, unconsolidated (7.5YR 6/6).
30					29–34		No recovery – loose sand.
35					34–39		Saturated to very wet, fine to medium-grained from 34–35'; becomes medium to coarse-grained; soft, poorly sorted few pockets or lenses of clay, few pebbles near base (7.5YR 5/4 to 4/4).
40					39–44		Same as above, greyish brown; coarsens downward (7.5YR 6/4). Occasional clay lense, probably cuttings.
45					44–49		Greyish brown; medium to coarse-grained, few pebbles and cobbles, few clay layers (7.5YR 6/4).
50					49–54		SAND AND GRAVEL: greyish brown, coarsens downward; saturated; cobbles up to 0.2' long (5YR 4/3).

R173

018634

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/ Well No. MW-30 (D-3) — Boring T.D. 104' — Boring Diam. 8"

Surface Elevation 167.09' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2" — Length 25'/2' SUMP — Slot Size 0.01"

Casing Dia. 2" — Length 77' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By D. Weidemann — Date Drilled 7/28/87

SKETCH MAP

NOTES

SURFACE CASING INSTALLED TO 59' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
50							
55				>4.5	54–59	54–64	SILTY CLAY: Grey with olive mottling; some fine sand present; have 6" layer of clayey silt at 54' which contains pebbles; dry; stiff (2.5Y 5/4).
					59–64		No recovery: Drilled out plug from pressure grouting.
60							
65				2.5	64–69	64–69	CLAYEY SAND: Olive green and grey; very fine-grained, dry; crumbly; sandier at 64–65; becomes clayier and stiffer at 64' (5Y 4/4).
70				>4.5	69–74	69–74	SILTY CLAY: Medium to light grey with abundant olive and reddish iron staining; occasional calcium carbonate nodules; dry; crumbly in very silty areas; slickensides at 45 degrees to 60 degrees off core axis; becomes sandier and more iron stained at 74'; stiffer too; with few black natural organic stains (5Y 6/1).
75				3.25	74–79	74–75	SANDY CLAY: Light grey with occasional iron stains; dry, stiff (2.5YR 6/2).

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018635

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-30 (D-3) Boring T.D. 104 ' Boring Diam. 8 "

Surface Elevation 167.09' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 25'/2' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 77' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann Date Drilled 7/28/87

SKETCH MAP

NOTES

SURFACE CASING INSTALLED TO 59' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
75						75–75.5	SLIGHTLY CLAYEY SAND: Medium grey with some iron staining; fine-grained; dry; friable (2.5YR 6/2).
						75.5–98	SAND: Reddish to brown to yellowish tan, trace of clay, occasional layers that are slightly to well cemented with calcium carbonate, very wet to saturated; fine to medium-grained (5Y 7/2 to 10YR 6/4 to 10YR 8/2).
80					79–84		
85					84–86		
					86–100		After 86', no recovery due to well cemented sand zones.
90							
95							
100						98–104	SANDY CLAY: Dry; limited recovery.

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018636

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-30 (D-3) Boring T.D. 104' Boring Diam. 8"

Surface Elevation 167.09' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2" Length 25'/2' SUMP Slot Size 0.01"

Casing Dia. 2" Length 77' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann Date Drilled 7/28/87

SKETCH MAP

NOTES

SURFACE CASING INSTALLED TO 59' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
100							T.D.=104'
105							
110							
115							
120							
125							

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

SKETCH MAP

NOTES

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/ Well No. MW-31 (S-4) — Boring T.D. 64' — Boring Diam. 11"

Surface Elevation 167.05' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4" — Length 35'/3' SUMP — Slot Size 0.01"

Casing Dia. 4" — Length 25' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By D. Weidemann — Date Drilled 7/16/87

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0					0–4	0–5.3	CLAY: Dark reddish brown, slightly silty at top, few rootlets, dry, stiff (5YR 3/3).
				3.75			
					4–9		
5						5.3–8	SANDY SILTY CLAY: Very dark brown, stiff, crumbly, dry, no odor (5YR2 5/2).
				>4.5			
						8–9	SAND: Reddish brown, very fine-grained, dry, crumbly to noncohesive (5YR 4/6).
				>4.5	9–14	9–11.7	SILTY CLAY: Dark reddish brown, calcium carbonate nodules, dry, stiff, with a dry reddish fine sandy clay layer from 10–10.7' (5YR 4/6 to 4/4).
10				>4.5			
						11.7–12.7	CLAYEY SAND: Reddish (5YR 4/6).
						12.7–19	SAND: Medium reddish brown; very fine-grained; trace clay to clay in lenses; crumbly, mostly unconsolidated; damp to dry (5YR 5/6).
					14–19		
15							
					19–24	19–20	VERY SANDY CLAY: Reddish, soft, damp (5YR 4/6).
20						20–24	SAND: Reddish tan, fine-grained, noncohesive except in a few zones, black natural organic speckles; slightly damp at 23–24' (5YR 6/6).
					24–29	24–25	SLIGHTLY CLAYEY SAND: Reddish brown; very fine-grained, some black natural organics, slightly cohesive (5YR 6/6).
25							

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/ Well No. MW-31 (S-4) — Boring T.D. 64 ' — Boring Diam. 11 "

Surface Elevation 167.05' — Water Depth: Initial --- — 24 Hrs. ---

Screen Dia. 4 " — Length 35'/3' SUMP — Slot Size 0.01 "

Casing Dia. 4 " — Length 25 ' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By D. Weidemann — Date Drilled 7/16/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25						25–26	SANDY CLAY: Medium reddish brown.
						26–28	VERY CLAYEY SAND: Reddish brown, fine-grained, wet to damp (5YR 4/6).
						28–34	SAND: Reddish tan, fine to medium-grained, wet to moist; noncohesive; (5YR 6/6 to 6/5).
30					29–34		Becomes reddish brown, slightly silty, very wet to saturated (5 YR 4/6).
35					34–39	34–39	SAND AND GRAVEL: Reddish brown; very wet to saturated; poorly sorted, few clayey areas; coarsens with depth (5YR 5/4).
40					39–44	39–55.5	SAND: Reddish brown; fine to medium to coarse, saturated (5YR 5/4).
							Occasional lenses of brown clay.
45					44–49		Grey; wet (5YR 5/2).
50					49–54		No recovery: sand.

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

SKETCH MAP

NOTES

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/ Well No. MW-31 (S-4) — Boring T.D. 64 ' — Boring Diam. 11 "

Surface Elevation 167.05' — Water Depth: Initial --- — 24 Hrs. ---

Screen Dia. 4 " — Length 35'/3' SUMP — Slot Size 0.01 "

Casing Dia. 4 " — Length 25 ' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By D. Weidemann — Date Drilled 7/16/87

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
50							
					54–59		Coarsens with depth.
55						55.5–56.5	GRAVEL: With large cobbles (5YR 5/2).
						56.5–57.8	CLAY: Medium blue grey with gravel within.
						57.8–64	CLAY: Bluish grey with reddish yellow to olive mottling, very stiff, dry. Olive green color becomes more prevalent with depth (2.5 Y 6/0 to 5Y 6/6).
				4.25	59–64		
60				>4.5			
							T.D.=64 '
65							
70							
75							

R173

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/ Well No. MW-32 (S-5) — Boring T.D. 64 ' — Boring Diam. 11 "

Surface Elevation 169.33' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " — Length 35'/3' SUMP — Slot Size 0.01 "

Casing Dia. 4 " — Length 25 ' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By D. Weidemann — Date Drilled 7/20/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0				3.25	0–4	0–1.8	SANDY CLAY: Reddish and dark reddish brown; very fine-grained; clayey and silty areas; dry to moist, rootlets (5YR 3/3 to 4/4).
				1.25		1.8–4	SLIGHTLY SILTY CLAY: Dark brown, moderately soft, moist; rootlets (5YR 3/2).
5				3.0	4–9	4–5.5	CLAY: Dark brown, stiff (5Y 3/3).
				4.0		5.5–7.5	SILTY CLAY: Very dark brown, some very fine sand: dry, stiff (5YR 3/2).
						7.5–9	CLAYEY SAND: Reddish brown, very fine-grained, dry, friable (7.5YR 5/6).
10					9–14	9–16.5	SILTY SAND: Light reddish tan, very fine-grained; dry, crumbly, becomes unconsolidated at 14–16.5' (7.5YR 6/6).
					14–19		
15				2.25			
				1.5		16.5–21	SILTY SANDY CLAY: Reddish brown: few calcium carbonate nodules; has 2" layer of dry sandy clay at 17'; becomes a slightly silty clay with trace of very fine sand and some black natural organic staining from 18.5–19' (5YR 4/4 to 7.5YR 5/6).
				2.0	19–24		
20				0.75			
						21–24	SLIGHTLY CLAYEY SAND: Light reddish tan, dry, friable (7.5YR 5/6).
					24–29	24–29	VERY SANDY CLAY: Reddish brown, fine to very fine-grained, soft, friable, black natural organics throughout;
25							

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

SKETCH MAP

NOTES

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/Well No. MW-32 (S-5) — Boring T.D. 64' — Boring Diam. 11"

Surface Elevation 169.33' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4" — Length 35'/3' SUMP — Slot Size 0.01"

Casing Dia. 4" — Length 25' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By D. Weidemann — Date Drilled 7/20/87

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25							damp from 25–26'; saturated from 27–28' (7.5YR 4/4).
30					29–34	29–34	SLIGHTLY CLAYEY SAND: Reddish brown; very fine-grained; saturated; becomes more cohesive with depth (5YR 4/6).
35					34–39	34–56	SAND: Dark brownish yellow, fine to very fine-grained, very wet to saturated, fairly well sorted, mainly quartz grains (7.5YR 4/6).
40					39–44		Becomes light reddish tan to brown, fine to medium-grained.
45					44–49		Becomes tannish grey; medium to coarse sand, few pebbles and few shell fragments (10YR 4/4).
50					49–54		Coarse sand, contains 6" clay layer (7.5YR 4/4).

R173

018642

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation | Owner Sheridan

Location Hempstead, TX | W.O. NO. 091-06

Boring/ Well No. MW-32 (S-5) | Boring T.D. 64 ' | Boring Diam. 11 "

Surface Elevation 169.33' | Water Depth: Initial --- | 24 Hrs. ---

Screen Dia. 4 " | Length 35'/3' SUMP | Slot Size 0.01 "

Casing Dia. 4 " | Length 25 ' | Type PVC Sch 40

Drilling Company Southwestern Labs | Drilling Method Hollow Stem Auger

Driller B. Christopher | Log By D. Weidemann | Date Drilled 7/20/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
50							
					54-59		As above.
55						56-58	GRAVEL: With cobbles & sand; saturated (10YR 5/4 to 4/4).
						58-59	CLAYEY SAND: Reddish brown, wet, with few cobbles (5YR 3/4).
				>4.5	59-64	59-64	SILTY CLAY: Olive green with grey; few calcium carbonate nodules, stiff; some iron staining with slickensides along 45 degree angle to core axis (5Y 5/3 to 5Y 6/1).
60							
							T.D.=64 '
65							
70							
75							

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018643

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/Well No. MW-33 (D-4) — Boring T.D. 102' — Boring Diam. 8"

Surface Elevation 169.66' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2" — Length 20'/3' SUMP — Slot Size 0.01"

Casing Dia. 2" — Length 77' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By D. Weidemann — Date Drilled 7/29/87

SKETCH MAP

NOTES

SURFACE CASING SET TO 65' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0				1.25	0–4	0–1.5	SANDY CLAYEY SILT: Medium to dark reddish brown; roots and rootlets, dry, soft (5YR 3/4).
				1.8			
				0.75		1.5–2	CLAY AND SILTY CLAY: Reddish brown, soft (5YR 3/2).
						2–3	SAND: Light reddish brown, very fine-grained, soft, crumbly, moist to wet (7.5YR 4/6).
				2.3		3–4	SILTY CLAY: Dark reddish brown, becomes sandy and stiffer with depth (5YR 3/4).
				2.25	4–9	4–6	CLAY: Dark reddish brown, few rootlets and calcium carbonate nodules, dry (5YR 3/3).
5						6–9	SANDY CLAY: Very dark brown to black, few rootlets and calcium carbonate nodules; very organic-rich, dry, crumbly, stiff. Becomes reddish brown, very sandy with rootles cavities and a few black natural organic speckles from 8–9' (5YR 2.5/1 to 5YR 4/6).
				>4.5	9–14	9–12.5	SILTY CLAYEY SAND: Medium to light red; very fine-grained; few gastropod shells, calcium carbonate staining, dry, crumbly and stiff, becomes sandier with depth (5YR 4/6).
10						12.5–14.5	SAND: Light red; very fine-grained, dry, unconsolidated (7.5YR 5/6).
				>4.5	14–19		
15						14.5–17	CLAY: Dark reddish brown, with interbedded 2–5" layers of sandy clay; very fine-grained, rootlets at 14.5', very stiff (5YR 4/4).
						17–18	CLAY: Dark reddish brown, with rootlets and gastropod shells, stiff (5YR 4/4).
						18–19	SANDY SILT: Dark reddish brown, rootlets, black natural organic speckles (5YR 4/4).
				4.25	19–24	19–27	SAND: Light reddish tan, fine to very fine-grained; slightly clayey and stiff from 19–19.5, unconsolidated below 19.5' (7.5YR 5/6 to 6/6).
20							
R173 25					24–29		Becomes medium reddish brown, fine-grained, well sorted quartz sand, becomes wetter below 24' (7.5YR 5/6).

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-33 (D-4) Boring T.D. 102 ' Boring Diam. 8 "

Surface Elevation 169.56' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 20'/3' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 77 ' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann Date Drilled 7/29/87

SKETCH MAP

NOTES

SURFACE CASING SET TO 65' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25							
						27–27.5	SILTY CLAY: Reddish brown (7.5YR 4/6).
						27.5–29	SILTY SAND: Reddish brown, very fine-grained; few black natural organics (7.5YR 4/6).
30					29–34	29–31.5	CLAYEY SAND: Reddish brown, fine-grained, saturated, with a soft, sticky clay layer from 31–31.5' (5YR 4/4).
						31.5–59	SAND: Reddish brown, fine-grained, wet to saturated (5YR 4/4).
35					34–39		Occasional clay lenses.
40					39–44		Tannish grey, medium to coarse-grained, wet to saturated (7.5YR 5/4).
45					44–49		
50					49–54		Becomes medium to coarse-grained, grayish brown with few pebbles and cobbles (5YR 4/3).

R173

018645

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation | Owner Sheridan

Location Hempstead, TX | W.O. NO. 091-06

Boring/ Well No. MW-33 (D-4) | Boring T.D. 102 ' | Boring Diam. 8 "

Surface Elevation 169.66' | Water Depth: Initial --- | 24 Hrs. ---

Screen Dia. 2 " | Length 20'/3' SUMP | Slot Size 0.01 "

Casing Dia. 2 " | Length 77 ' | Type PVC Sch 40

Drilling Company Southwestern Labs | Drilling Method Hollow Stem Auger

Driller B. Christopher | Log By D. Weidemann | Date Drilled 7/29/87

SKETCH MAP

NOTES

SURFACE CASING SET TO 65' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
50							
55					54–59		Becomes medium to fine-grained with depth, but coarsens again near clay (5YR 5/2).
60				>4.5	59–64	59–69	SILTY CLAY: Olive green and grey, very stiff, pebbles and cobbles at top (5Y 6/3).
65					64–69		64–69' Drilled out plug from pressure grouting.
70					69–74	69–74.3	CLAY: Medium to light grey with olive and reddish staining: slightly silty, somewhat crumbly, dry, trace very fine sand at 72', grey cemented damp to dry fine sand layer at 73.8–74' (5Y 7/1 to 10YR 7/1). Sandy clay from 74–74.3', color as above, some black natural organic staining.
75				4.0	74–79	74.3–75.5	SILTY CLAY: Medium grey with olive and red stains, dry, hard (5Y 6/2).

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018646

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX V.O. NO. 091-06

Boring/ Well No. MW-33 (D-4) Boring T.D. 102' Boring Diam. 8"

Surface Elevation 169.66' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2" Length 20'/3' SUMP Slot Size 0.01"

Casing Dia. 2" Length 77' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann Date Drilled 7/29/87

SKETCH MAP

NOTES

SURFACE CASING SET TO 65' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
75						75.5–77	SANDY CLAY: Medium gray with olive and iron staining, interbedded with small layers of clayey sand with wet sand at 75.5'; other segments cemented (5y 6/2).
						77–100	SAND: Reddish brown, very wet to saturated, fine-grained, with occasional well-cemented hard zones (10YR 6/6). Becomes yellowish tan to brown with occational thin clay layers from 79–81'.
80					79–81		
				4.1	81–100		Formation becomes too well-cemented below 81' to sample. Driller notes hard, cemented sand from 81–86', loose sand from 86–97.5'; clay at 97.5'.
85							
90							
95							
100							

R173

018647

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-33 (D-4) Boring T.D. 102 ' Boring Diam. 8 "

Surface Elevation 169.66' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 20'/3' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 77 ' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann Date Drilled 7/29/87

SKETCH MAP

NOTES

SURFACE CASING SET TO 65' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
100					100–102	100–102	SANDY CLAY: Medium grey with olive mottling and iron stains, some natural black organic stains, dry, stiff. T.D.=102 '
105							
110							
115							
120							
125							

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation | Owner Sheridan

Location Hempstead, TX | V.O. NO. 091-06

Boring/ Well No. MW-34 (S-7) | Boring T.D. 64 ' | Boring Diam. 11 "

Surface Elevation 172.02' | Water Depth: Initial --- | 24 Hrs. ---

Screen Dia. 4 " | Length 35'/3' SUMP | Slot Size 0.01 "

Casing Dia. 4 " | Length 26 ' | Type PVC Sch 40

Drilling Company Southwestern Labs | Drilling Method Hollow Stem Auger

Driller B. Christopher | Log By S. MacDonald | Date Drilled 7/23/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0					0–4	0–1.5	CLAYEY SAND: Brown with rootlets (5YR 3/4).
				3.5		1.5–2.8	SANDY CLAY: Brown (5YR 3/3).
						2.8–5	CLAYEY SAND: Brown, moist, with rootlets (5YR 3/3).
5					4–9	5–6	SANDY CLAY: Brown, moist, with rootlets (5YR 3/3).
						6–9	SAND: Reddish brown, minor silt and clay content, loose.
					9–14	9–10.5	SILTY SAND: Reddish brown with rootlets (5YR 4/6 to 5/6).
10				1.25		10.5–12	SANDY CLAY: Reddish brown (5YR 4/6).
						12–18	SAND: Reddish brown, fine to very fine-grained; dry (7.5YR 6/6 to 5/6).
					14–19		Clay lenses from 14.6–14.8'.
15							Becomes redder, darker at 15' (5YR 6/4).
						18–20.5	SANDY CLAY: Reddish brown, very moist at 18'; becomes drier and crumbly at 19' (5YR 4/4).
20				1.75	19–24		
						20.5–24	SILTY SAND: Reddish brown, saturated at 22'.
				2.0	24–29	24–29	CLAY: Dark reddish brown; silt content varies throughout, contains rootlets, black natural organic material.
25							

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018649

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation | Owner Sheridan

Location Hempstead, TX | W.O. NO. 091-06

Boring/ Well No. MW-34 (S-7) | Boring T.D. 64 ' | Boring Diam. 11 "

Surface Elevation 172.02' | Water Depth: Initial ---- | 24 Hrs. ----

Screen Dia. 4 " | Length 35'/3' SUMP | Slot Size 0.01 "

Casing Dia. 4 " | Length 26 ' | Type PVC Sch 40

Drilling Company Southwestern Labs | Drilling Method Hollow Stem Auger

Driller B. Christopher | Log By S. MacDonald | Date Drilled 7/23/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25							saturated clayey sand lenses throughout (5YR 4/6).
30				2.0	29–34	29–34.5	SILTY CLAY: Dark reddish brown, occasional trace of fine sand, black natural organic material throughout, dry, stiff (5YR 4/4).
35					34–39	34.5–55.5	SAND: Reddish brown; fine to very fine-grained; slightly silty, saturated (5YR 4/6).
40					39–44		
45					44–49		Becomes reddish brown to light grey, very saturated (5YR 4/3).
50					49–54		Becomes light grey, fine to medium-grained (10YR 5/2)

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-34 (S-7) Boring T.D. 64 ' Boring Diam. 11 "

Surface Elevation 172.02' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " Length 35'/3' SUMP Slot Size 0.01 "

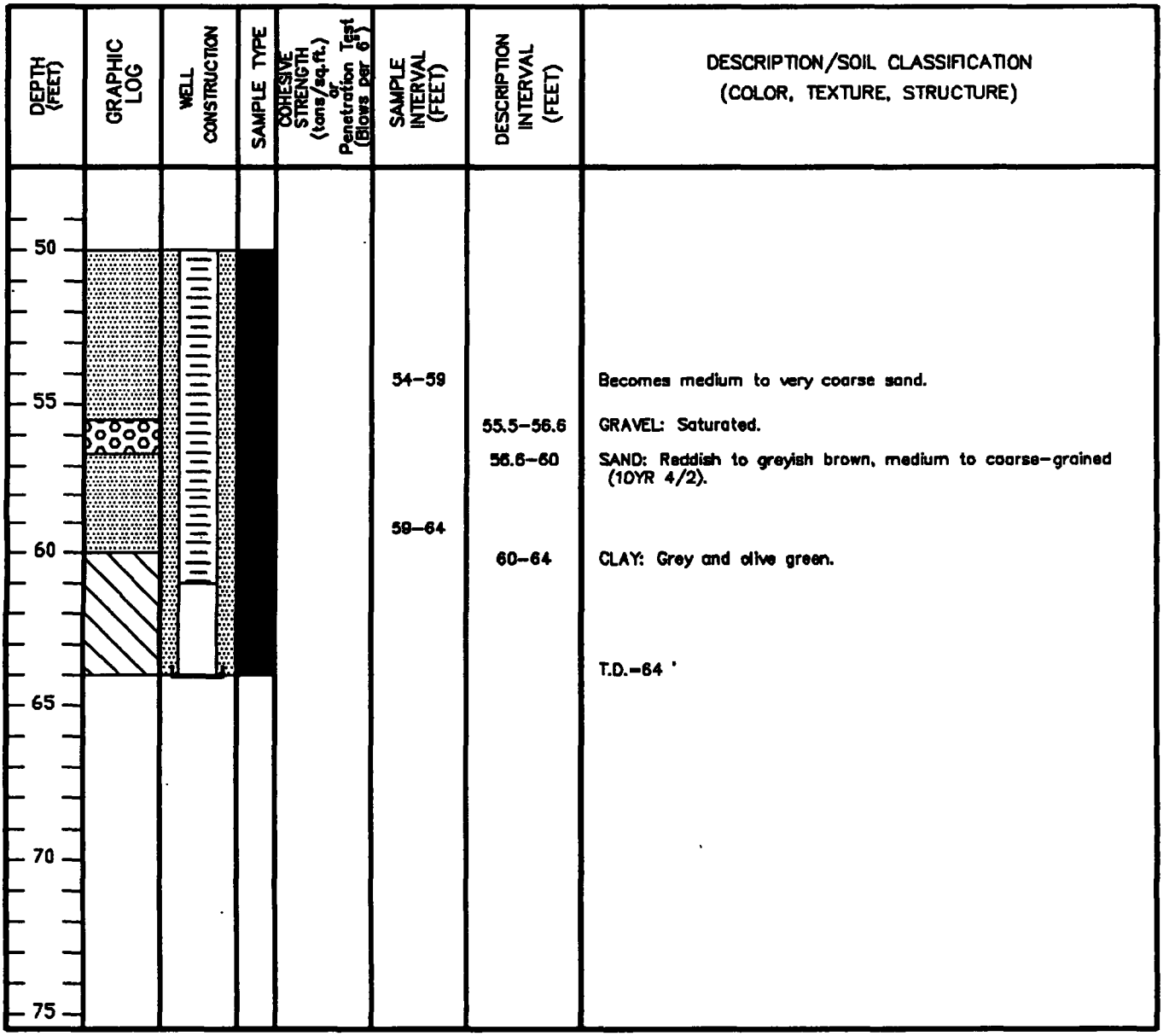
Casing Dia. 4 " Length 26 ' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By S. MacDonald Date Drilled 7/23/87

SKETCH MAP

NOTES



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018651

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-35 (D-5) Boring T.D. 103 ' Boring Diam. 8 "

Surface Elevation 172.24' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 20'/3' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 80 ' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann S. Macdonald Date Drilled 8/8/87

SKETCH MAP

NOTES

SURFACE CASING SET TO 68' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0				2.0	0–4	0–2	SILTY SAND: Medium reddish brown; very fine to fine-grained; roots and rootlets, dry to damp (5YR 4/4).
				1.5		2–3	SANDY CLAY: Medium reddish brown; very fine sand, rootlets, damp to dry (5YR 4/4).
				1.2		3–7	SILTY CLAY: Reddish brown, few shell pieces, rootlets, damp to dry, becomes dark reddish brown from 4–4.8' with some black natural organics. Becomes very dark brown, loose, organic-rich from 4.8–7' with plant roots and sand filled burrow cavities (5YR 4/4 to 3/3; also 7.5YR 3/2).
5				2.25 >4.5	4–9		
				>4.5		7–13	SLIGHTLY CLAYEY SAND: Reddish to reddish brown, calcareous material throughout; probably hard due to calcium carbonate matrix, clay content increases with depth (5YR 4/6 to 5/6).
10				>4.5	9–14		
						13–20	SAND: Reddish brown, fine to very fine-grained, saturated from 19–20' (5YR 5/6 to 6/6).
15					14–19		
					19–24		
20				0.75		20–23	SANDY CLAY: Reddish brown, few sand lenses throughout (5YR 4/6).
				1.75		23–24	CLAY: Reddish brown with black organic material and shell fragments.
25				2.0	24–29	24–31.5	CLAY: Reddish brown with interbedded saturated sandy clay

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-35 (D-5) Boring T.D. 103 ' Boring Diam. 8 "

Surface Elevation 172.24' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 20'/3' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 80 ' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann S. Macdonald Date Drilled 8/6/87

SKETCH MAP

NOTES
SURFACE CASING SET TO 68' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25							layers at 25, 25.5 and 27.5', becomes stiffer, loses sand, with calcareous material and black organics from 29' to 31.5' (5YR 4/4 to 4/6).
30				2.75	29–34		
						31.5–34	SILTY SAND: Reddish brown, saturated (5YR 4/6).
35					34–39	34–63	SAND: Reddish brown, saturated, somewhat silty in places, occasional interbedded clay layers (5YR 4/6).
40					39–44		No recovery. Sand.
45					44–49		Saturated, fine to very fine-grained (5YR 4/6).
50					49–54		Becomes brown, medium to coarse-grained, saturated (7.5YR 5/2).

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX V.O. NO. 091-06

Boring/ Well No. MW-35 (D-5) Boring T.D. 103 ' Boring Diam. 8 "

Surface Elevation 172.24' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 20'/3' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 80 ' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann S. Macdonald Date Drilled 8/6/87

SKETCH MAP

NOTES

SURFACE CASING SET TO 68' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
50							
55					54–59		Silt layer from 55.5–56.5', gravel layer from 57.5–58.5'.
60					59–64		
65					64–69	63–74	Driller notes clay at 63'. CLAY: Olive grey; dry, very stiff; possible slickensided surface at 45 degrees to core axis – may be a compaction phenomenon (5Y 5/3).
70					69–74		Drill out plug from pressure grouting to 74'.
75				4.5	74–79	74–78	CLAY: Medium grey with olive and red mottling, stiff, some sand (5Y 7/1 to 2.5Y 6/6).

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-05

Boring/Well No. MW-35 (D-5) — Boring T.D. 103' — Boring Diam. 8"

Surface Elevation 172.24' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2" — Length 20'/3' SUMP — Slot Size 0.01"

Casing Dia. 2" — Length 80' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By D. Weidemann, S. Macdonald — Date Drilled 8/8/87

SKETCH MAP

NOTES

SURFACE CASING SET TO 68' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
75						78–80	SANDY CLAY: color as above.
					79–84		
80						80–90	SAND: Brownish grey: wet to moist from 80–82'; damp from 82–84', fine to medium-grained, occasional cemented zones, occasional clay layer.
							Well cemented sand begins at 83', discontinue sampling.
85					84–103		
90						90–103	VERY CLAYEY SAND: Coarse grained sand; sample from cuttings.
95							
100							

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018655

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-35 (D-5) Boring T.D. 103 ' Boring Diam. 8 "

Surface Elevation 172.24' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 20'/3' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 80 ' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann S. Macdonald Date Drilled 8/8/87

SKETCH MAP

NOTES

SURFACE CASING SET TO 68' USING MUD ROTARY TECHNIQUES.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
100							T.D.=103 '
105							
110							
115							
120							
125							

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/Well No. MW-36 (S-8) — Boring T.D. 60' — Boring Diam. 11"

Surface Elevation 166.58' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4" — Length 30'/3' SUMP — Slot Size 0.01"

Casing Dia. 4" — Length 27' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By S. MacDonald/D. Weidemann — Date Drilled 8/7/87

SKETCH MAP

NOTES

IN DITCH

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0				2.75	0–4	0–1.5	CLAY: Dark brown, stiff, plant roots (7.5Y 3/4).
						1.5–4	SANDY CLAY: Dark brown; plant roots (7.5YR 3/2).
5					4–9	4–9	SAND: Reddish brown, fine-grained, dry (7.5YR 5/6).
10					9–14	9–13	VERY SANDY CLAY: Reddish brown.
					14–19	13–16	SAND: Light reddish brown, fine-grained, becomes saturated from 14–16' (5YR 4/6).
15				1.25		16–29	CLAY: Reddish brown, soft, plastic.
							Contains some black natural organic material in vertical pores.
				1.5	19–24		
20							From 21–22' have alternating layers of wet to saturated silty clay with clay (5YR 4/4).
					24–29		Contains some small sandy pockets in burrows or other vertical pores.
25				1.0			

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/Well No. MW-36 (S-8) — Boring T.D. 60' — Boring Diam. 11"

Surface Elevation 166.58' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4" — Length 30'/3' SUMP — Slot Size 0.01"

Casing Dia. 4" — Length 27' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By S. MacDonald/D. Weidemann — Date Drilled 8/7/87

SKETCH MAP

NOTES

IN DITCH

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25							
30					29–34	29–34	CLAYEY SAND: Reddish brown, lense of soft sandy clay from 29–29.3', becomes very wet to saturated at 29.3' (7.5YR 4/6).
35					34–39	34–56	SAND: No recovery.
40					39–44		Reddish brown, very fine-grained, saturated (7.5YR 4/6).
45					44–49		No recovery: sand.
50					49–54		Greyish brown, coarse to very coarse, mainly quartz, saturated (5YR 5/2).

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018658

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation — Owner Sheridan

Location Hempstead, TX — W.O. NO. 091-06

Boring/Well No. MW-36 (S-8) — Boring T.D. 60 ' — Boring Diam. 11 "

Surface Elevation 166.58' — Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " — Length 30'/3' SUMP — Slot Size 0.01 "

Casing Dia. 4 " — Length 27 ' — Type PVC Sch 40

Drilling Company Southwestern Labs — Drilling Method Hollow Stem Auger

Driller B. Christopher — Log By S. MacDonald/D. Weidemann — Date Drilled 8/7/87

SKETCH MAP

NOTES

IN DITCH

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
50							
55					54-60	56-60	CLAY: Olive and grey with mottling, very stiff.
60							T.D.=60 '
65							
70							
75							

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation | Owner Sheridan

Location Hempstead, TX | W.O. NO. 091-06

Boring/ Well No. MW-37 (S-9) | Boring T.D. 59 ' | Boring Diam. 11 "

Surface Elevation 166.04' | Water Depth: Initial --- | 24 Hrs. ---

Screen Dia. 4 " | Length 30'/3' SUMP | Slot Size 0.01 "

Casing Dia. 4 " | Length 25 ' | Type PVC Sch 40

Drilling Company Southwestern Labs | Drilling Method Hollow Stem Auger

Driller B. Christopher | Log By D. Weidemann | Date Drilled 8/7/87

SKETCH MAP

NOTES

IN DITCH

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0				4.0	0–4	0–1	SANDY CLAY: Dark reddish brown; roots; dry; stiff.
				1.0		1–6	CLAY: Dark reddish brown, slightly silty; some calcium carbonate nodules, few black natural organic speckles (5YR 3/4).
					4–9		Becomes dry, crumbly.
5						6–9.3	VERY SANDY CLAY: Very dark brown to black, dry, crumbly (10YR 2/2).
				>4.5	9–14	9.3–10.3	SILTY CLAY: Dark reddish brown, trace very fine sand, some calcium carbonate nodules (5YR 3/3).
10				4.25		10.3–13	CLAYEY SAND: Reddish brown, some sandy pockets, calcium carbonate nodules, vertical burrows and pores, dry (5YR 4/6).
						13–14	SAND: Light reddish brown, fine to very fine-grained, unconsolidated, soft, dry, occasional cross bedding (5YR 4/6).
				2.5	14–19	14–15	
15						15–19	SILTY SAND: Reddish brown; some black natural organic material, wet (5YR 4/6).
							SILTY CLAY: Dark reddish brown; few black natural organics, some vertical pores and rootlet cavities (5YR 4/4).
					19–24	19–20	SANDY CLAY: Reddish brown, soft, with some silty clay, wet to moist.
20						20–24	SILTY CLAY: Dark reddish brown, some sandy pockets, vertical pores, black natural organics, stiff, dry (5YR 3/4).
R173 25					24–29	24–55	SAND: Light to medium tannish red, very fine to fine-grained, damp to wet from 24–26', becomes saturated at 27'

018660

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HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-37 (S-9) Boring T.D. 59 ' Boring Diam. 11 "

Surface Elevation 166.04' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " Length 30'/3' SUMP Slot Size 0.01 "

Casing Dia. 4 " Length 25 ' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann Date Drilled 8/7/87

SKETCH MAP

NOTES

IN DITCH

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25							(5YR 4/6).
					29-34		Fine sand as above, saturated.
30							
					34-39		SAND: No recovery.
35							
					39-44		As above
40							
					44-49		Becomes reddish brown, some silt.
45							
					49-54		Becomes grayish red, medium to coarse-grained, coarsens downward to pebbles (5YR 5/2).
50							

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-37 (S-9) Boring T.D. 59 ' Boring Diam. 11 "

Surface Elevation 166.04' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " Length 30'/3' SUMP Slot Size 0.01 "

Casing Dia. 4 " Length 25 ' Type PVC Sch 40

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann Date Drilled 8/7/87

SKETCH MAP

NOTES

IN DITCH

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
50							
55				>4.5	54-59	55-59	SILTY CLAY: Medium grey to olive, stiff (5Y 5/4).
							T.D.=59 '
60							
65							
70							
75							

R173

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018662

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-38 (S-12) Boring T.D. 78 ' Boring Diam. 8 "

Surface Elevation 181.16' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 45'/2' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 31 ' Type 316 Stainless Steel

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By S. MacDonald Date Drilled 7/30/87

SKETCH MAP

NOTES
DRILLED WITH MUD ROTARY FROM 0-27', SURFACE CASING SET TO 26'. REMAINDER OF HOLE DRILLED AND SAMPLED USING HOLLOW STEM AUGER.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0					0-12	0-12	CLAY: HNU = 12 ppm (from cuttings)
5							
10						12-15	SANDY CLAY: From cuttings.
15					15-16	15-20	SANDY CLAY: Dark brown, glass-like crystals throughout, also contains wood fragments and black organic spots; HNU= 0.6 ppm.
20					20-21	20-29	CLAY: Reddish brown; some rootlets, discolored spots, stiff, has odor but HNU = 0 ppm.
25							As above: odor, but HNU=0 ppm.

R173

018663

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project: Monitor Well Installation
Owner: Sheridan
Location: Hempstead, TX
W.O. NO.: 091-06
Boring/Well No.: MW-38 (S-12)
Boring T.D.: 78'
Boring Diam.: 8"
Surface Elevation: 181.16'
Water Depth: Initial: ---
24 Hrs.: ---
Screen Dia.: 2"
Length: 45'/2' SUMP
Slot Size: 0.01"
Casing Dia.: 2"
Length: 31'
Type: 316 Stainless Steel
Drilling Company: Southwestern Labs
Drilling Method: Hollow Stem Auger
Driller: B. Christopher
Log By: S. MacDonald
Date Drilled: 7/30/87

SKETCH MAP

NOTES
DRILLED WITH MUD ROTARY FROM 0-27', SURFACE CASING SET TO 26'. REMAINDER OF HOLE DRILLED AND SAMPLED USING HOLLOW STEM AUGER.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25							
30				3.1	29-34	29-31	CLAY: Reddish brown, some calcium carbonate nodules and natural black organics; somewhat plastic (5YR 4/4).
						31-32.6	CLAYEY SAND: Reddish brown, with a sand lense and sandy clay; sand is fine, wet.
				2.75		32.6-39	CLAY: Reddish brown, silty and soft from 34-35'; has vertical pores from rootlets; black natural organics throughout; dry to damp (5YR 4/3).
35				0.6	34-39		
				3.5			
40					39-44	39-40	CLAYEY SAND: Medium reddish brown with grey sandy pockets; few rootlets; very fine-grained, wet to saturated (5YR 4/6).
						40-69	SAND: Reddish brown, very fine-grained, saturated, rare clay layer, unconsolidated (5YR 4/6).
45					44-49		As above.
50					49-54		As above.

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ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-38 (S-12) Boring T.D. 78 ' Boring Diam. 8 "

Surface Elevation 181.16' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 45'/2' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 31 ' Type 316 Stainless Steel

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By S. MacDonald Date Drilled 7/30/87

SKETCH MAP

NOTES
DRILLED WITH MUD ROTARY FROM 0–27', SURFACE CASING SET TO 26'. REMAINDER OF HOLE DRILLED AND SAMPLED USING HOLLOW STEM AUGER.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
50							
55					54–59		No recovery: sand.
60					59–64		Brownish grey, fine–grained, saturated (5YR 4/3).
65					64–69		As above.
70					69–74	69–75	GRAVEL AND COBBLES: Saturated, coarsens downward.
75					74–78	75–78	CLAY: Grey with olive mottling.

R173

018665

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX V.O. NO. 091-06

Boring/ Well No. MW-38 (S-12) Boring T.D. 78 ' Boring Diam. 8 "

Surface Elevation 181.16' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 2 " Length 45'/2' SUMP Slot Size 0.01 "

Casing Dia. 2 " Length 31 ' Type 316 Stainless Steel

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By S. MacDonald Date Drilled 7/30/87

SKETCH MAP

NOTES

DRILLED WITH MUD ROTARY FROM 0-27', SURFACE CASING SET TO 26'. REMAINDER OF HOLE DRILLED AND SAMPLED USING HOLLOW STEM AUGER.

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
75							T.D.=78 '
80							
85							
90							
95							
100							

R173

018666

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation | Owner Sheridan

Location Hempstead, TX | W.O. NO. 091-06

Boring/ Well No. MW-39 (S-11) | Boring T.D. 59 ' | Boring Diam. 11 "

Surface Elevation 165.55' | Water Depth: Initial --- | 24 Hrs. ---

Screen Dia. 4 " | Length 20'/3' SUMP | Slot Size 0.01 "

Casing Dia. 4 " | Length 34 ' | Type SCH 40 PVC

Drilling Company Southwestern Labs | Drilling Method Hollow Stem Auger

Driller B. Christopher | Log By D. Weidemann | Date Drilled 8/8/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0				>4.5	0–4	0–2	SANDY SILTY CLAY: Dark brown, roots, rootlets, calcium carbonate nodules, dry, hard (5YR 3/2).
				4.0		2–4	SILTY SAND: Reddish brown, calcium carbonate nodules, damp to dry, stiff (5YR 4/6).
5					4–9	4–10.5	SLIGHTLY CLAYEY SAND: Light reddish brown, crumbly but consolidated, damp to dry (5YR 4/6).
10					9–14		Becomes dry, very hard, very fine-grained, abundant vertical pores.
						10.5–14	SAND: Reddish brown, very fine-grained, occasional clayey sand layers, soft, dry, crumbly (5YR 4/6).
15				1.5	14–19	14–24	CLAYEY SAND: Reddish brown, vertical burrows, few black natural organic speckles, soft, damp (5YR 4/6).
20					19–24		Becomes more clayey, damp to wet in 1 small (3") zone.
25				0.75	24–29	24–26	SANDY CLAY: Medium reddish brown, some vertical pores, black natural organic materials; soft, damp to dry (5YR 4/6).

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018667

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-39 (S-11) Boring T.D. 59 ' Boring Diam. 11 "

Surface Elevation 165.55' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " Length 20'/3' SUMP Slot Size 0.01 "

Casing Dia. 4 " Length 34 ' Type SCH 40 PVC

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann Date Drilled 8/8/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25				2.0		26–29	SILTY CLAY: Medium reddish brown, trace sand, from 26–26.2', have wet layer of clayey sand, otherwise damp to dry, color as above.
30				2.0	29–34	29–36	SANDY CLAY: Medium to dark reddish brown, very fine-grained; vertical burrows, rootlets, some portions damp to wet (5YR 4/6).
35					34–39		Becomes tannish brown at 34' with abundant calcium carbonate nodules, soft, wet.
						36–39	SILTY SAND: Tannish brown; very fine-grained, occasional clay layers; wet to saturated at 37' (7.5YR 4/6).
40					39–44	39–54	SAND: Brown to reddish brown; very fine-grained, saturated, unconsolidated, layered from 43.5–44' (7.5YR 5/4).
45					44–49		No recovery: Sand.
50					49–54		Dark grey to brown; coarse sand and gravel, some clay. (10YR 4/2).

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018668

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX V.O. NO. 091-06

Boring/ Well No. MW-39 (S-11) Boring T.D. 59 ' Boring Diam. 11 "

Surface Elevation 165.55' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " Length 20'/3' SUMP Slot Size 0.01 "

Casing Dia. 4 " Length 34 ' Type SCH 40 PVC

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann Date Drilled 8/8/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
50							Coarse gravel and pebbles up to 1" long.
55				>4.5	54-59	54-59	SILTY CLAY: Olive grey, dry, stiff, with abundant calcium carbonate nodules near 59', some iron staining and slickensides (5Y 6/4 to 5Y 6/2).
60							T.D.=59 '
65							
70							
75							

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018669

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-40 Boring T.D. 85.5 ' Boring Diam. 11 "

Surface Elevation 168.59' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " Length 17.5'/2.5' SUMP Slot Size 0.01 "

Casing Dia. 4 " Length 65.5 ' Type SCH 40 PVC

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann/S. Ritter Date Drilled 10/10/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
0					0–4	0–2	SILTY CLAY: Dark brown to blackish, dry, crumbly, rootlets. nodules (5YR 3/2).
				>4.5		2–5	SLIGHTLY SILTY CLAY: Dark reddish brown, dry, stiff, few nodules, rootlets, slickensides, lighter color from 4–5'.
5				>4.5	4–9	5–7	CLAY: Dark reddish brown to black, dry, very stiff, calcium carbonate nodules (5YR 2.5/1).
				>4.5		7–8	SILTY CLAY: Dry, crumbly, calcium carbonate crystals, some slickensides.
				4.25		8–9	CLAY: Dark reddish brown to black, dry, very stiff, calcium carbonate nodules (5YR 2.5/1).
10				4.5	9–14	9–24	SLIGHTLY SILTY CLAY: Dark reddish brown, dry, stiff, abundant calcium carbonate and iron nodules, abundant slickensides throughout at 45–60 degrees from core axis (5YR 3/2 to 3/4).
				>4.5	14–19		
15							
20				3.5	19–24		From 19–24' becomes reddish brown, dry, stiff, few nodules and slickensides, black organic blebs throughout, few gray silty areas (5YR 4/4).
25					24–29	24–30.5	SILTY CLAY: Reddish brown, softer, no slickensides, iron nodules and organic blebs throughout, abundant calcium

R173

018670

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation Owner Sheridan

Location Hempstead, TX W.O. NO. 091-06

Boring/ Well No. MW-40 Boring T.D. 85.5 ' Boring Diam. 11 "

Surface Elevation 168.59' Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " Length 17.5'/2.5' SUMP Slot Size 0.01 "

Casing Dia. 4 " Length 65.5 ' Type SCH 40 PVC

Drilling Company Southwestern Labs Drilling Method Hollow Stem Auger

Driller B. Christopher Log By D. Weidemann/S. Ritter Date Drilled 10/10/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
25							carbonate nodules at 27.5', trace very fine sand (5YR 4/4 to 3/4).
				3.25			
				3.25	29–34		
30				3.25		30.5–35.5	SANDY CLAY: Dark brown to brown, very fine-grained, dry, stiff, becomes sandier and softer with depth, increasing moisture content with depth, calcium carbonate nodules at 33' (10YR 4/3 to 3/3 and 5YR 3/4).
				3.25			
				2.25	34–39		
35						35.5–39	CLAYEY SILTY SAND: Dark brown to yellowish brown, damp, soft, vertical burrow filled with gray clay (7.5YR 4/6 to 10YR 5/4).
					39–44	39–53	SILTY SAND: Yellowish brown, fine to medium-grained, subrounded quartz, few pebbles, wet to saturated, liquifies when disturbed (10YR 5/4).
40							Coarsens to more medium grained with depth.
					44–49		
45							
					49–52		
50							

R173

018671

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation | Owner Sheridan

Location Hempstead, TX | W.O. NO. 091-06

Boring/ Well No. MW-40 | Boring T.D. 85.5 ' | Boring Diam. 11 "

Surface Elevation 168.59' | Water Depth: Initial --- 24 Hrs. ---

Screen Dia. 4 " | Length 17.5'/2.5' SUMP | Slot Size 0.01 "

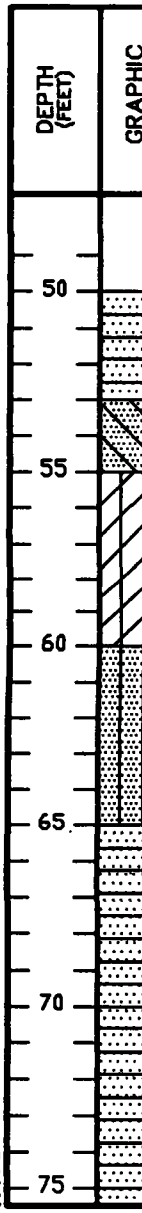
Casing Dia. 4 " | Length 65.5 ' | Type SCH 40 PVC

Drilling Company Southwestern Labs | Drilling Method Hollow Stem Auger

Driller B. Christopher | Log By D. Weidemann/S. Ritter | Date Drilled 10/10/87

SKETCH MAP

NOTES



DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
					52–54		
						53–55	SANDY CLAY: Light olive brown and gray, mottled, soft, poor recovery.
					54–55		
55				>4.5	55–60	55–60	CLAYEY SILT: Light olive brown and brownish gray, mottled, dry to damp, hard, crumbly, some fine sand, no odor, 2–3" cemented zone at 57.5' (2.5Y 5/6 and 6/2).
60				3.25	60–65	60–65	SANDY SILT: Light olive brown and brownish gray, trace clay, damp, sand coarsens from very fine to fine with depth (2.5Y 5/6 and 6/2).
							Cemented zone 64.5 – 65'
65					65–83	65–83	SILTY SAND: Logged from cuttings, tannish brown, medium-grained, soupy.
70							
75							

R173

018672

ERM-Southwest, inc.

HOUSTON, TEXAS

DRILLING LOG

Project Monitor Well Installation | Owner Sheridan

Location Hempstead, TX | W.O. NO. 091-06

Boring/ Well No. MW-40 | Boring T.D. 85.5 ' | Boring Diam. 11 "

Surface Elevation 168.59' | Water Depth: Initial --- | 24 Hrs. ---

Screen Dia. 4 " | Length 17.5'/2.5' SUMP | Slot Size 0.01 "

Casing Dia. 4 " | Length 65.5 ' | Type SCH 40 PVC

Drilling Company Southwestern Labs | Drilling Method Hollow Stem Auger

Driller B. Christopher | Log By D. Weidemann/S. Ritter | Date Drilled 10/10/87

SKETCH MAP

NOTES

DEPTH (FEET)	GRAPHIC LOG	WELL CONSTRUCTION	SAMPLE TYPE	COHESIVE STRENGTH (tons/sq.ft.) or Penetration Test (Blows per 6")	SAMPLE INTERVAL (FEET)	DESCRIPTION INTERVAL (FEET)	DESCRIPTION/SOIL CLASSIFICATION (COLOR, TEXTURE, STRUCTURE)
75							
80							
85				>4.5 >4.5	83–85.5	83–85.5	SANDY CLAY: Light brownish gray and olive brown, dry, very stiff. (2.5Y 6/2 and 5/6). T.D.=85.5 '
90							
95							
100							

R173

018673

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # B-19
Job # 288-02
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 3/5/85 — Hammer Wt. 140 lbs.
Date Completed 3/5/85 — Hammer Drop 30 in.
Drill Foreman Littel — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method CFA — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 167.8')	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10⁻ cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL - Liquid Limit PL - Plastic Limit SL - Shrinkage Limit
CLAY, very stiff to hard, brown			1	ST				2.2				
(CH)			2	ST				2.0				
(-)200 = 94.2%		5	3	ST				1.5				
Calcareous nodules @ 10 feet			4	ST				1.7				LL=50 PL=20 PI=30
(-)200 = 94.9%		10	5	ST				2.7				
Clayey Silt Layer 14.5 - 15.5 feet			6	ST				2.8				LL=54 PL=21 PI=33
Silt Seams 16 - 21 feet		15	7	ST				4.0				LL=41
			8	ST				3.8				PL=13 PI=28
		20										
SILT, stiff, brown to reddish brown, trace to little sand & clay (ML)			9	ST				2.6				
		25										
Continued on Page 2												

R173

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION 32.2 FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

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

018674

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # B-19
Job # 288-02
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 3/5/85 — Hammer Wt. 140 lbs.
Date Completed 3/5/85 — Hammer Drop 30 in.
Drill Foreman Littel — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method CFA — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 167.8')	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SILT, stiff, brown to reddish brown, trace to little sand and clay (ML)												
SITLY CLAY, stiff to very stiff, brown, with silt seams (CL)		30	10	ST		▽		2.1				
		35	11	ST				1.5				LL=41 PL=15 PI=26
Calcareous nodules @ 39 ft.		40	12	ST				2.2				
SANDY SILT, dense, tannish brown (ML)			13	ST			36					
BORING TERMINATED @ 45'. Note: Boring backfilled with a cement - bentonite grout.		45										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION 32.2 FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

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

R173

018675

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # 20
Job # 288-02
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 3/5/85 — Hammer Wt. 140 lbs.
Date Completed 3/5/85 — Hammer Drop 30 in.
Drill Foreman Littel — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method CFA — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 167.0)	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength qu Tons/Ft.² * Pocket Penetrometer qp Tons/Ft.²	Permeability X 10⁻⁹ cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL - Liquid Limit PL - Plastic Limit SL - Shrinkage Limit
CLAY, very stiff to hard, brown												
Dark gray 5.5 - 9.0 ft. (-)200 = 97.9%			1	ST				2.2				
			2	ST				3.5				LL=77 PL=25 PI=52
(-)200 = 97.1%		5	3	ST				4.5+	8.1	111	19.0	
			4	ST				4.5+				LL=63 PL=19 PI=44
		10	5	ST				3.7				
			6	ST				3.5				
		15	7	ST				3.2				LL=64 PL=25 PI=39
BORING TERMINATED @ 15'												
Note: Boring backfill with a cement - bentonite grout.												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION Dry FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

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

R173

018676

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # B-21
Job # 288-02
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 3/5/85
Date Completed 3/5/85
Drill Foreman Littel
Inspector Brothers
Boring Method CFA
Hammer Wt. 140 lbs.
Hammer Drop 30 in.
Spoon Sampler OD 2 in.
Rock Core Dia. N/A in.
Shelby Tube OD 3 in.

SOIL CLASSIFICATION SURFACE ELEVATION – 166.2	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	TEST DATA: Unconfined Compressive Strength qu Tons/Ft.² * Pocket Penetrometer qp Tons/Ft.²	Permeability x 10⁻⁹ cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, stiff to hard, brown												
Becomes gray @ 5.5 - 7.5ft.			1	ST				2.7				
			2	ST				4.5+				LL=58 PL=23 PI=35
(CH) (-)200= 90.7%		5	3	ST				4.5+				
			4	ST				4.5+				LL=62 PL=22 PI=40
(-)200= 96.6%		10	5	ST				4.5+	8.6	102	21.8	
			6	ST				4.5+				LL=65 PL=23 PI=42
(-)200 = 98.3%		15	7	ST								
BORING TERMINATED @ 15'												
Note: Boring backfilled with a cement bentonite grout.												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION Dry FT.
▼ AFTER HRS. FT.
WATER ON RODS FT.

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

R173

018677

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF BH-30

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. BH-30
Logged By G. Groene/J. Felhaber
Approved By
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/7/85 Date Completed 11/8/85
Method MD Total Depth 106 feet

WELL COMPLETION INFORMATION
Screen Dia. Length Not completed
Slot Size Type grouted to the surface.
Casing Dia. Length

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
0	SURFACE ELEVATION							
	SILTY SANDY CLAY, dark brown.		1	ST	25		2.75	
			2	ST	79			
5	SILTY CLAY, dark brown with calcareous nodules throughout.		3	ST	46		2.4	
			4	ST	50		2.5	
			5	ST	42		3.0	
10	- Olive green mottling present.		6	ST	69		2.5	
	- 5 inch silty clay layer at 13 feet.		7	ST	83		2.5	
15	- Iron nodules present, black.		8	ST	83		3.4	
			9	ST	75			
20			10	ST	88		2.5	
			11	ST	50		3.1	
			12	ST	75		3.6	
25			13	ST	67			
	- Silt inclusions (pockets) at 25 and 29 feet.		14	ST	92		3.4	
			15	ST	67			
30	- Grades into silty sand, brown with iron and calcareous nodules present.		16	ST	NA			
	- Very sandy silt, some clay, grey (6 inches).		17	ST	92		2.2	
	SILTY SAND with some clay, brown, calcareous and iron nodules present. Grey clay pockets throughout.		18	ST	58			
35			19	ST	67			
			20	ST	71			
40	SAND, tan to greyish tan loose, fine grained.		21	ST	33			
			22	ST	50			
	- 5 inch silty sand, tannish grey at 44 feet		23	ST	42			
45	- 3 inch silty clay seam at 46 feet.		24	ST	42			
	SAND AND SILTY CLAY LAYERS. Sand tan, loose clay brownish grey.		25	ST	42			
50			26	SS	29		35/50 for 6"	
	LOOSE SAND AND GRAVEL. 3 inch layer of gravel, 1/2 inch diameter. Layer of coarse sand mixed with 1 inch gravel, sub-rounded, pink to grey to black. 6 inch of coarse sand with a layer of gravel changing back into sand.		27	SS	29		28/50 for 7"	
55			28	SS	54		21/50 for 8"	
56	CONTINUED ON SHEET 2							

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

R173

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF BH-30

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. BH-30
Logged By G. Greene, J. Falhaber
Approved By
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/7/85 Date Completed 11/8/85
Method MD Total Depth 106'
WELL COMPLETION INFORMATION
Screen Dia. Length Not completed
Slot Size Type
Casing Dia. Length

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
	SURFACE ELEVATION CONTINUED FROM SHEET 1							
56	- Grades into silty clay with 1 inch gravel imbedded, yellow. (Driller observation - Larger gravel present but not recovered)		29	ST	83		>4.5	
	CLAY, greenish yellow with gray-blue mottling, calcareous nodules present throughout.		30	ST	42		>4.5	
60			31	ST	50			
			32	ST	92		>4.5	
65			33	ST	54			
			34	ST	50		>4.5	
	- Color change to grey with yellowish green mottling and brown spots, calcareous nodules absent.		35	ST	58		>4.5	
70	- Color change to grey with small amount of red and yellow mottling with some iron and calcareous nodules present.		36	ST	62			
			37	ST	67		>4.5	
75			38	ST	79		>4.5	
	- Very fine grained sand present throughout, becomes more abundant with depth.		39	ST	42		>4.5	
			40	ST	75		>4.5	
80			41	ST SS	WR 21		30for6"	
			42	SS	29		38/50 for 3"	
85			43	SS	33		38/50 for 4"	
			44	ST	38		>4.5	
			45	ST	33		>4.5	
90			46	SS	17		90 for 4"	
	SAND, tan, fine grained.			SS	WR			
95	Drilled 94 to 96, possible siltstone layer.		47	SS ST	WR 33			
	- 0.5 inch lense of silty clay at 96.5 and 97.5 feet.		48	SS	38		39/50 for 6"	
	- Grades into sandy silt, grey.		49	ST	38		>4.5	
100	CLAY, with fine grained sand, brown with grey and blue mottles, a few calcareous nodules			ST	WR			
			50	SS	46			
105	-Clay silt lense, 2 inches thick		51	SS	42			
	TERMINATED BORING AT 106'.							

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

R173

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF BH-31

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. BH-31
Logged By
Approved By G. Greene/J. Falhaber
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/8/85 Date Completed 11/11/85
Method MD Total Depth 104'

WELL COMPLETION INFORMATION
Screen Dia. Length Not completed
Slot Size Type Grouted to surface
Casing Dia. Length

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
0	SURFACE ELEVATION							
	SILTY CLAY, dark brown with calcareous nodules throughout.		1	ST	50		>4.5	
			2	ST	38		>4.5	
5			3	ST	38		>4.5	
			4	ST	46		>4.5	
			5	ST	42		>4.5	
10	- Iron and calcareous nodules abundant.		6	ST	54		>4.5	
			7	ST	42		>4.5	
15			8	ST	46		>4.5	
			9	ST	46		>4.5	
			10	ST	50		>4.5	
20			11	ST	54		3.7	
			12	ST	75		4.0	
25			13	ST	46		4.0	
			14	ST	83		2.7	
			15	ST	50		2.8	
30	- Grades into alternating layers of sand silty clay and clayey sand, reddish brown, some sand and gravel.		16	ST	83		1.0	
			17	ST	71			
35	- 3 inch sand and gravel layer at 36 feet.		18	ST	71			
			19	SS	50			
	- 6 inch sand and gravel layer at 39.5 feet.		20	SS	25			
40			21	SS	4			
	SAND, medium brown, fine grained, loose.		22	SS	33		45/50 for 7"	
45			23	SS	33		15/50 for 6"	
	- 1 inch diameter gravel mixed with sand at 47 feet.		24	SS	33		43/50 for 11"	
	SAND AND GRAVEL, sand is coarse mixed with gravel, gravel is mixed, 1 inch average diameter, angular, pink.		25	SS	33		12/11 for 16"	
50			26	SS	33		21/50 for 9"	
	- 2 inch sandy clay lense at 52 feet.		27	SS	46		13/50 for 11"	
			28	SS	46		28/50 for 8"	
55			29	SS	50		20/50 for 10"	
	- Clay lense at 57 feet.							
58								
	CONTINUED ON SHEET 2							

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

R173

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF BH-31

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288r04 Boring No. BH-31
Logged By G. Greene/J. Felhaber
Approved By
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/8/85 Date Completed 11/11/85
Method MD Total Depth 104'
WELL COMPLETION INFORMATION
Screen Dia. Length
Slot Size Type
Casing Dia. Length

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
	SURFACE ELEVATION							
	CONTINUED FROM SHEET 1							
58	SILTY CLAY, grey with brown mottling, some gravel embedded.		30	ST	75		>4.5	
60	CLAY, grey with brown and bluish mottling, very firm, calcareous nodules present.		31	ST	50		>4.5	
			32	ST	54		>4.5	
65	- Color grades into brownish grey with brown mottling.		33	ST	42		>4.5	
			34	ST	67		>4.5	
			35	ST	71		>4.5	
70	- Color grades into olive green with grey streaks, brown and black mottling.		36	ST	58		>4.5	
			37	ST	54		>4.5	
75			38	ST	46		>4.5	
	- Very fine grain sand is present and becomes more abundant with depth.		39	ST	46		>4.5	
			40	ST	42		>4.5	
80			41	ST	25		>4.5	
			42	ST	42		>4.5	
85			43	ST	29		>4.5	
			44	SS	NR		60/50 for 4"	
	Poor recovery from very resistant layer, drilled 89 to 90 feet, (drillers note - felt like sandstone layer).		45	SS	4			
90			46	DRILLED SS	NR			
	SAND, brown, medium grain. Grades into cemented sand layer, coarse, white.		47	SS	38		100/50 for 7"	
95			48	SS	8		100/50 for 4"	
	Drilled 96 to 98 feet, resistant cemented layer.		49	DRILLED	NR			
	CLAY, with very fine grained sand, olive green with grey mottling, very stiff. Sample pulled out of shelby tube at 102-104 foot interval.		50	SS	75		> 4.5	
100			51	SS	29		> 4.5	
			52	SS	NR			
105	BORING TERMINATED AT 104'.							

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

R173

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF BH-32

Client [redacted]
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. BH-32
Logged By G. Greene
Approved By
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/11/85 Date Completed 11/13/85
Method MD Total Depth 108'

WELL COMPLETION INFORMATION
Screen Dia. Length Not Completed
Slot Size Type Grouted to surface
Casing Dia. Length

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
0	SURFACE ELEVATION							
	SILTY CLAY, dark brown with roots present. Black staining 0 to 4 feet, no order.		1	ST	42		4.1	
			2	ST	42		> 4.5	
5	- Silty clay lense 4 to 5 feet with a trace of sand, brown.		3	ST	42		> 4.5	
			4	ST	42		4.4	
	SILTY SAND, some clay, brown with iron and calcareous nodules present. Interval firm at top, loose at bottom.		5	ST	50			
10	SILTY SANDY CLAY, dark brown with iron nodules, calcareous nodules absent.		6	ST	58		2.0	
			7	ST	58		4.2	
	CLAY, reddish brown with abundant iron and calcareous nodules.							
15	SANDY SILTY CLAY, reddish brown, some iron and calcareous nodules.		8	ST	50		4.2	
			9	ST	38		2.0	
			10	ST	50		2.1	
20	SILTY CLAY, dark brown, iron streaked with large iron nodules, some calcareous nodules present.		11	ST	33		3.3	
			12	ST	46		2.8	
25	- Sandy silty clay lenses, 1 foot thick 27-28 and 29-30 feet.		13	ST	42			
			14	ST	50		3.5	
			15	ST	62		3.5	
30			16	ST	62		3.5	
	- Grades into a color change at 32 feet, grey mottling with some fine grained sand present.		17	ST	58		3.8	
35			18	ST	58		3.2	
			19	ST	54		4.0	
	- Grades into sandy clay, reddish brown, fine grained sand iron and calcareous nodules present.		20	ST	50		3.4	
40			21	ST	75			
	SILTY SAND, reddish brown, fine sand, loose.							
	- 3 inch thick clay lense at 43, 43.5 and 45 feet.		22	ST	50			
45			23	ST	75			
			24	ST	NR			
	- No recovery.							
	- Silty sand, brown, medium grained.		25	SS	33		13/50 for 9"	
50	SAND, brown, coarse grained, rounded. Gravel is common, white and pink, from 1/8 to 1/2 inch some 1 inch diameter.		26	SS	21		22/24 for 15"	
	LOST CIRCULATION		27	SS	8			
55			28	SS	NA		30/50 for 6"	
			29	SS	38		14/24 for 16"	
58	CONTINUED ON SHEET 2							

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

R173

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF BH-32

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. BH-32
Logged By G. Greene
Approved By
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/11/85 Date Completed 11/13/85
Method MD Total Depth 108'

WELL COMPLETION INFORMATION
Screen Dia. Length Not completed
Slot Size Type Grouted to surface
Casing Dia. Length

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
	SURFACE ELEVATION							
	CONTINUED FROM SHEET 1							
58	CLAY, olive green with grey mottling, iron streaks and calcareous nodules present, very tight and brittle.		30	ST	50		>4.5	
60			31	ST	62		>4.5	
			32	ST	71		>4.5	
65			33	ST	54		>4.5	
	(LOST CIRCULATION)		34	ST	12			
	- Iron nodules become present. Fine grained sand throughout.		35	ST	50		>4.5	
70			36	ST	50		>4.5	
			37	ST	50		>4.5	
	- Color change, grades into grey clay with olive green mottling.		38	ST	50		>4.5	
75			39	ST	42		>4.5	
	- Iron nodules becoming more abundant.		40	ST	NR			
	- Fine grained sand increases with depth.		41	SS	38		50/50 for 4"	
80	SILTY SANDY CLAY, gray with olive green mottling, large calcareous nodules, firm.		42	SS	8			
			43	SS	12			
85	- Drillers note Resistant (sandstone) layer 2 inch thick at 86.4 feet.		44	SS	12		100/50 for 3"	
			45	SS	NR		100/50 for 7"	
90	SAND, tan, medium to fine grained, washed and sorted.		46	SS	21		100/50 for 8"	
	- Resistant layer at 92 feet. - Layers of loose sand resistant layers, unable to sample.		47	NOT SAMPLED, DRILLED				
95	SAND with some silt, fine to medium grained, yellowish brown.		48	SS	8		100/50 for 5"	
			49	SS	21		100/50 for 9"	
100	SILTY CLAY, gray with olive green and brown mottling, very stiff, large calcareous nodules.		50	SS	62		> 4.5	
			51	SS	33		> 4.5	
105			52	SS	4			
			53	SS	17		> 4.5	
110	BORING TERMINATED AT 108'.							

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

R173

018683

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

SHEET 1 of 4

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-7
Job # 288-01
Drawn By JDA
Approved By CDS

DRILLING and SAMPLING INFORMATION

Date Started 3/28/84 Hammer Wt. 140 lbs.
Date Completed 3/30/84 Hammer Drop 30 in.
Drill Foreman Littell Spoon Sampler OD 2 in.
Inspector Brothers Rock Core Dia. N/A in.
Boring Method HSA Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION – 165.68	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-8} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, very stiff, brown (CH MH)		1	ST				2.3				LL=83 PL=37 PI=46
SANDY CLAY, stiff, dark gray (CL)		2	ST				-				
becomes reddish brown @ 5 feet	5	3	ST				-	6.6	113	13.2	
(-) 200=51.1%		4	SS			15				10.0	LL=27 PL=14 PI=13
		5	SS			13					
becomes tan @ 9.5 feet	10	6	ST								
(-)200 = 54.3%		7	SS			17				9.9	LL=25 PL=14 PI=11
		8	SS			9					
SANDY SILT/SILTY SAND, compact, brownish tan	15	9	SS			12					
(-)200 = 48.19%		10	SS			11					
		11	SS			11					
		12	SS			13					
	20	13	SS			16					
		14	SS			14					
SAND, compact, brownish tan		15	SS			18					
(-)200 = 9.0%	25	16	SS			18					
Continued on Sheet 2											

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 144 HRS. 34.25 FT.
WATER ON RODS FT.

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

R173

018684

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

SHEET 2 of 4

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-7
Job # 288-01
Drawn By JDA
Approved By CDB

DRILLING and SAMPLING INFORMATION

Date Started 3/28/84
Date Completed 3/30/84
Drill Foreman Littell
Inspector Brothers
Boring Method HSA

Hammer Wt. 140 lbs.
Hammer Drop 30 in.
Spoon Sampler OD 2 in.
Rock Core Dia. N/A in.
Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 165.68)	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SAND, compact, brownish tan with loose and dense seams		17	SS			19					
		18	SS			37					
	30	19	SS			29					
		20	SS			24					
		21	SS			28					
		22	SS		▽	24					
	35	23	SS			7					
(-)200 = 7.8%		24	SS			14					
		25	SS			17					
	40	26	SS			19					
SILTY SAND with gravel 40' to 44'		27	SS			11					
(-)200 = 29.1%		28	SS			17					
	45	29	SS			39					
		30	SS			45					
		31	SS			21					
GRAVEL, compact, tan (-)200 = 0.6%		32	SS			20					
	50										
Continute on Sheet 3											

R173

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 144 HRS. 34.25 FT.
WATER ON RODS FT.

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

018685

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

SHEET 3 of 4

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-7
Job # 288-01
Drawn By JDA
Approved By CDB

DRILLING and SAMPLING INFORMATION

Date Started 3/28/84
Date Completed 3/30/84
Drill Foreman Littell
Inspector Brothers
Boring Method HSA

Hammer Wt. 140 lbs.
Hammer Drop 30 in.
Spoon Sampler OD 2 in.
Rock Core Dia. N/A in.
Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 165.68)	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability x 10^{-8} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
GRAVEL, compact to dense, tan, little sand (-)200 = 5.3%		33	SS			24					
		34	SS			37					
		35	SS			26					
	55	36	SS			30					
SANDY CLAY, (-)200 = 79.0% Very stiff, gray-brown, sand and gravel seam at 60' (CL)		37	SS			83					LL=33 PL=19 PI=14
		38	ST				4.5				
		39	SS			60					
	60	40	SS			131					
		41	ST				4.5	6.6	107	20.7	LL=44 PL=25 PI=19
	65	42	ST				4.5				
		43	ST				4.5	8.8	114	18.8	LL=48 PL=26 PI=22
	70	44	ST				4.5				
		45	ST								
CLAY, very stiff, gray-brown slickensided (CH)		46	ST								LL=66 PL=27 PI=39
	75	47	ST					5.8	109	20.6	

Continued on Sheet 4

R173

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 144 HRS. 34.25 FT.
WATER ON RODS FT.

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

018686

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

SHEET 4 of 4

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-7
Job # 288-01
Drawn By JDA
Approved By CDS

DRILLING and SAMPLING INFORMATION

Date Started 3/28/84 Hammer Wt. 140 lbs.
Date Completed 3/30/84 Hammer Drop 30 in.
Drill Foreman Littell Spoon Sampler OD 2 in.
Inspector Brothers Rock Core Dia. N/A in.
Boring Method HSA Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION – 165.68	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength qu Tons/Ft.² * Pocket Penetrometer qp Tons/Ft.²	Permeability X 10⁻⁸ cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, very stiff, gray-brown slickensided (CH)	80	48	ST								
		49	ST				4.5	2.9	111	20.4	LL=53 PL=24 PI=29
		50	ST				4.5				
SAND, compact to very dense, tan		51	SS			26					
	85	52	SS			115					
silty clay seam 88.3' to 88.9'		53	SS			71					
	90	54	SS			86					
		55	SS			98					
	95										
CLAY, very stiff, gray to light brown, slickensided (CH)		56	SS			34					LL=68 PL=27 PI=41
		57	ST				4.5				
Boring Terminated @ 100'	100										
Well screened 80' to 95'											

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 144 HRS. 34.25 FT.
WATER ON RODS FT.

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

R173

018687

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

SHEET 1 of 2

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-10
Job # 288-01
Drawn By JDA
Approved By CDO

DRILLING and SAMPLING INFORMATION

Date Started 4/2/84 — Hammer Wt. 140 lbs.
Date Completed 4/2/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method HSA — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 166.1)	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10⁻ cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, very stiff, brown	5	1	ST				4.5				
SILTY SAND, compact, reddish brown and tan, with layers of clay and sandy clay	10	2	ST				-				
(-) 200 = 34.7%	15	3	SS			11					
2" clay layer at 19' (-)200 = 90.3%	20	4	SS			11					
Sandy Clay Layer (-)200 = 57.9%	25	5	ST								
Continued on Sheet 2											

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 72 HRS 29.85 FT.
WATER ON RODS FT.

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

R173

018688

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

SHEET 2 of 2

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-10
Job # 288-01
Drawn By JDA
Approved By CDV

DRILLING and SAMPLING INFORMATION

Date Started 4/2/84 — Hammer Wt. 140 lbs.
Date Completed 4/2/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method HSA — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION – 166.1	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² / Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SILTY SAND, compact reddish brown and tan											
	30	6	SS		▽	16					
(-)200 = 15.1%	35	7	SS			12					
	40										
(-)200 = 38.2%		8	SS			22					
Boring Terminated @ 44.5'	45										
Well screened at 28'- 43'											
	50										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 72 HRS. 29.85 FT.
WATER ON RODS FT.

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

018689

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

SHEET 1 of 2

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-12
Job # 288-01
Drawn By JDA
Approved By CDO

DRILLING and SAMPLING INFORMATION

Date Started 4/3/84 — Hammer Wt. 140 lbs.
Date Completed 4/3/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method HSA — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION – 167.0	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, stiff to hard, gray to brown, iron oxide and calcareous nodules (CH)	5	1	ST				1.8				LL=73 PL=31 PI=42
(-)200 = 95.7%	10	2	ST				4.6				LL=73 PL=32 PI=41
	15										
	20	3	ST				3.8				LL=65 PL=29 PI=36
	25										
Continued on Sheet 2											

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 72 HRS. 26.0 FT.
WATER ON RODS FT.

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

018690

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

SHEET 2 of 2

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-12
Job # 288-01
Drawn By JDA
Approved By CDA

DRILLING and SAMPLING INFORMATION

Date Started 4/3/84
Date Completed 4/3/84
Drill Foreman Littell
Inspector Brothers
Boring Method HSA
Hammer Wt. 140 lbs.
Hammer Drop 30 in.
Spoon Sampler OD 2 in.
Rock Core Dia. N/A in.
Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 167.0)	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, stiff, gray to brown, calcareous nodules becomes sandier at 29'					▽						
(-)200 = 89.4% (CL)	30	4	ST				1.8				LL=47 PL=22 PI=25
GRAVEL, compact, tan	35										
(-)200 = 1.5%	40	5	SS			5					
Boring Terminated @ 40'											
Well screened 24' - 40'	45										
	50										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 72 HRS. 26.0 FT.
WATER ON RODS FT.

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

018691

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-13
Job # 288-01
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 6/7/84 — Hammer Wt. 140 lbs.
Date Completed 6/8/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method Rotary Wash — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION

SURFACE ELEVATION – 171.7

Layers of CLAY, SILT, SAND AND SILTY SAND ranging in thickness from 6" to 3'

(-) 200 = 71.2%
(CL-ML)

(-)200 = 69.3

Continued on Sheet 2

Sample No.	Sample Type	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²
1	ST		1.5
2	ST		
3	ST		
4	ST		
5	SS	12	
6	ST		3.5
7	ST		1.7
8	SS	11	

LL=28
PL=13
PI=15

Stratum Depth — DEPTH SCALE: 5, 10, 15, 20, 25

% RECOVERY — GROUND WATER — Permeability X 10⁻ cm/sec. — Natural Dry Density lbs./cu. ft. — Water Content % — LL = Liquid Limit, PL = Plastic Limit, SL = Shrinkage Limit

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 72 HRS. 36.9 FT.
WATER ON RODS FT.

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

018692

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-13
Job # 288-01
Drawn By JDA
Approved By CJO

DRILLING and SAMPLING INFORMATION

Date Started 6/7/84
Date Completed 6/8/84
Drill Foreman Littell
Inspector Brothers
Boring Method Rotary Wash
Hammer Wt. 140 lbs.
Hammer Drop 30 in.
Spoon Sampler OD 2 in.
Rock Core Dia. N/A in.
Shelby Tube OD 3 in.

TEST DATA

SURFACE ELEVATION – 171.7

SOIL CLASSIFICATION	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability x 10^{-8} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
Layers of CLAY, SILT, SAND and SILTY SAND		30										
SANDY CLAY, stiff, tannish brown, trace SILT												
(CL) (-)200 = 62.9		35	9	SS			11					LL=29 PL=11 PI=18
(-)200 = 81.6			10	ST		▽		1.8	5.3	108	20.7	LL=34 PL=15 PI=19
SILTY SAND, loose, tannish brown wet		40										
			11	SS			9					
(-)200 = 51%		45										
		50										
Continued on Sheet 3												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 72 HRS. 36.9 FT.
WATER ON RODS FT.

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

018693

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-13
Job # 288-01
Drawn By JDA
Approved By CNP

DRILLING and SAMPLING INFORMATION

Date Started 6/7/84 Hammer Wt. 140 lbs.
Date Completed 6/8/84 Hammer Drop 30 in.
Drill Foreman Littell Spoon Sampler OD 2 in.
Inspector Brothers Rock Core Dia. N/A in.
Boring Method Rotary Wash Shelby Tube OD 3 in.

SOIL CLASSIFICATION (SURFACE ELEVATION – 171.7)	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² / Pocket Penetrometer q_p Tons/Ft.²	Permeability x 10⁻¹⁰ cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
GRAVEL, compact, tan, trace to little SAND		55										
(-) 200 = 92.0		60	12	ST				4.5	8.1	101	23.4	LL=56 PL=14 PI=42
CLAY, very stiff, light gray to olive, scattered calcareous nodules, slickensided (CH)		65										
		70	13	ST				4.5				
Continued on sheet 4		75										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 72 HRS. 36.9 FT.
WATER ON RODS FT.

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

018694

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-13
Job # 288-01
Drawn By JDA
Approved By CDD

DRILLING and SAMPLING INFORMATION

Date Started 6/7/84
Date Completed 6/8/84
Drill Foreman Littell
Inspector Brothers
Boring Method Rotary Wash

Hammer Wt. 140 lbs.
Hammer Drop 30 in.
Spoon Sampler OD 2 in.
Rock Core Dia. N/A in.
Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION
SURFACE ELEVATION – 171.7

Stratum Depth | DEPTH SCALE | SAMPLE NO. | SAMPLE TYPE | % RECOVERY | GROUND WATER | Standard Penetration Test N, Blows/Ft. | Unconfined Compressive Strength q_u Tons/Ft.² | Pocket Penetrometer q_p Tons/Ft.² | Permeability X 10^{-} cm/sec. | Natural Dry Density lbs./cu. ft. | Water Content % | LL = Liquid Limit, PL = Plastic Limit, SL = Shrinkage Limit

CLAY, very stiff, light gray to olive, scattered calcareous nodules, slickensided

(CH)

80

SAND, compact to dense, tan

85

90

Layers of SAND, SILT, and CLAY

95

100

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 72 HRS. 36.9 FT.
WATER ON RODS FT.

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

018695

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-13
Job # 288-01
Drawn By JDA
Approved By CPS

DRILLING and SAMPLING INFORMATION

Date Started 6/7/84 — Hammer Wt. 140 lbs.
Date Completed 6/8/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method Rotary Wash — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 171.7)	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	* Unconfined Compressive Strength q_u Tons/Ft.² Pocket Penetrometer q_p Tons/Ft.²	Permeability x 10^{-10} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
Alternating layers of SAND, SILT and CLAY		105										
CLAY, very stiff, light gray to brown, slickensided (-)200=92.4 (CH) (-)200=91.9		110	14	SS			15					LL=56 PL=21 PI=35
			15	ST				4.5	4.5	95	27.6	LL=81 PL=22 PI=59
Boring terminated at 114' Well Screened 83'-93'		115										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 72 HRS. 36.9 FT.
WATER ON RODS FT.

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

018696

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Services
Project Location: Waller County, Texas

Boring # W-14
Job # 288-01
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 6/10/84 — Hammer Wt. 140 lbs.
Date Completed 6/10/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method Rotary Wash — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION – 173.1	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² / Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, stiff to very stiff, brown (CH)		5	1	ST				1.5				
(-)200=100%		10	2	ST				3.5				LL=69 PL=19 PI=50
SILT Seam 11' to 11.5'												
SANDY CLAY, very stiff, tannish brown to grayish brown (CL)		15	3	ST				3.0				LL=31 PL=17 PI=14
SANDY SILT, loose, tannish brown (-)200 = 88.6%			4	SS			8					
CLAY, stiff, brown, sand seams		20										
		25										
Continued on Sheet 2												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 24 HRS. 26.2 FT.
WATER ON RODS FT.

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

018697

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Services
Project Location: Waller County, Texas

Boring # W-14
Job # 288-01
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 6/10/84 — Hammer Wt. 140 lbs.
Date Completed 6/10/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method Rotary Wash — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 173.1)	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q/l Tons/Ft.² * Pocket Penetrometer q/p Tons/Ft.²	Permeability X 10⁻ cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, stiff, brown						▽						
SILTY SAND, compact, tan		30 35 40 45										
(-)200 = 10.4%			5	SS			26					
Continued on Sheet 3		50										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 24 HRS 26.2 FT.
WATER ON RODS FT.

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

018698

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Services
Project Location: Waller County, Texas

Boring # W-14
Job # 288-01
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 6/10/84 Hammer Wt. 140 lbs.
Date Completed 6/10/84 Hammer Drop 30 in.
Drill Foreman Littell Spoon Sampler OD 2 in.
Inspector Brothers Rock Core Dia. N/A in.
Boring Method Rotary Wash Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION – 173.1	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive * Strength q_u Tons/Ft.² Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SILTY SAND, compact, tan												
GRAVEL, compact, tan		55										
CLAY, very stiff, light gray to olive brown, slickensided, mottled (CH) (-)200=100%		60										
		65	6	ST				4.5	8.4	101	24.5	LL=66 PL=18 PI=48
		70	7	ST				4.5				
		75										
Continued on Sheet 4												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 24 HRS 26.2 FT.
WATER ON RODS FT.

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

018699

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Services
Project Location: Waller County, Texas

Boring # W-14
Job # 288-01
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 6/10/84 Hammer Wt. 140 lbs.
Date Completed 6/10/84 Hammer Drop 30 in.
Drill Foreman Littell Spoon Sampler OD 2 in.
Inspector Brothers Rock Core Dia. N/A in.
Boring Method Rotary Wash Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION – 173.1	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive * Strength q_u Tons/Ft.² Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, very stiff, light gray to olive brown, slickensided, mottled (CH)		80										
		85										
thin layers of claystone from 91' to 95'		90										
SAND, dense, tan, medium grained		95										
(-)200 = 10.7			8	SS			75					
Continued on Sheet 5		100										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 24 HRS. 26.2 FT.
WATER ON RODS FT.

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

018700

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts — Boring #: W-14
Architect Engineer: — Job #: 288-01
Project Name: Sheridan Disposal Services — Drawn By: JDA
Project Location: Waller County, Texas — Approved By:

DRILLING and SAMPLING INFORMATION

Date Started: 6/10/84 — Hammer Wt.: 140 lbs.
Date Completed: 6/10/84 — Hammer Drop: 30 in.
Drill Foreman: Littell — Spoon Sampler OD: 2 in.
Inspector: Brothers — Rock Core Dia.: N/A in.
Boring Method: Rotary Wash — Shelby Tube OD: 3 in.

SOIL CLASSIFICATION SURFACE ELEVATION – 173.1	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive * Strength q_u Tons/Ft.² Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SAND, dense, tan, medium grained		105										
CLAY, very stiff, light gray to olive brown, mottled (CH) (-)200=91.4%			9	ST				4.5				LL=65 PL=17 PI=48
Boring terminated at 110' Well Screened 92' - 102'		110										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 24 HRS. 26.2 FT.
WATER ON RODS FT.

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

018701

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-15
Job # 288-01
Drawn By JDA
Approved By CDO

DRILLING and SAMPLING INFORMATION

Date Started 6/9/84 Hammer Wt. 140 lbs.
Date Completed 6/9/84 Hammer Drop 30 in.
Drill Foreman Littell Spoon Sampler OD 2 in.
Inspector Brothers Rock Core Dia. N/A in.
Boring Method Rotary Wash Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION −171.7	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10⁻ cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SANDY CLAY, very stiff, tannish brown, with layers of SILT and SAND (CL)		5	1	ST				2.0				
			2	ST				3.3				LL=33 PL=17 PI=16
		10	3	ST				4.4				
SILTY SAND, compact, brown with clay		15	4	SS			12					
		20	5	ST				2.2				LL=36 PL=14 PI=22
		25										
Continued on Sheet 2												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 48 HRS. 38.8 FT.
WATER ON RODS FT.

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

018702

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-15
Job # 288-01
Drawn By JDA
Approved By CDO

DRILLING and SAMPLING INFORMATION

Date Started 6/9/84 — Hammer Wt. 140 lbs.
Date Completed 6/9/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method Rotary Wash — Shelby Tube OD 3 in.

SOIL CLASSIFICATION SURFACE ELEVATION – 171.7	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength qu Tons/Ft.² * Pocket Penetrometer qp Tons/Ft.²	Permeability X 10⁻⁸ cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SILTY SAND, loose, brown, with clay layers		30	6	SS			7					
SANDY CLAY, very stiff, brown, trace to little SILT (-)200 = 61% (CL)		35	7	ST				2.6	3.2	106	21.3	LL=30 PL=17 PI=13
SILTY SAND, loose, tannish brown, wet with layers of SILT and CLAY		40	8			▽		-				
SILTY SAND, compact, brown (-)200 = 32.7%		45										
		50	9	SS			28					
Continued on Sheet 3												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 48 HRS. 38.8 FT.
WATER ON RODS FT.

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

018703

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-15
Job # 288-01
Drawn By JDA
Approved By CDD

DRILLING and SAMPLING INFORMATION

Date Started 6/9/84 — Hammer Wt. 140 lbs.
Date Completed 6/9/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method Rotary Wash — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 171.7)	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability x 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
GRAVEL, compact, tan, little sand		55										
CLAY, very stiff, light gray to olive brown, mottled (CH) (-)200=100%		60	10	ST				4.2				LL=75 PL=22 PI=53
Boring Terminated at 61' Well Screened 61'to 51'		65										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 48 HRS. 38.8 FT.
WATER ON RODS FT.

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

018704

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-16
Job # 288-01
Drawn By JDA
Approved By CDO

DRILLING and SAMPLING INFORMATION

Date Started 6/9/84
Date Completed 6/9/84
Drill Foreman Littell
Inspector Brothers
Boring Method Rotary Wash

Hammer Wt. 140 lbs.
Hammer Drop 30 in.
Spoon Sampler OD 2 in.
Rock Core Dia. N/A in.
Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION – 171.9	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SILTY SAND, compact, tannish brown with SILTY CLAY layers at 10' and 15'			1	ST				-				
		5	2	ST				-				
(-)200=84.9%			3	ST				2.9				LL=34 PL=11 PI=23
(CL)		10										
(-)200=96.3%			4	ST				2.4				LL=29 PL=9 PI=20
(-)200=24.4%		15										
			5	SS			16					
		20										
		25										

Continued on Sheet 2

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 48 HRS. 40.1 FT.
WATER ON RODS FT.

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

018705

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-16
Job # 288-01
Drawn By JDA
Approved By CDO

DRILLING and SAMPLING INFORMATION

Date Started 6/9/84 — Hammer Wt. 140 lbs.
Date Completed 6/9/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method Rotary Wash — Shelby Tube OD 3 in.

SOIL CLASSIFICATION SURFACE ELEVATION – 171.9	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SILTY SAND, compact, tannish brown (-)200=38.6%		30	6	SS			11					
		35										
Layers of SILTY SAND, SILT and CLAY (-)200=19.2%		40	7	SS		▽	9					
(-)200=35.8%		45										
		50	8	SS			18					
Continued on Sheet 3												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 48 HRS. 40.1 FT.
WATER ON RODS FT.

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

018706

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-16
Job # 288-01
Drawn By JDA
Approved By CDO

DRILLING and SAMPLING INFORMATION

Date Started 6/9/84 — Hammer Wt. 140 lbs.
Date Completed 6/9/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method Rotary Wash — Shelby Tube OD 3 in.

SOIL CLASSIFICATION SURFACE ELEVATION – 171.9	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-8} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
Layers of SILTY SAND, SILT and CLAY		55										
GRAVEL, compact, tan												
SILTY CLAY, very stiff, light gray to olive brown (CL) (-)200=98.5%		60	9	ST				4.5	1.0	107	20.8	LL=40 PL=13 PI=27
Boring terminated at 61'		65										

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
∇ AT COMPLETION FT.
▼ AFTER 48 HRS. 40.1 FT.
WATER ON RODS FT.

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

018707

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts — Boring #: W-17
Architect Engineer: — Job #: 288-01
Project Name: Sheridan Disposal Service — Drawn By: JDA
Project Location: Waller County, Texas — Approved By: CDS

DRILLING and SAMPLING INFORMATION

Date Started: 6/11/84 — Hammer Wt.: 140 lbs.
Date Completed: 6/11/84 — Hammer Drop: 30 in.
Drill Foreman: Littell — Spoon Sampler OD: 2 in.
Inspector: Brothers — Rock Core Dia.: N/A in.
Boring Method: Rotary Wash — Shelby Tube OD: 3 in.

SOIL CLASSIFICATION / SURFACE ELEVATION – 170.3	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-6} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SILTY SAND, loose, brown												
SANDY CLAY, very stiff, brownish gray (CL) (-)200=67.5%		5	1	ST				3.6				LL=35 PL=16 PI=19
		10	2	ST				-				
Sandier at 12'		15	3	ST				-	2.3	104	13.0	LL=25 PL=14 PI=11
SILTY SAND, compact brown, with SILT and CLAY layers (-)200=69.3%		20	4	SS				9				
		25										

Continued on Sheet 2

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 504 HRS. 34.5 FT.
WATER ON RODS FT.

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

018708

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-17
Job # 288-01
Drawn By JDA
Approved By CDB

DRILLING and SAMPLING INFORMATION

Date Started 6/11/84 — Hammer Wt. 140 lbs.
Date Completed 6/11/84 — Hammer Drop 30 in.
Drill Foreman Littell — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method Rotary Wash — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION – 170.3)	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SILTY SAND, compact, brown with SILT and CLAY layers		30										
(-)200 = 68.5%		35	5	ST		▽		1.8				LL=31 PL=14 PI=17
		40										
GRAVEL, compact, tan		45										
		50										
Continued on Sheet 3												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 504 HRS. 34.5 FT.
WATER ON RODS FT.

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

018709

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # W-17
Job # 288-01
Drawn By JDA
Approved By CDO

DRILLING and SAMPLING INFORMATION

Date Started 6/11/84 Hammer Wt. 140 lbs.
Date Completed 6/11/84 Hammer Drop 30 in.
Drill Foreman Littell Spoon Sampler OD 2 in.
Inspector Brothers Rock Core Dia. N/A in.
Boring Method Rotary Wash Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION – 170.3	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-7} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
GRAVEL, compact, tan		55										
CLAY, stiff, tan and light gray (-)200 = 99.7%			6	ST				-	7.6		27.6	LL=81 PL=13 PI=68
Boring terminated at 59'		60										
Well Screened 45' - 55'												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 504 HRS. 34.5 FT.
WATER ON RODS FT.

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

018710

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # 22
Job # 288-02
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 3/5/85 — Hammer Wt. 140 lbs.
Date Completed 3/6/85 — Hammer Drop 30 in.
Drill Foreman Littel — Spoon Sampler OD 2 in.
Inspector Brothers — Rock Core Dia. N/A in.
Boring Method CFA/RW — Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION –	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-9} cm/sec	Natural Dry Density lbs./cu ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, very stiff to hard, brown			1	ST				4.5+				LL=48 PL=17 PI=31
Dark gray 3 — 5 ft. (-)200 = 94.2%		5	2	ST				4.5+				
			3	ST				4.5+	2.4	106	22.6	
			4	ST				4.5				
(-)200 = 94.9% (CH)		10	5	ST				4.5+				LL=67 PL=23 PI=44
			6	ST				3.0				
(-)200 = 97.6%			7	ST				3.5				LL=59 PL=23 PI=36
		15										
			8	ST				3.2				
		20										
Ferrous oxide nodules @ 24'			9	ST				3.6				
		25										

Continued on Page 2

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 120 HRS. 27 FT.
WATER ON RODS FT.

BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING
RW = Rotary Wash

018711

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts — Boring #: 22
Architect Engineer: — Job #: 288-02
Project Name: Sheridan Disposal Service — Drawn By: JDA
Project Location: Waller County, Texas — Approved By:

DRILLING and SAMPLING INFORMATION

Date Started: 3/5/85 — Hammer Wt.: 140 lbs.
Date Completed: 3/6/85 — Hammer Drop: 30 in.
Drill Foreman: Littel — Spoon Sampler OD: 2 in.
Inspector: Brothers — Rock Core Dia.: N/A in.
Boring Method: CFA/RW — Shelby Tube OD: 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION –	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² * Pocket Penetrometer q_p Tons/Ft.²	Permeability x 10^{-} cm/sec	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
CLAY, very stiff, brown (CH) Ferrous oxide and calcareous nodules @ 29'		30	10	ST		▽		2.6				
SANDY SILT, compact, tan, with clay seams (ML) (-)200 = 55.6%		35	11	ST								LL=22 PL=16 PI= 6
SAND, compact tan (SM) Gravel 44 - 46 feet		40 45 50										
Continued on Page 3												

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION 27 FT.
▼ AFTER 120 HRS. FT.
WATER ON RODS FT.

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

018712

RESOURCE ENGINEERING INCORPORATED

SUBSURFACE EXPLORATION RECORD

Client: Baker & Botts
Architect Engineer:
Project Name: Sheridan Disposal Service
Project Location: Waller County, Texas

Boring # 22
Job # 288-02
Drawn By JDA
Approved By

DRILLING and SAMPLING INFORMATION

Date Started 3/5/85
Date Completed 3/6/85
Drill Foreman Littel
Inspector Brothers
Boring Method CFA/RW
Hammer Wt. 140 lbs.
Hammer Drop 30 in.
Spoon Sampler OD 2 in.
Rock Core Dia. N/A in.
Shelby Tube OD 3 in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION –	Stratum Depth	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.² Pocket Penetrometer q_p Tons/Ft.²	Permeability X 10^{-} cm/sec.	Natural Dry Density lbs./cu. ft.	Water Content %	LL = Liquid Limit PL = Plastic Limit SL = Shrinkage Limit
SAND, compact tan (SM)												
CLAY(CH),stiff, olive green (-)200 = 94.9%		55	12	ST								LL=74 PL=23 PI=51
BORING TERMINATED @ 57'		60										

Note: a) Boring drilled dry to 20'.
b) Boring was converted to well W-19.
c) Screen set 31 - 56 ft.

SAMPLER TYPE
SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION FT.
▼ AFTER 120 HRS. 27 FT.
WATER ON RODS FT.

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

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF MW-20

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288.04 Boring No. MW-20
Logged By G. Groane
Approved By
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/14/85 Date Completed 11/18/85
Method MD Total Depth 100'

WELL COMPLETION INFORMATION
Screen Dia. 4 inches Length 12.5'
Slot Size 0.01 inches Type PVC schd 40
Casing Dia. 4 inch Length 85'

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
	SURFACE ELEVATION							
0	SILTY CLAY, chocolate brown, iron streaked, roots and shells present.		01	ST	21		1.3	
			02	ST	29		1.8	
5			03	ST	58			
	CLAY, reddish brown, iron streaked with calcareous nodules, firm, stiff.		04	ST	58		>4.5	
	SANDY SILTY CLAY, reddish brown, calcareous nodules.		05	ST	25		>4.5	
10			06	ST	50			
	- Grades into silty sand, tan, very fine grained. Silty clay lense at 14.5 feet, 8 inches thick. Grades into a silty clay.		07	ST	58			
15			08	ST	67			
			09	ST	83		3.0	
	SILTY CLAY, brown with grey mottling, iron streaked.		10	ST	33		4.0	
20			11	ST	54			
			12	ST	42			
	SILTY SAND, reddish tan, fine grained, loose.		13	ST	62			
25	- Sandy silt lense at 26 feet.		14	ST	50			
	- Frequent fingers of silt and clay.		15	ST	62			
	- Silty clay lense at 29 feet, 2 inches thick.		16	SS	58			
30	- Grey sand partings 30 to 32 feet.		17	SS	NR			
			18	SS	50			
35	- Sandy, clayey silt, dark grey at 36 to 37 feet		19	SS	N/A			
	- Grades into sand, brown, medium to coarse grained.		20	SS	21			
40			21	SS	25		38/50 for 6"	
			22	SS	33		11/50 for 9"	
	- Very fine grained sand, white-grey at 43 to 44 feet.		23	SS	29		18/50 for 10"	
45	- Clay inclusions at 46 feet.		24	SS	21			
			25	SS	33			
50	Gravel mixed with sand, from 50 to 54 feet. Gravel pink to white, rounded, 1/4 inch to 1 inch diameter.		26	SS	N/A		22/13 for 17"	
			27	SS	33		9/8 for 10"	
55	CLAY, olive green with grey mottling.		28	ST	38		3.3	
			29	ST SS	NR 8			
58								
	CONTINUED ON SHEET 2							

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF MW-20

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. MW-20
Logged By G. Groene
Approved By
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/14/85 Date Completed 11/18/85
Method MD Total Depth 100'

WELL COMPLETION INFORMATION
Screen Dia. 4 inch Length 12.5'
Slot Size 0.01 inch Type PVC schd 40
Casing Dia. 4 inch Length 85'

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
	SURFACE ELEVATION							
	CONTINUED FROM SHEET 1							
58	CLAY, olive green with grey mottling, very stiff and brittle.		30	ST	75		2.0	
60	- Color change, grades to grey with olive green red mottling.		31	ST	58		> 4.5	
	- Fine grained sand present.		32	ST	67		> 4.5	
65			33	ST	54		> 4.5	
			34	ST	25		> 4.5	
	- Lense from 67.5 to 70 feet, olive green with grey mottling		35	ST	42		> 4.5	
70	- Calcareous nodules present.		36	SS	25		11/12 for 22"	
	- Sand increasing with depth.		37	ST	75		> 4.5	
75			38	ST	100		> 4.5	
			39	ST	50		> 4.5	
	- Grades into a color change, grey with olive green mottling.		40	ST	75		> 4.5	
80			41	ST	50		> 4.5	
			42	ST	50		> 4.5	
85	SANDY CLAY, grey with olive green mottling.		43	ST	58		> 4.5	
			44	ST	58		> 4.5	
	SAND, greyish brown grading into a tan, medium to fine grained		45	SS	21		70/50 for 7"	
90	- Clayey sand lense 93-94 feet.		46	SS	25		20/50 for 6"	
			47	SS	25		32/50 for 8"	
95	- Grades into a clayey sand, brown with grey mottling, sand partings.		48	SS	21		25/50 for 5"	
			49	SS	33		32/50 for 8"	
	CLAY, carmel brown with grey mottling, some fine grained sand, iron streaked.		50	ST	62		> 4.5	
100	BORING TERMINATED AT 100'.							

WELL COMPLETION DETAILS

TD - 98'
Screen - 97.5' - 85.0'
Sand - 97.5' - 81'
Bentonite Seal - 81' - 75'
Grouted to surface.

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

018715

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

Sheet 1 of 1

LITHOLOGIC LOG AND CONSTRUCTION OF MW-22

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. MW-22
Logged By G. Greene
Approved By
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/20/85 Date Completed 11/21/85
Method MD Total Depth 101'

WELL COMPLETION INFORMATION
Screen Dia. 2 inch Length 15'
Slot Size 0.01 inch Type PVC schd 40
Casing Dia. 2 inch Length 85'

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
	HOLE DRILLED TO 80 FEET WITHOUT SAMPLING							
80	CLAY with fine grained sand, olive green with grey mottling, calcareous nodules present, very stiff.		01	ST	75		>4.5	
			02	ST	50		>4.5	
85	SANDY CLAY, tannish-grey, fine grained. Thin clay seams frequent.		03	ST	38		>4.5	
			04	SS	17		75/50 for 4"	
	- Drillers note - 2 inch sandstone layer at 87.5 feet.		05	SS	<1		100/50 for 3"	
90	- Sandy clay seam, 6 inches thick at 91 feet.		06	SS	38		19/50 for 9"	
			07	SS	50		36/50 for 2"	
95	SAND, brown, fine grained became coarse with depth, some pebbles present. Several thin layers of grey clay.		08	SS	17		38/50 for 4"	
			09	SS	21		30/50 for 3"	
			10	SS	NA		36/50 for 5"	
100	CLAY, with fine grained sand, greenish with olive green mottling, frequent sand partings.		11	ST	100		>4.5	
	BORING TERMINATED AT 101'.							

WELL COMPLETION DETAILS

TD - 101 feet
Screen - 100 - 85
Sand - 100 - 80
Seal - 80 - 75
Grouted to surface

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF MW-26

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. MW-26
Logged By C. Groene
Approved By
Drilled By J. Turner

DRILLING AND SAMPLING INFORMATION
Date Started 11/21/85 Date Completed 12/2/85
Method MD Total Depth 100'

WELL COMPLETION INFORMATION
Screen Dia. 2 inch Length 15'
Slot Size 0.01 inch Type PVC schd 40
Casing Dia. 2 inch Length 83.5'

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
	HOLE DRILLED TO 82 FEET WITHOUT SAMPLING							
82	CLAY with fine sand throughout, grey with olive green mottling, calcareous nodules.		01	ST	50		> 4.5	
85	SANDY SILTY CLAY, with sand partings.		02	ST	79		4.5	
	- 4 inch layer of sandstone, drilled from 86 to 87 feet.			DRILLED				
	SANDY CLAY, tan, fine to medium grained sand, some gravel present.		03	SS	67		50/50 for 4"	
90	- Several thin sand lenses.		04	SS	17		36/50 for 5"	
	- Several thin clay lenses.		05	SS	58		94/50 for 5"	
	SAND, grey, medium grained sand. Gravel present in sluff		06	SS	8		78/50 for 3"	
95			07	SS	12		90/50 for 6"	
	SILTY CLAY, some silt lenses, brown with grey mottling, very stiff.			NO SAMPLE DRILLED				
	Resistant layer at 98 feet, drilled to 98.5 feet.		08	ST	75		> 4.5	
100	BORING TERMINATED AT 100'.							

WELL COMPLETION DETAILS

TD - 98.5'
Screen - 98.5 - 83.5'
Sand - 98.5 - 78
Seal - 78 - 75
Grouted to surface

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF MW-27

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. MW-27
Logged By G. Groene
Approved By
Drilled By D. F.

DRILLING AND SAMPLING INFORMATION
Date Started 11/22/85 Date Completed 11/26/85
Method MD Total Depth 102'

WELL COMPLETION INFORMATION
Screen Dia. 2 inch Length 12'
Slot Size 0.01 inch Type PVC schd 40
Casing Dia. 2 inch Length 85'

DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
	SURFACE ELEVATION							
	HOLE DRILLED TO 82 FFET WITHOUT SAMPLING							
82	CLAY, with abundant fine grained sand, olive green with grey mottling, firm, pink tint at 83 feet.		01	ST	54		> 4.5	
	- Becomes sandy, small pebbles present.							
85			02	ST	92		> 4.5	
	SANDY CLAY, olive green with grey mottling grading to brown with grey mottling. Some pebbles and small gravel present in clay.		03	ST	92		> 4.5	
			04	SS	62		3.5	
90	- Sand lense 90 to 90.5, medium grained.							
	- Sand lense 2 inch thick at 91 feet.		05	ST	79		> 4.5	
	- Sand lense 2 inches at 92.2 feet, 3 inches at 92.5 feet, partings at 93.0, 93.3, 93.5 feet.		06	ST	92		> 4.5	
	- Sand lense at 94.5 to 95.0 feet, medium grained.							
95			07	ST	67		4.5	
	- Becomes clayier with depth.		08	ST	100		> 4.5	
	CLAY with fine sand, grey with olive green mottling, calcareous nodules present.		09	ST	50		> 4.5	
100			10	ST	54		> 4.5	
	BORING TERMINATED AT 102'.							

WELL COMPLETION DETAILS

TD - 102'
Screen - 97 - 85'
Sand - 97 to 85'.
Seal 84 to 82'.
Grouted to surface.

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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

018718

RESOURCE ENGINEERING
SUBSURFACE EXPLORATION

LITHOLOGIC LOG AND CONSTRUCTION OF MW-28

Client
Project Name Sheridan Disposal Site
Project Location Waller County, Texas
Job No. 288-04 Boring No. MW-28
Logged By G. Greene
Approved By
Drilled By D. F.

DRILLING AND SAMPLING INFORMATION
Date Started 11/26/85 Date Completed 11/27/85
Method MD Total Depth 98'

WELL COMPLETION INFORMATION
Screen Dia. 2 inch Length 12.5'
Slot Size 0.01 inch Type PVC schd 40
Casing Dia. 2 inch Length 85.5'

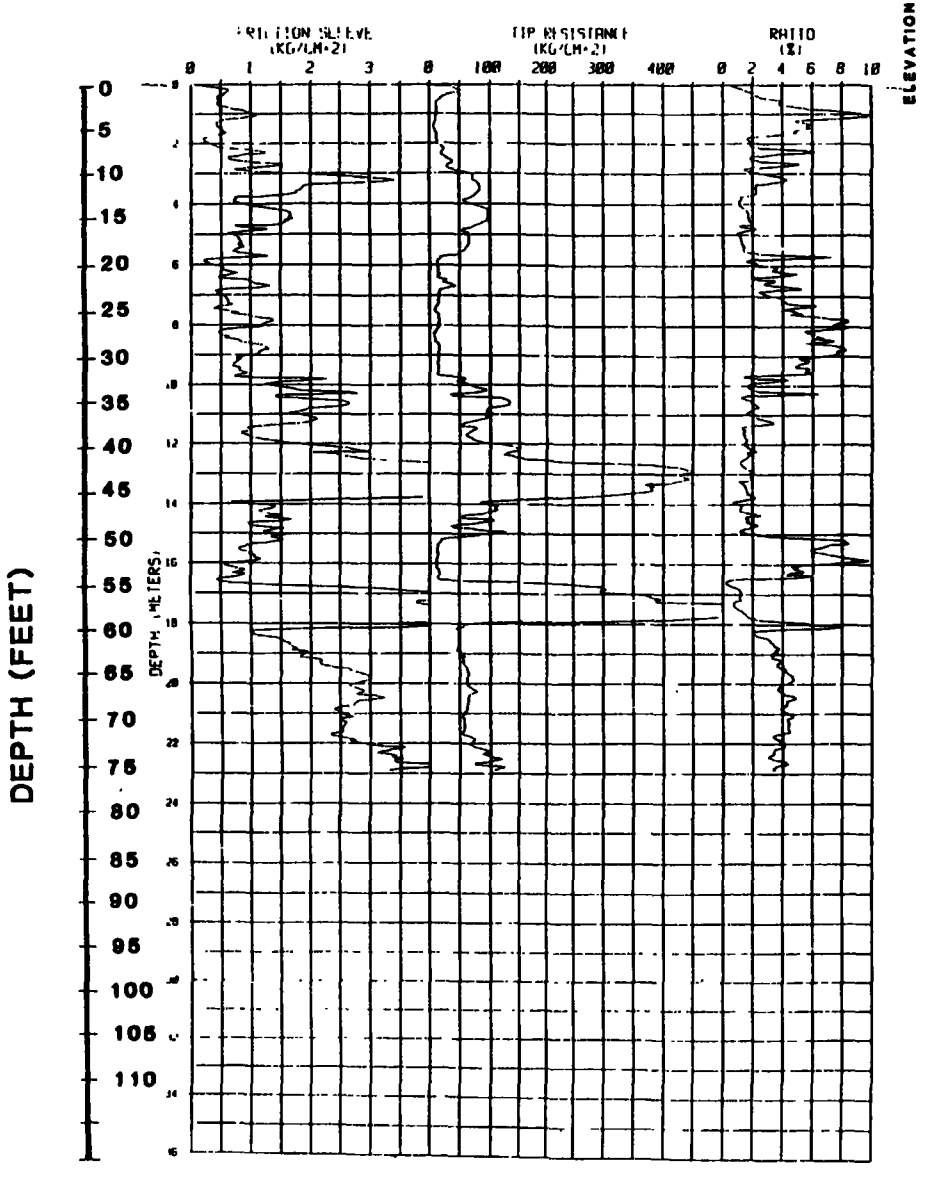
DEPTH IN FEET	DESCRIPTION	STRATUM ELEVATION IN FEET	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GRAPHIC LOG	POCKET PENETROMETER /BLOW COUNT	WATER LEVEL
	SURFACE ELEVATION							
	HOLE DRILLED TO 82 FEET WITHOUT SAMPLING							
82	CLAY with fine sand throughout, olive green with grey mottling, calcareous nodules, very stiff.		01	ST	50		>4.5	
85			02	ST	71		>4.5	
	SANDY CLAY grading into clayey sand, grey with brown mottling, calcareous nodules abundant.		03	ST	92		4.3	
	SAND, fine grained grading into medium grained, tan-brown. - Sandy clay lense 3 inches thick at 89 feet.		04	SS	RA		20/50 for 4"	
90			05	SS	17		18/50 for 6"	
			06	SS	17		25/50 for 4"	
95			07	SS	8		50/50 for 4"	
	END OF SAMPLING Drillers note, clay at 97.5'							
	BORING TERMINATED AT 98'							

WELL COMPLETION DETAILS

TD - 98
Screen - 98 - 85.5'
Sand - 98 to 83'
Seal - 83 to 81'
Grouted to surface.

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON CA - CONTINUOUS FLIGHT AUGER
ST - PRESSED SHELBY TUBE RC - ROCK CORE

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



172.26 ✓

DESCRIPTION

SAND

CLAY

LAYERS of SAND and SANDY CLAY

SAND

LAYERS OF SANDY CLAY, SAND AND SANDY SILT

CLAY

LAYERS OF SAND AND SANDY CLAY

SAND, SILT AND GRAVEL

CLAY

GRAVEL

SANDY SILT SEAM CLAY

Depth = 75.4'

NOTES

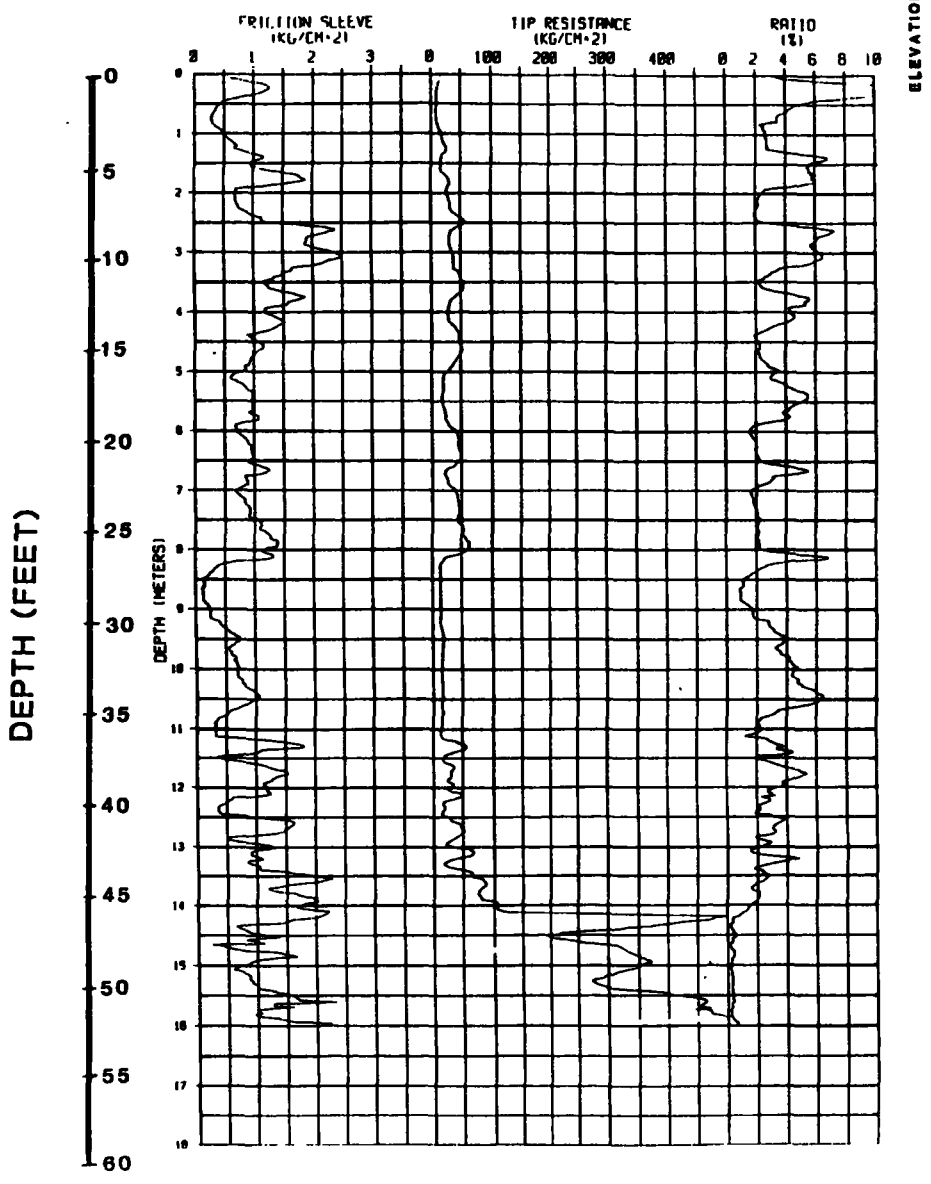
1. Test performed according to ASTM 3441-75T.
2. 1.0 kg/cm^2 ≅ 1.0 ton/ft^2
3. 1.0 meter ≅ 3.28 feet

REV	DESCRIPTION	DATE	BY

RESOURCE ENGINEERING INC.
ENVIRONMENTAL CONSULTANTS
HOUSTON TEXAS

Cone Penetrometer Data
Location C 3
Sheridan Disposal Services

DRAWN BY	DATE	PROJECT NO
JDA	4/18/84	288-01
	As Indicated	



DESCRIPTION

- CLAY WITH SILT, SAND AND SILTY SAND LAYERS
- SAND WITH CLAY and SILT SEAMS
- CLAY
- LAYERS OF SILT, SAND and CLAY
- SAND AND GRAVEL
- Depth = 52.5'

NOTES

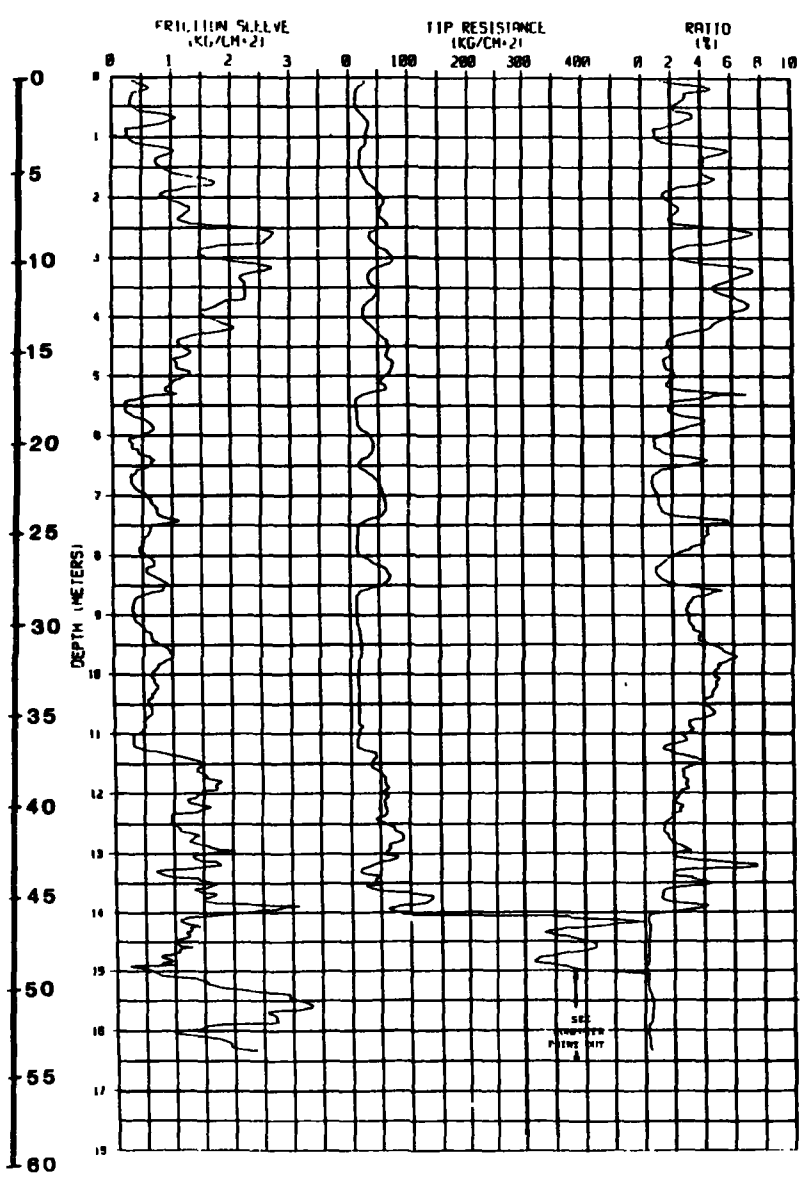
1. Test performed according to ASTM 3441-75T
2. 1.0 kg/cm^2 ≅ 1.0 ton/ft^2
3. 1.0 meter ≅ 3.28 feet

REV	DESCRIPTION	DATE	BY

RESOURCE ENGINEERING INC.
ENVIRONMENTAL CONSULTANTS
HOUSTON, TEXAS

Cone Penetrometer Data
Location C-7
Sheridan Disposal Services

DRAWN BY	DATE	PROJECT NO
JDA	7/23/84	288-01
	AS Indicated	



ELEVATION

171.11

DESCRIPTION

CLAY WITH LAYERS OF SILT AND SAND

SAND WITH CLAY LAYERS

CLAY

LAYERS OF SAND, SILT AND CLAY

GRAVEL

Depth = 53.5'

NOTES

1. Test performed according to ASTM 3441-75T
2. 1.0 $kg/cm^2 \cong 1.0$ ton/ft^2
3. 1.0 meter $\cong$ 3.28 feet

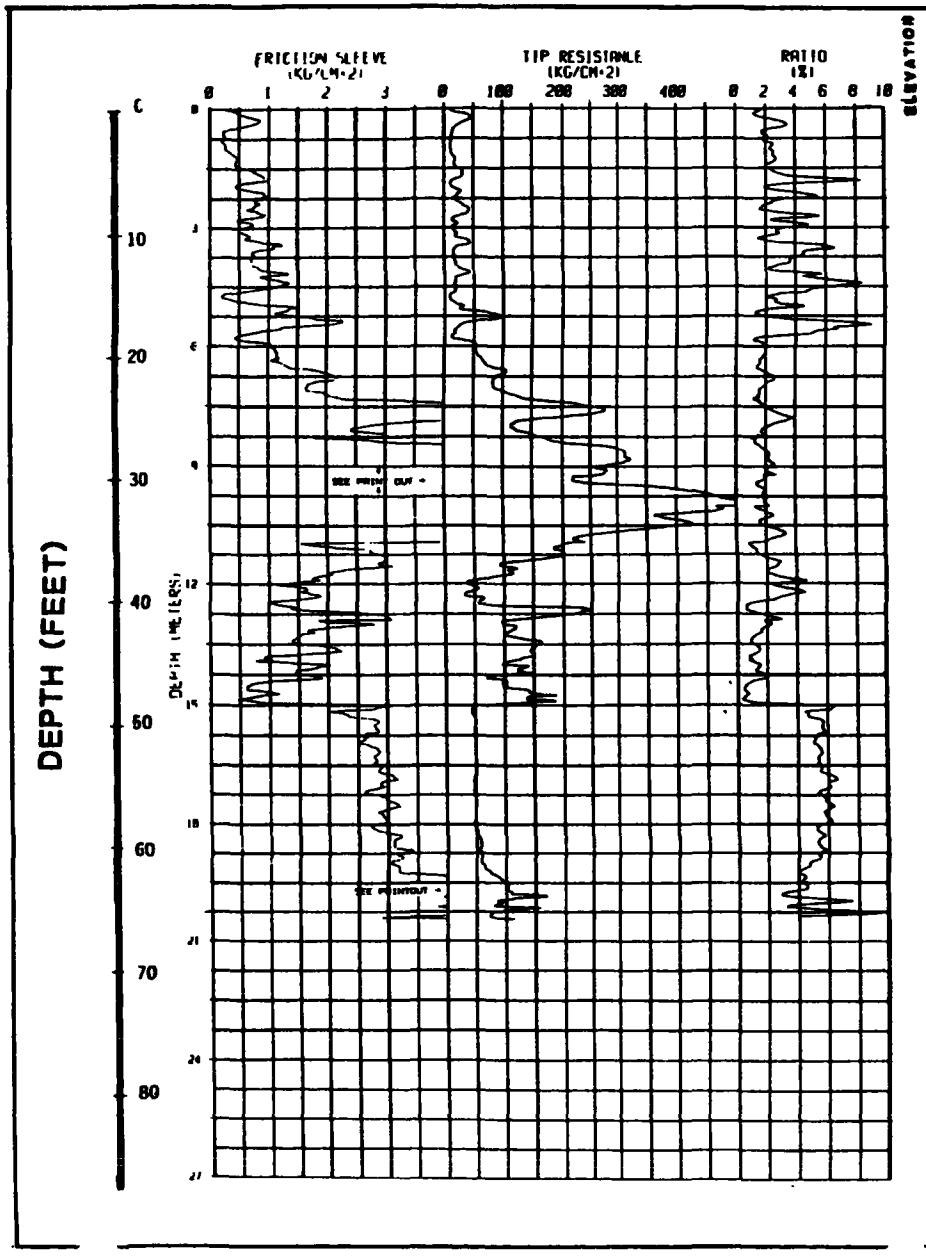
REV	DESCRIPTION	DATE	BY

RESOURCE ENGINEERING INC.
ENVIRONMENTAL CONSULTANTS
HOUSTON TEXAS

Cone Penetrometer Data
Location C-9
Sheridan Disposal Services

DRAWN BY	DATE	PROJECT NO
JDA	7/23/84	288-01
CHECKED	SCALE	
	As Indicated	

A-63



DESCRIPTION

165.34

LAYERS OF SAND, CLAYEY SAND, SILT CLAY AND GRAVEL

SILT SEAM

SAND

CLAY

Depth = 66.9'

NOTES

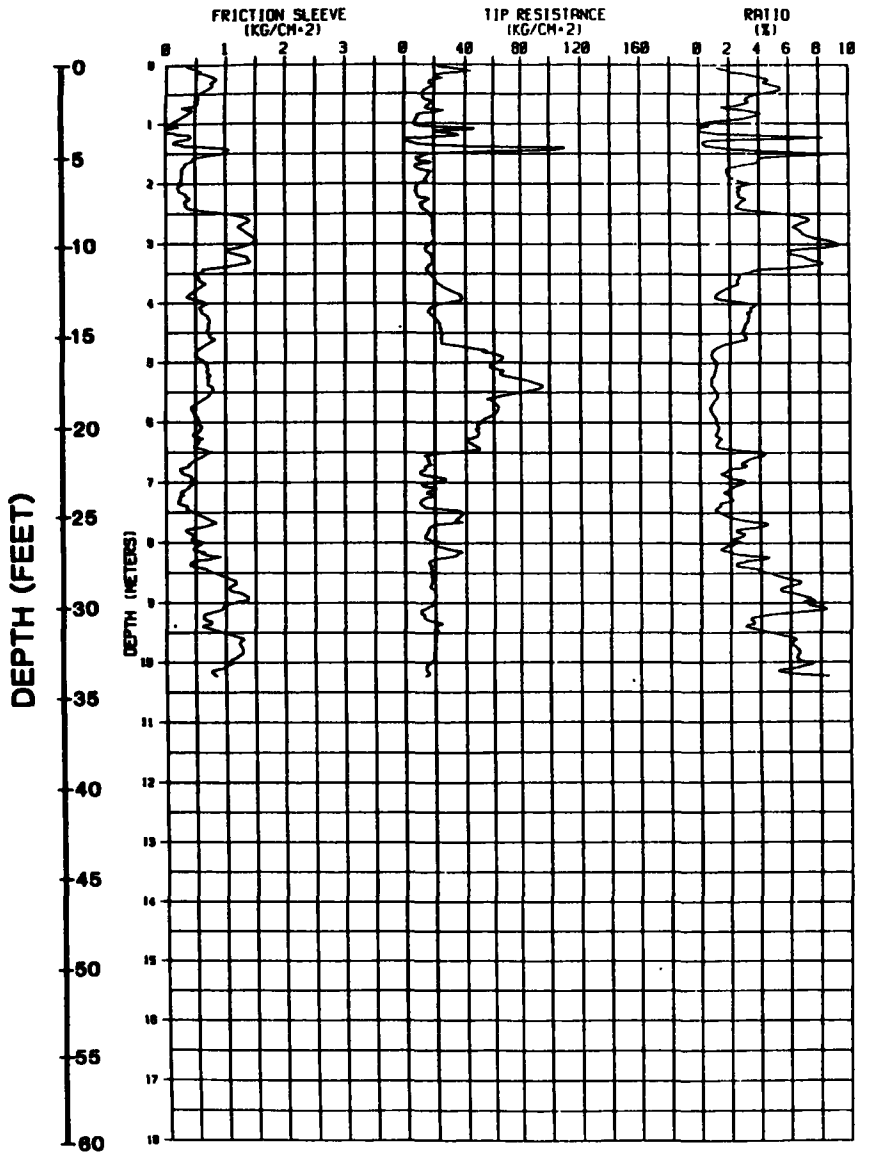
1. Test performed according to ASTM 3441-75T
2. 1.0 kg/cm^2 ≈ 1.0 ton/ft^2
3. 1.0 meter ≈ 3.28 feet

REV	DESCRIPTION	DATE	BY

RESOURCE ENGINEERING INC.
ENVIRONMENTAL CONSULTANTS
HOUSTON TEXAS

Cone Penetrometer Data
Location C-14
Sheridan Disposal Service

DRAWN BY	DATE	PROJECT NO
JDA	7/23/84	288-01
CHECKED	SCALE	DRAWING NO
CDS	As Indicated	



ELEV. 177.2

DESCRIPTION

DIKE FILL

CLAY

SAND WITH SILT AND CLAY LAYERS

Depth = 33.5'

NOTES

1. Test performed according to ASTM 3441-75T
2. 1.0 Kg/cm^2 = 1.0 tsf
3. 1.0 meter ≅ 3.28 feet

RESOURCE ENGINEERING INC.
ENVIRONMENTAL CONSULTANTS
HOUSTON, TEXAS

Cone Penetrometer Data
Location C-15
Sheridan Disposal Service

DRAWN BY	DATE	PROJECT NO
JDA	7/26/84	288-01
CHECKED	SCALE	DRAWING NO
CJR	As Indicated	

F873

SUMMARY OF WELL DEVELOPMENT
MONITORING WELLS INSTALLED FOR THE CWRI
SHERIDAN DISPOSAL SERVICES SITE

Well Number	Diameter (inches)	Volumes Removed (gallons)			Range of pH	Range of Specific Conductance	Range of Temperature	Final pH	Final SC	Water Clarity
		Air Lift	Submersible	Total						
MW-30	2	4200	-	4200	7.8-8.1	550-650	22.5-23	8.0	640	Clear to Sl. Cloudy
MW-31	4	14850	1850	16500	6.45-8.1	1025-1300	22-23	6.7	1025	Slightly Cloudy
MW-32	4	8000	1400	9400	6.5-7.8	2860-3520	21.5-23	6.7	2920	Slightly Cloudy
MW-33	2	6500	-	6500	7.3-7.9	460-701	23	7.9	680	Slightly Cloudy
MW-34	4	1850	1650	3500	6.75-8.15	1430-1630	22.5-25	6.9	1590	Clear
MW-35	2	6200	-	6200	7.0-7.65	657-754	22.5-23	7.7	740	Clear to Sl. Cloudy
MW-36	4	2750	1650	4400	6.60-8.16	1004-1300	23-24	6.7	1190	Slightly Cloudy
MW-37	4	1300	1900	3200	6.55-8.0	970-1370	25-26	6.8	1370	Slightly Cloudy
MW-38	2	4200	-	4200	6.86-8.0	976-1640	23-28	7.7	1300	Cloudy
MW-39	4	400	1200	1600	5.9-8.0	1198-1542	23-27.5	6.0	1520	Slightly Cloudy
MW-40	4	1200	-	1200	7.49-8.12	586-710	24-25	8.0	655	Clear

F874

Summary of Redevelopment of Wells
Installed Before 1987 and Sampled
For the First Priority Pollutant Sampling

October 1987
Sheridan Disposal Services Site

Well Number	Date	Volumes Removed (gallons) Air Lift	Submersible	Total	pH	Specific Conductance	Temperature	Water Clarity
MW-6	10/23/87	550	-	550	7.4-8.0	981-1090	NR	NR
MW-7	10/20-22/87	700	1200	1900	6.87-6.97	690-744	21-22	NR
MW-10	10/22/87	Nearly Dry - Air Lift Not Effective			-	-	-	-
MW-12	10/22/87	200	-	200	8.15	985	23	Slightly Cloudy
MW-13	10/28/87	100	-	100	NR	NR	NR	Clear
MW-18	10/27/87	100	-	100	NR	NR	NR	Clear
MW-19	10/23/87	1500	-	1500	7.39	1024-1043	21	Cloudy
MW-29	10/24-26/87	700	-	700	7.8	800	25	Cloudy

NOTES:
NR = Not Recorded

APPENDIX B

Analytical Results of Water Used During Field Activities at the SDS Site

Rocky Mountain
Analytical Laboratory

Enseco Incorporated

Enseco

ANALYTICAL RESULTS

FOR

ERM-SOUTHWEST, INC.

SEPTEMBER 3, 1987

Reviewed by:

Jean Zimmerman

Jerry L. Parr

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611

Facsimile: 303/431-7171

Introduction

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

- Sample Description Information
- Analytical Tests Assigned
- Analytical Results
- Quality Control Report
- Description of Analytical Methodology

The list of volatiles and semivolatiles have been modified to meet your requirements for this sample.

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Enseco - RMAL is assigned a unique five digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the five digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Tests Assigned

The Analytical Tests Assigned Table presents all of the tests assigned to each of the samples in the project. The tests are listed in the order in which data is presented.

In addition to a test description, information is provided concerning whether the test has been changed, or customized, to accommodate specific needs of the client. Customization can involve changes in the analyte list (addition or deletion of standard analytes) or changes in the standard detection limit.

Analytical Results

The analytical results for this project are presented in the following data tables. The results are presented by sample, by test, as shown in Analytical Tests Assigned.

Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Enseco reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content. All data is "blank corrected", i.e. the level of contamination, if any, found in the laboratory blank is subtracted from the analytical result before it is reported.

The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is provided subsequently.

Quality Control Results

The Enseco laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

In addition, the Enseco laboratories maintain a comprehensive set of certifications from both state and federal governmental agencies which require frequent analyses of blind audit samples. Enseco - Rocky Mountain Analytical Laboratory is certified by the EPA under the EPA/CLP program for both Organic and Inorganic analyses, under the USATHAMA (U.S. Army) program, by the Army Corps of Engineers, and the states of Colorado, New Jersey, New York, Utah, and Florida, among others.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

The Enseco QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of duplicate Laboratory Control Samples (LCS) at frequent, well-defined intervals. An LCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the LCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate LCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For Organic analyses an additional control measure is taken in the form of a Surrogate Control Sample (SCS). The SCS is a control sample spiked with surrogate standards which is analyzed with every analytical lot. The recovery of the SCS is charted in exactly the same manner as described for the LCS, and provides a daily check on the performance of the method.

Accuracy for LCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for LCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{\text{Measured Concentration LCS1} - \text{Measured Concentration LCS2}}{(\text{Measured Concentration LCS1} + \text{Measured Concentration LCS2})/2}$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, LCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report. The test codes assigned are defined in Section VI., Analytical Methodology.

Analytical Methodology

Enseco - Rocky Mountain Analytical Laboratory performs analytical services according to methods approved by EPA and other regulatory agencies, whenever possible.

Methods for metals and organic compounds are primarily derived from three sources of EPA methods, 1) the methods promulgated in 40 CFR 136 for priority pollutants, 2) the methods published in SW-846 and 3) methods developed by the EPA-EMSL/LV for Superfund investigations, as well as several documents published by the EPA and Enseco - Rocky Mountain Analytical Laboratory in 1984 and 1985. These methods all use the same generic technology as summarized below:

- Metals: acid digestion followed by analyses by ICP supported by graphite furnace AA
- Volatile Organics: purge and trap GC/MS or purge and trap GC with a selective detector.
- Semivolatile (base/neutral and acid) organics: solvent extraction followed by capillary column GC/MS, and
- Pesticides/Herbicides: solvent extraction, followed by gas chromatography.

Exact method references are provided in the Analytical Methodology Tables.

Analytical Results

The analytical results for this project are presented in the following data tables. The results are presented by sample, by test, as shown in Analytical Tests Assigned.

Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Enseco reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content. All data is "blank corrected", i.e. the level of contamination, if any, found in the laboratory blank is subtracted from the analytical result before it is reported.

The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is provided subsequently.

Enseco

SAMPLE DESCRIPTION INFORMATION

for

ERM SOUTHWEST INC

RMAL Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
64198-001	SHERIDAN WELL WATER	Water	07/30/87	08/01/87

Enseco

ANALYTICAL TESTS ASSIGNED

for

ERM SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64198-001	PRIORITY POLLUTANT VOLATILE ORGANICS	YES
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	YES
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA	
	TOTAL METALS	NO
	ARSENIC, FURNACE AA	
	TOTAL METALS	NO
	LEAD, FURNACE AA	
	TOTAL METALS	NO
	SELENIUM, FURNACE AA	
	TOTAL METALS	NO
	THALLIUM, FURNACE AA	
	TOTAL METALS	NO
	PRIORITY POLLUTANT METALS	
	TOTAL METALS	NO
	CORROSIVITY BY PH	NO
	SPECIFIC CONDUCTANCE	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

Enseco

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM SOUTHWEST INC

Client ID: SHERIDAN WELL WATER

Laboratory ID: 64198-001 Enseco ID: 64198-001

Matrix: Water Sampled: 07/30/87 Received: 08/01/87

Authorized: 08/02/87 Prepared: 08/04/87 Analyzed: 08/05/87

Parameter	Result	Units	Reporting Limit
Acrolein	N.D.	ug/L	100
Acrylonitrile	N.D.	ug/L	100
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethylvinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethylbenzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethylene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethylene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0
Trichlorofluoromethane	N.D.	ug/L	5.0
Dichlorodifluoromethane	N.D.	ug/L	10

N.D. = Not detected

1

Sample: 64198-001

Enseco

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM SOUTHWEST INC

Client ID: SHERIDAN WELL WATER

Laboratory ID: 64198-001 Enseco ID: 64198-001

Matrix: Water Sampled: 07/30/87 Received: 08/01/87

Authorized: 08/02/87 Prepared: 08/04/87 Analyzed: 08/05/87

Parameter	Result	Units	Reporting Limit
1,2-Dichloropropene	N.D.	ug/L	5.0
bis(Chloromethyl)ether	N.D.	ug/L	10
Surrogate			
Toluene-D8	104	%	-
Bromofluorobenzene	99	%	-
1,2-Dichloroethane-D4	102	%	-

N.D. = Not detected

Reported by: Stephen Siegal Approved by: Michael Brooks

Enseco

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM SOUTHWEST INC

Client ID: SHERIDAN WELL WATER

Laboratory ID: 64198-001 Enseco ID: 64198-001

Matrix: Water Sampled: 07/30/87 Received: 08/01/87

Authorized: 08/02/87 Prepared: 08/04/87 Analyzed: 08/20/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzidine	N.D.	ug/L	20
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butyl benzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10

N.D. = Not detected

Enseco

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM SOUTHWEST INC

Client ID: SHERIDAN WELL WATER

Laboratory ID: 64198-001 Enseco ID: 64198-001

Matrix: Water Sampled: 07/30/87 Received: 08/01/87

Authorized: 08/02/87 Prepared: 08/04/87 Analyzed: 08/20/87

Parameter	Result	Units	Reporting Limit
Fluorene	N.D.	ug/L	10
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodimethylamine	N.D.	ug/L	10
N-Nitroso-dipropylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	70	%	-
2-Fluorobiphenyl	65	%	-

N.D. = Not detected

Enseco

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM SOUTHWEST INC

Client ID: SHERIDAN WELL WATER

Laboratory ID: 64198-001 Enseco ID: 64198-001

Matrix: Water Sampled: 07/30/87 Received: 08/01/87

Authorized: 08/02/87 Prepared: 08/04/87 Analyzed: 08/20/87

Surrogate	Result	Units	Reporting Limit
Terphenyl-D14	61	%	-
Phenol-D5	57	%	-
2-Fluorophenol	68	%	-
2,4,6-Tribromophenol	79	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Michael Brooks

Enseco

ORGANOCHLORINE PESTICIDES/PCB's 608

EPA METHOD 608

Client Name: ERM SOUTHWEST INC

Client ID: SHERIDAN WELL WATER

Laboratory ID: 64198-001 Enseco ID: 64198-001

Matrix: Water Sampled: 07/30/87 Received: 08/01/87

Authorized: 08/02/87 Prepared: 08/05/87 Analyzed: 08/31/87

Parameter	Result	Units	Reporting Limit
Aldrin	N.D.	ug/L	0.0040
alpha BHC	N.D.	ug/L	0.0030
beta BHC	N.D.	ug/L	0.0060
gamma BHC (Lindane)	N.D.	ug/L	0.0040
delta BHC	N.D.	ug/L	0.0090
Chlordane	N.D.	ug/L	0.040
4,4'-DDT	N.D.	ug/L	0.012
4,4'-DDE	N.D.	ug/L	0.0080
4,4'-DDD	N.D.	ug/L	0.011
Dieldrin	N.D.	ug/L	0.0080
Endosulfan I	N.D.	ug/L	0.014
Endosulfan II	N.D.	ug/L	0.0080
Endosulfan sulfate	N.D.	ug/L	0.066
Endrin	N.D.	ug/L	0.0060
Endrin Aldehyde	N.D.	ug/L	0.023
Heptachlor	N.D.	ug/L	0.0030
Heptachlor Epoxide	N.D.	ug/L	0.083
Aroclor-1242	N.D.	ug/L	0.065
Aroclor-1254	N.D.	ug/L	0.50
Aroclor-1221	N.D.	ug/L	0.065
Aroclor-1232	N.D.	ug/L	0.065
Aroclor-1248	N.D.	ug/L	0.065
Aroclor-1260	N.D.	ug/L	0.50
Aroclor-1016	N.D.	ug/L	0.065
Toxaphene	N.D.	ug/L	0.60
Methoxychlor	N.D.	ug/L	0.25

N.D. = Not detected

Reported by: Hallie Hotchkiss Approved by: Maureen McDevitt

Sample: 64198-001

Enseco

METALS PARAMETERS
TOTAL METALS

Client Name: ERM SOUTHWEST INC

Client ID: SHERIDAN WELL WATER

Laboratory ID: 64198-001 Enseco ID: 64198-001

Matrix: Water Sampled: 07/30/87 Received: 08/01/87

Authorized: 08/02/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	08/19/87
Arsenic	0.005	mg/L	0.003	206.2	08/17/87
Beryllium	N.D.	mg/L	0.001	200.7	08/19/87
Cadmium	N.D.	mg/L	0.005	200.7	08/19/87
Chromium	N.D.	mg/L	0.01	200.7	08/19/87
Copper	0.016	mg/L	0.006	200.7	08/19/87
Lead	N.D.	mg/L	0.002	239.2	08/17/87
Mercury	N.D.	mg/L	0.0001	245.1	08/11/87
Nickel	N.D.	mg/L	0.04	200.7	08/19/87
Selenium	N.D.	mg/L	0.004	270.2	08/17/87
Silver	N.D.	mg/L	0.005	200.7	08/19/87
Thallium	N.D.	mg/L	0.008	279.2	08/17/87
Zinc	0.10	mg/L	0.01	200.7	08/19/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64198-001

Enseco

INORGANIC PARAMETERS

Client Name: ERM SOUTHWEST INC
Client ID: SHERIDAN WELL WATER
Laboratory ID: 64198-001 Enseco ID: 64198-001
Matrix: Water Sampled: 07/30/87 Received: 08/01/87
Authorized: 08/02/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
pH	7.61	units	0.01	150.1	08/01/87
Specific Conductance @ 25C	604	umhos/cm	1	120.1/9050	08/01/87
Total Organic Carbon	1.6	mg/L	0.1	415.1/9060	08/19/87
Total Organic Halogen	27	ug Cl/L	5	9020	08/12/87
Total Cyanide	N.D.	mg/L	0.01	335.3	08/12/87
Phenolics	0.01	mg/L	0.01	420.1	08/17/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64198-001

Quality Control Results

The Enseco laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

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2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

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Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate LCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For Organic analyses an additional control measure is taken in the form of a Surrogate Control Sample (SCS). The SCS is a control sample spiked with surrogate standards which is analyzed with every analytical lot. The recovery of the SCS is charted in exactly the same manner as described for the LCS, and provides a daily check on the performance of the method.

Accuracy for LCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for LCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{\text{Measured Concentration LCS1} - \text{Measured Concentration LCS2}}{(\text{Measured Concentration LCS1} + \text{Measured Concentration LCS2})/2}$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, LCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report. The test codes assigned are defined in Section VI., Analytical Methodology.

Enseco

QC LOT ASSIGNMENT REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	QC Lot Number SCS
64198-001	Reagent Water	BNA	BNA 033AA	BNA 033DA
64198-001	Reagent Water	VOA	VOA 010AA	VOA 010DA

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Concentration Measured LCS1	Concentration Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: BNA on Reagent Water								
QC Lot: BNA 033AA								
Concentration Units: (ug/L)								
Pentachlorophenol	100	34.9	67.2	35	67	9-103	63.3*	50
Phenol	100	29.5	46.4	30	46	12- 89	44.5*	42
2-Chlorophenol	100	39.7	55.8	40	56	27-123	33.7	40
4-Chloro-3-cresol	100	44.5	60.1	45	60	23- 97	29.8	42
4-Nitrophenol	100	32.0	51.4	32	51	10- 80	46.5	50
1,2,4-Trichlorobenzene	50	26.1	24.8	52	50	39- 98	5.1	28
Acenaphthene	50	34.9	35.0	70	70	46-118	0.3	31
2,4-Dinitrotoluene	50	39.8	39.3	80	79	24- 96	1.3	38
Pyrene	50	51.1	48.5	102	97	26-127	5.2	31
N-nitrosodi-n-propylamine	50	31.2	33.5	62	67	41-116	7.1	38
1,4-Dichlorobenzene	50	23.7	23.4	47	47	36- 97	1.3	28
Test: VOA on Reagent Water								
QC Lot: VOA 010AA								
Concentration Units: (ug/L)								
1,1-Dichloroethene	50.0	49.2	52.7	98	105	61-145	6.9	14
Trichloroethene	50.0	54.1	59.8	108	120	71-120	10.0	14
Chlorobenzene	50.0	51.6	54.1	103	108	75-130	4.7	13
Toluene	50.0	43.6	46.1	87	92	76-125	5.6	13
Benzene	50.0	40.6	42.8	81	86	76-127	5.3	11

* = RPD outside standard QC limits.

SURROGATE CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: BNA on Reagent Water QC Lot: BNA 033DA Concentration Units: (ug/L)				
Phenol-D5	200	115	58	10- 94
2-Fluorophenol	200	123	62	21-100
2,4,6-Tribromophenol	200	135	68	10-123
Nitrobenzene-D5	100	74.5	75	35-114
2-Fluorobiphenyl	100	63.8	64	43-116
Terphenyl-D14	100	82.0	82	33-141
Test: VOA on Reagent Water QC Lot: VOA 010DA Concentration Units: (ug/L)				
Toluene-D8	50.0	54.4	109	88-110
Bromofluorobenzene (BFB)	50.0	50.2	100	86-115
1,2-Dichloroethane-D4	50.0	53.8	108	76-114

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QC LOT ASSIGNMENT REPORT
GAS CHROMATOGRAPHY

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	QC Lot Number SCS
64198-001	Reagent Water	OCP	OCP 015AE	OCP 015AE

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LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: OCP on Reagent Water QC Lot: OCP 015AE Concentration Units: (ug/L)								
Lindane	0.2	0.158	0.160	79	80	56-123	1.3	15
Heptachlor	0.2	0.118	0.140	59	70	40-131	17.1	20
Aldrin	0.2	0.102	0.124	51	62	40-120	19.5	22
Dieldrin	0.5	0.315	0.315	63	63	52-126	0.0	18
Endrin	0.5	0.315	0.335	63	67	56-121	6.2	21
p,p'-DDT	0.5	0.320	0.340	64	68	38-127	6.1	27

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SURROGATE CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: OCP on Reagent Water QC Lot: OCP 015AE Concentration Units: (ug/L)				
Dibutylchloroendate	1.0	0.97	97	48-136

QC LOT ASSIGNMENT REPORT
INORGANICS - METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64198-001	Reagent Water	FAST	FAST088AA
64198-001	Reagent Water	FPBT	FPBT088AA
64198-001	Reagent Water	FSET	FSET088AA
64198-001	Reagent Water	FTLT	FTLT088AA
64198-001	Reagent Water	HGT	HGT 144AA
64198-001	Reagent Water	ICPT	ICPT087AA

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LABORATORY CONTROL SAMPLE REPORT
INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: FAST on Reagent Water								
QC Lot: FAST088AA								
Concentration Units: (mg/L)								
Arsenic	0.02	0.023	0.022	115	110	75-125	4.4	20
Test: FPBT on Reagent Water								
QC Lot: FPBT088AA								
Concentration Units: (mg/L)								
Lead	0.02	0.019	0.020	95	100	75-125	5.1	20
Test: FSET on Reagent Water								
QC Lot: FSET088AA								
Concentration Units: (mg/L)								
Selenium	0.01	0.011	0.010	110	100	75-125	9.5	20
Test: FTLT on Reagent Water								
QC Lot: FTLT088AA								
Concentration Units: (mg/L)								
Thallium	0.05	0.048	0.046	96	92	75-125	4.3	20
Test: HGT on Reagent Water								
QC Lot: HGT 144AA								
Concentration Units: (ug/L)								
Mercury	1.0	0.97	0.97	97	97	75-125	0.0	20
Test: ICPT on Reagent Water								
QC Lot: ICPT087AA								
Concentration Units: (mg/L)								
Aluminum	2.0	2.0	1.9	100	95	75-125	5.1	20
Antimony	0.5	0.48	0.48	96	96	75-125	0.0	20
Arsenic	0.5	0.42	0.46	84	92	75-125	9.1	20
Barium	2.0	1.9	1.9	95	95	75-125	0.0	20
Beryllium	0.05	0.050	0.048	100	96	75-125	4.1	20

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LABORATORY CONTROL SAMPLE REPORT
INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: ICPT on Reagent Water								
QC Lot: ICPT087AA								
Concentration Units: (mg/L)								
Cadmium	0.05	0.042	0.046	84	92	75-125	9.1	20
Calcium	100	104	104	104	104	75-125	0.0	20
Chromium	0.2	0.21	0.21	105	105	75-125	0.0	20
Cobalt	0.5	0.44	0.46	88	92	75-125	4.4	20
Copper	0.25	0.24	0.25	96	100	75-125	4.1	20
Iron	1.0	1.0	0.99	100	99	75-125	1.0	20
Lead	0.5	0.44	0.45	88	90	75-125	2.2	20
Magnesium	50	50	51	100	102	75-125	2.0	20
Manganese	0.2	0.19	0.20	95	100	75-125	5.1	20
Nickel	0.4	0.37	0.39	93	98	75-125	5.3	20
Potassium	50	50	51	100	102	75-125	2.0	20
Silver	0.05	0.052	0.051	104	102	75-125	1.9	20
Sodium	100	103	102	103	102	75-125	1.0	20
Tin	0.4	0.40	0.39	100	98	75-125	2.5	20
Vanadium	0.5	0.49	0.48	98	96	75-125	2.1	20
Zinc	0.2	0.20	0.21	100	105	75-125	4.9	20

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QC LOT ASSIGNMENT REPORT
INORGANICS - NON-METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64198-001	Reagent Water	CNT	CNT 084AB
64198-001	Reagent Water	COND	COND116AA
64198-001	Reagent Water	PHEN	PHEN053AB
64198-001	Reagent Water	PH	PH 153AA
64198-001	Reagent Water	TOC	TOC 118AB
64198-001	Reagent Water	TOX	TOX 075AB

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LABORATORY CONTROL SAMPLE REPORT
INORGANICS - NON-METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: CNT on Reagent Water QC Lot: CNT 084AB Concentration Units: (mg/L)								
Cyanide	0.058	0.059	0.059	102	102	75-125	0.0	20
Test: COND on Reagent Water QC Lot: COND116AA Concentration Units: (umhos/cm)								
Specific Conductance	1290	1293	1290	100	100	95-105	0.2	5
Test: PHEN on Reagent Water QC Lot: PHEN053AB Concentration Units: (mg/L)								
Phenolics	0.181	0.199	0.20	110	110	78-122	0.5	20
Test: PH on Reagent Water QC Lot: PH 153AA Concentration Units: (Units)								
PH	9.1	9.04	9.01	99	99	98-102	0.3	5
Test: TOC on Reagent Water QC Lot: TOC 118AB Concentration Units: (mg/L)								
Total Organic Carbon	29	28	29	97	100	91-109	3.5	20
Test: TOX on Reagent Water QC Lot: TOX 075AB Concentration Units: (ug Cl/L)								
Total Organic Halogens	100	110	110	110	110	80-120	0.0	20

Analytical Methodology

Enseco - Rocky Mountain Analytical Laboratory performs analytical services according to methods approved by EPA and other regulatory agencies, whenever possible.

Methods for metals and organic compounds are primarily derived from three sources of EPA methods, 1) the methods promulgated in 40 CFR 136 for priority pollutants, 2) the methods published in SW-846 and 3) methods developed by the EPA-EMSL/LV for Superfund investigations, as well as several documents published by the EPA and Enseco - Rocky Mountain Analytical Laboratory in 1984 and 1985. These methods all use the same generic technology as summarized below:

- Metals: acid digestion followed by analyses by ICP supported by graphite furnace AA

- Volatile Organics: purge and trap GC/MS or purge and trap GC with a selective detector.

- Semivolatile (base/neutral and acid) organics: solvent extraction followed by capillary column GC/MS, and

- Pesticides/Herbicides: solvent extraction, followed by gas chromatography.

Exact method references are provided in the Analytical Methodology Tables.

ANALYTICAL METHODOLOGY - ORGANIC TESTS

Test	Description	Methodology	Reference
VOA	Volatile Organics	Purge & Trap, GC/MS	624(1)/8240(2)
BNA	Semivolatile Organics	Extraction, GC/MS	625(1)/8270(2)
DXN	Dioxin	Extraction, GC/MS	613(1)/8280(2)
601	Halogenated Volatile Organics	Purge & Trap GC/Hall	601(1)/8010(2)
THM	Trihalomethanes	Purge & Trap GC/Hall	601(1)/8010(2)
602	Aromatic Volatile Organics	Purge & Trap GC/PID	602(1)/8020(2)
OCP	Organochlorine Pesticides	Extraction, GC/ECD	608(1)/8080(2)
OPP	Organophosphate Pesticides	Extraction, GC/FPD	614(1)/8140(2)
619	Triazine Pesticides	Extraction, GC/NPD	619(1)
LC CARB	Carbamate and Urea Pesticides	Extraction, HPLC	632(1)
PCB	PCB's	Extraction, GC/ECD	608(1)/8080(2)
HRB	Phenoxyacid Herbicides	Extraction, GC/ECD	615(1)/8150(2)
603	Acrolein & Acrylonitrile	Purge & Trap GC/FID	603(1)/8030(2)
604	Phenols	Extraction, GC/FID	604(1)/8040(2)
605	Benzidines	Extraction, HPLC	605(1)/8050(2)
606	Phthalate Esters	Extraction, GC/FID	606(1)/8060(2)
607	Nitrosamines	Extraction, GC/NPD	607(1)
609	Nitroaromatics & Cyclic Ketones	Extraction, GC/NPD	609(1)/8090(2)
PNA	Polynuclear Aromatic Hydrocarbons	Extraction, HPLC	610(1)/8310(2)
611	Haloethers	Extraction, GC/ECD	611(1)
612	Chlorinated Hydrocarbons	Extraction, GC/ECD	612(1)/8120(2)
GD FID	Hydrocarbon Scan	Extraction, GC/FID	D3328-78(3)
GC BPD	Boiling Point Determination	Extraction, GC/FID	D2887-84(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 2nd Edition, 1984.
(3) "Annual Book of ASTM Standards", Volume 11.01, 1985.
(4) "Annual Book of ASTM Standards", Volume 05.02, 1984.

ANALYTICAL METHODOLOGY - INORGANIC TESTS

Test	Description	Methodology	Reference
ICP	Trace Metals	ICP Emission Spectroscopy	200.7(1)/6010(2)
FSB	Antimony	Furnace Atomic Absorption	204.2(1)/7041(2)
FAS	Arsenic	Furnace Atomic Absorption	206.2(1)/7060(2)
FCD	Cadmium	Furnace Atomic Absorption	213.2(1)/7131(2)
FPB	Lead	Furnace Atomic Absorption	239.2(1)/7421(2)
FSE	Selenium	Furnace Atomic Absorption	270.2(1)/7740(2)
FAG	Silver	Furnace Atomic Absorption	272.2(1)/7761(2)
FTL	Thallium	Furnace Atomic Absorption	279.2(1)/7841(2)
CVHG	Mercury	Cold Vapor Atomic	245.1(1)/7471(2)
CR + 6	Chromium (VI)	Colorimetric	312B(3)
IC CL	Chloride	Ion Chromatography	300.0(1)
BURCL	Chloride	Manual Titrimetric	325.3(1)
METF	Fluoride	Electrode	340.2(1)
IC SO4	Sulfate	IC	300.0(1)
SPESO4	Sulfate	Manual Turbidimetric	375.4(1)
METALK	Alkalinity, Total	Titrimetric	310.1(1)
METACK	Alkalinity, Forms	Titrimetric	403(3)
TECNOXT	Nitrate+Nitrite as N	Cd Reduction Colorimetric	353.2(1)
METPH	pH	Meter	150.1(1)/9045(2)
CELSP	Specific Conductance @ 25C	Bridge	120.1(1)
BALTDS	Total Dissolved Solids	Gravimetric, 180C	160.1(1)
BALTSS	Total Suspended Solids	Gravimetric, 105C	160.2(1)
BALTS	Total Solids	Gravimetric, 105C	160.3(1)
BALTVS	Total Volatile Solids	Gravimetric, 550C	160.4(1)
TECO P	Ortho-Phosphate as P	Two Reagent Colorimetric	365.3(1)
TECT P	Total Phosphorus as P	Digestion-Colorimetric	365.3(1)
ICP	Total Phosphorus as P	Digestion-ICP/AES	200.7(1)
ICP	Silica as SiO_2	ICP/AES	200.7(1)
SPESIO2	Silica as SiO_2	Colorimetric	370.1(1)
METBOD	Biochemical Oxygen Demand	Dilution Bottle-D.O. probe	405.1(1)
METCOD	Chemical Oxygen Demand	Micro Colorimetric	410.4(1)
TOCTOC	Total Organic Carbon	UV Oxidation-IR	415.2(1)
METNH3	Ammonia as N	Electrode	350.3(1)
TECNH3	Ammonia as N	Automated Colorimetric	350.1(1)
METTKN	Total Kjeldahl Nitrogen as N	Digestion-Electrode	351.4(1)
TECTKN	Total Kjeldahl Nitrogen as N	Digestion-Colorimetric	351.2(1)
TOXTOX	Total Organic Halogen	Combustion-Titrimetric	9020(2)
TONOI	Total Organic Nitrogen	Calculation (TKN-NH_3)	-
BAL O&G	Oil and Grease	Freon Extraction-Gravimetric	413.1(1)
IR AO&G	Oil and Grease	Freon Extraction-IR	413.2(1)
TECCN F	Cyanide Amendable to Chlorination	Chlorination-Distillation-Colorimetric	335.1(1)
TECCN W	Weak & Dissolved Cyanide	Distillation-Colorimetric	412H(3)
TECCN T	Total Cyanide	Distillation-Colorimetric	335.2(1)/9010(2)
STEPHEN	Phenolics	Distillation-Colorimetric	420.1(1)
COLIF F	Fecal Coliform	Membrane Filter	909C(3)
COLIF T	Total Coliform	Membrane Filter	909A(3)

ANALYTICAL METHODOLOGY - INORGANIC TESTS (CONT.)

Test	Description	Methodology	Reference
IC BR	Bromide	Ion Chromatography	300.0(1)
POTCL2R	Residual Chlorine	Amperometric	330.2(1)
NESCOLR	Color	Pt-Co Colorimetric	110.2(1)
ICPHAR	Hardness as $CaCo_3$	Calculation	200.7(1)/314A(3)
TECNO2	Nitrite as N	Colorimetric	354.1(1)
SPES	Sulfide	Colorimetric	376.2(1)/9030(2)
BURSO3	Sulfite	Titrimetric	377.1(1)
SPEMBAS	MBAS (Surfactants)	Colorimetric	425.1(1)
SPETURB	Turbidity	Turbidimeter	180.1(1)
Gross Alpha		Proportional Counter	703(3)
Gross Beta		Proportional Counter	703(3)
Radium 226		Separation - Counter	705(3)
Radium 228		Separation - Counter	707(3)
Uranium		Fluorimetric	D2907.75(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 2nd Edition, 1984.
(3) "Standard Methods for the Examination of Water and Wastewater", 15th Edition, 1980.
(4) "Annual Book of ASTM Standards", Part 31, Water, 1980.

018763

APPENDIX C

Slug/Bail Test Data, Procedures and Calculations for the Unconfined Aquifer (Stratum B)

APPENDIX C

Slug/Bail Test Data, Procedures and Calculations for the Unconfined Aquifer (Stratum B)

Slug/bail tests were performed on the ten PVC wells installed for the GWMMRI (MW-30,31,32,33,34,35,36,37,39 and 40). This procedure involves dropping or removing a "slug" or volume that displaces water instantaneously in the well. The change in water level with time is recorded as the water level returns to its original or static position. At the SDS site, PVC slugs were used to displace a volume of water. In the 2-inch diameter wells a solid 1-inch, 10 foot long piece of PVC was used. For the 4-inch wells either a solid 2.5-inch diameter, 5 foot long piece of PVC was used, or a hollow 3.25-inch diameter, 8-foot long PVC slug was used. In most cases the larger slug was utilized for the 4-inch wells because it displaced more water and therefore had a longer recovery time. At most of the wells the recovery was very fast (<15 seconds) and increasing the recovery time would help increase the resolution of the data. At each well location two to four tests were completed; data was analyzed from the two or three best runs.

In order to have the hollow slug sink quickly in the water, it was partially filled with clean sand (sterilized playground variety). The sand was replaced with clean sand at each well. At one location (MW-39), clean cat litter was used along with sand inside the slug. The litter was wrapped in plastic and taped closed inside the slug to avoid any contamination of the well from the cat litter. The slug was lowered and raised out of the well using nylon rope which was also changed between each well. The slug itself was decontaminated by rinsing and wiping it with distilled water, again between each location. Plastic sheeting was placed around the well on the ground surface to preclude the rope from getting dirty between different tests at the same well.

Before each test the static water level was recorded with an electronic water level marker. A pressure transducer was then lowered into the well far enough below the depth where the slug could hit the transducer. The transducer was connected to a Hermit Environmental Data Logger (model SE1000B) which recorded the changes in water level with time. The data logger was started as soon as the slug was fully into or out of the water, and it recorded water levels on a logarithmic scale. The log scale yields more data points at the early part of the test when the changes in water level tend to be the greatest. These data

are printed out and supplied in this appendix. The transducer and its cable were decontaminated between each well by thoroughly rinsing it in distilled water and wiping it with clean paper towels.

018766

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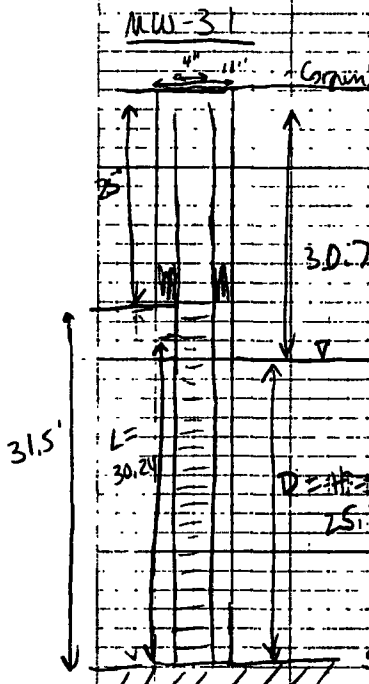
By DEW Date 11/23/87 Subject Slug Test Analysis Sheet No. 1 of 3

Chkd By ACW Date 12/1/87 Sheridan - MW-31 W.O. No. 9107



Depth to water = 33.00' below top of casing

Depth to water below grade = 33.00 - 30.76

Assume that screened portion within clay does not contribute to aquifer characteristics

Assume maximum length of screen = 25.74 + 4.5 = 30.24'

R_w = 2" (well casing) + 3.5" sand pack = 5.5" = .46'

$$R_{ce} = \left[r_c^2 + \phi_{sand} \left(r_w^2 - r_c^2 \right) \right]^{1/2}$$

$$R_{ce} = \left[(.167)^2 + .30 \left[(.46)^2 - (.167)^2 \right] \right]^{1/2} =$$

R_{ce} = .288'

R_c = 2" = .167'

L = 30.24 H = D = 25.74

Calculate Re for MW-31

Since D = H

$$\ln R_e/R_w = \left(\frac{1.1}{\ln (H/R_w)} + \frac{C}{L/R_w} \right)^{-1}$$

L/R_w = 30.24/.46 = 65.74

From graph C = 3.1

$$\ln R_e/R_w = \left(\frac{1.1}{\ln (25.74/.46)} + \frac{3.1}{65.74} \right)^{-1}$$

$\ln R_e/R_w$ = 3.12

R173

018767

ERM-Southwest, inc.

By DEW Date 11/23/87 Subject MW-31 Sheet No. ____ of ____

Chkd By ACW Date 12/1/87 W.O. No. 91-07

MW-31 Test 0 - slug Test

From graph: $t_0 = 0$, $y_0 = 1.02'$ $\ln R_e/R_w = 3.12$

$t = 0.25$ mm = 15 sec $y_t = 0.23'$

$$K = \frac{(R_{ce})^2 \ln (R_e/R_w)}{2 \cdot L} \cdot \frac{1}{t} \ln \frac{y_0}{y_t}$$

use R_{ce} because all water level changes in screened section

$$K = \frac{(.288)^2 \; 3.12}{2(30.24)} \cdot \frac{1}{15} \ln \frac{1.02}{0.23}$$

$K = 4.25 \times 10^{-4}$ ft/sec

$= 1.295 \times 10^{-2}$ cm/sec

$= 7.85$ m

$b = 25.74$ $T = 1.09 \times 10^{-2}$ ft²/sec

$T = Kb$ $= 3.33 \times 10^{-1}$ cm²/sec

$= 87.8$ m²/day

R173

018768

ERM-Southwest, inc.

By DEW Date 11/23/87 Subject Slug/Bail Test MW-31 Sheet No. 2 of 2

Chkd By ACW Date 12/1/87 W.O. No. 91-07

MW-31 - CONT.

Test #1 - Bail Test

$L = 30.24'$

$t = 0$, $y_0 = 1.5'$] from graph $\ln R_e/R_w = 3.12$

$t = .25$ min $= 15$ sec $y_t = .28'$

$$K = \frac{R_c^2 \ln(R_e/R_w)}{2L} \frac{1}{t} \ln y_0/y_t$$

Since all water level changes in screened section, $R_c = R_{ce} = 0.288'$

$$K = \frac{(0.288)^2 \cdot 3.12}{2 \cdot 30.24'} \frac{1}{15\text{ sec}} \ln \frac{1.5'}{.28'} = \text{ft/sec}$$

$K = 4.79 \times 10^{-4}$ ft/sec $= 1.46 \times 10^{-2}$ cm/sec

$T = Kb$; $b = 25.74' = 784.56$ cm $= T = 1.23 \times 10^{-2}$ ft²/sec $= 11.45$ cm²/sec $= 99.0$ m²/day

Test #2 - Bail Test

$t_0 = 0$, $y_0 = 3.90'$] from graph $\ln R_e/R_w = 3.12$

$t = .22$ min $= 13.2$ sec $y_t = .96'$

As above - all water level changes in screened section; use R_{ce}

$$K = \frac{(0.288\text{ ft})^2 \cdot 3.12}{2 \cdot (30.24')} \frac{1}{13.2\text{ sec}} \ln \frac{3.90}{.96}$$

$K = 4.54 \times 10^{-4}$ ft/sec

$= 1.39 \times 10^{-2}$ cm/sec

$= 785$ cm

if $b = 25.74'$

$T = K \cdot b$

$T = 1.17 \times 10^{-2}$ ft²/sec

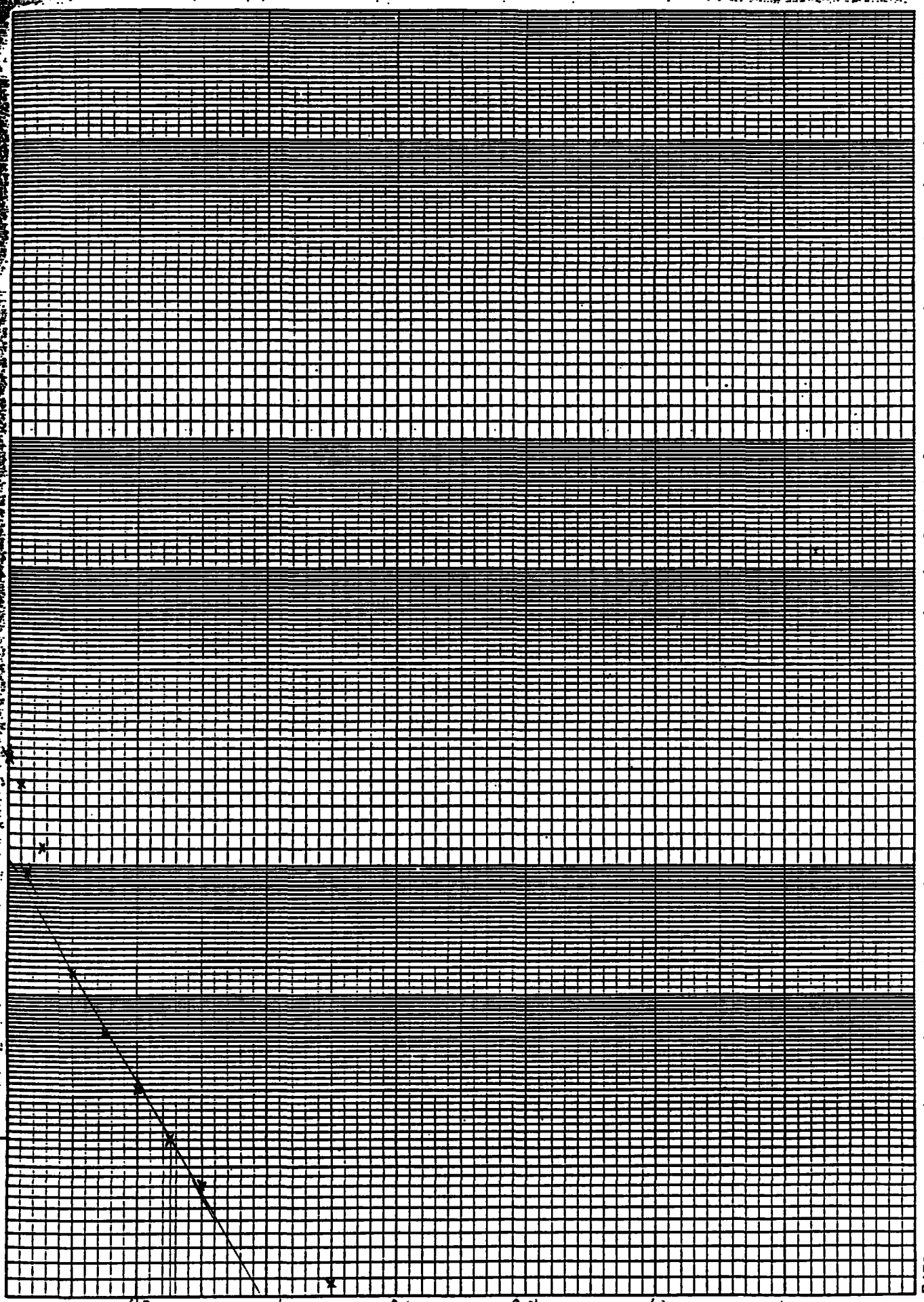
$T = 1.39 \times 10^{-2}$ cm/sec $\cdot$ 785 cm $= 10.9$ cm²/sec

$= 94.3$ m²/day

R173

018769

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log



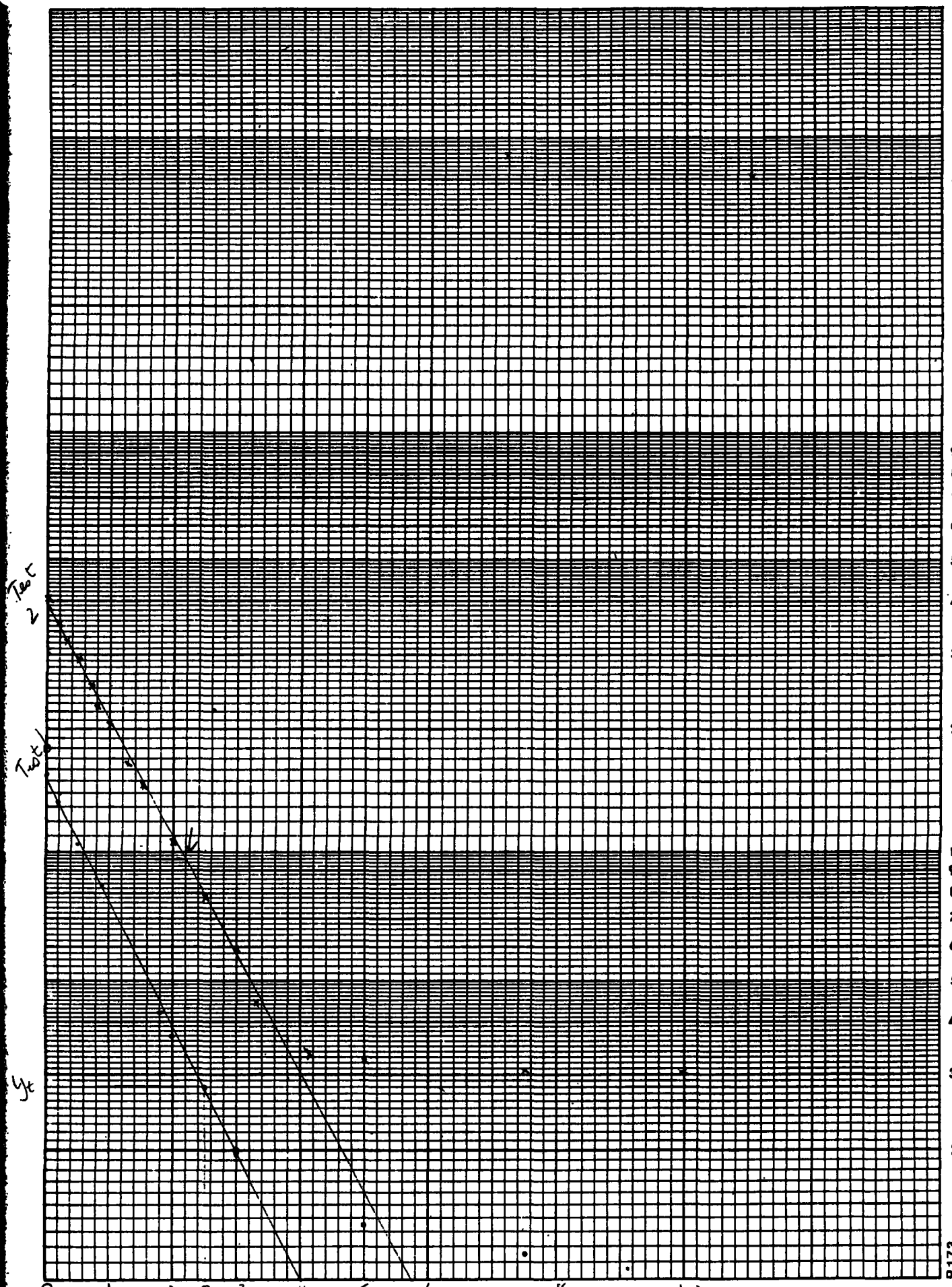
MW: 31
shallow
aquifer
Slug Test
Test #0

R173

018770

MW-31, Test 1

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

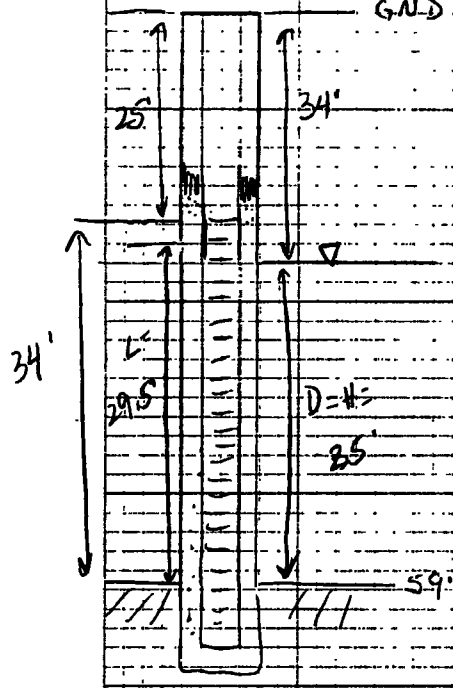


018771

ERM-Southwest, inc.

By DEW Date 11/24/87 Subject Slug Test - Slug Out Sheet No. ____ of ____

Chkd By ACW Date ____ MW-32 W.O. No. 91-07



Water level for TOC = 34.87

Elev. TOC - Elev. GND = 172.20 - 169.33 = 2.87 = stick-up

Water level from GND = 34.00

Assume that screened interval in clay does not contribute to aquifer characteristics

Note: all changes in water level take place in screened portion of well, therefore use

$$R_{ce} = \left[(R_c)^2 + \phi_{sand}\left[R_w^2 - R_c^2\right]\right]^{1/2}$$

R_c = 2" = .167'

R_w = 2" + 3.5" = 5.5" = .146'

$$R_{ce} = \left[(.167)^2 + .3\left[.146^2 - .167^2\right]\right]^{1/2}$$

R_{ce} = .288', H = D = 25'

L = max length of screen effected during slug out test

= 25 + 4.5' = 29.5' (= water column height + max. displacement of slug)

Calculate R_e for MW-32

Since D = H

$$\ln R_e/R_w = \left[\frac{1.1}{\ln(H/R_w)} + \frac{C}{L/R_w}\right]^{-1}$$

$L/R_w = \frac{29.5}{.146} = 64.13$ = choose C from graph = 3.05

$$\ln R_e/R_w = \left(\frac{1.1}{\ln(25/.146)} + \frac{3.05}{64.13}\right)^{-1}$$

$\ln R_e/R_w = 3.097$

R173

018772

ERM-Southwest, inc.

By DEW Date 11/24/87 Subject Slug/Bail Test - Sheridan Sheet No. ____ of ____

Chkd By fcw Date ____ MW-32 W.O. No. 91-07

MW-32 Test 0 - Slug Test

$t = 0$, $y_0 = 4.15'$] from graph $\ln R_e/R_w = 3.097$

$t = 3$ min $= 180$ sec, $y_t = 1.15'$]

$$K = \frac{(R_{ce})^2 \ln (R_e/R_w)}{2L} \frac{1}{t} \ln \frac{y_0}{y_t}$$

$$K = \frac{(288)^2\ 3.097}{2 \cdot (29.5)} \frac{1}{180} \ln \frac{4.15}{1.15}$$

$K = 3.10 \times 10^{-4}$ ft/sec

$= 9.46 \times 10^{-3}$ cm/sec

If $b = 25' = 7.62$ m

$T = Kb$ $T = 7.75 \times 10^{-3}$ ft^2/sec or 62.3 m^2/day or 2.37×10^{-1} cm^2/sec

MW-32 Test 1 - Bail Test

$t = 0$, $y_0 = 4.6'$ $\ln R_e/R_w = 3.097$

$t = 2$ min 12 sec, $y_t = 1.95'$

$$K = \frac{(R_{ce})^2 \ln (R_e/R_w)}{2L} \frac{1}{t} \ln \frac{y_0}{y_t}$$

$$K = \frac{(288)^2\ 3.097}{2 \cdot (29.5)} \frac{1}{12} \ln \frac{4.6}{1.95}$$

$K = 3.11 \times 10^{-4}$ ft/sec

$= 9.49 \times 10^{-3}$ cm/sec

$T = Kb$ where $b = 25' = 7.62$ m as above

$T = 7.78 \times 10^{-3}$ ft^2/sec

$= 2.37 \times 10^{-1}$ cm^2/sec

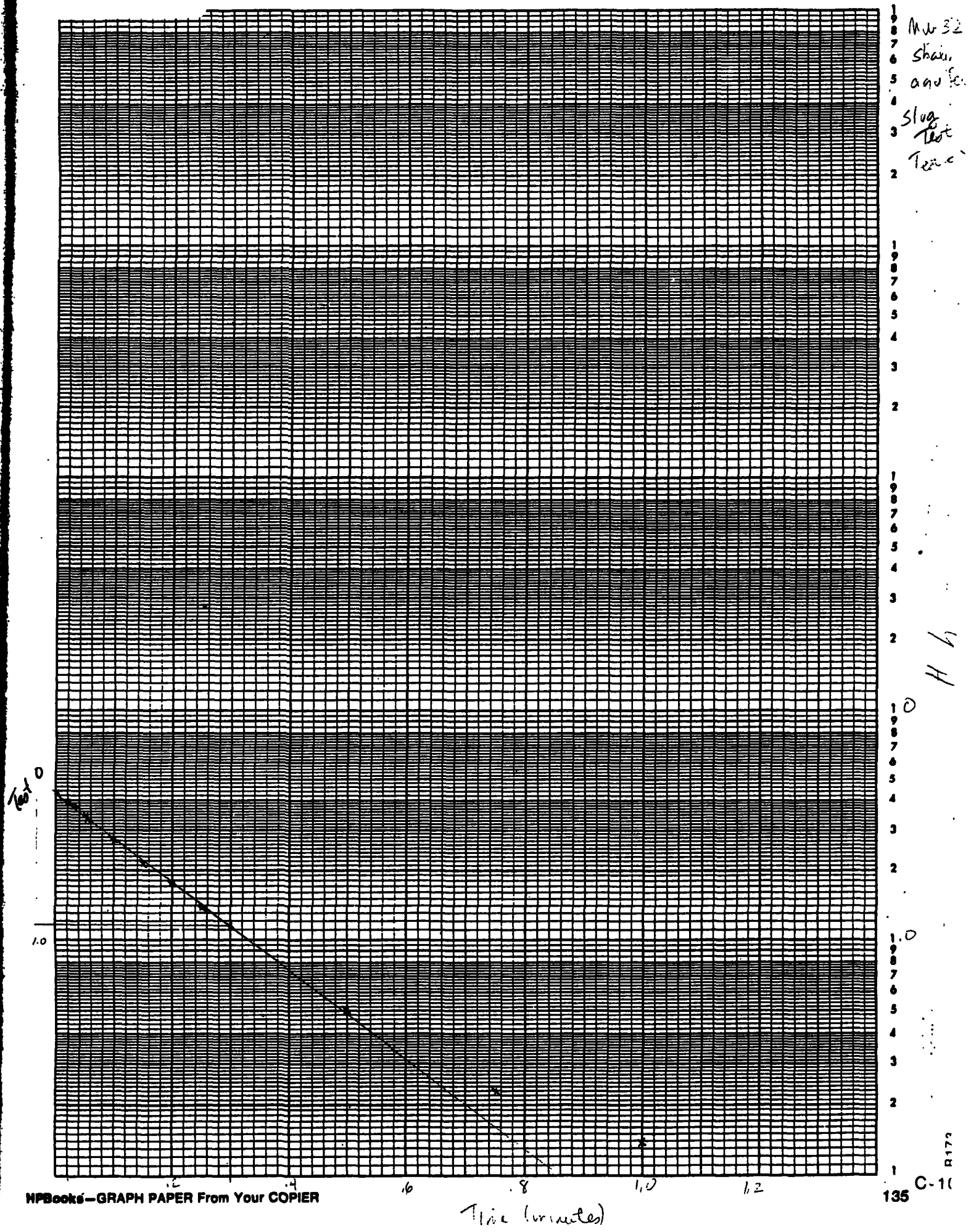
$= 62.5$ m^2/day

R173

018773

MW-32

70 Divisions 5th, 10th Accent by 5 Cycle Semi-Log



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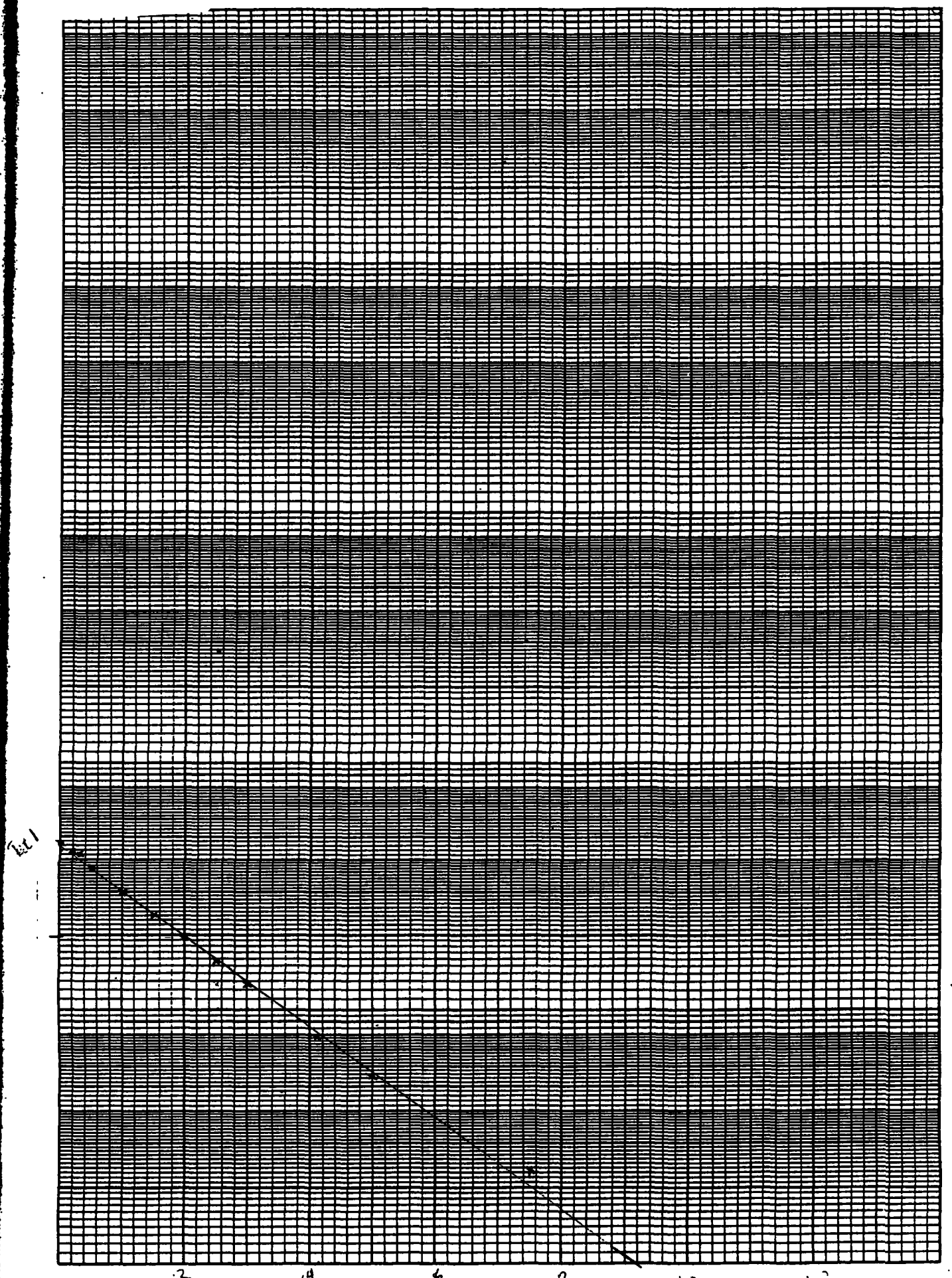
135

C-1(

018774

70 Divisions 5th, 10th Accent by 5 Cycle Semi-Log

MW-32



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R173

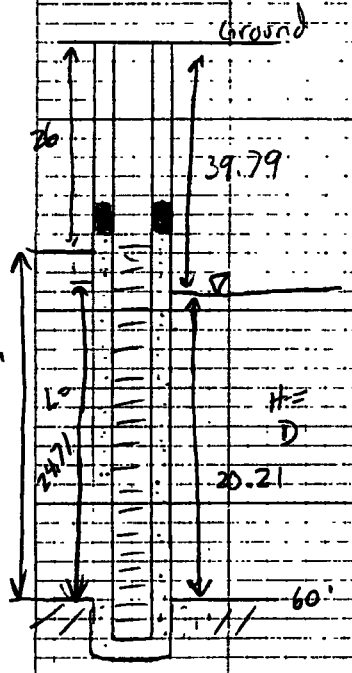
C-1

ERM-Southwest, inc.

By DEW Date 11/24/87 Subject Slug / Bail Tests - Shoudin Sheet No. ____ of ____

Chkd By ACW Date ____ MW-34 W.O. No. 91-07

MW-34



Water level from TOC = 42.09

TOC (msl) 174.32 − 2.30

GND (msl) 172.02 = 39.79 - water level from GND

2.30

Assume that sanded portion within clay does not contribute to aquifer characteristics

Note: water level changes all take place in screened section of well, therefore use R_{ce}.

$$R_{ce} = \left[R_c^2 + \phi_{sand}\left[R_w^2 - R_c^2\right]\right]^{1/2}$$

where R_c = 2" = .167'

R_w = 2"(casing) + 3.5"(borehole) = 5.5" = .46'

ϕ_{sand} = 30% = .3

$$R_{ce} = \left[(.167)^2 + .3\left[(.46)^2 - (.167)^2\right]\right]^{1/2} = .288'$$

L = max. length of sand affected by slug / bail test

= 20.21' + 4.5' = 24.71'

Calculate R_e

$$\ln R_e/R_w = \left(\frac{1.1}{\ln(H/R_w)} + \frac{C}{L/R_w}\right)^{-1}$$

L/R_w = 24.71 / .46 = 53.72 ; C = 2.8 (from graph)

$$\ln R_e/R_w = \left(\frac{1.1}{\ln\left(\frac{20.21}{.46}\right)} + \frac{2.8}{53.72}\right)^{-1}$$

$$= 2.92$$

R173

018776

ERM-Southwest, inc.

By DEW Date 11/24/87 Subject Slug/Bail Tests - Sheridan Sheet No. ____ of ____

Chkd By ACW Date ____ MW-34 W.O. No. 7107

MW-34 Test #1 - Slug Test

$t = 0$, $y_0 = 3.05'$] from graph

$t = .4$ min = 24 sec, $y_t = 1.5'$

$\ln R_e/R_w = 2.92$

REM. use R_{CE}

$$K = \frac{(R_{ce})^2 \ln R_e/R_w}{2 \cdot L} \cdot \frac{1}{t} \ln y_0/y_t$$

$$K = \frac{(.288)^2 \cdot 2.92}{2 \cdot (24.71)} \cdot \frac{1}{24} \ln 3.05/1.5$$

$K = 1.45 \times 10^{-4}$ ft/sec

$= 4.42 \times 10^{-3}$ cm/sec

$T = K \cdot b$ where $b = 20.21'$ $= 2.93 \times 10^{-3}$ ft²/sec

6.16m $= 8.93 \times 10^{-2}$ cm²/sec

$= 23.5$ m²/day

MW-34 Test #2 - Bail Test

$t = 0$ $y_0 = 4.80'$ $\ln R_e/R_w = 2.92$

$t = .2$ min = 12 sec $y_t = 3.35'$

$$K = \frac{(R_{ce})^2 \ln R_e/R_w}{2 \cdot L} \cdot \frac{1}{t} \ln y_0/y_t$$

$$K = \frac{(.288)^2 \cdot 2.92}{2(24.71)} \cdot \frac{1}{12} \ln \frac{4.80}{3.35}$$

$K = 1.47 \times 10^{-4}$ ft/sec

$= 4.48 \times 10^{-3}$ cm/sec

$T = K \cdot b$ where $T = 2.97 \times 10^{-3}$ ft²/sec

$b = 20.21'$

$= 6.16$m $= 9.05 \times 10^{-2}$ cm²/sec

$= 23.8$ m²/day

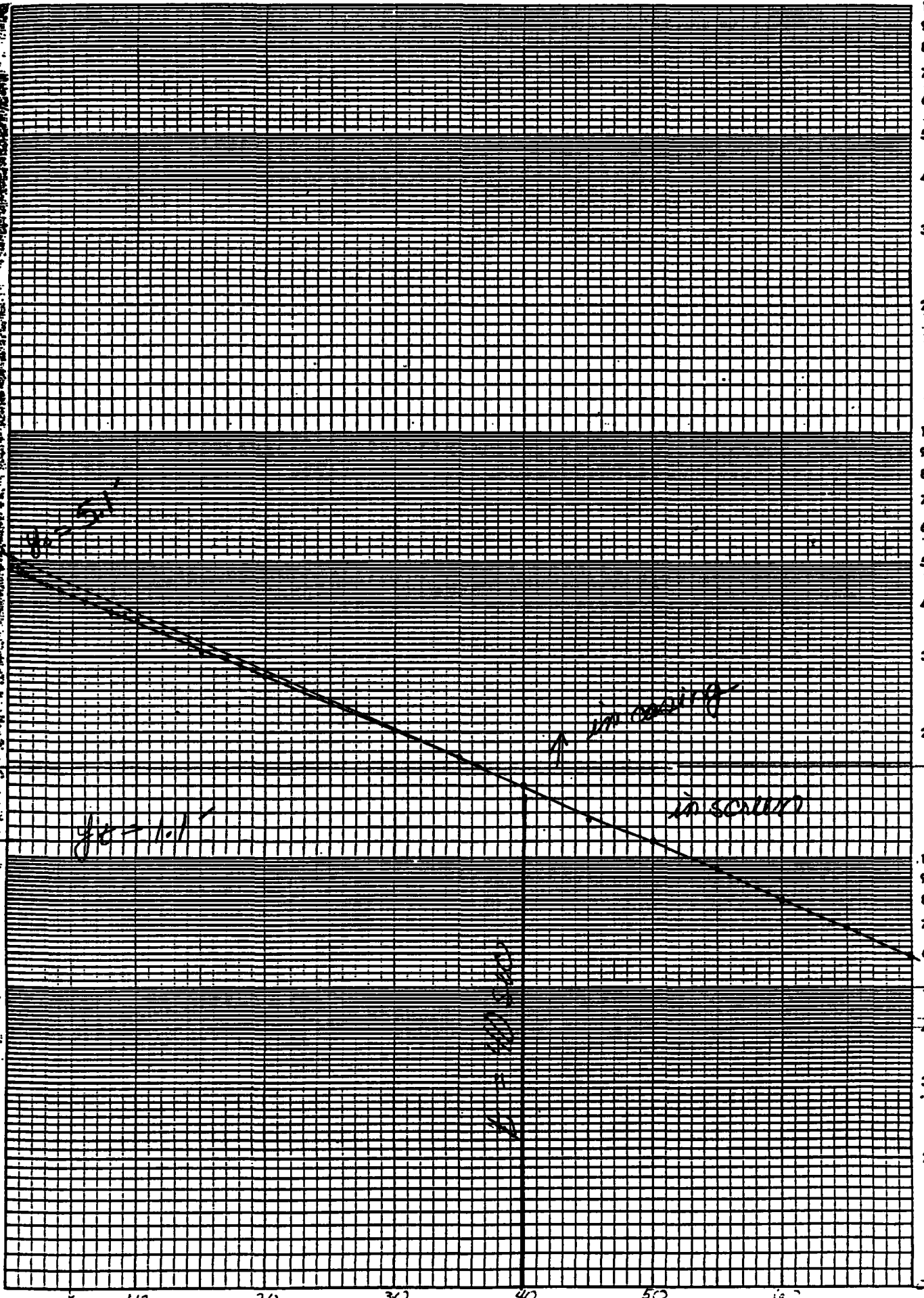
R173

018777

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

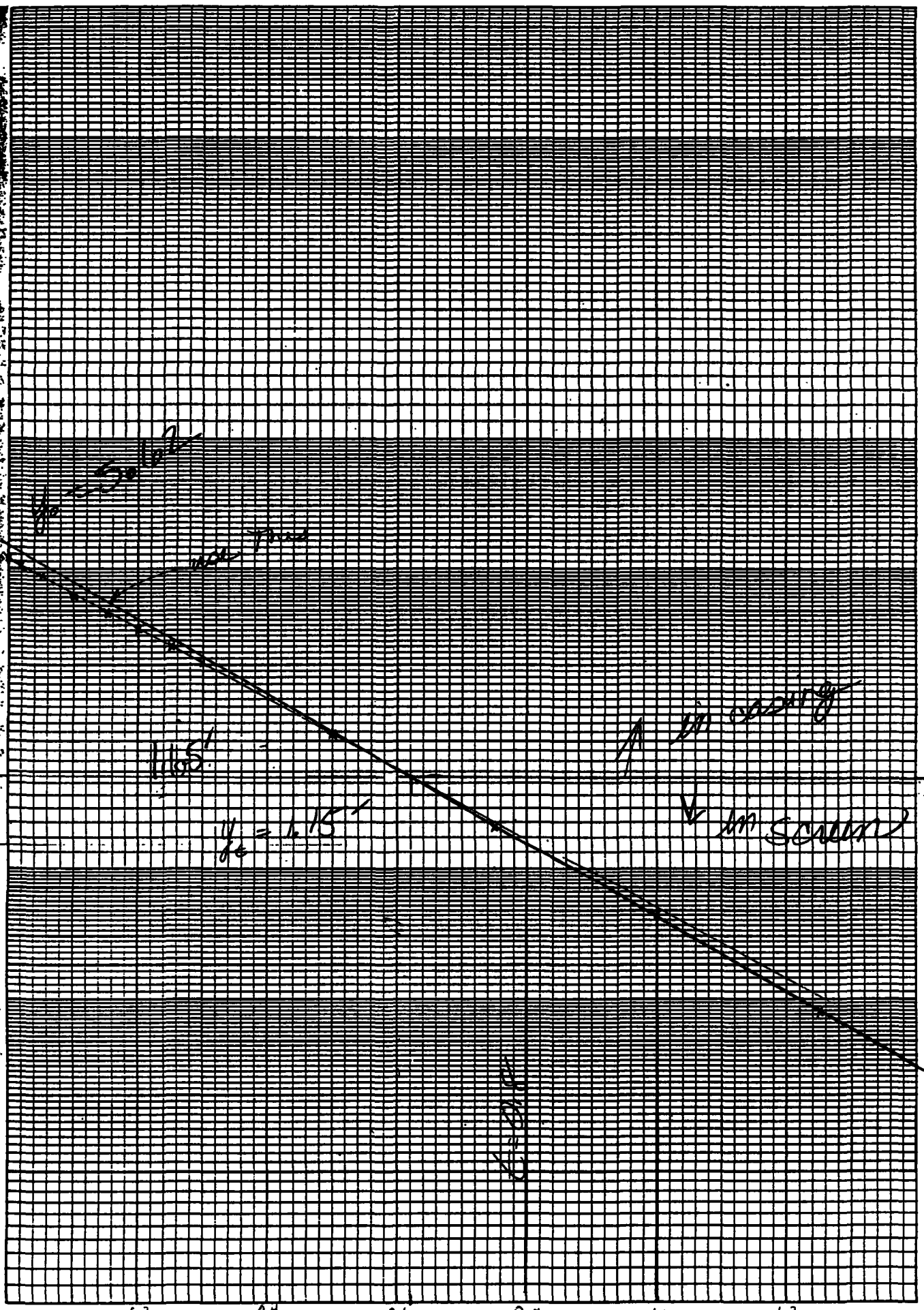
MW

Test #1
MW-34
bail
test



018778

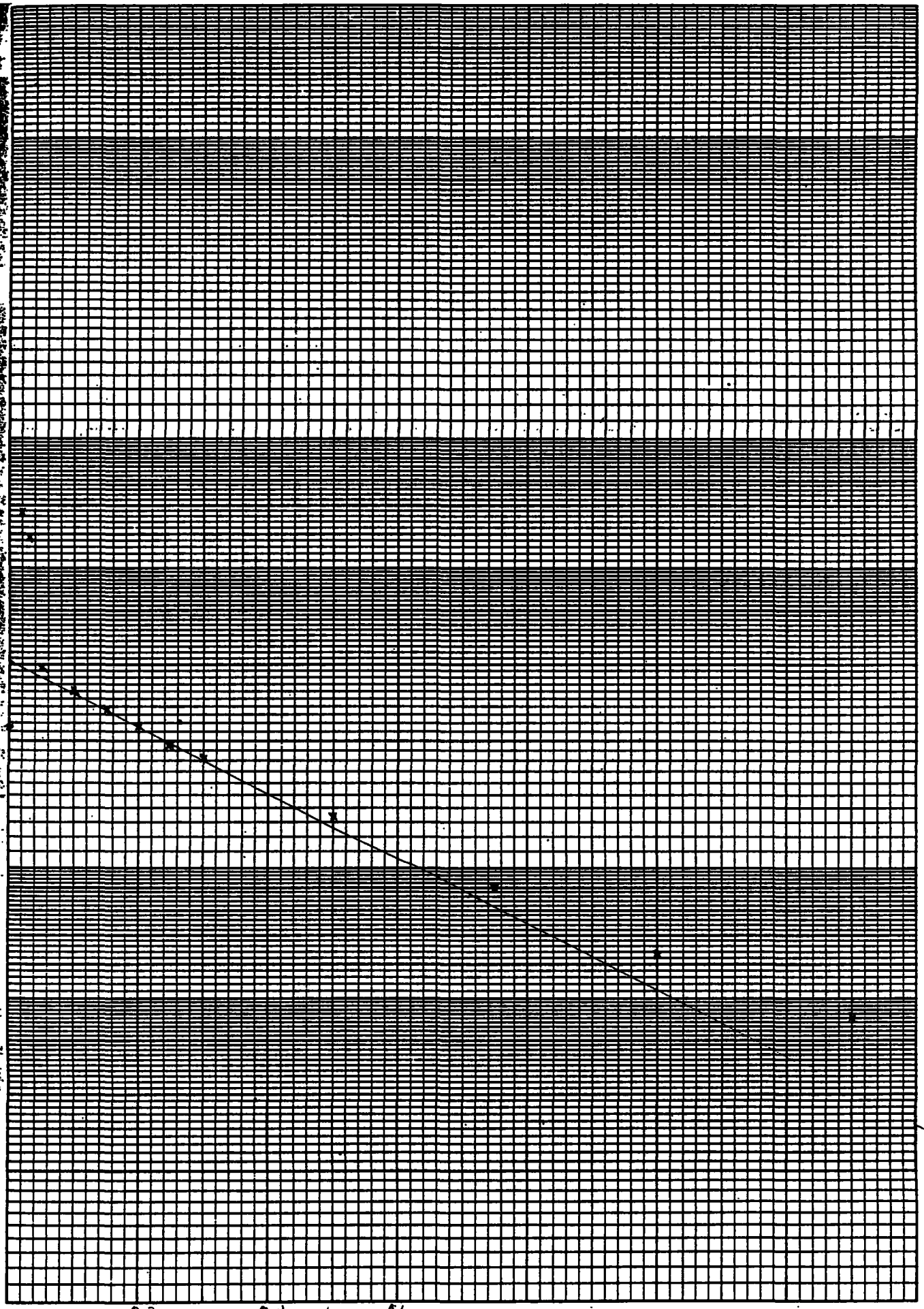
70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log



018779

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

shallow
MW-34
Test #1
Slug
Test



#4

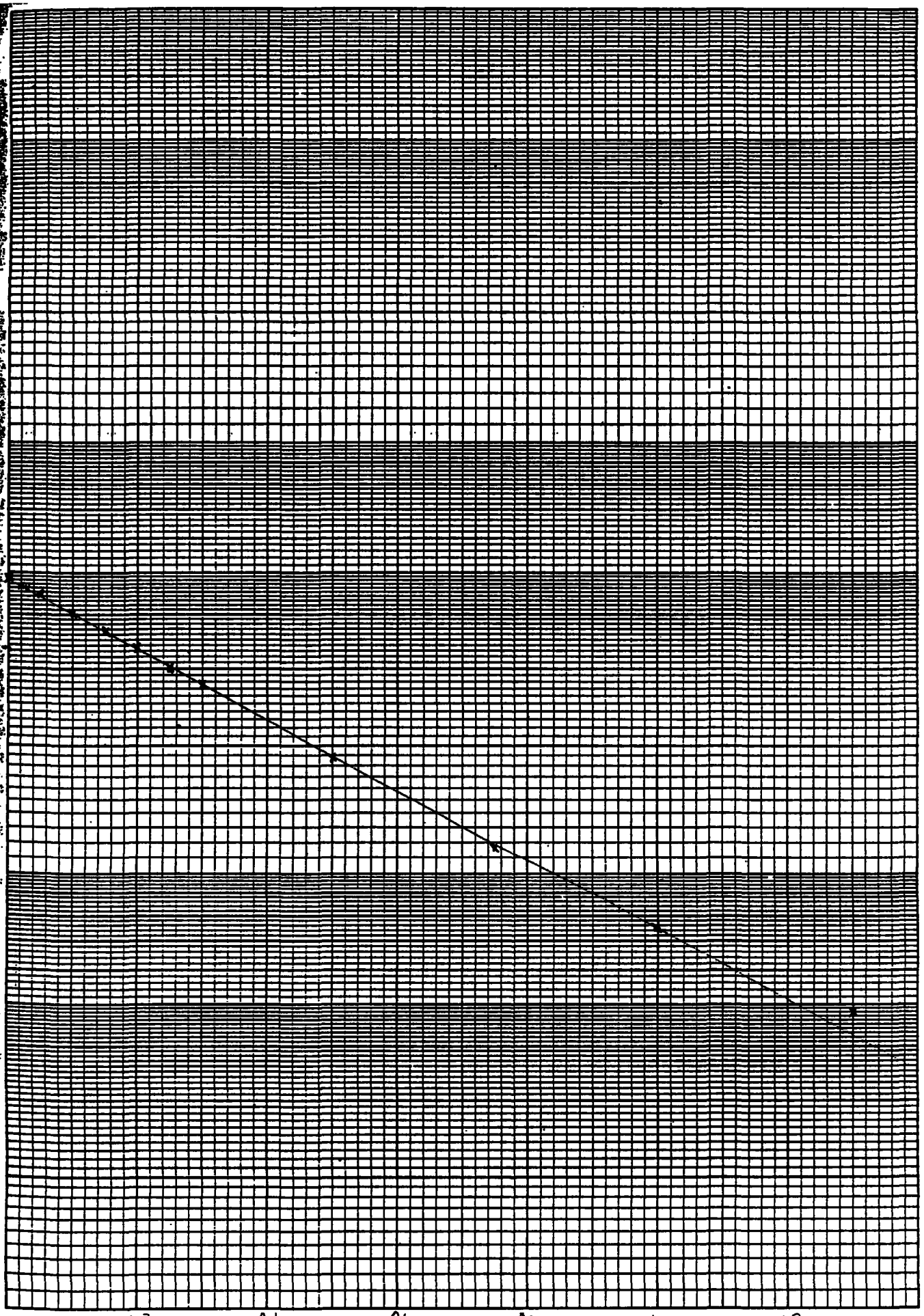
R173

C-14

018780

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

Shallow MW-34 Test #2 Bail Test



R173

#4

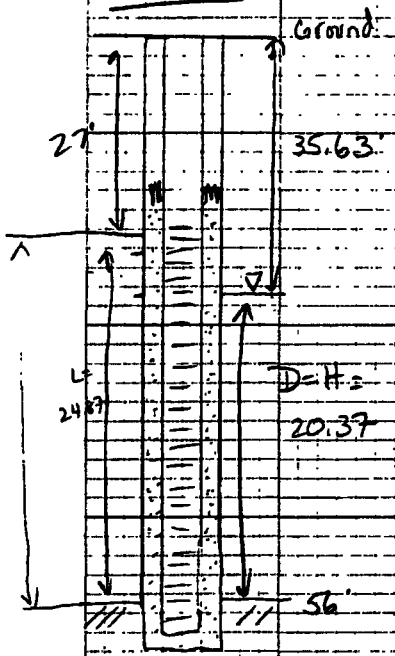
018781

ERM-Southwest, inc.

By DEW Date 11/24/87 Subject Slug/Bail Test - Sheridan Sheet No. ____ of ____

Chkd By ACW Date ____ MW-36 W.O. No. 91-07

MW-36



Water level from TOC = 38.51'
− 2.88
35.63'

TOC (msl) 169.46
GND (msl) 166.58
2.88

Maximum L = Height of water level plus [illegible] of slug 20.37' + 4.5 = 24.87'

Assume that screened interval within clay does not affect hydraulic characteristics of aquifer

NOTE: All changes in water level take place within screened interval – therefore use R_{ce}

$$R_{ce} = \left[(R_c^2) + \phi_{sand}\left[R_w^2 - R_c^2\right]\right]^{1/2}$$

$R_c = .167'$
$\phi_{sand} = 3$
$R_w = .46'$

$R_{ce} = .288'$
$H = D = 20.37'$
$L = 24.87'$

Calculate R_e

Since D = H $\quad \ln R_e/R_w = \left(\frac{1.1}{\ln(H/R_w)} + \frac{C}{L/R_w}\right)^{-1}$

$L/R_w = \frac{24.87}{.46} = 54.07$

$C = 2.85$

$\ln R_e/R_w = \left(\frac{1.1}{\ln \frac{20.37}{.46}} + \frac{2.85}{54.07}\right)^{-1}$

$\ln R_e/R_w = 2.917$

R173

ERM-Southwest, inc.

By DEW Date 11/24/87 Subject Slug Test - Slug Sheet No. ____ of ____

Chkd By AWW Date ____ MW-36 W.O. No. 9107

MW-36 Test #0 - SLUG TEST

From graph $t = 0$ $y_0 = 3.52$

$t = .2 \text{ min} = .12 \text{ sec}$ $y_t = 2.5'$

$L = 24.87$

$\ln R_e/R_w = 2.917$

$R_{ce} = .288'$

$$K = \frac{(R_{ce})^2 \ln R_e/R_w}{2 \cdot L} \cdot \frac{1}{t} \ln y_0/y_t =$$

$$\frac{(.288)^2 \, 2.917}{2(24.87)} \cdot \frac{1}{12} \ln \frac{3.52}{2.5}$$

$K = 1.39 \times 10^{-4}$ ft/sec

$= 4.23 \times 10^{-3}$ cm/sec

$T = Kb$, $b = 20.37'$ — $T = 2.83 \times 10^{-3}$ ft²/sec

$= 6.21 m$ $= 8.61 \times 10^{-2}$ cm²/sec

$= 22.7 m^2/day$

MW-36 Test #1 - Bail Test

From graph $t = 0$ $y_0 = 4.5'$

$t = .2 \text{ min} = 12 \text{ sec}$ $y_t = 3.35'$

$L = 24.87$

$\ln R_e/R_w = 2.917$

$R_{ce} = .288$

$$K = \frac{(R_{ce})^2 \ln R_e/R_w}{2 \cdot L} \cdot \frac{1}{t} \ln y_0/y_t$$

$$= \frac{(.288)^2 \, 2.917}{2(24.87)} \cdot \frac{1}{12} \ln \left(\frac{4.5}{3.35}\right)$$

$K = 1.20 \times 10^{-4}$ ft/sec

$= 3.65 \times 10^{-3}$ cm/sec

$T = Kb$ $T = 2.44 \times 10^{-3}$ ft²/sec

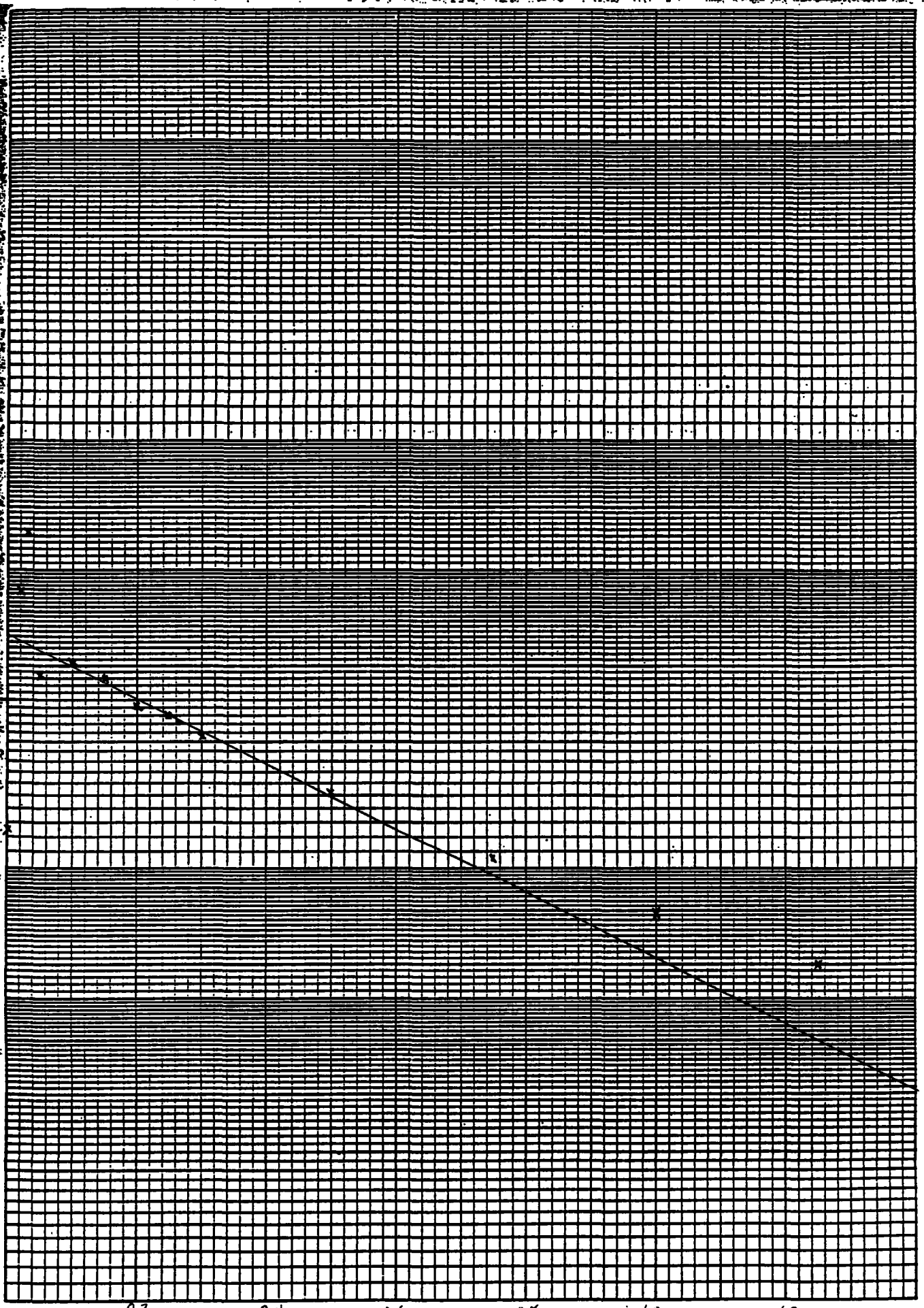
$b = 20.37'$ 2.27×10^{-1} cm²/sec

$= 6.21 m$ $= 19.5 m^2/day$

018783

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

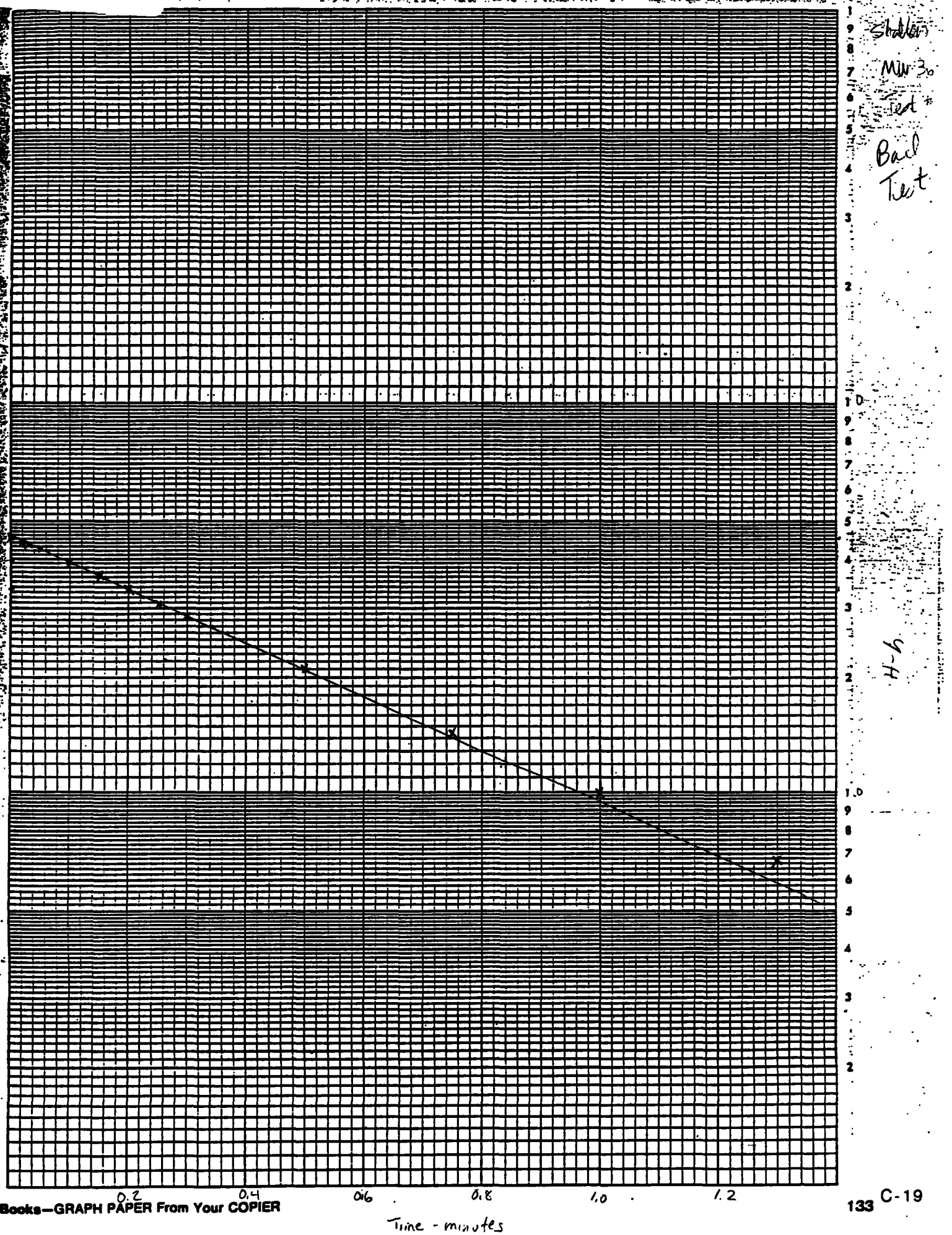
Shallow
MW-36
Test #0
Slug
Test



#4

018784

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log



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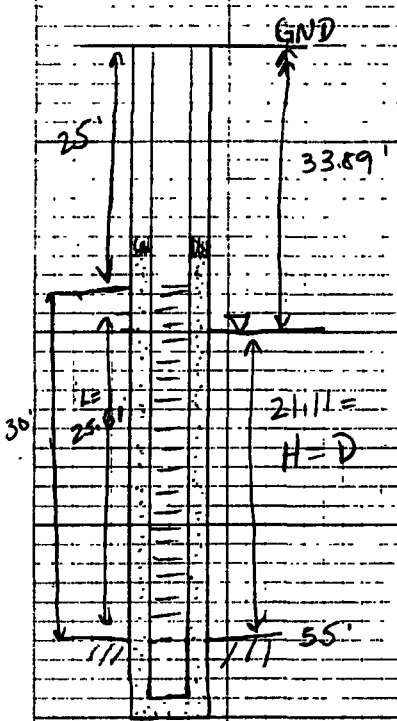
018785

ERM-Southwest, inc.

By DEW Date 11/24/87 Subject Slug Gas Tests - Sheridan Sheet No. ____ of ____

Chkd By TCW Date ____ MW-37 W.O. No. 71.7

MW-37



Water Level from TOC

TOC (msL)	168.75	36.60
GND (msL)	166.04	− 2.71
	2.71	33.89'

L = maximum length of screen through which water enters = H + maximum volume displacement also

= 21.11 + 4.5' = 25.61'

$R_w = .46'$

$R_c = .167'$

Note: All changes in water level take place within the screened interval of aquifer - ∴ use R_{ce}

$$R_{ce} = \left[(R_c)^2 + \phi_{sand}\left(R_w^2 - R_c^2\right)\right]^{1/2}$$

$$R_{ce} = \left[(.167)^2 + .3\left((.46)^2 - (.167)^2\right)\right]^{1/2}$$

$$R_{ce} = .288'$$

Calculate Re

Since D = H $\quad \ln R_e/R_w = \left(\frac{1.1}{\ln(H/R_w)} + \frac{C}{L/R_w}\right)^{-1}$

$L/R_w = 25.61/.46 = 55.67 \qquad C = 2.9$ from graph

$$\ln R_e/R_w = \left(\frac{1.1}{\ln \frac{21.11}{.46}} + \frac{2.9}{55.67}\right)^{-1}$$

$$= 2.945$$

018786

EKM-Southwest, inc.

By DEW Date 11/24/87 Subject Slug/Bail Tests - Shoreline Sheet No. ____ of ____

Chkd By ACW Date ____ MW-37 W.O. No. 91-07

MW-37 TEST 0 SLUG TEST

$t = 0$ $y_0 = 4.5$

$t = .2$ min $y_t = 3.45$] from graph

12 sec

$L = 25.61'$

$\ln R_e/R_w = 2.945$

REM - use R_{ce}

$$K = \frac{(R_{ce})^2 \ln R_e/R_w}{2 \cdot L} \frac{1}{t} \ln y_0/y_t$$

$$= \frac{(.288)^2 \; 2.945}{2 \cdot 25.61} \frac{1}{12} \ln \frac{4.5}{3.45}$$

$= 1.06 \times 10^{-4}$ ft/sec

$= 3.22 \times 10^{-3}$ cm/sec

$T = Kb$, where $b = 21.11'$ $T = 2.24 \times 10^{-3}$ ft²/sec

$= 6.43$ m 2.07×10^{-1} cm²/sec $= 17.9$ m²/day

MW-37 Test 1 Bail Test

$t = 0$, $y_0 = 5.1$] from graph

$t = .4$ min $y_t = 2.95$

24 sec

$$K = \frac{(R_e)^2 \ln R_e/R_w}{2 \cdot L} \frac{1}{t} \ln y_0/y_t$$

$$= \frac{(.288)^2 \; 2.945}{2 \cdot 25.61} \frac{1}{24} \ln \frac{5.1}{2.95}$$

$K = 1.09 \times 10^{-4}$ ft/sec

$= 3.32 \times 10^{-3}$ cm/sec

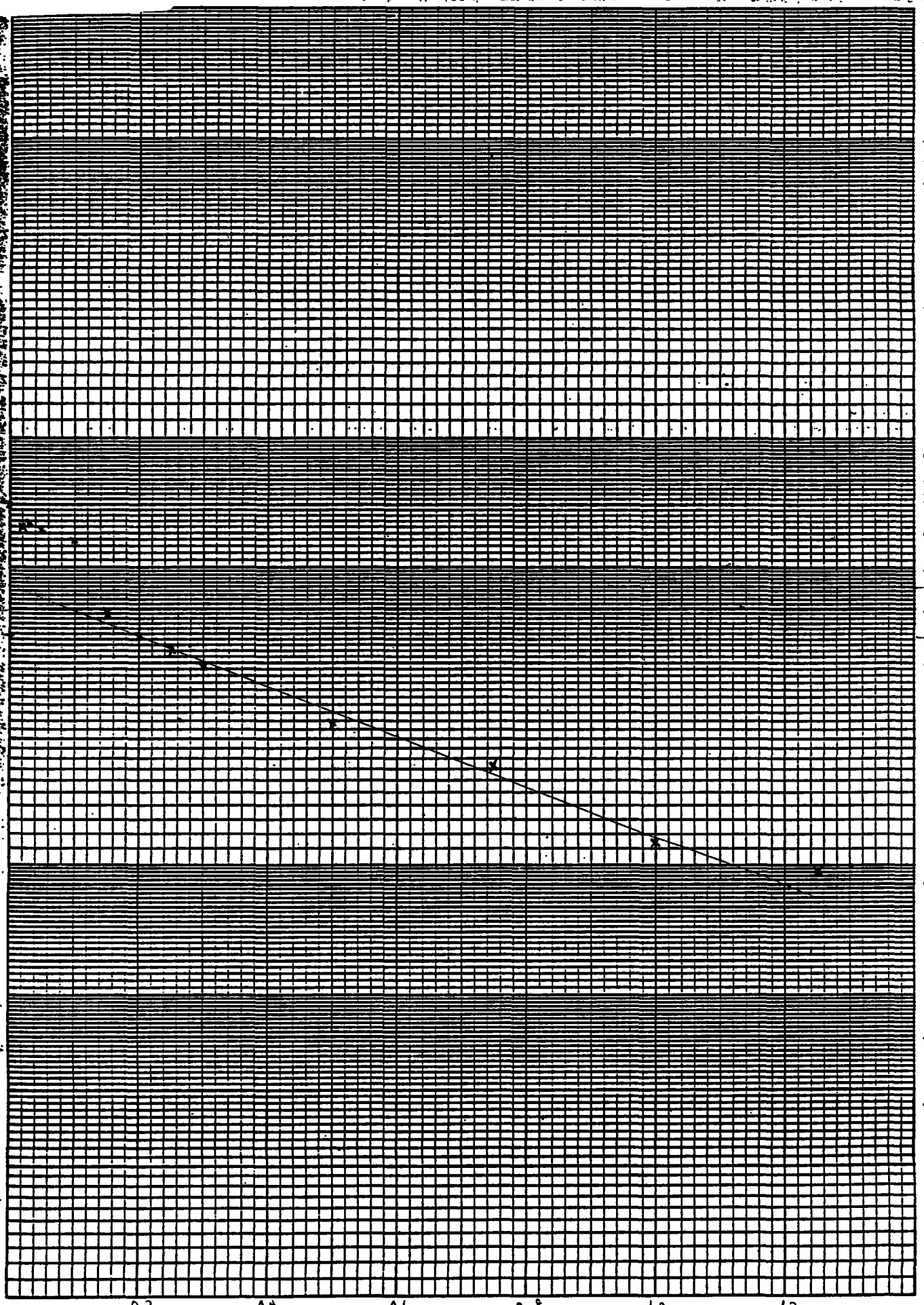
If $b = 21.11'$ $T = 2.30 \times 10^{-3}$ ft²/sec

$= 6.43$ m 2.13×10^{-1} cm²/sec

$= 18.4$ m²/day

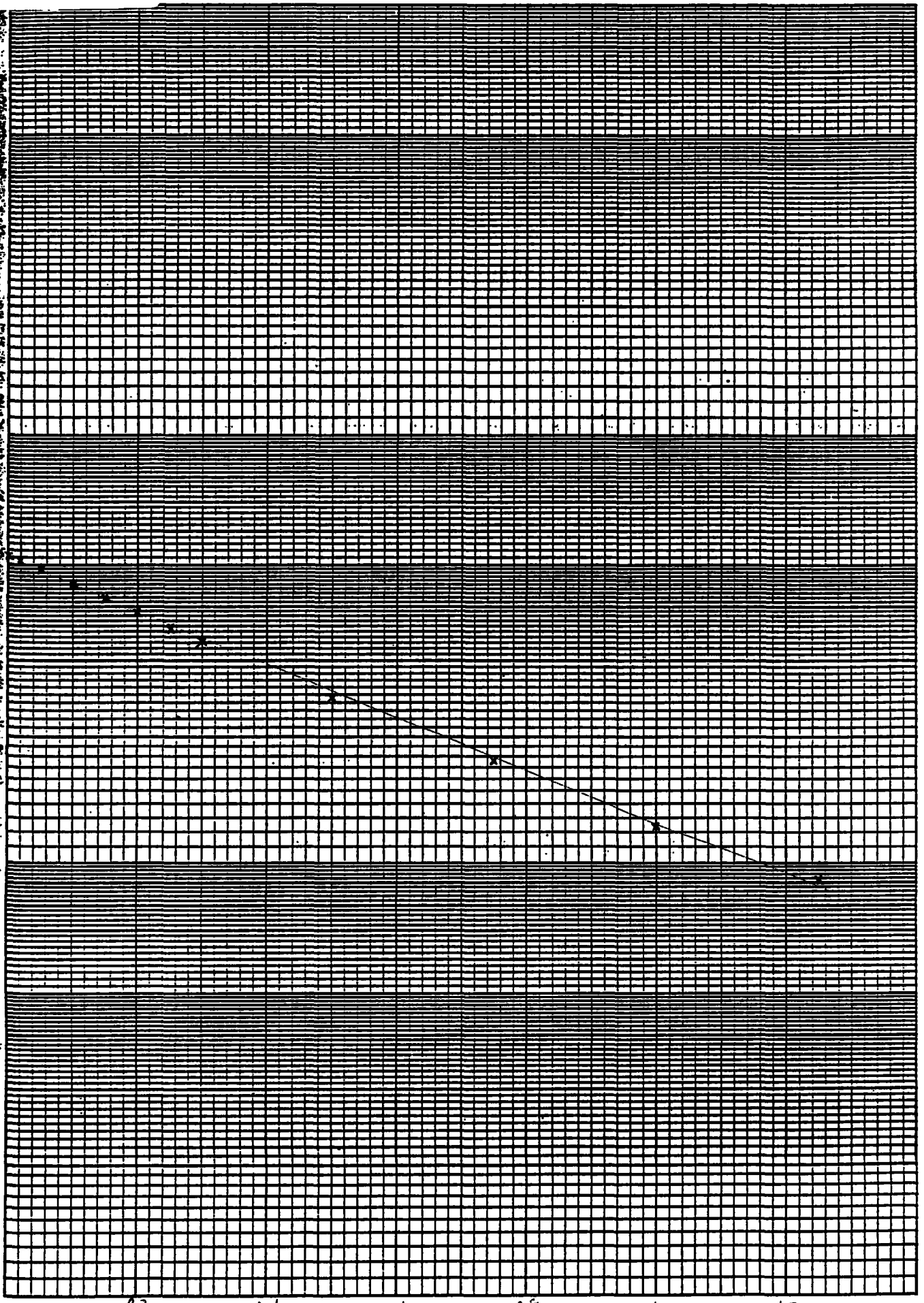
018787

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log



018788

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log



MW-37
Shallow
aquifer
Test
Bail
Test

H-4

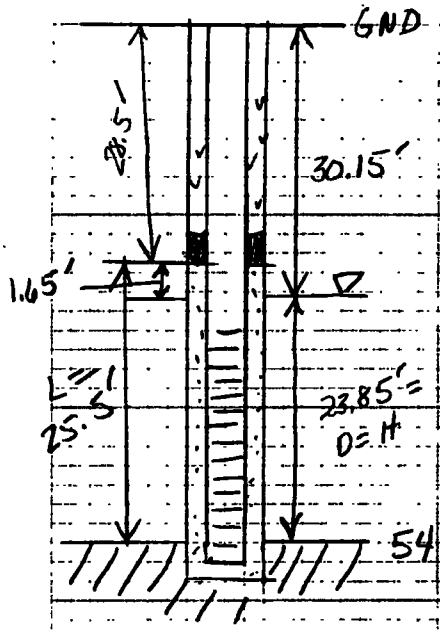
C-23

018789

ERM-Southwest, inc.

By HCW Date 12/3/87 Subject Slug/Bail Test Skwicka Sheet No. ____ of ____

Chkd By JCW Date ____ MW-39 W.O. No. ____



Water level from TOC: 32.18 − 2.03 = 30.15'

TOC (msl) 167.58

GND (msl) 165.55

2.03

Note: Change in water level takes place both in the casing and in the screen portion of the well, assuming length of screen (L) includes all well casing & screen below the bentonite seal. In this case, if H-b greater than 1.65', change in water level is in the casing, if less than 1.65', change is in screened portion. Will use change in screen portion for consistency to other calculations.

∴ use R_{ce} in calculations.

$L = 25.5'$ $R_c = .167'$

$R_w = .46'$

$R_{ce} = [(R_c)^2 + \phi \text{ sand } (R_w^2 - R_c^2)]^{1/2}$

$R_{ce} = .288$ FT ✓

Calculate Re:

Since D = H $\ln R_e/R_w = \left(\frac{1.1}{\ln(H/R_w)} + \frac{C}{L/R_w} \right)^{-1}$

$L/R_w = 25.5'/.46' = 55.43$ $C = 2.9$ from graph

$$\ln R_e/R_w = \left(\frac{1.1}{\ln\left(\frac{23.85}{.46}\right)} + \frac{2.9}{55.43} \right)^{-1}$$

$\ln R_e/R_w = 3.02$ ✓

ERM-Southwest, inc.

By ACW Date 12-3-87 Subject Slug/Bail Tests Sheet No. ____ of ____

Chkd By DEW Date ____ MW-39 W.O. No. 91-08

MW-39 Test #1

$t=0$ $y_o = 5.1'$

$t = 40\,sec$ $y_t = 1.1'$ } from graph

Know: $\ln R_e/R_w = 3.02$

$R_w = .46'$

$R_{ie} = .288'$

$L = 25.5'$

$$K = \frac{(R_{ie})^2 \ln R_e/R_w}{2L} \frac{1}{t} \ln y_o/y_t$$

$$K = \frac{(.288)^2 (3.02)}{2(25.5)} \frac{1}{40} \ln \frac{5.1}{1.1} \checkmark$$

$K = 1.88 \times 10^{-4}\ ft^2/sec$ ✓

$K = 5.74 \times 10^{-3}\ cm^2/sec$ ✓

Assume $b = 23.85' = 7.27m$ $T = Kb$

$T = 1.88 \times 10^{-4} (23.85) = 4.48 \times 10^{-3}\ ft^2/sec$ ✓

or $T = 5.74 \times 10^{-3} (727\,cm) = 4.17\ cm^2/sec$

or $36.05\ m^2/day$ ✓

Test #0 MW-39

$t=0$ $y_o = 5.62'$ } from graph

$t = 0.8\,min$ (48 sec) $y_t = 1.15'$ } graph

$$K = \frac{(R_{ie})^2 \ln R_e/R_w}{2L} \frac{1}{t} \ln y_o/y_t$$

$$K = \frac{(.288)^2\ 3.02}{2(25.5)} \frac{1}{48} \ln \frac{5.62}{1.15}$$

$K = 1.62 \times 10^{-4}\ Ft/sec$ ✓

or $4.95 \times 10^{-3}\ cm/sec$ ✓

$T = Kb$

$b = 23.85' = 7.27m$

$T = 3.86 \times 10^{-3}\ FT^2/sec$ ✓

or $3.60\ cm^2/sec$ ✓ $= 31.09\ m^2/day$ ✓

shallow aquifer

MW-31

READY

SE1000B
Environmental Logger
11/17 17:11

Unit# 00000 Test# 2

INPUT 1: Level (F) TOC

Reference	33.00
Scale factor	49.82
Offset	0.00

Step# 0 11/17 16:59

Elapsed Time	Value
0.0000	37.04
0.0033	36.94
0.0066	36.85
0.0099	36.75
0.0133	36.67
0.0166	36.61
0.0200	36.53
0.0233	36.44
0.0266	36.36
0.0300	36.26
0.0333	36.17
0.0500	35.90
0.0666	35.53
0.0833	35.26
0.1000	35.04
0.1166	34.83
0.1333	34.63
0.1500	34.46
0.1666	34.32
0.1833	34.19
0.2000	34.06
0.2166	33.95
0.2333	33.88
0.2500	33.78
0.2666	33.72
0.2833	33.66
0.3000	33.59
0.3166	33.53
0.3333	33.48
0.4167	33.33
0.5000	33.22
0.5833	33.15
0.6667	33.12
0.7500	33.09
0.8333	33.07
0.9167	33.06
1.0000	33.06
1.0833	33.04
1.1667	33.04
1.2500	33.04
1.3333	33.04
1.4166	33.04
1.5000	33.04
1.5833	33.04
1.6667	33.03
1.7500	33.04
1.8333	33.04
1.9167	33.03
2.0000	33.03
2.5000	33.03
3.0000	33.03
3.5000	33.03
4.0000	33.03
4.5000	33.03
5.0000	33.03
5.5000	33.03
6.0000	33.03
6.5000	33.01
7.0000	33.03
7.5000	33.03
8.0000	33.03
8.5000	33.03
9.0000	33.03
9.5000	33.03
10.0000	33.03

END

slug out

large (3", 8' long) slug

MW-31

SE1000B
Environmental Logger
11/17 16:16

Unit# 00000 Test# 1

INPUT 1: Level (F) TOC

Reference	33.00
Scale factor	49.82
Offset	0.00

Step# 0 11/17 16:10

Elapsed Time	Value
0.0000	34.57
0.0033	34.52
0.0066	34.47
0.0099	34.44
0.0133	34.39
0.0166	34.36
0.0200	34.32
0.0233	34.28
0.0266	34.27
0.0300	34.24
0.0333	34.19
0.0500	34.05
0.0666	33.94
0.0833	33.83
0.1000	33.73
0.1166	33.66
0.1333	33.59
0.1500	33.53
0.1666	33.47
0.1833	33.42
0.2000	33.37
0.2166	33.34
0.2333	33.31
0.2500	33.28
0.2666	33.25
0.2833	33.23
0.3000	33.20
0.3166	33.18
0.3333	33.17
0.4167	33.11
0.5000	33.07
0.5833	33.06
0.6667	33.04
0.7500	33.03
0.8333	33.03
0.9167	33.01
1.0000	33.01
1.0833	33.01
1.1667	33.01
1.2500	33.01
1.3333	33.01
1.4166	33.01
1.5000	33.01
1.5833	33.01
1.6667	33.01
1.7500	33.01
1.8333	33.01
1.9167	33.01
2.0000	33.01
2.5000	33.01
3.0000	33.01
3.5000	33.01
4.0000	33.00
4.5000	33.00
5.0000	33.00

END

slug out

READY MW-31

SE1000B
Environmental Logger
11/17 16:07

Unit# 00000 Test# 0

INPUT 1: Level (F) TOC

Reference	33.00
Scale factor	49.82
Offset	0.00

Step# 0 11/17 16:02

Elapsed Time	Value
0.0000	31.20
0.0033	30.39
0.0066	33.00
0.0099	34.25
0.0133	32.55
0.0166	31.36
0.0200	31.44
0.0233	32.08
0.0266	32.38
0.0300	32.15
0.0333	32.00
0.0500	31.89
0.0666	32.79
0.0833	32.46
0.1000	32.44
0.1166	32.51
0.1333	32.55
0.1500	32.59
0.1666	32.63
0.1833	32.66
0.2000	32.70
0.2166	32.73
0.2333	32.74
0.2500	32.77
0.2666	32.79
0.2833	32.81
0.3000	32.82
0.3166	32.84
0.3333	32.85
0.4167	32.90
0.5000	32.93
0.5833	32.95
0.6667	32.96
0.7500	32.96
0.8333	32.96
0.9167	32.98
1.0000	32.98
1.0833	33.00
1.1667	32.98
1.2500	32.98
1.3333	32.98
1.4166	32.98
1.5000	32.98
1.5833	32.98
1.6667	32.98
1.7500	32.98
1.8333	32.98
1.9167	33.00
2.0000	32.98
2.5000	32.98

END
READY

slug in

018791

shallow aquifer

0187792

READY
MW-32 SE1000B
Environmental Logger
11/17 18:17

Unit# 00000 Test# 1

INPUT 1: Level (F) TOC

Reference 36.91
Scale factor 49.82
Offset 0.00

Step# 0 11/17 18:10

Elapsed Time	Value
0.0000	41.64
0.0033	41.56
0.0066	41.45
0.0099	41.40
0.0133	41.34
0.0166	41.29
0.0200	41.21
0.0233	41.15
0.0266	41.10
0.0300	41.02
0.0333	40.98
0.0500	40.68
0.0666	40.38
0.0833	40.13
0.1000	39.89
0.1166	39.69
0.1333	39.50
0.1500	39.31
0.1666	39.15
0.1833	39.00
0.2000	38.84
0.2166	38.71
0.2333	38.59
0.2500	38.48
0.2666	38.37
0.2833	38.27
0.3000	38.18
0.3166	38.08
0.3333	38.01
0.4167	37.69
0.5000	37.47
0.5833	37.31
0.6667	37.22
0.7500	37.14
0.8333	37.08
0.9167	37.05
1.0000	37.02
1.0833	36.98
1.1667	36.97
1.2500	36.97
1.3333	36.95
1.4166	36.95
1.5000	36.94
1.5833	36.94
1.6667	36.94
1.7500	36.94
1.8333	36.92
1.9167	36.92
2.0000	36.92
2.5000	36.92
3.0000	36.92
3.5000	36.92
4.0000	36.94
4.5000	36.92
5.0000	36.92
5.5000	36.94
6.0000	36.94
6.5000	36.94
7.0000	36.92

END

slug out

READY
MW-32
SE1000B
Environmental Logger
11/17 18:01

Unit# 00000 Test# 0

INPUT 1: Level (F) TOC

Reference 36.91
Scale factor 49.82
Offset 0.00

Step# 0 11/17 17:56

Elapsed Time	Value
0.0000	41.28
0.0033	41.21
0.0066	41.17
0.0099	41.10
0.0133	41.06
0.0166	40.98
0.0200	40.87
0.0233	40.76
0.0266	40.74
0.0300	40.66
0.0333	40.63
0.0500	40.35
0.0666	40.10
0.0833	39.83
0.1000	39.62
0.1166	39.40
0.1333	39.23
0.1500	39.06
0.1666	38.90
0.1833	38.76
0.2000	38.63
0.2166	38.51
0.2333	38.38
0.2500	38.29
0.2666	38.18
0.2833	38.10
0.3000	38.02
0.3166	37.94
0.3333	37.88
0.4167	37.61
0.5000	37.41
0.5833	37.28
0.6667	37.20
0.7500	37.14
0.8333	37.09
0.9167	37.06
1.0000	37.05
1.0833	37.03
1.1667	37.02
1.2500	37.00
1.3333	37.00
1.4166	37.00
1.5000	36.98
1.5833	36.98
1.6667	36.98
1.7500	36.98
1.8333	36.97
1.9167	36.97
2.0000	36.97
2.5000	36.97
3.0000	36.97
3.5000	36.97
4.0000	36.97

END

slug in

slug + oxygen

READY

SE1000B
Environmental Logger
11/18 12:52

Unit# 00000 Test# 2

INPUT 1: Level (F) TOC

Reference	42.09
Scale factor	49.82
Offset	0.00

Step# 0 11/18 12:41

Elapsed Time	Value
0.0000	46.93
0.0033	46.93
0.0066	46.90
0.0099	46.86
0.0133	46.83
0.0166	46.82
0.0200	46.77
0.0233	46.75
0.0266	46.71
0.0300	46.69
0.0333	46.64
0.0500	46.50
0.0666	46.36
0.0833	46.24
0.1000	46.09
0.1166	45.97
0.1333	45.84
0.1500	45.73
0.1666	45.62
0.1833	45.51
0.2000	45.40
0.2166	45.29
0.2333	45.20
0.2500	45.09
0.2666	44.99
0.2833	44.90
0.3000	44.82
0.3166	44.73
0.3333	44.65
0.4167	44.27
0.5000	43.96
0.5833	43.67
0.6667	43.45
0.7500	43.25
0.8333	43.09
0.9167	42.95
1.0000	42.84
1.0833	42.73
1.1667	42.65
1.2500	42.57
1.3333	42.51
1.4166	42.46
1.5000	42.42
1.5833	42.37
1.6667	42.34
1.7500	42.31
1.8333	42.27
1.9167	42.26
2.0000	42.23
2.5000	42.16
3.0000	42.12
3.5000	42.10
4.0000	42.10
4.5000	42.09
5.0000	42.09
5.5000	42.09
6.0000	42.09
6.5000	42.09
7.0000	42.09
7.5000	42.09
8.0000	42.09
8.5000	42.09
9.0000	42.09
9.5000	42.09
10.0000	42.09

END

slug out

READY

SE1000B
Environmental Logger
11/18 12:35

Unit# 00000 Test# 1

INPUT 1: Level (F) TOC

Reference	42.08
Scale factor	49.82
Offset	0.00

Step# 0 11/18 12:25

Elapsed Time	Value
0.0000	39.91
0.0033	35.44
0.0066	33.15
0.0099	34.89
0.0133	37.20
0.0166	36.64
0.0200	35.36
0.0233	35.55
0.0266	36.46
0.0300	36.40
0.0333	36.01
0.0500	39.17
0.0666	39.40
0.0833	39.42
0.1000	39.48
0.1166	39.56
0.1333	39.64
0.1500	39.72
0.1666	39.80
0.1833	39.86
0.2000	39.92
0.2166	39.98
0.2333	40.05
0.2500	40.11
0.2666	40.16
0.2833	40.20
0.3000	40.27
0.3166	40.31
0.3333	40.36
0.4167	40.58
0.5000	40.75
0.5833	40.91
0.6667	41.05
0.7500	41.18
0.8333	41.27
0.9167	41.37
1.0000	41.45
1.0833	41.52
1.1667	41.57
1.2500	41.63
1.3333	41.68
1.4166	41.73
1.5000	41.76
1.5833	41.79
1.6667	41.82
1.7500	41.84
1.8333	41.87
1.9167	41.89
2.0000	41.90
2.5000	41.98
3.0000	42.01
3.5000	42.03
4.0000	42.04
4.5000	42.04
5.0000	42.06
5.5000	42.06
6.0000	42.08
6.5000	42.08
7.0000	42.08
7.5000	42.08
8.0000	42.09
8.5000	42.09
9.0000	42.09
9.5000	42.09
10.0000	42.09

END

slug in

SE1000B
Environmental Logger
11/18 12:20

Unit# 00000 Test# 0

INPUT 1: Level (F) TOC

Reference	42.08
Scale factor	49.82
Offset	0.00

Step# 0 11/18 12:07

Elapsed Time	Value
0.0000	47.03
0.0033	47.00
0.0066	46.96
0.0099	46.92
0.0133	46.90
0.0166	46.84
0.0200	46.82
0.0233	46.79
0.0266	46.76
0.0300	46.71
0.0333	46.68
0.0500	46.52
0.0666	46.37
0.0833	46.23
0.1000	46.08
0.1166	45.96
0.1333	45.83
0.1500	45.71
0.1666	45.58
0.1833	45.45
0.2000	45.34
0.2166	45.23
0.2333	45.12
0.2500	45.03
0.2666	44.92
0.2833	44.83
0.3000	44.73
0.3166	44.64
0.3333	44.56
0.4167	44.17
0.5000	43.84
0.5833	43.57
0.6667	43.35
0.7500	43.14
0.8333	42.99
0.9167	42.86
1.0000	42.75
1.0833	42.66
1.1667	42.58
1.2500	42.50
1.3333	42.45
1.4166	42.41
1.5000	42.36
1.5833	42.33
1.6667	42.30
1.7500	42.26
1.8333	42.25
1.9167	42.23
2.0000	42.22
2.5000	42.15
3.0000	42.12
3.5000	42.11
4.0000	42.11
4.5000	42.11
5.0000	42.11
5.5000	42.11
6.0000	42.09
6.5000	42.11
7.0000	42.11
7.5000	42.11
8.0000	42.11
8.5000	42.11
9.0000	42.09
9.5000	42.09
10.0000	42.11
12.0000	42.11

END

? slug out

Did not plot

Shallow aquifer

018794

SE1000B
Environmental Logger
11/18 15:03

Unit# 00000 Test# 1

INPUT 1: Level (F) TOC

Reference	38.51
Scale factor	49.82
Offset	0.00

Step# 0 11/18 14:48

Elapsed Time	Value
0.0000	43.10
0.0033	43.10
0.0066	43.08
0.0099	43.06
0.0133	43.02
0.0166	42.99
0.0200	42.92
0.0233	42.94
0.0266	42.89
0.0300	42.86
0.0333	42.86
0.0500	42.73
0.0666	42.62
0.0833	42.51
0.1000	42.42
0.1166	42.31
0.1333	42.22
0.1500	42.12
0.1666	42.03
0.1833	41.93
0.2000	41.85
0.2166	41.76
0.2333	41.68
0.2500	41.60
0.2666	41.52
0.2833	41.44
0.3000	41.37
0.3166	41.30
0.3333	41.22
0.4167	40.89
0.5000	40.61
0.5833	40.36
0.6667	40.14
0.7500	39.95
0.8333	39.78
0.9167	39.62
1.0000	39.50
1.0833	39.37
1.1667	39.28
1.2500	39.18
1.3333	39.10
1.4166	39.04
1.5000	38.99
1.5833	38.95
1.6667	38.90
1.7500	38.87
1.8333	38.84
1.9167	38.80
2.0000	38.79
2.5000	38.71
3.0000	38.65
3.5000	38.62
4.0000	38.60
4.5000	38.58
5.0000	38.57
5.5000	38.55
6.0000	38.55
6.5000	38.54
7.0000	38.54
7.5000	38.54
8.0000	38.52
8.5000	38.52
9.0000	38.52
9.5000	38.52
10.0000	38.52

END

slugout

READY

SE1000B
Environmental Logger
11/18 14:59

Unit# 00000 Test# 0

INPUT 1: Level (F) TOC

Reference	38.61
Scale factor	49.82
Offset	0.00

Step# 0 11/18 14:33

Elapsed Time	Value
0.0000	37.36
0.0033	34.28
0.0066	31.36
0.0099	30.08
0.0133	31.50
0.0166	33.59
0.0200	34.16
0.0233	33.10
0.0266	32.36
0.0300	32.57
0.0333	33.21
0.0500	35.76
0.0666	35.43
0.0833	35.38
0.1000	35.59
0.1166	35.48
0.1333	35.84
0.1500	35.79
0.1666	35.92
0.1833	36.00
0.2000	36.20
0.2166	36.36
0.2333	36.18
0.2500	36.31
0.2666	36.40
0.2833	36.37
0.3000	36.55
0.3166	36.58
0.3333	36.67
0.4167	36.89
0.5000	37.10
0.5833	37.27
0.6667	37.41
0.7500	37.54
0.8333	37.65
0.9167	37.74
1.0000	37.82
1.0833	37.90
1.1667	37.94
1.2500	38.01
1.3333	38.04
1.4166	38.10
1.5000	38.12
1.5833	38.18
1.6667	38.20
1.7500	38.21
1.8333	38.24
1.9167	38.26
2.0000	38.27
2.5000	38.35
3.0000	38.40
3.5000	38.45
4.0000	38.46
4.5000	38.48
5.0000	38.50
5.5000	38.51
6.0000	38.53
6.5000	38.54
7.0000	38.54
7.5000	38.56
8.0000	38.56
8.5000	38.56
9.0000	38.56
9.5000	38.57
10.0000	38.57
12.0000	38.59

END

slugin

shallow aquifer

READY

SE1000B
Environmental Logger
11/18 16:09

Unit# 00000 Test# 1

INPUT 1: Level (F) TOC

Reference	36.61
Scale factor	49.82
Offset	0.00

Step# 0 11/18 15:51

Elapsed Time	Value
0.0000	41.86
0.0033	41.84
0.0066	41.84
0.0099	41.79
0.0133	41.81
0.0166	41.76
0.0200	41.71
0.0233	41.70
0.0266	41.67
0.0300	41.62
0.0333	41.56
0.0500	41.48
0.0666	41.35
0.0833	41.20
0.1000	41.09
0.1166	40.98
0.1333	40.87
0.1500	40.76
0.1666	40.66
0.1833	40.55
0.2000	40.46
0.2166	40.36
0.2333	40.27
0.2500	40.17
0.2666	40.09
0.2833	40.02
0.3000	39.92
0.3166	39.86
0.3333	39.78
0.4167	39.40
0.5000	39.09
0.5833	38.82
0.6667	38.57
0.7500	38.37
0.8333	38.16
0.9167	38.00
1.0000	37.85
1.0833	37.72
1.1667	37.61
1.2500	37.52
1.3333	37.42
1.4166	37.34
1.5000	37.28
1.5833	37.22
1.6667	37.16
1.7500	37.11
1.8333	37.06
1.9167	37.01
2.0000	36.98
2.5000	36.84
3.0000	36.76
3.5000	36.73
4.0000	36.70
4.5000	36.67
5.0000	36.68
5.5000	36.65
6.0000	36.67
6.5000	36.67
7.0000	36.65
7.5000	36.65
8.0000	36.67
8.5000	36.65
9.0000	36.65
9.5000	36.65
10.0000	36.64
12.0000	36.64

END

slug out

READY

SE1000B
Environmental Logger
11/18 16:12

Unit# 00000 Test# 0

INPUT 1: Level (F) TOC

Reference	36.62
Scale factor	49.82
Offset	0.00

Step# 0 11/18 15:36

Elapsed Time	Value
0.0000	29.65
0.0033	28.71
0.0066	30.15
0.0099	30.22
0.0133	29.89
0.0166	30.11
0.0200	30.42
0.0233	30.28
0.0266	30.28
0.0300	30.36
0.0333	30.34
0.0500	30.45
0.0666	30.59
0.0833	30.74
0.1000	30.86
0.1166	31.38
0.1333	33.31
0.1500	32.75
0.1666	33.02
0.1833	33.08
0.2000	33.17
0.2166	33.27
0.2333	33.36
0.2500	33.42
0.2666	33.52
0.2833	33.61
0.3000	33.68
0.3166	33.75
0.3333	33.69
0.4167	34.16
0.5000	34.43
0.5833	34.68
0.6667	34.89
0.7500	34.90
0.8333	35.20
0.9167	35.33
1.0000	35.48
1.0833	35.55
1.1667	35.72
1.2500	35.66
1.3333	35.86
1.4166	35.94
1.5000	35.99
1.5833	36.05
1.6667	36.10
1.7500	36.14
1.8333	36.17
1.9167	36.22
2.0000	36.25
2.5000	36.35
3.0000	36.46
3.5000	36.51
4.0000	36.54
4.5000	36.55
5.0000	36.55
5.5000	36.55
6.0000	36.57
6.5000	36.57
7.0000	36.57
7.5000	36.57
8.0000	36.57
8.5000	36.58
9.0000	36.58
9.5000	36.58
10.0000	36.58
12.0000	36.58

END

slug in

shallow aquifer

READY MW-39

SE1000B
Environmental Logger
11/18 09:50

Unit# 00000 Test# 1

INPUT 1: Level (F) TOC

Reference	32.18
Scale factor	49.82
Offset	0.00

Step# 0 11/18 09:40

Elapsed Time	Value
0.0000	37.00
0.0033	37.02
0.0066	37.00
0.0099	36.97
0.0133	36.89
0.0166	36.89
0.0200	36.83
0.0233	36.78
0.0266	36.81
0.0300	36.78
0.0333	36.72
0.0500	36.58
0.0666	36.47
0.0833	36.34
0.1000	36.23
0.1166	36.12
0.1333	36.01
0.1500	35.90
0.1666	35.81
0.1833	35.70
0.2000	35.60
0.2166	35.49
0.2333	35.41
0.2500	35.32
0.2666	35.22
0.2833	35.15
0.3000	35.05
0.3166	34.97
0.3333	34.89
0.4167	34.52
0.5000	34.20
0.5833	33.92
0.6667	33.68
0.7500	33.46
0.8333	33.28
0.9167	33.12
1.0000	32.98
1.0833	32.87
1.1667	32.77
1.2500	32.68
1.3333	32.60
1.4166	32.54
1.5000	32.49
1.5833	32.44
1.6667	32.40
1.7500	32.36
1.8333	32.33
1.9167	32.30
2.0000	32.29
2.5000	32.21
3.0000	32.19
3.5000	32.18
4.0000	32.18
4.5000	32.18
5.0000	32.18
5.5000	32.18
6.0000	32.18
6.5000	32.18
7.0000	32.18
7.5000	32.18
8.0000	32.18
8.5000	32.18
9.0000	32.18
9.5000	32.18
10.0000	32.18

END

slug out

READY
READY MW-39

SE1000B
Environmental Logger
11/18 09:31

Unit# 00000 Test# 0

INPUT 1: Level (F) TOC

Reference	32.18
Scale factor	49.82
Offset	0.00

Step# 0 11/18 09:21

Elapsed Time	Value
0.0000	37.44
0.0033	37.38
0.0066	37.33
0.0099	37.36
0.0133	37.32
0.0166	37.25
0.0200	37.19
0.0233	37.16
0.0266	37.17
0.0300	37.13
0.0333	37.06
0.0500	36.97
0.0666	36.75
0.0833	36.67
0.1000	36.50
0.1166	36.36
0.1333	36.25
0.1500	36.12
0.1666	36.01
0.1833	35.90
0.2000	35.79
0.2166	35.68
0.2333	35.57
0.2500	35.48
0.2666	35.38
0.2833	35.29
0.3000	35.19
0.3166	35.10
0.3333	35.02
0.4167	34.61
0.5000	34.25
0.5833	33.95
0.6667	33.70
0.7500	33.46
0.8333	33.28
0.9167	33.10
1.0000	32.96
1.0833	32.85
1.1667	32.74
1.2500	32.65
1.3333	32.58
1.4166	32.52
1.5000	32.46
1.5833	32.41
1.6667	32.38
1.7500	32.35
1.8333	32.32
1.9167	32.29
2.0000	32.27
2.5000	32.21
3.0000	32.18
3.5000	32.18
4.0000	32.18
4.5000	32.18
5.0000	32.18
5.5000	32.16
6.0000	32.16
6.5000	32.16
7.0000	32.18
7.5000	32.16
8.0000	32.16
8.5000	32.16
9.0000	32.16
9.5000	32.18
10.0000	32.16

END

slug out

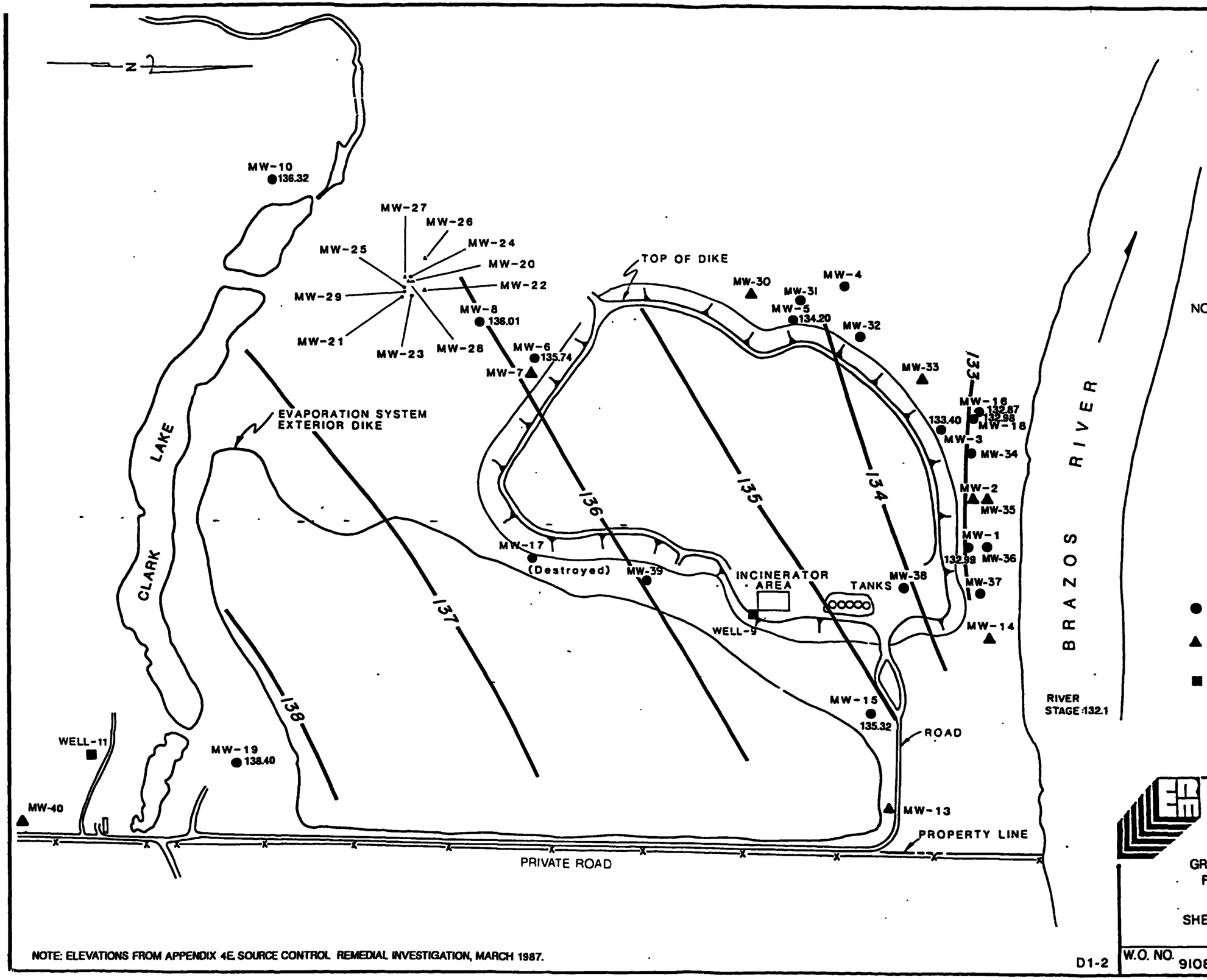
APPENDIX D-1

Ground Water Contour Maps of the Unconfined Aquifer (Stratum B)

11/85 through 2/88

ADDENDUM TO APPENDIX D-1

Summary of Gradient Calculations in the Unconfined Aquifer Can Be Found in Table 3-11



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

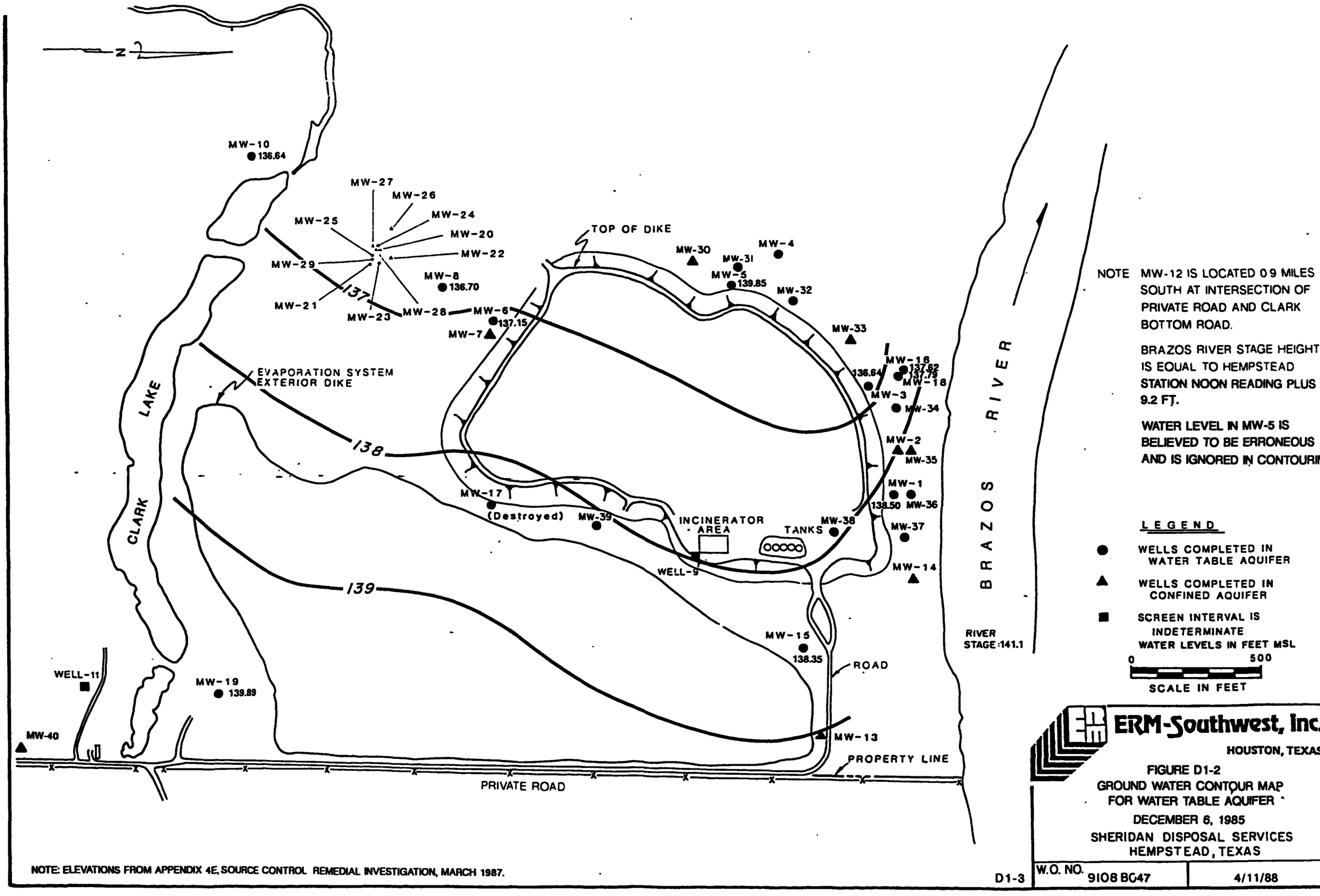
NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-1
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
NOVEMBER 22, 1985
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 B046	4/11/88



NOTE MW-12 IS LOCATED 0 9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

WATER LEVEL IN MW-5 IS BELIEVED TO BE ERRONEOUS AND IS IGNORED IN CONTOURING.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

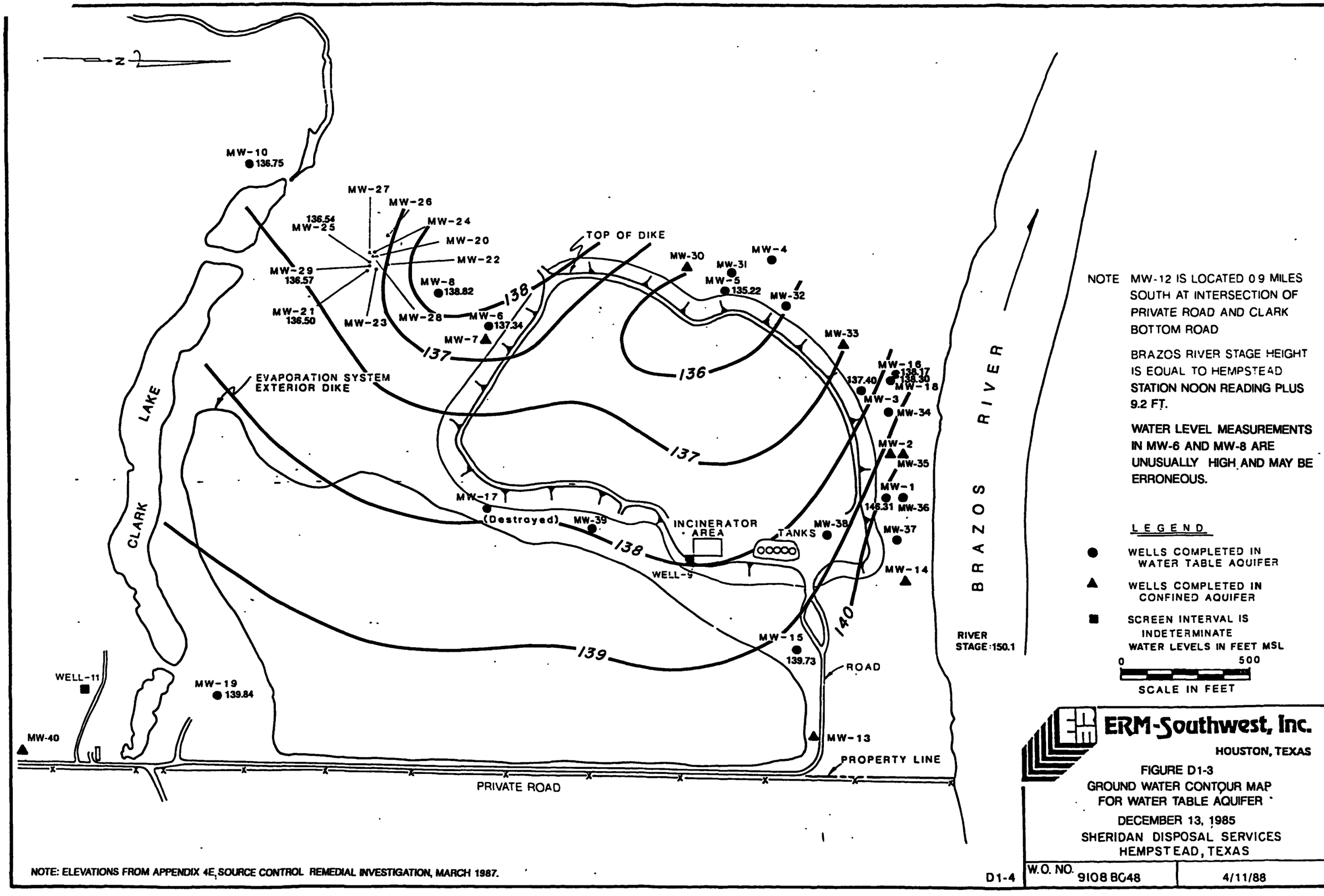
NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-2
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
DECEMBER 6, 1985
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 BC47	4/11/88



NOTE MW-12 IS LOCATED 0 9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

WATER LEVEL MEASUREMENTS IN MW-6 AND MW-8 ARE UNUSUALLY HIGH AND MAY BE ERRONEOUS.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

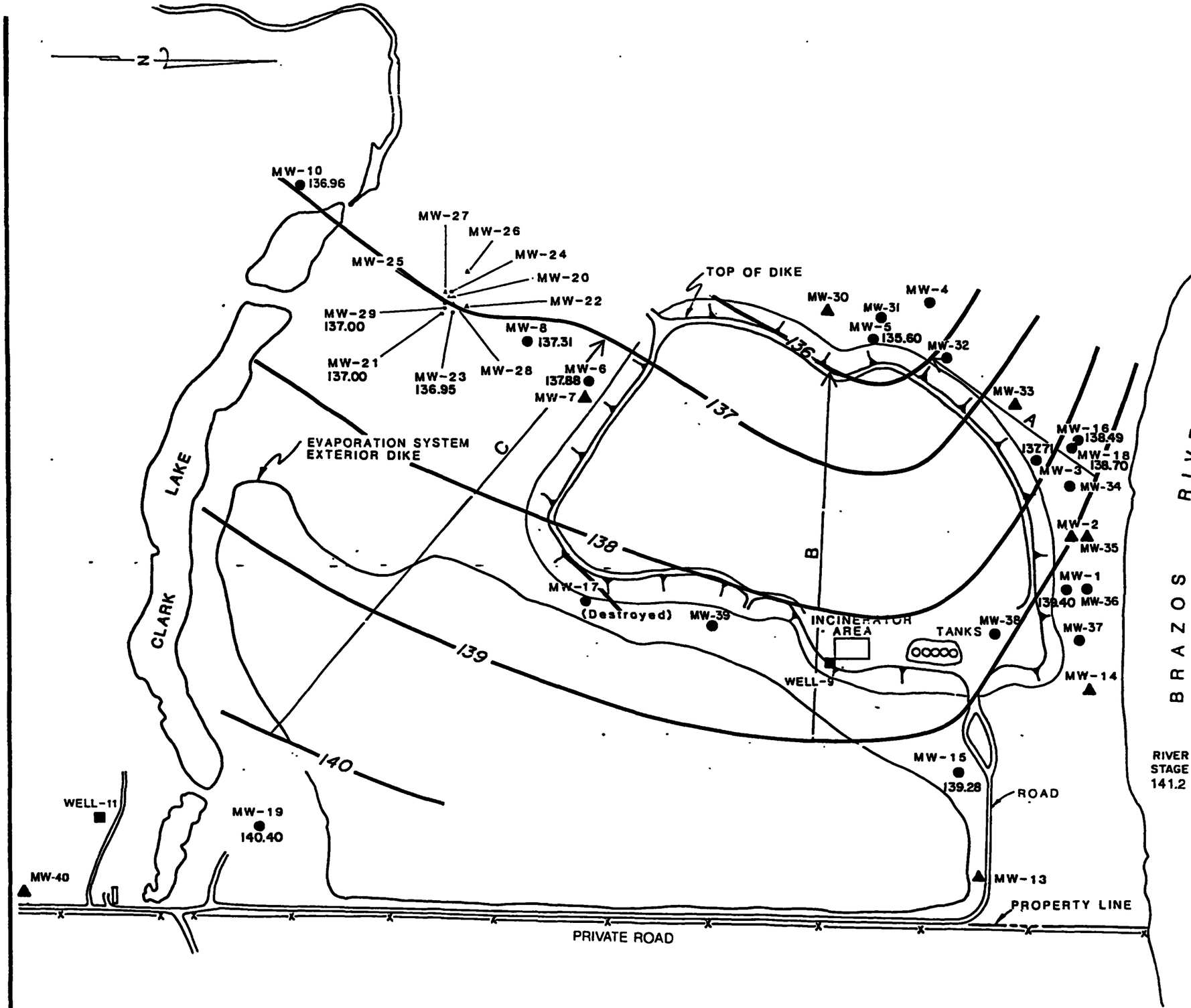
NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-3
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
DECEMBER 13, 1985
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B048 | 4/11/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

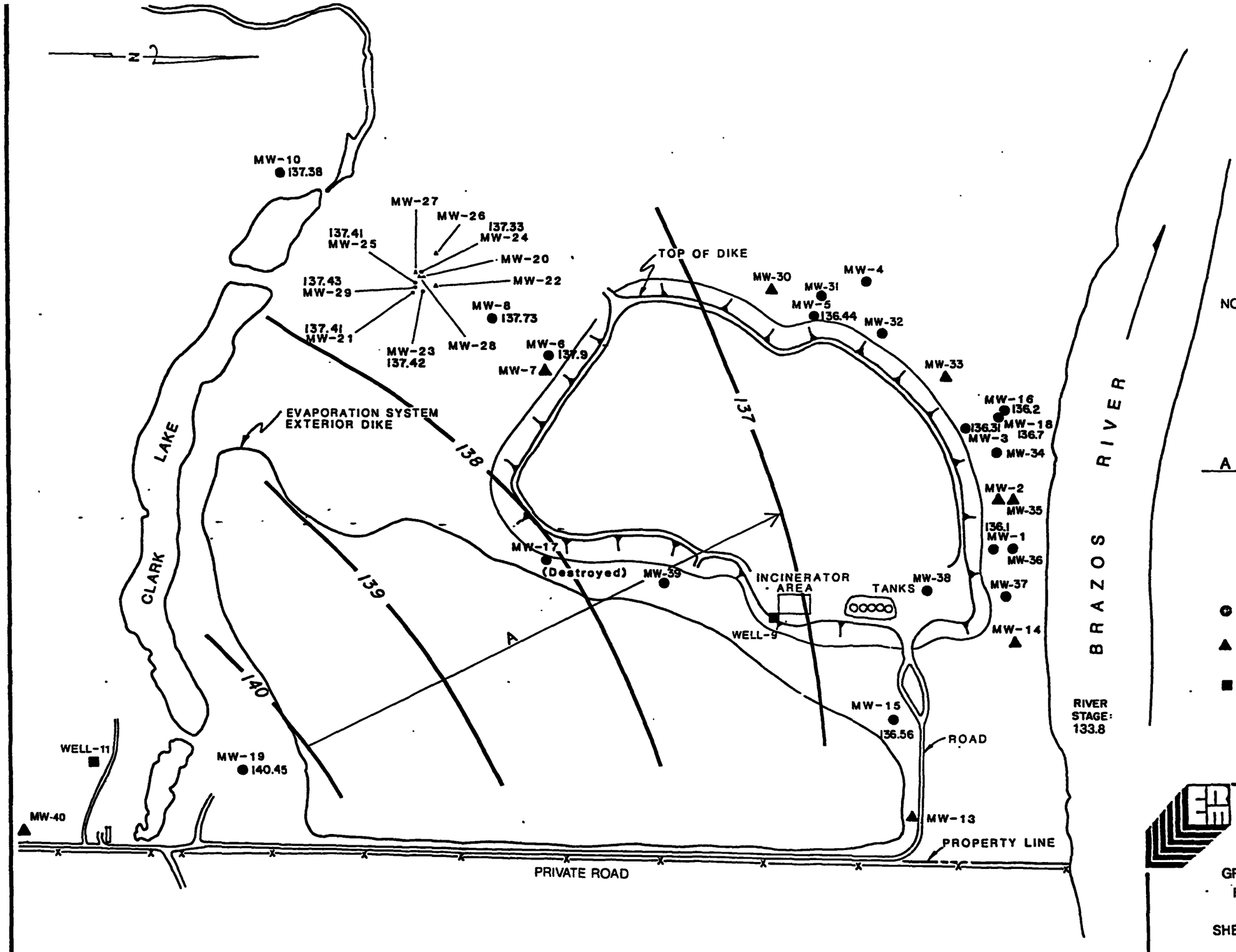
NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987. CONTOURS CORRECTED WHERE NECESSARY.

D1-5

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-4
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
DECEMBER 19, 1985
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 8020 | 4/12/88



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- WELLS COMPLETED IN WATER TABLE AQUIFER
- WELLS COMPLETED IN CONFINED AQUIFER
- SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

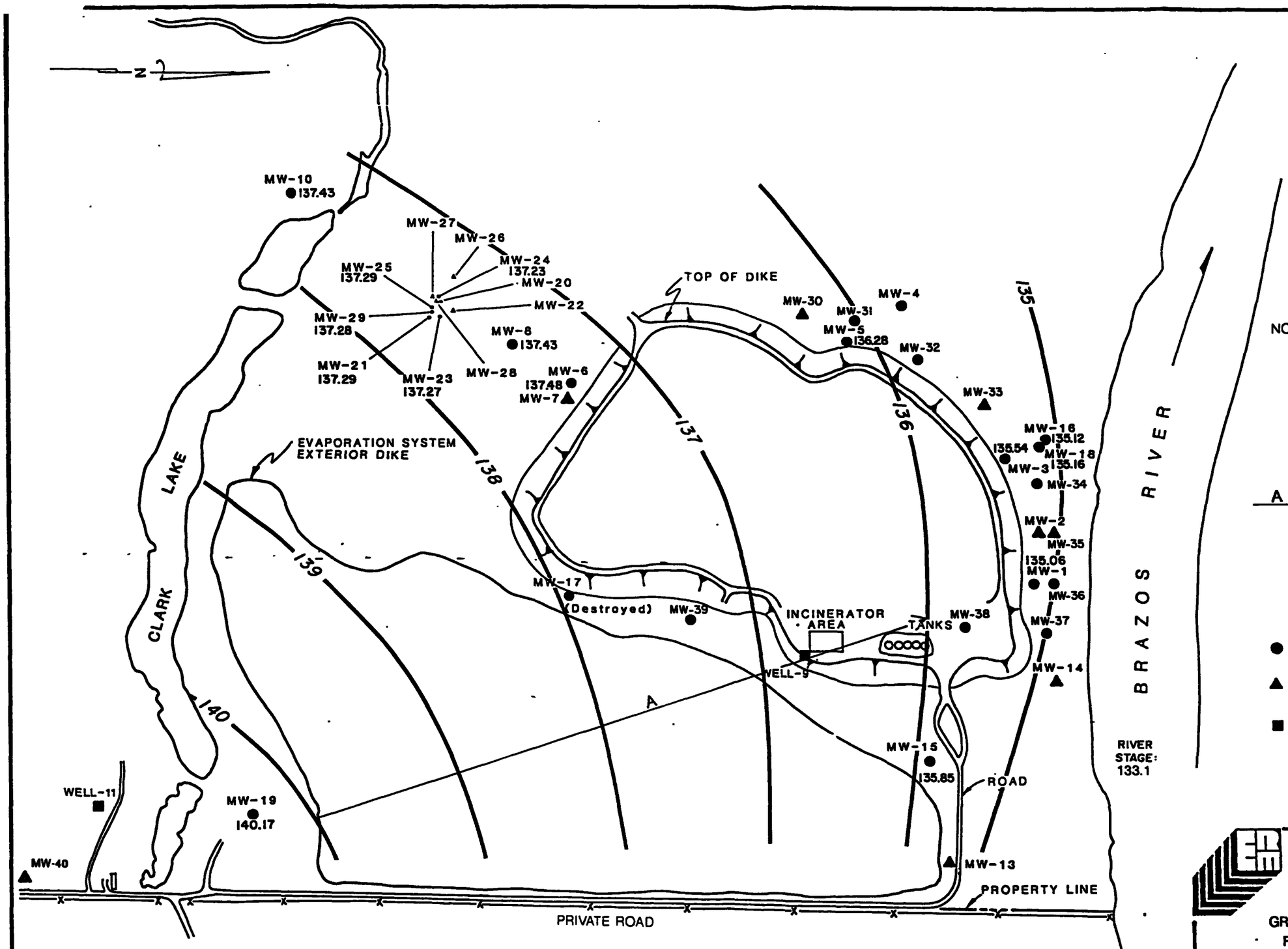
NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987. CONTOURS CORRECTED WHERE NECESSARY.

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-5
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
JANUARY 3, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 8021 | 4/12/88



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

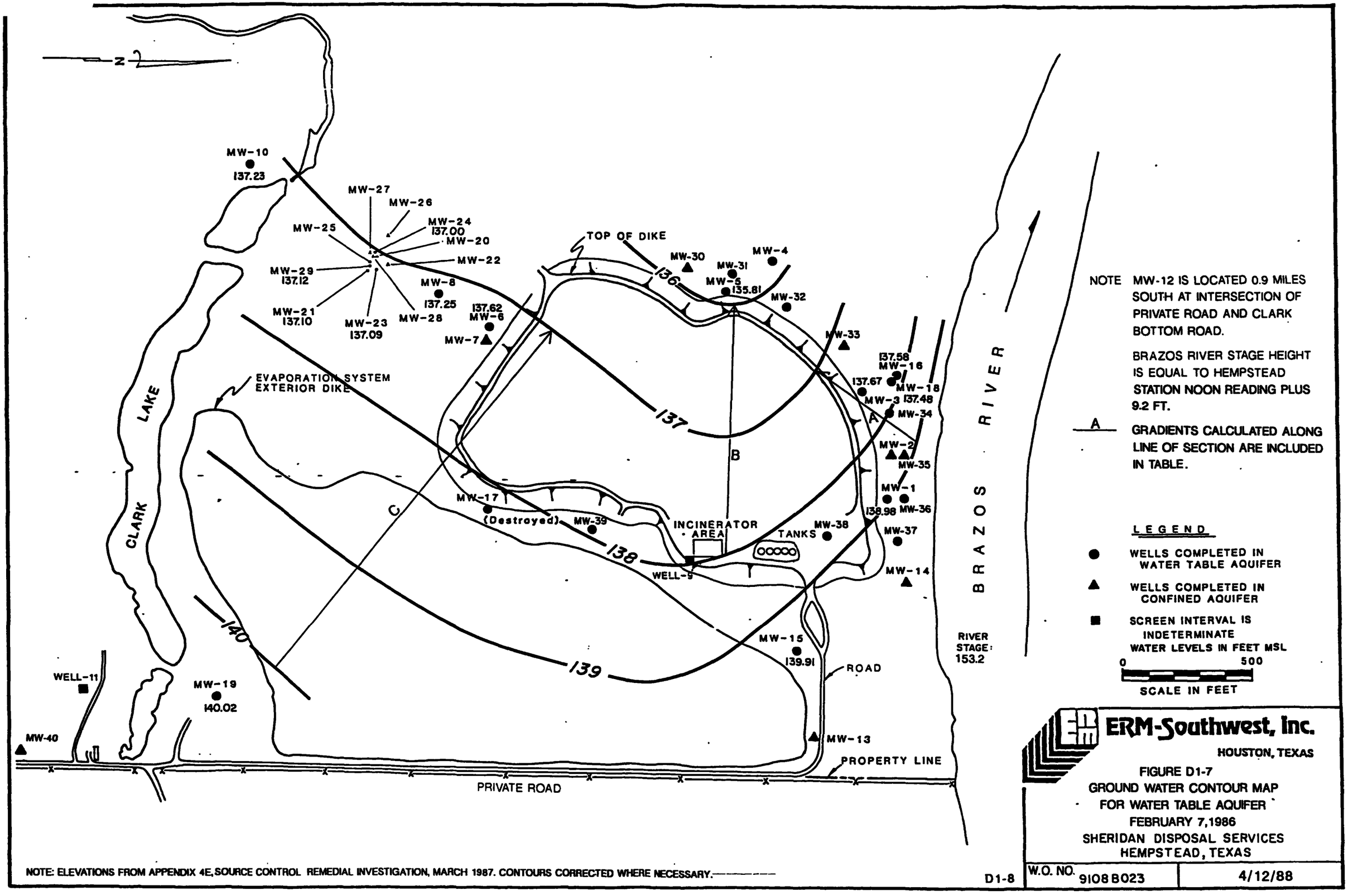
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-6
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
JANUARY 14, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B022 | 4/12/88

018805



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

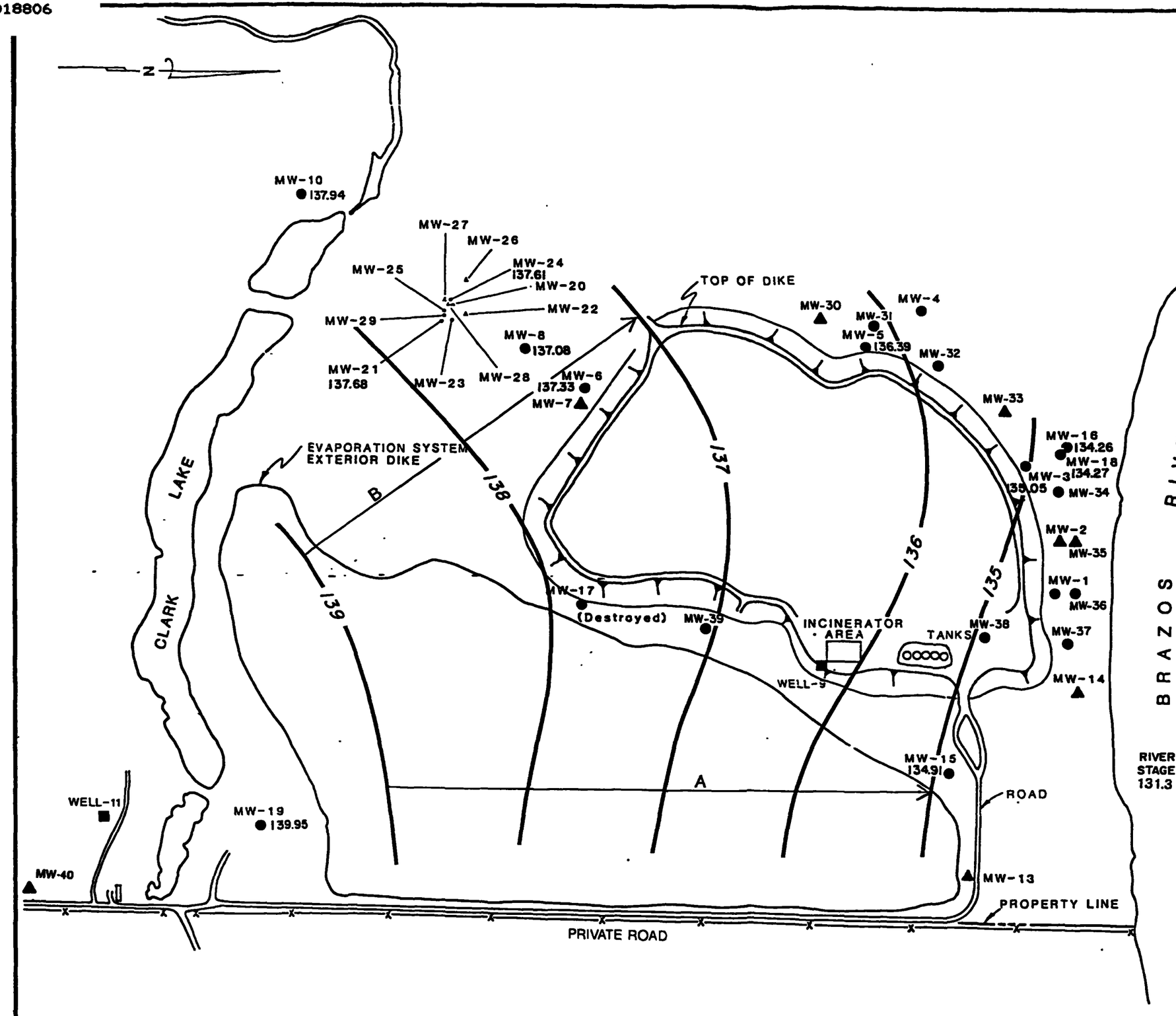
SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987. CONTOURS CORRECTED WHERE NECESSARY.

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-7
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
FEBRUARY 7, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108B023 | 4/12/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

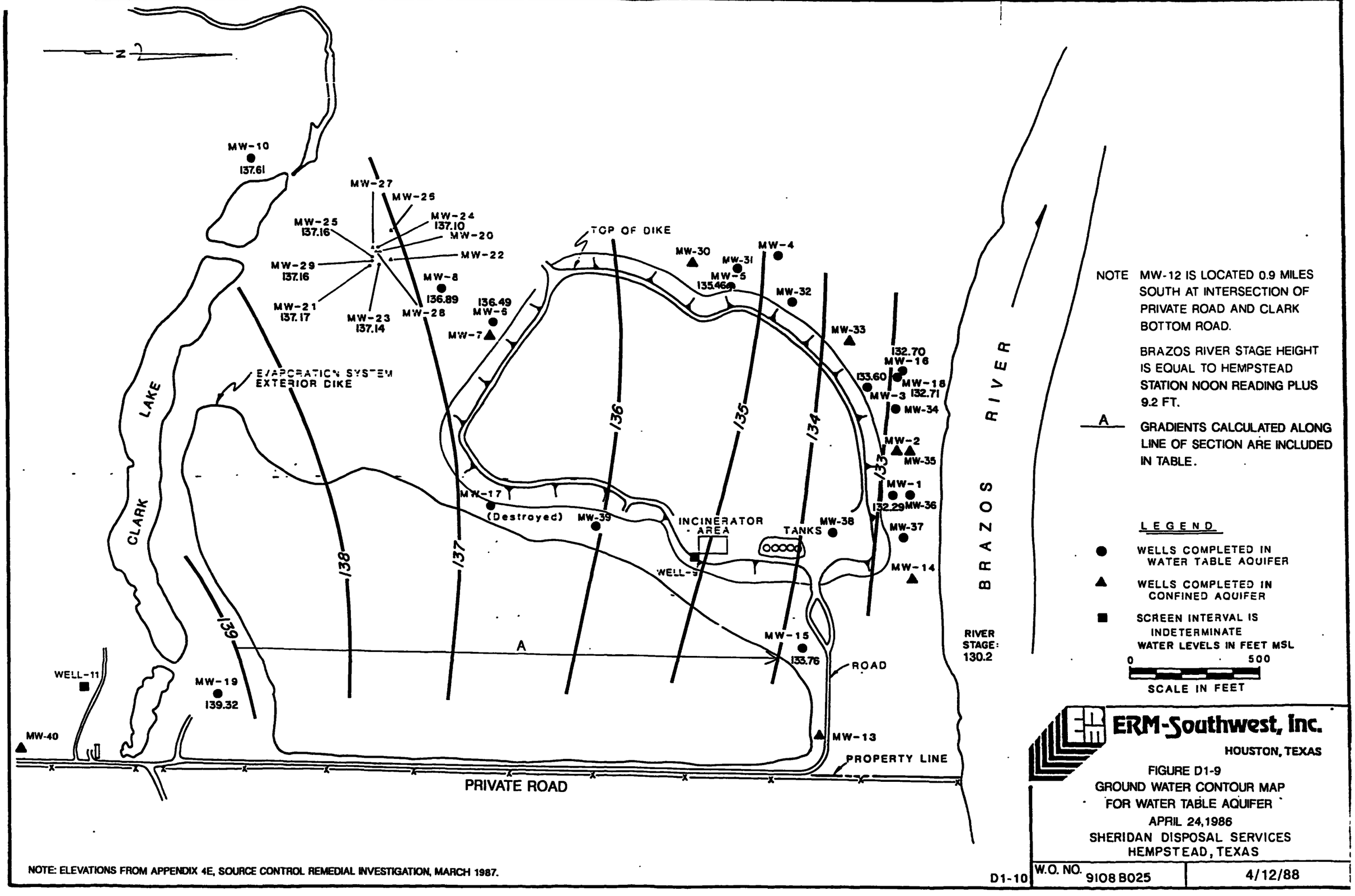
SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-8
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
MARCH 21, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B024 | 4/12/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

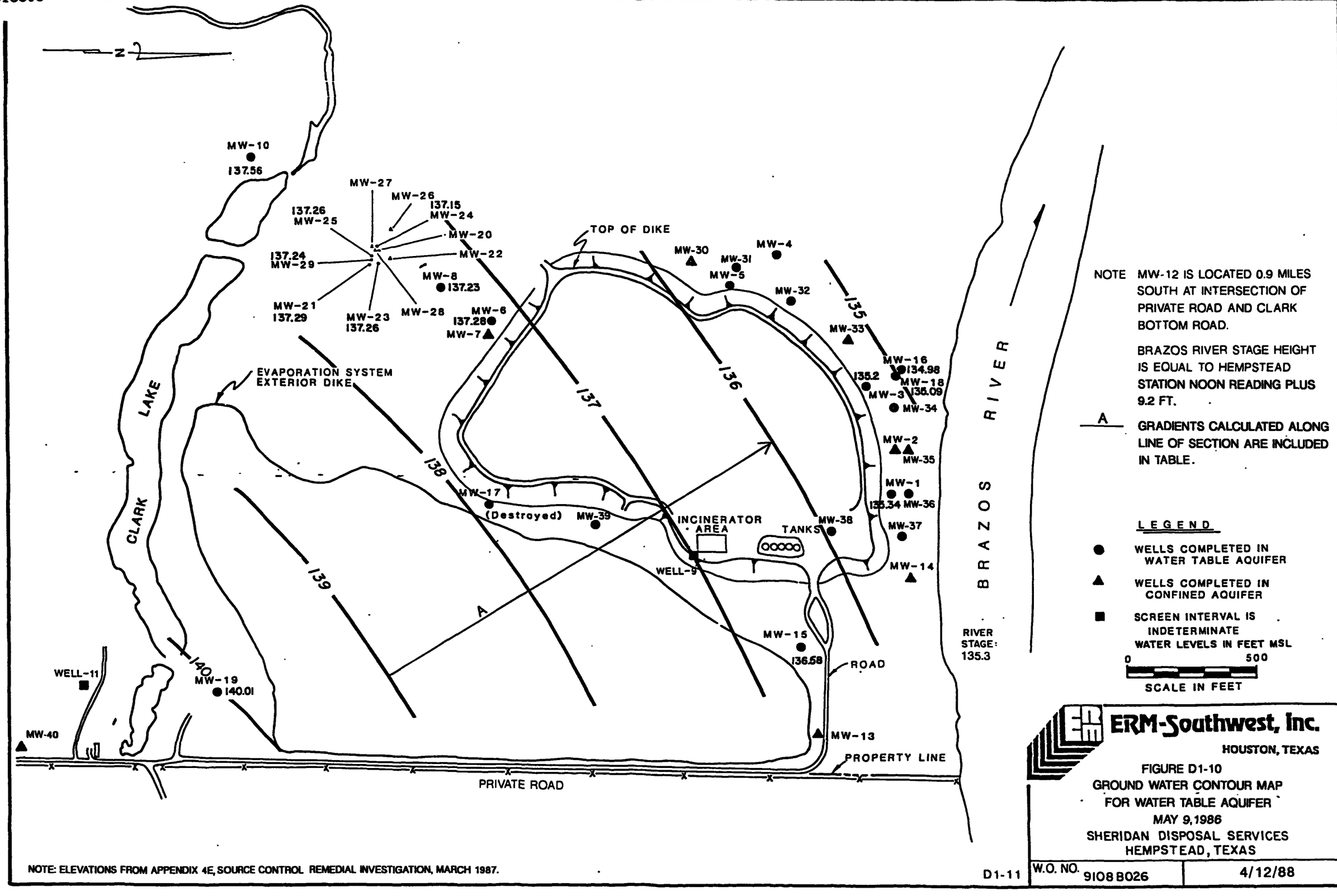
SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-9
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
APRIL 24,1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B025 | 4/12/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

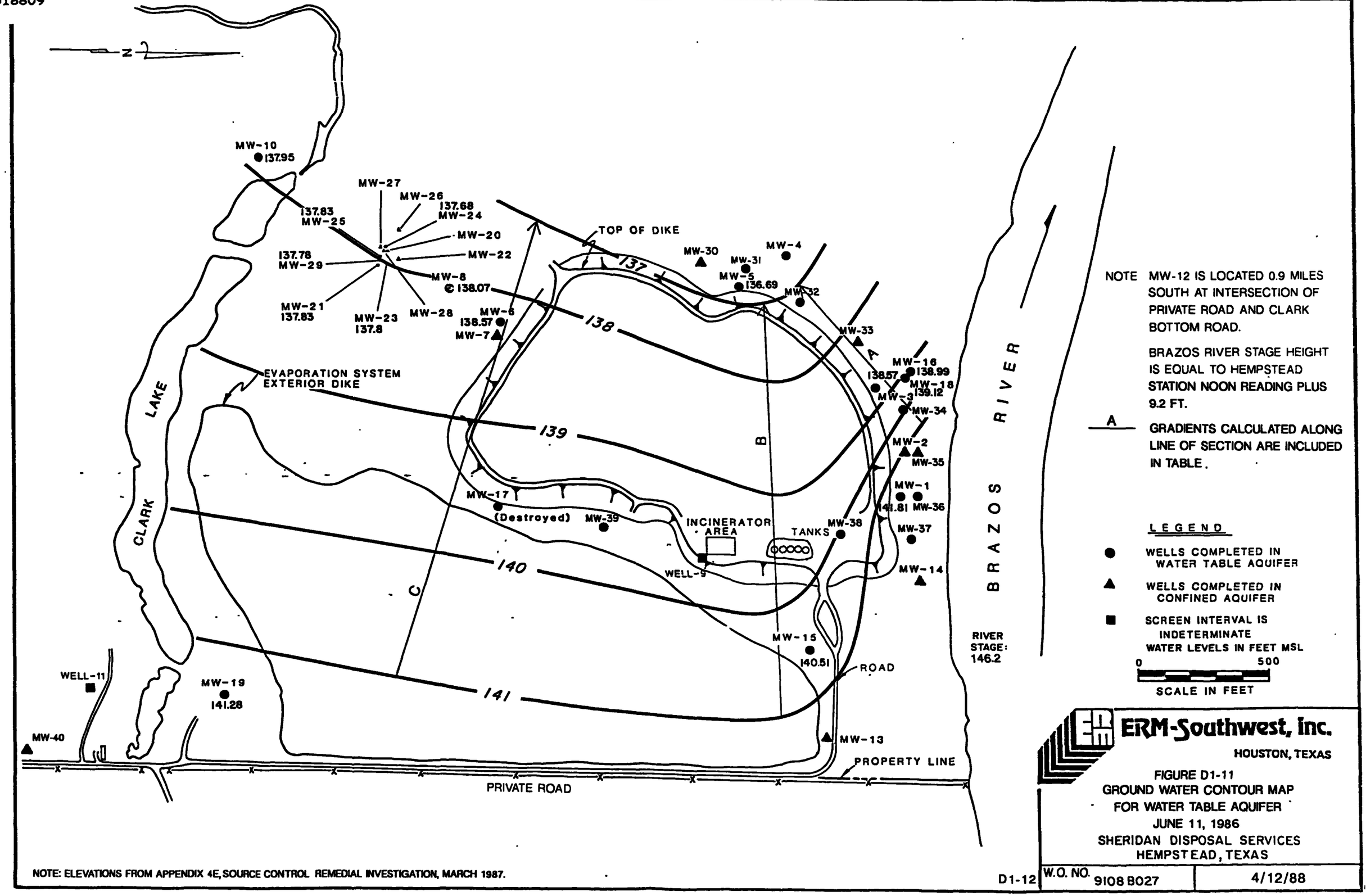
NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-10
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
MAY 9, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 8026 | 4/12/88

018809



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-11
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
JUNE 11, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B027	4/12/88

018810

N

MW-10
138.3

MW-27
MW-26
138.17
MW-24
138.39
MW-25
MW-20
MW-22
138.25
MW-29
MW-8
138.5
MW-21
138.44
MW-23
138.42
MW-28
MW-6
138.55
MW-7

TOP OF DIKE

MW-30
MW-31
MW-5
137.51
MW-4
MW-32
MW-33

MW-16
136.51
136.86
MW-18
136.57
MW-3
MW-34
MW-2
MW-35
MW-1
136.14
MW-36
MW-37
MW-14

EVAPORATION SYSTEM
EXTERIOR DIKE

LAKE

CLARK

137
138
139
140
B
A

MW-17
(Destroyed)
MW-39

INCINERATOR
AREA
TANKS
MW-38
WELL-9

MW-15
137.24

ROAD

RIVER
STAGE:
135.3

BRAZOS RIVER

WELL-11
MW-19
140.8
MW-40
MW-13

PROPERTY LINE

PRIVATE ROAD

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

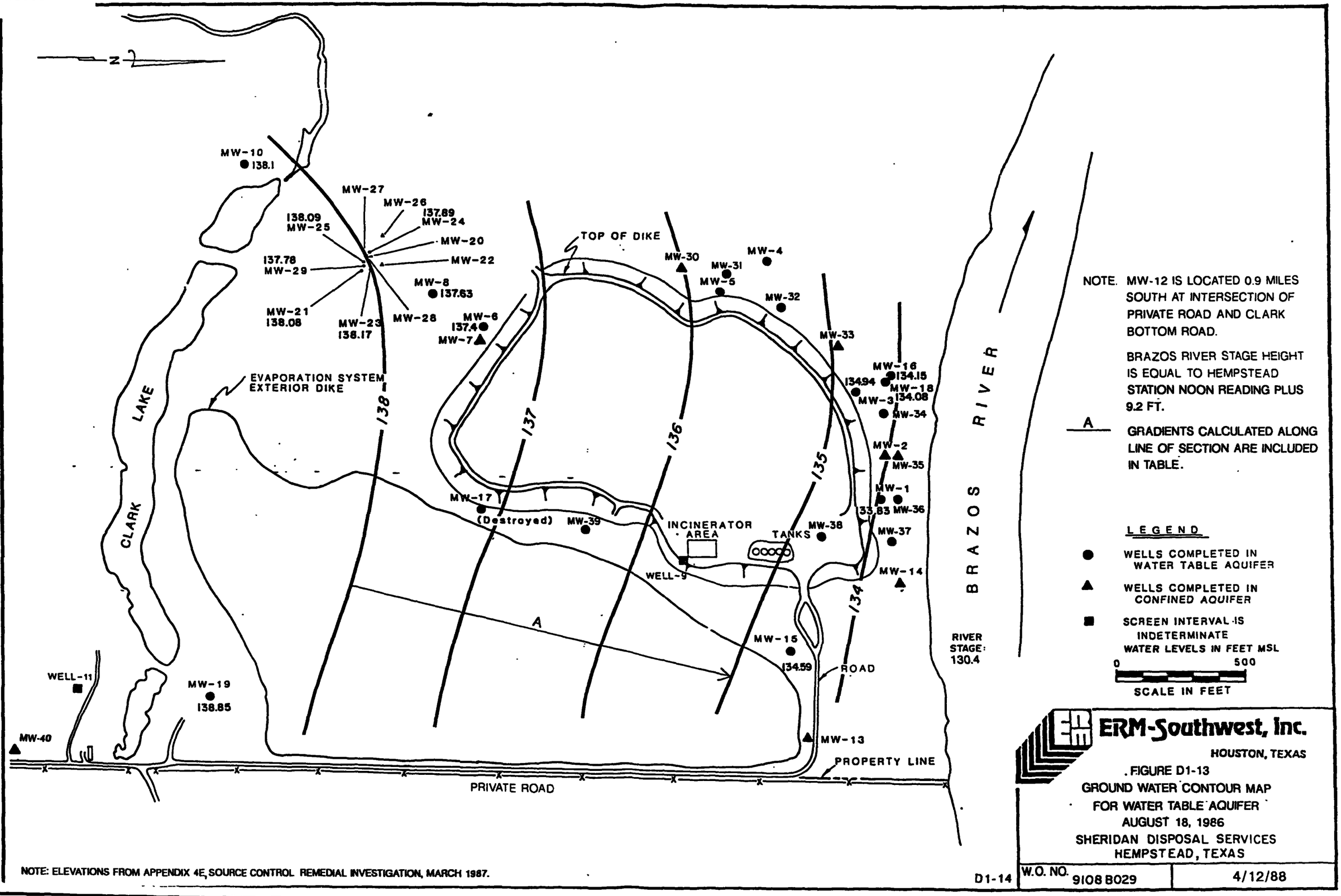
SCALE IN FEET

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-12
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
JULY 15, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108B028 | 4/12/88

018811



NOTE. MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-13

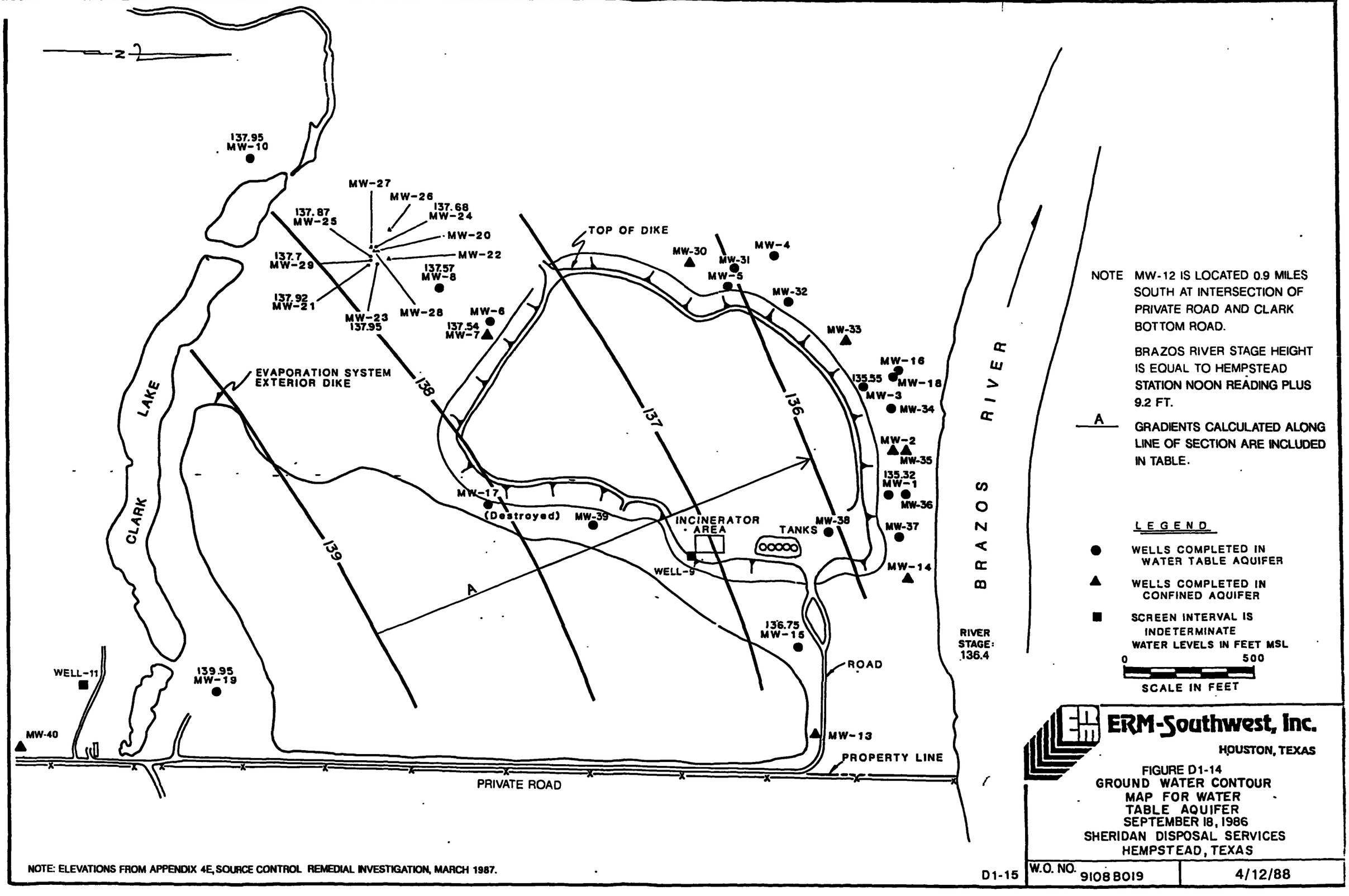
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER AUGUST 18, 1986

SHERIDAN DISPOSAL SERVICES HEMPSTEAD, TEXAS

D1-14

W.O. NO. 9108 B029

4/12/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

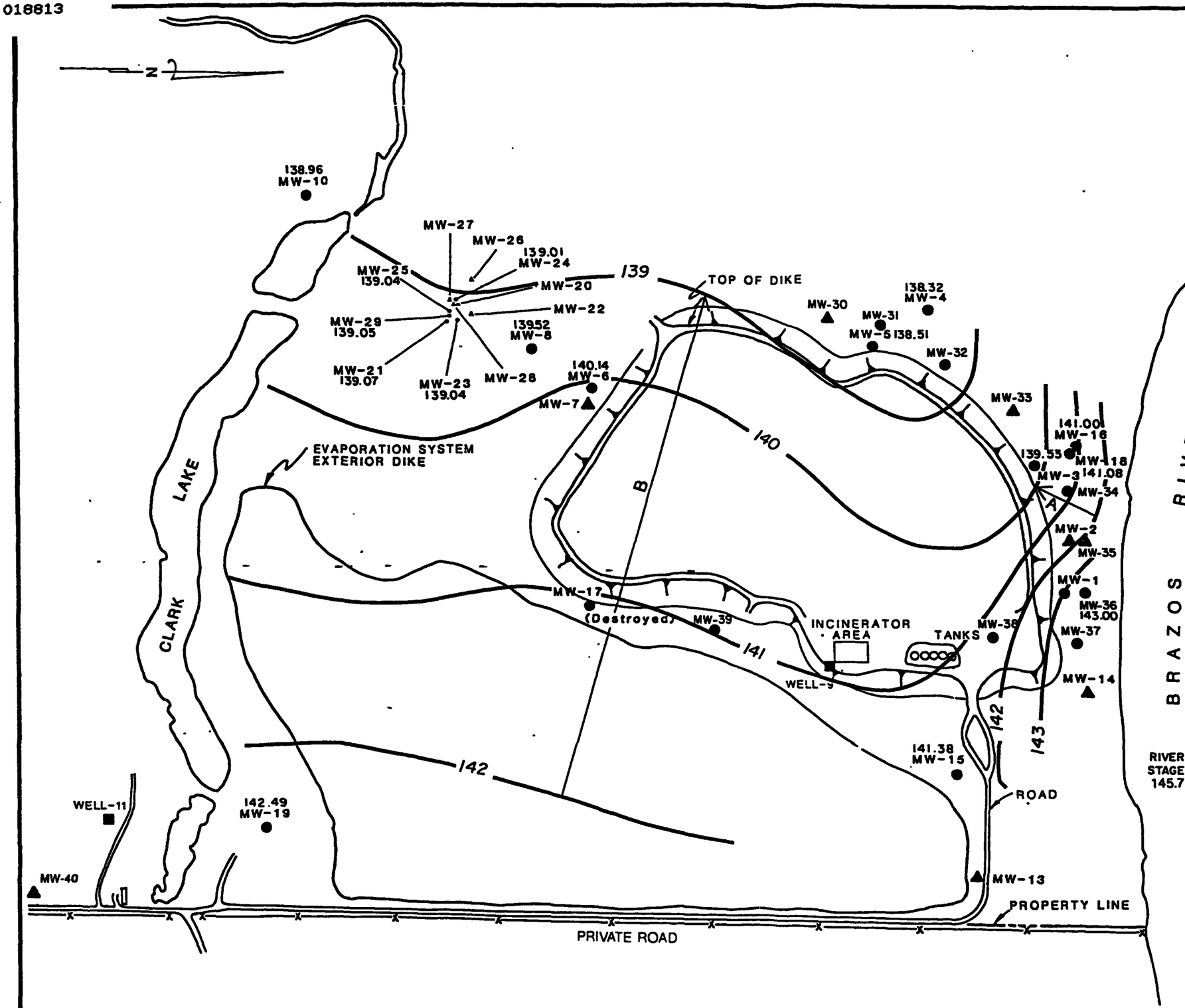
SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-14
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER
SEPTEMBER 18, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108B019 | 4/12/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

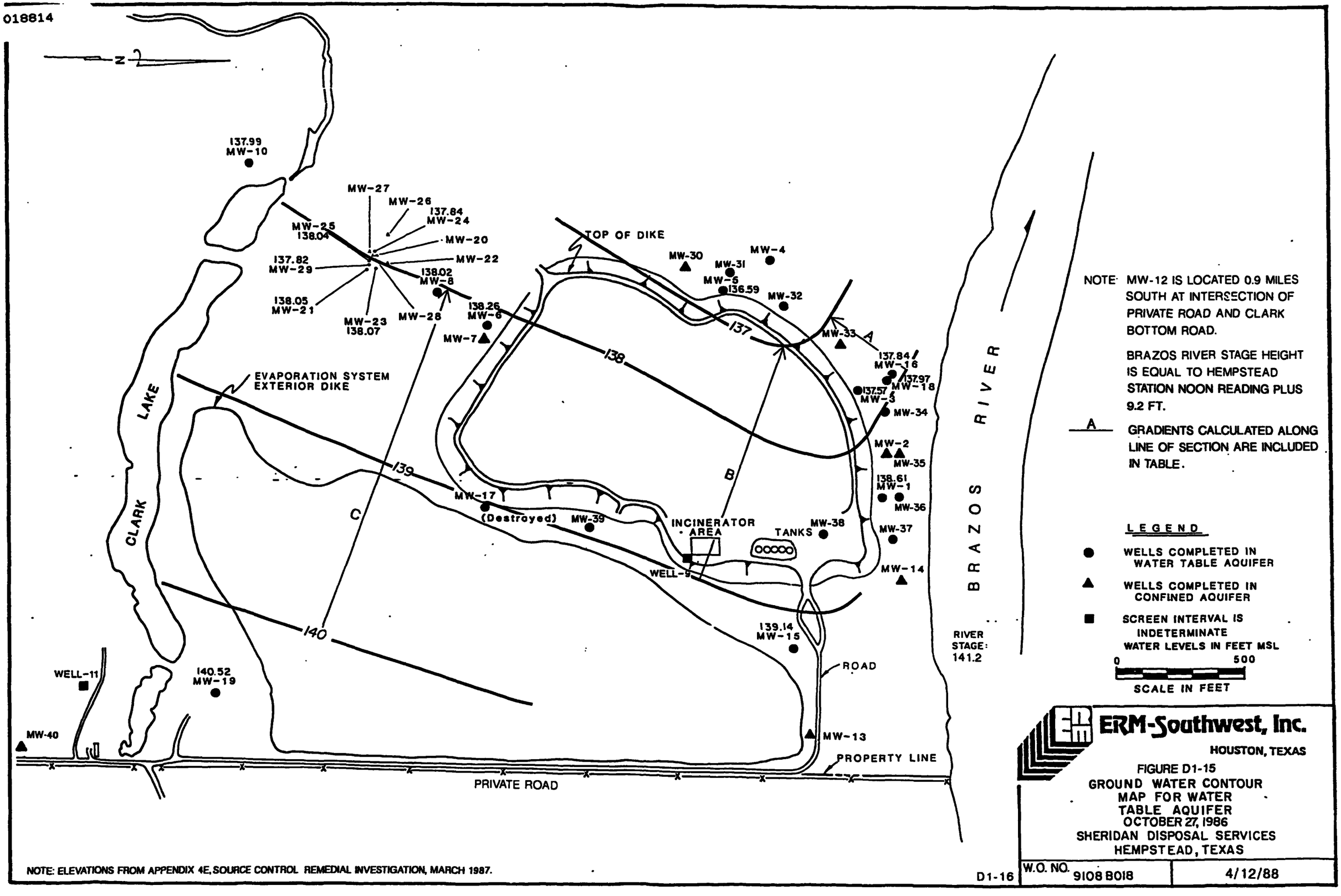
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-21
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER
MARCH 9, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B012 | 4/12/88

018814



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

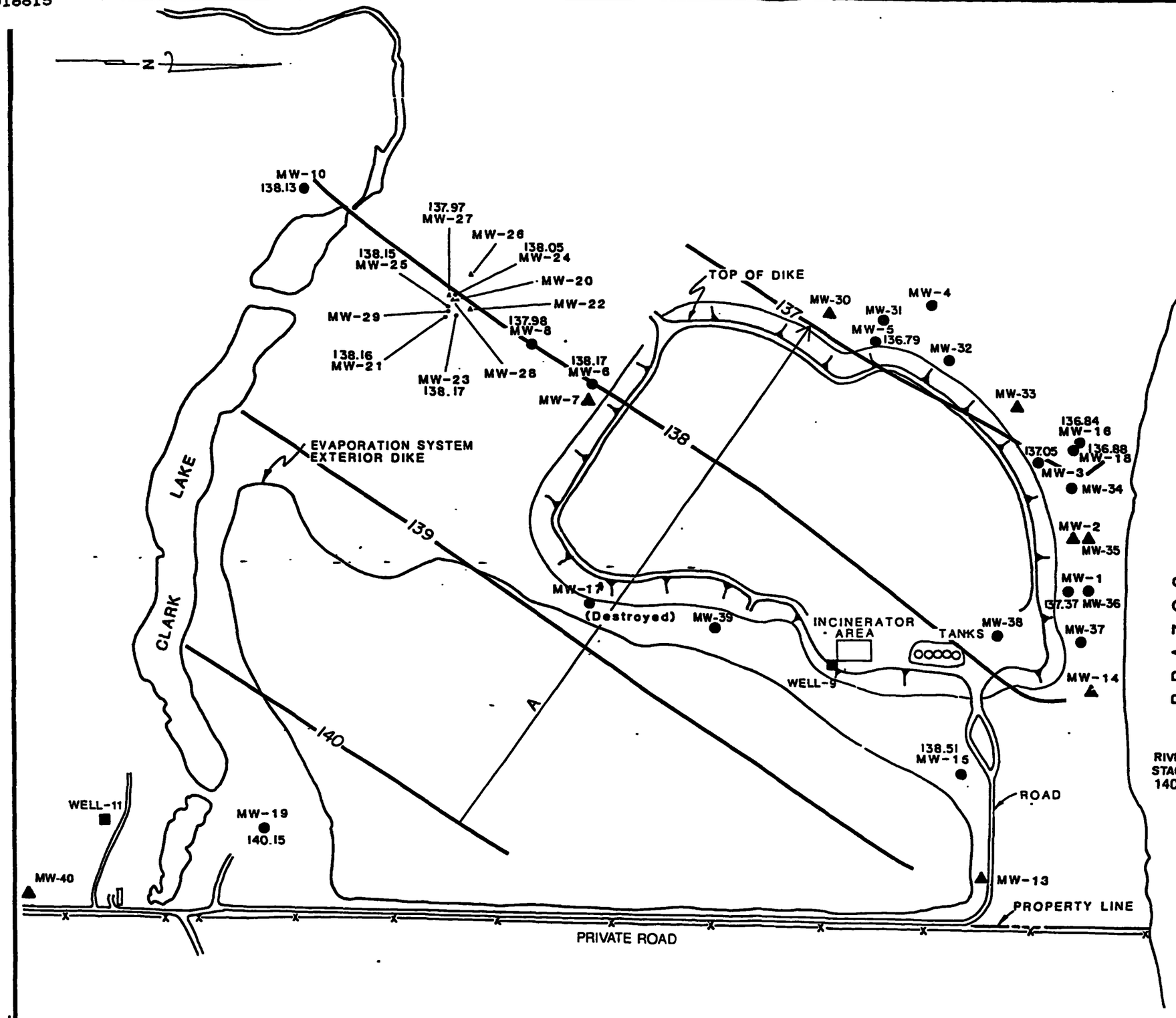
SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-15
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER
OCTOBER 27, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B018	4/12/88



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

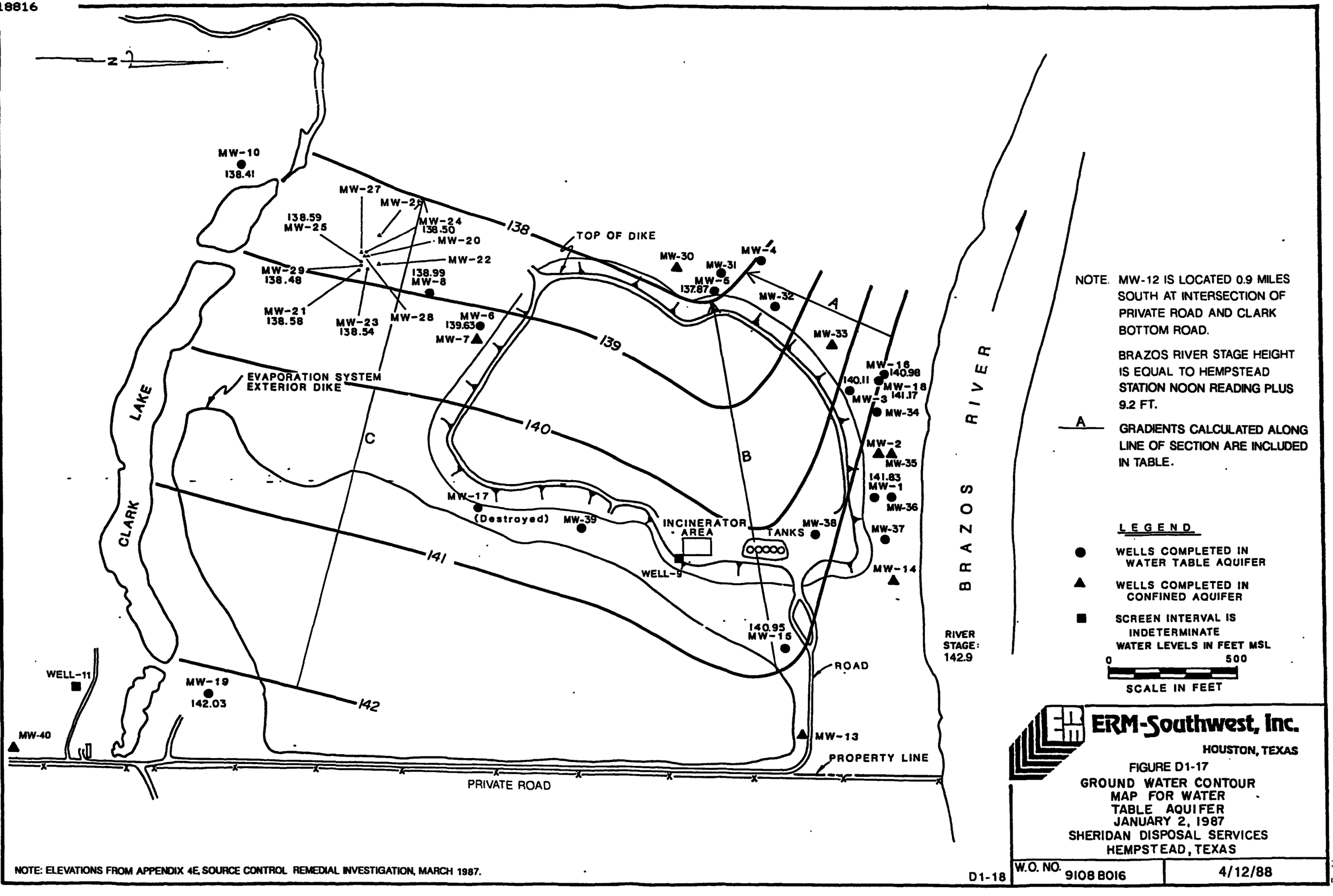
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-16
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER
NOVEMBER 28, 1986
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B017

4/12/88



NOTE. MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

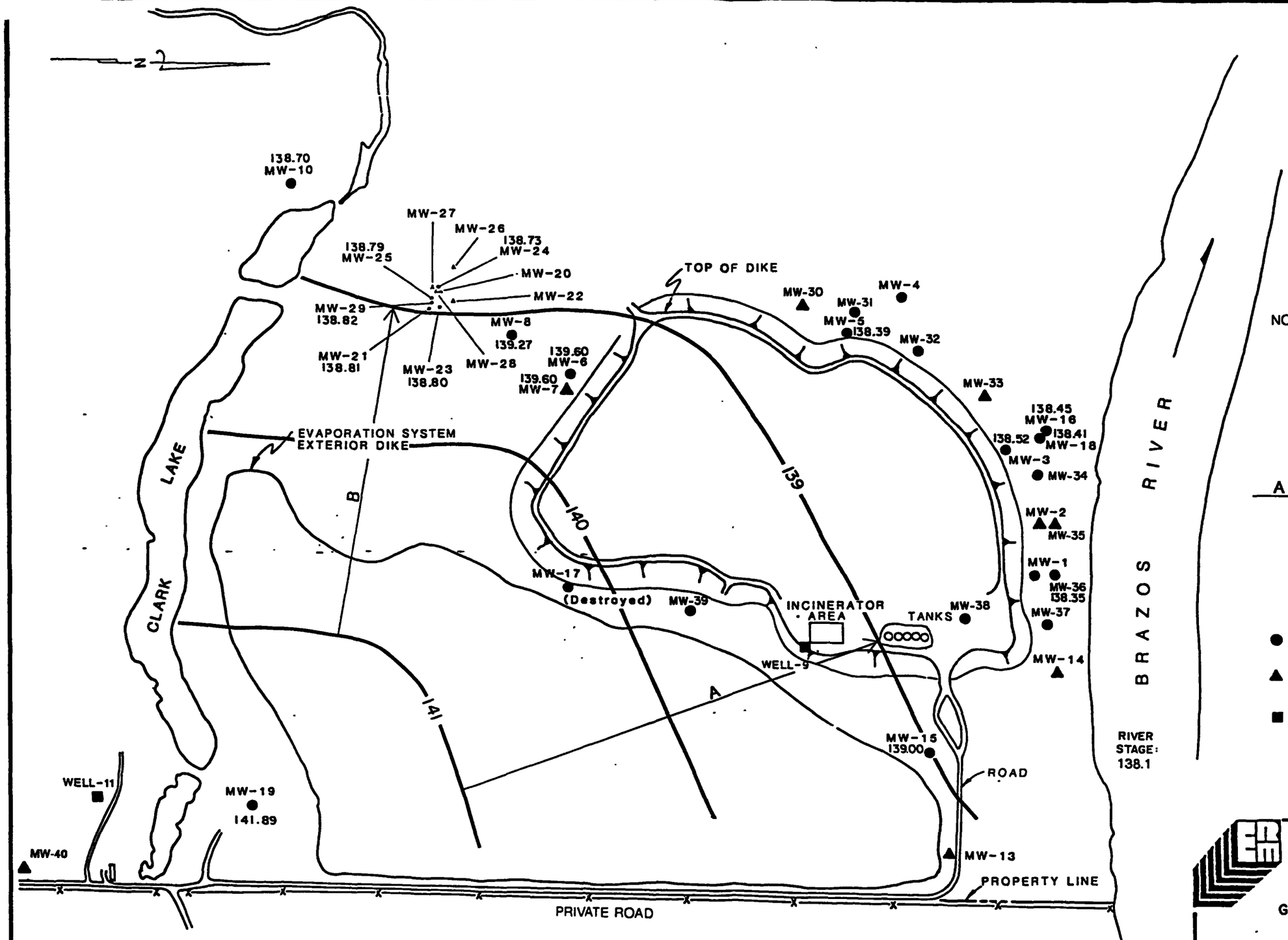
SCALE IN FEET

NOTE: ELEVATIONS FROM APPENDIX 4E, SOURCE CONTROL REMEDIAL INVESTIGATION, MARCH 1987.

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-17
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER
JANUARY 2, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B016 | 4/12/88



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

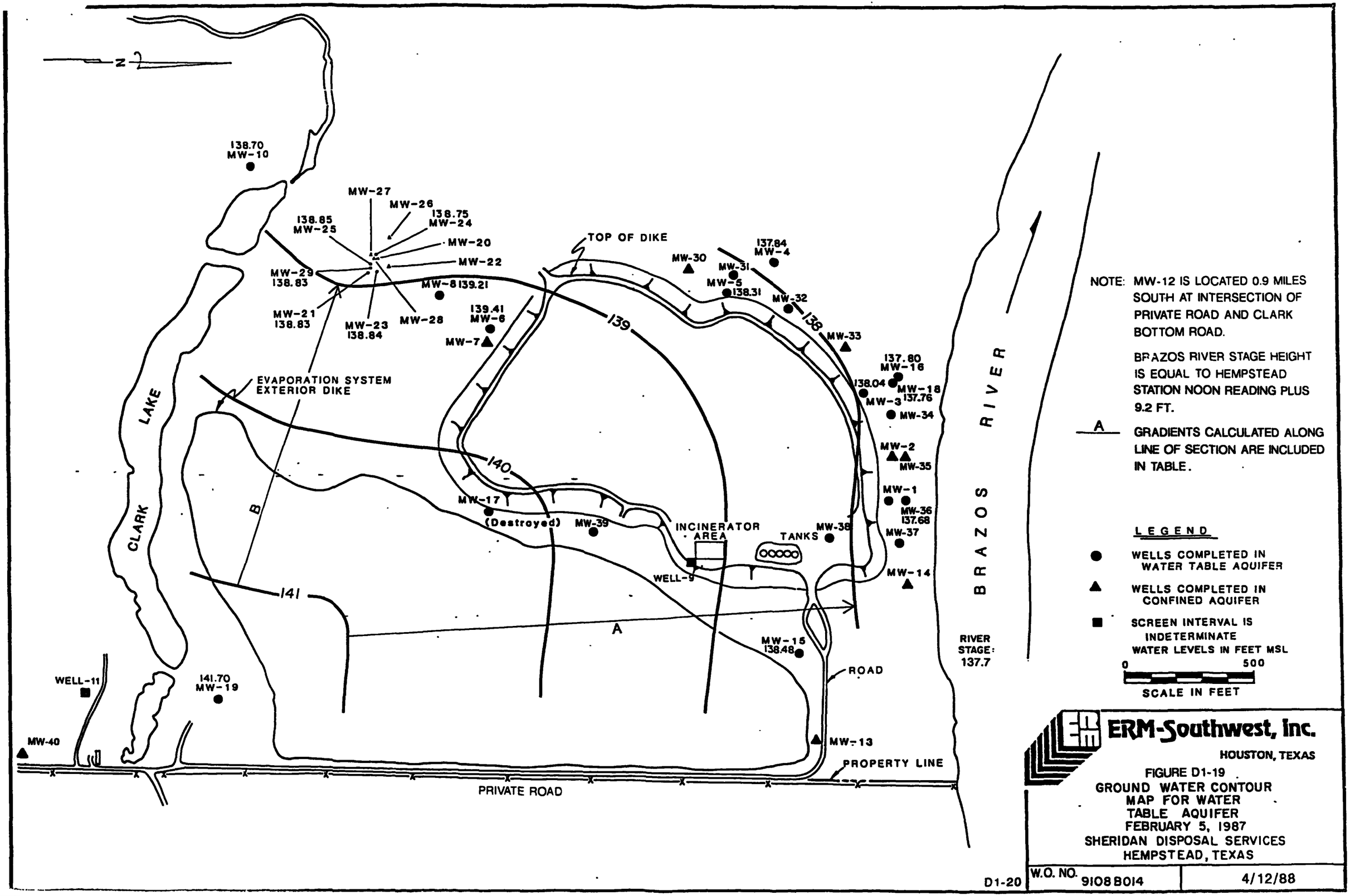
SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-18
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER
JANUARY 22, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B015 | 4/12/88



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

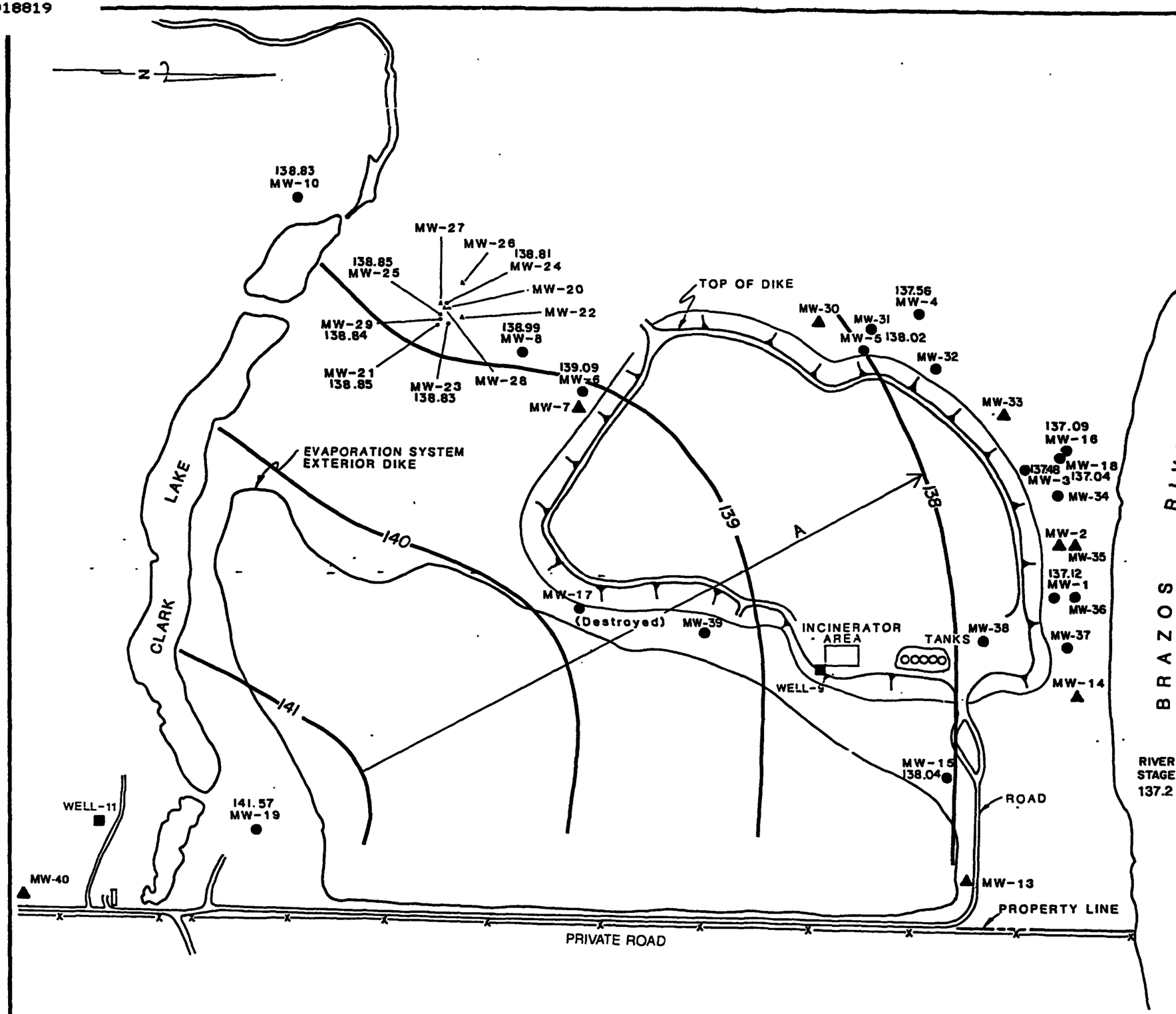
SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-19
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER
FEBRUARY 5, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108B014 | 4/12/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

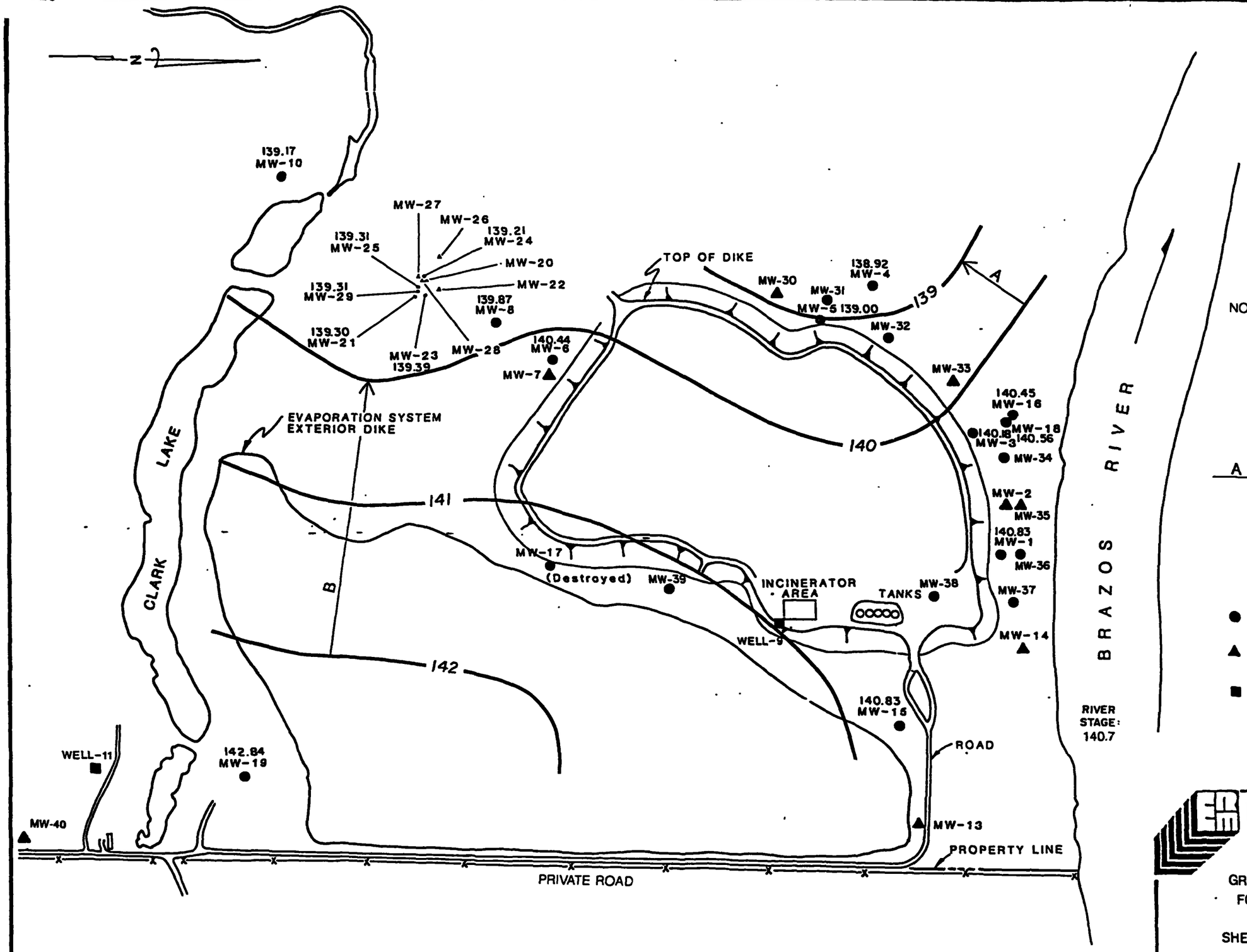
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-20
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER
FEBRUARY 23, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 B013	4/12/88

018820



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

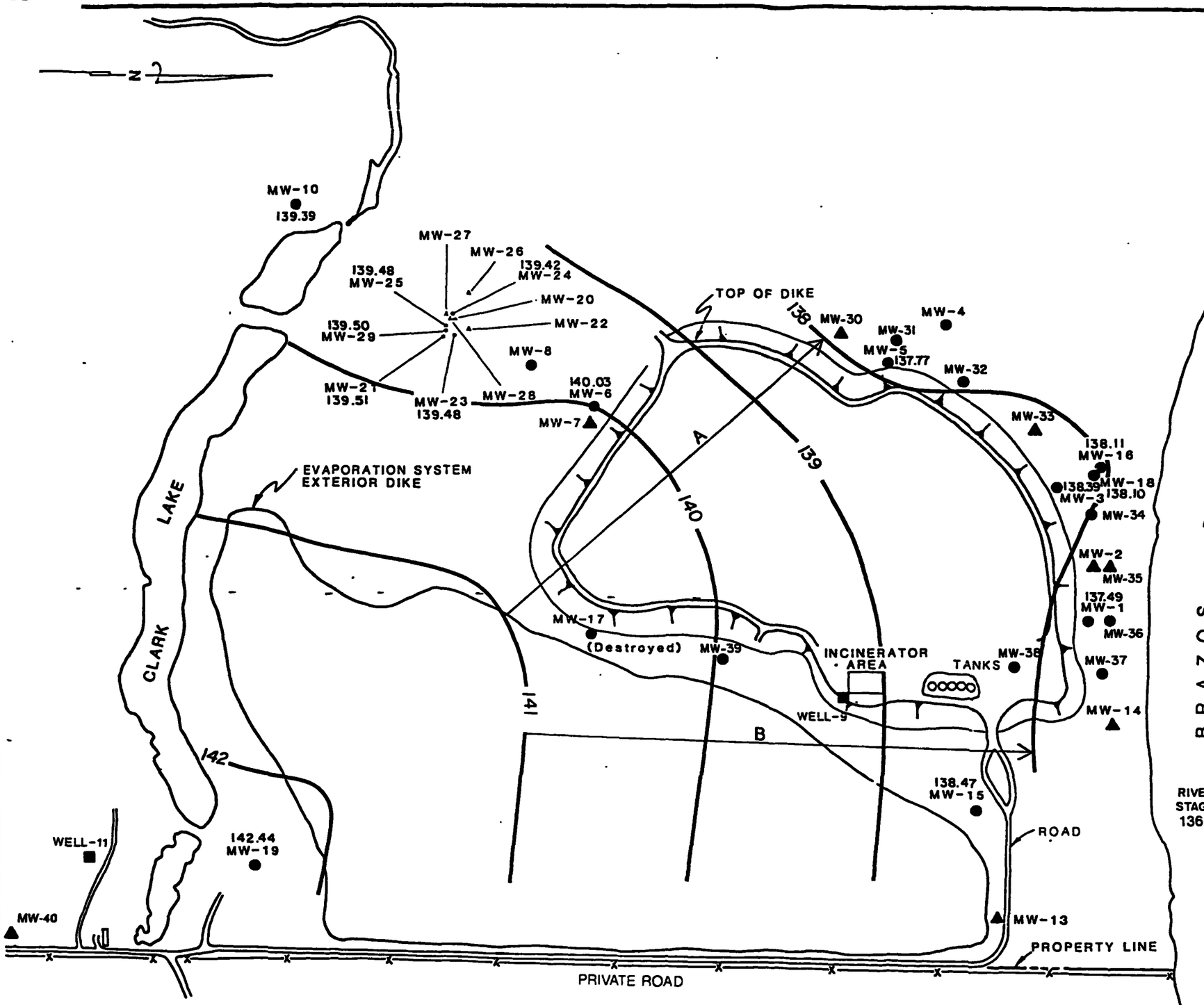
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-22
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER

MARCH 23, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108B011 | 4/12/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

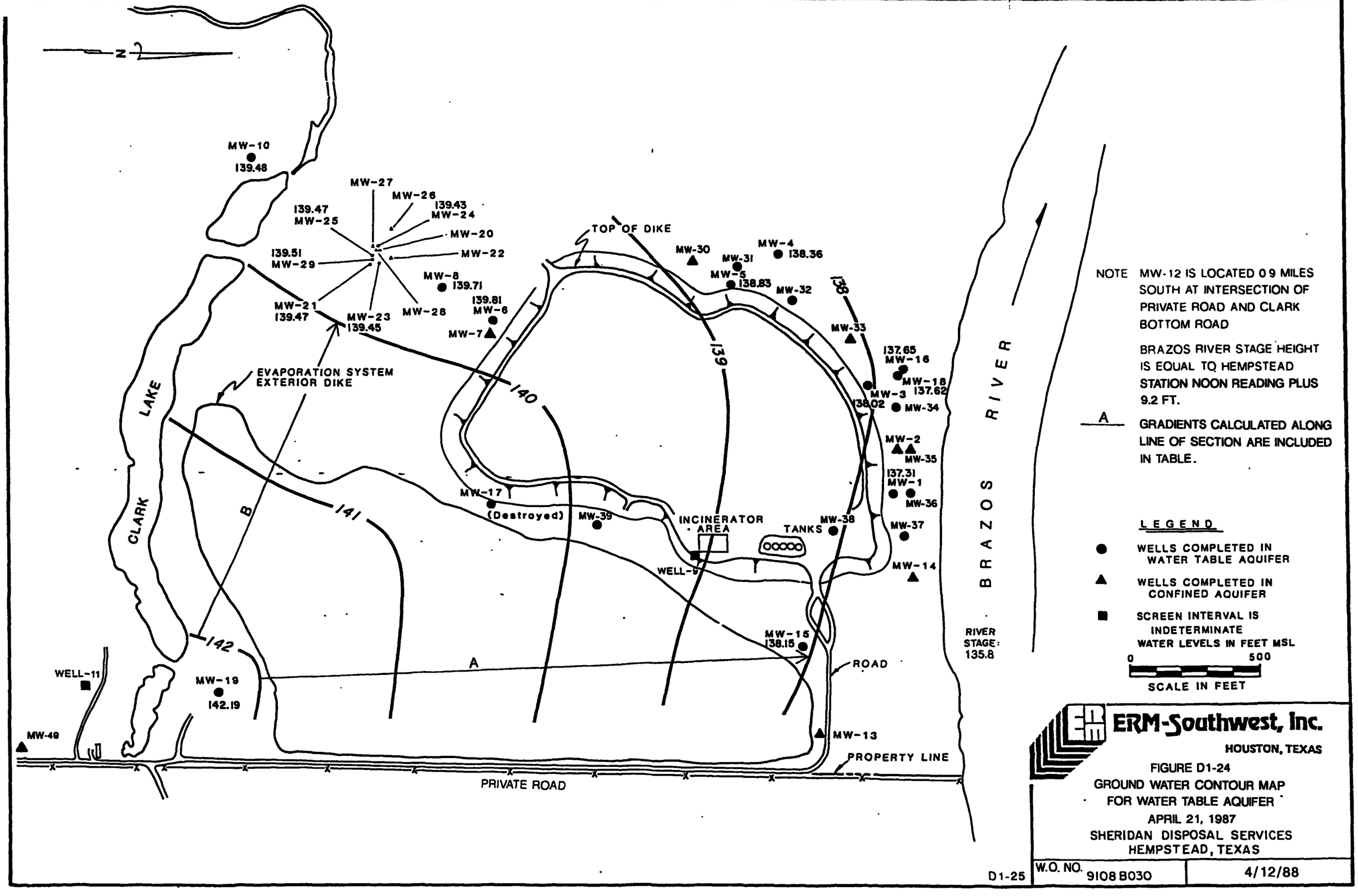
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-23
GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER
APRIL 6, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 B010	4/12/88

018822



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-24

GROUND WATER CONTOUR MAP FOR WATER TABLE AQUIFER

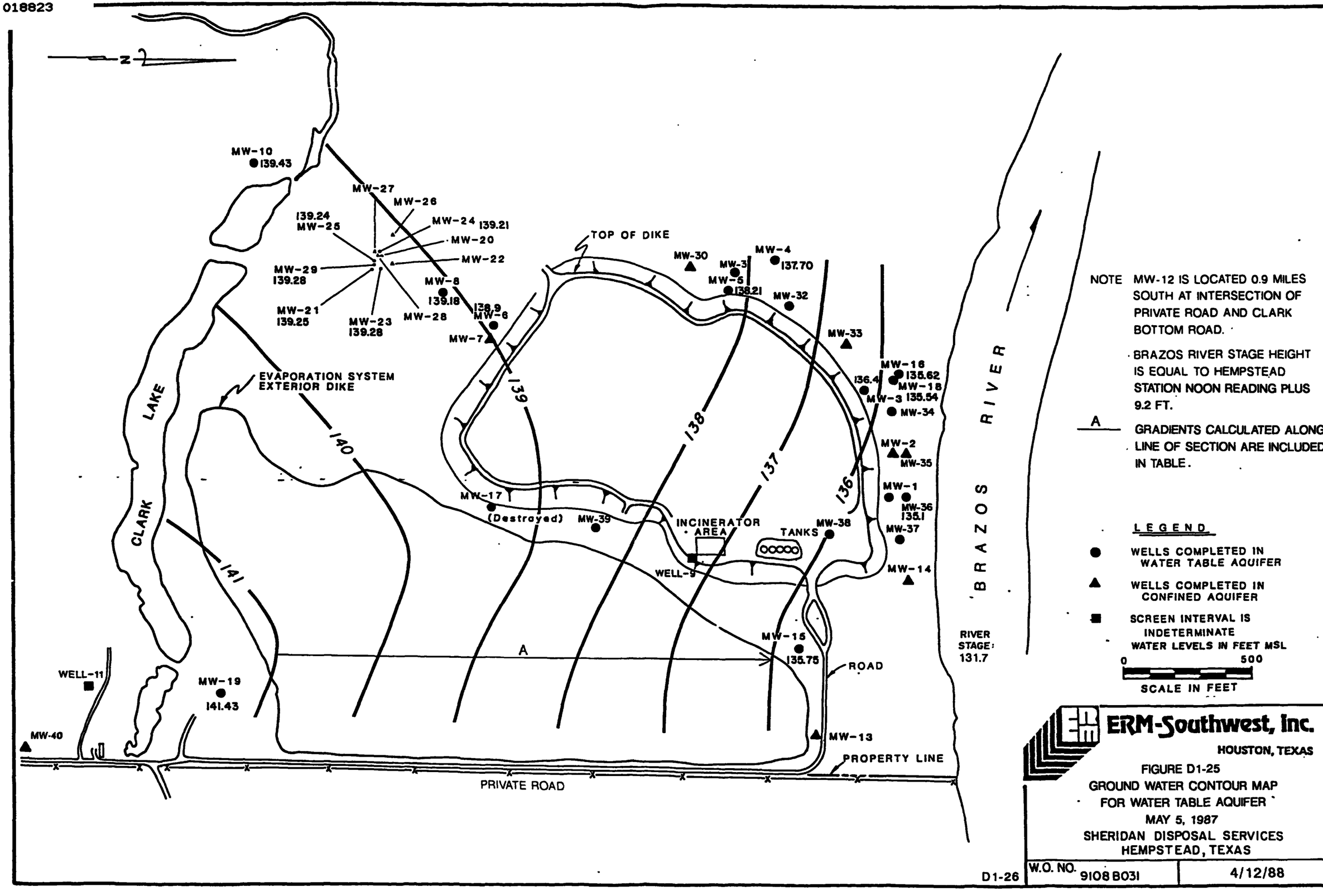
APRIL 21, 1987

SHERIDAN DISPOSAL SERVICES

HEMPSTEAD, TEXAS

W.O. NO.	
9108B030	4/12/88

018823



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

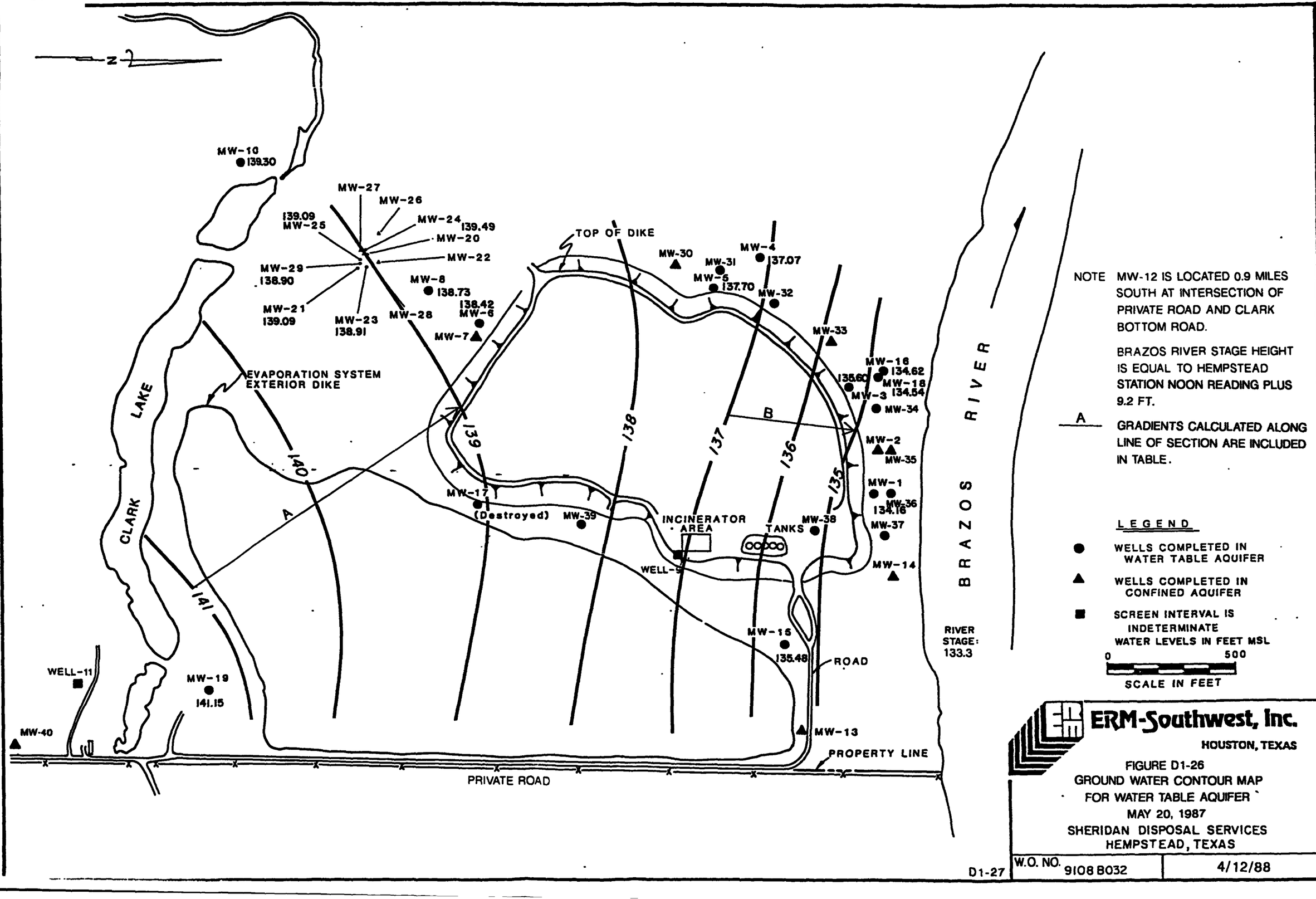
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-25
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
MAY 5, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108B031 | 4/12/88

018824



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

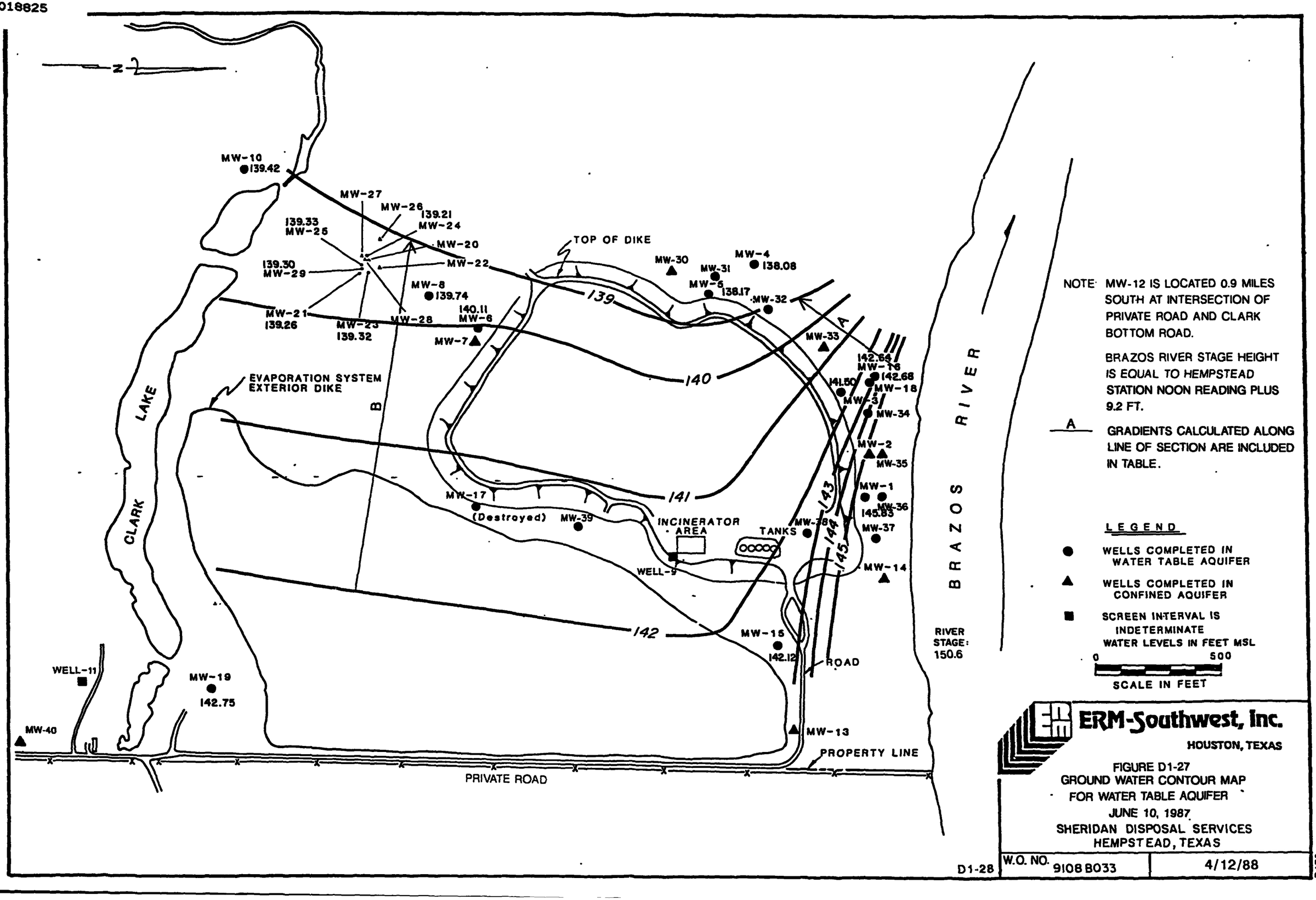
SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-26
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
MAY 20, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B032	4/12/88



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

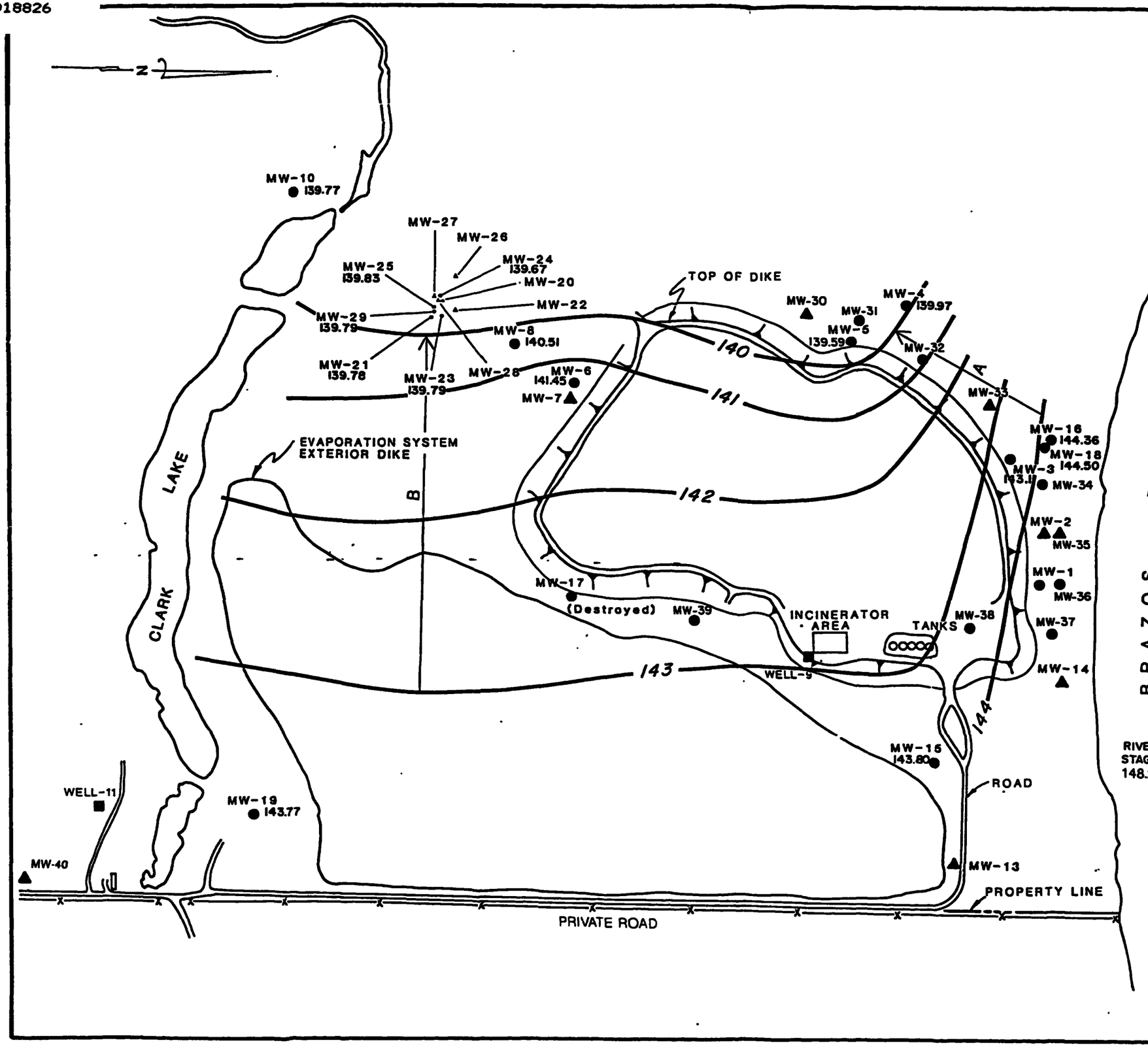
SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-27
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
JUNE 10, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108B033	4/12/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

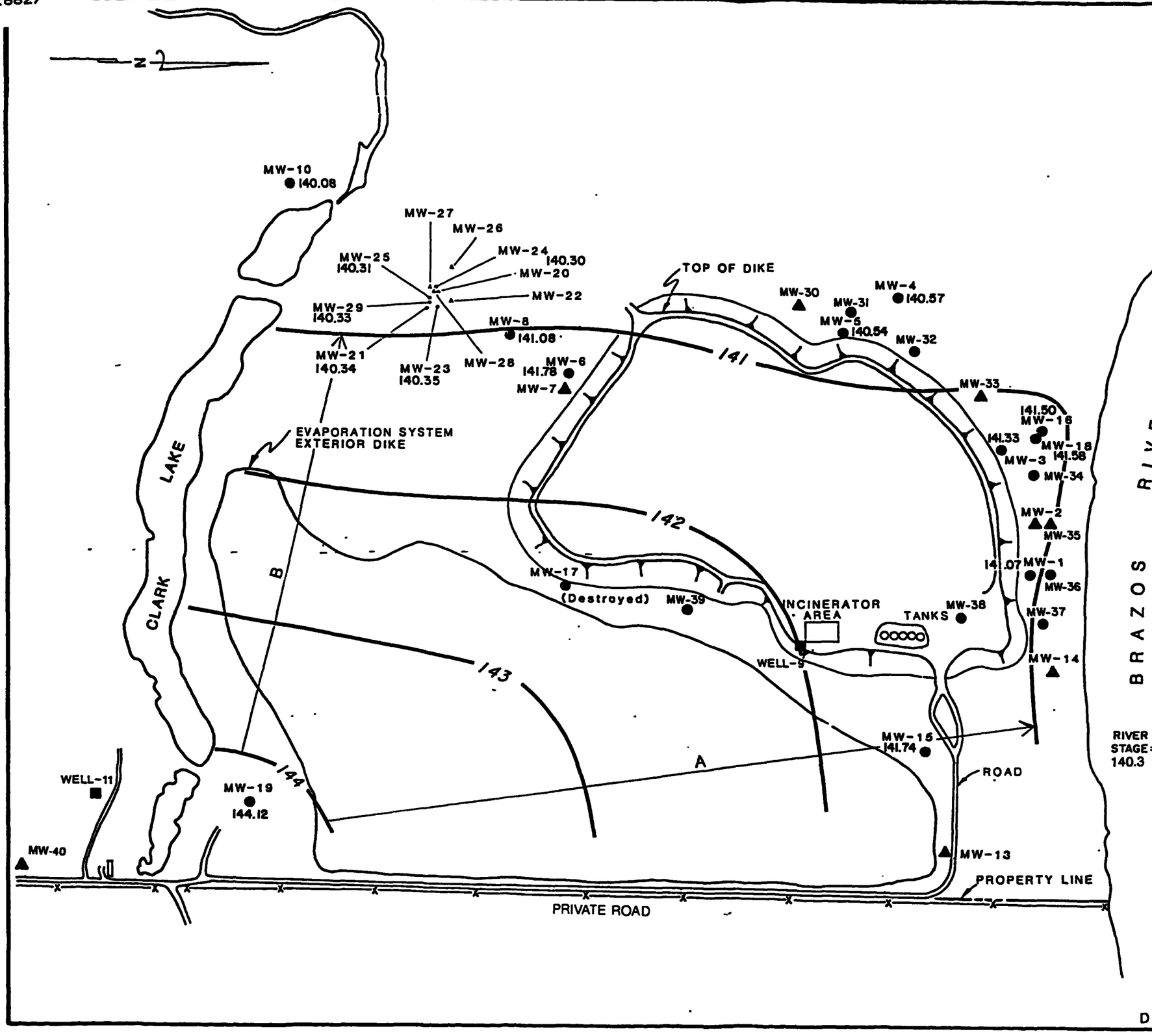
SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-28
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
JUNE 23, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 B034	4/12/88



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

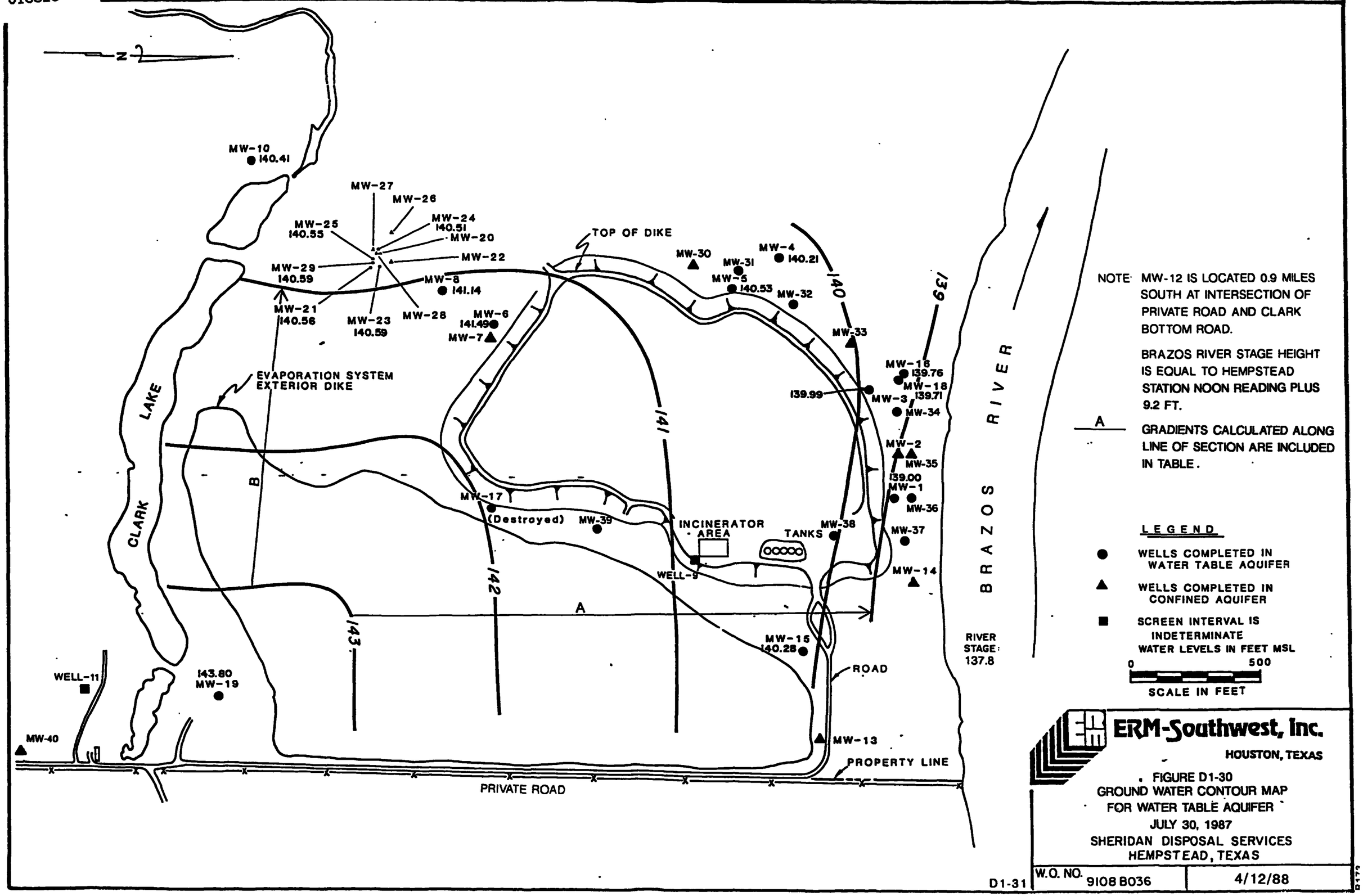
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-29
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
JULY 15, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 8035	4/12/88

R172



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

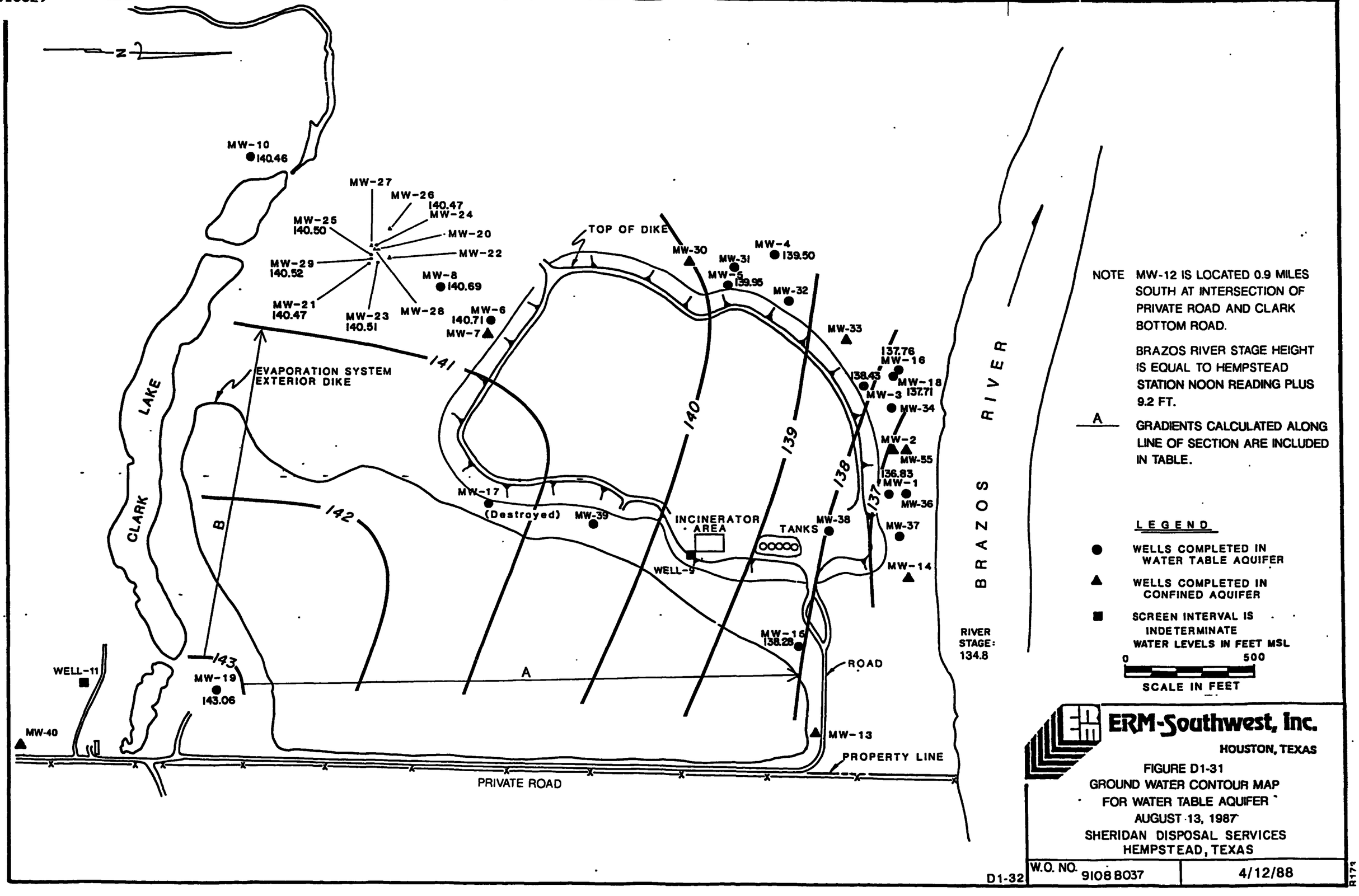
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-30
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
JULY 30, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 B036	4/12/88

018829



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

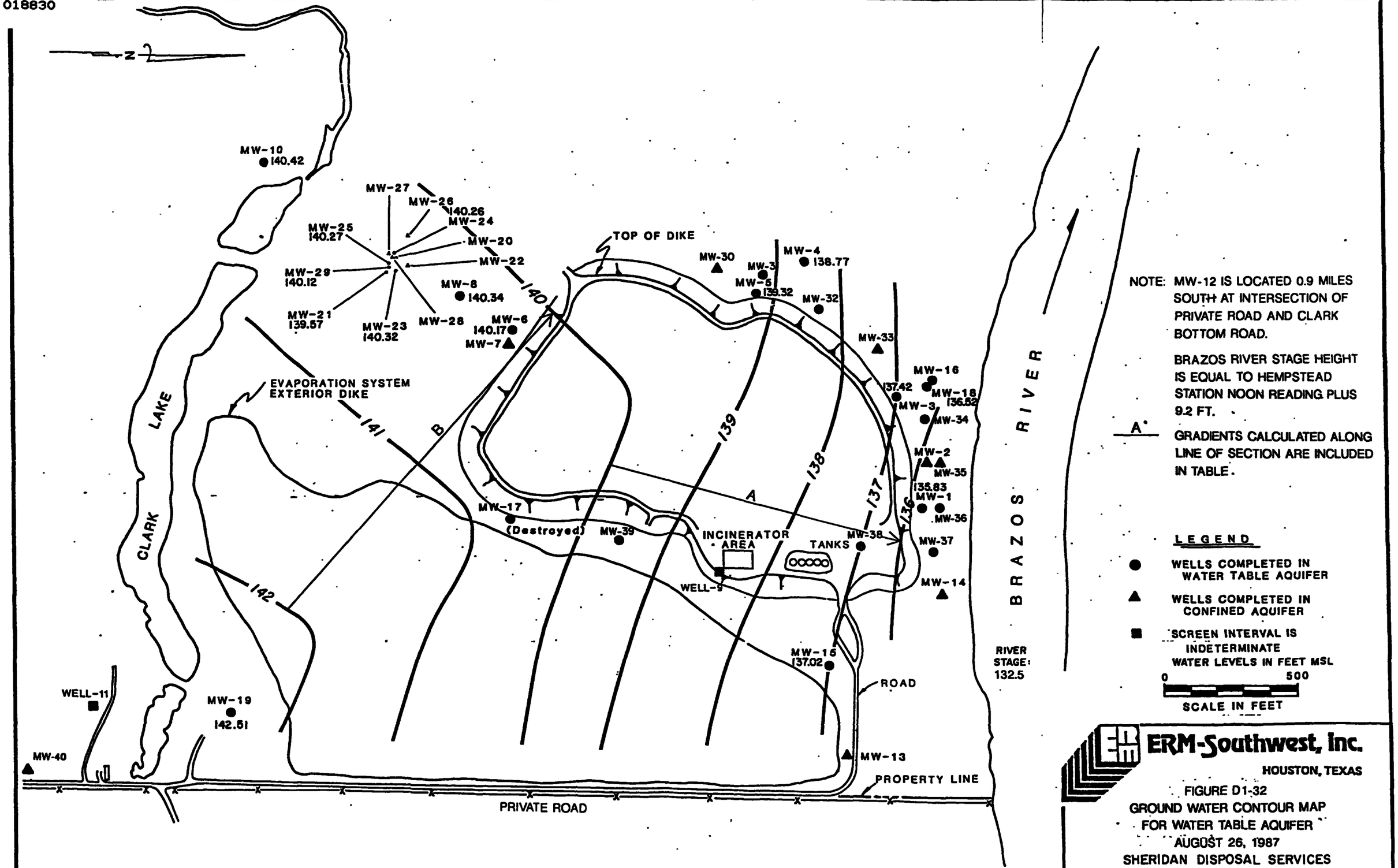
HOUSTON, TEXAS

FIGURE D1-31
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
AUGUST 13, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 B037	4/12/88

R174

018830



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — A' GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

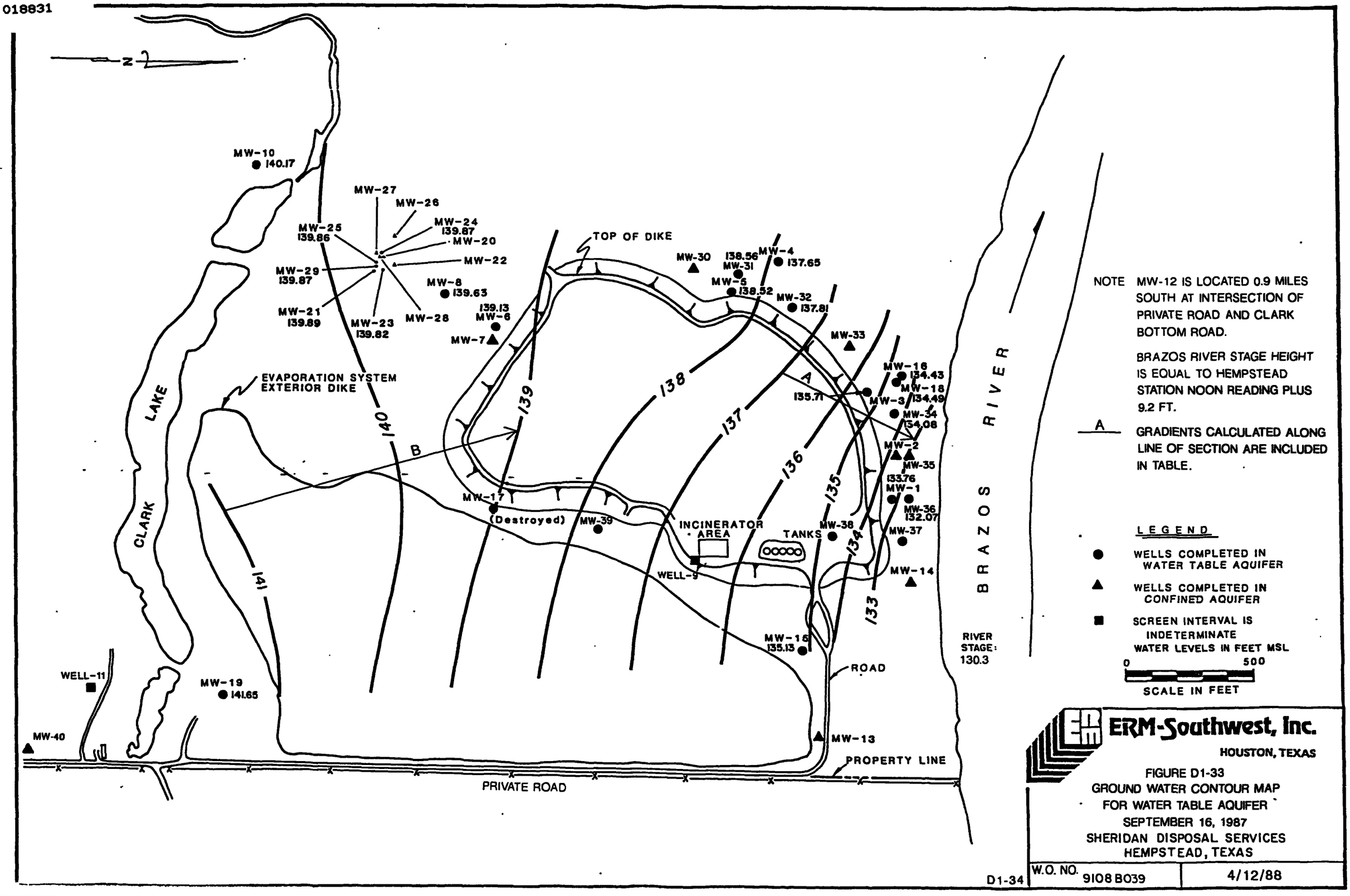
SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-32
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
AUGUST 26, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B038	4/12/88



ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-33
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
SEPTEMBER 16, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B039	4/12/88

018832

MW-10
139.95

MW-27
MW-26
MW-24
139.67
MW-25
139.58
MW-20
MW-22
MW-29
139.59
MW-8
139.24
MW-21
139.56
MW-23
139.55
MW-28
138.60
MW-6
MW-7

TOP OF DIKE

MW-30
137.98
MW-31
MW-4
137.08
MW-5
137.95
MW-32
137.16
MW-33
133.90
MW-16
136.2
MW-18
133.91
MW-3
MW-34
133.64
MW-2
MW-35
133.29
MW-1
MW-36
131.87
MW-37
MW-14

EVAPORATION SYSTEM EXTERIOR DIKE

LAKE

CLARK

RIVER

BRAZOS

138
137
136
135
134
133
140
139
141

MW-17
(Destroyed)
MW-39
136.94
INCINERATOR AREA
TANKS
MW-38
WELL-9
A
MW-15
134.94
ROAD
RIVER STAGE:
130.9
WELL-11
MW-19
141.07
MW-40
MW-13
PROPERTY LINE
PRIVATE ROAD

NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

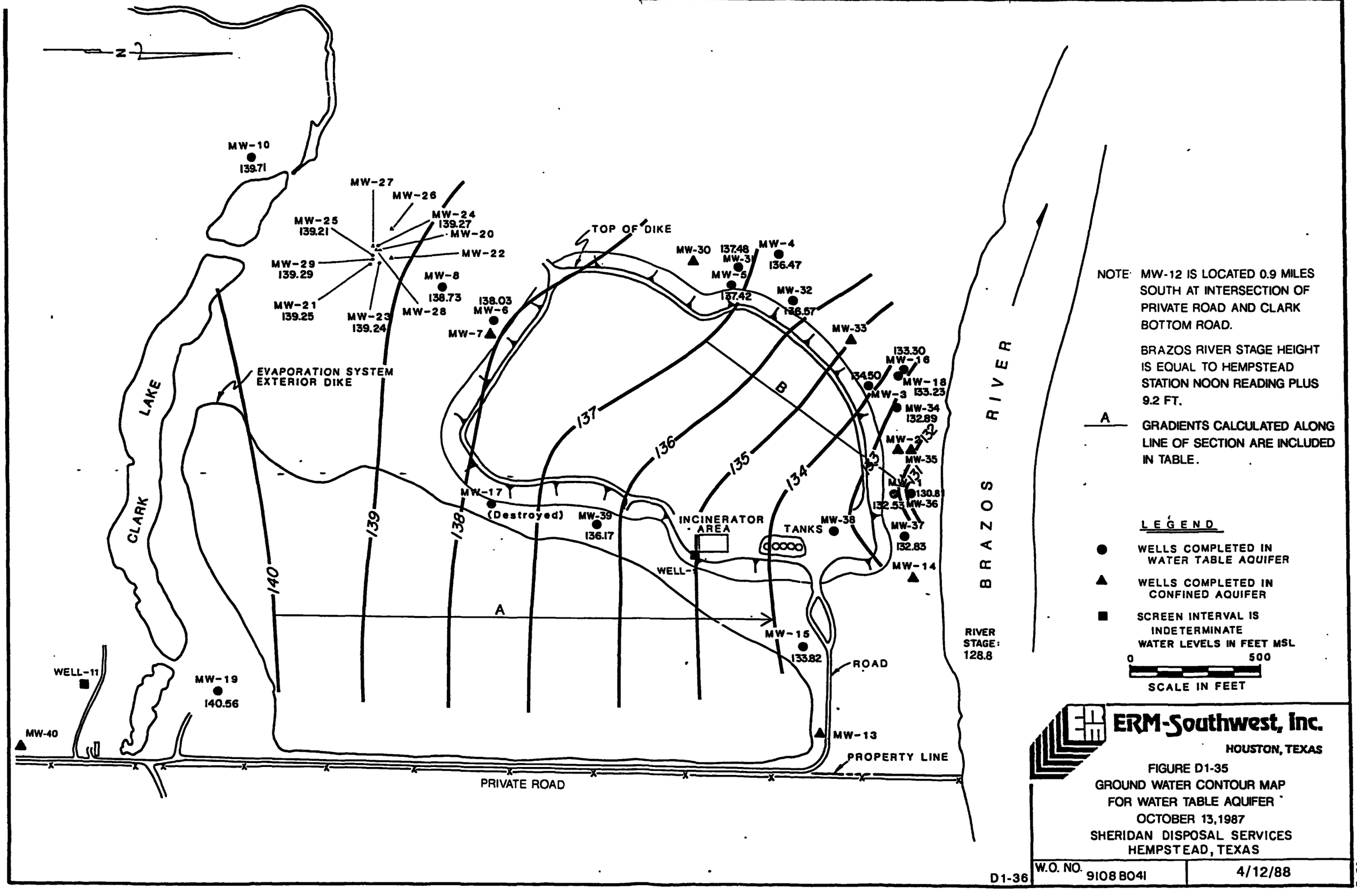
SCALE IN FEET

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-34
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
SEPTEMBER 30,1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B040 | 4/12/88

018833



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

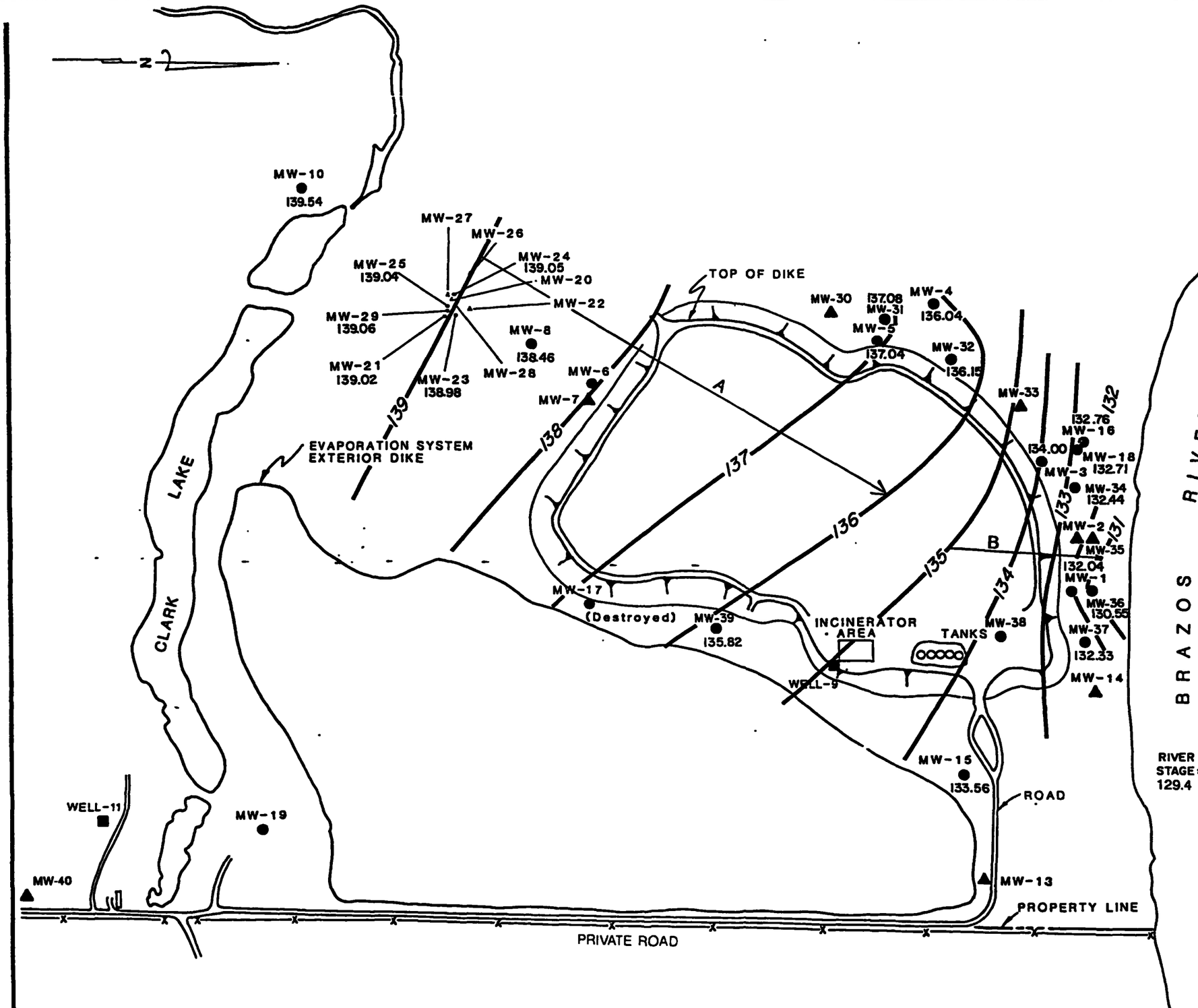
SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-35
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
OCTOBER 13,1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108B041	4/12/88



NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

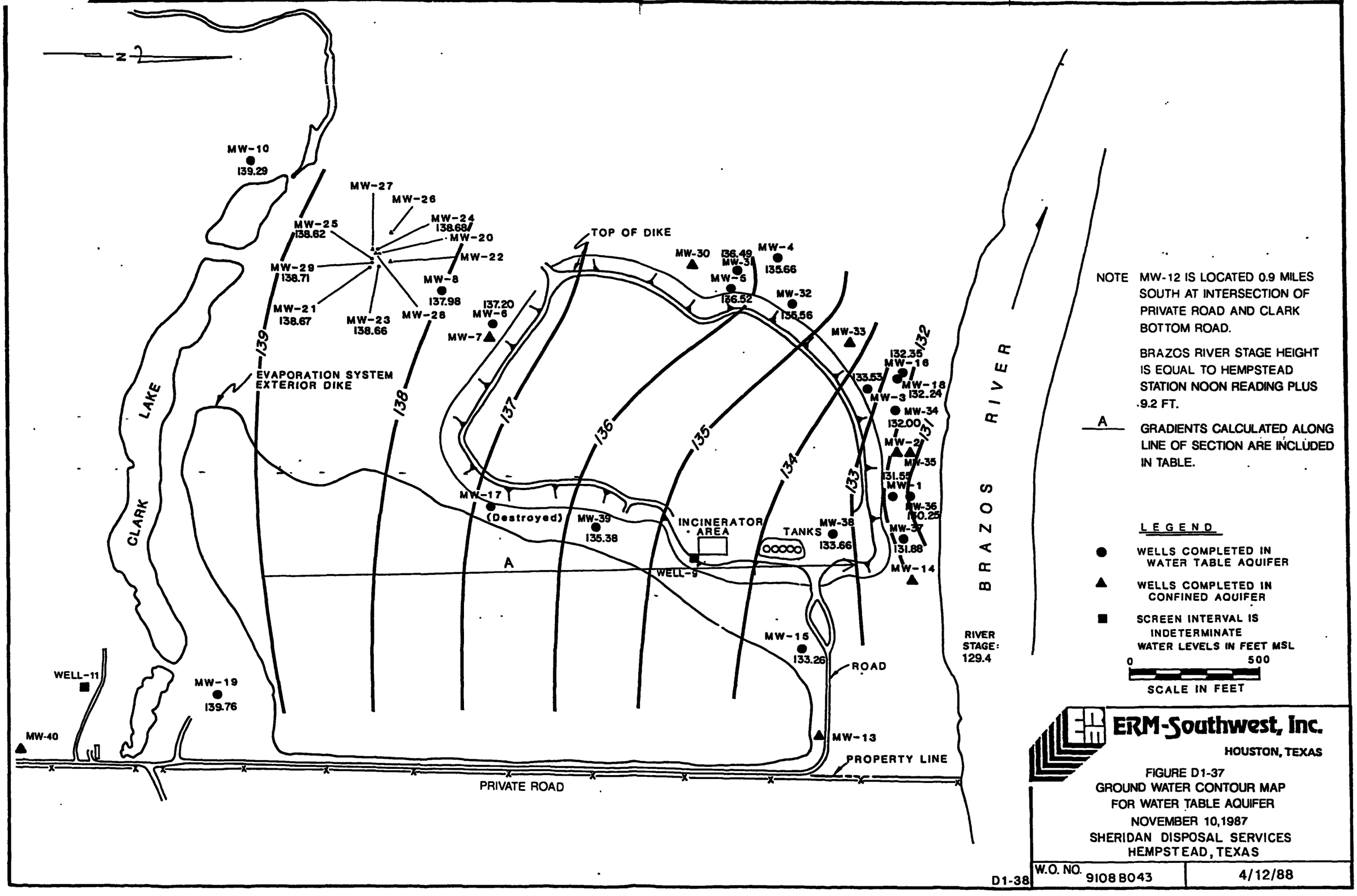
SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-36
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
OCTOBER 23,1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B042	4/12/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

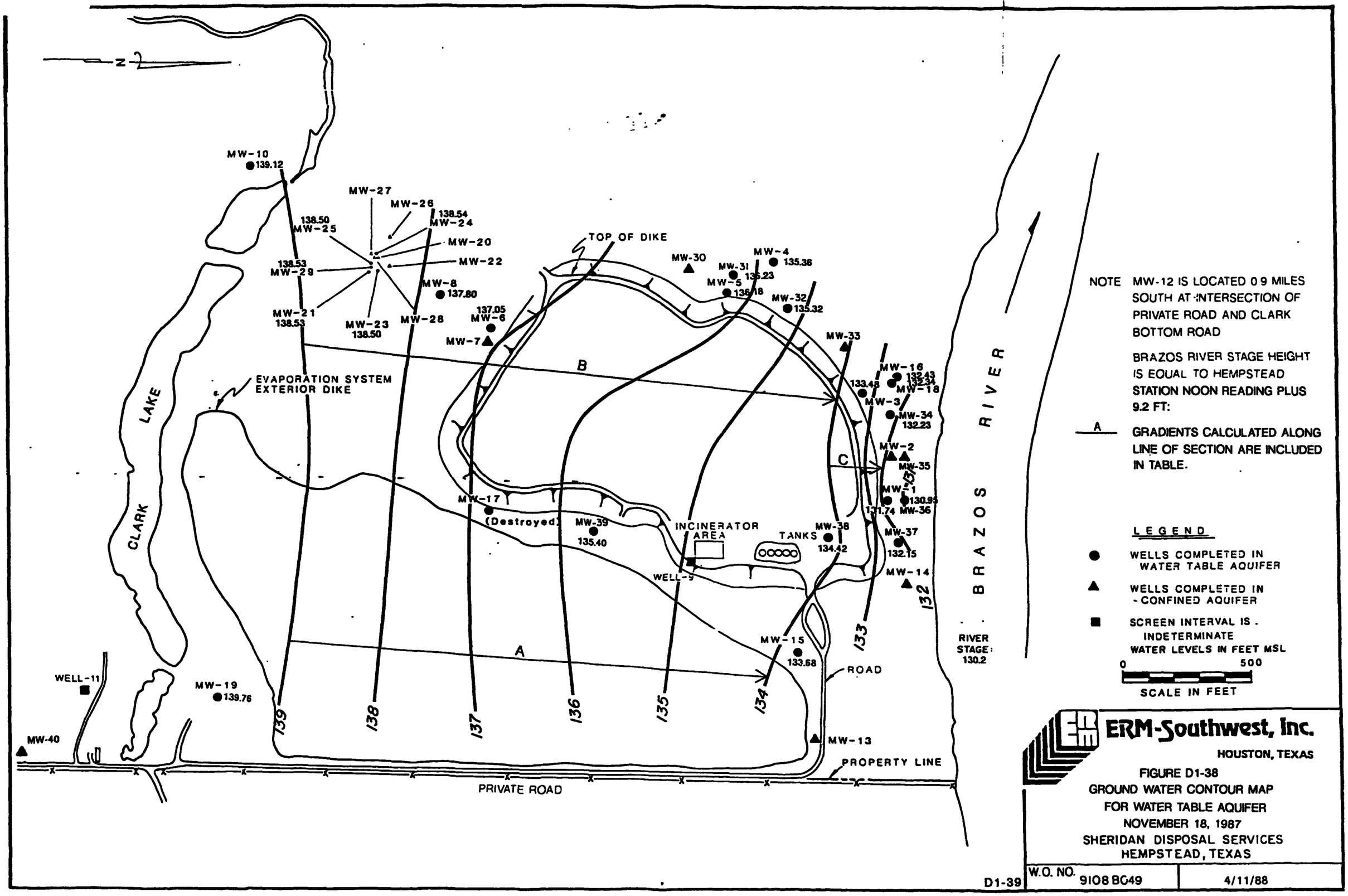
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-37
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
NOVEMBER 10,1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 B043	4/12/88

018836



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT:

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN - CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

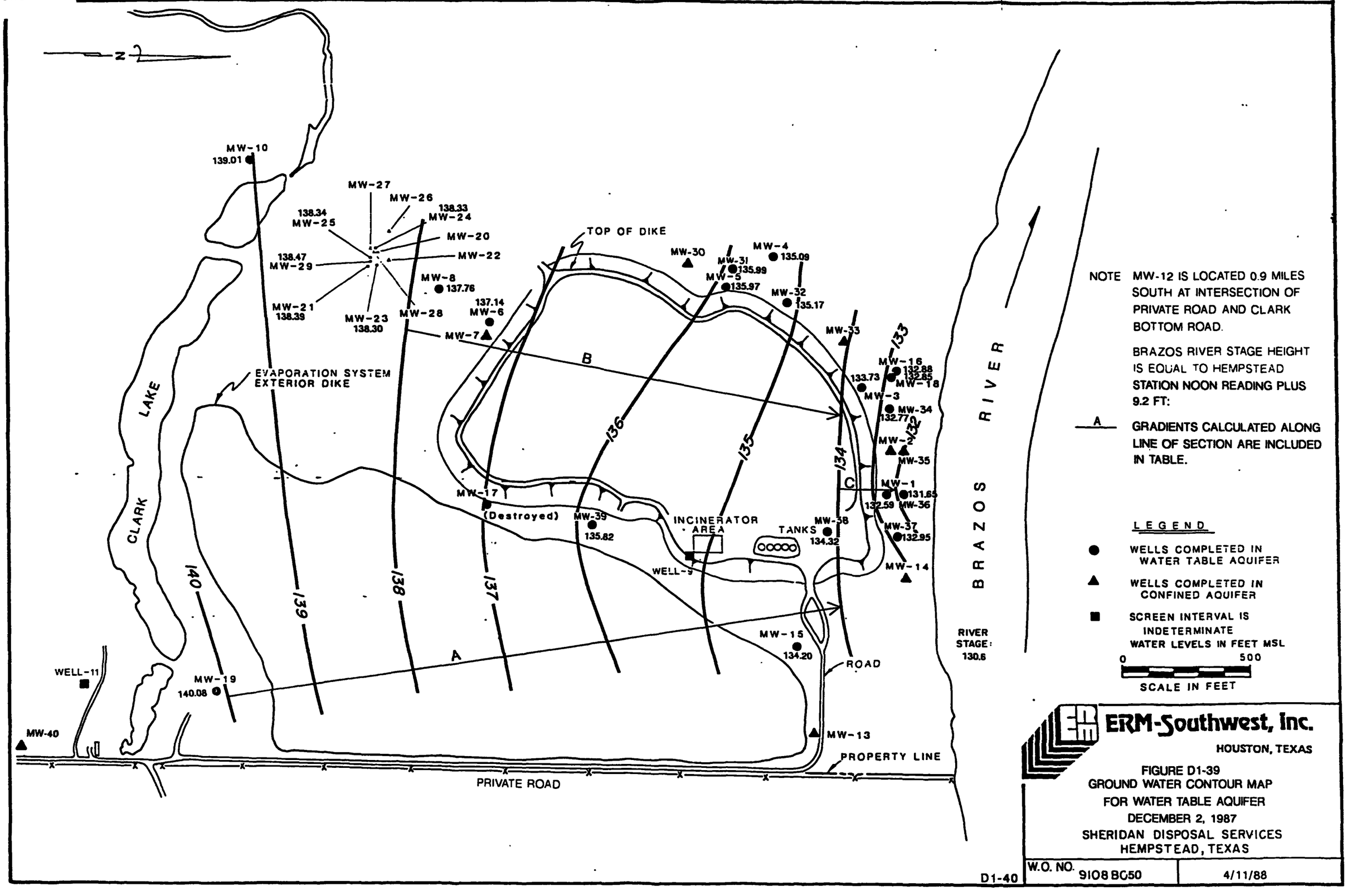
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-38
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
NOVEMBER 18, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B049	4/11/88

018837



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT:

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

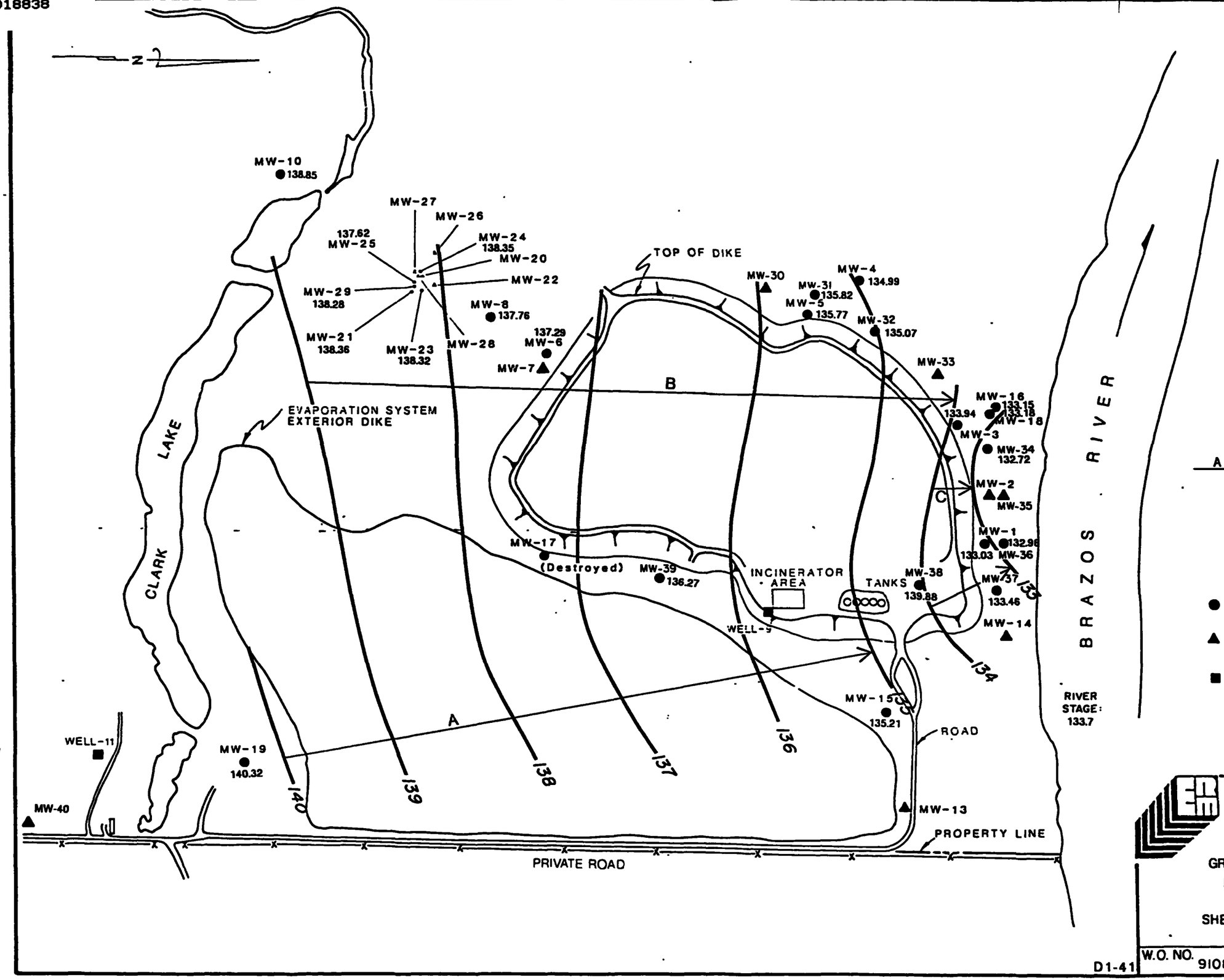
SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-39
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
DECEMBER 2, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 BC50	4/11/88



NOTES

WATER LEVEL IN MW-38 IS BELIEVED TO BE ERRONEOUS AND IS IGNORED IN CONTOURING.

MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT:

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE ACQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 . 500

SCALE IN FEET

ERM-Southwest, Inc.

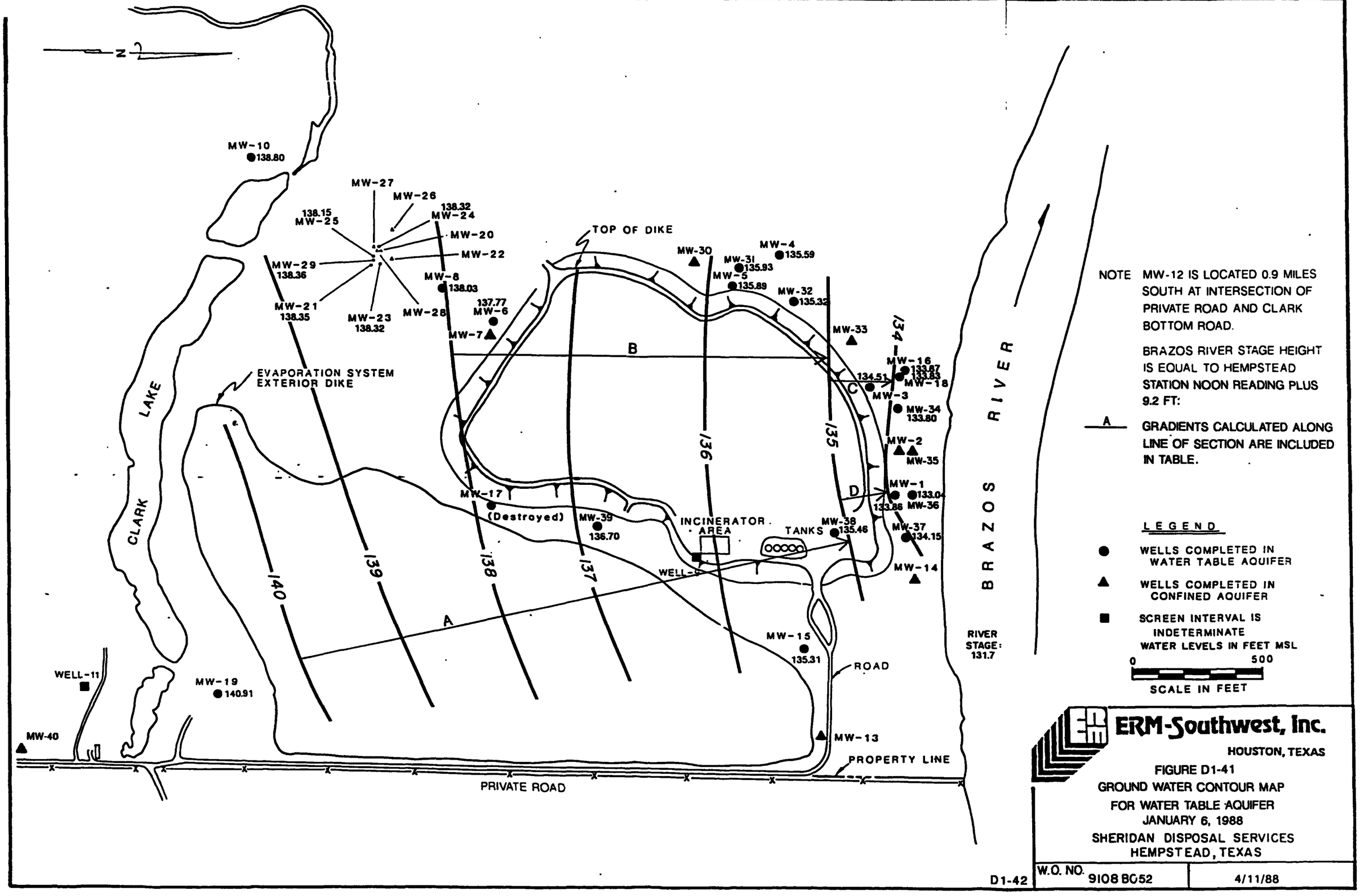
HOUSTON, TEXAS

FIGURE D1-40
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
DECEMBER 23, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 B051	4/11/88

R173

018839



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT:

A GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

● WELLS COMPLETED IN WATER TABLE AQUIFER

▲ WELLS COMPLETED IN CONFINED AQUIFER

■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-41

GROUND WATER CONTOUR MAP

FOR WATER TABLE AQUIFER

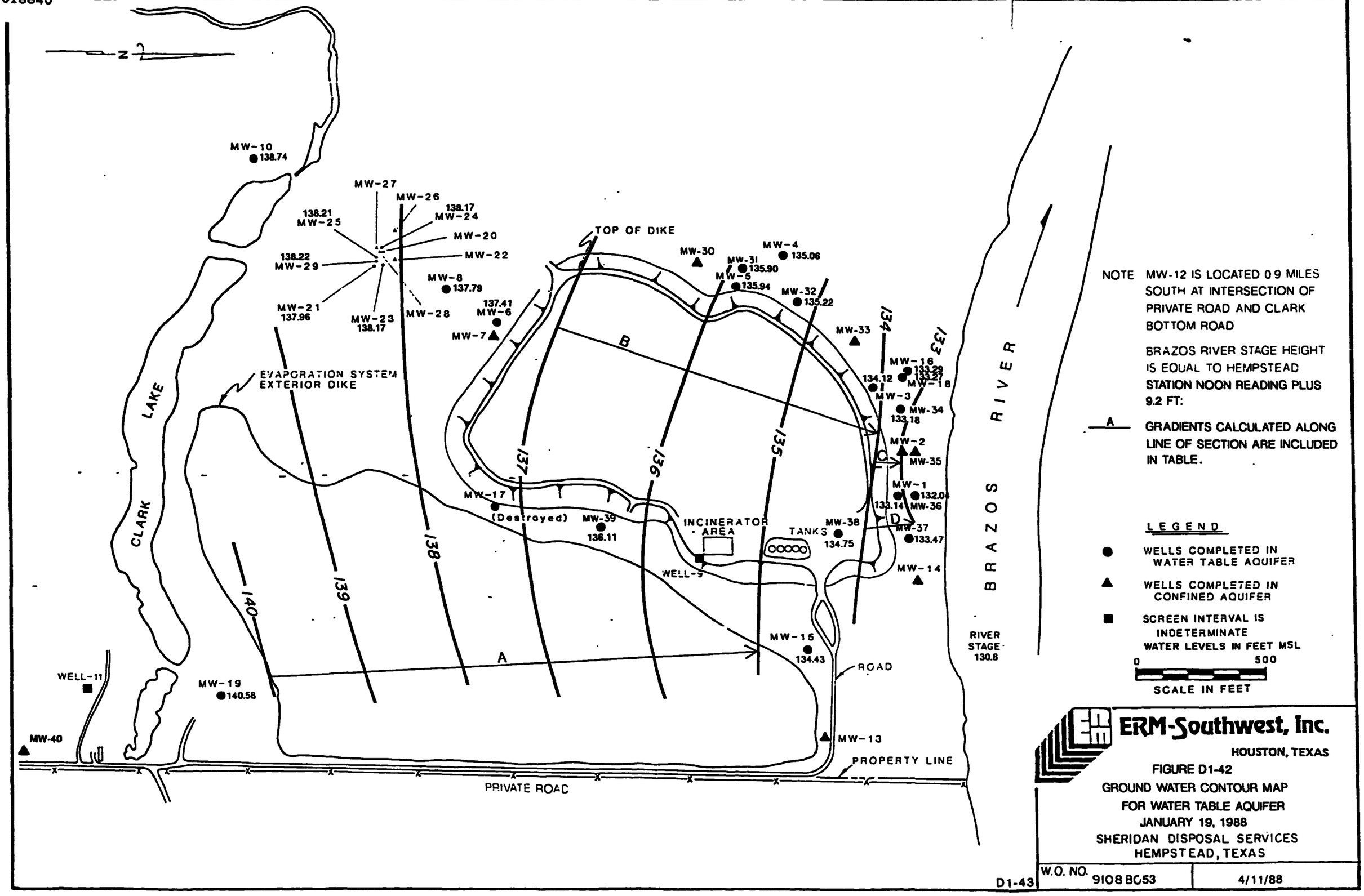
JANUARY 6, 1988

SHERIDAN DISPOSAL SERVICES

HEMPSTEAD, TEXAS

W.O. NO. 9108 B052	4/11/88

D1-42



NOTE MW-12 IS LOCATED 0 9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT:

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-42

GROUND WATER CONTOUR MAP

FOR WATER TABLE AQUIFER

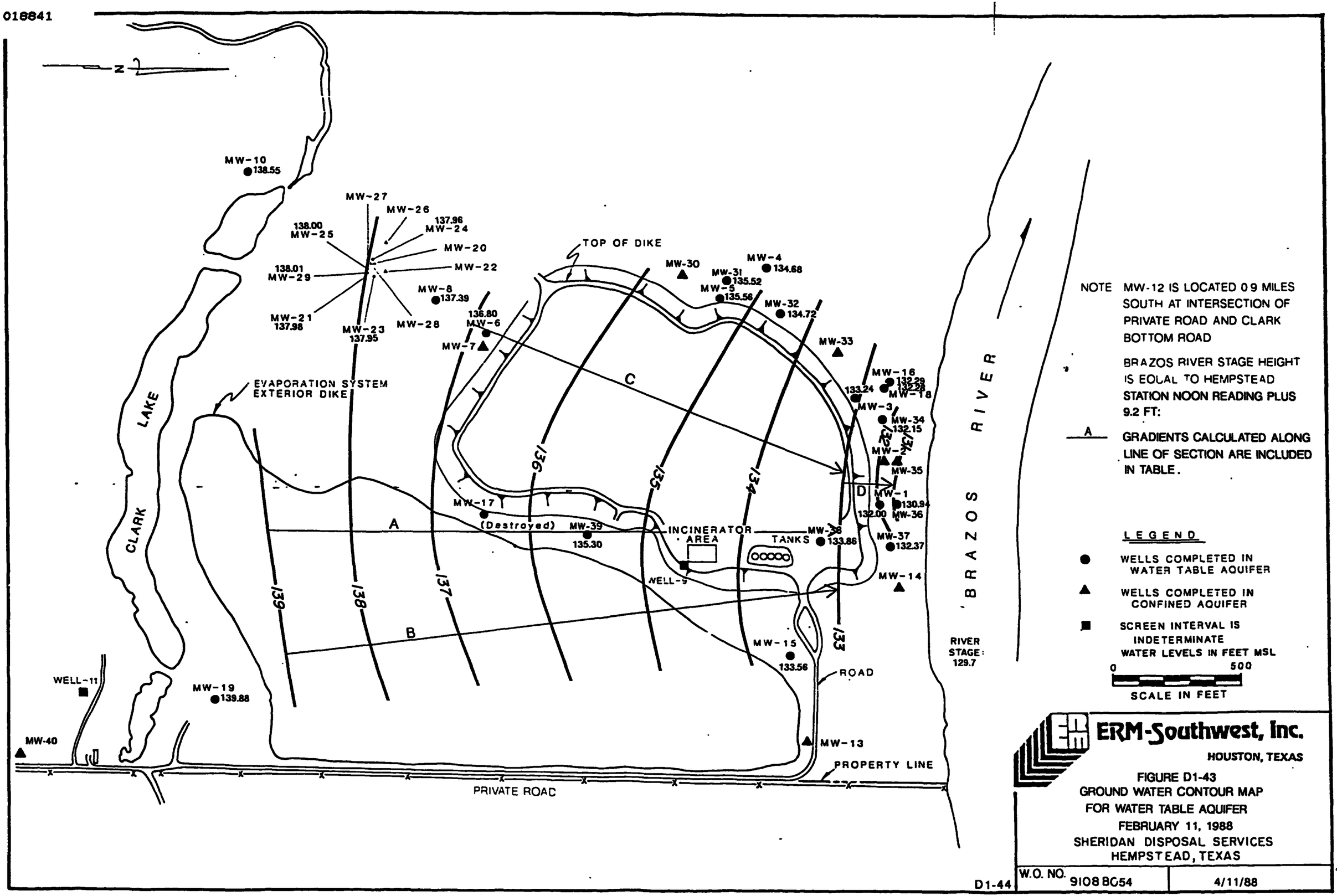
JANUARY 19, 1988

SHERIDAN DISPOSAL SERVICES

HEMPSTEAD, TEXAS

W.O. NO. 9108 B053 | 4/11/88

018841

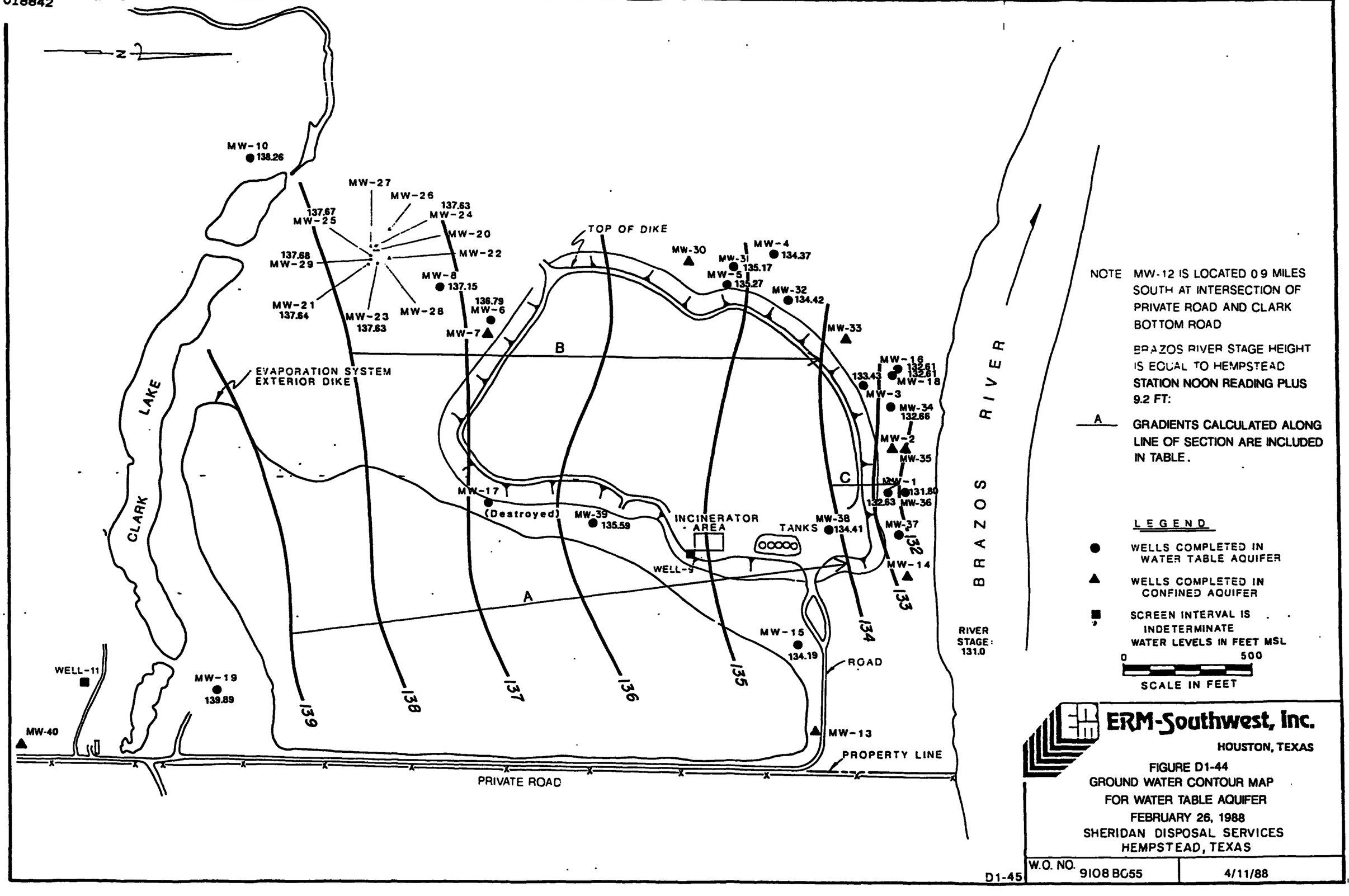


ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE D1-43
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
FEBRUARY 11, 1988
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 BC54 | 4/11/88

018842



NOTE MW-12 IS LOCATED 0 9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT:

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE.

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE D1-44
GROUND WATER CONTOUR MAP
FOR WATER TABLE AQUIFER
FEBRUARY 26, 1988
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 BC55 | 4/11/88

APPENDIX D-2

Calculations of Gradients in the Unconfined Aquifer

APPENDIX D-2

Date	Line*	Height (Feet)	Length (Feet)	Gradient (Δ H/ Δ L)
12/19/85	A	3	667	0.0045
	B	3	1200	0.0025
	C	3	1729	0.0017
01/03/86	A	3	1867	0.0016
01/14/86	A	4	2167	0.0018
02/07/86	A	2	467	0.0043
	B	2	1000	0.0020
	C	3	1733	0.0017
03/21/86	A	4	1800	0.0022
	B	2	1367	0.0015
04/24/86	A	5	2133	0.0023
05/09/86	A	3	1767	0.0017
06/11/86	A	4	725	0.0055
	B	4	1625	0.0025
	C	4	1883	0.0022
07/15/86	A	3	1867	0.0016
	B	2	1533	0.0013
08/18/86	A	3	1533	0.0020
09/18/86	A	3	1833	0.0016
10/27/86	A	1	375	0.0027
	B	2	983	0.0020
	C	2	1458	0.0014
11/28/86	A	3	2000	0.0015

*NOTE: Line designation refers to lines shown on ground water contour maps in Appendix D-1.

APPENDIX D-2 (Continued)

Date	Line*	Height (Feet)	Length (Feet)	Gradient ($\Delta H/\Delta L$)
01/02/87	A	3	633	0.0047
	B	3	1500	0.0020
	C	4	2033	0.0020
01/22/87	A	2	1500	0.0013
	B	2	1133	0.0018
02/05/87	A	3	2000	0.0015
	B	2	1267	0.0016
02/23/87	A	3	2100	0.0014
03/09/87	A	2	208	0.0096
	B	3	1742	0.0017
03/23/87	A	1	275	0.0036
	B	2	975	0.0021
04/16/87	A	3	1350	0.0022
	B	3	1608	0.0019
04/21/87	A	4	2167	0.0018
	B	2	1367	0.0015
05/05/87	A	5	1967	0.0025
05/20/87	A	2	1300	0.0022
	B	2	500	0.0015
06/10/87	A	6	479	0.0120
	B	3	1433	0.0021
06/23/87	A	4	575	0.0070
	B	3	1200	0.0025
07/15/87	A	3	2417	0.0012
	B	3	1475	0.0020

*NOTE: Line designation refers to lines shown on ground water contour maps in Appendix D-1.

APPENDIX D-2 (Continued)

Date	Line*	Height (Feet)	Length (Feet)	Gradient ($\Delta H/\Delta L$)
07/30/87	A	4	2025	0.0020
	B	2	1167	0.0017
08/13/87	A	5	2200	0.0022
	B	2	1333	0.0015
08/26/87	A	4	1167	0.0034
	B	2	1533	0.0013
09/16/87	A	4	583	0.0069
	B	2	1217	0.0016
09/30/87	A	5	1850	0.0027
10/13/87	A	6	1967	0.0030
	B	6	983	0.0061
10/23/87	A	3	1550	0.0019
	B	4	480	0.0083
11/10/87	A	6	2333	0.0026
11/18/87	A	5	1904	0.0026
	B	5	2128	0.0023
	C	2	224	0.0089
12/02/87	A	6	2498	0.0024
	B	4	1769	0.0023
	C	2	224	0.0090
12/23/87	A	5	2184	0.0023
	B	5	2352	0.0021
	C	1	150	0.0067
	D	1	333	0.0030

*NOTE: Line designation refers to lines shown on ground water contour maps in Appendix D-1.

APPENDIX D-2 (Continued)

Date	Line*	Height (Feet)	Length (Feet)	Gradient ($\Delta H / \Delta L$)
01/06/88	A	5	2229	0.0022
	B	3	1490	0.0020
	C	1	2520	0.0040
	D	1	1960	0.0051
01/19/88	A	5	1938	0.0026
	B	3	1344	0.0023
	C	1	112	0.0089
	D	2	202	0.0050
02/11/88	A	6	2292	0.0027
	B	6	2240	0.0027
	C	4	1612	0.0025
	D	2	151	0.0132
02/26/88	A	5	2240	0.0023
	B	4	1870	0.0021

*NOTE: Line designation refers to lines shown on ground water contour maps in Appendix D-1.

Strata in B - Unconfined flow - Using average I across site

1986

North $k = 2.9 \times 10^{-3}$ cm/sec = 22.4 ft/day (From SCRI pumping test)

$i = 0.0018$ ([redacted])

$n_e = 0.30$

$$V = \frac{ki}{n_e} = \frac{22.4 \text{ ft/day} (0.0018)}{.30} = 1.3 \times 10^{-1} \text{ ft/day}$$

Northerly flow between the Main Pond & the Brazos River occurred 88% of the time in 1986 (or 321 days/year)

1.3×10^{-1} ft/day * 321 days/yr = 42 ft/year

South $k = 22.4$ ft/day

$i = .0042$ $n_e = 0.30$

$$V = \frac{ki}{n_e} = \frac{22.4 \text{ ft/day} (.0042)}{.30} = 3.1 \times 10^{-1} \text{ ft/day}$$

Southerly flow from the Brazos River toward the Main Pond occurred 12% of the time in 1986 (or 44 days/year)

3.1×10^{-1} ft/day * 44 days/year = 14 ft/year

[redacted] between the Main Pond and the Brazos River was [redacted] (towards the River)

Stratum B - Unconfined Aquifer

1987

North... $k = 22.4$ ft/day (from SCRE pumping test ... 7×10^{-3} cm/s ...
$i = 0.0028$ ([redacted])
$n_e = 0.30$

$$V = \frac{22.4 \text{ ft/day} (.0028)}{.30} = 2.1 \times 10^{-1} \text{ ft/day}$$

Northerly flow from the Main Pond toward the Brazos River occurred 90% of the time in 1987 (or 328 days/year)

2.1×10^{-1} ft/day $\times$ 328 days/yr = 69 ft/yr

South... $k = 22.4$ ft/day
$i = 0.0074$ $n_e = 0.30$

$$V = \frac{22.4 \text{ ft/day} (.0074)}{.30} = 5.5 \times 10^{-1} \text{ ft/day}$$

Southerly flow from the Brazos River toward the Main Pond occurred 10% of the time in 1987 (or 37 days/yr)

5.5×10^{-1} ft/day $\times$ 37 days/yr = 20 ft/yr

1987 [redacted] between the Main Pond and Brazos River [redacted] direction (towards the River)

Stratum B - using I between Main Pond + River only

[redacted]

North $k = 22.4$ ft/day (fr. SCRI pumping test)

$i = .0028$ ([redacted])

$n_e = .30$

$$v = \frac{22.4 \text{ ft/day} (.0028)}{.30} = 2.1 \times 10^{-1} \text{ ft/day}$$

A northerly flow gradient occurred between the Main Pond + Brazos River 55% of the time (or 200 days) in 1986

$$2.1 \times 10^{-1} \text{ ft/day} \times 200 \text{ days/yr} = 42 \text{ ft/yr}$$

South $k = 22.4$ ft/day

$i = .0046$ $n_e = .30$

$$v = \frac{(22.4 \text{ ft/day}) \times (.0058)}{.30} = 4.3 \times 10^{-1} \text{ ft/day}$$

A southerly flow gradient occurred between the Main Pond + Brazos River 27% of the time (or 99 days) in 1986

$$4.3 \times 10^{-1} \text{ ft/day} \times 99 \text{ days/year} = 43 \text{ ft/yr}$$

[redacted]

AJ2
5/6/88

Stratum B

[redacted]

North $k = 22.4$ ft/day (from [redacted] pumping test)

$i = .0067$ ([redacted])

$n_e = .30$

$$V = \frac{22.4 \text{ ft/day } (.0067)}{.30} = 5.0 \times 10^{-1} \text{ ft/day}$$

A Northerly flow gradient occurred between the Main Pond & Brazos River 79% of the time (288 days) in 1987

$$5.0 \times 10^{-1} \text{ ft/day} \times 288 \text{ days/yr} = 144 \text{ ft/yr}$$

South $k = 22.4$ ft/day

$i = .0055$ $n_e = .30$

$$V = \frac{22.4 \text{ ft/day } (.0055)}{.30} = 3.7 \times 10^{-1} \text{ ft/day}$$

A Southerly flow gradient occurred between the Pond & River 17% of the time (or 62 days) in 1987

$$3.7 \times 10^{-1} \text{ ft/day} \times 62 \text{ days/yr} = 23 \text{ ft}$$

1987 [redacted]

018852 [redacted]

checked 5/88 DEW SJR 5/6/88

1986	Δh	Δx	gradient	direction
N - Jan 3	.5	390	.0013	N
N - Jan 14	1	420	.0024	N
S - Feb 7	1.5	330	.0045	S
N - March 21	1.5	300	.0050	N
N - April 24	1	300	.0033	N
N - May 9	1	570	.0018	NW
	($\cos 30° = \frac{570}{x}$	$x = 658$		North vector = .0015
S - June 11	2	167	.012	SW
N - July 15	.5	267	.0019	N
N - Aug 18	1	250	.0040	N
Sept 18	.5	250	.0020	N
	.5	167	.0030	S
S - Oct 27	1	200	.005	SW
	($\cos 30° = \frac{200}{x}$	$x = 231$		south vector .0043
Nov 28	1	767	.0013	West

$\cos 45 = \frac{167}{x}$

Avg N grad = .0028
55 % time = 200 days

Avg S grad = .0058
27 % time 96 days

Neutral N-S flow occurred
18% of the time = 66 days

Stratum 3 Area Between Point & River JJR 5/6/88

018853

1981	Δh (ft)	Δx (ft)	Gradient	Direction
Jan 2	1	167	.006	S
Jan 22	.5	600	.00083	N
Feb 5	.25	150	.0017	N
Feb 23	.5	250	.002	N
Mar 9	2	220 (240) Sweder	.0091	SW (Sweder .0082)
Mar 23				Neutral
Apr 6	.5	133	.0038	N
Apr 21	.5	133	.0038	N
May 5	1	167	.006	N
May 20	1	133	.0075	N
June 10	3	167	.0018	S
June 29	1	167	.006	S
July 15	.5	333	.0015	N
July 30	1	167	.006	N
Aug 13	1	133	.0075	N
Aug 26	1	133	.0075	N
Sept 16	3	333 (367)	.0091	N (N-vector .0082)
Sept 30	3	300	.01	N
Oct 13	2	200	.01	N
Oct 23	4	480	.0083	N
Nov 10	2	200	.01	N
Nov 18	3	300	.01	N
Dec 2	2	233	.0086	N
Dec 23	1	133	.0075	N

N 19
S 4
Neutral 1

North Avg grad = .0067 , 79% of time = 288 days

South Avg grad = .0055 , 17% of time = 62 days

Neutral 4% of time = 15 days

018854

APPENDIX E

Slug/Bail Test Data and Calculations for the Confined Aquifer (Stratum D)

EKM-Southwest, inc.

By SJR Date 11/25/87 Subject Sheridan Wiw)-30 #1 Sheet No. ____ of ____

Chkd By DLD Date 3/31/88 W.O. No. ____

(Bouwer + Rice, 1976)

r_c = 1.03 in. = 0.086 ft (slug should displace 2.5 ft in well)

r_w = 4 in = 0.33 ft

L = 25 ft

L/r_w = 75.8

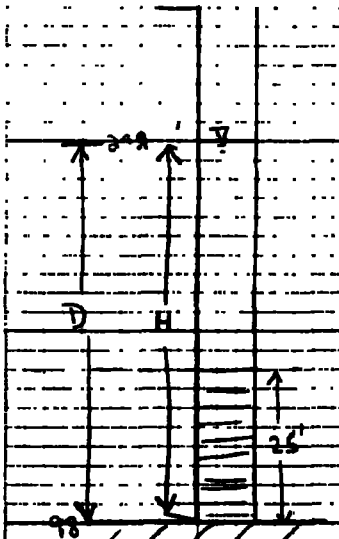
D = H = 68.1 ft

H/r_w = 206

from fig 3: C = 3.5

$\ln R_e/r_w = \left(\frac{1.1}{\ln H/r_w} + \frac{C}{L/r_w}\right)^{-1}$ (Eq 7)

$= \left(\frac{1.1}{5.33} + \frac{3.5}{75.8}\right)^{-1} = 3.96$



$K = \frac{r_c^2 \ln R_e/r_w}{2L} \cdot \frac{1}{t} \cdot \ln y_o/y_t$ (Eq 6)

for y_o = 2.4 ft

y_t = 0.35 ft

y_o/y_t = 6.86

t = 2 sec

$K = \frac{(.086\text{ ft})^2 3.96}{2(25)} \cdot \frac{1}{2\text{ sec}} \cdot \ln 6.86$

$= 5.64 \times 10^{-4}$ ft/sec $\times$ 30.48 cm/ft = 1.72×10^{-2} cm/sec

b = 22.5 ft = 6.86 m

$T = Kb = 1.72 \times 10^{-2}$ cm/sec $\times \frac{1\text{ m}}{100\text{ cm}} \times 6.86\text{ m} \times 86400\text{ sec/day} = 10.2\text{ m}^2/\text{day}$

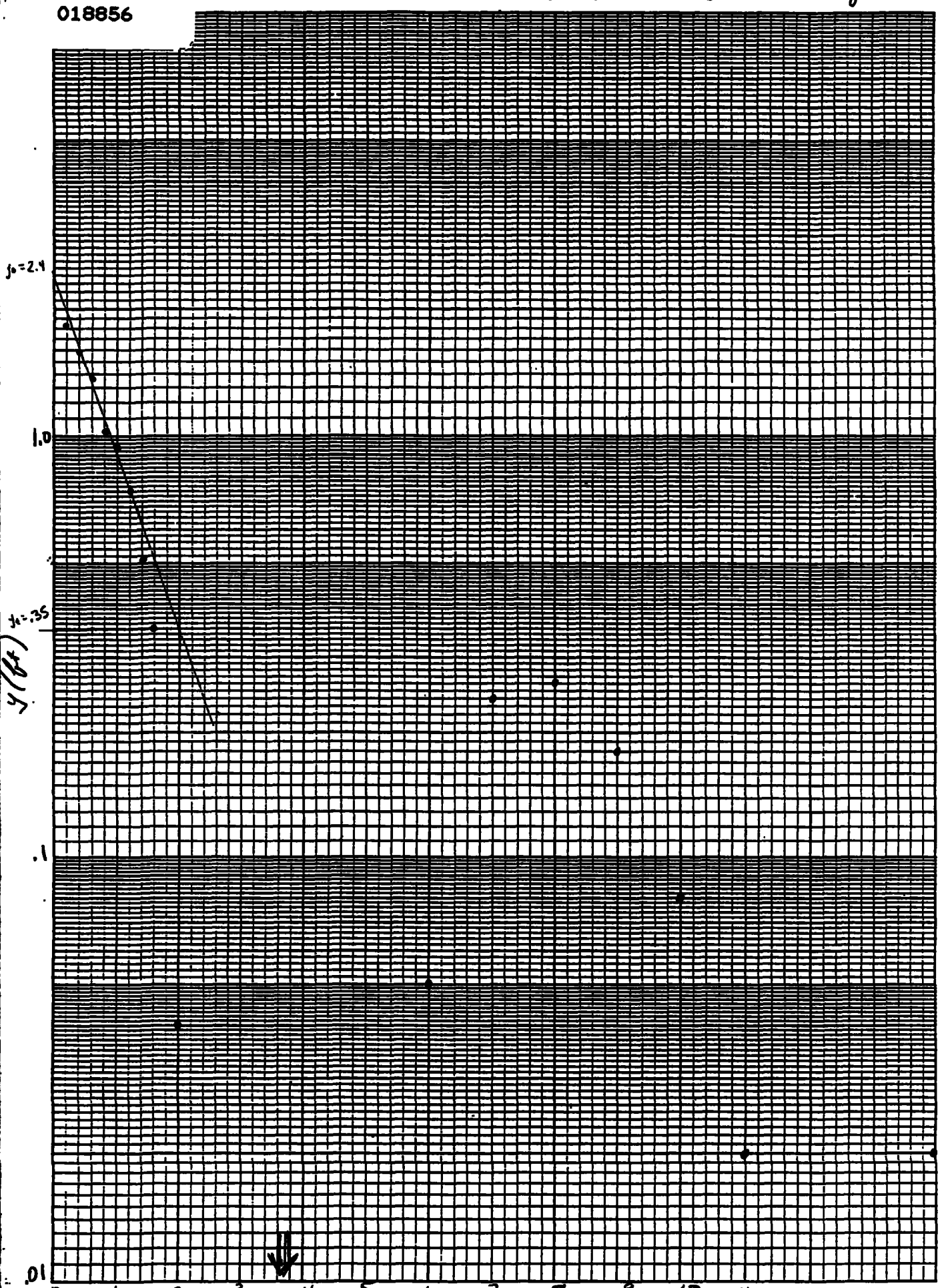
$\frac{10.2\text{ m}^2/\text{day}}{.01242} = 821.3$ gpd/ft

MW-30 Test # 1
(11/17/87)

Deep Aq
Slug Test

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

018856



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133

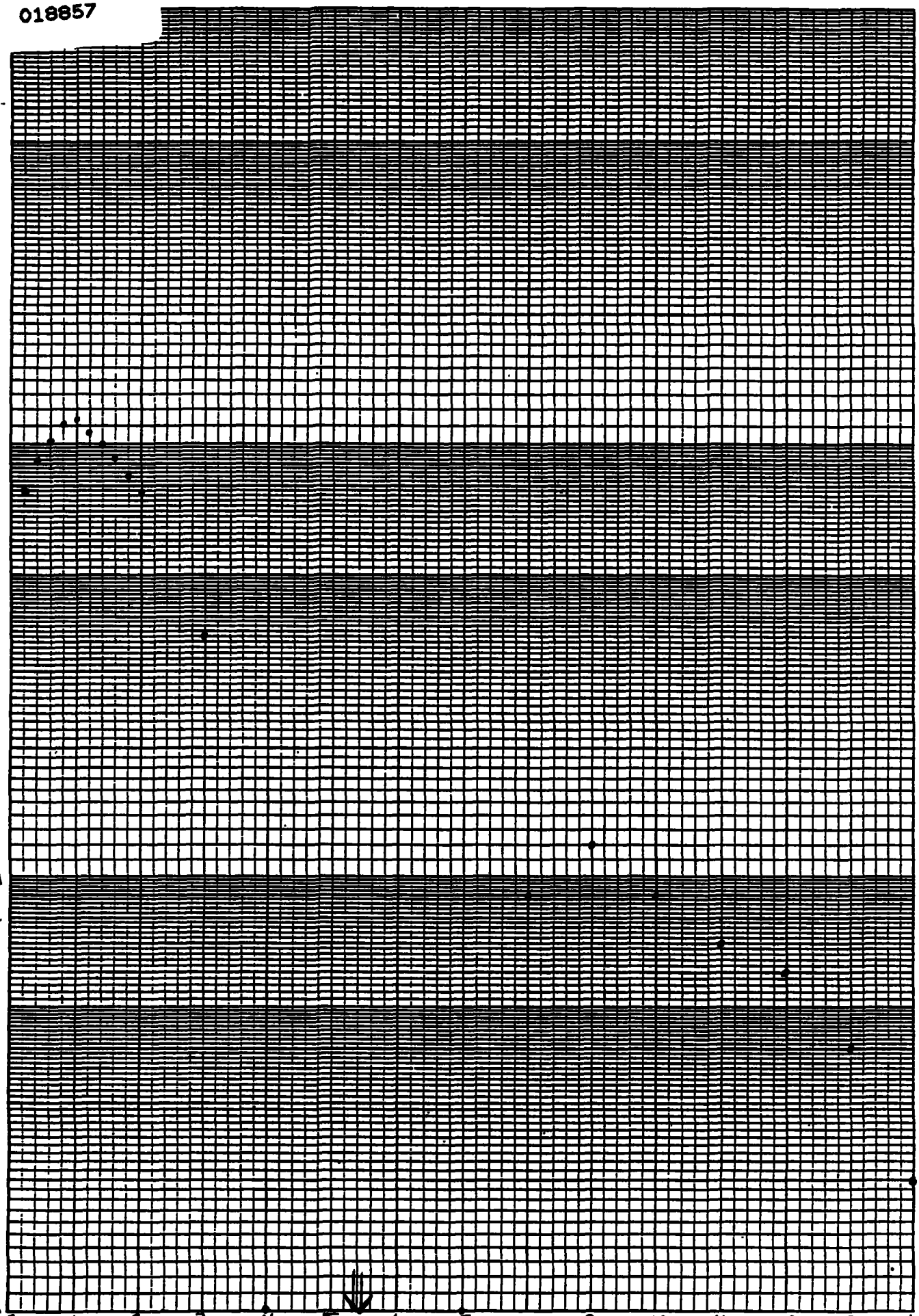
E-2

MW-30 test #2
11/17/87

Deep Aq
Bail Test

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

018857



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checked 2/3/89 DCW

MW-30 Slug / Bail Test Analysis - Cooper et al 1967

Test #1 - Slug Test

at match point $\frac{Tt}{r^2} = 1$

$t = .9$ sec

$\alpha = 10^{-3}$

$$T = \frac{r_c^2}{t} = \frac{(2.54\text{cm})^2}{.9\text{sec}} = 7.1 \frac{\text{cm}^2}{\text{sec}}$$

$$7.1 \frac{\text{cm}^2}{\text{sec}} \cdot \left(\frac{\text{ft}}{30.48\text{cm}}\right)^2 \cdot \left(\frac{7.48\text{gal}}{\text{ft}^3}\right) \times \frac{60\text{sec}}{\text{min}} \times \frac{60\text{min}}{\text{hr}} \times \frac{24\text{hr}}{\text{day}} = 4990 \text{ gpd/ft}$$

if saturated thickness = 22.5 feet

$K = T/b = 222 \text{ gpd/ft}^2$ ✓

or $222 \text{ gpd/ft}^2 \times \frac{\text{ft}^3}{7.48\text{gal}} \times \frac{30.48\text{cm}}{\text{ft}} \times \frac{\text{day}}{24\text{hr}} \times \frac{\text{hr}}{60\text{min}} \times \frac{\text{min}}{60\text{sec}} =$

$K = 1.05 \times 10^{-2}$ cm/sec ✓

Checked & U.

018859

ERM-Southwest, inc.

By SJR Date 2/15/88 Subject Sheridan MW-30 Test #1 Sheet No. ____ of ____

Chkd By ____ Date ____ Slug Test (11/17/87) W.O. No. ____

2" diam well screen

1"x10' slug displaces 0.0545 ft³

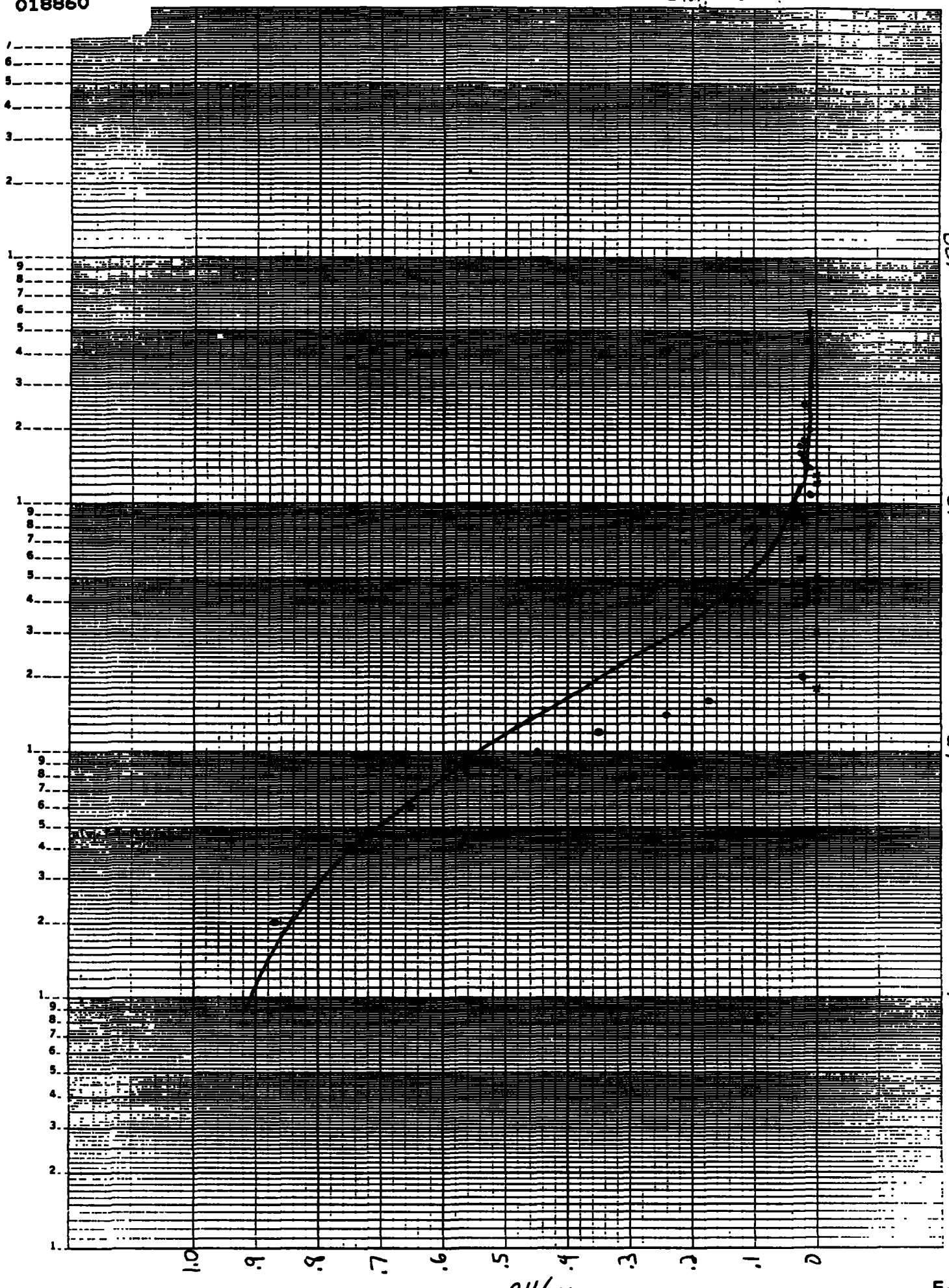
in 2" well = 2.5 ft (Ho = 2.1 ft at t=0)

don't enter 0

Time (min)	H (ft)	H/Ho	Time (sec)	
← 0	2.1	1		
.003	1.83	.87	.2	
.007	1.58	.75	.4	
.01	1.36	.65	.6	
.013	1.01	.48	.8	
.017	.95	.45	1.0	
.02	.74	.35	1.2	
.023	.51	.24	1.4	
.027	.35	.17	1.6	← negative
.033	.04	.02	2.0	← negative
.1	.05	.024	6	
.117	.24	.11	7	
.13	.26	.12	8	
.15	.18	.086	9	
.17	.08	.038	10	
.18	.02	.01	11	← negative
.23	.02	.01	14	
.25	.04	.02	15	
.27	.05	.024	16	
.28	.05	.024	17	
.3	.04	.02	18	
.33	.03	.01	20	
.417	.04	.02	25	
.5	.02	.01	30	
.75	.02	.01	45	
1.0	.02	.01	60	

018860

Slug Test (11/17/87)



46 6212

SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

Bouwer + Rice

EKM-Southwest, inc.

By SJR Date 11/30/87 Subject Sheridan MW-33 Test #1 Sheet No. ____ of ____

Chkd By DCW Date 3/31/88 Bail Test 11/18/87 W.O. No. ____

$r_c = 1.03\ in = 0.086\ ft$

$r_w = 4\ in = 0.33\ ft$

$L = 20\ ft$

$D = H = 63.7\ ft$

$H/r_w = 60.6$

$C = 2.9$ (fig 3, Bouwer & Rice, 1976)

$H/r_e = 193.0$

$$\ln R_e/r_w = \left(\frac{1.1}{\ln(H/r_w)} + \frac{C}{L/r_w}\right)^{-1}$$ (Eq 9, Bouwer & Rice, 1976)

$$= \left(\frac{1.1}{\ln 193.} + \frac{2.9}{60.6}\right)^{-1} = 3.89$$

$$K = \frac{r_c^2 \ln R_e/r_w}{2L} \cdot \frac{1}{t} \ln y_0/y_t$$ (Eq 5, Bouwer & Rice, 1976)

For $y_0 = .22\ ft$ $\quad y_0/y_t = 4.23$

$y_t = 0.052\ ft$

$t = 10\ sec$

$$K = \frac{(.086\ ft)^2 \cdot 3.89}{2(20\ ft)} \cdot \frac{1}{10\ sec} \cdot \ln 4.23$$

$$K = 1.04 \times 10^{-3}\ ft/sec \times 30.48\ cm/ft = \boxed{3.17 \times 10^{-3}\ cm/sec.}$$

$b = 7.01\ m$

$$T = 3.17 \times 10^{-3}\ cm/sec \times \frac{1\ m}{100\ cm} \times 7.01\ m \times 86400\ sec/day = 19.2\ m^2/day$$

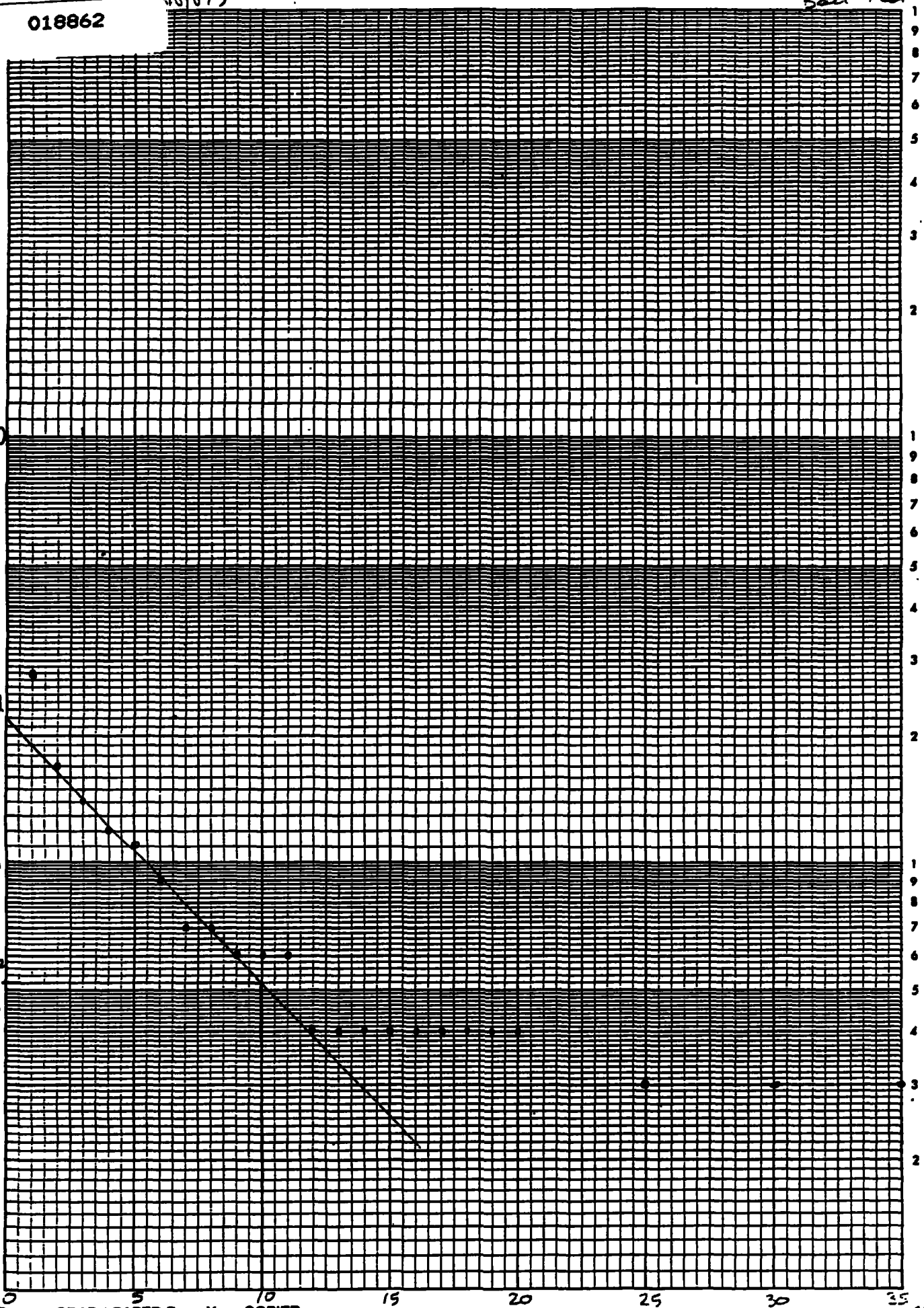
$$= \frac{19.2\ m^2/day}{.0142} = \boxed{1546\ gpd/ft}$$

MW-33 Test #1 (10/87)

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

Deep Aq Bail Test

018862



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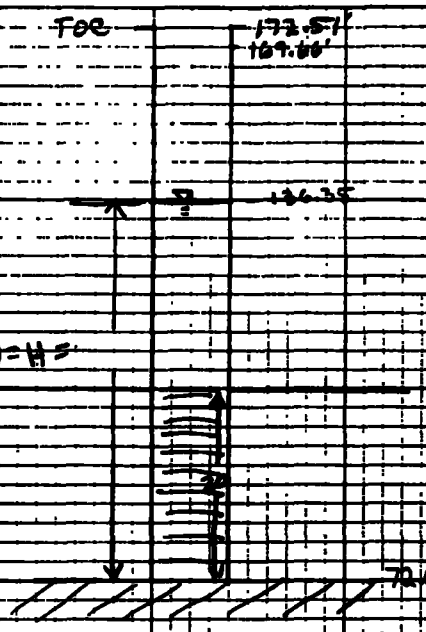
EKM-Southwest, inc.

By SJP Date 11/24/87 Subject Sheridan MW(L)-33 Sheet No. ____ of ____

Chkd By D.L. Date 3/31/88 Test #2 Slug In (11/18/87) W.O. No. ____



(Bouwer & Rice, 1976)

(Slug should displace 2.5 ft in well)

$r_c = 1.03 in = 0.086 ft$

$L = 20 ft$

$r_w = 4 in = 0.33 ft$

$D = H = 63.7 ft$

$\frac{L}{r_w} = 60.6$

$\therefore C = 2.9$ (from Fig. 3)

$$\ln R_e/r_w = \left(\frac{1.1}{\ln(H/r_w)} + \frac{C}{L/r_w}\right)^{-1} \quad (Eq. 9)$$

$$\ln R_e/r_w = \left(\frac{1.1}{\ln \frac{63.7 ft}{.33 ft}} + \frac{2.9}{(20 ft/.33 ft)}\right)^{-1}$$

$$= \left(\frac{1.1}{5.24} + .048\right)^{-1}$$

$$= (.201 + .048)^{-1}$$

$$\ln R_e/r_w = 3.89$$

$$K = \frac{r_c^2 \ln R_e/r_w}{2L} \cdot \frac{1}{t} \cdot \ln y_0/y_t$$

$y_0 = .25 ft$

$t = 10 sec$

$y_t = .079 ft$

$y_0/y_t = 3.2$

$$K = \frac{(0.086 ft)^2 \times 3.89}{2(20 ft)} \cdot \frac{1}{10 sec} \ln \frac{.25 ft}{.079 ft}$$

$K = 7.19 \times 10^{-5} ft^2/sec$ (1.16)

$K = 8.311 \times 10^{-5} ft/sec \times 86400 sec/day = 7.21 ft/day$

$K = 8.31 \times 10^{-5} ft/sec \times \frac{12 in}{ft} \times 2.54 cm/in = 2.54 \times 10^{-3} cm/sec$

$b = 23 ft = 7.01 m$

$T = 2.54 \times 10^{-3} cm/sec \times 7.01 m \times \frac{1 m}{100 cm} \times 86400 sec/day = 15.38 m^2/day$

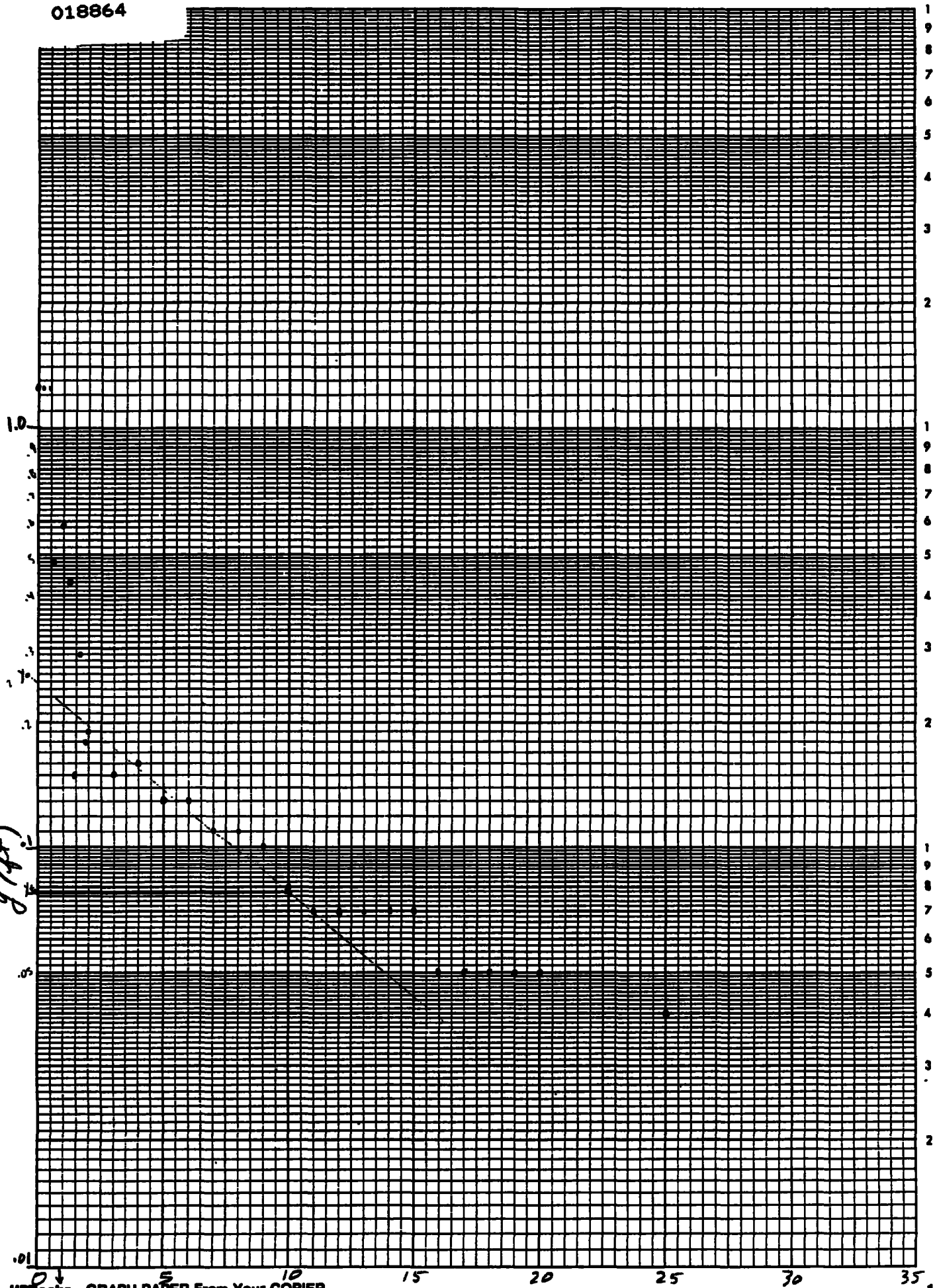
$$\frac{15.38 m^2/day}{.012 92} = \boxed{1237 gpd/ft}$$

MW-33 Test # 2

Leap Ag. Slug Test

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

018864



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018865

ERM-Southwest, inc.

By SJR Date 11/30/87 Subject Sheridan MW-33 Test #3 Sheet No. ____ of ____

Chkd By DCW Date 5/3/88 Bail Test (11/18/87) W.O. No. ____

$r_c = 1.03 in = 0.086 ft$

$r_w = 4 in = 0.33 ft$

$L = 20 ft$

$D = H = 63.7 ft$

$L/r_w = 60.6$

$C = 2.9$ (fig 3, Bouwer & Rice, 1976)

$H/r_w = 193.0$

$\ln R_e/r_w = \left(\frac{1.1}{\ln(H/r_w)} + \frac{C}{L/r_w}\right)^{-1}$ (Eq 7 Bouwer & Rice 1976)

$= \left(\frac{1.1}{\ln 193} + \frac{2.9}{60.6}\right)^{-1} = 3.89$

$K = \frac{r_c^2 \ln R_e/r_w}{2L} \cdot \frac{1}{t} \cdot \ln y_o/y_t$ (Eq 5, Bouwer & Rice, 1976)

for $y_o = .56 ft$

$y_t = 0.23 ft$

$t = 5 sec$

$y_o/y_t = 2.43$

$K = \frac{(0.086 ft)^2 \cdot 3.89}{2(20 ft)} \cdot \frac{1}{5 sec} \cdot \ln 2.43$

$= 1.28 \times 10^{-4} ft/sec \cdot 30.48 cm/ft = \boxed{3.89 \times 10^{-3} cm/sec}$

$h = 7.01 m$

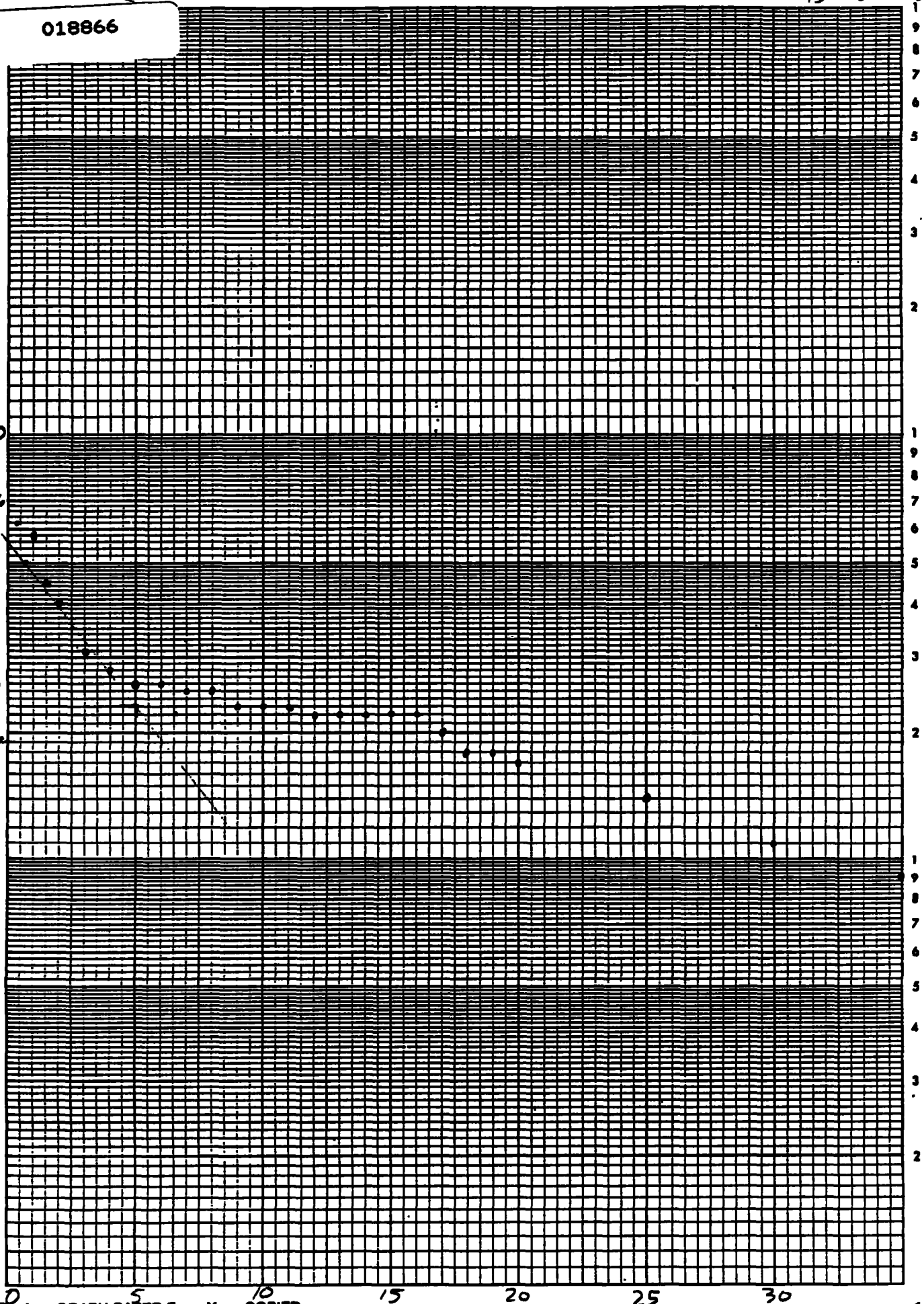
$T = 3.89 \times 10^{-3} cm/sec \times 7.01 m \times \frac{1 m}{100 cm} \times 86,400 sec/day = 23.56 m^2/day$

$\frac{23.56 m^2/day}{.01292} = \boxed{1817 gpd/ft}$

MW-33 Test #3 (11/18/87) 70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

Deaf Ag. Bail Test

018866



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MW-33 Slug Bail Test Analysis - Cooper et. al, 1967

Test # 1 - Bail Test

at match point $\frac{Tt}{r_c^2} = 1$

$t = 1.8$ sec

$\alpha = 10^{-1}$

$T = \frac{(r_c)^2}{t} = \frac{(2.54\text{cm})^2}{1.8\text{sec}} = 3.58\ \text{cm}^2/\text{sec}$

$3.58\ \frac{\text{cm}^2}{\text{sec}} \times \left(\frac{\text{ft}}{30.48\text{cm}}\right)^2 \times \frac{7.48\text{gal}}{\text{ft}^3} \times \frac{60\text{sec}}{\text{min}} \times \frac{60\text{min}}{\text{hr}} \times \frac{24\text{hr}}{\text{day}} = 2490\ \text{gpd/ft}$

If saturated thickness = 23 feet,

$K = T/b = \frac{2490}{23} = 108\ \text{gpd/ft}^2$

$108\ \text{gpd/ft}^2 \times \frac{\text{ft}^3}{7.48\text{gal}} \times \frac{30.48\text{cm}}{\text{ft}} \times \frac{\text{day}}{24\text{hr}} \times \frac{\text{hr}}{60\text{min}} \times \frac{\text{min}}{60\text{sec}} =$

or $K = 5.11 \times 10^{-3}$ cm/sec ✓

018868

ERM-Southwest, inc.

By SJR Date 11/30/87 Subject Sheridan MW-33 Test # 1 Sheet No. ____ of ____

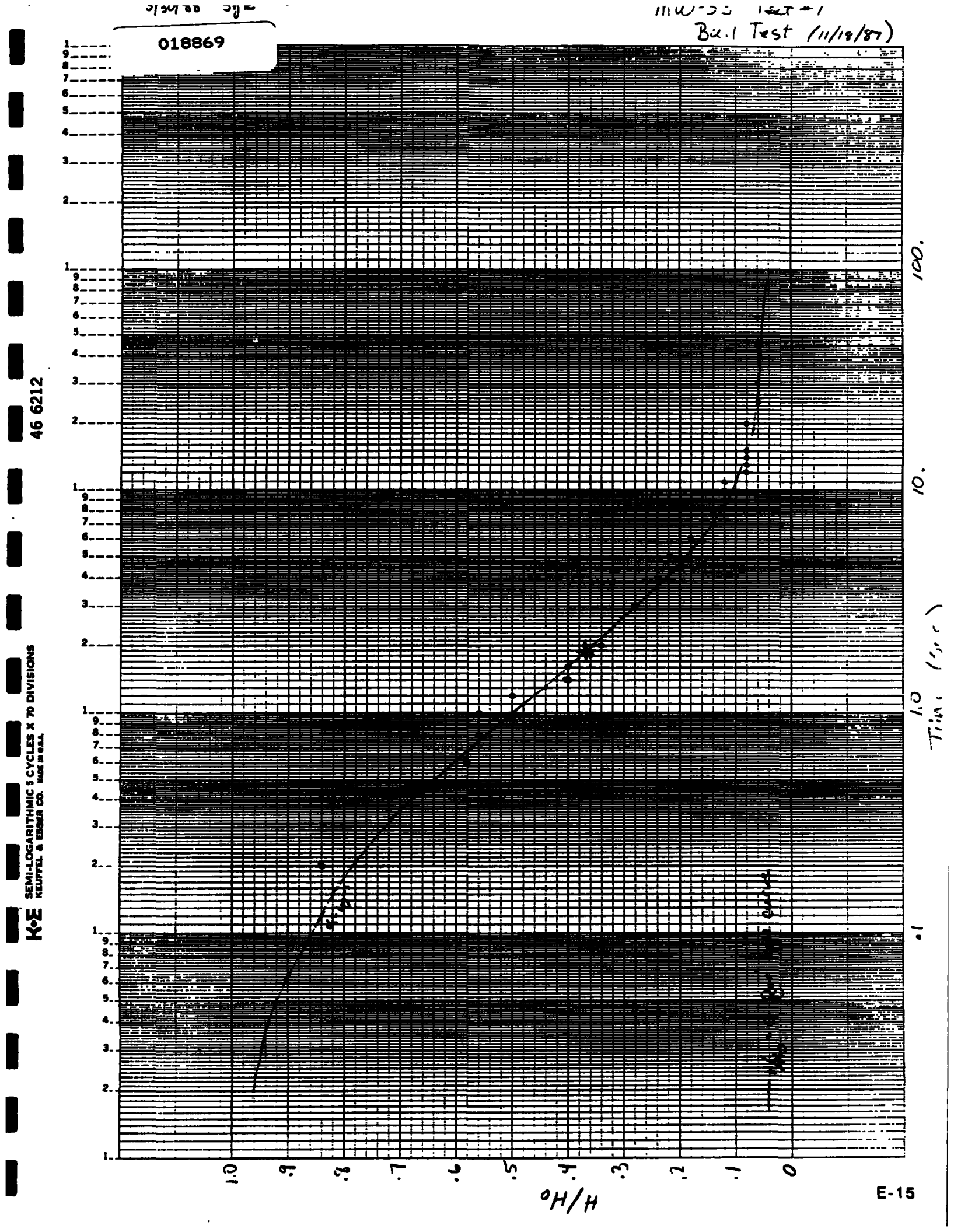
Chkd By ____ Date ____ Bail Test (11/18/87) W.O. No. ____

2" diam well screen

1" x 10' slug displaces 0.0545 ft^3 in 2" well:

H_0 = .5 ft at t = 0

Time (sec)	H (ft)	H/H_0	min
.0	.5	1	
.2	.42	.84	.0033
.4	.42	.84	.0060
.6	.29	.58	.0099
.8	.28	.56	.0133
1.0	.28	.56	.0166
1.2	.25	.5	.02
1.4	.2	.4	.0233
1.6	.2	.4	.0266
1.8	.18	.36	.03
2.0	.17	.34	.0333
3	.14	.28	.05
4	.12	.24	.0666
5	.11	.22	.0833
6	.09	.18	.1
7	.07	.14	.1166
8	.07	.14	.1333
9	.06	.12	.15
10	.06	.12	.166
11	.06	.12	.1833
12	.04	.08	.2
13	.04	.08	.2166
14	.04	.08	.233
15	.04	.08	.25
20	.04	.08	
25	.03	.06	
30	.03	.06	
45	.03	.06	
60	.03	.06	


018869
MW-33 Test #1
Bail Test (11/18/87)
100.
10.
1.0
.1
Time (sec)
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
°H/H
E-15
46 6212
SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

018870

Bouwer + Rice

ERM-Southwest, inc.

By SJR Date 11/30/87 Subject Sheridan MW-35 Sheet No. ____ of ____

Chkd By DCW Date 3/31/88 Test #0 (4/18/87) Slug Test W.O. No. ____

$r_c = 1.03 in = 0.086 ft$

$r_w = 4 in = 0.33 ft$

$L = 20 ft$

$D = ? = 67 ft$

$L/r_w = 60.6$

$C = 2.9$ (Fig 3, Bouwer & Rice, 1976)

$H/r_w = 203$

$\ln R_e/r_w = \left(\frac{1.1}{L/r_w} + \frac{C}{L/r_w}\right)^{-1}$ (Eq 9, Bouwer & Rice, 1976)

$= 3.92$

$K = \frac{r_c^2 \ln R_e/r_w}{2L} \cdot \frac{1}{t} \cdot \ln y_0/y_t$ (Eq 5 Bouwer & Rice, 1976)

for $y_0 = 1.85 ft$ $\quad y_0/y_t = 4.30$

$y_t = 0.43 ft$

$t = 2 sec$

$K = \frac{(0.086 ft)^2 \cdot 3.92}{2(20 ft)} \cdot \frac{1}{2 sec} \cdot \ln 4.30$

$K = 5.29 \times 10^{-4} ft/sec \cdot 30.48 = cm/ft$

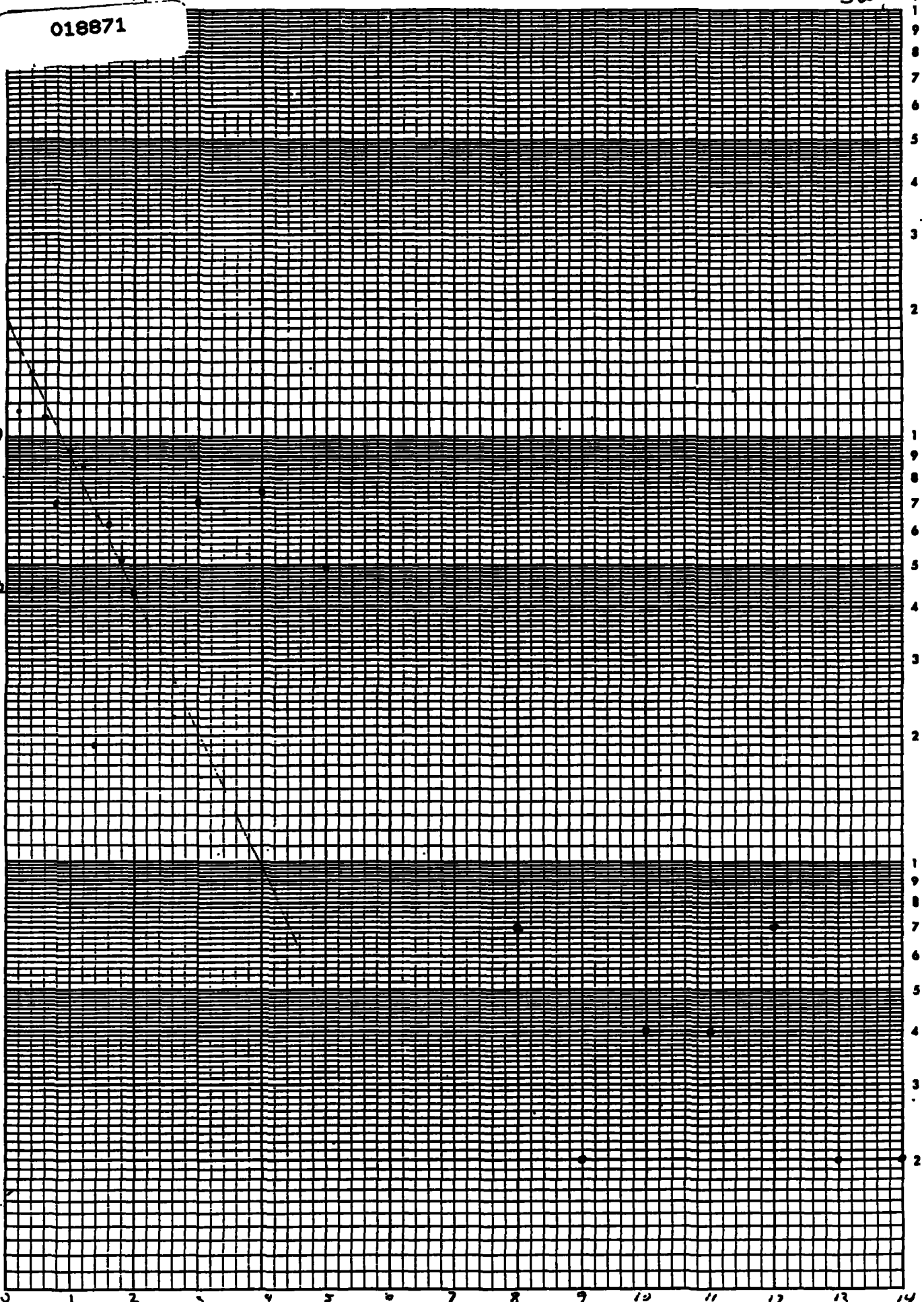
$= \boxed{1.61 \times 10^{-2} cm/sec}$

$b = 7.01 m$

$T = 1.61 \times 10^{-2} cm/sec \times 7.01 m \times \frac{1 m}{100 cm} \times 86400 = 97.5 m^2/day$

$\frac{97.5 m^2/day}{.0929} = \boxed{785 gpd/ft}$

MW-3S Test #0
11/18/87
70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log
Deep Aq Slug Test
018871



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By SJR Date 11/25/87 Subject Sheridan MW-35 Sheet No. ____ of ____

Chkd By DEW Date 3/31/88 Test #1 (11/18/87) Bail Test W.O. No. ____

(Bouwer + Rice, 1976)

$r_c = 1.03\text{ in} = 0.086\text{ ft}$ (drop should displace 2.5 ft in well)

$r_w = 4\text{ in} = 0.33\text{ ft}$

$L = 20\text{ ft}$

$L/r_w = 60.6$

$D = H = 67\text{ ft}$

$C = 2.9$ (from fig. 3)

$H/r_w = 203$

$$\ln R_e/r_w = \left(\frac{1.1}{\ln(H/r_w)} + \frac{C}{L/r_w}\right)^{-1} \quad \text{[Eq 9]}$$

$$= \left(\frac{1.1}{\ln(203)} + \frac{2.9}{60.6}\right)^{-1}$$

$$\ln R_e/r_w = (.207 + .048)^{-1} = 3.721$$

$$K = \frac{r_c^2 \ln R_e/r_w}{2L} \cdot \frac{1}{t} \cdot \ln y_o/y_t \quad \text{[Eq 5]}$$

for $y_o = 1.8\text{ ft}$

$y_t = .57\text{ ft}$

$\ln y_o/y_t = 1.15$

$t = 2\text{ sec}$

$$K = \frac{(0.086\text{ ft})^2 \cdot 3.72}{2(20\text{ ft})} \cdot \frac{1}{2\text{ sec}} \cdot 1.15$$

$K = 4.17 \times 10^{-2}\text{ ft/sec}$

$K = 4.17 \times 10^{-2}\text{ ft/sec} \times 12\text{ in/ft} \times 2.54\text{ cm/in} = \boxed{1.27 \times 10^{-2}\text{ cm/sec}}$

$b = 23\text{ ft} = 7.01\text{ m}$

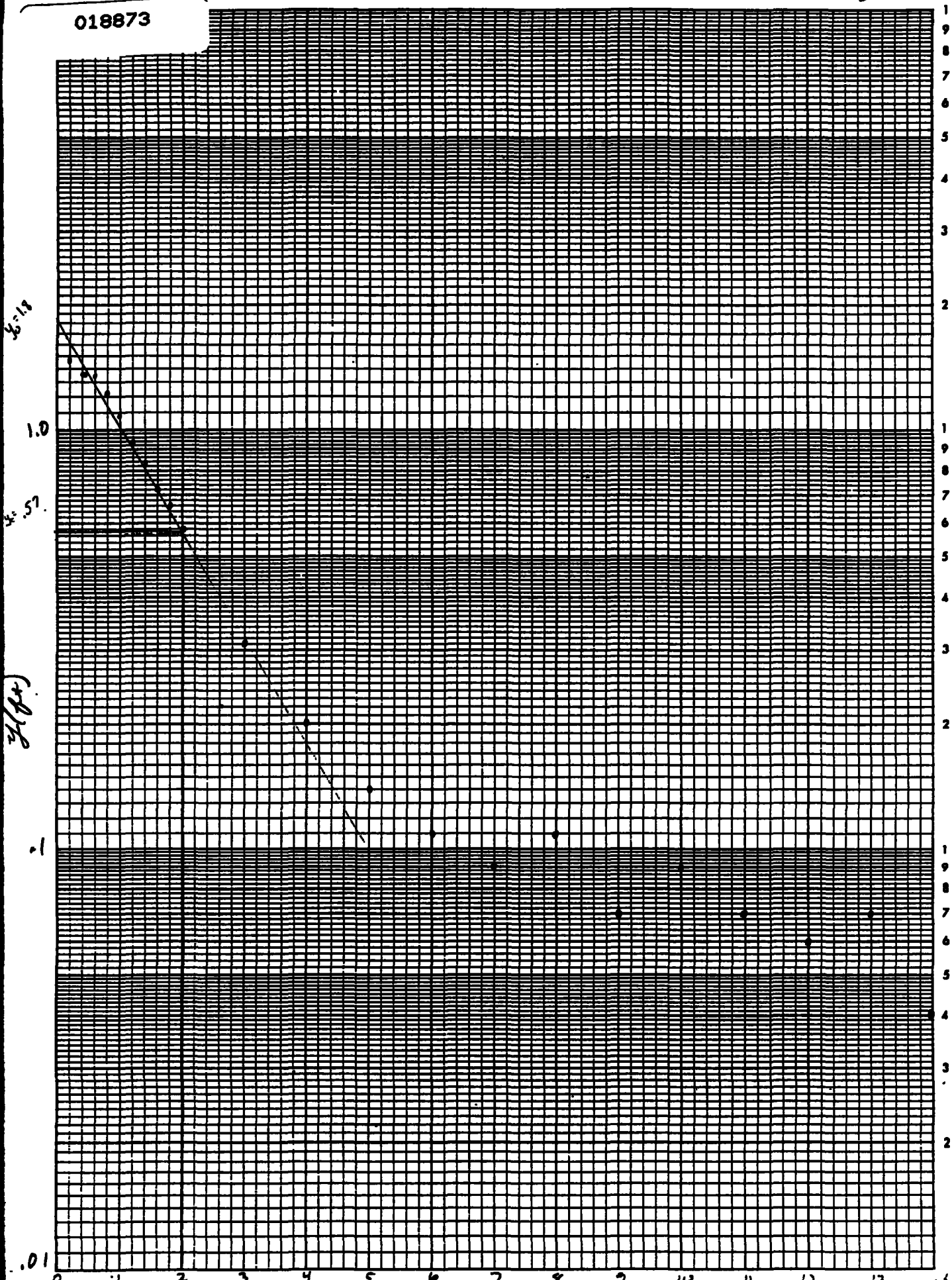
(extended vertically 10 ft = 3.05 m)

$T = 1.27 \times 10^{-2}\text{ cm/sec} \times 7.01\text{ m} \times \frac{1\text{ m}}{100\text{ cm}} \times 86400\text{ sec/day} = 76.92\text{ m}^2/\text{day}$

$$\frac{76.92\text{ m}^2/\text{day}}{.0292} = \boxed{2693\text{ gpd/ft}}$$

MW-35 Test #1
11/18/87
70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log
Deep Aq
Bail Test

018873



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E-19

018874

ERM-Southwest, inc.

By SJR Date 11/27/87 Subject Sheridan MW-35 Sheet No. ____ of ____

Chkd By DEW Date 3/31/88 Test #3 (11/18/87) Bail Test W.O. No. ____

$r_c = 1.03 in = 0.086 ft$

$r_w = 4 in = 0.33 ft$

$L = 20 ft$

$D = H = 67 ft$

$L/r_w = 60.6$

$C = 2.9$ (Fig 3, Bouwer & Rice, 1976)

$H/r_w = 203$

$$\ln R_e/r_w = \left(\frac{1}{\frac{L}{r_w}\left(\frac{H}{r_w}\right)} + \frac{C}{\frac{L}{r_w}}\right)^{-1}$$ (Eq. 7, Bouwer & Rice 1976)

$$= \left(\frac{1}{\ln(203)} + \frac{2.9}{60.6}\right)^{-1} = 3.92$$

$$K = \frac{r_c^2 \ln R_e/r_w}{2L} \cdot \frac{1}{t} \ln y_0/y_t$$ (Eq 5, Bouwer & Rice, 1976)

for $y_0 = 11.45 ft$ $y_0/y_t = 3.82$

$y_t = 0.38 ft$

$t = 2 min$

$$K = \frac{(0.086 ft)^2 \cdot 3.92}{2(20 ft)} \cdot \frac{1}{2 min} \cdot \ln 3.82$$

$= 4.86 \times 10^{-4} ft/sec$

$K = 4.86 \times 10^{-4} \frac{ft}{sec} \times \frac{12 in}{ft} \times \frac{2.54 cm}{in} = \boxed{1.48 \times 10^{-2} cm/sec}$

$b = 10 ft$

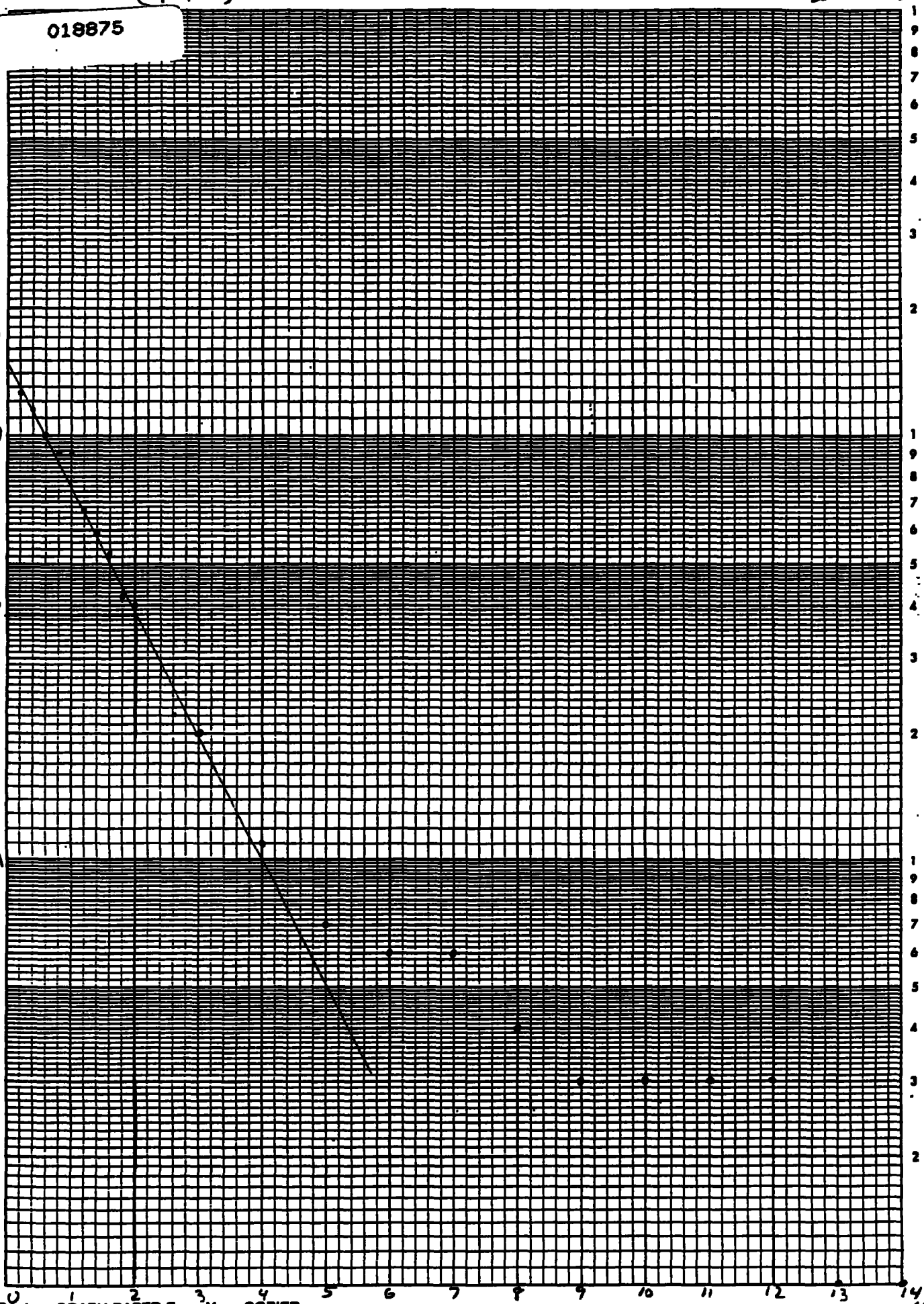
$T = 1.48 \times 10^{-2} \frac{cm}{sec} \times 70 ft \times \frac{1 m}{100 cm} \times 86400 \frac{sec}{day} = 89.6 m^2/day$

$\frac{89.6 m^2/day}{10.92} = \boxed{720 gpd/ft}$

MW-35 Test #3
(11/18/87) 70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

Deep Aq
Bail Test

018875



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t=2sec

Time (sec)

133

E-21

MW-35 Slug / Bail Test Analysis - Cooper et al 1967

Test # 3 - Bail Test :

use data from linear curve for best fit.

at match point $\frac{Tt}{r_c^2} = 1$, $t = .39$ sec

$$T = \frac{r_c^2}{t} = \frac{(2.54\text{cm})^2}{.39\text{ sec}} = 16.5\ \text{cm}^2/\text{sec}$$

$$16.5\ \text{cm}^2/\text{sec} \cdot \left(\frac{\text{ft}}{30.48\text{cm}}\right)^2 \cdot \frac{7.48\ \text{gal}}{\text{ft}^3} \cdot \frac{60\ \text{sec}}{\text{min}} \cdot \frac{60\ \text{min}}{\text{hr}} \cdot \frac{24\ \text{hr}}{\text{day}}$$

or $T = 11480$ gpd/ft

if saturated thickness = 23'

$$K = T/b = \frac{11480}{23} = 499\ \text{gpd/ft}^2$$

$$\text{or } K = 499\ \text{gpd/ft}^2 \cdot \frac{\text{ft}^3}{7.48\text{g}} \cdot \frac{30.48\text{cm}}{\text{ft}} \cdot \frac{\text{day}}{24\text{hr}} \cdot \frac{\text{hr}}{60\text{min}} \cdot \frac{\text{min}}{60\text{sec}} =$$

$K = 2.35 \times 10^{-2}$ cm/sec ✓

018877

ERM-Southwest, inc.

By SJR Date 2/3/88 Subject MW-35 #3 Bail Test Sheet No. ____ of ____

Chkd By ____ Date ____ Sheridan (for Papadopulos) W.O. No. ____

1" x 10' slug displaces 0.0545 ft³

in 2" diam well: H_o = 2.5 ft

but at t_o; H_o = 1.35 ft

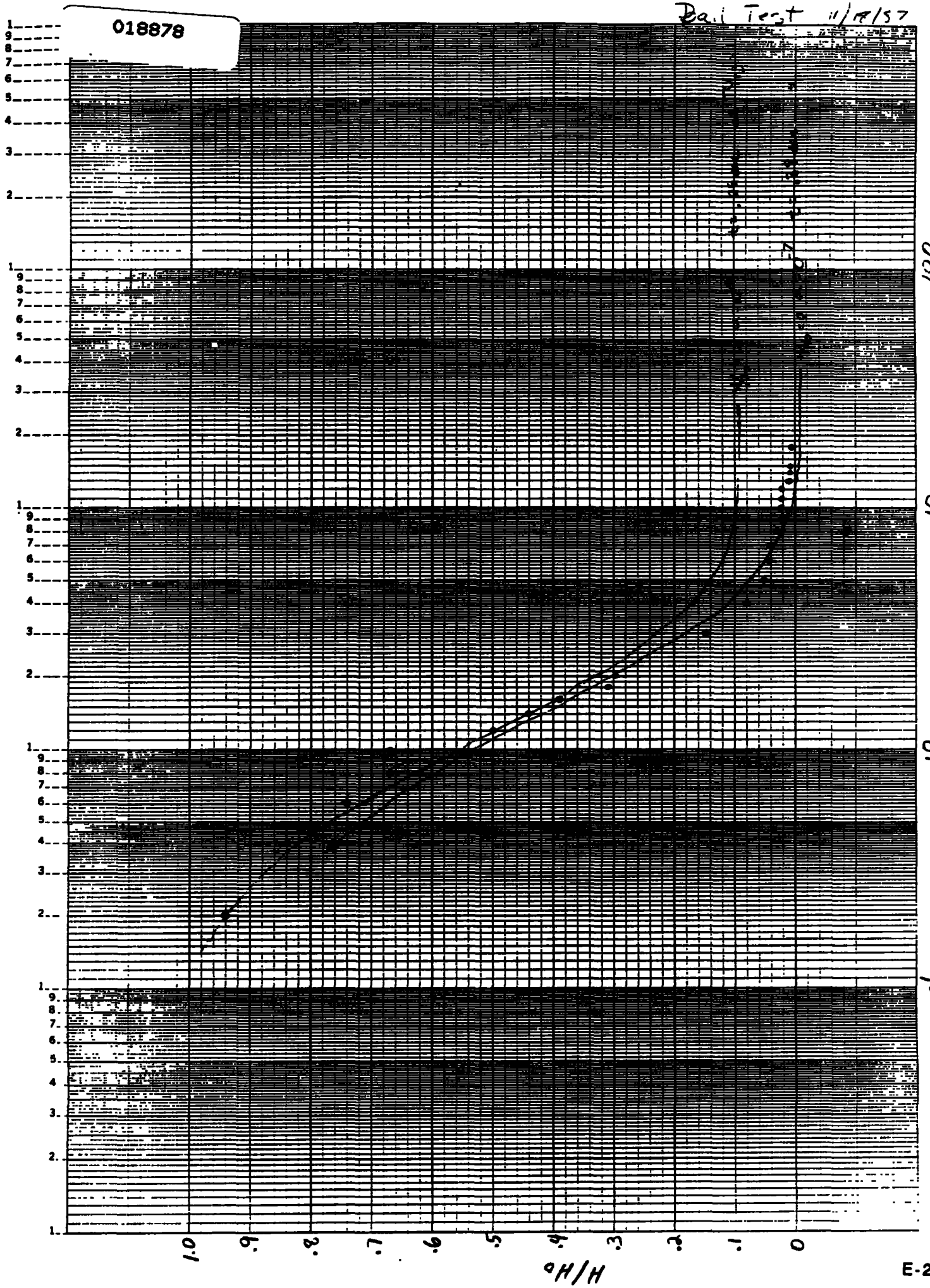
time (min)	H (ft)	H/Ho	t (sec)
0	1.35	1	
.0033	1.27	.94	.2
.0066	1.14	.84	.4
.0099	1.0	.74	.6
.0133	.91	.67	.8
.0166	.91	.67	1.0
.02	.67	.5	1.2
.0233	.59	.44	1.4
.0266	.53	.39	1.6
.03	.42	.31	1.8
.0333	.40	.3	2.0
.05	.2	.15	3
.0666	.11	.08	4
.0833	.07	.052	5
.1	.06	.044	6
.1166	.06	.044	7
.1333	.04	.03	8
.15	.03	.022	9
.1666	.03	.022	10
.1833	.03	.022	11
.2	.03	.022	12
.2166	.01	.007	13
.2333	.01	.007	14
.25	.01	.007	15
.30	.01	.007	18

3/30/66 SYK

M/W-35 Test - 3

Bail Test 11/18/57

018878



K•E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6212

Bouwer + Rice

ERM-Southwest, inc.

By SJR Date 11/30/87 Subject Sheridan MW-40 Test #D Sheet No. ____ of ____

Chkd By DEP Date 3/3/88 Slug Test (11/17/87) W.O. No. ____

$r_c = 2 in = 0.17 ft$

$r_w = 5.5 in = 0.46 ft$

$L = 17.5 ft$

$D = H = 55 ft$

$L/r_w = 38.0$

$C = 2.4$ (fig 3, Bouwer + Rice, 1976)

$H/r_w = 119.6$

$\ln R_e/r_w = \left(\frac{1.1}{\ln(H/r_w)} + \frac{C}{L/r_w}\right)^{-1}$ (Eq 9, Bouwer + Rice, 1976)

$= \left(\frac{1.1}{\ln(119.6)} + \frac{2.4}{38.0}\right)^{-1}$

$\ln R_e/r_w = 3.41$

$K = \frac{r_c^2 \ln R_e/r_w}{2L} \cdot \frac{1}{t} \ln y_0/y_t$ (Eq 5, Bouwer + Rice, 1976)

For $y_0 = 2.0 ft$ $y_0/y_t = 2.38$ $\ln 2.38 = .867$

$y_t = 0.84 ft$

$t = 10 min = 600 sec$

$K = \frac{(0.17 ft)^2 \cdot 3.41}{2(17.5 ft)} \cdot \frac{1}{600 sec} \cdot \ln 2.38$

$= 6.09 \times 10^{-6} ft/sec \times 30.48 cm/ft = \boxed{1.21 \times 10^{-4} cm/sec}$

$b = 5.99 m$

$T = 1.09 \times 10^{-4} cm/sec \times 5.99 m \times \frac{1}{100 cm} \times 86400 sec/day = .59 m^2/day$

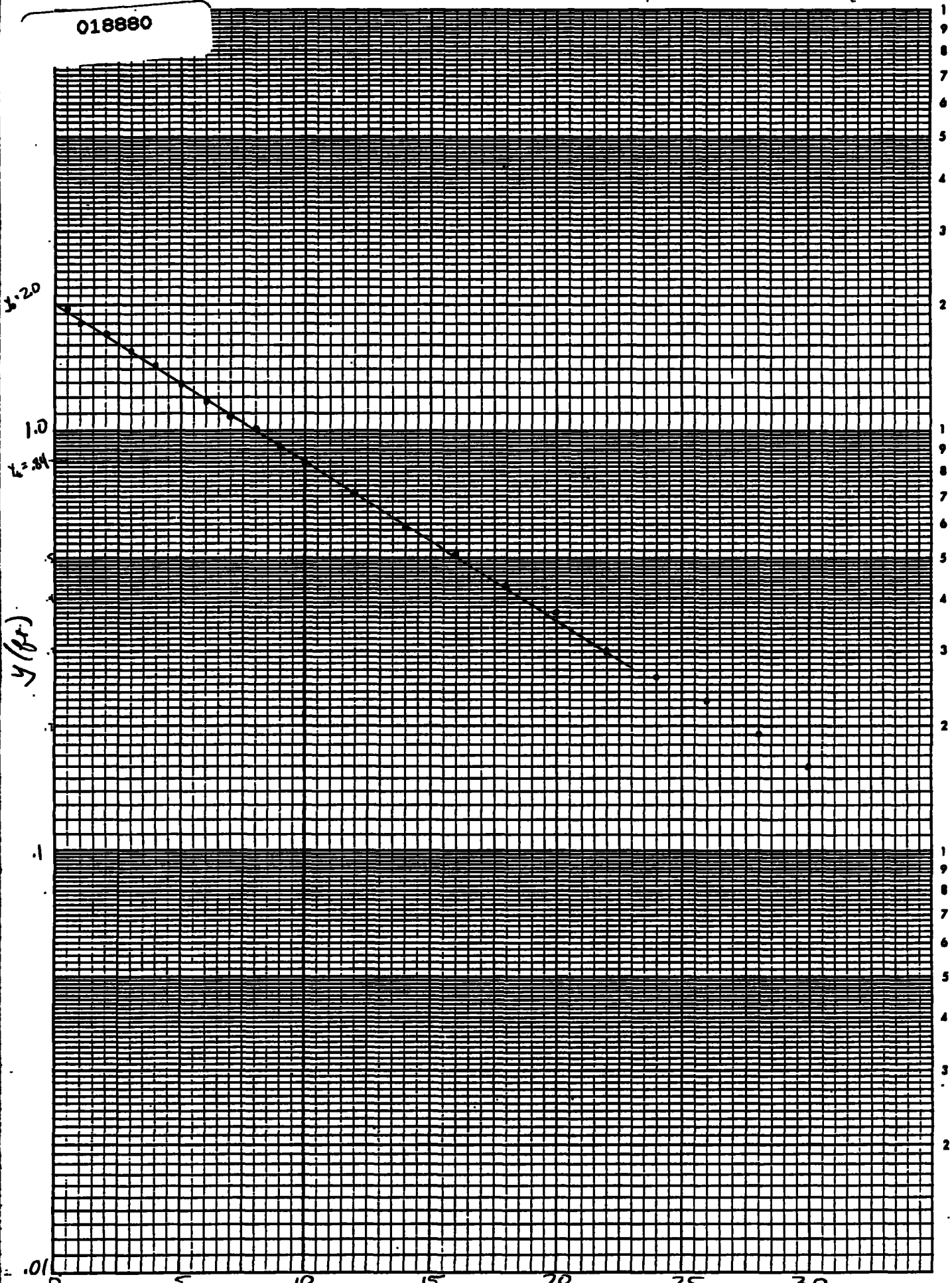
$\frac{.59 m^2/day}{.0124} = \boxed{47.3 gpd/ft}$

MW-40 Test #6 (11/17/87)

Deep Hg. Slug Test

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

018880



018881

ERM-Southwest, inc.

By JR Date 11/30/87 Subject Sheridan MW-40 Test #1 Sheet No. ____ of ____

Chkd By JW Date 3/31/88 Bail Test (11/17/87) W.O. No. ____

$r_c = 2.5\,in = 0.17\,ft$

$r_w = 5.5\,in = 0.46\,ft$

$L = 17.5\,ft$

$D = H = 55\,ft$

$L/r_w = 38.0$

$C = 2.4$ (fig 3, Bouwer & Rice, 1976)

$H/r_w = 119.6$

$\ln R_e/r_w = \left(\frac{1.1}{\ln H/r_w} + \frac{C}{L/r_w}\right)^{-1}$ (eq 9, Bouwer & Rice, 1976)

$= \left(\frac{1.1}{\ln(119.6)} + \frac{2.4}{38.0}\right)^{-1}$

$= 3.41$

$K = \frac{r_c^2 \ln R_e/r_w}{2L} \cdot \frac{1}{t} \cdot \ln y_0/y_t$ (eq 5, Bouwer & Rice, 1976)

for: $y_0 = 3.7\,ft$

$y_t = 2.15\,ft$

$y_0/y_t = 1.30$ $\ln 1.3 = .26$

$t = 5\,min = 300\,sec$

$K = \frac{(0.17\,ft)^2 \cdot 3.41}{2(17.5\,ft)} \cdot \frac{1}{300\,sec} \cdot \ln 1.30$

$K = 2.44 \times 10^{-4}\,ft/sec \times 30.48\,cm/ft = \boxed{7.44 \times 10^{-3}\,cm/sec}$

$b = 5.49\,m$

$T = 7.44 \times 10^{-3}\,cm/sec \times 5.49\,m \times \frac{1\,m}{100\,cm} \times 86400\,sec/day = .36\,m^2/day$

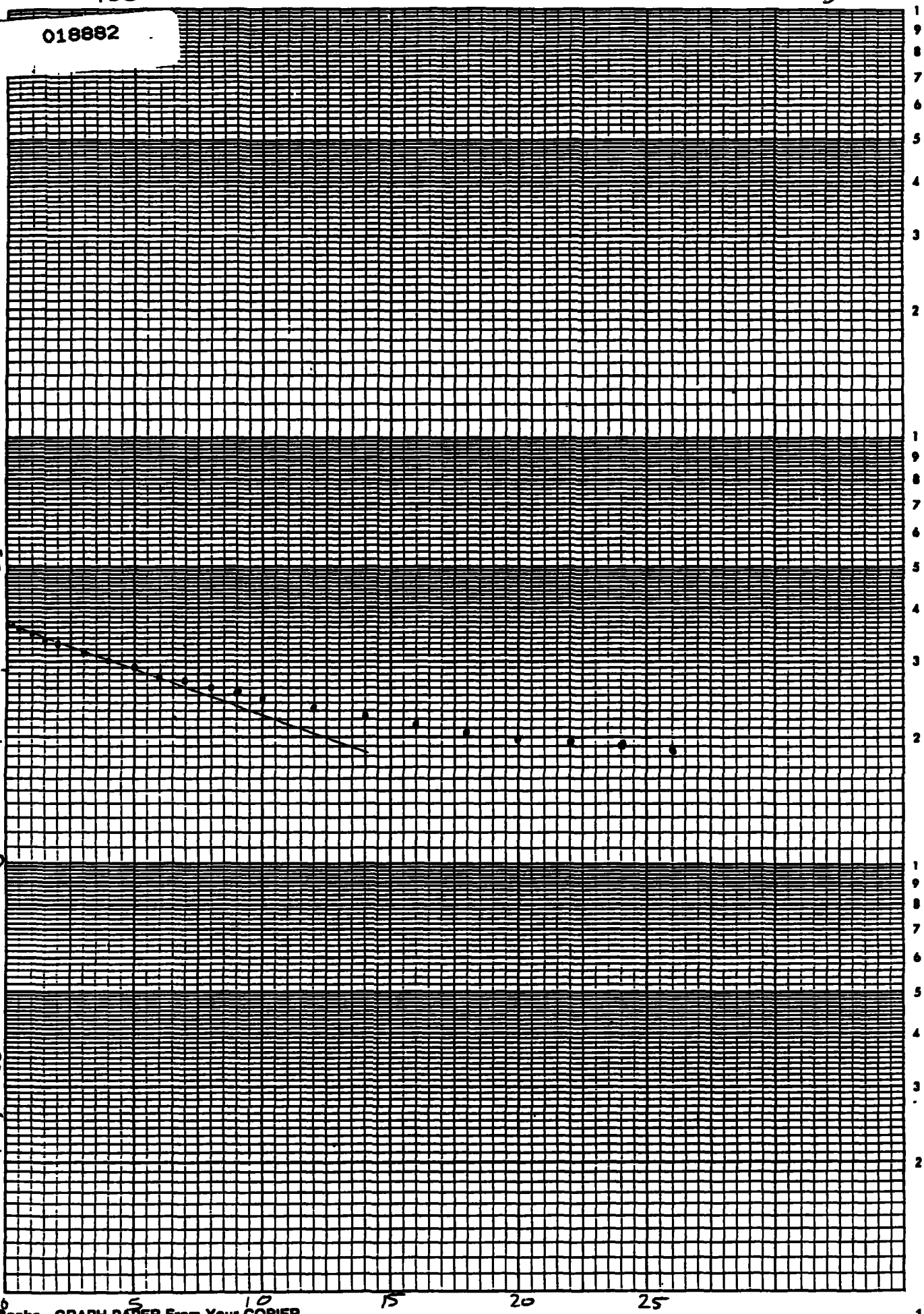
$\frac{.36\,m^2/day}{.01292} = \boxed{28.4\,gpd/ft}$

MW-40 (11/17/87)
Test #1

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

Leaf Pkg
Bail Test

018882



018883

ERM-Southwest, inc.

By SJB Date 11/25/87 Subject Sheridan MW-40 Test #3 Sheet No. ____ of ____

Chkd By DKW Date 3/31/88 Bail Test (11/17/87) W.O. No. ____

(slug should displace 1.95 ft in well)

For Bouwer & Rice (1976)

$r_c = 2 \text{ in} = 0.17 \text{ ft}$

$r_w = 5.5 \text{ in} = 0.46 \text{ ft}$

$L = 11.5 \text{ ft}$

$D = H = 55 \text{ ft}$

$y_0 = 2.0 \text{ ft}$

$t = 10 \text{ min} = 600 \text{ sec}$

$y_t = 0.78 \text{ ft}$

$\ln y_0/y_t = .94$

$L/r_w = \frac{11.5 \text{ ft}}{0.46 \text{ ft}} = 25.0$

$\ln H/r_w = \ln(55 \text{ ft}/.46 \text{ ft}) = 4.78$

from figure 3: $C = 2.4$

$\ln R_e/r_w = \left(\frac{1.1}{\ln(H/r_w)} + \frac{C}{L/r_w}\right)^{-1}$ [Eq 7]

$\ln R_e/r_w = \left(\frac{1.1}{4.78} + \frac{2.4}{25.0}\right)^{-1}$

$\ln R_e/r_w = 2.4$

$K = \frac{r_c^2 \ln(R_e/r_w)}{2L} \cdot \frac{1}{t} \ln y_0/y_t$ [Eq 5]

$= \frac{(.017 \text{ ft})^2 (2.4)}{2(11.5 \text{ ft})} \times \frac{1}{600 \text{ sec}} \times (.94)$

$= 4.9 \times 10^{-6} \text{ ft/sec} \times 12 \text{ in/ft} \times 2.54 \text{ cm/in} = \boxed{1.34 \times 10^{-4} \text{ cm/sec}}$

$b = 18 \text{ ft} = 5.49 \text{ m}$

$T = 1.34 \times 10^{-4} \text{ cm/sec} \times 5.49 \text{ m} \times \frac{1 \text{ m}}{100 \text{ cm}} \times 86{,}400 \text{ sec/day} = .636 \text{ m}^2/\text{day}$

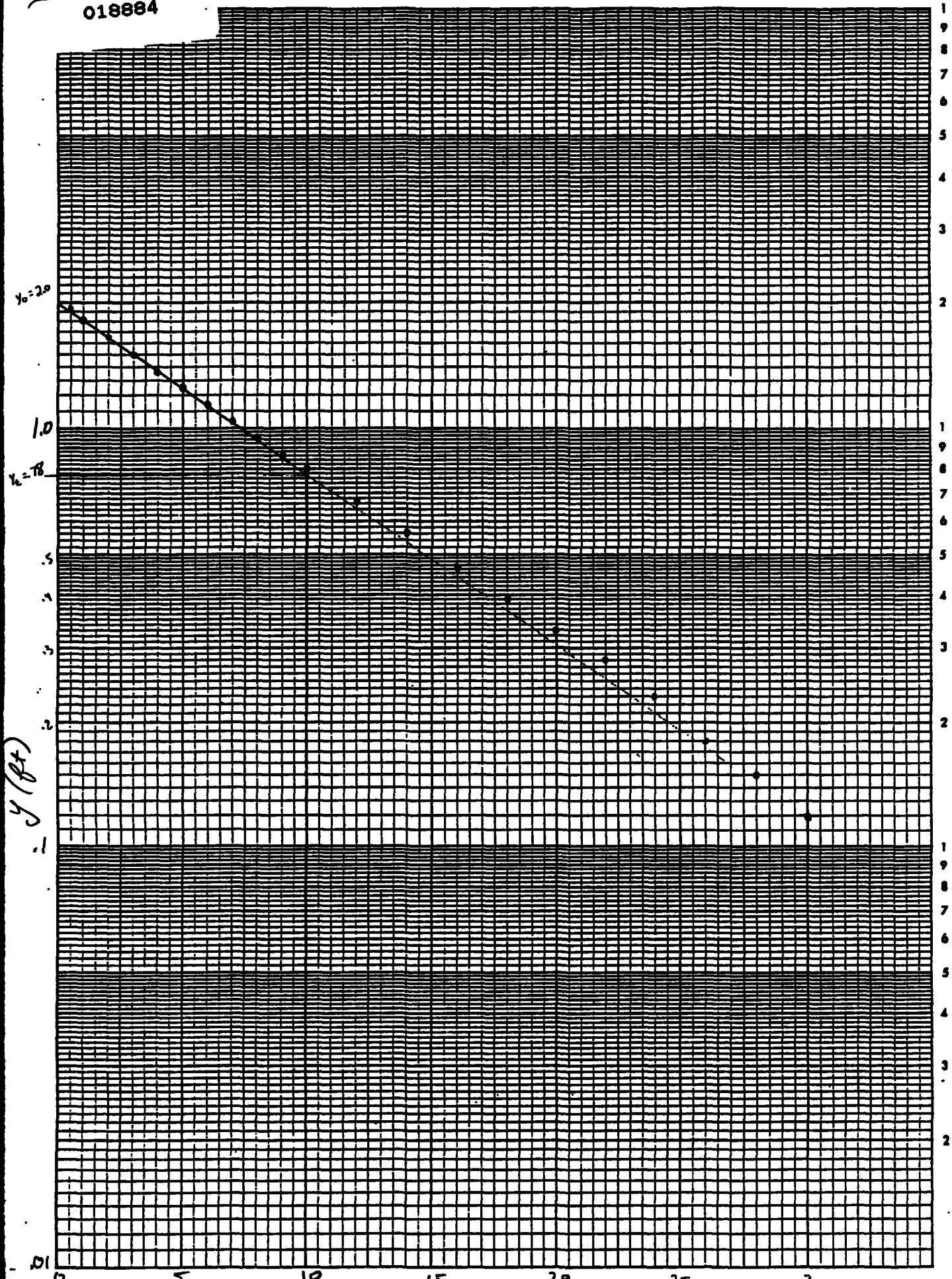
$\frac{.636 \text{ m}^2/\text{day}}{.0124 \text{ m}} = \boxed{51.2 \text{ gpd/ft}}$

MW-40 Test #3

Deep Mg. Bail Test

70 Divisions 5th, 10th Accent by 3 Cycle Semi-Log

018884



HPBooks—GRAPH PAPER From Your COPIER

Corrected Data
3/31/88

MW-40 Slug/Bail Test fractures

Test #3 - Bail Test - using method of Cooper et al, 1967.

at match point, $Tt/r_c^2 = 1$

$t = 100$ sec

$\alpha = 10^{-0}$

$T = \frac{(r_c)^2}{t} = \frac{(5.08\text{ cm})^2}{100\text{ sec}} = .258\text{ cm}^2/\text{sec} =$

$.258 \frac{\text{cm}^2}{\text{sec}} \times \left(\frac{\text{ft}}{30.48\text{ cm}}\right)^2 \times \frac{7.48\text{ gal}}{\text{ft}^3} \times \frac{\text{bottle}}{\text{min}} \times \frac{60\text{ min}}{\text{hr}} \times \frac{24\text{ hr}}{\text{day}} =$

180 gpd/ft

if b (saturated thickness) = 18'

$K = T/b = 10\text{ gpd/ft}^2$

$10 \frac{\text{gpd}}{\text{ft}^2} \times \frac{\text{ft}^3}{7.48\text{ gal}} \times \frac{30.48\text{ cm}}{\text{ft}} \times \frac{\text{day}}{24\text{ hr}} \times \frac{\text{hr}}{60\text{ min}} \times \frac{\text{min}}{60\text{ sec}}$

or $K = 4.72 \times 10^{-4}$ cm/sec

018886

ERM-Southwest, inc.

By SQR Date 2/3/88 Subject MW-40 #3 Bail Test Sheet No. ____ of ____

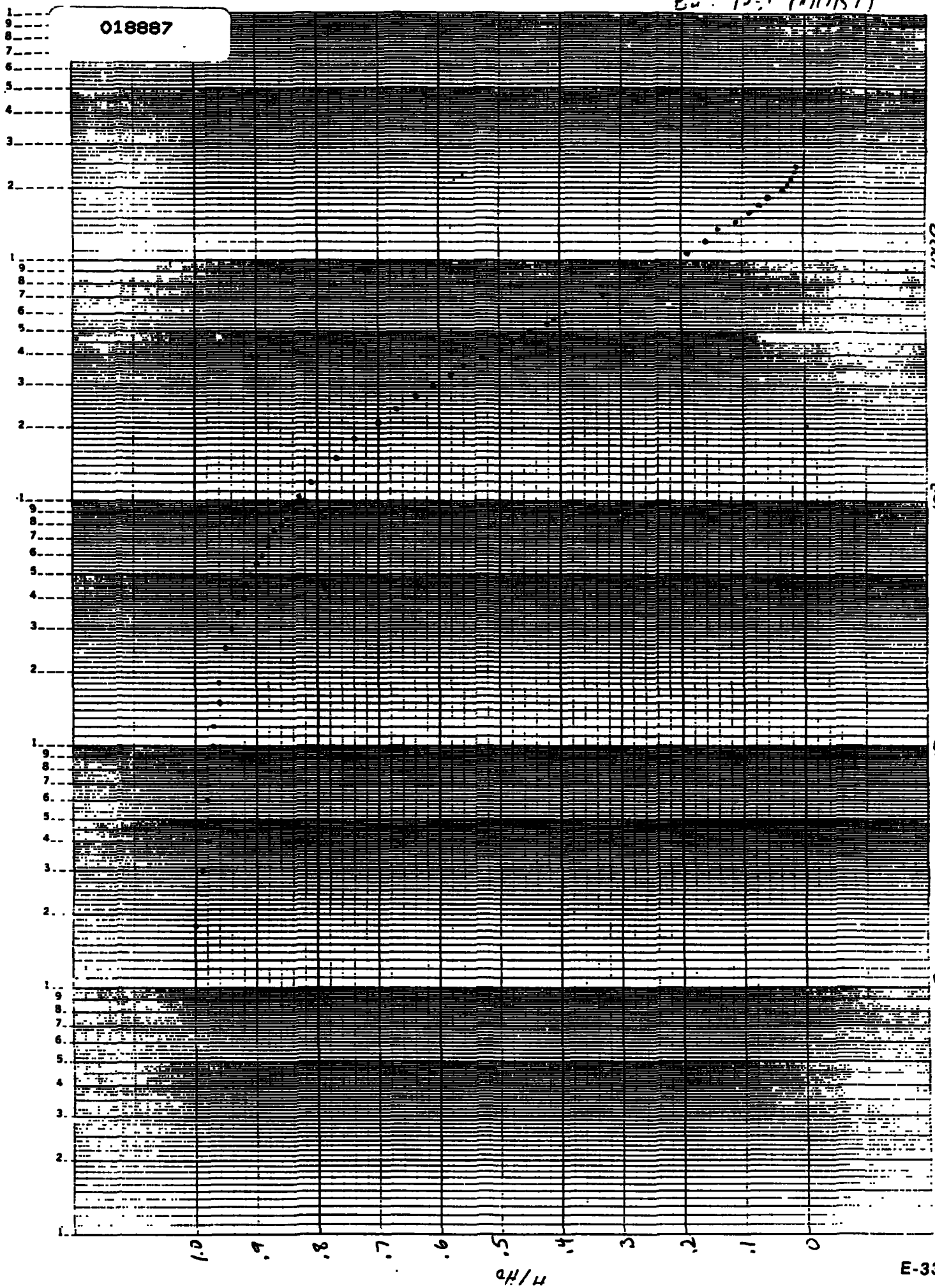
Chkd By ____ Date ____ Sheridan (for Papadopulos) W.O. No. ____

2.5" x 5' slug displaces 0.07ft³

in 4" diam well H_0 = 1.95ft

but at t=0, H_0 = 2.04ft

time (min)	H (ft)	H/Ho	Δt
0	2.04	1	
.0099	2.04	1	1
.02	2.05	1	1.2
.03	2.04	1	1.8
.05	2.02	.99	3.0
.01666	2.01	.98	4
.0833	2.01	.98	5
.1	1.99	.98	6
.1166	2.01	.98	7
.1333	1.99	.98	8
.15	1.99	.98	9
.166	1.98	.97	10
.2	1.98	.97	12
.25	1.96	.96	15
.30	1.96	.96	18
.4167	1.93	.95	25
.50	1.91	.94	30
.5833	1.90	.93	35
.6667	1.88	.92	40
.75	1.87	.92	45
.8333	1.85	.91	50
.9167	1.83	.90	55
1.0	1.82	.89	60
1.083	1.80	.88	65
1.1667	1.79	.88	70
1.25	1.77	.87	75
1.33	1.76	.86	80
1.4166	1.74	.85	85
1.5	1.72	.84	90
1.75	1.69	.83	105
2.0	1.65	.81	120
2.5	1.57	.77	150
3.0	1.5	.74	180
3.5	1.43	.7	210
4.0	1.36	.67	240
4.5	1.3	.64	270
5.0	1.25	.61	300
5.5	1.19	.58	330
6.0	1.14	.56	360
6.5	1.08	.53	390
7.0	1.03	.50	420
7.5	.99	.48	450
8.0	.95	.46	480
8.5	.91	.45	510
9.0	.86	.42	540
9.5	.83	.41	570
10.	.8	.39	600
12.	.67	.33	720
14.	.56	.27	840
16.	.47	.23	960
18.	.39	.19	1080
20.	.33	.16	1200
22.	.28	.14	1320
24.	.23	.11	1440
26.	.18	.088	1560
28.	.15	.074	1680
30.	.12	.059	1800
32.	.07	.034	1920
34.	.046	.022	2040
36.	.044	.02	2160
38	.03	.015	2280
40	.01	.005	2400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K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
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GROUND WATER MIGRATION MANAGEMENT REMEDIAL INVESTIGATION

Sheridan Disposal Services Site Hempstead, Texas

Volume III Appendices F - K

ERM-Southwest, inc.

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GROUND WATER MIGRATION MANAGEMENT REMEDIAL INVESTIGATION

Sheridan Disposal Services Site
Hempstead, Texas

Volume III
Appendices F - K

Prepared For:

The Sheridan Site Committee

W.O. #91-09

December 30, 1988

Prepared by:

ERM-SOUTHWEST, INC.
16000 Memorial Dr., Suite 200
Houston, Texas 77079
(713) 496-9600

D071

018891

APPENDIX F

Pump/Recovery Test Procedures and Data Analysis

APPENDIX F

Pump/Recovery Test Procedures

A 65-hour pump and recovery test was conducted on the confined aquifer (stratum B) from December 15-18, 1987 at the well nest (MW 20-29) at the SDS site. For this test a submersible pump was lowered into MW-20 to a depth of 92 feet below ground surface, approximately six feet above the bottom of the well. The pump was connected to the surface via galvanized steel and PVC pipe. All pipe and the pump were cleaned with distilled water/liquinox solution before being lowered into the well. At the surface a flow meter was attached to the horizontal pipe leading away from the well. Water removed during the test was routed approximately 300 feet away, towards Clark Lake, where it was allowed to discharge onto the ground, as per prior agreement with EPA Region VI.

Before any testing was begun, on the morning of December 15, water level measurements were recorded on all the wells in the well nest. The pump was then allowed to run and the flow rate was adjusted to 9.6 gallons per minute (gpm). This measurement was taken using the flow meter and confirmed by measuring at the discharge hose with a bucket of known volume. This procedure took approximately 1.5 to 2 hours, at which time the pump was shut off and final preparations were made to begin the test. Water level measurements were also taken around the SDS site (as they had been the previous day) in order to know ground water flow directions in both aquifers during the test.

The pump test was begun approximately three to four hours after the pump rate had been set. Before the test water level measurements were taken in all the wells in the well nest to be sure that the levels had returned to static and the aquifer had recovered from the earlier pumping. The pumping well (MW-20) and four piezometers screened in the confined aquifer were periodically monitored during the pump test. These piezometers are MW-22, 26, 27 and 28. Wells 20, 22, 26 and 28 had their measurments recorded using electronic water level indicators and recorded on the data sheets provided in this appendix. A Hermit Environmental Data Logger (model SE1000B) with a pressure transducer was used in MW-27 to record the change in water level. Measurements were made in MW-27 on a logarithmic scale (taken every .2 seconds for 0-2 seconds, every 1 second for 2-20 seconds, every 5 seconds for 20-120 seconds, etc.). In the

other piezometers (22,26 and 28) measurements were taken approximately at the frequency listed below.

Time Since Test Started	Frequency of Measurements
0 to 10 min	As quickly as possible
10 to 30 min	Every 2 min
30 min to 1 hour	Every 5 min
1 to 2 hours	Every 10 min
2 to 3 hours	Every 15 min
3 to 7 hours	Every 30 min
7 to 24 hours	Every 1 hour
24 to 65 hours	Every 4 hours

Measurements were taken in the pumping well as often as possible to record the amount of drawdown. The discharge rate was checked every half hour for the first three hours of the test, then to every hour or at the frequency of the water level measurements. The pumping rate was adjusted only once during the 65 hours of continuous puming (at 653 minutes into the test) and throughout the test the pumping rate did not vary more than 6 percent.

During the test the piezometers screened in the unconfined aquifer were also periodically monitored to see if pumping the confined aquifer might have an effect on the water level in the unconfined aquifer. Measurements were taken using an electronic water level indicator in wells MW-21,23,24,25 and 29 every few hours throughout the test; data is provided in this appendix.

Approximately 65 hours after pumping began the pump was shut off and the recovery of the confined aquifer was recorded in wells 20, 22, 27 and 28. Data was recorded using the Hermit Data Logger in MW-27; electronic water level indicators were used for the other wells. The water level in MW-20 (pumping well) recovered to within 90% of its original measurement in approximately six minutes, although recovery was recorded for approximately 40 minutes in all wells.

Data from both the pump and recovery tests were plotted on log-log paper and analyzed using the method of Hantush and Jacob (1955). All raw data and data analyses are provided in this appendix.

018894

MW-22 Leaky Aquifer Analyses - Using Hantush Curve Method - Match by Hand.

DEW 3/30/88

Checked 4/88

$L(u,v) = 1$, $1/u = 1$, $u = 1$ $v = 0.2$

match best between 10 + 150 minutes

$r = 51.6'$

At match point $s = .67'$, $t = .81$ minutes

$Q = 9.37$ gpm $= 1.25\ ft^3/min$

$$T = \frac{Q}{4\pi}(L(u,v)) = \frac{1.25\ ft^3/min}{4\pi\,(67ft)} \cdot 1 = 0.148\ ft^2/min$$

$$T = 0.148\ ft^2/min \times \frac{60\,min}{hr} \times \frac{24\,hr}{day} \times 7.48\ gal/ft^3 = 1599\ gpd/ft$$

if $b = 10'$ $K = T/b = 0.0148\ ft/min \times \frac{30.49\,cm}{ft} \times \frac{min}{60\,sec} = 7.52 \times 10^{-3}\ cm/sec$

$$S = 4T\,\frac{t/r^2}{1/u} = 4(0.148\ ft^2/min) \cdot (.81\,min)\left(\frac{1}{51.6\,ft}\right)^2 = 1.8 \times 10^{-4}$$

At match point $v = 0.2$, $b' = 30'$

$$K'/b' = \frac{4T}{r^2}\,v^2 = 4(0.148\ ft^2/min)(0.2)^2 \times \left(\frac{1}{51.6\,ft}\right)^2$$

$K'/b' = 8.89 \times 10^{-6}/min$ v $30'$

$K' = 2.67 \times 10^{-4}\ ft/min \times \frac{30.48\,cm}{ft} \times \frac{min}{60\,sec}$

$K' = 1.36 \times 10^{-4}\ cm/sec$

Checked [illegible] Date

MW-22

Sheridan Disposal Services
MW-22
12-16-87

K&E LOGARITHMIC 3 x 5 CYCLES
KEUFFEL & ESSER CO

46 7520

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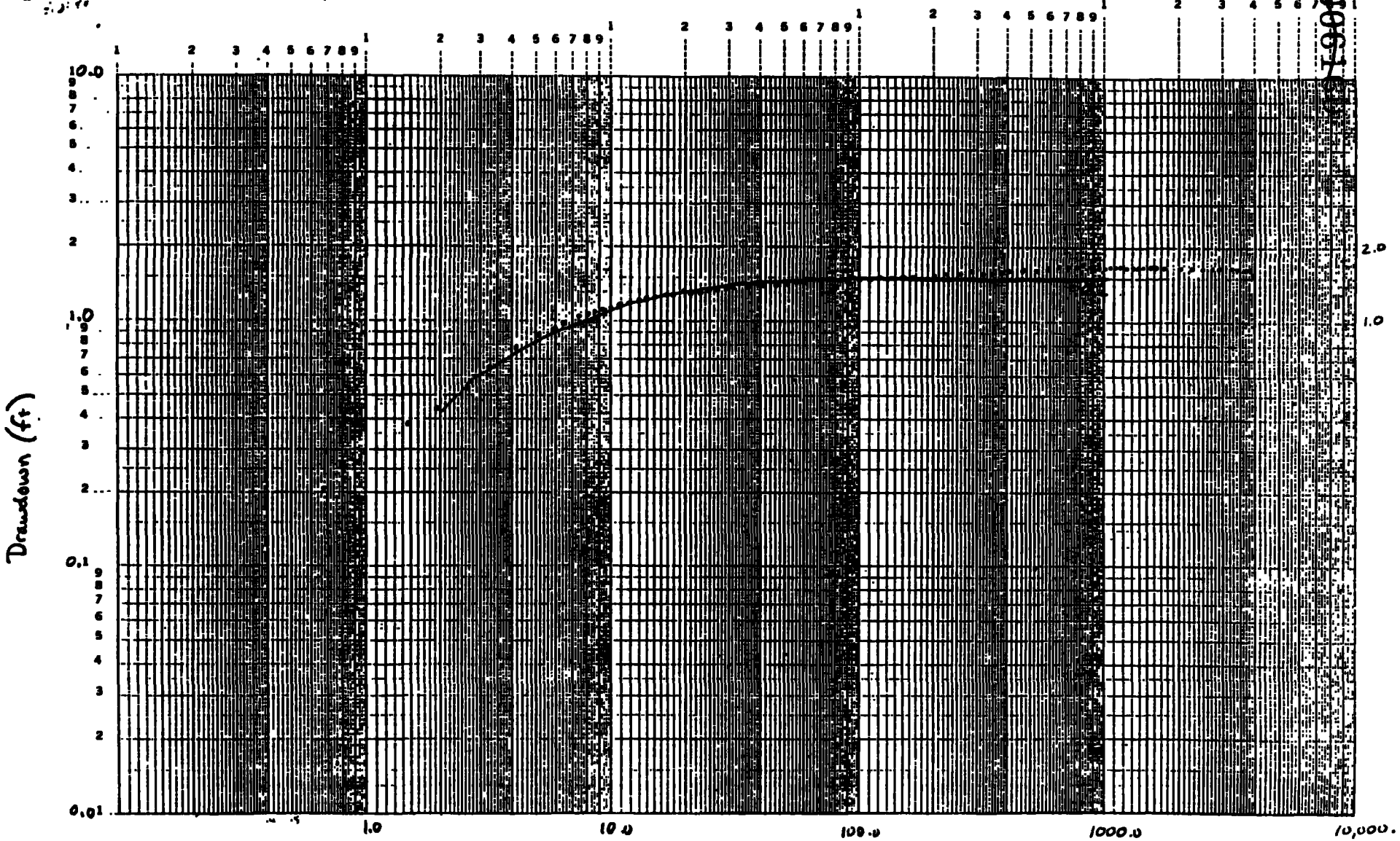

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AQUIFER TEST DATA

Owner Sheridan Disposal Services Address Clark's Bottom Rd County Waller State Tx

Date 12/15/87 Company performing test ERM-Southwest Measured by TBDiehl

Well No. 22 Distance from pumping well 51.6' Type of test pump - constant Q Test No. ____

Measuring equipment Slope Indicator ERM #4

Time Data
Pump on: Date 12/15/87 Time 2:15PM (L)
Pump off: Date ____ Time ____ (L)
Duration of aquifer test:
Pumping ____ Recovery ____

Water Level Data
Static water level 31.54'
Measuring point Top
Elevation of measuring point ____

Discharge Data
How Q measured flow meter
Depth of pump/air line 92'
Previous pumping? Yes ____ No ____
Duration ____ End ____

Comments on factors affecting test data: START TIME 2:15PM 12/15/87

Date	Clock time	Time since pump started (t)	Time since pump stopped (t')	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'	Discharge measurement	Rate		
12-15		3	.05			31'6.8"	31.51		—				
		17	.22			31'6.1"	31.51		—				
		40	.67			31'9"	31.75		.21				
		1:39"	1.98			32'4"	31.92		.38				
		1:55"	1.92			32'11.2"	31.91		.44				
		2.39"	2.63			33'1"	32.01		.47				
		3.11"	3.28			33'3.2"	32.11		.65				
		4.14	4.23			33'3.8"	32.31		.78				
		5.01	5.15			33'5"	32.4		.88				
		5.57	5.95			33'5.6"	32.47		.93				
		6.29	6.98			33'6.2"	32.53		.98				
		7.35	7.92			33'7"	32.58		1.04				
		8.01	8.07			33'7.3"	32.62		1.06				
		8.36	8.60			33'7.5"	32.63		1.09				
		9.11	9.18			33'7.7"	32.64		1.10				
		10.00	10.00			33'8"	32.67		1.13				
		10.59	10.98			33'8.5"	32.71		1.17				
		11.50	11.83			33'8.7"	32.73		1.19				
		12.59	12.99			33'9"	32.75		1.21				
		13.50	13.83			33'9.3"	32.78		1.24				
		15.04	15.07			33'9.5"	32.79		1.25				
		16.38	16.63			33'9.8"	32.82		1.28				
		17.42	17.70			33'9.8"	32.82		1.28				
		19.40	19.67			33'10.3"	32.86		1.32				
		21.05	21.06			33'10.1"	32.84		1.30				
		23.00	23			33'10.2"	32.84		1.30				
		25.00	25			33'10.5"	32.87		1.33				
		27.00	27			33'10.5"	32.88		1.34				
		29.00	29			33'10.5"	32.9		1.36				

(#22)

018897

AQUIFER TEST DATA

Owner Sheridan Address _____ County Waller State Tx

Date _____ Company performing test _____ Measured by _____

Well No. 22 Distance from pumping well _____ Type of test _____ Test No. _____

Measuring equipment _____

Time Data	Water Level Data	Discharge Data	Comments on factors affecting test data
Pump on: Date 12/15/87 Time 2:15PM (t_0) Pump off: Date _____ Time _____ (t_0') Duration of aquifer test: Pumping _____ Recovery _____	Static water level 31.54' Measuring point _____ Elevation of measuring point _____	How Q measured _____ Depth of pump/air line _____ Previous pumping? Yes ____ No ____ Duration _____ End _____	Start time 2:15 PM 12/15/87

Date	Clock time	Time since pump started t	~~Time since pump started~~ t'	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	Rate		
		31:00	31			32'10.9"	32.98		1.37					
		36:00	36			32'11.1"	32.93		1.39					
		41:00	41			32'11.3"	32.94		1.40					
		46:00	46			32'11.3"	32.94		1.40					
		51:00	51			32'11.5"	32.96		1.42					
		56:00	56			32'11.7"	32.98		1.44					
		1:00:00	60			32'11.7"	32.98		1.44					
		1:10:00	70			32'11.7"	32.98		1.44					
		1:20:00	80		→	32'11.1"	32.93		1.39	→	probable error in recording			W.L. measurements
		1:30:00	90			33'.2"	33.02		1.48					
		1:40:00	100			33'.3"	33.03		1.49					
		1:50:00	110			33'.3"	33.03		1.49					
		2:00:00	120			33'.5"	33.04		1.50					
		2:15:00	135			33'.5"	33.04		1.50					
		2:30:00	150			33'.7"	33.06		1.52					
		2:45:00	165			33'.7"	33.06		1.52					
	5:30	PM	202			33.07			1.53					
	6:00		225			33.12			1.58					
	6:30		255			33.12			1.58					
	7:00		285			33.15			1.61					
	7:30		319			33.12			1.58					ANT 8 [illegible] START
	8:03		348			33.13			1.59					
	8:32		377			33.14			1.60					
	9:02		407			33.16			1.62					
	10:01		466			33.16			1.62					
	11:06	531 min.				33.15			1.62'					
12/16/87	12:02	AM	587			33.19			1.65			9.34 GPM		
	1:02	AM	647			33.22			1.68			9.52 9.49		
	2:01		706			33.20			1.66					
	3:02		767			33.20			1.66					

Change to clock time & Change to 10ths of Feet

(#22) p. 2

018898

AQUIFER TEST DATA

Owner Sheridan Address _____ County Waller State Tx

Date 12/15/87 Company performing test _____ Measured by AHT/JRW/TBD/SJR

Well No. 22 Distance from pumping well _____ Type of test _____ Test No _____

Measuring equipment Slope Indicator ERM #4

Time Data	Water Level Data	Discharge Data	Comments on factors affecting test data
Pump on: Date 12/10/87 Time 2115P (t)	Static water level 31.54'	How Q measured flow meter	
Pump off: Date _____ Time _____ (t')	Measuring point T.O.C.	Depth of pump/air line 921	
Duration of aquifer test:	Elevation of measuring point 169.37	Previous pumping? Yes ___ No ___	
Pumping _____ Recovery _____		Duration _____ End _____	

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	GPM Rate		
12/16/87	3:02 AM	767				33.20'			1.66		~~9.43 GPM~~	9.43		
	4:02	827				33.28'			1.74'					
	5:03	888				33.23			1.69'					Moon 30° above G. horizon
	6:09	954				33.20			1.66'					
	7:01	1006				33.20			1.66'			9.4		
	8:00	1065				33.22			1.68'					
	[illegible]					[illegible]								(S R)
	9:00	1125				33.22			1.68'					
	10:00	1185				33.23			1.69'					
						[illegible]								
	11:00	1245				33.2			1.66'					
	12:00	1305				33.19			1.65'					
	[illegible]	[illegible]				[illegible]								
	12:57	1362				33.21			1.67'					
	3:00	1425				33.2			[illegible]'					
	9:00	1545				33.19			1.65'					
	6:00	1665				33.19			1.65'					
	8:09	1794				33.20			1.66'					(AHT)
12/17/87	12:11 A	2036				33.21			1.67'					
	3:58 A	2269				33.22			1.68					
	8:00	2505				33.20			1.66					
	12:00	2745				33.20			1.66					
	4:00	2985				33.20			1.66					
	6:00 AM	3225				33.22			1.68					DEW
12/18	MID NITE	3465				33.19			1.65'					Rain - hard
	4:02 A	3707				33.16			1.61'					Rain
	6:15 AM	3840				33.15			1.61					
	8:00	3945				33.12			1.58					
														p 3 (#22)

018899 ~~006164~~

checked 4/8/89 DEW

Recovery Test Calculations for MW-22

Given $Q = 9.37$ gpm $= 1.25$ ft^3/min

$r = 51.6$ ft

$b = 10$ ft (sand)

$b' = 30$ ft (clay)

At Match Point

$L(u,v) = 1$

$1/u = 1$, $v = 0.5$

$s = 1.6$ ft

$t = 1.89$ min

$$T = \frac{Q\,L(u,v)}{4\pi s}$$

$$T = \frac{1.25 \text{ ft}^3/\text{min} \times 1}{4 \cdot \pi \cdot 1.6 \text{ ft}} = 0.062 \text{ ft}^2/\text{min} = 668 \text{ gpd/ft}$$

$K = T/b = 3.15 \times 10^{-3}$ cm/sec

$$S = 4T\,\frac{t/r^2}{1/u} = \frac{4 \times 6.2 \times 10^{-2} \text{ ft}^2/\text{min} \cdot 1.89 \text{ min}/(51.6 \text{ ft})^2}{1}$$

$S = 1.77 \times 10^{-4}$

$$K' = 4T\,\frac{v^2 b'}{r^2} = \frac{4 \times 6.2 \times 10^{-2} \text{ ft}^2/\text{min} \times (0.5)^2 \times 30}{(51.6')^2} = 7.0 \times 10^{-4} \text{ ft/min}$$

$K' = 3.56 \times 10^{-4}$ cm/sec

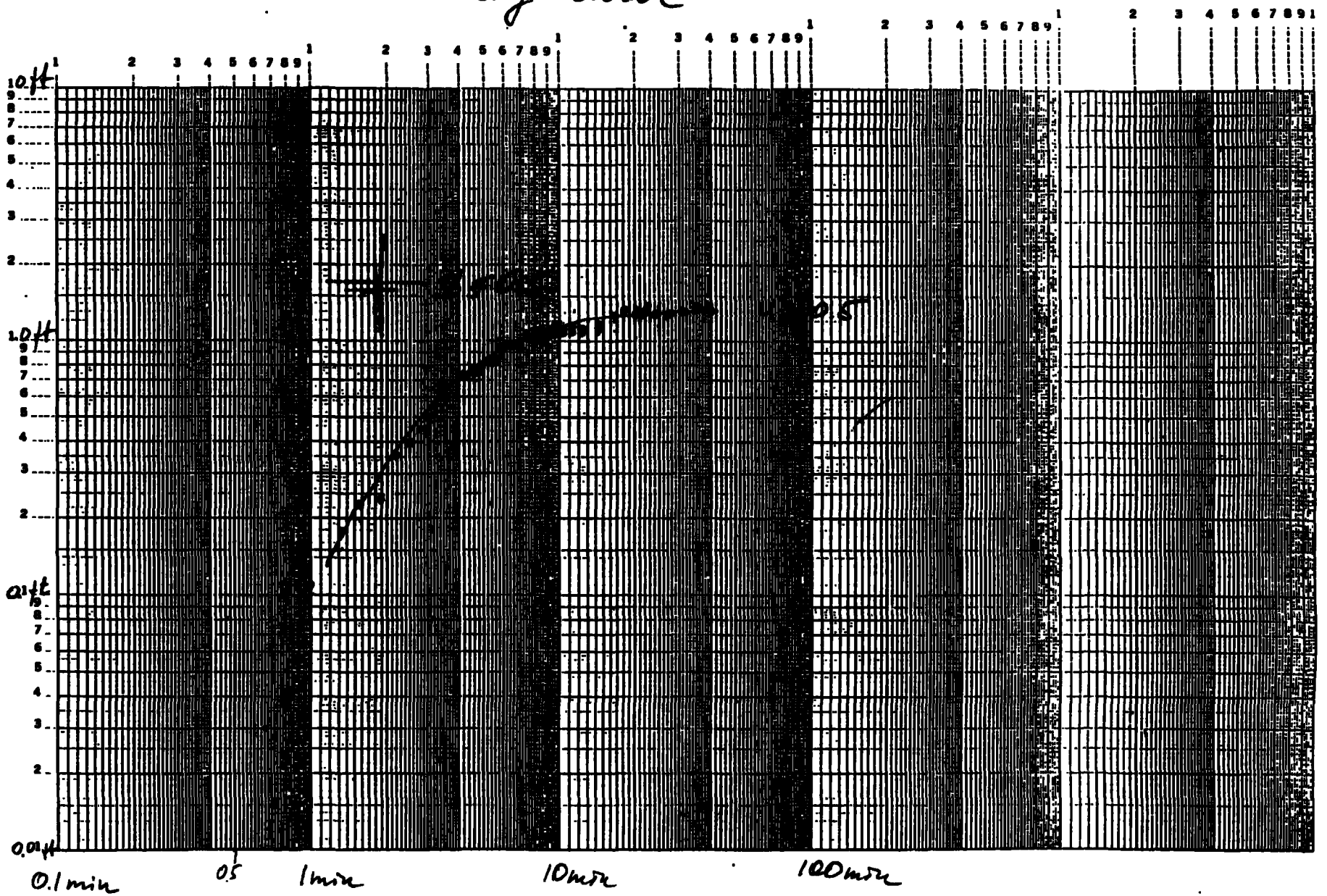
K+E LOGARITHMIC 3 x 5 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7520

Well-22

r = 51.6 ft

Recovery curve



018900

018901 ~~06166~~ Z = 51.6 ft

AQUIFER TEST DATA

Owner Sheridan Address Clark Bottom Rd County Waller State Tx

Date 12/18/87 Company performing test ERM-Southwest Measured by

Well No. 22 Distance from pumping well Type of test Recovery Test No.

Measuring equipment o/w Interface Probe

Time Data
Pump on: Date Time (I:)
Pump off: Date Time (I:)
Duration of aquifer test:
Pumping Recovery

Water Level Data
Static water level 31.54 (33.13)
Measuring point
Elevation of measuring point

Discharge Data
How Q measured
Depth of pump/air line
Previous pumping? Yes No
Duration End

Comments on factors affecting test data

Date	Clock time	Time since pump started t	Time since pump stopped t'		t/t'	Water level measurement	Correction or Conversion	Water level	s-s' Water level change s or s'	Residual drawdown s'	Discharge measurement	Rate		
12/18/87		4011				33.13			✓					
	1:40		0.67		5988	33.10			2.03	1.56				
	1:00	4012	1.00		4012	33.02			2.11	1.48				
	1:20		1.33		3017	32.95			0.18	1.41				
	1:32		1.53		2623	32.90			0.23	1.36				
	1:55		1.92		2090	32.89		?	0.24	1.35				
	2:10	4013	2.17		1849	32.77			0.36	1.23				
	2:30		2.50		1605	32.73			0.40	1.19				
	2:45		2.75		1460	32.68			0.45	1.14				
	3:00	4014	3.00		1338	32.68			0.50	1.09				
	3:15		3.25		1235	32.56			0.57	1.02				
	3:38		3.63		1106	32.42			0.67	.92				
	4:05	4015	4.08		984	32.42			0.71	.88				
	4:25		4.42		908	32.40			0.73	.86				
	4:48		4.80		837	32.37			0.76	.83				
	5:08	4016	5.07		792	32.30			0.83	.76				
	5:15		5.25		765	32.29			0.84	.75				
	5:30		5.50		730	32.28			0.85	.74				
	5:55		5.92		691	32.17			0.96	.63				
	6:10	4017	6.17		651	32.16			0.97	.62				
	6:50		6.83		588	32.20		?	0.93	.66				
	7:	4018	7.00		574	32.15			0.98	.61				
	7:30		7.50		536	32:06			1.07	.52				
	8:00	4019	8.00		502	32.16		?	1.03	.56				
	8:20		8.33		481	32.07			1.06	.53				
	8:32		8.53		471	32.02			1.11	.48				
	9:10	4020	9.17		438	32.04			1.09	.50				
	9:40		9.67		416	31.96			1.17	.42				
	9:55		9.92		405	32.03		?	1.10	.49				

#22 Pg 1

018902

~~67~~

AQUIFER TEST DATA

Owner Sheridan Address Clark Bottom Rd County Waller State Tx

Date 12/16/87 Company performing test ERM-Southwest Measured by

Well No. 22 Distance from pumping well Type of test Recovery Test No.

Measuring equipment

Time Data
Pump on: Date Time (t:)
Pump off: Date Time (t')
Duration of aquifer test:
Pumping Recovery

Water Level Data
Static water level
Measuring point
Elevation of measuring point

Discharge Data
How Q measured
Depth of pump/air line
Previous pumping? Yes No
Duration End

Comments on factors affecting test data

Date	Clock time	Time since pump started t	Time since pump stopped t' ✓	Δt	t/t'	Water level measurement	Correction or Correction	Water level	Δ-Δ' Water level change s or s'	Δ'	Discharge measurement	Rate		
	11:30	4021	10.50		383	32.02		1	1.17	.46				
	11:30	4022	11.50		350	31.96			1.17	.42				
	12:35	4123	12.58		320	31.97		?	1.16	.43				
	14:30	4025	14.50		279	31.99			1.16	.43				
	16:30	4027	16.50		244	31.89			1.24	.35				
	18:30	4029	18.50		218	31.82			1.31	.28				
	20:45	4031	20.75		194	31.87			1.26	.33				
	22:30	4033	22.50		179	31.81			1.32	.27				
	24:40	4035	24.67		164	31.87			1.26	.33				
	26:30	4037	26.50		152	31.85			1.28	.31				
	28:46	4039	28.67		141	31.82			1.27	.32				
	30:35	4041	30.58		132	31.85			1.28	.31				
	35.35	4046	35.58		114	31.75			1.38	.21				
	35.40		35.67		113	31.74			1.39	.20				
	40.45		40.75		99	31.76			1.37	.22				
		HOS1												

#22 pg 2

018903

~~006168~~

3/30/88

MW-26 - Leaky Aquifer Analysis - using Tantish-Jacob method - Matching Tand

$L(u,v) = 1$, $1/u = 1$, $\therefore u = 1$ $\quad v = 0.2$

$r = 100.2'$, $Q = 9.37\,gpm = 1.25\,ft^3/min$

At match pt., $s = 0.38'$, $t = 1.38\,min$.

checked 4/88

$T = \frac{Q}{4\pi s}(L(u,v)) = 1.25\,ft^3/min \cdot \frac{1}{4\pi} \cdot \frac{1}{0.38'} = 0.2618\,ft^2/min$

$0.2618\,ft^2/min \times \frac{60\,min}{hr} \times \frac{24\,hr}{day} \times 7.48\,gal/ft^3 = \boxed{2819.6\,gpd/ft = T}$

if $b = 10'$

$K = T/b = .2618\,ft^2/min / 10' = 0.0218\,ft/min \times \frac{30.48\,cm}{ft} \times \frac{min}{60\,sec} = 0.0133\,cm$

$\boxed{K = 1.33 \times 10^{-2}\,cm}$

$S = 4T \frac{t/r^2}{1/u} = 4 \cdot 0.2618\,ft^2/min \times 1.38\,min \times \frac{1}{(100.2')^2} =$

$\boxed{1.44 \times 10^{-4}}$

$K'/b' = 4T \frac{v^2}{r^2} = 4(0.2618\,ft^2/min)(0.2)^2 \cdot \frac{1}{(100.2')^2}$

$= 4.17 \times 10^{-6}\,/min$

if $b' = 30'$ $\quad = 1.25 \times 10^{-4}\,ft/min \times \frac{30.48\,cm}{ft} \cdot \frac{min}{60\,sec}$

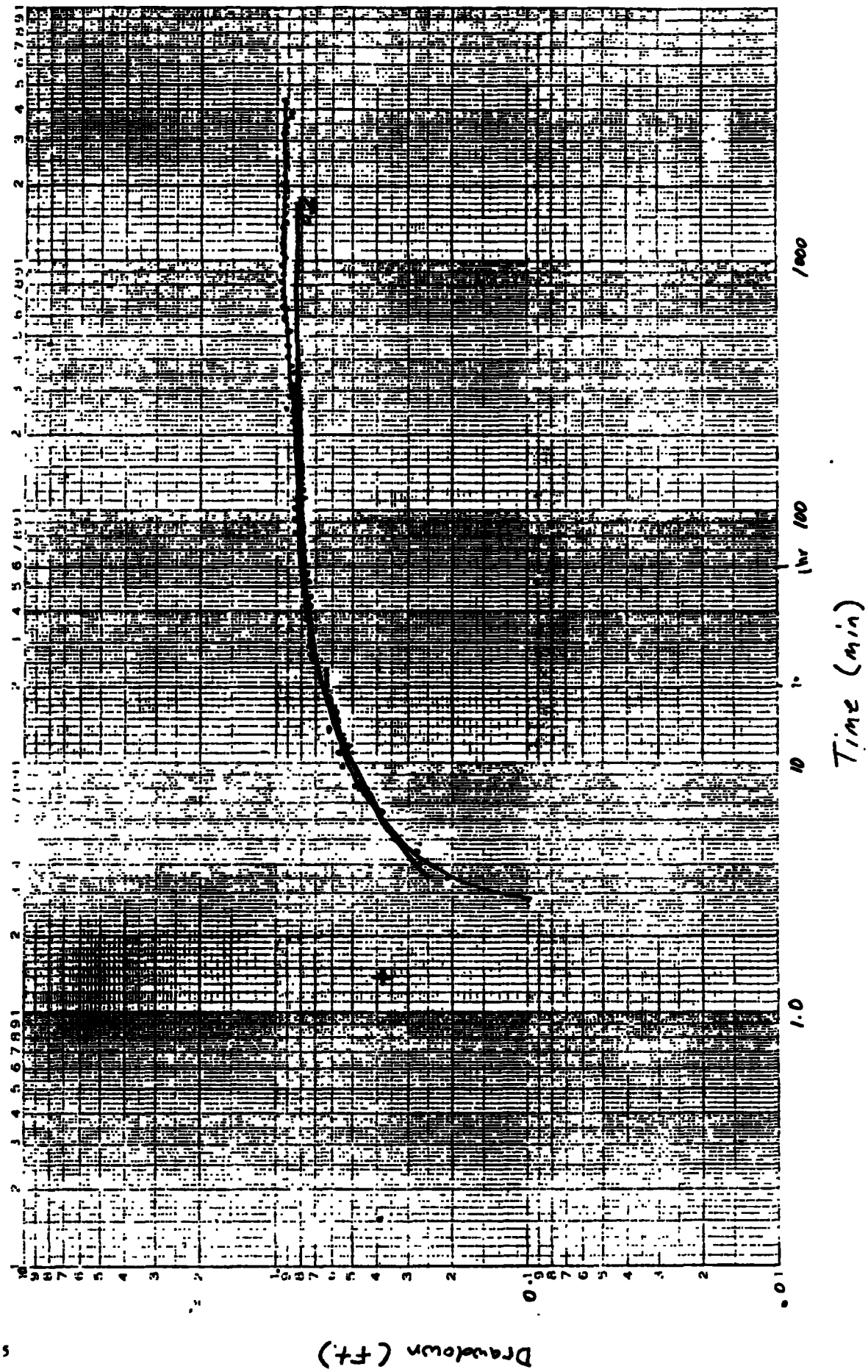
$\boxed{K' = 6.38 \times 10^{-5}\,cm/sec}$

3/30/88

NATIONAL 12-191

018904

MW-26



Sheridan Disposal Services
MW-26
12-15-87
3/30/88

Full Logarithmic, 3 × 5

(Chem... DEN)

018905

AQUIFER TEST DATA

Owner Sheridan Disposal Serv. Address Clark Bottom Rd County Waller State TX

Date 12/15/87 Company performing test ERM-Southwest Measured by Weidemann

Well No. 26 - oil/water probe Distance from pumping well 100.2' Type of test Pump - Constant Q Test No. ____

Measuring equipment Oil/water Interface Probe

Time Data	Water Level Data	Discharge Data	Comments on factors affecting test data
2:15 Pump on: Date 12/15/87 Time 2:15 pm (t_1)	Static water level 31.83'	How Q measured flow meter	
Pump off: Date ____ Time ____ (t_2)	Measuring point TOC	Depth of pump/air line 92'	
Duration of aquifer test:	Elevation of measuring point 169.69'	Previous pumping? Yes ____ No ____	
Pumping ____ Recovery ____		Duration ____ End ____	

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	Rate		Comments on factors affecting test data
12/15/87														on MW-27 started Hermit 1 min after pumping started
														Start time 2:15 PM
		2.5	2.83			31.93			.10					
		3.3	3.5			32.04			.21					Note: First row of times
		4.05	4.[illegible]			32.10			.27					in minutes + seconds -
		4.30	4.5			32.11			.28					second row is minutes
		5.00	5.0			32.17			.34					and tenths of minutes
		5.30	5.5			32.19			.36					
		6.30	6.5			32.21			.38					
		6.50	6.[illegible]			32.24			.41					
		7.35	7.[illegible]			32.28			.45					
		8.05	8.[illegible]			32.32			.49					
		8.30	8.5			32.30			.47					
		9.00	9.0			32.31			.48					
		9.45	9.75			32.38			.55					
		10:30	10.5			32.35			.52					
		11	11.0			32.41			.57					
		11:45	11.75			32.35			.52					
		12:15	12.[illegible]			32.37			.59					
		13.30	13.5			32.45			.62					
		13.45	13.75			32.45			.62					
		14:45	14.75			32.40			.57					
		15:20	15.33			32.41			.58					
		16:00	16.0			32.41			.58					
		16:50	16.83			32.42			.59					
		17:40	17.67			32.44			.61					
		18:25	18.42			32.45			.62					
		Kids												
		19:30	19.50			32.47			.64					
		20:30	20.[illegible]			32.46			.63					p.1

26

018906

~~J6171~~

AQUIFER TEST DATA

Owner Sheridan Address _____ County Waller State Tx

Date 12/15/87 Company performing test _____ Measured by Waldrop/Diehl

Well No. 26 Distance from pumping well _____ Type of test _____ Test No. _____

Measuring equipment Oil/water Interface Probe / Slope Indicator ERM-SW #4

Time Data
Pump on: Date _____ Time _____ (t1)
Pump off: Date _____ Time _____ (t2)
Duration of aquifer test:
Pumping _____ Recovery _____

Water Level Data
Static water level 31.83'
Measuring point TOC
Elevation of measuring point 166.69'

Discharge Data
How Q measured _____
Depth of pump/air line _____
Previous pumping? Yes ____ No ____
Duration _____ End _____

Comments on factors affecting test data

Date	Time	Time since pump started t	Time since pump stopped t'	t/t'	Minutes	Water level measurement	Correction or Correction	Water level	Water level change s	Discharge measurement	Rate		
12/15	21.30				21.5	32.47			.64				Note - times actually 26'10" even though written as 26.1. - There are minute
	22.30				82.5	32.47			.64				STREET TIME 2:15PM 12/15/87 S
	23.40				83.67	32.47			.64				
	26.10				86.17	32.55			.72				
	27.0				87.0	32.57			.74				
	28.0				88.0	32.56			.73				
	29.15				89.25	32.57			.74				
	30.20				90.33	32.57			.74				
	32.0				92.0	32.57			.74				
	37.3				97.5	32.60			.77				
	42.3				102.5	32.56			.73				
	46				106.0	32.56			.73				
	52.45				112.75	32.68			.75				
	57.30				117.5	32.60			.77				
	1hr 2min 30"				67	32.62			.79				
	1hr 12min 30sec				72	32.65			.82				
	1hr 22min 20sec				82	32.68			.85				
	1hr 32min				92	32.68			.85				
	1hr 42min				102	32.69			.85				
	1hr 52min				112	32.68			.79				
	2hr 2min				122	32.61			.76				
	2hr 17min				137	32.64			.81				
	2hr 32min				152	32.64			.81				
	2hr 47min				167	32.64			.81				
change to clock time	5:30 PM				145	32.65			.82				
	6:03				228	32.7			.87				
	6:33				258	32.75			.92				
	7:03				288	32.73			.89				
	7:57				322	32.69			.86				

018907

AQUIFER TEST DATA

Owner Sheridan Address _____ County Waller State Tx

Date 12/15/87 Company performing test _____ Measured by AHT/JBW/JBD/SJR

Well No. 26 Distance from pumping well _____ Type of test _____ Test No. _____

Measuring equipment Slope Indicator ERM Sw #4

Time Data
Pump on: Date 12/15/87 Time 2:15 PM (t_1)
Pump off: Date _____ Time _____ (t_2)
Duration of aquifer test:
Pumping _____ Recovery _____

Water Level Data DEW
Static water level 31.5 ft 3' 1/11/87
Measuring point TOC
Elevation of measuring point 169.69

Discharge Data
How Q measured flow meter
Depth of pump/air line 92'
Previous pumping? Yes ____ No ____
Duration _____ End _____

Comments on factors affecting test data

START TIME 2:15 PM 12/15/87

Date	Clock time	Time since pump started (min) t	Time since pump stopped t'	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	GPM Rate		
12/15/87	8:06	387 PM				32.70	32.70 AHT		.87					
	8:34	379 PM				32.72	32.72 AHT		.89					
	9:04	409 PM				32.74			.91					
	10:03	468				32.74			.91					
	11:08	533				32.73			0.90		DEW			
12/16/87	12:04	589 PM				32.77			.94					
	1:04	649				32.79			.96					
	2:02	707				32.79			.96					
	3:03	768				32.79			0.96			9.43		
	4:04	829				32.80			0.97					
	5:05	890				32.78			0.95					Moon ~30° above E. horizon
	6:11	956				32.79			0.96					
	7:03	1008				32.76			.93					
	8:02	1067				32.78			.95					(S R)
	9:02	1127				32.79			.96					
	10:02	1187				32.8			.97					
	11:02	1247				32.78			.95					
	12:01	1306				32.77			.94					
	1:00	1365				32.79			.96					
	2:01	1426				32.75			.92					
	4:03	1548				32.77			.94					
	6:03	1668				32.77			.94					
	8:10	1795				32.77			.94					(AHT)
12/17/87	12:13A	2038				32.77			.94					
	4:00A	2265				32.78			.95					
	8:02	2507				32.76			.93					
	12:02	2747				32.77			.94					
	4:02	2987				32.76			.93					
	8:00	PM 3225				32.77			.94					

p. 3 (26)

018908 ~~73~~

AQUIFER TEST DATA

Owner Sheridan Address _____ County Waller State TX

Date 12/18/87 Company performing test _____ Measured by DDW/JBW

Well No. 26 Distance from pumping well _____ Type of test _____ Test No. _____

Measuring equipment Sloan Indicator ERMSW #24

Time Data
Pump on: Date 12/15/87 Time 2:15 PM (h)
Pump off: Date _____ Time _____ (h)
Duration of aquifer test:
Pumping _____ Recovery _____

Water Level Data DDW 11/11/88
Static water level 31.83
Measuring point TOC
Elevation of measuring point 169-69

Discharge Data
How Q measured _____
Depth of pump/air line _____
Previous pumping? Yes ____ No ____
Duration _____ End _____

Comments on factors affecting test data

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	Rate		
12/18/87	9:00 AM	0	3765			32.74			.91					DDW - midnight
	9:05 AM		3770			32.71			.88					
	6:15 AM		3780			32.70			.87					
	8:42		4007			32.75			.92					

p.4 (#26) F-17

018909

1/26/88
DEW

Pump Test MW-27 (Data from Hermit Data Logger)

Use curve matching of log-log (drawdown vs time) and Hantush-Jacob method (1955) for non-steady flow in a leaky confined aquifer with vertical movements

Checked 4/88

Match point $L(U,V) = 1$

$1/u = 1 \quad \therefore u = 1$

$S = 4.0$ feet

$t = 1.58$ minutes

$Q = 9.37 \text{ gal/min} \times \frac{ft^3}{7.48 \text{ gal}} = 1.25 \text{ ft}^3/\text{min}$

$T = \frac{Q}{4\pi s} L(U,V)$

$T = \frac{1.25 \text{ ft}^3/\text{min}}{} \times \frac{1}{4} \times \frac{1}{\pi} \times \frac{1}{4.0 \text{ feet}} \times 1 = 2.49 \times 10^{-2} \text{ ft}^2/\text{min}$

$2.49 \times 10^{-2} \text{ ft}^2/\text{min} \times 7.48 \text{ gal/ft}^3 \times \frac{60 \text{ min}}{hr} \times \frac{24 \text{ hr}}{day} = 267.9 \text{ gpd/ft}$

$db = 10' \quad K = T/b \quad K = 2.49 \times 10^{-2} \text{ ft}^2/\text{min} / 10' \times \frac{30.48 \text{ cm}}{ft} \times \frac{min}{60 \text{ sec}} = 1.26 \times 10^{-3} \text{ cm/sec}$

where $r = 25'$

$S = 4T \frac{t/r^2}{1/u}$

$= 4 \cdot 2.49 \times 10^{-2} \text{ ft}^2/\text{min} \cdot 1.58 \text{ min} \times 1/(25 \text{ feet})^2$

$S = .00025 = 2.5 \times 10^{-4}$

At match point $V = 0.4$

assume $b' = 30'$ (thickness of confining unit)

$\frac{K'}{b'} = 4T \frac{V^2}{r^2} = 4 \cdot 2.49 \times 10^{-2} \text{ ft}^2/\text{min} \cdot (0.4)^2 \cdot \frac{1}{(25 \text{ ft})^2} =$

$K'/b' = 2.55 \times 10^{-5}/\text{min} \times 30' = 7.65 \times 10^{-4} \text{ ft/min} = 1C'$

$K' = 7.65 \times 10^{-4} \text{ ft/min} \times \frac{30.48 \text{ cm}}{ft} \times \frac{min}{60 \text{ sec}} = 3.89 \times 10^{-4} \text{ cm/sec}$

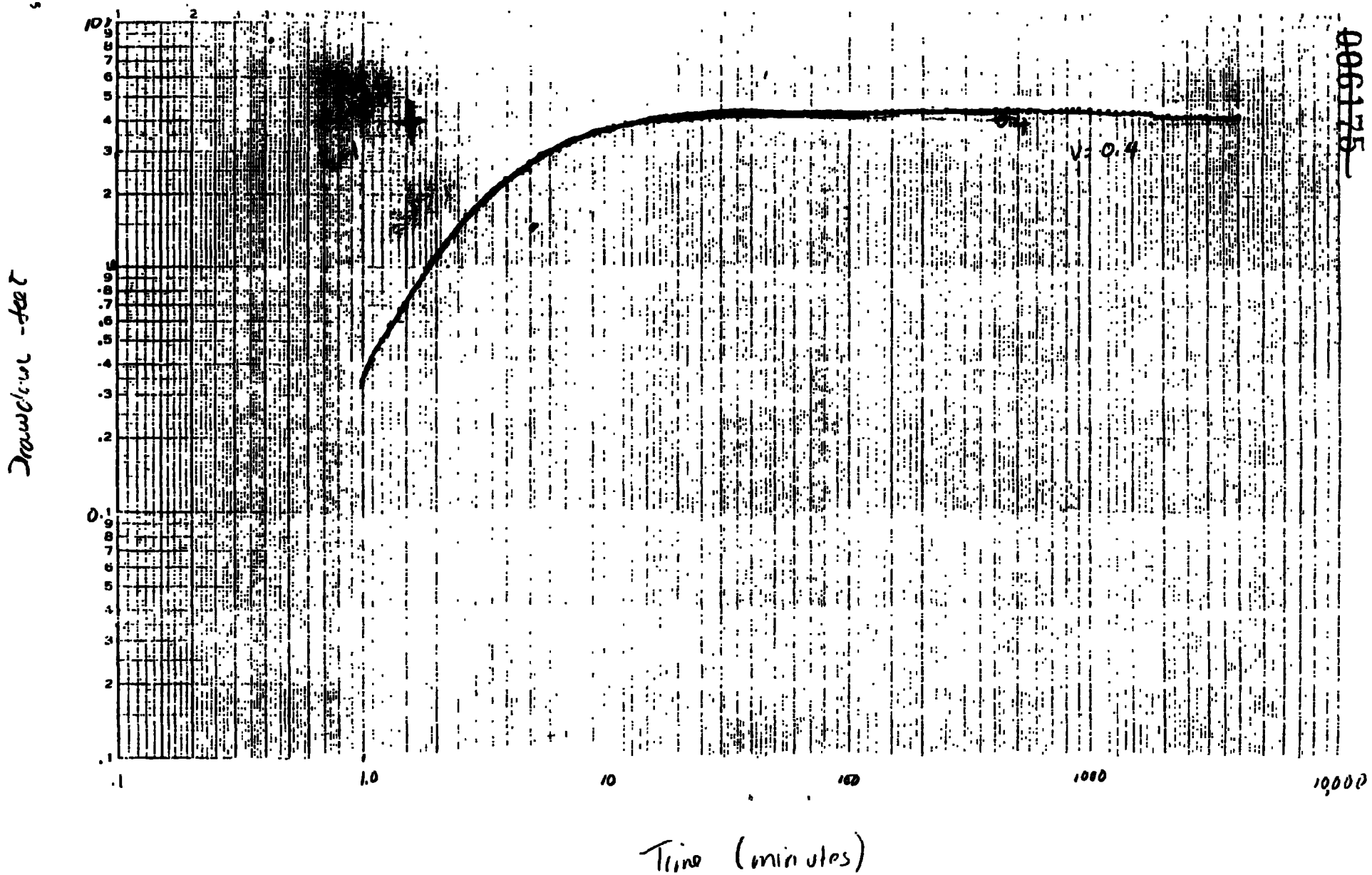
Drawdown vs. time

Sheridan
MW-27
Data from Hermit Data Logger

1/11/87
DcW

018910

~~006175~~



Full Logarithmic, 3 x 5

018911

Page ____ of ____

AQUIFER TEST DATA

Owner Sheridan Disposal Services Address Clark Bottom Rd County Weller State Tx

Date 12/15/87 Company performing test ERM-Southwest Measured by ____

Well No. MW-27 Distance from pumping well 25' Type of test ____ Test No. ____

Measuring equipment Slope Indicator (Hermit in place)

Time Data
Pump on: Date 12/15/87 Time 2:15P (I:)
Pump off: Date ____ Time ____ (I:)
Duration of aquifer test:
Pumping ____ Recovery ____

Water Level Data
Static water level 32.00
Measuring point T.O.C.
Elevation of measuring point 100.02

Discharge Data
How Q measured Flow meter
Depth of pump/air line 92'
Previous pumping? Yes ____ No ____
Duration ____ End ____

Comments on factors affecting test data

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	Rate		
														Hermit in well Supplemental Measurements w/ G.T.
12/15/87	1053	519				36.65			4.65					(AWB)
12/16/87	3:07	772				36.70			4.70					
	6:24	966				36.70			4.70					
	8:11	1076				36.72			4.72					(S R)
	10:04	1189				36.68			4.68					
	12:57	1318				36.66			4.66					
	2:13	1434				36.67			4.67					
	4:13	1554				36.68			4.68					
	6:19	1678				36.69			4.69					
	8:17	1802				36.68			4.68					(AWT)
12/17/87	12:24	2045				36.61			4.61					
	4:07 A	2272				36.63			4.63					
	8:09	2514				36.58			4.58					
	12:09					36.57			4.57					
	4:[illegible]					36.55			4.55					
	8:46 PM					36.53			4.57					(DCW)
12/18	12:10					36.55			4.55					Rain - cold
	4:10 AM					36.56			4.56					
	6:20 AM					36.49								
	8:10					36.57								

(MW-27) p. 1

MW-27

018912

READY

SE1000B
Environmental Logger
12/18 08:04

Unit# 00000 Test# 0

INPUT 1: Level (F) TOC

Reference 32.06 Static
Scale factor 49.82
Offset 0.00

Step# 0 12/15 14:14

Time(min) Add 1min	Elapsed Time	Value	Δwl
1	0.0000	32.40	.34
	0.0033	32.42	.36
	0.0066	32.42	.36
	0.0099	32.42	.36
1.01	0.0133	32.43	.39
	0.0166	32.43	.37
1.02	0.0200	32.43	.37
	0.0233	32.43	.37
	0.0266	32.43	.37
1.03	0.0300	32.43	.37
	0.0333	32.45	.39
1.05	0.0500	32.45	.39
1.07	0.0666	32.46	.40
1.08	0.0833	32.48	.42
1.10	0.1000	32.48	
	0.1166	32.50	
	0.1333	32.51	
1.15	0.1500	32.53	.47
	0.1666	32.54	
	0.1833	32.56	
1.2	0.2000	32.56	.50
	0.2166	32.57	
	0.2333	32.59	
	0.2500	32.59	.53
	0.2666	32.61	
	0.2833	32.62	
	0.3000	32.64	.58
	0.3166	32.65	
	0.3333	32.65	
	0.4167	32.73	
1.5	0.5000	32.78	0.72
	0.5833	32.84	.78
	0.6667	32.90	.84
1.75	0.7500	32.97	0.91
	0.8333	33.03	
	0.9167	33.09	1.03
2.0	1.0000	33.16	1.10
	1.0833	33.22	
	1.1667	33.28	
2.25	1.2500	33.34	1.28
	1.3333	33.41	
	1.4166	33.45	
2.5	1.5000	33.52	1.46
	1.5833	33.56	
	1.6667	33.63	
2.75	1.7500	33.69	1.63
	1.8333	33.74	
	1.9167	33.80	
3.0	2.0000	33.85	1.79
3.5	2.5000	34.15	2.09
4.0	3.0000	34.40	2.34
4.5	3.5000	34.62	2.56
5.0	4.0000	34.82	2.76
5.5	4.5000	34.99	2.93
6.0	5.0000	35.14	3.08
6.5	5.5000	35.26	3.20
7.0	6.0000	35.37	3.31
7.5	6.5000	35.47	3.41
8.0	7.0000	35.54	3.48
8.5	7.5000	35.62	3.56
9.0	8.0000	35.69	3.63
9.5	8.5000	35.75	3.69
10.0	9.0000	35.80	3.74
10.5	9.5000	35.84	3.78
11.0	10.0000	35.88	3.82
13	12.0000	36.00	3.94
15	14.0000	36.06	4.00
17	16.0000	36.11	4.05
19	18.0000	36.16	4.10
21	20.0000	36.19	4.13
23	22.0000	36.22	4.16
25	24.0000	36.24	4.18
27	26.0000	36.27	4.21
29	28.0000	36.27	4.21
	30.0000	36.28	4.22
	32.0000	36.28	
35	34.0000	36.30	4.24
	36.0000	36.30	
39	38.0000	36.32	4.26
	40.0000	36.32	
	42.0000	36.32	
	44.0000	36.32	
47	46.0000	36.33	4.27
	48.0000	36.35	4.29
	50.0000	36.35	
	52.0000	36.35	
	54.0000	36.35	
	56.0000	36.35	
	58.0000	36.36	4.30
	60.0000	36.36	
	62.0000	36.36	
	64.0000	36.38	4.32
	66.0000	36.38	
	68.0000	36.38	
	70.0000	36.38	
	72.0000	36.38	
	74.0000	36.39	4.33
	76.0000	36.39	
	78.0000	36.39	
	80.0000	36.39	
	82.0000	36.39	
	84.0000	36.39	
	86.0000	36.41	4.35
	88.0000	36.41	
	90.0000	36.41	
	92.0000	36.43	

MW-27 continued

	92.0000	36.43	
	94.0000	36.43	
	96.0000	36.43	
	98.0000	36.43	
101	100.000	36.41	4.35
	110.000	36.43	
	120.000	36.44	
	130.000	36.46	4.40
	140.000	36.46	
151	150.000	36.47	4.41
	160.000	36.49	
	170.000	36.49	
	180.000	36.50	
	190.000	36.50	
201	200.000	36.50	4.44
	210.000	36.50	
	220.000	36.50	
	230.000	36.52	
	240.000	36.52	
251	250.000	36.52	4.46
	260.000	36.54	
	270.000	36.52	
	280.000	36.52	
	290.000	36.54	
301	300.000	36.55	4.49
	310.000	36.54	
	320.000	36.55	
	330.000	36.55	
	340.000	36.55	
351	350.000	36.57	4.51
	360.000	36.58	
	370.000	36.60	
	380.000	36.58	
	390.000	36.60	
401	400.000	36.60	4.54
	410.000	36.60	
	420.000	36.63	
	430.000	36.61	
	440.000	36.60	
451	450.000	36.60	4.54
	460.000	36.60	
	470.000	36.60	
	480.000	36.60	
	490.000	36.60	
501	500.000	36.61	4.55
	510.000	36.61	
	520.000	36.61	
	530.000	36.60	4.54
	540.000	36.58	4.52
551	550.000	36.60	4.54
	560.000	36.60	
	570.000	36.60	
	580.000	36.60	
	590.000	36.61	
601	600.000	36.61	4.55
	610.000	36.61	
	620.000	36.60	
	630.000	36.61	
	640.000	36.60	
651	650.000	36.55	4.49
	660.000	36.55	
	670.000	36.76	
	680.000	36.68	
	690.000	36.63	
701	700.000	36.61	4.55
	710.000	36.63	
	720.000	36.65	
	730.000	36.63	
	740.000	36.65	
751	750.000	36.65	4.59
	760.000	36.65	
	770.000	36.65	
	780.000	36.63	
	790.000	36.63	
801	800.000	36.65	4.59
	810.000	36.65	
	820.000	36.65	
	830.000	36.65	
	840.000	36.65	
851	850.000	36.65	4.59
	860.000	36.65	
	870.000	36.65	
	880.000	36.65	
	890.000	36.65	
901	900.000	36.65	4.59
	910.000	36.65	
	920.000	36.63	
	930.000	36.65	
	940.000	36.65	
951	950.000	36.63	4.57
	960.000	36.65	
	970.000	36.63	
	980.000	36.63	
	990.000	36.63	
1001	1000.00	36.63	4.57
	1100.00	36.60	4.54
	1200.00	36.57	4.51
	1300.00	36.54	4.49
	1400.00	36.47	
	1500.00	36.47	4.41
	1600.00	36.49	4.43
	1700.00	36.47	4.41
	1800.00	36.47	
	1900.00	36.38	
	2000.00	36.38	4.32
	2100.00	36.41	4.35
	2200.00	36.38	4.32
	2300.00	36.35	4.29
	2400.00	36.36	4.30
2501	2500.00	36.38	4.32
	2600.00	36.38	
	2700.00	36.38	
	2800.00	36.36	4.30
	2900.00	36.36	
	3000.00	36.36	
	3100.00	36.36	
	3200.00	36.39	4.33
	3300.00	36.38	4.32
	3400.00	36.36	4.30
	3500.00	36.33	4.27
	3600.00	36.35	
	3700.00	36.33	
	3800.00	36.33	
	3900.00	36.36	

END

adjust anything? — adjust flow rate @ 653 min.

Lamp — check inside

018913

018914

well 27

K' calculations from recovery curve

checked DEW 4/8/86

given:

$Q = 9.37$ gpm $= 1.25$ ft³/min

$r = 25$ ft

$b' = 30$ ft (clay)

$b = 10'$ (sand)

$$S = \frac{Q}{4\pi T} L(u,v)$$

$$T = \frac{Q\,L(u,v)}{4\pi S}$$

Match point : $L(u,v) = 1.0$

$1/u = 1.0$

$v = 0.4$

$S = 3.9$ ft

$t = 1.28$ min

$$T = \frac{1.25\ ft^3/min \times 1.0}{4 \times 3.1416 \times 3.9\ ft} = 0.0255\ ft^2/min = 2.55 \times 10^{-2}\ ft^2/min$$

$= 275$ gpd/ft

$K = 1.30 \times 10^{-3}$ cm/sec

$$S = 4T \frac{t/r^2}{1/u} = \frac{4 \times 2.55 \times 10^{-2}\ ft^2/min \times 1.28\ min / 25^2\ ft^2}{1} =$$

$$= 4 \times 2.55 \times 10^{-2} \times \frac{1.28}{625} = 0.0002089 = 2.09 \times 10^{-4}$$

$$\frac{K'}{b'} = 4T \frac{v^2}{r^2} \qquad K' = \frac{4T v^2 b'}{r^2} = \frac{4 \times 2.55 \times 10^{-2} \times 0.4^2 \times 30}{625} = 7.8 \times 10^{-4}$$

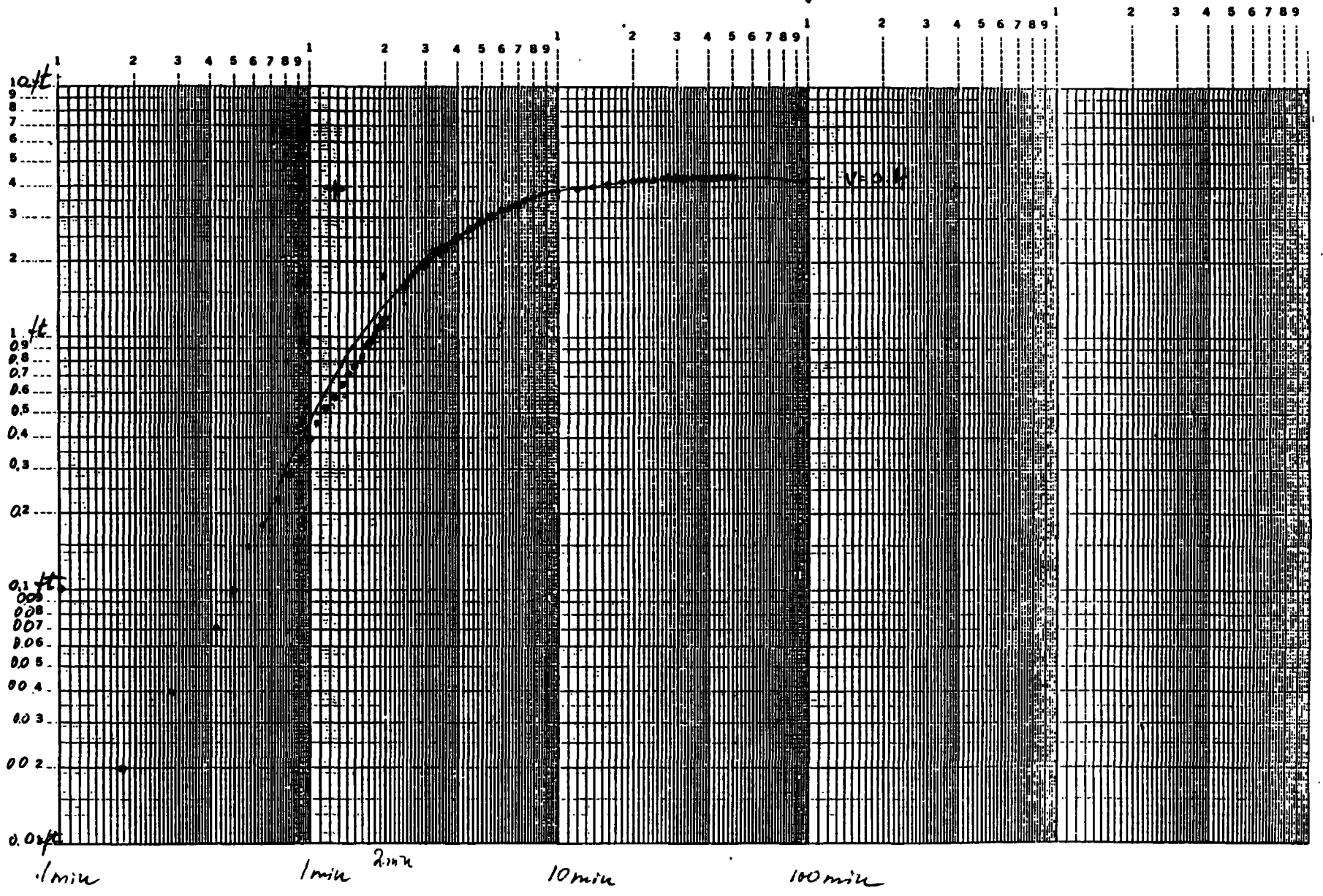
$$K' = 7.8 \times 10^{-4} \frac{ft}{min} = 3.96 \times 10^{-4}\ cm/sec$$

K&E LOGARITHMIC 3 x 5 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7520

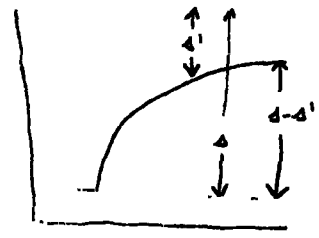
MW 27

Recovery curve



018915

F-24



$s-s'$ = calculated recovery
s = drawdown
s' = residual drawdown
t = time since pump started
t' = time since pump stopped

checked 11/5/98 DEW

Recovery

MW-27

018916

READY

SE1000B
Environmental Logger
12/13 09:59

Unit# 00000 Test# 0

INPUT 1: Level (F) TOC

Reference	36.51
Scale factor	49.82
Offset	0.00

"static"

initial static 32.06' before pumping

Step# 0 12/13 09:05

t/t'	t Elapsed Time	Value	Δwl (s-s') calculated Recovery	s' ft residual drawdown
4011	0.0000	36.49	0.02	
	0.0033	36.49		
	0.0066	36.51	0.0	4.45
	0.0099	36.51		
	0.0133	36.51		
	0.0166	36.51		
	0.0200	36.51		
	0.0233	36.51		
	0.0266	36.51		
	0.0300	36.51		
	0.0333	36.51		
	0.0500	36.51		
	0.0666	36.51		
	0.0833	36.51		
	0.1000	36.51		
	0.1166	36.51		
	0.1333	36.51		
	0.1500	36.51		
	0.1666	36.51		
21883	0.1833	36.49	0.02	4.43
	0.2000	36.49		
	0.2166	36.49		
	0.2333	36.49		
	0.2500	36.49		
	0.2666	36.49		
14159	0.2833	36.47	0.04	4.41
	0.3000	36.47		
	0.3166	36.47		
	0.3333	36.47		
9626	0.4167	36.44	0.07	4.38
8022	0.5000	36.41	0.10	4.35
6877	0.5833	36.36	0.15	4.30
6017	0.6667	36.33	0.18	4.27
5348	0.7500	36.28	0.23	4.22
4814	0.8333	36.22	0.29	4.16
4376	0.9167	36.17	0.34	4.11
4012	1.0000	36.11	0.40	4.05
3711	1.0833	36.05	0.46	3.99
3439	1.1667	35.99	0.52	3.93
3200	1.2500	35.92	0.59	3.86
3009	1.3333	35.86	0.65	3.80
2832	1.4166	35.80	0.71	3.74
2675	1.5000	35.73	0.78	3.67
2538	1.5833	35.66	0.85	3.60
2407	1.6667	35.59	0.92	3.53
2292	1.7500	35.53	0.98	3.47
2189	1.8333	35.47	1.04	3.41
2098	1.9167	35.39	1.12	3.33
2007	2.0000	35.33	1.18	3.27
1605	2.5000	34.93	1.59	2.87
1338	3.0000	34.59	1.92	2.53
1147	3.5000	34.27	2.24	2.21
1004	4.0000	34.01	2.50	1.95
892	4.5000	33.77	2.74	1.71
803	5.0000	33.58	2.93	1.52
730	5.5000	33.41	3.10	1.35
670	6.0000	33.28	3.23	1.22
619	6.5000	33.16	3.35	1.10
574	7.0000	33.06	3.45	1.00
536	7.5000	32.97	3.54	.91
502	8.0000	32.91	3.60	.85
473	8.5000	32.84	3.67	.78
447	9.0000	32.78	3.73	.72
423	9.5000	32.73	3.78	.67
402	10.0000	32.70	3.81	.64
336	12.5000	32.57	3.94	.51
289	14.0000	32.50	4.01	.44
252	16.0000	32.45	4.06	.39
224	18.0000	32.40	4.11	.34
202	20.0000	32.37	4.14	.31
183	22.0000	32.35	4.16	.29
168	24.0000	32.34	4.17	.28
155	26.0000	32.32	4.19	.26
144	28.0000	32.31	4.20	.25
134	30.0000	32.29	4.22	.23
125	32.0000	32.29	4.22	.23
119	34.0000	32.28	4.23	.23
112	36.0000	32.28	4.23	.22
106	38.0000	32.26	4.25	.20
101	40.0000	32.26	4.25	.20
97	42.0000	32.26	4.25	.20
92	44.0000	32.24	4.27	.18
89	46.0000	32.24	4.27	.19
85	48.0000	32.24	4.27	.18
81	50.0000	32.23	4.28	.17
78	52.0000	32.23	4.28	.17

018917

DEW 11/27/88 9/08

Curve matching - Hantush + Jacob (1955) method

Pump Test MW-28 - Sheridan -

At match pt $L(u,v) = 1$, $1/u = 1$

$s = 4.05'$

$t = .595$ minutes

$Q = 9.37 \text{ gal/min} \times \frac{ft^3}{7.48 \text{ gal}} = 1.25 \text{ ft}^3/\text{min}$

Checked 4/88

$T = \frac{Q}{4\pi s} L(u,v)$

$= 1.25 \text{ ft}^3/\text{min} \times \frac{1}{4} \times \frac{1}{\pi} \times \frac{1}{4.05 \text{ ft}} \times 1 = 2.46 \times 10^{-2} \text{ ft}^2/\text{min}$

If $b = 10'$ $K = T/b = 2.46 \times 10^{-3} \text{ ft/min} \times \frac{30.48 \text{ cm}}{\text{ft}} \times \frac{\text{min}}{60 \text{ sec}} = 1.25 \times 10^{-3} \text{ cm/sec} = T$

$r = 6.6'$

$S = 4T \frac{t}{r^2/u} = 4 \cdot 2.46 \times 10^{-2} \text{ ft}^2/\text{min} \times (.595 \text{ min}) \times \left(\frac{1}{6.6 \text{ ft}}\right)^2$

$= .00134 = 1.34 \times 10^{-3}$

At match point: $V = 0.267$

assume $b' = 30'$

$\frac{K'}{b'} = 4T \frac{V^2}{r^2} = 4 (2.46 \times 10^{-2} \text{ ft}^2/\text{min} \times (.267)^2 \times \frac{1}{(6.6 \text{ ft})^2}$

$\frac{K'}{b'} = .00016 \text{ /min} \times 30' = 4.83 \times 10^{-3} \text{ ft/min}$

$K' = 4.83 \times 10^{-3} \text{ ft/min} \times \frac{30.48 \text{ cm}}{\text{ft}} \times \frac{\text{min}}{60 \text{ sec}}$ $.0245 \text{ cm/sec}$

$= 2.45 \times 10^{-3} \text{ cm/sec}$

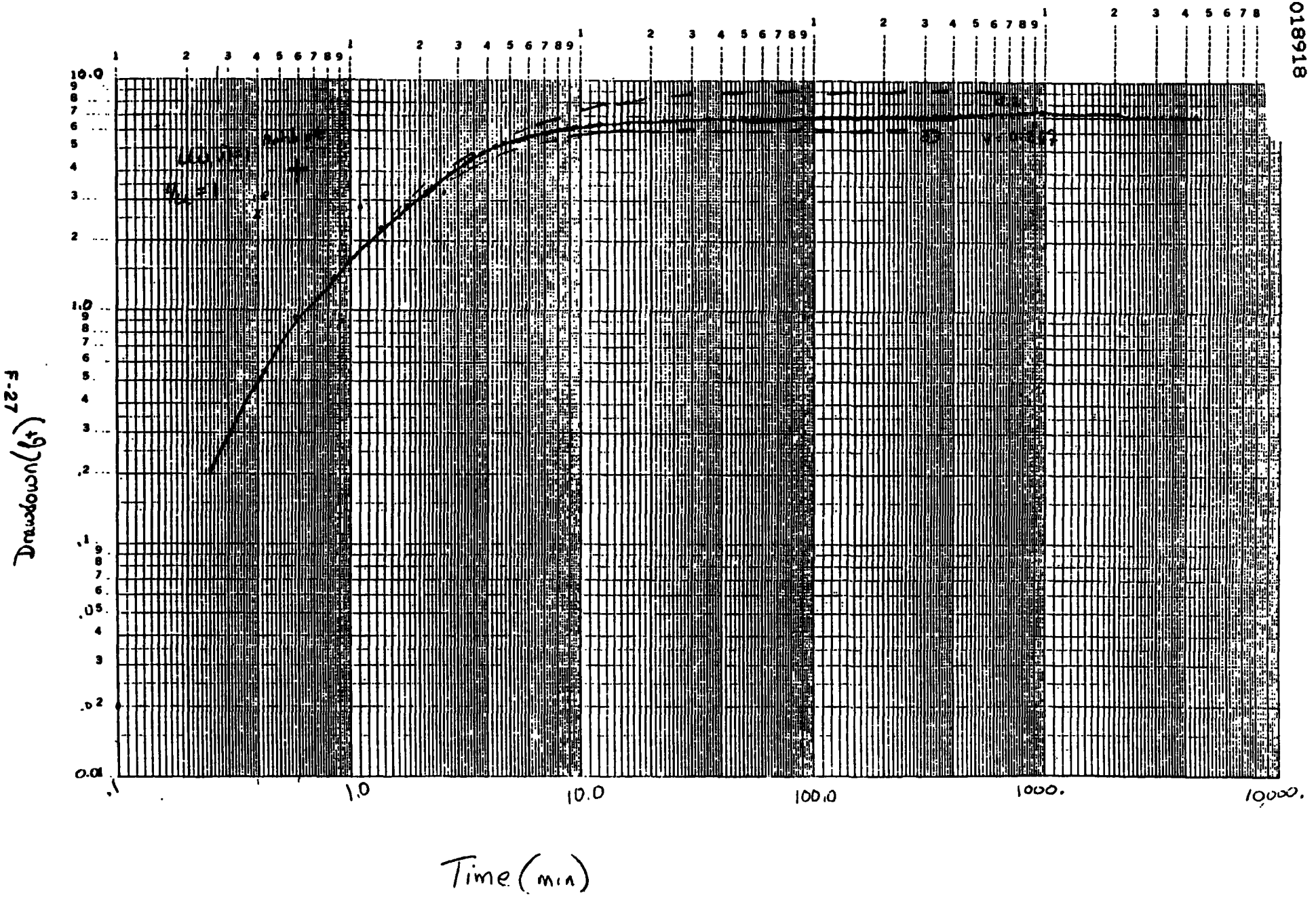
checked and changed 1/2/88

K+E LOGARITHMIC 3 x 5 CYCLES KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7520

MW-2

018918



F-27

018919

AQUIFER TEST DATA

Owner Sheridan Disposal Serv. Address Clarke Bottom Rd County Waller State Tx

Date 12/15/87 Company performing test ERM-SW Measured by Ritter/Woods/[illegible]

Well No. #28 Distance from pumping well 6.6' Type of test Constant Q Test No.

Measuring equipment Slope Indicator (Rental)

Time Data	Water Level Data	Discharge Data	Comments on factors affecting test data
Pump on: Date 12/15 Time 2:15 pm (t)	Static water level 32.10 13 (1/12/88 DEZ)	How Q measured flow meter	
Pump off: Date ____ Time ____ (t')	Measuring point TOC	Depth of pump/air line 92'	
Duration of aquifer test: Pumping ____ Recovery ____	Elevation of measuring point ____	Previous pumping? Yes ____ No ____ Duration ____ End ____	

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'	Minutes	Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	Rate		
12/15		6"			.10	32.15			.02					
		15"			.25	32.34			.21					
		25"			.42	32.68			.55					
		35"			.58	33.06			.93					
		51"			.85	33.52			1.39					
		1.06'			1.10	34.90			2.77					Bad measurement?
		1.21			1.35	34.38			2.25					
		1.44			1.73	34.95			2.82					
		2.00			2.00	35.17			3.04					
		2.08			2.13	35.36			3.23					
		2.18			2.3	35.59			3.46					
		2.27			2.45	35.68			3.55					
		2.37			2.62	35.39			3.26	—??				
		2.46			2.77	36.10			3.97					
		3.09			3.15	36.38			4.25					
		3.19			3.32	36.52			4.39					
		3.30			3.50	36.76			4.63					
		3.43			3.70	36.79			4.66					
		3.53			3.88	36.94			4.81					
		4.04			4.07	37.05			4.92					
		4.14			4.23	37.16			5.03					
		4.25			4.42	37.27			5.14					
		4.46			4.77	37.46			5.33					
		5.01			5.02	37.51			5.38					
		5.17			5.28	37.57			5.44					
		5.27			5.45	37.59			5.46					
		5.35			5.58	37.59			5.46					
		5.48			5.80	37.76			5.63					
		6.00			6.00	37.81			5.68					

pg 1 28

018920

AQUIFER TEST DATA

Owner Sheridan Address _____ County _____ State _____

Date 12/15/87 Company performing test _____ Measured by Ritter/Woods

Well No. 28 Distance from pumping well _____ Type of test _____ Test No. _____

Measuring equipment Slope Indicator (Rental)

Time Data
Pump on: Date _____ Time _____ (f:)
Pump off: Date _____ Time _____ (f:)
Duration of aquifer test:
Pumping _____ Recovery _____

Water Level Data
Static water level 32.131
Measuring point _____
Elevation of measuring point _____

Discharge Data
How Q measured _____
Depth of pump/air line _____
Previous pumping? Yes ____ No ____
Duration _____ End _____

Comments on factors affecting test data

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'	Minutes	Water level measurement	Correction or Conversion	Water level	Water level change s or s'	Discharge measurement	Rate		
12/15/87		6.10			6.17	37.83			5.70				
		6.22			6.37	37.88			5.75				
		6.35			6.58	38.04			5.81				
		6.48			6.8	38.00			5.87				
		7.05			7.08	38.07			5.94				
		7.12			7.2	38.10			5.97				
		7.20			7.33	38.11			5.98				
		7.32			7.53	38.16			6.03				
		7.42			7.7	38.19			6.06				
		7.50			7.83	38.19			6.06				
		8.0			8.0	38.22			6.09				
		8.10			8.17	38.27			6.14				
		8.19			8.32	38.26			6.13				
		8.30			8.5	38.30			6.17				
		8.40			8.67	38.31			6.18				
		8.50			8.83	38.33			6.20				
		9.0			9.0	38.35			6.22				
		9.10			9.17	38.35			6.22				
		9.17			9.28	38.37			6.24				
		9.26			9.43	38.38			6.25				
		9.39			9.65	38.41			6.28				
		9.51			9.85	38.41			6.28				
		11.00			11.00	38.52			6.39				
		12.00			12.00	38.57			6.44				
		14.00			14.00	38.65			6.52				
		16.00			16.00	38.70			6.57				
		18.00			18.00	38.77			6.64				
		20.00			20.00	38.79			6.66				
	*	23.00			23.00	38.86			6.73				

(#28) Pg 2

018921

AQUIFER TEST DATA

Owner Sheridan Address _____ County _____ State _____

Date 12/15/87 Company performing test _____ Measured by Watts/Diehl/Tofuri

Well No. #28 Distance from pumping well _____ Type of test _____ Test No. _____

Measuring equipment Slope Indicator (Rental) / Slope Indicator ERM-Sw#4

Time Data	Water Level Data	Discharge Data	Comments on factors affecting test data
Pump on: Date _____ Time _____ (t₁)	Static water level 32.13'	How Q measured _____	
Pump off: Date _____ Time _____ (t₂)	Measuring point _____	Depth of pump/air line _____	
Duration of aquifer test:	Elevation of measuring point _____	Previous pumping? Yes ____ No ____	
Pumping _____ Recovery _____		Duration _____ End _____	

START TIME 2:15 PM 12/15/87

ALL TIME SINCE START IN "MINUTES"

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	Rate		
		24.00				38.85			6.72					
		26.00				38.88			6.75					
		28.00				38.90			6.77					
		30.00				38.90			6.77					
		35.00				38.93			6.80					
		40.00				38.96			6.83					
		45.00				38.92			6.79					
		50.00				39.00 ~~40.00~~			6.87					
		55.00				39.01 ~~40.01~~			6.88					
		60.00				39.01 ~~40.01~~			6.88					
		70.00				39.02 ~~40.02~~			6.89					
		80.00				39.02 ~~40.02~~			6.89					
		90.00				39.02 ~~40.02~~			6.89					
		100.00				39.03 ~~40.03~~			6.90					
		110.00				39.04 ~~40.04~~			6.91					
		120.00				39.07 ~~40.07~~			6.94					
		130.00				~~39.08~~ ~~41.08~~			6.95					
		140.00				39.10 ~~40.11~~			6.97					
	2hr	35min	155.00			39.12 ~~40.12~~			6.99					
	2hr	50min	170.00			39.14 ~~40.14~~			7.01					
5:32 pm		197				39.17			7.04					
	6:06	231				39.18			7.05					
	6:36	261				39.22			7.09					
	7:06	291				39.2			7.07					
	7:39	324				39.21			7.08					ANT & IBW START
	8:08	353				39.25			7.12					
	8:37	382				39.26			7.13					
	9:06	411				39.29			7.16					
	10:05	470				39.27			7.14					

clock time

#28

pg 3

018922

AQUIFER TEST DATA

Owner _____ Address _____ County _____ State _____

Date _____ Company performing test _____ Measured by _____

Well No. 28 Distance from pumping well _____ Type of test _____ Test No. _____

Measuring equipment _____

Time Data
Pump on: Date 12/15/87 Time 2:15 PM (t.)
Pump off: Date _____ Time _____ (t')
Duration of aquifer test:
Pumping _____ Recovery _____

Water Level Data
Static water level 32.13'
Measuring point T.O.C.
Elevation of measuring point 1702.93

Discharge Data
How Q measured flow meter
Depth of pump/air line 92'
Previous pumping? Yes ____ No ____
Duration _____ End _____

Comments on factors affecting test data

Date	Clock time	Time since pump started (min) t	Time since pump stopped t'	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	GPM - Rate		
12/15/87	11:10	535				39.30			7.17'					
12/16/87	12:06	591				39.36'			7.23'					
	1:05	650				39.32			7.19'					
	2:09	709				39.39			7.26'					
	3:05	770				39.43			7.30'			9.43		AW-27 = 36.70' @ 3:07
	4:06	831				39.45			7.32'					
	5:07	892				39.43			7.30'					Moon 30° above E horizon
	6:13	958				39.45			7.32'					
	7:05	1010				39.42			7.29'					
	8:16	1071				39.44			7.31					(S R)
	9:01	1129				39.42			7.29					
	10:03	1188				39.44			7.31					
	11:04	1249				39.37			7.24					
PM	12:04	1309				39.35			7.20					
↓	1:00	1367				39.36			7.23					
	2:04	1429				39.37			7.24					
	4:05	1550				39.4			7.27					
	5:05	1670				39.43			7.30					
	6:12	1797				39.43			7.30					(AHT)
12/17/87	12:15A	2040				39.37			7.24			9.5 (12:38)		
	4:02A	2267				39.30			7.17			9.4 (0400)		
	5:04	2509				39.30			7.17					
	10:04	2749				39.31			7.18					
	4:04	2989				39.30			7.17					
	8:05	3230				39.30			7.17					DCJU
12/18	12:07	3472				39.36			7.17					Rem
	4:06	AM	3711			39.24			7.11					
	8:25	AM	3965			39.22			7.09					
	806	AM	4191			39.29			7.16					

(#28) p.4 F-31

checked DCV 4/6/88

Recovery test calculations - MW-28

Given $Q = 9.37$ gpm $= 1.25$ ft^3/min

$r = 6.6$ feet

$b' = 30$ feet (clay)

$b = 10$ feet (sand)

$$T = \frac{Q \cdot L(U,V)}{4\pi s}$$

at Match point $L(u,v) = 1$

$1/u = 1$; $v = 0.6$

$s = 1.1$ feet

$t = 1.39$ min

$$T = \frac{1.25 \text{ ft}^3/\text{min} \times 1}{4 \times \pi \times 1.1 \text{ ft}} = 9.04 \times 10^{-2} \text{ ft}^2/\text{min} = 974 \text{ gpd/ft}$$

if $b = 10'$, $K = 9.95 \times 10^{-3}$ cm/sec

$$S = 4T \frac{t/r^2}{1/u}$$

$$S = \frac{4 \cdot 9.04 \times 10^{-2} \text{ ft}^2/\text{min} \cdot 1.39 \text{ min}/(6.6 \text{ ft})^2}{1} = 1.15 \times 10^{-2}$$

$$K' = \frac{4 T v^2 b'}{r^2} = \frac{4 \times 9.04 \times 10^{-2} \text{ ft}^2/\text{min} \times (0.6)^2 \cdot 30 \text{ ft}}{(6.6 \text{ ft})^2} =$$

$$K' = 8.97 \times 10^{-2} \text{ ft/min} = 4.55 \times 10^{-2} \text{ cm/sec}$$

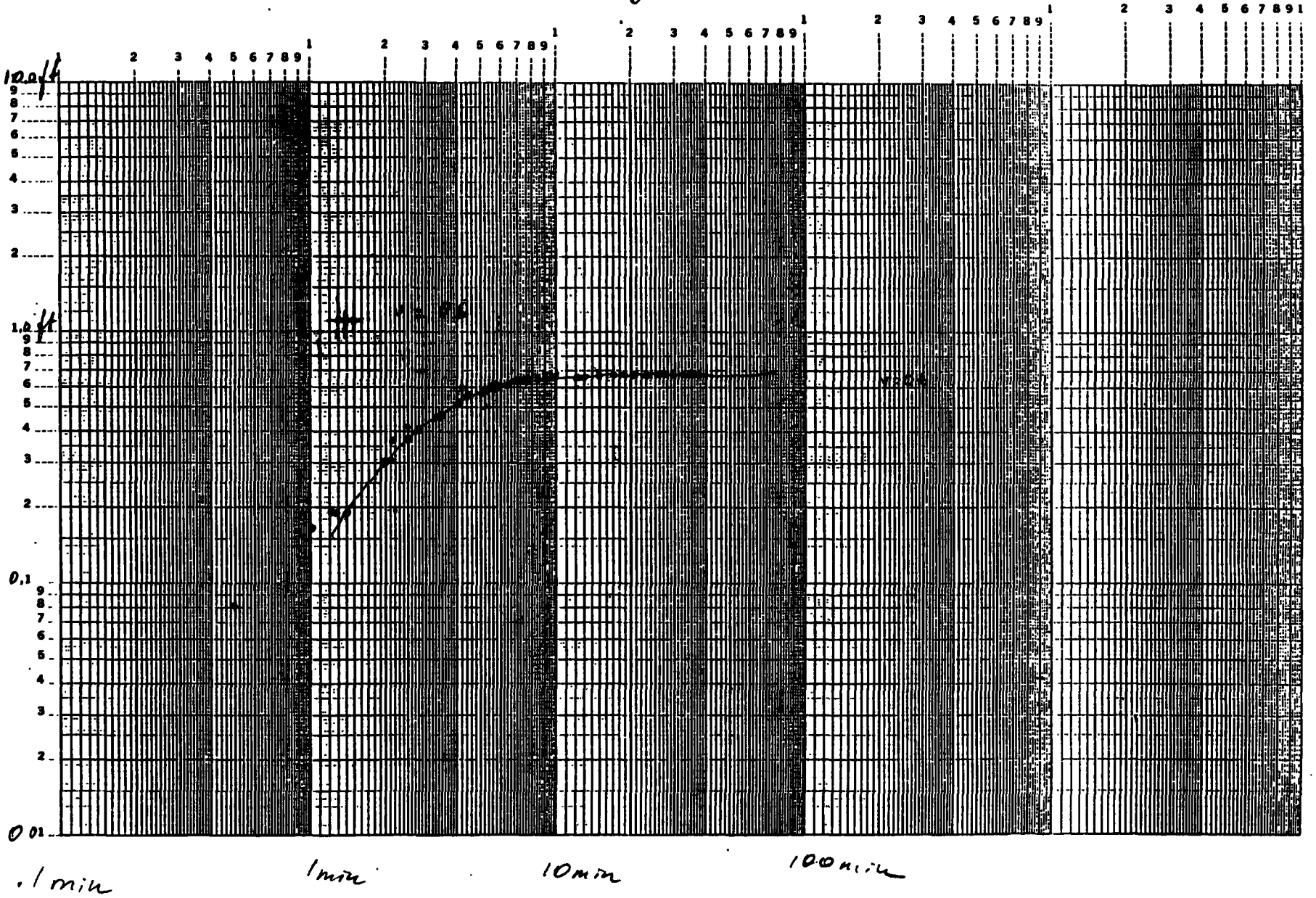
K&E LOGARITHMIC 3 x 5 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7520

Well 28

T = 6.6

Recovery curve



018924

F-33

018925

AQUIFER TEST DATA

Owner Sheridan Address Clark Bottom Rd County Waller State Tx

Date 12/18/87 Company performing test ERM-Southwest Measured by

Well No. 28 Distance from pumping well 6.6' Type of test Recovery Test No.

Measuring equipment Slope Indicator

Time Data
Pump on: Date ____ Time ____ (t1)
Pump off: Date 12/18 Time ____ (t2)
Duration of aquifer test:
Pumping ____ Recovery ____

Water Level Data
Static water level 32.13 (39.27)
Measuring point TOC
Elevation of measuring point 170.03

Discharge Data
How Q measured
Depth of pump/air line
Previous pumping? Yes ____ No ____
Duration ____ End ____

Comments on factors affecting test data

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'	Water level measurement	Correction or Conversion	Water level	Water level change s or s'	s-s'	Discharge measurement	Rate	
				min				feet	feet			
12/18	9:10	4011			39.27							
			.30'	0.50	8023	39.19			.08	7.06		
	9:20	4012	1.00	1.00	4012	37.66			1.61	5.53		
			1.24	1.40	2866	37.35			1.92	5.22		
		4013	2.00	2.05	1977	36.26			3.01	4.13		
			2.30	2.50	1605	35.51			3.76	3.38		
			2.50	2.83	1418	35.09			4.19	2.95		
		4014	3.30	3.50	1147	34.57			4.70	2.44		
		4015	4.30	4.17	963	33.23			5.04	2.10		
			4.47	4.45	902	33.73			5.54	1.60		
		4016	5.13	5.23	769	33.41			5.86	1.29		
			5.42	5.70	705	33.25			6.02	1.12		
		4017	6.15	6.25	643	33.1			6.17	.97		
			6.55	6.92	581	33.0			6.27	.87		
		4018	7.24	7.40	543	32.89			6.38	.76		
			7.54	7.90	509	32.83			6.44	.70		
		4019	8.40	8.67	464	32.75			6.52	.62		
		4020	9.03	9.05	444	32.73			6.55	.59		
			9.32	9.53	422	32.69			6.59	.55		
		4021	10.03	10.05	400	32.65			6.62	.52		
			10.35	10.58	380	32.63			6.64	.50		
		4023	12.0	12.0	335	32.56			6.71	.43		
		4024	13.0		310	32.58			6.69	.45		
		4026	15.0		268	32.48			6.79	.35		
		4028	17.0		237	32.45			6.82	.32		
		4030	19.0		212	32.43			6.84	.30		
		4032	21.0		192	32.40			6.87	.27		
		4034	23.0		175	32.38			6.89	.25		

32.13

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018926

AQUIFER TEST DATA

Owner ~~Sheridan~~ Address Clark Bottom Rd County Waller State Tx

Date 12/18/87 Company performing test ERM-Southwest Measured by

Well No. 28 Distance from pumping well 16.6' Type of test Recovery Test No.

Measuring equipment Slope Indicator

Time Data
Pump on: Date ____ Time ____ (I:)
Pump off: Date ____ Time ____ (I':)
Duration of aquifer test:
Pumping ____ Recovery ____

Water Level Data
Static water level 29.27'
Measuring point TOC
Elevation of measuring point ____

Discharge Data
How Q measured ____
Depth of pump/air line ____
Previous pumping? Yes ____ No ____
Duration ____ End ____

Comments on factors affecting test data

Date	Clock time	Time since pump started t	Time since pump stopped t'	Δr	t/t'	Water level measurement	Correction or Conversion	Water level	Δ-Δ' Water level change s or s'	Δ'	Discharge measurement	Rate		
12/18			0.0 ✓						feet					
		4037	26.0		155	32.36			6.91	.23				
		4039	28.0		149	32.31			6.96	.18				
		4041	30.0		135	32.31			6.96	.19				
		4046	35.0		116	32.31			6.95	.19				
		4051	40.0		101	32.30			6.97	.17				
		4054	45.0		90	32.28			6.99	.15				
		4061	50.0		81									

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018927

ERM-Southwest, inc.

MW-24

TCES pump started 12/15/87 @ 2:15 PM

By _____ Date _____ Subject Pump Test - Sheridan Sheet No. _____ of _____

Chkd By _____ Date _____ Shallow Aquifer W.O. No. _____

Static WL = 30.55 (12/15/87)
TOC 168.81

DATE	Clock Time	Time Since Pump Began (min)	WATER LEVEL	WATER Level change	
12/15	3:45 pm	90	30.55	0	
	4:15	120	31.54	(Should be 30.54) NOTE	DEW
	5:40 pm	205	30.57	-0.02	
	8:38 pm	383	30.54'	+.01	(AHT) Used slope Rental E.T.
12/16/87	12:08	593	30.55'	-0-	
	3:09	774 min	30.55'	-0-	35
	6:23	968	30.53'	+.02	
	8:09	1074	30.58'	-.03	(S R)
	10:07	1192	30.58'	-.03	
	12:14 pm	1319	30.56'	-.01	
	2:18	1440	30.59	-.04	
	4:15	1560	30.57	-.02	
	6:15	1680	30.60	-.05	
	8:19	1804	30.54	+.01	(AHT)
12/17/87	12:23 A	2048	30.55	-0-	
	4:07 A	2294	30.57	-.02	
	8:11	2516	30.58	-.03	
	12:10		30.57	-.02	
	4:10		30.57	-.02	
	8:12		30.56	-.03	DEW
12/18	12:15 AM		30.56	-.03	Rain / cold
	4:15 AM		30.57	-0.02	
	8:12		30.58		

MW-24

018928

ERM-Southwest, inc. MW-25

pumping started TUES 2:15 PM 12/15/87

By _____ Date _____ Subject Pump Test Sheridan Shallow Aquifer Sheet No. _____ of _____

Chkd By _____ Date _____ W.O. No. _____

Static WL = 30.59 (12/15/87)
TOC 169.85

DATE	Clock TIME	Time Since Pump Started	WATER LEVEL	Change in Water Level from static	
12/15/87	8:40 PM	385	30.58	+0.01	(AHT) used rental E.T.
12/16/87	12:10 AM	595	30.59'	-0-	
	3:11	776 min	30.59'	-0-	
	6:25	970	30.48'	+0.11	Measured tower, both same
	8:14	1079	30.62	-.03	(S R)
	10:10	1203	30.61	.02	
	12:17 PM	1330	30.60	-.01	
	2:17	1450	30.61	-.02	
	4:17	1570	30.60	-.01	
	6:17	1692	30.63	.04	
	8:21	1806	30.59	0	(AHT)
12/17/87	12:24 A	2049	30.57	+.02	
	4:11 A	2276	30.58	+.01	
	8:14	2519	30.60	-.01	
	12:14		30.60	-.01	
	4:14		30.60	-.01	
	8:15 PM		30.59	0.00	DCW
12/18 →	12:17 PM		30.59	0.00	
	4:15 AM		30.59	0.00	
	8:13		30.61		

MW-25

018929

MW-29

EKM-Southwest, inc.

pump started TUES 12/15/87 2:15 PM

By _____ Date _____ Subject Pump Test - Sheridan Sheet No. _____ of _____

Chkd By _____ Date _____ Shallow Aquifer W.O. No. _____

Static WL = 31.30
TOC 69.58

DATE	Clock Time	Time Since Pump Started	WATER LEVEL	change in water level from static	
12/15/87	8:41 PM	386	31.30'	-0-	(ANT) and initial E.T.
12/16/87	12:12 AM	597	31.30'	-0-	
	3:12 AM	777 min	31.29'	+0.01	
	6:28	975	31.29'	+0.01	
	8:17	1114	31.33'	-.03	(E)
	10:13	1160	31.32'	-.02	
	12:16 PM	1386	31.31	-.01	(E)
	2:19	1506	31.32	-.02	
	4:18	1625	31.33	-.03	
	6:18	1693	31.30	.0	
	8:22	1807	31.29	+.01	(ANT)
12/17/87	12:25A	2050	31.30	0	
	4:12 A	2277	31.30 (31.30 ANT)	0	
	8:12	2517	31.32	-.02	
	12:12		31.32	-.02	
	4:12		31.31	-.01	
	8:16 P		31.30	.00	DCLW
12/18	12:18 AM		31.31	+0.01	
	4:18 AM		31.30	0.00	
	8:15		31.31		

MW-29

018930

ERM-Southwest, inc.

Well MW-21

TUES

pumping start = 2:15 PM (12/15)

By _____ Date _____ Subject W.L. Measurements Sheet No. _____ of _____

Chkd By _____ Date _____ Pump Test - Shallow Aquifer W.O. No. _____

Static W.L. = 30.87 (12/15/87)

TOC 169.16

DATE	Clock Time	Time Since Start Pump	WATER LEVEL	water level change from static	
12/15/87	8:43 PM	365	30.78	+0.09	Checked twice - ANT - used Slope rental G.T.
12/16/87	12:14 AM	599	30.81	+0.06	
	3:14 AM	779 min	30.89	-0.02	Checked twice, both times
	6:30	977	30.89	-0.02	
	8:21	1119	30.93	-.06	(DJR)
	10:16	1263	30.92	-.05	
	12:20 PM	1387	30.87	-0-	
	2:22	1509	30.93	-.06	
	4:21	1628	30.92	-.05	
	6:21	1748	30.81	+.06	
	8:23	1870	30.81	+.06	(ANT)
12/17/87	12:26 A	2053	30.90	-.03	
	4:13 A	2279	30.89	-.02	
	8:16	2524	30.81	+.06	
	12:16		30.80		
	4:16		30.80		
	8:17 P		30.91	-.04	DCW
12/18	12:18 A		30.90	-.03	
	4:20 A		30.80	-0.07	
	8:17		30.57		

MW-21

018931 ~~006196~~

MW-23 start pump 12/15/87 @ 2:15 PM TUES

ERM-Southwest, inc.

By _____ Date _____ Subject Pump Test - Sheridan Sheet No. _____ of _____

Chkd By _____ Date _____ Shallow Aquifer W.O. No. _____

Static W.L. = 30.28
TOC 1008.49

DATE	Clock Time	Time Since Pump Start	Water Level	Water Level Change From static	
12/15/87	8:16 PM	391	30.16	+0.12'	AHT - used control C.T.
12/16/87	12:16 AM	601	30.24	+0.04'	Checked twice, both same
	3:15 AM	780 min	30.28	-0-	Checked twice, both same
	6:31	978	30.20	+0.08'	Checked twice, both same
	8:24	1121	30.27	+.01	(S R)
	10:18	1235	30.3'	-.02	
	12:24 PM	1361	30.21'	+.07	
	2:24	1511	30.30'	-.02	
	4:27	1630	30.28'	.00	
	6:27	1488	30.29	-.01	
	9:24	1809	30.27	+.01	(AHT)
12/17/87	12:27 A	2052	30.20	+.08	
	4:14 A	2279	30.16	+.12	
	8:17	2522	30.27	+.01	
	12:17		30.21	+.07	
	4:17		30.27	+.01	
	8:20		30.26	+.02	DCW
12/18	12:20A		30.29	-.01	
	4:20PM		30.26	+0.02	
	8:18		30.29		

MW-23

018932 ~~006197~~ Pumping Well Page 1 of 1

AQUIFER TEST DATA

Owner Sheridan Disposal Service Address _____ County _____ State _____

Date 12/15/87 Company performing test _____ Measured by AHT/JBW TBD/STR

Well No. #20 Distance from pumping well 0 Type of test pump - Constant Q Test No. _____

Measuring equipment Slope Indicator

Time Data
Pump on: Date 12/15 Time 2:15 pm (t:)
Pump off: Date _____ Time _____ (t':)
Duration of aquifer test:
Pumping _____ Recovery _____

Water Level Data
Static water level 31.90'
Measuring point T.O.C.
Elevation of measuring point 169.82

Discharge Data
How Q measured flow meter
Depth of pump/air line 92'
Previous pumping? Yes ____ No ____
Duration _____ End _____

Comments on factors affecting test data

Date	Clock time	Time since pump started t	Time since pump stopped t'	t/t'		Water level measurement	Correction or Conversion	Water level	Water level change s or s'		Discharge measurement	Rate		
														START TIME 2:15 PM 12/15/87
12/15		30.10				57.05			25.15					
		31.00				57.17			25.27			9.37 gpm		
	5:08 pm	195				57.73			25.83			9.23 gpm		
	6:50 pm	275				57.80			25.90					
	10:53 pm	518				58.16			26.26			9.24		
12/16/87	1:08 am	653				57.77			25.87			9.52 GPM 9.49 GPM		Adjust valve - close a bit
	4:08	833				58.59			26.69					
	6:19	964				58.54			26.65			9.4 (6:30)		MW-27, 6:21, 36.70'
	8:09	1314				58.26			26.37			9.38 gpm		(SSR)
	8:26	1431				58.18			26.28			9.35 gpm		
	2:20 pm	1509				58.22			26.32			9.41 gpm		
	4:10	1559				58.24			26.44			9.41 gpm		
	6:10	1675				58.42			26.53					
	8:15	1800				58.41			26.51					(AHT)
12/17/87	12:16 am	2041				57.90			26.00					
	4:05	2270				57.55			25.65		65.74 sec	9.41		
	8:27	2512				57.54			25.64					
	12:07	2752				57.53			25.63					
	4:07	2992				57.48			25.58					
	8:09	3234				57.54			25.64		10 gal/64.4 sec	9.32		TDW
12/18	12:08	3473				57.55			25.65		10 gal/64.4 sec	9.37		Rain
	4:10	A 3715				57.46			25.56		10 gal/64.15	9.35		Rain
	6:20	AM 3845				57.47			25.57					
	8:10		3953			57.55			25.65					

(420) p.1

018933 ~~106198~~

Pumping Test Flow Rates - MW-20

Start time 14:15 PM on 12/15/87

Date + Time	Time (min) Since Pump Started	Flow Rate (gpm)
12/15 14:15	3	9.52
	30	9.37
	35	9.38
	53	9.23
	70	9.23
	85	9.23
	110	9.23
	132	9.23
17:15	180	9.23
18:00	225	9.26
18:50	275	9.26
19:40	325	9.26
21:10	415	9.24
22:10	475	9.24
12/16 00:19	604	9.34
01:08	653	9.82
	Adjusted to	9.49
02:06	711	9.43
03:20	785	9.43
05:25	910	9.43
06:50	995	9.37
08:00	1065	9.45
09:36	1161	9.40
11:55	1360	9.38
12:55	1360	9.34
14:15	1540	9.35

Date + Time	Time (min) Since Pump Started	Flow Rate (gpm)
12/16 1520	1505	9.41
16:25	1570	9.41
18:00	1665	9.43
20:45	1830	9.32
22:00 (2400)	1905 (2025)	9.41
12/17 0028	2053	9.50
02:00	2145	9.45
04:05	2280	9.41
05:00	2325	9.38
07:00	2445	9.40
08:00	2505	9.40
10:00	2625	9.38
12:06	2751	9.39
14:30	2895	9.37
17:00	3045	9.36
19:09	3174	9.32
22:15 (2400)	3360 (3465)	9.52
12/18 0020	3485	9.37
02:15	3600	9.38
04:20	3725	9.35
06:10	3835	9.34
09:06	4011	Pump off

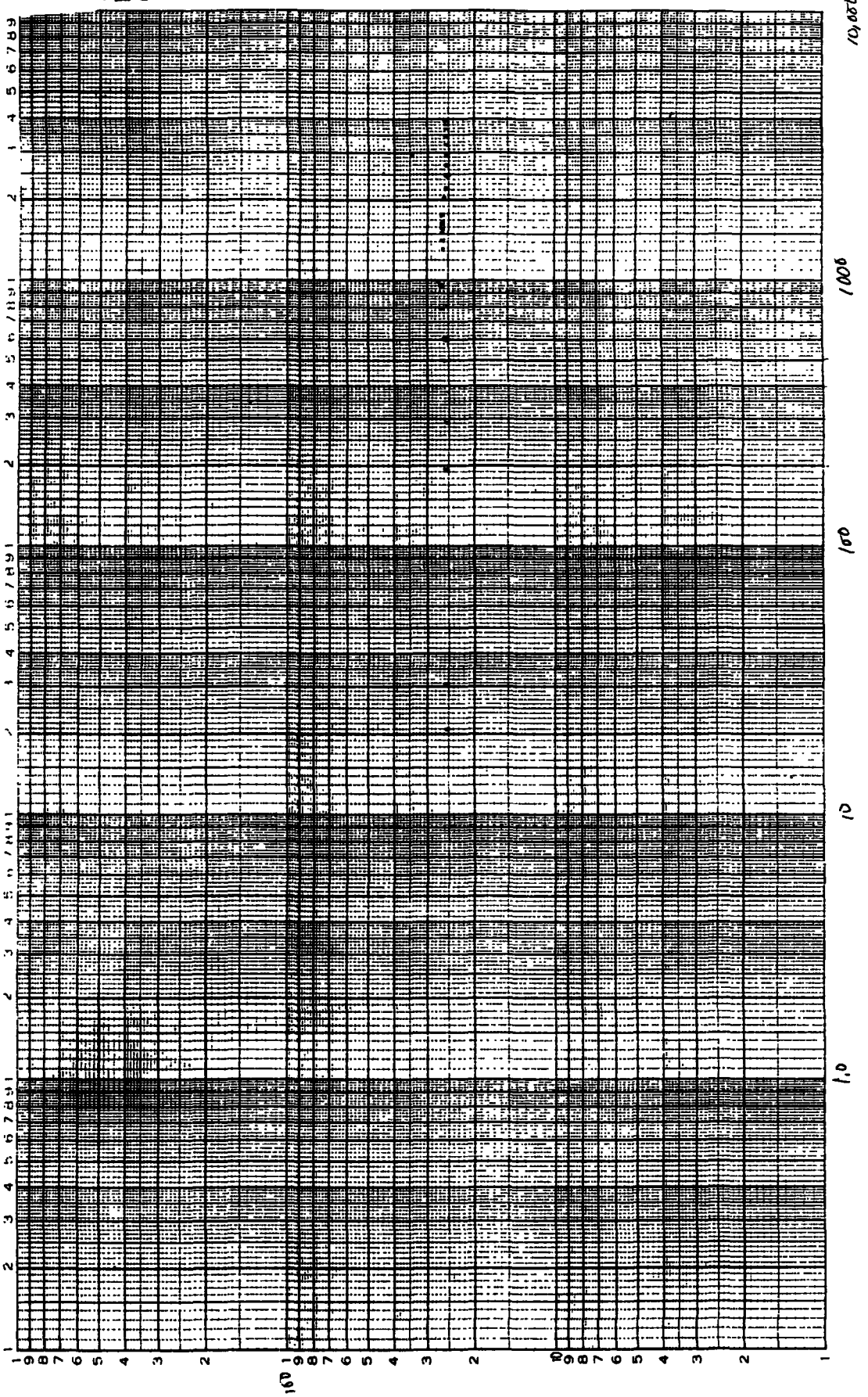
Average gpm = 9.37 for 47 values

018934

~~199~~

PUMP TEST

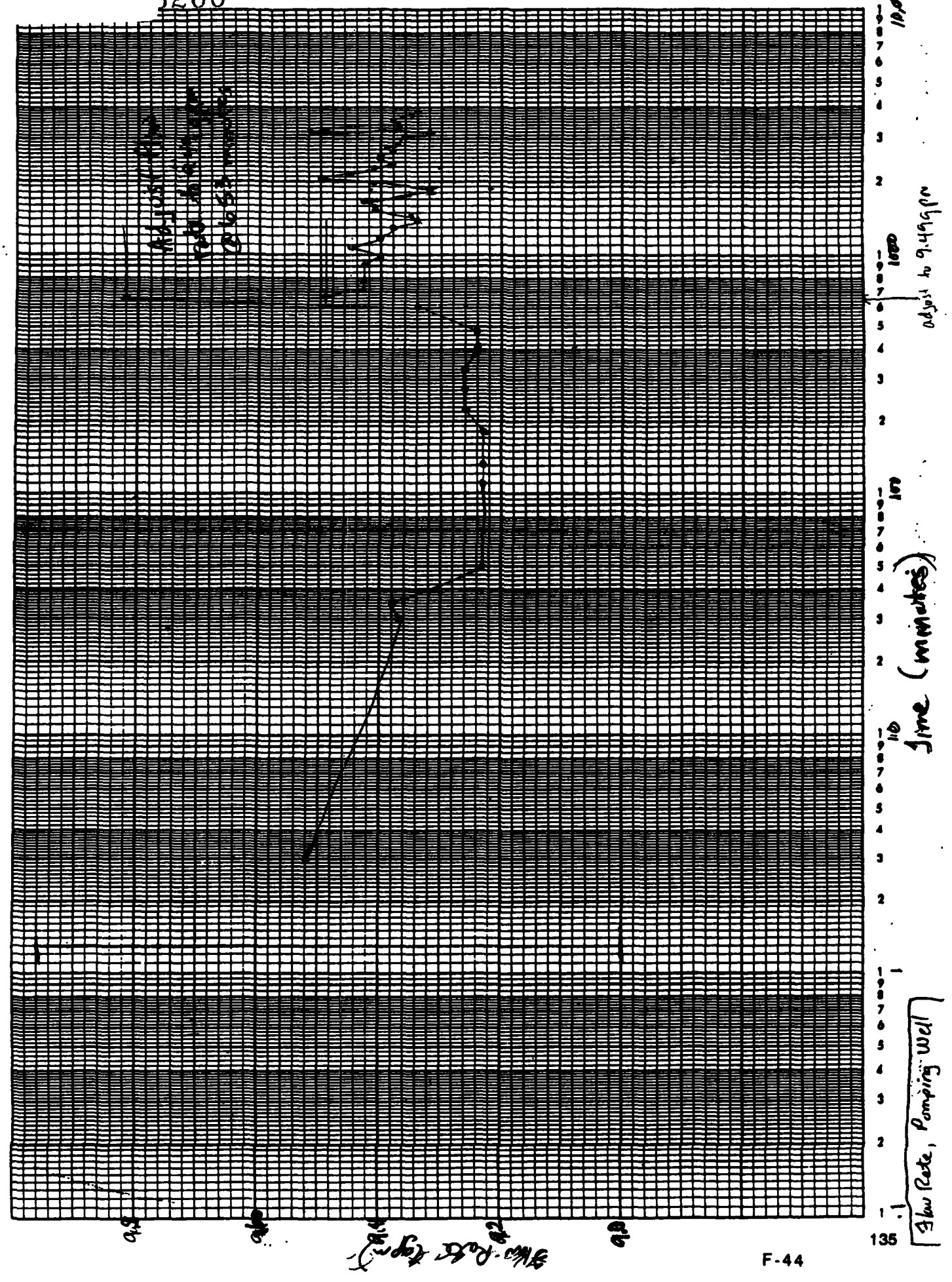
MW-20 - pumping well



Drawdown (ft)

Full Logarithmic, 3 × 5

018935



018936

~~6201~~

APPENDIX G-1

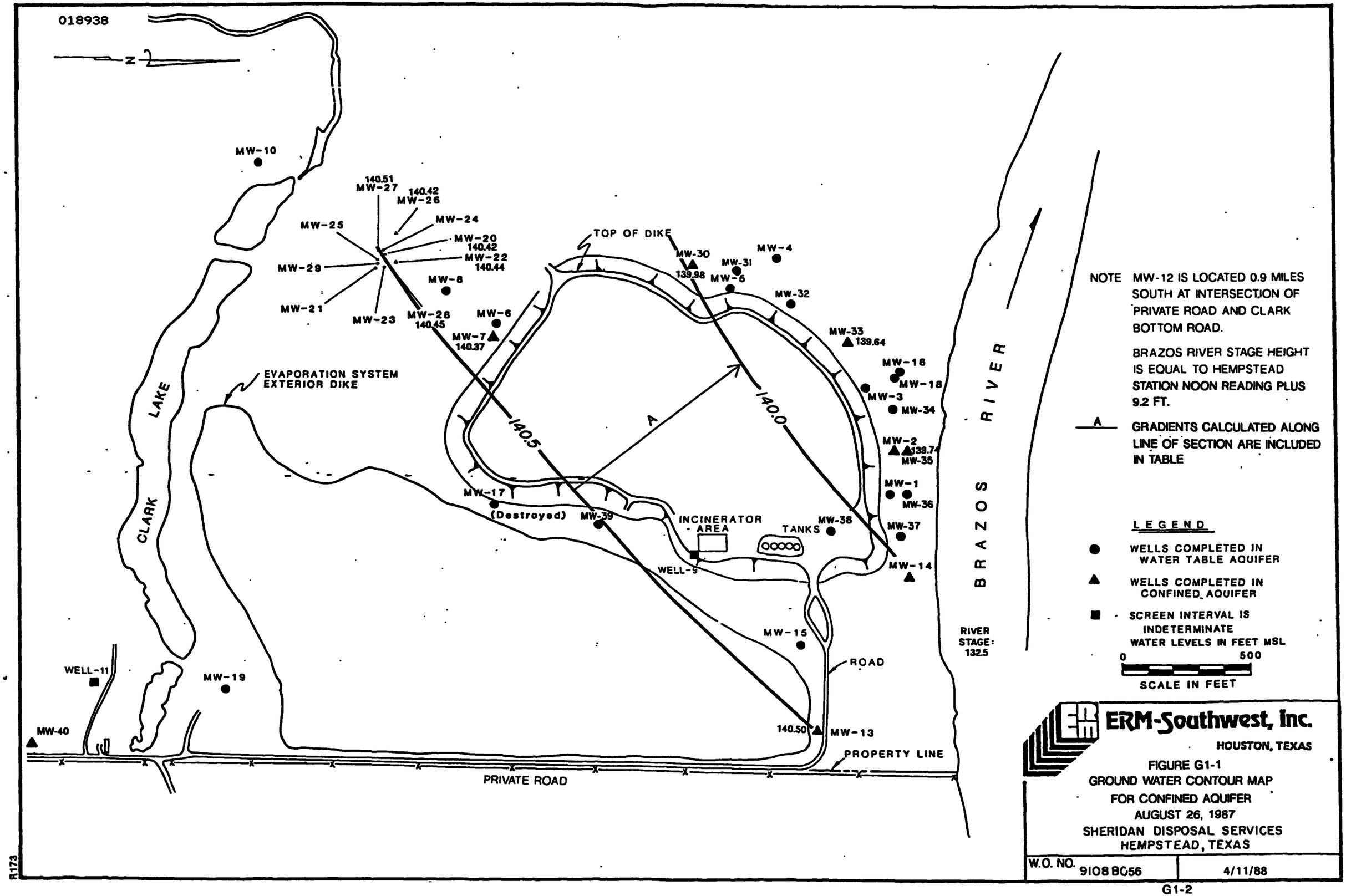
Ground Water Contour Maps of the Confined Aquifer (Stratum B)

8/87 through 2/88

ADDENDUM TO APPENDIX G-1

Summary of Gradient Calculations in the Confined Aquifer Can Be Found in Table 3-16

018938



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

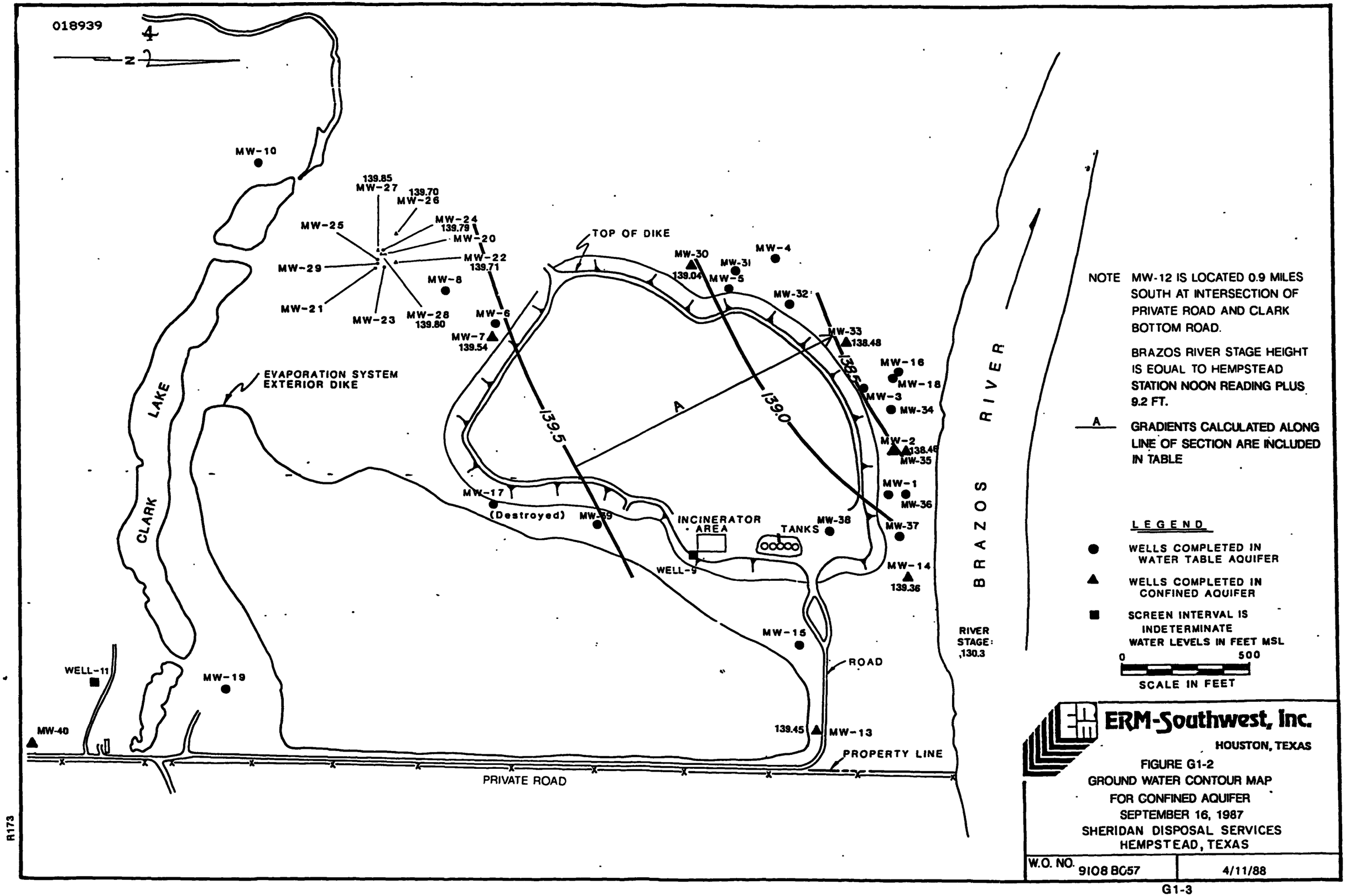
HOUSTON, TEXAS

FIGURE G1-1
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
AUGUST 26, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B056	4/11/88

R173

018939



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

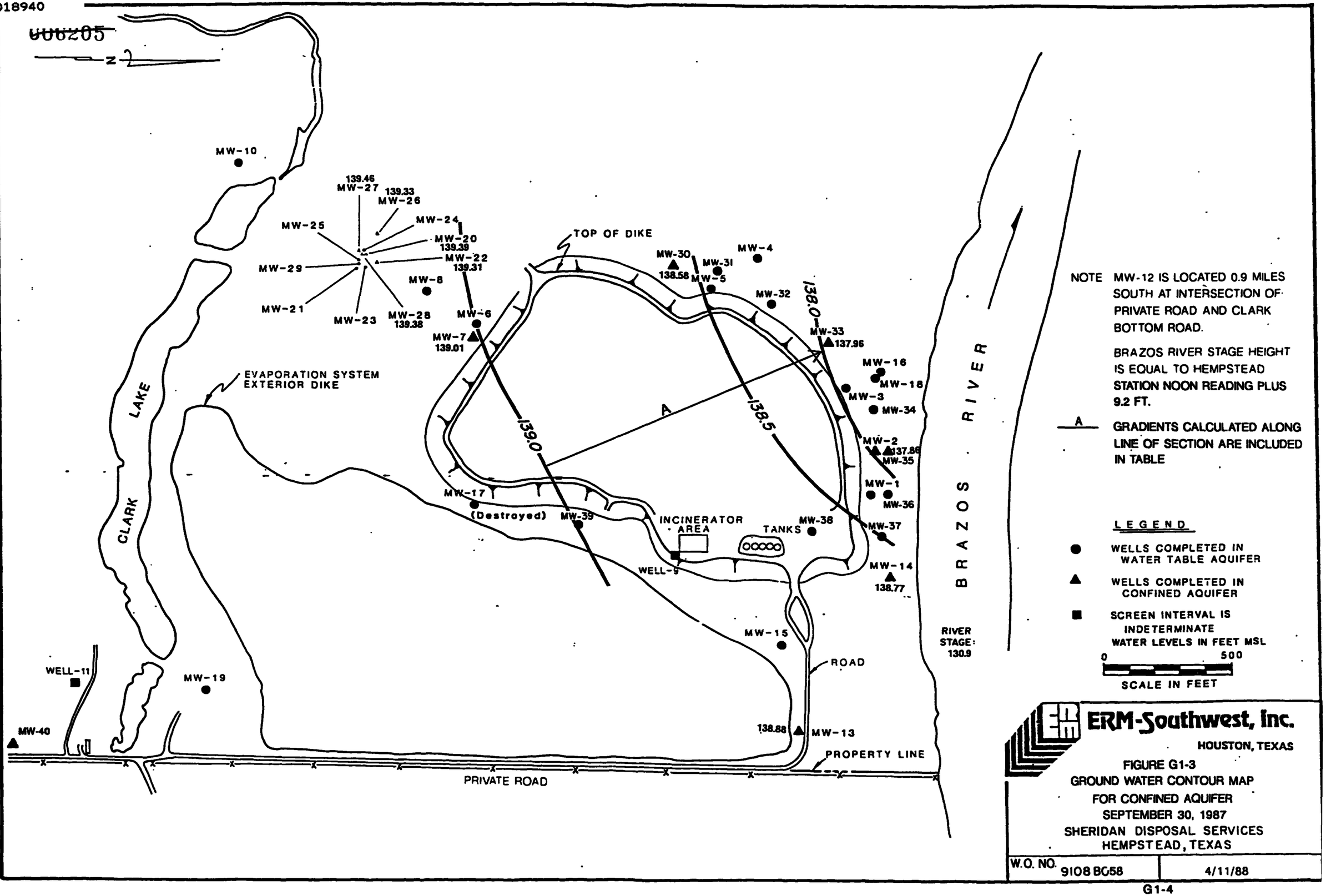
FIGURE G1-2
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
SEPTEMBER 16, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 BC57	4/11/88

R173

~~006205~~

z2



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

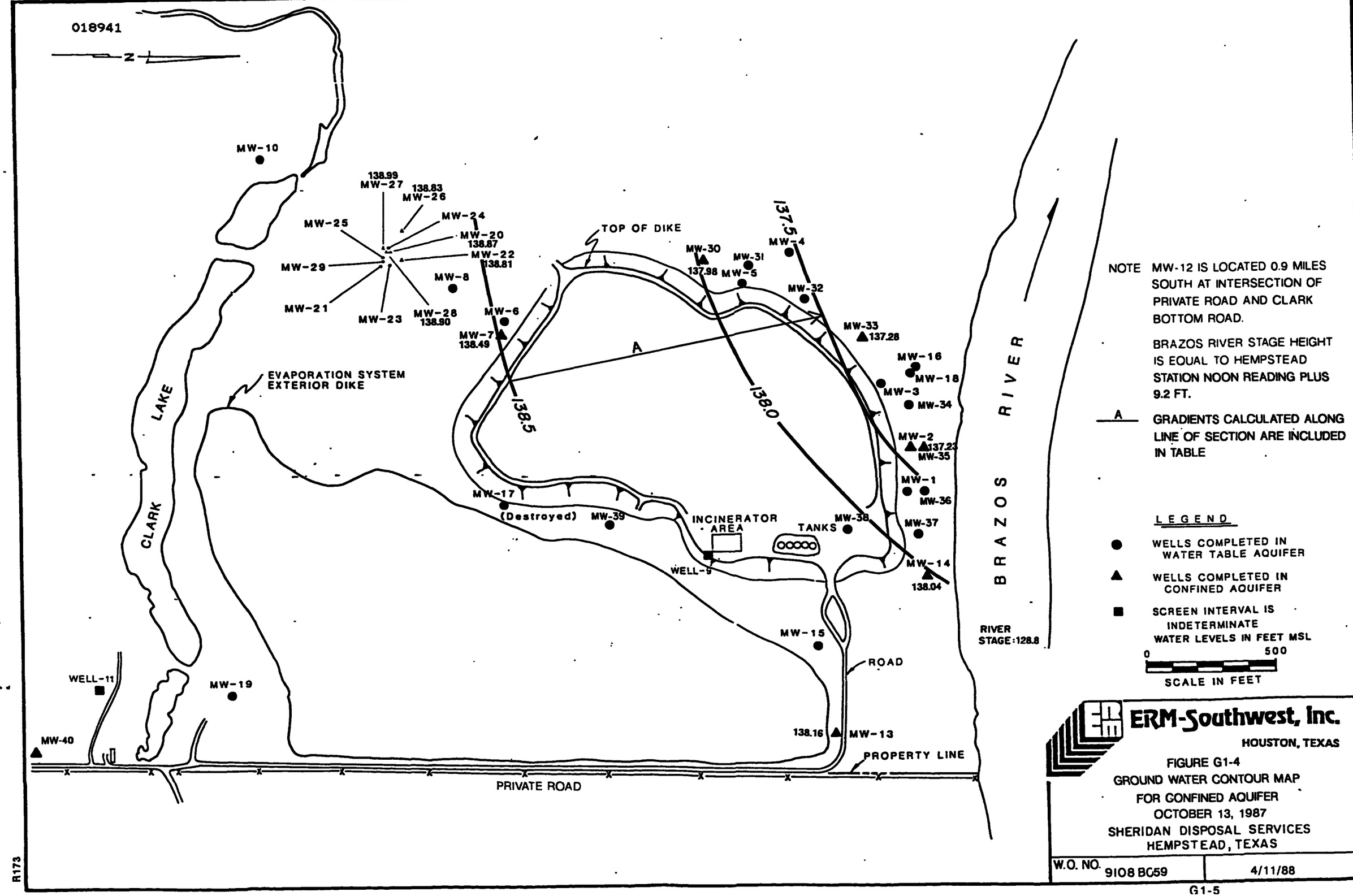
HOUSTON, TEXAS

FIGURE G1-3
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
SEPTEMBER 30, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 8058	4/11/88

R173

018941



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

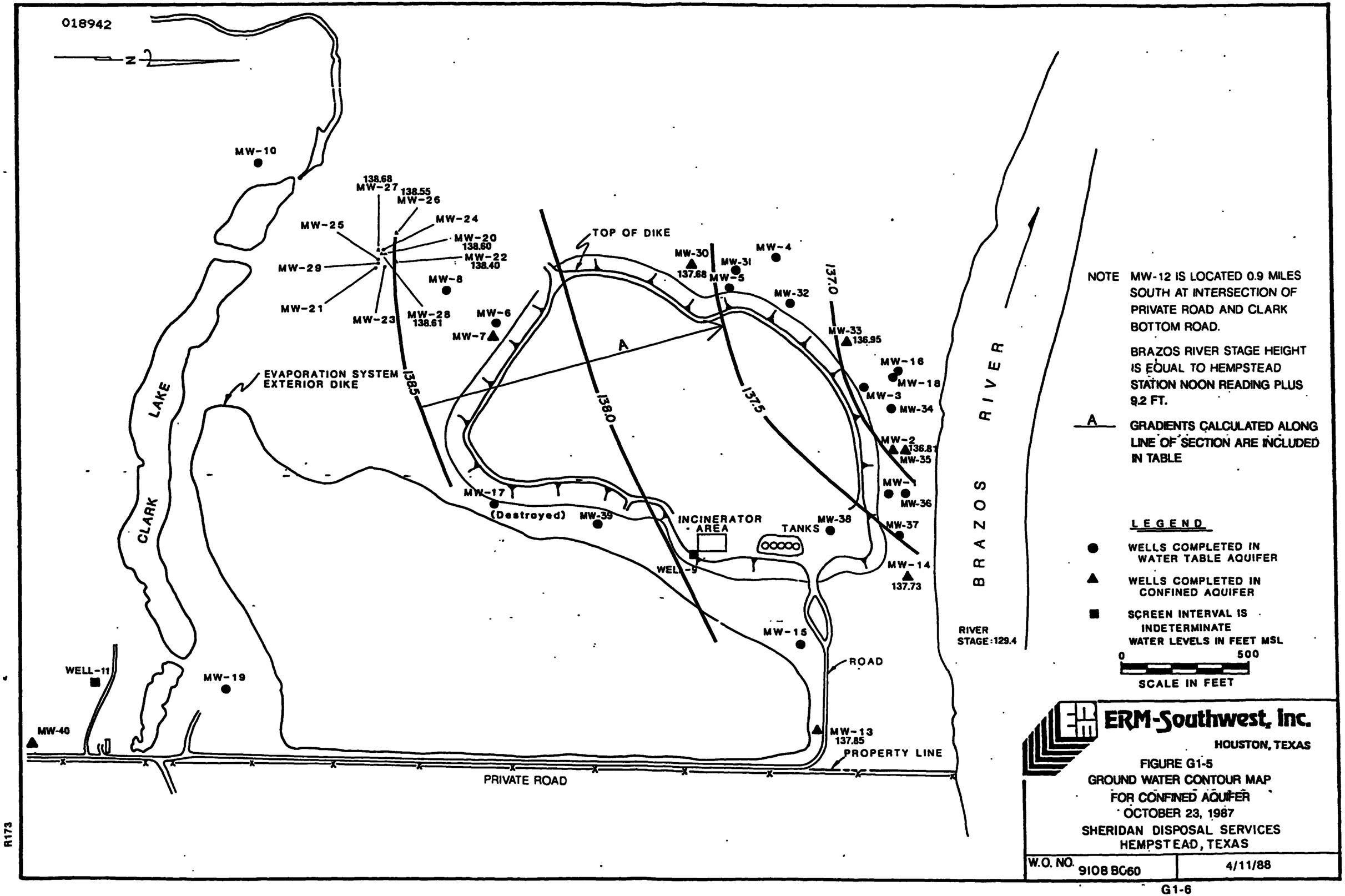
HOUSTON, TEXAS

FIGURE G1-4
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
OCTOBER 13, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 BC59	4/11/88

R173

018942



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE G1-5
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
OCTOBER 23, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B060	4/11/88

R173

018943

MW-10

138.31
MW-27
138.17
MW-26
MW-24
138.19
MW-20
MW-25
MW-22
138.08
MW-29
MW-8
MW-21
MW-23
MW-28
138.21
MW-6
MW-7
137.78

TOP OF DIKE

137.23
MW-30
MW-4
MW-31
MW-5
MW-32
MW-33
136.41
MW-16
MW-18
MW-3
MW-34
MW-2
136.26
MW-35
MW-1
MW-36
MW-37
MW-14
137.26

EVAPORATION SYSTEM
EXTERIOR DIKE

LAKE CLARK

137

138

139

140

A

MW-17
(Destroyed)
MW-39
INCINERATOR
AREA
TANKS
MW-38
WELL-9
MW-15
ROAD
MW-13
137.36
PROPERTY LINE

WELL-11
MW-19
MW-40
140.59

PRIVATE ROAD

BRAZOS RIVER

RIVER
STAGE: 129.4

NOTE. MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500
SCALE IN FEET

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE G1-6
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
NOVEMBER 10, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 BG61	4/11/88

R173

018944

N 2

MW-10

138.20
MW-27
138.06
MW-26
MW-24
MW-25
MW-20
138.11
MW-22
138.05
MW-29
MW-8
MW-21
MW-23
MW-28
138.07
MW-6
MW-7
137.66

TOP OF DIKE

137.13
MW-30
MW-31
MW-5
MW-4
MW-32
136.34
MW-33
MW-16
MW-18
MW-3
MW-34
MW-2
MW-35
136.24
MW-1
MW-36
MW-37
MW-14
137.15

EVAPORATION SYSTEM
EXTERIOR DIKE

LAKE

CLARK

A

137

138

139

140

MW-17
(Destroyed)
MW-39

INCINERATOR
AREA

TANKS
MW-38

WELL-9

MW-15

ROAD

WELL-11

MW-19

MW-40
140.50

MW-13
137.35

PROPERTY LINE

PRIVATE ROAD

BRAZOS RIVER

RIVER
STAGE: 130.2

NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500
SCALE IN FEET

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE G1-7
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
NOVEMBER 18, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 BG62	4/11/88

R173

018945

MW-10

138.23
MW-27

138.09
MW-26

MW-24

MW-25

MW-20
138.13

MW-22
138.07

MW-29

MW-8

MW-21

MW-23

MW-28
138.13

MW-6

MW-7
137.70

TOP OF DIKE

MW-30
137.15

MW-31

MW-5

MW-4

MW-32

MW-33
136.32

MW-16

MW-18

MW-3

MW-34

MW-2
136.23

MW-35

MW-1

MW-36

MW-37

MW-14
137.19

EVAPORATION SYSTEM
EXTERIOR DIKE

LAKE

CLARK

137

139

138

140

A

MW-17
(Destroyed)

MW-39

INCINERATOR
AREA

TANKS

MW-38

WELL-9

MW-15

ROAD

WELL-11

MW-19

MW-40
140.74

MW-13
137.40

PROPERTY LINE

PRIVATE ROAD

BRAZOS RIVER

RIVER
STAGE: 130.6

NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

R173

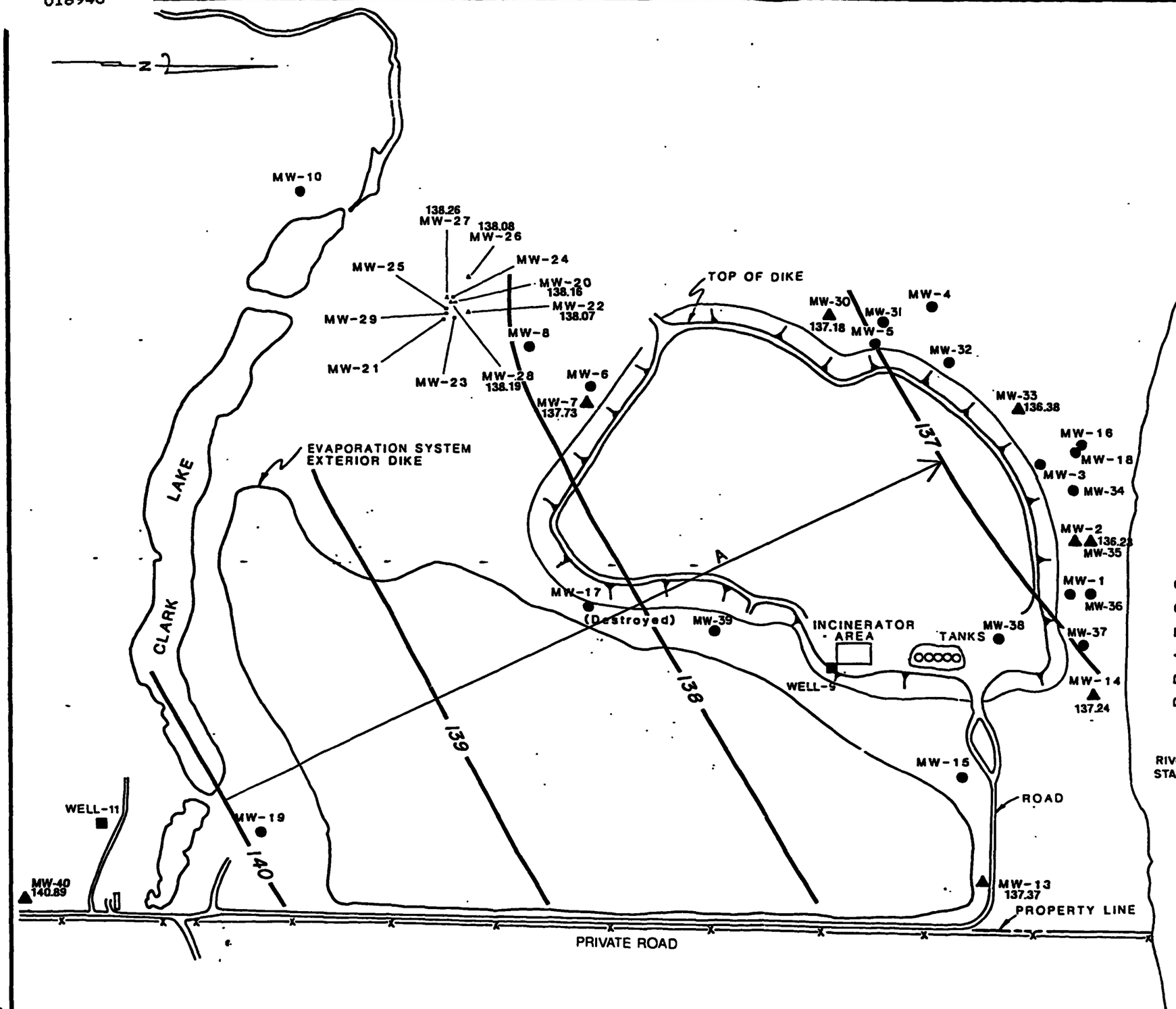
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE G1-8
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
DECEMBER 2, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 BG45	4/11/88

018946



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE G1-9
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
DECEMBER 23, 1987
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO.	
9108 8063	4/11/88

R173

018947

MW-10

138.34
MW-27
138.24
MW-26
MW-24
MW-25
MW-20
138.29
MW-22
138.19
MW-29
MW-8
MW-21
MW-23
MW-28
138.30
MW-6
MW-7
137.87

TOP OF DIKE

MW-30
137.28
MW-31
MW-5
MW-4
MW-32
MW-33
136.48
MW-16
MW-18
MW-3
MW-34
MW-2
136.33
MW-35
MW-1
MW-36
MW-37
MW-14
137.35

EVAPORATION SYSTEM
EXTERIOR DIKE

LAKE

CLARK

A

137
138
139
140
141

MW-17
(Destroyed)
MW-39
INCINERATOR
AREA
TANKS
MW-38
WELL-9
MW-15
ROAD
MW-13
137.54
PROPERTY LINE

WELL-11
MW-19
MW-40
141.30

PRIVATE ROAD

BRAZOS RIVER

RIVER
STAGE: 131.7

NOTE: MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500
SCALE IN FEET

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE G1-10
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
JANUARY 6, 1988
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B064

R173

018948

MW-10

138.17
MW-27
138.01
MW-26
MW-24
MW-25
MW-20
138.09
MW-22
138.02
MW-29
MW-8
MW-21
MW-23
MW-28
138.10
MW-6
MW-7
137.67

TOP OF DIKE

MW-30
137.07
MW-31
MW-4
MW-5
MW-32
MW-33
136.24
MW-16
MW-18
MW-3
MW-34
MW-2
136.09
MW-35
MW-1
MW-36
MW-37
MW-14
137.17

EVAPORATION SYSTEM
EXTERIOR DIKE

LAKE

CLARK

137
138
139
140
141

MW-17
(Destroyed)
MW-39
INCINERATOR
AREA
TANKS
MW-38
WELL-9
MW-15
ROAD
MW-13
137.35
PROPERTY LINE

WELL-11
MW-19
MW-40
141.16

PRIVATE ROAD

BRAZOS RIVER

RIVER
STAGE: 130.8

NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

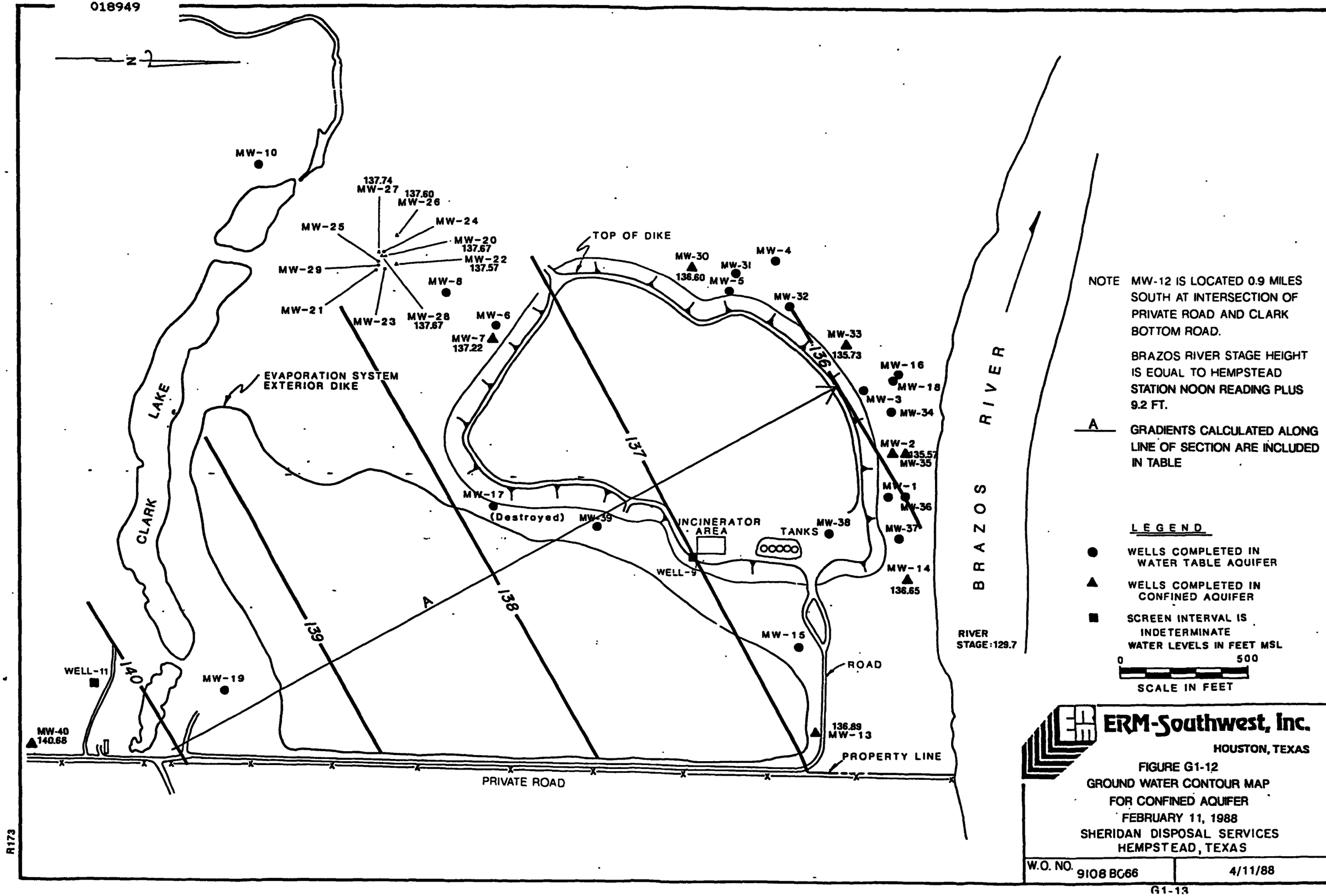
0 500
SCALE IN FEET

R173

ERM-Southwest, Inc.
HOUSTON, TEXAS

FIGURE G1-11
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
JANUARY 19, 1988
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B065	4/11/88



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — A GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 500

SCALE IN FEET

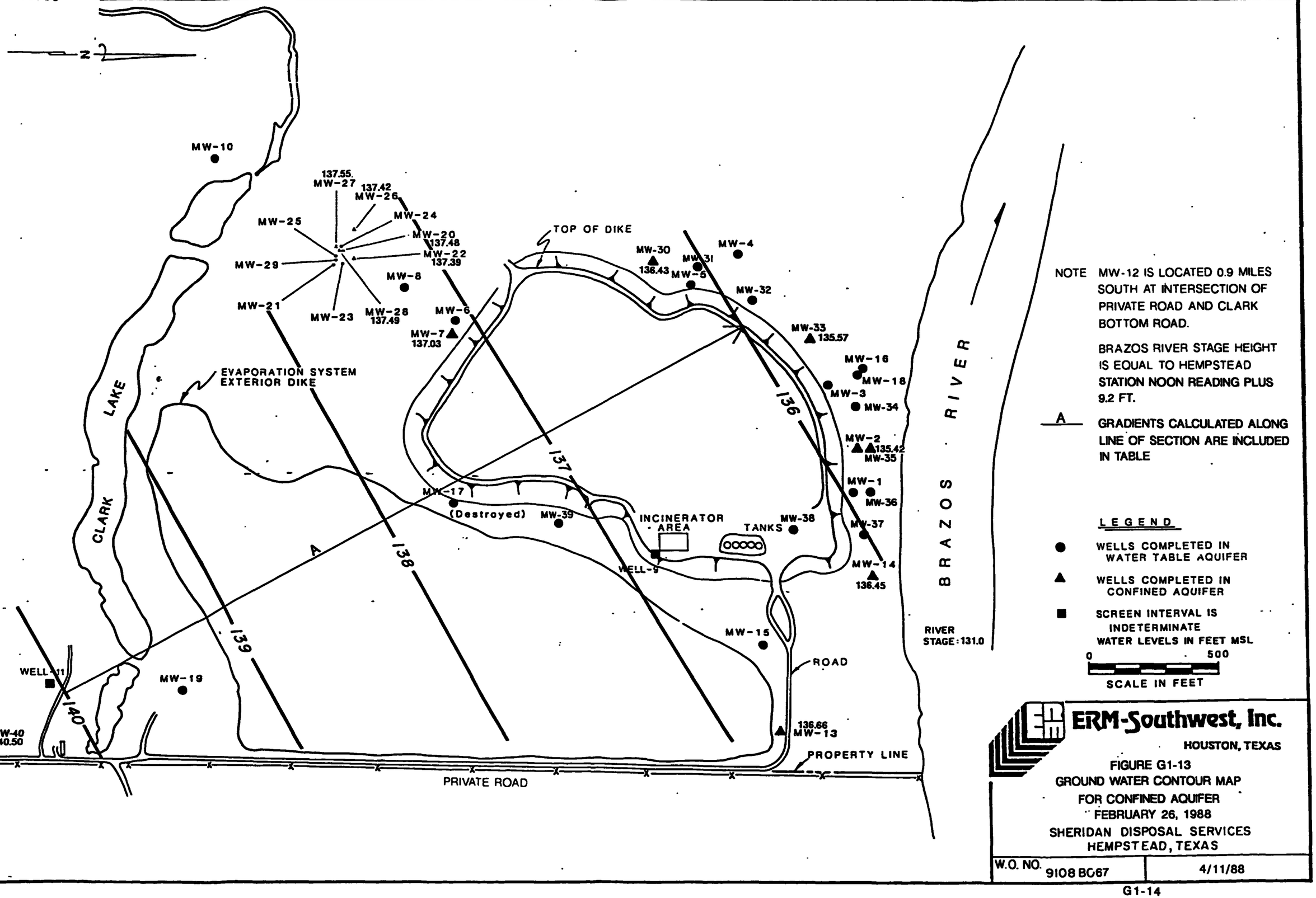
ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE G1-12
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
FEBRUARY 11, 1988
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 B066	4/11/88

R173



NOTE MW-12 IS LOCATED 0.9 MILES SOUTH AT INTERSECTION OF PRIVATE ROAD AND CLARK BOTTOM ROAD.

BRAZOS RIVER STAGE HEIGHT IS EQUAL TO HEMPSTEAD STATION NOON READING PLUS 9.2 FT.

A — GRADIENTS CALCULATED ALONG LINE OF SECTION ARE INCLUDED IN TABLE

LEGEND

- ● WELLS COMPLETED IN WATER TABLE AQUIFER
- ▲ WELLS COMPLETED IN CONFINED AQUIFER
- ■ SCREEN INTERVAL IS INDETERMINATE

WATER LEVELS IN FEET MSL

0 — 500

SCALE IN FEET

ERM-Southwest, Inc.

HOUSTON, TEXAS

FIGURE G1-13
GROUND WATER CONTOUR MAP
FOR CONFINED AQUIFER
FEBRUARY 26, 1988
SHERIDAN DISPOSAL SERVICES
HEMPSTEAD, TEXAS

W.O. NO. 9108 BG67	4/11/88

R173

Hydraulic Gradients - Confined Aquifer

Date	Line*	Height (feet)	Length (feet)	Gradient ($\Delta H / \Delta L$)
08/26/87	A	0.5	850	0.0006
09/16/87	A	1	1167	0.0009
09/30/87	A	1	1217	0.0008
10/13/87	A	1	1267	0.0008
10/23/87	A	1	1267	0.0008
11/10/87	A	3	2833	0.0011
11/18/87	A	3	2769	0.0011
12/02/87	A	3	2666	0.0011
12/28/87	A	3	2564	0.0012
01/06/88	A	4	3090	0.0013
01/19/88	A	4	3141	0.0013
02/11/88	A	4	2974	0.0013
02/26/88	A	4	3000	0.0013

*NOTE: Line designation refers to lines shown on ground water contour maps in Appendix G-1.

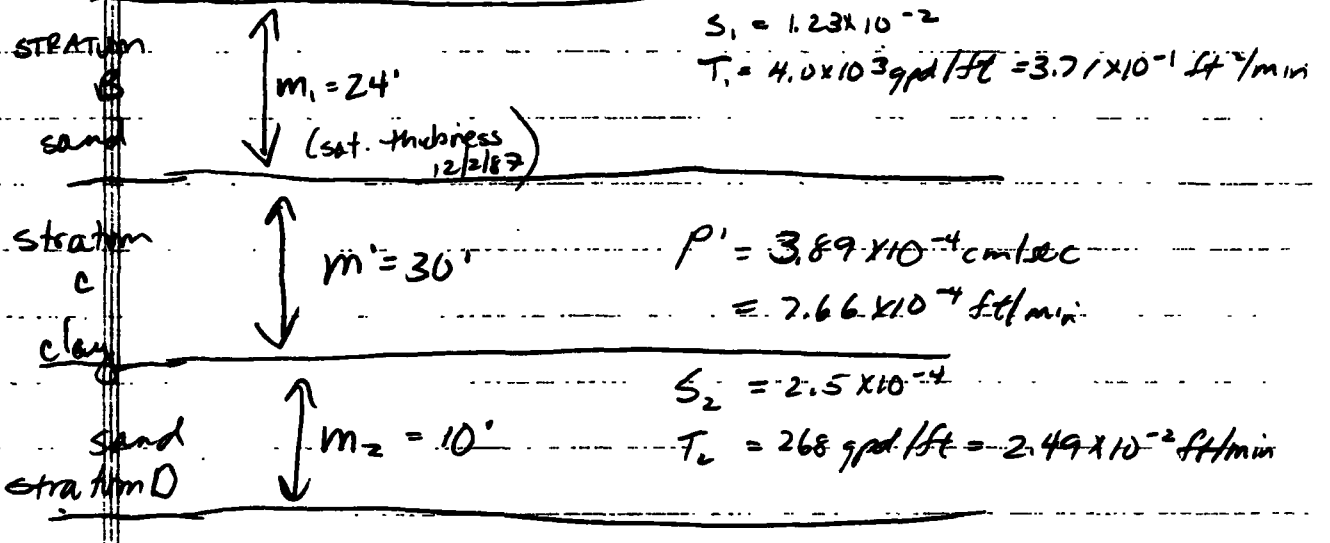
018952

APPENDIX H-1

Calculation of Expected Drawdown in the Unconfined Aquifer During Confined Aquifer Pump Test

Sheridan Site

Pump Test Data Analysis to Calculate Drawdown in Stratum B when pumping in Stratum D due to Leakance through Stratum C



Know $Q_2 = 9.37$ gpm $= 1.25$ ft³/min

Assume that for leakance P' calculated using Hantush-Jacob method (7.66×10^{-4} ft/min), all leakance coming from Stratum B through Stratum C.

Checked EV 4/6/88

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1/30/88

To calculate drawdown in upper aquifer due to pumping in lower aquifer, use eq. 5.83 from Walton

$$s_1 = \frac{Q_2}{4\pi(T_1+T_2)}\left[W(u_v) - W(u_v, \beta_v)\right]$$

$$s_1 = \frac{1.25\,ft^3/min}{4\pi\,(4\times10^3\,gpd/ft + 268\,gpd/ft)}\left[W(\right.$$

$$B_1 = \sqrt{T_1/(P'/m')}$$

$$u_v = \frac{r^2}{4 v_v t} \qquad B_2 = \sqrt{T_2/(P'/m')}$$

check:

$$t > 3.3(v_2 - v_1)\,B_1 B_2 / v_1 v_2$$

$$v_2 = T_2/s_2 = 2.49\times10^{-2}\,ft^2/min \times \frac{1}{2.5\times10^{-4}} = 9.96\times10^{1}\,ft^2/min \quad ✓$$

$$v_1 = T_1/s_1 \quad 3.71\times10^{-1}\,ft^2/min \times \frac{1}{1.23\times10^{-2}} = 3.02\times10^{1}\,ft^2/min \quad ✓$$

$$B_1 = \sqrt{\frac{3.71\times10^{-1}\,ft^2/min}{\left(\frac{7.66\times10^{-4}\,ft/min}{30'}\right)}} = 1.21\times10^{2}\,ft$$

$$B_2 = \sqrt{\frac{2.49\times10^{-2}\,ft^2/min}{\left(\frac{7.66\times10^{-4}\,ft/min}{30}\right)}} = 3.12\times10^{1}\,ft$$

$$t > 3.3(9.96 - 3.02\times10^{1})(1.21\times10^{2}(3.02\times10^{1}))/\,9.96\times10^{1} + 3.02\times10^{1}$$

$$t > 2.78\times10^{2}\,min$$

$$2.78\,min$$

Use t for total time of test = 4000 minutes

2/30/88

Calc. drawdown in unconfined aquifer when pumping confined

$$S_1 = \frac{Q_2}{4\pi(T_1 + T_2)} [W(u_v) - W(u_v, \beta_v)]$$

$u_v = r^2/4 v_v t$ ___ $t = 4000$ min (approx. length of test)

$r = 25'$ (distance to well MW-27 from pump)

$v_v = 2 v_1 v_2 / (v_1 + v_2)$

$= 2(3.02 \times 10^{1})(9.96 \times 10^{1}) / (3.02 \times 10^{1} + 9.96 \times 10^{1})$

✓ $v_v = 4.63 \times 10^{1}$ ft²/min ✓

$u_v = \frac{(25 ft)^2}{4 \cdot 4.63 \times 10^{1} ft^2/min \cdot 4000 min}$

✓ $\boxed{u_v = 8.4 \times 10^{-4}}$

$\beta_v^2 = \beta_1^2 (1 + \delta_1)$

✓ $\beta_1 = r/B_1$ where $r = 25'$; $B_1 = 1.21 \times 10^2$ ft

✓ $\beta_1^2 = \left(\frac{25'}{1.21 \times 10^2'}\right)^2 = 4.27 \times 10^{-2}$

✓ $\delta_1 = T_1/T_2 = \frac{3.71 \times 10^{-1}}{2.49 \times 10^{-2}} = 1.49 \times 10^{1}$

$\beta_v^2 = 4.27 \times 10^{-2}(1 + 1.49 \times 10^{1})$

✓ $\boxed{\beta_v = \sqrt{\beta_v^2} = 8.24 \times 10^{-1}}$

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$u_v = 3.0 \times 10^{-4}$ need $W(u_v)$

$\beta_v = 8.24 \times 10^{-1} = .824$ $W(u_v, \beta_v)$

from Warlosh (1959), Table 2 $W(u_v, \beta_v) = 1.0896$ (≈ ½ way between 0.8 and .85)

$W(u_v) = 6.53 \times 10^{0}$

$$S_1 = \frac{Q_2}{4\pi(T_1 + T_2)}\left[W(u_v) - W(u_v, \beta_v)\right]$$

$$S_1 = \frac{1.25 \text{ ft}^3/\text{min}}{4\pi(3.71 \times 10^{-1} + 2.49 \times 10^{-1})}\left[6.53 - 1.0896\right]$$

[5.44]

✓ $S_1 = 1.37$ ft

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APPENDIX H-2

Hourly Record of Water Levels in MW-14 from Oct. 14-22, 1987

APPENDIX H-2

LOCATION: SHERIDAN SITE
OPERATOR: W. R. WILDER
REPORT: 1

SCAN INTERVAL: 60 MINUTES
REPORT INTERVAL: 60 MINUTES
START WHEN?:
STOP WHEN?:

DATE (1987)	TIME	AIR TEMP DEG C INST	RAIN FALL 0.01" SUM	H2O LEV MW16 FEET INST	H2O LEV MW14 FEET INST	H2O LEV BRAZOS VOLTS INST	MW16 Daily Range	MW14 Daily range
10/14	13:10	27.42	0.01	39.27	36.97	0.207	min	min
10/14	14:10	28.35	0	39.27	36.97	0.207	39.27	36.98
10/14	15:10	29.61	0	39.27	36.98	0.207	max	max
10/14	16:10	28.14	0	39.27	36.98	0.207	39.3	36.98
10/14	17:10	25.66	0	39.28	36.98	0.207	range	range
10/14	18:10	24.8	0	39.28	36.97	0.207	0.03	0.02
10/14	19:10	21.98	0	39.29	36.97	0.207		
10/14	20:10	19.45	0	39.29	36.97	0.207		
10/14	21:10	18.23	0	39.29	36.98	0.207		
10/14	22:10	17.43	0	39.3	36.98	0.207		
10/14	23:10	17.07	0	39.3	36.98	0.207		
10/15	00:10	16.34	0	39.3	36.98	0.207	min	min
10/15	01:10	16.45	0	39.3	36.99	0.207	39.3	36.98
10/15	02:10	16.98	0	39.3	36.99	0.207	max	max
10/15	03:10	16.73	0	39.31	36.99	0.207	39.36	37.03
10/15	04:10	16.88	0	39.31	36.99	0.207	range	range
10/15	05:10	16.15	0	39.31	36.99	0.207	0.06	0.05
10/15	06:10	16.3	0	39.32	37	0.207		
10/15	07:10	16.22	0	39.32	37	0.207		
10/15	08:10	17.32	0	39.33	37.01	0.207		
10/15	09:10	19.52	0	39.33	37.01	0.207		
10/15	10:10	24.12	0	39.33	37.02	0.207		
10/15	11:10	26.52	0	39.33	37.02	0.207		
10/15	12:10	26.09	0	39.33	37.01	0.207		
10/15	13:10	27.55	0	39.33	37.01	0.207		
10/15	14:10	27.73	0	39.33	37.01	0.207		
10/15	15:10	29.51	0	39.34	37.01	0.207		
10/15	16:10	28.95	0	39.34	37.01	0.207		
10/15	17:10	27.6	0	39.35	37.01	0.207		
10/15	18:10	25.83	0	39.35	37.01	0.207		
10/15	19:10	23.75	0	39.35	37.02	0.206		
10/15	20:10	22.21	0	39.36	37.02	0.206		
10/15	21:10	21.16	0	39.36	37.02	0.206		
10/15	22:10	19.93	0	39.36	37.03	0.206		
10/15	23:10	19.43	0	39.36	37.03	0.206		
10/16	00:10	18.94	0	39.36	37.03	0.206	min	min
10/16	01:10	19.1	0	39.37	37.03	0.206	39.36	37.03
10/16	02:10	18.36	0	39.37	37.03	0.206	max	max
10/16	03:10	16.66	0	39.38	37.04	0.206	39.43	37.08
10/16	04:10	17	0	39.38	37.04	0.206	range	range
10/16	05:10	17.11	0	39.38	37.04	0.206	0.07	0.05
10/16	06:10	16.65	0	39.39	37.04	0.206		
10/16	07:10	15.93	0	39.39	37.05	0.206		
10/16	08:10	16.84	0	39.39	37.05	0.206		
10/16	09:10	21.39	0	39.4	37.06	0.206		

10/16	10:10	25.43	0	39.4	37.06	0.206		
10/16	11:10	27.68	0	39.4	37.06	0.206		
10/16	12:10	30.01	0	39.4	37.06	0.206		
10/16	13:10	30.25	0	39.4	37.06	0.206		
10/16	14:10	31.43	0	39.4	37.06	0.207		
10/16	15:10	31.39	0	39.4	37.08	0.206		
10/16	16:10	31.08	0	39.41	37.08	0.206		
10/16	17:10	29.25	0	39.41	37.08	0.206		
10/16	18:10	27.53	0	39.41	37.07	0.206		
10/16	19:10	24.68	0	39.42	37.07	0.206		
10/16	20:10	23.36	0	39.42	37.07	0.206		
10/16	21:10	22.05	0	39.42	37.07	0.206		
10/16	22:10	22.14	0	39.43	37.07	0.206		
10/16	23:10	20.66	0	39.43	37.08	0.206		
10/17	00:10	18.96	0	39.43	37.07	0.206	min	min
10/17	01:10	17.76	0	39.43	37.07	0.206	39.43	37.07
10/17	02:10	16.43	0	39.43	37.07	0.206	max	max
10/17	03:10	15.45	0	39.44	37.07	0.206	39.49	37.1
10/17	04:10	15.45	0	39.44	37.07	0.206	range	range
10/17	05:10	15	0	39.45	37.07	0.206	0.06	0.03
10/17	06:10	14.41	0	39.45	37.08	0.206		
10/17	07:10	16.35	0	39.45	37.08	0.206		
10/17	08:10	17.44	0	39.46	37.09	0.206		
10/17	09:10	20.96	0	39.46	37.09	0.206		
10/17	10:10	25.19	0	39.46	37.09	0.206		
10/17	11:10	27.41	0	39.46	37.09	0.206		
10/17	12:10	28.54	0	39.46	37.09	0.206		
10/17	13:10	31.34	0	39.46	37.08	0.206		
10/17	14:10	30.69	0	39.46	37.07	0.207		
10/17	15:10	31.79	0	39.46	37.07	0.206		
10/17	16:10	30.16	0	39.47	37.07	0.206		
10/17	17:10	28.61	0	39.47	37.07	0.206		
10/17	18:10	27.09	0	39.47	37.08	0.206		
10/17	19:10	23.29	0	39.48	37.08	0.206		
10/17	20:10	20.92	0	39.48	37.09	0.206		
10/17	21:10	19.97	0	39.49	37.09	0.206		
10/17	22:10	18.49	0	39.48	37.1	0.206		
10/17	23:10	20.43	0	39.49	37.1	0.206		
10/18	00:10	18.47	0	39.49	37.1	0.206	min	min
10/18	01:10	19.39	0	39.49	37.1	0.206	39.49	37.09
10/18	02:10	19.15	0	39.49	37.1	0.206	max	max
10/18	03:10	18.07	0	39.5	37.1	0.206	39.54	37.11
10/18	04:10	18.48	0	39.5	37.1	0.206	range	range
10/18	05:10	18.5	0	39.5	37.1	0.206	0.05	0.02
10/18	06:10	16.84	0	39.51	37.1	0.206		
10/18	07:10	17.88	0	39.51	37.1	0.206		
10/18	08:10	18.13	0	39.51	37.11	0.206		
10/18	09:10	21.78	0	39.52	37.11	0.206		
10/18	10:10	26.89	0	39.52	37.11	0.207		
10/18	11:10	29.44	0	39.51	37.11	0.207		
10/18	12:10	30.88	0	39.51	37.11	0.207		
10/18	13:10	31.69	0	39.52	37.11	0.207		
10/18	14:10	30.88	0	39.51	37.1	0.207		
10/18	15:10	31.09	0	39.52	37.1	0.207		
10/18	16:10	29.02	0	39.52	37.09	0.207		
10/18	17:10	28.46	0	39.52	37.09	0.206		

10/18	18:10	27.09	0	39.53	37.09	0.208		
10/18	19:10	24.99	0	39.53	37.09	0.208		
10/18	20:10	22.71	0	39.54	37.1	0.208		
10/18	21:10	20.94	0	39.54	37.11	0.208		
10/18	22:10	19.98	0	39.54	37.11	0.208		
10/18	23:10	18.48	0	39.53	37.11	0.209		
10/19	00:10	18.87	0	39.54	37.11	0.209	min	min
10/19	01:10	16.82	0	39.54	37.11	0.209	39.54	37.1
10/19	02:10	15.44	0	39.54	37.1	0.209	max	max
10/19	03:10	13.76	0	39.54	37.1	0.209	39.57	37.17
10/19	04:10	13.8	0	39.54	37.1	0.21	range	range
10/19	05:10	14.66	0	39.55	37.1	0.21	0.03	0.07
10/19	06:10	14.57	0	39.55	37.1	0.21		
10/19	07:10	13.32	0	39.54	37.11	0.21		
10/19	08:10	14.51	0	39.55	37.11	0.21		
10/19	09:10	21.45	0	39.55	37.12	0.21		
10/19	10:10	25.76	0	39.55	37.13	0.21		
10/19	11:10	27.53	0	39.56	37.13	0.21		
10/19	12:10	29.51	0	39.55	37.14	0.21		
10/19	13:10	29.05	0	39.55	37.13	0.211		
10/19	14:10	31.37	0	39.54	37.13	0.211		
10/19	15:10	28.6	0	39.55	37.13	0.211		
10/19	16:10	29.97	0	39.55	37.13	0.211		
10/19	17:10	28.2	0	39.56	37.13	0.211		
10/19	18:10	26.61	0	39.56	37.13	0.211		
10/19	19:10	20.75	0	39.56	37.14	0.211		
10/19	20:10	19.32	0	39.57	37.15	0.211		
10/19	21:10	19.14	0	39.57	37.16	0.211		
10/19	22:10	21.38	0	39.56	37.16	0.211		
10/19	23:10	19.13	0	39.57	37.17	0.211		
10/20	00:10	17.41	0	39.56	37.17	0.211	min	min
10/20	01:10	16.74	0	39.57	37.17	0.211	39.56	37.17
10/20	02:10	16.59	0	39.57	37.17	0.211	max	max
10/20	03:10	14.95	0	39.57	37.17	0.211	39.6	37.27
10/20	04:10	14.89	0	39.57	37.17	0.211	range	range
10/20	05:10	16.32	0	39.58	37.17	0.211	0.04	0.1
10/20	06:10	17.07	0	39.58	37.18	0.211		
10/20	07:10	16.98	0	39.58	37.19	0.211		
10/20	08:10	18.48	0	39.58	37.19	0.211		
10/20	09:10	19.41	0	39.59	37.2	0.211		
10/20	10:10	16.82	0	39.58	37.21	0.212		
10/20	11:10	17.84	0	39.58	37.23	0.212		
10/20	12:10	20.31	0	39.59	37.25	0.212		
10/20	13:10	21.57	0	39.58	37.26	0.211		
10/20	14:10	23.21	0	39.57	37.25	0.211		
10/20	15:10	23.32	0	39.58	37.24	0.212		
10/20	16:10	23.38	0	39.59	37.23	0.212		
10/20	17:10	22.52	0	39.59	37.24	0.211		
10/20	18:10	19.99	0	39.59	37.24	0.211		
10/20	19:10	17.84	0	39.59	37.24	0.211		
10/20	20:10	16.19	0	39.6	37.26	0.211		
10/20	21:10	15.38	0	39.6	37.26	0.211		
10/20	22:10	14.5	0	39.6	37.27	0.211		
10/20	23:10	13.18	0	39.6	37.27	0.211		
10/21	00:10	14.11	0	39.6	37.28	0.211	min	min
10/21	01:10	13.09	0	39.6	37.27	0.211	39.6	37.27

10/21	02:10	11.71	0	39.6	37.27	0.211	max	max
10/21	03:10	11.05	0	39.6	37.27	0.211	39.63	37.34
10/21	04:10	10.33	0	39.6	37.27	0.21	range	range
10/21	05:10	9.42	0	39.61	37.27	0.21	0.03	0.07
10/21	06:10	8.76	0	39.61	37.27	0.21		
10/21	07:10	7.95	0	39.61	37.27	0.21		
10/21	08:10	8.77	0	39.62	37.28	0.21		
10/21	09:10	12.36	0	39.62	37.29	0.21		
10/21	10:10	17.32	0	39.62	37.32	0.21		
10/21	11:10	19.61	0	39.62	37.34	0.21		
10/21	12:10	22.23	0	39.61	37.33	0.21		
10/21	13:10	23.04	0	39.61	37.31	0.21		
10/21	14:10	22.65	0	39.61	37.3	0.21		
10/21	15:10	23.31	0	39.61	37.29	0.21		
10/21	16:10	23.92	0	39.62	37.29	0.21		
10/21	17:10	22.9	0	39.62	37.28	0.21		
10/21	18:10	20.28	0	39.62	37.28	0.209		
10/21	19:10	13.84	0	39.63	37.28	0.209		
10/21	20:10	10.76	0	39.63	37.29	0.209		
10/21	21:10	8.32	0	39.63	37.29	0.209		
10/21	22:10	9.06	0	39.63	37.3	0.209		
10/21	23:10	9.05	0	39.63	37.3	0.209		
10/22	00:10	8.61	0	39.63	37.3	0.209	min	min
10/22	01:10	8.29	0	39.64	37.3	0.209	39.63	37.27
10/22	02:10	7.28	0	39.64	37.29	0.209	max	max
10/22	03:10	6.13	0	39.64	37.28	0.209	39.68	37.32
10/22	04:10	5.74	0	39.64	37.28	0.208	range	range
10/22	05:10	7	0	39.64	37.27	0.208	0.05	0.05
10/22	06:10	8.75	0	39.64	37.27	0.208		
10/22	07:10	8.39	0	39.65	37.27	0.208		
10/22	08:10	9.23	0	39.65	37.27	0.208		
10/22	09:10	12.54	0	39.66	37.28	0.208		
10/22	10:10	16.51	0	39.65	37.29	0.208		
10/22	11:10	22.25	0	39.66	37.3	0.208		
10/22	12:10	22.42	0	39.65	37.32	0.208		
10/22	13:10	23.82	0	39.65	37.32	0.208		
10/22	14:10	23.05	0	39.65	37.31	0.208		
10/22	15:10	21.55	0	39.66	37.3	0.208		
10/22	16:10	22.18	0	39.66	37.29	0.208		
10/22	17:10	22.64	0	39.66	37.29	0.208		
10/22	18:10	21.52	0	39.66	37.28	0.208		
10/22	19:10	20.26	0	39.67	37.28	0.208		
10/22	20:10	19.67	0	39.67	37.28	0.208		
10/22	21:10	19.1	0	39.67	37.29	0.208		
10/22	22:10	18.53	0	39.68	37.29	0.208		
10/22	23:10	17.77	0	39.67	37.29	0.208		
10/23	00:10	17.53	0	39.68	37.29	0.208	min	min
10/23	01:10	17	0.01	39.68	37.29	0.208	39.68	37.03
10/23	02:10	16.82	0	39.68	37.29	0.208	max	max
10/23	03:10	16.83	0	39.68	37.29	0.208	39.69	37.45
10/23	04:10	17.05	0.03	39.68	37.29	0.208	range	range
10/23	05:10	17.55	0.06	39.69	37.3	0.208	0.01	0.42
10/23	06:10	17.97	0.41	39.69	37.29	0.208		
10/23	07:10	17.87	0	39.69	37.28	0.209		
10/23	08:10	18.12	0	39.69	37.3	0.209		
10/23	09:10	18.66	0	39.69	37.37	0.209		

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APPENDIX H-3

Calculation of Vertical Permeability (P') of the Confining Clay Based on Drawdown Observed in the Unconfined Aquifer During Pump Test

018963

DEW 9/88

checked EV 9/29/88

Recalculation of vertical permeability (P') in the confining clay based on drawdown seen in unconfined aquifer while pumping on confined aquifer (Test of Dec. 1987 - GWRI)

sand	$m_1 = 24'$	$S_1 = 1.23 \times 10^{-2}$ $T_1 = 4.0 \times 10^3$ gpd/ft = 3.7×10^{-1} ft²/min
clay	$m' = 30'$	$P' = ?$
sand	$m_2 = 10'$	$S_2 = 2.5 \times 10^{-4}$ $T_2 = 268$ gpd/ft = 2.5×10^{-2} ft²/min

S_2, T_2 calculated from pump test data analysis from MW-27 where $r = 25$ feet

$Q_2 = 9.37$ gpm $= 1.25$ ft³/min

$s_1 = .07$ feet

$t = 4000$ minutes = duration of test

-use Equation 5.100 of Walton (1985) for short pumping periods

$$s_2 = \frac{Q_2}{4\pi T_2 (1-\delta_1)} \left[W(u_2, \beta_2) - W(u_1, \beta_1) + f_1 - f_2 \right]$$

-calculate $\delta_m = v_1 v_2 (1/B_1^2 - 1/B_2^2) / (v_2 - v_1)$

where $v_1 = T_1/S_1$

$v_2 = T_2/S_2$

$B_1 = \sqrt{T_1/(P'/m')}$

$B_2 = \sqrt{T_2/(P'/m')}$

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DEW 9/88

$$\nu_1 = \frac{3.7\times10^{-1}\ ft^2/min}{1.23\times10^{-2}} = 3.01\times10^{1}\ ft^2/min$$

$$\nu_2 = \frac{2.5\times10^{-2}\ ft^2/min}{2.5\times10^{-4}\ ft^2/min} = 1.0\times10^{2}\ ft^2/min$$

$$(B_1)^2 = \frac{3.7\times10^{-1}\ ft^2/min}{P'/30'} = \frac{1.11\times10^{1}\ ft^2/min}{P'}$$

$$(B_2)^2 = \frac{2.5\times10^{-2}\ ft^2/min}{P'/30} = \frac{7.5\times10^{-1}\ ft^2/min}{P'}$$

$$\gamma_m = (3.02\times10^{1})(1.0\times10^{2})\left(\frac{P'}{1.11\times10^{1}} - \frac{P'}{7.5\times10^{-1}}\right)/6.99\times10^{1}$$

$$\gamma_m = 4.33\times10^{1}\left(\frac{P'}{1.11\times10^{1}} - \frac{P'}{7.5\times10^{-1}}\right)$$

$$= 4.33\times10^{1}\ \frac{7.5\times10^{-1}\cdot P - 1.11\times10^{1}P'}{8.33}$$

$\gamma_m < 1 \quad -\gamma_m = 5.20\left(P'\left[-1.04\times10^{1}\right]\right) = -53.51\,P'$

f_1 - since $\gamma_m B_1^2/\nu_1 < 1$ and $\gamma_m \neq 0$ - use eq. (5.104)

f_2 - since $\gamma_m B_2^2/\nu_1 < 1$ and $\gamma_m \neq 0$ - use eq (5.106)

$$u_1 = r^2/4\nu_1 t = \frac{(25\ ft)^2}{4(3.01\times10^{1})\cdot 4000\ m} = .0013$$

$$u_2 = r^2/4\nu_2 t = \frac{(25\ ft)^2}{4(1\times10^{2})(4000\ min)} = .0004$$

$$\delta = \frac{3.7\times10^{-1}}{2.5\times10^{-2}} = 14.80$$

$$B_1 = \frac{25'}{\sqrt{1.11\times10^{1}/P}} = 7.50\sqrt{P}$$

$$B_2 = \frac{25'}{\sqrt{7.5\times10^{-1}/P'}} = 28.87\sqrt{P}$$

$$B_{\gamma_1} = B_1\sqrt{1-\gamma_m B_1^2/\nu_1}$$

$$= 7.50\sqrt{P}\sqrt{1+53.51P'\cdot\frac{1.11\times10^{1}}{P}}\Big/3.01\times10^{1}$$

$$B_{\gamma_1} = 33.63\sqrt{P}$$

DCW 9/88

F-2

$$\beta_{\gamma_2} = \beta_2 \sqrt{1 - \gamma_m B_2^2 / v_2}$$

$$= 28.87\sqrt{P} \cdot \sqrt{1 + 53.51 \cdot \frac{7.5\times10^{-5}}{P}}^{1/2}$$

$$\beta_{\gamma_2} = 34.17\sqrt{P}$$

$$f_1 = e^{-\gamma_m t} N(u_1, \beta_{\gamma_1})$$

$$f_1 = e^{53.51P(4000)} w(.0013, 34.27\sqrt{P})$$

$$f_2 = e^{-\gamma_m t} W(u_2, \beta_{\gamma_2})$$

$$= e^{53.51P \cdot 4000} \cdot w(.0004, 34.17\sqrt{P})$$

Note that will not be able to solve eqn 5.100 without assuming value for P', solving for s_1, and then comparing to measured s_1.

① Assume $P' = 1\times10^{-5}$ ft/min $= 5\times10^{-6}$ cm/sec

Calculate

$\beta_{K_1} = .1084$	$W_1(.0013, .1084) = 4.6452$
$\beta_{\gamma_2} = .1081$	$W_2(.0004, .1081) = 4.8539$
$f_1 = 8.5028\ w(.0013, .1084)$	$f_1 = 39.4974$
$f_2 = 8.5028\ w(.0004, .1082)$	$f_2 = 41.2717$

$\beta_1 = .0237$ $\quad w(u_1, \beta_1) = w(.0013, .0237) = 6.3799$

$\beta_2 = .0913$ $\quad w(u_2, \beta_2) = w_2(.0004, .0913) = 5.0[illegible]$

$$\frac{Q_2}{4\pi T_2 (1 - \delta_2)} = \frac{1.25\ ft^3/min}{4\cdot\pi\cdot 2.51\times10^{-2}(1 - 14.80)} = -.2883$$

S_0 - at $P' = 1 \times 10^{-5}$ ft/min = 5×10^{-6} cm/sec

$$S = \frac{Q_2}{4\pi T_2 (1-\delta_1)} \left(W_2(u_2, \beta_2) - W(u_1, \beta_1) + f_1 - f_2 \right]$$

$$S = -0.2883 \left(50397. - 6.3799 + 39.4974 - 41.2717 \right)$$

$$= -0.2883 (-3.114)$$

$$S = 0.9547$$

---

② At $P' = 1 \times 10^{-7}$ cm/sec = 1.97×10^{-7} ft/min

Calculate

$\beta_{\delta_1} = 0.0149$

$\beta_{\delta_2} = 0.0152$

$W_1(u_1, \beta_{\delta_1}) - W(.0013, .0149) = 6.0770$

$W_2(u_2, \beta_{\delta_2}) = W(.0004, .0152) = 7.1119$

$f_1 = e^{-\gamma_m t} W(u_1, \beta_{\delta_1}) = e^{53.51(1.97\times10^{-7})(4000)} \cdot 6.0770 = 6.3382 = f_1$

$f_2 = e^{-\gamma_m t} W(u_2, \beta_{\delta_2}) \quad e^{53.51(1.97\times10^{-7})4000} \cdot 7.1119 = 7.4782 = f_2$

$\beta_1 = .0033$

$\beta_2 = .0128$

$W_1(u_1, \beta_1) = W(.0013, .0033) = 6.0993$

$W_2(u_2, \beta_2) = W(.0004, .0128) = 7.1415$

$$S_1 = -0.2883 \left[W(u_2, \beta_2) - W(u_1, \beta_1) + f_1 - f_2 \right] =$$

$$-0.2883 \left[7.1415 - 6.0993 + 6.3382 - 7.4182 \right]$$

$$= -0.2883 [-0.0378]$$

$S_1 = .01$ feet

Dc.

9/27/88

③ for $P' = 5 \times 10^{-7}$ cm/sec $= 9.84 \times 10^{-7}$ ft/min

Calculate

$\beta_{\gamma_1} = .0334$

$\beta_{\gamma_2} = .0339$

$W_1(u_1, \beta_{\gamma_1}) = W(.0013, .0334) = 5.9220$

$W_2(u_2, \beta_{\gamma_2}) = W(.0004, .0339) = 6.6384$

$f_1 = e^{-\gamma_m t} W(u_1, \beta_{\gamma_1}) = e^{53.51(9.84 \times 10^{-7})4000} \cdot 5.9220 = 7.3103 = f_1$

$f_2 = e^{-\gamma_m t} W_2(u_2, \beta_{\gamma_2}) = e^{53.51(9.84 \times 10^{-7})4000} \cdot 6.6384 = 8.1947 = f_2$

$\beta_1 = .0074$

$\beta_2 = .0286$

$W_1(u_1, \beta_1) = (.0013, .0074) = 6.1121$

$W_2(u_2, \beta_2) = (.0004, .0286) = 6.7839$

$S_1 = -0.2883 [W_2(u_2, \beta_2) - W_1(u_1, \beta_1) + f_1 - f_2]$

$= -0.2883 [6.7839 - 6.1123 + 7.3103 - 8.1947]$

$= -0.2883 [-0.2126]$

$S_1 = .0613'$

~~H6233~~

P 6

Assume $P = 6 \times 10^{-7}$ cm/sec = 1.12×10^{-6} [illegible]

Calculate

$\beta_{\delta_1} = .0365$

$\beta_{\delta_2} = .0371$

$W_1(u_1, \beta_{\delta_1}) = W(.0013, .0365) = 5.8625$

$W_2(u_2, \beta_{\delta_2}) = W(.0004, .0371) = 6.5468$

$f_1 = e^{-\delta t} W_1(u_1, \beta_{\delta_1}) = e^{53.51 \cdot P \cdot 4000} \cdot 5.8625 = 7.5469$

$f_2 = e^{-\delta t} W_2(u_2, \beta_{\delta_2}) = e^{53.51 \cdot P \cdot 4000} \cdot 6.5468 = 8.4279$

$\beta_1 = .0081 \quad W(u_1, \beta_1) = W(.0013, .0081) = 6.1104$

$\beta_2 = .0314 \quad W(u_2, \beta_2) = W(.0004, .0314) = 6.7271$

$S = -0.2883 \cdot [6.7271 - 6.1104 + 7.5469 - 8.4279]$

$-0.2883 \cdot (-0.2643)$

$S = 0.0698 \approx 0.07$

018969

~~06234~~

APPENDIX H-4

Calculation of Travel Times Through Stratum C Between Well Pairs at the SDS Site

~~006235~~

Calculation of Travel Times Between Well Pairs at the SDS Site

Use a clay permeability of 1.7×10^{-3} ft/day or 6×10^{-7} cm/sec

Assume a thickness of stratum C clay = 25 feet.

MW-13 / MW-15

Downward gradient - occurs 23% of time (84 days/year)

Maximum downward gradient = 1.54'/25' = .062

$$v = \frac{ki}{ne} = \frac{1.7 \times 10^{-3} \text{ ft/day} \times .062}{.25}$$

$$v = 4.2 \times 10^{-4} \text{ ft/day}$$

$$\frac{25 \text{ ft}}{4.2 \times 10^{-4} \text{ ft/day}} = 59298 \text{ days}$$

$$= 162 \text{ years}$$

Average downward gradient = .90'/25' = .036

$$v = \frac{1.7 \times 10^{-3} \text{ ft/day} \times .036}{.25} = 2.45 \times 10^{-4} \text{ ft/day}$$

$$\frac{25}{2.45 \times 10^{-4} \text{ ft/day}} = 102,124 \text{ days}$$

$$= 279 \text{ years}$$

~~006236~~

MW-13 / MW-15

Average upward gradient $2.48'/25' = .099$

Upward head potential occurs 77% or 281 days/year

$$V = \frac{1.7 \times 10^{-3} \text{ ft/day} \cdot 0.099}{.25} = 6.7 \times 10^{-4} \text{ ft/day}$$

$\frac{25'}{6.7 \times 10^{-4} \text{ ft/day}} = 37,136 \text{ days}$

or $6.7 \times 10^{-4} \text{ ft/day} \times 281 \text{ days/year} = .188 \text{ ft/year upward}$

Downward head potential 23% of time or 84 days/year

Average downward gradient = $.90/25 = .036$

$$V = \frac{1.7 \times 10^{-3} \cdot .036}{.25} = 2.45 \times 10^{-4} \text{ ft/day}$$

$2.45 \times 10^{-4} \text{ ft/day} \times 84 \text{ d/y} = .021 \text{ ft/year downward.}$

MW-14 / MW-16

- Downward gradient 14% of time (51 days/year)

Max. downward grad = 1024'/25' = .05

$$V = \frac{1.7 \times 10^{-3} \cdot .05}{.25} = 3.4 \times 10^{-4} \text{ ft/day}$$

$$\frac{25'}{3.4 \times 10^{-4}} = 7.35 \times 10^{4} \text{ days} = 201 \text{ years to cross clay}$$

- Average downward gradient = .74'/25 = .0296 = .03

$$V = \frac{1.7 \times 10^{-3} \text{ ft/day} \times .03}{.25} = 2.04 \times 10^{-4} \text{ ft/day}$$

$$\frac{25'}{2.04 \times 10^{-4}} = 1.23 \times 10^{5} \text{ days} = 336 \text{ years}$$

- Upward head gradient - average - 2.89'/25' = .116

$$V = \frac{1.7 \times 10^{-3} \cdot .116}{.25} = 7.89 \times 10^{-4} \text{ ft/day}$$

Upward head - 86% or 314 days/year

7.89×10^{-4} ft/day x 314 days/year = .248 ft/year upward

Ave. downward head - 51 days/year

3.4×10^{-4} ft/day x 51 days/year = .017 ft/year downward

Well Nest - (average of wells screened in confined vs. unconfined aq.)

Downward gradient 38% of time (139 days/year)

- Max downward grad. = $^{.48'}/_{25'} = .019$

$$v = \frac{1.7 \times 10^{-3} \times .019}{.25} = 1.31 \times 10^{-4} \text{ ft/day}$$

$$\frac{25'}{1.31 \times 10^{-4}} = 1.91 \times 10^{5} \text{ days} = 524 \text{ years}$$

- Average downward gradient = $^{.22'}/_{25'} = .0088 = .009$

$$v = \frac{1.7 \times 10^{-3} \times .009}{.25} = 6.12 \times 10^{-5} \text{ ft/day}$$

$$\frac{25'}{6.12 \times 10^{-5}} = 4.08 \times 10^{5} \text{ days} = 1120 \text{ years}$$

- Average upward gradient = $^{.70}/_{25'} = .028$ (62% upward or 226 days/yr.)

$$v = \frac{1.7 \times 10^{-3} \times .028}{.25} = 1.90 \times 10^{-4} \text{ ft/day}$$

1.90×10^{-4} ft/day x 226 days/year = .043 ft/year upward

- For downward (average gradient)

$v = 6.12 \times 10^{-5}$ ft/day x 139 days/yr = .0085 ft/year downward

~~006239~~

MW-6 | MW-7

Downward gradient 16 % of time ≈ 58 days/year

Max. downward gradient = $.22'/25' = .0088 \approx .009$

$$V = \frac{1.7 \times 10^{-3} \times .009}{.25} = 6.12 \times 10^{-5} \text{ ft/day}$$

$25'/6.12 \times 10^{-5} = 4.08 \times 10^{5}$ days = 1120 years

Average downward gradient = $.11'/25' = .004$

$$V = \frac{1.7 \times 10^{-3} \times .004}{.25} = 2.72 \times 10^{-5} \text{ ft/day}$$

$25'/2.72 \times 10^{-5} = 9.19 \times 10^{5}$ days = 2520 years

Upward gradient 84 % of time ≈ 307 days/year

Average gradient upward = $.28'/25' = .011$

$$V = \frac{1.7 \times 10^{-3} \times .011}{.25} = 7.62 \times 10^{-5} \text{ ft/day}$$

7.62×10^{-5} ft/day × 307 days/year = .023 ft/year upward

For average downward gradient

$V = 2.72 \times 10^{-5}$ ft/day × 58 days/year = .0016 ft/year downward

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006240

APPENDIX I

Historical Ground Water Quality Results from Wells at the SDS Site

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~~006241~~

MONITOR WELL RECORD

WELL NO. 1

DATE INSTALLED 07/14/83

TOP OF CASING ELEV. 167.84

GROUND ELEV. 165.46

TOTAL DEPTH 65'* Now 40.5'

SCREENED INTERVAL 50'-65' Original

* Original Installed Depth

DESCRIPTION: Shallow Well Downgradient from Lagoon Originally Fit Well #3 65' Deep with 2" Casing - Casing Filled with Sand to Elev. 132.3 REI Installed 1" Casing to 40.5'

GRAVEL PACKED: 47' to 65'

SCREEN: 2" Original now 1" Slotted PVC

DATE	04/09/84	04/20/84
	DRY AT	
WATER ELEVATION	129.96	131.29
Ph		7.9
CONDUCTIVITY		885
CHLORIDES		125
SULFATES		20
PHENOLICS		<.01
TOC		123
SODIUM		69
CALCIUM		39
MAGNESIUM		23
BICARBONATE		283
CARBONATE		

018977

~~006242~~

WELL RECORD

WELL NO. 2

DATE INSTALLED 01/06/72

TOP OF CASING ELEV. 172.49

GROUND ELEV. 172.09

TOTAL DEPTH 115'

SCREENED INTERVAL 98'- 110'

DESCRIPTION: Deep Well Down Gradient from Lagoon - used as Water Supply for Livestock

GRAVEL PACKED: No Information

SCREEN: 4" Dia.
5' of 16 Gauge Ribbed Stainless Steel
5' of 20 Gauge Ribbed Stainless Steel

DATE	04/05/84	04/20/84	06/29/84	07/05/84	07/20/84
WATER ELEVATION		134.12		134.29	
Ph	6.8	7.2	7.4		7.0
CONDUCTIVITY	-	1,065	415		640
CHLORIDES	63	65	62		46
SULFATES	5	5	3		9
PHENOLICS	<.01	<.01	.08		.06
TOC	57	51	7		7
SODIUM	86	81	-		
CALCIUM	27	29	-		
MAGNESIUM	7	7	-		
BICARBONATE	289	285	-		
CARBONATE	<.01		-		

018978

006243

WELL RECORD

WELL NO. 3

DATE INSTALLED 07/13/83

TOP OF CASING ELEV. 167.92

GROUND ELEV. 165.3

TOTAL DEPTH 65

SCREENED INTERVAL 53 - 63

DESCRIPTION: Shallow Well Down Gradient from Lagoon Originally Fit Well #2

GRAVEL PACKED: 51' - 65'

SCREEN: 2"

DATE	04/05/84	04/20/84	06/29/84	07/05/84	07/20/84
WATER ELEVATION	132.42	131.68	132.72	132.71	
Ph	6.7	7.0	6.9		6.7
CONDUCTIVITY		4,050	3,150		2,840
CHLORIDES	598	657	661		654
SULFATES	10	30	3		22
PHENOLICS	.53	<.01	.13		.20
TOC	101	165	36		35
SODIUM	116	122			
CALCIUM	32	380			
MAGNESIUM	47	49			
BICARBONATE	293	325			
CARBONATE	<.01				

~~006244~~

018979

WELL RECORD

WELL NO. 4

DATE INSTALLED 01/07/72

TOP OF CASING ELEV. 169.73

GROUND ELEV. 168.73

TOTAL DEPTH 69'

SCREENED INTERVAL 55' - 61'

DESCRIPTION: Shallow Well West of Lagoon; Pump Lodged in Well in June

GRAVEL PACKED: No Information

SCREEN: 4" Dia. - 20 Gauge Ribbed Stainless Steel

DATE	04/05/84	04/20/84
WATER ELEVATION		133.05
Ph	6.9	7.9
CONDUCTIVITY		1,328
CHLORIDES	212	200
SULFATES	15	5.0
PHENOLICS	.11	.25
TOC	134	88
SODIUM	78	77
CALCIUM	84	81
MAGNESIUM	26	29
BICARBONATE	297	347
CARBONATE	<.01	

018980

~~006245~~

WELL RECORD

WELL NO. 5

DATE INSTALLED 05/63

TOP OF CASING ELEV. 172.18

GROUND ELEV. 166.0

TOTAL DEPTH 60'

SCREENED INTERVAL 54 - 60'

DESCRIPTION: Shallow Well Originally Windmill Well - Located on West Side of Lagoon

GRAVEL PACKED: No Information

SCREEN: 4" Dia. Slotted Plastic

DATE	04/05/84	04/20/84	07/02/84	07/20/84
WATER ELEVATION	133.73	133.94	133.59	
Ph	7.8	8.0	7.0	6.8
CONDUCTIVITY		1,310	1,100	1,060
CHLORIDES	159	171	173	183
SULFATES	5.0	<1	<1	5
PHENOLICS	<.01	.03	.08	.24
TOC	35	59	29	16
SODIUM	60	72		
CALCIUM	45	54		
MAGNESIUM	21	26		
BICARBONATE	160	313		
CARBONATE	<.01			

018981

~~006246~~

WELL RECORD

WELL NO. 6

DATE INSTALLED 07/14/83

TOP OF CASING ELEV. 168.16

GROUND ELEV. 165.4

TOTAL DEPTH 58'

SCREENED INTERVAL 43 - 58'

DESCRIPTION: Shallow Well Upgradient from Lagoon - Originally Fit Well #1

GRAVEL PACKED: 40' - 58'

SCREEN SIZE: 2"

DATE	04/05/84	04/20/84	06/29/84	07/20/84
WATER ELEVATION	135.66	135.22		
Ph	6.7	7.2	7.1	6.9
CONDUCTIVITY		1,385	650	840
CHLORIDES	81	77	91	87
SULFATES	15	5.0	25	30
PHENOLICS	<.01	<.01	.10	.23
TOC	54	128	8	36
SODIUM	60	56		
CALCIUM	44	41		
MAGNESIUM	16	20		
BICARBONATE	263	357		
CARBONATE	<.01			

018982

~~006247~~

WELL RECORD

WELL NO. 7

DATE INSTALLED 03/29/84

TOP OF CASING ELEV. 169.43

GROUND ELEV. 165.68

TOTAL DEPTH 96'

SCREENED INTERVAL 80 - 95'

DESCRIPTION: Deep Well Up-gradient from Lagoon Installed by REI

GRAVEL PACKED: 78' - 96'

SCREEN: 4" PVC with 0.02 Slots

DATE	04/05/84	04/20/84	06/29/84	07/20/84
WATER ELEVATION	131.84	135.91	135.85	
Ph	6.8	7.5	7.4	7.1
CONDUCTIVITY		1,025	580	700
CHLORIDES	59	58	60	65
SULFATES	12	15	5	56
PHENOLICS	<.01	<.01	.02	.21
TOC	52	115	3	25
SODIUM	90	89		
CALCIUM	44	26		
MAGNESIUM	6	8		
BICARBONATE	218	253		
CARBONATE	<.01			

018983

~~006248~~

WELL RECORD

WELL NO. 8

DATE INSTALLED 01/07/82

TOP OF CASING ELEV. 169.25

GROUND ELEV. 168.25

TOTAL DEPTH 65'

SCREENED INTERVAL 51 - 57'

DESCRIPTION: Shallow Well Upgradient from Lagoon

GRAVEL PACKED: No Information

SCREEN: 4" Dia. - 20 Gauge Ribbed Stainless Steel

DATE	04/05/84	04/20/84	07/02/84	07/20/84
WATER ELEVATION	135.75	135.69	138.25	
Ph	7.3	7.6	7.0	6.6
CONDUCTIVITY		794	1,150	840
CHLORIDES	65	77	75	82
SULFATES	5	5.0	<1	7
PHENOLICS	.04	<.01	.21	.14
TOC	44	82	35	13
SODIUM	33	31		
CALCIUM	34	42		
MAGNESIUM	10	15		
BICARBONATE	236	305		
CARBONATE	<.01			

018984

006249

WELL RECORD

WELL NO. 9

DATE INSTALLED Not Available

TOP OF CASING ELEV. 178.73

GROUND ELEV. 178.2

TOTAL DEPTH 165'*

SCREENED INTERVAL Not Available

DESCRIPTION: Deep Well on East Side of Lagoon Used for Boiler Water Supply Has 4" Casing and Pump

GRAVEL PACKED: Not Available

SCREEN:

* Reported by D. Sheridan as 165'; top of Pump at 106.47' depth

DATE	04/09/84	04/29/84	07/02/84	07/20/84
WATER ELEVATION	138.83	138.80		
Ph		7.2	6.7	7.0
CONDUCTIVITY		896	530	540
CHLORIDES		34	32	34
SULFATES		20	<1	9
PHENOLICS		<.01	.04	.03
TOC		57	12	18
SODIUM		43		
CALCIUM		36		
MAGNESIUM		9		
BICARBONATE		27		

018985

~~006250~~

WELL RECORD

WELL NO. 10

DATE INSTALLED 03/31/84

TOP OF CASING ELEV. 168.39

GROUND ELEV. 166.1

TOTAL DEPTH 45'

SCREENED INTERVAL 28 - 43'

DESCRIPTION: Shallow Well Upgradient from Lagoon South of Clark Lake

GRAVEL PACKED: 20' - 45'

SCREEN: 2" PVC with 0.02" Slots

DATE	04/05/84	04/20/84	07/02/84	07/20/84
WATER ELEVATION	136.79	136.79	136.42	
Ph	6.8	7.3	7.0	6.9
CONDUCTIVITY		1,280	220	740
CHLORIDES	90	77	64	68
SULFATES	53	48	35	73
PHENOLICS	<.01	<.01	.06	.39
TOC	46	142	21	64
SODIUM	51	54		
CALCIUM	37	39		
MAGNESIUM	12	12		
BICARBONATE	228	317		
CARBONATE	<.01			

018986

~~006251~~

WELL RECORD

WELL NO. 11

DATE INSTALLED Not Available

TOP OF CASING ELEV. 170.00

GROUND ELEV. _____

TOTAL DEPTH 135'*

SCREENED INTERVAL Not Available

DESCRIPTION: Deep Well Up-gradient from Lagoon at Farm House South of Clark Lake 4" Dia. with Pump

GRAVEL PACKED: Not Available

SCREEN: Not Available

* Reported by D. Sheridan

DATE	04/05/84	04/20/84	07/02/84	07/20/84
WATER ELEVATION	-	-	-	
Ph	6.9	7.2	7.2	7.0
CONDUCTIVITY		1,195	720	700
CHLORIDES	60	63	64	63
SULFATES	<1	12	3	8
PHENOLICS	.02	<.01	.04	.08
TOC	50	50	10	13
SODIUM	100	99		
CALCIUM	37	31		
MAGNESIUM	11	12		
BICARBONATE	303	313		
CARBONATE	<.01			

018987

~~006252~~

WELL RECORD

WELL NO. 12

DATE INSTALLED 04/03/84

TOP OF CASING ELEV. 169.06

GROUND ELEV. 167.0

TOTAL DEPTH 40'

SCREENED INTERVAL 24' - 39'

DESCRIPTION: Shallow Well Upgradient from Lagoon Located at Clark Bottom Road at Site Entrance

GRAVEL PACKED: 20' - 40'

SCREEN: 2" PVC, 0.02" Slots

DATE	04/05/84	04/06/84	04/20/84	07/02/84	07/20/84
WATER ELEVATION	141.06	141.31	141.29	140.06	
Ph	7.6	7.3	7.5	6.6	7.0
CONDUCTIVITY			1,765	980	1,016
CHLORIDES	108	106	125	101	121
SULFATES	328	198	171	64	68
PHENOLICS	<.01	.08	<.01	.01	.04
TOC	48	43	95	17	5
SODIUM	138	138	165		
CALCIUM	33	34	31		
MAGNESIUM	11	21	21		
BICARBONATE	81	188	285		
CARBONATE	<.01				

018988

~~006253~~

WELL RECORD

WELL NO. 13

DATE INSTALLED 06/07/84

TOP OF CASING ELEV. 173.09

GROUND ELEV. 171.7

TOTAL DEPTH 93

SCREENED INTERVAL 83 - 93

DESCRIPTION: Deep Well Down Gradient North of Landfarm

GRAVEL PACKED: 80' To 93'

SCREEN: 2" PVC; 0.01" Slots

DATE	06/09/84	07/02/84	07/05/84	07/20/84
WATER ELEVATION	135.89	135.79	135.84	
Ph		7.3	7.3	7.3
CONDUCTIVITY		603	680	680
CHLORIDES		74	68	68
SULFATES		10	7	7
PHENOLICS		.02	.04	.04
TOC		17	8	8
SODIUM				
CALCIUM				
MAGNESIUM				
BICARBONATE				
CARBONATE				

018989

~~006254~~

WELL RECORD

WELL NO. 14

DATE INSTALLED 06/10/84

TOP OF CASING ELEV. 176.27

GROUND ELEV. 173.1

TOTAL DEPTH 102'

SCREENED INTERVAL 92' - 102'

DESCRIPTION: Deep Well Down Gradient North of Lagoon

GRAVEL PACKED: 90' - 102'

SCREEN: 2" PVC; 0.01" Slots

DATE	06/29/84	07/20/84			
WATER ELEVATION	135.92				
Ph	7.3	7.2			
CONDUCTIVITY	540	700			
CHLORIDES	70	65			
SULFATES	5	5			
PHENOLICS	.06	.03			
TOC	10	3			
SODIUM					
CALCIUM					
MAGNESIUM					
BICARBONATE					
CARBONATE					

018990

~~006255~~

WELL RECORD

WELL NO. 15

DATE INSTALLED 06/09/84

TOP OF CASING ELEV. 173.30

GROUND ELEV. 171.7

TOTAL DEPTH 52'

SCREENED INTERVAL 42' - 52'

DESCRIPTION: Shallow Well Down Gradient N.W. Corner of Landfarm

GRAVEL PACKED: 35' - 52'

SCREEN: 2" PVC; 0.01" Slots

DATE	07/02/84	07/20/84
WATER ELEVATION	133.85	6.7
Ph	6.9	1.260
CONDUCTIVITY	1170	205
CHLORIDES	208	9
SULFATES	38	.14
PHENOLICS	.03	36
TOC	5	
SODIUM		
CALCIUM		
MAGNESIUM		
BICARBONATE		
CARBONATE		

018991

~~006256~~

WELL RECORD

WELL NO. 16

DATE INSTALLED 06/09/84

TOP OF CASING ELEV. 172.86

GROUND ELEV. 171.9

TOTAL DEPTH 53'

SCREENED INTERVAL 48' - 53'

DESCRIPTION: Shallow Well Down Gradient N.W. of Lagoon

GRAVEL PACKED 11' - 53'

SCREEN: 2" PVC: 0.01" Slots

DATE	06/11/84	06/29/84	07/20/84
WATER ELEVATION	132.76	132.41	
Ph		6.8	6.6
CONDUCTIVITY		2640	1,960
CHLORIDES		494	521
SULFATES		98	76
PHENOLICS		.08	.26
TOC		46	34
SODIUM			
CALCIUM			
MAGNESIUM			
BICARBONATE			
CARBONATE			

018992

~~006257~~

WELL RECORD

WELL NO. 17

DATE INSTALLED 06/11/84

TOP OF CASING ELEV. 171.86

GROUND ELEV. 170.3

TOTAL DEPTH 55'

SCREENED INTERVAL 45' to 55'

DESCRIPTION: Shallow Well Down Gradient of Landfarm

GRAVEL PACKED 36' - 55'

SCREEN: 2" PVC: 0.01" Slots

DATE	07/02/84	07/20/84
WATER ELEVATION	135.76	
Ph	6.9	6.5
CONDUCTIVITY	1024	1,380
CHLORIDES	292	292
SULFATES	67	54
PHENOLICS	.11	.10
TOC	35	49
SODIUM		
CALCIUM		
MAGNESIUM		
BICARBONATE		
CARBONATE		

018993

006258

APPENDIX J

Analytical Reports from TOC/TOX Data

018994 006259

Rocky Mountain Analytical Laboratory
4955 Yarrow Street, Arvada, CO 80002 (303) 421-6611

A DIVISION OF
ENSECO
INCORPORATED

February 2, 1987

Georgia Bost
ERM - Southwest, Inc.
8989 Westheimer, Suite 111
Houston, TX 77063

Dear Georgia:

Enclosed are the analytical results for the eight Sheridan site waters received January 24, 1987.

Please call if you have any questions.

Sincerely,

Corinne L. Bogert

Corinne L. Bogert
Project Coordinator

Reviewed by:

Mark J. Bollinger, Ph.D.
Technical Director

CLB/MJB/bjb
Enclosures

RMAL # 62689

SAMPLE DESCRIPTION INFORMATION

for

ERM - Southwest, Inc.

RMA Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
62689-01	MW-20	Groundwater	01/22/87	01/24/87
62689-02	MW-29	Groundwater	01/22/87	01/24/87
62689-03	MW-13	Groundwater	01/22/87	01/24/87
62689-04	MW-15	Groundwater	01/22/87	01/24/87
62689-05	MW-3	Groundwater	01/23/87	01/24/87
62689-06	MW-18	Groundwater	01/23/87	01/24/87
62689-07	MW-6	Groundwater	01/23/87	01/24/87
62689-08	Field Blank	Groundwater	01/23/87	01/24/87

February 2, 1987

ANALYTICAL RESULTS

for

ERM - Southwest, Inc.

018996

INORGANIC PARAMETERS

Parameter	Units	62689-01		62689-02		62689-03		62689-04	
Total Organic Carbon	mg/L	0.7	(0.1)	2.5	(0.1)	0.5	(0.1)	28	(0.1)
Total Organic Halogen	ug Cl/L	ND	(5)	ND	(5)	16	(5)	170	(5)

Parameter	Units	62689-05		62689-06		62689-07		62689-08	
Total Organic Carbon	mg/L	38	(0.1)	19	(0.1)	7.2	(0.1)	0.3	(0.1)
Total Organic Halogen	ug Cl/L	180	(5)	19	(5)	23	(5)	ND	(5)

006261

ND = Not Detected. Detection limits in parentheses.

ROCKY MOUNTAIN ANALYTICAL LABORATORY

Inorganic Analytical Methodology

Parameter	Units	Nominal Detection Limit[a]	Methodology	Reference	Preservation Bottle No.	Maximum Holding Time[b]
MAJOR IONS						
Sodium	mg/l	0.5	ICP Emission Spectroscopy	3	4	6 months
Potassium	mg/l	0.3	ICP Emission Spectroscopy	3	4	6 months
Calcium	mg/l	0.1	ICP Emission Spectroscopy	3	4	6 months
Magnesium	mg/l	0.1	ICP Emission Spectroscopy	3	4	6 months
Chloride	mg/l	3	Manual Titrimetric, $Hg(NO_3)_2$	1-325.3/2-407B	1	28 days
			Automated Colorimetric Ferricyanide	1-325.2	1	28 days
Fluoride	mg/l	0.1	Electrode	1-340.2/2-413B	1	28 days
Sulfate	mg/l	5	Manual Turbidimetric	1-375.4/2-426C	1	28 days
			Automated Colorimetric MTB	1-375.2	1	28 days
Total Alkalinity as $CaCO_3$ at pH 4.5	mg/l	5	Titrimetric	1-310.1/2-403	1	14 days
Carbonate Alkalinity as $CaCO_3$ at pH 8.3	mg/l	5	Titrimetric	1-310.1/2-403	1	14 days
Bicarbonate Alkalinity as $CaCO_3$ at pH 4.5	mg/l	5	Titrimetric	1-310.1/2-403	1	14 days
Hydroxide Alkalinity as $CaCO_3$	mg/l	5	Calculation	2-403	-	-
Nitrate+Nitrite as N	mg/l	0.1	Manual Cd Reduction - Colorimetric	1-353.3/2-418C	2	28 days
		0.1	Automated Cd Reduction - Colorimetric	1-353.2	2	28 days
Total Cations	meq/l	0.1	Calculation	2-104C	-	-
Total Anions	meq/l	0.1	Calculation	2-104C	-	-
Difference	%	0.1	Calculation	2-104C	-	-
RADIOCHEMISTRY						
Gross Alpha	pCi/l	0.1	Proportional Counter	2-703	5	6 months
Gross Beta	pCi/l	0.1	Proportional Counter	2-703	5	6 months
Radium 226	pCi/l	0.1	Separation - Counter	2-705	5	6 months
Radium 228	pCi/l	0.1	Separation - Counter	2-707	5	6 months
Uranium	mg/l	0.005	Fluorimetric	4-D2907-75	5	6 months

018997

Inorganic Analytical Methodology (Continued)

018998

Parameter	Units	Nominal Detection Limit[a]	Methodology	Reference	Preservation Bottle No.	Maximum Holding Ti
TRACE METALS[c]						
Aluminum	mg/l	0.05	ICP Emission Spectroscopy	3	4	6 months
Antimony	mg/l	0.002	Furnace Atomic Absorption	1-204.2	4	6 months
Arsenic	mg/l	0.002	Furnace Atomic Absorption	1-206.2	4	6 months
Barium	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Beryllium	mg/l	0.001	ICP Emission Spectroscopy	3	4	6 months
Boron	mg/l	0.004	ICP Emission Spectroscopy	3	4	6 months
Cadmium	mg/l	0.002	ICP Emission Spectroscopy	3	4	6 months
Chromium	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Cobalt	mg/l	0.003	ICP Emission Spectroscopy	3	4	6 months
Copper	mg/l	0.002	ICP Emission Spectroscopy	3	4	6 months
Iron	mg/l	0.05	ICP Emission Spectroscopy	3	4	6 months
Lead	mg/l	0.025	ICP Emission Spectroscopy	3	4	6 months
		0.001	Furnace Atomic Absorption	1-239.2	4	6 months
Manganese	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Mercury	mg/l	0.0002	Cold Vapor Atomic Absorption	1-245.1	4	6 months
Molybdenum	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Nickel	mg/l	0.01	ICP Emission Spectroscopy	3	4	6 months
Selenium	mg/l	0.002	Furnace Atomic Absorption	1-270.2	4	6 months
Silver	mg/l	0.003	ICP Emission Spectroscopy	3	4	6 months
Strontium	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Thallium	mg/l	0.002	Furnace Atomic Absorption	1-279.2	4	6 months
Tin	mg/l	0.03	ICP Emission Spectroscopy	3	4	6 months
Titanium	mg/l	0.002	ICP Emission Spectroscopy	3	4	6 months
Vanadium	mg/l	0.002	ICP Emission Spectroscopy	3	4	6 months
Zinc	mg/l	0.004	ICP Emission Spectroscopy	3	4	6 months
INORGANIC PARAMETERS						
pH	units	0.01	Meter	1-150.1; 2-423	1	ASAP
Specific Conductance at 25°C	umhos/cm	1	Bridge	1-120.1; 2-205	1	28 days
Total Dissolved Solids	mg/l	10	Gravimetric, 180°C	1-160.1; 2-209B	1	7 days
Total Suspended Solids	mg/l	2	Gravimetric, 105°C	1-160.2	1	7 days
Total Solids	mg/l	10	Gravimetric, 105°C	1-160.3	1	7 days
Total Volatile Solids	mg/l	10	Gravimetric, 550°C	1-160.4	1	7 days
Ortho-Phosphate as P	mg/l	0.01	Single Reagent Colorimetric	1-365.2; 2-424F	1	48 hours

Inorganic Analytical Methodology (Continued)

Parameter	Units	Nominal Detection Limit[a]	Methodology	Reference	Preservation Bottle No.	Maximum HoldingTime[b]
INORGANIC PARAMETERS (Continued)						
Total Phosphorus as P	mg/l	0.06	Digestion; ICP Emission Spectroscopy	1-4.1.4; 3	4	28 days
		0.01	Digestion - Colorimetric	1-365.2; 1-424C,F	2	28 days
Silica as SiO_2	mg/l	0.1	ICP Emission Spectroscopy	3	4	28 days
	mg/l	1	Colorimetric	1-370.1; 2-425C	1	28 days
Biological Oxygen Demand	mg/l	2	Dilution Bottle - D.O. Probe	1-405.1; 2-507	1	48 hours
Chemical Oxygen Demand	mg/l	5	Micro Colorimetric	1-410.4; 2-508A	2	28 days
Total Organic Carbon	mg/l	0.1	Oxidation-Infrared Absorption	1-415.1; 2-505	2	28 days
Ammonia as N	mg/l	0.1	Electrode	1-350.3; 2-417E	2	28 days
		0.1	Automated Colorimetric	1-350.1	2	28 days
Total Kjeldahl Nitrogen as N	mg/l	0.1	Digestion - Electrode	1-351.4; 2-420B	2	28 days
		0.1	Digestion - Colorimetric	1-351.2	2	28 days
Total Organic Nitrogen as N	mg/l	0.1	Calculation (TKN - NH_3)	-	-	-
Oil and Grease	mg/l	1	Freon Extraction-Gravimetric	1-413.1; 2-503A	3	28 days
Free Cyanide	mg/l	0.01	Chlorination-Distillation-Colorimetric	1-335.1; 2-412F,D	6	14 days
Total Cyanide	mg/l	0.01	Distillation - Colorimetric	1-335.2; 2-412B,D	6	14 days
Phenolics	mg/l	0.01	Distillation - Colorimetric	1-420.1; 2-510A,B	2	28 days
Fecal Coliform	Colonies/100 ml	1	Membrane Filter	2-909C	8	ASAP
Total Coliform	Colonies/100 ml	1	Membrane Filter	2-909A	8	ASAP
Bromide	mg/l	0.1	Colorimetric	2-405	1	28 days
Residual Chlorine	mg/l	0.05	Amperometric	1-330.2; 2-408C	1	ASAP
Hexavalent Chromium	mg/l	0.01	Colorimetric	1-218.4; 2-312B	1	24 hours
Color	units	5	Pt-Co Colorimetric	1-110.2; 2-204A	1	48 hours
Hardness as $CaCO_3$	mg/l	5	Calculation	2-314A	4	6 months
Nitrite as N	mg/l	0.01	Colorimetric	1-354.1; 2-419	1	48 hours
Sulfide	mg/l	0.05	Titrimetric - Electrode	1-376.1; 2-427B,D	7	7 days
Sulfite	mg/l	2	Titrimetric	1-377.1; 2-428	1	ASAP
MBAS (Surfactants)	mg/l	0.1	Colorimetric	1-425.1; 2-512A	1	48 hours
Turbidity	NTU	0.1	Turbidimeter	1-180.1; 2-214A	1	48 hours

018999

019000

006285

References

(1) "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, EMSL, Cincinnati, 1979.

(2) "Standard Methods for the Examination of Water and Wastewater", 15th Edition, APHA, 1980.

(3) Federal Register, 40 CFR 136, December 3, 1979; USEPA EMSL-Cincinnati, OH 45268.

(4) "Annual Book of ASTM Standards", Part 31, Water, 1980.

Notes

[a] Nominal values are the best achievable with the listed analytical method. Interferences in specific samples may result in a higher detection limit.

[b] Applicable to NPDES wastes as updated by Robert C. Booth, Director, EMSL-Cincinnati, September 22, 1981.

[c] Digestion procedure 1-4.1.4 used for elements determined by ICP Emission Spectroscopy when determining total metals. Digestion procedures for graphite furnace elements included with reference listed.

11/10/82

GUIDELINES FOR SAMPLE BOTTLES AND PRESERVATIVES[a]

Bottle No.	Parameters	Container	Preservative	Notes
1	Cl^-, F^-, $SO_4^=$, Tot. Alk., $CO_3^=$ Alk., HCO_3^- Alk., OH^- Alk., pH, spec. cond., TDS, TSS, TS, TVS, o-PO_4 SiO_2, BOD, Br^-, res. Cl_2, Cr^{+6}, color, NO_2^-, $SO_3^=$, MBAS, Turbidity.	1 liter poly	4° C	Provide unfiltere sample for solids and turbidi
2	Tot. P, COD, TOC, NH_3, TKN, TON, Phenolics NO_3 + NO_2.	500 ml poly	2 ml 50% H_2SO_4, 4°C	
3	O & G	1 liter glass	4 ml 50% H_2SO_4, 4°C	Do not filter, collect directly in bottle.
4	Na, K, Ca, Mg, Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, Sr, Tl, Sn, Ti, V, Zn, ICP, Hardness.	500 ml poly	5 ml 50% HNO_3	Provide separate samples for total and dissolved sample (filter before adding to bottle.)
5	Alpha, Beta, Ra^{226}, Ra^{228}, U	1 liter poly (no Ra^{228}) ½ gallon poly (with Ra^{228})	10 ml 50% HNO_3 20 ml 50% HNO_3	
6	Free CN, Tot. CN	500 ml poly	2 ml 50% NaOH, 4°C	
7	Sulfide	250 ml poly	1 ml 1 N Zn acetate, 1 ml 50% NaOH, 4°C	
8	Fecal coli., total coli.	8 oz. sterile	4° C	Collect directly in sterile bottle
11	VOA, purgeable organics, THM	2 - 40 ml glass vial	4° C	Completely fill bottle, leave no air bubbles.
12	B/NA	1 liter glass	4° C	
13	Pest./PCB	1 liter glass	4° C	
14	Herbicides	1 liter glass	4° C	
15	TOX	1 liter glass	4° C	

[a] Federal Register, 40 CFR 136, December 3, 1979, as updated by EPA, EMSL-Cincinnati, September 22, 1981.

11/5/82

019001

019002 ~~006267~~

Rocky Mountain Analytical Laboratory
4955 Yarrow Street, Arvada, CO 80002 (303) 421-6611

A DIVISION OF
ENSECO
INCORPORATED

March 12, 1987

Scott MacDonald
ERM - Southwest Inc.
16000 Memorial Drive, Suite 200
Houston, TX 77079-4006

Dear Mr. MacDonald:

Enclosed please find the results for ten groundwater samples from the Sheridan site received February 25, 1987.

Please call if you have any questions.

Best Regards,

Jean Zimmerman
Project Coordinator

Reviewed by:

Jerry L. Parr
Technical Director

JZ/JLP/bjb
Enclosures

RMAL # 63083

SAMPLE DESCRIPTION INFORMATION

for

ERM-Southwest, Inc.

RMA Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
63083-01	MW-3	Groundwater	02/23/87	02/25/87
63083-02	MW-6	Groundwater	02/23/87	02/25/87
63083-03	MW-13	Groundwater	02/23/87	02/25/87
63083-04	MW-14	Groundwater	02/23/87	02/25/87
63083-05	MW-15	Groundwater	02/23/87	02/25/87
63083-06	MW-18	Groundwater	02/23/87	02/25/87
63083-07	MW-20	Groundwater	02/23/87	02/25/87
63083-08	MW-29	Groundwater	02/23/87	02/25/87
63083-09	MW-00	Groundwater	02/23/87	02/25/87
63083-10	Field Blank	Groundwater	02/23/87	02/25/87

March 12, 1987

ANALYTICAL RESULTS

for

ERM - Southwest, Inc.

019004

INORGANIC PARAMETERS

Parameter	Units	63083-01		63083-02		63083-03		63083-04	
Total Organic Carbon	mg/L	37	(0.1)	4.2	(0.1)	1.4	(0.1)	2.1	(0.1)
Total Organic Halogen	ug Cl/L	56	(5)	17	(5)	20	(5)	48	(5)

6209

Parameter	Units	63083-05		63083-06		63083-07		63083-08	
Total Organic Carbon	mg/L	26	(0.1)	17	(0.1)	0.8	(0.1)	2.5	(0.1)
Total Organic Halogen	ug Cl/L	210	(5)	49	(5)	34	(5)	16	(5)

Parameter	Units	63083-09		63083-10	
Total Organic Carbon	mg/L	0.5	(0.1)	0.3	(0.1)
Total Organic Halogen	ug Cl/L	46	(5)	33	(5)

019005 20

Rocky Mountain Analytical Laboratory
4955 Yarrow Street, Arvada, CO 80002 (303) 421-6611

A DIVISION OF
ENSECO
INCORPORATED

March 18, 1987

Scott MacDonald
ERM - Southwest Inc.
16000 Memorial Drive, Suite 200
Houston, TX 77079-4006

Dear Mr. MacDonald:

Enclosed please find a corrected report for RMAL project 63083.

RMAL samples -09 and -10 were reanalyzed for TOX. Please note that the TOX result for sample -09 is almost identical to the previous result. The trip blank was not detected at a detection limit of 15 ugCl^-/L.

Do not hesitate to call if you have any questions.

Best regards,

Jean Zimmerman
Project Coordinator

Reviewed by:

Jerry L. Parr
Technical Director

JZ/JLP/brm
Enclosures

RMAL # 63083

SAMPLE DESCRIPTION INFORMATION

for

ERM-Southwest, Inc.

RMA Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
63083-01	MW-3	Groundwater	02/23/87	02/25/87
63083-02	MW-6	Groundwater	02/23/87	02/25/87
63083-03	MW-13	Groundwater	02/23/87	02/25/87
63083-04	MW-14	Groundwater	02/23/87	02/25/87
63083-05	MW-15	Groundwater	02/23/87	02/25/87
63083-06	MW-18	Groundwater	02/23/87	02/25/87
63083-07	MW-20	Groundwater	02/23/87	02/25/87
63083-08	MW-29	Groundwater	02/23/87	02/25/87
63083-09	MW-00	Groundwater	02/23/87	02/25/87
63083-10	Trip Blank	Groundwater	02/23/87	02/25/87

March 18, 1987

ANALYTICAL RESULTS

for

ERM - Southwest, Inc.

019007

INORGANIC PARAMETERS

Parameter	Units	63083-01		63083-02		63083-03		63083-04	
Total Organic Carbon	mg/L	37	(0.1)	4.2	(0.1)	1.4	(0.1)	2.1	(0.1)
Total Organic Halogen	ugCl⁻/L	56	(5)	17	(5)	20	(5)	48	(5)

Parameter	Units	63083-05		63083-06		63083-07		63083-08	
Total Organic Carbon	mg/L	26	(0.1)	17	(0.1)	0.8	(0.1)	2.5	(0.1)
Total Organic Halogen	ugCl⁻/L	210	(5)	49	(5)	34	(5)	16	(5)

Parameter	Units	63083-09		63083-10	
Total Organic Carbon	mg/L	0.5	(0.1)	0.3	(0.1)
Total Organic Halogen	ugCl⁻/L	45	(15)	ND	(15)

ND = Not Detected. Detection limits in parentheses.

~~J06273~~

Rocky Mountain
Analytical Laboratory

Enseco Incorporated

Enseco

ANALYTICAL RESULTS

FOR

ERM - SOUTHWEST, INC.

APRIL 24, 1987

Reviewed by:

Jean Zimmerman

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I. OVERVIEW

On March 25, 1987, Enseco-Rocky Mountain Analytical Laboratory received ten water samples from ERM - Southwest, Inc. A complete listing of tests requested, by sample, is given in Section III.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information
III. Analytical Tests Assigned
IV. Analytical Results
V. Quality Control Report
VI. Description of Analytical Methodology

Standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory QC samples analyzed in conjunction with the samples in this project were within established control limits.

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II. SAMPLE DESCRIPTION INFORMATION

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Enseco - RMAL is assigned a unique five digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the five digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

SAMPLE DESCRIPTION INFORMATION

for

ERM-SOUTHWEST, INC.

RMAL Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
63269-001	MW-3	Groundwater	03/23/87	03/25/87
63269-002	MW-6	Groundwater	03/23/87	03/25/87
63269-003	MW-13	Groundwater	03/23/87	03/25/87
63269-004	MW-14	Groundwater	03/23/87	03/25/87
63269-005	MW-15	Groundwater	03/23/87	03/25/87
63269-006	MW-18	Groundwater	03/23/87	03/25/87
63269-007	MW-20	Groundwater	03/23/87	03/25/87
63269-008	MW-29	Groundwater	03/23/87	03/25/87
63269-009	MW-00	Groundwater	03/23/87	03/25/87
63269-010	TRIP BLANK	Groundwater	03/23/87	03/25/87

III. ANALYTICAL TESTS ASSIGNED

The following section presents all of the tests assigned to each of the samples in the project. The tests are listed in the order in which data is presented in Section IV. (Analytical Results).

In addition to a test description, information is provided concerning whether the test has been changed, or customized, to accommodate specific needs of the client. Customization can involve changes in the analyte list (addition or deletion of standard analytes) or changes in the standard detection limit.

ANALYTICAL TESTS ASSIGNED

for

ERM-SOUTHWEST, INC.

RMAL Sample No.	Analysis Description	Custom Test*
63269-001	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63269-002	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63269-003	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63269-004	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63269-005	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63269-006	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63269-007	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63269-008	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63269-009	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63269-010	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

IV. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. The results are presented by sample, by test, with tests reported in the following order: GC/MS, Chromatography, Metals and Inorganics.

Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Enseco reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content. All data is "blank corrected", i.e. the level of contamination, if any, found in the laboratory blank is subtracted from the analytical result before it is reported.

Where regulatory limits have been established by the EPA, a column on the data sheet labeled "Regulatory Limit", lists that limit for purposes of comparison.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is given in Section V.

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.
Client ID: MW-3
Laboratory ID: 63269-001 Enseco ID: 63269-001
Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87
Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	32	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	52	ug Cl/L	5	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-001

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-6

Laboratory ID: 63269-002 Enseco ID: 63269-002

Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87

Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	3.0	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	210	ug Cl/L	5	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-002

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-13

Laboratory ID: 63269-003 Enseco ID: 63269-003

Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87

Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	0.9	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	26	ug Cl/L	5	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-003

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-14

Laboratory ID: 63269-004 Enseco ID: 63269-004

Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87

Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	0.6	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	150	ug Cl/L	5	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-004

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.
Client ID: MW-15
Laboratory ID: 63269-005 Enseco ID: 63269-005
Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87
Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	37	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	340	ug Cl/L	5	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-005

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-18

Laboratory ID: 63269-006 Enseco ID: 63269-006

Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87

Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	17	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	64	ug Cl/L	5	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-006

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.
Client ID: MW-20
Laboratory ID: 63269-007 Enseco ID: 63269-007
Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87
Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	0.6	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	95	ug Cl/L	5	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-007

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INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-29

Laboratory ID: 63269-008 Enseco ID: 63269-008

Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87

Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	1.5	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	N.D.	ug Cl/L	5	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-008

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-00

Laboratory ID: 63269-009 Enseco ID: 63269-009

Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87

Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	0.4	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	N.D.	ug Cl/L	10	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-009

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: TRIP BLANK

Laboratory ID: 63269-010 Enseco ID: 63269-010

Matrix: Groundwater Sampled: 03/23/87 Received: 03/25/87

Authorized: 03/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	0.4	mg/L	0.1	415.1/9060	04/16/87
Total Organic Halogen	N.D.	ug Cl/L	5	9020	04/09/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63269-010

V. QUALITY CONTROL REPORT

The Enseco laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

In addition, the Enseco laboratories maintain a comprehensive set of certifications from both state and federal governmental agencies which require frequent analyses of blind audit samples. Enseco - Rocky Mountain Analytical Laboratory is certified by the EPA under the EPA/CLP program for both Organic and Inorganic analyses, under the USATHAMA (U.S. Army) program, by the Army Corps of Engineers, and the states of Colorado, New Jersey, New York, Utah, and Florida, among others.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

The Enseco QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of duplicate Laboratory Control Samples (LCS) at frequent, well-defined intervals. An LCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the LCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Enseco

QC LOT ASSIGNMENT REPORT
INORGANICS - NON-METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
63269-001	Reagent Water	TOC	TOC 038AA
63269-001	Reagent Water	TOX	TOX 022AB
63269-002	Reagent Water	TOC	TOC 038AA
63269-002	Reagent Water	TOX	TOX 022AB
63269-003	Reagent Water	TOC	TOC 039AA
63269-003	Reagent Water	TOX	TOX 022AB
63269-004	Reagent Water	TOC	TOC 039AA
63269-004	Reagent Water	TOX	TOX 022AB
63269-005	Reagent Water	TOC	TOC 039AA
63269-005	Reagent Water	TOX	TOX 022AB
63269-006	Reagent Water	TOC	TOC 039AA
63269-006	Reagent Water	TOX	TOX 022AB
63269-007	Reagent Water	TOC	TOC 039AA
63269-007	Reagent Water	TOX	TOX 022AB
63269-008	Reagent Water	TOC	TOC 039AA
63269-008	Reagent Water	TOX	TOX 022AB
63269-009	Reagent Water	TOC	TOC 039AA
63269-009	Reagent Water	TOX	TOX 022AB
63269-010	Reagent Water	TOC	TOC 039AA
63269-010	Reagent Water	TOX	TOX 022AB

LABORATORY CONTROL SAMPLE REPORT
INORGANICS - NON-METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: TOC on Reagent Water QC Lot: TOC 038AA Concentration Units: (mg/L)								
Total Organic Carbon	24	22	22	92	92	91-109	0.0	20
Test: TOC on Reagent Water QC Lot: TOC 039AA Concentration Units: (mg/L)								
Total Organic Carbon	24	22	23	92	96	91-109	4.4	20
Test: TOX on Reagent Water QC Lot: TOX 022AB Concentration Units: (ug Cl/L)								
Total Organic Halogens	100	112	107	112	107	80-120	4.6	20

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate LCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For Organic analyses an additional control measure is taken in the form of a Surrogate Control Sample (SCS). The SCS is a control sample spiked with surrogate standards which is analyzed with every analytical lot. The recovery of the SCS is charted in exactly the same manner as described for the LCS, and provides a daily check on the performance of the method.

Accuracy for LCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for LCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{\text{Measured Concentration LCS1} - \text{Measured Concentration LCS2}}{(\text{Measured Concentration LCS1} + \text{Measured Concentration LCS2})/2}$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, LCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report. The test codes assigned are defined in Section VI., Analytical Methodology.

VI. ANALYTICAL METHODOLOGY

Enseco - Rocky Mountain Analytical Laboratory performs analytical services according to methods approved by EPA and other regulatory agencies, whenever possible.

Methods for metals and organic compounds are primarily derived from three sources of EPA methods, 1) the methods promulgated in 40 CFR 136 for priority pollutants, 2) the methods published in SW-846 and 3) methods developed by the EPA-EMSL/LV for Superfund investigations, as well as several documents published by the EPA and Enseco - Rocky Mountain Analytical Laboratory in 1984 and 1985. These methods all use the same generic technology as summarized below:

- Metals: acid digestion followed by analyses by ICP supported by graphite furnace AA
- Volatile Organics: purge and trap GC/MS or purge and trap GC with a selective detector.
- Semivolatile (base/neutral and acid) organics: solvent extraction followed by capillary column GC/MS, and
- Pesticides/Herbicides: solvent extraction, followed by gas chromatography.

Exact method references are given in the following tables.

ANALYTICAL METHODOLOGY - ORGANIC TESTS

Test	Description	Methodology	Reference
VOA	Volatile Organics	Purge & Trap, GC/MS	624(1)/8240(2)
BNA	Semivolatile Organics	Extraction, GC/MS	625(1)/8270(2)
DXN	Dioxin	Extraction, GC/MS	613(1)/8280(2)
601	Halogenated Volatile Organics	Purge & Trap GC/Hall	601(1)/8010(2)
THM	Trihalomethanes	Purge & Trap GC/Hall	601(1)/8010(2)
602	Aromatic Volatile Organics	Purge & Trap GC/PID	602(1)/8020(2)
OCP	Organochlorine Pesticides	Extraction, GC/ECD	608(1)/8080(2)
OPP	Organophosphate Pesticides	Extraction, GC/FPD	614(1)/8140(2)
619	Triazine Pesticides	Extraction, GC/NPD	619(1)
LC CARB	Carbamate and Urea Pesticides	Extraction, HPLC	632(1)
PCB	PCB's	Extraction, GC/ECD	608(1)/8080(2)
HRB	Phenoxyacid Herbicides	Extraction, GC/ECD	615(1)/8150(2)
603	Acrolein & Acrylonitrile	Purge & Trap GC/FID	603(1)/8030(2)
604	Phenols	Extraction, GC/FID	604(1)/8040(2)
605	Benzidines	Extraction, HPLC	605(1)/8050(2)
606	Phthalate Esters	Extraction, GC/FID	606(1)/8060(2)
607	Nitrosamines	Extraction, GC/NPD	607(1)
609	Nitroaromatics & Cyclic Ketones	Extraction, GC/NPD	609(1)/8090(2)
PNA	Polynuclear Aromatic Hydrocarbons	Extraction, HPLC	610(1)/8310(2)
611	Haloethers	Extraction, GC/ECD	611(1)
612	Chlorinated Hydrocarbons	Extraction, GC/ECD	612(1)/8120(2)
GD FID	Hydrocarbon Scan	Extraction, GC/FID	D3328-78(3)
GC BPD	Boiling Point Determination	Extraction, GC/FID	D2887-84(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 3rd Edition, 1987.
(3) "Annual Book of ASTM Standards", Volume 11.01, 1985.
(4) "Annual Book of ASTM Standards", Volume 05.02, 1984.

ANALYTICAL METHODOLOGY - INORGANIC TESTS

Test	Description	Methodology	Reference
ICP	Trace Metals	ICP Emission Spectroscopy	200.7(1)/6010(2)
FSB	Antimony	Furnace Atomic Absorption	204.2(1)/7041(2)
FAS	Arsenic	Furnace Atomic Absorption	206.2(1)/7060(2)
FCD	Cadmium	Furnace Atomic Absorption	213.2(1)/7131(2)
FPB	Lead	Furnace Atomic Absorption	239.2(1)/7421(2)
FSE	Selenium	Furnace Atomic Absorption	270.2(1)/7740(2)
FAG	Silver	Furnace Atomic Absorption	272.2(1)/7761(2)
FTL	Thallium	Furnace Atomic Absorption	279.2(1)/7841(2)
CVHG	Mercury	Cold Vapor Atomic	245.1(1)/7471(2)
CR + 6	Chromium (VI)	Colorimetric	312B(3)
IC CL	Chloride	Ion Chromatography	300.0(1)
BURCL	Chloride	Manual Titrimetric	325.3(1)
METF	Fluoride	Electrode	340.2(1)
IC S04	Sulfate	IC	300.0(1)
SPES04	Sulfate	Manual Turbidimetric	375.4(1)
METALK	Alkalinity, Total	Titrimetric	310.1(1)
METACK	Alkalinity, Forms	Titrimetric	403(3)
TECNOXT	Nitrate+Nitrite as N	Cd Reduction Colorimetric	353.2(1)
METPH	pH	Meter	150.1(1)/9045(2)
CELSP	Specific Conductance @ 25°C	Bridge	120.1(1)
BALTDS	Total Dissolved Solids	Gravimetric, 180°C	160.1(1)
BALTSS	Total Suspended Solids	Gravimetric, 105°C	160.2(1)
BALTS	Total Solids	Gravimetric, 105°C	160.3(1)
BALTVS	Total Volatile Solids	Gravimetric, 550°C	160.4(1)
TECO P	Ortho-Phosphate as P	Two Reagent Colorimetric	365.3(1)
TECT P	Total Phosphorus as P	Digestion-Colorimetric	365.3(1)
ICP	Total Phosphorus as P	Digestion-ICP/AES	200.7(1)
ICP	Silica as SiO_2	ICP/AES	200.7(1)
SPESI02	Silica as SiO_2	Colorimetric	370.1(1)
METBOD	Biochemical Oxygen Demand	Dilution Bottle-D.O. probe	405.1(1)
METCOD	Chemical Oxygen Demand	Micro Colorimetric	410.4(1)
TOCTOC	Total Organic Carbon	UV Oxidation-IR	415.2(1)
METNH3	Ammonia as N	Electrode	350.3(1)
TECNH3	Ammonia as N	Automated Colorimetric	350.1(1)
METTKN	Total Kjeldahl Nitrogen as N	Digestion-Electrode	351.4(1)
TECTKN	Total Kjeldahl Nitrogen as N	Digestion-Colorimetric	351.2(1)
TOXTOX	Total Organic Halogen	Combustion-Titrimetric	9020(2)
TONO1	Total Organic Nitrogen	Calculation (TKN-NH_3)	-
BAL O&G	Oil and Grease	Freon Extraction-Gravimetric	413.1(1)
IR AO&G	Oil and Grease	Freon Extraction-IR	413.2(1)
TECCN F	Cyanide Amendable to Chlorination	Chlorination-Distillation-Colorimetric	335.1(1)
TECCN W	Weak & Dissolved Cyanide	Distillation-Colorimetric	412H(3)
TECCN T	Total Cyanide	Distillation-Colorimetric	335.2(1)/9010(2)
STEPHEN	Phenolics	Distillation-Colorimetric	420.1(1)
COLIF F	Fecal Coliform	Membrane Filter	909C(3)
COLIF T	Total Coliform	Membrane Filter	909A(3)

ANALYTICAL METHODOLOGY - INORGANIC TESTS (CONT.)

Test	DescriptionMethodology	Reference	
IC BR	Bromide	Ion Chromatography	300.0(1)
POTCL2R	Residual Chlorine	Amperometric	330.2(1)
NESCOLR	Color	Pt-Co Colorimetric	110.2(1)
ICPHAR	Hardness as $CaCo_3$	Calculation	200.7(1)/314A(3)
TECN02	Nitrite as N	Colorimetric	354.1(1)
SPES	Sulfide	Colorimetric	376.2(1)/9030(2)
BURS03	Sulfite	Titrimetric	377.1(1)
SPEMBAS	MBAS (Surfactants)	Colorimetric	425.1(1)
SPETURB	Turbidity	Turbidimeter	180.1(1)
Gross Alpha		Proportional Counter	703(3)
Gross Beta		Proportional Counter	703(3)
Radium 226		Separation - Counter	705(3)
Radium 228		Separation - Counter	707(3)
Uranium		Fluorimetric	D2907.75(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 3rd Edition, 1987.
(3) "Standard Methods for the Examination of Water and Wastewater", 15th Edition, 1980.
(4) "Annual Book of ASTM Standards", Part 31, Water, 1980.

Rocky Mountain
Analytical Laboratory

Enseco Incorporated

Enseco

ANALYTICAL RESULTS

FOR

ERM - SOUTHWEST, INC.

May 22, 1987

Reviewed by:

Jean Zimmerman

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Introduction

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

- o Sample Description Information
- o Analytical Tests Assigned
- o Analytical Results
- o Quality Control Report
- o Description of Analytical Methodology

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The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is provided subsequently.

SAMPLE DESCRIPTION INFORMATION

for

ERM-SOUTHWEST, INC.

RMAL Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
63460-001	MW-29	Water	04/21/87	04/23/87
63460-002	MW-18	Water	04/21/87	04/23/87
63460-003	MW-6	Water	04/21/87	04/23/87
63460-004	MW-3	Water	04/21/87	04/23/87
63460-005	MW-00	Water	04/21/87	04/23/87
63460-006	MW-13	Water	04/21/87	04/23/87
63460-007	MW-14	Water	04/21/87	04/23/87
63460-008	MW-15	Water	04/21/87	04/23/87
63460-009	MW-20	Water	04/21/87	04/23/87
63460-010	TRIP BLANK	Water	04/21/87	04/23/87

ANALYTICAL TESTS ASSIGNED

for

ERM-SOUTHWEST, INC.

RMAL Sample No.	Analysis Description	Custom Test*
63460-001	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	TURBIDITY (NTU)	NO
63460-002	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	TURBIDITY (NTU)	NO
63460-003	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	TURBIDITY (NTU)	NO
63460-004	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	TURBIDITY (NTU)	NO
63460-005	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63460-006	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63460-007	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63460-008	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63460-009	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63460-010	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-29

Laboratory ID: 63460-001 Enseco ID: 63460-001

Matrix: Water Sampled: 04/21/87 Received: 04/23/87

Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	2.1	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	23	ug Cl/L	5	9020	05/03/87
Turbidity	220	NTU	0.1	180.1	04/23/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-001

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-18

Laboratory ID: 63460-002 Enseco ID: 63460-002

Matrix: Water Sampled: 04/21/87 Received: 04/23/87

Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	17	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	110	ug Cl/L	5	9020	05/03/87
Turbidity	40	NTU	0.1	180.1	04/24/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-002

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-6

Laboratory ID: 63460-003 Enseco ID: 63460-003

Matrix: Water Sampled: 04/21/87 Received: 04/23/87

Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	12	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	61	ug Cl/L	5	9020	05/03/87
Turbidity	49	NTU	0.1	180.1	04/24/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-003

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.
Client ID: MW-3
Laboratory ID: 63460-004 Enseco ID: 63460-004
Matrix: Water Sampled: 04/21/87 Received: 04/23/87
Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	37	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	95	ug Cl/L	5	9020	05/03/87
Turbidity	52	NTU	0.1	180.1	04/24/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-004

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-00

Laboratory ID: 63460-005 Enseco ID: 63460-005

Matrix: Water Sampled: 04/21/87 Received: 04/23/87

Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	0.2	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	5	ug Cl/L	5	9020	05/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-005

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Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-13

Laboratory ID: 63460-006 Enseco ID: 63460-006

Matrix: Water Sampled: 04/21/87 Received: 04/23/87

Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	6.4	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	25	ug Cl/L	5	9020	05/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-006

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-14

Laboratory ID: 63460-007 Enseco ID: 63460-007

Matrix: Water Sampled: 04/21/87 Received: 04/23/87

Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	8.9	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	34	ug Cl/L	5	9020	05/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-007

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-15

Laboratory ID: 63460-008 Enseco ID: 63460-008

Matrix: Water Sampled: 04/21/87 Received: 04/23/87

Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	35	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	240	ug Cl/L	5	9020	05/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-008

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-20

Laboratory ID: 63460-009 Enseco ID: 63460-009

Matrix: Water Sampled: 04/21/87 Received: 04/23/87

Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	1.1	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	380	ug Cl/L	5	9020	05/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-009

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: TRIP BLANK

Laboratory ID: 63460-010 Enseco ID: 63460-010

Matrix: Water Sampled: 04/21/87 Received: 04/23/87

Authorized: 04/23/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	0.6	mg/L	0.1	415.1/9060	05/05/87
Total Organic Halogen	10	ug Cl/L	5	9020	05/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63460-010

Quality Control Results

The Enseco laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

In addition, the Enseco laboratories maintain a comprehensive set of certifications from both state and federal governmental agencies which require frequent analyses of blind audit samples. Enseco - Rocky Mountain Analytical Laboratory is certified by the EPA under the EPA/CLP program for both Organic and Inorganic analyses, under the USATHAMA (U.S. Army) program, by the Army Corps of Engineers, and the states of Colorado, New Jersey, New York, Utah, and Florida, among others.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

The Enseco QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of duplicate Laboratory Control Samples (LCS) at frequent, well-defined intervals. An LCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the LCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate LCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For multi-analyte determinations, eighty percent of the accuracy and precision measurements must be within control limits for the QC Lot to be considered acceptable.

For Organic analyses an additional control measure is taken in the form of a Surrogate Control Sample (SCS). The SCS is a control sample spiked with surrogate standards which is analyzed with every analytical lot. The recovery of the SCS is charted in exactly the same manner as described for the LCS, and provides a daily check on the performance of the method.

Accuracy for LCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for LCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{\text{Measured Concentration LCS1} - \text{Measured Concentration LCS2}}{(\text{Measured Concentration LCS1} + \text{Measured Concentration LCS2})/2}$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, LCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report. The test codes assigned are defined in Section VI., Analytical Methodology.

Enseco

QC LOT ASSIGNMENT REPORT
INORGANICS - NON-METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
63460-001	Reagent Water	TOC	TOC 055AA
63460-001	Reagent Water	TOX	TOX 040AB
63460-001	Reagent Water	TURB	TURB007AA
63460-002	Reagent Water	TOC	TOC 055AA
63460-002	Reagent Water	TOX	TOX 040AB
63460-002	Reagent Water	TURB	TURB007AA
63460-003	Reagent Water	TOC	TOC 055AA
63460-003	Reagent Water	TOX	TOX 040AB
63460-003	Reagent Water	TURB	TURB007AA
63460-004	Reagent Water	TOC	TOC 055AA
63460-004	Reagent Water	TOX	TOX 040AB
63460-004	Reagent Water	TURB	TURB007AA
63460-005	Reagent Water	TOC	TOC 055AA
63460-005	Reagent Water	TOX	TOX 040AB
63460-006	Reagent Water	TOC	TOC 055AA
63460-006	Reagent Water	TOX	TOX 040AB
63460-007	Reagent Water	TOC	TOC 055AA
63460-007	Reagent Water	TOX	TOX 040AB
63460-008	Reagent Water	TOC	TOC 055AA
63460-008	Reagent Water	TOX	TOX 040AB
63460-009	Reagent Water	TOC	TOC 055AA
63460-009	Reagent Water	TOX	TOX 040AB
63460-010	Reagent Water	TOC	TOC 055AA
63460-010	Reagent Water	TOX	TOX 040AB

Enseco

LABORATORY CONTROL SAMPLE REPORT
INORGANICS - NON-METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: TOC on Reagent Water QC Lot: TOC 055AA Concentration Units: (mg/L)								
Total Organic Carbon	91.8	87	87	95	95	91-109	0.0	20
Test: TOX on Reagent Water QC Lot: TOX 040AB Concentration Units: (ug Cl/L)								
Total Organic Halogens	100	87	95	87	95	80-120	8.8	20
Test: TURB on Reagent Water QC Lot: TURB007AA Concentration Units: (NTU)								
Turbidity	2.4	2.5	2.6	104	108	92-108	3.9	10

Analytical Methodology

Enseco - Rocky Mountain Analytical Laboratory performs analytical services according to methods approved by EPA and other regulatory agencies, whenever possible.

Methods for metals and organic compounds are primarily derived from three sources of EPA methods, 1) the methods promulgated in 40 CFR 136 for priority pollutants, 2) the methods published in SW-846 and 3) methods developed by the EPA-EMSL/LV for Superfund investigations, as well as several documents published by the EPA and Enseco - Rocky Mountain Analytical Laboratory in 1984 and 1985. These methods all use the same generic technology as summarized below:

- Metals: acid digestion followed by analyses by ICP supported by graphite furnace AA
- Volatile Organics: purge and trap GC/MS or purge and trap GC with a selective detector.
- Semivolatile (base/neutral and acid) organics: solvent extraction followed by capillary column GC/MS, and
- Pesticides/Herbicides: solvent extraction, followed by gas chromatography.

Exact method references are provided in the Analytical Methodology Tables.

ANALYTICAL METHODOLOGY - ORGANIC TESTS

Test	Description	Methodology	Reference
VOA	Volatile Organics	Purge & Trap, GC/MS	624(1)/8240(2)
BNA	Semivolatile Organics	Extraction, GC/MS	625(1)/8270(2)
DXN	Dioxin	Extraction, GC/MS	613(1)/8280(2)
601	Halogenated Volatile Organics	Purge & Trap GC/Hall	601(1)/8010(2)
THM	Trihalomethanes	Purge & Trap GC/Hall	601(1)/8010(2)
602	Aromatic Volatile Organics	Purge & Trap GC/PID	602(1)/8020(2)
OCP	Organochlorine Pesticides	Extraction, GC/ECD	608(1)/8080(2)
OPP	Organophosphate Pesticides	Extraction, GC/FPD	614(1)/8140(2)
619	Triazine Pesticides	Extraction, GC/NPD	619(1)
LC CARB	Carbamate and Urea Pesticides	Extraction, HPLC	632(1)
PCB	PCB's	Extraction, GC/ECD	608(1)/8080(2)
HRB	Phenoxyacid Herbicides	Extraction, GC/ECD	615(1)/8150(2)
603	Acrolein & Acrylonitrile	Purge & Trap GC/FID	603(1)/8030(2)
604	Phenols	Extraction, GC/FID	604(1)/8040(2)
605	Benzidines	Extraction, HPLC	605(1)/8050(2)
606	Phthalate Esters	Extraction, GC/FID	606(1)/8060(2)
607	Nitrosamines	Extraction, GC/NPD	607(1)
609	Nitroaromatics & Cyclic Ketones	Extraction, GC/NPD	609(1)/8090(2)
PNA	Polynuclear Aromatic Hydrocarbons	Extraction, HPLC	610(1)/8310(2)
611	Haloethers	Extraction, GC/ECD	611(1)
612	Chlorinated Hydrocarbons	Extraction, GC/ECD	612(1)/8120(2)
GD FID	Hydrocarbon Scan	Extraction, GC/FID	D3328-78(3)
GC BPD	Boiling Point Determination	Extraction, GC/FID	D2887-84(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 3rd Edition, 1987.
(3) "Annual Book of ASTM Standards", Volume 11.01, 1985.
(4) "Annual Book of ASTM Standards", Volume 05.02, 1984.

ANALYTICAL METHODOLOGY - INORGANIC TESTS

Test	Description	Methodology	Reference
ICP	Trace Metals	ICP Emission Spectroscopy	200.7(1)/6010(2)
FSB	Antimony	Furnace Atomic Absorption	204.2(1)/7041(2)
FAS	Arsenic	Furnace Atomic Absorption	206.2(1)/7060(2)
FCD	Cadmium	Furnace Atomic Absorption	213.2(1)/7131(2)
FPB	Lead	Furnace Atomic Absorption	239.2(1)/7421(2)
FSE	Selenium	Furnace Atomic Absorption	270.2(1)/7740(2)
FAG	Silver	Furnace Atomic Absorption	272.2(1)/7761(2)
FTL	Thallium	Furnace Atomic Absorption	279.2(1)/7841(2)
CVHG	Mercury	Cold Vapor Atomic	245.1(1)/7471(2)
CR + 6	Chromium (VI)	Colorimetric	312B(3)
IC CL	Chloride	Ion Chromatography	300.0(1)
BURCL	Chloride	Manual Titrimetric	325.3(1)
METF	Fluoride	Electrode	340.2(1)
IC S04	Sulfate	IC	300.0(1)
SPES04	Sulfate	Manual Turbidimetric	375.4(1)
METALK	Alkalinity, Total	Titrimetric	310.1(1)
METACK	Alkalinity, Forms	Titrimetric	403(3)
TECNOXT	Nitrate+Nitrite as N	Cd Reduction Colorimetric	353.2(1)
METPH	pH	Meter	150.1(1)/9045(2)
CELSP	Specific Conductance @ 25°C	Bridge	120.1(1)
BALTDS	Total Dissolved Solids	Gravimetric, 180°C	160.1(1)
BALTSS	Total Suspended Solids	Gravimetric, 105°C	160.2(1)
BALTS	Total Solids	Gravimetric, 105°C	160.3(1)
BALTVS	Total Volatile Solids	Gravimetric, 550°C	160.4(1)
TECO P	Ortho-Phosphate as P	Two Reagent Colorimetric	365.3(1)
TECT P	Total Phosphorus as P	Digestion-Colorimetric	365.3(1)
ICP	Total Phosphorus as P	Digestion-ICP/AES	200.7(1)
ICP	Silica as SiO_2	ICP/AES	200.7(1)
SPESI02	Silica as SiO_2	Colorimetric	370.1(1)
METBOD	Biochemical Oxygen Demand	Dilution Bottle-D.O. probe	405.1(1)
METCOD	Chemical Oxygen Demand	Micro Colorimetric	410.4(1)
TOCTOC	Total Organic Carbon	UV Oxidation-IR	415.2(1)
METNH3	Ammonia as N	Electrode	350.3(1)
TECNH3	Ammonia as N	Automated Colorimetric	350.1(1)
METTKN	Total Kjeldahl Nitrogen as N	Digestion-Electrode	351.4(1)
TECTKN	Total Kjeldahl Nitrogen as N	Digestion-Colorimetric	351.2(1)
TOXTOX	Total Organic Halogen	Combustion-Titrimetric	9020(2)
TONO1	Total Organic Nitrogen	Calculation (TKN-NH_3)	-
BAL O&G	Oil and Grease	Freon Extraction-Gravimetric	413.1(1)
IR AO&G	Oil and Grease	Freon Extraction-IR	413.2(1)
TECCN F	Cyanide Amendable to Chlorination	Chlorination-Distillation-Colorimetric	335.1(1)
TECCN W	Weak & Dissolved Cyanide	Distillation-Colorimetric	412H(3)
TECCN T	Total Cyanide	Distillation-Colorimetric	335.2(1)/9010(2)
STEPHEN	Phenolics	Distillation-Colorimetric	420.1(1)
COLIF F	Fecal Coliform	Membrane Filter	909C(3)
COLIF T	Total Coliform	Membrane Filter	909A(3)

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APPENDIX K

GC/MS Volatile and Semi-Volatile Analyses of Ground Water

Completed for the Source Control RI. 1984-1985

ANALYTICAL METHODOLOGY - INORGANIC TESTS (CONT.)

Test	Description	Methodology	Reference
IC BR	Bromide	Ion Chromatography	300.0(1)
POTCL2R	Residual Chlorine	Amperometric	330.2(1)
NESCOLR	Color	Pt-Co Colorimetric	110.2(1)
ICPHAR	Hardness as $CaCo_3$	Calculation	200.7(1)/314A(3)
TECN02	Nitrite as N	Colorimetric	354.1(1)
SPES	Sulfide	Colorimetric	376.2(1)/9030(2)
BURS03	Sulfite	Titrimetric	377.1(1)
SPEMBAS	MBAS (Surfactants)	Colorimetric	425.1(1)
SPETURB	Turbidity	Turbidimeter	180.1(1)
Gross Alpha		Proportional Counter	703(3)
Gross Beta		Proportional Counter	703(3)
Radium 226		Separation - Counter	705(3)
Radium 228		Separation - Counter	707(3)
Uranium		Fluorimetric	D2907.75(4)

References

(1) "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, EMSL, Cincinnati, 1979.
(2) SW-846, 3rd Edition, 1987.
(3) "Standard Methods for the Examination of Water and Wastewater", 15th Edition, 1980.
(4) "Annual Book of ASTM Standards", Part 31, Water, 1980.

Rocky Mountain
Analytical Laboratory

Enseco Incorporated

Enseco

ANALYTICAL RESULTS

FOR

ERM-SOUTHWEST, INC.

JUNE 22, 1987

Reviewed by:

Jean Zimmerman

Jerry L. Parr

4955 Yarrow Street
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303/421-6611

Facsimile: 303/431-7171

Introduction

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

- o Sample Description Information
- o Analytical Tests Assigned
- o Analytical Results
- o Quality Control Report
- o Description of Analytical Methodology

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Enseco - RMAL is assigned a unique five digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the five digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Tests Assigned

The Analytical Tests Assigned Table presents all of the tests assigned to each of the samples in the project. The tests are listed in the order in which data is presented.

In addition to a test description, information is provided concerning whether the test has been changed, or customized, to accommodate specific needs of the client. Customization can involve changes in the analyte list (addition or deletion of standard analytes) or changes in the standard detection limit.

Analytical Results

The analytical results for this project are presented in the following data tables. The results are presented by sample, by test, as shown in Analytical Tests Assigned.

Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization date is the date when the project was defined by the client such that laboratory work could begin.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Enseco reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content. All data is "blank corrected", i.e. the level of contamination, if any, found in the laboratory blank is subtracted from the analytical result before it is reported.

The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is provided subsequently.

Enseco

SAMPLE DESCRIPTION INFORMATION

for

ERM-SOUTHWEST, INC.

RMAL Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
63713-001	MW-3	Groundwater	05/20/87	05/22/87
63713-002	MW-6	Groundwater	05/20/87	05/22/87
63713-003	MW-13	Groundwater	05/20/87	05/22/87
63713-004	MW-14	Groundwater	05/20/87	05/22/87
63713-005	MW-15	Groundwater	05/20/87	05/22/87
63713-006	MW-20	Groundwater	05/20/87	05/22/87
63713-007	MW-29	Groundwater	05/20/87	05/22/87
63713-008	MW-00	Groundwater	05/20/87	05/22/87
63713-009	TRIP BLANK	Groundwater	05/20/87	05/22/87
63713-010	MW-18	Groundwater	05/20/87	05/22/87

ANALYTICAL TESTS ASSIGNED

for

ERM-SOUTHWEST, INC.

RMAL Sample No.	Analysis Description	Custom Test*
63713-001	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63713-002	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63713-003	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63713-004	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63713-005	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63713-006	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63713-007	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63713-008	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63713-009	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63713-010	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-3

Laboratory ID: 63713-001 Enseco ID: 63713-001

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	39	mg/L	0.1	415.1/9060	05/29/87
Total Organic Halogen	150	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-001

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-6

Laboratory ID: 63713-002 Enseco ID: 63713-002

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	12	mg/L	0.1	415.1/9060	05/29/87
Total Organic Halogen	74	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-002

Enseco

~~006338~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-13

Laboratory ID: 63713-003 Enseco ID: 63713-003

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	3.5	mg/L	0.1	415.1/9060	06/19/87
Total Organic Halogen	20	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-003

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-14

Laboratory ID: 63713-004 Enseco ID: 63713-004

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	3.2	mg/L	0.1	415.1/9060	06/19/87
Total Organic Halogen	39	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-004

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-15

Laboratory ID: 63713-005 Enseco ID: 63713-005

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	20	mg/L	0.1	415.1/9060	05/29/87
Total Organic Halogen	160	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-005

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-20

Laboratory ID: 63713-006 Enseco ID: 63713-006

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	3.2	mg/L	0.1	415.1/9060	06/19/87
Total Organic Halogen	26	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-006

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-29

Laboratory ID: 63713-007 Enseco ID: 63713-007

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	6.4	mg/L	0.1	415.1/9060	06/19/87
Total Organic Halogen	39	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-007

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-00

Laboratory ID: 63713-008 Enseco ID: 63713-008

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	N.D.	mg/L	0.1	415.1/9060	06/19/87
Total Organic Halogen	6	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-008

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: TRIP BLANK

Laboratory ID: 63713-009 Enseco ID: 63713-009

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	N.D.	mg/L	0.1	415.1/9060	06/19/87
Total Organic Halogen	N.D.	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-009

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-18

Laboratory ID: 63713-010 Enseco ID: 63713-010

Matrix: Groundwater Sampled: 05/20/87 Received: 05/22/87

Authorized: 05/22/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	21	mg/L	0.1	415.1/9060	05/29/87
Total Organic Halogen	94	ug Cl/L	5	9020	06/02/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63713-010

Quality Control Results

The Enseco laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

In addition, the Enseco laboratories maintain a comprehensive set of certifications from both state and federal governmental agencies which require frequent analyses of blind audit samples. Enseco - Rocky Mountain Analytical Laboratory is certified by the EPA under the EPA/CLP program for both Organic and Inorganic analyses, under the USATHAMA (U.S. Army) program, by the Army Corps of Engineers, and the states of Colorado, New Jersey, New York, Utah, and Florida, among others.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

The Enseco QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of duplicate Laboratory Control Samples (LCS) at frequent, well-defined intervals. An LCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the LCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate LCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For multi-analyte determinations, eighty percent of the accuracy and precision measurements must be within control limits for the QC Lot to be considered acceptable.

For Organic analyses an additional control measure is taken in the form of a Surrogate Control Sample (SCS). The SCS is a control sample spiked with surrogate standards which is analyzed with every analytical lot. The recovery of the SCS is charted in exactly the same manner as described for the LCS, and provides a daily check on the performance of the method.

Accuracy for LCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for LCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{\text{Measured Concentration LCS1} - \text{Measured Concentration LCS2}}{(\text{Measured Concentration LCS1} + \text{Measured Concentration LCS2})/2}$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, LCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report. The test codes assigned are defined in Section VI., Analytical Methodology.

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QC LOT ASSIGNMENT REPORT
INORGANICS - NON-METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
63713-001	Reagent Water	TOC	TOC 069AA
63713-001	Reagent Water	TOX	TOX 047AB
63713-002	Reagent Water	TOC	TOC 069AA
63713-002	Reagent Water	TOX	TOX 047AB
63713-003	Reagent Water	TOC	TOC 075AA
63713-003	Reagent Water	TOX	TOX 047AB
63713-004	Reagent Water	TOC	TOC 075AA
63713-004	Reagent Water	TOX	TOX 047AB
63713-005	Reagent Water	TOC	TOC 069AA
63713-005	Reagent Water	TOX	TOX 047AB
63713-006	Reagent Water	TOC	TOC 075AA
63713-006	Reagent Water	TOX	TOX 047AB
63713-007	Reagent Water	TOC	TOC 075AA
63713-007	Reagent Water	TOX	TOX 047AB
63713-008	Reagent Water	TOC	TOC 075AA
63713-008	Reagent Water	TOX	TOX 047AB
63713-009	Reagent Water	TOC	TOC 075AA
63713-009	Reagent Water	TOX	TOX 047AB
63713-010	Reagent Water	TOC	TOC 069AA
63713-010	Reagent Water	TOX	TOX 047AB

LABORATORY CONTROL SAMPLE REPORT
INORGANICS - NON-METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: TOC on Reagent Water QC Lot: TOC 069AA Concentration Units: (mg/L)								
Total Organic Carbon	35	32	33	91	94	91-109	3.1	20
Test: TOC on Reagent Water QC Lot: TOC 075AA Concentration Units: (mg/L)								
Total Organic Carbon	35	36	36	103	103	91-109	0.0	20
Test: TOX on Reagent Water QC Lot: TOX 047AB Concentration Units: (ug Cl/L)								
Total Organic Halogens	100	93	80	93	80	80-120	15.0	20

Analytical Methodology

Enseco - Rocky Mountain Analytical Laboratory performs analytical services according to methods approved by EPA and other regulatory agencies, whenever possible.

Methods for metals and organic compounds are primarily derived from three sources of EPA methods, 1) the methods promulgated in 40 CFR 136 for priority pollutants, 2) the methods published in SW-846 and 3) methods developed by the EPA-EMSL/LV for Superfund investigations, as well as several documents published by the EPA and Enseco - Rocky Mountain Analytical Laboratory in 1984 and 1985. These methods all use the same generic technology as summarized below:

- Metals: acid digestion followed by analyses by ICP supported by graphite furnace AA
- Volatile Organics: purge and trap GC/MS or purge and trap GC with a selective detector.
- Semivolatile (base/neutral and acid) organics: solvent extraction followed by capillary column GC/MS, and
- Pesticides/Herbicides: solvent extraction, followed by gas chromatography.

Exact method references are provided in the Analytical Methodology Tables.

ANALYTICAL METHODOLOGY - ORGANIC TESTS

Test	Description	Methodology	Reference
VOA	Volatile Organics	Purge & Trap, GC/MS	624(1)/8240(2)
BNA	Semivolatile Organics	Extraction, GC/MS	625(1)/8270(2)
DXN	Dioxin	Extraction, GC/MS	613(1)/8280(2)
601	Halogenated Volatile Organics	Purge & Trap GC/Hall	601(1)/8010(2)
THM	Trihalomethanes	Purge & Trap GC/Hall	601(1)/8010(2)
602	Aromatic Volatile Organics	Purge & Trap GC/PID	602(1)/8020(2)
OCP	Organochlorine Pesticides	Extraction, GC/ECD	608(1)/8080(2)
OPP	Organophosphate Pesticides	Extraction, GC/FPD	614(1)/8140(2)
619	Triazine Pesticides	Extraction, GC/NPD	619(1)
LC CARB	Carbamate and Urea Pesticides	Extraction, HPLC	632(1)
PCB	PCB's	Extraction, GC/ECD	608(1)/8080(2)
HRB	Phenoxyacid Herbicides	Extraction, GC/ECD	615(1)/8150(2)
603	Acrolein & Acrylonitrile	Purge & Trap GC/FID	603(1)/8030(2)
604	Phenols	Extraction, GC/FID	604(1)/8040(2)
605	Benzidines	Extraction, HPLC	605(1)/8050(2)
606	Phthalate Esters	Extraction, GC/FID	606(1)/8060(2)
607	Nitrosamines	Extraction, GC/NPD	607(1)
609	Nitroaromatics & Cyclic Ketones	Extraction, GC/NPD	609(1)/8090(2)
PNA	Polynuclear Aromatic Hydrocarbons	Extraction, HPLC	610(1)/8310(2)
611	Haloethers	Extraction, GC/ECD	611(1)
612	Chlorinated Hydrocarbons	Extraction, GC/ECD	612(1)/8120(2)
GD FID	Hydrocarbon Scan	Extraction, GC/FID	D3328-78(3)
GC BPD	Boiling Point Determination	Extraction, GC/FID	D2887-84(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 3rd Edition, 1987.
(3) "Annual Book of ASTM Standards", Volume 11.01, 1985.
(4) "Annual Book of ASTM Standards", Volume 05.02, 1984.

ANALYTICAL METHODOLOGY - INORGANIC TESTS

Test	Description	Methodology	Reference
ICP	Trace Metals	ICP Emission Spectroscopy	200.7(1)/6010(2)
FSB	Antimony	Furnace Atomic Absorption	204.2(1)/7041(2)
FAS	Arsenic	Furnace Atomic Absorption	206.2(1)/7060(2)
FCD	Cadmium	Furnace Atomic Absorption	213.2(1)/7131(2)
FPB	Lead	Furnace Atomic Absorption	239.2(1)/7421(2)
FSE	Selenium	Furnace Atomic Absorption	270.2(1)/7740(2)
FAG	Silver	Furnace Atomic Absorption	272.2(1)/7761(2)
FTL	Thallium	Furnace Atomic Absorption	279.2(1)/7841(2)
CVHG	Mercury	Cold Vapor Atomic	245.1(1)/7471(2)
CR + 6	Chromium (VI)	Colorimetric	312B(3)
IC CL	Chloride	Ion Chromatography	300.0(1)
BURCL	Chloride	Manual Titrimetric	325.3(1)
METF	Fluoride	Electrode	340.2(1)
IC S04	Sulfate	IC	300.0(1)
SPES04	Sulfate	Manual Turbidimetric	375.4(1)
METALK	Alkalinity, Total	Titrimetric	310.1(1)
METACK	Alkalinity, Forms	Titrimetric	403(3)
TECNOXT	Nitrate+Nitrite as N	Cd Reduction Colorimetric	353.2(1)
METPH	pH	Meter	150.1(1)/9045(2)
CELSP	Specific Conductance @ 25°C	Bridge	120.1(1)
BALTDS	Total Dissolved Solids	Gravimetric, 180°C	160.1(1)
BALTSS	Total Suspended Solids	Gravimetric, 105°C	160.2(1)
BALTS	Total Solids	Gravimetric, 105°C	160.3(1)
BALTVS	Total Volatile Solids	Gravimetric, 550°C	160.4(1)
TECO P	Ortho-Phosphate as P	Two Reagent Colorimetric	365.3(1)
TECT P	Total Phosphorus as P	Digestion-Colorimetric	365.3(1)
ICP	Total Phosphorus as P	Digestion-ICP/AES	200.7(1)
ICP	Silica as SiO_2	ICP/AES	200.7(1)
SPESI02	Silica as SiO_2	Colorimetric	370.1(1)
METBOD	Biochemical Oxygen Demand	Dilution Bottle-D.O. probe	405.1(1)
METCOD	Chemical Oxygen Demand	Micro Colorimetric	410.4(1)
TOCTOC	Total Organic Carbon	UV Oxidation-IR	415.2(1)
METNH3	Ammonia as N	Electrode	350.3(1)
TECNH3	Ammonia as N	Automated Colorimetric	350.1(1)
METTKN	Total Kjeldahl Nitrogen as N	Digestion-Electrode	351.4(1)
TECTKN	Total Kjeldahl Nitrogen as N	Digestion-Colorimetric	351.2(1)
TOXTOX	Total Organic Halogen	Combustion-Titrimetric	9020(2)
TONO1	Total Organic Nitrogen	Calculation (TKN-NH_3)	-
BAL O&G	Oil and Grease	Freon Extraction-Gravimetric	413.1(1)
IR AO&G	Oil and Grease	Freon Extraction-IR	413.2(1)
TECCN F	Cyanide Amendable to Chlorination	Chlorination-Distillation-Colorimetric	335.1(1)
TECCN W	Weak & Dissolved Cyanide	Distillation-Colorimetric	412H(3)
TECCN T	Total Cyanide	Distillation-Colorimetric	335.2(1)/9010(2)
STEPHEN	Phenolics	Distillation-Colorimetric	420.1(1)
COLIF F	Fecal Coliform	Membrane Filter	909C(3)
COLIF T	Total Coliform	Membrane Filter	909A(3)

ANALYTICAL METHODOLOGY - INORGANIC TESTS (CONT.)

Test	Description	Methodology	Reference
IC BR	Bromide	Ion Chromatography	300.0(1)
POTCL2R	Residual Chlorine	Amperometric	330.2(1)
NESCOLR	Color	Pt-Co Colorimetric	110.2(1)
ICPHAR	Hardness as $CaCo_3$	Calculation	200.7(1)/314A(3)
TECN02	Nitrite as N	Colorimetric	354.1(1)
SPES	Sulfide	Colorimetric	376.2(1)/9030(2)
BURS03	Sulfite	Titrimetric	377.1(1)
SPEMBAS	MBAS (Surfactants)	Colorimetric	425.1(1)
SPETURB	Turbidity	Turbidimeter	180.1(1)
Gross Alpha		Proportional Counter	703(3)
Gross Beta		Proportional Counter	703(3)
Radium 226		Separation - Counter	705(3)
Radium 228		Separation - Counter	707(3)
Uranium		Fluorimetric	D2907.75(4)

References

(1) "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, EMSL, Cincinnati, 1979.
(2) SW-846, 3rd Edition, 1987.
(3) "Standard Methods for the Examination of Water and Wastewater", 15th Edition, 1980.
(4) "Annual Book of ASTM Standards", Part 31, Water, 1980.

Rocky Mountain
Analytical Laboratory

Enseco Incorporated

Enseco

ANALYTICAL RESULTS

FOR

ERM - SOUTHWEST, INC.

JULY 29, 1987

Reviewed by:

Jean Zimmerman

Jerry L. Parr

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Introduction

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

- Sample Description Information
- Analytical Tests Assigned
- Analytical Results
- Quality Control Report
- Description of Analytical Methodology

RMAL sample 608, which is the field blank, shows a higher concentration of organic chloride in comparison with previous sampling rounds.

Sample Description Information

The Sample Description Information lists all of the samples received in this project together with the internal laboratory identification number assigned for each sample. Each project received at Enseco - RMAL is assigned a unique five digit number. Samples within the project are numbered sequentially. The laboratory identification number is a combination of the five digit project code and the sample sequence number.

Also given in the Sample Description Information is the Sample Type (matrix), Date of Sampling (if known) and Date of Receipt at the laboratory.

Analytical Tests Assigned

The Analytical Tests Assigned Table presents all of the tests assigned to each of the samples in the project. The tests are listed in the order in which data is presented.

In addition to a test description, information is provided concerning whether the test has been changed, or customized, to accommodate specific needs of the client. Customization can involve changes in the analyte list (addition or deletion of standard analytes) or changes in the standard detection limit.

Analytical Results

The analytical results for this project are presented in the following data tables. The results are presented by sample, by test, as shown in Analytical Tests Assigned.

Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization date is the date when the project was defined by the client such that laboratory work could begin.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Enseco reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content. All data is "blank corrected", i.e. the level of contamination, if any, found in the laboratory blank is subtracted from the analytical result before it is reported.

The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is provided subsequently.

Enseco

SAMPLE DESCRIPTION INFORMATION

for

ERM-SOUTHWEST, INC.

RMAL Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
63949-001	TRIP BLANK	Water	06/23/87	06/25/87
63949-002	MW-13	Water	06/23/87	06/25/87
63949-003	MW-15	Water	06/23/87	06/25/87
63949-004	MW-14	Water	06/23/87	06/25/87
63949-005	MW-20	Water	06/23/87	06/25/87
63949-006	MW-29	Water	06/23/87	06/25/87
63949-007	MW-18	Water	06/23/87	06/25/87
63949-008	MW-00	Water	06/23/87	06/25/87
63949-009	MW-06	Water	06/23/87	06/25/87
63949-010	MW-03	Water	06/23/87	06/25/87

ANALYTICAL TESTS ASSIGNED

for

ERM-SOUTHWEST, INC.

RMAL Sample No.	Analysis Description	Custom Test*
63949-001	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63949-002	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63949-003	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63949-004	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63949-005	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63949-006	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63949-007	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63949-008	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63949-009	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
63949-010	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: TRIP BLANK

Laboratory ID: 63949-001 Enseco ID: 63949-001

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	1.9	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	13	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-001

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-13

Laboratory ID: 63949-002 Enseco ID: 63949-002

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	18	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	19	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-002

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-15

Laboratory ID: 63949-003 Enseco ID: 63949-003

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	56	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	190	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-003

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-14

Laboratory ID: 63949-004 Enseco ID: 63949-004

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	13	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	40	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-004

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-20

Laboratory ID: 63949-005 Enseco ID: 63949-005

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	13	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	35	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-005

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-29

Laboratory ID: 63949-006 Enseco ID: 63949-006

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	37	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	54	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-006

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-18

Laboratory ID: 63949-007 Enseco ID: 63949-007

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	47	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	34	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-007

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-00

Laboratory ID: 63949-008 Enseco ID: 63949-008

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	1.2	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	35	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-008

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-06

Laboratory ID: 63949-009 Enseco ID: 63949-009

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	20	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	40	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-009

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST, INC.

Client ID: MW-03

Laboratory ID: 63949-010 Enseco ID: 63949-010

Matrix: Water Sampled: 06/23/87 Received: 06/25/87

Authorized: 06/25/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	65	mg/L	0.5	415.1/9060	07/21/87
Total Organic Halogen	63	ug Cl/L	5	9020	07/14/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 63949-010

Quality Control Results

The Enseco laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

In addition, the Enseco laboratories maintain a comprehensive set of certifications from both state and federal governmental agencies which require frequent analyses of blind audit samples. Enseco - Rocky Mountain Analytical Laboratory is certified by the EPA under the EPA/CLP program for both Organic and Inorganic analyses, under the USATHAMA (U.S. Army) program, by the Army Corps of Engineers, and the states of Colorado, New Jersey, New York, Utah, and Florida, among others.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

The Enseco QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of duplicate Laboratory Control Samples (LCS) at frequent, well-defined intervals. An LCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the LCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate LCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis. For multi-analyte determinations, eighty percent of the accuracy and precision measurements must be within control limits for the QC Lot to be considered acceptable.

For Organic analyses an additional control measure is taken in the form of a Surrogate Control Sample (SCS). The SCS is a control sample spiked with surrogate standards which is analyzed with every analytical lot. The recovery of the SCS is charted in exactly the same manner as described for the LCS, and provides a daily check on the performance of the method.

Accuracy for LCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for LCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{\text{Measured Concentration LCS1} - \text{Measured Concentration LCS2}}{(\text{Measured Concentration LCS1} + \text{Measured Concentration LCS2})/2}$$

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, LCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report. The test codes assigned are defined in Section VI., Analytical Methodology.

QC LOT ASSIGNMENT REPORT
INORGANICS - NON-METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
63949-001	Reagent Water	TOC	TOC 093AA
63949-001	Reagent Water	TOX	TOX 057AB
63949-002	Reagent Water	TOC	TOC 093AA
63949-002	Reagent Water	TOX	TOX 057AB
63949-003	Reagent Water	TOC	TOC 093AA
63949-003	Reagent Water	TOX	TOX 057AB
63949-004	Reagent Water	TOC	TOC 093AA
63949-004	Reagent Water	TOX	TOX 057AB
63949-005	Reagent Water	TOC	TOC 093AA
63949-005	Reagent Water	TOX	TOX 057AB
63949-006	Reagent Water	TOC	TOC 093AA
63949-006	Reagent Water	TOX	TOX 063AB
63949-007	Reagent Water	TOC	TOC 093AA
63949-007	Reagent Water	TOX	TOX 057AB
63949-008	Reagent Water	TOC	TOC 093AA
63949-008	Reagent Water	TOX	TOX 063AB
63949-009	Reagent Water	TOC	TOC 093AA
63949-009	Reagent Water	TOX	TOX 057AB
63949-010	Reagent Water	TOC	TOC 093AA
63949-010	Reagent Water	TOX	TOX 063AB

LABORATORY CONTROL SAMPLE REPORT
INORGANICS - NON-METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Limits	Precision(RPD) LCS	Limits
Test: TOC on Reagent Water QC Lot: TOC 093AA Concentration Units: (mg/L)								
Total Organic Carbon	29	27	27	93	93	91-109	0.0	20
Test: TOX on Reagent Water QC Lot: TOX 057AB Concentration Units: (ug Cl/L)								
Total Organic Halogens	100	94	97	94	97	80-120	3.1	20
Test: TOX on Reagent Water QC Lot: TOX 063AB Concentration Units: (ug Cl/L)								
Total Organic Halogens	100	87	94	87	94	80-120	7.7	20

Analytical Methodology

Enseco - Rocky Mountain Analytical Laboratory performs analytical services according to methods approved by EPA and other regulatory agencies, whenever possible.

Methods for metals and organic compounds are primarily derived from three sources of EPA methods, 1) the methods promulgated in 40 CFR 136 for priority pollutants, 2) the methods published in SW-846 and 3) methods developed by the EPA-EMSL/LV for Superfund investigations, as well as several documents published by the EPA and Enseco - Rocky Mountain Analytical Laboratory in 1984 and 1985. These methods all use the same generic technology as summarized below:

- Metals: acid digestion followed by analyses by ICP supported by graphite furnace AA
- Volatile Organics: purge and trap GC/MS or purge and trap GC with a selective detector.
- Semivolatile (base/neutral and acid) organics: solvent extraction followed by capillary column GC/MS, and
- Pesticides/Herbicides: solvent extraction, followed by gas chromatography.

Exact method references are provided in the Analytical Methodology Tables.

ANALYTICAL METHODOLOGY - ORGANIC TESTS

Test	Description	Methodology	Reference
VOA	Volatile Organics	Purge & Trap, GC/MS	624(1)/8240(2)
BNA	Semivolatile Organics	Extraction, GC/MS	625(1)/8270(2)
DXN	Dioxin	Extraction, GC/MS	613(1)/8280(2)
601	Halogenated Volatile Organics	Purge & Trap GC/Hall	601(1)/8010(2)
THM	Trihalomethanes	Purge & Trap GC/Hall	601(1)/8010(2)
602	Aromatic Volatile Organics	Purge & Trap GC/PID	602(1)/8020(2)
OCP	Organochlorine Pesticides	Extraction, GC/ECD	608(1)/8080(2)
OPP	Organophosphate Pesticides	Extraction, GC/FPD	614(1)/8140(2)
619	Triazine Pesticides	Extraction, GC/NPD	619(1)
LC CARB	Carbamate and Urea Pesticides	Extraction, HPLC	632(1)
PCB	PCB's	Extraction, GC/ECD	608(1)/8080(2)
HRB	Phenoxyacid Herbicides	Extraction, GC/ECD	615(1)/8150(2)
603	Acrolein & Acrylonitrile	Purge & Trap GC/FID	603(1)/8030(2)
604	Phenols	Extraction, GC/FID	604(1)/8040(2)
605	Benzidines	Extraction, HPLC	605(1)/8050(2)
606	Phthalate Esters	Extraction, GC/FID	606(1)/8060(2)
607	Nitrosamines	Extraction, GC/NPD	607(1)
609	Nitroaromatics & Cyclic Ketones	Extraction, GC/NPD	609(1)/8090(2)
PNA	Polynuclear Aromatic Hydrocarbons	Extraction, HPLC	610(1)/8310(2)
611	Haloethers	Extraction, GC/ECD	611(1)
612	Chlorinated Hydrocarbons	Extraction, GC/ECD	612(1)/8120(2)
GD FID	Hydrocarbon Scan	Extraction, GC/FID	D3328-78(3)
GC BPD	Boiling Point Determination	Extraction, GC/FID	D2887-84(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 2nd Edition, 1984.
(3) "Annual Book of ASTM Standards", Volume 11.01, 1985.
(4) "Annual Book of ASTM Standards", Volume 05.02, 1984.

ANALYTICAL METHODOLOGY - INORGANIC TESTS

Test	Description	Methodology	Reference
ICP	Trace Metals	ICP Emission Spectroscopy	200.7(1)/6010(2)
FSB	Antimony	Furnace Atomic Absorption	204.2(1)/7041(2)
FAS	Arsenic	Furnace Atomic Absorption	206.2(1)/7060(2)
FCD	Cadmium	Furnace Atomic Absorption	213.2(1)/7131(2)
FPB	Lead	Furnace Atomic Absorption	239.2(1)/7421(2)
FSE	Selenium	Furnace Atomic Absorption	270.2(1)/7740(2)
FAG	Silver	Furnace Atomic Absorption	272.2(1)/7761(2)
FTL	Thallium	Furnace Atomic Absorption	279.2(1)/7841(2)
CVHG	Mercury	Cold Vapor Atomic	245.1(1)/7471(2)
CR + 6	Chromium (VI)	Colorimetric	312B(3)
IC CL	Chloride	Ion Chromatography	300.0(1)
BURCL	Chloride	Manual Titrimetric	325.3(1)
METF	Fluoride	Electrode	340.2(1)
IC S04	Sulfate	IC	300.0(1)
SPES04	Sulfate	Manual Turbidimetric	375.4(1)
METALK	Alkalinity, Total	Titrimetric	310.1(1)
METACK	Alkalinity, Forms	Titrimetric	403(3)
TECNOXT	Nitrate+Nitrite as N	Cd Reduction Colorimetric	353.2(1)
METPH	pH	Meter	150.1(1)/9045(2)
CELSP	Specific Conductance @ 25°C	Bridge	120.1(1)
BALTDS	Total Dissolved Solids	Gravimetric, 180°C	160.1(1)
BALTSS	Total Suspended Solids	Gravimetric, 105°C	160.2(1)
BALTS	Total Solids	Gravimetric, 105°C	160.3(1)
BALTVS	Total Volatile Solids	Gravimetric, 550°C	160.4(1)
TECO P	Ortho-Phosphate as P	Two Reagent Colorimetric	365.3(1)
TECT P	Total Phosphorus as P	Digestion-Colorimetric	365.3(1)
ICP	Total Phosphorus as P	Digestion-ICP/AES	200.7(1)
ICP	Silica as SiO_2	ICP/AES	200.7(1)
SPESI02	Silica as SiO_2	Colorimetric	370.1(1)
METBOD	Biochemical Oxygen Demand	Dilution Bottle-D.O. probe	405.1(1)
METCOD	Chemical Oxygen Demand	Micro Colorimetric	410.4(1)
TOCTOC	Total Organic Carbon	UV Oxidation-IR	415.2(1)
METNH3	Ammonia as N	Electrode	350.3(1)
TECNH3	Ammonia as N	Automated Colorimetric	350.1(1)
METTKN	Total Kjeldahl Nitrogen as N	Digestion-Electrode	351.4(1)
TECTKN	Total Kjeldahl Nitrogen as N	Digestion-Colorimetric	351.2(1)
TOXTOX	Total Organic Halogen	Combustion-Titrimetric	9020(2)
TONO1	Total Organic Nitrogen	Calculation (TKN-NH_3)	-
BAL O&G	Oil and Grease	Freon Extraction-Gravimetric	413.1(1)
IR AO&G	Oil and Grease	Freon Extraction-IR	413.2(1)
TECCN F	Cyanide Amendable to Chlorination	Chlorination-Distillation-Colorimetric	335.1(1)
TECCN W	Weak & Dissolved Cyanide	Distillation-Colorimetric	412H(3)
TECCN T	Total Cyanide	Distillation-Colorimetric	335.2(1)/9010(2)
STEPHEN	Phenolics	Distillation-Colorimetric	420.1(1)
COLIF F	Fecal Coliform	Membrane Filter	909C(3)
COLIF T	Total Coliform	Membrane Filter	909A(3)

ANALYTICAL METHODOLOGY - INORGANIC TESTS (CONT.)

Test	Description	Methodology	Reference
IC BR	Bromide	Ion Chromatography	300.0(1)
POTCL2R	Residual Chlorine	Amperometric	330.2(1)
NESCOLR	Color	Pt-Co Colorimetric	110.2(1)
ICPHAR	Hardness as $CaCo_3$	Calculation	200.7(1)/314A(3)
TECN02	Nitrite as N	Colorimetric	354.1(1)
SPES	Sulfide	Colorimetric	376.2(1)/9030(2)
BURS03	Sulfite	Titrimetric	377.1(1)
SPEMBAS	MBAS (Surfactants)	Colorimetric	425.1(1)
SPETURB	Turbidity	Turbidimeter	180.1(1)
Gross Alpha		Proportional Counter	703(3)
Gross Beta		Proportional Counter	703(3)
Radium 226		Separation - Counter	705(3)
Radium 228		Separation - Counter	707(3)
Uranium		Fluorimetric	D2907.75(4)

References

(1) "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, EMSL, Cincinnati, 1979.
(2) SW-846, 2nd Edition, 1984.
(3) "Standard Methods for the Examination of Water and Wastewater", 15th Edition, 1980.
(4) "Annual Book of ASTM Standards", Part 31, Water, 1980.

~~006376~~

019104

Technical Report

for

RESOURCE ENGINEERING

11 GREENWAY PLAZA

HOUSTON, TX 77406

MW-7

UP GRADIENT DEEP WELL

Chain of Custody Data Required for ETC Data Management Summary Reports						
E9440	RESOURCE ENGINEERING	RESSHER	MW7	840629	1200	
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*	*Time*	*Elapsed Hours*

Denis C. K. Lin, Ph.D.

Vice President
Research and Operations

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Introduction

This report contains the analytical results on your water sample, WMW7 84/06/29 12:00. It is designed to include comprehensive data from the entire analytical process in order to satisfy the needs of various levels of review.

The results obtained from your sample are presented in tabular format immediately following this introduction. Quality assurance data is tabulated along with the appropriate sample results for verification. Depending on the analyses ordered, the quality assurance data may include results from blank, spiked blank, spiked sample (i.e. matrix spike) and replicate sample as well as results from surrogate compound analyses. Quality assurance data for verification of proper instrument performance is also included where appropriate. The report appendices include the chain of custody record for your sample and, where appropriate, the gas chromatograms and mass spectra.

The procedures used in the analysis of the sample are described in this report's methodology section. All analytical procedures within our laboratory are performed within a strictly enforced Quality Assurance Protocol. A description of this Protocol is included in the report.

Results

Sample results, and associated quality assurance data, are always tabulated in one or more of this report's Quantitative Results Tables. The format of each table varies with the class of analysis.

Priority Pollutants

The priority pollutant compounds and elements are listed with their NPDES (National Pollution Discharge Elimination System) numbers, and the Method Detection Limit (MDL) published in the Federal Register, December 3, 1979. When a compound or element is present below its published MDL it is reported as BMDL (Below Method Detection Limit). When a compound or element is not present at any detectable concentrations it is reported as ND (Not Detected). Matrix spike and replicate analyses, where included, were performed on samples randomly chosen within each quality assurance batch and are therefore not necessarily spikes and replicates of this report's sample. Surrogate compound recovery data and instrument calibration data are included in the Method Performance Data Tables.

Qualitative Analysis

The GC/MS identification of compounds which are not included in the normal compound list for a given method is reported in a Qualitative Results Table. Each sample fraction is reported on an individual Qualitative Results Table. Wherever possible these compounds are reported with their molecular weight, empirical formula, and CAS number. The retention time and scan number is also provided to match the spectra included in the report appendices.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 21, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9440	RESOURCE ENGINEERING	RES28801	MW7	840629	1200	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen Added ug/l	% Recov
1V	Acrolein	ND	100	ND	ND	ND	1600	102	ND	1600	112
2V	Acrylonitrile	ND	100	ND	ND	ND	160	98	ND	160	99
3V	Benzene	ND	10	ND	ND	ND	36	97	ND	36	95
4V	bis(Chloromethyl)ether	ND	10	ND	ND	ND	0	-	ND	0	-
5V	Bromoform	ND	10	ND	ND	ND	36	102	ND	36	106
6V	Carbon tetrachloride	ND	10	ND	ND	ND	36	102	ND	36	103
7V	Chlorobenzene	ND	10	ND	ND	ND	36	100	ND	36	101
8V	Chlorodibromomethane	ND	10	ND	ND	ND	36	102	ND	36	103
9V	Chloroethane	ND	10	ND	ND	ND	36	91	ND	36	101
10V	2-Chloroethylvinyl ether	ND	10	ND	ND	ND	36	69	ND	36	71
11V	Chloroform	ND	10	ND	ND	BMDL	36	98	ND	36	77
12V	Dichlorobromomethane	ND	10	ND	ND	ND	36	101	ND	36	101
13V	Dichlorodifluoromethane	ND	10	ND	ND	ND	0	-	ND	0	-
14V	1,1-Dichloroethane	ND	10	ND	ND	ND	36	107	ND	36	95
15V	1,2-Dichloroethane	ND	10	ND	ND	ND	36	102	ND	36	105
16V	1,1-Dichloroethylene	ND	10	ND	ND	ND	36	97	ND	36	100
17V	1,2-Dichloropropane	ND	10	ND	ND	ND	36	104	ND	36	101
18V	cis-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	104	ND	36	100
19V	Ethylbenzene	ND	10	ND	ND	ND	36	99	ND	36	98
20V	Methyl bromide	ND	10	ND	ND	ND	36	96	ND	36	54
21V	Methyl chloride	ND	10	ND	ND	ND	36	103	ND	36	93
22V	Methylene chloride	ND	10	ND	ND	BMDL	36	55	ND	36	32.
23V	1,1,2,2-Tetrachloroethane	ND	10	ND	ND	ND	36	102	ND	36	108
24V	Tetrachloroethylene	BMDL	10	ND	2	ND	36	100	ND	36	100
25V	Toluene	ND	10	ND	ND	BMDL	36	88	ND	36	93
26V	1,2-Trans-dichloroethylene	ND	10	ND	ND	ND	36	103	ND	36	93
27V	1,1,1-Trichloroethane	ND	10	ND	ND	ND	36	100	ND	36	100
28V	1,1,2-Trichloroethane	ND	10	ND	ND	ND	36	70	ND	36	103
29V	Trichloroethylene	ND	10	ND	ND	ND	36	99	ND	36	95
30V	Trichlorofluoromethane	ND	10	ND	ND	ND	36	97	ND	36	103
31V	Vinyl chloride	ND	10	ND	ND	ND	36	86	ND	36	92

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 21, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9440	RESOURCE ENGINEERING	RES28801	MW7	840629	1200	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
	trans-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	105	ND	36	110

a EPA published Method Detection Limit.

b Recovery low due to sample matrix interference.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Acid Compounds - GC/MS Analysis Data (QR02)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9440	RESOURCE ENGINEERING	RES28801	MW7	840629	1200	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l [a]	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1A	2-Chlorophenol	ND	25	ND	ND	ND	150	78	ND	150	57
2A	2,4-Dichlorophenol	ND	25	ND	ND	ND	150	95	ND	150	53
3A	2,4-Dimethylphenol	ND	25	ND	ND	ND	150	2[b]	ND	150	0[b]
4A	4,6-Dinitro-o-cresol	ND	250	ND	ND	ND	250	88	ND	250	75
5A	2,4-Dinitrophenol	ND	250	ND	ND	ND	250	110	ND	250	130
6A	2-Nitrophenol	ND	25	ND	ND	ND	150	78	ND	150	70
7A	4-Nitrophenol	ND	25	ND	ND	ND	150	71	ND	150	86
8A	p-Chloro-m-cresol	ND	25	ND	ND	ND	150	67	ND	150	25[c]
9A	Pentachlorophenol	ND	25	ND	ND	ND	150	106	ND	150	86
10A	Phenol	ND	25	ND	ND	ND	150	77	ND	150	45
11A	2,4,6-Trichlorophenol	ND	25	ND	ND	ND	150	101	ND	150	76

[a] EPA published Method Detection Limit.

[b] Recovery normally low using EPA Protocol Method 625.

[c] Recovery low due to sample matrix interference.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9440	RESOURCE ENGINEERING	RES28801	WW7	840629	1200	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen Added ug/l	% Recov
1B	Acenaphthene	ND	10	ND	ND	ND	100	104	ND	105	100
2B	Acenaphthylene	ND	10	ND	ND	ND	100	101	ND	105	100
3B	Anthracene	ND	10	ND	ND	ND	100	67	ND	105	81
4B	Benzidine	ND	10	ND	ND	ND	100	0.	ND	105	0.
5B	Benzo(a)anthracene	ND	10	ND	ND	ND	100	133	ND	105	126
6B	Benzo(a)pyrene	ND	10	ND	ND	ND	100	128	ND	105	133
7B	Benzo(b)fluoroanthene	ND	10	ND	ND	ND	100	160	ND	105	153
8B	Benzo(ghi)perylene	ND	10	ND	ND	ND	0	-	ND	0	-
9B	Benzo(k)fluoranthene	ND	10	ND	ND	ND	100	124	ND	105	114
10B	bis(2-Chloroethoxy)methane	ND	10	ND	ND	ND	100	65	ND	105	87
11B	bis(2-Chloroethyl) ether	ND	10	ND	ND	ND	100	100	ND	105	246.
12B	bis(2-Chloroisopropyl)ether	ND	10	ND	ND	ND	100	306.	ND	105	107.
13B	bis(2-Ethylhexyl)phthalate	10	10	135	44	BMDL	100	103	ND	105	230.
14B	4-Bromophenyl phenyl ether	ND	10	ND	ND	ND	100	65	ND	105	81
15B	Butyl benzyl phthalate	ND	10	ND	ND	ND	100	110	ND	105	94
16B	2-Chloronaphthalene	ND	10	ND	ND	ND	100	80	ND	105	87
17B	4-Chlorophenyl phenyl ether	ND	10	ND	ND	ND	100	105	ND	105	95
18B	Chrysene	ND	10	ND	ND	ND	100	102	ND	105	86
19B	Dibenzo(a,h)anthracene	ND	10	ND	ND	ND	0	-	ND	0	-
20B	1,2-Dichlorobenzene	ND	10	ND	ND	ND	100	33.	ND	105	52.
21B	1,3-Dichlorobenzene	ND	10	ND	ND	ND	100	30.	ND	105	45.
22B	1,4-Dichlorobenzene	ND	10	ND	ND	ND	100	33.	ND	105	47.
23B	3,3'-Dichlorobenzidine	ND	10	ND	ND	ND	100	17.	ND	105	21.
24B	Diethyl phthalate	ND	10	ND	ND	ND	100	6.	ND	105	44.
25B	Dimethyl phthalate	ND	10	ND	ND	ND	100	1	ND	105	12
26B	Di-n-butyl phthalate	ND	10	ND	ND	BMDL	100	60	ND	105	80
27B	2,4-Dinitrotoluene	ND	10	ND	ND	ND	100	74	ND	105	88
28B	2,6-Dinitrotoluene	ND	10	ND	ND	ND	100	98	ND	105	100
29B	Di-n-octyl phthalate	ND	10	ND	ND	ND	100	137	ND	105	117
30B	1,2-Diphenylhydrazine	ND	10	ND	ND	ND	100	92	ND	105	90
31B	Fluoranthene	ND	10	ND	ND	ND	100	62	ND	105	90

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9440	RESOURCE ENGINEERING	RES28801	MW7	840629	1200	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
32B	Fluorene	ND	10	ND	ND	ND	100	95	ND	105	94
33B	Hexachlorobenzene	ND	10	ND	ND	ND	100	107	ND	105	87
34B	Hexachlorobutadiene	ND	10	ND	ND	ND	100	14b	ND	105	43b
35B	Hexachlorocyclopentadiene	ND	10	ND	ND	ND	0	-	ND	0	-
36B	Hexachloroethane	ND	10	ND	ND	ND	100	16b	ND	105	32b
37B	Indeno(1,2,3-c,d)pyrene	ND	10	ND	ND	ND	0	-	ND	0	-
38B	Isophorone	ND	10	ND	ND	ND	100	83	ND	105	88
39B	Naphthalene	ND	10	ND	ND	ND	100	44	ND	105	54
40B	Nitrobenzene	ND	10	ND	ND	ND	100	83	ND	105	198
41B	N-Nitrosodimethylamine	ND	10	ND	ND	ND	0	-	ND	0	-
42B	N-Nitrosodi-n-propylamine	ND	10	ND	ND	ND	100	74	ND	105	77
43B	N-Nitrosodiphenylamine	ND	10	ND	ND	ND	100	127	ND	105	129
44B	Phenanthrene	ND	10	ND	ND	ND	100	81	ND	105	83
45B	Pyrene	ND	10	ND	ND	ND	100	108	ND	105	96
46B	1,2,4-Trichlorobenzene	ND	10	ND	ND	ND	100	209c	ND	105	197c

a EPA published Method Detection Limit.
b Recovery normally low using EPA Protocol Method 625.
b Recovery variable due to sample matrix interference.
c Recovery normally variable using EPA Protocol Method 625.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds – GC/MS Analysis Data – Base/Neutral Fraction (QR08)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9440	RESOURCE ENGINEERING	RES28801	WW7	840629	1200	
ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

Compound Name	Data			Identifiers				
	Scan Number	Retention Time (Min)	M.W.	CAS Number	Empirical Formula			
None Found								

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ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds - GC/MS Analysis Data - Acid Fraction (QR07)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9440	RESOURCE ENGINEERING	RES28801	WMW7	840629	1200	

Compound Name	Data			Identifiers				
	Scan Number	Retention Time (Min)	M.W.	CAS Number	Empirical Formula			
None Found								

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 21, 1

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TABLE 1: QUANTITATIVE RESULTS

Conventionals Analysis Data (QR12)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9440	RESOURCE ENGINEERING	RES28801	MW7	840629	1200	

Parameter	Results							
	Sample Measure	MDL	Units of Measure					
pH	7.37		std					
Specific Conductance	580		um/cm					
Temperature	40.80		Deg. C					

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 2: METHOD PERFORMANCE DATA

Surrogate Recovery - GC/MS Data (QR20)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9440

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

Compound	Amount Added ug	% Recovery	Control Limits *	
			Lower	Upper
VOLATILE FRACTION				
Bromochloromethane	.200	117	74	122
Benzene, d_6	.150	107	83	119
Fluorobenzene	.150	108	88	116
1,4-Dichlorobutane	.200	83	75	123
Pentafluorobenzene	.150	107	90	126
Ethylbenzene, d_{10}	.150	103	83	127
ACID FRACTION				
2-Fluorophenol	80	66	16	100
Pentafluorophenol	80	54	25	113
BASE/NEUTRAL FRACTION				
2-Fluorobiphenyl	80	69	57	101
1-Fluoronaphthalene	80	59	55	103
Nitrobenzene, d_5	80	34**	63	143

* Two Standard Deviations About the Mean.

** Recovery low due to sample matrix interference.

July 21, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data - Bromofluorobenzene (BFB) for Volatiles Analysis (QR21)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9440

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
50	15-40% of Mass 95	21
75	30-60% of Mass 95	48
95	Base Peak, 100% relative abundance	100
96	5-9% of Mass 95	8
173	Less than 1% of Mass 95	<1
174	Greater than 50% of Mass 95	75
175	5-9% of mass 174	6
176	Greater than 95% but less than 101% of Mass 174	75
177	5-9% of mass 176	5

Date: 840718
Run No: >C3066
Spectrum No: 95
Analyst: R. Albert

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 26, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Acids Analysis (QR22)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9440

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	59
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	50
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	6
275	10-30% of mass 198	22
365	Greater than 1% of mass 198	>1
441	Less than mass 443	12
442	Greater than 40% of mass 198	71
443	17-23% of mass 442	14

Date: 840722
Run No: >E3118
Spectrum No: +374 -155
Analyst: T. Rusowicz

July 26, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Base/Neutrals Analysis (QR23)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9440

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

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m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	56
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	53
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	7
275	10-30% of mass 198	21
365	Greater than 1% of mass 198	2
441	Less than mass 443	12
442	Greater than 40% of mass 198	83
443	17-23% of mass 442	17

Date: 840720
Run No: G3466
Spectrum No: 489
Analyst: K. Bonaparte

Methodology for GC/MS Analysis of Priority Pollutant Compounds

The methods employed in the GC/MS analysis for priority pollutants are established EPA methods. Rigid compliance with the instrument parameters and performance criteria of the published methods was achieved. In some cases, the precise amounts of sample used and the sample handling procedures vary with the complexity of the sample matrix. Qualitative identification of the priority pollutants was performed using the relative retention times, the relative abundance of three characteristic ions and the abundance ratios. The entire mass spectrum was reviewed to confirm each identification. Quantitative analysis of detected compounds was performed by using a response factor generated by a major characteristic ion of the specific compound and an internal standard.

Compounds, in addition to those on the priority pollutant list, were identified through a computer-aided search of the NBS-EPA spectra library. After review the identifications are included in a separate tabulation and labelled "tentatively identified".

Volatile Priority Pollutant Compounds

For the analysis of Volatile priority pollutants, EPA Method 624 (Federal Register, December 3, 1979; page 69532) was used. The method can be summarized as follows: Helium is bubbled through a 5 ml water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the organic components are trapped. After the purge cycle is complete, the sorbent column is heated and backflushed with helium to desorb the organic purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeable mixture. The separated purgeable components are then identified and quantitated using a computerized mass spectrometer.

Acid, Base/Neutral and Pesticide Priority Pollutant Compounds

For the analysis of the Acid, Base/Neutral and Pesticide priority pollutants in an aqueous liquid matrix, EPA Method 625 (Federal Register, December 3, 1979; page 69540) was used. The method can be summarized as follows: A measured volume of sample, approximately 1 liter, is adjusted to a pH greater than 11 and extracted with methylene chloride. The pH of the sample is adjusted to a value less than 2 and extracted with an aliquot of fresh methylene chloride. A separatory funnel or continuous extractor is used to perform the extractions. The two extracts are dried and concentrated to a 1 ml final volume. Each extract is injected into a GC/MS instrument specifically configured for the correct fraction.

Quality Assurance/Quality Control Procedures (QA/QC)

ETC bases its quality assurance protocols on the following government guidelines:

. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;

. National Enforcement Investigation Center Policies, and Procedures manual; EPA-330/9/79/001-R, October 1979;

. the recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979, pp. 69532-69559);

. "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980; and

. "Determination of 2,3,7,8-TCDD in Soil and Sediment" EPA, Region VII, Kansas City, September 1983.

However, we have modified our protocols to provide a higher level of QA/QC than the guidelines require. For example, we analyze a higher than required number of quality control samples and we pay especially careful attention to the certification of the "reference standard" compounds we use in analysis. Below are listed the key QA/QC elements for the methods we used.

Analysis of Volatile Organic Compounds (EPA Method 624)

- Each batch of 13 samples consists of 9 customer samples (at maximum), one blank sample, one spiked blank, one spiked sample and one replicate sample. This amounts to a 30% quality control factor.

- Three surrogate compounds are added to each sample in the batch of 13.

- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.

- Each GC/MS is checked and retuned, if necessary, every 8 hours to ensure that its performance on bromofluorobenzene (BFB) meets the EPA criteria.

- A calibration curve for quantitation is prepared using a mixture of Volatile Organic Priority Pollutant "standards" at a minimum of 3 different concentrations and using a mixture of 3 internal standards at a constant concentration.

- The calibration curve is verified with a mixture of priority pollutant standards every 8 hours.

- Results are compared to the acceptance criteria given in Method 624; any that do not meet the criteria are re-analyzed.

Analysis of Organic Compounds Extracted in Acid or Base/Neutral Solutions (EPA Method 625)

- Each batch of 20 samples consists of 16 customer samples (at maximum), one blank sample, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate customer sample. This amounts to a 20% quality control factor.

- Five surrogate compounds are added to each sample in the batch of 20.

- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.

- Each GC/MS is checked and retuned, if necessary, every eight hours to ensure that its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of standards composed of either the Organic Acid or Base/Neutral Extractable Compounds at a minimum of 3 concentrations and using 2,2'-difluorobiphenyl as an internal standard.
- The calibration curve is verified with a mixture of priority pollutant standards every eight hours.
- Results are compared to the acceptance criteria given in Method 625; any that do not meet the criteria are re-analyzed.

Analysis of Metals

All Samples

- New standards are prepared for each batch of samples.
- Normal calibration is performed using a blank sample and four standards that have been through the sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis that requires the use of the "method of additions" technique, a three point calibration is performed using U.S EPA "Methods for Chemical Analysis of Water and Wastes, 1979". Results are obtained using linear regression analysis. Any results with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- In constructing the normal calibration curves the lowest concentration levels we use are values greater than or equal to 5 times the Instrumental Detection Limit (IDL).
- All calibration standards are analyzed in duplicate, at a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to validate the normal calibration curve.

Homogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are homogeneous, the QC program is a minimum of 42% and consists of analyzing:

- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method),
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

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Heterogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are heterogeneous, the QC program is a minimum of 65% and consists of analyzing:

- each of the 30 customer samples in duplicate;
- 4 Replicates;
- 4 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Analysis of Mercury

To analyze samples for mercury we group them by matrix in batches of 20 or less. Our QC program is a minimum of 66% and consists of analyzing:

- each of the 20 customer samples in duplicate;
- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 10 Calibration standards (processed using the sample preparation method); and
- 2 Blanks.

Analysis of Pesticides, Herbicides and PCB's (EPA Method 608)

Pesticide, herbicide and PCB samples are grouped in batches of 16 customer samples or less according to the type of analysis to be performed. The QC program for each of these three types of analyses is a minimum of 20% and consists of analyzing:

- 1 blank sample;
- 1 spiked blank sample;
- 1 replicate sample;
- 1 replicate spiked sample; and
- 1 blank QC sample for at least each 100 samples analyzed.

The GC instruments are tuned daily to meet performance criteria in Method 608. Because Method 608 lacks data acceptance criteria, ETC has developed its own upper and lower quality control limits. When a test result falls outside the control limits, the test is re-run.

Analysis of Cyanides and Phenols

Cyanides and phenols are analyzed using a Technicon AutoAnalyzer II GT.

- Absorbance of full scale standards must be within +/- 25% of nominal absorbance.
- Duplicate calibration standards at four different concentrations are run with each batch of customer samples.
- At least one intersample standard is run for each 20 customer samples.
- Gain and carryover standards are analyzed at the end of each run.

Analysis of Total Organic Halide (TOX)

- Blank reagent water must contain less than 5 ug/l of halide (as chloride).
- Using a trichlorophenol standard, the mean adsorption efficiency must be within +/- 15% of the standard value.
- Pure compound recoveries must average 100 +/-15% (standard deviation).

Analysis of 2,3,7,8-TCDD (Dioxin) by GC/MS (SIM)

- Each sample is dosed with a known quantity of $^{13}C_{12}$-2,3,7,8-TCDD as internal standard and $^{37}Cl_4$-TCDD as surogate standard. The action limits for surrogate standard results is +/- 40% of the true value. Samples showing surrogate standard results outside of these limits are reextracted and reanalyzed.
- A laboratory "method blank" is run along with each set of 24 or fewer samples. The method blank is also dosed with the internal standard and surrrogate standard.
- At least one per set of 24 samples is run in duplicate to determine intralaboratory precision.
- Qualitative Requirements. The following are met in order to confirm the presence of native 2,3,7,8-TCDD:

  a. Isomer specificity must be demonstrated initially and verified once per 8-hour work shift. The verification consists of injecting a mixture containing TCDD isomers which elute close to 2,3,7,8-TCDD. The 2,3,7,8-TCDD must be separated from interferring isomers, with no more than 25% valley relative to the 2,3,7,8-TCDD peak.

  b. The 320/322 ratio is within the range of 0.67 to 0.87.

  c. Ions 320, 322, and 257 are all present and maximize together the signal to mean noise ratio must be 2.5 to 1 or better for all 3 ions.

  d. The retention time is equal (within 3 seconds) the retention time for the isotopically labeled 2,3,7,8-TCDD.

  e. At least one of the positives can be confirmed by obtaining partial scan spectra from mass 150 to mass 350. The partial scan guidelines are as follows:

  . the 320/324 ratio should be 1.58 +/- 0.16

  . the 257/259 ratio should be 1.03 +/- 0.10

  . the 194/196 ratio should be 1.54 +/- 0.15

- One sample is spiked with native 2,3,7,8-TCDD at a level of 1.0 PPB (for soil) for each set of 24 or fewer samples.

- In cases where no native 2,3,7,8-TCDD is detected, the actual detection limit is estimated and reported based on a signal to noise ratio of 2.5 to 1 at ions 320 and 322.

- For each sample, the internal standard is present with at least a 10 to 1 signal to noise ratio for both mass 332 and mass 334. Also, the internal standard 332/334 ratio must be within the range of 0.67 to 0.87.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;

- outgoing shipping manifests;

- the chain-of-custody form completed by the person(s) breaking the Shuttle seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;

- incoming shipping manifests;

- breaking the Shuttle's reseal;

- storing each labeled sample bottle in a secured area;

- disposition of each sample to an analyst or technician; and

- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody; and

- the time and date each person accepted or relinquished custody.

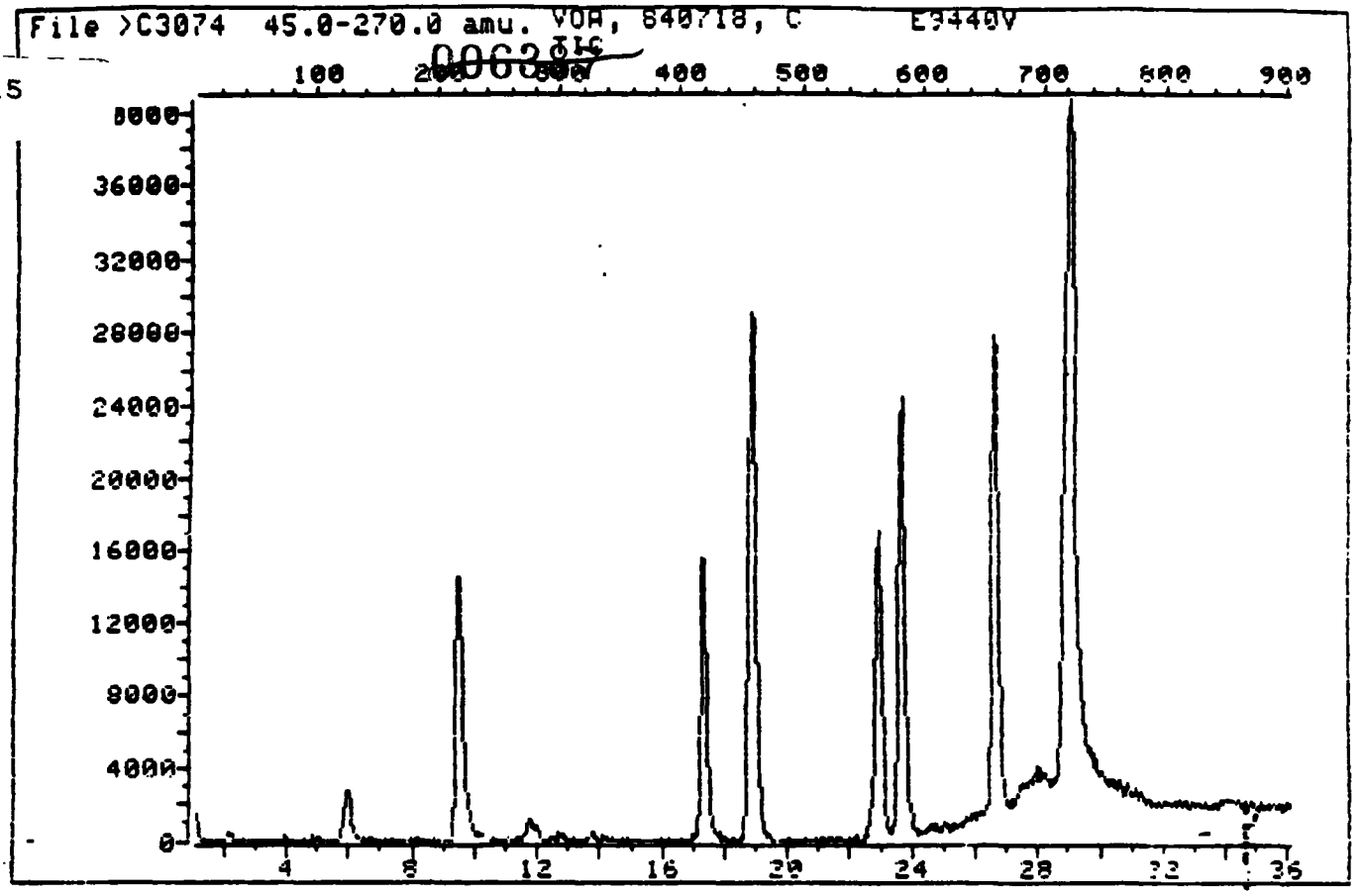
Appendix A

Mass Spectral Data for Quantitated Compounds

1) A total ion chromatogram for each sample analysed by a GC/MS instrument.

2) A mass spectrum and a reference spectrum for each priority pollutant compound detected in the sample.

TOTAL ION CHROMATOGRAM



019115

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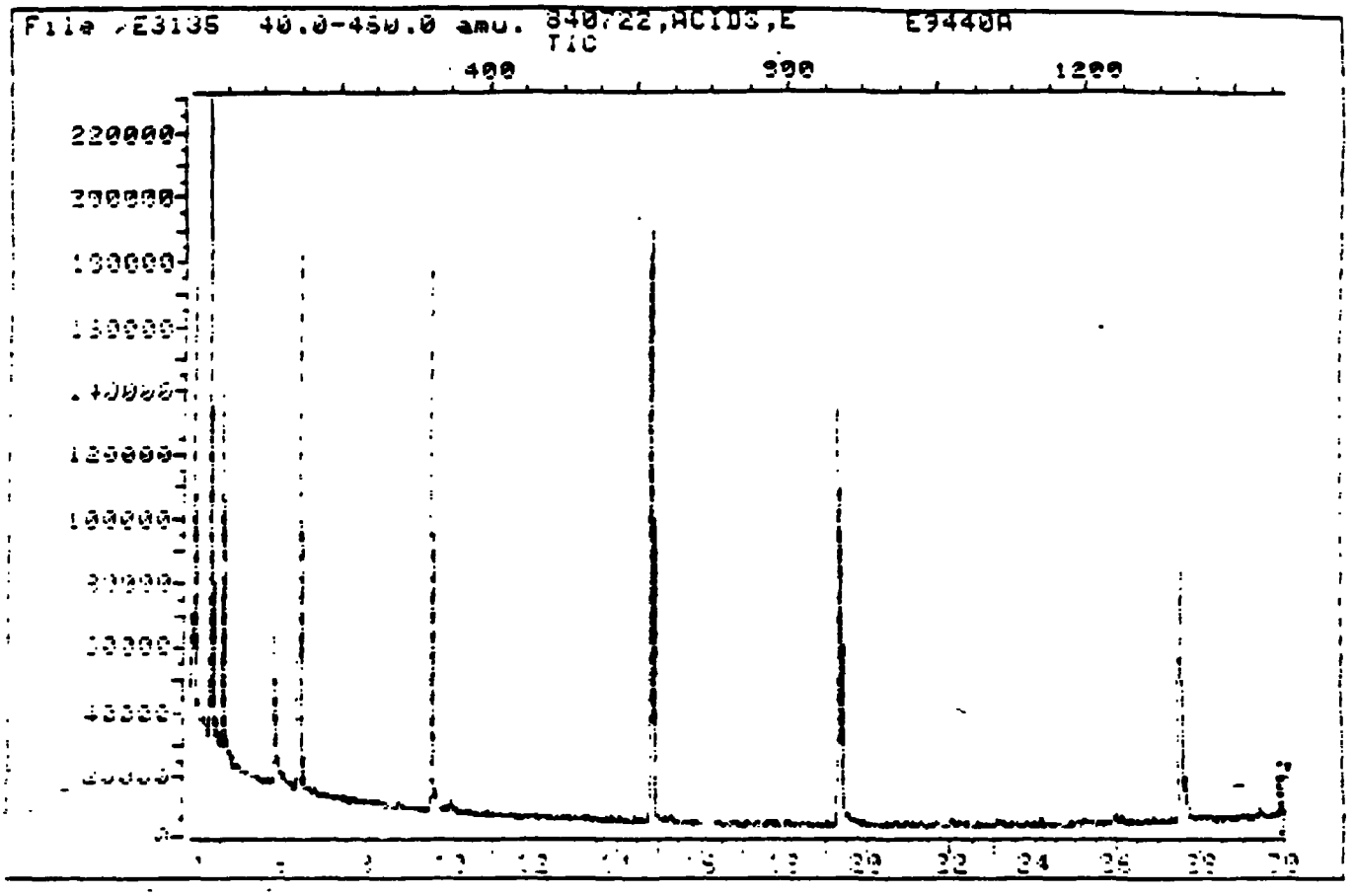
Misc: E9440V

Id File: VOA
Title: IDFILE, PURGEABLE PRIORITY POLLUTANTS, C
Last Calibration: 840718 23:51

Operator ID: RA0157
Daunt Time: 840719 03:06

TOTAL ION CHROMATOGRAM



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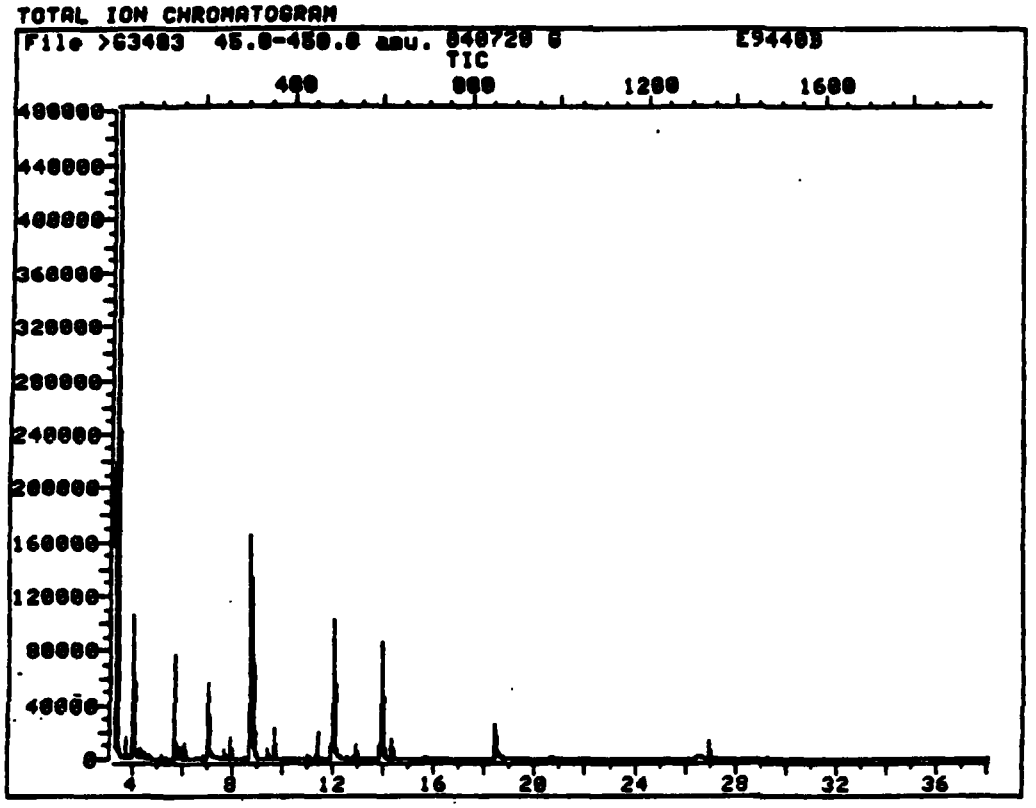
Name 840722,ACIDS,E
Mode E9440A

Id File EACID
Title ACID ID [illegible] WWC 6/21/83,#E
Last Calibration [illegible] 00 06

Operator ID [illegible]
Qaunt Time 840722 05 22

TOTAL ION CHROMATOGRAM



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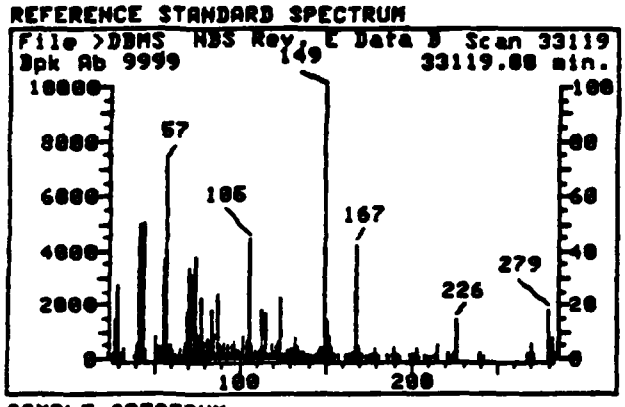
Name: 840720 G
Misc: E9440B

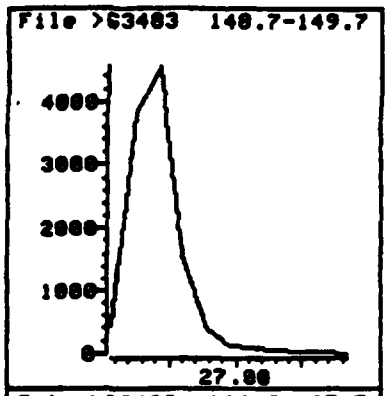
BTL#17

Id File: GBNP
Title: BN,PEST,IFB ISTDS IDFILE PVC..840510
Last Calibration: 840721 08:25

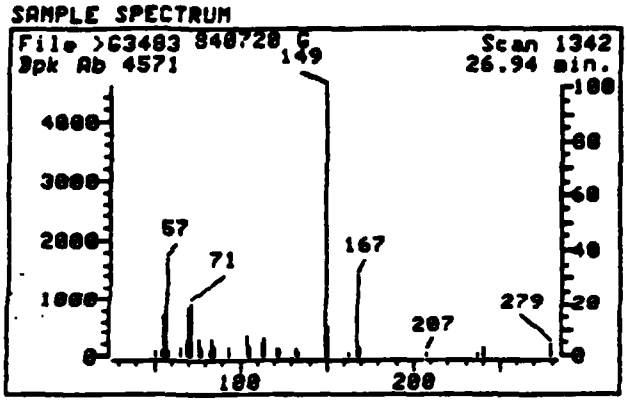
Operator ID: KB5414
Qaunt Time: 840721 10:07

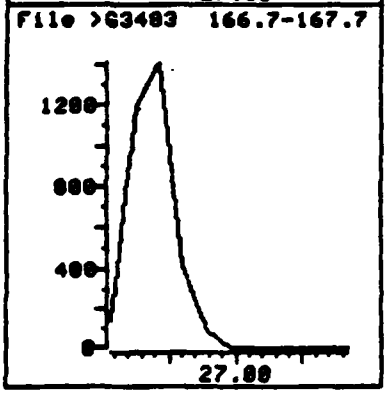
REFERENCE STANDARD SPECTRUM





SAMPLE SPECTRUM





Data File: >G3483::U3
Name: 840720 G
Misc: E94408

BTL#17

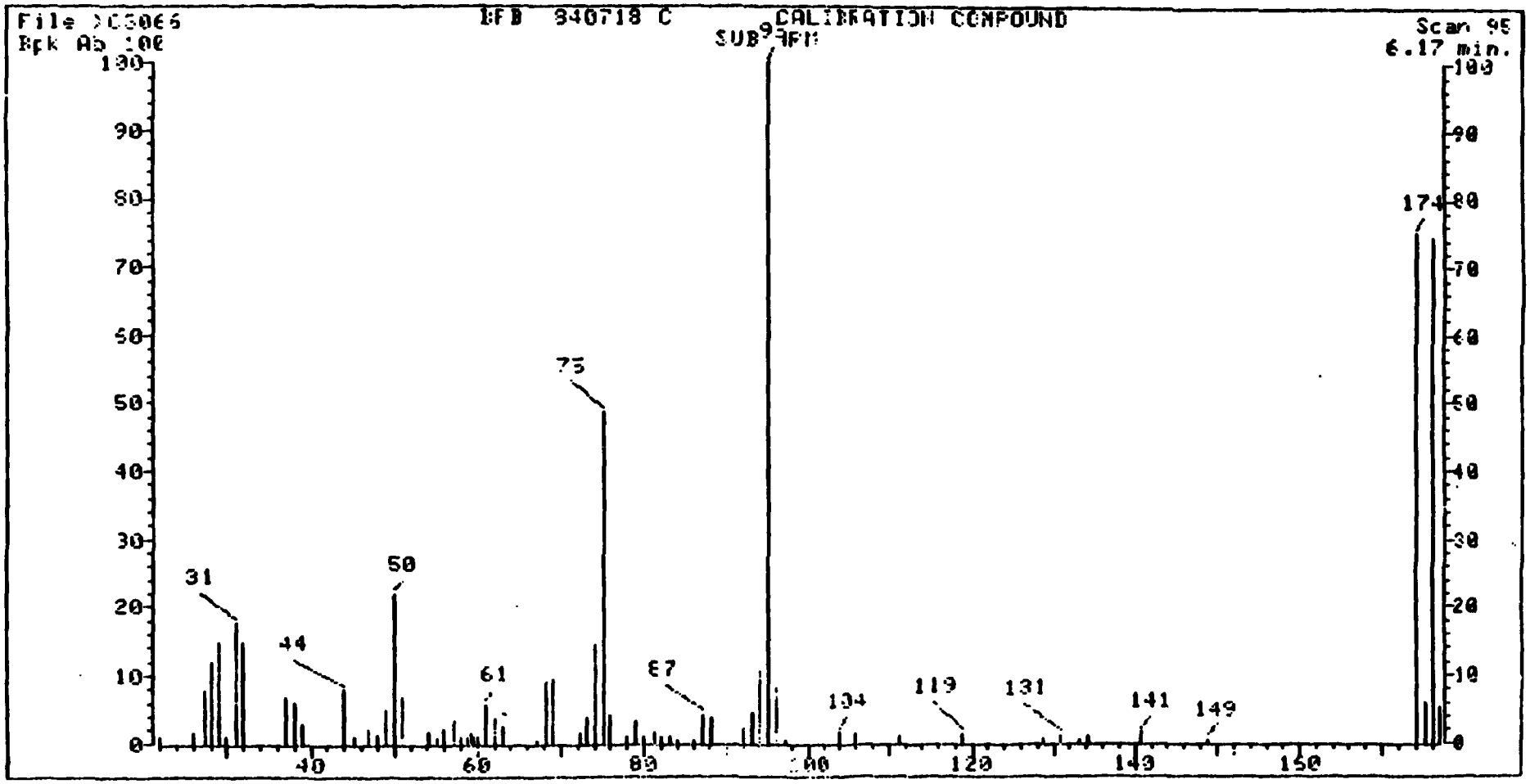
Compound No: 46
Compound Name: bis(2-Ethylhexyl)phthalate
Scan Number: 1342
Retention Time: 26.94 min.
Area: 8512
Concentration: 10.21 UG/ML

Appendix B

Mass Spectral Data for Calibration Compounds

1) If the sample analysis included the determination of purgeable organic compounds then a mass spectrum for 4-bromofluorobenzene (BFB) is included. This data was used in the instrument calibration protocol on the day of analysis.

2) If the sample analysis included the determination of non-purgeable organic compounds then a mass spectrum for decafluorotriphenylphosphine (DFTPP) is included. This data was used in the instrument calibration protocol on the day of analysis.

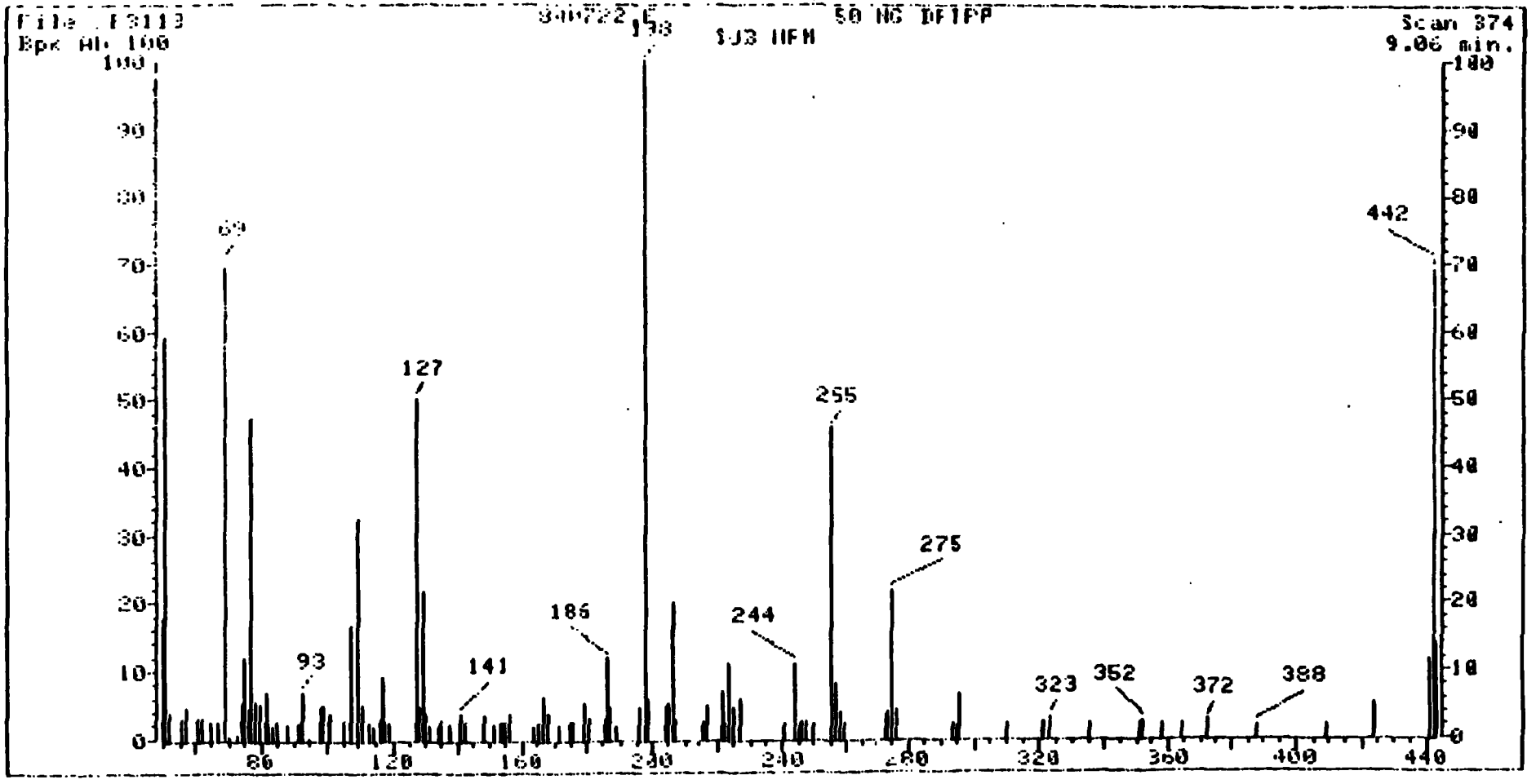

File >CC0065
Bpk Ab 100
BFB 940718 C
CALIBRATION COMPOUND
SUB9 AFM
Scan 95
6.17 min.
100
90
80
70
60
50
40
30
20
10
0
31
44
50
61
73
87
104
119
131
141
149
174
40
60
80
100
120
140
150

K-28

019118 SUB NRM ~~006390~~

File:)C3066 Scan #: 95 Retn. time: 6.17

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int	m/z	Int.
21.90	.66	48.00	1.27	62.10	3.71	82.05	.66	106.15	1.02
26.10	1.37	49.10	4.98	63.10	2.46	83.15	.66	111.05	.89
27.20	7.62	50.10	21.70	67.10	.23	84.15	.08	118.95	1.27
28.10	11.94	51.00	6.73	68.30	9.17	86.05	23	128.85	.51
29.00	14.71	54.20	1.50	69.10	9.22	87.15	4.01	130.95	.89
30.00	.81	55.10	.84	72.30	1.47	88.05	3.51	133.15	.33
31.10	17.45	56.00	2.08	73.10	3.58	92.05	1.93	134.25	.94
32.00	14.84	57.10	3.33	74.10	14.28	93.05	4.14	140.95	1.42
37.10	6.94	58.10	.71	75.20	48.55	94.05	10.52	149.05	.28
38.10	6.02	58.80	.84	75.90	4.07	95.05	100.00	174.05	75.05
39.00	2.79	59.30	1.30	78.05	.94	96.05	8.00	175.05	5.77
44.00	7.65	59.60	.89	78.95	3.13	97.15	.33	176.05	74.57
45.10	.97	60.00	.81	79.95	.97	103.95	1.42	176.95	5.18
47.10	2.01	61.10	5.67	81.15	1.40				


File F3113
Bpk Ab 100
840722 E
198
50 NG DFTPP
Scan 374
9.06 min.
69
93
127
141
186
244
255
275
323
352
372
388
442
100
90
80
70
60
50
40
30
20
10
0
80
120
160
200
240
280
320
360
400
440

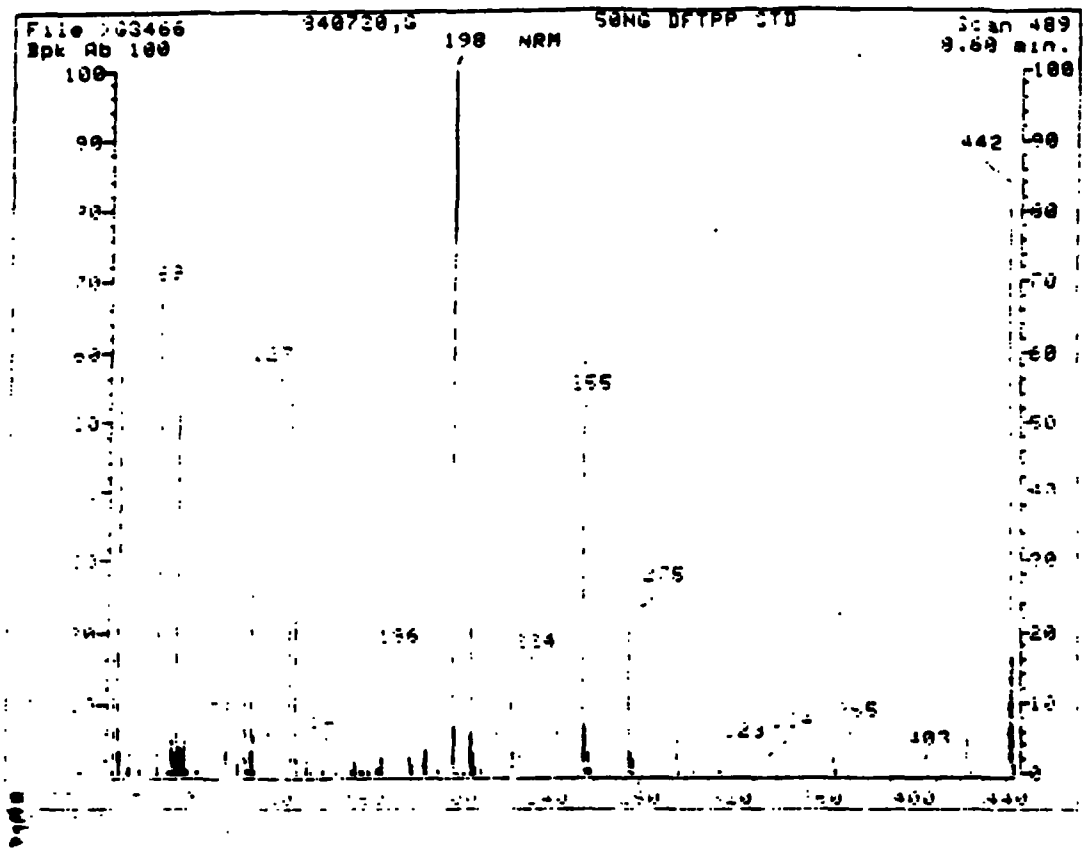
>E3110 840722,E 006391 50 NG DFTPP
374 SUB NRM

019119

File: >E3110 Scan #: [illegible] Retn. Time: 9.06

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
50.00	18.03	88.35	1.97	134.80	2.84	198.05	100.00	273.10	3.31
51.00	59.25	91.45	2.17	137.30	2.01	198.85	5.92	274.00	3.87
51.95	3.83	93.05	6.86	141.05	3.75	204.05	4.46	275.00	21.70
56.05	3.16	94.95	.20	142.15	2.52	205.15	5.29	276.10	4.54
57.05	4.73	97.90	4.54	147.95	3.43	206.05	20.20	293.25	2.13
60.95	3.12	99.00	5.05	151.35	2.01	206.85	2.80	294.95	1.85
62.15	3.12	100.90	3.63	153.05	2.45	216.10	2.45	296.05	6.51
65.15	2.45	105.20	2.72	154.70	2.29	217.00	4.89	310.30	2.09
67.00	2.49	107.00	16.73	155.00	2.25	221.00	6.71	321.15	2.25
67.00	70.61	108.00	3.20	156.10	3.75	222.40	1.93	322.95	3.00
70.30	.24	110.00	32.54	163.70	1.89	223.70	10.81	333.50	.20
73.10	.43	111.05	4.85	165.20	2.49	225.10	4.46	335.20	2.17
74.00	5.36	113.15	2.49	167.00	6.11	227.00	6.00	350.55	2.09
75.00	11.77	114.45	1.78	168.00	3.55	240.75	2.09	352.05	2.41
76.10	4.34	116.15	2.92	171.35	2.21	244.10	11.01	358.25	2.05
77.00	47.34	117.05	8.92	174.75	2.37	245.30	2.13	364.70	2.21
78.00	5.44	117.75	2.33	176.05	2.41	245.70	2.25	372.10	2.60
79.00	5.29	119.05	2.29	179.05	5.29	247.00	2.29	387.65	1.05
79.60	.75	127.00	50.22	180.85	2.88	250.00	2.01	409.35	1.70
80.95	6.75	128.10	4.50	185.30	3.08	255.00	46.04	423.10	4.09
82.15	2.29	129.00	21.78	186.00	11.87	256.00	8.09	441.15	11.52
82.55	2.37	130.00	3.51	187.00	4.69	257.95	3.94	442.05	70.52
83.75	1.89	131.30	1.97	188.60	1.89	259.25	2.37	443.05	13.05
85.15	2.25	134.40	1.39	190.10	4.65				

AL,,3 Move cursor, then press carriage return


File >G3466
Bpk Ab 100
340720,G
198 NRM
50NG DFTPP STD
Scan 489
0.60 min.
442
155
275
196
124
403
100
90
80
70
60
50
40
30
20
10
0
400
440

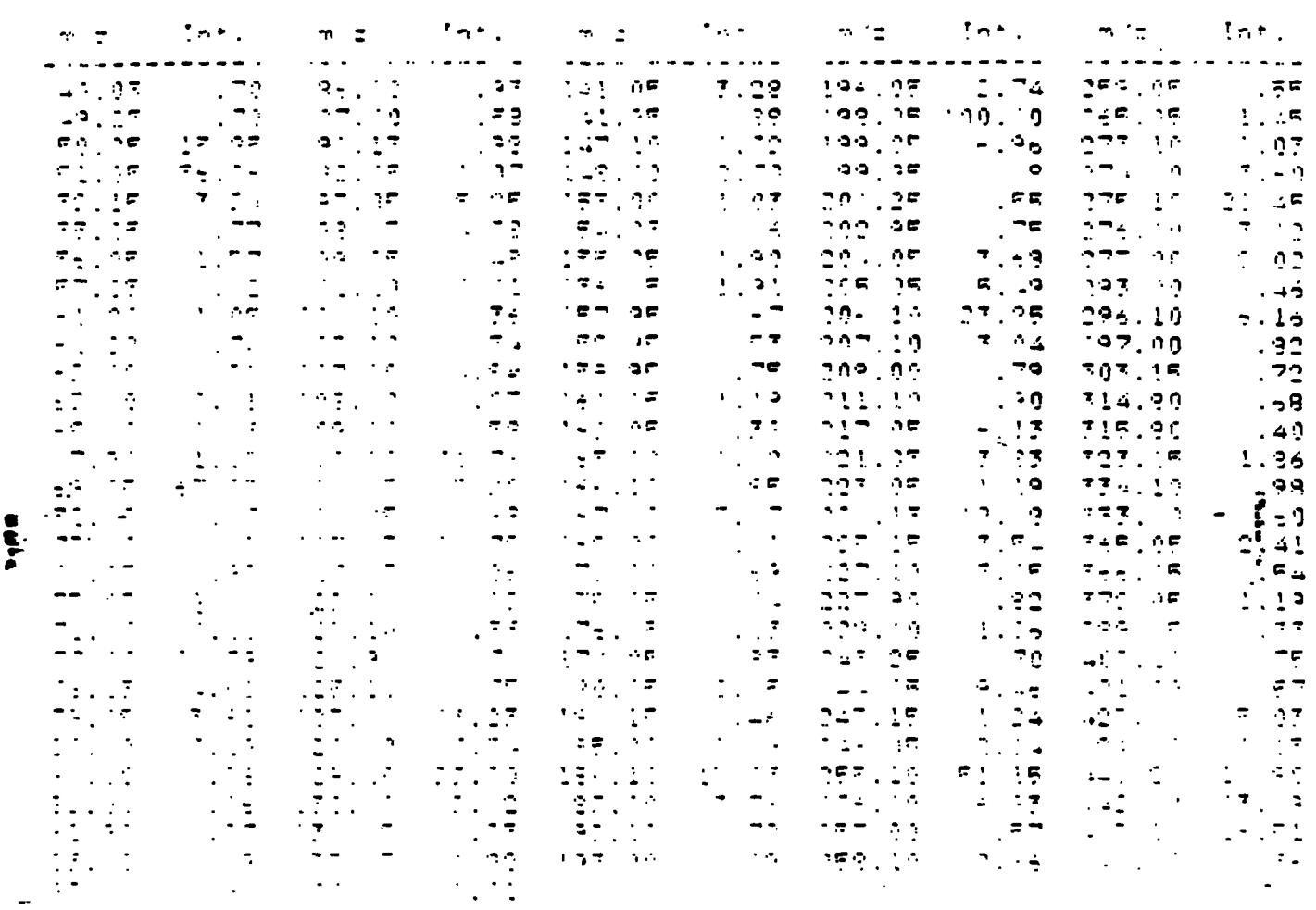
019120

~~006392~~

:TAB

/G3466 840720,G FONG DFTPP STD
489 NRM

File: G3466 Scan #: 489 Retn. Time: 3.50



Appendix C

Mass Spectral Data for Tentatively Identified Compounds

1) For each tentatively identified compound a mass spectrum of the detected compound, a reference mass spectrum for that compound and a plot of the spectral differences are provided.

006393

TENTATIVELY IDENTIFIED ORGANIC COMPOUNDS

ACID FRACTION: NONE FOUND.

See Total Ion Chromatogram in Appendix A.

TENTATIVELY IDENTIFIED ORGANIC COMPOUNDS

BASE/NEUTRAL FRACTION: NONE FOUND.

See Total Ion Chromatogram in Appendix A.

Appendix E

Chain-of Custody Forms

1) A field Chain-of-Custody form (CC1) is included for all samples shipped by ETC shuttle.

2) An in-house sample Chain-of Custody form is included for the period the sample was in ETC's possession.

3) A subcontractor's Chain-of-Custody form is included for any analytical work not performed within ETC's laboratory.

4) Any additional Chain-of-Custody material provided by a client or by a client's sampling agent is also included.

CHAIN OF CUSTODY FORM (CC1)

Seal Date: 6/25/84
Sealed By: J. Trotter

SHIP TO:

Company: RESOURCE ENGINEERING
Facility/Site: 11 GREENWAY PLAZA
Address: Houston, TX 77406
Attn.: COBY SHER
Phone: (713) 621 - 5900

SAMPLE IDENTIFICATION

Facility/Site Code: RES-288-01

Source Codes:

Well	(W)	River/Stream	(R)	Surface Impoundment	(I)	Lake/Ocean	(L)
Soil	(S)	Bottom Sediment	(B)	Pretreatment Facility	(P)	Treatment Facility	(T)
Outfall	(O)	Generation Point	(G)	Leachate Collection Sys.	(C)	Other	(X)

Source Code (from above)	Your Sample Point ID (left justify)	Start Date (mo/day/yr)	Start Time (2400 hr. clock)	Elapsed Hours (composite)
W	MW-7	06 29 84	1200	
Example: W	101J263P	05 15 81	0930	13

481
3

SHUTTLE CONTENTS

Sample Bottle	Condition	Sample Bottle	Condition
E9440 E_1-E_4	✓ E_4 PARTLY FROZEN	Bottles Not Completely full	
E9440 V_1-V_2	✓ V_2 Not Rec'd		
E9440 TB	✓ TB Rec'd w/ Head Space		
E9440 V_2	Broken		

CHAIN OF CUSTODY CHRONICLE

1. Shuttle Opened By: (print) S G Itin Date: 6-26-84 Time: 1330
   Signature: [signature] Seal #: NOT NOTED Intact: YES

2. I have received these materials in good condition from the above person.
   Name: W.D. Gore Jr. Signature: [signature]
   Date: 6/29/84 Time: 12:00 Remarks:

3. I have received these materials in good condition from the above person.
   Name: Wm Thomas Beck Signature: Wm Thomas Beck
   Date: 7-2-84 Time: 6:34 Remarks: V_2 VOA Broken

4. I have received these materials in good condition from the above person.
   Name: Signature:
   Date: Time: Remarks:

5. Shuttle Sealed By: (print) Date: Time:
   Signature: Seal #:

ETC USE ONLY Opened By: J. Trotter Date: 7/3/84 Time: 12:00
Seal #: 18332 Condition: Seal Intact

ETC Form CC1 6/1/82

019123

ETC ONMENTAL TESTING and CERTIFICATION 006395

E9440
ETC Sample No.:

SAMPLE POINT INFORMATION FORM (CC2)

FIELD MEASUREMENT DATA

Select up to 3 parameters to be recorded by entering the appropriate code letter in the first space for each of the 3 data entry fields provided. Enter the actual measurement data (in the units specified) for the three parameters you have selected.

PARAMETERS		ACTUAL (left justify)	EXAMPLE
Flow (CFS)	A	D33.2	C25
Volume (Gal)	B		
Sample Depth (Ft)	C		
Depth to Water (Ft)	D	G1200	E50
Discharge Rate (GPM)	E		
Depth to Bottom (Ft)	F		
Event Time (2400-Hr Clock)	G		G1103
Depth to Screen (Ft)	H		

FIELD TEST DATA

DO (Mg/L) ____ Sample Temp. (°C) 40.8

pH 7.37 (Single Measurement) ____ (2nd of Quadruplicate) ____ (3rd of Quadruplicate) ____ (4th of Quadruplicate)

Specific Conductance (uMHOS/Cm) 580 (Single Measurement) ____ (2nd of Quadruplicate) ____ (3rd of Quadruplicate) ____ (4th of Quadruplicate)

THE FOLLOWING DATA IS FOR YOUR RECORDS ONLY

SAMPLING METHOD (choose one)

AIR-LIFT PUMP ( )	PERISTALTIC PUMP....( )	THIEF.....( )
AUGER.....( )	PETERSEN.....( )	TRIER.....( )
BAILER.....(X)	PISTON PUMP.....( )	VEHMEYER..( )
BOTTLE.....( )	SCOOP/SHOVEL.....( )	OTHER _____
COLIWASA.....( )	SQUEEZE PUMP.....( )	
DIPPER.....( )	SUBMERSIBLE PUMP.( )	
KEMMERER.....( )	SUCTION LIFT PUMP ( )	
NISKIN.....( )	SURGER.....( )	

SAMPLE TYPE (choose one)

GRAB (X) COMPOSITE ( ) OTHER ( )

_____ _____
(describe) (describe)

WEATHER: Sunny, hot, humid (describe)

SAMPLE DESCRIPTION (e.g. color, odor) (describe)

Form Prepared By: DEAN GORE (name (print)) Employer: RESOURCE ENG.

ETC Form CC2 6/1/82

5582

ETC ENVIRONMENTAL TESTING and CERTIFICATION

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number(s) E9440 TO E9442

Sample Preparation For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	L. Scalise/K. Albretson (J. [illegible])	7/16/84
Acids	Greg Manson	7/18/84
Metals		
Others		
Others		
Others		
Others		

Sample Analysis For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Kris Bonaparte (cw)	7/20/84
Acids	Tom Rusowicz	7-22-84
VOA/Purgeables	[illegible]	7/18-7/17/84
Metals		
Others		
Others		
Others		
Others		
Others		
Others		

Verified By: Harry Klaus

019124

~~006396~~

Technical Report

for

RESOURCE ENGINEERING

11 GREENWAY PLAZA

HOUSTON, TX 77406

MW-2

DOWN GRADIENT DEEP WELL

Chain of Custody Data Required for ETC Data Management Summary Reports						
E9441	RESOURCE ENGINEERING	RESSHER	MW2	840629		
ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

James N. Bowers for

Denis C. K. Lin, Ph.D.

Vice President
Research and Operations

Introduction

This report contains the analytical results on your water sample, WMW2 84/06/29. It is designed to include comprehensive data from the entire analytical process in order to satisfy the needs of various levels of review.

The results obtained from your sample are presented in tabular format immediately following this introduction. Quality assurance data is tabulated along with the appropriate sample results for verification. Depending on the analyses ordered, the quality assurance data may include results from blank, spiked blank, spiked sample (i.e. matrix spike) and replicate sample as well as results from surrogate compound analyses. Quality assurance data for verification of proper instrument performance is also included where appropriate. The report appendices include the chain of custody record for your sample and, where appropriate, the gas chromatograms and mass spectra.

The procedures used in the analysis of the sample are described in this report's methodology section. All analytical procedures within our laboratory are performed within a strictly enforced Quality Assurance Protocol. A description of this Protocol is included in the report.

Results

Sample results, and associated quality assurance data, are always tabulated in one or more of this report's Quantitative Results Tables. The format of each table varies with the class of analysis.

Priority Pollutants

The priority pollutant compounds and elements are listed with their NPDES (National Pollution Discharge Elimination System) numbers, and the Method Detection Limit (MDL) published in the Federal Register, December 3, 1979. When a compound or element is present below its published MDL it is reported as BMDL (Below Method Detection Limit). When a compound or element is not present at any detectable concentrations it is reported as ND (Not Detected). Matrix spike and replicate analyses, where included, were performed on samples randomly chosen within each quality assurance batch and are therefore not necessarily spikes and replicates of this report's sample. Surrogate compound recovery data and instrument calibration data are included in the Method Performance Data Tables.

Qualitative Analysis

The GC/MS identification of compounds which are not included in the normal compound list for a given method is reported in a Qualitative Results Table. Each sample fraction is reported on an individual Qualitative Results Table. Wherever possible these compounds are reported with their molecular weight, empirical formula, and CAS number. The retention time and scan number is also provided to match the spectra included in the report appendices.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 24, 19

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9441	RESOURCE ENGINEERING	RES28801	MW2	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1V	Acrolein	ND	100	ND	ND	ND	1600	4.	ND	1600	4.
2V	Acrylonitrile	ND	100	ND	ND	ND	160	77.	ND	160	99.
3V	Benzene	ND	10	ND	ND	ND	36	95	ND	36	97
4V	bis(Chloromethyl)ether	ND	10	ND	ND	ND	0	-	ND	0	-
5V	Bromoform	ND	10	ND	ND	ND	36	92	ND	36	108
6V	Carbon tetrachloride	ND	10	ND	ND	ND	36	93	ND	36	96
7V	Chlorobenzene	ND	10	ND	ND	ND	36	103	ND	36	110
8V	Chlorodibromomethane	ND	10	1	ND	ND	36	100	ND	36	103
9V	Chloroethane	ND	10	ND	ND	ND	36	88	ND	36	89
10V	2-Chloroethylvinyl ether	ND	10	ND	ND	ND	36	62	ND	36	61
11V	Chloroform	ND	10	ND	ND	BMDL	36	91	ND	36	96
12V	Dichlorobromomethane	ND	10	ND	ND	ND	36	93	ND	36	96
13V	Dichlorodifluoromethane	ND	10	ND	ND	ND	0	-	ND	0	-
14V	1,1-Dichloroethane	ND	10	ND	ND	ND	36	97	ND	36	101
15V	1,2-Dichloroethane	ND	10	ND	ND	ND	36	98	ND	36	98
16V	1,1-Dichloroethylene	ND	10	ND	ND	ND	36	87	ND	36	91
17V	1,2-Dichloropropane	ND	10	ND	ND	ND	36	92	ND	36	96
18V	cis-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	85	ND	36	93
19V	Ethylbenzene	ND	10	ND	ND	ND	36	99	2	36	101
20V	Methyl bromide	ND	10	ND	ND	ND	36	122	ND	36	104
21V	Methyl chloride	ND	10	ND	ND	ND	36	89	ND	36	94
22V	Methylene chloride	BMDL	10	6	1	BMDL	36	58	4	36	56
23V	1,1,2,2-Tetrachloroethane	ND	10	ND	ND	ND	36	77	ND	36	102
24V	Tetrachloroethylene	ND	10	1	ND	ND	36	85	1	36	88
25V	Toluene	ND	10	ND	ND	BMDL	36	86	ND	36	115
26V	1,2-Trans-dichloroethylene	ND	10	ND	ND	ND	36	87	ND	36	87
27V	1,1,1-Trichloroethane	ND	10	2	ND	ND	36	93	ND	36	97
28V	1,1,2-Trichloroethane	ND	10	ND	ND	ND	36	109	ND	36	116
29V	Trichloroethylene	ND	10	ND	ND	ND	36	113	ND	36	114
30V	Trichlorofluoromethane	ND	10	ND	ND	ND	36	89	ND	36	90
31V	Vinyl chloride	ND	10	ND	ND	ND	36	84	ND	36	93

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 24, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9441	RESOURCE ENGINEERING	RES28801	MW2	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
	trans-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	90	ND	36	90

a EPA published Method Detection Limit.

b Recovery normally variable using EPA Protocol Method 624.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Acid Compounds - GC/MS Analysis Data (QR02)

019126

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9441	RESOURCE ENGINEERING	RES28801	WW2	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen Added ug/l	% Recov	Unspiked Sample ug/l	Concen Added ug/l	% Recov
1A	2-Chlorophenol	ND	25	ND	ND	ND	150	78	ND	150	57
2A	2,4-Dichlorophenol	ND	25	ND	ND	ND	150	95	ND	150	53
3A	2,4-Dimethylphenol	ND	25	ND	ND	ND	150	2b	ND	150	0b
4A	4,6-Dinitro-o-cresol	ND	250	ND	ND	ND	250	88	ND	250	75
5A	2,4-Dinitrophenol	ND	250	ND	ND	ND	250	110	ND	250	130
6A	2-Nitrophenol	ND	25	ND	ND	ND	150	78	ND	150	70
7A	4-Nitrophenol	ND	25	ND	ND	ND	150	71	ND	150	86
8A	p-Chloro-m-cresol	ND	25	ND	ND	ND	150	67	ND	150	25c
9A	Pentachlorophenol	ND	25	ND	ND	ND	150	106	ND	150	86
10A	Phenol	ND	25	ND	ND	ND	150	77	ND	150	45
11A	2,4,6-Trichlorophenol	ND	25	ND	ND	ND	150	101	ND	150	76

a EPA published Method Detection Limit.

b Recovery normally low using EPA Protocol Method 625.

c Recovery low due to sample matrix interference.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9441	RESOURCE ENGINEERING	RES28801	WM/2	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1B	Acenaphthene	ND	10	ND	ND	ND	100	104	ND	105	100
2B	Acenaphthylene	ND	10	ND	ND	ND	100	101	ND	105	100
3B	Anthracene	ND	10	ND	ND	ND	100	67	ND	105	81
4B	Benzidine	ND	10	ND	ND	ND	100	0[e]	ND	105	0[e]
5B	Benzo(a)anthracene	ND	10	ND	ND	ND	100	133	ND	105	126
6B	Benzo(a)pyrene	ND	10	ND	ND	ND	100	128	ND	105	133
7B	Benzo(b)fluoroanthene	ND	10	ND	ND	ND	100	160	ND	105	153
8B	Benzo(ghi)perylene	ND	10	ND	ND	ND	0	-	ND	0	-
9B	Benzo(k)fluoranthene	ND	10	ND	ND	ND	100	124	ND	105	114
10B	bis(2-Chloroethoxy)methane	ND	10	ND	ND	ND	100	65	ND	105	87
11B	bis(2-Chloroethyl) ether	ND	10	ND	ND	ND	100	100	ND	105	246[e]
12B	bis(2-Chloroisopropyl)ether	ND	10	ND	ND	ND	100	306[c]	ND	105	107[c]
13B	bis(2-Ethylhexyl)phthalate	ND	10	135	44	BMDL	100	103	ND	105	230[e]
14B	4-Bromophenyl phenyl ether	ND	10	ND	ND	ND	100	65	ND	105	81
15B	Butyl benzyl phthalate	ND	10	ND	ND	ND	100	110	ND	105	94
16B	2-Chloronaphthalene	ND	10	ND	ND	ND	100	80	ND	105	87
17B	4-Chlorophenyl phenyl ether	ND	10	ND	ND	ND	100	105	ND	105	95
18B	Chrysene	ND	10	ND	ND	ND	100	102	ND	105	86
19B	Dibenzo(a,h)anthracene	ND	10	ND	ND	ND	0	-	ND	0	-
20B	1,2-Dichlorobenzene	ND	10	ND	ND	ND	100	33[e]	ND	105	52[e]
21B	1,3-Dichlorobenzene	ND	10	ND	ND	ND	100	30[e]	ND	105	45[e]
22B	1,4-Dichlorobenzene	ND	10	ND	ND	ND	100	33[e]	ND	105	47[e]
23B	3,3'-Dichlorobenzidine	ND	10	ND	ND	ND	100	17[e]	ND	105	21[e]
24B	Diethyl phthalate	ND	10	ND	ND	ND	100	6[e]	ND	105	44[e]
25B	Dimethyl phthalate	ND	10	ND	ND	ND	100	1	ND	105	12
26B	Di-n-butyl phthalate	ND	10	ND	ND	BMDL	100	60	ND	105	80
27B	2,4-Dinitrotoluene	ND	10	ND	ND	ND	100	74	ND	105	88
28B	2,6-Dinitrotoluene	ND	10	ND	ND	ND	100	98	ND	105	100
29B	Di-n-octyl phthalate	ND	10	ND	ND	ND	100	137	ND	105	117
30B	1,2-Diphenylhydrazine	ND	10	ND	ND	ND	100	92	ND	105	90
31B	Fluoranthene	ND	10	ND	ND	ND	100	62	ND	105	90

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

019127

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9441	RESOURCE ENGINEERING	RES28801	WMW2	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
32B	Fluorene	ND	10	ND	ND	ND	100	95	ND	105	94
33B	Hexachlorobenzene	ND	10	ND	ND	ND	100	107	ND	105	87
34B	Hexachlorobutadiene	ND	10	ND	ND	ND	100	14b	ND	105	43b
35B	Hexachlorocyclopentadiene	ND	10	ND	ND	ND	0	-	ND	0	-
36B	Hexachloroethane	ND	10	ND	ND	ND	100	16b	ND	105	32b
37B	Indeno(1,2,3-c,d)pyrene	ND	10	ND	ND	ND	0	-	ND	0	-
38B	Isophorone	ND	10	ND	ND	ND	100	83	ND	105	88
39B	Naphthalene	ND	10	ND	ND	ND	100	44	ND	105	54
40B	Nitrobenzene	ND	10	ND	ND	ND	100	83	ND	105	198
41B	N-Nitrosodimethylamine	ND	10	ND	ND	ND	0	-	ND	0	-
42B	N-Nitrosodi-n-propylamine	ND	10	ND	ND	ND	100	74	ND	105	77
43B	N-Nitrosodiphenylamine	ND	10	ND	ND	ND	100	127	ND	105	129
44B	Phenanthrene	ND	10	ND	ND	ND	100	81	ND	105	83
45B	Pyrene	ND	10	ND	ND	ND	100	108	ND	105	96
46B	1,2,4-Trichlorobenzene	ND	10	ND	ND	ND	100	209c	ND	105	197c

a EPA published Method Detection Limit.
b Recovery normally low using EPA Protocol Method 625.
b Recovery variable due to sample matrix interference.
c Recovery normally variable using EPA Protocol Method 625.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds – GC/MS Analysis Data – Acid Fraction (QR07)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No:	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9441	RESOURCE ENGINEERING	RES28801	WW2	840629		

Compound Name	Data			Identifiers				
	Scan Number	Retention Time (Min)	M.W.	CAS Number	Empirical Formula	Estimated Concen. ug/l		
1 3-bromo -cyclohexene	247	9.98	159.9	1521513	C_6H_9Br	5		

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds – GC/MS Analysis Data – Base/Neutral Fraction (QR08)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9441	RESOURCE ENGINEERING	RES28801	MW2	840629		

Compound Name	Data			Identifiers				
	Scan Number	Retention Time (Min)	M.W.	CAS Number	Empirical Formula			
None Found								

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ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 24, 1984

TABLE 1: QUANTITATIVE RESULTS

Conventionals Analysis Data (QR12)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9441	RESOURCE ENGINEERING	RES28801	WM2	840629		

Parameter	Results							
	Sample Measure	MDL	Units of Measure					
pH	7.42		std					
Specific Conductance	415		um/cm					
Temperature	41.20		Deg. C					

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 2: METHOD PERFORMANCE DATA

Surrogate Recovery - GC/MS Data (QR20)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9441

ETC Sample No. | Company | Facility | Sample Point | Date | Time | Elapsed Hours

Compound	Amount Added ug	% Recovery	Control Limits * Lower	Control Limits * Upper
VOLATILE FRACTION				
Bromochloromethane	200	203**	74	122
Benzene, d_6	150	105	83	119
Fluorobenzene	150	102	88	116
1,4-Dichlorobutane	200	107	75	123
Pentafluorobenzene	150	99	90	126
Ethylbenzene, d_{10}	150	94	83	127
ACID FRACTION				
2-Fluorophenol	80	63	16	100
Pentafluorophenol	80	84	25	113
BASE/NEUTRAL FRACTION				
2-Fluorobiphenyl	80	72	57	101
1-Fluoronaphthalene	80	46***	55	103
Nitrobenzene, d_5	80	104	63	143

* Two Standard Deviations About the Mean.

** Recovery variable due to sample matrix interference.

*** Recovery low due to sample matrix interference.

019129

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ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 24, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Bromofluorobenzene (BFB) for Volatiles Analysis (QR21)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9441

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
50	15-40% of Mass 95	22
75	30-60% of Mass 95	51
95	Base Peak, 100% relative abundance	100
96	5-9% of Mass 95	7
173	Less than 1% of Mass 95	<1
174	Greater than 50% of Mass 95	77
175	5-9% of mass 174	6
176	Greater than 95% but less than 101% of Mass 174	75
177	5-9% of mass 176	5

Date: 840717
Run No: >C3051
Spectrum No: 99
Analyst: R. Albert

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 26, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Acids Analysis (QR22)

Chain of Custody Data Required for ETC Data Management Summary Reports						
E9441						
ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	59
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	50
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	6
275	10-30% of mass 198	22
365	Greater than 1% of mass 198	>1
441	Less than mass 443	12
442	Greater than 40% of mass 198	71
443	17-23% of mass 442	14

Date: 840722
Run No: >E3118
Spectrum No: +374 -155
Analyst: T. Rusowicz

019130

064402

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 26, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Base/Neutrals Analysis (QR23)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9441

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	56
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	53
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	7
275	10-30% of mass 198	21
365	Greater than 1% of mass 198	2
441	Less than mass 443	12
442	Greater than 40% of mass 198	83
443	17-23% of mass 442	17

Date: 840720
Run No: G3466
Spectrum No: 489
Analyst: K. Bonaparte

019131

~~00640~~ Methodology for GC/MS Analysis of Priority Pollutant Compounds

The methods employed in the GC/MS analysis for priority pollutants are established EPA methods. Rigid compliance with the instrument parameters and performance criteria of the published methods was achieved. In some cases, the precise amounts of sample used and the sample handling procedures vary with the complexity of the sample matrix. Qualitative identification of the priority pollutants was performed using the relative retention times, the relative abundance of three characteristic ions and the abundance ratios. The entire mass spectrum was reviewed to confirm each identification. Quantitative analysis of detected compounds was performed by using a response factor generated by a major characteristic ion of the specific compound and an internal standard.

Compounds, in addition to those on the priority pollutant list, were identified through a computer-aided search of the NBS-EPA spectra library. After review the identifications are included in a separate tabulation and labelled "tentatively identified".

Volatile Priority Pollutant Compounds

For the analysis of Volatile priority pollutants, EPA Method 624 (Federal Register, December 3, 1979; page 69532) was used. The method can be summarized as follows: Helium is bubbled through a 5 ml water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the organic components are trapped. After the purge cycle is complete, the sorbent column is heated and backflushed with helium to desorb the organic purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeable mixture. The separated purgeable components are then identified and quantitated using a computerized mass spectrometer.

Acid, Base/Neutral and Pesticide Priority Pollutant Compounds

For the analysis of the Acid, Base/Neutral and Pesticide priority pollutants in an aqueous liquid matrix, EPA Method 625 (Federal Register, December 3, 1979; page 69540) was used. The method can be summarized as follows: A measured volume of sample, approximately 1 liter, is adjusted to a pH greater than 11 and extracted with methylene chloride. The pH of the sample is adjusted to a value less than 2 and extracted with an aliquot of fresh methylene chloride. A separatory funnel or continuous extractor is used to perform the extractions. The two extracts are dried and concentrated to a 1 ml final volume. Each extract is injected into a GC/MS instrument specifically configured for the correct fraction.

Quality Assurance/Quality Control Procedures (QA/QC)

ETC bases its quality assurance protocols on the following government guidelines:

- "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;
- National Enforcement Investigation Center Policies, and Procedures manual; EPA-330/9/79/001-R, October 1979;
- the recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979, pp. 69532-69559);
- "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980; and
- "Determination of 2,3,7,8-TCDD in Soil and Sediment" EPA, Region VII, Kansas City, September 1983.

However, we have modified our protocols to provide a higher level of QA/QC than the guidelines require. For example, we analyze a higher than required number of quality control samples and we pay especially careful attention to the certification of the "reference standard" compounds we use in analysis. Below are listed the key QA/QC elements for the methods we used.

Analysis of Volatile Organic Compounds (EPA Method 624)

- Each batch of 13 samples consists of 9 customer samples (at maximum), one blank sample, one spiked blank, one spiked sample and one replicate sample. This amounts to a 30% quality control factor.
- Three surrogate compounds are added to each sample in the batch of 13.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.
- Each GC/MS is checked and retuned, if necessary, every 8 hours to ensure that its performance on bromofluorobenzene (BFB) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of Volatile Organic Priority Pollutant "standards" at a minimum of 3 different concentrations and using a mixture of 3 internal standards at a constant concentration.
- The calibration curve is verified with a mixture of priority pollutant standards every 8 hours.
- Results are compared to the acceptance criteria given in Method 624; any that do not meet the criteria are re-analyzed.

Analysis of Organic Compounds Extracted in Acid or Base/Neutral Solutions (EPA Method 625)

- Each batch of 20 samples consists of 16 customer samples (at maximum), one blank sample, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate customer sample. This amounts to a 20% quality control factor.
- Five surrogate compounds are added to each sample in the batch of 20.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.

- Each GC/MS is checked and retuned, if necessary, every eight hours to ensure that its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of standards composed of either the Organic Acid or Base/Neutral Extractable Compounds at a minimum of 3 concentrations and using 2,2'-difluorobiphenyl as an internal standard.
- The calibration curve is verified with a mixture of priority pollutant standards every eight hours.
- Results are compared to the acceptance criteria given in Method 625; any that do not meet the criteria are re-analyzed.

Analysis of Metals

All Samples

- New standards are prepared for each batch of samples.
- Normal calibration is performed using a blank sample and four standards that have been through the sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis that requires the use of the "method of additions" technique, a three point calibration is performed using U.S EPA "Methods for Chemical Analysis of Water and Wastes, 1979". Results are obtained using linear regression analysis. Any results with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- In constructing the normal calibration curves the lowest concentration levels we use are values greater than or equal to 5 times the Instrumental Detection Limit (IDL).
- All calibration standards are analyzed in duplicate, at a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to validate the normal calibration curve.

Homogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are homogeneous, the QC program is a minimum of 42% and consists of analyzing:

- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Heterogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are heterogeneous, the QC program is a minimum of 65% and consists of analyzing:

- each of the 30 customer samples in duplicate;
- 4 Replicates;
- 4 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Analysis of Mercury

To analyze samples for mercury we group them by matrix in batches of 20 or less. Our QC program is a minimum of 66% and consists of analyzing:

- each of the 20 customer samples in duplicate;
- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 10 Calibration standards (processed using the sample preparation method); and
- 2 Blanks.

Analysis of Pesticides, Herbicides and PCB's (EPA Method 608)

Pesticide, herbicide and PCB samples are grouped in batches of 16 customer samples or less according to the type of analysis to be performed. The QC program for each of these three types of analyses is a minimum of 20% and consists of analyzing:

- 1 blank sample;
- 1 spiked blank sample;
- 1 replicate sample;
- 1 replicate spiked sample; and
- 1 blank QC sample for at least each 100 samples analyzed.

The GC instruments are tuned daily to meet performance criteria in Method 608. Because Method 608 lacks data acceptance criteria, ETC has developed its own upper and lower quality control limits. When a test result falls outside the control limits, the test is re-run.

Analysis of Cyanides and Phenols

Cyanides and phenols are analyzed using a Technicon AutoAnalyzer II GT.

- Absorbance of full scale standards must be within +/- 25% of nominal absorbance.
- Duplicate calibration standards at four different concentrations are run with each batch of customer samples.
- At least one intersample standard is run for each 20 customer samples.
- Gain and carryover standards are analyzed at the end of each run.

Analysis of Total Organic Halide (TOX)

- Blank reagent water must contain less than 5 ug/l of halide (as chloride).
- Using a trichlorophenol standard, the mean adsorption efficiency must be within +/- 15% of the standard value.
- Pure compound recoveries must average 100 +/-15% (standard deviation).

Analysis of 2,3,7,8-TCDD (Dioxin) by GC/MS (SIM)

- Each sample is dosed with a known quantity of $^{13}C_{12}$-2,3,7,8-TCDD as internal standard and $^{37}Cl_4$-TCDD as surogate standard. The action limits for surrogate standard results is +/- 40% of the true value. Samples showing surrogate standard results outside of these limits are reextracted and reanalyzed.
- A laboratory "method blank" is run along with each set of 24 or fewer samples. The method blank is also dosed with the internal standard and surrrogate standard.
- At least one per set of 24 samples is run in duplicate to determine intralaboratory precision.
- Qualitative Requirements. The following are met in order to confirm the presence of native 2,3,7,8-TCDD:

  a. Isomer specificity must be demonstrated initially and verified once per 8-hour work shift. The verification consists of injecting a mixture containing TCDD isomers which elute close to 2,3,7,8-TCDD. The 2,3,7,8-TCDD must be separated from interferring isomers, with no more than 25% valley relative to the 2,3,7,8-TCDD peak.

  b. The 320/322 ratio is within the range of 0.67 to 0.87.

  c. Ions 320, 322, and 257 are all present and maximize together the signal to mean noise ratio must be 2.5 to 1 or better for all 3 ions.

  d. The retention time is equal (within 3 seconds) the retention time for the isotopically labeled 2,3,7,8-TCDD.

  e. At least one of the positives can be confirmed by obtaining partial scan spectra from mass 150 to mass 350. The partial scan guidelines are as follows:

  . the 320/324 ratio should be 1.58 +/- 0.16

  . the 257/259 ratio should be 1.03 +/- 0.10

  . the 194/196 ratio should be 1.54 +/- 0.15

- One sample is spiked with native 2,3,7,8-TCDD at a level of 1.0 PPB (for soil) for each set of 24 or fewer samples.

- In cases where no native 2,3,7,8-TCDD is detected, the actual detection limit is estimated and reported based on a signal to noise ratio of 2.5 to 1 at ions 320 and 322.

- For each sample, the internal standard is present with at least a 10 to 1 signal to noise ratio for both mass 332 and mass 334. Also, the internal standard 332/334 ratio must be within the range of 0.67 to 0.87.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;

- outgoing shipping manifests;

- the chain-of-custody form completed by the person(s) breaking the Shuttle seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;

- incoming shipping manifests;

- breaking the Shuttle's reseal;

- storing each labeled sample bottle in a secured area;

- disposition of each sample to an analyst or technician; and

- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody; and

- the time and date each person accepted or relinquished custody.

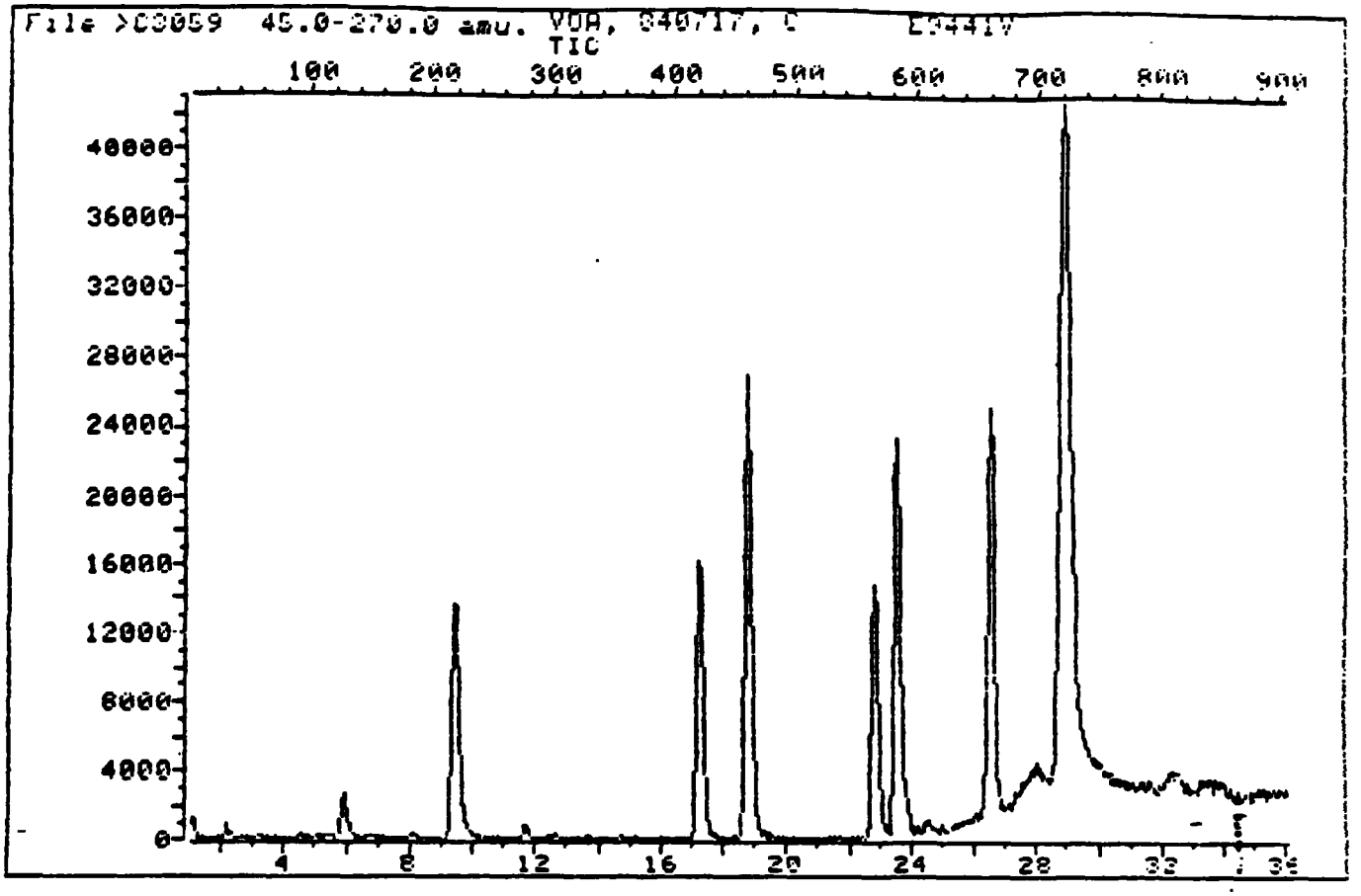
Appendix A

Mass Spectral Data for Quantitated Compounds

1) A total ion chromatogram for each sample analysed by a GC/MS instrument.

2) A mass spectrum and a reference spectrum for each priority pollutant compound detected in the sample.

TOTAL ION CHROMATOGRAM



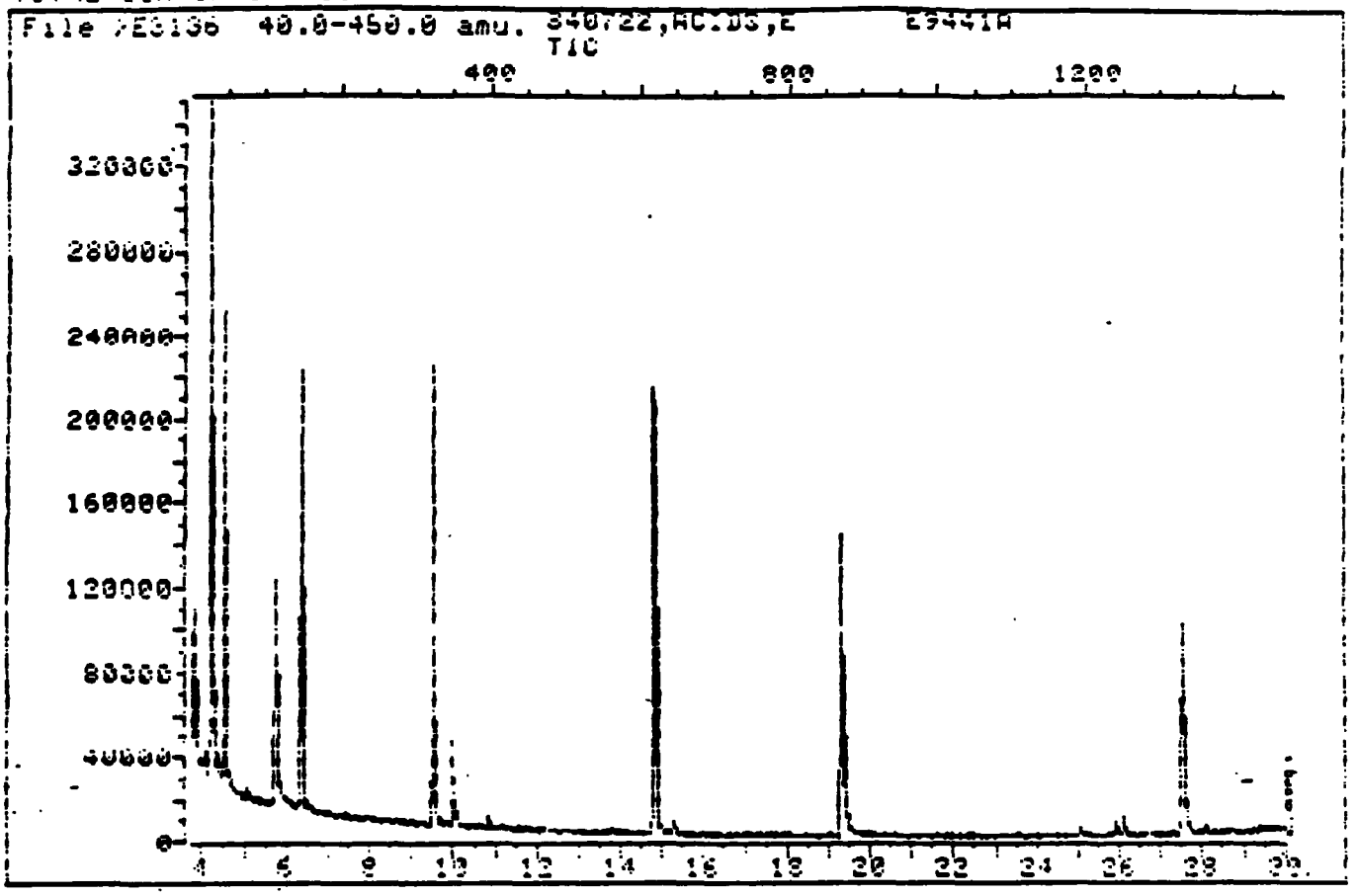
Data File: >C3059::U2
Name: VOA, 840717, C
Misc: E9441V

Id File: VOA
Title: IDFILE, PURGEABLE PRIORITY POLLUTANTS, C
Last Calibration: 840718 04:29

Operator ID: PK2050
Count Time: 840718 11.50

~~006407~~

TOTAL ION CHROMATOGRAM

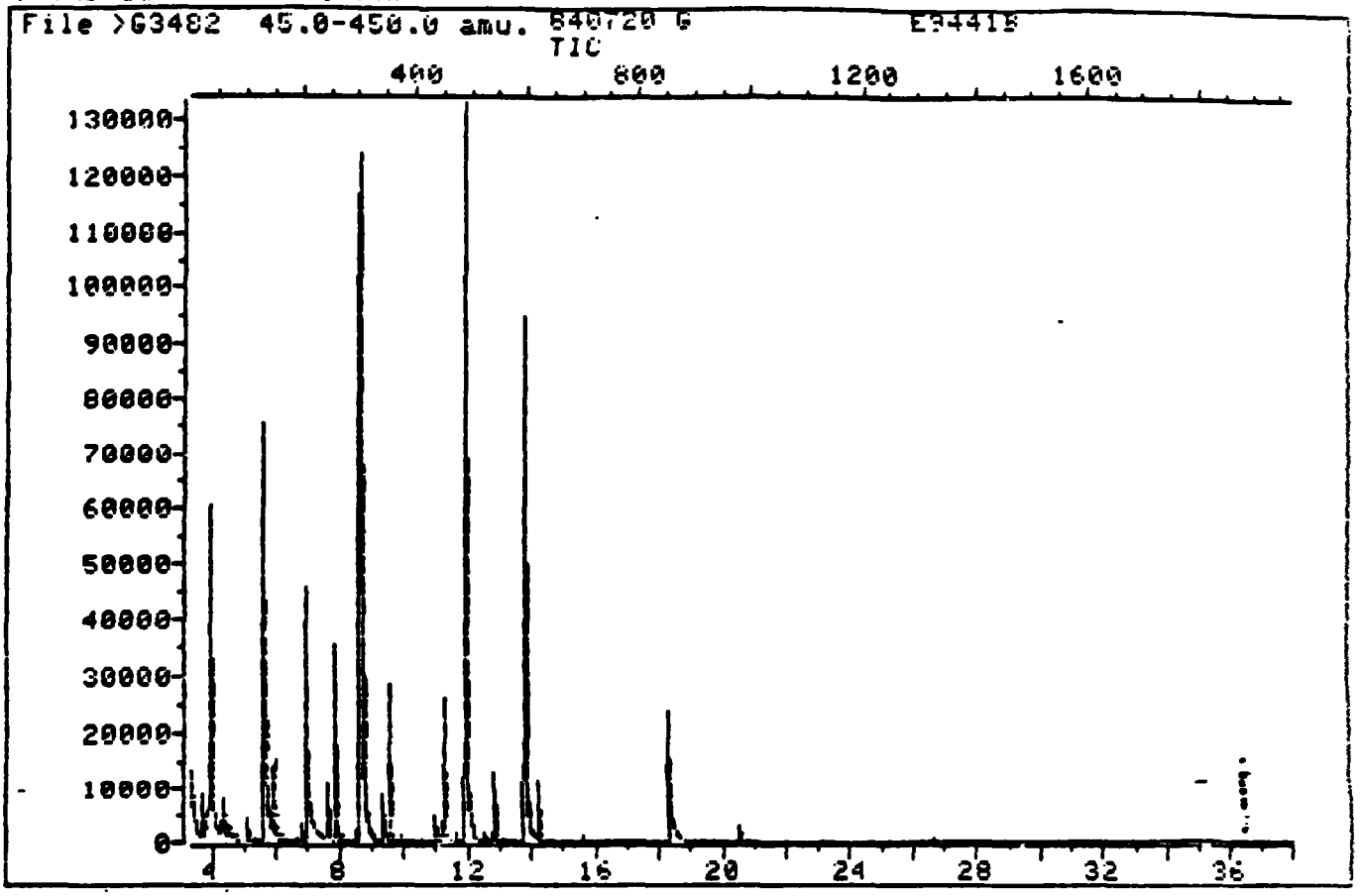


Data File >E3136 U4
Name 840722,ACIDS,E
Misc E7441A DTL#10

Id File EACID
Title ACID ID FILE.....WWC 6/21/83,#E
Last Calibration 840723 00:06

Operator ID TR7113
Qaunt Time 840723 06 02

TOTAL ION CHROMATOGRAM



Data File: >G3482::UM
Name: 840720 G
Misc: E9441B RTL#16

Id File: GBNP
Title: BN,PEST,IFB ISTDS IDFILE PVC..840510
Last Calibration: 840721 08:25

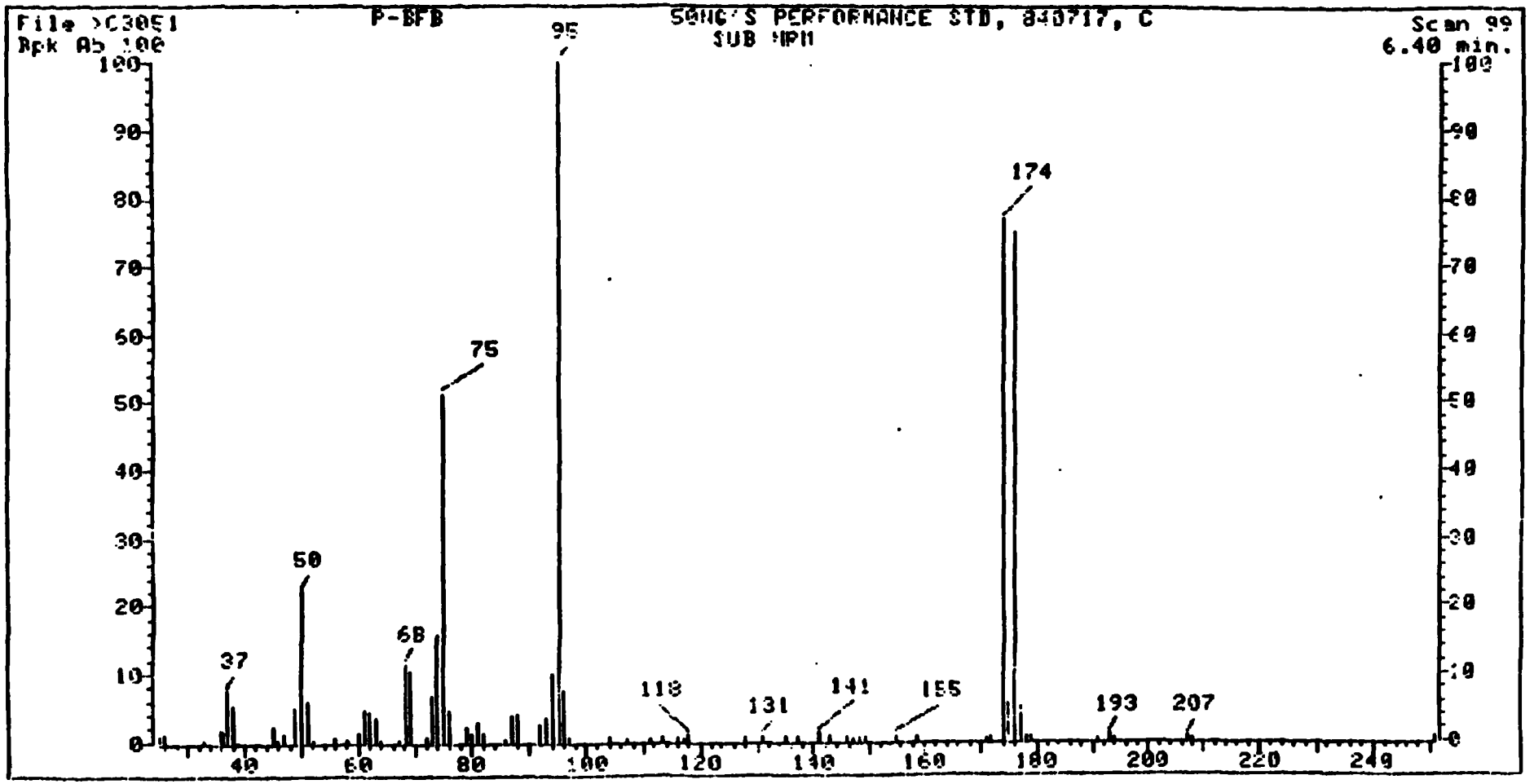
Operator ID: KB5414
Quant Time: 840721 15:51

Appendix B

Mass Spectral Data for Calibration Compounds

1) If the sample analysis included the determination of purgeable organic compounds then a mass spectrum for 4-bromofluorobenzene (BFB) is included. This data was used in the instrument calibration protocol on the day of analysis.

2) If the sample analysis included the determination of non-purgeable organic compounds then a mass spectrum for decafluorotriphenylphosphine (DFTPP) is included. This data was used in the instrument calibration protocol on the day of analysis.


File >C30E1
Rpk Ab 100
P-BFB
50NG'S PERFORMANCE STD, 840717, C
SUB HPM
Scan 99
6.40 min.
95
174
75
50
68
37
118
131
141
155
193
207
100
90
80
70
60
50
40
30
20
10
0
40
60
80
100
120
140
160
180
200
220
240

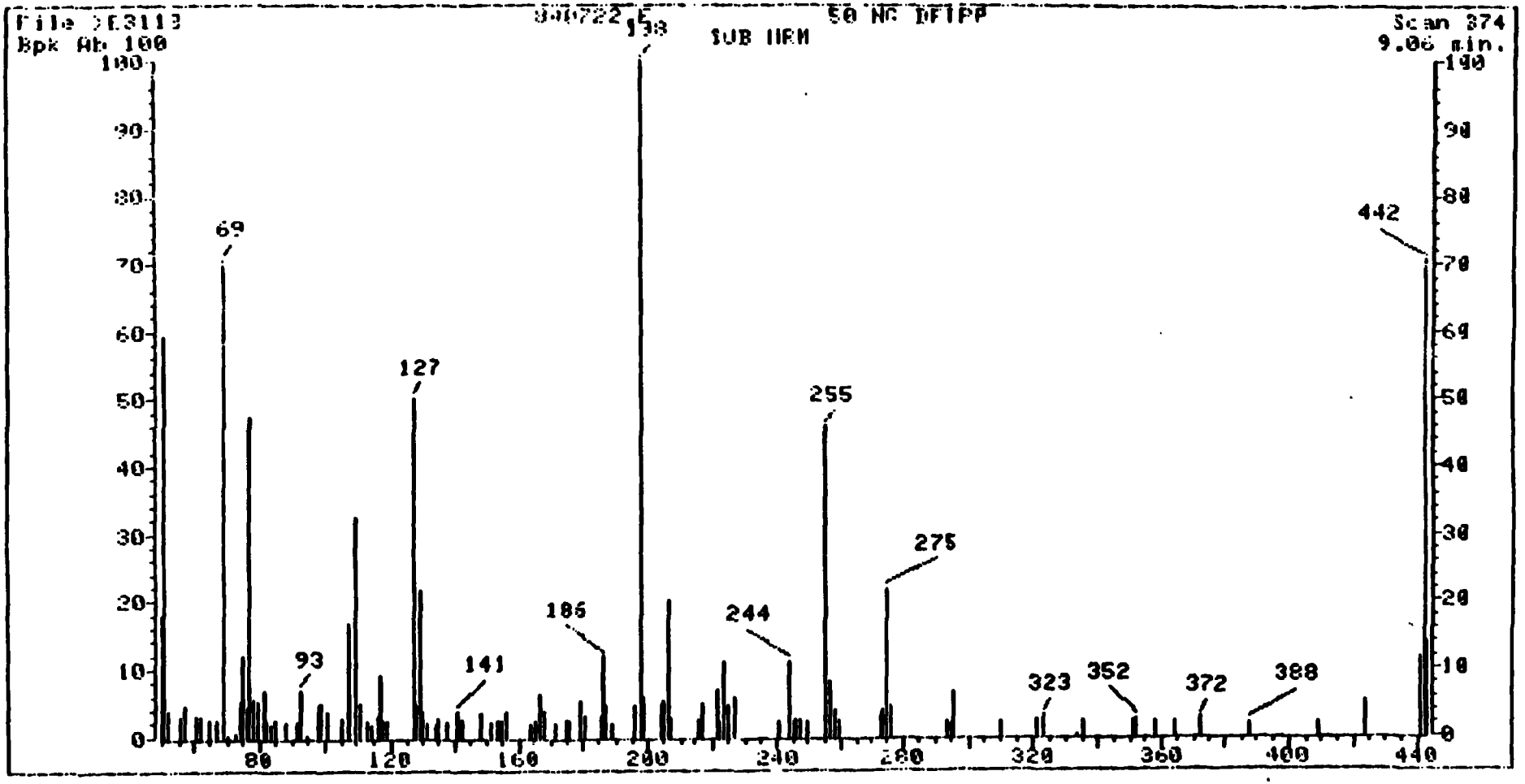
K-66

019137

>C3051 -BFB 006409 SONG'S PERFORMANCE STD, 840717, C
99 SUB NRM

File: >C3051 Scan #: 99 Retn. time: 6.40

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
25.00	.91	56.10	.52	79.85	1.10	113.35	.38	158.95	.39
26.00	1.23	58.10	.16	81.05	2.85	115.95	.46	171.15	.28
32.80	.31	60.10	1.19	82.05	1.23	117.15	.16	171.95	.39
35.90	1.71	61.10	4.69	85.95	.20	117.95	.70	174.05	76.99
36.30	1.52	62.00	4.18	86.95	3.78	127.95	.39	175.05	5.63
37.00	7.42	63.10	3.23	88.05	3.84	130.95	.52	175.95	75.11
38.00	5.34	64.00	.03	91.95	2.30	134.95	.50	176.95	4.81
39.00	.01	67.10	.04	93.05	3.48	137.15	.37	178.05	.45
45.10	2.02	68.20	11.40	94.05	9.92	141.05	1.04	179.05	.60
46.00	.16	69.10	10.29	95.15	100.00	142.95	.83	191.05	.20
46.90	1.23	72.10	.35	95.95	7.36	145.95	.52	193.05	.66
47.10	1.25	73.00	6.85	97.05	.52	146.95	.03	193.95	.28
49.10	4.99	73.90	15.55	104.15	.35	147.95	.46	207.15	.47
49.90	22.21	75.00	51.14	106.95	.07	149.15	.35	208.05	.16
51.00	5.76	76.10	4.53	111.25	.30	155.05	.53	251.00	.50
52.10	.11	79.05	1.97						


File DE3113
Bpk Ab 100
SUB IRM
50 NG DFIPP
Scan 374
9.06 min.
69
93
127
141
186
198
244
255
275
323
352
372
388
442

K-68

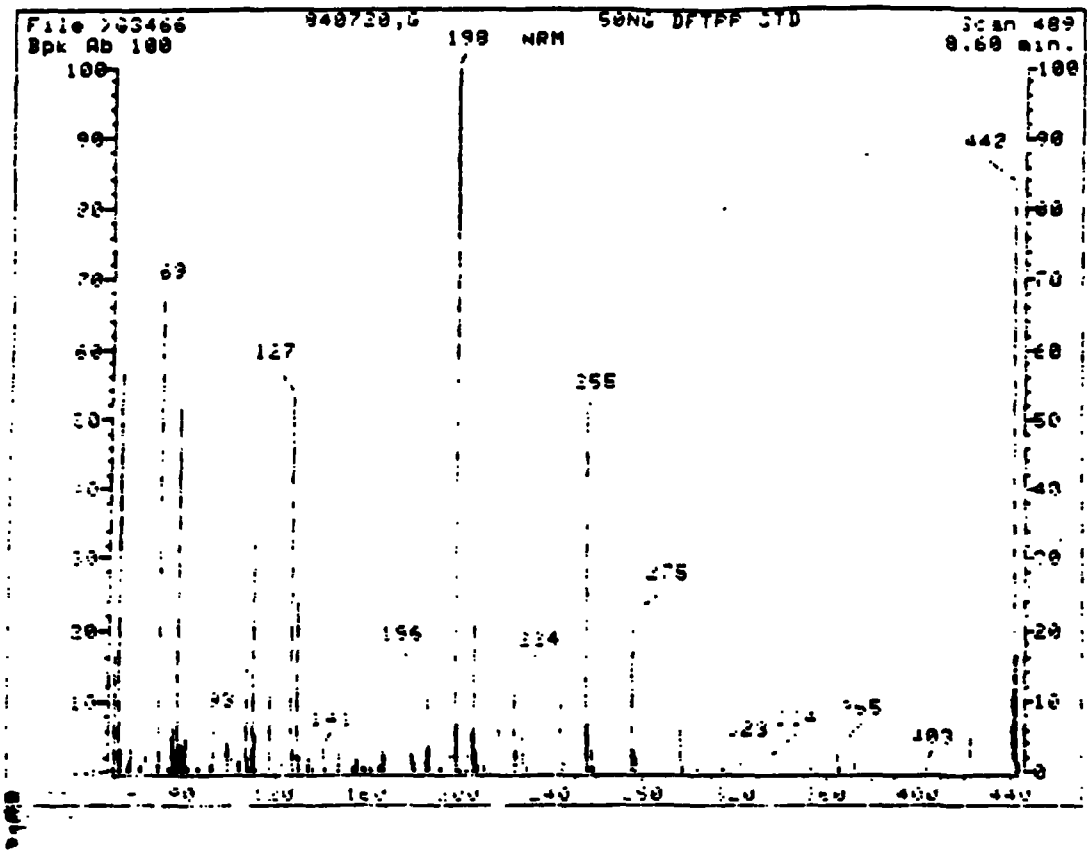
E3110 840722,E G DFTPP
374 SUB NRM

006410

File >E3110 Scan # 374 Retn. time: 9.06

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
50.00	18.03	88.35	1.97	134.80	2.84	198.05	100.00	273.10	3.31
51.00	59.25	91.45	2.17	137.30	2.01	198.85	5.92	274.00	3.07
51.95	3.83	93.05	6.86	141.05	3.75	204.05	4.46	275.00	21.70
56.05	3.16	94.95	.20	142.15	2.52	205.15	5.29	276.10	4.54
57.05	4.73	97.90	4.54	147.95	3.43	206.05	20.20	293.25	2.13
60.95	3.12	99.00	5.05	151.35	2.01	206.85	2.80	294.95	1.85
62.15	3.12	100.90	3.63	153.05	2.45	216.10	2.45	296.05	6.51
65.15	2.45	105.20	2.72	154.70	2.29	217.00	4.89	310.30	2.09
67.00	2.49	107.00	16.73	155.00	2.25	221.00	6.71	321.15	2.25
69.00	70.61	108.00	3.20	156.10	3.75	222.40	1.93	322.95	3.00
70.30	.24	110.00	32.54	163.70	1.89	223.70	10.81	333.50	.20
73.10	.43	111.05	4.85	165.20	2.49	225.10	4.46	335.20	2.17
74.00	5.36	113.15	2.49	167.00	6.11	227.00	6.00	350.55	2.09
75.00	11.79	114.45	1.78	168.00	3.55	240.75	2.09	352.05	2.41
76.10	4.34	116.15	2.92	171.35	2.21	244.10	11.01	358.25	2.05
77.00	47.34	117.05	8.92	174.75	2.37	245.30	2.13	364.70	2.21
78.00	5.44	117.75	2.33	176.05	2.41	245.70	2.25	372.10	2.60
79.00	5.29	119.05	2.29	179.05	5.29	247.00	2.29	387.65	1.85
79.60	.75	127.00	50.22	180.85	2.88	250.00	2.01	409.35	1.70
80.95	6.75	128.10	4.50	185.30	3.08	255.00	46.04	423.10	4.89
82.15	2.29	129.00	21.78	186.00	11.87	256.00	8.09	441.15	11.58
82.55	2.37	130.00	3.51	187.00	4.69	257.95	3.94	442.05	70.57
83.75	1.89	131.30	1.97	188.60	1.89	259.25	2.37	443.05	13.85
85.15	2.25	134.40	1.89	196.10	4.65				

4L,,3 Move cursor, then press carriage return :


File >G3466
Bpk Ab 100
840720,G
198 NRM
50NG DFTPP STD
Scan 489
8.60 min.
69
127
255
275
442
196
224
93
141
223
403
100
90
80
70
60
50
40
30
20
10
0
90
120
160
200
240
280
320
360
400
440

006411

:TAB

G3466 340720,G 50NG DFTPP STD
489 NRM

File: G3466 Scan #: 489 Retn. time: 3.20

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
41.05	.70	86.10	.97	141.05	3.29	194.05	2.74	253.05	.55
42.05	.73	87.10	.83	141.95	.89	198.05	100.00	145.05	1.26
50.05	15.07	91.15	.93	147.10	1.30	199.05	6.96	277.10	1.07
51.05	36.70	92.15	1.17	148.10	2.71	199.95	.80	274.10	3.00
52.15	7.04	97.05	5.05	152.00	1.07	201.25	.55	275.10	21.45
55.15	.77	98.15	1.78	154.05	.96	202.95	.75	276.10	3.10
62.05	1.57	99.05	1.43	157.05	1.90	204.05	7.69	277.00	2.02
63.05	1.02	101.00	3.71	164.15	1.91	205.05	6.49	283.20	.46
64.05	1.05	102.10	1.74	167.95	.67	208.10	27.95	296.10	6.16
65.05	.71	103.10	1.74	69.35	.53	207.10	7.04	297.00	.92
67.05	.71	104.10	1.68	172.95	.75	209.00	.79	303.15	.72
68.05	2.11	105.10	1.07	181.15	1.19	211.10	.90	314.90	.98
69.05	1.96	06.15	55	182.05	.79	217.05	6.13	315.90	.40
70.05	1.12	107.10	1.70	85.00	1.10	221.05	7.03	327.15	1.96
73.05	4.77	108.10	1.71	186.10	.95	223.05	1.10	334.10	.99
74.05	1.71	109.10	2.11	187.10	5.17	224.15	12.9	353.1	2.20
75.05	1.71	110.10	1.70	188.05	1.01	225.15	7.85	345.05	2.41
76.05	1.23	111.10	2.11	193.10	1.13	227.10	5.15	349.05	.54
77.05	3.11	112.10	1.75	195.05	1.14	229.90	.82	352.05	1.10
78.05	3.11	117.10	.92	196.15	1.17	230.10	1.06	366.15	.77
79.05	1.11	118.10	1.11	197.05	1.97	247.05	.70	403.10	.75
80.05	1.11	119.10	.77	200.15	3.15	264.05	6.45	421.10	.87
81.05	3.11	121.10	1.77	201.15	1.44	265.15	1.04	427.10	2.07
82.05	3.11	122.10	.74	205.20	1.03	269.15	2.14	431.10	1.15
83.05	1.13	123.10	77.70	210.10	1.07	288.10	51.15	44.10	1.00
84.05	.11	131.10	1.12	87.20	2.76	294.10	4.17	452.10	3.12
85.05	.75	132.10	.98	91.10	.70	297.00	.57	465.10	14.51
87.10	.75	133.10	1.00	197.90	.70	299.10	2.14	467.10	.75

Appendix C

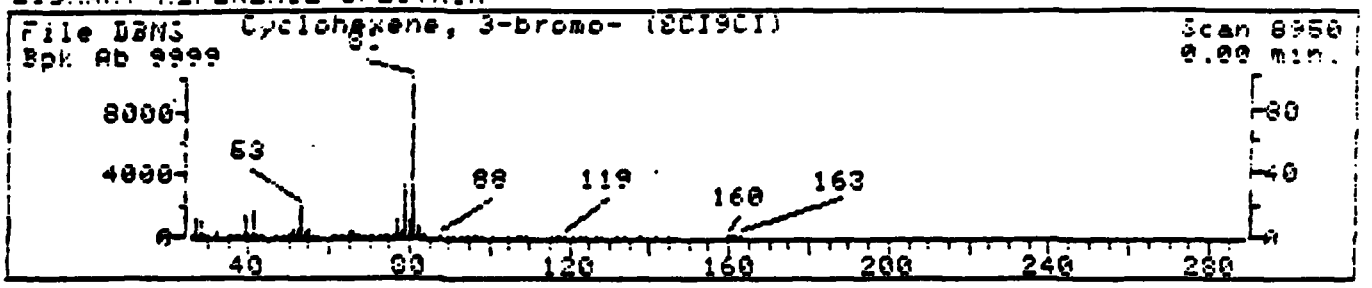
Mass Spectral Data for Tentatively Identified Compounds

1) For each tentatively identified compound a mass spectrum of the detected compound, a reference mass spectrum for that compound and a plot of the spectral differences are provided.

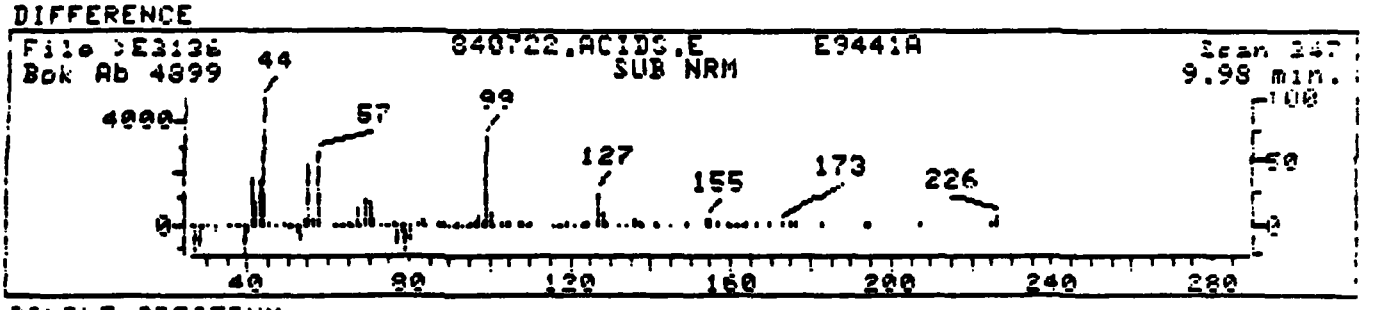
019140

006412

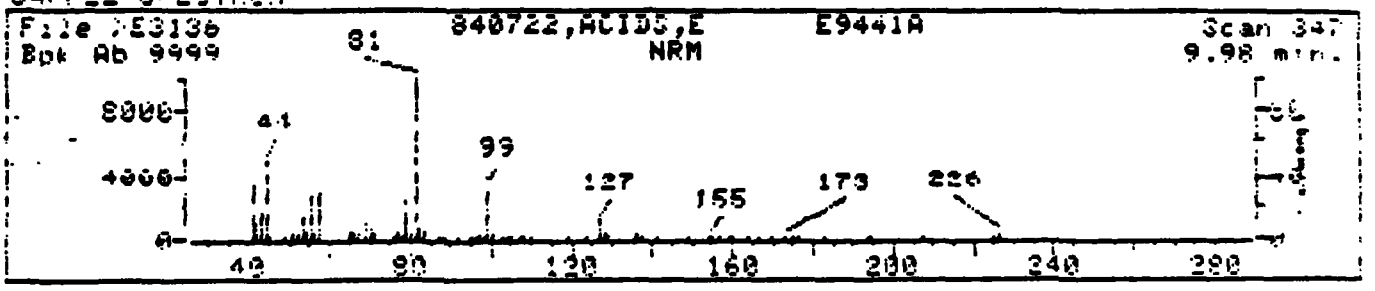
LIBRARY REFERENCE SPECTRUM



DIFFERENCE



SAMPLE SPECTRUM



Data File)E3136
Scan Number 347
Hit number 2 of 3

Rec.# 8950 Reg.#: 1521313 Xref.#: 62480 Base DBMS D
Name Cyclohexene, 3-bromo- (8CI9CI)
MW 159.989 QI: 553 MF C6H9Br

PBM Values

Class IV Reliability value 25
K-value 43
dK-value 45
Flagged Ions 2
Tilt factor 0

TENTATIVELY IDENTIFIED ORGANIC COMPOUNDS

BASE/NEUTRAL FRACTION: NONE FOUND.

See Total Ion Chromatogram in Appendix A.

Appendix E

Chain-of Custody Forms

1) A field Chain-of-Custody form (CC1) is included for all samples shipped by ETC shuttle.

2) An in-house sample Chain-of Custody form is included for the period the sample was in ETC's possession.

3) A subcontractor's Chain-of-Custody form is included for any analytical work not performed within ETC's laboratory.

4) Any additional Chain-of-Custody material provided by a client or by a client's sampling agent is also included.

CHAIN OF CUSTODY FORM (CC1)

Sealed By: J. Thrutter

SHIP TO:

Company: RESOURCE ENGINEERING
Facility/Site: 11 GREENWAY PLAZA
Address: Houston, Tx 77406
Attn.: COBY SHER
Phone: (713) 621 - 5900

SAMPLE IDENTIFICATION

Facility/Site Code: RES-MW-12B1-D11

Source Codes:

Well	(W)	River/Stream	(R)	Surface Impoundment	(I)	Lake/Ocean	(L)
Soil	(S)	Bottom Sediment	(B)	Pretreatment Facility	(P)	Treatment Facility	(T)
Outfall	(O)	Generation Point	(G)	Leachate Collection Sys.	(C)	Other	(X)

308

Source Code (from above)	Your Sample Point ID (at least 5)	Start Date (mo/day/yr)	Start Time (2400 hr. clock)	Elapsed Hours (composite)
W	MW1-12	06/29/84		
Example: W	101J2163P	05/15/81	0930	13

SHUTTLE CONTENTS

Sample Bottle	Condition	Sample Bottle	Condition
E9441	E_1-E_4 XXXX		
E9441	V_1-V_2 XX T.B.		
E9441	TB X		
	V_1-V_2- T.B Recd with H.S		

3°

CHAIN OF CUSTODY CHRONICLE

1. Shuttle Opened By: (print) J C Tatin — Date: 6-26-84 — Time: 1330
   Signature: D. C. Tatin — Seal #: NOT NOTED — Intact: YES

2. I have received these materials in good condition from the above person.
   Name: Wm THOMAS Beck — Signature: Wm Thomas Beck
   Date: 6-29-84 — Time: 8:24 — Remarks:

3. I have received these materials in good condition from the above person.
   Name: MARSHALL H. SMITH — Signature: Marshall H Smith
   Date: 06/29/84 — Time: 17:00 — Remarks:

4. I have received these materials in good condition from the above person.
   Name: DEAN GOCE — Signature: W D Goce Jr.
   Date: 6/2/84 — Time: 6:05 — Remarks:

5. Shuttle Sealed By: (print) — Date: — Time:
   Signature: — Seal #:

ETC USE ONLY — Opened By: B Shoup — Date: 7/3/84 — Time: 1200
Seal #: 1834 — Condition: INTACT

ETC Form CC1 6/1/82

019142

ETC ENVIRONMENTAL TESTING and CERTIFICATION

~~006414~~ E9441
ETC Sample No.:

SAMPLE POINT INFORMATION FORM (CC2)

FIELD MEASUREMENT DATA

Select up to 3 parameters to be recorded by entering the appropriate code letter in the first space for each of the 3 data entry fields provided. Enter the actual measurement data (in the units specified) for the three parameters you have selected.

PARAMETERS		ACTUAL (left justify)	EXAMPLE
Flow (CFS)	A		
Volume (Gal)	B		
Sample Depth (Ft)	C		C 2.5
Depth to Water (Ft)	D		F 5.0
Discharge Rate (GPM)	E		
Depth to Bottom (Ft)	F		
Event Time (2400-Hr Clock)	G		G 1 1 0 3
Depth to Screen (Ft)	H		

FIELD TEST DATA

DO (Mg/L) _____ Sample Temp. (°C) 4 1 . 2

pH 7 . 4 2 (Single Measurement) — (2nd of Quadruplicate) — (3rd of Quadruplicate) — (4th of Quadruplicate)

Specific Conductance (uMHOS/Cm) 4 1 5 (Single Measurement) — (2nd of Quadruplicate) — (3rd of Quadruplicate) — (4th of Quadruplicate)

THE FOLLOWING DATA IS FOR YOUR RECORDS ONLY

SAMPLING METHOD (choose one)

AIR-LIFT PUMP ( )	PERISTALTIC PUMP ( )	THIEF ( )
AUGER ( )	PETERSEN ( )	TRIER ( )
BAILER ( )	PISTON PUMP ( )	VEHMEYER ( )
BOTTLE ( )	SCOOP/SHOVEL ( )	OTHER _____
COLIWASA ( )	SQUEEZE PUMP ( )	
DIPPER ( )	SUBMERSIBLE PUMP (X)	
KEMMERER ( )	SUCTION LIFT PUMP ( )	
NISKIN ( )	SURGER ( )	

SAMPLE TYPE (choose one)

GRAB (X) COMPOSITE ( ) OTHER ( )

_____ (describe) _____ (describe)

WEATHER: Sunny, hot, humid (describe)

SAMPLE DESCRIPTION (e.g. color, odor): clear (describe)

Form Prepared By: MARSHALL H. SMITH (name (print)) Employer: Resource Engineering

ETC Form CC2 6/1/82

ETC ENVIRONMENTAL TESTING and CERTIFICATION

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number(s) E9440 TO E9442

Sample Preparation For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	L. Scalise/K. Albretson (J. [illegible])	7/16/84
Acids	Greg Morrison	7/18/84
Metals		
Others		
Others		
Others		
Others		

Sample Analysis For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Kris Bonaparte (cw)	7/30/84
Acids	Tom Rusowicz	7-22-84
VOA/Purgeables	[illegible] 7/18-	7/17/84/"
Metals		
Others		
Others		
Others		
Others		
Others		
Others		

Verified By

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1L) – All Parameters Present, Samples Linked by Order

August 8, 1984
Page 1

Chain of Custody Data Required for ETC Data Management Summary Report

See Below — ETC Sample No. | RESOURCE ENGINEERING — Company | RES28801 — Facility | See Below — Sample Point / Date

Parameters	Units	R UPSTREAM 840628 E9434	L CLARK LAKE 840628 E9435	W MW3 840629 E9436	W MW6 840629 E9437	W MW16 840629 E9438	I SECORNER 840628 E9439	W MW7 840629 E9440	W MW2 840629 E9441
Sample Points, Sampling Dates, and ETC Sample No.'s									
PP Volatile Compounds									
Benzene	ug/l	ND	ND	ND	ND	ND	239E+4	ND	ND
Chlorodibromomethane	ug/l	ND	ND	11	ND	ND	ND	ND	ND
Chloroform	ug/l	ND	ND	60	ND	ND	ND	ND	ND
Dichlorobromomethane	ug/l	ND	ND	63	ND	ND	ND	ND	ND
Methyl chloride	ug/l	ND	ND	ND	ND	ND	387000	ND	ND
Methylene chloride	ug/l	ND	BMDL	BMDL	BMDL	BMDL	524000	ND	BMDL
1,1,1-Trichloroethane	ug/l	ND	ND	11	ND	ND	ND	ND	ND
PP Acid Compounds									
Phenol	ug/l	ND	ND	ND	ND	ND	3550	ND	ND
PP Base/Neutral Compounds									
bis(2-Ethylhexyl)phthalate	ug/l	BMDL	81	BMDL	BMDL	BMDL	ND	10	ND
Butyl benzyl phthalate	ug/l	ND	16	ND	ND	ND	ND	ND	ND
Isophorone	ug/l	ND	ND	30	ND	BMDL	77	ND	ND
Miscellaneous Parameters									
Specific Conductance	um/cm	501	510	3150	650	2640	-	580	415
Temperature	Deg. C	31	32.5	39.1	39.4	37.3	-	40.8	41.2
pH	std	8.24	8.81	6.9	7.14	6.77	-	7.37	7.42

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

006415

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1L) - All Parameters Present, Samples Linked by Order

August 8, 1984
Page 1

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	RESOURCE ENGINEERING	RES27506	See Below	
ETC Sample No.	Company	Facility	Sample Point	Date

Parameters	Units	Sample Points, Sampling Dates, and ETC Sample No.'s							
		S SW1 840703 F0120	S SW2 840703 F0121	S SW3 840703 F0122	B LS1 840703 F0123	S LS2 840703 F0124			
PP Pesticide Compounds									
PCB-1242	ug/kg	160000	1400	93200	4840	ND			

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1L) - All Parameters Present, Samples Linked by Order

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	RESOURCE ENGINEERING	RES28801	See Below	
ETC Sample No.	Company	Facility	Sample Point	Date

Parameters	Units	Sample Points, Sampling Dates, and ETC Sample No.'s							
		R DOWNSTREAM S D1 840628 E9442	840703 E9443						
PP Volatile Compounds									
Benzene	ug/l	ND	-						
Chlorodibromomethane	ug/l	ND	-						
Chloroform	ug/l	ND	-						
Dichlorobromomethane	ug/l	ND	-						
Methyl chloride	ug/l	ND	-						
Methylene chloride	ug/l	BMDL	-						
1,1,1-Trichloroethane	ug/l	ND	-						
PP Acid Compounds									
Phenol	ug/l	ND	-						
PP Base/Neutral Compounds									
bis(2-Ethylhexyl)phthalate	ug/l	BMDL	-						
Butyl benzyl phthalate	ug/l	ND	-						
Isophorone	ug/l	ND	-						
Miscellaneous Parameters									
Specific Conductance	um/cm	1100	-						
Temperature	Deg. C	32.6	-						
pH	std	8.23	-						

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

006416

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1L) - All Parameters Present, Samples Linked by Order

August 6, 1984
Page 1

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	RESOURCE ENGINEERING	RES27506	See Below	
ETC Sample No.	Company	Facility	Sample Point	Date

Parameters	Units	Sample Points, Sampling Dates, and ETC Sample No.'s							
		S SW1 840703 F0120	S SW2 840703 F0121	S SW3 840703 F0122	B LS1 840703 F0123	S LS2 840703 F0124			
PP Pesticide Compounds									
PCB-1242	ug/kg	160000	1400	93200	4840	ND			

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1L) - All Parameters Present, Samples Linked by Order

August 8, 194
Page 1

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	RESOURCE ENGINEERING	RES28801	See Below	
ETC Sample No.	Company	Facility	Sample Point	Date

Parameters	Units	Sample Points, Sampling Dates, and ETC Sample No.'s							
		R UPSTREAM 840628 E9434	L CLARK LAKE 840628 E9435	W MW3 840629 E9436	W MW6 840629 E9437	W MW16 840629 E9438	I SECORNER 840628 E9439	W MW7 840629 E9440	W MW2 840629 E9441
PP Volatile Compounds									
Benzene	ug/l	ND	ND	ND	ND	ND	239E+4	ND	ND
Chlorodibromomethane	ug/l	ND	ND	11	ND	ND	ND	ND	ND
Chloroform	ug/l	ND	ND	60	ND	ND	ND	ND	ND
Dichlorobromomethane	ug/l	ND	ND	63	ND	ND	ND	ND	ND
Methyl chloride	ug/l	ND	ND	ND	ND	ND	387000	ND	ND
Methylene chloride	ug/l	ND	BMDL	BMDL	BMDL	BMDL	524000	ND	BMDL
1,1,1-Trichloroethane	ug/l	ND	ND	11	ND	ND	ND	ND	ND
PP Acid Compounds									
Phenol	ug/l	ND	ND	ND	ND	ND	3550	ND	ND
PP Base/Neutral Compounds									
bis(2-Ethylhexyl)phthalate	ug/l	BMDL	81	BMDL	BMDL	BMDL	ND	10	ND
Butyl benzyl phthalate	ug/l	ND	16	ND	ND	ND	ND	ND	ND
Isophorone	ug/l	ND	ND	30	ND	BMDL	77	ND	ND
Miscellaneous Parameters									
Specific Conductance	um/cm	501	510	3150	650	2640	-	580	415
Temperature	Deg. C	31	32.5	39.1	39.4	37.3	-	40.8	41.2
pH	std	8.24	8.81	6.9	7.14	6.77	-	7.37	7.42

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

006417

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DATA MANAGEMENT SUMMARY REPORT
(DM-1L) - All Parameters Present, Samples Linked by Order

August 8, 1984
Page 2

Chain of Custody Data Required for ETC Data Management Summary Report

See Below	RESOURCE ENGINEERING	RES28801	See Below	
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*

Parameters	*Units*	*Sample Points, Sampling Dates, and ETC Sample No.'s*							
		R DOWNSTREAMS 840628 E9442	DI 840703 E9443						
PP Volatile Compounds									
Benzene	ug/l	ND	-						
Chlorodibromomethane	ug/l	ND	-						
Chloroform	ug/l	ND	-						
Dichlorobromomethane	ug/l	ND	-						
Methyl chloride	ug/l	ND	-						
Methylene chloride	ug/l	BMDL	-						
1,1,1-Trichloroethane	ug/l	ND	-						
PP Acid Compounds									
Phenol	ug/l	ND	-						
PP Base/Neutral Compounds									
bis(2-Ethylhexyl)phthalate	ug/l	BMDL	-						
Butyl benzyl phthalate	ug/l	ND	-						
Isophorone	ug/l	ND	-						
Miscellaneous Parameters									
Specific Conductance	um/cm	1100	-						
Temperature	Deg. C	32.6	-						
pH	std	8.23	-						

Footnotes: BMDL=Below Method Detection Limit ND=Parameter not detected '-'=Parameter not tested

Technical Report

for

RESOURCE ENGINEERING

ATTENTION: CHRIS ITIN

3000 RICHMOND AVENUE

HOUSTON, TX 77098

MW-14

DOWN GRADIENT DEEP WELL

Chain of Custody Data Required for ETC Data Management Summary Reports						
KB177	RESOURCE ENGINEERING	RES24400	W14	851219		
ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

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Introduction

This report contains the analytical results on your water sample, W14 85/12/19. It is designed to include comprehensive data from the entire analytical process in order to satisfy the needs of various levels of review.

The results obtained from your sample are presented in tabular format immediately following this introduction. Quality assurance data is tabulated along with the appropriate sample results for verification. Depending on the analyses ordered, the quality assurance data may include results from blank, spiked blank, spiked sample (i.e. matrix spike) and replicate sample as well as results from surrogate compound analyses. Quality assurance data for verification of proper instrument performance is also included where appropriate. The report appendices include the chain of custody record for your sample and, where appropriate, the gas chromatograms and mass spectra.

The procedures used in the analysis of the sample are described in this report's methodology section. All analytical procedures within our laboratory are performed within a strictly enforced Quality Assurance Protocol. A description of this Protocol is included in the report.

Results

Sample results, and associated quality assurance data, are always tabulated in one or more of this report's Quantitative Results Tables. The format of each table varies with the class of analysis.

Priority Pollutants

The priority pollutant compounds and elements are listed with their NPDES (National Pollution Discharge Elimination System) numbers, and the Method Detection Limit (MDL) published in the Federal Register. When a compound or element is present below its published MDL it is reported as BMDL (Below Method Detection Limit). When a compound or element is not present at any detectable concentrations it is reported as ND (Not Detected). MDL's for non-aqueous matrices are based on USEPA published MDL's but are adjusted as per sample weight. Matrix spike and replicate analyses, where included, were performed on samples randomly chosen within each quality assurance batch and are therefore not necessarily spikes and replicates of this report's sample. Surrogate compound recovery data and instrument calibration data are included in the Method Performance Data Tables.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

DEC 30, 1985

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
K8177	RESOURCE ENGINEERING	RES24400	W14	851219		

NPDES Number	Compound (Acrolein and Acrylonitrile values are screen only.)	Results: Sample Concen. ug/l	Results: MDL ug/l	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Concen. Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Sample ug/l	QC Matrix Spike: Concen. Added ug/l	QC Matrix Spike: % Recov
1V	Acrolein	ND	100	ND	ND	ND	800	82	ND	800	99
2V	Acrylonitrile	ND	100	ND	ND	ND	80.0	97	ND	80.0	107
3V	Benzene	ND	4.4	ND	ND	ND	18.0	92	ND	18.0	105
4V	bis(Chloromethyl)ether	ND	10	ND	ND	ND	0	-	ND	0	-
5V	Bromoform	ND	4.7	ND	ND	ND	18.0	89	ND	18.0	96
6V	Carbon tetrachloride	ND	2.8	ND	ND	ND	18.0	94	ND	18.0	99
7V	Chlorobenzene	ND	6.0	ND	ND	ND	18.0	96	ND	18.0	101
8V	Chlorodibromomethane	ND	3.1	ND	ND	ND	18.0	92	ND	18.0	103
9V	Chloroethane	ND	10	ND	ND	ND	18.0	91	ND	18.0	108
10V	2-Chloroethylvinyl ether	ND	10	ND	ND	ND	18.0	0a	ND	18.0	0a
11V	Chloroform	ND	1.6	ND	ND	ND	18.0	101	ND	18.0	111
12V	Dichlorobromomethane	ND	2.2	ND	ND	ND	18.0	93	ND	18.0	98
13V	Dichlorodifluoromethane	ND	10	ND	ND	ND	18.0	97	ND	18.0	113
14V	1,1-Dichloroethane	ND	4.7	ND	ND	ND	18.0	101	ND	18.0	110
15V	1,2-Dichloroethane	ND	2.8	ND	ND	ND	18.0	100	ND	18.0	111
16V	1,1-Dichloroethylene	ND	2.8	ND	ND	ND	18.0	100	ND	18.0	105
17V	1,2-Dichloropropane	ND	6.0	ND	ND	ND	18.0	91	ND	18.0	107
18V	cis-1,3-Dichloropropylene	ND	5.0	ND	ND	ND	18.0	94	ND	18.0	105
19V	Ethylbenzene	ND	7.2	ND	ND	ND	18.0	96	ND	18.0	106
20V	Methyl bromide	ND	10	ND	ND	ND	18.0	127	ND	18.0	132
21V	Methyl chloride	ND	10	ND	ND	ND	18.0	93	ND	18.0	[illegible]2
22V	Methylene chloride	5.20	2.8	3.60	3.80	BMDL	18.0	103	4.00	18.0	[illegible]
23V	1,1,2,2-Tetrachloroethane	ND	6.9	ND	ND	ND	18.0	115	ND	18.0	Ti8
24V	Tetrachloroethylene	ND	4.1	ND	ND	ND	18.0	99	ND	18.0	109
25V	Toluene	ND	6.0	ND	ND	ND	18.0	100	ND	18.0	106
26V	1,2-Trans-dichloroethylene	ND	1.6	ND	ND	ND	18.0	99	ND	18.0	108
27V	1,1,1-Trichloroethane	ND	3.8	ND	ND	ND	18.0	93	ND	18.0	104
28V	1,1,2-Trichloroethane	ND	5.0	ND	ND	ND	18.0	96	ND	18.0	100
29V	Trichloroethylene	ND	1.9	ND	ND	ND	18.0	85	ND	18.0	91
30V	Trichlorofluoromethane	ND	10	ND	ND	ND	18.0	98	ND	18.0	104
31V	Vinyl chloride	ND	10	ND	ND	ND	18.0	99	ND	18.0	118
18V	trans-1,3-Dichloropropylene	ND	10	ND	ND	ND	18.0	94	ND	18.0	97

a Recoveries normally low and variable using EPA Protocol Method 624.

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DEC 29, 1985

TABLE 2: METHOD PERFORMANCE DATA
Surrogate Recovery Water – GC/MS Data (QR20)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
K8177	RESOURCE ENGINEERING	RES24400	W14	85121		0

Compound	Amount added ug	% Recovery	Control Limits *	
			Lower	Upper
VOLATILE FRACTION				
Toluene-D8	.250	99	86	119
p-Bromofluorobenzene	.250	103	85	121
1,2-Dichloroethane-D4	.250	113	77	120
ACID FRACTION				
Phenol-D5	-	-	15	103
2-Fluorophenol	-	-	23	121
2,4,6-Tribromophenol	-	-	10	130
BASE/NEUTRAL FRACTION				
Nitrobenzene-D5	-	-	41	120
2-Fluorobiphenyl	-	-	44	119
Terphenyl-D14	-	-	33	128

* IFB EPA Control Limits

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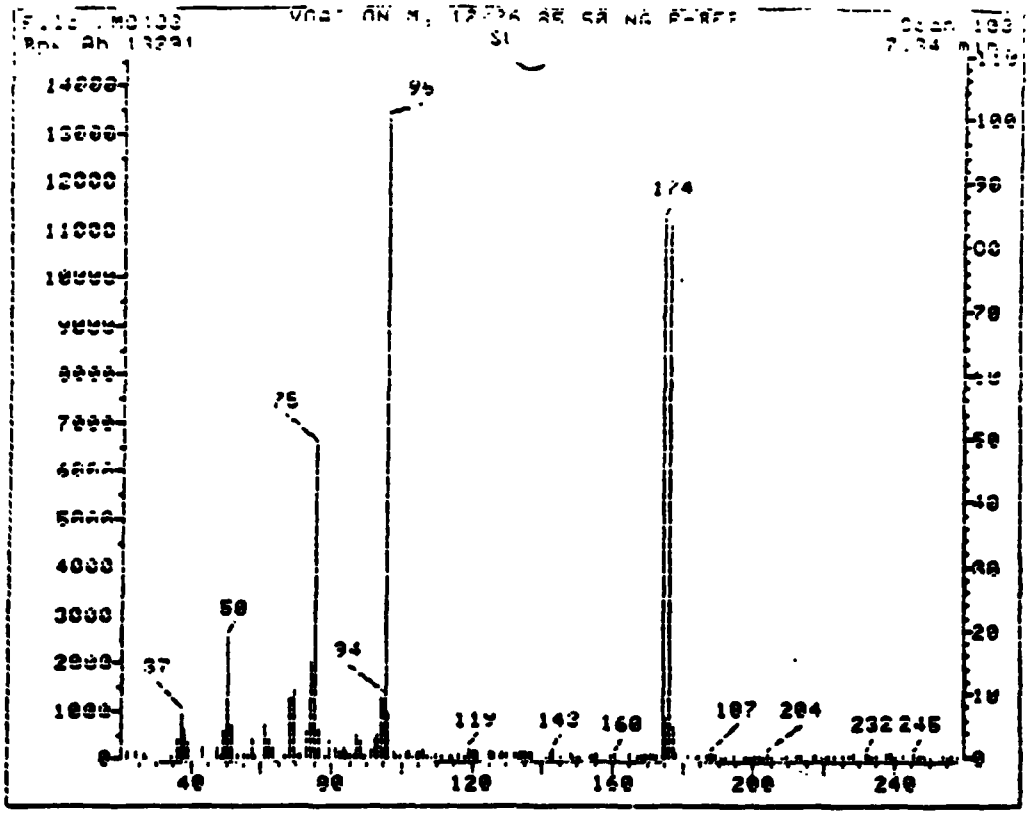


TABLE 2: METHOD PERFORMANCE DATA (QA/1)

GC/MS Tuning Data - Bromofluorobenzene (BFB) for Volatiles Analysis

m/z	Ion Abundance Criteria	% Relative Abundance Base Peak	% Relative Abundance Appropriate Peak	Status
50	15-40% of mass 95	19.07	19.07	Ok
75	30-60% of mass 95	49.14	49.14	Ok
95	Base peak, 100% relative abundance	100.00	100.00	Ok
96	5-9% of mass 95	7.13	7.13	Ok
173	Less than 1% of mass 95	0.00	0.00	Ok
174	Greater than 50% of mass 95	84.49	84.49	Ok
175	5-9% of mass 174	6.26	7.41	Ok
176	95-101% of mass 174	84.16	99.62	Ok
177	5-9% of mass 176	4.82	5.72	Ok

Injection Date: 12/28/85 Analyst: Richard Stoche
Injection Time: 19:13 Processor: Richard Stoche
Run No: >M14113 QC Batch: QV4173
Spectrum No: 103 Samples: K7835, K7836, K7412, K6381, K6382, K6388, K6389, K6392, K6397, K6399, K6411, J9590, K6996, K8177, K7511

K Stearns 12/30/85

Methodology
for
GC/MS Analysis of Priority Pollutant Compounds

The methods employed in the GC/MS analysis for priority pollutants are established EPA methods. Rigid compliance with the instrument parameters and performance criteria of the published methods was achieved. In some cases, the precise amounts of sample used and the sample handling procedures vary with the complexity of the sample matrix. Qualitative identification of the priority pollutants was performed using the relative retention times, the relative abundance of three characteristic ions and the abundance ratios. The entire mass spectrum was reviewed to confirm each identification. Quantitative analysis of detected compounds was performed by using a response factor generated by a major characteristic ion of the specific compound and an internal standard.

Compounds, in addition to those on the priority pollutant list, were identified through a computer-aided search of the NBS-EPA spectra library. After review the identifications are included in a separate tabulation and labelled "tentatively identified".

Volatile Priority Pollutant Compounds

For the analysis of Volatile priority pollutants, EPA Method 624 was used. The method can be summarized as follows: Helium is bubbled through a 5 ml water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the organic components are trapped. After the purge cycle is complete, the sorbent column is heated and backflushed with helium to desorb the organic purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeable mixture. The separated purgeable components are then identified and quantitated using a computerized mass spectrometer.

Summary of
Quality Assurance/Quality Control Procedures (QA/QC)

ETC bases its quality assurance protocols on the following government guidelines:

- "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;
- National Enforcement Investigation Center Policies, and Procedures manual; EPA-330/9/79/001-R, October 1979;
- the recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979; updated on October 26, 1984);
- "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980;
- "Determination of 2,3,7,8-TCDD in Soil and Sediment" EPA, Region VII, Kansas City, September 1983;
- Organic Analysis: Multi-media, Multi Concentration-IFB WA84-A267; and
- Dioxin Analysis:Soil/Sediment Matrix; Multi-Concentration; Selected Ion Monitoring with Jar Extration Procedure-IFB WA84-A002

However, we have modified our protocols to provide a higher level of QA/QC than the guidelines require. For example, we analyze a higher than required number of quality control samples and we pay especially careful attention to the certification of the "reference standard" compounds we use in analysis. Below are listed the key QA/QC elements for the methods we used.

Analysis of Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry

- Each batch of 13 samples consists of 9 customer samples (at a maximun), one blank sample, one spiked blank, one spiked sample and one replicate sample. This amounts to a 30% quality control factor.
- Three surrogate compounds are added to each sample in the batch of 13.
- A blind quality control sample is introduced to the laboratory for analysis on a weekly basis.
- Each GC/MS is checked and retuned, if necessary, at the beginning of each day to ensure that its performance on bromofluorobenzene (BFB) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of Volatile Organic Priority Pollutant "standards" at a minimum of 3 different concentrations and using a mixture of 3 internal standards at a constant concentration.
- The calibration curve is verified with a mixture of priority pollutant standards every day. If the response factors vary greater than 25%, the instrument must be recalibrated.

Analysis of Organic Compounds Extracted in Acid or Base/Neutral Solutions by Gas Chromatography/Mass Spectrometry

- Each batch of 20 samples consists of 16 customer samples (at a maximum), one blank sample, one spiked blank (for water matrices), one sample spiked with the priority pollutant standard mixture and a duplicate customer sample. This amounts to a 20% quality control factor.

- Three surr[illegible]ate compounds are added to each sa[illegible]e in the batch for Base/Neutral analysis.
- Three surrogate compounds are added to each sample in the batch for Acid analysis.
- A blind quality control sample is introduced to the laboratory for analysis on a weekly basis.
- Each GC/MS is checked and retuned, if necessary, at the beginning of each day to ensure that its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of standards composed of either the Organic Acid or Base/Neutral Extractable Compounds at a minimum of 3 concentrations and using five internal standards for quantitation.

Analysis of Metals

All Samples

- New standards are prepared for each batch of samples.
- Normal calibration is performed using a blank sample and four standards that have been through the sample preparation procedure. A regression analysis is used to construct the calibration curve.
- All EP Toxicity samples and all samples determined by furnace atomic absorption are calculated by the "method of additions".
- For each sample analysis that requires the use of the "method of additions" technique, a three point calibration is performed using U.S. EPA "Methods for Chemical Analysis of Water and Wastes, 1979". Results are obtained using linear regression analysis. Any regression with a coefficient of correlation below 0.990 is considered suspect, necessitating review of calibration data or sample re-analysis.
- In constructing the normal calibration curves the lowest concentration levels we use are values greater than or equal to 5 times the Instrumental Detection Limit (IDL).
- All calibration standards are analyzed in duplicate, at a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to validate the normal calibration curve.
- One customer sample out of every ten is analyzed in triplicate.

Homogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are homogeneous, the QC program is a minimum of 25% and consists of analyzing:

- 3 sets of triplicate analyses;
- 2 Replicate spikes;
- 1 independent reference standard;
- 4 Calibration standards (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Reagent Blank.

Heterogeneous Samples (e.g. except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are heterogeneous, the QC program is a minimum of 35% and consists of analyzing:

- 3 sets of triplicate analyses;
- 2 Replicate spikes;
- 1 Replicate independent reference standards;
- 4 Calibration standards (processed using the sample preparation method);
- 1 Procedural Blank;
- 4 Calibration standards (without sample preparation); and
- 1 Reagent Blank.

Analysis of Mercury

To analyze samples for mercury we group them by matrix in batches of 30 or less. Our QC program is a minimum of 30% and consists of analyzing:

- each of the 30 customer samples in duplicate;
- 3 sets of triplicate anaylses;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 10 Calibration standards (processed using the sample preparation method); and
- 2 Procedural Blanks.

Analysis of Pesticides, Herbicides and PCB's by Gas Chromatography

Pesticide, herbicide and PCB samples are grouped in batches of 16 customer samples or less according to the type of analysis to be performed. The QC program for each of these three types of analyses is a minimum of 20% and consists of analyzing:

- 1 procedural blank sample(a reagent blank is analyzed in the case of non-water matrices);
- 1 spiked blank sample (the spiked blank is eliminated in the case of non-water matrices);
- 1 replicate sample;
- 1 replicate spiked sample; and
- 1 known refernece QC sample for at least each 100 samples analyzed.

The instrument is calibrated each run with three standards, and checked every 10 samples.

Analysis of Cyanides, Phenols, Fluoride, Chloride, Nitrate and Nitrite

- All parameters are analyzed using a Technicon Autoanalyzer II GT.
- 3 calibration standards are analyzed at the beginning and end of each batch.

- Each batch (1 to 20 samples) consists of analyzing one blank, one spiked blank, one duplicate and spiked sample every 20 samples, and an EPA known reference sample.

Analysis of Total Organic Carbon (TOC)

TOC samples are analyzed on a daily basis with the number of samples analyzed per day dependent on the request for duplicate or quadruplicate analyses. The quality control program is designed to maintain the appropriate amount of QC and consists of the following elements:

- Daily instrument calibration
- One blank
- Standard recalibration every 10 samples
- Spiked samples at a low and high level
- Every sample is run in duplicate at a minimum

Analysis of Total Organic Halide (TOX)

- Blank reagent water for absolute carbon backround must contain less than 5 ug/l of halide (as chloride).
- Using a trichlorophenol standard, the mean adsorption efficiency must be within +/- 15% of the standard value.
- Calibration standards are run every 10 samples.
- Every sample is run in duplicate at a minimum.

Analysis of 2,3,7,8-TCDD (Dioxin) by GC/MS (SIM)

- Each sample is dosed with a known quantity of $^{13}C_{12}$-2,3,7,8-TCDD as internal standard and $^{37}Cl_4$-TCDD as surogate standard. The action limits for surrogate standard results is +/- 40% of the true value. Samples showing surrogate standard results outside of these limits are reextracted and reanalyzed.
- Two laboratory "method blanks" are run along with each set of 24 or fewer samples. The method blank is also dosed with the internal standard and surrrogate standard.
- At least one per set of 24 samples is run in duplicate to determine intralaboratory precision.
- Qualitative Requirements. The following are met in order to confirm the presence of native 2,3,7,8-TCDD:

  a. Isomer specificity must be demonstrated initially and verified once per 8-hour work shift. The verification consists of injecting a mixture containing TCDD isomers which elute close to 2,3,7,8-TCDD. The 2,3,7,8-TCDD must be separated from interferring isomers, with no more than 25% valley relative to the 2,3,7,8-TCDD peak.

  b. The 320/322 ratio is within the range of 0.67 to 0.87.

  c. Ions 320, 322, and 257 are all present and maximize together the signal to mean noise ratio must be 2.5 to 1 or better for all 3 ions.

  d. The retention time is equal (within 3 seconds) the retention time for the isotopically labeled 2,3,7,8-TCDD.

  e. At least one of the positives can be confirmed by obtaining partial scan spectra from mass 150 to mass 350. The partial scan guidelines are as follows:

. the 320/324 r. should be 1.56 +/- 0.16

. the 257/259 ratio should be 1.03 +/- 0.10

. the 194/196 ratio should be 1.54 +/- 0.15

- One sample is spiked with native 2,3,7,8-TCDD at a level of 1.0 PPB (for soil) for each set of 24 or fewer samples.
- In cases where no native 2,3,7,8-TCDD is detected, the actual detection limit is estimated and reported based on a signal to noise ratio of 2.5 to 1 at ions 320 and 322.
- For each sample, the internal standard is present with at least a 10 to 1 signal to noise ratio for both mass 332 and mass 334. Also, the internal standard 332/334 ratio must be within the range of 0.67 to 0.87.

Subcontractor QA/QC

Each subcontractoer is required to maintain an appropriate level of quality control. To insure this, each subcontractor is required to submit to ETC the quality control data for all analyses it performs. This data is kept on file at ETC. In general, the amount of quality control required is one duplicate sample with one spiked sample for every ten analyses.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;
- outgoing shipping manifests;
- the chain-of-custody form completed by the person(s) breaking the Shuttle seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;
- incoming shipping manifests;
- breaking the Shuttle's reseal;
- storing each labeled sample bottle in a secured area;
- disposition of each sample to an analyst or technician; and
- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The records show for each link in this process:

- the person with custody; and
- the time and date each person accepted or relinquished custody.

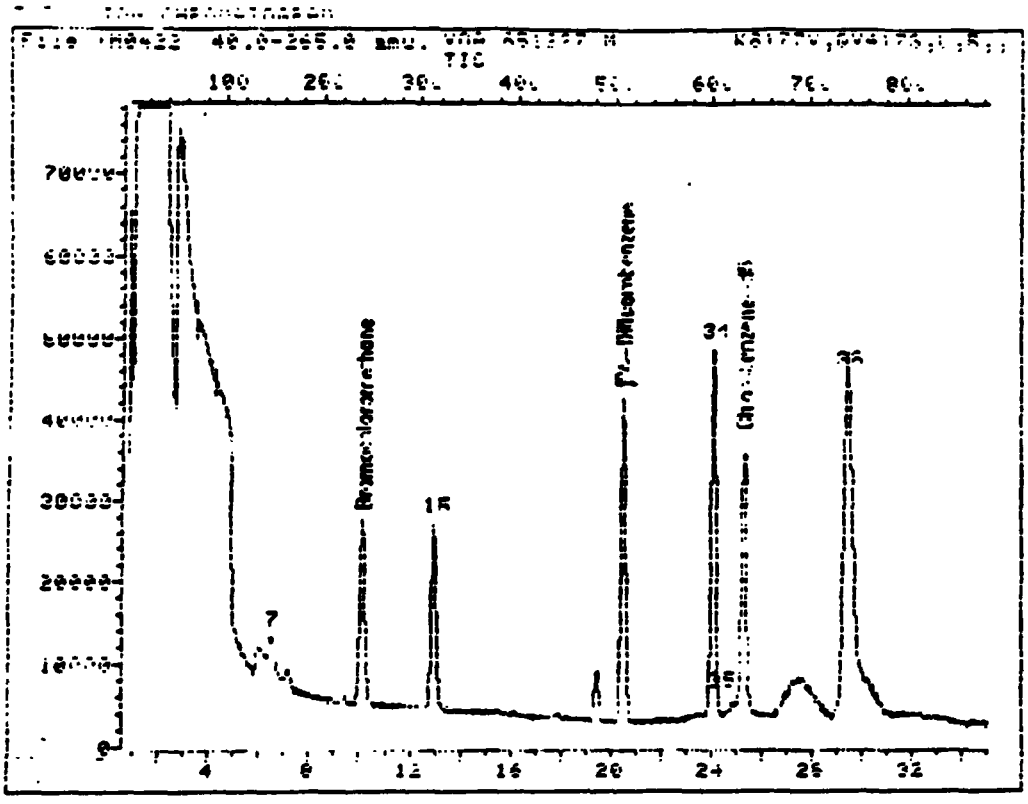
Appendix A

Mass Spectral Data for Quantitated Compounds

1) A total ion chromatogram for each sample analyzed by a GC/MS instrument.

2) A Quant. report used by the analyst to determine qualitative and quantitative results of the compounds present.

3) A mass spectrum and a reference spectrum for each priority pollutant compound detected in the sample.



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Misc: [illegible]

Id File: MVHA::US
Title: Volatile Priority Pollutant ID File
Last Calibration: 851226 18:51

Operator ID: [illegible]
Quant Time: 851222 18:[illegible]
Injected at: 851222 15:[illegible]

019153 ~~006425~~

QUANT REPORT

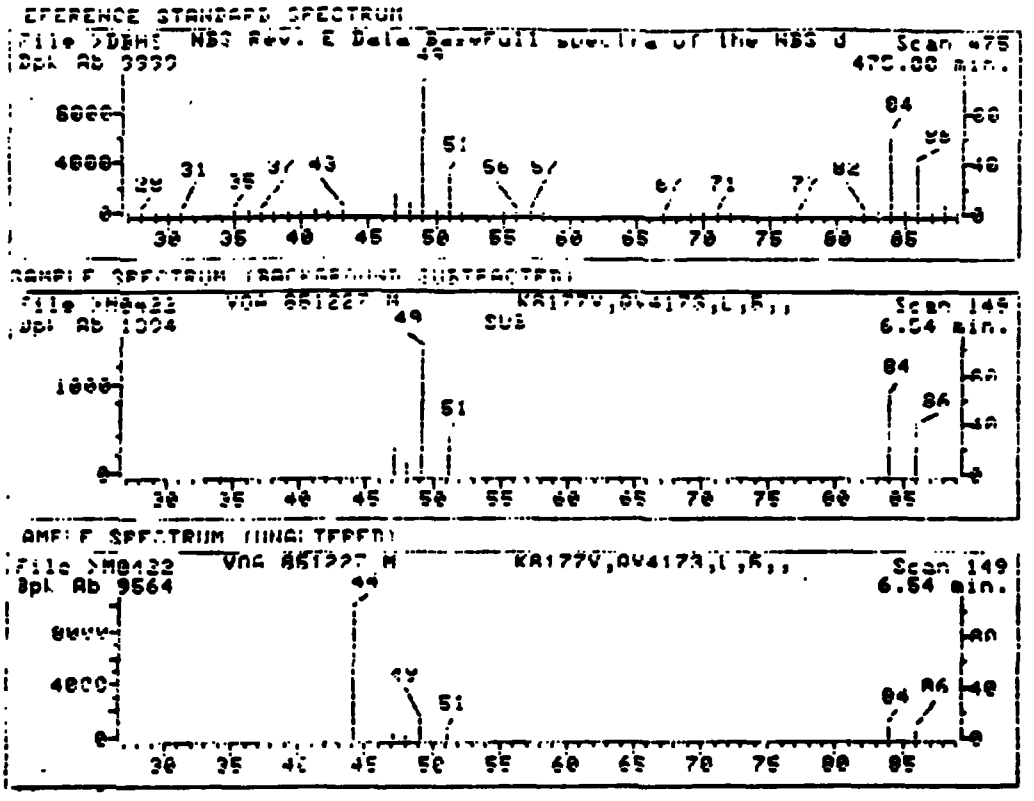
Operator ID: [illegible] Quant Rev: 4 Quant Time: 851[illegible] 18:[illegible]
Output File: [illegible]::AQ Injected at: 851[illegible] 15:05
Data File: [illegible]::US Dilution Factor: 1.[illegible]
Name: VHA 851227 M
Misc: [illegible],[illegible],[illegible],[illegible],,

ID File: MVHA::US
Title: Volatile Priority Pollutant ID File
Last Calibration: 851226 18:51

	Compound		R.T.	Scan#	Area	Conc	Units	q
1)	*Bromochloromethane		10.14	242	51544	250.00	NG	96
2)	Methylene chloride		6.54	149	13065	~~[illegible]~~	NG 26	[illegible]
15)	1,2-Dichloroethane-D4	(SURR)	12.97	315	47841	281.56	NG	89
1[illegible])	*1,4-Difluorobenzene		20.53	510	1896[illegible]	250.00	NG	[illegible]
30)	*Chlorobenzene-d5		25.34	634	130194	250.00	NG	92
~~[illegible]~~	~~[illegible] ether~~		~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~NG~~	~~[illegible]~~
34)	Toluene-D8	(SURR)	24.10	602	210729	24[illegible].68	NG	91
~~[illegible]~~	~~Toluene~~		~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~NG~~	~~[illegible]~~
[illegible]	p-Bromofluorobenzene	(SURR)	29.41	739	116779	258.28	NG	9[illegible]
~~[illegible]~~	~~Methyl methacrylate~~		~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~NG~~	~~[illegible]~~

* Compound is ISTD

E.L.

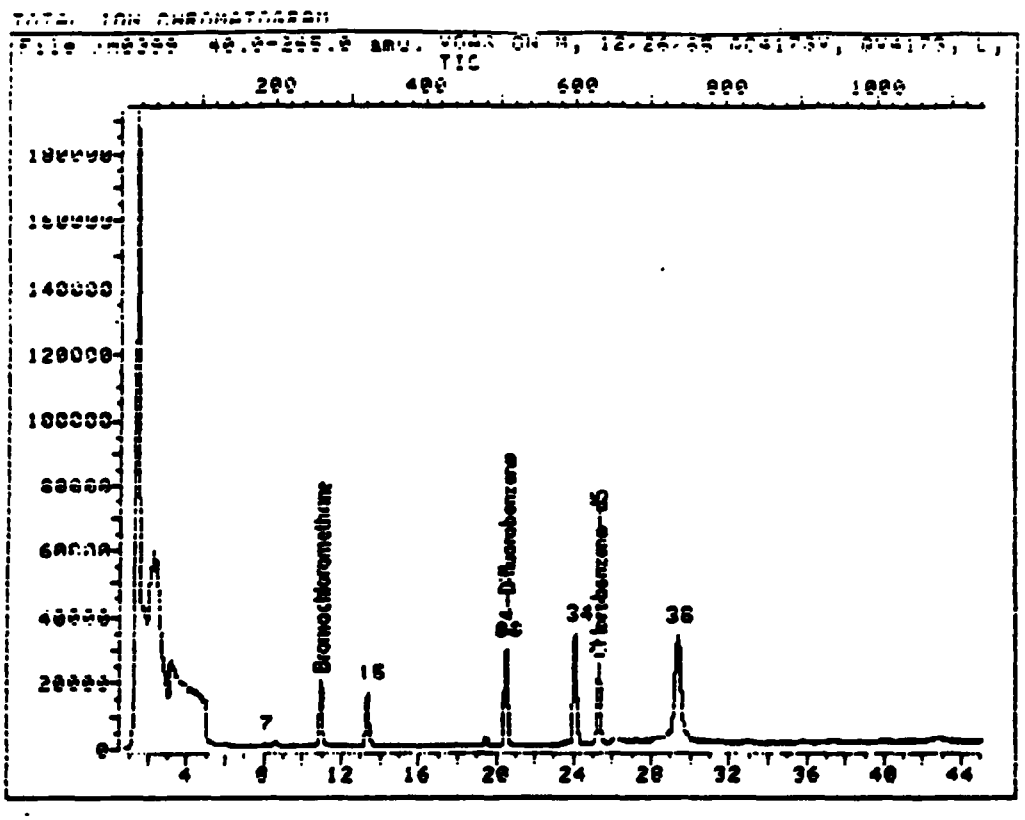


Data File: [illegible]
Name: VOA 851227 M
Misc: [illegible]
Quant Time: 851227 18:10
Injected at: 851227 15:05

Compound No: 2
Compound Name: Methylene chloride
Scan Number: 149
Retention Time: 6.54 min.
Area: 13065
Concentration: [illegible]
q-value: 91

Appendix C1

GC/MS Subsidiary Data



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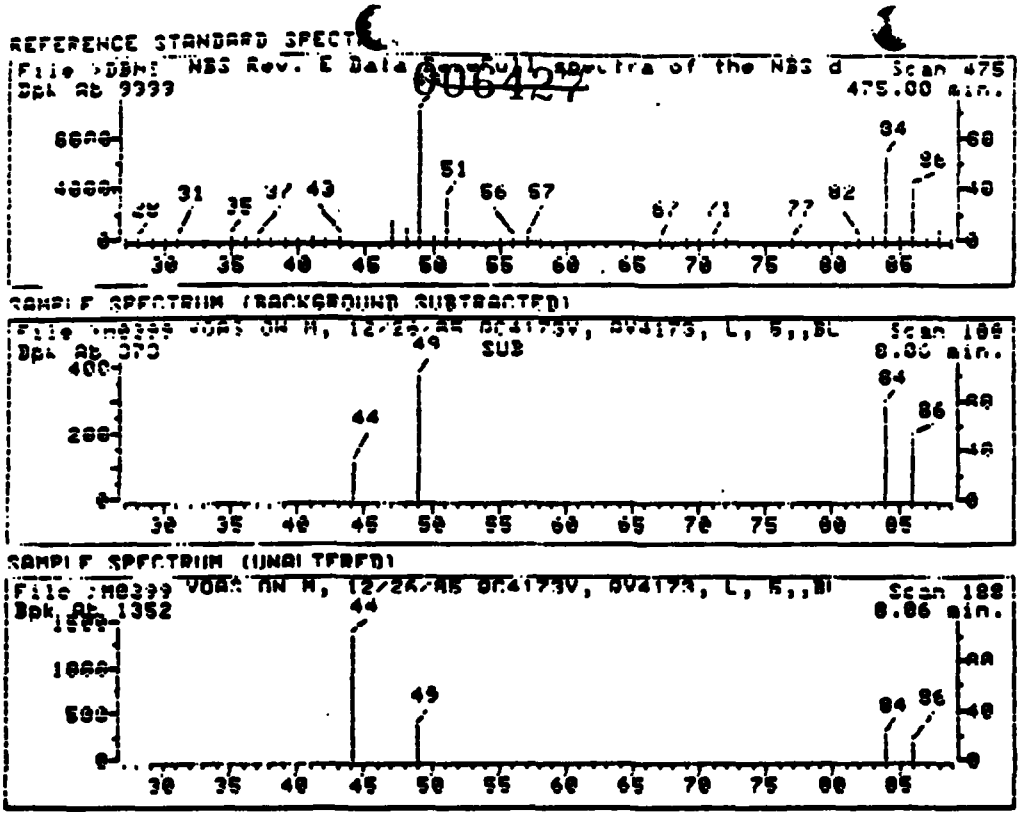
Misc: QU4173U, QU4173, L, 5,,BLANK

Id File: MUIA::115
Title: Volatile Priority Pollutant ID FILE
Last Calibration: 851226 10:51

Operator ID: RL9134
Quant Time: 851226 21:15
Injected at: 851226 14:19

019155



Data File: >M0399::04
Name: VOAS ON M, 12/26/85
Misc: QC4173V, QV4173, L, 5,,BLANK
Quant Time: 851226 20:03
Injected at: 851226 14:19

Compound No: 7
Compound Name: Methylene chloride
Scan Number: 188
Retention Time: 8.06 min.
Area: 3335
Concentration: 13.12 NG
q-value: 98

Appendix E

Chain-of Custody Forms

1) A field Chain-of-Custody form (CC1) is included for all samples shipped by ETC shuttle.

2) An in-house sample Chain-of Custody form is included for all samples not shipped by ETC shuttle.

3) Any additional Chain-of-Custody material provided by a client or by a client's sampling agent is also included.

4) A subcontractor's Chain-of-Custody form is included for any analytical work not performed within ETC's laboratory.

5) Analysis and Extraction Custody forms are included for the period the sample was in ETC's possession.

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ETC ENVIRONMENTAL TESTING and CERTIFICA

CHAIN OF CUSTOD FORM (CC1)

Seal No. 47285 ETC Job # K8177

Date Sealed 2-6-85 By: M. Ickstad

Company: RESOURCE ENGINEERING

Facility/Site:

Address: 3000 RICHMOND AVE.
HOUSTON, TX 77098

Attn.: CHRIS ITIN

Phone: ( )

SAMPLE IDENTIFICATION

Facility: RES2886-04 (Facility/Site Code) MW-14 (Optional Sample Point Descriptions)

Sample Point: W-14 (Source Code (from below) / Your Sample Point ID (left justify)) 85/12/19 (Start Date (YY/MM/DD)) (Start Time (2400 hr clock)) (Elapsed Hours (composite))

Source Codes
Well (W) Outfall (O) Bottom Sediment ...(B) Surface Impoundment....(I) Leachate Collection Sys. ...(C) Other
Soil (S) River/Stream .(R) Generation Point ...(G) Treatment Facility .....(T) Lake/Ocean .....(L) Specify

SHUTTLE CONTENTS

BOTTLE No	Type	Size	Preserv.	ANALYSIS	SAMPLER Fill. (Y/N)	SAMPLER Observations	LAB Observations
2	V	40mL	sod.thio	VOA	N		✓

CHAIN OF CUSTODY CHRONICLE

1. Shuttle Opened By: (print) JOHN BINS Date: 12/9/85 Time: 6:30 PM
Signature: John Bins Seal #: 0047285 Intact: YES

2. I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

3. I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

4. Shuttle Sealed By: (print) JOHN BINS Date: 12/19/85 Time: 5:30 PM
Signature: John Bins Seal #: 0047286 Intact: YES

ETC USE ONLY Opened By: [signature] Date: 12/20/85 Time: 11:00
Seal #: 47286 Condition: Intact

ETC ENVIRONMENTAL TESTING and CERTIFICATION

FIELD PARAMETER FORM (CC2)

ETC JOB # KP 77

Sample Point [W] [114] (Source Code / Sample Point I.D)

FIELD PROCEDURES

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	VOLUME PURGED (Gallons)

SAMPLING METHOD: TEFLON BAILER 3 WELL VOLUMES PURGED

Sampler Type [ ] A-Submersible Pump, B-ISCO, C-Bladder Pump, D-Dipper/Bottle, E-Bailer, F-Scoop/Shovel, X-Other (SPECIFY OTHER)

Sampler Material [ ] A-Teflon, B-Metal, C-PVC, D-Plastic, X-Other (SPECIFY OTHER)

Tubing Material [ ] A-Teflon, B-Tygon, C-Polyethylene, D-Silicon, X-Other (SPECIFY OTHER)

Sample Composited [Y/N] (Procedure/Preparation)

FIELD MEASUREMENTS

Well Elevation (ft/msl)

Depth to Ground water (ft) 37.16

Groundwater Elevation (ft msl)

Well Depth (ft) 37.16

Sample Depth (non-well) (ft)

	pH		Spec. Cond.		(other parameter)	value	units
1st	6.9	(STD)	660	umhos at 25°C			
2nd		(STD)		umhos at 25°C			
3rd		(STD)		umhos at 25°C			
4th		(STD)		umhos at 25°C			

Sample Temp (°C)

Turbidity NTU

FIELD COMMENTS

Sample Appearance: SLIGHTLY TURBID

Weather Conditions:

Other:

FILTERING: Use Chain of Custody (CC1) to indicate which bottles were filtered

Sampler: (Print) JOHN BINS Employer: RESOURCE ENGINEERING INC.

I certify that sampling procedures were in accordance with applicable EPA state and corporate protocols.

Date 12/19/85 Signature John Bins

019157

ETC ENVIRONMENTAL TESTING and CERTIFICATION

LABORATORY CHRONICLE: GC S Department

DATE 12/26/85 SHIFT
FRACTION Purgeables
INSTRUMENT M
TUNE FILE APEI02
SEQUENCE FILE LAL
METHOD FILE VOAM
ID FILE MVOA
ANALYST(S) Richard Lacha
SUPERVISOR [signature]
BATCH #'s QV4173

(PLEASE INITIAL)

CURRENT CS05 STATUS		STANDARDS UPDATED	
ACQ		DATE	12/26/85
WIP		BY	[initials]

STANDARD	CONC PPM	LOT NO.	LOT VOL.
P-BFB	50	11952	1
ISTD	25	12066	10
Surr	25	12019	10
ABC/SCVOA	18	12009-5	5,10,30
Methyl Methacrylate	100	11,504	5,10,30

NAME	DATA FILE	uL INJ	ALS #	DIL	TAPE #	SPECIALS (WRITE A-TYPE)	PLUS Y/N
50ng P-BFB	>M0398	1	—	OK		+403(ENH)-303(ENH)	!
QC4173V	>M0399	5ml	1	OK		VC15 PLSV15	✓
QC4173VS	>M0400	5ml	2			5µl ABC/SCVOA/Methyl Methacrylate	
QC4173VS	>M0401	5ml	3			10µl ABC/SVOA/ "	"
QC4173VS	>M0402	5ml	4			30µl ABC/SCVOA/ "	"
50ng P-BFB	>M0403	1µl	—			OK	
K7835VS	>M0404	5ml	1		OK	5µl ABC/SCVOA methyl methac	
K7835V	>M0405		2			OK	
K7836V	>M0406		3			OK	
K7836VR	>M0407		4			OK	
K7412V	>M0408		5			OK VC15 PLSV15	✓
K6381V	>M0409		6			OK	
K6382V	>M0410		7			OK	
K6388V	>M0411		8			OK	
K6389V	>M0412		9			OK	
K6392V	>M0413		10			OK	
P-BFB	>M0414	1µl			OK		
QC4173VS	>M0415	5ml	1		OK	5µl ABC/SCVOA methyl Meth	
K6397V	>M0416		1			OK	
K6399V	>M0417		2			OK	
K6411V	>M0418		3			OK	
J9590V	>M0419		4			OK	
K8454	>M0420		5	1:10	rerun	no tachlite rerun strength	
K6996	>M0421		6			OK	
K8177	>M0422		7			OK	

ETC FORM #102

ETC ENVIRONMENTAL TESTING and CERTIFICATION

LABORATORY CHRONICLE: GC-MS Department

DATE 12/27/85 SHIFT
FRACTION VOA
INSTRUMENT M
TUNE FILE APEI02
SEQUENCE FILE
METHOD FILE VOAM
ID FILE MOA
ANALYST(S) [signature]
SUPERVISOR [signature]
BATCH #'s QV4173

(PLEASE INITIAL)

CURRENT CS05 STATUS		STANDARDS UPDATED	
ACQ		DATE	
WIP		BY	

STANDARD	CONC PPM	LOT NO.	LOT VOL.
see previous page			

NAME	DATA FILE	uL INJ	ALS #	DIL	TAPE #	SPECIALS (WRITE A-TYPE)	PLUS Y/N
K7511V	>M0423	5ml	8		L00007	OK	!
K7992V	>M0424	↓	9	1:50	rerun	Np foodelete rerun straight	
K7994V	>M0425	↓	10	1:50	rerun	MS shutdown (cool flow problem)	

ETC FORM #102

019158

~~006430~~

Technical Report

for

RESOURCE ENGINEERING

11 GREENWAY PLAZA

HOUSTON, TX 77406

MW-6

UP GRADIENT SHALLOW WELL

Chain of Custody Data Required for ETC Data Management Summary Reports						
E9437	RESOURCE ENGINEERING	RESSHER	MW6	840629	1730	
ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

James N. Bowerfor

Denis C. K. Lin, Ph.D.

Vice President
Research and Operations

Introduction

This report contains the analytical results on your water sample, WMW6 84/06/29 17:30. It is designed to include comprehensive data from the entire analytical process in order to satisfy the needs of various levels of review.

The results obtained from your sample are presented in tabular format immediately following this introduction. Quality assurance data is tabulated along with the appropriate sample results for verification. Depending on the analyses ordered, the quality assurance data may include results from blank, spiked blank, spiked sample (i.e. matrix spike) and replicate sample as well as results from surrogate compound analyses. Quality assurance data for verification of proper instrument performance is also included where appropriate. The report appendices include the chain of custody record for your sample and, where appropriate, the gas chromatograms and mass spectra.

The procedures used in the analysis of the sample are described in this report's methodology section. All analytical procedures within our laboratory are performed within a strictly enforced Quality Assurance Protocol. A description of this Protocol is included in the report.

Results

Sample results, and associated quality assurance data, are always tabulated in one or more of this report's Quantitative Results Tables. The format of each table varies with the class of analysis.

Priority Pollutants

The priority pollutant compounds and elements are listed with their NPDES (National Pollution Discharge Elimination System) numbers, and the Method Detection Limit (MDL) published in the Federal Register, December 3, 1979. When a compound or element is present below its published MDL it is reported as BMDL (Below Method Detection Limit). When a compound or element is not present at any detectable concentrations it is reported as ND (Not Detected). Matrix spike and replicate analyses, where included, were performed on samples randomly chosen within each quality assurance batch and are therefore not necessarily spikes and replicates of this report's sample. Surrogate compound recovery data and instrument calibration data are included in the Method Performance Data Tables.

Qualitative Analysis

The GC/MS identification of compounds which are not included in the normal compound list for a given method is reported in a Qualitative Results Table. Each sample fraction is reported on an individual Qualitative Results Table. Wherever possible these compounds are reported with their molecular weight, empirical formula, and CAS number. The retention time and scan number is also provided to match the spectra included in the report appendices.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 20, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9437	RESOURCE ENGINEERING	RES28801	WW6	840629	1730	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1V	Acrolein	ND	100	ND	ND	ND	1600	96	ND	1600	100
2V	Acrylonitrile	ND	100	ND	ND	ND	160	53e	ND	160	70e
3V	Benzene	ND	10	ND	ND	ND	36	96	ND	36	111
4V	bis(Chloromethyl)ether	ND	10	ND	ND	ND	0	-	ND	0	-
5V	Bromoform	ND	10	ND	ND	ND	36	97	ND	36	118
6V	Carbon tetrachloride	ND	10	ND	ND	ND	36	100	ND	36	115
7V	Chlorobenzene	ND	10	ND	ND	ND	36	95	ND	36	109
8V	Chlorodibromomethane	ND	10	ND	ND	ND	36	99	ND	36	126
9V	Chloroethane	ND	10	ND	ND	ND	36	97	ND	36	111
10V	2-Chloroethylvinyl ether	ND	10	ND	ND	ND	36	78	ND	36	87
11V	Chloroform	ND	10	ND	ND	BMDL	36	88	ND	36	190
12V	Dichlorobromomethane	ND	10	ND	ND	ND	36	98	ND	36	161
13V	Dichlorodifluoromethane	ND	10	ND	ND	ND	0	-	ND	0	-
14V	1,1-Dichloroethane	ND	10	ND	ND	ND	36	96	ND	36	111
15V	1,2-Dichloroethane	ND	10	ND	ND	ND	36	94	ND	36	110
16V	1,1-Dichloroethylene	ND	10	ND	ND	ND	36	93	ND	36	98
17V	1,2-Dichloropropane	ND	10	ND	ND	ND	36	96	ND	36	111
18V	cis-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	97	ND	36	108
19V	Ethylbenzene	ND	10	ND	ND	ND	36	95	ND	36	109
20V	Methyl bromide	ND	10	ND	ND	ND	36	108	ND	36	115
21V	Methyl chloride	ND	10	ND	ND	ND	36	97	ND	36	107
22V	Methylene chloride	BMDL	10	ND	ND	BMDL	36	56	ND	36	74
23V	1,1,2,2-Tetrachloroethane	ND	10	ND	ND	ND	36	91	ND	36	115
24V	Tetrachloroethylene	ND	10	ND	ND	ND	36	96	ND	36	108
25V	Toluene	ND	10	ND	ND	BMDL	36	83	ND	36	103
26V	1,2-Trans-dichloroethylene	ND	10	ND	ND	ND	36	99	ND	36	110
27V	1,1,1-Trichloroethane	ND	10	ND	ND	ND	36	97	ND	36	112
28V	1,1,2-Trichloroethane	ND	10	ND	ND	ND	36	95	ND	36	111
29V	Trichloroethylene	ND	10	ND	ND	ND	36	96	ND	36	107
30V	Trichlorofluoromethane	BMDL	10	ND	ND	ND	36	96	ND	36	112
31V	Vinyl chloride	ND	10	ND	ND	ND	36	100	ND	36	114

019159

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 21, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9437	RESOURCE ENGINEERING	RES28801	MW6	840629	1730	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
	trans-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	100	ND	36	107

a EPA published Method Detection Limit.

b Recovery normally variable using EPA Protocol Method 624.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 198

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Acid Compounds - GC/MS Analysis Data (QR02)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9437	RESOURCE ENGINEERING	RES28801	MW6	840629	1730	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen Added ug/l	% Recov
1A	2-Chlorophenol	ND	25	ND	ND	ND	150	78	ND	150	57
2A	2,4-Dichlorophenol	ND	25	ND	ND	ND	150	95	ND	150	53
3A	2,4-Dimethylphenol	ND	25	ND	ND	ND	150	2e	ND	150	0
4A	4,6-Dinitro-o-cresol	ND	250	ND	ND	ND	250	88	ND	250	75
5A	2,4-Dinitrophenol	ND	250	ND	ND	ND	250	110	ND	250	130
6A	2-Nitrophenol	ND	25	ND	ND	ND	150	78	ND	150	70
7A	4-Nitrophenol	ND	25	ND	ND	ND	150	71	ND	150	86
8A	p-Chloro-m-cresol	ND	25	ND	ND	ND	150	67	ND	150	25
9A	Pentachlorophenol	ND	25	ND	ND	ND	150	106	ND	150	86
10A	Phenol	ND	25	ND	ND	ND	150	77	ND	150	45
11A	2,4,6-Trichlorophenol	ND	25	ND	ND	ND	150	101	ND	150	76

a EPA published Method Detection Limit.

b Recovery normally low using EPA Protocol Method 625.

c Recovery low due to sample matrix interference.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9437	RESOURCE ENGINEERING	RES28801	WMW6	840629	1730	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1B	Acenaphthene	ND	10	ND	ND	ND	100	104	ND	105	100
2B	Acenaphthylene	ND	10	ND	ND	ND	100	101	ND	105	100
3B	Anthracene	ND	10	ND	ND	ND	100	67	ND	105	81
4B	Benzidine	ND	10	ND	ND	ND	100	0.	ND	105	0.
5B	Benzo(a)anthracene	ND	10	ND	ND	ND	100	133	ND	105	126
6B	Benzo(a)pyrene	ND	10	ND	ND	ND	100	128	ND	105	133
7B	Benzo(b)fluoroanthene	ND	10	ND	ND	ND	100	160	ND	105	153
8B	Benzo(ghi)perylene	ND	10	ND	ND	ND	0	-	ND	0	-
9B	Benzo(k)fluoranthene	ND	10	ND	ND	ND	100	124	ND	105	114
10B	bis(2-Chloroethoxy)methane	ND	10	ND	ND	ND	100	65	ND	105	87
11B	bis(2-Chloroethyl) ether	ND	10	ND	ND	ND	100	100	ND	105	246.
12B	bis(2-Chloroisopropyl)ether	ND	10	ND	ND	ND	100	306c	ND	105	107.
13B	bis(2-Ethylhexyl)phthalate	BMDL	10	135	44	BMDL	100	103	ND	105	230.
14B	4-Bromophenyl phenyl ether	ND	10	ND	ND	ND	100	65	ND	105	81
15B	Butyl benzyl phthalate	ND	10	ND	ND	ND	100	110	ND	105	94
16B	2-Chloronaphthalene	ND	10	ND	ND	ND	100	80	ND	105	87
17B	4-Chlorophenyl phenyl ether	ND	10	ND	ND	ND	100	105	ND	105	95
18B	Chrysene	ND	10	ND	ND	ND	100	102	ND	105	86
19B	Dibenzo(a,h)anthracene	ND	10	ND	ND	ND	0	-	ND	0	-
20B	1,2-Dichlorobenzene	ND	10	ND	ND	ND	100	33.	ND	105	52.
21B	1,3-Dichlorobenzene	ND	10	ND	ND	ND	100	30.	ND	105	45.
22B	1,4-Dichlorobenzene	ND	10	ND	ND	ND	100	33.	ND	105	47.
23B	3,3'-Dichlorobenzidine	ND	10	ND	ND	ND	100	17.	ND	105	21.
24B	Diethyl phthalate	ND	10	ND	ND	ND	100	6.	ND	105	44.
25B	Dimethyl phthalate	ND	10	ND	ND	ND	100	1	ND	105	12
26B	Di-n-butyl phthalate	ND	10	ND	ND	BMDL	100	60	ND	105	80
27B	2,4-Dinitrotoluene	ND	10	ND	ND	ND	100	74	ND	105	88
28B	2,6-Dinitrotoluene	ND	10	ND	ND	ND	100	98	ND	105	100
29B	Di-n-octyl phthalate	ND	10	ND	ND	ND	100	137	ND	105	117
30B	1,2-Diphenylhydrazine	ND	10	ND	ND	ND	100	92	ND	105	90
31B	Fluoranthene	ND	10	ND	ND	ND	100	62	ND	105	90

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9437	RESOURCE ENGINEERING	RES28801	MW6	840629	1730	

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
32B	Fluorene	ND	10	ND	ND	ND	100	95	ND	105	94
33B	Hexachlorobenzene	ND	10	ND	ND	ND	100	107	ND	105	87
34B	Hexachlorobutadiene	ND	10	ND	ND	ND	100	14b	ND	105	43b
35B	Hexachlorocyclopentadiene	ND	10	ND	ND	ND	0	-	ND	0	-
36B	Hexachloroethane	ND	10	ND	ND	ND	100	16b	ND	105	32b
37B	Indeno(1,2,3-c,d)pyrene	ND	10	ND	ND	ND	0	-	ND	0	-
38B	Isophorone	ND	10	ND	ND	ND	100	83	ND	105	88
39B	Naphthalene	ND	10	ND	ND	ND	100	44	ND	105	54
40B	Nitrobenzene	ND	10	ND	ND	ND	100	83	ND	105	198
41B	N-Nitrosodimethylamine	ND	10	ND	ND	ND	0	-	ND	0	-
42B	N-Nitrosodi-n-propylamine	ND	10	ND	ND	ND	100	74	ND	105	77
43B	N-Nitrosodiphenylamine	ND	10	ND	ND	ND	100	127	ND	105	129
44B	Phenanthrene	ND	10	ND	ND	ND	100	81	ND	105	83
45B	Pyrene	ND	10	ND	ND	ND	100	108	ND	105	96
46B	1,2,4-Trichlorobenzene	ND	10	ND	ND	ND	100	209c	ND	105	197c

a EPA published Method Detection Limit.
b Recovery normally low using EPA Protocol Method 625.
b Recovery variable due to sample matrix interference.
c Recovery normally variable using EPA Protocol Method 625.

006433

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds – GC/MS Analysis Data – Acid Fraction (QR07)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9437	RESOURCE ENGINEERING	RES28801	WW6	840629	1730	

Compound Name	Data			Identifiers				
	Scan Number	Retention Time (Min)	M.W.	CAS Number	Empirical Formula			
None Found								

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds - GC/MS Analysis Data - Base/Neutral Fraction (QR08)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9437	RESOURCE ENGINEERING	RES28801	WM6	840629	1730	

Compound Name	Data			Identifiers				
	Scan Number	Retention Time (Min)	M.W.	CAS Number	Empirical Formula			
None Found								

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 21, 1984

TABLE 1: QUANTITATIVE RESULTS

Conventionals Analysis Data (QR12)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9437	RESOURCE ENGINEERING	RES28801	MW6	840629	1730	

Parameter	Results: Sample Measure.	MDL	Units of Measure.					
pH	7.14		std					
Specific Conductance	650		um/cm					
Temperature	39.40		Deg. C					

July 27, 1984

TABLE 2: METHOD PERFORMANCE DATA

Surrogate Recovery - GC/MS Data (QR20)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9437						

Compound	Amount Added ug	% Recovery	Control Limits * Lower	Control Limits * Upper
VOLATILE FRACTION				
Bromochloromethane	200	98	74	122
Benzene, d_6	150	86	83	119
Fluorobenzene	150	87	88	116
1,4-Dichlorobutane	200	97	75	123
Pentafluorobenzene	150	89	90	126
Ethylbenzene, d_{10}	150	87	83	127
ACID FRACTION				
2-Fluorophenol	80	66	16	100
Pentafluorophenol	80	100	25	113
BASE/NEUTRAL FRACTION				
2-Fluorobiphenyl	80	130**	57	101
1-Fluoronaphthalene	80	90	55	103
Nitrobenzene, d_5	80	60**	63	143

* Two Standard Deviations About the Mean.

** Recovery variable due to sample matrix interference.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 21, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Bromofluorobenzene (BFB) for Volatiles Analysis (QR21)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9437

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
50	15-40% of Mass 95	24
75	30-60% of Mass 95	49
95	Base Peak, 100% relative abundance	100
96	5-9% of Mass 95	7
173	Less than 1% of Mass 95	<1
174	Greater than 50% of Mass 95	60
175	5-9% of mass 174	4
176	Greater than 95% but less than 101% of Mass 174	58
177	5-9% of mass 176	4

Date: 840718
Run No: >A2864
Spectrum No: 69
Analyst: R. Albert

July 26, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Acids Analysis (QR22)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9437

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	59
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	50
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	6
275	10-30% of mass 198	22
365	Greater than 1% of mass 198	>1
441	Less than mass 443	12
442	Greater than 40% of mass 198	71
443	17-23% of mass 442	14

Date: 840722
Run No: >E3118
Spectrum No: +374 -155
Analyst: T. Rusowicz

006486

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 26, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Base/Neutrals Analysis (QR23)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9437

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	56
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	53
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	7
275	10-30% of mass 198	21
365	Greater than 1% of mass 198	2
441	Less than mass 443	12
442	Greater than 40% of mass 198	83
443	17-23% of mass 442	17

Date: 840720
Run No: G3466
Spectrum No: 489
Analyst: K. Bonaparte

Methodology
for
GC/MS Analysis of Priority Pollutant Compounds

The methods employed in the GC/MS analysis for priority pollutants are established EPA methods. Rigid compliance with the instrument parameters and performance criteria of the published methods was achieved. In some cases, the precise amounts of sample used and the sample handling procedures vary with the complexity of the sample matrix. Qualitative identification of the priority pollutants was performed using the relative retention times, the relative abundance of three characteristic ions and the abundance ratios. The entire mass spectrum was reviewed to confirm each identification. Quantitative analysis of detected compounds was performed by using a response factor generated by a major characteristic ion of the specific compound and an internal standard.

Compounds, in addition to those on the priority pollutant list, were identified through a computer-aided search of the NBS-EPA spectra library. After review the identifications are included in a separate tabulation and labelled "tentatively identified".

Volatile Priority Pollutant Compounds

For the analysis of Volatile priority pollutants, EPA Method 624 (Federal Register, December 3, 1979; page 69532) was used. The method can be summarized as follows: Helium is bubbled through a 5 ml water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the organic components are trapped. After the purge cycle is complete, the sorbent column is heated and backflushed with helium to desorb the organic purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeable mixture. The separated purgeable components are then identified and quantitated using a computerized mass spectrometer.

Acid, Base/Neutral and Pesticide Priority Pollutant Compounds

For the analysis of the Acid, Base/Neutral and Pesticide priority pollutants in an aqueous liquid matrix, EPA Method 625 (Federal Register, December 3, 1979; page 69540) was used. The method can be summarized as follows: A measured volume of sample, approximately 1 liter, is adjusted to a pH greater than 11 and extracted with methylene chloride. The pH of the sample is adjusted to a value less than 2 and extracted with an aliquot of fresh methylene chloride. A separatory funnel or continuous extractor is used to perform the extractions. The two extracts are dried and concentrated to a 1 ml final volume. Each extract is injected into a GC/MS instrument specifically configured for the correct fraction.

Quality Assurance/Quality Control Procedures (QA/QC)

ETC bases its quality assurance protocols on the following government guidelines:

- "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;
- National Enforcement Investigation Center Policies, and Procedures manual; EPA-330/9/79/001-R, October 1979;
- the recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979, pp. 69532-69559);
- "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980; and
- "Determination of 2,3,7,8-TCDD in Soil and Sediment" EPA, Region VII, Kansas City, September 1983.

However, we have modified our protocols to provide a higher level of QA/QC than the guidelines require. For example, we analyze a higher than required number of quality control samples and we pay especially careful attention to the certification of the "reference standard" compounds we use in analysis. Below are listed the key QA/QC elements for the methods we used.

Analysis of Volatile Organic Compounds (EPA Method 624)

- Each batch of 13 samples consists of 9 customer samples (at maximum), one blank sample, one spiked blank, one spiked sample and one replicate sample. This amounts to a 30% quality control factor.
- Three surrogate compounds are added to each sample in the batch of 13.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.
- Each GC/MS is checked and retuned, if necessary, every 8 hours to ensure that its performance on bromofluorobenzene (BFB) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of Volatile Organic Priority Pollutant "standards" at a minimum of 3 different concentrations and using a mixture of 3 internal standards at a constant concentration.
- The calibration curve is verified with a mixture of priority pollutant standards every 8 hours.
- Results are compared to the acceptance criteria given in Method 624; any that do not meet the criteria are re-analyzed.

Analysis of Organic Compounds Extracted in Acid or Base/Neutral Solutions (EPA Method 625)

- Each batch of 20 samples consists of 16 customer samples (at maximum), one blank sample, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate customer sample. This amounts to a 20% quality control factor.
- Five surrogate compounds are added to each sample in the batch of 20.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.

- Each GC/MS is checked and retuned, if necessary, every eight hours to ensure that its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of standards composed of either the Organic Acid or Base/Neutral Extractable Compounds at a minimum of 3 concentrations and using 2,2'-difluorobiphenyl as an internal standard.
- The calibration curve is verified with a mixture of priority pollutant standards every eight hours.
- Results are compared to the acceptance criteria given in Method 625; any that do not meet the criteria are re-analyzed.

Analysis of Metals

All Samples

- New standards are prepared for each batch of samples.
- Normal calibration is performed using a blank sample and four standards that have been through the sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis that requires the use of the "method of additions" technique, a three point calibration is performed using U.S. EPA "Methods for Chemical Analysis of Water and Wastes, 1979". Results are obtained using linear regression analysis. Any results with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- In constructing the normal calibration curves the lowest concentration levels we use are values greater than or equal to 5 times the Instrumental Detection Limit (IDL).
- All calibration standards are analyzed in duplicate, at a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to validate the normal calibration curve.

Homogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are homogeneous, the QC program is a minimum of 42% and consists of analyzing:

- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Heterogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are heterogeneous, the QC program is a minimum of 65% and consists of analyzing:

- each of the 30 customer samples in duplicate;
- 4 Replicates;
- 4 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Analysis of Mercury

To analyze samples for mercury we group them by matrix in batches of 20 or less. Our QC program is a minimum of 66% and consists of analyzing:

- each of the 20 customer samples in duplicate;
- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 10 Calibration standards (processed using the sample preparation method); and
- 2 Blanks.

Analysis of Pesticides, Herbicides and PCB's (EPA Method 608)

Pesticide, herbicide and PCB samples are grouped in batches of 16 customer samples or less according to the type of analysis to be performed. The QC program for each of these three types of analyses is a minimum of 20% and consists of analyzing:

- 1 blank sample;
- 1 spiked blank sample;
- 1 replicate sample;
- 1 replicate spiked sample; and
- 1 blank QC sample for at least each 100 samples analyzed.

The GC instruments are tuned daily to meet performance criteria in Method 608. Because Method 608 lacks data acceptance criteria, ETC has developed its own upper and lower quality control limits. When a test result falls outside the control limits, the test is re-run.

Analysis of Cyanides and Phenols

Cyanides and phenols are analyzed using a Technicon AutoAnalyzer II GT.

- Absorbance of full scale standards must be within +/- 25% of nominal absorbance.
- Duplicate calibration standards at four different concentrations are run with each batch of customer samples.
- At least one intersample standard is run for each 20 customer samples.
- Gain and carryover standards are analyzed at the end of each run.

Analysis of Total Organic Halide (TOX)

- Blank reagent water must contain less than 5 ug/l of halide (as chloride).
- Using a trichlorophenol standard, the mean adsorption efficiency must be within +/- 15% of the standard value.
- Pure compound recoveries must average 100 +/-15% (standard deviation).

Analysis of 2,3,7,8-TCDD (Dioxin) by GC/MS (SIM)

- Each sample is dosed with a known quantity of $^{13}C_{12}$-2,3,7,8-TCDD as internal standard and $^{37}Cl_4$-TCDD as surogate standard. The action limits for surrogate standard results is +/- 40% of the true value. Samples showing surrogate standard results outside of these limits are reextracted and reanalyzed.
- A laboratory "method blank" is run along with each set of 24 or fewer samples. The method blank is also dosed with the internal standard and surrrogate standard.
- At least one per set of 24 samples is run in duplicate to determine intralaboratory precision.
- Qualitative Requirements. The following are met in order to confirm the presence of native 2,3,7,8-TCDD:

  a. Isomer specificity must be demonstrated initially and verified once per 8-hour work shift. The verification consists of injecting a mixture containing TCDD isomers which elute close to 2,3,7,8-TCDD. The 2,3,7,8-TCDD must be separated from interferring isomers, with no more than 25% valley relative to the 2,3,7,8-TCDD peak.

  b. The 320/322 ratio is within the range of 0.67 to 0.87.

  c. Ions 320, 322, and 257 are all present and maximize together the signal to mean noise ratio must be 2.5 to 1 or better for all 3 ions.

  d. The retention time is equal (within 3 seconds) the retention time for the isotopically labeled 2,3,7,8-TCDD.

  e. At least one of the positives can be confirmed by obtaining partial scan spectra from mass 150 to mass 350. The partial scan guidelines are as follows:

  . the 320/324 ratio should be 1.58 +/- 0.16

  . the 257/259 ratio should be 1.03 +/- 0.10

  . the 194/196 ratio should be 1.54 +/- 0.15

- One sample is spiked with native 2,3,7,8-TCDD at a level of 1.0 PPB (for soil) for each set of 24 or fewer samples.

- In cases where no native 2,3,7,8-TCDD is detected, the actual detection limit is estimated and reported based on a signal to noise ratio of 2.5 to 1 at ions 320 and 322.

- For each sample, the internal standard is present with at least a 10 to 1 signal to noise ratio for both mass 332 and mass 334. Also, the internal standard 332/334 ratio must be within the range of 0.67 to 0.87.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;

- outgoing shipping manifests;

- the chain-of-custody form completed by the person(s) breaking the Shuttle seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;

- incoming shipping manifests;

- breaking the Shuttle's reseal;

- storing each labeled sample bottle in a secured area;

- disposition of each sample to an analyst or technician; and

- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody; and

- the time and date each person accepted or relinquished custody.

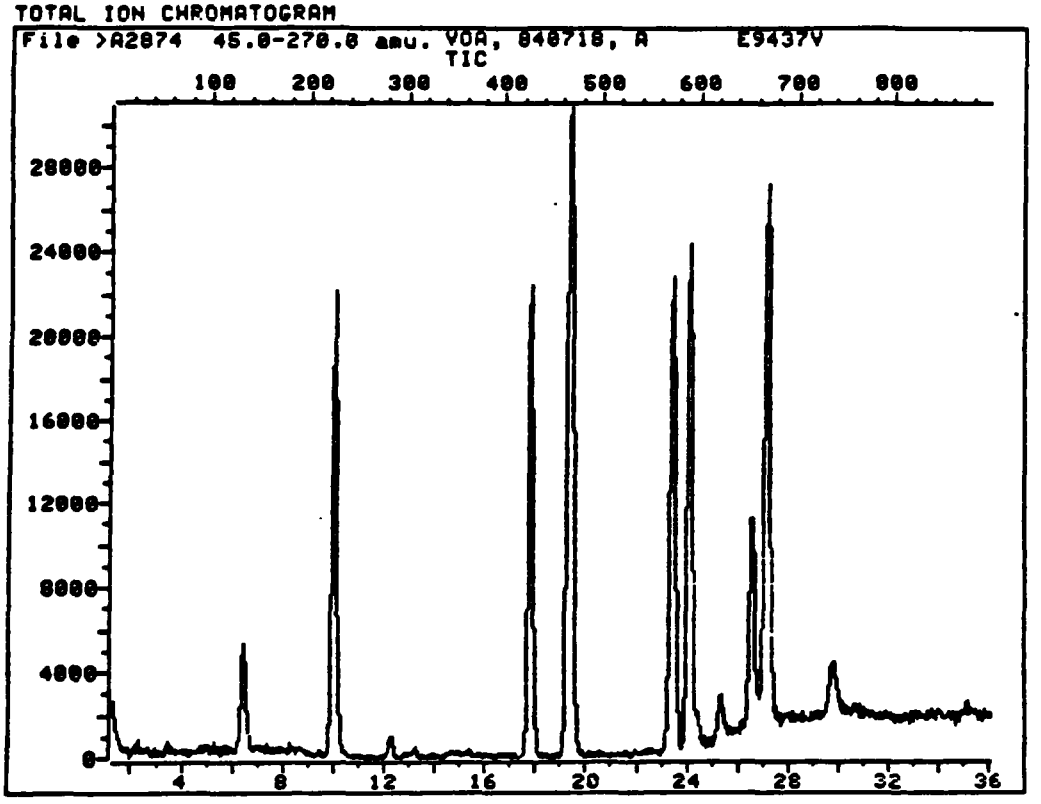
Appendix A

Mass Spectral Data for Quantitated Compounds

1) A total ion chromatogram for each sample analysed by a GC/MS instrument.

2) A mass spectrum and a reference spectrum for each priority pollutant compound detected in the sample.

TOTAL ION CHROMATOGRAM



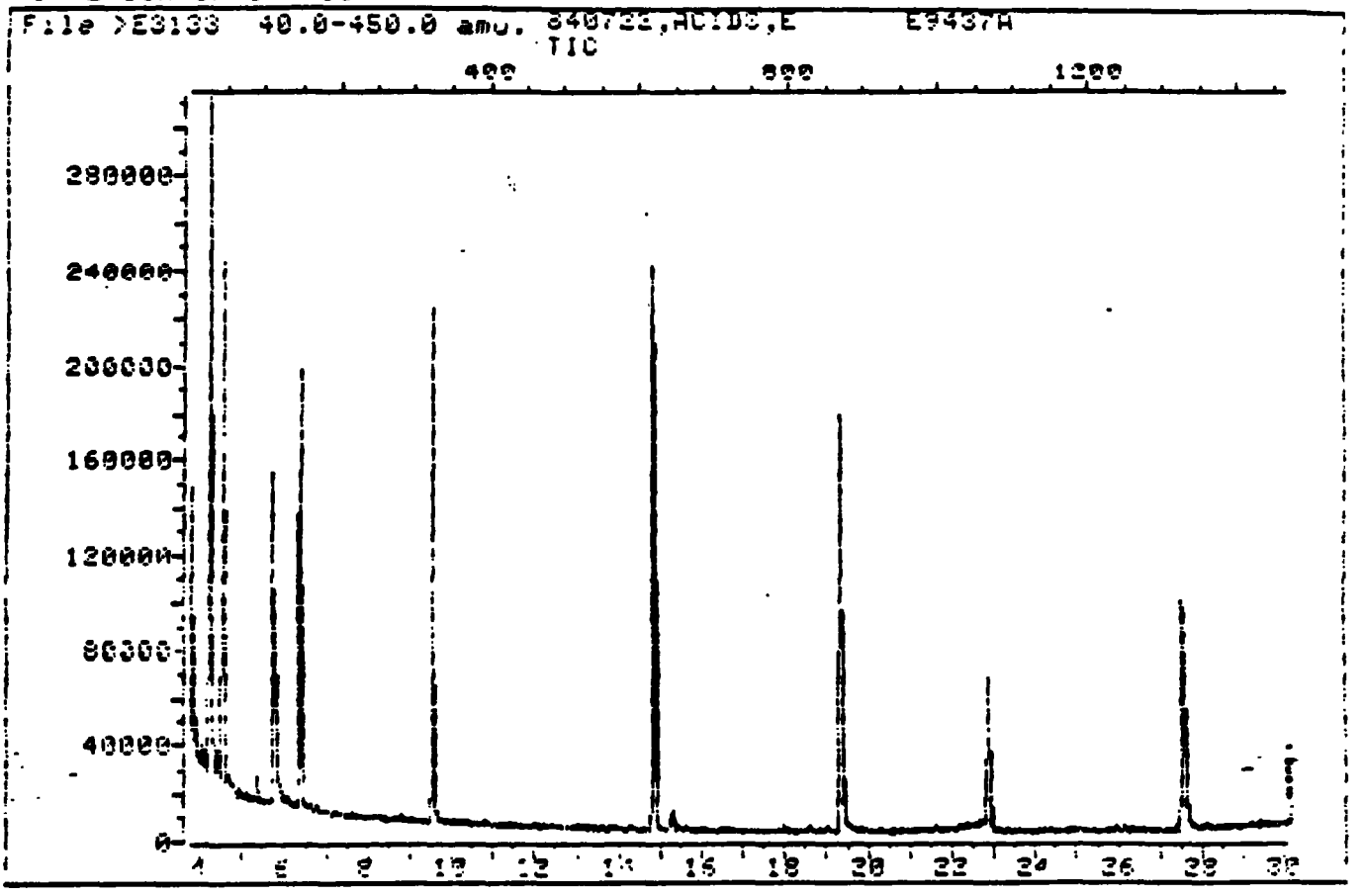
Data File: >A2874::U2
Name: VOA, 840718, A
Misc: E9437V

Id File: VOA1
Title: IDFILE, PURGEABLE PRIORITY POLLUTANTS, A
Last Calibration: 840718 19:38

Operator ID: RA0157
Count Time: 840719 01:00

~~006441~~

TOTAL ION CHROMATOGRAM

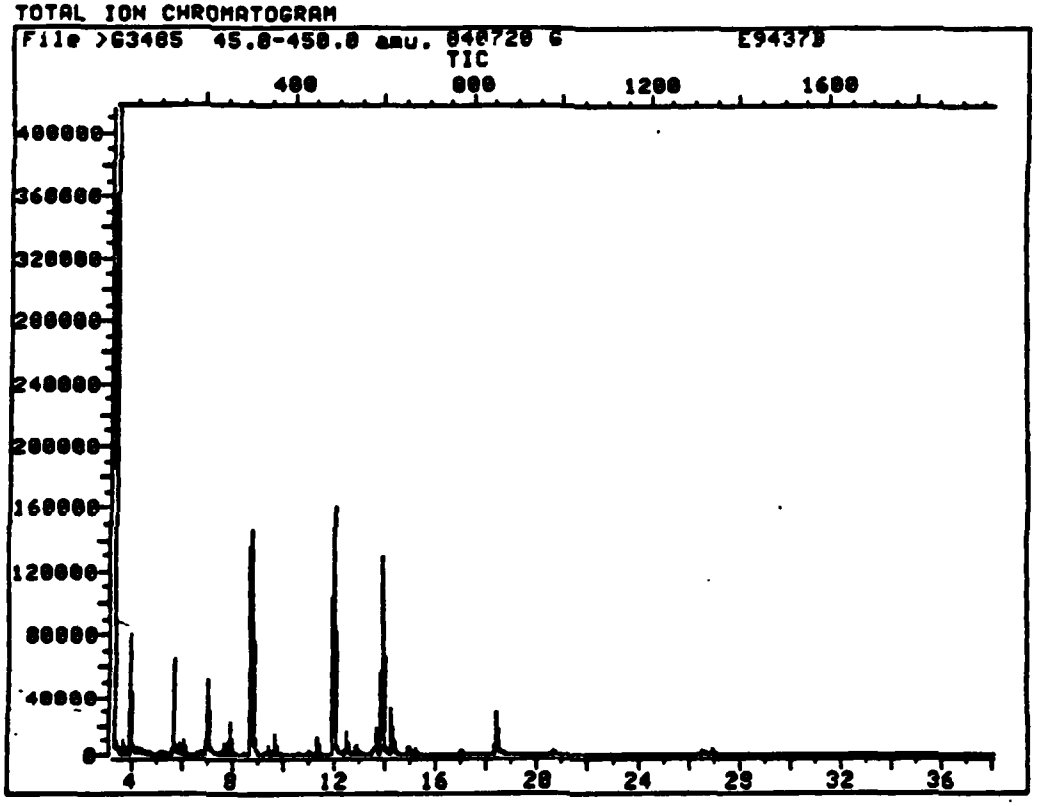


Data File: >E3133 U4
Name: 840722,ACIDS,E
Misc: E9437A BTL#13

Id File: EACID
Title ACID ID FILE.....WWC 6/21/83,#E
Last Calibration: 840723 00:06

Operator ID: TR0113
Quant Time: 840723 04:03

TOTAL ION CHROMATOGRAM



Data File: >G3485::U3
Name: 840720 G
Misc: E9437B

BTL#19

Id File: GBNP
Title: BN,PEST,IFB ISTDS IDFILE PVC..840510
Last Calibration: 840721 08:25

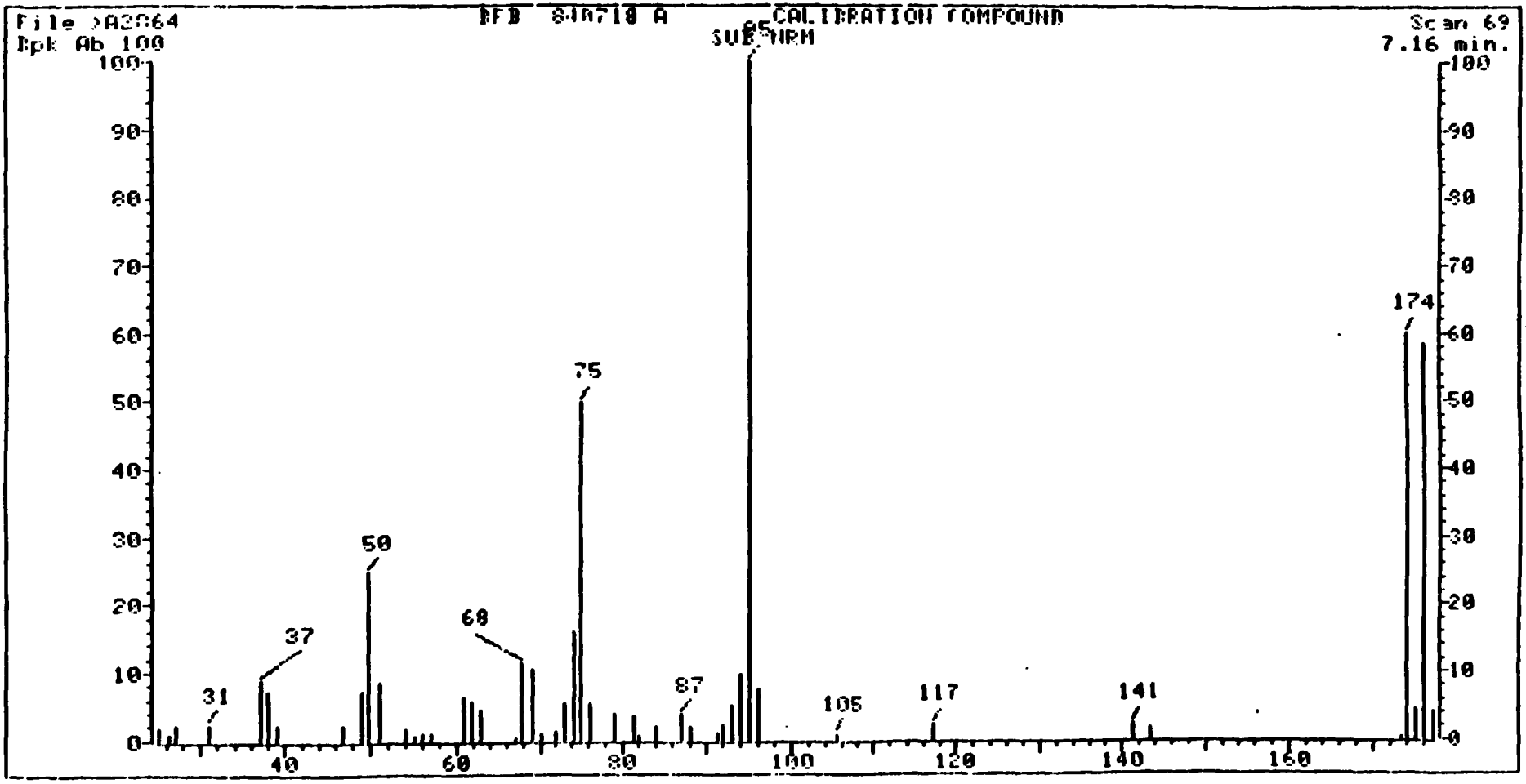
Operator ID: KB5414
Qaunt Time: 840721 10:45

Appendix B

Mass Spectral Data for Calibration Compounds

1) If the sample analysis included the determination of purgeable organic compounds then a mass spectrum for 4-bromofluorobenzene (BFB) is included. This data was used in the instrument calibration protocol on the day of analysis.

2) If the sample analysis included the determination of non-purgeable organic compounds then a mass spectrum for decafluorotriphenylphosphine (DFTPP) is included. This data was used in the instrument calibration protocol on the day of analysis.


File >A2064
Bpk Ab 100
BFB 840718 A
CALIBRATION COMPOUND
SUB NRM
Scan 69
7.16 min.
100
90
80
70
60
50
40
30
20
10
0
31
37
50
68
75
87
95
105
117
141
174
40
60
80
100
120
140
160

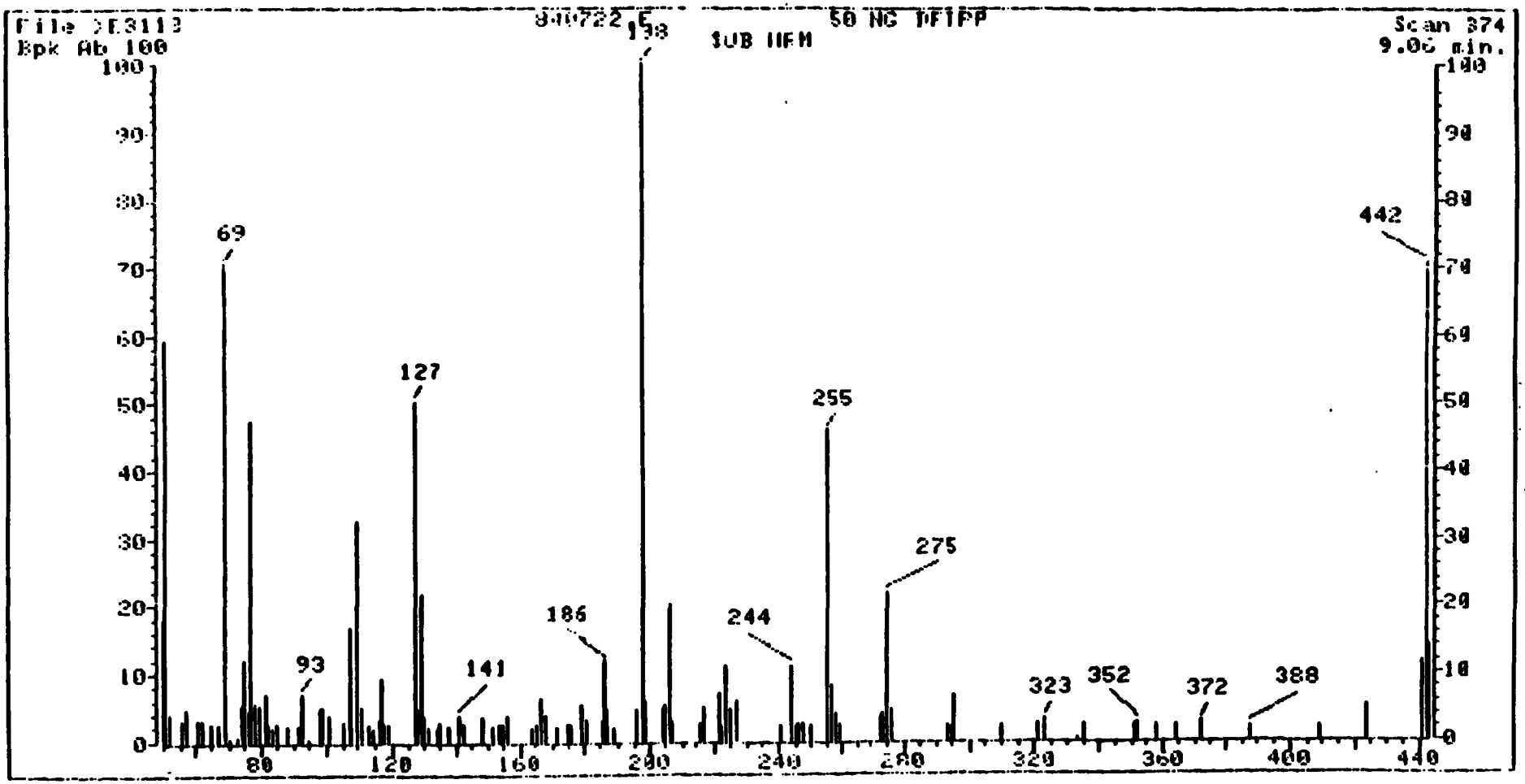
019171

69

BFB 840718 A CALIBRATION COMPOUND
SUM NRM

File: >A2864 Scan #: 69 Retn. time: 7.16

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
24.90	1.87	51.00	8.29	69.05	10.37	84.05	1.75	105.15	.64
26.10	.88	54.00	1.44	70.05	.84	86.95	3.51	117.15	1.94
26.90	1.95	55.10	.36	71.85	1.20	88.05	1.87	141.05	2.07
31.00	2.15	56.00	.76	72.95	5.30	91.15	.68	143.05	1.52
37.00	8.69	57.10	.84	74.05	15.99	92.05	2.11	173.30	.08
37.90	7.14	60.95	6.14	74.95	49.72	93.05	4.86	174.00	59.89
39.00	2.11	61.95	5.42	76.05	5.10	94.05	9.61	175.10	4.19
46.90	2.15	62.95	4.39	78.95	3.75	95.05	100.00	176.00	58.33
49.10	7.02	67.05	.20	81.05	3.23	96.05	7.54	177.10	4.03
49.80	24.72	67.95	11.12	81.95	.48				

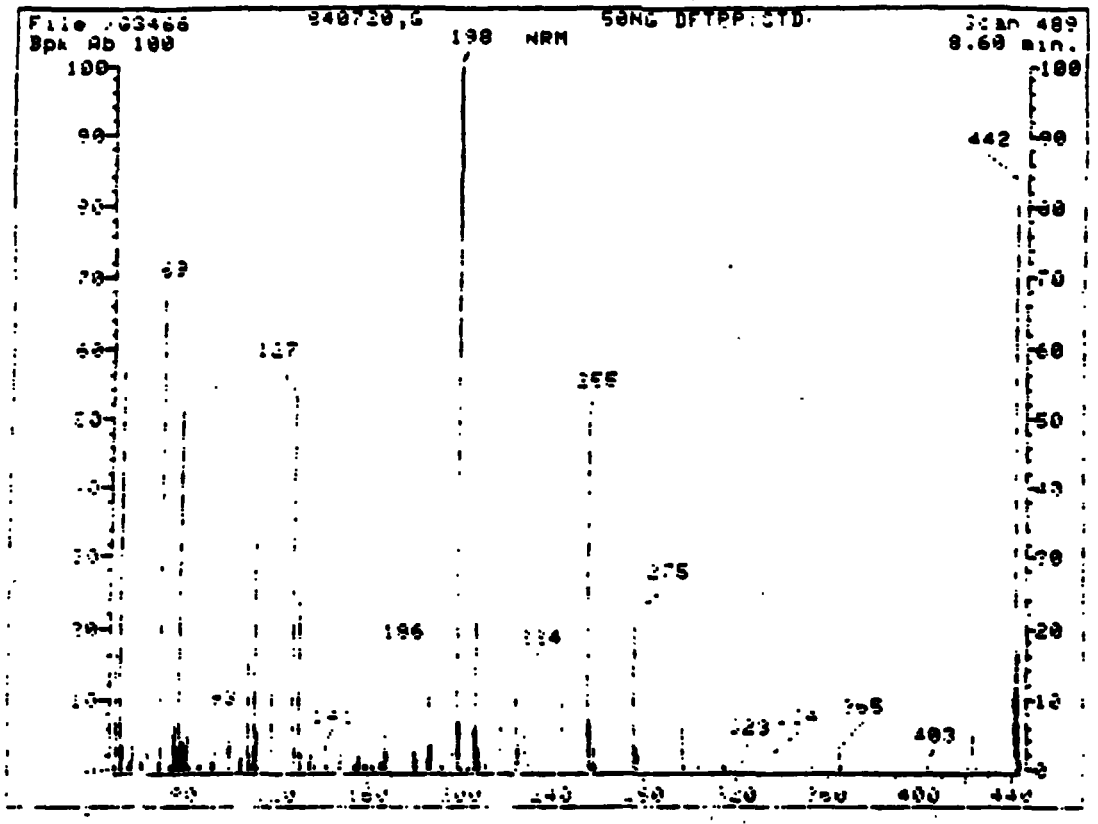

File DE3113
Bpk Ab 100
840722 15
SUB HFM
50 NG DFTPP
Scan 374
9.06 min.
100
90
80
70
60
50
40
30
20
10
0
69
93
127
141
186
198
244
255
275
323
352
372
388
442
80
120
160
200
240
280
320
360
400
440

>E3118 840722,E 50 NG DFTPP
374 SUB NRM
006444
019172

File >E3118 Scan #: 374 Retn. time: ,.06

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
50.00	18.03	88.35	1.97	134.80	2.84	198.05	100.00	273.10	3.31
51.00	59.25	91.45	2.17	137.30	2.01	198.85	5.92	274.00	3.87
51.95	3.83	93.05	6.86	141.05	3.75	204.05	4.46	275.00	21.70
56.05	3.16	94.95	.20	142.15	2.52	205.15	5.29	276.10	4.54
57.05	4.73	97.90	4.54	147.95	3.43	206.05	20.20	293.25	2.13
60.95	3.12	99.00	5.05	151.35	2.01	206.85	2.80	294.95	1.65
62.15	3.12	100.90	3.63	153.05	2.45	216.10	2.45	296.05	6.51
65.15	2.45	105.20	2.72	154.70	2.29	217.00	4.89	310.30	2.09
67.00	2.49	107.00	16.73	155.00	2.25	221.00	6.71	321.15	2.25
69.00	70.61	108.00	3.20	156.10	3.75	222.40	1.93	322.95	3.00
70.30	.24	110.00	32.54	163.70	1.89	223.70	10.81	333.50	.20
73.10	.43	111.05	4.85	165.20	2.49	225.10	4.46	335.20	2.17
74.00	5.36	113.15	2.49	167.00	6.11	227.00	6.00	350.55	2.09
75.00	11.79	114.45	1.78	168.00	3.55	240.75	2.09	352.05	2.41
76.10	4.34	116.15	2.92	171.35	2.21	244.10	11.01	358.25	2.05
77.00	47.34	117.05	0.92	174.75	2.37	245.30	2.13	364.70	2.21
78.00	5.44	117.75	2.33	176.05	2.41	245.70	2.25	372.10	2.60
79.00	5.29	119.05	2.29	179.05	5.29	247.00	2.29	387.65	1.05
79.60	.75	127.00	50.22	180.85	2.88	250.00	2.01	409.35	1.78
80.95	6.75	128.10	4.50	185.30	3.08	255.00	46.04	423.10	4.89
82.15	2.29	129.00	21.78	186.00	11.87	256.00	8.09	441.15	11.92
82.55	2.37	130.00	3.51	187.00	4.69	257.95	3.94	442.05	70.57
83.75	1.89	131.30	1.97	188.60	1.89	259.25	2.37	443.05	13.85
85.15	2.25	134.40	1.99	196.10	4.65				

AL,,3 Move cursor, then press carriage return :



Bpk Ab 100
198 NRM
8.60 min.
442
127
255
275
186
403

019173

006445

:TAB

>G3466 840720,G 50NG DFTPP STD
489 NRM

File: >G3466 Scan #: 489 Retn. time: 3.60

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
49.05	.70	84.10	.37	141.05	7.28	194.05	2.74	262.05	.58
50.05	.70	97.10	.59	141.95	.99	199.95	100.00	265.95	1.65
69.05	15.95	81.15	.93	147.10	1.30	199.05	6.96	277.10	1.03
81.05	76.25	82.05	1.07	148.00	2.70	199.95	.9	97.10	7.40
82.15	7.54	97.05	5.05	167.00	1.03	201.05	.55	275.10	21.45
93.15	.77	82.15	4.78	54.05	.56	202.05	.75	276.10	7.10
95.05	1.57	99.05	1.13	177.05	1.00	204.05	7.69	277.05	9.02
97.05	1.02	101.00	9.71	154.15	1.91	205.05	5.49	293.10	.46
41.05	1.05	111.10	1.74	187.05	.7	20-.10	27.95	294.10	6.16
11.10	.72	100.10	1.54	50.05	.73	207.10	7.04	307.00	.92
12.10	.61	111.10	1.04	150.05	.75	209.00	.70	307.15	.72
13.10	2.11	105.10	1.07	161.15	1.19	211.10	.90	314.00	.58
15.10	1.06	100.10	59	162.05	.39	217.05	6.13	315.00	.40
17.15	1.12	12.10	71.75	165.00	1.10	121.05	7.33	327.15	1.96
29.05	47.17	11.15	5.11	169.10	.95	227.05	1.10	334.10	.98
31.05	1.15	11.15	53	1.7.10	5.17	234.15	12.19	353.1	1.10
33.05	1.15	11.15	55	1.8.00	2.11	235.15	7.85	345.05	2.41
35.05	1.11	111.15	31	177.00	.43	237.10	5.15	355.05	.54
37.05	1.10	111.15	1.15	176.05	1.44	237.95	.92	377.15	1.13
39.10	1.10	111.10	1.55	179.05	1.17	239.10	1.05	386.1	.77
41.10	1.75	111.95	.7	170.05	.97	247.05	70	407.1	75
43.10	1.11	115.10	75	130.15	2.15	1.1.15	9.45	421.10	57
45.05	7.61	117.10	77.23	191.15	1.44	245.15	1.24	427.10	7.07
47.10	1.13	121.1	1.74	95.20	1.15	241.15	7.14	7.1.1	1.15
51.10	1.75	121.10	77.90	15.10	17.97	255.10	5.15	44.1	1.50
53.10	1.15	130.1	1.02	197.00	7.74	254.10	4.17	1.2	97.13
55.05	1.11	127.1	.33	199.10	70	257.00	.57	1.1	1.21
57.10	1.10	125.1	1.00	197.00	99	259.10	7.14	1.1	75
59.1	1.11	1.1.1	1.11						

Appendix C

Mass Spectral Data for Tentatively Identified Compounds

1) For each tentatively identified compound a mass spectrum of the detected compound, a reference mass spectrum for that compound and a plot of the spectral differences are provided.

TENTATIVELY IDENTIFIED ORGANIC COMPOUNDS

ACID FRACTION: NONE FOUND.

See Total Ion Chromatogram in Appendix A.

TENTATIVELY IDENTIFIED ORGANIC COMPOUNDS

BASE/NEUTRAL FRACTION: NONE FOUND.

See Total Ion Chromatogram in Appendix A.

Appendix E

Chain-of Custody Forms

1) A field Chain-of-Custody form (CC1) is included for all samples shipped by ETC shuttle.

2) An in-house sample Chain-of Custody form is included for the period the sample was in ETC's possession.

3) A subcontractor's Chain-of-Custody form is included for any analytical work not performed within ETC's laboratory.

4) Any additional Chain-of-Custody material provided by a client or by a client's sampling agent is also included.

CHAIN OF CUSTODY FORM (CC1)

Sealed By: J. Trotter

SHIP TO:

Company: RESOURCE ENGINEERING

Facility/Site: 11 GREENWAY PLAZA

Address: Houston, TX 77406

Attn.: COBY SHER

Phone: (713) 621 - 5900

SAMPLE IDENTIFICATION

Facility/Site Code: RES-288-01

Source Codes:

Well	(W)	River/Stream	(R)	Surface Impoundment	(I)	Lake/Ocean	(L)
Soil	(S)	Bottom Sediment	(B)	Pretreatment Facility	(P)	Treatment Facility	(T)
Outfall	(O)	Generation Point	(G)	Leachate Collection Sys.	(C)	Other	(X)

Source Code (from above)	Your Sample Point ID (left justify)	Start Date (mo/day/yr)	Start Time (2400 hr. clock)	Elapsed Hours (composite)
W	MW-6	06 29 84	1730	
Example: W	101J263P	05 15 81	0930	13

458

3'

SHUTTLE CONTENTS

Sample Bottle	Condition	Sample Bottle	Condition
E9437 E_1-E_4	~~X X X X~~	TB V2 REC'D	WITH HEAD SPACE
E9437 V_1-V_2	~~X X~~		
E9437 TB	X O.K.		

CHAIN OF CUSTODY CHRONICLE

1. Shuttle Opened By: (print) S. C. Itin Date: 6/26/84 Time: 1330
Signature: S. C. Itin Seal #: NOT NOTED Intact: YES

I have received these materials in good condition from the above person.
2. Name: Tom Beck Signature: Wm Thomas Beck
Date: 6-28-84 Time: 7:50 Remarks: Removed temporary seal

I have received these materials in good condition from the above person.
3. Name: DEAN GORE Signature: W D Gore Jr
Date: 6/29/84 Time: 18:20 Remarks:

I have received these materials in good condition from the above person.
4. Name: DEAN GORE Signature: W D Gore Jr
Date: 7/2/84 Time: 6:05 Remarks:

5. Shuttle Sealed By: (print) Date: Time:
Signature: Seal #:

ETC USE ONLY Opened By: B. Sharp Date: 7/3/84 Time: 12:00
Seal #: 18332 Condition: INTACT

ETC Form CC1 6/1/82

019176

ETC ENVIRONMENTAL TESTING and CERTIFICATION

E9437
ETC Sample No.:

SAMPLE POINT INFORMATION FORM (CC2)

FIELD MEASUREMENT DATA

Select up to 3 parameters to be recorded by entering the appropriate code letter in the first space for each of the 3 data entry fields provided. Enter the actual measurement data (in the units specified) for the three parameters you have selected.

PARAMETERS		ACTUAL (left justify)	EXAMPLE
Flow (CFS)	A		
Volume (Gal)	B		C25
Sample Depth (Ft)	C		
Depth to Water (Ft)	D		F50
Discharge Rate (GPM)	E		
Depth to Bottom (Ft)	F		
Event Time (2400-Hr Clock)	G		G1103
Depth to Screen (Ft)	H		

FIELD TEST DATA

DO (Mg/L) _____ Sample Temp. (°C) 39.4

pH 7.14 (Single Measurement) — (2nd of Quadruplicate) — (3rd of Quadruplicate) — (4th of Quadruplicate)

Specific Conductance (uMHOS/CM) 650 (Single Measurement) — (2nd of Quadruplicate) — (3rd of Quadruplicate) — (4th of Quadruplicate)

THE FOLLOWING DATA IS FOR YOUR RECORDS ONLY

SAMPLING METHOD (choose one)

AIR-LIFT PUMP ( )	PERISTALTIC PUMP ( )	THIEF ( )
AUGER ( )	PETERSEN ( )	TRIER ( )
BAILER (X)	PISTON PUMP ( )	VEIHMEYER ( )
BOTTLE ( )	SCOOP/SHOVE ( )	OTHER
COLIWASA ( )	SQUEEZE PUMP ( )	
DIPPER ( )	SUBMERSIBLE PUMP ( )	
KEMMERER ( )	SUCTION LIFT PUMP ( )	
NISKIN ( )	SURBER ( )	

SAMPLE TYPE (choose one)

GRAB (X) COMPOSITE ( ) OTHER ( )

(describe) (describe)

WEATHER: clear, hot, humid (describe)

SAMPLE DESCRIPTION (e.g., color, odor): very cloudy, brown, no obvious odor (describe)

Form Prepared By: DEAN GOPE (name (print)) Employer: RESOURCE ENGINEERING

ETC Form CC2 6/1/82

ETC ENVIRONMENTAL TESTING and CERTIFICATION

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number(s) E9434 TO E9438

Sample Preparation For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	L. Scalise/K. Albretson (J. [illegible])	7/16/84
Acids	Greg Marrin	7/18/84
Metals		
Others		
Others		
Others		
Others		

Sample Analysis For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Kris Bonaparte (cw)	7/20/84
Acids	Tom Rusowicz	7-22-84
VOA/Purgeables	(PK) ~~[illegible]~~	
Metals	Rich Albert (cw)	7/18/84
Others VOA	(PK) ~~[illegible] (E9237)~~	~~7/16/84~~
Others VOA/Purgeables	[illegible] 7/18	7/17/84
Others VOA/Purgeable	[illegible] E9434 7/18	
Others		
Others		
Others		

Verified By Harry Klaus

019177

~~006449~~

Technical Report

for

RESOURCE ENGINEERING

11 GREENWAY PLAZA

HOUSTON, TX 77406

MW-3

DOWN GRADIENT SHALLOW WELL

Chain of Custody Data Required for ETC Data Management Summary Reports						
E9436	RESOURCE ENGINEERING	RESSHER	WMW3	840629		
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*	*Time*	*Elapsed Hours*

James N. Bowen/fos

Denis C. K. Lin, Ph.D.

Vice President
Research and Operations

Introduction

This report contains the analytical results on your water sample, WMW3 84/06/29. It is designed to include comprehensive data from the entire analytical process in order to satisfy the needs of various levels of review.

The results obtained from your sample are presented in tabular format immediately following this introduction. Quality assurance data is tabulated along with the appropriate sample results for verification. Depending on the analyses ordered, the quality assurance data may include results from blank, spiked blank, spiked sample (i.e. matrix spike) and replicate sample as well as results from surrogate compound analyses. Quality assurance data for verification of proper instrument performance is also included where appropriate. The report appendices include the chain of custody record for your sample and, where appropriate, the gas chromatograms and mass spectra.

The procedures used in the analysis of the sample are described in this report's methodology section. All analytical procedures within our laboratory are performed within a strictly enforced Quality Assurance Protocol. A description of this Protocol is included in the report.

Results

Sample results, and associated quality assurance data, are always tabulated in one or more of this report's Quantitative Results Tables. The format of each table varies with the class of analysis.

Priority Pollutants

The priority pollutant compounds and elements are listed with their NPDES (National Pollution Discharge Elimination System) numbers, and the Method Detection Limit (MDL) published in the Federal Register, December 3, 1979. When a compound or element is present below its published MDL it is reported as BMDL (Below Method Detection Limit). When a compound or element is not present at any detectable concentrations it is reported as ND (Not Detected). Matrix spike and replicate analyses, where included, were performed on samples randomly chosen within each quality assurance batch and are therefore not necessarily spikes and replicates of this report's sample. Surrogate compound recovery data and instrument calibration data are included in the Method Performance Data Tables.

Qualitative Analysis

The GC/MS identification of compounds which are not included in the normal compound list for a given method is reported in a Qualitative Results Table. Each sample fraction is reported on an individual Qualitative Results Table. Wherever possible these compounds are reported with their molecular weight, empirical formula, and CAS number. The retention time and scan number is also provided to match the spectra included in the report appendices.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 20, 198

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds – GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9436	RESOURCE ENGINEERING	RES28801	WM/3	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1V	Acrolein	ND	100	ND	ND	ND	1600	96	ND	1600	100
2V	Acrylonitrile	ND	100	ND	ND	ND	160	53.	ND	160	70.
3V	Benzene	ND	10	ND	ND	ND	36	96	ND	36	111
4V	bis(Chloromethyl)ether	ND	10	ND	ND	ND	0	-	ND	0	-
5V	Bromoform	BMDL	10	ND	ND	ND	36	97	ND	36	118
6V	Carbon tetrachloride	ND	10	ND	ND	ND	36	100	ND	36	115
7V	Chlorobenzene	ND	10	ND	ND	ND	36	95	ND	36	109
8V	Chlorodibromomethane	11	10	ND	ND	ND	36	99	ND	36	126
9V	Chloroethane	ND	10	ND	ND	ND	36	97	ND	36	111
10V	2-Chloroethylvinyl ether	ND	10	ND	ND	ND	36	78	ND	36	87
11V	Chloroform	60	10	ND	ND	BMDL	36	88	ND	36	190
12V	Dichlorobromomethane	63	10	ND	ND	ND	36	98	ND	36	161
13V	Dichlorodifluoromethane	ND	10	ND	ND	ND	0	-	ND	0	-
14V	1,1-Dichloroethane	ND	10	ND	ND	ND	36	96	ND	36	111
15V	1,2-Dichloroethane	ND	10	ND	ND	ND	36	94	ND	36	110
16V	1,1-Dichloroethylene	ND	10	ND	ND	ND	36	93	ND	36	98
17V	1,2-Dichloropropane	ND	10	ND	ND	ND	36	96	ND	36	111
18V	cis-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	97	ND	36	108
19V	Ethylbenzene	ND	10	ND	ND	ND	36	95	ND	36	109
20V	Methyl bromide	ND	10	ND	ND	ND	36	108	ND	36	115
21V	Methyl chloride	ND	10	ND	ND	ND	36	97	ND	36	107
22V	Methylene chloride	BMDL	10	ND	ND	BMDL	36	56	ND	36	74
23V	1,1,2,2-Tetrachloroethane	ND	10	ND	ND	ND	36	91	ND	36	115
24V	Tetrachloroethylene	ND	10	ND	ND	ND	36	96	ND	36	108
25V	Toluene	ND	10	ND	ND	BMDL	36	83	ND	36	103
26V	1,2-Trans-dichloroethylene	ND	10	ND	ND	ND	36	99	ND	36	110
27V	1,1,1-Trichloroethane	11	10	ND	ND	ND	36	97	ND	36	112
28V	1,1,2-Trichloroethane	ND	10	ND	ND	ND	36	95	ND	36	111
29V	Trichloroethylene	ND	10	ND	ND	ND	36	96	ND	36	107
30V	Trichlorofluoromethane	ND	10	ND	ND	ND	36	96	ND	36	112
31V	Vinyl chloride	ND	10	ND	ND	ND	36	100	ND	36	114

019178

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ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 21, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9436	RESOURCE ENGINEERING	RES28801	MW3	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
	trans-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	100	ND	36	107

a EPA published Method Detection Limit.

b Recovery normally variable using EPA Protocol Method 624.

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ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Acid Compounds - GC/MS Analysis Data (QR02)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9436	RESOURCE ENGINEERING	RES28801	WW3	840629		

NPDES Number	Compound	Results: Sample Concen. ug/l	Results: MDL ug/l a	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Concen. Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Sample ug/l	QC Matrix Spike: Concen Added ug/l	QC Matrix Spike: % Recov
1A	2-Chlorophenol	ND	25	ND	ND	ND	150	78	ND	150	57
2A	2,4-Dichlorophenol	ND	25	ND	ND	ND	150	95	ND	150	53
3A	2,4-Dimethylphenol	ND	25	ND	ND	ND	150	2b	ND	150	0c
4A	4,6-Dinitro-o-cresol	ND	250	ND	ND	ND	250	88	ND	250	75
5A	2,4-Dinitrophenol	ND	250	ND	ND	ND	250	110	ND	250	130
6A	2-Nitrophenol	ND	25	ND	ND	ND	150	78	ND	150	70
7A	4-Nitrophenol	ND	25	ND	ND	ND	150	71	ND	150	86
8A	p-Chloro-m-cresol	ND	25	ND	ND	ND	150	67	ND	150	25c
9A	Pentachlorophenol	ND	25	ND	ND	ND	150	106	ND	150	86
10A	Phenol	ND	25	ND	ND	ND	150	77	ND	150	45
11A	2,4,6-Trichlorophenol	ND	25	ND	ND	ND	150	101	ND	150	76

a EPA published Method Detection Limit.
b Recovery normally low using EPA Protocol Method 625.
c Recovery low due to sample matrix interference.

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ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9436	RESOURCE ENGINEERING	RES28801	WM3	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1B	Acenaphthene	ND	10	ND	ND	ND	100	104	ND	105	100
2B	Acenaphthylene	ND	10	ND	ND	ND	100	101	ND	105	100
3B	Anthracene	BMDL	10	ND	ND	ND	100	67	ND	105	81
4B	Benzidine	ND	10	ND	ND	ND	100	0.	ND	105	0.
5B	Benzo(a)anthracene	ND	10	ND	ND	ND	100	133	ND	105	126
6B	Benzo(a)pyrene	ND	10	ND	ND	ND	100	128	ND	105	133
7B	Benzo(b)fluoroanthene	ND	10	ND	ND	ND	100	160	ND	105	153
8B	Benzo(ghi)perylene	ND	10	ND	ND	ND	0	-	ND	0	-
9B	Benzo(k)fluoranthene	ND	10	ND	ND	ND	100	124	ND	105	114
10B	bis(2-Chloroethoxy)methane	ND	10	ND	ND	ND	100	65	ND	105	87
11B	bis(2-Chloroethyl) ether	ND	10	ND	ND	ND	100	100	ND	105	246.
12B	bis(2-Chloroisopropyl)ether	ND	10	ND	ND	ND	100	306c	ND	105	107c
13B	bis(2-Ethylhexyl)phthalate	BMDL	10	135	44	BMDL	100	103	ND	105	230.
14B	4-Bromophenyl phenyl ether	ND	10	ND	ND	ND	100	65	ND	105	81
15B	Butyl benzyl phthalate	ND	10	ND	ND	ND	100	110	ND	105	94
16B	2-Chloronaphthalene	ND	10	ND	ND	ND	100	80	ND	105	87
17B	4-Chlorophenyl phenyl ether	ND	10	ND	ND	ND	100	105	ND	105	95
18B	Chrysene	ND	10	ND	ND	ND	100	102	ND	105	86
19B	Dibenzo(a,h)anthracene	ND	10	ND	ND	ND	0	-	ND	0	-
20B	1,2-Dichlorobenzene	ND	10	ND	ND	ND	100	33.	ND	105	52.
21B	1,3-Dichlorobenzene	ND	10	ND	ND	ND	100	30.	ND	105	45.
22B	1,4-Dichlorobenzene	ND	10	ND	ND	ND	100	33.	ND	105	47.
23B	3,3'-Dichlorobenzidine	ND	10	ND	ND	ND	100	17.	ND	105	21.
24B	Diethyl phthalate	ND	10	ND	ND	ND	100	6.	ND	105	44.
25B	Dimethyl phthalate	ND	10	ND	ND	ND	100	1	ND	105	12
26B	Di-n-butyl phthalate	ND	10	ND	ND	BMDL	100	60	ND	105	80
27B	2,4-Dinitrotoluene	ND	10	ND	ND	ND	100	74	ND	105	88
28B	2,6-Dinitrotoluene	ND	10	ND	ND	ND	100	98	ND	105	100
29B	Di-n-octyl phthalate	ND	10	ND	ND	ND	100	137	ND	105	117
30B	1,2-Diphenylhydrazine	ND	10	ND	ND	ND	100	92	ND	105	90
31B	Fluoranthene	ND	10	ND	ND	ND	100	62	ND	105	90

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9436	RESOURCE ENGINEERING	RES28801	WW3	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen, ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
32B	Fluorene	ND	10	ND	ND	ND	100	95	ND	105	94
33B	Hexachlorobenzene	ND	10	ND	ND	ND	100	107	ND	105	87
34B	Hexachlorobutadiene	ND	10	ND	ND	ND	100	14b	ND	105	43b
35B	Hexachlorocyclopentadiene	ND	10	ND	ND	ND	0	-	ND	0	-
36B	Hexachloroethane	ND	10	ND	ND	ND	100	16b	ND	105	32b
37B	Indeno(1,2,3-c,d)pyrene	ND	10	ND	ND	ND	0	-	ND	0	-
38B	Isophorone	30	10	ND	ND	ND	100	83	ND	105	88
39B	Naphthalene	ND	10	ND	ND	ND	100	44	ND	105	54
40B	Nitrobenzene	ND	10	ND	ND	ND	100	83	ND	105	198
41B	N-Nitrosodimethylamine	ND	10	ND	ND	ND	0	-	ND	0	-
42B	N-Nitrosodi-n-propylamine	ND	10	ND	ND	ND	100	74	ND	105	77
43B	N-Nitrosodiphenylamine	ND	10	ND	ND	ND	100	127	ND	105	129
44B	Phenanthrene	ND	10	ND	ND	ND	100	81	ND	105	83
45B	Pyrene	ND	10	ND	ND	ND	100	108	ND	105	96
46B	1,2,4-Trichlorobenzene	ND	10	ND	ND	ND	100	209c	ND	105	197c

a EPA published Method Detection Limit.
b Recovery normally low using EPA Protocol Method 625.
D Recovery variable due to sample matrix interference.
C Recovery normally variable using EPA Protocol Method 625.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds - GC/MS Analysis Data - Acid Fraction (QR07)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9436	RESOURCE ENGINEERING	RES28801	MW3	840629		

	Compound Name	Data: Scan Number	Data: Retention Time (Min)	Data: M.W.	Identifiers: CAS Number	Identifiers: Empirical Formula	Estimated Concen. ug/l		
1	3-Buten-2-one, 4-phenyl	822	18.5	146	122576	$C_{10}H_{10}O$	1		
2	1,2,4-Triazolo [4,3-a]pyridine, 3-phenyl	794	18.0	195	778654	$C_{12}H_9N_3$	1		
3	1,3-Isobenzofurandione	458	11.9	148	85449	$C_8H_4O_3$	1		
4	2(3H)-Furanone, dihydro	60	4.8	86	96480	$C_2H_6O_2$	11		

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds – GC/MS Analysis Data – Base/Neutral Fraction (QR08)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9436	RESOURCE ENGINEERING	RES28801	MW3	840629		

Compound Name	Data: Scan Number	Data: Retention Time (Min)	Data: M.W.	Identifiers: CAS Number	Identifiers: Empirical Formula	Estimated Concen. ug/l		
1 Cyclopentanol, 1,2-Dimethyl -3- Methylethenyl	278	82	154	4099074	$C_{10}H_{18}O$	4		
2 3-cyclohexen-1-ol, 3 methyl	512	12.4	112	53783918	$C_7N_{12}O$	4		
3 2(1H)-Pyrimidinone, 4-amino	573	13.4	111	71307	$C_4H_5N_3O$	25		

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 27, 1984

TABLE 1: QUANTITATIVE RESULTS

Conventionals Analysis Data (QR12)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9436	RESOURCE ENGINEERING	RES28801	MW3	840629		

Parameter	Results							
	Sample Measure.	MDL	Units of Measure.					
pH	6.90		std					
Specific Conductance	3150		um/cm					
Temperature	39.10		Deg. C					

019182

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Acids Analysis (QR22)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9436

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	59
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	50
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	6
275	10-30% of mass 198	22
365	Greater than 1% of mass 198	>1
441	Less than mass 443	12
442	Greater than 40% of mass 198	71
443	17-23% of mass 442	14

Date: 840722
Run No: >E3118
Spectrum No: +374 -155
Analyst: T. Rusowicz

006454

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 26, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Base/Neutrals Analysis (QR23)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9436

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	56
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	53
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	7
275	10-30% of mass 198	21
365	Greater than 1% of mass 198	2
441	Less than mass 443	12
442	Greater than 40% of mass 198	83
443	17-23% of mass 442	17

Date: 840720
Run No: G3466
Spectrum No: 489
Analyst: K. Bonaparte

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 2: METHOD PERFORMANCE DATA

Surrogate Recovery – GC/MS Data (QR20)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9436

ETC Sample No. | Company | Facility | Sample Point | Date | Time | Elapsed Hours

Compound	Amount Added ug	% Recovery	Control Limits * Lower	Control Limits * Upper
VOLATILE FRACTION				
Bromochloromethane	200	94	74	122
Benzene, d_6	150	81**	83	119
Fluorobenzene	150	81**	88	116
1,4-Dichlorobutane	200	94	75	123
Pentafluorobenzene	150	84**	90	126
Ethylbenzene, d_{10}	150	83	83	127
ACID FRACTION				
2-Fluorophenol	80	22	16	100
Pentafluorophenol	80	33	25	113
BASE/NEUTRAL FRACTION				
2-Fluorobiphenyl	80	90	57	101
1-Fluoronaphthalene	80	55	55	103
Nitrobenzene, d_5	80	105	63	143

* Two Standard Deviations About the Mean.

** Recovery low due to sample matrix interference.

019183

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 21, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Bromofluorobenzene (BFB) for Volatiles Analysis (QR21)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9436

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
50	15-40% of Mass 95	24
75	30-60% of Mass 95	49
95	Base Peak, 100% relative abundance	100
96	5-9% of Mass 95	7
173	Less than 1% of Mass 95	<1
174	Greater than 50% of Mass 95	60
175	5-9% of mass 174	4
176	Greater than 95% but less than 101% of Mass 174	58
177	5-9% of mass 176	4

Date: 840718
Run No: >A2864
Spectrum No: 69
Analyst: R. Albert

006456

019184

Methodology
for
GC/MS Analysis of Priority Pollutant Compounds

The methods employed in the GC/MS analysis for priority pollutants are established EPA methods. Rigid compliance with the instrument parameters and performance criteria of the published methods was achieved. In some cases, the precise amounts of sample used and the sample handling procedures vary with the complexity of the sample matrix. Qualitative identification of the priority pollutants was performed using the relative retention times, the relative abundance of three characteristic ions and the abundance ratios. The entire mass spectrum was reviewed to confirm each identification. Quantitative analysis of detected compounds was performed by using a response factor generated by a major characteristic ion of the specific compound and an internal standard.

Compounds, in addition to those on the priority pollutant list, were identified through a computer-aided search of the NBS-EPA spectra library. After review the identifications are included in a separate tabulation and labelled "tentatively identified".

Volatile Priority Pollutant Compounds

For the analysis of Volatile priority pollutants, EPA Method 624 (Federal Register, December 3, 1979; page 69532) was used. The method can be summarized as follows: Helium is bubbled through a 5 ml water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the organic components are trapped. After the purge cycle is complete, the sorbent column is heated and backflushed with helium to desorb the organic purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeable mixture. The separated purgeable components are then identified and quantitated using a computerized mass spectrometer.

Acid, Base/Neutral and Pesticide Priority Pollutant Compounds

For the analysis of the Acid, Base/Neutral and Pesticide priority pollutants in an aqueous liquid matrix, EPA Method 625 (Federal Register, December 3, 1979; page 69540) was used. The method can be summarized as follows: A measured volume of sample, approximately 1 liter, is adjusted to a pH greater than 11 and extracted with methylene chloride. The pH of the sample is adjusted to a value less than 2 and extracted with an aliquot of fresh methylene chloride. A separatory funnel or continuous extractor is used to perform the extractions. The two extracts are dried and concentrated to a 1 ml final volume. Each extract is injected into a GC/MS instrument specifically configured for the correct fraction.

Quality Assurance/Quality Control Procedures (QA/QC)

ETC bases its quality assurance protocols on the following government guidelines:

. "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;

. National Enforcement Investigation Center Policies, and Procedures manual; EPA-330/9/79/001-R, October 1979;

. the recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979, pp. 69532-69559);

. "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980; and

. "Determination of 2,3,7,8-TCDD in Soil and Sediment" EPA, Region VII, Kansas City, September 1983.

However, we have modified our protocols to provide a higher level of QA/QC than the guidelines require. For example, we analyze a higher than required number of quality control samples and we pay especially careful attention to the certification of the "reference standard" compounds we use in analysis. Below are listed the key QA/QC elements for the methods we used.

Analysis of Volatile Organic Compounds (EPA Method 624)

- Each batch of 13 samples consists of 9 customer samples (at maximum), one blank sample, one spiked blank, one spiked sample and one replicate sample. This amounts to a 30% quality control factor.

- Three surrogate compounds are added to each sample in the batch of 13.

- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.

- Each GC/MS is checked and retuned, if necessary, every 8 hours to ensure that its performance on bromofluorobenzene (BFB) meets the EPA criteria.

- A calibration curve for quantitation is prepared using a mixture of Volatile Organic Priority Pollutant "standards" at a minimum of 3 different concentrations and using a mixture of 3 internal standards at a constant concentration.

- The calibration curve is verified with a mixture of priority pollutant standards every 8 hours.

- Results are compared to the acceptance criteria given in Method 624; any that do not meet the criteria are re-analyzed.

Analysis of Organic Compounds Extracted in Acid or Base/Neutral Solutions (EPA Method 625)

- Each batch of 20 samples consists of 16 customer samples (at maximum), one blank sample, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate customer sample. This amounts to a 20% quality control factor.

- Five surrogate compounds are added to each sample in the batch of 20.

- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.

- Each GC/MS is checked and retuned, if necessary, every eight hours to ensure that its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of standards composed of either the Organic Acid or Base/Neutral Extractable Compounds at a minimum of 3 concentrations and using 2,2'-difluorobiphenyl as an internal standard.
- The calibration curve is verified with a mixture of priority pollutant standards every eight hours.
- Results are compared to the acceptance criteria given in Method 625; any that do not meet the criteria are re-analyzed.

Analysis of Metals

All Samples

- New standards are prepared for each batch of samples.
- Normal calibration is performed using a blank sample and four standards that have been through the sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis that requires the use of the "method of additions" technique, a three point calibration is performed using U.S EPA "Methods for Chemical Analysis of Water and Wastes, 1979". Results are obtained using linear regression analysis. Any results with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- In constructing the normal calibration curves the lowest concentration levels we use are values greater than or equal to 5 times the Instrumental Detection Limit (IDL).
- All calibration standards are analyzed in duplicate, at a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to validate the normal calibration curve.

Homogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are homogeneous, the QC program is a minimum of 42% and consists of analyzing:

- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Heterogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are heterogeneous, the QC program is a minimum of 65% and consists of analyzing:

- each of the 30 customer samples in duplicate;
- 4 Replicates;
- 4 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Analysis of Mercury

To analyze samples for mercury we group them by matrix in batches of 20 or less. Our QC program is a minimum of 66% and consists of analyzing:

- each of the 20 customer samples in duplicate;
- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 10 Calibration standards (processed using the sample preparation method); and
- 2 Blanks.

Analysis of Pesticides, Herbicides and PCB's (EPA Method 608)

Pesticide, herbicide and PCB samples are grouped in batches of 16 customer samples or less according to the type of analysis to be performed. The QC program for each of these three types of analyses is a minimum of 20% and consists of analyzing:

- 1 blank sample;
- 1 spiked blank sample;
- 1 replicate sample;
- 1 replicate spiked sample; and
- 1 blank QC sample for at least each 100 samples analyzed.

The GC instruments are tuned daily to meet performance criteria in Method 608. Because Method 608 lacks data acceptance criteria, ETC has developed its own upper and lower quality control limits. When a test result falls outside the control limits, the test is re-run.

Analysis of Cyanides and Phenols

Cyanides and phenols are analyzed using a Technicon AutoAnalyzer II GT.

- Absorbance of full scale standards must be within +/- 25% of nominal absorbance.
- Duplicate calibration standards at four different concentrations are run with each batch of customer samples.
- At least one intersample standard is run for each 20 customer samples.
- Gain and carryover standards are analyzed at the end of each run.

Analysis of Total Organic Halide (TOX)

- Blank reagent water must contain less than 5 ug/l of halide (as chloride).
- Using a trichlorophenol standard, the mean adsorption efficiency must be within +/- 15% of the standard value.
- Pure compound recoveries must average 100 +/-15% (standard deviation).

Analysis of 2,3,7,8-TCDD (Dioxin) by GC/MS (SIM)

- Each sample is dosed with a known quantity of $^{13}C_{12}$-2,3,7,8-TCDD as internal standard and $^{37}Cl_4$-TCDD as surogate standard. The action limits for surrogate standard results is +/- 40% of the true value. Samples showing surrogate standard results outside of these limits are reextracted and reanalyzed.
- A laboratory "method blank" is run along with each set of 24 or fewer samples. The method blank is also dosed with the internal standard and surrrogate standard.
- At least one per set of 24 samples is run in duplicate to determine intralaboratory precision.
- Qualitative Requirements. The following are met in order to confirm the presence of native 2,3,7,8-TCDD:

  a. Isomer specificity must be demonstrated initially and verified once per 8-hour work shift. The verification consists of injecting a mixture containing TCDD isomers which elute close to 2,3,7,8-TCDD. The 2,3,7,8-TCDD must be separated from interferring isomers, with no more than 25% valley relative to the 2,3,7,8-TCDD peak.

  b. The 320/322 ratio is within the range of 0.67 to 0.87.

  c. Ions 320, 322, and 257 are all present and maximize together the signal to mean noise ratio must be 2.5 to 1 or better for all 3 ions.

  d. The retention time is equal (within 3 seconds) the retention time for the isotopically labeled 2,3,7,8-TCDD.

  e. At least one of the positives can be confirmed by obtaining partial scan spectra from mass 150 to mass 350. The partial scan guidelines are as follows:

  . the 320/324 ratio should be 1.58 +/- 0.16

  . the 257/259 ratio should be 1.03 +/- 0.10

  . the 194/196 ratio should be 1.54 +/- 0.15

- One sample is spiked with native 2,3,7,8-TCDD at a level of 1.0 PPB (for soil) for each set of 24 or fewer samples.

- In cases where no native 2,3,7,8-TCDD is detected, the actual detection limit is estimated and reported based on a signal to noise ratio of 2.5 to 1 at ions 320 and 322.

- For each sample, the internal standard is present with at least a 10 to 1 signal to noise ratio for both mass 332 and mass 334. Also, the internal standard 332/334 ratio must be within the range of 0.67 to 0.87.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;

- outgoing shipping manifests;

- the chain-of-custody form completed by the person(s) breaking the Shuttle seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;

- incoming shipping manifests;

- breaking the Shuttle's reseal;

- storing each labeled sample bottle in a secured area;

- disposition of each sample to an analyst or technician; and

- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody; and

- the time and date each person accepted or relinquished custody.

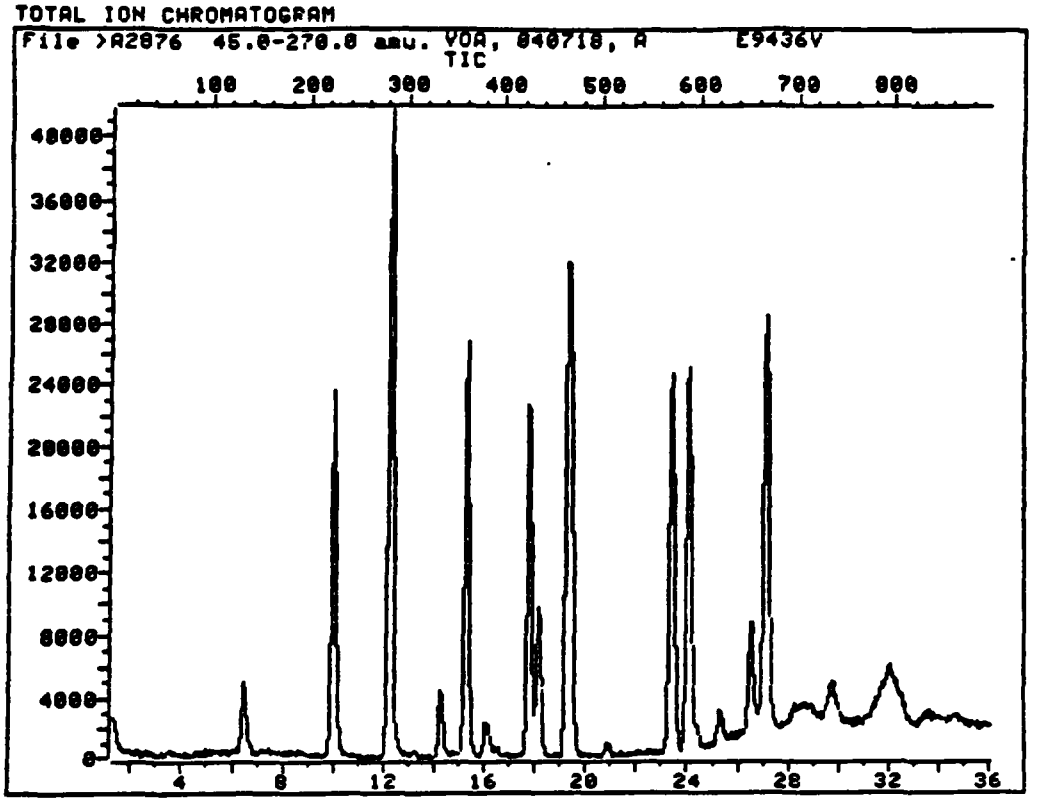
Appendix A

Mass Spectral Data for Quantitated Compounds

1) A total ion chromatogram for each sample analysed by a GC/MS instrument.

2) A mass spectrum and a reference spectrum for each priority pollutant compound detected in the sample.

TOTAL ION CHROMATOGRAM



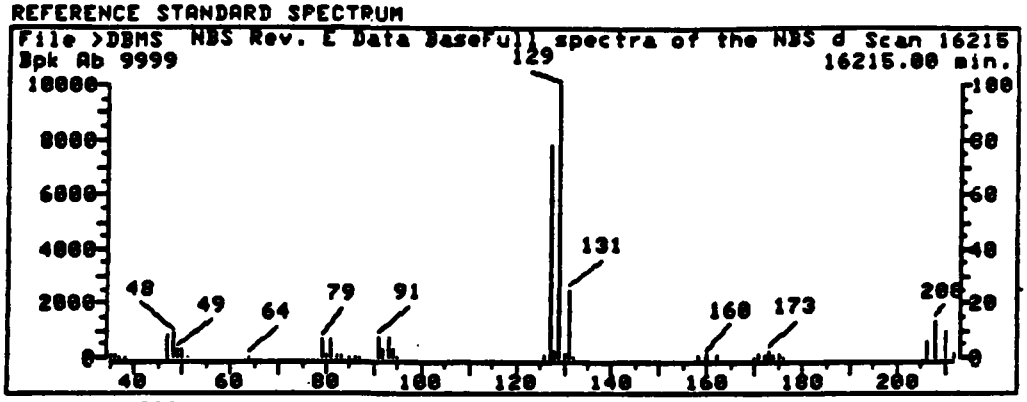
Data File: >A2876::U2
Name: VOA, 840718, A
Misc: E9436V

Id File: VOA1
Title: IDFILE, PURGEABLE PRIORITY POLLUTANTS, A
Last Calibration: 840718 19:38

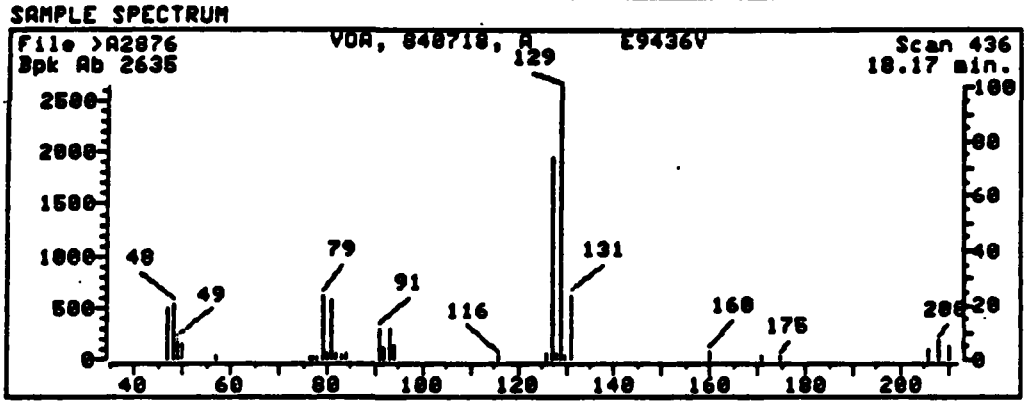
Operator ID: RA0157
Count Time: 840719 02:27

~~006460~~

REFERENCE STANDARD SPECTRUM



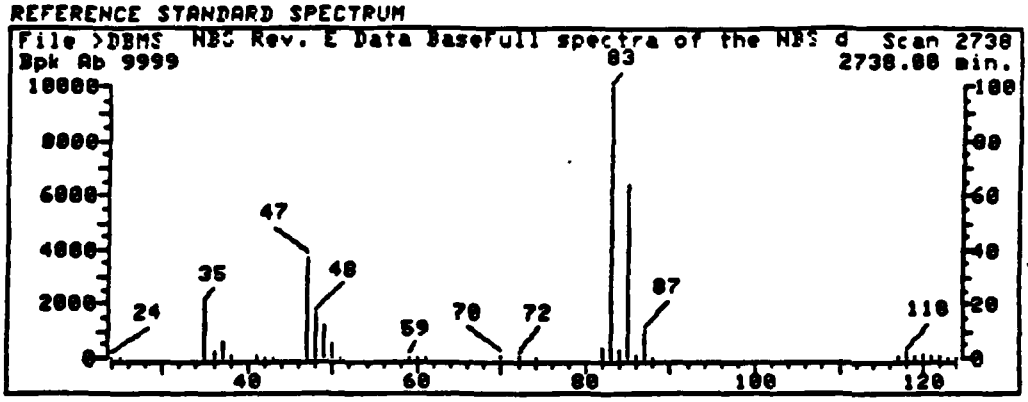
SAMPLE SPECTRUM



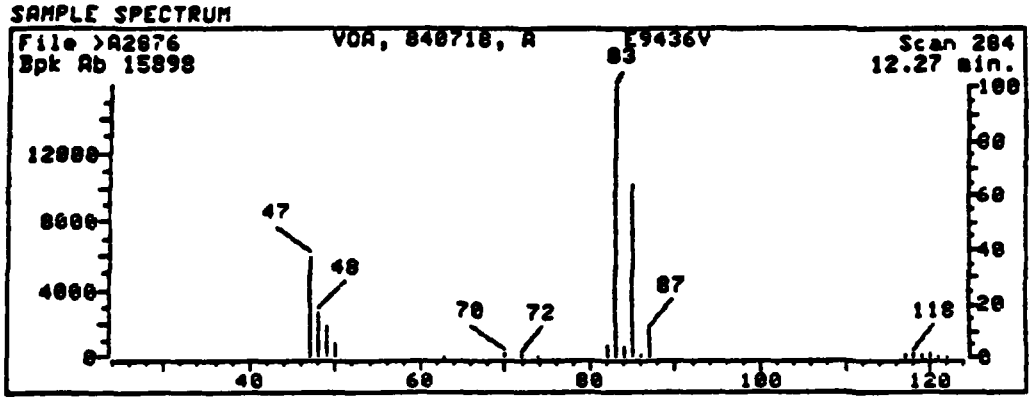
Data File: >A2876::U2
Name: VOA, 840718, A
Misc: E9436V

Compound No: 9
Compound Name: Chlorodibromomethane
Scan Number: 436
Retention Time: 18.17 min.
Area: 14215
Concentration: 54.63 NG

REFERENCE STANDARD SPECTRUM



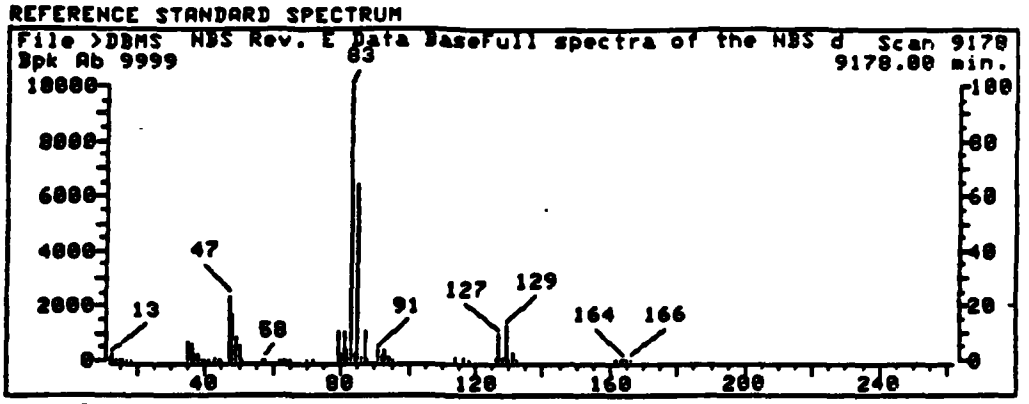
SAMPLE SPECTRUM



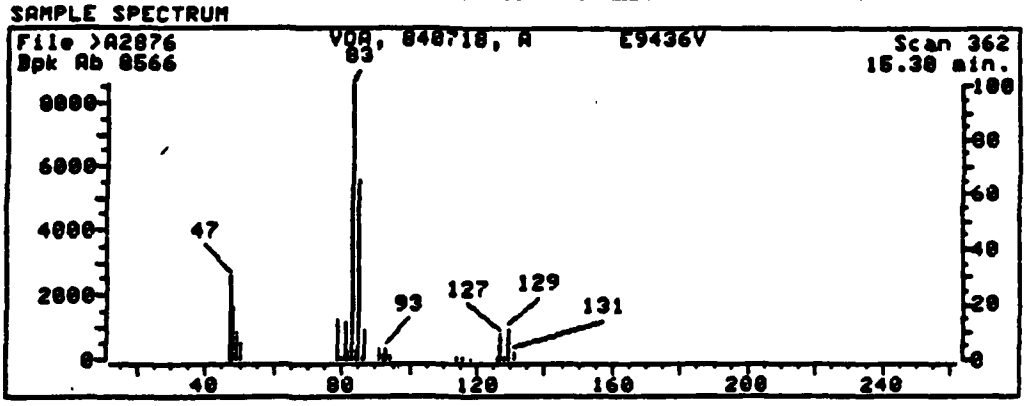
Data File: >A2676::U2
Name: VOA, 840718, A
Misc: *E9436V*

Compound No: 12
Compound Name: Chloroform
Scan Number: 284
Retention Time: 12.27 min.
Area: 85282
Concentration: 308.82 NG

REFERENCE STANDARD SPECTRUM



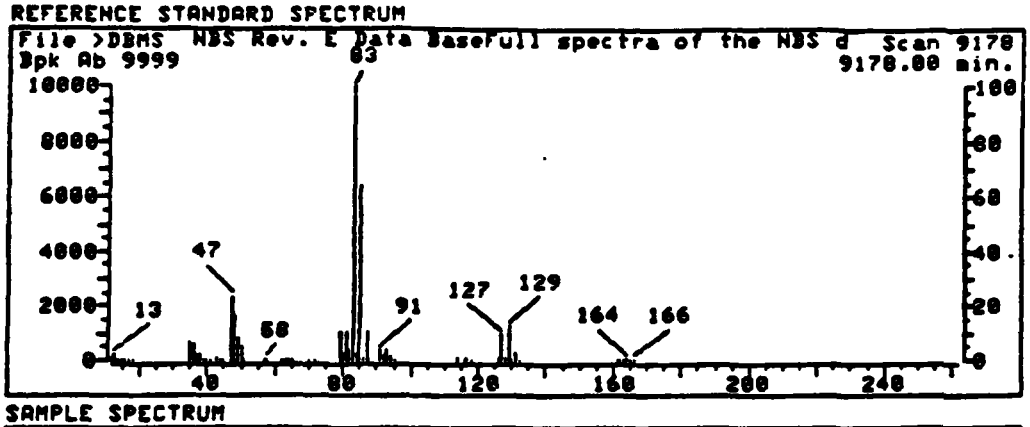
SAMPLE SPECTRUM



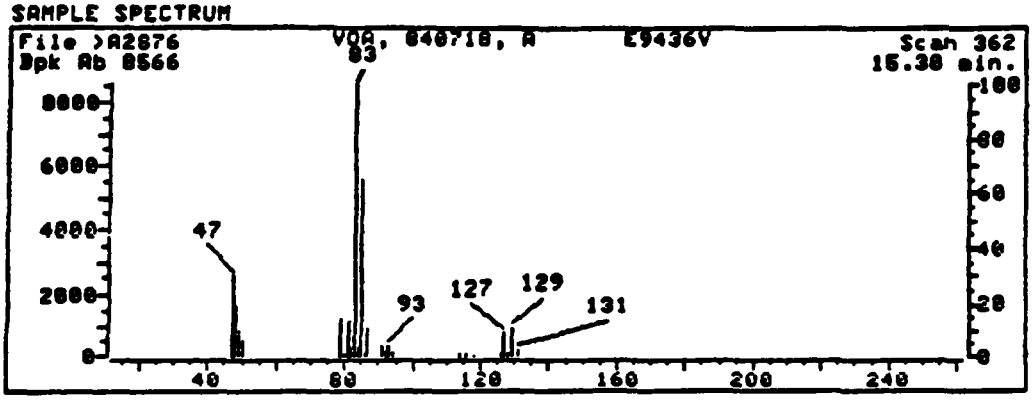
Data File: >A2876::U2
Name: VOA, 840718, A
Misc: E9436V

Compound No: 13
Compound Name: Dichlorobromomethane
Scan Number: 362
Retention Time: 15.30 min.
Area: 45903
Concentration: 317.14 NG

REFERENCE STANDARD SPECTRUM



SAMPLE SPECTRUM

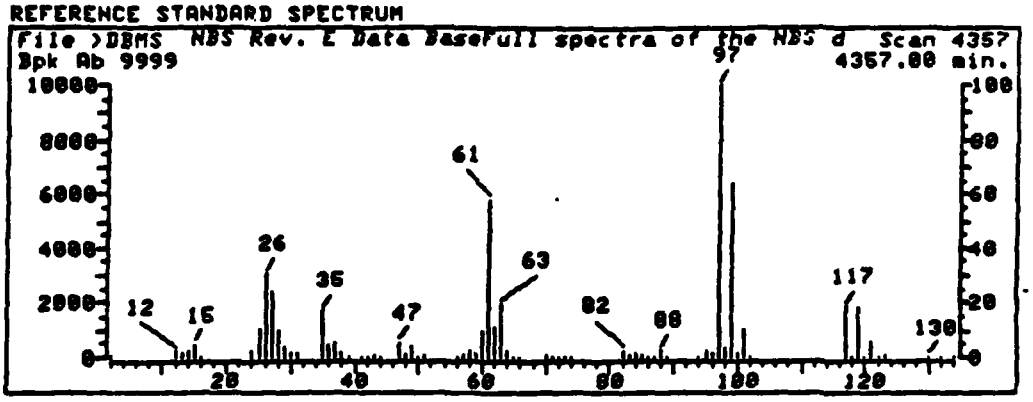


Data File: >A2876::U2
Name: VOA, 840718, A
Misc: E9436V

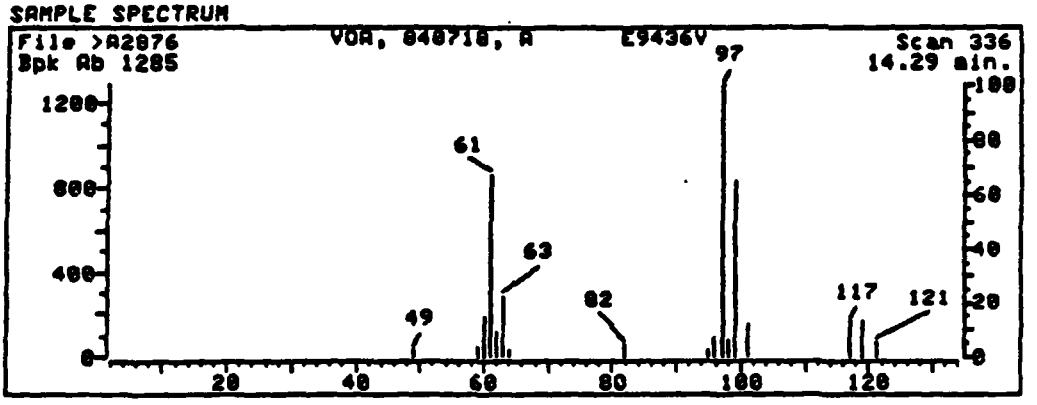
Compound No: 13
Compound Name: Dichlorobromomethane
Scan Number: 362
Retention Time: 15.30 min.
Area: 45903
Concentration: 317.14 NG

~~006462~~

REFERENCE STANDARD SPECTRUM



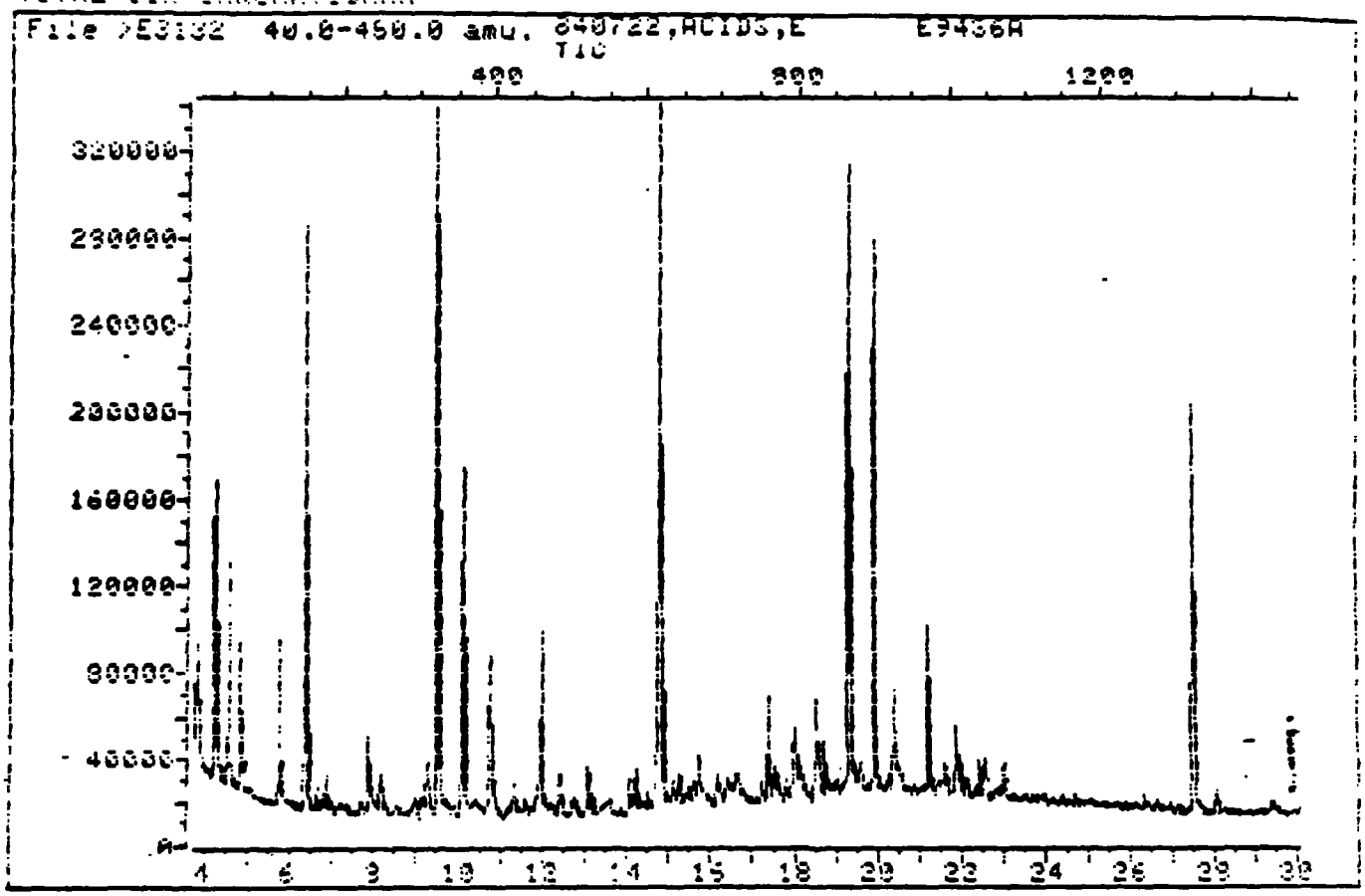
SAMPLE SPECTRUM



Data File: >A2876::U2
Name: VOA, 840718, A
Misc: E9436V

Compound No: 29
Compound Name: 1,1,1-Trichloroethane
Scan Number: 336
Retention Time: 14.29 min.
Area: 7399
Concentration: 56.02 NG

TOTAL ION CHROMATOGRAM



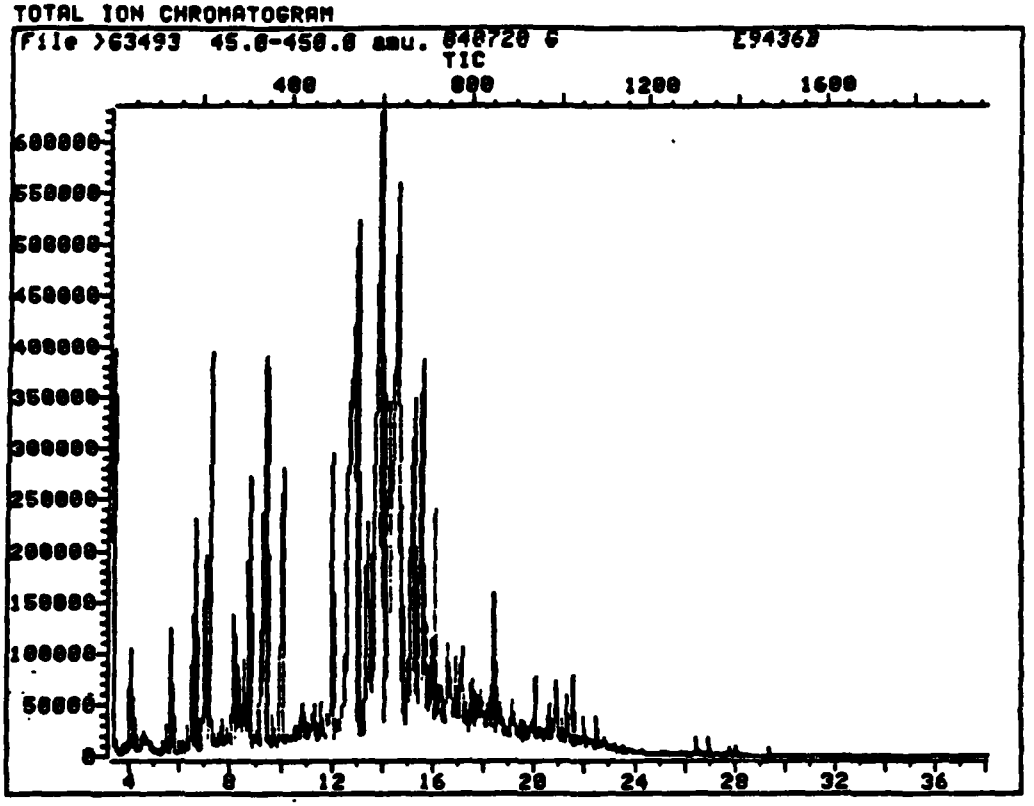
Data File >E3132 .U4
Name 840722,ACIDS,E
Misc E9436A BTL#14

Id File: CACID
Title ACID ID FILE.....WWC 6/21/83,#E
Last Calibration: 840723 00:06

Operator ID: TR9113
Qaunt Time 840722 03:24

006463

TOTAL ION CHROMATOGRAM



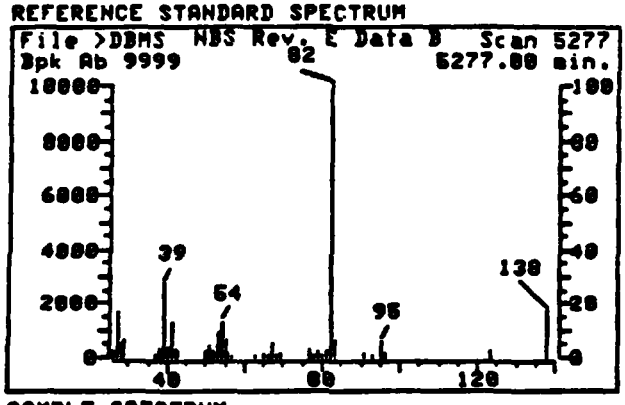
Data File: >G3493::U3
Name: 840720 G
Misc: E9436B

BTL#27

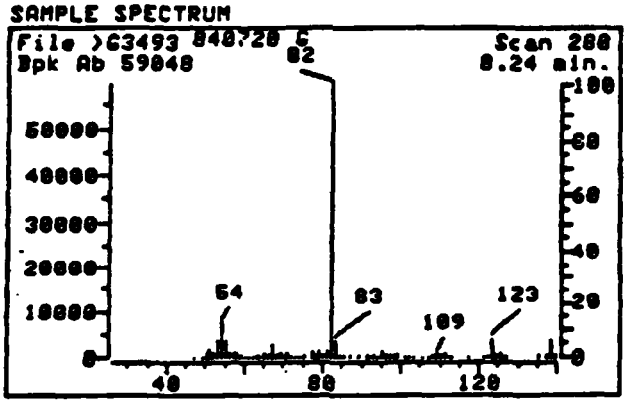
Id File: GBNP
Title: BN,PEST,IFB ISTDS IDFILE PVC..840510
Last Calibration: 840721 08:25

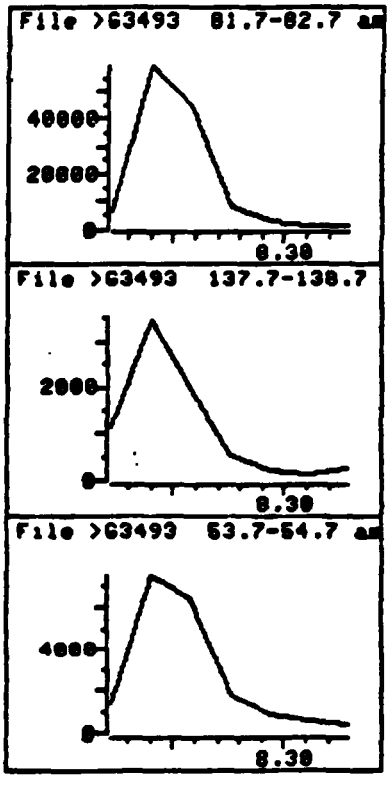
Operator ID: KB5414
Qaunt Time: 840721 17:06

REFERENCE STANDARD SPECTRUM



SAMPLE SPECTRUM





Data File: >G3493::U3
Name: 840720 G
Misc: E9436B

BTL#27

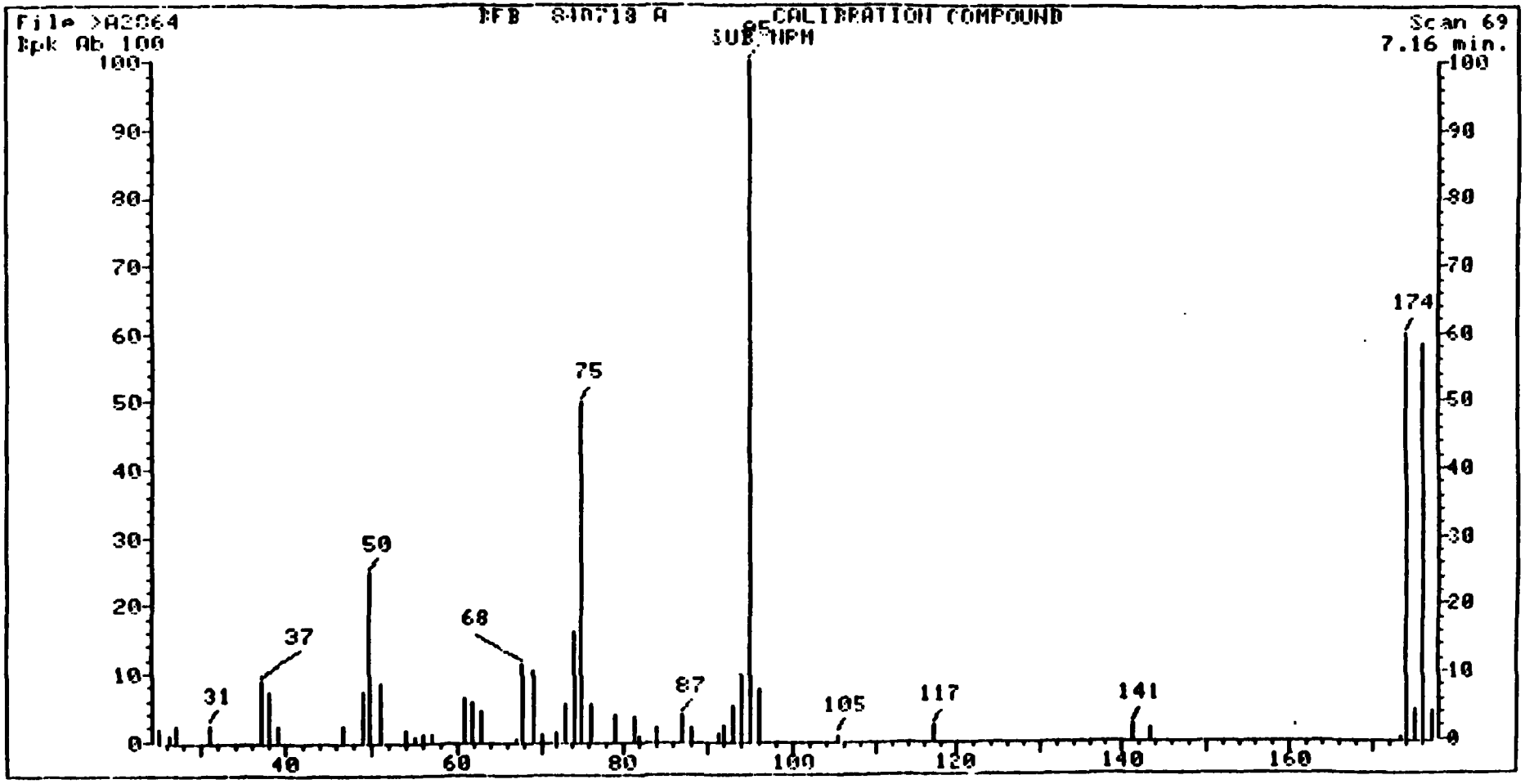
Compound No: 15
Compound Name: Isophorone
Scan Number: 280
Retention Time: 8.24 min.
Area: 94572
Concentration: 27.57 UG/ML

Appendix B

Mass Spectral Data for Calibration Compounds

1) If the sample analysis included the determination of purgeable organic compounds then a mass spectrum for 4-bromofluorobenzene (BFB) is included. This data was used in the instrument calibration protocol on the day of analysis.

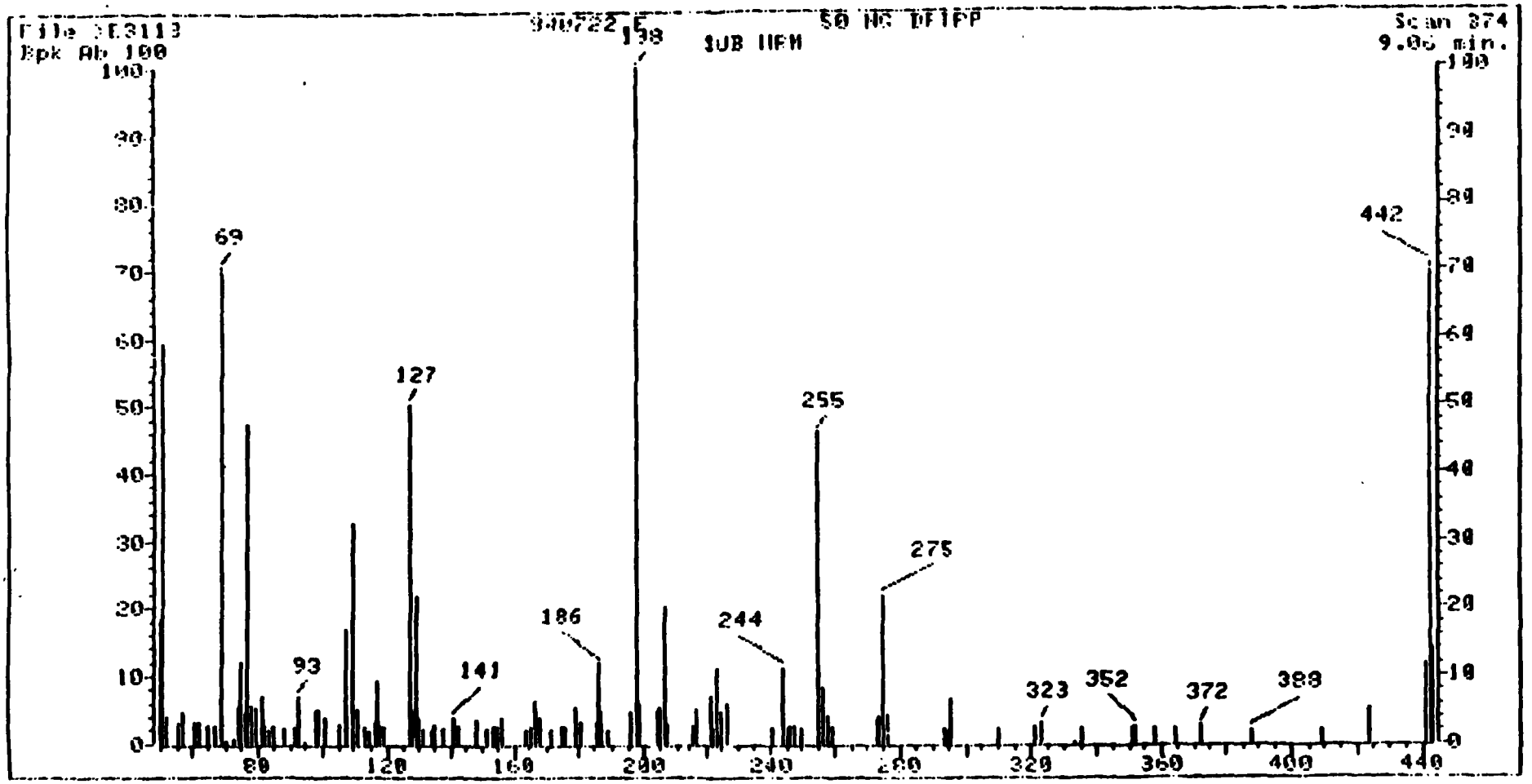
2) If the sample analysis included the determination of non-purgeable organic compounds then a mass spectrum for decafluorotriphenylphosphine (DFTPP) is included. This data was used in the instrument calibration protocol on the day of analysis.


File >A2064
Bpk Ab 100
DFB 840718 A
CALIBRATION COMPOUND
SUB NPH
Scan 69
7.16 min.
100
90
80
70
60
50
40
30
20
10
0
31
37
50
68
75
87
95
105
117
141
174
40
60
80
100
120
140
160

K-178

File:)A2864 Scan #: 69 Retn. time: 7.16

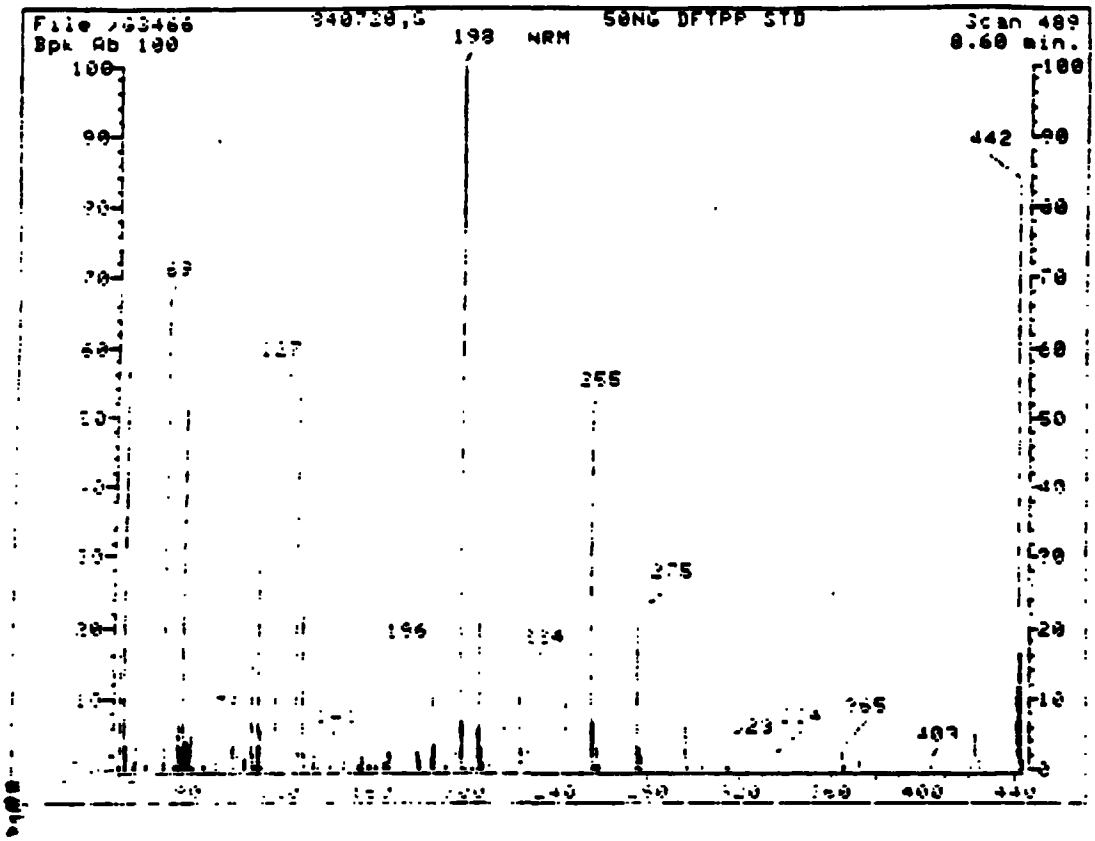
m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
24.90	1.87	51.00	8.29	69.05	10.37	84.05	1.75	105.15	.64
26.10	.88	54.00	1.44	70.05	.84	86.95	3.51	117.15	1.94
26.90	1.95	55.10	.36	71.85	1.20	88.05	1.87	141.05	2.07
31.00	2.15	56.00	.76	72.95	5.30	91.15	.68	143.05	1.52
37.00	8.69	57.10	.84	74.05	15.99	92.05	2.11	173.30	.08
37.90	7.14	60.95	6.14	74.95	49.72	93.05	4.86	174.00	59.89
39.00	2.11	61.95	5.42	76.05	5.10	94.05	9.61	175.10	4.19
46.90	2.15	62.95	4.39	78.95	3.75	95.05	100.00	176.00	58.33
49.10	7.02	67.05	.20	81.05	3.23	96.05	7.54	177.10	4.03
49.80	24.72	67.95	11.12	81.95	.48				


File 3E3113
Bpk Ab 100
940722 E
198
SUB HRM
50 NG DFIPP
Scan 374
9.06 min.
69
127
255
275
186
244
93
141
323
352
372
388
442
100
90
80
70
60
50
40
30
20
10
0
80
120
160
200
240
280
320
360
400
440

File.)E3110 Scan #: 374 Retn. time: 9.06

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
50.00	18.03	88.35	1.97	134.80	2.84	198.05	100.00	273.10	3.31
51.00	59.25	91.45	2.17	137.30	2.01	198.85	5.92	274.00	3.87
51.95	3.83	93.05	6.86	141.05	3.75	204.05	4.46	275.00	21.70
56.05	3.16	94.95	.20	142.15	2.52	205.15	5.29	276.10	4.54
57.05	4.73	97.90	4.54	147.95	3.43	206.05	20.20	293.25	2.13
60.95	3.12	99.00	5.05	151.35	2.01	206.85	2.80	294.95	1.85
62.15	3.12	100.90	3.63	153.05	2.45	216.10	2.45	296.05	6.51
65.15	2.45	105.20	2.72	154.70	2.29	217.00	4.89	310.30	2.09
67.00	2.49	107.00	16.73	155.00	2.25	221.00	6.71	321.15	2.25
69.00	70.61	108.00	3.20	156.10	3.75	222.40	1.93	322.95	3.00
70.30	.24	110.00	32.54	163.70	1.89	223.70	10.81	333.50	.20
73.10	.43	111.05	4.85	165.20	2.49	225.10	4.46	335.20	2.17
74.00	5.36	113.15	2.49	167.00	6.11	227.00	6.00	350.55	2.09
75.00	11.79	114.45	1.78	168.00	3.55	240.75	2.09	352.05	2.41
76.10	4.34	116.15	2.92	171.35	2.21	244.10	11.01	358.25	2.05
77.00	47.34	117.05	8.92	174.75	2.37	245.30	2.13	364.70	2.21
78.00	5.44	117.75	2.33	176.05	2.41	245.70	2.25	372.10	2.00
79.00	5.29	119.05	2.29	179.05	5.29	247.00	2.29	387.65	1.05
79.60	.75	127.00	50.22	180.85	2.88	250.00	2.01	409.35	1.78
80.95	6.75	128.10	4.50	185.30	3.08	255.00	46.04	423.10	4.09
82.15	2.29	129.00	21.78	186.00	11.87	256.00	8.09	441.15	11.52
82.55	2.37	130.00	3.51	187.00	4.69	257.95	3.94	442.05	70.57
83.75	1.89	131.30	1.97	188.60	1.89	259.25	2.37	443.05	13.05
85.15	2.25	134.40	1.89	196.10	4.65				

AL,,3 Move cursor, then press carriage return :


File
Bpk Ab 100
50NG DFTPP STD
Scan 489
0.60 min.
198
NRM
442
255
275
196
400
440

019195

~~006467~~

:TAB

>G3466 840720,G FONG DFTPP STD
489 NRM

File: >G3466 Scan #: 489 Retn. time: 3.60

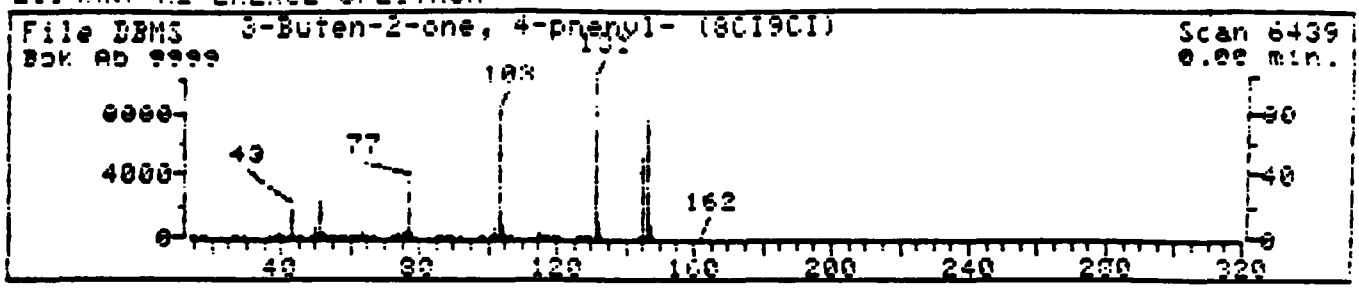
m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
49.05	.70	96.10	.97	141.05	7.29	194.05	2.74	256.05	.55
49.25	.70	97.10	.59	141.25	.38	198.05	100.00	258.05	1.65
50.05	15.95	97.15	.92	147.10	1.70	199.05	6.96	272.10	1.07
51.05	56.26	98.15	1.07	148.00	2.70	199.25	.18	274.10	3.40
52.15	7.24	97.05	5.05	152.00	1.07	201.25	.55	275.10	21.45
55.05	.77	98.05	4.78	154.05	.46	202.05	.75	276.10	1.00
56.05	1.57	99.05	1.40	155.05	1.00	204.05	7.69	277.00	0.02
57.05	4.02	101.10	2.71	164.15	1.91	205.05	5.49	283.10	.45
61.00	1.05	104.10	1.74	167.05	.27	20-.10	23.95	296.10	6.16
61.20	.74	105.10	1.54	169.05	.57	207.10	3.04	297.00	.92
62.05	.91	107.10	1.84	169.25	.75	209.00	.79	303.15	.72
63.20	2.41	109.10	1.07	181.15	1.19	211.10	.30	314.80	.58
65.10	1.06	109.15	.59	182.05	.39	213.05	6.13	315.80	.40
67.05	1.10	111.10	71.74	185.00	1.10	221.05	7.33	327.15	1.96
69.05	47.57	111.15	5.06	196.10	.56	227.05	1.10	334.10	.99
70.10	.77	111.25	.58	197.10	7.77	228.10	12.19	353.0	.50
71.05	.59	117.05	71.76	198.00	1.11	229.10	7.58	365.05	2.41
73.15	1.88	117.15	.91	199.10	.59	237.10	7.15	366.05	.64
77.05	1.26	121.10	.10	198.05	1.11	239.90	.82	378.05	11.19
79.15	7.21	123.10	.57	178.15	1.13	259.10	1.26	380.15	.77
80.10	71.78	124.30	.71	179.05	1.37	247.05	.70	403.10	.75
81.10	4.01	125.10	.75	180.05	2.75	248.05	8.42	421.10	.57
82.05	7.61	127.10	77.23	181.15	1.44	249.15	1.04	423.10	2.07
83.10	7.13	128.10	1.71	182.20	1.18	251.15	2.14	424.10	1.15
91.10	4.72	129.15	77.90	183.10	11.37	255.10	51.15	441.0	11.60
92.10	.36	130.10	5.02	187.00	7.76	256.10	4.13	442.10	77.13
93.00	.07	131.15	.38	188.10	.75	257.00	.57	443.10	14.51
93.10	.10	135.15	1.02	197.00	.10	259.10	7.64	444.10	1.76
95.10	.24	137.05	1.71						

Appendix C

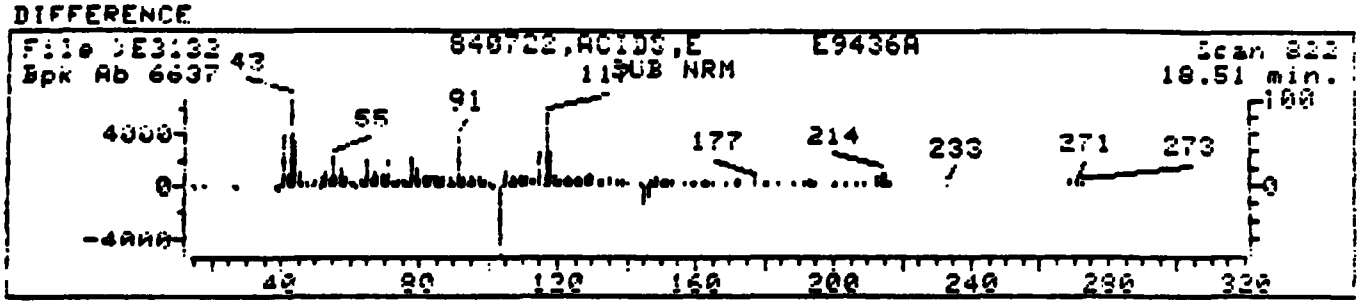
Mass Spectral Data for Tentatively Identified Compounds

1) For each tentatively identified compound a mass spectrum of the detected compound, a reference mass spectrum for that compound and a plot of the spectral differences are provided.

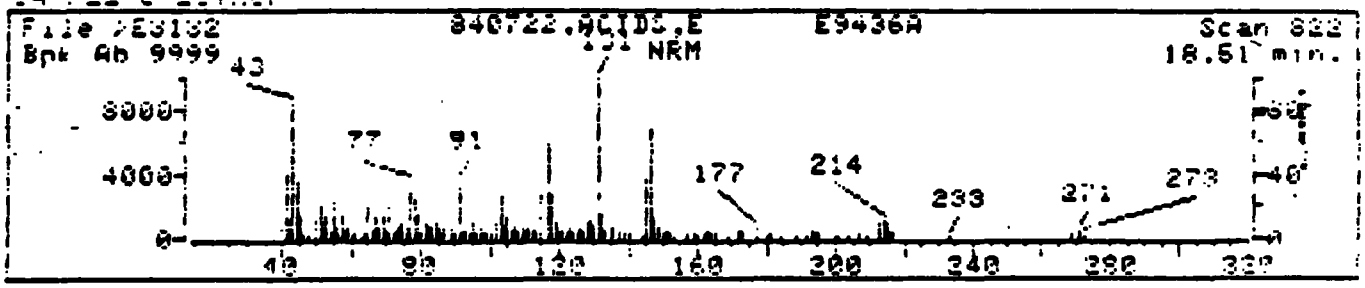
LIBRARY REFERENCE SPECTRUM



DIFFERENCE



SAMPLE SPECTRUM

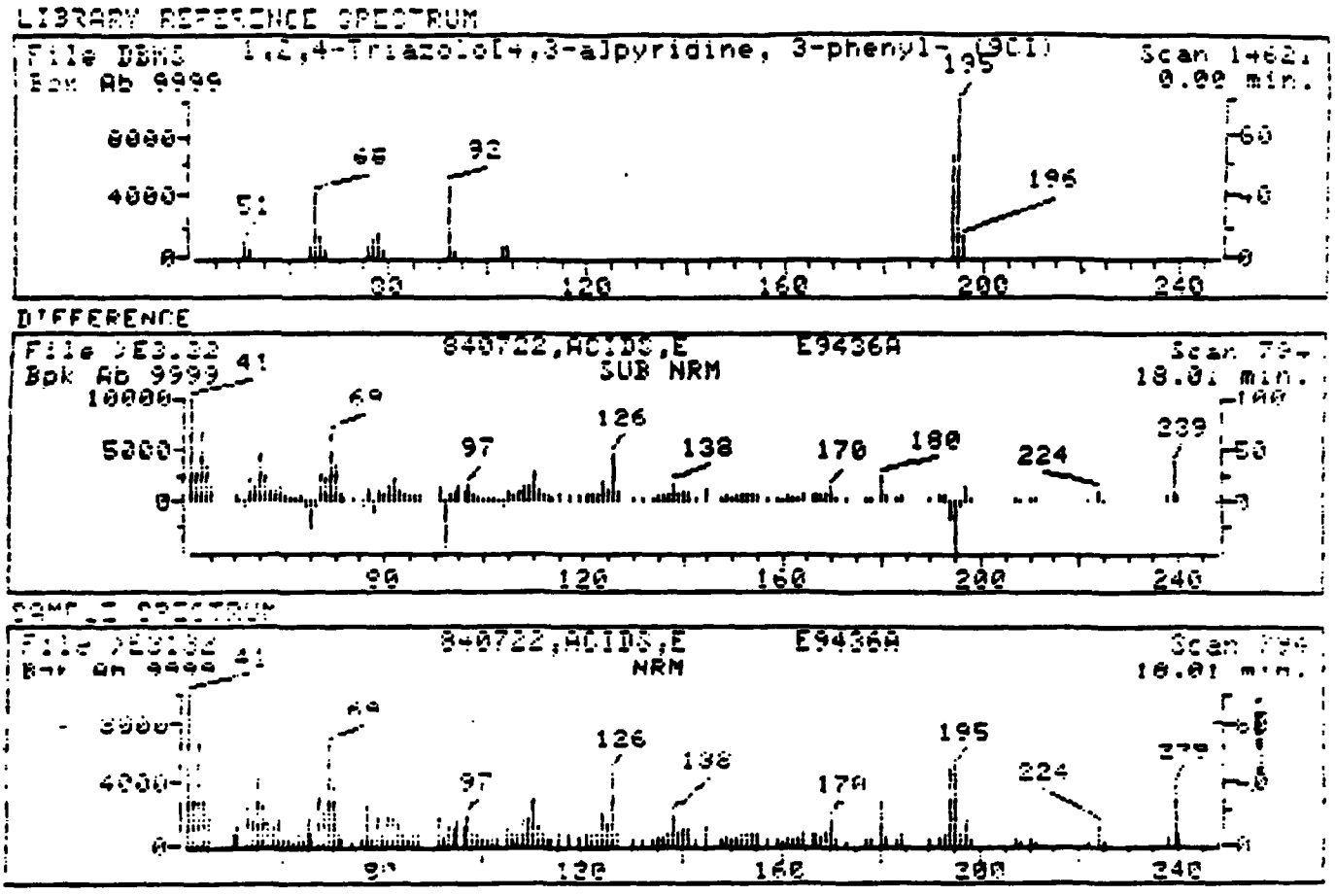


Data File DE3132
Scan Number 822
Hit number 1 of 3

Rec.#. 6439 Reg.# 122576 Xref.#: 4248 Base . DBMS D.
Name 3-Buten-2-one, 4-phenyl- (8CI9CI)
MW . 146.073 QI. 573 MF C10H10O

PBM Values

Class IV Reliability value: 70
K-value 76
dK-value: 32
Flagged Ions 1
Tilt factor: 0



Data File DE3132
Scan Number 794
Hit number 1 of 3

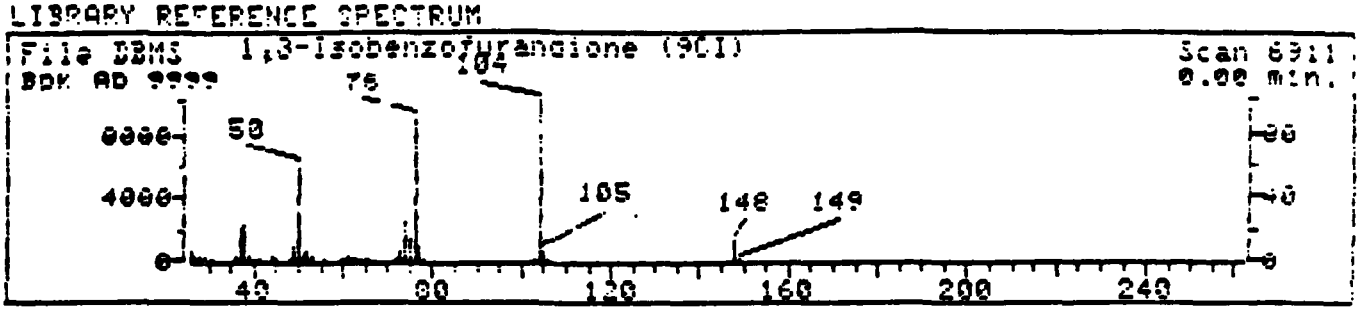
Rec.# 14621 Reg.# 778654 Xref.#: 8589 Base DBM3 D
Name: 1,2,4-Triazolo[4,3-a]pyridine, 3-phenyl- (9CI)
MW: 195.079 CI 203 MF C12H9N3

DBM Values

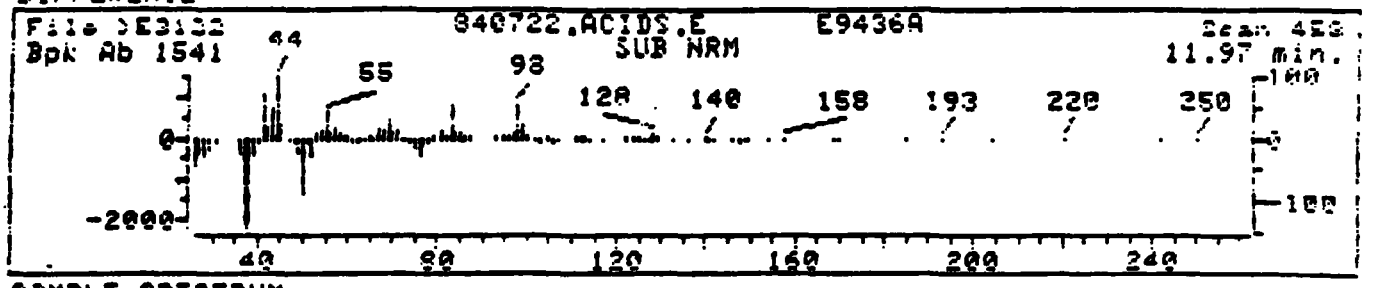
Class IV Reliability value: 47
K-value: 60
dK-value 44
Flagged Ions 1
Tilt factor: *

006469

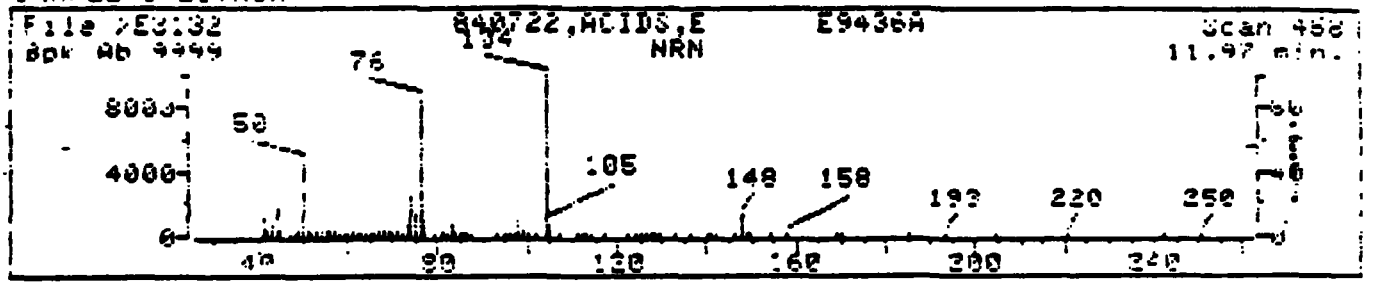
LIBRARY REFERENCE SPECTRUM



DIFFERENCE



SAMPLE SPECTRUM

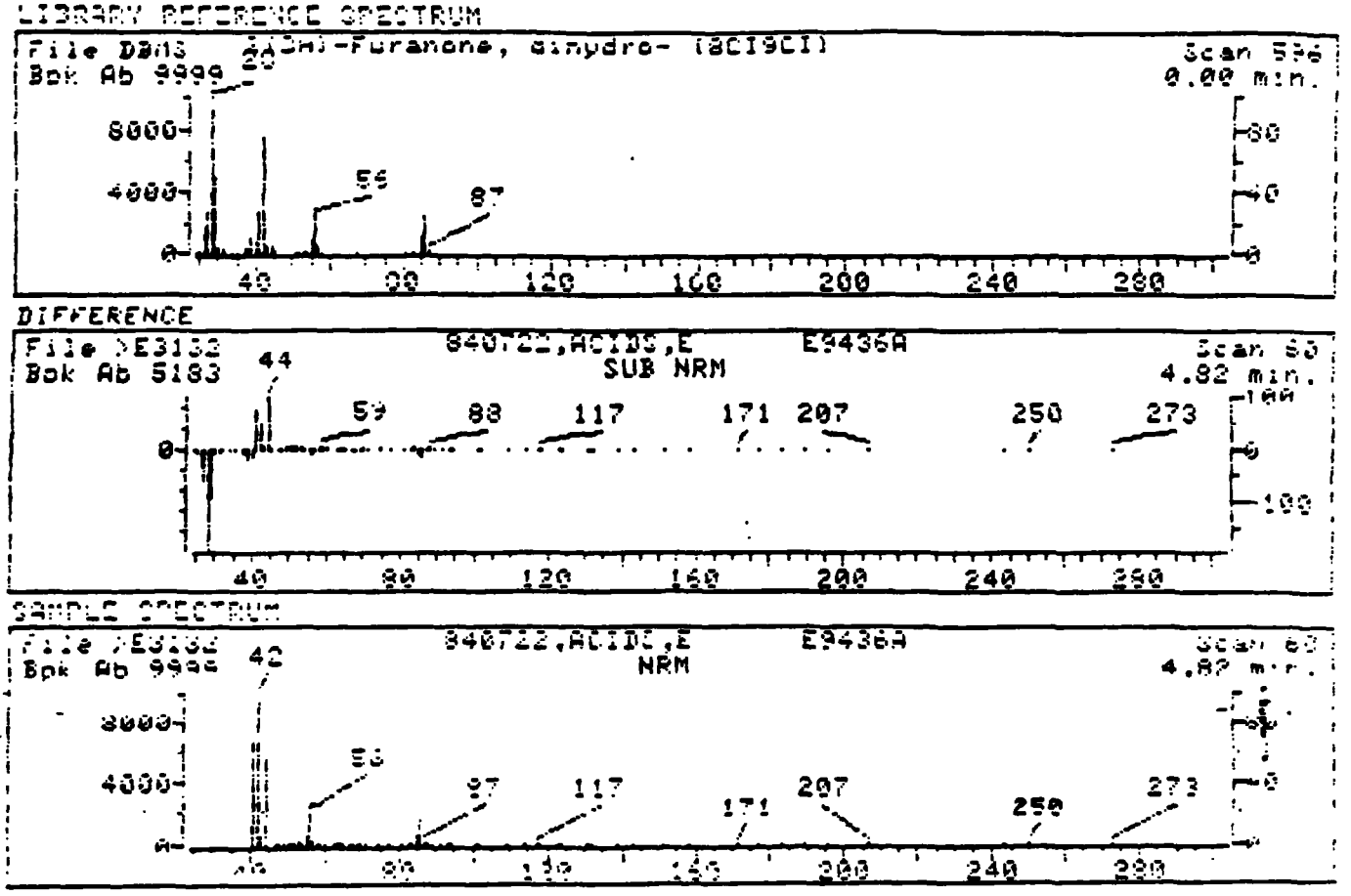


Data File: DE3132
Scan Number: 450
Hit number: 1 of 3

Rec.# 6911 Reg.# 05449 Xref.#: 34987 Base: DBMS D
Name: 1,3-Isobenzofurandione (9CI)
MW: 148.016 QI: 723 MF: C8H4O3

PBM Values:

Class IV Reliability value: 93
K-value: 91
dK value: 30
Flagged Ions: 1
Tilt factor: 0



Data File >EC132
Scan Number 60
Hit number 2 of 2

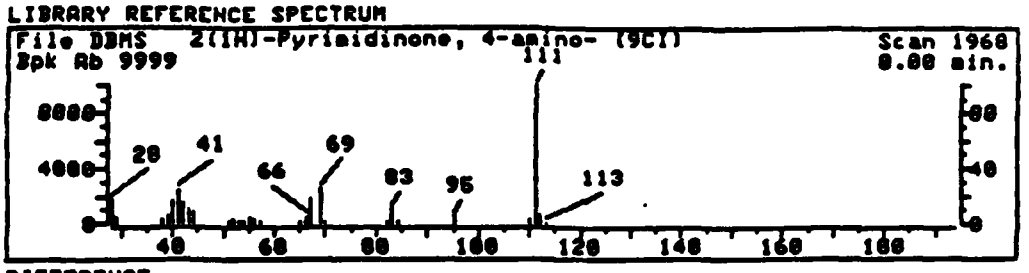
Rec.# 596 Reg.# 76400 Xref.#: 61732 Base DBMS D
Name: 2(3H)-Furanone, dihydro- (8CI9CI)
MW 86.037 CI 117 MF C4H6O2

PBM Values

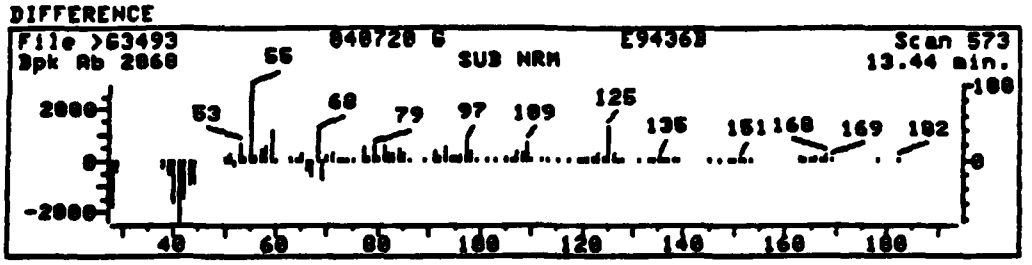
Class IV Reliability value 11
K-value 22
dK-value 60
Flagged Ions 0
Tilt factor 0

006470

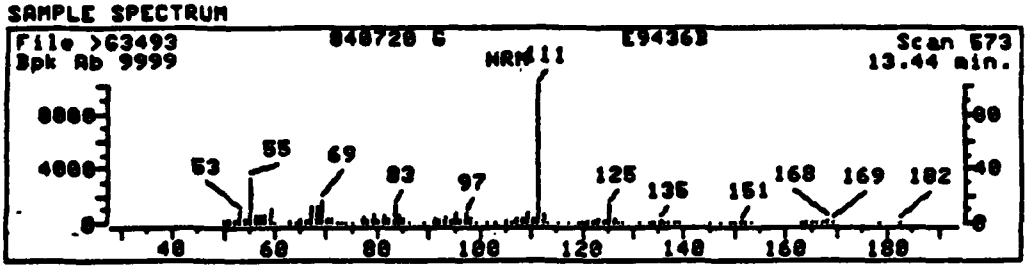
LIBRARY REFERENCE SPECTRUM



DIFFERENCE



SAMPLE SPECTRUM



Data File: >G3493
Scan Number: 573
Hit number : 4 of 4

Rec.#: 1968 Reg.#: 71307 Xref.#: 25326 Base : DBMS:D
Name: 2(1H)-Pyrimidinone, 4-amino- (9CI)
MW : 111.043 QI: 665 MF: C4H5N3O

PBM Values:

Class IV Reliability value: 41
K-value: 37
dK-value: 49
Flagged Ions: 2
Tilt factor: 0

Appendix E

Chain-of Custody Forms

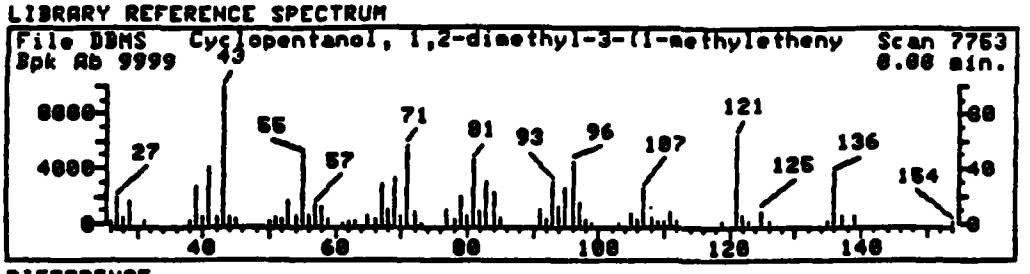
1) A field Chain-of-Custody form (CC1) is included for all samples shipped by ETC shuttle.

2) An in-house sample Chain-of Custody form is included for the period the sample was in ETC's possession.

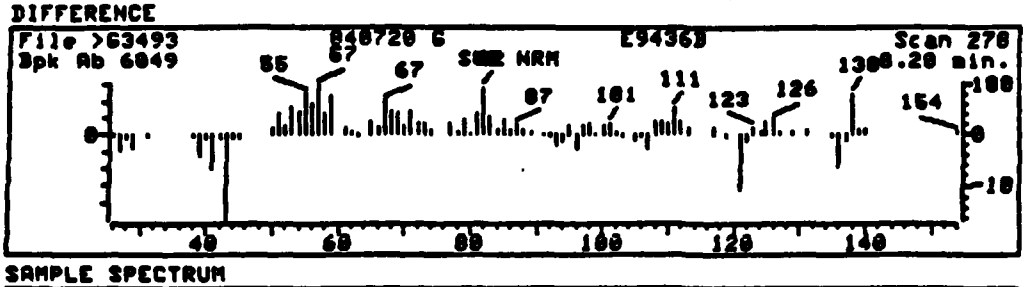
3) A subcontractor's Chain-of-Custody form is included for any analytical work not performed within ETC's laboratory.

4) Any additional Chain-of-Custody material provided by a client or by a client's sampling agent is also included.

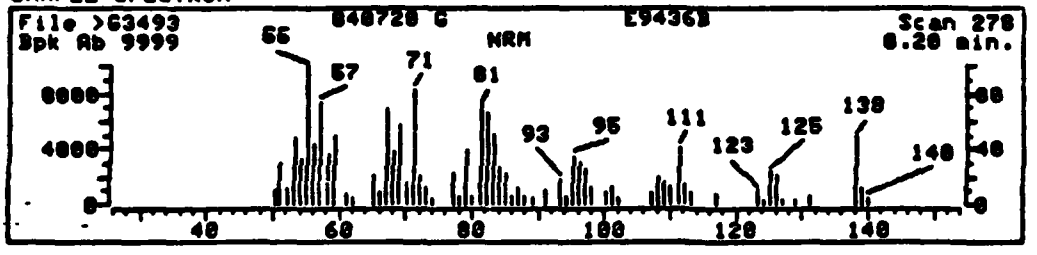
LIBRARY REFERENCE SPECTRUM



DIFFERENCE



SAMPLE SPECTRUM

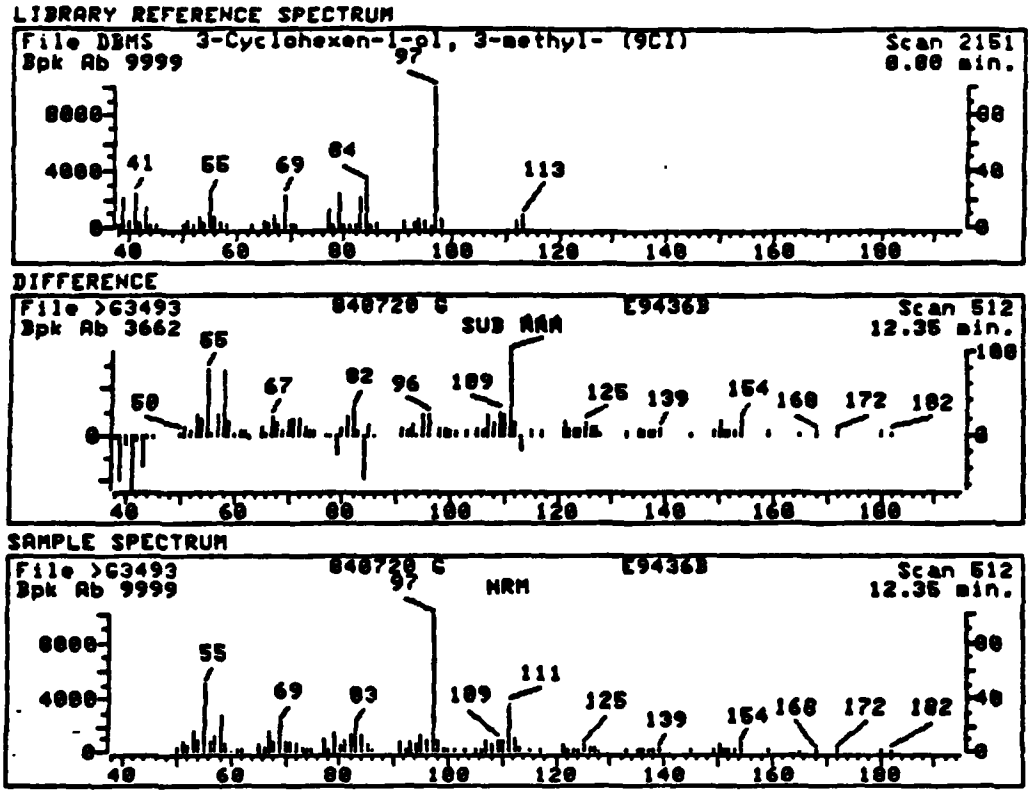


Data File: >G3493
Scan Number: 278
Hit number : 1 of 2

Rec.#: 7753 Reg.#: 4099074 Xref.#: 38849 Base : DBMS:D
Name: Cyclopentanol, 1,2-dimethyl-3-(1-methylethenyl)-, [1R-(1.alpha.,2.beta.,3.alpha.)]- (9CI)
MW : 154.135 QI: 715 MF: C10H18O

PBM Values:

Class IV Reliability value: 15
K-value: 22
dK-value: 96
Flagged Ions: 3
Tilt factor: 0



Data File: >G3493
Scan Number: 512
Hit number : 2 of 4

Rec.#: 2151 Reg.#: 53783918 Xref.#: 1646 Base : DBMS:D
Name: 3-Cyclohexen-1-ol, 3-methyl- (9CI)
MW : 112.089 QI: 74 MF: C7H12O

PBM Values:

Class IV Reliability value: 36
K-value: 49
dK-value: 45
Flagged Ions: 3
Tilt factor: 0

019200

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CHAIN OF CUSTODY FORM (CC1)

Seal Date: 6/25/84
Sealed By: J. Trotter

SHIP TO:

Company: RESOURCE ENGINEERING
Facility/Site: 11 GREENWAY PLAZA
Address: Houston, TX 77406
Attn.: COBY SHER
Phone: (713) 621-5900

SAMPLE IDENTIFICATION

Facility/Site Code: RES-288-01

Source Codes:

Well	(W)	River/Stream	(R)	Surface Impoundment	(I)	Lake/Ocean	(L)
Soil	(S)	Bottom Sediment	(B)	Pretreatment Facility	(P)	Treatment Facility	(T)
Outfall	(O)	Generation Point	(G)	Leachate Collection Sys.	(C)	Other	(X)

Source Code (from above)	Your Sample Point ID (left justify)	Start Date (mo/day/yr)	Start Time (2400 hr. clock)	Elapsed Hours (composite)
W	MW-3	06 29 84		
Example: W	101J263P	05 15 81	0930	13

173

SHUTTLE CONTENTS

Sample Bottle	Condition	Sample Bottle	Condition
E9436 E_1-E_4	XXXX		
E9436 V_1-V_2	XX		
E9436 TB	XOK	V_1-T.B REC'd WITH H.S	

CHAIN OF CUSTODY CHRONICLE

1. Shuttle Opened By: (print) [illegible] Date: 6-26-84 Time: 13:30
Signature: [illegible] Seal #: NOT NOTED Intact: YES

2. I have received these materials in good condition from the above person.
Name: Wm Thomas Beck Signature: Wm Thomas Beck
Date: 6-29-84 Time: 8:30 Remarks:

3. I have received these materials in good condition from the above person.
Name: DEAN GORE Signature: [illegible]
Date: 6/29/84 Time: 17:00 Remarks:

4. I have received these materials in good condition from the above person.
Name: Marbell H Smith Signature: Marbell H Smith
Date: 7/2/84 Time: 17:00 Remarks:

5. Shuttle Sealed By: (print) Date: Time:
Signature: Seal #:

ETC USE ONLY Opened By: B. Sharp Date: 7/3/84 Time: 12:00
Seal #: 18330 Condition: INTACT

ETC Form CC1 8/1/82

ETC ENVIRONMENTAL TESTING and CERTIFICATION

E9436
ETC Sample No.:

SAMPLE POINT INFORMATION FORM (CC2)

FIELD MEASUREMENT DATA

Select up to 3 parameters to be recorded by entering the appropriate code letter in the first space for each of the 3 data entry fields provided. Enter the actual measurement data (in the units specified) for the three parameters you have selected.

PARAMETERS		ACTUAL (left justify)	EXAMPLE
Flow (CFS)	A	D35.2	C25
Volume (Gal)	B		
Sample Depth (Ft)	C		
Depth to Water (Ft)	D		F50
Discharge Rate (GPM)	E		
Depth to Bottom (Ft)	F		
Event Time (2400-Hr Clock)	G		G1103
Depth to Screen (Ft)	H		

FIELD TEST DATA

DO (Mg/L) _____ Sample Temp. (°C) 39.1

pH 6.90 (Single Measurement) — _____ (2nd of Quadruplicate) — _____ (3rd of Quadruplicate) — _____ (4th of Quadruplicate)

Specific Conductance (uMHOS/CM) 3150 (Single Measurement) — _____ (2nd of Quadruplicate) — _____ (3rd of Quadruplicate) — _____ (4th of Quadruplicate)

THE FOLLOWING DATA IS FOR YOUR RECORDS ONLY

SAMPLING METHOD (choose one)

AIR-LIFT PUMP ( )	PERISTALTIC PUMP ( )	THIEF ( )
AUGER ( )	PETERSEN ( )	TRIER ( )
BAILER (X)	PISTON PUMP ( )	VENNEYER ( )
BOTTLE ( )	SCOOP/SHOVEL ( )	OTHER _____
COLIWASA ( )	SQUEEZE PUMP ( )	_____
DIPPER ( )	SUBMERSIBLE PUMP ( )	_____
KEMMERER ( )	SUCTION LIFT PUMP ( )	
MISION ( )	SURGER ( )	

SAMPLE TYPE (choose one)

GRAB (X) COMPOSITE ( ) OTHER ( )

_____ (describe) _____ (describe)

WEATHER: Sunny, hot, humid (describe)

SAMPLE DESCRIPTION (e.g. color, odor): slightly cloudy, no obvious odor (describe)

Form Prepared By: DEAN GORE (name (print)) Employer: RESOURCE ENGINEERING

ETC Form CC2 6/1/82

ETC ENVIRONMENTAL TESTING and CERTIFICATION

~~006473~~

019201

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number(s) E9434 TO E9438

Sample Preparation For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	L. Sealise/K. Albretson (J. [illegible])	7/16/84
Acids	Greg Marrin	7/18/84
Metals		
Others		
Others		
Others		
Others		

Sample Analysis For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Kris Bonaparte (cw)	7/20/84
Acids	Tom Rusowicz	7-22-84
VOA/Purgeables	(PK) ~~[illegible]~~	
Metals	Rich Albert (cw)	7/18/84
Others VOA	(PK) ~~[illegible] (E9237)~~	~~7/16/84~~
Others VOA/Purgeables	[illegible] 7/18	7/17/84
Others VOA/Purgeable	[illegible] E9434 7/17	
Others		
Others		
Others		

Verified By Harry Klaus

Technical Report

for

RESOURCE ENGINEERING

11 GREENWAY PLAZA

HOUSTON, TX 77406

MW-16

DOWN GRADIENT SHALLOW WELL

Chain of Custody Data Required for ETC Data Management Summary Reports						
E9438	RESOURCE ENGINEERING	RESSHER	MW16	840629		
ETC Sample No.	*Company*	*Facility*	*Sample Point*	*Date*	*Time*	*Elapsed Hours*

James N. Bowerfor

Denis C. K. Lin, Ph.D.

Vice President
Research and Operations

Introduction

This report contains the analytical results on your water sample, WMW16 84/06/29. It is designed to include comprehensive data from the entire analytical process in order to satisfy the needs of various levels of review.

The results obtained from your sample are presented in tabular format immediately following this introduction. Quality assurance data is tabulated along with the appropriate sample results for verification. Depending on the analyses ordered, the quality assurance data may include results from blank, spiked blank, spiked sample (i.e. matrix spike) and replicate sample as well as results from surrogate compound analyses. Quality assurance data for verification of proper instrument performance is also included where appropriate. The report appendices include the chain of custody record for your sample and, where appropriate, the gas chromatograms and mass spectra.

The procedures used in the analysis of the sample are described in this report's methodology section. All analytical procedures within our laboratory are performed within a strictly enforced Quality Assurance Protocol. A description of this Protocol is included in the report.

Results

Sample results, and associated quality assurance data, are always tabulated in one or more of this report's Quantitative Results Tables. The format of each table varies with the class of analysis.

Priority Pollutants

The priority pollutant compounds and elements are listed with their NPDES (National Pollution Discharge Elimination System) numbers, and the Method Detection Limit (MDL) published in the Federal Register, December 3, 1979. When a compound or element is present below its published MDL it is reported as BMDL (Below Method Detection Limit). When a compound or element is not present at any detectable concentrations it is reported as ND (Not Detected). Matrix spike and replicate analyses, where included, were performed on samples randomly chosen within each quality assurance batch and are therefore not necessarily spikes and replicates of this report's sample. Surrogate compound recovery data and instrument calibration data are included in the Method Performance Data Tables.

Qualitative Analysis

The GC/MS identification of compounds which are not included in the normal compound list for a given method is reported in a Qualitative Results Table. Each sample fraction is reported on an individual Qualitative Results Table. Wherever possible these compounds are reported with their molecular weight, empirical formula, and CAS number. The retention time and scan number is also provided to match the spectra included in the report appendices.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 26, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9438	RESOURCE ENGINEERING	RES28801	WMW16	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1V	Acrolein	ND	100	ND	ND	ND	1600	4.	ND	1600	14.
2V	Acrylonitrile	ND	100	ND	ND	ND	160	77.	ND	160	89.
3V	Benzene	ND	10	ND	ND	ND	36	95	ND	36	97
4V	bis(Chloromethyl)ether	ND	10	ND	ND	ND	0	-	ND	0	-
5V	Bromoform	ND	10	ND	ND	ND	36	92	ND	36	108
6V	Carbon tetrachloride	ND	10	ND	ND	ND	36	93	ND	36	96
7V	Chlorobenzene	ND	10	ND	ND	ND	36	103	ND	36	110
8V	Chlorodibromomethane	ND	10	1	ND	ND	36	100	ND	36	103
9V	Chloroethane	ND	10	ND	ND	ND	36	88	ND	36	89
10V	2-Chloroethylvinyl ether	ND	10	ND	ND	ND	36	62	ND	36	61
11V	Chloroform	ND	10	ND	ND	BMDL	36	91	ND	36	96
12V	Dichlorobromomethane	ND	10	ND	ND	ND	36	93	ND	36	96
13V	Dichlorodifluoromethane	ND	10	ND	ND	ND	0	-	ND	0	-
14V	1,1-Dichloroethane	ND	10	ND	ND	ND	36	97	ND	36	101
15V	1,2-Dichloroethane	ND	10	ND	ND	ND	36	98	ND	36	98
16V	1,1-Dichloroethylene	ND	10	ND	ND	ND	36	87	ND	36	91
17V	1,2-Dichloropropane	ND	10	ND	ND	ND	36	92	ND	36	96
18V	cis-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	85	ND	36	93
19V	Ethylbenzene	ND	10	ND	ND	ND	36	99	2	36	101
20V	Methyl bromide	ND	10	ND	ND	ND	36	122	ND	36	104
21V	Methyl chloride	ND	10	ND	ND	ND	36	89	ND	36	94
22V	Methylene chloride	BMDL	10	6	1	BMDL	36	58	4	36	56
23V	1,1,2,2-Tetrachloroethane	ND	10	ND	ND	ND	36	77	ND	36	102
24V	Tetrachloroethylene	ND	10	1	ND	ND	36	85	1	36	88
25V	Toluene	ND	10	ND	ND	BMDL	36	86	ND	36	115
26V	1,2-Trans-dichloroethylene	ND	10	ND	ND	ND	36	87	ND	36	87
27V	1,1,1-Trichloroethane	ND	10	2	ND	ND	36	93	ND	36	97
28V	1,1,2-Trichloroethane	ND	10	ND	ND	ND	36	109	ND	36	116
29V	Trichloroethylene	ND	10	ND	ND	ND	36	113	ND	36	114
30V	Trichlorofluoromethane	ND	10	ND	ND	ND	36	89	ND	36	90
31V	Vinyl chloride	ND	10	ND	ND	ND	36	84	ND	36	93

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 26, 198

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds - GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9438	RESOURCE ENGINEERING	RES28801	MW16	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
***	trans-1,3-Dichloropropylene	ND	10	ND	ND	ND	36	90	ND	36	90

* EPA published Method Detection Limit.
@ Recovery normally variable using EPA Protocol Method 624.

0064?5

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Acid Compounds - GC/MS Analysis Data (QR02)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9438	RESOURCE ENGINEERING	RES28801	WM16	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen, ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1A	2-Chlorophenol	ND	25	ND	ND	ND	150	78	ND	150	57
2A	2,4-Dichlorophenol	ND	25	ND	ND	ND	150	95	ND	150	53
3A	2,4-Dimethylphenol	ND	25	ND	ND	ND	150	2b	ND	150	0b
4A	4,6-Dinitro-o-cresol	ND	250	ND	ND	ND	250	88	ND	250	75
5A	2,4-Dinitrophenol	ND	250	ND	ND	ND	250	110	ND	250	130
6A	2-Nitrophenol	ND	25	ND	ND	ND	150	78	ND	150	70
7A	4-Nitrophenol	ND	25	ND	ND	ND	150	71	ND	150	86
8A	p-Chloro-m-cresol	ND	25	ND	ND	ND	150	67	ND	150	25c
9A	Pentachlorophenol	ND	25	ND	ND	ND	150	106	ND	150	86
10A	Phenol	ND	25	ND	ND	ND	150	77	ND	150	45
11A	2,4,6-Trichlorophenol	ND	25	ND	ND	ND	150	101	ND	150	76

a EPA published Method Detection Limit.

b Recovery normally low using EPA Protocol Method 625.

c Recovery low due to sample matrix interference.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9438	RESOURCE ENGINEERING	RES28801	WMW16	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
1B	Acenaphthene	ND	10	ND	ND	ND	100	104	ND	105	100
2B	Acenaphthylene	ND	10	ND	ND	ND	100	101	ND	105	100
3B	Anthracene	ND	10	ND	ND	ND	100	67	ND	105	81
4B	Benzidine	ND	10	ND	ND	ND	100	0.	ND	105	0.
5B	Benzo(a)anthracene	ND	10	ND	ND	ND	100	133	ND	105	126
6B	Benzo(a)pyrene	ND	10	ND	ND	ND	100	128	ND	105	133
7B	Benzo(b)fluoroanthene	ND	10	ND	ND	ND	100	160	ND	105	153
8B	Benzo(ghi)perylene	ND	10	ND	ND	ND	0	-	ND	0	-
9B	Benzo(k)fluoranthene	ND	10	ND	ND	ND	100	124	ND	105	114
10B	bis(2-Chloroethoxy)methane	ND	10	ND	ND	ND	100	65	ND	105	87
11B	bis(2-Chloroethyl) ether	ND	10	ND	ND	ND	100	100	ND	105	246
12B	bis(2-Chloroisopropyl)ether	ND	10	ND	ND	ND	100	306c	ND	105	107
13B	bis(2-Ethylhexyl)phthalate	BMDL	10	135	44	BMDL	100	103	ND	105	230
14B	4-Bromophenyl phenyl ether	ND	10	ND	ND	ND	100	65	ND	105	81
15B	Butyl benzyl phthalate	ND	10	ND	ND	ND	100	110	ND	105	94
16B	2-Chloronaphthalene	ND	10	ND	ND	ND	100	80	ND	105	87
17B	4-Chlorophenyl phenyl ether	ND	10	ND	ND	ND	100	105	ND	105	95
18B	Chrysene	ND	10	ND	ND	ND	100	102	ND	105	86
19B	Dibenzo(a,h)anthracene	ND	10	ND	ND	ND	0	-	ND	0	-
20B	1,2-Dichlorobenzene	ND	10	ND	ND	ND	100	33.	ND	105	52.
21B	1,3-Dichlorobenzene	ND	10	ND	ND	ND	100	30.	ND	105	45.
22B	1,4-Dichlorobenzene	ND	10	ND	ND	ND	100	33.	ND	105	47.
23B	3,3'-Dichlorobenzidine	ND	10	ND	ND	ND	100	17.	ND	105	21.
24B	Diethyl phthalate	ND	10	ND	ND	ND	100	6.	ND	105	44.
25B	Dimethyl phthalate	ND	10	ND	ND	ND	100	1	ND	105	12
26B	Di-n-butyl phthalate	ND	10	ND	ND	BMDL	100	60	ND	105	80
27B	2,4-Dinitrotoluene	ND	10	ND	ND	ND	100	74	ND	105	88
28B	2,6-Dinitrotoluene	ND	10	ND	ND	ND	100	98	ND	105	100
29B	Di-n-octyl phthalate	ND	10	ND	ND	ND	100	137	ND	105	117
30B	1,2-Diphenylhydrazine	ND	10	ND	ND	ND	100	92	ND	105	90
31B	Fluoranthene	ND	10	ND	ND	ND	100	62	ND	105	90

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 25, 1984

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

BASE/NEUTRAL COMPOUNDS - GC/MS ANALYSIS DATA (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9438	RESOURCE ENGINEERING	RES28801	WW16	840629		

NPDES Number	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	MDL ug/l a	First ug/l	Second ug/l	Blank Data ug/l	Concen. Added ug/l	% Recov	Unspiked Sample ug/l	Concen. Added ug/l	% Recov
32B	Fluorene	ND	10	ND	ND	ND	100	95	ND	105	94
33B	Hexachlorobenzene	ND	10	ND	ND	ND	100	107	ND	105	87
34B	Hexachlorobutadiene	ND	10	ND	ND	ND	100	14b	ND	105	43b
35B	Hexachlorocyclopentadiene	ND	10	ND	ND	ND	0	-	ND	0	-
36B	Hexachloroethane	ND	10	ND	ND	ND	100	16b	ND	105	32b
37B	Indeno(1,2,3-c,d)pyrene	ND	10	ND	ND	ND	0	-	ND	0	-
38B	Isophorone	BMDL	10	ND	ND	ND	100	83	ND	105	88
39B	Naphthalene	ND	10	ND	ND	ND	100	44	ND	105	54
40B	Nitrobenzene	ND	10	ND	ND	ND	100	83	ND	105	198
41B	N-Nitrosodimethylamine	ND	10	ND	ND	ND	0	-	ND	0	-
42B	N-Nitrosodi-n-propylamine	ND	10	ND	ND	ND	100	74	ND	105	77
43B	N-Nitrosodiphenylamine	ND	10	ND	ND	ND	100	127	ND	105	129
44B	Phenanthrene	BMDL	10	ND	ND	ND	100	81	ND	105	83
45B	Pyrene	ND	10	ND	ND	ND	100	108	ND	105	96
46B	1,2,4-Trichlorobenzene	ND	10	ND	ND	ND	100	209c	ND	105	197c

a EPA published Method Detection Limit.
b Recovery normally low using EPA Protocol Method 625.
B Recovery variable due to sample matrix interference.
C Recovery normally variable using EPA Protocol Method 625.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds - GC/MS Analysis Data - Acid Fraction (QR07)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9438	RESOURCE ENGINEERING	RES28801	MW16	840629		

	Compound Name	Data: Scan Number	Data: Retention Time (Min)	Data: M.W.	Identifiers: CAS Number	Identifiers: Empirical Formula	Estimated Concen. ug/l		
1	Alkane	352	10.1	-	-	C_nH_{2n+2}	3		
2	Benzenamine, (phenyl ethenyl)	792	18.0	195	-	$C_{14}H_{13}N$	2		
3	1,3,5-Triazin-2(1H)-one 4,6 diamino	800	18.2	127	27269	$C_3H_5N_5O$	1		
4	C_2-Alkyl Tetrahydronaphthalene	1007	21.9	160	-	$C_{12}H_{16}$	2		

006477

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 1: QUALITATIVE RESULTS

Tentatively Identified Organic Compounds - GC/MS Analysis Data - Base/Neutral Fraction (QR08)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9438	RESOURCE ENGINEERING	RES28801	WMW16	840629		

Compound Name	Data			Identifiers				
	Scan Number	Retention Time (Min)	M.W.	CAS Number	Empirical Formula	Estimated Concen. ug/l		
1 1,3-Benezendiol, 4-hexyl	667	15.1	194	136778	$C_{12}H_{18}O_2$	80		

ETC ENVIRONMENTAL TESTING and CERTIFICATION

JUL 24, 19

TABLE 1: QUANTITATIVE RESULTS

Conventionals Analysis Data (QR12)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
E9438	RESOURCE ENGINEERING	RES28801	WMW16	840629		

Parameter	Results								
	Sample Measure	MDL	Units of Measure						
pH	6.77		std						
Specific Conductance	2640		um/cm						
Temperature	37.30		Deg. C						

004478

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 2: METHOD PERFORMANCE DATA

Surrogate Recovery - GC/MS Data (QR20)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9438

ETC Sample No. | Company | Facility | Sample Point | Date | Time | Elapsed Hours

Compound	Amount Added ug	% Recovery	Control Limits * Lower	Control Limits * Upper
VOLATILE FRACTION				
Bromochloromethane	.200	194**	74	122
Benzene, d_6	.150	102	83	119
Fluorobenzene	.150	100	88	116
1,4-Dichlorobutane	.200	100	75	123
Pentafluorobenzene	.150	100	90	126
Ethylbenzene, d_{10}	.150	103	83	127
ACID FRACTION				
2-Fluorophenol	80	80	16	100
Pentafluorophenol	80	105	25	113
BASE/NEUTRAL FRACTION				
2-Fluorobiphenyl	80	77	57	101
1-Fluoronaphthalene	80	62	55	103
Nitrobenzene, d_5	80	98	63	143

* Two Standard Deviations About the Mean.

** Recovery variable due to sample matrix interference.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 27, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Bromofluorobenzene (BFB) for Volatiles Analysis (QR21)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9438

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
50	15-40% of Mass 95	22
75	30-60% of Mass 95	51
95	Base Peak, 100% relative abundance	100
96	5-9% of Mass 95	7
173	Less than 1% of Mass 95	1
174	Greater than 50% of Mass 95	77
175	5-9% of mass 174	6
176	Greater than 95% but less than 101% of Mass 174	75
177	5-9% of mass 176	5

Date: 840717
Run No: >C3051
Spectrum No: 99
Analyst: R. Albert

019207

ETC ENVIRONMENTAL TESTING and CERTIFICATION

July 28, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Acids Analysis (QR22)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9438

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	59
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	50
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	6
275	10-30% of mass 198	22
365	Greater than 1% of mass 198	>1
441	Less than mass 443	12
442	Greater than 40% of mass 198	71
443	17-23% of mass 442	14

Date: 840722
Run No: >E3118
Spectrum No: +374 -155
Analyst: T. Rusowicz

July 26, 1984

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Base/Neutrals Analysis (QR23)

Chain of Custody Data Required for ETC Data Management Summary Reports

E9438

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	56
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	53
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	7
275	10-30% of mass 198	21
365	Greater than 1% of mass 198	2
441	Less than mass 443	12
442	Greater than 40% of mass 198	83
443	17-23% of mass 442	17

Date: 840720
Run No: G3466
Spectrum No: 489
Analyst: K. Bonaparte

019208

Methodology
for
GC/MS Analysis of Priority Pollutant Compounds

The methods employed in the GC/MS analysis for priority pollutants are established EPA methods. Rigid compliance with the instrument parameters and performance criteria of the published methods was achieved. In some cases, the precise amounts of sample used and the sample handling procedures vary with the complexity of the sample matrix. Qualitative identification of the priority pollutants was performed using the relative retention times, the relative abundance of three characteristic ions and the abundance ratios. The entire mass spectrum was reviewed to confirm each identification. Quantitative analysis of detected compounds was performed by using a response factor generated by a major characteristic ion of the specific compound and an internal standard.

Compounds, in addition to those on the priority pollutant list, were identified through a computer-aided search of the NBS-EPA spectra library. After review the identifications are included in a separate tabulation and labelled "tentatively identified".

Volatile Priority Pollutant Compounds

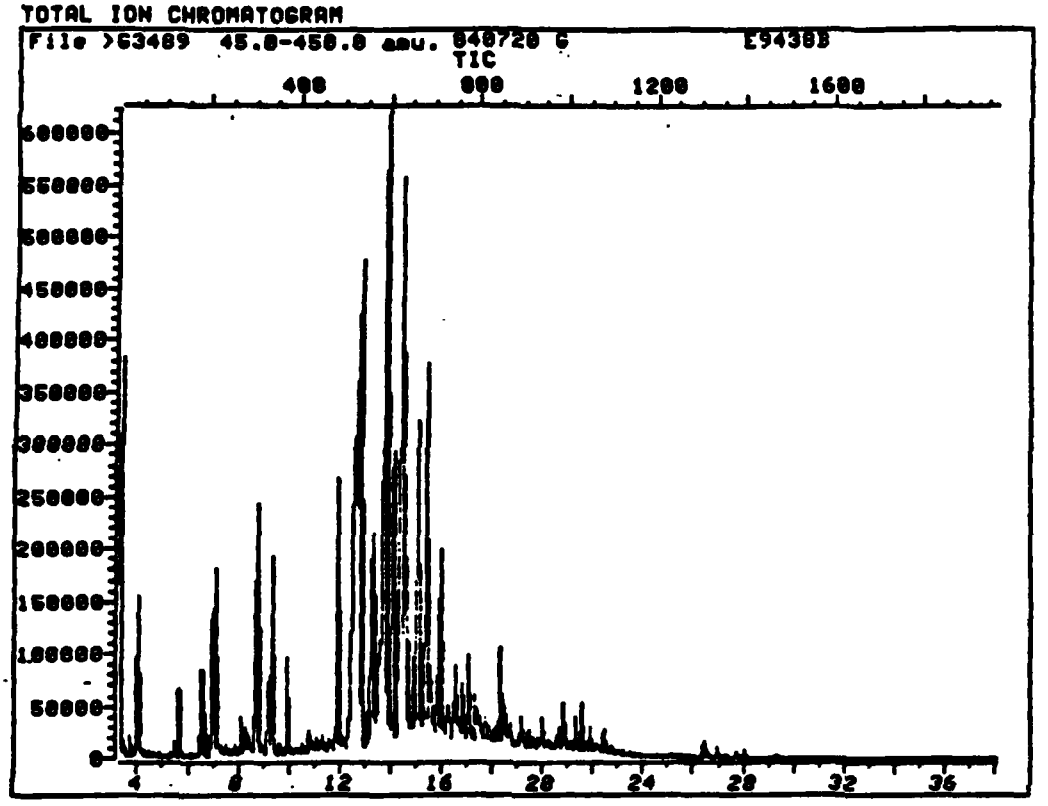
For the analysis of Volatile priority pollutants, EPA Method 624 (Federal Register, December 3, 1979; page 69532) was used. The method can be summarized as follows: Helium is bubbled through a 5 ml water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the organic components are trapped. After the purge cycle is complete, the sorbent column is heated and backflushed with helium to desorb the organic purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeable mixture. The separated purgeable components are then identified and quantitated using a computerized mass spectrometer.

Acid, Base/Neutral and Pesticide Priority Pollutant Compounds

For the analysis of the Acid, Base/Neutral and Pesticide priority pollutants in an aqueous liquid matrix, EPA Method 625 (Federal Register, December 3, 1979; page 69540) was used. The method can be summarized as follows: A measured volume of sample, approximately 1 liter, is adjusted to a pH greater than 11 and extracted with methylene chloride. The pH of the sample is adjusted to a value less than 2 and extracted with an aliquot of fresh methylene chloride. A separatory funnel or continuous extractor is used to perform the extractions. The two extracts are dried and concentrated to a 1 ml final volume. Each extract is injected into a GC/MS instrument specifically configured for the correct fraction.

~~006481~~

TOTAL ION CHROMATOGRAM



Data File: >G3489::U3
Name: 840720 G
Misc: E9438B

BTL#23

Id File: GBNP
Title: BN,PEST,IFB ISTDS IDFILE PVC..840510
Last Calibration: 840721 08:25

Operator ID: KB5414
Qaunt Time: 840721 14:17

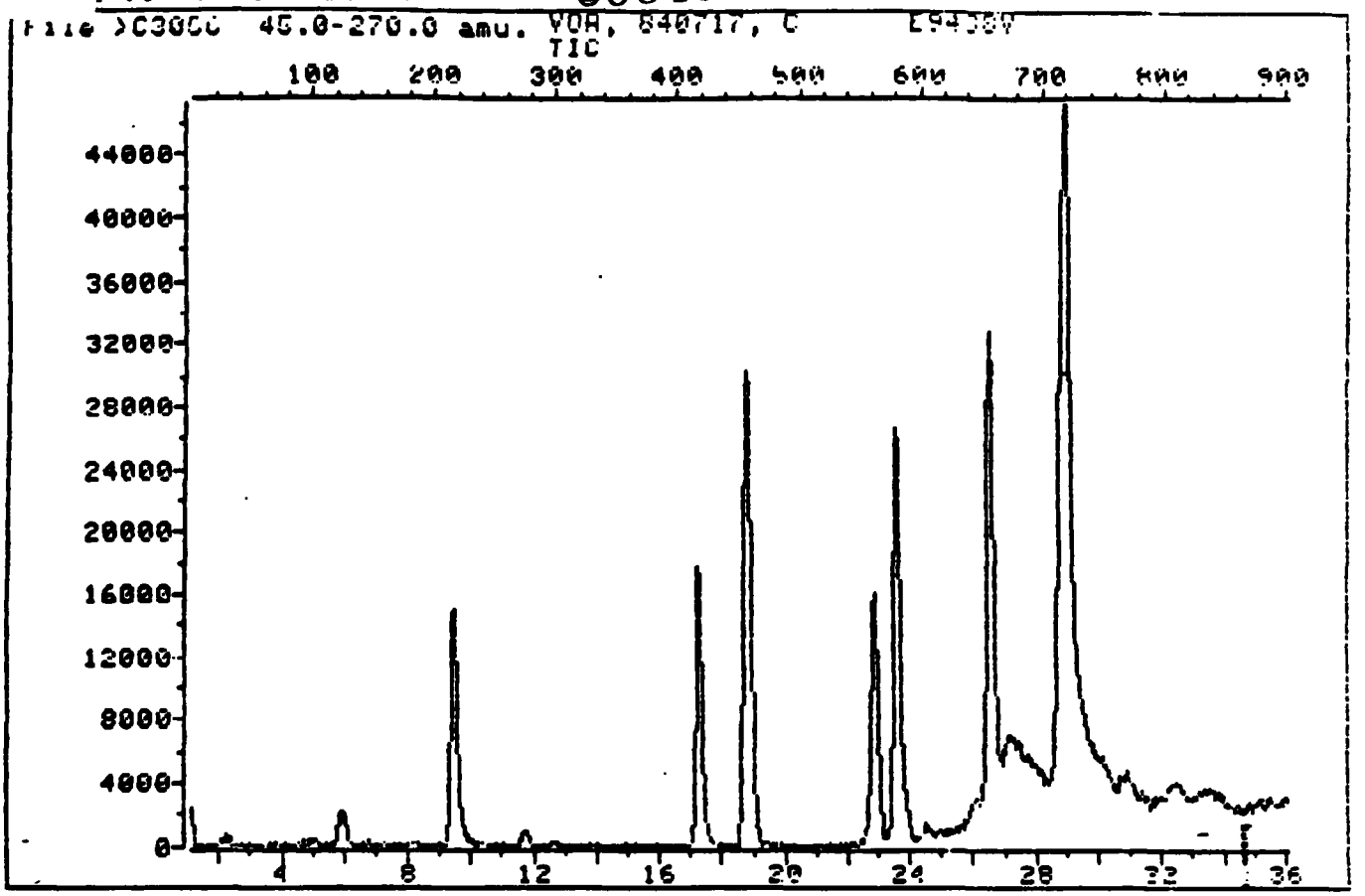
Appendix B

Mass Spectral Data for Calibration Compounds

1) If the sample analysis included the determination of purgeable organic compounds then a mass spectrum for 4-bromofluorobenzene (BFB) is included. This data was used in the instrument calibration protocol on the day of analysis.

2) If the sample analysis included the determination of non-purgeable organic compounds then a mass spectrum for decafluorotriphenylphosphine (DFTPP) is included. This data was used in the instrument calibration protocol on the day of analysis.

. ION CHROMATOGRAM 006482

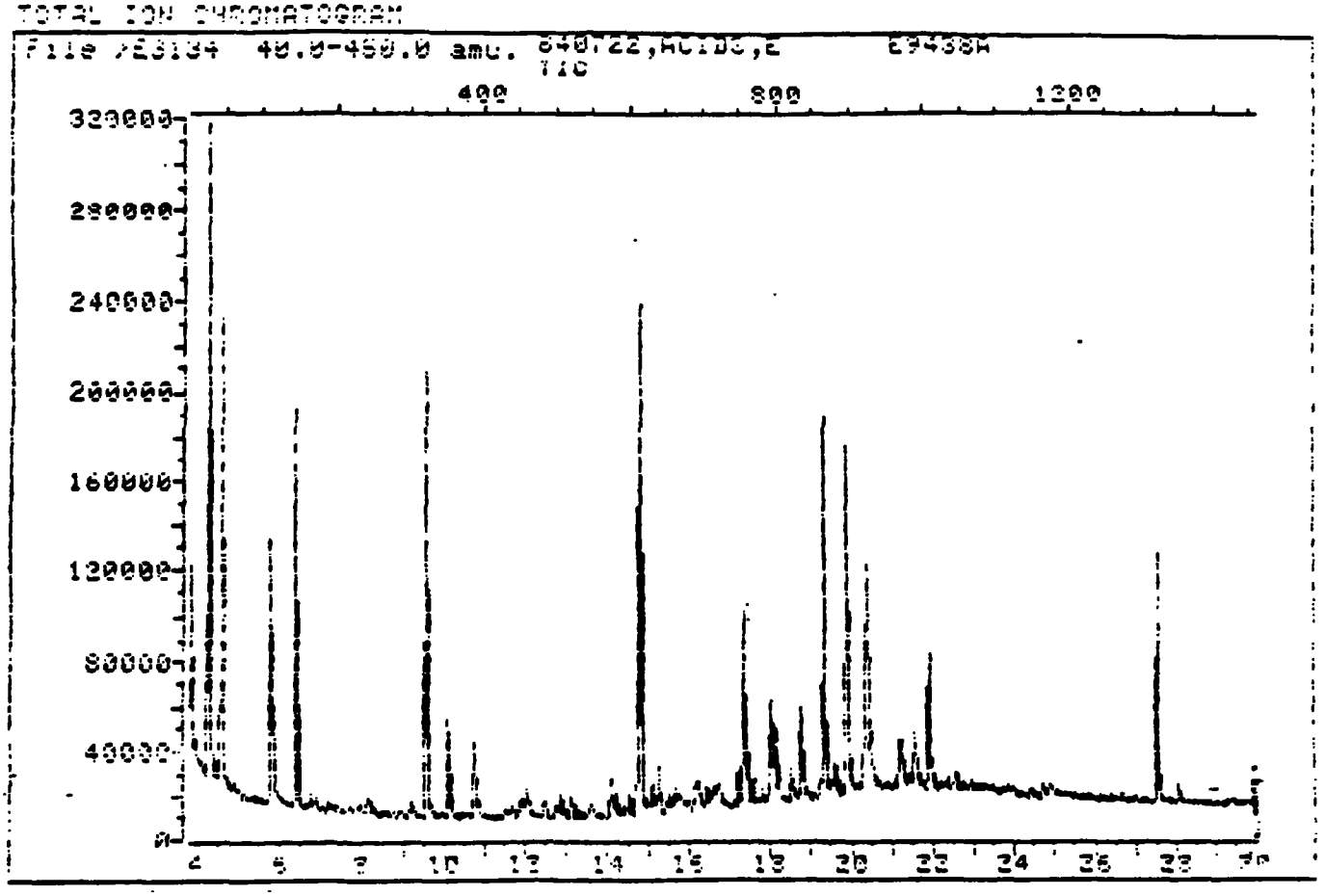


Data File: >C3056::U2
Name: VOA, 840717, C
Misc: E943

Id File: VOA
Title: IDFILE, PURGEABLE PRIORITY POLLUTANTS, C
Last Calibration: 840718 04:29

Operator ID: PK2050
Quant Time: 840718 10:32

TOTAL ION CHROMATOGRAM



Data File >E3134 U4
Name: 840722,ACIDC,E
Misc E9438A BTL#1

Id File: EACID
Title ACID ID FILE.....WWC 6/21/03,#E
Last Calibration: 840723 00:06

Operator ID TP#113
Quant Time: 840723 04:43

- In cases where no native 2,3,7,8-TCDD is detected, the actual detection limit is estimated and reported based on a signal to noise ratio of 2.5 to 1 at ions 320 and 322.

- For each sample, the internal standard is present with at least a 10 to 1 signal to noise ratio for both mass 332 and mass 334. Also, the internal standard 332/334 ratio must be within the range of 0.67 to 0.87.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;

- outgoing shipping manifests;

- the chain-of-custody form completed by the person(s) breaking the Shuttle seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;

- incoming shipping manifests;

- breaking the Shuttle's reseal;

- storing each labeled sample bottle in a secured area;

- disposition of each sample to an analyst or technician; and

- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody; and

- the time and date each person accepted or relinquished custody.

Appendix A

Mass Spectral Data for Quantitated Compounds

1) A total ion chromatogram for each sample analysed by a GC/MS instrument.

2) A mass spectrum and a reference spectrum for each priority pollutant compound detected in the sample.

Heterogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are heterogeneous, the QC program is a minimum of 65% and consists of analyzing:

- each of the 30 customer samples in duplicate;
- 4 Replicates;
- 4 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Analysis of Mercury

To analyze samples for mercury we group them by matrix in batches of 20 or less. Our QC program is a minimum of 66% and consists of analyzing:

- each of the 20 customer samples in duplicate;
- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 10 Calibration standards (processed using the sample preparation method); and
- 2 Blanks.

Analysis of Pesticides, Herbicides and PCB's (EPA Method 608)

Pesticide, herbicide and PCB samples are grouped in batches of 16 customer samples or less according to the type of analysis to be performed. The QC program for each of these three types of analyses is a minimum of 20% and consists of analyzing:

- 1 blank sample;
- 1 spiked blank sample;
- 1 replicate sample;
- 1 replicate spiked sample; and
- 1 blank QC sample for at least each 100 samples analyzed.

The GC instruments are tuned daily to meet performance criteria in Method 608. Because Method 608 lacks data acceptance criteria, ETC has developed its own upper and lower quality control limits. When a test result falls outside the control limits, the test is re-run.

Analysis of Cyanides and Phenols

Cyanides and phenols are analyzed using a Technicon AutoAnalyzer II GT.

- Absorbance of full scale standards must be within +/- 25% of nominal absorbance.
- Duplicate calibration standards at four different concentrations are run with each batch of customer samples.
- At least one intersample standard is run for each 20 customer samples.
- Gain and carryover standards are analyzed at the end of each run.

Analysis of Total Organic Halide (TOX)

- Blank reagent water must contain less than 5 ug/l of halide (as chloride).
- Using a trichlorophenol standard, the mean adsorption efficiency must be within +/- 15% of the standard value.
- Pure compound recoveries must average 100 +/-15% (standard deviation).

Analysis of 2,3,7,8-TCDD (Dioxin) by GC/MS (SIM)

- Each sample is dosed with a known quantity of $^{13}C_{12}$-2,3,7,8-TCDD as internal standard and $^{37}Cl_4$-TCDD as surogate standard. The action limits for surrogate standard results is +/- 40% of the true value. Samples showing surrogate standard results outside of these limits are reextracted and reanalyzed.
- A laboratory "method blank" is run along with each set of 24 or fewer samples. The method blank is also dosed with the internal standard and surrrogate standard.
- At least one per set of 24 samples is run in duplicate to determine intralaboratory precision.
- Qualitative Requirements. The following are met in order to confirm the presence of native 2,3,7,8-TCDD:

  a. Isomer specificity must be demonstrated initially and verified once per 8-hour work shift. The verification consists of injecting a mixture containing TCDD isomers which elute close to 2,3,7,8-TCDD. The 2,3,7,8-TCDD must be separated from interferring isomers, with no more than 25% valley relative to the 2,3,7,8-TCDD peak.

  b. The 320/322 ratio is within the range of 0.67 to 0.87.

  c. Ions 320, 322, and 257 are all present and maximize together the signal to mean noise ratio must be 2.5 to 1 or better for all 3 ions.

  d. The retention time is equal (within 3 seconds) the retention time for the isotopically labeled 2,3,7,8-TCDD.

  e. At least one of the positives can be confirmed by obtaining partial scan spectra from mass 150 to mass 350. The partial scan guidelines are as follows:

  . the 320/324 ratio should be 1.58 +/- 0.16

  . the 257/259 ratio should be 1.03 +/- 0.10

  . the 194/196 ratio should be 1.54 +/- 0.15

- One sample is spiked with native 2,3,7,8-TCDD at a level of 1.0 PPB (for soil) for each set of 24 or fewer samples.

Quality Assurance/Quality Control Procedures (QA/QC)

ETC bases its quality assurance protocols on the following government guidelines:

- "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;
- National Enforcement Investigation Center Policies, and Procedures manual; EPA-330/9/79/001-R, October 1979;
- the recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979, pp. 69532-69559);
- "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980; and
- "Determination of 2,3,7,8-TCDD in Soil and Sediment" EPA, Region VII, Kansas City, September 1983.

However, we have modified our protocols to provide a higher level of QA/QC than the guidelines require. For example, we analyze a higher than required number of quality control samples and we pay especially careful attention to the certification of the "reference standard" compounds we use in analysis. Below are listed the key QA/QC elements for the methods we used.

Analysis of Volatile Organic Compounds (EPA Method 624)

- Each batch of 13 samples consists of 9 customer samples (at maximum), one blank sample, one spiked blank, one spiked sample and one replicate sample. This amounts to a 30% quality control factor.
- Three surrogate compounds are added to each sample in the batch of 13.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.
- Each GC/MS is checked and retuned, if necessary, every 8 hours to ensure that its performance on bromofluorobenzene (BFB) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of Volatile Organic Priority Pollutant "standards" at a minimum of 3 different concentrations and using a mixture of 3 internal standards at a constant concentration.
- The calibration curve is verified with a mixture of priority pollutant standards every 8 hours.
- Results are compared to the acceptance criteria given in Method 624; any that do not meet the criteria are re-analyzed.

Analysis of Organic Compounds Extracted in Acid or Base/Neutral Solutions (EPA Method 625)

- Each batch of 20 samples consists of 16 customer samples (at maximum), one blank sample, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate customer sample. This amounts to a 20% quality control factor.
- Five surrogate compounds are added to each sample in the batch of 20.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.

- Each GC/MS is checked and retuned, if necessary, every eight hours to ensure that its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of standards composed of either the Organic Acid or Base/Neutral Extractable Compounds at a minimum of 3 concentrations and using 2,2'-difluorobiphenyl as an internal standard.
- The calibration curve is verified with a mixture of priority pollutant standards every eight hours.
- Results are compared to the acceptance criteria given in Method 625; any that do not meet the criteria are re-analyzed.

Analysis of Metals

All Samples

- New standards are prepared for each batch of samples.
- Normal calibration is performed using a blank sample and four standards that have been through the sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis that requires the use of the "method of additions" technique, a three point calibration is performed using U.S EPA "Methods for Chemical Analysis of Water and Wastes, 1979". Results are obtained using linear regression analysis. Any results with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- In constructing the normal calibration curves the lowest concentration levels we use are values greater than or equal to 5 times the Instrumental Detection Limit (IDL).
- All calibration standards are analyzed in duplicate, at a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to validate the normal calibration curve.

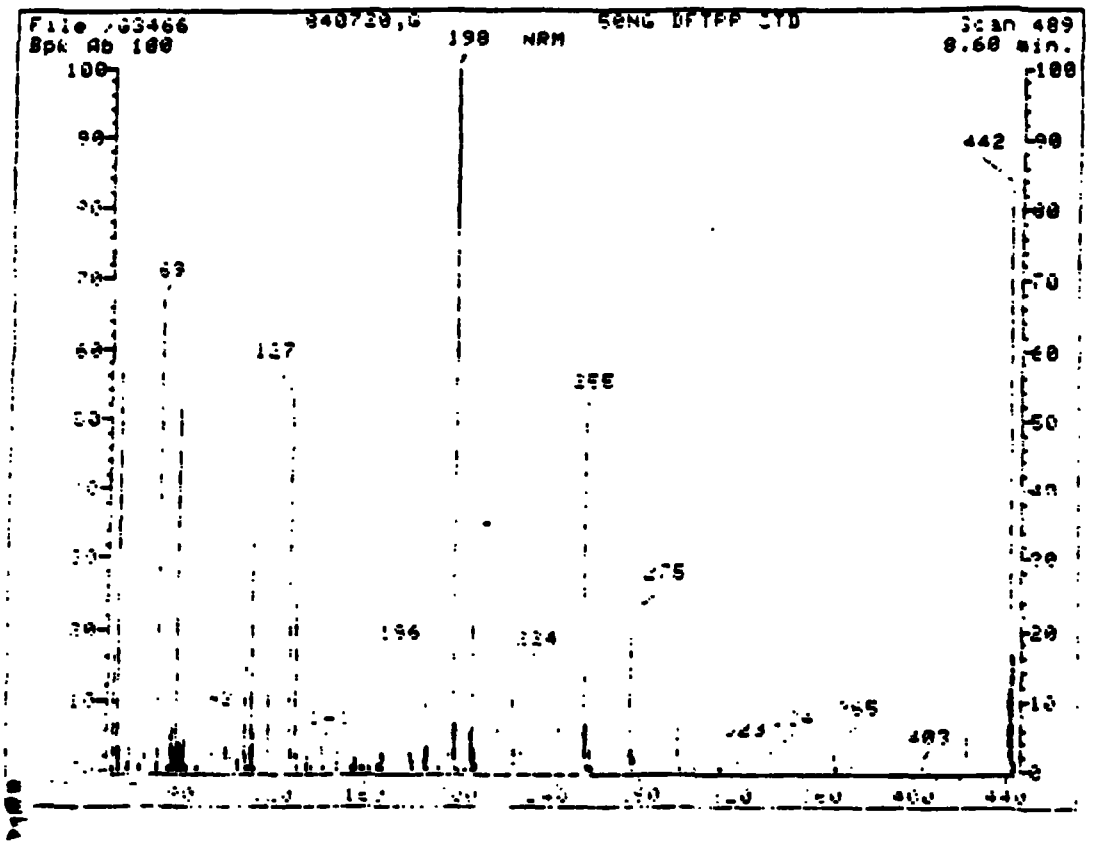
Homogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are homogeneous, the QC program is a minimum of 42% and consists of analyzing:

- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

019214

~~006486~~



:TAB

G3466 840720,G 50NG DFTPP STD
489 NRM

File: G3466 Scan #: 489 Retn. time: 3.50

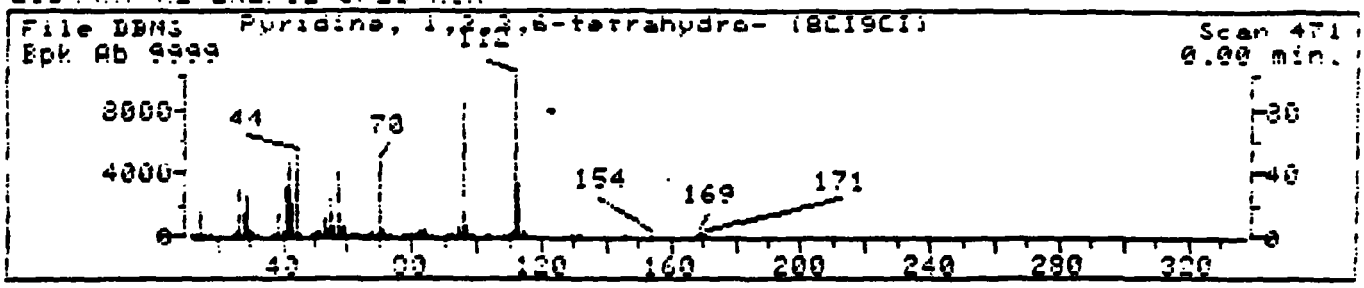
m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
50.05	.70	86.10	.93	141.05	7.29	194.05	2.74	256.05	.55
63.15	.70	87.10	.59	141.95	.98	199.05	100.00	146.05	1.45
69.05	15.05	91.15	.93	147.10	11.30	199.05	6.96	272.10	1.03
71.15	54.75	92.15	1.37	148.10	2.70	199.95	.40	274.10	3.40
82.15	7.24	97.05	5.05	157.00	1.07	201.25	.55	275.10	21.45
87.15	.77	98.15	4.78	158.05	.96	202.95	.75	276.10	3.10
96.05	1.57	99.05	4.45	162.05	1.90	204.05	7.63	277.00	2.02
97.05	1.02	101.10	2.71	164.15	1.91	205.05	6.39	283.10	.46
81.00	1.05	104.10	1.74	167.05	.47	208.10	27.25	296.10	6.16
81.10	.74	107.10	1.54	168.05	.53	207.10	3.04	297.00	.82
82.05	.61	113.10	4.04	169.05	.75	209.00	.79	307.15	.72
83.10	1.41	109.10	1.07	181.15	1.19	211.10	.90	314.90	.58
85.10	1.05	109.10	.59	182.05	.39	217.05	6.13	315.90	.40
87.05	1.13	110.10	71.75	185.05	1.10	221.05	3.33	323.15	1.96
89.05	4.17	111.05	5.20	186.10	.95	227.05	1.10	334.10	.98
91.10	1.77	111.05	.73	187.10	3.17	228.15	12.29	353.10	.60
93.10	1.01	112.05	66.00	188.00	1.41	229.15	7.54	345.05	2.41
95.10	1.33	113.05	.96	197.10	1.13	237.10	5.15	355.05	.54
97.10	1.07	114.05	1.13	198.05	1.44	237.95	.92	372.05	1.19
99.10	1.14	117.10	1.33	202.05	1.13	239.10	1.25	386.15	.77
101.10	71.15	119.05	1.97	203.05	1.97	247.05	.70	401.10	.75
103.10	4.11	122.10	.75	210.05	2.15	253.05	9.46	431.10	.67
105.10	7.61	127.10	77.25	191.15	1.44	245.15	1.24	427.10	2.07
107.10	7.13	131.10	1.71	192.10	1.43	247.15	2.14	454.10	1.15
111.10	1.72	132.10	27.70	193.10	1.07	255.10	51.15	466.10	11.60
113.10	.13	133.10	1.92	197.00	7.75	256.10	4.13	467.10	2.13
115.05	.44	134.10	.58	198.10	.79	257.05	.57	468.10	.51
117.10	.13	135.10	1.22	197.10	.29	259.10	2.14	481.10	.75
119.10	.21	136.10	1.11						

Appendix C

Mass Spectral Data for Tentatively Identified Compounds

1) For each tentatively identified compound a mass spectrum of the detected compound, a reference mass spectrum for that compound and a plot of the spectral differences are provided.

LIBRARY REFERENCE SPECTRUM



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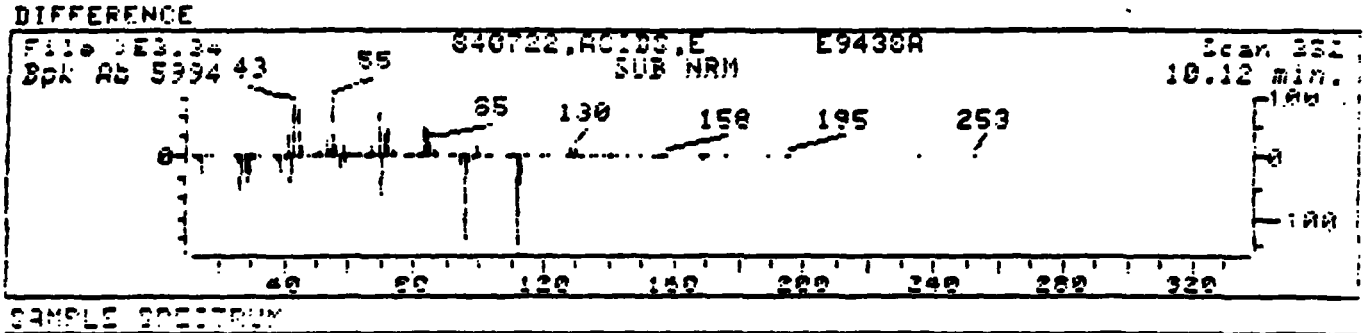
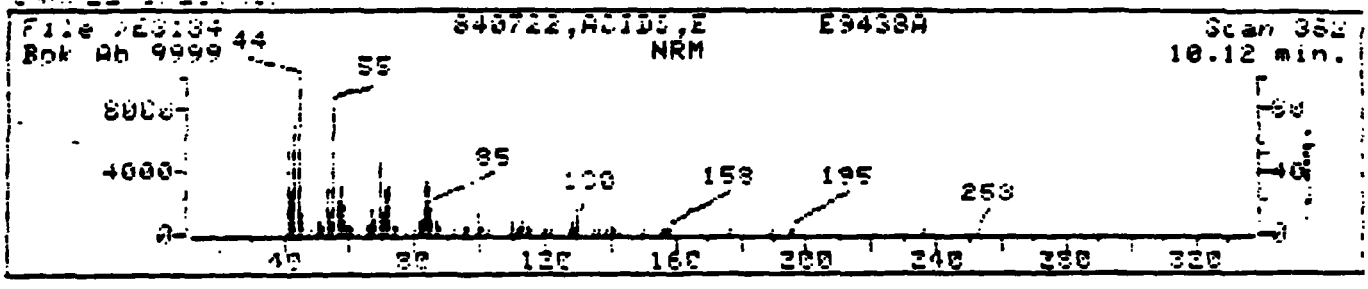


SAMPLE SPECTRUM



Data File: DE3134
Scan Number: 352
Hit number: 1 of 3

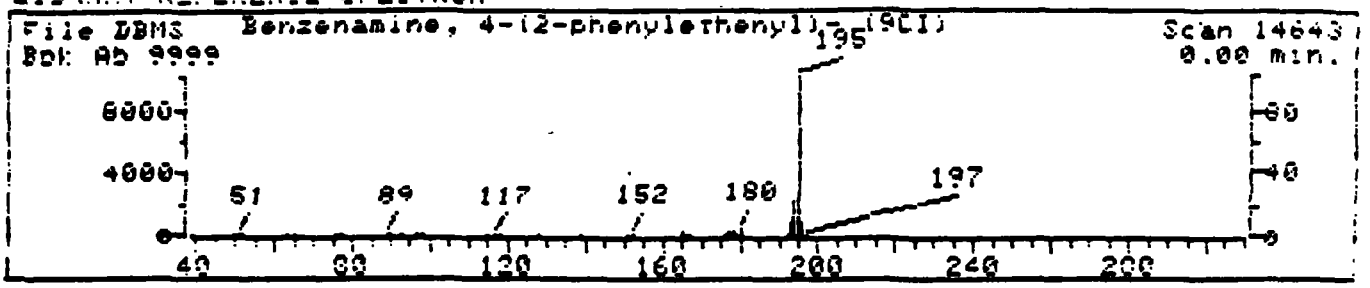
Rec.# 471 Reg.#: 694052 Xref.#: 26076 Base: DBMS D
Name: Pyridine, 1,2,3,6-tetrahydro- (8CI9CI)
MW: 83.133 QI: 0 MF: C5H9N

PBM Values

Class IV Reliability value: 26
K-value: 29
dK value: 78
Flagged Ions: 2
Tilt factor: 0

~~006488~~

LIBRARY REFERENCE SPECTRUM



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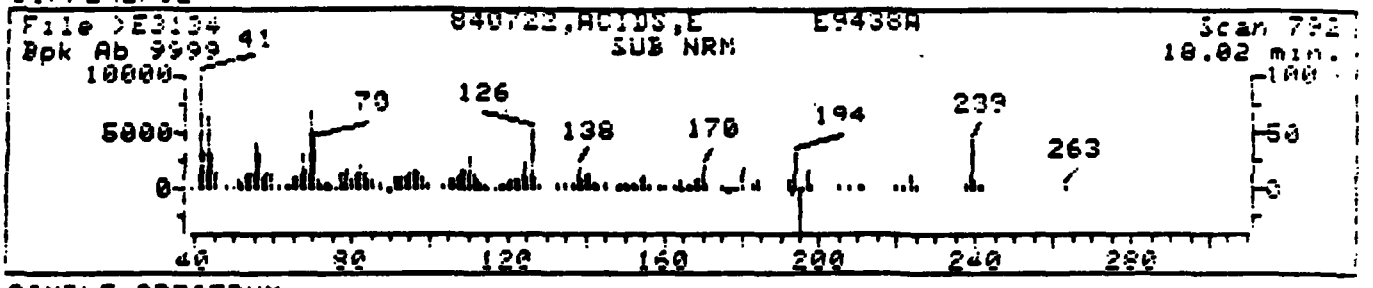
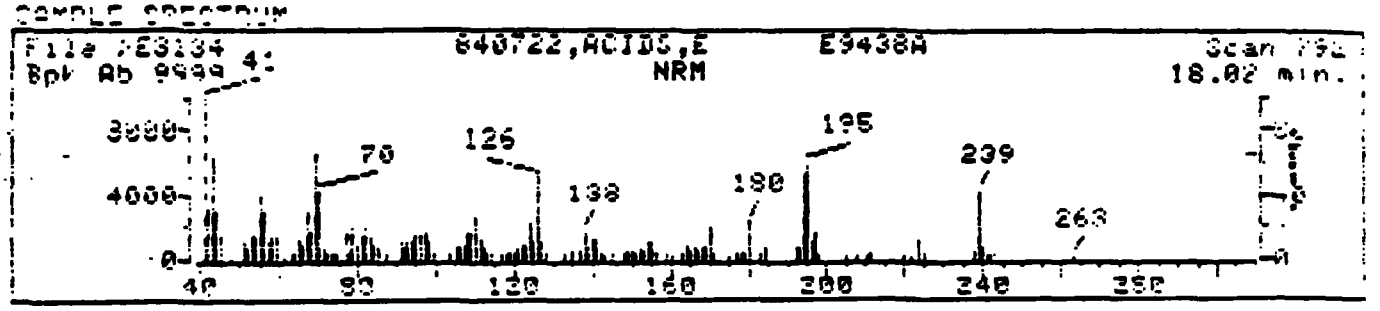


SAMPLE SPECTRUM

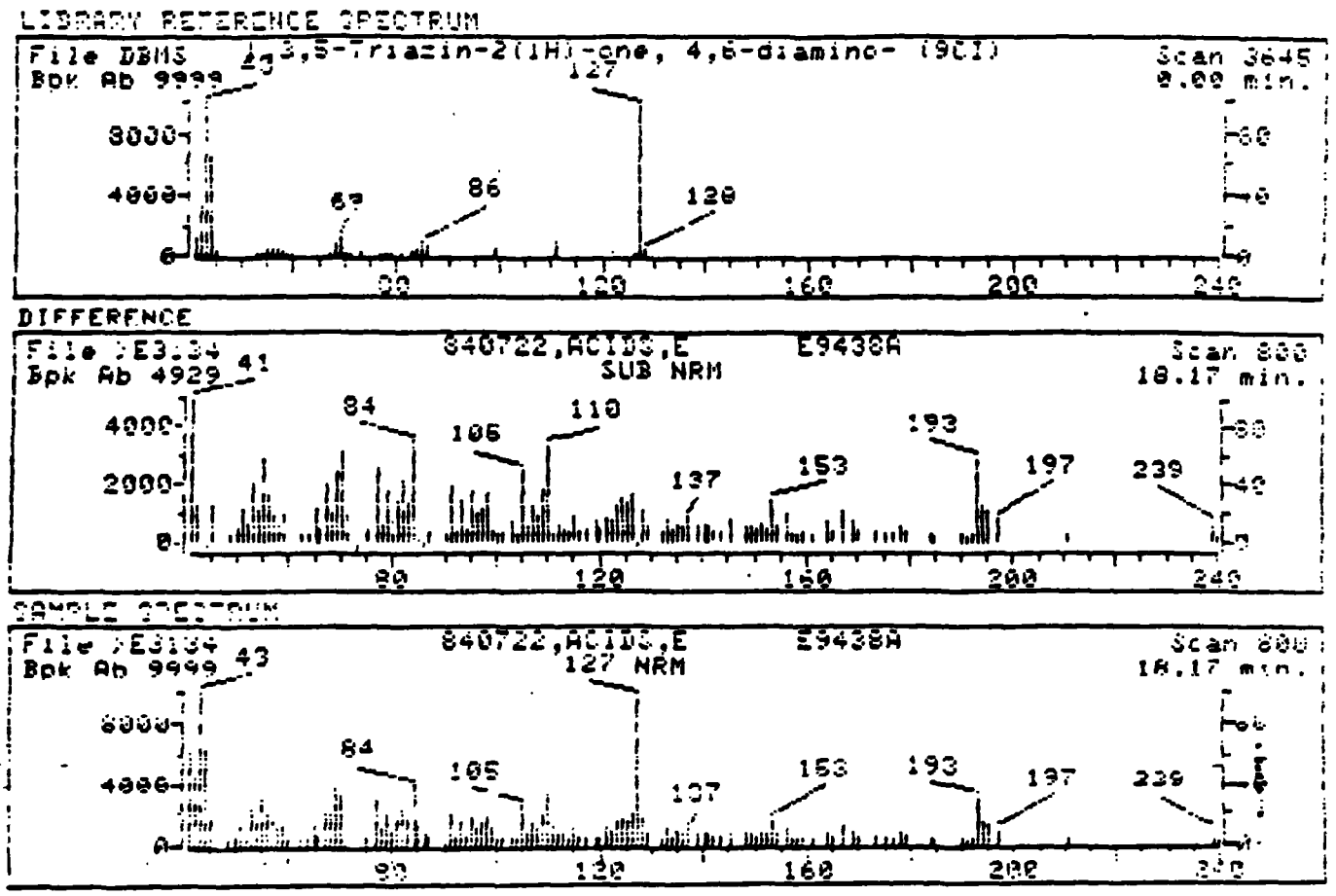


Data File: >E3134
Scan Number 792
Hit number 3 of 3

Rec.# 14643 Reg.#. 834242 Xref.#: 57084 Base DBMS D
Name Benzenamine, 4-(2-phenylethenyl)- (9CI)
MW 195 195 QI. 462 MF C14H13N

PBM Values.

Class IV Reliability value. 28
K-value: 39
dK value. 49
Flagged Ions: 0
Tilt factor. *

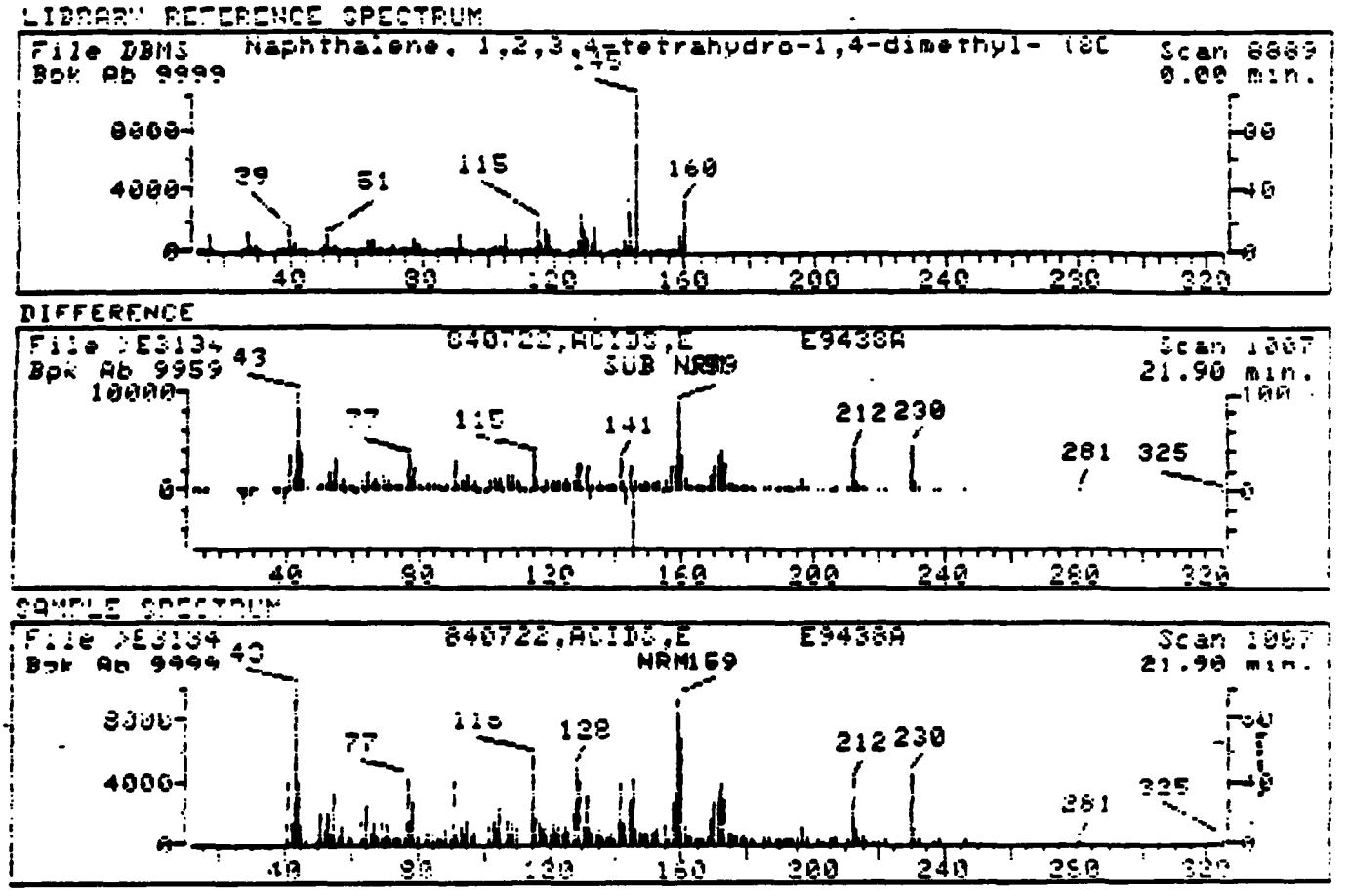


Data File)E3134
Scan Number 800
Hit number 1 of 3

Rec.# 3645 Reg.# 645921 Xref.#: 27269 Base DBMS.D
Name 1,3,5-Triazin-2(1H)-one, 4,6-diamino- (9CI)
MW 127.047 CI 637 MF C3H5N5O

PBM Values

Class IV Reliability value: 49
K-value: 49
dK-value 50
Flagged Ions: 0
Tilt factor. 0



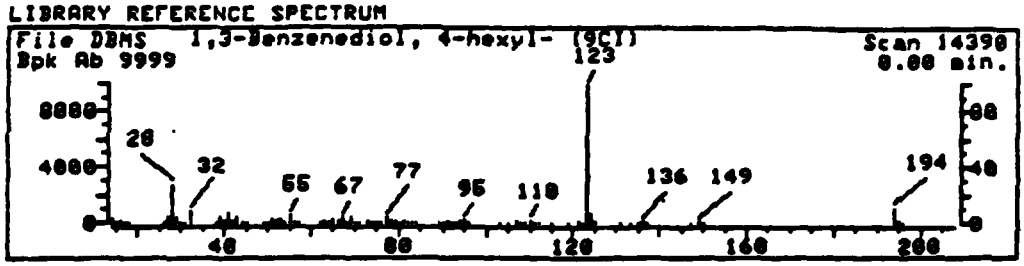
Data File: >E3134
Scan Number 1007
Hit number 1 of 3

Rec.# 8809 Reg.# 4175546 Xref.# 5673 Base DBMS D
Name Naphthalene, 1,2,3,4-tetrahydro-1,4-dimethyl- (8CI9CI)
MW 160.125 Cl 322 MF C12H16

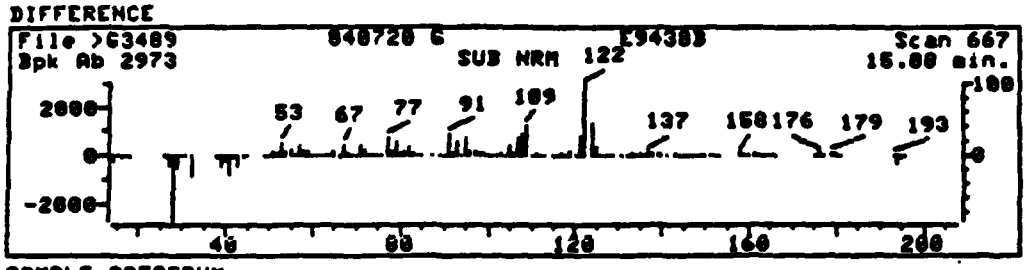
PBM Values

Class IV Reliability value 45
K-value: 33
dK-value 63
Flagged Ions 0
Tilt factor 3

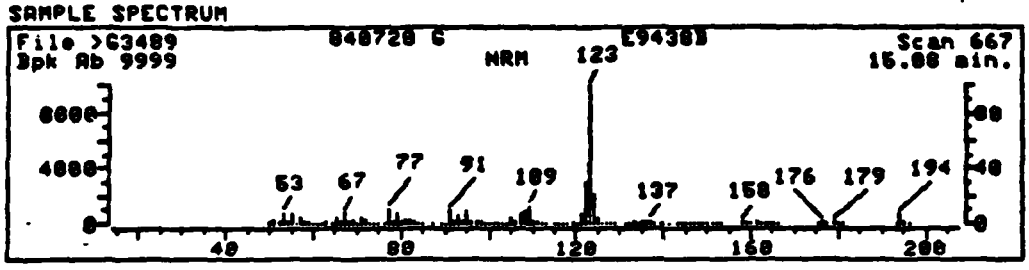
LIBRARY REFERENCE SPECTRUM



DIFFERENCE



SAMPLE SPECTRUM

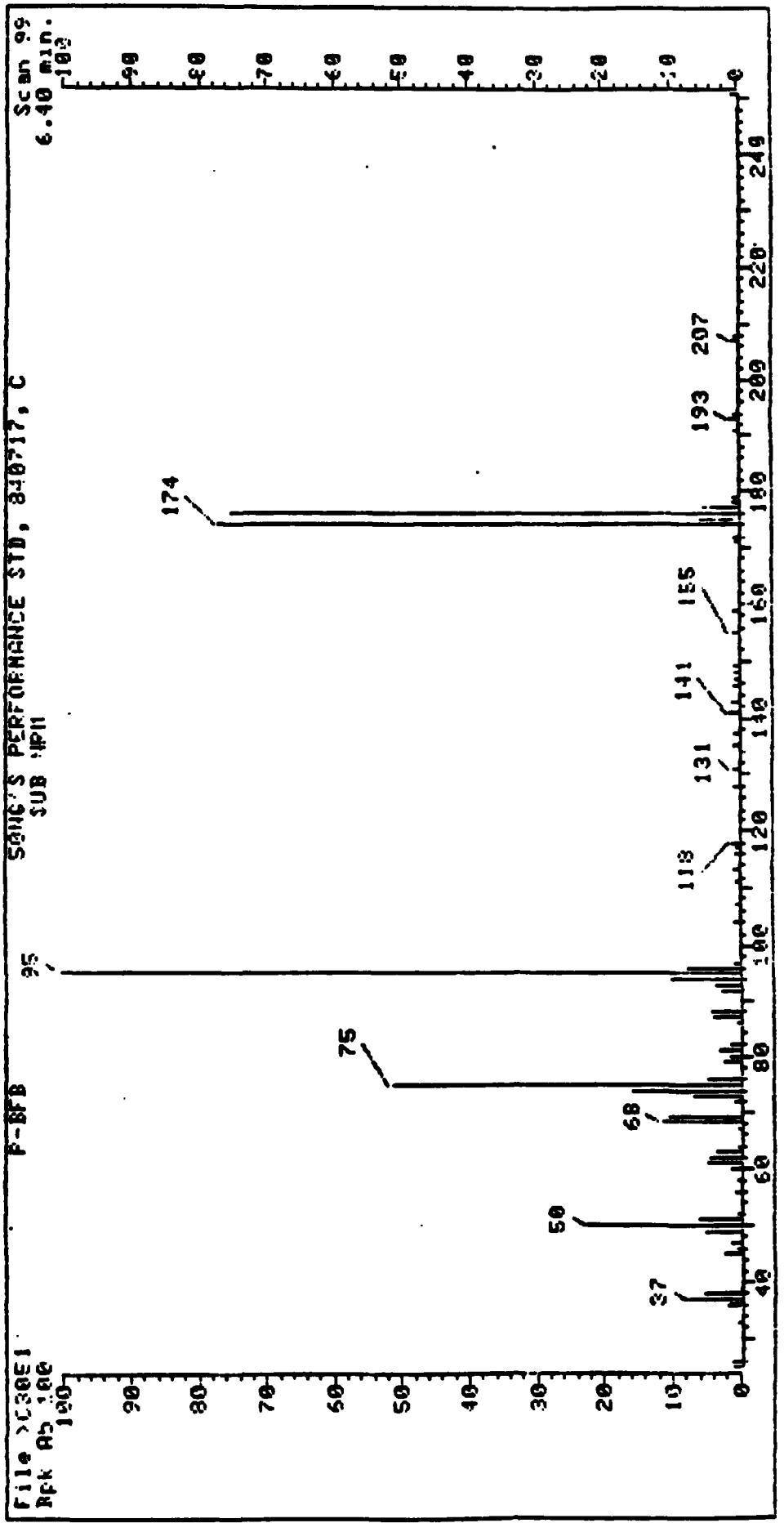


Data File: >G3489
Scan Number: 667
Hit number : 2 of 4

Rec.#: 14390 Reg.#: 136776 Xref.#: 70327 Base : DB11S:D
Name: 1,3-Benzenediol, 4-hexyl- (9CI)
MW : 194.130 QI: 477 MF: C12H18O2

PBM Values:

Class IV Reliability value: 38
K-value: 46
dK-value: 43
Flagged Ions: 1
Tilt factor: 0


File >C30E1
Rpk Ab 100
P-BFB
50NG'S PERFORMANCE STD, 840717, C
SUB NPM
Scan 99
6.40 min.
37
50
68
75
95
118
131
141
155
174
193
207

File: >C3051 Scan #: 99 Retn. time: 6.40

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
25.00	.91	56.10	.52	79.05	1.10	113.35	.38	158.95	.39
26.00	1.23	58.10	.16	81.05	2.85	115.95	.46	171.15	.28
32.80	.31	60.10	1.19	82.05	1.23	117.15	.16	171.95	.39
35.90	1.71	61.10	4.69	85.95	.20	117.95	.70	174.05	76.99
36.30	1.52	62.00	4.18	86.95	3.78	127.95	.39	175.05	5.63
37.00	7.42	63.10	3.23	88.05	3.84	130.95	.52	175.95	75.11
38.00	5.34	64.00	.03	91.95	2.30	134.95	.50	176.95	4.81
39.00	.01	67.10	.04	93.05	3.48	137.15	.37	178.05	.45
45.10	2.02	68.20	11.40	94.05	9.92	141.05	1.04	179.05	.60
46.00	.16	69.10	10.29	95.15	100.00	142.95	.83	191.05	.20
46.90	1.23	72.10	.35	95.95	7.36	145.95	.52	193.05	.66
47.10	1.25	73.00	6.85	97.05	.52	146.95	.03	193.95	.20
49.10	4.99	73.90	15.55	104.15	.35	147.95	.46	207.15	.47
49.90	22.21	75.00	51.14	106.95	.07	149.15	.35	208.05	.16
51.00	5.76	76.10	4.53	111.25	.30	155.05	.53	251.00	.50
52.10	.11	79.05	1.97						

Appendix E

Chain-of Custody Forms

1) A field Chain-of-Custody form (CC1) is included for all samples shipped by ETC shuttle.

2) An in-house sample Chain-of Custody form is included for the period the sample was in ETC's possession.

3) A subcontractor's Chain-of-Custody form is included for any analytical work not performed within ETC's laboratory.

4) Any additional Chain-of-Custody material provided by a client or by a client's sampling agent is also included.

CHAIN OF CUSTODY FORM (CC1)

Seal Date: 6/25/84
Sealed By: J. Trotter

SHIP TO:

Company: RESOURCE ENGINEERING
Facility/Site: 11 GREENWAY PLAZA
Address: Houston, TX 77406
Attn.: COBY SHER
Phone: (713) 621 - 5900

SAMPLE IDENTIFICATION

Facility/Site Code: RES-288-011

Source Codes:

Well	(W)	River/Stream	(R)	Surface Impoundment	(I)	Lake/Ocean	(L)
Soil	(S)	Bottom Sediment	(B)	Pretreatment Facility	(P)	Treatment Facility	(T)
Outfall	(O)	Generation Point	(G)	Leachate Collection Sys.	(C)	Other	(X)

Source Code (from above)	Your Sample Point ID (left justify)	Start Date (mo/day/yr)	Start Time (2400 hr. clock)	Elapsed Hours (composite)
W	MW-16	06 29 84		
Example: W	101J263P	05 15 81	0930	13

SHUTTLE CONTENTS

Sample Bottle	Condition	Sample Bottle	Condition
E9438 E_1-E_4	~~XXXX~~		
E9438 V_1-V_2	~~XX~~ OK.	T.B H.S	
E9438 TB	~~X~~		

175
3

CHAIN OF CUSTODY CHRONICLE

1. Shuttle Opened By: (print) S. C. Itin Date: 6-26-84 Time: 1330
Signature: [signature] Seal #: NOT NOTED Intact: YES

2. I have received these materials in good condition from the above person.
Name: Tom Beck Signature: Wm Thomas Beck
Date: 6-29-84 Time: 8:22 am Remarks:

3. I have received these materials in good condition from the above person.
Name: DEAN GORE Signature: [signature]
Date: 6/29/84 Time: 17:00 Remarks:

4. I have received these materials in good condition from the above person.
Name: Marshall H. Smith Signature: Marshall H Smith
Date: 7/2/84 Time: 07:00 Remarks:

5. Shuttle Sealed By: (print) Date: Time:
Signature: Seal #:

ETC USE ONLY Opened By: ~~18334~~ B. Sharp Date: 7/3/84 Time: 12:00
Seal #: 18334 Condition: INTACT

ETC Form CC1 6/1/82

~~006492~~

ETC ENVIRONMENTAL TESTING and CERTIFICATION

019220

E9438
ETC Sample No.:

SAMPLE POINT INFORMATION FORM (CC2)

FIELD MEASUREMENT DATA

Select up to 3 parameters to be recorded by entering the appropriate code letter in the first space for each of the 3 data entry fields provided. Enter the actual measurement data (in the units specified) for the three parameters you have selected.

PARAMETERS		ACTUAL (left justify)	EXAMPLE
Flow (CFS)	A	D 40.45	C 2.5
Volume (Gal)	B		E 5.0
Sample Depth (Ft)	C		G 1/1/03
Depth to Water (Ft)	D		
Discharge Rate (GPM)	E		
Depth to Bottom (Ft)	F		
Event Time (2400-Hr Clock)	G		
Depth to Screen (Ft)	H		

FIELD TEST DATA

DO (Mg/L) [ ]

Sample Temp. (°C) 37.3

pH 6.77 (Single Measurement) — [ ] (2nd of Quadruplicate) — [ ] (3rd of Quadruplicate) — [ ] (4th of Quadruplicate)

Specific Conductance (uMHOS/CM) 2640 (Single Measurement) — [ ] (2nd of Quadruplicate) — [ ] (3rd of Quadruplicate) — [ ] (4th of Quadruplicate)

THE FOLLOWING DATA IS FOR YOUR RECORDS ONLY

SAMPLING METHOD (choose one)

AIR-LIFT PUMP ( )	PERISTALTIC PUMP ( )	THIEF ( )
AUGER ( )	PETERSEN ( )	TRIER ( )
BAILER (X)	PISTON PUMP ( )	VEHMEYER ( )
BOTTLE ( )	SCOOP/SHOVEL ( )	OTHER
COLIWASA ( )	SQUEEZE PUMP ( )	
DIPPER ( )	SUBMERSIBLE PUMP ( )	
KEMMERER ( )	SUCTION LIFT PUMP ( )	
MISKIN ( )	SURGER ( )	

SAMPLE TYPE (choose one)

GRAB (X) COMPOSITE ( ) OTHER ( )

(describe) (describe)

WEATHER: clear, hot, humid (describe)

SAMPLE DESCRIPTION (e.g. color, odor): cloudy (slightly), no odors other (describe)

Form Prepared By: DEAN GORE (name (print)) Employer: RESOURCE ENGINEERING

ETC Form CC2 6/1/82

ETC ENVIRONMENTAL TESTING and CERTIFICATION

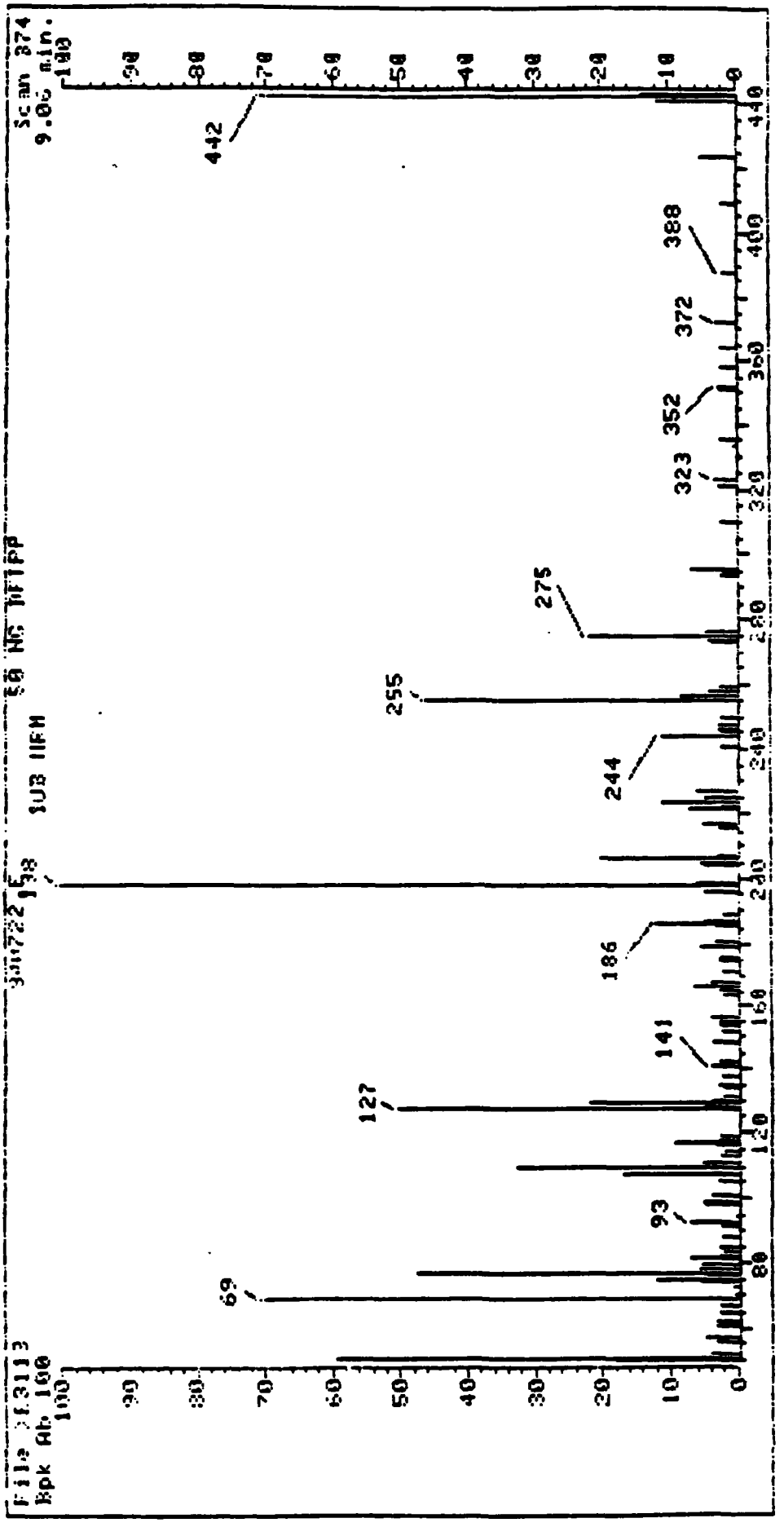
LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number(s) E9434 TO E9438

Sample Preparation For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	L. Scalise/K. Albretson (J. [illegible])	7/16/84
Acids	Greg Mennin	7/18/84
Metals		
Others		
Others		
Others		
Others		

Sample Analysis For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Kris Bonaparte (cw)	7/20/84
Acids	Tom Rusowicz	7-22-84
VOA/Purgeables	(PK) ~~[illegible]~~	
Metals	Rich Albert (cw)	7/18/84
Others VOA	(PK) ~~[illegible] (E9237)~~	~~7/16/84~~
Others VOA/Purgeables	[illegible] 7/18	7/17/84
Others VOA/Purgeable	[illegible] E9434 7/18	
Others		
Others		
Others		

Verified By Harry Klaus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9.06 min.
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1UB HFM
File 3E3113
Bpk Ab 100
442
388
372
352
323
275
255
244
198
186
141
127
93
69

E3110 840722,E 50 NG DFTPP
374 SUB NRM

File:)E3118 Scan #: 374 Retn. time: 9.06

m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.	m/z	Int.
50.00	18.03	88.35	1.97	134.80	2.84	198.05	100.00	273.10	3.31
51.00	59.25	91.45	2.17	137.30	2.01	198.85	5.92	274.00	3.87
51.95	3.83	93.05	6.86	141.05	3.75	204.05	4.46	275.00	21.70
56.05	3.16	94.95	.20	142.15	2.52	205.15	5.29	276.10	4.54
57.05	4.73	97.90	4.54	147.95	3.43	206.05	20.20	293.25	2.13
60.95	3.12	99.00	5.05	151.35	2.01	206.85	2.80	294.95	1.85
62.15	3.12	100.90	3.63	153.05	2.45	216.10	2.45	296.05	6.51
65.15	2.45	105.20	2.72	154.70	2.29	217.00	4.89	310.30	2.09
67.00	2.49	107.00	16.73	155.00	2.25	221.00	6.71	321.15	2.25
69.00	70.61	108.00	3.20	156.10	3.75	222.40	1.93	322.95	3.00
70.30	.24	110.00	32.54	163.70	1.89	223.70	10.81	333.50	.20
73.10	.43	111.05	4.85	165.20	2.49	225.10	4.46	335.20	2.17
74.00	5.36	113.15	2.49	167.00	6.11	227.00	6.00	350.55	2.09
75.00	11.79	114.45	1.78	168.00	3.55	240.75	2.09	352.05	2.41
76.10	4.34	116.15	2.92	171.35	2.21	244.10	11.01	358.25	2.05
77.00	47.34	117.05	8.92	174.75	2.37	245.30	2.13	364.70	2.21
78.00	5.44	117.75	2.33	176.05	2.41	245.70	2.25	372.10	2.60
79.00	5.29	119.05	2.29	179.05	5.29	247.00	2.29	387.65	1.85
79.60	.75	127.00	50.22	180.85	2.88	250.00	2.01	409.35	1.78
80.95	6.75	128.10	4.50	185.30	3.08	255.00	46.04	423.10	4.89
82.15	2.29	129.00	21.78	186.00	11.87	256.00	8.09	441.15	11.53
82.55	2.37	130.00	3.51	187.00	4.69	257.95	3.94	442.05	70.57
83.75	1.89	131.30	1.97	188.60	1.89	259.25	2.37	443.05	13.85
85.15	2.25	134.40	1.89	196.10	4.65				

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GROUND WATER MIGRATION MANAGEMENT REMEDIAL INVESTIGATION

Sheridan Disposal Services Site
Hempstead, Texas

Volume IV
Appendix L

ERM-Southwest, inc.

019392

GROUND WATER MIGRATION MANAGEMENT
REMEDIAL INVESTIGATION

Sheridan Disposal Services Site
Hempstead, Texas

Volume IV
Appendix L

Prepared For:

The Sheridan Site Committee

W.O. #91-09

December 30, 1988

Prepared by:

ERM-SOUTHWEST, INC.
16000 Memorial Dr., Suite 200
Houston, Texas 77079
(713) 496-9600

019393

APPENDIX L

Ground Water Sampling Procedures and Results of Priority Pollutant Sampling (October 1987)

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APPENDIX L

Priority Pollutant Sampling Procedures

Before each well was sampled, a minimum of three casing volumes of water was removed. The volume of water to be evacuated was determined by measuring the height of the water column in the well in feet and multiplying that value by $0.489*r^2$, where r is the radius of the well in inches. Water was purged from the wells using dedicated bailers. Bailers used in PVC wells are constructed of PVC with nylon rope, while a teflon bailer with nylon rope was used for the stainless steel well (MW-38). Prior to evacuation MW-38 was checked for both light and heavy immiscible fractions using as oil-water interface probe. No immiscible fractions were detected in this well in October 1987. During bailing and sampling plastic sheeting was placed around the well on the ground to keep the bailer rope clean and free from surface contamination. Ground water removed from wells adjacent to the site was collected in 55 gallon drums for later disposal in the main pond. Water from the three background wells and MW-29 in the well nest were judged by EPA to be far enough removed from the site and free from contamination to allow this water to be disposed of on the ground near each well location.

Wells were sampled with the same bailer used during purging. The bailer was carefully lowered into the well and allowed to fill. A teflon bottom-emptying device was placed on the bottom of the bailer to decrease aeration of the sample. This device has silicon tubing and a clamp on the outlet side to control water flow. This set up was used to fill all sample bottles except for metals, which were field filtered (to .45 microns) from plastic cups prior to sample collection.

The field filtering equipment and teflon bottom-emptying device were thoroughly cleaned between each well by washing in a liquinox/distilled water solution and then rinsing with distilled water. The tygon tubing for field filtering and the silicon tubing used for the bottom-emptying device was discarded and replaced with new tubing for each well.

An EPA representative from Jacobs Engineering Group split four samples with ERM-Southwest personnel (MW-12,34,35 and 38). Each group used the same procedures and sampling equipment to insure consistency. Samples were split between Jacobs and ERM by partially filling the same bottle type (i.e. VOAs; BNAs; etc.) for

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each group from the same bailer of water until all bottles were full.

Upon completion of sampling, labelled bottles were placed in ice chests with ice. Samples collected that day were shipped with proper chain of custody forms via Federal Express for next day delivery to Enseco/Rocky Mountain Analytical Laboratories. All samples arrived at the lab within 24 hours of sampling for immediate processing.

Rocky Mountain
Analytical Laboratory

Enseco Incorporated

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Enseco

ANALYTICAL RESULTS

FOR

ERM-SOUTHWEST, INC.

NOVEMBER 30, 1987

Reviewed by:

Jean Zimmerman

Michael P. Phillips. Ph.D.

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611

Facsimile: 303/431-7171

I. OVERVIEW

On October 28-31, 1987, Enseco-Rocky Mountain Analytical Laboratory received 24 samples from ERM-Southwest, Inc. A complete listing of tests requested, by sample, is given in Section III.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

I. Overview
II. Sample Description Information
III. Analytical Tests Assigned
IV. Analytical Results
V. Quality Control Report
VI. Description of Analytical Methodology

LCS #2 for BNA QC LOT 054 AA was lost during sample preparation.

SAMPLE DESCRIPTION INFORMATION

for

ERM-SOUTHWEST INC

RMAL Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
64874-001	MW-29	Groundwater	10/27/87	10/28/87
64874-002	MW-19	Groundwater	10/27/87	10/28/87
64874-003	TRIP BLANK	Water	10/27/87	10/28/87
64874-004	MW-6	Groundwater	10/27/87	10/28/87
64874-005	MW-10	Groundwater	10/27/87	10/28/87
64874-006	MW-40	Groundwater	10/27/87	10/28/87
64874-007	MW-33	Groundwater	10/28/87	10/29/87
64874-008	DUPLICATE #1	Groundwater	10/28/87	10/29/87
64874-009	DUPLICATE #2	Groundwater	10/28/87	10/29/87
64874-010	MW-7	Groundwater	10/28/87	10/29/87
64874-011	MW-30	Groundwater	10/28/87	10/29/87
64874-012	MW-39	Groundwater	10/28/87	10/29/87
64874-013	MW-12	Groundwater	10/28/87	10/29/87
64874-014	MW-31	Groundwater	10/28/87	10/29/87
64874-015	MW-32	Groundwater	10/28/87	10/29/87
64874-016	MW-14	Groundwater	10/29/87	10/30/87
64874-017	MW-36	Groundwater	10/29/87	10/30/87
64874-018	MW-37	Groundwater	10/29/87	10/30/87
64874-019	MW-35	Groundwater	10/29/87	10/30/87
64874-020	MW-34	Groundwater	10/29/87	10/30/87
64874-021	MW-18	Groundwater	10/29/87	10/30/87
64874-022	DUPLICATE #3	Groundwater	10/30/87	10/31/87
64874-023	MW-13	Groundwater	10/30/87	10/31/87
64874-024	MW-38	Groundwater	10/30/87	10/31/87

III. ANALYTICAL TESTS ASSIGNED

The following section presents all of the tests assigned to each of the samples in the project. The tests are listed in the order in which data is presented in Section IV. (Analytical Results).

In addition to a test description, information is provided concerning whether the test has been changed, or customized, to accommodate specific needs of the client. Customization can involve changes in the analyte list (addition or deletion of standard analytes) or changes in the standard detection limit.

ANALYTICAL TESTS ASSIGNED

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-001	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-002	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-002	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-003	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-004	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-004	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-005	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-006	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-006	PRIORITY POLLUTANT METALS	
	DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-007	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA	
	DISSOLVED METALS	NO
	ARSENIC, FURNACE AA	
	DISSOLVED METALS	NO
	LEAD, FURNACE AA	
	DISSOLVED METALS	NO
	SELENIUM, FURNACE AA	
	DISSOLVED METALS	NO
	THALLIUM, FURNACE AA	
	DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS	
	DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-008	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA	
	DISSOLVED METALS	NO
	ARSENIC, FURNACE AA	
	DISSOLVED METALS	NO
	LEAD, FURNACE AA	
	DISSOLVED METALS	NO
	SELENIUM, FURNACE AA	
	DISSOLVED METALS	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-008	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-009	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-010	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

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ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-010	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-011	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-012	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

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ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-012	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-013	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-014	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-014	ARSENIC, FURNACE AA	
	DISSOLVED METALS	NO
	LEAD, FURNACE AA	
	DISSOLVED METALS	NO
	SELENIUM, FURNACE AA	
	DISSOLVED METALS	NO
	THALLIUM, FURNACE AA	
	DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS	
	DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-015	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA	
	DISSOLVED METALS	NO
	ARSENIC, FURNACE AA	
	DISSOLVED METALS	NO
	LEAD, FURNACE AA	
	DISSOLVED METALS	NO
	SELENIUM, FURNACE AA	
	DISSOLVED METALS	NO
	THALLIUM, FURNACE AA	
	DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS	
	DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-016	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-016	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-017	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-018	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-019	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-019	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-020	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-021	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-021	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-022	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-023	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA DISSOLVED METALS	NO
	ARSENIC, FURNACE AA DISSOLVED METALS	NO
	LEAD, FURNACE AA DISSOLVED METALS	NO
	SELENIUM, FURNACE AA DISSOLVED METALS	NO
	THALLIUM, FURNACE AA DISSOLVED METALS	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

ANALYTICAL TESTS ASSIGNED (cont.)

for

ERM-SOUTHWEST INC

RMAL Sample No.	Analysis Description	Custom Test*
64874-023	PRIORITY POLLUTANT METALS	
	DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO
64874-024	PRIORITY POLLUTANT VOLATILE ORGANICS	NO
	PRIORITY POLLUTANT SEMIVOLATILE ORGANICS	NO
	ORGANOCHLORINE PESTICIDES/PCB's 608	NO
	MERCURY, COLD VAPOR AA	
	DISSOLVED METALS	NO
	ARSENIC, FURNACE AA	
	DISSOLVED METALS	NO
	LEAD, FURNACE AA	
	DISSOLVED METALS	NO
	SELENIUM, FURNACE AA	
	DISSOLVED METALS	NO
	THALLIUM, FURNACE AA	
	DISSOLVED METALS	NO
	PRIORITY POLLUTANT METALS	
	DISSOLVED METALS	NO
	TOTAL ORGANIC CARBON (TOC)	NO
	TOTAL ORGANIC HALOGEN (TOX)	NO
	CYANIDE, TOTAL	NO
	PHENOLICS (4-AAP)	NO

*This test has been customized in terms of analyte list or detection limit to accommodate special needs of the client.

~~005633~~

IV. ANALYTICAL RESULTS

The analytical results for this project are presented in the following data tables. The results are presented by sample, by test, with tests reported in the following order: GC/MS, Chromatography, Metals and Inorganics.

Each data table includes sample identification information, and when available and appropriate, dates sampled, received, authorized, prepared and analyzed. The authorization data is the date when the project was defined by the client such that laboratory work could begin.

Data sheets contain a listing of the parameters measured in each test, the analytical results and the Enseco reporting limit. Reporting limits are adjusted to reflect dilution of the sample, when appropriate. Solid and waste samples are reported on an "as received" basis, i.e. no correction is made for moisture content. All data is "blank corrected", i.e. the level of contamination, if any, found in the laboratory blank is subtracted from the analytical result before it is reported.

In addition, surrogate recovery data is presented for all GC/MS analyses. The surrogate recovery is an indication of the affect of the sample matrix on the performance of the method. The results from the Standard Enseco QA/QC Program, which generates data which are independent of matrix effects, is given in Section V.

The analytical data reported are subject to the following limitations of the analytical methodology:

GC/MS

Volatile Organics

a) The cis- and trans-isomers of dichloroethylene cannot be distinguished using EPA Method 624. All dichloroethylene present is reported as trans-dichloroethylene.

Semivolatile Organics

a) Benzo(b) and benzo(k) fluoranthene cannot be differentiated based on their mass spectra; retention times are almost identical. The isomer which is the closest in retention time to the sample is reported.

b) 1,2-diphenylhydrazine is measured as azobenzene.

c) N-Nitrosodiphenylamine decomposes in the gas chromatographic inlet to diphenylamine.

Enseco

~~005635~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-29

Laboratory ID: 64874-001 Enseco ID: 64874-001

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

~~005636~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-29

Laboratory ID: 64874-001 Enseco ID: 64874-001

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	105	%	-
Bromofluorobenzene	90	%	-
1,2-Dichloroethane-D4	105	%	-

N.D. = Not detected

Reported by: Steve Meritt Approved by: Jeffrey Lowry

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-29

Laboratory ID: 64874-001 Enseco ID: 64874-001

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

005638

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-29

Laboratory ID: 64874-001 Enseco ID: 64874-001

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	80	%	-
2-Fluorobiphenyl	75	%	-
Terphenyl-D14	76	%	-
Phenol-D5	30	%	-

N.D. = Not detected

Enseco

~~005639~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-29

Laboratory ID: 64874-001 Enseco ID: 64874-001

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	35	%	-
2,4,6-Tribromophenol	98	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

019420

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Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-29

Laboratory ID: 5762-01 Enseco ID: 64874-01

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 10/30/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005641~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-29

Laboratory ID: 64874-001 Enseco ID: 64874-001

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	0.005	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	10/30/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	0.02	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-001

Enseco

~~005642~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-29

Laboratory ID: 64874-001 Enseco ID: 64874-001

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	2.5	mg/L	0.1	415.1/9060	11/02/87
Total Organic Halogen	23	ug Cl/L	5	9020	11/12/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-001

Enseco

~~005643~~.

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-19

Laboratory ID: 64874-002 Enseco ID: 64874-002

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

~~005644~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-19

Laboratory ID: 64874-002 Enseco ID: 64874-002

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	100	%	-
Bromofluorobenzene	88	%	-
1,2-Dichloroethane-D4	113	%	-

N.D. = Not detected

Reported by: Steve Meritt Approved by: Jeffrey Lowry

Enseco

005645

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-19

Laboratory ID: 64874-002 Enseco ID: 64874-002

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-19

Laboratory ID: 64874-002 Enseco ID: 64874-002

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	88	%	-
2-Fluorobiphenyl	71	%	-
Terphenyl-D14	78	%	-
Phenol-D5	38	%	-

N.D. = Not detected

Enseco

~~005647~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-19

Laboratory ID: 64874-002 Enseco ID: 64874-002

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	47	%	-
2,4,6-Tribromophenol	100	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

019428

Enseco

~~005648~~

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-19

Laboratory ID: 5762-02 Enseco ID: 64874-02

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 10/30/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.50
beta-BHC	N.D.	µg/L	0.50
delta-BHC	N.D.	µg/L	0.50
gamma-BHC (Lindane)	N.D.	µg/L	0.50
Heptachlor	N.D.	µg/L	0.50
Aldrin	N.D.	µg/L	0.50
Heptachlor Epoxide	N.D.	µg/L	0.50
Endosulfan I	N.D.	µg/L	0.50
Dieldrin	N.D.	µg/L	1.0
4,4'-DDE	N.D.	µg/L	1.0
Endrin	N.D.	µg/L	1.0
Endosulfan II	N.D.	µg/L	1.0
4,4'-DDD	N.D.	µg/L	1.0
Endosulfan Sulfate	N.D.	µg/L	1.0
4,4'-DDT	N.D.	µg/L	1.0
Endrin Aldehyde	N.D.	µg/L	1.0
Methoxychlor	N.D.	µg/L	5.0
Chlordane	N.D.	µg/L	5.0
Toxaphene	N.D.	µg/L	10
Aroclor-1016	N.D.	µg/L	5.0
Aroclor-1221	N.D.	µg/L	5.0
Aroclor-1232	N.D.	µg/L	5.0
Aroclor-1242	N.D.	µg/L	5.0
Aroclor-1248	N.D.	µg/L	5.0
Aroclor-1254	N.D.	µg/L	5.0
Aroclor-1260	N.D.	µg/L	5.0

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005649~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-19

Laboratory ID: 64874-002 Enseco ID: 64874-002

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	10/30/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	0.06	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-002

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-19

Laboratory ID: 64874-002 Enseco ID: 64874-002

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	2.7	mg/L	0.1	415.1/9060	11/02/87
Total Organic Halogen	36	ug Cl/L	5	9020	11/12/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-002

Enseco

~~005651~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: TRIP BLANK

Laboratory ID: 64874-003 Enseco ID: 64874-003

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: TRIP BLANK

Laboratory ID: 64874-003 Enseco ID: 64874-003

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	110	%	-
Bromofluorobenzene	92	%	-
1,2-Dichloroethane-D4	112	%	-

N.D. = Not detected

Reported by: Steve Meritt Approved by: Jeffrey Lowry

Enseco

~~005653~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: TRIP BLANK

Laboratory ID: 64874-003 Enseco ID: 64874-003

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

005654

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: TRIP BLANK

Laboratory ID: 64874-003 Enseco ID: 64874-003

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	88	%	-
2-Fluorobiphenyl	82	%	-
Terphenyl-D14	92	%	-
Phenol-D5	40	%	-

N.D. = Not detected

Enseco

~~005655~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: TRIP BLANK

Laboratory ID: 64874-003 Enseco ID: 64874-003

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	48	%	-
2,4,6-Tribromophenol	114	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

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Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: TB

Laboratory ID: 5762-03 Enseco ID: 64874-03

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 10/30/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005657~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: TRIP BLANK

Laboratory ID: 64874-003 Enseco ID: 64874-003

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	10/30/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.002	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	N.D.	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-003

Enseco

~~005658~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: TRIP BLANK

Laboratory ID: 64874-003 Enseco ID: 64874-003

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	0.5	mg/L	0.1	415.1/9060	11/02/87
Total Organic Halogen	13	ug Cl/L	5	9020	11/12/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-003

Enseco

~~005659~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-6

Laboratory ID: 64874-004 Enseco ID: 64874-004

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

005660

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-6

Laboratory ID: 64874-004 Enseco ID: 64874-004

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	108	%	-
Bromofluorobenzene	91	%	-
1,2-Dichloroethane-D4	109	%	-

N.D. = Not detected

Reported by: Steve Meritt Approved by: Jeffrey Lowry

Enseco

~~005661~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-6

Laboratory ID: 64874-004 Enseco ID: 64874-004

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

~~005662~~

Enseco

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-6

Laboratory ID: 64874-004 Enseco ID: 64874-004

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	69	%	-
2-Fluorobiphenyl	73	%	-
Terphenyl-D14	66	%	-
Phenol-D5	27	%	-

N.D. = Not detected

Enseco

~~005663~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-6

Laboratory ID: 64874-004 Enseco ID: 64874-004

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	33	%	-
2,4,6-Tribromophenol	87	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

019444

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-6

Laboratory ID: 5762-04 Enseco ID: 64874-04

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 10/30/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-6

Laboratory ID: 64874-004 Enseco ID: 64874-004

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	0.007	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	10/30/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.002	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	0.05	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-004

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-6

Laboratory ID: 64874-004 Enseco ID: 64874-004

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	3.8	mg/L	0.1	415.1/9060	11/02/87
Total Organic Halogen	17	ug Cl/L	5	9020	11/12/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-004

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-10

Laboratory ID: 64874-005 Enseco ID: 64874-005

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-10

Laboratory ID: 64874-005 Enseco ID: 64874-005

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 10/30/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	110	%	-
Bromofluorobenzene	91	%	-
1,2-Dichloroethane-D4	111	%	-

N.D. = Not detected

Reported by: Steve Meritt Approved by: Jeffrey Lowry

Enseco

~~005669~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-10

Laboratory ID: 64874-005 Enseco ID: 64874-005

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-10

Laboratory ID: 64874-005 Enseco ID: 64874-005

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	81	%	-
2-Fluorobiphenyl	71	%	-
Terphenyl-D14	75	%	-
Phenol-D5	41	%	-

N.D. = Not detected

Enseco

~~005671~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-10

Laboratory ID: 64874-005 Enseco ID: 64874-005

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	52	%	-
2,4,6-Tribromophenol	97	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

019452

Enseco

~~00072~~

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-10

Laboratory ID: 5762-05 Enseco ID: 64874-05

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 10/30/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005873~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-10

Laboratory ID: 64874-005 Enseco ID: 64874-005

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	10/30/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	0.04	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-005

Enseco

~~005674~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-10

Laboratory ID: 64874-005 Enseco ID: 64874-005

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	4.7	mg/L	0.1	415.1/9060	11/02/87
Total Organic Halogen	17	ug Cl/L	5	9020	11/12/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-005

Enseco

005675

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-40

Laboratory ID: 64874-006 Enseco ID: 64874-006

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

005676

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-40

Laboratory ID: 64874-006 Enseco ID: 64874-006

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	98	%	-
Bromofluorobenzene	99	%	-
1,2-Dichloroethane-D4	98	%	-

N.D. = Not detected

Reported by: Christian Ricardi Approved by: Jeffrey Lowry

~~005677~~

Enseco

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-40

Laboratory ID: 64874-006 Enseco ID: 64874-006

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-40

Laboratory ID: 64874-006 Enseco ID: 64874-006

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	45	%	-
2-Fluorobiphenyl	65	%	-
Terphenyl-D14	76	%	-
Phenol-D5	35	%	-

N.D. = Not detected

~~005679~~

Enseco

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-40

Laboratory ID: 64874-006 Enseco ID: 64874-006

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	43	%	-
2,4,6-Tribromophenol	100	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

Enseco

~~005880~~ PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-40

Laboratory ID: 5762-06 Enseco ID: 64874-06

Matrix: Water Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87 Prepared: 10/30/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005681~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-40

Laboratory ID: 64874-006 Enseco ID: 64874-006

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	10/30/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	0.04	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-006

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-40

Laboratory ID: 64874-006 Enseco ID: 64874-006

Matrix: Groundwater Sampled: 10/27/87 Received: 10/28/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	1.2	mg/L	0.1	415.1/9060	11/02/87
Total Organic Halogen	17	ug Cl/L	5	9020	11/12/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-006

Enseco

~~000583~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-33

Laboratory ID: 64874-007 Enseco ID: 64874-007

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

~~005684~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-33

Laboratory ID: 64874-007 Enseco ID: 64874-007

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	100	%	-
Bromofluorobenzene	99	%	-
1,2-Dichloroethane-D4	101	%	-

N.D. = Not detected

Reported by: Jenifer Tavernier Approved by: Jeffrey Lowry

Enseco

~~005685~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-33

Laboratory ID: 64874-007 Enseco ID: 64874-007

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-33

Laboratory ID: 64874-007 Enseco ID: 64874-007

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	71	%	-
2-Fluorobiphenyl	63	%	-
Terphenyl-D14	83	%	-
Phenol-D5	31	%	-

N.D. = Not detected

Enseco

~~005687~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-33

Laboratory ID: 64874-007 Enseco ID: 64874-007

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	34	%	-
2,4,6-Tribromophenol	94	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

019468

Enseco

005688

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-33

Laboratory ID: 5774-01 Enseco ID: 64874-07

Matrix: Water Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/29/87 Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

~~005689~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-33

Laboratory ID: 64874-007 Enseco ID: 64874-007

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	0.003	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.002	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	0.02	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-007

Enseco

~~005690~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-33

Laboratory ID: 64874-007 Enseco ID: 64874-007

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	6.8	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	80	ug Cl/L	5	9020	11/13/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-007

Enseco

005691

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #1

Laboratory ID: 64874-008 Enseco ID: 64874-008

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #1

Laboratory ID: 64874-008 Enseco ID: 64874-008

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	100	%	-
Bromofluorobenzene	99	%	-
1,2-Dichloroethane-D4	101	%	-

N.D. = Not detected

Reported by: Jenifer Tavernier Approved by: Jeffrey Lowry

~~005693~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #1

Laboratory ID: 64874-008 Enseco ID: 64874-008

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

~~005694~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #1

Laboratory ID: 64874-008 Enseco ID: 64874-008

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	85	%	-
2-Fluorobiphenyl	62	%	-
Terphenyl-D14	84	%	-
Phenol-D5	34	%	-

N.D. = Not detected

Enseco

~~005695~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #1

Laboratory ID: 64874-008 Enseco ID: 64874-008

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	40	%	-
2,4,6-Tribromophenol	68	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

019476

Enseco

~~005696~~

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Duplicate #1

Laboratory ID: 5774-02 Enseco ID: 64874-08

Matrix: Water Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/29/87 Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.50
beta-BHC	N.D.	µg/L	0.50
delta-BHC	N.D.	µg/L	0.50
gamma-BHC (Lindane)	N.D.	µg/L	0.50
Heptachlor	N.D.	µg/L	0.50
Aldrin	N.D.	µg/L	0.50
Heptachlor Epoxide	N.D.	µg/L	0.50
Endosulfan I	N.D.	µg/L	0.50
Dieldrin	N.D.	µg/L	1.0
4,4'-DDE	N.D.	µg/L	1.0
Endrin	N.D.	µg/L	1.0
Endosulfan II	N.D.	µg/L	1.0
4,4'-DDD	N.D.	µg/L	1.0
Endosulfan Sulfate	N.D.	µg/L	1.0
4,4'-DDT	N.D.	µg/L	1.0
Endrin Aldehyde	N.D.	µg/L	1.0
Methoxychlor	N.D.	µg/L	5.0
Chlordane	N.D.	µg/L	5.0
Toxaphene	N.D.	µg/L	10
Aroclor-1016	N.D.	µg/L	5.0
Aroclor-1221	N.D.	µg/L	5.0
Aroclor-1232	N.D.	µg/L	5.0
Aroclor-1242	N.D.	µg/L	5.0
Aroclor-1248	N.D.	µg/L	5.0
Aroclor-1254	N.D.	µg/L	5.0
Aroclor-1260	N.D.	µg/L	5.0

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005697~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #1

Laboratory ID: 64874-008 Enseco ID: 64874-008

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	0.048	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.008	279.2	11/11/87
Zinc	0.02	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-008

Enseco

005698

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #1

Laboratory ID: 64874-008 Enseco ID: 64874-008

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	35	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	310	ug Cl/L	5	9020	11/13/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-008

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #2

Laboratory ID: 64874-009 Enseco ID: 64874-009

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

~~005700~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #2

Laboratory ID: 64874-009 Enseco ID: 64874-009

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	101	%	-
Bromofluorobenzene	98	%	-
1,2-Dichloroethane-D4	98	%	-

N.D. = Not detected

Reported by: Jenifer Tavernier Approved by: Jeffrey Lowry

Enseco

~~005701~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #2

Laboratory ID: 64874-009 Enseco ID: 64874-009

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #2

Laboratory ID: 64874-009 Enseco ID: 64874-009

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	72	%	-
2-Fluorobiphenyl	68	%	-
Terphenyl-D14	65	%	-
Phenol-D5	33	%	-

N.D. = Not detected

Enseco

~~005703~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #2

Laboratory ID: 64874-009 Enseco ID: 64874-009

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	39	%	-
2,4,6-Tribromophenol	88	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

019484

Enseco

~~005704~~ PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Duplicate #2

Laboratory ID: 5774-03 Enseco ID: 64874-09

Matrix: Water Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/29/87 Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.50
beta-BHC	N.D.	µg/L	0.50
delta-BHC	N.D.	µg/L	0.50
gamma-BHC (Lindane)	N.D.	µg/L	0.50
Heptachlor	N.D.	µg/L	0.50
Aldrin	N.D.	µg/L	0.50
Heptachlor Epoxide	N.D.	µg/L	0.50
Endosulfan I	N.D.	µg/L	0.50
Dieldrin	N.D.	µg/L	1.0
4,4'-DDE	N.D.	µg/L	1.0
Endrin	N.D.	µg/L	1.0
Endosulfan II	N.D.	µg/L	1.0
4,4'-DDD	N.D.	µg/L	1.0
Endosulfan Sulfate	N.D.	µg/L	1.0
4,4'-DDT	N.D.	µg/L	1.0
Endrin Aldehyde	N.D.	µg/L	1.0
Methoxychlor	N.D.	µg/L	5.0
Chlordane	N.D.	µg/L	5.0
Toxaphene	N.D.	µg/L	10
Aroclor-1016	N.D.	µg/L	5.0
Aroclor-1221	N.D.	µg/L	5.0
Aroclor-1232	N.D.	µg/L	5.0
Aroclor-1242	N.D.	µg/L	5.0
Aroclor-1248	N.D.	µg/L	5.0
Aroclor-1254	N.D.	µg/L	5.0
Aroclor-1260	N.D.	µg/L	5.0

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

005705

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #2

Laboratory ID: 64874-009 Enseco ID: 64874-009

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.002	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	0.04	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-009

Enseco

~~005706~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #2

Laboratory ID: 64874-009 Enseco ID: 64874-009

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	3.0	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	35	ug Cl/L	5	9020	11/13/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-009

Enseco

~~005707~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-7

Laboratory ID: 64874-010 Enseco ID: 64874-010

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

005708

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-7

Laboratory ID: 64874-010 Enseco ID: 64874-010

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	101	%	-
Bromofluorobenzene	97	%	-
1,2-Dichloroethane-D4	99	%	-

N.D. = Not detected

Reported by: Jenifer Tavernier Approved by: Jeffrey Lowry

Enseco

005709

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-7

Laboratory ID: 64874-010 Enseco ID: 64874-010

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

005710

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-7

Laboratory ID: 64874-010 Enseco ID: 64874-010

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	77	%	-
2-Fluorobiphenyl	72	%	-
Terphenyl-D14	82	%	-
Phenol-D5	35	%	-

N.D. = Not detected

005711

Enseco

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-7

Laboratory ID: 64874-010 Enseco ID: 64874-010

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	48	%	-
2,4,6-Tribromophenol	98	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

019492

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

005712

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-7

Laboratory ID: 5774-04 Enseco ID: 64874-10

Matrix: Water Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/29/87 Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005718~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-7

Laboratory ID: 64874-010 Enseco ID: 64874-010

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	0.02	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-010

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-7

Laboratory ID: 64874-010 Enseco ID: 64874-010

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	1.7	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	72	ug Cl/L	5	9020	11/13/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	0.01	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-010

Enseco

~~005714~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-30

Laboratory ID: 64874-011 Enseco ID: 64874-011

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

005715

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-30

Laboratory ID: 64874-011 Enseco ID: 64874-011

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/02/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	102	%	-
Bromofluorobenzene	95	%	-
1,2-Dichloroethane-D4	100	%	-

N.D. = Not detected

Reported by: Jenifer Tavernier Approved by: Jeffrey Lowry

Enseco

~~105716~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-30

Laboratory ID: 64874-011 Enseco ID: 64874-011

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-30

Laboratory ID: 64874-011 Enseco ID: 64874-011

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	87	%	-
2-Fluorobiphenyl	80	%	-
Terphenyl-D14	76	%	-
Phenol-D5	37	%	-

N.D. = Not detected

Enseco

~~005717~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-30

Laboratory ID: 64874-011 Enseco ID: 64874-011

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	52	%	-
2,4,6-Tribromophenol	84	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

019500

Enseco

~~005718~~ PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-30

Laboratory ID: 5774-05 Enseco ID: 64874-11

Matrix: Water Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/29/87 Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.50
beta-BHC	N.D.	µg/L	0.50
delta-BHC	N.D.	µg/L	0.50
gamma-BHC (Lindane)	N.D.	µg/L	0.50
Heptachlor	N.D.	µg/L	0.50
Aldrin	N.D.	µg/L	0.50
Heptachlor Epoxide	N.D.	µg/L	0.50
Endosulfan I	N.D.	µg/L	0.50
Dieldrin	N.D.	µg/L	1.0
4,4'-DDE	N.D.	µg/L	1.0
Endrin	N.D.	µg/L	1.0
Endosulfan II	N.D.	µg/L	1.0
4,4'-DDD	N.D.	µg/L	1.0
Endosulfan Sulfate	N.D.	µg/L	1.0
4,4'-DDT	N.D.	µg/L	1.0
Endrin Aldehyde	N.D.	µg/L	1.0
Methoxychlor	N.D.	µg/L	5.0
Chlordane	N.D.	µg/L	5.0
Toxaphene	N.D.	µg/L	10
Aroclor-1016	N.D.	µg/L	5.0
Aroclor-1221	N.D.	µg/L	5.0
Aroclor-1232	N.D.	µg/L	5.0
Aroclor-1242	N.D.	µg/L	5.0
Aroclor-1248	N.D.	µg/L	5.0
Aroclor-1254	N.D.	µg/L	5.0
Aroclor-1260	N.D.	µg/L	5.0

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-30

Laboratory ID: 64874-011 Enseco ID: 64874-011

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	0.010	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/11/87
Zinc	0.04	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-011

Enseco

~~005720~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-30

Laboratory ID: 64874-011 Enseco ID: 64874-011

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	25	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	87	ug Cl/L	5	9020	11/13/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	0.05	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-011

Enseco

~~005721~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-39

Laboratory ID: 64874-012 Enseco ID: 64874-012

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/03/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

005722

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-39

Laboratory ID: 64874-012 Enseco ID: 64874-012

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/03/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	101	%	-
Bromofluorobenzene	102	%	-
1,2-Dichloroethane-D4	101	%	-

N.D. = Not detected

Reported by: Jenifer Tavernier Approved by: Jeffrey Lowry

Enseco

005723

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-39

Laboratory ID: 64874-012 Enseco ID: 64874-012

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-39

Laboratory ID: 64874-012 Enseco ID: 64874-012

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	83	%	-
2-Fluorobiphenyl	75	%	-
Terphenyl-D14	63	%	-
Phenol-D5	39	%	-

N.D. = Not detected

Enseco

~~005725~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-39

Laboratory ID: 64874-012 Enseco ID: 64874-012

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	48	%	-
2,4,6-Tribromophenol	76	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

Enseco

~~005726~~ PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-39

Laboratory ID: 5774-06 Enseco ID: 64874-12

Matrix: Water Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/29/87 Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	1.0
beta-BHC	N.D.	µg/L	1.0
delta-BHC	N.D.	µg/L	1.0
gamma-BHC (Lindane)	N.D.	µg/L	1.0
Heptachlor	N.D.	µg/L	1.0
Aldrin	N.D.	µg/L	1.0
Heptachlor Epoxide	N.D.	µg/L	1.0
Endosulfan I	N.D.	µg/L	1.0
Dieldrin	N.D.	µg/L	2.0
4,4'-DDE	N.D.	µg/L	2.0
Endrin	N.D.	µg/L	2.0
Endosulfan II	N.D.	µg/L	2.0
4,4'-DDD	N.D.	µg/L	2.0
Endosulfan Sulfate	N.D.	µg/L	2.0
4,4'-DDT	N.D.	µg/L	2.0
Endrin Aldehyde	N.D.	µg/L	2.0
Methoxychlor	N.D.	µg/L	10
Chlordane	N.D.	µg/L	10
Toxaphene	N.D.	µg/L	20
Aroclor-1016	N.D.	µg/L	10
Aroclor-1221	N.D.	µg/L	10
Aroclor-1232	N.D.	µg/L	10
Aroclor-1242	N.D.	µg/L	10
Aroclor-1248	N.D.	µg/L	10
Aroclor-1254	N.D.	µg/L	10
Aroclor-1260	N.D.	µg/L	10

N.D. = Not detected.

Reported by EK Approved by KC

~~005727~~

Enseco

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-39

Laboratory ID: 64874-012 Enseco ID: 64874-012

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	0.043	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.008	279.2	11/11/87
Zinc	0.04	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-012

~~005728~~

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-39

Laboratory ID: 64874-012 Enseco ID: 64874-012

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	39	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	310	ug Cl/L	5	9020	11/13/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	0.01	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-012

Enseco

~~005729~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-12

Laboratory ID: 64874-013 Enseco ID: 64874-013

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/03/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-12

Laboratory ID: 64874-013 Enseco ID: 64874-013

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/03/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	99	%	-
Bromofluorobenzene	103	%	-
1,2-Dichloroethane-D4	96	%	-

N.D. = Not detected

Reported by: Jenifer Tavernier Approved by: Jeffrey Lowry

Enseco

~~005731~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-12

Laboratory ID: 64874-013 Enseco ID: 64874-013

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-12

Laboratory ID: 64874-013 Enseco ID: 64874-013

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	80	%	-
2-Fluorobiphenyl	69	%	-
Terphenyl-D14	66	%	-
Phenol-D5	28	%	-

N.D. = Not detected

~~605733~~

Enseco

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-12

Laboratory ID: 64874-013 Enseco ID: 64874-013

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	39	%	-
2,4,6-Tribromophenol	82	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

Enseco

005734 PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-12

Laboratory ID: 5774-07 Enseco ID: 64874-13

Matrix: Water Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/29/87 Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005735~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-12

Laboratory ID: 64874-013 Enseco ID: 64874-013

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	0.012	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.008	279.2	11/11/87
Zinc	0.06	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-013

Enseco

005736

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-12

Laboratory ID: 64874-013 Enseco ID: 64874-013

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	3.2	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	22	ug Cl/L	5	9020	11/13/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-013

Enseco

C05737

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-31

Laboratory ID: 64874-014 Enseco ID: 64874-014

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/03/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

~~005738~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-31

Laboratory ID: 64874-014 Enseco ID: 64874-014

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/03/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	101	%	-
Bromofluorobenzene	100	%	-
1,2-Dichloroethane-D4	96	%	-

N.D. = Not detected

Reported by: Jenifer Tavernier Approved by: Jeffrey Lowry

Enseco

~~739~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-31

Laboratory ID: 64874-014 Enseco ID: 64874-014

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

~~005740~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-31

Laboratory ID: 64874-014 Enseco ID: 64874-014

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	79	%	-
2-Fluorobiphenyl	66	%	-
Terphenyl-D14	74	%	-
Phenol-D5	37	%	-

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-31

Laboratory ID: 64874-014 Enseco ID: 64874-014

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	44	%	-
2,4,6-Tribromophenol	91	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

Enseco

005742 PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-31

Laboratory ID: 5774-08 Enseco ID: 64874-14

Matrix: Water Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/29/87 Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.50
beta-BHC	N.D.	µg/L	0.50
delta-BHC	N.D.	µg/L	0.50
gamma-BHC (Lindane)	N.D.	µg/L	0.50
Heptachlor	N.D.	µg/L	0.50
Aldrin	N.D.	µg/L	0.50
Heptachlor Epoxide	N.D.	µg/L	0.50
Endosulfan I	N.D.	µg/L	0.50
Dieldrin	N.D.	µg/L	1.0
4,4'-DDE	N.D.	µg/L	1.0
Endrin	N.D.	µg/L	1.0
Endosulfan II	N.D.	µg/L	1.0
4,4'-DDD	N.D.	µg/L	1.0
Endosulfan Sulfate	N.D.	µg/L	1.0
4,4'-DDT	N.D.	µg/L	1.0
Endrin Aldehyde	N.D.	µg/L	1.0
Methoxychlor	N.D.	µg/L	5.0
Chlordane	N.D.	µg/L	5.0
Toxaphene	N.D.	µg/L	10
Aroclor-1016	N.D.	µg/L	5.0
Aroclor-1221	N.D.	µg/L	5.0
Aroclor-1232	N.D.	µg/L	5.0
Aroclor-1242	N.D.	µg/L	5.0
Aroclor-1248	N.D.	µg/L	5.0
Aroclor-1254	N.D.	µg/L	5.0
Aroclor-1260	N.D.	µg/L	5.0

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-31

Laboratory ID: 64874-014 Enseco ID: 64874-014

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	0.006	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.008	279.2	11/11/87
Zinc	0.07	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-014

Enseco

~~005743~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-31

Laboratory ID: 64874-014 Enseco ID: 64874-014

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	15	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	120	ug Cl/L	5	9020	11/13/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-014

Enseco

~~005744~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-32

Laboratory ID: 64874-015 Enseco ID: 64874-015

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/03/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

~~005745~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-32

Laboratory ID: 64874-015 Enseco ID: 64874-015

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Analyzed: 11/03/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	100	%	-
Bromofluorobenzene	100	%	-
1,2-Dichloroethane-D4	96	%	-

N.D. = Not detected

Reported by: Jenifer Tavernier Approved by: Jeffrey Lowry

Enseco

005746

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-32

Laboratory ID: 64874-015 Enseco ID: 64874-015

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

005747

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-32

Laboratory ID: 64874-015 Enseco ID: 64874-015

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	72	%	-
2-Fluorobiphenyl	65	%	-
Terphenyl-D14	71	%	-
Phenol-D5	39	%	-

N.D. = Not detected

Enseco

005748

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-32

Laboratory ID: 64874-015 Enseco ID: 64874-015

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87 Prepared: 11/01/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	44	%	-
2,4,6-Tribromophenol	98	%	-

N.D. = Not detected

Reported by: Kevin Schilling Approved by: Jeffrey Lowry

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

~~005749~~

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-32

Laboratory ID: 5774-09 Enseco ID: 64874-15

Matrix: Water Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/29/87 Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	5.0
beta-BHC	N.D.	µg/L	5.0
delta-BHC	N.D.	µg/L	5.0
gamma-BHC (Lindane)	N.D.	µg/L	5.0
Heptachlor	N.D.	µg/L	5.0
Aldrin	N.D.	µg/L	5.0
Heptachlor Epoxide	N.D.	µg/L	5.0
Endosulfan I	N.D.	µg/L	5.0
Dieldrin	N.D.	µg/L	10
4,4'-DDE	N.D.	µg/L	10
Endrin	N.D.	µg/L	10
Endosulfan II	N.D.	µg/L	10
4,4'-DDD	N.D.	µg/L	10
Endosulfan Sulfate	N.D.	µg/L	10
4,4'-DDT	N.D.	µg/L	10
Endrin Aldehyde	N.D.	µg/L	10
Methoxychlor	N.D.	µg/L	50
Chlordane	N.D.	µg/L	50
Toxaphene	N.D.	µg/L	100
Aroclor-1016	N.D.	µg/L	50
Aroclor-1221	N.D.	µg/L	50
Aroclor-1232	N.D.	µg/L	50
Aroclor-1242	N.D.	µg/L	50
Aroclor-1248	N.D.	µg/L	50
Aroclor-1254	N.D.	µg/L	50
Aroclor-1260	N.D.	µg/L	50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

005750

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-32

Laboratory ID: 64874-015 Enseco ID: 64874-015

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/11/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/11/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.002	270.2	11/11/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.008	279.2	11/11/87
Zinc	0.05	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-015

Enseco

005751

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-32

Laboratory ID: 64874-015 Enseco ID: 64874-015

Matrix: Groundwater Sampled: 10/28/87 Received: 10/29/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	16	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	230	ug Cl/L	5	9020	11/13/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-015

Enseco

005752

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-14

Laboratory ID: 64874-016 Enseco ID: 64874-016

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/05/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

005753

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-14

Laboratory ID: 64874-016 Enseco ID: 64874-016

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/05/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	100	%	-
Bromofluorobenzene	101	%	-
1,2-Dichloroethane-D4	97	%	-

N.D. = Not detected

Reported by: Julieann L. Kramer Approved by: Jeffrey Lowry

Enseco

~~005754~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-14

Laboratory ID: 64874-016 Enseco ID: 64874-016

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

~~005755~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-14

Laboratory ID: 64874-016 Enseco ID: 64874-016

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	77	%	-
2-Fluorobiphenyl	71	%	-
Terphenyl-D14	83	%	-
Phenol-D5	36	%	-

N.D. = Not detected

Enseco

005756

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-14

Laboratory ID: 64874-016 Enseco ID: 64874-016

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	54	%	-
2,4,6-Tribromophenol	84	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Jeffrey Lowry

019540

005752

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-14

Laboratory ID: 5798-01 Enseco ID: 64874-16

Matrix: Water Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/30/87 Prepared: 11/03/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005758~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-14

Laboratory ID: 64874-016 Enseco ID: 64874-016

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/12/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/17/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.002	270.2	11/12/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/12/87
Zinc	0.05	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-016

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-14

Laboratory ID: 64874-016 Enseco ID: 64874-016

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	6.4	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	31	ug Cl/L	5	9020	11/14/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-016

Enseco

005760

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-36

Laboratory ID: 64874-017 Enseco ID: 64874-017

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

~~005761~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-36

Laboratory ID: 64874-017 Enseco ID: 64874-017

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	114	%	-
Bromofluorobenzene	90	%	-
1,2-Dichloroethane-D4	106	%	-

N.D. = Not detected

Reported by: Julieann L. Kramer Approved by: Jeffrey Lowry

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-36

Laboratory ID: 64874-017 Enseco ID: 64874-017

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-36

Laboratory ID: 64874-017 Enseco ID: 64874-017

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	80	%	-
2-Fluorobiphenyl	66	%	-
Terphenyl-D14	89	%	-
Phenol-D5	36	%	-

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-36

Laboratory ID: 64874-017 Enseco ID: 64874-017

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	52	%	-
2,4,6-Tribromophenol	86	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Jeffrey Lowry

~~005765~~

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-36

Laboratory ID: 5798-02 Enseco ID: 64874-17

Matrix: Water Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/30/87 Prepared: 11/03/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.50
beta-BHC	N.D.	µg/L	0.50
delta-BHC	N.D.	µg/L	0.50
gamma-BHC (Lindane)	N.D.	µg/L	0.50
Heptachlor	N.D.	µg/L	0.50
Aldrin	N.D.	µg/L	0.50
Heptachlor Epoxide	N.D.	µg/L	0.50
Endosulfan I	N.D.	µg/L	0.50
Dieldrin	N.D.	µg/L	1.0
4,4'-DDE	N.D.	µg/L	1.0
Endrin	N.D.	µg/L	1.0
Endosulfan II	N.D.	µg/L	1.0
4,4'-DDD	N.D.	µg/L	1.0
Endosulfan Sulfate	N.D.	µg/L	1.0
4,4'-DDT	N.D.	µg/L	1.0
Endrin Aldehyde	N.D.	µg/L	1.0
Methoxychlor	N.D.	µg/L	5.0
Chlordane	N.D.	µg/L	5.0
Toxaphene	N.D.	µg/L	10
Aroclor-1016	N.D.	µg/L	5.0
Aroclor-1221	N.D.	µg/L	5.0
Aroclor-1232	N.D.	µg/L	5.0
Aroclor-1242	N.D.	µg/L	5.0
Aroclor-1248	N.D.	µg/L	5.0
Aroclor-1254	N.D.	µg/L	5.0
Aroclor-1260	N.D.	µg/L	5.0

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

005766

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-36

Laboratory ID: 64874-017 Enseco ID: 64874-017

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/12/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/17/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	0.010	mg/L	0.004	270.2	11/12/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/12/87
Zinc	0.07	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-017

Enseco

~~005767~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-36

Laboratory ID: 64874-017 Enseco ID: 64874-017

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	7.2	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	20	ug Cl/L	5	9020	11/14/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-017

~~005768~~

Enseco

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-37

Laboratory ID: 64874-018 Enseco ID: 64874-018

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	13	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	5.2	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

~~005769~~

Enseco

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-37

Laboratory ID: 64874-018 Enseco ID: 64874-018

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	103	%	-
Bromofluorobenzene	91	%	-
1,2-Dichloroethane-D4	104	%	-

N.D. = Not detected

Reported by: Julieann L. Kramer Approved by: Jeffrey Lowry

Enseco

~~005770~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-37

Laboratory ID: 64874-018 Enseco ID: 64874-018

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

005771

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-37

Laboratory ID: 64874-018 Enseco ID: 64874-018

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	73	%	-
2-Fluorobiphenyl	63	%	-
Terphenyl-D14	83	%	-
Phenol-D5	36	%	-

N.D. = Not detected

Enseco

005772

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-37

Laboratory ID: 64874-018 Enseco ID: 64874-018

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	52	%	-
2,4,6-Tribromophenol	80	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Jeffrey Lowry

Enseco

~~0057773~~ PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-37

Laboratory ID: 5798-03 Enseco ID: 64874-18

Matrix: Water Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/30/87 Prepared: 11/03/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	1.0
beta-BHC	N.D.	µg/L	1.0
delta-BHC	N.D.	µg/L	1.0
gamma-BHC (Lindane)	N.D.	µg/L	1.0
Heptachlor	N.D.	µg/L	1.0
Aldrin	N.D.	µg/L	1.0
Heptachlor Epoxide	N.D.	µg/L	1.0
Endosulfan I	N.D.	µg/L	1.0
Dieldrin	N.D.	µg/L	2.0
4,4'-DDE	N.D.	µg/L	2.0
Endrin	N.D.	µg/L	2.0
Endosulfan II	N.D.	µg/L	2.0
4,4'-DDD	N.D.	µg/L	2.0
Endosulfan Sulfate	N.D.	µg/L	2.0
4,4'-DDT	N.D.	µg/L	2.0
Endrin Aldehyde	N.D.	µg/L	2.0
Methoxychlor	N.D.	µg/L	10
Chlordane	N.D.	µg/L	10
Toxaphene	N.D.	µg/L	20
Aroclor-1016	N.D.	µg/L	10
Aroclor-1221	N.D.	µg/L	10
Aroclor-1232	N.D.	µg/L	10
Aroclor-1242	N.D.	µg/L	10
Aroclor-1248	N.D.	µg/L	10
Aroclor-1254	N.D.	µg/L	10
Aroclor-1260	N.D.	µg/L	10

N.D. = Not detected.

Reported by EK Approved by KC

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-37

Laboratory ID: 64874-018 Enseco ID: 64874-018

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/12/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/17/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/12/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.008	279.2	11/12/87
Zinc	0.04	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-018

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-37

Laboratory ID: 64874-018 Enseco ID: 64874-018

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	16	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	1100	ug Cl/L	5	9020	11/18/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	0.02	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-018

Enseco

~~005776~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-35

Laboratory ID: 64874-019 Enseco ID: 64874-019

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Sample: 64874-019

Enseco

005777

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-35

Laboratory ID: 64874-019 Enseco ID: 64874-019

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	107	%	-
Bromofluorobenzene	86	%	-
1,2-Dichloroethane-D4	104	%	-

N.D. = Not detected

Reported by: Steve Meritt Approved by: Jeffrey Lowry

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-35

Laboratory ID: 64874-019 Enseco ID: 64874-019

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy) methane	N.D.	ug/L	10
bis(2-Chloroethyl) ether	N.D.	ug/L	10
bis(2-Chloroisopropyl) ether	N.D.	ug/L	10
bis(2-Ethylhexyl) phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butyl benzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-35

Laboratory ID: 64874-019 Enseco ID: 64874-019

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitroso-dipropylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	76	%	-
2-Fluorobiphenyl	73	%	-
Terphenyl-D14	71	%	-
Phenol-D5	35	%	-

N.D. = Not detected

Enseco

~~005780~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-35

Laboratory ID: 64874-019 Enseco ID: 64874-019

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	49	%	-
2,4,6-Tribromophenol	88	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Jeffrey Lowry

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-35

Laboratory ID: 5798-04 Enseco ID: 64874-19

Matrix: Water Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/30/87 Prepared: 11/03/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.50
beta-BHC	N.D.	µg/L	0.50
delta-BHC	N.D.	µg/L	0.50
gamma-BHC (Lindane)	N.D.	µg/L	0.50
Heptachlor	N.D.	µg/L	0.50
Aldrin	N.D.	µg/L	0.50
Heptachlor Epoxide	N.D.	µg/L	0.50
Endosulfan I	N.D.	µg/L	0.50
Dieldrin	N.D.	µg/L	1.0
4,4'-DDE	N.D.	µg/L	1.0
Endrin	N.D.	µg/L	1.0
Endosulfan II	N.D.	µg/L	1.0
4,4'-DDD	N.D.	µg/L	1.0
Endosulfan Sulfate	N.D.	µg/L	1.0
4,4'-DDT	N.D.	µg/L	1.0
Endrin Aldehyde	N.D.	µg/L	1.0
Methoxychlor	N.D.	µg/L	5.0
Chlordane	N.D.	µg/L	5.0
Toxaphene	N.D.	µg/L	10
Aroclor-1016	N.D.	µg/L	5.0
Aroclor-1221	N.D.	µg/L	5.0
Aroclor-1232	N.D.	µg/L	5.0
Aroclor-1242	N.D.	µg/L	5.0
Aroclor-1248	N.D.	µg/L	5.0
Aroclor-1254	N.D.	µg/L	5.0
Aroclor-1260	N.D.	µg/L	5.0

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

005782

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-35

Laboratory ID: 64874-019 Enseco ID: 64874-019

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/12/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/17/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.002	270.2	11/12/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/12/87
Zinc	0.04	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-019

Enseco

~~005783~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-35

Laboratory ID: 64874-019 Enseco ID: 64874-019

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	13	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	86	ug Cl/L	5	9020	11/14/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	0.01	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-019

Enseco

~~005784~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-34

Laboratory ID: 64874-020 Enseco ID: 64874-020

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Benzene	27	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	25	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	15	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

~~005785~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-34

Laboratory ID: 64874-020 Enseco ID: 64874-020

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	105	%	-
Bromofluorobenzene	85	%	-
1,2-Dichloroethane-D4	105	%	-

N.D. = Not detected

Reported by: Julieann L. Kramer Approved by: Jeffrey Lowry

Enseco

005786

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-34

Laboratory ID: 64874-020 Enseco ID: 64874-020

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

005787

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-34

Laboratory ID: 64874-020 Enseco ID: 64874-020

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	77	%	-
2-Fluorobiphenyl	38	%	-
Terphenyl-D14	61	%	-
Phenol-D5	35	%	-

N.D. = Not detected

Enseco

~~005788~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-34

Laboratory ID: 64874-020 Enseco ID: 64874-020

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	46	%	-
2,4,6-Tribromophenol	63	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Jeffrey Lowry

Enseco

005789

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-34

Laboratory ID: 5798-05 Enseco ID: 64874-20

Matrix: Water Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/30/87 Prepared: 11/03/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	1.0
beta-BHC	N.D.	µg/L	1.0
delta-BHC	N.D.	µg/L	1.0
gamma-BHC (Lindane)	N.D.	µg/L	1.0
Heptachlor	N.D.	µg/L	1.0
Aldrin	N.D.	µg/L	1.0
Heptachlor Epoxide	N.D.	µg/L	1.0
Endosulfan I	N.D.	µg/L	1.0
Dieldrin	N.D.	µg/L	2.0
4,4'-DDE	N.D.	µg/L	2.0
Endrin	N.D.	µg/L	2.0
Endosulfan II	N.D.	µg/L	2.0
4,4'-DDD	N.D.	µg/L	2.0
Endosulfan Sulfate	N.D.	µg/L	2.0
4,4'-DDT	N.D.	µg/L	2.0
Endrin Aldehyde	N.D.	µg/L	2.0
Methoxychlor	N.D.	µg/L	10
Chlordane	N.D.	µg/L	10
Toxaphene	N.D.	µg/L	20
Aroclor-1016	N.D.	µg/L	10
Aroclor-1221	N.D.	µg/L	10
Aroclor-1232	N.D.	µg/L	10
Aroclor-1242	N.D.	µg/L	10
Aroclor-1248	N.D.	µg/L	10
Aroclor-1254	N.D.	µg/L	10
Aroclor-1260	N.D.	µg/L	10

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~64790~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-34

Laboratory ID: 64874-020 Enseco ID: 64874-020

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/12/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/17/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/12/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.008	279.2	11/12/87
Zinc	0.06	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-020

~~791~~

Enseco

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-34

Laboratory ID: 64874-020 Enseco ID: 64874-020

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	42	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	160	ug Cl/L	5	9020	11/14/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	0.04	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-020

Enseco

~~005792~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-18

Laboratory ID: 64874-021 Enseco ID: 64874-021

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-18

Laboratory ID: 64874-021 Enseco ID: 64874-021

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Analyzed: 11/04/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	108	%	-
Bromofluorobenzene	86	%	-
1,2-Dichloroethane-D4	105	%	-

N.D. = Not detected

Reported by: Steve Meritt Approved by: Jeffrey Lowry

Enseco

~~005794~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-18

Laboratory ID: 64874-021 Enseco ID: 64874-021

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

005795

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-18

Laboratory ID: 64874-021 Enseco ID: 64874-021

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	78	%	-
2-Fluorobiphenyl	72	%	-
Terphenyl-D14	80	%	-
Phenol-D5	33	%	-

N.D. = Not detected

Enseco

005796

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-18

Laboratory ID: 64874-021 Enseco ID: 64874-021

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	46	%	-
2,4,6-Tribromophenol	62	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Jeffrey Lowry

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

~~005797~~

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-18

Laboratory ID: 5798-06 Enseco ID: 64874-21

Matrix: Water Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/30/87 Prepared: 11/03/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	1.0
beta-BHC	N.D.	µg/L	1.0
delta-BHC	N.D.	µg/L	1.0
gamma-BHC (Lindane)	N.D.	µg/L	1.0
Heptachlor	N.D.	µg/L	1.0
Aldrin	N.D.	µg/L	1.0
Heptachlor Epoxide	N.D.	µg/L	1.0
Endosulfan I	N.D.	µg/L	1.0
Dieldrin	N.D.	µg/L	2.0
4,4'-DDE	N.D.	µg/L	2.0
Endrin	N.D.	µg/L	2.0
Endosulfan II	N.D.	µg/L	2.0
4,4'-DDD	N.D.	µg/L	2.0
Endosulfan Sulfate	N.D.	µg/L	2.0
4,4'-DDT	N.D.	µg/L	2.0
Endrin Aldehyde	N.D.	µg/L	2.0
Methoxychlor	N.D.	µg/L	10
Chlordane	N.D.	µg/L	10
Toxaphene	N.D.	µg/L	20
Aroclor-1016	N.D.	µg/L	10
Aroclor-1221	N.D.	µg/L	10
Aroclor-1232	N.D.	µg/L	10
Aroclor-1242	N.D.	µg/L	10
Aroclor-1248	N.D.	µg/L	10
Aroclor-1254	N.D.	µg/L	10
Aroclor-1260	N.D.	µg/L	10

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005798~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-18

Laboratory ID: 64874-021 Enseco ID: 64874-021

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/12/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/17/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/12/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.008	279.2	11/12/87
Zinc	0.07	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-021

Enseco

~~005799~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-18

Laboratory ID: 64874-021 Enseco ID: 64874-021

Matrix: Groundwater Sampled: 10/29/87 Received: 10/30/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	23	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	79	ug Cl/L	5	9020	11/14/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	0.01	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-021

Enseco

~~005800~~

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #3

Laboratory ID: 64874-022 Enseco ID: 64874-022

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Analyzed: 11/05/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

005801

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #3

Laboratory ID: 64874-022 Enseco ID: 64874-022

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Analyzed: 11/05/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	100	%	-
Bromofluorobenzene	99	%	-
1,2-Dichloroethane-D4	91	%	-

N.D. = Not detected

Reported by: Julieann L. Kramer Approved by: Jeffrey Lowry

Enseco

005802

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #3

Laboratory ID: 64874-022 Enseco ID: 64874-022

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

Enseco

005803

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #3

Laboratory ID: 64874-022 Enseco ID: 64874-022

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	81	%	-
2-Fluorobiphenyl	60	%	-
Terphenyl-D14	91	%	-
Phenol-D5	37	%	-

N.D. = Not detected

Enseco

~~005804~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #3

Laboratory ID: 64874-022 Enseco ID: 64874-022

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	54	%	-
2,4,6-Tribromophenol	80	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Jeffrey Lowry

019588

~~005805~~

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Duplicate #3

Laboratory ID: 5845-01 Enseco ID: 64874-22

Matrix: Water Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/31/87 Prepared: 11/05/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005306~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: DUPLICATE #3

Laboratory ID: 64874-022 Enseco ID: 64874-022

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/12/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	0.026	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/17/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.002	270.2	11/12/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/12/87
Zinc	0.03	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-022

Enseco

~~065807~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC
Client ID: DUPLICATE #3
Laboratory ID: 64874-022 Enseco ID: 64874-022
Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87
Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	0.7	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	7	ug Cl/L	5	9020	11/18/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-022

Enseco

005808

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-13

Laboratory ID: 64874-023 Enseco ID: 64874-023

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Analyzed: 11/06/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	N.D.	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	N.D.	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

~~005809~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-13

Laboratory ID: 64874-023 Enseco ID: 64874-023

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Analyzed: 11/06/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	99	%	-
Bromofluorobenzene	118	%	-
1,2-Dichloroethane-D4	94	%	-

N.D. = Not detected

Reported by: Julieann L. Kramer Approved by: Jeffrey Lowry

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-13

Laboratory ID: 64874-023 Enseco ID: 64874-023

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	10
Acenaphthylene	N.D.	ug/L	10
Anthracene	N.D.	ug/L	10
Benzo(a)anthracene	N.D.	ug/L	10
Benzo(a)pyrene	N.D.	ug/L	10
Benzo(b)fluoranthene	N.D.	ug/L	10
Benzo(g,h,i)perylene	N.D.	ug/L	10
Benzo(k)fluoranthene	N.D.	ug/L	10
bis(2-Chloroethoxy)methane	N.D.	ug/L	10
bis(2-Chloroethyl)ether	N.D.	ug/L	10
bis(2-Chloroisopropyl)ether	N.D.	ug/L	10
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	10
4-Bromophenyl phenyl ether	N.D.	ug/L	10
Butylbenzyl phthalate	N.D.	ug/L	10
2-Chloronaphthalene	N.D.	ug/L	10
4-Chlorophenyl phenyl ether	N.D.	ug/L	10
Chrysene	N.D.	ug/L	10
Dibenzo(a,h)anthracene	N.D.	ug/L	10
1,2-Dichlorobenzene	N.D.	ug/L	10
1,3-Dichlorobenzene	N.D.	ug/L	10
1,4-Dichlorobenzene	N.D.	ug/L	10
3,3'-Dichlorobenzidine	N.D.	ug/L	20
Diethyl phthalate	N.D.	ug/L	10
Dimethyl phthalate	N.D.	ug/L	10
Di-n-butyl phthalate	N.D.	ug/L	10
2,4-Dinitrotoluene	N.D.	ug/L	10
2,6-Dinitrotoluene	N.D.	ug/L	10
Di-n-octyl phthalate	N.D.	ug/L	10
1,2-Diphenylhydrazine	N.D.	ug/L	10
Fluoranthene	N.D.	ug/L	10
Fluorene	N.D.	ug/L	10

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-13

Laboratory ID: 64874-023 Enseco ID: 64874-023

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	10
Hexachlorobutadiene	N.D.	ug/L	10
Hexachlorocyclopentadiene	N.D.	ug/L	10
Hexachloroethane	N.D.	ug/L	10
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	10
Isophorone	N.D.	ug/L	10
Naphthalene	N.D.	ug/L	10
Nitrobenzene	N.D.	ug/L	10
N-Nitrosodi-n-propylamine	N.D.	ug/L	10
N-Nitrosodiphenylamine	N.D.	ug/L	10
Phenanthrene	N.D.	ug/L	10
Pyrene	N.D.	ug/L	10
1,2,4-Trichlorobenzene	N.D.	ug/L	10
2-Chlorophenol	N.D.	ug/L	10
2,4-Dichlorophenol	N.D.	ug/L	10
2,4-Dimethylphenol	N.D.	ug/L	10
4,6-Dinitro-2-methylphenol	N.D.	ug/L	50
2,4-Dinitrophenol	N.D.	ug/L	50
2-Nitrophenol	N.D.	ug/L	10
4-Nitrophenol	N.D.	ug/L	50
4-Chloro-3-methylphenol	N.D.	ug/L	10
Pentachlorophenol	N.D.	ug/L	50
Phenol	N.D.	ug/L	10
2,4,6-Trichlorophenol	N.D.	ug/L	10
Surrogate			
Nitrobenzene-D5	86	%	-
2-Fluorobiphenyl	65	%	-
Terphenyl-D14	93	%	-
Phenol-D5	35	%	-

N.D. = Not detected

Enseco

~~005812~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-13

Laboratory ID: 64874-023 Enseco ID: 64874-023

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	53	%	-
2,4,6-Tribromophenol	82	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Jeffrey Lowry

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-13

Laboratory ID: 5845-02 Enseco ID: 64874-23

Matrix: Water Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/31/87 Prepared: 11/05/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~025814~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-13

Laboratory ID: 64874-023 Enseco ID: 64874-023

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/12/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	N.D.	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/17/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.002	270.2	11/12/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.004	279.2	11/12/87
Zinc	0.06	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-023

Enseco

~~005815~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-13

Laboratory ID: 64874-023 Enseco ID: 64874-023

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	2.6	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	75	ug Cl/L	5	9020	11/18/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-023

Enseco

005816

PRIORITY POLLUTANT VOLATILE ORGANICS

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-38

Laboratory ID: 64874-024 Enseco ID: 64874-024

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Analyzed: 11/05/87

Parameter	Result	Units	Reporting Limit
Benzene	N.D.	ug/L	5.0
Bromoform	N.D.	ug/L	5.0
Carbon tetrachloride	N.D.	ug/L	5.0
Chlorobenzene	N.D.	ug/L	5.0
Dibromochloromethane	N.D.	ug/L	5.0
Chloroethane	N.D.	ug/L	10
2-Chloroethyl vinyl ether	N.D.	ug/L	10
Chloroform	N.D.	ug/L	5.0
Bromodichloromethane	N.D.	ug/L	5.0
1,1-Dichloroethane	N.D.	ug/L	5.0
1,2-Dichloroethane	N.D.	ug/L	5.0
1,1-Dichloroethene	N.D.	ug/L	5.0
1,2-Dichloropropane	N.D.	ug/L	5.0
Ethyl benzene	N.D.	ug/L	5.0
Bromomethane	N.D.	ug/L	10
Chloromethane	N.D.	ug/L	10
Methylene chloride	N.D.	ug/L	25
1,1,2,2-Tetrachloroethane	N.D.	ug/L	5.0
Tetrachloroethene	21	ug/L	5.0
Toluene	N.D.	ug/L	5.0
trans-1,2-Dichloroethene	N.D.	ug/L	5.0
1,1,1-Trichloroethane	N.D.	ug/L	5.0
1,1,2-Trichloroethane	N.D.	ug/L	5.0
Trichloroethene	13	ug/L	5.0
Vinyl chloride	N.D.	ug/L	10
cis-1,3-Dichloropropene	N.D.	ug/L	5.0
trans-1,3-Dichloropropene	N.D.	ug/L	5.0

N.D. = Not detected

Enseco

~~005817~~

PRIORITY POLLUTANT VOLATILE ORGANICS (CONT.)

EPA METHOD 624

Client Name: ERM-SOUTHWEST INC

Client ID: MW-38

Laboratory ID: 64874-024 Enseco ID: 64874-024

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Analyzed: 11/05/87

Surrogate	Result	Units	Reporting Limit
Toluene-D8	100	%	-
Bromofluorobenzene	101	%	-
1,2-Dichloroethane-D4	95	%	-

N.D. = Not detected

Reported by: Julieann L. Kramer Approved by: Jeffrey Lowry

Enseco

~~005818~~

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-38

Laboratory ID: 64874-024 Enseco ID: 64874-024

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Acenaphthene	N.D.	ug/L	20
Acenaphthylene	N.D.	ug/L	20
Anthracene	N.D.	ug/L	20
Benzo(a)anthracene	N.D.	ug/L	20
Benzo(a)pyrene	N.D.	ug/L	20
Benzo(b)fluoranthene	N.D.	ug/L	20
Benzo(g,h,i)perylene	N.D.	ug/L	20
Benzo(k)fluoranthene	N.D.	ug/L	20
bis(2-Chloroethoxy)methane	N.D.	ug/L	20
bis(2-Chloroethyl)ether	N.D.	ug/L	20
bis(2-Chloroisopropyl)ether	N.D.	ug/L	20
bis(2-Ethylhexyl)phthalate	N.D.	ug/L	20
4-Bromophenyl phenyl ether	N.D.	ug/L	20
Butylbenzyl phthalate	N.D.	ug/L	20
2-Chloronaphthalene	N.D.	ug/L	20
4-Chlorophenyl phenyl ether	N.D.	ug/L	20
Chrysene	N.D.	ug/L	20
Dibenzo(a,h)anthracene	N.D.	ug/L	20
1,2-Dichlorobenzene	N.D.	ug/L	20
1,3-Dichlorobenzene	N.D.	ug/L	20
1,4-Dichlorobenzene	N.D.	ug/L	20
3,3'-Dichlorobenzidine	N.D.	ug/L	40
Diethyl phthalate	N.D.	ug/L	20
Dimethyl phthalate	N.D.	ug/L	20
Di-n-butyl phthalate	N.D.	ug/L	20
2,4-Dinitrotoluene	N.D.	ug/L	20
2,6-Dinitrotoluene	N.D.	ug/L	20
Di-n-octyl phthalate	N.D.	ug/L	20
1,2-Diphenylhydrazine	N.D.	ug/L	20
Fluoranthene	N.D.	ug/L	20
Fluorene	N.D.	ug/L	20

N.D. = Not detected

PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-38

Laboratory ID: 64874-024 Enseco ID: 64874-024

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Parameter	Result	Units	Reporting Limit
Hexachlorobenzene	N.D.	ug/L	20
Hexachlorobutadiene	N.D.	ug/L	20
Hexachlorocyclopentadiene	N.D.	ug/L	20
Hexachloroethane	N.D.	ug/L	20
Indeno(1,2,3-c,d)pyrene	N.D.	ug/L	20
Isophorone	N.D.	ug/L	20
Naphthalene	N.D.	ug/L	20
Nitrobenzene	N.D.	ug/L	20
N-Nitrosodi-n-propylamine	N.D.	ug/L	20
N-Nitrosodiphenylamine	N.D.	ug/L	20
Phenanthrene	N.D.	ug/L	20
Pyrene	N.D.	ug/L	20
1,2,4-Trichlorobenzene	N.D.	ug/L	20
2-Chlorophenol	N.D.	ug/L	20
2,4-Dichlorophenol	N.D.	ug/L	20
2,4-Dimethylphenol	N.D.	ug/L	20
4,6-Dinitro-2-methylphenol	N.D.	ug/L	100
2,4-Dinitrophenol	N.D.	ug/L	100
2-Nitrophenol	N.D.	ug/L	20
4-Nitrophenol	N.D.	ug/L	100
4-Chloro-3-methylphenol	N.D.	ug/L	20
Pentachlorophenol	N.D.	ug/L	100
Phenol	N.D.	ug/L	20
2,4,6-Trichlorophenol	N.D.	ug/L	20
Surrogate			
Nitrobenzene-D5	82	%	-
2-Fluorobiphenyl	83	%	-
Terphenyl-D14	91	%	-
Phenol-D5	22	%	-

N.D. = Not detected

Enseco

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PRIORITY POLLUTANT SEMIVOLATILE ORGANICS (CONT.)

EPA METHOD 625

Client Name: ERM-SOUTHWEST INC

Client ID: MW-38

Laboratory ID: 64874-024 Enseco ID: 64874-024

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87 Prepared: 11/02/87 Analyzed: 11/09/87

Surrogate	Result	Units	Reporting Limit
2-Fluorophenol	25	%	-
2,4,6-Tribromophenol	64	%	-

N.D. = Not detected

Reported by: Julie Thomson Approved by: Jeffrey Lowry

Enseco

~~005821~~ PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: MW-38

Laboratory ID: 5845-03 Enseco ID: 64874-24

Matrix: Water Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/31/87 Prepared: 11/05/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	1.0
beta-BHC	N.D.	µg/L	1.0
delta-BHC	N.D.	µg/L	1.0
gamma-BHC (Lindane)	N.D.	µg/L	1.0
Heptachlor	N.D.	µg/L	1.0
Aldrin	N.D.	µg/L	1.0
Heptachlor Epoxide	N.D.	µg/L	1.0
Endosulfan I	N.D.	µg/L	1.0
Dieldrin	N.D.	µg/L	2.0
4,4'-DDE	N.D.	µg/L	2.0
Endrin	N.D.	µg/L	2.0
Endosulfan II	N.D.	µg/L	2.0
4,4'-DDD	N.D.	µg/L	2.0
Endosulfan Sulfate	N.D.	µg/L	2.0
4,4'-DDT	N.D.	µg/L	2.0
Endrin Aldehyde	N.D.	µg/L	2.0
Methoxychlor	N.D.	µg/L	10
Chlordane	N.D.	µg/L	10
Toxaphene	N.D.	µg/L	20
Aroclor-1016	N.D.	µg/L	10
Aroclor-1221	N.D.	µg/L	10
Aroclor-1232	N.D.	µg/L	10
Aroclor-1242	N.D.	µg/L	10
Aroclor-1248	N.D.	µg/L	10
Aroclor-1254	N.D.	µg/L	10
Aroclor-1260	N.D.	µg/L	10

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005822~~

PRIORITY POLLUTANT METALS
DISSOLVED METALS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-38

Laboratory ID: 64874-024 Enseco ID: 64874-024

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Antimony	N.D.	mg/L	0.05	200.7	11/11/87
Arsenic	N.D.	mg/L	0.003	206.2	11/12/87
Beryllium	N.D.	mg/L	0.001	200.7	11/11/87
Cadmium	N.D.	mg/L	0.005	200.7	11/11/87
Chromium	N.D.	mg/L	0.01	200.7	11/11/87
Copper	0.006	mg/L	0.006	200.7	11/11/87
Lead	N.D.	mg/L	0.002	239.2	11/17/87
Mercury	N.D.	mg/L	0.0001	245.1	11/05/87
Nickel	N.D.	mg/L	0.04	200.7	11/11/87
Selenium	N.D.	mg/L	0.004	270.2	11/12/87
Silver	N.D.	mg/L	0.005	200.7	11/11/87
Thallium	N.D.	mg/L	0.008	279.2	11/12/87
Zinc	0.11	mg/L	0.01	200.7	11/11/87

N.D. = Not detected

Approved by: Will Pratt

Sample: 64874-024

Enseco

~~005823~~

INORGANIC PARAMETERS

Client Name: ERM-SOUTHWEST INC

Client ID: MW-38

Laboratory ID: 64874-024 Enseco ID: 64874-024

Matrix: Groundwater Sampled: 10/30/87 Received: 10/31/87

Authorized: 10/28/87

Parameter	Result	Units	Reporting Limit	Analytical Method	Analyzed
Total Organic Carbon	28	mg/L	0.1	415.1/9060	11/17/87
Total Organic Halogen	320	ug Cl/L	5	9020	11/18/87
Total Cyanide	N.D.	mg/L	0.01	335.3	11/05/87
Phenolics	N.D.	mg/L	0.01	420.1	11/03/87

N.D. = Not detected

Approved by: Lindsay Breyer

Sample: 64874-024

V. QUALITY CONTROL REPORT

The Enseco laboratories operate under a vigorous QA/QC program designed to ensure the generation of scientifically valid, legally defensible data by monitoring every aspect of laboratory operations. Routine QA/QC procedures include the use of approved methodologies, independent verification of analytical standards, use of duplicate Laboratory Control Samples to assess the precision and accuracy of the methodology on a routine basis, and a rigorous system of data review.

In addition, the Enseco laboratories maintain a comprehensive set of certifications from both state and federal governmental agencies which require frequent analyses of blind audit samples. Enseco - Rocky Mountain Analytical Laboratory is certified by the EPA under the EPA/CLP program for both Organic and Inorganic analyses, under the USATHAMA (U.S. Army) program, by the Army Corps of Engineers, and the states of Colorado, New Jersey, New York, Utah, and Florida, among others.

The standard laboratory QC package is designed to:

1) establish a strong, cost-effective QC program that ensures the generation of scientifically valid, legally defensible data

2) assess the laboratory's performance of the analytical method using control limits generated with a well-defined matrix

3) establish clear-cut guidelines for acceptability of analytical data so that QC decisions can be made immediately at the bench, and

4) provide a standard set of reportables which assures the client of the quality of his data.

005825

The Enseco QC program is based upon monitoring the precision and accuracy of an analytical method by analyzing a set of duplicate Laboratory Control Samples (LCS) at frequent, well-defined intervals. An LCS is a well-characterized matrix which is spiked with target compounds at 5-100 times the reporting limit, depending upon the methodology being monitored. The purpose of the LCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix from which to gather data to establish control limits. These limits are used to determine whether data generated by the laboratory on any given day is in control.

Control limits for accuracy (percent recovery) are based on the average, historical percent recovery +/- 3 standard deviation units. Control limits for precision (relative percent difference) range from 0 (identical duplicate LCS results) to the average, historical relative percent difference + 3 standard deviation units. These control limits are fairly narrow based on the consistency of the matrix being monitored and are updated on a quarterly basis.

For Organic analyses an additional control measure is taken in the form of a Surrogate Control Sample (SCS). The SCS is a control sample spiked with surrogate standards which is analyzed with every analytical lot. The recovery of the SCS is charted in exactly the same manner as described for the LCS, and provides a daily check on the performance of the method.

Accuracy for LCS and SCS is measured by Percent Recovery.

$$\% \text{ Recovery} = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

Precision for LCS is measured by Relative Percent Difference (RPD).

$$\text{RPD} = \frac{\text{Measured Concentration LCS1} - \text{Measured Concentration LCS2}}{(\text{Measured Concentration LCS1} + \text{Measured Concentration LCS2})/2}$$

005826

All samples analyzed concurrently by the same test are assigned the same QC lot number. Projects which contain numerous samples, analyzed over several days, may have multiple QC lot numbers associated with each test. The QC information which follows includes a listing of the QC lot numbers associated with each of the samples reported, LCS and SCS (where applicable) recoveries from the QC lots associated with the samples, and control limits for these lots. The QC data is reported by test code, in the order that the tests are reported in the analytical results section of this report. The test codes assigned are defined in Section VI., Analytical Methodology.

QC LOT ASSIGNMENT REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	QC Lot Number SCS
64874-001	Reagent Water	BNA	BNA 053AA	BNA 053BA
64874-001	Reagent Water	VOA	VOA 004AY	VOA 004CY
64874-002	Reagent Water	BNA	BNA 053AA	BNA 053BA
64874-002	Reagent Water	VOA	VOA 004AY	VOA 004CY
64874-003	Reagent Water	BNA	BNA 053AA	BNA 053BA
64874-003	Reagent Water	VOA	VOA 004AY	VOA 004CY
64874-004	Reagent Water	BNA	BNA 053AA	BNA 053BA
64874-004	Reagent Water	VOA	VOA 004AY	VOA 004CY
64874-005	Reagent Water	BNA	BNA 053AA	BNA 053BA
64874-005	Reagent Water	VOA	VOA 004AY	VOA 004CY
64874-006	Reagent Water	BNA	BNA 053AA	BNA 053BA
64874-006	Reagent Water	VOA	VOA 002AJ	VOA 002CJ
64874-007	Reagent Water	BNA	BNA 053AA	BNA 053BA
64874-007	Reagent Water	VOA	VOA 053AK	VOA 053AK
64874-008	Reagent Water	BNA	BNA 053AA	BNA 053BA
64874-008	Reagent Water	VOA	VOA 053AK	VOA 053AK
64874-009	Reagent Water	BNA	BNA 054AA	BNA 054AA
64874-009	Reagent Water	VOA	VOA 053AK	VOA 053AK
64874-010	Reagent Water	BNA	BNA 054AA	BNA 054AA
64874-010	Reagent Water	VOA	VOA 053AK	VOA 053AK
64874-011	Reagent Water	BNA	BNA 054AA	BNA 054AA
64874-011	Reagent Water	VOA	VOA 053AK	VOA 053AK
64874-012	Reagent Water	BNA	BNA 054AA	BNA 054AA
64874-012	Reagent Water	VOA	VOA 053AK	VOA 053BK
64874-013	Reagent Water	BNA	BNA 054AA	BNA 054AA
64874-013	Reagent Water	VOA	VOA 053AK	VOA 053BK
64874-014	Reagent Water	BNA	BNA 054AA	BNA 054AA
64874-014	Reagent Water	VOA	VOA 053AK	VOA 053BK
64874-015	Reagent Water	BNA	BNA 054AA	BNA 054AA
64874-015	Reagent Water	VOA	VOA 053AK	VOA 053BK
64874-016	Reagent Water	BNA	BNA 055AA	BNA 055AA
64874-016	Reagent Water	VOA	VOA 005AY	VOA 005CY
64874-017	Reagent Water	BNA	BNA 055AA	BNA 055AA
64874-017	Reagent Water	VOA	VOA 005AY	VOA 005BY
64874-018	Reagent Water	BNA	BNA 055AA	BNA 055AA
64874-018	Reagent Water	VOA	VOA 005AY	VOA 005BY
64874-019	Reagent Water	BNA	BNA 055AA	BNA 055AA
64874-019	Reagent Water	VOA	VOA 005AY	VOA 005BY
64874-020	Reagent Water	BNA	BNA 055AA	BNA 055AA
64874-020	Reagent Water	VOA	VOA 005AY	VOA 005BY
64874-021	Reagent Water	BNA	BNA 055AA	BNA 055AA
64874-021	Reagent Water	VOA	VOA 005AY	VOA 005BY

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~~005828~~

QC LOT ASSIGNMENT REPORT

GAS CHROMATOGRAPHY/MASS SPECTROMETRY (cont.)

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS	QC Lot Number SCS
64874-022	Reagent Water	BNA	BNA 055AA	BNA 055AA
64874-022	Reagent Water	VOA	VOA 005AY	VOA 005CY
64874-023	Reagent Water	BNA	BNA 055AA	BNA 055AA
64874-023	Reagent Water	VOA	VOA 005AY	VOA 005CY
64874-024	Reagent Water	BNA	BNA 055AA	BNA 055AA
64874-024	Reagent Water	VOA	VOA 005AY	VOA 005CY

005829

LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Concentration Measured LCS1	Concentration Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: BNA on Reagent Water								
QC Lot: BNA 053AA								
Concentration Units: (ug/L)								
Pentachlorophenol	100	83.4	97.7	83	98	9-103	15.8	50
Phenol	100	30.9	31.2	31	31	12- 89	1.0	42
2-Chlorophenol	100	64.0	65.9	64	66	27-123	2.9	40
4-Chloro-3-methylphenol	100	65.9	68.0	66	68	23- 97	3.1	42
4-Nitrophenol	100	31.7	36.9	32	37	10- 80	15.2	50
1,2,4-Trichlorobenzene	50	32.2	31.5	64	63	39- 98	2.2	28
Acenaphthene	50	37.7	36.7	75	73	46-118	2.7	31
2,4-Dinitrotoluene	50	40.0	42.1	80	84	24- 96	5.1	38
Pyrene	50	43.0	40.0	86	80	26-127	7.2	31
N-Nitrosodi-n-propylamine	50	40.5	42.8	81	86	41-116	5.5	38
1,4-Dichlorobenzene	50	27.9	27.3	56	55	36- 97	2.2	28
Test: BNA on Reagent Water								
QC Lot: BNA 054AA								
Concentration Units: (ug/L)								
Pentachlorophenol	100	94.5		95		9-103		50
Phenol	100	38.8		39		12- 89		42
2-Chlorophenol	100	80.8		81		27-123		40
4-Nitrophenol	100	10.0		10		10- 80		50
1,2,4-Trichlorobenzene	50	32.8		66		39- 98		28
Acenaphthene	50	39.5		79		46-118		31
2,4-Dinitrotoluene	50	37.5		75		24- 96		38
Pyrene	50	46.3		93		26-127		31
N-Nitrosodi-n-propylamine	50	44.4		89		41-116		38
1,4-Dichlorobenzene	50	30.8		62		36- 97		28
Test: BNA on Reagent Water								
QC Lot: BNA 055AA								
Concentration Units: (ug/L)								
Pentachlorophenol	100	77.5	76.8	78	77	9-103	0.9	50
Phenol	100	34.0	34.5	34	35	12- 89	1.5	42
2-Chlorophenol	100	73.5	72.8	74	73	27-123	1.0	40
4-Chloro-3-methylphenol	100	73.9	72.5	74	73	23- 97	1.9	42
4-Nitrophenol	100	15.5	18.4	16	18	10- 80	17.1	50
1,2,4-Trichlorobenzene	50	26.0	24.6	52	49	39- 98	5.5	28
Acenaphthene	50	36.5	36.7	73	73	46-118	0.5	31

= Recovery outside standard QC limits.
* = RPD outside standard QC limits.

005830 LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: BNA on Reagent Water								
QC Lot: BNA 055AA								
Concentration Units: (ug/L)								
2,4-Dinitrotoluene	50	40.1	38.1	80	76	24- 96	5.1	38
Pyrene	50	46.4	42.8	93	86	26-127	8.1	31
N-Nitrosodi-n-propylamine	50	37.6	37.8	75	76	41-116	0.5	38
1,4-Dichlorobenzene	50	26.1	24.7	52	49	36- 97	5.5	28
Test: VOA on Reagent Water								
QC Lot: VOA 002AJ								
Concentration Units: (ug/L)								
1,1-Dichloroethene	50.0	55.4	51.5	111	103	61-145	7.3	14
Trichloroethene	50.0	56.1	54.8	112	110	71-120	2.3	14
Chlorobenzene	50.0	55.8	54.0	112	108	75-130	3.3	13
Toluene	50.0	53.4	52.3	107	105	76-125	2.1	13
Benzene	50.0	54.8	53.0	110	106	76-127	3.3	11
Test: VOA on Reagent Water								
QC Lot: VOA 004AY								
Concentration Units: (ug/L)								
1,1-Dichloroethene	50.0	56.3	57.4	113	115	61-145	1.9	14
Trichloroethene	50.0	49.2	50.5	98	101	71-120	2.6	14
Chlorobenzene	50.0	50.4	51.2	101	102	75-130	1.6	13
Toluene	50.0	49.0	51.8	98	104	76-125	5.6	13
Benzene	50.0	53.4	56.8	107	114	76-127	6.2	11
Test: VOA on Reagent Water								
QC Lot: VOA 005AY								
Concentration Units: (ug/L)								
1,1-Dichloroethene	50.0	56.6	53.3	113	107	61-145	6.0	14
Trichloroethene	50.0	52.4	57.5	105	115	71-120	9.3	14
Chlorobenzene	50.0	52.3	53.8	105	108	75-130	2.8	13
Toluene	50.0	47.4	47.0	95	94	76-125	0.8	13
Benzene	50.0	49.0	52.1	98	104	76-127	6.1	11

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005831 LABORATORY CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: VOA on Reagent Water QC Lot: VOA 053AK Concentration Units: (ug/L)								
1,1-Dichloroethene	50.0	49.6	47.6	99	95	61-145	4.1	14
Trichloroethene	50.0	43.7	42.3	87	85	71-120	3.3	14
Chlorobenzene	50.0	53.2	52.5	106	105	75-130	1.3	13
Toluene	50.0	51.1	53.0	102	106	76-125	3.7	13
Benzene	50.0	50.6	50.8	101	102	76-127	0.4	11

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~~005832~~ **SURROGATE CONTROL SAMPLE REPORT**
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: BNA on Reagent Water				
QC Lot: BNA 053BA				
Concentration Units: (ug/L)				
Phenol-D5	200	69.6	35	10- 94
2-Fluorophenol	200	91.1	46	21-100
2,4,6-Tribromophenol	200	171.	86	10-123
Nitrobenzene-D5	100	72.6	73	35-114
2-Fluorobiphenyl	100	69.3	69	43-116
Terphenyl-D14	100	88.2	88	33-141
Test: BNA on Reagent Water				
QC Lot: BNA 054AA				
Concentration Units: (ug/L)				
Phenol-D5	200	67.0	34	10- 94
2-Fluorophenol	200	91.1	46	21-100
2,4,6-Tribromophenol	200	144.	72	10-123
Nitrobenzene-D5	100	72.9	73	35-114
2-Fluorobiphenyl	100	70.9	71	43-116
Terphenyl-D14	100	79.0	79	33-141
Test: BNA on Reagent Water				
QC Lot: BNA 055AA				
Concentration Units: (ug/L)				
Phenol-D5	200	67.9	34	10- 94
2-Fluorophenol	200	110	55	21-100
2,4,6-Tribromophenol	200	154	77	10-123
Nitrobenzene-D5	100	80.4	80	35-114
2-Fluorobiphenyl	100	68.3	68	43-116
Terphenyl-D14	100	82.9	83	33-141
Test: VOA on Reagent Water				
QC Lot: VOA 002CJ				
Concentration Units: (ug/L)				
Toluene-D8	50.0	49.1	98	88-110
Bromofluorobenzene (BFB)	50.0	49.7	99	86-115
1,2-Dichloroethane-D4	50.0	50.9	102	76-114

Enseco

005833

SURROGATE CONTROL SAMPLE REPORT
GAS CHROMATOGRAPHY/MASS SPECTROMETRY

Analyte	Concentration Spiking	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Test: VOA on Reagent Water				
QC Lot: VOA 004CY				
Concentration Units: (ug/L)				
Toluene-D8	50.0	53.7	107	88-110
Bromofluorobenzene (BFB)	50.0	43.8	88	86-115
1,2-Dichloroethane-D4	50.0	50.5	101	76-114
Test: VOA on Reagent Water				
QC Lot: VOA 005BY				
Concentration Units: (ug/L)				
Toluene-D8	50.0	53.1	106	88-110
Bromofluorobenzene (BFB)	50.0	48.4	97	86-115
1,2-Dichloroethane-D4	50.0	49.8	100	76-114
Test: VOA on Reagent Water				
QC Lot: VOA 005CY				
Concentration Units: (ug/L)				
Toluene-D8	50.0	49.7	99	88-110
Bromofluorobenzene (BFB)	50.0	51.4	103	86-115
1,2-Dichloroethane-D4	50.0	47.8	96	76-114
Test: VOA on Reagent Water				
QC Lot: VOA 053AK				
Concentration Units: (ug/L)				
Toluene-D8	50.0	51.4	103	88-110
Bromofluorobenzene (BFB)	50.0	48.5	97	86-115
1,2-Dichloroethane-D4	50.0	48.1	96	76-114
Test: VOA on Reagent Water				
QC Lot: VOA 053BK				
Concentration Units: (ug/L)				
Toluene-D8	50.0	50.7	101	88-110
Bromofluorobenzene (BFB)	50.0	50.9	102	86-115
1,2-Dichloroethane-D4	50.0	66	132#	76-114

= Recovery outside standard QC limits.

Enseco

005834 PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Method Blank

Laboratory ID: 5762-01B Enseco ID: Method Blank

Matrix: Water Sampled: N.A. Received: N.A.

Authorized: N.A. Prepared: 10/30/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.A. = Not applicable.

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.
Client ID: Method Blank
Laboratory ID: 5774-01B Enseco ID: Method Blank
Matrix: Water Sampled: N.A. Received: N.A.
Authorized: N.A. Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.A. = Not applicable.
N.D. = Not detected.

Reported by EK Approved by KC

019619

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Method Blank

Laboratory ID: 5798-018 Enseco ID: Method Blank

Matrix: Water Sampled: N.A. Received: N.A.

Authorized: N.A. Prepared: 11/03/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.A. = Not applicable.

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Method Blank

Laboratory ID: 5845-038 Enseco ID: Method Blank

Matrix: Water Sampled: N.A. Received: N.A.

Authorized: N.A. Prepared: 11/05/87 Analyzed: 11/15/87

Parameter	Result	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	N.D.	µg/L	0.05
Heptachlor	N.D.	µg/L	0.05
Aldrin	N.D.	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	N.D.	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	N.D.	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	N.D.	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

N.A. = Not applicable.

N.D. = Not detected.

Reported by EK Approved by KC

019621

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

005838

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Laboratory Control Spike

Laboratory ID: 5774-03BS Enseco ID: Laboratory Control Spike

Matrix: Water Sampled: N.A. Received: N.A.

Authorized: N.A. Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result**	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	0.21 (105)	µg/L	0.05
Heptachlor	0.17 (85)	µg/L	0.05
Aldrin	0.17 (85)	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	0.63 (126)	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	0.60 (120)	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	0.61 (122)	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

**Value in parentheses represents percent spike recovery.

N.A. = Not applicable.

N.D. = Not detected.

Reported by EK Approved by KC

019622

Enseco

00583 PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Laboratory Control Spike Dup.

Laboratory ID: 5774-03BSD Enseco ID: Laboratory Control Spike Dup.

Matrix: Water Sampled: N.A. Received: N.A.

Authorized: N.A. Prepared: 11/02/87 Analyzed: 11/15/87

Parameter	Result**	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	0.19 (95)	µg/L	0.05
Heptachlor	0.14 (70)	µg/L	0.05
Aldrin	0.13 (65)	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	0.60 (120)	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	0.55 (110)	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	0.57 (114)	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

**Value in parentheses represents percent spike recovery.

N.A. = Not applicable.

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

005840

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Laboratory Control Spike

Laboratory ID: 5682-02BS Enseco ID: Laboratory Control Spike

Matrix: Water Sampled: N.A. Received: N.A.

Authorized: N.A. Prepared: 10/26/87 Analyzed: 11/12/87

Parameter	Result**	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	0.20 (100)	µg/L	0.05
Heptachlor	0.22 (110)	µg/L	0.05
Aldrin	0.18 (90)	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	0.55 (110)	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	0.54 (108)	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	0.58 (116)	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

**Value in parentheses represents percent spike recovery.

N.A. = Not applicable.

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

005841 PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES/PCBs

EPA Method 608

Client Name: ERM - Southwest, Inc.

Client ID: Laboratory Control Spike Dup.

Laboratory ID: 5682-02BSD Enseco ID: Laboratory Control Spike Dup.

Matrix: Water Sampled: N.A. Received: N.A.

Authorized: N.A. Prepared: 10/26/87 Analyzed: 11/12/87

Parameter	Result**	Units	Reporting Limit
alpha-BHC	N.D.	µg/L	0.05
beta-BHC	N.D.	µg/L	0.05
delta-BHC	N.D.	µg/L	0.05
gamma-BHC (Lindane)	0.17 (85)	µg/L	0.05
Heptachlor	0.17 (85)	µg/L	0.05
Aldrin	0.15 (75)	µg/L	0.05
Heptachlor Epoxide	N.D.	µg/L	0.05
Endosulfan I	N.D.	µg/L	0.05
Dieldrin	0.48 (96)	µg/L	0.10
4,4'-DDE	N.D.	µg/L	0.10
Endrin	0.44 (88)	µg/L	0.10
Endosulfan II	N.D.	µg/L	0.10
4,4'-DDD	N.D.	µg/L	0.10
Endosulfan Sulfate	N.D.	µg/L	0.10
4,4'-DDT	0.53 (106)	µg/L	0.10
Endrin Aldehyde	N.D.	µg/L	0.10
Methoxychlor	N.D.	µg/L	0.50
Chlordane	N.D.	µg/L	0.50
Toxaphene	N.D.	µg/L	1.0
Aroclor-1016	N.D.	µg/L	0.50
Aroclor-1221	N.D.	µg/L	0.50
Aroclor-1232	N.D.	µg/L	0.50
Aroclor-1242	N.D.	µg/L	0.50
Aroclor-1248	N.D.	µg/L	0.50
Aroclor-1254	N.D.	µg/L	0.50
Aroclor-1260	N.D.	µg/L	0.50

**Value in parentheses represents percent spike recovery.

N.A. = Not applicable.

N.D. = Not detected.

Reported by EK Approved by KC

Enseco

~~005842~~

QC LOT ASSIGNMENT REPORT
INORGANICS - METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64874-001	Reagent Water	FASD	FASD133AA
64874-001	Reagent Water	FASD	FASD133AA
64874-001	Reagent Water	FPBD	FPBD133AA
64874-001	Reagent Water	FSED	FSED133AA
64874-001	Reagent Water	FSED	FSED133AA
64874-001	Reagent Water	FTLD	FTLD133AA
64874-001	Reagent Water	FTLD	FTLD133AA
64874-001	Reagent Water	HGT	HGT 209AA
64874-001	Reagent Water	ICPD	ICPD164AA
64874-002	Reagent Water	FASD	FASD133AA
64874-002	Reagent Water	FASD	FASD133AA
64874-002	Reagent Water	FPBD	FPBD133AA
64874-002	Reagent Water	FSED	FSED133AA
64874-002	Reagent Water	FSED	FSED133AA
64874-002	Reagent Water	FTLD	FTLD133AA
64874-002	Reagent Water	FTLD	FTLD133AA
64874-002	Reagent Water	HGT	HGT 209AA
64874-002	Reagent Water	ICPD	ICPD164AA
64874-003	Reagent Water	FASD	FASD133AA
64874-003	Reagent Water	FASD	FASD133AA
64874-003	Reagent Water	FPBD	FPBD133AA
64874-003	Reagent Water	FSED	FSED133AA
64874-003	Reagent Water	FSED	FSED133AA
64874-003	Reagent Water	FTLD	FTLD133AA
64874-003	Reagent Water	FTLD	FTLD133AA
64874-003	Reagent Water	HGT	HGT 224AB
64874-003	Reagent Water	ICPD	ICPD164AA
64874-004	Reagent Water	FASD	FASD133AA
64874-004	Reagent Water	FASD	FASD133AA
64874-004	Reagent Water	FPBD	FPBD133AA
64874-004	Reagent Water	FSED	FSED133AA
64874-004	Reagent Water	FSED	FSED133AA
64874-004	Reagent Water	FTLD	FTLD133AA
64874-004	Reagent Water	FTLD	FTLD133AA
64874-004	Reagent Water	HGT	HGT 209AA
64874-004	Reagent Water	ICPD	ICPD164AA
64874-005	Reagent Water	FASD	FASD133AA
64874-005	Reagent Water	FASD	FASD133AA
64874-005	Reagent Water	FPBD	FPBD133AA
64874-005	Reagent Water	FSED	FSED133AA
64874-005	Reagent Water	FSED	FSED133AA
64874-005	Reagent Water	FTLD	FTLD133AA

Enseco

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QC LOT ASSIGNMENT REPORT
INORGANICS - METALS (cont.)

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64874-005	Reagent Water	FTLD	FTLD133AA
64874-005	Reagent Water	HGT	HGT 209AA
64874-005	Reagent Water	ICPD	ICPD164AA
64874-006	Reagent Water	FASD	FASD133AA
64874-006	Reagent Water	FASD	FASD133AA
64874-006	Reagent Water	FPBD	FPBD133AA
64874-006	Reagent Water	FSED	FSED133AA
64874-006	Reagent Water	FSED	FSED133AA
64874-006	Reagent Water	FTLD	FTLD133AA
64874-006	Reagent Water	FTLD	FTLD133AA
64874-006	Reagent Water	HGT	HGT 209AA
64874-006	Reagent Water	ICPD	ICPD164AA
64874-007	Reagent Water	FASD	FASD133AA
64874-007	Reagent Water	FASD	FASD133AA
64874-007	Reagent Water	FPBD	FPBD133AA
64874-007	Reagent Water	FSED	FSED133AA
64874-007	Reagent Water	FSED	FSED133AA
64874-007	Reagent Water	FTLD	FTLD133AA
64874-007	Reagent Water	FTLD	FTLD133AA
64874-007	Reagent Water	HGT	HGT 210AA
64874-007	Reagent Water	ICPD	ICPD164AA
64874-008	Reagent Water	FASD	FASD133AA
64874-008	Reagent Water	FASD	FASD133AA
64874-008	Reagent Water	FPBD	FPBD133AA
64874-008	Reagent Water	FSED	FSED133AA
64874-008	Reagent Water	FSED	FSED133AA
64874-008	Reagent Water	FTLD	FTLD133AA
64874-008	Reagent Water	FTLD	FTLD133AA
64874-008	Reagent Water	HGT	HGT 210AA
64874-008	Reagent Water	ICPD	ICPD164AA
64874-009	Reagent Water	FASD	FASD133AA
64874-009	Reagent Water	FASD	FASD133AA
64874-009	Reagent Water	FPBD	FPBD133AA
64874-009	Reagent Water	FSED	FSED133AA
64874-009	Reagent Water	FSED	FSED133AA
64874-009	Reagent Water	FTLD	FTLD133AA
64874-009	Reagent Water	FTLD	FTLD133AA
64874-009	Reagent Water	HGT	HGT 210AA
64874-009	Reagent Water	ICPD	ICPD164AA
64874-010	Reagent Water	FASD	FASD133AA
64874-010	Reagent Water	FASD	FASD133AA
64874-010	Reagent Water	FPBD	FPBD133AA

Enseco

005844

QC LOT ASSIGNMENT REPORT
INORGANICS - METALS (cont.)

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64874-010	Reagent Water	FSED	FSED133AA
64874-010	Reagent Water	FSED	FSED133AA
64874-010	Reagent Water	FTLD	FTLD133AA
64874-010	Reagent Water	FTLD	FTLD133AA
64874-010	Reagent Water	HGT	HGT 210AA
64874-010	Reagent Water	ICPD	ICPD164AA
64874-011	Reagent Water	FASD	FASD133AA
64874-011	Reagent Water	FASD	FASD133AA
64874-011	Reagent Water	FPBD	FPBD133AA
64874-011	Reagent Water	FSED	FSED133AA
64874-011	Reagent Water	FSED	FSED133AA
64874-011	Reagent Water	FTLD	FTLD133AA
64874-011	Reagent Water	FTLD	FTLD133AA
64874-011	Reagent Water	HGT	HGT 210AA
64874-011	Reagent Water	ICPD	ICPD164AA
64874-012	Reagent Water	FASD	FASD133AA
64874-012	Reagent Water	FASD	FASD133AA
64874-012	Reagent Water	FPBD	FPBD133AA
64874-012	Reagent Water	FSED	FSED133AA
64874-012	Reagent Water	FSED	FSED133AA
64874-012	Reagent Water	FTLD	FTLD133AA
64874-012	Reagent Water	FTLD	FTLD133AA
64874-012	Reagent Water	HGT	HGT 210AA
64874-012	Reagent Water	ICPD	ICPD164AA
64874-013	Reagent Water	FASD	FASD133AA
64874-013	Reagent Water	FASD	FASD133AA
64874-013	Reagent Water	FPBD	FPBD133AA
64874-013	Reagent Water	FSED	FSED133AA
64874-013	Reagent Water	FSED	FSED133AA
64874-013	Reagent Water	FTLD	FTLD133AA
64874-013	Reagent Water	FTLD	FTLD133AA
64874-013	Reagent Water	HGT	HGT 210AA
64874-013	Reagent Water	ICPD	ICPD164AA
64874-014	Reagent Water	FASD	FASD133AA
64874-014	Reagent Water	FASD	FASD133AA
64874-014	Reagent Water	FPBD	FPBD133AA
64874-014	Reagent Water	FSED	FSED133AA
64874-014	Reagent Water	FSED	FSED133AA
64874-014	Reagent Water	FTLD	FTLD133AA
64874-014	Reagent Water	FTLD	FTLD133AA
64874-014	Reagent Water	HGT	HGT 210AA
64874-014	Reagent Water	ICPD	ICPD164AA

QC LOT ASSIGNMENT REPORT
INORGANICS - METALS (cont.)

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64874-015	Reagent Water	FASD	FASD133AA
64874-015	Reagent Water	FASD	FASD133AA
64874-015	Reagent Water	FPBD	FPBD133AA
64874-015	Reagent Water	FSED	FSED133AA
64874-015	Reagent Water	FSED	FSED133AA
64874-015	Reagent Water	FTLD	FTLD133AA
64874-015	Reagent Water	FTLD	FTLD133AA
64874-015	Reagent Water	HGT	HGT 210AA
64874-015	Reagent Water	ICPD	ICPD164AA
64874-016	Reagent Water	FASD	FASD134AA
64874-016	Reagent Water	FPBD	FPBD134AA
64874-016	Reagent Water	FSED	FSED134AA
64874-016	Reagent Water	FTLD	FTLD134AA
64874-016	Reagent Water	HGT	HGT 211AA
64874-016	Reagent Water	ICPD	ICPD164AA
64874-017	Reagent Water	FASD	FASD134AA
64874-017	Reagent Water	FPBD	FPBD134AA
64874-017	Reagent Water	FSED	FSED134AA
64874-017	Reagent Water	FTLD	FTLD134AA
64874-017	Reagent Water	HGT	HGT 211AA
64874-017	Reagent Water	ICPD	ICPD164AA
64874-018	Reagent Water	FASD	FASD134AA
64874-018	Reagent Water	FPBD	FPBD134AA
64874-018	Reagent Water	FSED	FSED134AA
64874-018	Reagent Water	FTLD	FTLD134AA
64874-018	Reagent Water	HGT	HGT 211AA
64874-018	Reagent Water	ICPD	ICPD164AA
64874-019	Reagent Water	FASD	FASD134AA
64874-019	Reagent Water	FPBD	FPBD134AA
64874-019	Reagent Water	FSED	FSED134AA
64874-019	Reagent Water	FTLD	FTLD134AA
64874-019	Reagent Water	HGT	HGT 211AA
64874-019	Reagent Water	ICPD	ICPD164AA
64874-020	Reagent Water	FASD	FASD134AA
64874-020	Reagent Water	FPBD	FPBD134AA
64874-020	Reagent Water	FSED	FSED134AA
64874-020	Reagent Water	FTLD	FTLD134AA
64874-020	Reagent Water	HGT	HGT 211AA
64874-020	Reagent Water	ICPD	ICPD164AA
64874-021	Reagent Water	FASD	FASD134AA
64874-021	Reagent Water	FPBD	FPBD134AA
64874-021	Reagent Water	FSED	FSED134AA

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QC LOT ASSIGNMENT REPORT
INORGANICS - METALS (cont.)

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64874-021	Reagent Water	FTLD	FTLD134AA
64874-021	Reagent Water	HGT	HGT 211AA
64874-021	Reagent Water	ICPD	ICPD165AA
64874-022	Reagent Water	FASD	FASD134AA
64874-022	Reagent Water	FPBD	FPBD134AA
64874-022	Reagent Water	FSED	FSED134AA
64874-022	Reagent Water	FTLD	FTLD134AA
64874-022	Reagent Water	HGT	HGT 211AA
64874-022	Reagent Water	ICPD	ICPD165AA
64874-023	Reagent Water	FASD	FASD134AA
64874-023	Reagent Water	FPBD	FPBD134AA
64874-023	Reagent Water	FSED	FSED134AA
64874-023	Reagent Water	FTLD	FTLD134AA
64874-023	Reagent Water	HGT	HGT 211AA
64874-023	Reagent Water	ICPD	ICPD165AA
64874-024	Reagent Water	FASD	FASD134AA
64874-024	Reagent Water	FPBD	FPBD134AA
64874-024	Reagent Water	FSED	FSED134AA
64874-024	Reagent Water	FTLD	FTLD134AA
64874-024	Reagent Water	HGT	HGT 211AA
64874-024	Reagent Water	ICPD	ICPD165AA

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LABORATORY CONTROL SAMPLE REPORT
INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: FASD on Reagent Water								
QC Lot: FASD133AA								
Concentration Units: (mg/L)								
Arsenic	0.02	0.020	0.020	100	100	75-125	0.0	20
Test: FASD on Reagent Water								
QC Lot: FASD134AA								
Concentration Units: (mg/L)								
Arsenic	0.040	0.033	0.036	83	90	75-125	8.7	20
Test: FPBD on Reagent Water								
QC Lot: FPBD133AA								
Concentration Units: (mg/L)								
Lead	0.04	0.041	0.034	103	85	75-125	18.7	20
Test: FPBD on Reagent Water								
QC Lot: FPBD134AA								
Concentration Units: (mg/L)								
Lead	0.04	0.044	0.040	110	100	75-125	9.5	20
Test: FSED on Reagent Water								
QC Lot: FSED133AA								
Concentration Units: (mg/L)								
Selenium	0.04	0.039	0.039	98	98	75-125	0.0	20
Test: FSED on Reagent Water								
QC Lot: FSED134AA								
Concentration Units: (mg/L)								
Selenium	0.020	0.018	0.020	90	100	75-125	10.5	20

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LABORATORY CONTROL SAMPLE REPORT
INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: FTLD on Reagent Water								
QC Lot: FTLD133AA								
Concentration Units: (mg/L)								
Thallium	0.05	0.047	0.049	94	98	75-125	4.2	20
Test: FTLD on Reagent Water								
QC Lot: FTLD134AA								
Concentration Units: (mg/L)								
Thallium	0.05	0.047	0.047	94	94	75-125	0.0	20
Test: HGT on Reagent Water								
QC Lot: HGT 209AA								
Concentration Units: (ug/L)								
Mercury	1.0	1.0	1.0	100	100	75-125	0.0	20
Test: HGT on Reagent Water								
QC Lot: HGT 210AA								
Concentration Units: (ug/L)								
Mercury	1.0	1.0	1.0	100	100	75-125	0.0	20
Test: HGT on Reagent Water								
QC Lot: HGT 211AA								
Concentration Units: (ug/L)								
Mercury	1.0	1.0	1.0	100	100	75-125	0.0	20
Test: HGT on Reagent Water								
QC Lot: HGT 224AB								
Concentration Units: (ug/L)								
Mercury	1.0	1.0	1.1	100	110	75-125	9.5	20

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LABORATORY CONTROL SAMPLE REPORT
INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: ICPD on Reagent Water								
QC Lot: ICPD164AA								
Concentration Units: (mg/L)								
Aluminum	2.0	2.11	2.09	105	105	75-125	1.0	20
Antimony	0.5	0.50	0.48	100	96	75-125	4.1	20
Arsenic	0.5	0.49	0.47	98	94	75-125	4.2	20
Barium	2.0	1.99	1.96	100	98	75-125	1.5	20
Beryllium	0.05	0.046	0.046	92	92	75-125	0.0	20
Cadmium	0.05	0.047	0.051	94	102	75-125	8.2	20
Calcium	100	107	105	107	105	75-125	1.9	20
Chromium	0.2	0.20	0.20	100	100	75-125	0.0	20
Cobalt	0.5	0.49	0.48	98	96	75-125	2.1	20
Copper	0.25	0.26	0.26	104	104	75-125	0.0	20
Iron	1.0	1.01	1.00	101	100	75-125	1.0	20
Lead	0.5	0.49	0.48	98	96	75-125	2.1	20
Magnesium	50	49	48	98	96	75-125	2.1	20
Manganese	0.2	0.21	0.21	105	105	75-125	0.0	20
Nickel	0.4	0.40	0.39	100	98	75-125	2.5	20
Potassium	50	54	53	108	106	75-125	1.9	20
Silver	0.05	0.052	0.053	104	106	75-125	1.9	20
Sodium	100	98	97	98	97	75-125	1.0	20
Tin	0.4	0.41	0.42	103	105	75-125	2.4	20
Vanadium	0.5	0.50	0.49	100	98	75-125	2.0	20
Zinc	0.2	0.20	0.20	100	100	75-125	0.0	20
Test: ICPD on Reagent Water								
QC Lot: ICPD165AA								
Concentration Units: (mg/L)								
Aluminum	2.0	2.10	2.09	105	105	75-125	0.5	20
Antimony	0.5	0.50	0.48	100	96	75-125	4.1	20
Arsenic	0.5	0.48	0.46	96	92	75-125	4.3	20
Barium	2.0	1.99	1.97	100	99	75-125	1.0	20
Beryllium	0.05	0.046	0.046	92	92	75-125	0.0	20
Cadmium	0.05	0.049	0.045	98	90	75-125	8.5	20
Calcium	100	106	105	106	105	75-125	0.9	20
Chromium	0.2	0.21	0.20	105	100	75-125	4.9	20
Cobalt	0.5	0.49	0.48	98	96	75-125	2.1	20
Copper	0.25	0.26	0.26	104	104	75-125	0.0	20
Iron	1.0	1.01	1.00	101	100	75-125	1.0	20
Lead	0.5	0.47	0.47	94	94	75-125	0.0	20
Magnesium	50	49	48	98	96	75-125	2.1	20

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LABORATORY CONTROL SAMPLE REPORT
INORGANICS - METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: ICPD on Reagent Water QC Lot: ICPD165AA Concentration Units: (mg/L)								
Manganese	0.2	0.21	0.21	105	105	75-125	0.0	20
Nickel	0.4	0.40	0.39	100	98	75-125	2.5	20
Potassium	50	54	53	108	106	75-125	1.9	20
Silver	0.05	0.054	0.053	108	106	75-125	1.9	20
Sodium	100	98	98	98	98	75-125	0.0	20
Tin	0.4	0.43	0.42	108	105	75-125	2.4	20
Vanadium	0.5	0.50	0.49	100	98	75-125	2.0	20
Zinc	0.2	0.21	0.20	105	100	75-125	4.9	20

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QC LOT ASSIGNMENT REPORT
INORGANICS - NON-METALS

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64874-001	Reagent Water	CNT	CNT 126AA
64874-001	Reagent Water	PHEN	PHEN080AC
64874-001	Reagent Water	TOC	TOC 169AB
64874-001	Reagent Water	TOX	TOX 114AB
64874-002	Reagent Water	CNT	CNT 126AA
64874-002	Reagent Water	PHEN	PHEN080AC
64874-002	Reagent Water	TOC	TOC 169AB
64874-002	Reagent Water	TOX	TOX 114AB
64874-003	Reagent Water	CNT	CNT 126AA
64874-003	Reagent Water	PHEN	PHEN080AC
64874-003	Reagent Water	TOC	TOC 169AB
64874-003	Reagent Water	TOX	TOX 114AB
64874-004	Reagent Water	CNT	CNT 126AA
64874-004	Reagent Water	PHEN	PHEN080AC
64874-004	Reagent Water	TOC	TOC 169AB
64874-004	Reagent Water	TOX	TOX 114AB
64874-005	Reagent Water	CNT	CNT 126AA
64874-005	Reagent Water	PHEN	PHEN080AC
64874-005	Reagent Water	TOC	TOC 169AB
64874-005	Reagent Water	TOX	TOX 114AB
64874-006	Reagent Water	CNT	CNT 126AA
64874-006	Reagent Water	PHEN	PHEN080AC
64874-006	Reagent Water	TOC	TOC 169AB
64874-006	Reagent Water	TOX	TOX 114AB
64874-007	Reagent Water	CNT	CNT 125AA
64874-007	Reagent Water	PHEN	PHEN080AC
64874-007	Reagent Water	TOC	TOC 182AB
64874-007	Reagent Water	TOX	TOX 115AB
64874-008	Reagent Water	CNT	CNT 125AA
64874-008	Reagent Water	PHEN	PHEN080AC
64874-008	Reagent Water	TOC	TOC 182AB
64874-008	Reagent Water	TOX	TOX 115AB
64874-009	Reagent Water	CNT	CNT 125AA
64874-009	Reagent Water	PHEN	PHEN080AC
64874-009	Reagent Water	TOC	TOC 182AB
64874-009	Reagent Water	TOX	TOX 115AB
64874-010	Reagent Water	CNT	CNT 125AA
64874-010	Reagent Water	PHEN	PHEN080AC
64874-010	Reagent Water	TOC	TOC 182AB
64874-010	Reagent Water	TOX	TOX 115AB
64874-011	Reagent Water	CNT	CNT 125AA
64874-011	Reagent Water	PHEN	PHEN080AC

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QC LOT ASSIGNMENT REPORT
INORGANICS - NON-METALS (cont.)

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64874-011	Reagent Water	TOC	TOC 182AB
64874-011	Reagent Water	TOX	TOX 115AB
64874-012	Reagent Water	CNT	CNT 125AA
64874-012	Reagent Water	PHEN	PHEN080AC
64874-012	Reagent Water	TOC	TOC 182AB
64874-012	Reagent Water	TOX	TOX 115AB
64874-013	Reagent Water	CNT	CNT 125AA
64874-013	Reagent Water	PHEN	PHEN080AC
64874-013	Reagent Water	TOC	TOC 182AB
64874-013	Reagent Water	TOX	TOX 115AB
64874-014	Reagent Water	CNT	CNT 125AA
64874-014	Reagent Water	PHEN	PHEN080AC
64874-014	Reagent Water	TOC	TOC 182AB
64874-014	Reagent Water	TOX	TOX 115AB
64874-015	Reagent Water	CNT	CNT 125AA
64874-015	Reagent Water	PHEN	PHEN080AC
64874-015	Reagent Water	TOC	TOC 182AB
64874-015	Reagent Water	TOX	TOX 115AB
64874-016	Reagent Water	CNT	CNT 126AA
64874-016	Reagent Water	PHEN	PHEN080AC
64874-016	Reagent Water	TOC	TOC 176AB
64874-016	Reagent Water	TOX	TOX 116AB
64874-017	Reagent Water	CNT	CNT 126AA
64874-017	Reagent Water	PHEN	PHEN080AC
64874-017	Reagent Water	TOC	TOC 176AB
64874-017	Reagent Water	TOX	TOX 116AB
64874-018	Reagent Water	CNT	CNT 126AA
64874-018	Reagent Water	PHEN	PHEN081AC
64874-018	Reagent Water	TOC	TOC 176AB
64874-018	Reagent Water	TOX	TOX 117AB
64874-019	Reagent Water	CNT	CNT 126AA
64874-019	Reagent Water	PHEN	PHEN081AC
64874-019	Reagent Water	TOC	TOC 176AB
64874-019	Reagent Water	TOX	TOX 116AB
64874-020	Reagent Water	CNT	CNT 126AA
64874-020	Reagent Water	PHEN	PHEN082AC
64874-020	Reagent Water	TOC	TOC 176AB
64874-020	Reagent Water	TOX	TOX 116AB
64874-021	Reagent Water	CNT	CNT 126AA
64874-021	Reagent Water	PHEN	PHEN082AC
64874-021	Reagent Water	TOC	TOC 176AB
64874-021	Reagent Water	TOX	TOX 116AB

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QC LOT ASSIGNMENT REPORT
INORGANICS - NON-METALS (cont.)

Laboratory Sample Number	QC Matrix	Test	QC Lot Number LCS
64874-022	Reagent Water	CNT	CNT 126AA
64874-022	Reagent Water	PHEN	PHEN082AC
64874-022	Reagent Water	TOC	TOC 176AB
64874-022	Reagent Water	TOX	TOX 121AB
64874-023	Reagent Water	CNT	CNT 126AA
64874-023	Reagent Water	PHEN	PHEN082AC
64874-023	Reagent Water	TOC	TOC 176AB
64874-023	Reagent Water	TOX	TOX 117AB
64874-024	Reagent Water	CNT	CNT 126AA
64874-024	Reagent Water	PHEN	PHEN082AC
64874-024	Reagent Water	TOC	TOC 176AB
64874-024	Reagent Water	TOX	TOX 117AB

LABORATORY CONTROL SAMPLE REPORT
INORGANICS - NON-METALS

Analyte	Concentration Spiking	Measured LCS1	Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: CNT on Reagent Water								
QC Lot: CNT 125AA								
Concentration Units: (mg/L)								
Total Cyanide	**0.046**	**0.045**	**0.046**	**98**	**100**	**75-125**	**2.2**	**20**
Test: CNT on Reagent Water								
QC Lot: CNT 126AA								
Concentration Units: (mg/L)								
Total Cyanide	**0.046**	**0.049**	**0.048**	**107**	**104**	**75-125**	**2.1**	**20**
Test: PHEN on Reagent Water								
QC Lot: PHEN080AC								
Concentration Units: (mg/L)								
Phenolics	**0.063**	**0.064**	**0.068**	**102**	**108**	**78-122**	**6.1**	**20**
Test: PHEN on Reagent Water								
QC Lot: PHEN081AC								
Concentration Units: (mg/L)								
Phenolics	**0.063**	**0.069**	**0.071**	**110**	**113**	**78-122**	**2.9**	**20**
Test: PHEN on Reagent Water								
QC Lot: PHEN082AC								
Concentration Units: (mg/L)								
Phenolics	**0.063**	**0.072**	**0.077**	**114**	**122**	**78-122**	**6.7**	**20**
Test: TOC on Reagent Water								
QC Lot: TOC 169AB								
Concentration Units: (mg/L)								
Total Organic Carbon	**29**	**29**	**29**	**100**	**100**	**91-109**	**0.0**	**20**

LABORATORY CONTROL SAMPLE REPORT
INORGANICS - NON-METALS

Analyte	Concentration Spiking	Concentration Measured LCS1	Concentration Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: TOC on Reagent Water **QC Lot: TOC 176AB** **Concentration Units: (mg/L)**								
Total Organic Carbon	**29**	**28**	**28**	**97**	**97**	**91-109**	0.0	20
Test: TOC on Reagent Water **QC Lot: TOC 182AB** **Concentration Units: (mg/L)**								
Total Organic Carbon	**29**	**28**	**28**	**97**	**97**	**91-109**	0.0	20
Test: TOX on Reagent Water **QC Lot: TOX 114AB** **Concentration Units: (ug Cl/L)**								
Total Organic Halogen	**100**	**97**	**95**	**97**	**95**	**80-120**	2.1	20
Test: TOX on Reagent Water **QC Lot: TOX 115AB** **Concentration Units: (ug Cl/L)**								
Total Organic Halogen	**100**	**110**	**114**	**110**	**114**	**80-120**	3.6	20
Test: TOX on Reagent Water **QC Lot: TOX 116AB** **Concentration Units: (ug Cl/L)**								
Total Organic Halogen	**100**	**106**	**110**	**106**	**110**	**80-120**	3.7	20
Test: TOX on Reagent Water **QC Lot: TOX 117AB** **Concentration Units: (ug Cl/L)**								
Total Organic Halogen	**100**	**90**	**89**	**90**	**89**	**80-120**	1.1	20

LABORATORY CONTROL SAMPLE REPORT

INORGANICS - NON-METALS

Analyte	Concentration Spiking	Concentration Measured LCS1	Concentration Measured LCS2	Accuracy(%) LCS1	Accuracy(%) LCS2	Accuracy(%) Limits	Precision(RPD) LCS	Precision(RPD) Limits
Test: TOX on Reagent Water								
QC Lot: TOX 121AB								
Concentration Units: (ug Cl/L)								
Total Organic Halogen	100	95	98	95	98	80-120	3.1	20

VI. ANALYTICAL METHODOLOGY

Enseco - Rocky Mountain Analytical Laboratory performs analytical services according to methods approved by EPA and other regulatory agencies, whenever possible.

Methods for metals and organic compounds are primarily derived from three sources of EPA methods, 1) the methods promulgated in 40 CFR 136 for priority pollutants, 2) the methods published in SW-846 and 3) methods developed by the EPA-EMSL/LV for Superfund investigations, as well as several documents published by the EPA and Enseco - Rocky Mountain Analytical Laboratory in 1984 and 1985. These methods all use the same generic technology as summarized below:

- Metals: acid digestion followed by analyses by ICP supported by graphite furnace AA
- Volatile Organics: purge and trap GC/MS or purge and trap GC with a selective detector.
- Semivolatile (base/neutral and acid) organics: solvent extraction followed by capillary column GC/MS, and
- Pesticides/Herbicides: solvent extraction, followed by gas chromatography.

Exact method references are given in the following tables.

ANALYTICAL METHODOLOGY - ORGANIC TESTS

Test	Description	Methodology	Reference
VOA	Volatile Organics	Purge & Trap, GC/MS	624(1)/8240(2)
BNA	Semivolatile Organics	Extraction, GC/MS	625(1)/8270(2)
DXN	Dioxin	Extraction, GC/MS	613(1)/8280(2)
601	Halogenated Volatile Organics	Purge & Trap GC/Hall	601(1)/8010(2)
THM	Trihalomethanes	Purge & Trap GC/Hall	601(1)/8010(2)
602	Aromatic Volatile Organics	Purge & Trap GC/PID	602(1)/8020(2)
OCP	Organochlorine Pesticides	Extraction, GC/ECD	608(1)/8080(2)
OPP	Organophosphate Pesticides	Extraction, GC/FPD	614(1)/8140(2)
619	Triazine Pesticides	Extraction, GC/NPD	619(1)
LC CARB	Carbamate and Urea Pesticides	Extraction, HPLC	632(1)
PCB	PCB's	Extraction, GC/ECD	608(1)/8080(2)
HRB	Phenoxyacid Herbicides	Extraction, GC/ECD	615(1)/8150(2)
603	Acrolein & Acrylonitrile	Purge & Trap GC/FID	603(1)/8030(2)
604	Phenols	Extraction, GC/FID	604(1)/8040(2)
605	Benzidines	Extraction, HPLC	605(1)/8050(2)
606	Phthalate Esters	Extraction, GC/FID	606(1)/8060(2)
607	Nitrosamines	Extraction, GC/NPD	607(1)
609	Nitroaromatics & Cyclic Ketones	Extraction, GC/NPD	609(1)/8090(2)
PNA	Polynuclear Aromatic Hydrocarbons	Extraction, HPLC	610(1)/8310(2)
611	Haloethers	Extraction, GC/ECD	611(1)
612	Chlorinated Hydrocarbons	Extraction, GC/ECD	612(1)/8120(2)
GD FID	Hydrocarbon Scan	Extraction, GC/FID	D3328-78(3)
GC BPD	Boiling Point Determination	Extraction, GC/FID	D2887-84(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 2nd Edition, 1984.
(3) "Annual Book of ASTM Standards", Volume 11.01, 1985.
(4) "Annual Book of ASTM Standards", Volume 05.02, 1984.

ANALYTICAL METHODOLOGY - INORGANIC TESTS

Test	Description	Methodology	Reference
ICP	Trace Metals	ICP Emission Spectroscopy	200.7(1)/6010(2)
FSB	Antimony	Furnace Atomic Absorption	204.2(1)/7041(2)
FAS	Arsenic	Furnace Atomic Absorption	206.2(1)/7060(2)
FCD	Cadmium	Furnace Atomic Absorption	213.2(1)/7131(2)
FPB	Lead	Furnace Atomic Absorption	239.2(1)/7421(2)
FSE	Selenium	Furnace Atomic Absorption	270.2(1)/7740(2)
FAG	Silver	Furnace Atomic Absorption	272.2(1)/7761(2)
FTL	Thallium	Furnace Atomic Absorption	279.2(1)/7841(2)
CVHG	Mercury	Cold Vapor Atomic	245.1(1)/7471(2)
CR + 6	Chromium (VI)	Colorimetric	312B(3)
IC CL	Chloride	Ion Chromatography	300.0(1)
BURCL	Chloride	Manual Titrimetric	325.3(1)
METF	Fluoride	Electrode	340.2(1)
IC SO4	Sulfate	IC	300.0(1)
SPESO4	Sulfate	Manual Turbidimetric	375.4(1)
METALK	Alkalinity, Total	Titrimetric	310.1(1)
METACK	Alkalinity, Forms	Titrimetric	403(3)
TECNOXT	Nitrate+Nitrite as N	Cd Reduction Colorimetric	353.2(1)
METPH	pH	Meter	150.1(1)/9045(2)
CELSP	Specific Conductance @ 25°C	Bridge	120.1(1)
BALTDS	Total Dissolved Solids	Gravimetric, 180°C	160.1(1)
BALTSS	Total Suspended Solids	Gravimetric, 105°C	160.2(1)
BALTS	Total Solids	Gravimetric, 105°C	160.3(1)
BALTVS	Total Volatile Solids	Gravimetric, 550°C	160.4(1)
TECO P	Ortho-Phosphate as P	Two Reagent Colorimetric	365.3(1)
TECT P	Total Phosphorus as P	Digestion-Colorimetric	365.3(1)
ICP	Total Phosphorus as P	Digestion-ICP/AES	200.7(1)
ICP	Silica as SiO_2	ICP/AES	200.7(1)
SPESIO2	Silica as SiO_2	Colorimetric	370.1(1)
METBOD	Biochemical Oxygen Demand	Dilution Bottle-D.O. probe	405.1(1)
METCOD	Chemical Oxygen Demand	Micro Colorimetric	410.4(1)
TOCTOC	Total Organic Carbon	UV Oxidation-IR	415.2(1)
METNH3	Ammonia as N	Electrode	350.3(1)
TECNH3	Ammonia as N	Automated Colorimetric	350.1(1)
METTKN	Total Kjeldahl Nitrogen as N	Digestion-Electrode	351.4(1)
TECTKN	Total Kjeldahl Nitrogen as N	Digestion-Colorimetric	351.2(1)
TOXTOX	Total Organic Halogen	Combustion-Titrimetric	9020(2)
TONO1	Total Organic Nitrogen	Calculation (TKN-NH_3)	-
BAL O&G	Oil and Grease	Freon Extraction-Gravimetric	413.1(1)
IR AO&G	Oil and Grease	Freon Extraction-IR	413.2(1)
TECCN F	Cyanide Amendable to Chlorination	Chlorination-Distillation-Colorimetric	335.1(1)
TECCN W	Weak & Dissolved Cyanide	Distillation-Colorimetric	412H(3)
TECCN T	Total Cyanide	Distillation-Colorimetric	335.2(1)/9010(2)
STEPHEN	Phenolics	Distillation-Colorimetric	420.1(1)
COLIF F	Fecal Coliform	Membrane Filter	909C(3)
COLIF T	Total Coliform	Membrane Filter	909A(3)

ANALYTICAL METHODOLOGY - INORGANIC TESTS (CONT.)

Test	Description	Methodology	Reference
IC BR	Bromide	Ion Chromatography	300.0(1)
POTCL2R	Residual Chlorine	Amperometric	330.2(1)
NESCOLR	Color	Pt-Co Colorimetric	110.2(1)
ICPHAR	Hardness as $CaCo_3$	Calculation	200.7(1)/314A(3)
TECNO2	Nitrite as N	Colorimetric	354.1(1)
SPES	Sulfide	Colorimetric	376.2(1)/9030(2)
BURSO3	Sulfite	Titrimetric	377.1(1)
SPEMBAS	MBAS (Surfactants)	Colorimetric	425.1(1)
SPETURB	Turbidity	Turbidimeter	180.1(1)
Gross Alpha		Proportional Counter	703(3)
Gross Beta		Proportional Counter	703(3)
Radium 226		Separation - Counter	705(3)
Radium 228		Separation - Counter	707(3)
Uranium		Fluorimetric	D2907.75(4)

References

(1) Code of Federal Regulations, Chapter 40, Part 136 (40 CFR 136).
(2) SW-846, 2nd Edition, 1984.
(3) "Standard Methods for the Examination of Water and Wastewater", 15th Edition, 1980.
(4) "Annual Book of ASTM Standards", Part 31, Water, 1980.

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