PERMIT APPLICATION FOR A CLASS I NON-HAZARDOUS WASTE INJECTION WELL

Prepared for

THE DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

Prepared by

TERRA
DYNAMICS INC
ENVIRONMENTAL SERVICES

AUSTIN, TEXAS

Project No. 99-177
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Permit Application Form

STATE OF ARKANSAS
DEPARTMENT OF ENVIROMENTAL QUALITY
8001 National Drive
Little Rock, Arkansas 72209
Telephone (501) 562-7444

UNDERGROUND INJECTION CONTROL PERMIT APPLICATION

SIC No. 2819, 2829, 2879 CSN No.__________
(office use only)

I. Name, address and telephone number of parent organization requesting permit:

Name: The Dow Chemical Company

Address: P.O. Box 150, Bldg. 3502-E City: Plaquemine

State: Louisiana Zip: 70765-0150 Telephone: (225) 353-1630

2. Name, address and telephone number of facility to be permitted if different from above:

The Dow Chemical Company c/o Albemarle Corporation

Hwy 371 South

Magnolia, AR 71753 (879)235-6000

3. Name, address and telephone number of person to be contacted:

Name: Mr. Ivy B. Dupree

Address: P. O. Box 150, Bldg. 3502-E City: Plaquemine

State: Louisiana Zip: 70765 Telephone: (225) 353-1630

4. Name, address and telephone number of consulting engineering firm:

Name: Terra Dynamics Inc.

Address: 4900 Spicewood Springs Road City: Austin

State: Texas Zip: 78759 Telephone: (512) 795-8183

5. Location of facility: Section 18 Township 17 South

Range 21 West County Columbia

Latitude And Longitude (nearest 1/10 second): Lat. 33° 15' 46"N

Long. 93° 19' 53"W

Nearest Town: Magnolia, AR

Give a verbal description of the plant or disposal site with respect to known or easily identifiable landmarks.

The West Plant is located approximately four miles west of the Magnolia, Arkansas city limits on State Highway 371, approximately one mile west of the intersection with County Road 344

6. Type of permit for which application is submitted: Check correct blanks.

✓ New Permit — ______ Modification of permit/facility

______ New Facility — ✓ Existing facility

______ Change in location — ______ Change in ownership

______ Current permits no(s):

7. Type of establishment, operation or process from which wastewater(s) will emanate. For example: sulphuric acid plant, bromine extraction plant, petro-chemical plant, etc.)

Groundwater Recovery System, Bromine Extraction Facility Process Wastewater

8. What estimated date will waste disposal operations begin; or if operations have begun, what date did waste disposal operations begin at the site described by this application? If facilities are to be completed in stages, include schedule of dates of each increment.

Upon issuance of the permit, it is anticipated that initiation of an injection program of wastewater in the proposed DWD No. 1 well will begin as soon as possible after completion of the well

9. Status of Activity:
   (a) Current method of waste disposal: Currently, the waste stream is pumped from holding tanks, through a steam stripper with organic waste material collected and shipped for disposal. The stripped waste stream is routed to the plant's tail brine disposal system. This system is permitted under State Water Permit No. 690-WR-2.

   (b) Treatability Studies: Various disposal techniques for the waste stream have been investigated, such as incineration, biological, physical and chemical treatment; however, with each of the alternate disposal methods the process is not economically feasible and increases health and safety hazards by concentrating the contaminants for shipping and disposal.

10. Proposed Injection Program: Well # DWD-1

(a) Depth of Well: ± 4,600 feet BGL

(b) Geologic Name of Injection Interval(s)	Perforated Interval(s)
Tokio Formation	2,915 ft – 3,100 ft BGL
James Formation	4,365 ft – 4,475 ft BGL

(c) Type of waste:

Identity/Source of Individual Waste streams:	See Section 6.0 – Wastes and Waste Management
Waste Volume:	100 gpm max. per interval; equivalent to 4,464,000 gal/mon per interval
EP Toxicity:	NA
Corrosivity pH:	3.0 – 12.0
Ignitability Flash Point Temperature:	NA
Reactivity:	NA
Wastestream Specific Gravity:	1.05 Max.
Wastestream Compressibility:	3 x 10^{-6}/psi
Wastestream Viscosity:	1.0 cp
Combined Injection Stream: (if applicable)	NA

(f) Construction Specifications:

	Type	Setting Depth or Spacing	Size or Volume	Grade	Weight (lb/ft)
Surface Casing	Carbon steel; 8rd ST&C	1400 ft	11 ¾”	K-55	47
Long String Casing	Mixed string of carbon steel & corrosion-resistant alloy (CRA); 8rd LT&C	4600 ft	7 5/8”	N-80 (or equivalent)	26.4
Tubing	Fiberglass	2900 ft – Tokio 4300 ft –James	3 ½”	2,000 psi	
Tubing Packer	Carbon Steel w/CRA surfaces; GPS Model “12”	2900 ft – Tokio 4300 ft –James	3 ½” x 7 5/8”	NA	NA
Cement	Surface – Class “H” Longstring – Epseal Class “H”	0’ – 1400’ 2700’ – 4600’ 0’ – 2700’	120% of calculated annular volume	H Epseal H	13.1, 15.6 13.1, 15.6
Scratchers/Centralizers	12 Centralizers (Surface) 36 Centralizers (Longstring)	- -	- -	- -	- -
Annular Space Monitoring Instrumentation	2-pen Foxboro Model NR 0-1500 psi	-	-	-	-
Injection Pressure Monitoring Instrumentation	2-pen Foxboro Model NR 0-1500 psi	-	-	-	-
Flow Monitoring Instrumentation	Foxboro Model 40 0-15,000 bbl/day	-	-	-	-

(e) Operational Requirements:

Max. Rate of Injection	Max. Volume of Injection	Max. Surface Inj. Pressure	Annular Fluid	Min. Annulus Pressure
100 gpm (Tokio)	4,464,000 gal/mo.	825 psig.	Inhibited Water	100 psig
100 gpm (James)	4,464,000 gal/mo.	1400 psig.	Inhibited Water	100 psig

(f) Plugging and Abandonment: Financial Assurance

Type Corporate Financial Test (40 CFR264.143 (F) Amount $ 92,000

(g) For existing wells provide the following information:

	Logs Run	Date Run
Resistivity Log	NA	NA
Spontaneous Potential	NA	NA
Caliper Log	NA	NA
Cement Bond Log	NA	NA
Variable Density Log	NA	NA
Temperature/Noise Log	NA	NA
Gamma Ray Log	NA	NA
Radioactive Tracer Survey	NA	NA

11. Please provide a map of scale 1" = 0.125 mile depicting:

(a) The approximate boundaries of the tract of land on which the waste disposal activity is or will be conducted. See Figure II-1

(b) The location of the disposal well and plant water supply wells as related to plant boundaries and adjacent survey lines. See Figure III-2

(c) The general character of the areas adjacent to the place or places of disposal such as residential, commercial, recreational, agricultural, undeveloped, etc. The areas adjacent to the proposed disposal well and Albemarle facility are undeveloped and utilized for tree farming. The proposed disposal well will be located on 7.081 acres of property owned by DOW, located in the southwestern portion of Albemarle's West Plant Site.

(d) The boundaries and ownerships of tracts of land adjacent to the plant boundaries. Include, with a map a list containing the names and mailing addresses of the owners of the tracts of land adjacent to the plant boundaries keyed to the map. See Figure II-1 and Table II-1

12. Identify and provide a complete mailing address for all mineral owners that may be affected by the migration of injected waste over the life of the well. If the name(s) submitted represent less than 100% mineral ownership, specify the total percentage owned by all persons identified. See Table II-1

13. The names and mailing addresses of persons identified as affected persons, Item 11(d) and 12 above, were obtained from: The Land Department of Albemarle Corporation
(Source: City, County, School or Water District Records or Abstract Co.)

14. Will operation of the facility result in any of the following type(s) of discharge(s)? Check correct blank(s).

(a) Atmospheric emissions for which a permit has not already been issued:

_____ yes ✓ no

If yes, briefly describe type and source

(b) Solid Waste for which a permit has not already been issued:

✓ yes _____ no

If yes, briefly describe type and source Filter Material

15. If waste is to be treated, briefly describe process: The proposed surface treatment system will consist of a filter system consisting of replacement cartridges, steam stripping or carbon absorbent beds as a portion of the treatment process, and pH control equipment with the necessary tankage.

16. Estimated costs:

    Water pollution control equipment: $ 200,000

    Total cost of facilities: $800,000

17. List and index all attachments to this application below: see Technical Report Table of Contents

18. Submit with application:

    (a) Technical Report (See attached instructions) Technical Report attached

    (b) A copy of the financial assurance mechanism (performance bond) demonstrating that resources necessary to close, plug, and abandon the well are available. See Appendix A

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Ivy B. Dupree
Printed name of person signing
(Must be the owner/operator or person authorized by the applicant)

Regulatory Issues Supervisory Specialist
Title

August 7, 2000
Date Signed

Signature of Applicant

I. INTRODUCTION

The Dow Chemical Company (DOW) owns 7.08 acres of property contiguous to its former bromine production facility, located four miles west of Magnolia, Arkansas. That facility is currently owned and operated by Albemarle Corporation. A groundwater recovery operation is currently underway on the DOW and adjacent Albemarle properties, √ with the treated groundwater being disposed of into the Albemarle facility's tail brine disposal system. This Class I non-hazardous injection well permit application is being submitted to allow DOW to construct and operate a Class I injection well to dispose of the treated groundwater from their and Albemarle's on-site groundwater recovery operation, and to accelerate the remediation efforts.

DOW is requesting authorization for construction and operation of the Class I well under Arkansas Department of Environmental Quality (ADEQ) Underground Injection Control (UIC) regulations. DOW is initially permitting this well as a non-hazardous Class I injection well, so that permit approval and well construction can be expedited. DOW will operate this well as a non-hazardous injection well, injecting groundwater treated to below hazardous levels and non-hazardous process wastewater from the adjacent Albemarle bromine production facility, until such time as a federal No-Migration Petition Application is submitted and approved by the USEPA. At that time, DOW intends to request an amendment to the UIC well permit to allow injection of hazardous wastewater (groundwater unstripped of organic constituents). Until approved, DOW will continue to strip its recovered groundwater of hazardous constituents to below hazardous levels prior to injection.

The chemical constituents within the waste stream that Dow will inject that could make the injectate a hazardous waste stream include ethylene dichloride (EDC), ethylene dibromide (EDB), and dibromochloropropane (DBCP) (see Appendix I of the permit application document for concentrations in the Dow L5 stripper effluent and Albermarle waste streams). The concentrations of these constituents that could make the waste streams hazardous are defined in 40 CFR 261.24 (Toxicity Characteristic) for EDC, and 268.40 (Applicability of Treatment Standards) for EDB and DBCP. For EDC (ethylene dichloride--D028), the regulatory level is ~~0.5~~ 0.21 mg/l, for EDB (ethylene dibromide—U067), the wastewater treatment standard is 0.028 mg/l, and for DBCP (dibromochloropropane—U066), the wastewater treatment standard is 0.11 mg/l. Since neither the Dow or Albemarle waste streams contain these constituents at above these hazardous concentrations (or even above detection levels), the proposed injectate is considered to be non-hazardous.

This technical report is submitted in support of the permit application (attached) for a non-hazardous Class I waste disposal well to be located on the DOW property. The report follows the procedures and guidelines established under the ADEQ UIC Division, and contains the required supporting administrative, geological and engineering data. This technical report also addresses the notices of deficiencies from the ADEQ for the original draft permit application for this well (Walk Haydel, November 1999).

II. GENERAL ADMINISTRATIVE INFORMATION

The Dow Chemical Company (DOW) West Plant facility previously manufactured organic and inorganic chemicals using bromine extracted from Smackover Formation brines. Albemarle currently owns this plant and utilizes numerous Class V injection wells for tail brine disposal into Upper Jurassic Smackover limestones. DOW intends to use the proposed Class I injection well to dispose of recovered groundwater from their acreage and surrounding areas on the Albemarle facility. In addition, the well will be permitted to inject non-hazardous process wastewaters from the Albemarle bromine extraction facility. The proposed injection intervals for the new well are the upper Cretaceous James Lime and Tokio Sand Formations. The proposed injection rate into each interval is 100 gpm.

II.A. Location of Facility

The West Plant site is located approximately four miles west of Magnolia, Arkansas in Columbia County, within Section 18, T-17-S, R-21-W. DOW owns the property on which the primary groundwater recovery operation and the proposed injection well are located. A United States Geological Survey (USGS) topographic map (1:24,000) showing the location of the DOW property, Albemarle West Plant property, and proposed injection well is included as Figure III-2. Depicted on this map are the locations of all water wells on or adjacent to the DOW property. Also shown are the name and location of all surface bodies of water, springs, mines, quarries, and other pertinent surface features, including residences and roads within the ½-mile area of review. The USGS 7.5-minute quadrangle map used to construct this map is the Waldo Quadrangle.

The geographical coordinates of the proposed disposal well is:

North Latitude: 33° 15' 46"
West Longitude: 93° 19' 53"

II.B. Legal Description of Facility

A map denoting the location of the proposed Class I injection well and DOW property referred to in this permit application is included as Fig II-1. The proposed well will be located approximately 1,900 feet from the west line and 1,900 feet from the north line of Section 18, T-17-S, R-21-W, Columbia County, Arkansas. The well site is located on seven acres of property owned by DOW, just to the west of the Albemarle West Plant and within the Albemarle property boundaries (see Figure II-1). DOW owns the surface and mineral rights to the well site and property.

II.C. Adjacent Land and Affected Mineral Owners

DOW has gathered a list of the surface owners for the properties immediately adjacent to the DOW and surrounding Albemarle properties, obtained from the Land Department of Albemarle Corporation. The locations of these properties are shown on Figure II-1. The adjacent surface and affected mineral owner tabulations are included as Table II-1. The ownership information was extracted from the 1999 Walk Haydel draft permit application and technical report.

II.D. Financial Assurance

Evidence showing that DOW has sufficient financial resources to operate the well in a safe manner in compliance with the permit and applicable regulations and to close, plug, and abandon the well is included as Appendix A.

II.E. Justification for Subsurface Disposal

This application is being submitted for a UIC Permit for a Class I injection well at the DOW West Plant property. This application addresses the latest changes in the rules and regulations governing injection well applications, and provides additional information concerning the status of the wastestreams to be injected.

Subsurface disposal of hazardous and non-hazardous wastewater is a proven safe and effective disposal method in South Arkansas. Currently, in Columbia and Union counties, numerous Class I disposal wells are in service for the disposal of waste streams very similar to the waste stream proposed in this application. The current treatment and disposal of the West Plant groundwater consists of removing organic compounds by steam stripping and incinerating the organics offsite. The non-hazardous effluent from the steam-stripping unit is disposed in Albemarle's Class V Tail Brine Reinjection Wells. These wells are reinjecting tail brine into the Smackover Formation.

Selection of the proper disposal method for contaminated groundwater at the West Plant must consider the following issues:

1. **Safety** - The proper disposal method must minimize or eliminate the potential for exposure of workers, the public and the surrounding environment to contaminants found in the groundwater. This can best be accomplished by minimizing the concentration of contaminants in the waste stream and reducing the amount of handling of contaminants by workers in the treatment and disposal process.

2. **Effectiveness** - The proper disposal method must be reliable and as simple as possible to operate and maintain. There should be a minimum number of process steps between groundwater recovery and final disposal of the contaminants. The capacity of the disposal method should be large enough to expedite the removal of contaminants. The final disposal of the contaminants must be safe and permanent.

3. **Cost** – Cost is not a primary deciding factor in the selection of the proper disposal method. However, if the cheaper of two or more equally safe and effective disposal methods can be implemented, the overall effectiveness of the system will be inherently augmented.

The following treatment and disposal methods have been considered for groundwater at the West Plant:

1. **<u>Incineration</u>** – Currently, organic contaminants are steam stripped from the groundwater, transferred to portable tanks, and transported to a permitted incinerator at DOW's Freeport, Texas facility. The organic waste stream is removed from the portable tanks and incinerated at the Texas site.

   This disposal method has been operated without incident for many years, however it poses several potential safety hazards. The current method collects contaminated groundwater averaging 10 to 100 parts per million (ppm) of the major constituents of concern (EDB, DBCP, EDC, BCE) and concentrates the organic compounds into a pure-phase (100% organics). This pure-phase of contaminants (approximately 4,000 pounds per year) must be managed by workers during the transferring and transporting from the steam-stripping unit in Magnolia, Arkansas to the incinerator in Freeport, Texas. The contaminants are less of a safety hazard diluted in the groundwater prior to concentration by steam stripping.

Steam-stripping and incinerating the contaminants requires intense operation and maintenance by workers in Magnolia and Freeport. Compared to other alternative methods disposal, this is the most complicated and requires the largest amount of equipment. Several tanks, pumps, pipelines, valves, utilities, heat exchangers and pressure vessels are necessary to implement incineration of the organics contaminants. In addition, this method also requires the most number of workers to execute, including operation and maintenance personnel in Magnolia and Freeport, and contract transportation personnel. Overall, this is the most complicated and labor-intensive disposal method available for managing the groundwater problem at the West Plant.

The current groundwater treatment and disposal system at the West Plant has a flow rate of up to 50 gallons per minute (gpm). The steam-stripping unit has been upgraded to handle the increased flow of groundwater generated from the addition of three additional interceptor trenches now in operation. This will expedite remediation efforts and enhance measures to contain and control contaminent migration.

Subsurface injection is a part of the treatment and disposal method being conducted at the West Plant. Removal of the organic compounds from the groundwater leaves effluent water with a high concentration of inorganic salts (12,500 ppm of total dissolved solids). The high concentration of salts is due to brine pond leaks that occurred in the late 1960's and early 1970's. Currently, the appropriate disposal alternative for this waste stream is deep well injection. Mechanical means to remove the salts from the stripper discharge, such as membrane separation are complicated and expensive to operate. These methods concentrate the salts in a smaller wastewater stream that eventually must also be deep well injected.

2. **Biological Treatment** - Biological treatment of the West Plant groundwater will not remove the necessary amount of halogenated contaminants to allow discharge of the treated water to "waters of the state". Reaction from inorganic salts will interfere with the effectiveness of biological treatment and remain unaffected by this treatment method. Thus, the treated groundwater would still have to be deep well injected due to the salt content. In addition, to remove the necessary amount of organic contaminants, an extensive aboveground biological treatment system will have to be constructed with an excessive amount of retention-time on the wastewater stream.

In situ biological treatment will be investigated as a secondary treatment method that may expedite remediation at the West Plant. This may be effective in the vadose zone and areas where the groundwater has not been impacted by brine.

3. **<u>Physical and Chemical Treatment</u>** – Air stripping and activated carbon treatment will separate the organic contaminants from the groundwater but will concentrate the waste stream and produce salty wastewater that will have to be deep well injected. Carbon treatment of the West Plant groundwater was tried in the early 1980's. Inorganic salts and iron in the groundwater caused problems with plugging in the carbon beds. This method was not as effective as steam stripping in removing heavy halogenated compounds.

   Air stripping and carbon treatment presents the same problems as the incineration disposal method. The organic contaminants will be concentrated in the carbon, which will have to be regenerated or incinerated. This method will present safety problems and will not be effective in meeting the long-term remediation goals for the site.

4. **<u>Subsurface Injection</u>** – At this time, several industrial facilities are injecting hazardous and non-hazardous wastewater into the saline filled Tokio and James Limestone Formations in Columbia and Union counties. Rock formations suitable for wastewater injection contain over 10,000 ppm of total dissolved solids and have impermeable rock formations above and below that form a natural containment barrier. The primary criteria associated with subsurface injection is the presence of a geologically homogenous and permeable formation that is confined by impermeable formations that minimizes the risk of leaking wastewater into Underground Sources of Drinking Water (USDW). The Tokio and James Limestone Formations are very permeable and separated from upper freshwater aquifers and lower brine and petroleum producing zones by impermeable formations of shale, marl, limestone and evaporites.

   All of the alternative treatment and disposal methods yield two separate waste streams. One of the waste streams is a pure-phase of highly concentrated organic contaminants that presents potential safety hazards. Once a No-Migration Petition demonstration is approved and a permit amendment issued, Dow intends to inject these organic contaminants and remove this potential safety hazard. The remaining waste stream contains high concentrations of inorganic salts and requires subsurface injection for disposal. Subsurface injection does not produce any contaminated vent gases and a very small amount of solid waste in the form of spent filters. Subsurface injection is the least complicated disposal method and requires much less labor to operate and maintain. These factors make subsurface injection the safest and most effective treatment and disposal method for the West Plant groundwater. The subsurface injection system being proposed will have the capacity to inject at least twice the amount of contaminated groundwater than the current system. In addition, the estimated annual operation and maintenance cost for subsurface injection is substantially less than other alternative methods.

Subsurface injection in Arkansas has been demonstrated to be highly effective and environmentally sound. Freshwater aquifers that serve as USDW can be protected from environmental risk by proper design, construction, operation and monitoring of the injection well. Subsurface injection eliminates the inherent risk associated with land application and surface discharge of waste streams. Issues of safety, effectiveness and cost being considered for the treatment and disposal of the West Plant groundwater are best achieved by subsurface injection.

III. AREA OF REVIEW

III.A. Area of Review Maps

A base map showing the location, name, number, and depth of all the non-freshwater artificial penetrations (oil & gas wells, exploratory tests, brine supply wells, disposal wells, etc.) within the 0.5-mile radius Area of Review (AOR) surrounding the proposed well is included as Figure III-1. There are a total of three (3) non-freshwater artificial penetration locations identified on Figure III-1 within the DOW 0.5-mile radius AOR for the proposed well. Information regarding depths, completion, well names, and well numbers are keyed from the map in Figure III-1 to Table III-1, which is a tabulation of data on all penetrations within the proposed well 0.5-mile radius AORs. Available well records are included in Appendix B (the best available originals from the Arkansas Oil & Gas Commission were copied).

A total of six freshwater artificial penetrations have been identified within the property boundary or property adjacent to DOW. Information pertinent to these wells is presented on Table III-2. For water well information within the search area (within the property boundary or adjacent property boundaries), data was gathered from the Albemarle Land Department. Freshwater artificial penetrations are plotted on Figure III-2. Available records are also included in Appendix B.

III.B Non-Freshwater Artificial Penetrations

In accordance with the Arkansas Underground Injection Control Code and 40 CFR 146.14(a)(2) and (3), a search of the artificial penetrations within the DOW AOR was conducted by TDI in March 2000 to supplement records submitted with the draft injection well permit application (Walk Haydel, 1999). The following sections describe the protocol used to conduct the artificial penetrations identification, location, and plugging adequacy review for the DOW AOR.

6

Protocol for Non-Freshwater Artificial Penetration Identification and Location

The records researcher utilizes both public and private sources of data to identify artificial penetrations.

Arkansas Oil and Gas Commission

The Arkansas Oil and Gas Commission (AOGC) is the primary agency in which files are researched for oil and gas well records. The AOGC was established in 1939 to provide a State regulatory agency for the oil and gas industry. This agency was originally called the Arkansas Railroad Commission. Preceding the AOGC, several other agencies existed for securing well location and completion records, and some of these early records are included in current AOGC files. As the AOGC records for the non-freshwater artificial penetrations within the DOW AOR were sufficiently complete and informative, it was unnecessary in most cases to go beyond the following AOGC research protocol for well records and information.

Before the retrieval process can begin, it is necessary to know the operator, lease name, and county in which the well is found. The preceding information was available from the previous AOR search maps for the proposed well. Well records in the AOGC office were searched to verify locations and information on all non-freshwater penetrations within the AOR. The following Commission files were reviewed to determine well information.

Field Files: This is a series of files for each well in a field, arranged alphabetically by operator, by lease name, and by well number. Many loose forms and letters regarding a well are placed in the file folder.

Wildcat Files: This is a series of files for wells classified as wildcats; that is, wells not located in a field. These folders are arranged alphabetically by county, by township and range number, by operator alphabetically, and by well name alphabetically.

Class V Wells: This is a file of the approved Class V injection wells, a folder for each well.

Salt Water Disposal Files: This is a series of files for each approved salt water injection system. These files are arranged alphabetically by field, operator, and well system name.

Old Wells File: A file is kept at the front of some field files to collect any papers on old wells for which there is no other record. Most of these papers are plugging reports filed when old wells were plugged and abandoned.

Ledger Book: A record of some driller's logs from the 1921-1922 era were reviewed in the Commission files. Many locations were vague and the information was limited to the initial driller's log sheets.

Protocol for Determining Non-Freshwater Artificial Penetration Status

Records for artificial penetrations identified within the AOR were retrieved and reviewed to determine the actual location and status of each well, i.e., operating or plugged. In Arkansas, these wells are required by the Oil and Gas Commission and/or the Arkansas Department of Environmental Quality to have surface casings set below the base of fresh water and cemented to the ground surface. Surface casing provides a primary means of protecting ground waters penetrated by a wellbore. Wells that penetrated the injection zone were further reviewed. Casing and cementing data of the operating wells were reviewed to determine if sufficient cement is in place to adequately prevent upward migration of fluids. Plugged wells were reviewed to determine the adequacy of plugging.

Condition of Wells Which Penetrate the Injection Zone

From the above described review, there are a total of three (3) non-freshwater artificial penetration locations which are in the DOW 0.5-mile radius AOR for the proposed well (see Figure III-1). Of these wells, one (Map ID No. 4) does not have any complete plugging records, although it penetrated to the Tokio injection interval. The other two

(Map ID Nos. 1 and 3) penetrated through the James injection interval, and are completed into the Smackover Formation as either an operating Class V saltwater brine disposal well (Map ID No. 1) or brine supply well (Map ID No. 3).

The plugged well (Map ID No. 4), which is subject to the plugging protocol review, is considered to be adequately plugged in a manner to prevent the upward migration of fluids, and would not be affected by pressure increases in the injection zone reservoir due to injection operations at the DOW facility. This well is outside of the Tokio and James cones of endangerment, but within the 0.5-mile radius AOR, and has sufficient density fluid (brine with a specific gravity equal to 1.10, as per ADEQ guidelines) in the borehole to prevent upward fluid movement.

The two operating wells (Map ID Nos. 1 and 3), which are subject to review, are considered to be properly and/or adequately completed in a manner to prevent the upward migration of fluids from the DOW injection intervals, and would not be affected by pressure increases in the injection zone reservoirs due to injection operations at the DOW facility. The operating wells within the 0.5-mile radius AOR have sufficient cemented casing in place across and above the DOW injection zone to adequately prevent upward migration of fluids. Map ID No. 1 has longstring casing cemented from the Smackover Formation at 8,500 feet to surface using 3,117 cubic feet of cement. Map ID No. 3 has intermediate casing cemented from 4,534 feet to surface using 1674 cubic feet of cement. In both cases, by using 3.193 linear feet/cubic feet of cement in a 12 ¼-inch X 9 5/8-inch borehole to casing annulus (Halliburton Cementing Tables, 1981), one calculates a cement column height to surface. These cement sheaths extend upward to completely cover the DOW injection intervals from 2,915 to 4,475 feet BGL, and thus adequately prevent these wells' annuluses from allowing flow of fluid vertically due to pressure effects from the DOW injection intervals.

III.C. Tabulation and Records of Non-Freshwater Artificial Penetrations

A tabulation of data for all three non-freshwater artificial penetrations within the AOR is included on Table III-1. The data provided for the artificial penetrations includes operator or owner, approximate distance from the proposed injection well, well number, date drilled, depth, current status, and information regarding casing size, setting depth, and surface and long string casing cement records. The Map ID Nos. depicted on Table III-1 are keyed to Figure III-1. All available records for these wells are presented in Appendix B.

III.D. Schematics of Non-Freshwater Artificial Penetrations

There are no inadequately plugged non-freshwater artificial penetrations within the proposed well's cones of endangerment in the Tokio or James Formations (proposed injection intervals) as determined from Section V.A.7. While no well schematics are required for submittal with this report, all available well schematics for wells within the 0.5-mile radius AOR are presented with the corresponding records in Appendix B. All of the wells subject to evaluation meet the non-endangerment standards through sufficient casing, cement, or brine plugs.

III.E. Improperly Constructed or Abandoned Wells

Based on a review of available completion and/or plugging records, all wells within the 0.5-mile radius AOR that penetrated the DOW injection intervals are adequately constructed, plugged and/or abandoned so as to prevent the movement of fluids into or between USDWs which could be caused by pressure increases in the injection intervals due to DOW injection well operations.

III.F. Corrective Action Plan

No corrective action plan is warranted for any of the artificial penetrations identified in the AOR. Each of the subject artificial penetrations is adequately constructed, plugged and/or abandoned so as to prevent the movement of fluids into or between USDWs which could be caused by the modeled pressure increases in the injection intervals due to DOW injection well operations.

IV. GEOLOGY AND HYDROGEOLOGY

The following sections present a summary of the regional and local stratigraphic and structural geology, lithology, hydrostratigraphy, and hydrogeology within the Dow Chemical Company (DOW) geologic study area. The DOW injection well site is located in the southwestern portion of Albemarle Corporation's West Plant. Information obtained from the data, interpretations, and conclusions of the artificial penetrations review (AOR) study, and from publications of the Arkansas Geological Commission and U.S. Geological Survey, was used for the evaluation of the geologic conditions at and surrounding the DOW facility.

IV.A Regional Geology

The DOW regional geologic study area covers portions of Union and Columbia Counties, which are situated in southern Arkansas, and Claiborne and Union Parishes situated in northern Louisiana. The regional study area is circular with an approximate radius of 20 miles (Figure IV-1). The center of the study area (the Albemarle West Plant facility) is approximately four miles west of Magnolia, Arkansas.

The West Plant facility is located within the Gulf Coastal Plain in the geologic region known as the Mississippi Embayment. Sediments ranging in age from Triassic to Quaternary have been deposited with a maximum thickness of about 18,000 feet within this basinal area. Figure IV-2 is a stratigraphic column showing the formations represented in Southern Arkansas and Figure IV-3 shows the major structural features of the region.

The Ouachita peneplain, eroded across the folded rocks of the Ouachita geosyncline, was slowly tilted southward during Middle Mesozoic time and submerged beneath the waters of the ancestral Gulf of Mexico. The rate of sedimentation approached the rate of subsidence in the Gulf, which resulted in the deposition of 13,000 feet of sediments by the end of Lower Cretaceous time. Sea level fluctuated as a result of upward movement along the site of the Ouachita Mountains accompanied by downward movement of areas to the south.

Until Upper Cretaceous time, marine transgressions were generally limited on the north by a landmass in the region of the present Ouachita Mountains (Figure IV-3). It was during this time that the James Limestone member of the Glen Rose Formation was deposited. The James Lime is proposed as the primary injection interval for the DOW injection well.

The pre-Upper Cretaceous regional uplift caused a pronounced southwestward tilting of the strata in southern Arkansas, and associated faulting developed along an east-west zone that was an extension of the Mexia-Talco Fault Zone of Texas. Lower Cretaceous and older rocks were displaced as much as 400 feet to 1,200 feet before Upper Cretaceous time as a consequence of faulting. Differential warping of the basement floor produced local salt domes and other anticlinal uplifts. At the end of the Lower Cretaceous, southern Arkansas, northern Louisiana, and portions of Mississippi and Texas were exposed and eroded before being covered by an early Upper Cretaceous sea. Figures IV-4 and IV-5 are generalized structural cross-sections through southern Arkansas that show the structural configuration of the Lower Cretaceous and overlying Upper Cretaceous units. Figures IV-6 and IV-7 are generalized structural cross-sections through Columbia County that show the structural configuration of the Upper Cretaceous units.

Subsidence and sedimentation resumed as the Upper Cretaceous sea oscillated across southern Arkansas. Clastic sediments were supplied to southern Arkansas by a region located to the north. A 700-foot thick sequence of upper-shelf and fluvio-deltaic sands and clays was deposited in the study area at this time. This sequence of alternating sandstones and shales includes the proposed Tokio injection interval for the DOW well. Figure IV-8 shows the regional structure on top of the Upper Cretaceous Tokio Formation, which occurs approximately 700 feet beneath the top of the DOW injection zone. The Tokio is encountered at a structural elevation of about –2,620 feet subsea or 2,915 feet below ground level at the DOW site. No faulting or other unusual structural deformation is evident from the regional mapping.

The Upper Cretaceous Gulf continued to subside, but the sedimentation rate decreased, resulting in the deposition of approximately 500 feet of deep-water chalks and marls including the Saratoga Chalk, chosen as the top of the DOW injection zone due to its readily identifiable and regionally correlatible log signature. Note: regulatory terminology defines the injection zone as containing both an injection interval (James and Tokio) and an overlying containment interval. The subsidence rate decreased and the Nacatoch Formation was deposited as a series of coastal barrier sand bars. The Nacatoch coastline trended east-west across southern Arkansas, and curved toward the southeast across Union County. The transgression continued through the Upper Cretaceous and into the Paleocene with the deposition of about 800 feet of marine shale on top of the Nacatoch Formation. This thick stratigraphic sequence forms the confining zone and a buffer aquitard that act as a hydraulic barrier between the injection zone and the shallowest fresh-water aquifers.

The remainder of the Paleocene and the Eocene were characterized by a dramatic lowering of sea level that is reflected in the deposition of alternating sequences of thin lignitic sands and shales. A major episode of uplift and/or subsidence in the Eocene is marked by the rapid deposition of the massive fluvio-deltaic sands and interbedded shales of the Claiborne Group (Figure IV-2). These Eocene sands are the fresh-water aquifers in the DOW study area and in much of the Gulf Coastal Plain province of Arkansas. The proposed DOW Injection Well (DWD-1) is located on the gentle slope of the Eocene strata that dip southeastward. Northwest of Columbia County, the formations that appear at the surface are progressively older, further evidence that the strata dip to the southeast.

IV.A.1 Regional Stratigraphy

The subsurface geology of the Triassic to Tertiary units has been evaluated by oil exploration wells since the 1920's. These units have been described comprehensively in the technical literature by examination of cores, sample cuttings, and log data. The description of regional stratigraphy that follows is derived from the technical literature. The stratigraphic section is described from oldest to youngest (deep to shallow, Figure IV-2).

Triassic

The Triassic within the regional study area is represented by the Eagle Mills Formation, which overlies the Paleozoic basement and underlies the Smackover Limestone. The thickness of this unit ranges from 1,000 to 1,200 feet within southern Arkansas (Imlay, 1940). The Eagle Mills consists primarily of salt with some red shale, anhydrite, and a basal conglomerate.

Upper Jurassic

The Upper Jurassic is represented by the Smackover Limestone, the Buckner Formation, and the Cotton Valley Group. The Smackover Limestone overlies the Eagle Mills Formation. The formation may be subdivided into two laterally continuous units: an upper oolite and a lower limestone. The upper 20 to 340 feet is an oolitic, porous to dense limestone that contains some dolomite. The upper unit is approximately 135 feet thick at the West Plant site. The lower unit of the Smackover consists of 300 to 400 feet of predominantly dense limestone, with some shale interbeds in the basal portion.

The Smackover Formation has been exploited for oil, gas, and bromide-rich brine in southern Arkansas. All water in the Jurassic units is highly saline, with dissolved-solids concentrations ranging from 250,000 to 350,000 mg/l (Petersen et al., 1985).

The Buckner Formation overlies the Smackover Limestone, and consists of massive anhydrite beds; red, green, and brown shale; and red sandstone. Within Columbia County the Buckner ranges in thickness from 100 to 260 feet (Golden Environmental Services, 1993).

The Cotton Valley Group unconformably overlies the Buckner Formation and consists of red and gray shales interbedded with sandstone and limestone. Locally, this group may contain lignite and a basal conglomerate. The thickness of this unit ranges from 1,500 to greater than 2,500 feet within Columbia County (Golden Environmental Services, 1993).

Lower Cretaceous

The Lower Cretaceous consists of the Hosston Formation and the Glen Rose Formation. The Hosston Formation unconformably overlies the Cotton Valley Group. This formation consists of interbedded red and gray shales and sandstones with limestone and dolomite streaks, similar to those of the underlying Cotton Valley Group. Shale predominates in the upper half of this formation, while sands are more abundant near the base. Locally, the basal member of the Hosston Formation is a conglomerate. Within Columbia County, the thickness of the unit ranges from 900 to 1,900 feet (Golden Environmental Services, 1993).

The Glen Rose Formation Equivalents (Figures IV-4 and IV-5) overlie the Hosston Formation and are sub-divided into the Mooringsport Formation, the Ferry Lake Anhydrite, and the Rodessa (including the James Limestone), Pine Island, and Sligo Formations in southern Arkansas (Figures IV-6 and IV-7). The Rodessa, Pine Island, and Sligo Formations are composed of oolitic, dense to porous limestones; red, gray, black, and brown shales; and some sandstone. The James Limestone Member of the Rodessa Formation is proposed as the primary injection interval. Porous sandy units of the James Limestone are 35 to 50 feet thick in the vicinity of the West Plant. The overlying Ferry Lake Anhydrite consists of massive and thin-bedded anhydrite, shale, and limestone. The Mooringsport Formation consists of shaly and sandy limestone, shale, and thin-bedded sandstone and red shales. In Columbia County, the gross thickness of the Glen Rose Formation Equivalents ranges from about 1,500 feet to 2,000 feet.

Upper Cretaceous

Upper Cretaceous Formations within the regional study area include the Eagleford Shale and Tuscaloosa Formation; the Tokio, Brownstown Marl, and Ozan Formations; the Annona Chalk, Marlbrook Marl, and Saratoga Chalk; the Nacatoch Formation; and the Arkadelphia Marl. The Tuscaloosa Formation of the Eagleford-Woodbine Group unconformably overlies the Glen Rose Formation and underlies the Eagleford Shale. The Tuscaloosa consists of red and brown tuffaceous sandstone and shale, while the Eagleford is gray to black marine shale. The thickness of the two units ranges up to 300 feet within Columbia County (Golden Environmental Services, 1993).

The Tokio Formation unconformably overlies the Eagleford Shale. It consists of an upper unit of sands, shales, and siltstones, and a lower unit of mainly sand. Brown siltstones, gray lignitic, bentonitic, and slightly calcareous shales, and a little sand are found in the upper unit. Gravel lenses are scattered throughout the formation, and the gray clay contains varying amounts of lignite. Thick, white to gray, fine- to coarse-grained, tuffaceous, lignitic sandstone and a novaculitic basal gravel form the lower layer. Within Columbia County, the Tokio Formation ranges in thickness from less than 100 feet in the northeast to nearly 350 feet in the southwest (Figure IV-9). The Tokio Formation has been chosen as the alternate injection interval for DWD #1 and occurs at a depth of approximately 2,915 feet beneath the West Plant facility. It is favorable for waste disposal because of its large regional extent, moderate permeability and porosity characteristics, and dissolved solids content of greater than 10,000 parts per million. The Tokio is currently used as the injection interval in Albemarle South Plant BDW-2 injection well.

The Brownstown Marl and Ozan Formation overlie the Tokio Formation in ascending order. These formations consist of fossiliferous, micaceous, gray sandy marls, sandy limestones, clay, shale, and chalk. They are approximately 370 feet thick in the vicinity of the West Plant.

The Annona Chalk, the Marlbrook Marl, and the Saratoga Chalk form a relatively impermeable layer (aquitard) above the Ozan Formation. This aquitard is regionally extensive and has a gross thickness of approximately 335 feet in thevicinity of the West Plant. The Annona Chalk is a 105-foot thick, massive, fossiliferous, bluish-gray to white chalk that directly overlies the Ozan Formation.

The Marlbrook Marl overlies the Annona Chalk and consists of blue to gray marl and chalky marl, with minor glauconitic sand and thin beds of chalk. Within Columbia County, the thickness of this unit ranges from 140 feet in the east to 220 feet in the west (Golden Environmental Services, 1993).

The Saratoga Chalk overlies the Marlbrook Marl. Its lithology is white glauconitic chalk at the base, with sandy glauconitic chalk near the top. In the study area the Saratoga Chalk thins from 100 feet in the east to 50 feet in the west. The Saratoga Chalk is considered to be the top of the DOW injection zone.

The Nacatoch Formation overlies the Saratoga Chalk and is subdivided into an upper sand unit and a lower shale unit. The upper unit is a massive, white, fine- to medium-grained, well-sorted, calcareous sandstone. The lower unit is a massive, gray, sandy, calcareous shale that is regionally extensive and approximately 110 feet thick within the study area. This lower unit forms the Confining Zone for the proposed DOW injection well. Within Columbia County the gross thickness of the Nacatoch Formation increases from 390 feet in the east to 500 feet in the west (Golden Environmental Services, 1993).

The Arkadelphia Marl overlies the Nacatoch Formation, and consists of dark gray to black, fossiliferous marl. The Arkadelphia Marl has very low permeability, and ranges in thickness from 140 to 160 feet within Columbia County (Dolloff et al., 1967).

Tertiary

The Tertiary is represented by the Midway Group, the Wilcox Group, and the Claiborne Group. The Midway Group unconformably overlies the Arkadelphia Marl. It consists of low-permeability, gray and blue marine clays, with calcareous clays and marls in the lower 50 to 75 feet. Within southern Arkansas, the Midway Group is about 400 to 600 feet thick. Figure IV-10 is a structure map of the top of the Midway Group.

The Wilcox Group overlies the Midway Group, and is composed of thin beds of lignitic sand, silt, and clay. The upper half of the Wilcox consists of sandier beds that grade laterally and vertically into shales over short distances (within a few miles), making it difficult to correlate individual beds over a substantial distance. The Wilcox Group is approximately 420 feet thick in the vicinity of the West Plant. The deepest potential (<10,000 parts per million of dissolved solids) underground sources of drinking water (USDWs) in the study area are found in the Wilcox Group.

The Claiborne Group overlies the Wilcox Group and is exposed at the surface, except in stream beds where it is covered by Quaternary alluvium. This group is of particular interest as it contains the major fresh-water aquifers in the area. The Claiborne Group is composed of marine and non-marine sand, sandy clay, and clay. It is subdivided in southern Arkansas into the Carrizo Sand, the Cane River Formation, the Sparta Formation, the Cook Mountain Formation, and the Cockfield Formation, from oldest to youngest, respectively. The Claiborne Group is approximately 930 feet thick in the vicinity of the West Plant.

The Carrizo Sand, the basal member of the Claiborne Group, is discontinuous in parts of Columbia County. Where present, it is treated as the uppermost part of the Wilcox because the Carrizo Sand and the Wilcox sands are hydraulically connected and constitute a single hydraulic unit (Broom et al., 1984). The Carrizo Sand is approximately 50 feet thick within the study area (Golden Environmental Services, 1993).

The Cane River Formation is composed of approximately 300 feet of clay and silty clay throughout most of Columbia County. The Cane River Formation overlies the Wilcox Group where the Carrizo Sand is absent. The clays within the Cane River are considered essentially impermeable. With very limited capacity for intake, transmission, or release of fluids, the clays act as a hydraulic barrier to movement of more saline fluids from units below to fresh water aquifers above.

The Sparta Formation overlies the Cane River Formation and is exposed at the surface in northern Columbia County, except where it is covered by Quaternary alluvium in streambeds. Figure IV-11 is a surface geology map of Columbia County showing those areas where alluviual sediments are present. The Sparta is the major source of fresh water in the eastern half of Columbia County. The Sparta Formation consists of a 200-foot thick massive Sparta Sand and underlying interbedded massive sands and thin shales. The sand layers are thick-bedded, fine- to coarse-grained sands. The gross thickness of the Sparta Formation is approximately 400 feet within the DOW study area.

The Cook Mountain Formation overlies the Sparta Formation and is exposed at the surface through the middle section of Columbia County, except where it is covered by Quaternary alluvium (Figure IV-11). The Cook Mountain consists of interbedded clay and silty sands. The formation is approximately 100 feet thick at the DOW injection well site.

The Cockfield Formation overlies the Cook Mountain Formation and crops out at the surface in southeastern Columbia County (Figure IV-11). The Cockfield is composed of interbedded lignitic sands and clay and is approximately 200 feet thick within the study area. The Sparta Sand and the Cockfield Formation contain most of the fresh water in the regional study area. The hydrologic characteristics of these units are described in Section IV.A.2.

Quaternary

The Quaternary alluvial sediments are composed of gravel, sand, and silt, and occur primarily in stream channels and in the floodplains of major area rivers (Figure IV-11). The thickness of the alluvium ranges from 0 to 85 feet in Columbia County (Golden Environmental Services, 1993). No alluvium is present at the DOW injection well site.

IV.A.2 Regional Hydrostratigraphy

The Gulf Coastal Plain of Arkansas is underlain by vast artesian aquifer systems with most of the surface blanketed by alluvial sands and gravel, which contain water under both water-table and artesian conditions (Hosman, 1969). The base of fresh water (defined as containing less than 1,000 parts per million (ppm) of dissolved solids) occurs in units of Cretaceous age or younger at depths of several hundred feet in the northwest to more than a thousand feet in the southeast within the Gulf Coastal Plain region. Water quality generally deteriorates with depth and down-dip within the Coastal Plain aquifer systems. In the vicinity of the West Plant, the base of fresh water occurs at the base of the Sparta Sand, or at approximately 700 feet below the surface.

Regional groundwater flow velocities within the deep saline aquifers of Southern Arkansas are relatively low. This is attributed to the lack of discharge pathways related to the burial and enclosure of permeable bodies by dense, relatively low permeability evaporites and shales. Insufficient data are available to generate piezometric surface maps for the Tokio or James injection intervals.

Shallow hydrostratigraphic units within the regional study area include the Cockfield Formation, the Sparta Sand, the Cane River Formation, the Carrizo Sand, and the Wilcox Group, which are known to produce fresh to moderately saline water (less than 1,000 ppm of dissolved solids to less than 10,000 ppm dissolved solids). All of these formations are considered underground sources of drinking water (USDWs) in the regional study area. Figure IV-12 is a regional cross section trending west to east across Southern Arkansas and showing the positions of the various hydrostratigraphic units. Figure IV-13 is a map showing dissolved solids concentrations in the Wilcox Group beneath southern and eastern Arkansas.

Deeper units including the Cretaceous-age Nacatoch Formation, sands of the Ozan Formation and Brownstown Marl, and the Tokio Sands, produce very saline (10,000 to 35,000 ppm dissolved solids) to brine water (greater than 35,000 ppm dissolved solids) and are better suited for waste disposal activities. Figure IV-14 is a map showing dissolved solids concentrations in the Nacatoch Formation.

Cockfield Formation

The Cockfield Formation is exposed at the surface in southeastern Columbia County except in stream beds, where it is covered by Quaternary alluvium (Figure IV-11). Since the Cockfield is exposed at the surface, groundwater in the formation occurs under both confined and water-table conditions. Where sandy beds of the Cockfield Formation are overlain by alluviual sands and gravels, they are generally in hydraulic connection with the alluvium. The Cockfield Formation is up to 200 feet thick locally. The underlying clayey Cook Mountain Formation is a hydraulic barrier sealing the Cockfield aquifer from below (Hosman, 1969).

The Cockfield aquifer is used mainly for rural domestic and stock water supply, and by a few industries. As of 1975, approximately 300,000 gallons per day were pumped from this formation within Columbia County (Terry et al., 1986).

Sparta Formation

The Sparta Formation is overlain by the Cook Mountain Formation aquitard and underlain by the Cane River Formation. The Sparta crops out at the surface in northern Columbia County and in Lafayette County to the west. The major aquifer of the Sparta Formation, the Sparta Sand, is a massive sand, up to several hundred feet thick, which extends from at about 300 feet to 700 feet below the surface in the vicinity of the West Plant. A 50-foot thick shale layer separates the upper Sparta Sand from two or three deeper massive sand layers. The Sparta Sand is recharged by infiltation of water from precipitation on the outcrop, by leakage from other aquifers, and by seepage from streams (Payne, 1968). The Cane River Formation is a hydraulic barrier sealing the Sparta aquifer from below.

The Sparta Formation dips regionally to the southeast. The potentiometric surface of the aquifer slopes eastward from an altitude of about 100 above sea level at Magnolia to about

40 feet above sea level in the east (Figure IV-15). The Sparta Sand is the major source of groundwater in Columbia County. In 1985 withdrawals from the Sparta were about 7.1 million gallons per day (Holland, 1987). Total dissolved solids (TDS) concentration is about 200 ppm (or mg/l) in the Magnolia area (Terry et al., 1986).

Cane River Formation

The Cane River Formation contains beds of fine sands that are utilized as water sources in parts of Columbia County. The Cane River is approximately 300 feet thick in the Magnolia area. In 1975 withdrawals from the Cane River Formation were approximately 100,000 gallons per day.

Carrizo Sand and Wilcox Group

The Carrizo Sand (approximately 50 feet thick near Magnolia) is a source of fresh water in its updip portions in the northwestern corner of Columbia County. In most of the rest of the county, water from the Carrizo has more than 1,000 mg/l TDS, and is too highly mineralized for public use. Likewise, the Wilcox Group is a source of fresh water near its outcrop area north and northwest of Columbia County, but becomes moderately saline within a short distance downdip of the outcrop area.

IV.A.3 Confining and Injection Zone

Confining Zone

The Confining Zone for the DOW injection well is composed of the lower shale unit of the Nacatoch Formation found above the Saratoga Chalk. The zone is comprised of a regionally extensive massive, gray, sandy, calcareous shale. The Confining Zone depths for DWD-1 are from approximately 2,095 feet to 2,205 feet below ground level. A structure map of the top of the Confining Zone (Nacatoch Shale) is included as Figure IV-16. Note: The text of this application typically uses depths below ground level when discussing formation tops or geologic reference points at the location of the proposed DOW well, while the referenced structure maps of necessity (due to varying surface topography) are plotted using a common datum of elevations in feet below sea level.

110' [illegible]

Injection Zone

The Injection Zone for the DOW injection well includes the following formations: Saratoga Chalk, Marlbrook Marl, Annona Chalk, Ozan Formation, Brownstown Marl, Tokio Formation, Eagleford Shale, Tuscaloosa Formation, and Glen Rose Formation (including the James Limestone). These formations consist of sandstone, conglomerate, tuffaceous sand, sandy marl, sandy shale, shale, limestone, and anhydrite. The Injection Zone depths for the DWD-1 well are from approximately 2,205 feet to 4,475 feet below ground level. A structure map of the top of the Injection Zone (Saratoga Chalk) is included as Figure IV-17.

Injection Intervals

The primary Injection Interval for the proposed DOW DWD-1 injection well will be the sandy strata of the James Limestone. The Injection Interval depths for the DWD-1 well are from approximately 4,365 feet to 4,475 feet below ground level. A structure map of the top of the Injection Interval (James Limestone) is included as Figure IV-18. A net sand isopach map of the James Limestone Injection Interval is included as Figure IV-19.

The sands of the Tokio Formation will serve as the alternate Injection Interval for DWD-1. Interval depths in the Tokio strata occur from 2,915 to 3,100 feet below ground level. A structure map of the top of the Tokio Injection Interval is included as Figure IV-20. A net sand isopach map of the Tokio Injection Interval is included as Figure IV-21.

IV.A.4 Regional Structural Geology

Structurally, the regional study area is located between two fault systems, the South Arkansas Fault Zone and the North Louisiana Fault Zone, which were formed by processes associated with gravitationally induced creeping of the Middle Jurassic-age Louann Salt. These fault systems are north of the North Louisiana Syncline, which lies between the Sabine Arch and the Monroe Uplift. Figure IV-3 is a regional map showing major structural features of the Mississippi Embayment.

The South Arkansas Fault Zone is located north of Columbia County and is an extension of the Mexia-Talco Fault Zone located in East Texas. The faults in the South Arkansas Fault Zone generally trend west - east and are thought to have been active from the Jurassic until at least the Eocene. These fault zones are defined by strike-parallel normal faults that formed symmetrical grabens (Dutton et al., 1993).

Figure IV-8 is a structure contour map on top of the Tokio Formation by Bush (1981). Figure IV-10 is a structure contour map on top of the Midway Group prepared by Terry et al. (1986). These structure maps are representative of the general structural orientation of sediments through Southern Arkansas. Several west - east trending faults are depicted outside of the DOW AOR and north of Columbia County in Figures IV-8 and IV-10, and on the surface geology map in Figure IV-11.

IV.A.5 Regional Seismic Activity

Southern Arkansas is an area of moderate, low intensity seismic activity, based on observational data obtained from the National Geophysical Data Center (NGDC) of the National Oceanic and Atmospheric Administration (NOAA, 2000). The West Plant facility is located within an earthquake risk area zone of (1), which represents an area where only minor damage is expected as a result of earthquake activity (Algermissen, 1969) (Figure IV-22). This is due, in part, to the relatively low level of tectonic activity occurring within the regional study area.

A computer search for recorded seismic events within a 50 km (31 mile) radius of the West Plant facility provided a list of only two (2) individual events. These seismic events took place during the period from 1987 to 1988 (Table IV-1, Figure IV-23). The recorded magnitudes of the two events were 2.0 and 2.5. Intensities on the Modified Mercalli Scale were not reported for the events. The nearest of the two seismic disturbances reported by the NGDC occurred approximately 22.3 miles (36 km) east-southeast of the West Plant facility on December 12, 1988.

Based on the NGDC data, there are no reported earthquake events of any intensity or magnitude within the 0.5-mile radius AOR around the proposed injection well. The seismic activity that has occurred within the 31-mile search area is probably associated with movement along faults within the North Louisiana Fault Zone (Figure IV-3). This fault zone lies along the Arkansas-Louisiana state boundary approximately 20 miles south of the West Plant facility. A review of the NGDC Earthquake Data File for the subject area indicates a depth of approximately 5 to 16 km (3.1 to 9.9 miles) to the earthquake epicenters.

Earthquake Risk Assessment

Risk assessment of earthquakes requires description of the kinds of events that would disrupt injection operations. In this report, four aspects of earthquake risk assessment are addressed:

- Earthquake Intensity
- Time interval between Earthquakes
- Distance from an Earthquake to an Injection Site
- Earthquake Data Quality.

Earthquake Intensity

The most severe earthquake within the 50-kilometer radius of search occurred in 1988 at a distance of approximately 22 miles (36 km) east-southeast of the West Plant facility (Table IV-1). A maximum intensity for the earthquake is not listed. Therefore, it can be assumed that the intensities were probably less than a Mm III on the Modified Mercalli Scale and not recognized by local observers. An intensity Mm III is:

> "Felt indoors by several, motion usually rapid vibration. Sometimes not recognized to be an earthquake at first. Duration estimated in some cases. Vibration like that due to passing of light, or lightly loaded trucks, or heavy trucks some distance away. Hanging objects may swing slightly. Movements may be appreciable on upper levels of tall structures. Rocked standing motor cars slightly."

Compared to the description above, it is unlikely that the occurrence of a Mm intensity II or III earthquake at a distance of 22 miles east or south of the West Plant site would shear cemented casing and steel tubing downhole, cause interruption in injection operations, or impair the mechanical integrity of the DOW injection well. This is supported by the fact that there are no recorded incidents of impairment of injection, oil, and/or gas wells within the West Plant study area due to the occurrence of the recorded seismic activity in 1987 or 1988.

Time Interval Between Earthquakes

An earthquake of a size sufficient to disrupt industrial operations or threaten life has not occurred in recorded seismic history within 50 kilometers of the DOW injection well site. The time interval between damaging earthquakes (or the lack thereof) is a direct reflection of the earthquake frequency and relative risk within an area. In over 60 years of regional seismic monitoring, only two relatively low-magnitude earthquakes have occurred in the area, indicative of the low potential for earthquakes in this area. There is no evidence based on historical frequency of earthquakes for forecasting a significant shock within the radius of investigation.

Distance From An Earthquake To The Injection Site

If a relatively strong earthquake were to occur within 50 kilometers (earthquake data search area) of the DOW injection well site, the distance between the injection site and a hypocenter (focus of earthquake energy) would determine potential damage because the energy of earthquakes generally decreases in relation to radial distance from the hypocenter. The distance from the hypocenter is thus important in determining the potential risk to a location. The rate of decreasing energy can be expressed as an exponential function of the radius. The two regionally recorded earthquakes have depths to a hypocenter recorded; the shallowest depth is approximately 3 miles (5 kilometers) and nearest distance to the site is 22 miles (36 kilometers). Due to the distance of these two events, the potential risk to the DOW location is considered minimal due to the exponential energy loss that would occur over this distance, even with larger earthquake from those locations. Figure IV-22 shows that even regionally southern Arkansas is in a zone of low seismic damage.

Earthquake Data Quality

All earthquakes recorded in the study area are below magnitude 2.5 on either a Local Magnitude Richter scale, Nuttli Magnitude, Coda Length Magnitude, or Felt Area Magnitude. There are no fault-plane solutions on record. There are no ground acceleration or ground displacement data in the National Earthquake Information Service report; no quantitative assessment of facility design is done for this report. Maximum and minimum horizontal stress data have not been obtained that would allow resolution of the present state of stress in the Tokio or James Formations.

Based on: (1) the history of seismic activity (intensity and magnitude) within the area, (2) information regarding geologic structures (faulting) within the subject area, (3) the location of seismic activity in the study area, seismic activity within the regional study area should have no impact on injection well activity at the West Plant facility. In addition, given the distances to faults that may be associated with some of the recorded seismic activity, Injection Interval permeability and lateral continuity, injection at the West Plant facility should not generate any noticeable seismic events. This is supported by a 12-year injection well history at the Albemarle BDW-2 (Tokio) and BDW-13 (James) South Plant injection wells located nine miles southeast of the West Plant, with no record of any recordable seismic events near the Albemarle wells (Table IV-1).

IV.B Local Geology

This discussion addresses the local surface, stratigraphic, and structural geology, lithology, hydrostratigraphy, and hydrology pertinent to the proposed DOW injection operations. For the purposes of this application, the local geologic area of study is defined as a 40-square mile rectangular area approximately centered on the DWD-1 AOR (see Figure IV-16). The local geology is described from nearby artificial penetrations and from log data and whole cores from Albemarle South Plant well BDW-2 (located 9 miles to the southeast) and Ethyl Corporation #61 BSW well (located 11 miles east of the proposed DOW well site). A listing of wells used to generate all maps relating to the geological investigation is included in Table IV-2. The Core Laboratories reports are included in Appendix C.

IV.B.1 Surface Geology

The Gulf Coastal Plain in Arkansas is generally of low relief with a predominantly southeastern trend to stream drainage. The Cook Mountain Formation is exposed at the surface throughout the local study area, except where Quaternary Alluvium has been deposited along stream channels. The Cook Mountain is composed of interbedded clay and silty sands, while the Alluvium consists of gravel, sand, silt, and clay. The Cook Mountain Formation is exposed at the surface at the proposed injection well site.

IV.B.2 Stratigraphy

Most of the strata in the approximately 8,000-foot thick sedimentary column within the local study area (Figure IV-2) are Mesozoic in age, and the sediments were deposited near sea level through a relatively long time interval when the climate was warm and humid. Figures IV-4, IV-5, IV-6, and IV-7 (Regional West-East and North-South Structural Cross Sections) depict the lithologies of the lower and middle stratigraphic sections. Through Upper Cretaceous and Tertiary time, the climate and oscillating marine setting contributed to deposition of limestones, chalks, marls, and shales upward from the Tokio Formation to the base of the Wilcox Group. The carbonates and shales constitute a rock thickness of approximately 1,600 feet (Figures IV-24 and IV-25 (Structural Cross Sections A-A' and B-B')). These sedimentary layers have been relatively unaltered since deposition and act as barriers to vertical fluid movement. Note: the Nacatoch Formation, which lies within this upper Cretaceous and Tertiary sedimentary section, is the defined confining zone for this permit application.

The James and Tokio portions of the Injection Zone have been mapped in the local area (Figures IV-18, IV-19, IV-20, and IV-21). The source direction of sediment was primarily from the north, and clastic material was washed to the sea during Cretaceous and Tertiary time and deposited on the carbonate shelf. The local interpretation is supported by lithologic data from wells drilled through the Tokio and into deeper formations within or near the local study area.

Geophysical logs from a group of 72 wells in the local study area were used to estimate the structural top of the Confining Zone, the Injection Zone, the Tokio Injection Interval, the James Injection Interval, and the net thickness of the Tokio sand and James Lime sand in the vicinity of the DWD-1 AOR. Table IV-2 presents the log-derived data for the 72 wells. Figure IV-2 (Stratigraphic Column) includes formation ages, acknowledged nomenclature, and hydrologic division for this study. A general description and approximate interval thickness of the various geologic units of interest to this application follows.

Quaternary

Quaternary alluvium is present in the Dismukes Branch of the Big Creek stream channel that occurs within the local study area (Figures IV-11 and III-2). The thickness of the alluvium is estimated to range from 0 to 30 feet and consists of gravel, sand, silt, and clay. The Quaternary alluvium is not present beneath the injection well site.

Tertiary – Claiborne Group

The Claiborne Group is exposed at the surface, except in stream beds where it is covered by Quaternary alluvium (Figure IV-11). Members of the Claiborne Group present within the local study area include the Cook Mountain Formation, the Sparta Formation, and the Cane River Formation. The Sparta Sand aquifer contains groundwater with less than 500 ppm (or mg/l) TDS (Payne, 1968). The Claiborne Group is composed of marine and non-marine sand, sandy clay, and clay and is approximately 1,050 feet thick in the vicinity of the proposed DOW injection well.

Tertiary – Wilcox Group

Beds of the Wilcox Group lie below the base of the Cane River Formation, and are approximately 420 feet thick at the proposed well location. Groundwater contained within the Wilcox Group has less than 10,000 mg/l TDS under the local study area (Figure IV-13) and represents the lowermost USDW. The Wilcox Group is composed of lignitic sand, silt, and clay.

Tertiary – Midway Group

The Midway Group consists of low-permeability, gray and blue clays, with calcareous clays and marls represented in the lower portion of the group. The Midway Group is present throughout the local study area and is approximately 430 feet thick at the DWD-1 well location.

Upper Cretaceous – Navarro Group (contains Confining Zone)

The Navarro Group, which underlies the Midway Group, includes the Arkadelphia Marl and the Nacatoch Formation. The Arkadelphia Marl consists of dark gray to black, fossiliferous marl interbedded with sandy limestone and is approximately 120 feet thick in the vicinity of the proposed DOW injection well. The Nacatoch Formation is subdivided into an upper calcareous sand unit and a lower calcareous shale unit and is about 330 feet thick at the DOW well location. The lower calcareous shale unit (approximately 110 feet thick) serves as the Confining Zone for the proposed DWD-1 well.

Upper Cretaceous – Taylor Group (top of Injection Zone)

The Taylor Group underlies the Navarro Group and consists of the Saratoga Chalk, the Marlbrook Marl, the Annona Chalk, and the Ozan Formation. The Saratoga Chalk (top of the Injection Zone), Marlbrook Marl, and Annona Chalk have a gross thickness of approximately 335 feet in the West Plant area and consist of thin to thick beds of bluish-gray to white chalk, blue to gray marl and chalky marl, with minor glauconitic sand and sandy glauconitic chalk. The Ozan Formation is approximately 170 feet thick at the DOW well site.

Upper Cretaceous – Austin Group (contains alternate Injection Interval)

The Austin Group includes the Brownstown Marl and the Tokio Formation, which is designated as the alternate injection interval for the DOW DWD-1 injection well. The Austin Group consists of fossiliferous, micaceous, gray sandstones, shale, and sandy marls that are approximately 390 feet thick in the vicinity of the DOW well site. The net thickness of the Tokio Sands is approximately 55 feet in the vicinity of the proposed DWD-1 well (Figure IV-21).

Upper Cretaceous – Eagleford-Woodbine Group

The Eagleford Shale of the Eagleford-Woodbine Group underlies the Austin Group and is composed of gray to black marine shale. Underlying the Eagleford Shale is the Tuscaloosa Formation, which is approximately 80 feet thick and consists of red and brown tuffaceous sandstone and shale. The Tuscaloosa Formation and Eagleford Shale are approximately 215 feet thick in the vicinity of the proposed DOW well.

Lower Cretaceous – Glen Rose Fm. Equivalents (contains primary Injection Interval)

The Glen Rose Formation Equivalents unconformably underlie the Eagleford-Woodbine Group within the local study area and are sub-divided (youngest to oldest) into the Mooringsport Formation, the Ferry Lake Anhydrite, and the Rodessa (includes James Limestone Member), Pine Island, and Sligo Formations. The gross thickness of the Glen Rose Equivalents at the proposed DOW well site is approximately 1,700 feet.

The lower portion of the Glen Rose Equivalents includes the Rodessa, Pine Island, and Sligo Formations, which are approximately 900 feet thick within the local study area. The upper part of this three-formation group is composed of red, gray, and black shale, gray oolitic, dense to porous limestones, and some sandstone (Imlay, 1940). Local anhydrite stringers also occur in the upper portion of the group. The lower 400 to 450 feet consists of gray to brown limestone and shale. These units underlie the entire county and thicken as well as darken toward the south and southeast.

The James Limestone Member of the Rodessa Formation is designated as the primary injection interval for the proposed DOW well. The James Limestone occurs at the base of the Rodessa and is a very easily recognizable marker bed both on electric logs and in drill cuttings. It consists of limestones that are light gray, oolitic to coquinoid and slightly porous, and sandstones that are very fine-grained, white, and in places glauconitic (Dolloff et al., 1967). The James Limestone sandy unit is used as an injection interval for the Albemarle BDW-13 Class I well located at Albemarle's South Plant, approximately 9 miles southeast of the West Plant. The net sand thickness of the James Limestone sandy unit varies from 28 feet to over 50 feet in the vicinity of the proposed DOW well site (see Figure IV-19).

The Ferry Lake Anhydrite consists of anhydrite with streaks of shale and limestone. It is present everywhere in Columbia County except in the northeastern corner and is approximately 190 feet thick in the vicinity of the West Plant.

The Mooringsport Formation ranges in thickness from 0 feet to over 550 feet across Columbia County and is present in all but the northeastern corner of the county. It is composed of red and gray shale, with layers of limestone and streaks of sandstone. This shale unit thickens, darkens, and becomes more calcareous toward the south (Imlay, 1940). The Mooringsport is approximately 445 feet thick in the vicinity of the proposed DOW well site.

Lower Cretaceous – Hosston Formation

The Hosston Formation is approximately 1,500 feet thick in the vicinity of the Albemarle West Plant. The Hosston Formation consists primarily of interbedded red and gray shales and sandstones with minor limestone and lignite, and a basal conglomerate.

Upper Jurassic

The Upper Jurassic within the local study area is represented by the Cotton Valley Group, the Buckner Formation, and the Smackover Limestone. The Cotton Valley Group unconformably underlies the Hosston Formation and consists of shale, sandstone, and some red and gray limestone. The Buckner Formation unconformably underlies the Cotton Valley Group and consists of massive anhydrite beds, shale, and sandstone that are approximately 220 feet thick within the local study area. The Smackover Limestone, which ranges up to 700 feet thick beneath the local study area, underlies the Buckner Formation and is subdivided into two laterally continuous units consisting of an upper oolite and a lower limestone.

Triassic

The Triassic-age Eagle Mills Formation underlies the Smackover Limestone and overlies the Paleozoic basement rocks within the local study area. The Eagle Mills is approximately 1,100 feet thick in the vicinity of the proposed DOW injection well and consists primarily of salt with some red shale, anhydrite, and a conglomerate.

IV.B.3 Hydrostratigraphy

An inventory of water wells within and adjacent to the West Plant boundary was performed, based on existing state agency records. A total of six wells were found within the specified area and are included on Figure III-2. Records for these wells can be found in Appendix B and are summarized on Table III-2. The information on the records for these wells has been used to depict the local groundwater conditions within the vicinity of the DOW injection operations.

The local shallow hydrostratigraphy is influenced by the surface topographic features and drainage. The Dismukes Branch of Big Creek (and its tributaries) is an intermittent stream that runs southerly through the AOR. Land surface elevation across the AOR ranges from approximately 250 to 310 feet (see Figure III-2).

All of the shallow hydrostratigraphic units discussed in Section IV.A.2 are present within the local study area, with the exception of the Cockfield Formation. The Sparta Formation is the primary source of fresh water within the local study area (Payne, 1968). Figure IV-15 illustrates the altitude of water levels in the Sparta Aquifer in Southern Arkansas in 1996-1997. The figure indicates that the water level in the vicinity of the West Plant facility was at an elevation of +180 feet relative to sea level and that the groundwater flow pattern in central Columbia County was generally toward the east.

Records for three water wells drilled on the West Plant (Table III-2) indicate that two of the wells reached total depths of 430 to 438 feet and are completed in the Sparta aquifer. Depth to water within the Sparta aquifer measured in 1974 was 181 feet to 184 feet below the land surface. The third well (Water well #1) was drilled to a depth of 81 feet into the Cook Mountain Formation in 1971 and had a depth to water of 30 feet below land surface.

The next two closest wells to the West Plant facility (Water wells #4 and #5 on Table III-2) are located southwest of the site and used for domestic purposes. The wells were drilled in 1977 and 1975 to depths of 47 feet and 46 feet below ground surface, respectively, and completed in the Cook Mountain Formation. Depth to water in the wells was reported to be 21 feet and 15 feet below ground level, respectively, when they were drilled. The sixth well drilled in the vicinity of the West Plant (Water well #6) is located northwest of the site and was drilled as a water supply well during the drilling of the DOW #1 Jameson Brine Supply Well. The well was drilled in 1983 to a depth of 445 feet below ground surface and completed in the Sparta aquifer. The depth to water was reported to be 240 feet below ground level.

IV.B.4 USDW, Confining and Injection Zone Description

The approximate depths to the various zones of interest for this permit application include the following:

*Depth to:	DWD-1
Base of USDW	1,335'
Top of Upper Confining Zone	2,095'
Top of Injection Zone	2,205'
Top of Tokio Injection Interval	2,915'
Base of Tokio Injection Interval	3,100'
Top of James Lime Injection Interval	4,365'
Base of James Lime Injection Interval	4,475'
Base of Injection Zone	4,475'

* Note: depths are relative to ground level

IV.B.4.a Base of USDW

The base of the lowest underground source of drinking water (USDW) is defined as being the base of the Wilcox Group. This deduction is derived from electric log characteristics, from a 1969 U.S. Geological Survey report on the geohydrology of the Coastal Plain aquifers by Hosman (1969), and from publications of the Arkansas Geological Commission. Typically, sands within the Wilcox Group contain groundwater with concentrations of 1,000 to 8,000 ppm or mg/l TDS in Columbia County (Figure IV-13).

The base of water having less than 10,000 mg/l TDS is typically picked on electric logs as the depth where the deep resistivity log curve in a clean sand first kicks below 3 ohms. On the Dismukes Heirs #1 (Map ID #2) well log, the event is at 1,293 BKB (see Figure IV-27). The base of the USDW is relatively flat over the local study area. Structural cross sections on Figures IV-24 and IV-25 show the vertical distance of more than 1,580 feet separating the base of the USDW from the top of the Tokio Injection Interval.

Some published water quality information is available for the Nacatoch Sand, the next deeper water-bearing formation beneath the lowermost USDW. Figure IV-14 is a map showing regional dissolved solids concentrations in the Nacatoch beneath southern and eastern Arkansas. This figure illustrates that Nacatoch groundwater has greater than 10,000 mg/l TDS under all of Columbia County.

IV.B.4.b Confining Zone

The Confining Zone for the DOW injection well is composed of the lower shale unit of the Nacatoch Formation. The Confining Zone depths are from approximately 2,095 feet to 2,205 feet below ground level at the DWD-1 well location, approximately 110 feet thick. Rock types include: low-permeability shales, and sandy, calcareous shales. The Confining Zone is depicted on the local cross-sections (Figures IV-24 and IV-25). Figure IV-16 is a structure map of the top of the Confining Zone, and Figure IV-17 is a structure map on the base of the Confining Zone (top of the Injection Zone). These maps show that there are no faults mapped which transect the Confining Zone.

The Confining Zone provides an additional layer of confinement strata between the Injection Zone and the base of the USDW. The stratigraphic sequence in the Confining Zone provides an adequate barrier to the upward migration of waste fluids. The Confining Zone is laterally continuous and free of transecting faults or fractures over an area sufficient to prevent movement of constituents into USDW's and contains a formation with sufficient thickness and with lithologic and stress characteristics capable of preventing vertical propagation of fractures. In addition, the Confining Zone is separated from the base of the lowermost USDW by at least one sequence of permeable (upper Nacatoch Sand unit) and less permeable strata (Midway Group) that will provide an added layer of protection for the USDWs.

The confining zone consists primarily of massive low-permeability shale strata at the DOW well location. Upper Cretaceous and Tertiary Gulf Coast shale typically deforms plastically in response to stress, as the shale is lithologically semi-consolidated. This results in few if any fractures or faults developing in this poorly consolidated rock. The confining zone lithology is confirmed through both regional studies (Dolloff et al, 1967), and local electric logs. The #1 Dow well (Map ID No. 1) induction-electric log (Appendix D) shows the typical shale lithology log traces, with no SP or resistivity curve deflections.

IV.B.4.c Injection Zone

The Injection Zone for DOW's injection well includes the following formations: the Saratoga Chalk, the Marlbrook Marl, the Annona Chalk, the Ozan Formation, the Brownstown Marl, the Tokio Formation, the Eagleford Shale, the Tuscaloosa Formation, and the Glen Rose Formation. The Injection Zone depths for DWD-1 are from approximately 2,205 feet to 4,475 feet below ground level (BGL). A structure map of the top of the Injection Zone (Saratoga Chalk) is included as Figure IV-17. Table IV-3 is a chart showing the Injection Zone reservoir properties, as determined from the drilling of the Brazos #1 DOW (Map ID #1), the Albemarle BDW-2 (located 9 miles southeast of the proposed DWD-1 well site at the Albemarle South Plant), and the Ethyl #61 BSW (located 11 miles east-northeast of the proposed well site in Section 12, T17S, R20W). The two Injection Intervals (defined as the strata receiving wastewater injected through perforations or screen in the proposed DOW well) and the Containment Interval (defined as the upper portion of the Injection Zone above the uppermost injection interval) are described in Table IV-3 for the proposed DOW well.

IV.B.4.d Injection Intervals

Porous sandy intervals of the James Limestone Member and the Tokio Formation will serve as the primary and alternate Injection Intervals for the proposed well. The reservoir properties of the two Injection Intervals are shown on Table IV-3. The James Lime and Tokio Formation injection intervals consist of fine to medium grained, slightly limy to slightly shaly quartz sands. Whole core analyses of these intervals are included in Appendix C.

James Limestone (Primary)

The James Injection Interval depths for DWD-1 are from approximately 4,365 feet to 4,475 feet BGL. A structure map of the top of the James Injection Interval is included as Figure IV-18. A net sand isopach map of the James Injection Interval is included as Figure IV-19. The porous sandy units of the proposed James Injection Interval are approximately 50 feet thick in the vicinity of the proposed DOW well.

The porosity and permeability of the James Limestone are available from analyses of samples of whole core taken from Albemarle BDW-2 (drilled as Ethyl Corporation Brine Disposal Well #2), located approximately nine miles southeast of the West Plant. The core analysis report is included in Appendix C. Of the James Lime cores that contained sand (48 cores), approximately 22 cores had values of permeability of greater than 10 millidarcies (md), which is conservatively representative of sand strata that would be perforated for completion. In samples from these permeable zones, the permeability values ranged from 11 md to 1168 md (198 md average), and the porosity ranged from

15% to 28% (21% average). The permeability used in the pressure modeling was chosen to be 115 md, based on an average of whole core and fall-off test analyses (see Section V.A.1). When the DOW injection well is drilled at the West Plant location, actual James sand permeability values will be gathered from whole core analyses.

Tokio Formation (Alternate)

The Tokio Injection Interval depths for DWD-1 are from approximately 2,915 feet to 3,100 feet BGL. A structure map of the top of the Tokio Injection Interval is included as Figure IV-20. A net sand isopach map of the Tokio Injection Interval is included as Figure IV-21. The Tokio Formation is characterized by three sands, an upper sand about 20 feet thick, a middle sand about 10 feet thick, and a lower sand about 20 feet thick. The sands are separated by 20-foot and 30-foot shale units, respectively. Throughout the study area, the Tokio consists of two or more sands separated by thin shales (Figures IV-24 and IV-25). The Tokio Sand has a net thickness of approximately 55 feet at the DWD-1 well site. The Tokio net sand isopach map (Figure IV-21) suggests that the net porous thickness of the Tokio Formation increases to the west, east, and south of the West Plant.

The porosity and permeability of the Tokio sands at the West Plant range from 25% to 33% (28% average) and 13 md to 1504 md (246 md average), respectively (Table IV-3). These data are determined from whole core (Appendix C), openhole density logs, and fall-off test data from Albemarle's BDW-2 Tokio injection well at its South Plant and the Ethyl #61 BSW well in the Magnolia Field (see Section V.A.1 for a detailed discussion of reservoir parameters).

IV.B.4.e Confining Strata Beneath Injection Zone

The confining strata beneath the injection zone are comprised of shales, limestones, and sandstones of the Lower Glen Rose Formation Equivalents (lower Rodessa, Pine Island, and Sligo Formations). Dolloff et al (1967) and Imlay (1940) describe these formations in some detail. The shales of these formations are typical low permeability aquacludes, which serve as hydrologic barriers to vertical fluid movement (Freeze and Cherry, 1979). It is anticipated that the lower permeabilities of these mostly shaley strata are sufficient to contain any injected fluids that might migrate below the Tokio and/or James Injection Intervals. These strata are approximately 500 feet thick, based on local electric logs.

IV.B.5 Structural Geology

Records and wireline log data from wells in the local study area that penetrate James Limestone strata were obtained and integrated into the study. Wireline logs were obtained for a total of 72 wells, which were utilized in mapping the geology of the study area. Table IV-2 presents the well control used for detailed mapping of the local study area. Cross-section Figures IV-24 (Local Structural Cross-Section A-A') and IV-25 (Local Structural Cross-Section B-B') illustrate the continuity of the Confining Zones, Injection Zone, and Injection Intervals within the AOR. A map showing the locations of the wells and the cross-sections is included as Figure IV-26.

Figure IV-17 is a structure contour map of the top of the Injection Zone (Saratoga Chalk). This map shows the top of the Injection Zone to lie between sea-level relative depths of approximately –1,800 feet and –2,050 feet across the study area. The top of this formation is at a depth of 2,205 feet (ground), and an elevation of –1,911 feet at the DWD-1 injection well site.

A structure contour map of the top of the James Injection Interval is depicted in Figure IV-18. This map shows the top of the James Injection Interval to be between datums of approximately –3,900 feet and –4,700 feet across the study area. The top of the James Injection Interval is at a depth of 4,365 feet (ground), and an elevation of –4,071 feet in DWD-1. A net sand thickness isopach map of the James Injection Interval is shown in Figure IV-19. The net thickness of the James Lime Sand is from 24 feet to 58 feet thick across the study area.

A structure contour map of the top of the Tokio Injection Interval is depicted in Figure IV-20. This map shows the top of the Tokio Injection Interval to be between datums of approximately –2,500 feet and –2,750 feet across the study area. The top of the Injection Interval is at a depth of 2,915 feet (ground), and an elevation of –2,619 feet in DWD-1. A net sand thickness isopach map of the Tokio Injection Interval is shown in Figure IV-21. The net thickness of the Tokio Sand is from 26 feet to 91 feet thick across the study area.

IV.B.6 Mineral Resources – Natural Gas, Oil, and Bromine

The West Plant is located on the southwestern flank of a structural high on which are located two small oil and gas fields and a larger bromine-rich brine field. Oil was discovered in 1939 in the Big Creek Field located approximately three miles northeast of the West Plant facility. Oil has been produced from the Smackover Formation since the field's discovery. In 1988, the cumulative production from a total of three wells was 198,248 barrels of oil and 438 million cubic feet of gas (Arkansas Oil and Gas Commission, 1989). The Kilgore Lodge Oil Field, located approximately 1.5 miles northeast of the West Plant, had a total of two oil wells completed in the Smackover Formation. The cumulative production for the Kilgore Lodge Field to 1988 was 9,569 barrels of oil (Arkansas Oil and Gas Commission, 1989).

The Kilgore Lodge Smackover Brine Field surrounds the West Plant. Formation water from the Smackover Formation has been mined for bromide extraction since 1967. Eleven brine supply wells and nine brine disposal wells are associated with the field. Since the formation water surrounding the plant has been depleted of bromide to the extent that it is not economical for recovery, many of the brine supply wells near the West Plant are no longer operating.

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V. RESERVOIR MECHANICS

V.A Injection Reservoir Mechanics

The injection intervals have sufficient permeability, porosity, thickness and areal extent to prevent migration of constituents from the injection zone into a USDW or freshwater aquifer. A summary of the reservoir parameters, bottom hole pressure (BHP) and bottom hole temperature (BHT), fracture gradient, cone of endangerment, and pressure buildup calculations is provided in the following sections.

V.A.1 Injection Reservoir Parameters

The proposed DOW well will be completed in either the Tokio Formation or James Lime sands. Parameters used in modeling the Tokio Formation and James Lime injection interval sands are discussed in the following sections. Detailed lithological discussions of the proposed injection intervals are included in Section IV.

The primary injection interval chosen for the Dow well is the James Lime sand strata. This is the deeper of the two proposed injection intervals. The well will be initially completed into this interval to simplify completion and possible later recompletion operations for the well. The secondary injection interval chosen is the shallower Tokio Formation sand strata.

The James sand strata are considered suitable as the primary injection interval based on offset injection well history. The Ethyl (Albemarle) BDW No. 13 injection well at their South Plant, located 7 miles away, was completed in 1988 into James sand strata, and has injected over 250 million gallons of wastewater since initiation of operations, at an average injection rate of 75 gpm (Walk Haydel, 1999). Although used irregularly during 1999, the maximum flow rate into that well exceeded 150 gpm; yearly static bottomhole pressure measurements indicate no increase in reservoir pressures. This well also has not required acid stimulations to increase injectivity. The proposed DOW well is also expected to have sufficient capacity to allow the proposed 100 gpm injection rate. The induction-resistivity

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log signature of the the Brazos No. 1 DOW well (located at the DOW West Plant) indicates a cleaner sand than the Ethyl (Albemarle) BDW No. 2 well located at the South Plant, and core/injectivity test data (discussed later in this section) from the Ethyl BDW No. 13 well also indicates sufficient injectivity for the James strata. The James portions of the electric logs from these three wells are included in Appendix C. Although the Ethyl BDW No. 2 well at the South Plant was initially completed into the James Lime strata in 1988, prior to initiation of operations it was recompleted into the Tokio Formation strata as a result of a low flow capacity compared to BDW No. 13. The cause for this lowered flow capacity was never determined (Ethyl, 1988), although it was speculated that it was a result of formation damage during the drilling of the well, and resultant near-wellbore formation (skin) damage.

The secondary injection interval chosen for the DOW well is the Tokio Formation sand strata. This is the shallower of the two proposed injection intervals. The DOW well may later be recompleted into the Tokio strata if the James strata injectivity decreases, or the sands pressure up excessively.

Porosity

Tokio Formation

The porosity values determined for the Tokio injection interval sands are based on ~~two~~ 3 sources: 1) Tokio Formation whole core analyses gathered from the Ethyl (Albemarle) BSW No. 61, located approximately 11 miles to the east in Magnolia Field, and; 2) an open hole Compensated Neutron-Formation Density log run on the Ethyl (Albemarle) BDW No. 2 well, located approximately 9 miles to the southeast. A copy of the whole core analyses from the No. 61 well is included in Appendix C, as is the Tokio section of the neutron-density log from the BDW No. 2 well. No other closer whole core analyses or porosity logs are available for the Tokio Formation. The average porosity value from the cores in the Tokio sands in BSW No. 61 is 29.4%, determined by averaging the 30 cores with a permeability of 10 md or higher. The average porosity value visually approximated from the Ethyl BDW No. 2 neutron-density log curves over the Tokio sand section is 30% (the range in log porosities is 10% to 49%). 3) By comparison, the Tokio average porosity value

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from cores taken from the Great Lakes West Plant SWD-1M well (located approximately 20 miles to the east) is 28% (see Appendix C). For the pressure increase modeling for the Tokio Formation sands in this permit application, a value of 28% is used to provide a conservative (high) estimate of pressure buildup.

James Lime

The porosity values determined for the James Lime injection interval sands are based on 3 ~~two~~ sources: 1) James Lime whole core analyses gathered from the Ethyl (Albemarle) BDW No. 2, located approximately nine miles to the southeast at their South Plant, and; 2) an open hole Compensated Neutron-Formation Density log run on that same well. A copy of the whole core analyses from the No. 2 well is included in Appendix C, as is the James Lime section of the neutron-density log from the BDW No. 2 well. No other closer whole core analyses or porosity logs are available for the James Lime. The average porosity value from the cores in the James Lime sands in the Ethyl BDW No. 2 well is 22.1%, determined by averaging the 22 cores with a permeability of 10 md or higher. The average porosity value visually approximated from the Ethyl BDW No. 2 neutron-density log curves over that James sand section is 21% (the range in log porosities is 12% to 30%). 3) By comparison, the James Lime average porosity value from sand strata cores taken from the Great Lakes West Plant SWD-1M well (located approximately 20 miles to the east) is 23%. For the pressure increase modeling for the James Lime sands in this permit application, a value of 21% is used to provide a conservative (high) estimate of pressure buildup.

Permeability

Tokio Formation

Several sources for a permeability value for the Tokio Formation sands are available. Whole core analyses from the Ethyl (Albemarle) BSW No. 61 well (see Appendix C) show a range of 13 to 1,504 millidarcies (md) from 30 whole cores with permeabilities of 10 md or higher, with an average of 246 md. The USEPA petition-approved permeability value for the Tokio injection interval for the Ethyl BDW No. 2 well (located at their South plant) is 321 md, calculated from a 1990 fall-off test. The most recent (2000) fall-off test analysis

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from that well provided a permeability of 62 md, with significant skin damage evident. If one averages these three values, one gets a permeability of 210 md. Instead of employing either of the end-range fall-off test values, the pressure modeling for this permit application employs a permeability of 200 md (slightly lower than the all-sources average) in order to provide a conservative (high) estimate of pressure buildup in the Tokio sands reservoir. By comparison, the core-documented permeability value used in the Great Lakes permit renewal application for their El Dorado Central Plant WDW-3 and WDW-4 Tokio wells is greater than 400 md.

<u>James Lime</u>

Several sources for a permeability value for the James Lime sands are available. Whole core analyses from the Ethyl (Albemarle) BDW No. 2 well (see Appendix C) show a range of 11 to 1,168 millidarcies (md) from 22 cores with permeabilities of 10 md or higher, with an average of 198.5 md. From the Great Lakes West Plant SWD-1M well, James Lime sand core permeabilities range from 11 to 463 md, and average 105 md. The latest (1999) fall-off test performed on the Ethyl (Albemarle) South Plant BDW No. 13 well injecting into the James Lime sands indicates a permeability of 43 md for the net sand interval tested. If one averages these three values, one gets a permeability of 115 md. Instead of employing either of the end-range core/fall-off test values, the pressure modeling for this permit application employs the all-source average permeability of 115 md in order to provide a conservative (high) estimate of pressure buildup in the James Lime sands reservoir.

- **<u>Reservoir Thickness</u>**

<u>Tokio Formation</u>

The net sand thickness of the Tokio Formation sands at the DOW facility is 55 feet out of a gross interval thickness of 185 feet, based on an evaluation of the net sand thickness as seen on the open hole log from the nearby Brazos No. 1 DOW well (see Appendix C). The pressure model uses a thickness of 55 feet to conservatively estimate (maximize) the pressure increase from DOW injection activities into the Tokio injection interval, and the projected plume extent at the end of operations.

James Lime

The net sand thickness of the James Lime sands at the DOW facility is 50 feet out of a gross interval thickness of 110 feet, based on an evaluation of the net sand thickness as seen on the open hole log from the nearby Brazos No. 1 DOW well (see Appendix C). The pressure model uses a thickness of 50 feet to conservatively estimate (maximize) the pressure increase from DOW injection activities into the James injection interval, and the projected plume extent at the end of operations. OK

V.A.2 Injection Reservoir Fluids

Formation fluid samples from the Tokio and James Formation sands were obtained during the completion of the Ethyl (Albemarle) BDW No. 2 well in February 1988 and were analyzed by Western Atlas (see Appendix C). The results of the analysis indicated that the Tokio Formation sand native fluids have a total dissolved solids content of approximately 78,200 mg/l and a specific gravity of 1.053 at 72 °F. For the James Lime sand, the native fluids have a total dissolved solids content of approximately 185,000 mg/l and a specific gravity of 1.127 at 72 °F.

The initial formation temperatures in the Tokio and James injection intervals can be inferred from published regional gradient maps (Figure V-3) (Western, 1980), and using a surface temperature of 65 °F. Using a gradient of 1.8 °F/100 feet, the subsurface temperature at the top of the Tokio Formation sands is 118 °F, and the subsurface temperature at the top of the James Lime sands is 144 °F.

(1.8°F x 29.15') + 65°F = 52° + 65° = 117°
(1.8°F x 43.65') + 65°F = 79° + 65° = 144°

The viscosity of the Tokio reservoir brine at reservoir temperature (118 °F) was calculated empirically since no specific measurement of viscosity was obtained at the time the brine was analyzed in March 1988. Utilizing published viscosity versus temperature data from Earlougher (1977) and an equivalent (to 1.05 S. G.) ~~7.6%~~ 7.137% NaCl solution, the formation fluid viscosity for the Tokio Formation sands is 0.67 cp at the reservoir temperature of 118 °F (see Figure V-4).

7823' ... = 7.8%
1.05 SG

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The viscosity of the James Lime reservoir brine at reservoir temperature (144 °F) was also calculated empirically since no specific measurement of viscosity was obtained at the time the brine was analyzed in March 1988. Utilizing published viscosity versus temperature data from Earlougher (1977) and an equivalent (to 1.127 S.G.) 17 % NaCl solution, the formation fluid viscosity for the James Formation sands is 0.68 cp at the reservoir temperature of 144 °F (see Figure V-4).

17.5%

V.A.3 Static Reservoir Pressures

Static bottomhole pressures (BHP's) were measured for the Tokio Formation during the completion of Ethyl (Albemarle) BDW No. 1 well in 1978 (Golden, 1993). Static bottomhole pressures (BHP's) were measured for the James Lime during the completion of Ethyl (Albemarle) BDW No. 2 well in February 1988 (see Appendix E). The observed pressures and depths are listed below:

Ethyl BDW-1 (Tokio)		Ethyl BDW-2 (James)	
Static Pressure (psia)	Date	Static Pressure (psia)	Date
1,244 @ 3,000 ft BGL	1978	1,954 @ 4,526 ft BGL	2/1988

The expected static bottomhole pressures in the Tokio and James Lime injection interval sands at the proposed DOW well location can be calculated using the above pressures measured in these offset wells located nine miles to the southeast, and converting them to the depths at the tops of the DOW injection intervals (2,915' BGL--Tokio and 4,365' BGL--James) using measured formation brine fluid densities. By converting these densities (1.053--Tokio and 1.127--James) to gradients of 0.456 psi/ft (Tokio) and 0.488 psi/ft (James), one gets expected static bottomhole pressures at the DOW well of 1,205 psia (1,244 psi – [85 ft x 0.456 psi/ft]) at the top of the Tokio injection interval (2,915' BGL) and 1,875 psia (1,954 psi – [161 ft x 0.488 psi/ft]) at the top the James injection interval (4,365' BGL).

34 79

62.4 lb / 144 sq in = 0.433 psi   62.4 lb / 144 sq in × 1.053 = 0.456   62.4 lb / 144 in × 1.127 = 0.488

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V.A.4 Fracture Pressure

The fracture pressure for the Tokio Formation sands injection interval reservoir can be calculated using the equation developed by Hubbert and Willis (1957) and refined by Eaton (1969, 1974). The equation is listed below.

$$P_t = \left[(P_{ob} - P_r) \left[\frac{V}{(1 - V)} \right] + P_r \right] * Z$$

Where:

P_t = fracture pressure (psi)
P_{ob} = overburden pressure gradient (psi/ft)
P_r = reservoir pressure gradient (psi/ft)
V = Poisson's ratio
Z = depth of interest (ft)

For the DOW Tokio and James injection intervals the variable values are:

0.9 ? P_{ob} = 1.0 psi/ft
P_r (Tokio) = 0.413 psi/ft (1,205 psi/2,915 ft) *
P_r (James) = 0.430 psi/ft (1,875 psi/4,365 ft) *
V (Tokio) = 0.36 (Eaton 1969, 1974), see Figure V-5
V (James) = 0.38 (Eaton 1969, 1974), see Figure V-5
Z (Tokio) = 2,915 ft
Z (James) = 4,365 ft

* P_r calculated using this method is lower as compared to using brine gradient shown on previous page, thus resulting in more conservative calculated reservoir fracture pressures

The calculated reservoir fracture pressures for the Tokio and James are:

P_{ob} - 0.9 : 2022 psi

2,166 psi at 2,915 feet (top of Tokio injection interval)
3,401 psi at 4,365 feet (top of James injection interval)

These calculated fracture pressures are equivalent to reservoir pressure increases of 961 psi (2,166 psi – 1,205 psi) for the Tokio injection interval, and 1,526 psi (3,401 psi – 1,875 psi) for the James injection interval. However, the maximum predicted reservoir pressure increases at the proposed DOW well of 338 psi in the Tokio sands reservoir and 650 psi in the James sands reservoir (as discussed in Section V.A.5—Pressure Buildup Predictions) do not approach the calculated fracture pressures.

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The fracture pressure calculation can also provide a calculation of the maximum allowable surface injection pressure (MASIP). The MASIP is equivalent to the reservoir fracture pressure minus the hydraulic head of the heaviest permitted fluid column in the well. The gradient used to determine the hydraulic head is 0.433×1.05= 0.455 psi/ft, equivalent to the heaviest injectate requested for these permits of 1.05 S. G. Calculating the pressure exerted by a full fluid column of this specific gravity at the reference depths listed above (2,915 feet--Tokio and 4,365 feet--James) yields pressures of 1325 1,326 psi (Tokio) and 1985 1,986 psi (James). Using these fluid column pressure values yield a MASIP of 840 psi (2,166 psi – 1,326 psi) for the Tokio, and 1,415 psi (3,401 psi – 1,986 psi) for the James. The proposed permitted MASIPs for the two injection intervals (825 psi--Tokio and 1,400 psi--James) thus maintain the injecting bottomhole pressures below the calculated fracture pressures. The effects of tubing friction pressure (an additional 15-20 psi) and wellbore skin have been ignored in calculating these MASIPs, thus allowing even larger safety margins above the requested maximum wellhead injection pressures. ?

V.A.5 Pressure Buildup Predictions

The THWELLS pressure model (Van der Heijde, 1990) was used to calculate maximum pressure increases that could occur in the Tokio and James injection intervals at the end of the 10-year permit period for the proposed DOW well. The THWELLS model employs the exponential integral to solve the equation of radial flow to or from single or multiple wells in an aquifer of infinite extent. The principle of superposition is employed to sum the effects of multiple real or image wells. The model is based on the following assumptions: the reservoir stratum is isotropic, homogeneous, and of infinite areal extent; regional groundwater flow is small and can be neglected during the injection period; groundwater is confined; and groundwater flows in a single layer of constant thickness which is bounded by impermeable boundaries on the top and bottom.

Modeling Procedure

The THWELLS model was used to simulate the pressure buildup due to injection at the proposed DOW well location. Simulation periods of ten years were used in modeling the

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pressure increase in the Tokio and James Lime injection intervals. The proposed maximum injection rates of 100 gpm into each interval were input into the models for the ten-year modeling periods.

Each injection interval is modeled separately as there is no interference between the two zones due to their vertical separation. The simulation begins in each model on day 0 with injection into the proposed DOW well at 100 gpm. The maximum proposed flow rates are projected into the future for ten years (3653 days).

The results of the pressure model runs (included in Appendix F--Tokio and G--James) were then used to develop contour maps illustrating the predicted pressure increases in the Tokio and James injection intervals. The modeling output was also used to predict the maximum extent of the cones of endangerment in each injection interval, and the maximum pressure increases at a distance of one foot from the center of well's borehole.

Model Input Parameters

The pressure model input parameters for the Tokio and James Formation injection interval are listed in Table V-1. As described in Section V.A.1, the porosity values for the Tokio and James Formation sands were derived from whole core analyses and open-hole density log evaluations. The permeabilities for the Tokio and James Formations sands were determined from whole core analyses and fall-off test results. The flow rates for the two injection intervals are 100 gpm each, for a period of ten years.

Pressure Modeling Results

The computed injection intervals reservoir pressure increases are conservative approximations for the purposes of predicting pressure increases within the Tokio and James Formation injection intervals, and potential endangerment of USDWs. The future rates are conservative for both models because injection rates actually will fluctuate and will be effectively lower during the projected injection history of the DOW well. These model parameters thus conservatively represent the conditions at DOW, and the resultant

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predictions are more than satisfactory for the purposes of determining pressure increases within the injection intervals.

For model verification purposes, hand calculations of pressure buildup were made using the Matthews and Russell (1967, p.16) equation presented by Walk Haydel (1999). Results of these calculations are included in Appendix H. Table V-2 presents a comparison of these results to the THWELLS derived pressure buildup results.

The Walk Haydel (1999) draft application provided pressure model inputs that were in many cases unverified. It is the intent of this current application to provide pressure modeling input values that are representative of actual measured values from the James and Tokio injection intervals and can be documented, not to default to previous draft permit values. Numerous values used in this application (Tokio thickness, James porosity, total compressibility) are more conservative (result in higher pressures) than the Walk Haydel values, and work to provide larger pressure increases in the modeling; others of the model input parameters used in this application result in less conservative (lower) pressure increases. DOW believes that all of the input values used herein are representative of the injection interval characteristics, are more appropriate than the ones selected in the draft permit application prepared by Walk Haydel, and are justified by the previously discussed documented references.

The results of the THWELLS pressure modeling for the Tokio and James Formation strata injection intervals are shown on Figures V-1 and V-2. Figure V-1 is a map showing the modeled pressure increases (contoured in psi) within the Tokio Formation strata injection interval after ten years at the proposed maximum rate of 100 gpm. Figure V-2 is a map showing the modeled pressure increases (contoured in psi) within the James Lime strata injection interval after ten years at the proposed maximum rate of 100 gpm.

The pressure model results indicate that after 10 years of future injection at 100 gallons per minute into each proposed DOW well injection interval, the injection interval reservoir pressure increases will be a maximum of 338 psi in the Tokio strata at one foot from the

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well, and 650 psi in the James strata at one foot from the well. The pressure increases around the well decrease radially to a maximum of approximately 110 psi in the Tokio strata at a distance of 0.5 miles (AOR) from the wellbore, and approximately 195 psi in the James strata at that same distance. These model results are similar to the results obtained using the Matthews and Russell equation (see Appendix H and Table V-2). The THWELLS output files for the pressure increase in the Tokio and James Formation injection intervals are included in Appendix F (Tokio) and G (James).

V.A.6 Cone of Influence Calculations

The THWELLS model was used to predict whether artificial penetrations within the 0.5-mile radius AOR surrounding the proposed DOW well meets standards so as to prevent endangerment of the USDW due to increased injection interval pressures. In order to assure that no artificial penetrations in the AOR pose a risk for movement of injected fluids out of the receiving interval and into an overlying USDW, the model predicted reservoir pressures are compared to the calculated reservoir pressure increase necessary to displace a mud or weighted fluid column in an abandoned wellbore and potentially force injected fluids into a USDW.

Drilling mud in an abandoned wellbore is a barrier to vertical migration of native or injected fluids from the injection zone because of the hydrostatic pressure differential between the mud column and the injection zone reservoir pressure. One purpose of drilling mud is to control or overcome the formation pressures of the geologic stratum penetrated. To accomplish this, the hydrostatic gradient of the mud column must be equal to or greater than the equivalent of the formation pressure encountered. To determine the pressure or gradient exerted by a column of mud, a reported or estimated value of the mud weight in the wellbore is required. A review of available data indicates a range of mud weights was used for drilling and plugging wells within the DOW 0.5-mile radius AOR and the local geologic study area. For purposes of this demonstration, a brine weight of 1.10 specific gravity (S.G.) is employed for this calculation, as per ADEQ request. The pressure gradient increases in direct proportion with the weight of the fluid. A brine weight of 1.10 S.G. would result in a pressure gradient of approximately 0.4763

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psi/foot of depth. Before vertical migration of fluids from an abandoned wellbore can occur, the injection reservoir pressure at such an abandoned wellbore (plugged only with brine) would have to increase to that pressure necessary to displace a 1.10 S.G. brine column. This is considered to be a very conservative figure since the gel strength of any mud present, the resistances of the mud to flow, borehole conditions, and other factors have not been considered.

Since the top of the Tokio injection interval is at a depth of 2,915 feet BGL at the proposed DOW well location, the pressure exerted by a brine column from that depth to the surface at a well plugged and abandoned only with 1.10 S.G. brine in the borehole would be 1,388 psi (2,915 feet x 0.4763 psi/ft). The estimated native formation pressure in the Tokio Formation is 1,205 psi at 2,915 feet BGL. The formation pressure increase at 2,915 feet would have to exceed 183 psi (1,388 psi – 1,205 psi) before any upward movement of fluid would be possible in an abandoned borehole plugged with only 1.10 specific gravity brine. This 183 psi pressure increase "cone of endangerment" is plotted with a bold, dashed contour line on Figure V-1.

Since the top of the James Lime injection interval is at a depth of 4,365 feet BGL at the proposed DOW well location, the pressure exerted by a brine column from that depth to the surface at a well plugged and abandoned only with 1.10 S.G. brine in the borehole would be 2,079 psi (4,365 feet x 0.4763 psi/ft). The estimated native formation pressure in the James Lime is 1,875 psi at 4,365 feet BGL. The formation pressure increase at 4,365 feet would have to exceed 204 psi (2,079 psi – 1,875 psi) before any upward movement of fluid would be possible in an abandoned borehole plugged with only 1.10 specific gravity brine. This 204 psi pressure increase "cone of endangerment" is plotted with a bold, dashed contour line on Figure V-2.

Two artificial penetrations were identified which penetrated the Tokio or James Formation injection intervals within the proposed DOW well location 0.5-mile radius AOR, and are completed as Smackover brine production or disposal wells. These two wells (Map ID Nos. 1 and 3) are cased and cemented entirely across the Tokio and James

Formation injection intervals (see Section 3.0), and thus provide no conduits for movement of fluid or pressure effects upward out of the DOW injection zone. One well within the AOR (Map ID No. 4, located 2,500 feet to the northwest of the proposed DOW well location) has no completion or plugging records available; it is known from maps and records that this well was plugged in 1934, and has a total depth of 3,110 feet (see Appendix B). As such, this well could be considered as a borehole analogous to the worst case abandoned borehole described in the previous paragraph, filled only with 1.10 specific gravity brine. The three non-freshwater artificial penetrations within the 0.5-mile radius AOR (Map ID Nos. 1, 3, and 4) are plotted on Figures V-1 and V-2. Figure V-1 illustrates that under the Tokio modeling scenario, these three wells are outside of the cone of endangerment for the Tokio Formation injection interval, and thus pose no threat for upward movement of injected fluids. Figure V-2 illustrates that under the James modeling scenario, the worst-case well (Map ID No. 4) is also outside of the cone of endangerment for the James Formation injection interval, and poses no threat for upward movement of injected fluids through its borehole. In addition, this well has a total depth some 1,250 feet shallower than the top of the James injection interval. Minor expansion of the James cone of endangerment to incorporate this well within the cone still would not result in an endangerment problem from the James at this well, as the intervening shale, limestone, and anhydrite strata between the top of the James and the base of the Map ID 4 borehole provide no conduit for upward fluid movement. As a result, no endangerment due to James pressure effects into this well is possible. The two operating wells within the cone of endangerment both have sufficient cement and casing to prevent upward movement of injected fluids from the James Formation strata into USDWs. Records for the wells within the AOR are included in Appendix B.

When the DOW injection well is drilled and completed, the model input values will be verified with site-specific values, and if these values would result in larger cones of endangerment, DOW will rerun the pressure modeling to determine revised sizes of the cones of endangerment.

Actual operations typically include shut down periods, which allow for reservoir pressure recovery cycles that reduce the maximum build up pressures. In addition, it is not anticipated that DOW will operate the injection wells in the future at continuous, non-ceasing, maximum injection rates. Therefore, there appears to be no potential for vertical movement of fluid from an abandoned wellbore into a USDW due to the operations of the proposed DOW injection well.

V.A.7 Extent of the Waste Plumes

The radii of the waste fronts around the proposed DOW well projected 10 years into the future are calculated below for the Tokio and James Formation injection intervals. The predicted radii of the waste fronts are calculated assuming that 100 percent of the proposed yearly maximum injection rate for each interval will be injected. The radial distance of displacement was calculated using the following equation:

$$r = \sqrt{\frac{Q}{\pi h \phi}} \qquad \text{(Greene, 1983)}$$

Where:

r = radial distance of fluid front from well, feet;

Q = cumulative volume of fluid injected, cubic feet (ft^3)

ϕ = porosity of receiving formation

h = thickness of formation, feet.

For the Tokio 10-year projected operational period (at 100 gpm), the radius of the waste plume for the proposed DOW well is:

$Q = (100\ \text{gpm})(525{,}600\ \text{min/yr})(10\ \text{yr})(0.1337\ ft^3/\text{gal})$

$= 70{,}272{,}720\ ft^3$

$\phi = 0.28$ fractional porosity

h = 55 feet (net perforated thickness)

Thus,

$$r = \sqrt{\frac{70{,}272{,}720\,\text{ft}^3}{(\pi)(55\,\text{ft})(0.28)}} = 1{,}205\,\text{ft}$$

For the James 10-year projected operational period (at 100 gpm), the radius of the waste plume for the proposed DOW well is:

$$Q = (100\text{ gpm})(525{,}600\text{ min/yr})(10\text{ yr})(0.1337\text{ ft}^3\text{/gal})$$
$$= 70{,}272{,}720\text{ ft}^3$$
$$\phi = 0.21 \text{ fractional porosity}$$
$$h = 50 \text{ feet (net perforated thickness)}$$

Thus,

$$r = \sqrt{\frac{70{,}272{,}720\,\text{ft}^3}{(\pi)(50\,\text{ft})(0.21)}} = 1{,}460\,\text{ft}$$

V.B References

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VI. WASTES AND WASTE MANAGEMENT

The Dow Chemical Company (DOW) West Plant facility previously manufactured organic and inorganic chemicals using bromine extracted from Smackover Formation brines. Albemarle Corporation currently owns this plant and utilizes numerous Class V injection wells for tail brine disposal into Upper Jurassic Smackover limestones. A groundwater recovery operation is currently underway on the DOW and adjacent Albemarle property, with the treated groundwater being disposed of into Albemarle's tail brine disposal system. DOW intends to use the proposed Class I injection well to dispose of recovered groundwater from its acreage and surrounding areas on the Albemarle facility. In addition, the well will inject inherently non-hazardous process wastewaters from the Albemarle bromine extraction facility. The Albemarle wastewater sources are included in Table VI-1.

DOW will operate the well as a non-hazardous injection well, injecting groundwater treated to below hazardous levels (as defined in 40 CFR 261.24 and 268.40) and non-hazardous process wastewater from the adjacent Albemarle bromine production facility. The chemical constituents within the DOW waste stream that could make the injectate a hazardous waste stream include ethylene dichloride (EDC), ethylene dibromide (EDB), and dibromochloropropane (DBCP). A steam stripper process is used to pre-treat the recovered groundwater to non-hazardous levels (see EDC Table VI-2). The disposal system will consist of two 500-barrel storage tanks, transfer pumps, and a cartridge filtration facility that will deliver treated groundwater and process wastewater to the Class I injection well. Replaceable cartridge filters will provide filtration down to 10 microns. Figure VI-1 is a flow diagram illustrating the pretreatment process and disposal facilities. A plat of the plant showing the location of all waste flow lines and the preinjection facilities is included as Figure VI-2. A low pressure wastewater flow line from the steam stripper to the proposed DOW injection well location will be constructed of HDPE pipe with a relatively high burst pressure (approximately 200 psi), and located in the same pipe racks as currently service the French Drain No. 4 system. The line will be monitored

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visually at least once per shift to prevent spills along the line. The injection pumps will be located near the injection wellhead, and the high pressure flow line to the wellhead will be constructed of high-burst steel piping.

The recovered groundwater to be injected into DWD-1 is collected and routed through dedicated systems to the steam stripper. Groundwater is pumped from the French Drain Sumps into surge tanks. Water from these tanks is pumped to a holding tank at the stripper. Organics are separated in the steam stripper and collected in an accumulation vessel prior to being transferred to one of two dedicated transportation canisters for recovered organics. The water phase is transferred from the stream stripping unit to storage tanks and then pumped from the tanks to the booster pumps for disposal into an injection well. Condensate from the steam stripper is transferred back to the accumulation vessel and vapor is vented through carbon filters.

The capacity of the stream stripper is now approximately 60 gpm as a result of a recent retrofit, with the current throughput averaging 10-30 gpm. The stripped wastestream will be directed to the planned DOW injection well. As such, the proposed injection well has been designed to accept 100 gpm, and the reservoir pressure modeling incorporates this injection rate.

The purpose of the French Drain system and the proposed injection well is to keep the debrominated brine in the groundwater from migrating offsite. As such, there is currently no estimate available as to when the groundwater management system will have recovered all of the leaked tail brine pond fluids. At this time, DOW intends to operate the groundwater management system for the foreseeable future.

VI.A Waste Streams for Injection

The West Plant generates wastewater from groundwater recovery and from the production of bromine. The waste stream proposed for injection into DOW well DWD-1 is non-hazardous. Table VI-1 lists the wastewater sources. Effluent from the pre-treatment

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facility is primarily water with only (rarely) trace amounts of brominated organic compounds. Trace amounts generally are considered to be concentrations slightly above detection limits, but well below hazardous levels.

Representative injectate samples will be collected on an annual basis and sent to a laboratory for analysis of certain metals, organics, and inorganic constituents. Analytical results from recent representative wastestream samples from both the DOW (L5 stripper effluent) and Albemarle (grab sample 358329) sources are included in Appendix I. The pH of the injected wastestream shall be greater than 3.0 and less than 12.0. The density of the injected waste will not exceed a specific gravity of 1.05.

VI.B Injection Fluid Volumes

During normal operation, the proposed injection well will operate continually except when mechanical integrity tests, workovers, maintenance or possible emergency shutdowns occur. All operating parameters will be closely monitored to prevent exceeding ADEQ permit limits.

The maximum instantaneous rate of injection requested in this permit application for DWD-1 is 100 gpm into either the James Lime Injection Interval (primary) or the Tokio Injection Interval (alternate). The requested maximum injection rate and volume on a cumulative basis are summarized below:

Rate/Volume Catagory	Rate/Volume
Maximum Injection Rate	100 gpm
Maximum Monthly Injection Volume	4,464,000 gallons(1)
Maximum Annual Injection Volume	52,560,000 gallons(2)

(1) equivalent to 100 gpm over 31 days
(2) equivalent to 100 gpm over 365 days

VI.C Compatibility

Following completion of injection well DWD-1 and retrieval of reservoir fluid and cores, a determination of the compatibility of the proposed injection fluid with the formation and formation fluids will be conducted. Compatibility testing between the waste stream and well construction materials is discussed in Section VII.C. The following discussion presents the methodology that will be utilized to determine the compatibility of the injected waste stream to the formation brine and injection zone matrix (injection interval and confinement interval).

Compatibility of Injection Fluid to Formation Water

Wastewater/formation water compatibility testing will be performed after formation fluid samples have been recovered from the proposed injection intervals. The formation water samples will be analyzed for standard groundwater parameters prior to compatibility testing to confirm inorganic constituent concentration. Filtered wastewater samples will be mixed at varying ratios with formation brine and placed in a temperature-controlled environment to duplicate bottomhole temperature conditions. After 24 to 48 hours, the wastewater/formation water samples will be evaluated for precipitation of suspended solids. If suspended solids generated by the precipitation are present in the mixtures, suggesting incompatibility, the solids will be analyzed to determine the nature of the precipitate. If appropriate, buffer solutions will be emplaced in the formation prior to wastewater injection to provide a neutral interface between the native formation brine and the injected wastewater, thereby minimizing mixing of any incompatible fluids in the reservoir in the near-wellbore region.

Compatibility of Injection Fluid to Formation Rock

Wastewater compatibility testing with formation rock material will be performed once cores of the injection intervals have been recovered from the well. Wastewater compatibility will be determined in the following fashion:

1) liquid flow-through permeability of the core to native formation brine will be determined to establish a base-line core permeability,
2) liquid flow-through permeability of the core to wastewater will be determined, and
3) liquid flow-through permeability of the core to native formation brine will be redetermined to establish a final core permeability.

OK 5 Nov 02

Permeability measurements will be taken at successive increments of total fluid throughput up to a maximum of 100 pore volumes. Compatibility of the wastewater to formation core will be assessed by comparing permeability of the core to formation fluid (before and after testing with wastewater) with the permeability of the core while injecting the proposed wastestream.

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VII. INJECTION WELL CONSTRUCTION AND OPERATION

Dow Chemical Company (DOW) is requesting a permit to drill a Class I injection well primarily for the disposal of recovered groundwater and process wastewater. The proposed DOW injection well will be constructed in accordance with Arkansas UIC regulations. All materials of construction will be new. The following sections discuss the procedures that will be followed to drill, construct, test, and plug and abandon (when operations cease) the proposed DOW injection well. Additionally, DOW will submit a detailed drilling and completion plan to the ADEQ for review and approval following permit issuance, but prior to commencement of drilling activities.

VII.A. Construction and Completion Summary

The DOW well will be drilled to a depth of approximately 4,600 feet. Two injection intervals are proposed for perforated completion in the DWD-1 well. The primary injection interval is the James Limestone Formation between the approximate subsurface depths of 4,365 feet to 4,475 feet. The Tokio Formation, between the approximate subsurface depths of 2,915 feet to 3,100 feet, has been chosen as the alternate injection interval, in the event that the James is deemed unsuitable (or at a later date, should become unsuitable) for injection.

VII.A.1. Proposed Well Configuration

Figure VII-1 is a construction schematic of the proposed injection well utilizing the James completion. The alternate Tokio injection interval depth is also shown. Surface casing (11 ¾-inch) will be set and cemented at approximately 1,400 feet in the DOW well. The base of the surface casing at 1,400 feet will extend into confining beds below the base of the lowermost USDW and will be cemented from the base of the casing to the surface using a minimum of 120% of the calculated annular volume (or as appropriate based on borehole conditions). This depth allows for protection of the lowermost USDW (base at approximately 1,335 feet, see Section IV) from injected fluids.

DOW's proposed injection well will be completed with 7 5/8-inch longstring casing set and cemented at approximately 4,600 feet by circulating cement from the base of the casing to the surface using a minimum of 120% of the calculated annular volume (or as appropriate based on borehole conditions). Setting the casing at this depth allows for accessing either injection interval via perforated completion techniques.

The 11 ¾-inch surface casing will consist of API Standard K-55 (or equivalent) grade carbon steel, which has proven to be compatible with shallow formation fluids. The 7 5/8-inch longstring casing will consist of a mixed string of approximately 4,600 feet of N-80 (or equivalent) grade carbon steel casing and corrosion-resistant alloy (CRA) casing adjacent to the injection intervals. The surface and longstring casings will be set using centralizers as appropriate to centralize the casing strings in the borehole to allow for a more thorough cementing job.

The injection tubing will be 3 ½-inch, Tubular Fiberglass Company (TFC) Red Box, 2,000 psi-rated, set into a packer above the appropriate injection interval depth (4,300 (±) feet for the James Formation or 2,900 (±) feet for the Tokio Formation). The packer will be a Groundwater Protection Systems (GPS) "Model 12" (or equivalent), full-bore retrievable packer with flow-wetted surfaces manufactured of CRA. This packer design has been widely used in injection well applications with excellent results. The packer will be seated in the 7 5/8-inch CRA casing immediately above the chosen injection interval.

Cement and casing to be used in the construction of the well will be designed for the life expectancy of the well, including the post-closure care period and will be emplaced in accordance with Arkansas UIC regulations. The casings proposed for the DOW well (including casing connections), are rated to have sufficient structural strength to withstand, for the design life of the well, the maximum burst and collapse pressures which may be experienced and the maximum tensile stress which may be experienced at any point along the length of casing or tubing. The following factors were considered when selecting and designing casing, tubing, packers and cements to be used in constructing DOW's injection well:

1) depth of the lowermost USDW or fresh water aquifer
2) depth of setting (depth to top of injection interval);
3) injection pressure, annular pressure, external pressure, and axial loading;
4) hole size;
5) quantity and chemical composition of the injected wastestream;
6) corrosiveness and temperature of injected fluid and formation fluids,
7) lithology of the injection zone and confining zone;
8) types and grades of cement;
9) casing size and grade and tensile, burst, and collapse strengths; and,
10) tubing size and grade and tensile, burst, and collapse strengths.

Historical materials performance, discussions with vendors, past performance records and materials brochures were also considered when selecting the materials to be used in constructing the proposed injection well.

Cementing will be by the pump and plug method. The cement properties for the surface and longstring casings are as follows:

11 ¾-Inch Surface Casing:

Lead Slurry: Standard (Class "H") Lite Cement containing 8% Bentonite, 2% ~~Salt~~ (accelerator), ¼ lb/bbl Fluid Loss additives. Mixed at 13.1 lb/gal, 1.92 ft^3/sk, 10.4 gal H_2O/sk for 360 psi compressive strength in 24 hours at 80°F. Cement volume designed to occupy 14 ¾-inch x 11 ¾-inch annular volume from 900 feet to surface (900 feet annular fill).

Tail Slurry: Standard (Class "H") Cement containing 2% ~~Salt~~ (accelerator), ¼ lb/bbl Fluid Loss additives. Mixed at 15.6 lb/gal, 1.18 ft^3/sk, 5.20 gal H_2O/sk for 2,026 psi compressive strength in 24 hours, 3,835 psi compressive strength in 72 hours at 110°F. Cement volume designed to occupy shoe joint plus 14 ¾-inch x 11 ¾-inch annular volume from shoe at 1,400 feet to 900 feet (500 feet annular fill).

7 5/8-Inch Longstring Casing:

First Stage: Epseal synthetic cement. Epseal volume designed to occupy shoe joint plus 10 5/8-inch x 7 5/8-inch annular volume from shoe at 4,600 feet to stage tool at approximately 2,700 feet (1,900 feet annular fill).

Second Stage:
Lead Slurry: Standard (Class "H") Lite Cement containing 8% bentonite, ¼ lb/bbl fluid loss additives. Mixed at 13.1 lb/gal, 1.92 ft^3/sk, 10.4 gal H_2O/sk for 360 psi compressive strength in 24 hours at 80°F. Cement volume designed to occupy 10 5/8-inch x 7 5/8-inch annular volume from 2,100 feet to surface (2,100 feet annular fill).

Tail Slurry: Standard (Class "H") Cement with ¼ lb/bbl fluid loss additives. Mixed at 15.6 lb/gal, 1.18 ft^3/sk, 5.20 gal H_2O/sk for 2,026 psi compressive strength in 24 hours, 3,835 psi compressive strength in 72 hours at 110°F. Cement volume designed to occupy 10 5/8-inch x 7 5/8-inch annular volume from stage tool at approximately 2,700 feet to 2,100 feet (600 feet annular fill).

Waste Fluid Management Program

Drilling mud, which is circulated out of the borehole during drilling operations, will flow through solids control equipment consisting at a minimum of a shale shaker, desander, and/or desilter to remove drill cuttings from the drilling mud. The drill cuttings and drilling mud will be disposed of according to applicable federal and state regulations.

VII.A.2. Proposed Logging and Formation Testing Program

Electric Logs

During the drilling and construction of the injection well, appropriate logs and tests will be run to determine or verify the depth, thickness, porosity, permeability, rock type, and the salinity of any entrained fluids, in all relevant geologic units to assure conformance with applicable regulations, and to establish accurate baseline data against which future measurements may be compared.

DOW will run, at a minimum, the following logs in the following situations: (i) Prior to installation of the 11 ¾-inch surface casing: resistivity, spontaneous potential, natural gamma ray, and 4-arm caliper logs will be run; and a cement bond with variable density log, and a temperature log will be run after the 11 ¾-inch surface casing is set and cemented. (ii) Prior to installation of the 7 5/8-inch longstring casing: resistivity, spontaneous potential, compensated density and/or neutron porosity, fracture finder, dipmeter, 4-arm caliper and natural gamma ray logs will be run. Additionally, a cement no deviation std. given

bond with variable density log, temperature, casing inspection and inclination survey will be run after the 7 5/8-inch longstring casing is set and cemented.

Formation Core Sample Testing Program

The retrieval of full-hole cores will be attempted from the proposed Tokio and James injection intervals and from the confining and upper injection zones. Full-hole cores will be recovered in fiberglass sleeved core barrels and recovery depths will need to be affixed upon retrieval. Once this has been accomplished, cores are to be sealed (to retain in-situ fluid content), and sent to core laboratories for pertinent analyses. The core testing will include:

Type	**Frequency**
Slabbing	Entire length
Standard Full Diameter Analysis	Every foot
Core Gamma Ray	Entire length
Vertical Permeability	Selected samples in Confinement
Mineralog Analysis	Selected samples from all cores
X-Ray Diffraction	Selected samples in Tokio and James
Scanning Electron Microscopy	Selected samples in Tokio and James
Thin Section Preparation and Petrography	Selected samples in Tokio and James
Waste to Formation Compatibility	Selected samples in Tokio, James, and Confinement
Mechanical Properties and Acoustic Velocity	Selected samples in Tokio, James, and Confinement

If full-hole cores cannot be retrieved, sidewall cores will be taken over the intervals of interest. The core samples will be described and analyzed for permeability, porosity, and water saturation.

Formation Fluid Compatibility Testing Program [illegible]

Actual samples of the proposed waste streams will be provided by DOW for fluid compatibility testing with Tokio and James formation water and injection interval core.

Fluid Sampling Program

A minimum of one quart of mud will be recovered prior to each open hole logging suite. The mud sample will be given to the logging company for resistivity analysis.

Formation fluid will be recovered after perforating the James and/or Tokio Formations via workstring swabbing or pumping operations. A minimum of one (1) 55-gallon drum of formation fluid will be recovered (after the fluid returns have cleaned up) for use in compatibility testing with the waste stream and core samples.

VII.A.3. Wellhead and Annulus Monitoring Drawings

Figure VII-2 is a schematic illustrating the proposed wellhead configuration. The drawing illustrates the type and size of valves, flanges, fittings, etc. proposed for the DWD-1 injection wellhead. The wellbore annulus monitoring system of the DWD-1 injection well is shown in Figure VII-3.

Once the well is completed, a sign shall be posted at the well site showing the name of the company, company well number, and ADEQ permit number. The sign and identification will be in the English language, clearly legible and will be in numbers and letters at least 1-inch high. Also, an all-weather road will allow access to the proposed injection well and related facilities.

VII.A.4. Injectivity Testing and Well Stimulation

Following perforation of the selected injection interval, the bottom-hole pressure will be measured as close to the completion depth as practical to obtain the initial reservoir pressure. In addition, the static fluid level in the well will be determined. The hole will then be cleared of drilling fluid by swabbing or pumping and a representative sample of reservoir fluid obtained. A clean reservoir fluid sample will be collected during the final stages of flowback, and pH and conductivity will be determined.

Injectivity testing will be conducted following well completion to establish the initial reservoir parameters and to determine if well stimulation is required. A 24-hour step-rate injection test is proposed for the potential injection interval in the DWD-1 well. The maximum injection rate during the test period should be considered as the permitted maximum rate for that interval. The injectivity test will be conducted as follows:

1. Go in the hole with a quartz crystal-type pressure gauge/spinner survey combination to the mid-point of the injection interval.

2. Measure static bottom-hole pressure at a fixed depth.

3. Begin injection test at approximately one-fourth of permitted injection rate (25 gpm). Increase injection rate to the maximum permitted (100 gpm) or until maximum permitted surface injection pressure is reached (1,400 psi for James or 825 psi for Tokio).

4. Record bottom-hole pressure during fall-off period until bottom-hole pressure has stabilized. Pressure gauge should be located at the same depth as the static bottom-hole pressure was recorded.

5. Evaluate injectivity test to determine the need for stimulation to increase well capacity.

If initial injectivity is not adequate, the perforated interval will be stimulated to establish better hydraulic connection with the reservoir. The ADEQ will be notified of any stimulation procedures before the zones are stimulated.

The final phase of the completion will involve installation of a retrievable injection packer and the running of the 3 1/2-inch injection tubing. In addition, post-assembly mechanical integrity testing consisting of an annulus pressure test, a baseline temperature log, a radioactive tracer survey, and a spinner survey will be performed.

VII.B. Injection Well Operations

VII.B.1. Maximum Injection Rates and Volumes

The maximum rate of injection requested in this injection well permit application for DOW well DWD-1 is 100 gpm. This maximum instantaneous rate of injection is requested for either a James or Tokio completion. The maximum monthly injection volume is 4,464,000 gallons for DWD-1 and the maximum annual injection volume is 52,560,000 gallons.

VII.B.2. Maximum Surface Injection Pressures

The requested maximum surface injection pressures for this permit application are 1,400 psig and 825 psig for injection of the permitted aqueous waste stream into the James Lime Formation or Tokio Formation, respectively. This pressure is consistent with fracture pressure calculations made using the analytical solution presented in Section V.A.4.

VII.B.3. Range in Injection Rate and Surface Injection Pressure

Average monthly rates of injection for the proposed injection well are anticipated to range from 50 gpm to 100 gpm. Anticipated surface injection pressures for the proposed injection well should range from 0 psig to 1,400 psig for a James Lime completion and 0 psig to 825 psig for a Tokio completion. The anticipated average annual volume of waste to be disposed of into the proposed injection well is 40,000,000 gallons (at 75 gpm). The anticipated operational life of the proposed injection well is 20 years. Therefore, the anticipated volume to be injected over the life of the well is 800,000,000 gallons.

75 gal/min x 60 min/hr x 24 hr/day x 365 day/yr = 39,400,000 gal

VII.B.4. Facility Monitoring Plans

DOW will operate the DWD-1 injection well and the injection pump system to ensure that the permitted operating parameters, as reviewed, approved, and permitted by the ADEQ, are not exceeded. Table VII-1 lists the monitoring and reporting requirements for the injection well operations.

VII.B.4.1 Routine Monitoring Practices

Typical operations will require semi-continuous injection into DWD-1, with occasional downtime to conduct calibration, maintenance, and repair work associated with the pretreatment system and injection wellhead monitoring devices. The instrumentation and pressure gauges for the injection well will be located in a weatherproof enclosure near the wellhead. Recording devices will be located at the well that record well operating parameters. These instruments will measure and continuously monitor and record the injection tubing and annulus pressures and flow rate of the injected fluid into the injection well.

Annulus pressure and injection pressure gauges will be installed at the wellhead to allow visual monitoring of operating conditions. Additionally, alarms will be provided to alert operators to high flow rates, low annulus pressure, and low level in the annulus fluid tank. All gauges, pressure sensing and recording devices will be tested and calibrated quarterly. In the event that an alarm sounds, facility personnel will notify a trained operator who will investigate and correct the problem.

Notification of Well Failures or Significant Operating Parameter Changes

DOW will operate the permitted injection well and the injection pump system to ensure that the maximum allowable surface injection pressure, as reviewed and permitted by the ADEQ, is not exceeded. While in operation, DOW will maintain an annulus pressure as specified in the permit. DOW will assure that the annulus pressure maintained on the injection well will be a minimum of 100 psi at all times. The fluid in the annulus of the injection well will consist of corrosion inhibited fresh water, which is non-corrosive.

DOW personnel will notify the ADEQ within 24 hours of any significant change in monitoring parameters or any other observations which could reasonably be attributed to a leak or other failure of the well equipment or injection zone integrity.

Injectate Monitoring

DOW will annually sample and test its injectate to obtain a detailed chemical and physical analysis of the fluid to be disposed of in DWD-1. Analysis of the injection fluid will be performed following the ~~guidelines~~ conditions set forth in the ADEQ Class I permits, and results will be provided to the ADEQ as required in the permits. DOW will analyze the injected waste following the applicable [illegible] ~~guidelines~~. In addition, DOW will conduct continuous monitoring of the pH of the injected fluids so that specified permit limits are maintained.

Operations Record Maintenance

DOW will maintain complete and accurate records of all monitoring required by the permits, all periodic well tests, all shut-in periods and times that emergency measures were used for handling injection fluid, and all additional information on conditions that might reasonably affect the operation of the DWD-1 injection well. DOW will retain all monitoring and reporting records at the facility site for a period of at least three years from the date of the record or sample. DOW will also retain for a period of five years following abandonment of the DWD-1 injection well, records of all information resulting from any monitoring activities or other records required by the permits. DOW will make available to the ADEQ all records, upon request, that are required to be kept by the permits.

VII.B.4.2 Mechanical Integrity Testing

The mechanical integrity tests to be used by DOW will consist of an annual annulus pressure test and bottomhole pressure survey, plus the running of a radioactive tracer survey every five years, as required by the ADEQ. The methods and standards generally accepted in the industry are applied in conducting and evaluating the tests required to demonstrate mechanical integrity. Testing results must be demonstrated to the satisfaction of the Director in accordance with 40 CFR 146.08 and within the guidelines established by the ADEQ.

DOW will maintain mechanical integrity in the injection well at all times by undertaking, at a minimum, the following steps:

1. DOW will demonstrate the mechanical integrity of DWD-1 once every year during the operating life of the well.

2. A radioactive tracer survey will be run to demonstrate external mechanical integrity above the injection interval once every five (5) years during the operating life of the well.

3. The tubing-casing annulus will be tested at least once a year during the operating life of the well.

4. Mechanical integrity will be demonstrated following any major operation that involves removal of the injection tubing, recompletions, or unseating of the packer.

5. Mechanical integrity will be demonstrated following any shut-down period of the well in excess of 30 days.

6. During major workovers, the bottom hole pressure will be determined by either direct measurement by conventional techniques ~~or~~ and by calculation using the specific gravity of fluid in the wellbore and the static fluid level.

VII.B.5 Contingency Plans

An on-demand agreement with an off-site waste injection well commercial facility will be established prior to commencement of injection operations. In the event that the DWD-1 well suffers a catastrophic failure, DOW will utilize two 500-barrel above ground storage tanks for emergency containment. The tanks will be located in a diked concrete-lined area, which drains to a sump, routed to holding tanks. Each holding tank will have a 21,000-gallon capacity (42,000 gallons for both) and necessary piping for inlet of waste stream and header arrangement for loading of transports from a commercial injection well facility. The capacity of both tanks will allow approximately 5.6 hours of retention time at a flow rate of 100 gpm, which is expected only during extended periods of abnormally high rainfall. The commercial facility will dispose of the wastewater until the DOW well can be placed back into operation.

VII.C. Waste Compatibility and Corrosion Monitoring

VII.C.1 Compatibility Testing

The wastewater to be disposed of in DWD-1 is not identical to that disposed of in Albemarle's BDW No. 2, BDW No. 3, and BDW No. 13 at their South Plant. Therefore, compatibility testing conducted of those wastewaters with the proposed DOW well materials prior to drilling has not been performed. DOW will integrate the results of ongoing wastewater compatibility testing with the proposed materials of construction (i.e., tubulars and cement) into the final detailed drilling and completion plan prior to submittal of the plan to the ADEQ for final review and approvals. Preliminary results of the wastewaters-to-materials of construction compatibility testing indicate that the materials specified in Figure VII-1 should provide the necessary corrosion resistance to the wastewaters that could be injected into DWD-1.

VII.C.2 Corrosion Monitoring

The components of all the facilities and the proposed well, which will come in contact with the proposed waste stream, will be selected so that any corrosion will be minimal. Carbon steel equipment has been successfully used for more than 10 years at the Albemarle West Plant to store, pump, and pipe similar fluids. No corrosion problems have been observed on surface or subsurface equipment. However, given the low pH range for the DOW wastewater, CRA casing material adjacent to the proposed injection intervals, a packer with flow-wetted surfaces manufactured of CRA, and fiberglass injection tubing will be required to provide long-term, trouble-free well operation. ?

VII.D. Well Closure and Post-Closure Care Plans

VII.D.1. Closure Plan for Injection Well

DOW's DWD-1 will be plugged and abandoned following the requirements of applicable regulations. Prior to closing the well, DOW will observe and record the pressure decay for a time specified by the Director. In addition, appropriate mechanical integrity testing shall be conducted to ensure the integrity of that portion of the longstring casing and cement that will be left in the ground after closure to ensure that no fluids move into or between USDWs.

Prior to plugging, the well to be closed will be in a state of static equilibrium with the mud or fluid weight equalized top to bottom, either by circulating the mud or fluid in the well at least once or by a comparable method prescribed by the Director.

Notice of intent to plug and abandon the subject disposal well will be given at least 60 working days prior to closure of each disposal well. A closure report certifying that the well or wells were closed in accordance with applicable requirements, will be submitted to the proper agencies within 30 days of plugging each well. The report will include any newly constructed or discovered wells within the area of review. When plugging and abandonment is complete, DOW will submit certification to the Director (signed by DOW and by a licensed, professional engineer with current registration, who is knowledgeable and experienced in practical drilling engineering and who is familiar with the special conditions and requirements of injection well construction) that the injection well has been closed in accordance with ADEQ regulations.

DOW will accomplish plugging of the proposed injection well by cementing the well from total depth to surface. The procedures utilized for the closure of the injection well, depending upon the completion interval, are described on the following pages:

DWD-1 (James) Well Closure Plan

1. Notify the ADEQ Director at least 60 days prior to commencement of closure according to the following closure plan (once approved).

2. Prepare location for workover rig.

3. Move in and rig up workover rig and support equipment.

4. Pressure test 7 5/8-inch x 3 ½-inch annulus to 1,500 psi for 60 minutes with ADEQ inspector present. Record test results.

5. Perform and record a pressure decay test for a length of time specified by the Director.

6. Run logging program to include a radioactive tracer survey to verify the external mechanical integrity of the well.

7. Pump two tubing volumes of fresh water (or brine water of sufficient density) to kill well.

8. Break down the christmas tree valving and bonnet and nipple up BOP stack to tubing head.

9. Release seal assembly from packer and recover injection tubing.

10. Retrieve CRA packer.

11. Rig up and run casing inspection log and cement bond log.

12. Run in hole with 7 5/8-inch cement retainer on workstring and set above packer at approximately 4,300 feet.

13. Sting back into retainer and pump sufficient volume of cement to fill the wellbore from retainer to TD.

14. Un-sting from retainer and pump 20 sacks of cement on top of retainer. Pull up hole and reverse circulate tubing to clear it of cement.

15. Wait on cement for 24 hours.

16. Tag plug and record depth. Pressure test plug to 1,000 psi or as required.

17. Rig up and circulate 500-foot stages of cement from top of lower cement plug to surface. Wait 24-hours for cement to cure, and if necessary, circulate additional cement from top of upper cement plug to surface. Test upper plug for seal and stability.

18. Rig down BOP stack and cut off tubing head and 7 5/8-inch and 11 ¾-inch casings below grade.

19. Weld ½-inch steel plate to inside of longstring casing and weld ¼-inch steel plate over 7 5/8-inch and 11 3/4-inch casing strings.

20. Set marker with Facility Well No., ADEQ Permit No, years of operation, and injected volumes.

21. Release workover rig and support equipment. Restore location.

DWD-1 (Tokio) Well Closure Plan

1. Notify the ADEQ Director at least 60 days prior to commencement of closure according to the following closure plan (once approved).

2. Prepare location for workover rig.

3. Move in and rig up workover rig and support equipment.

4. Pressure test 7 5/8-inch x 3 ½-inch annulus to 925 psi for 60 minutes with ADEQ inspector present. Record test results.

5. Perform and record a pressure decay test for a length of time specified by the Director.

6. Run logging program to include a radioactive tracer survey to verify the external mechanical integrity of the well.

7. Pump two tubing volumes of fresh water (or brine water of sufficient density) to kill well.

8. Break down the christmas tree valving and bonnet and nipple up BOP stack to tubing head.

9. Release seal assembly from packer and recover injection tubing.

10. Retrieve CRA packer.

11. Rig up and run casing inspection log and cement bond log.

12. Run in hole with 7 5/8-inch cement retainer on workstring and set at approximately 2,900 feet.

13. Sting back into retainer and pump sufficient volume of cement to fill the wellbore from retainer to TD.

14. Un-sting from retainer and pump 20 sacks of cement on top of retainer. Pull up hole and reverse circulate tubing to clear it of cement.

15. Wait on cement for 24 hours.

16. Tag plug and record depth. Pressure test plug to 1,000 psi or as required.

17. Rig up and circulate 500-foot stages of cement from top of lower cement plug to surface. Wait 24-hours for cement to cure, and if necessary, circulate additional cement from top of upper cement plug to surface. Test upper plug for seal and stability.

18. Rig down BOP stack and cut off tubing head and 7 5/8-inch and 11 ¾ inch casings below grade.

19. Weld ½-inch steel plate to inside of longstring casing and weld ¼-inch steel plate over 7 5/8-inch and 11 ¾-inch casing strings.

20. Set marker with Facility Well No., ADEQ Permit No, years of operation, and injected volumes.

21. Release workover rig and support equipment. Restore location.

VII.D.2. Post Closure Plan for Injection Well

The anticipated pressure increases after 10 years of operation in either of the two injection zones at depths of approximately 2,915 feet (near the top of the Tokio injection interval) and 3,365 feet (near the top of the James injection interval), one foot from DWD-1, were calculated using the THWELLS pressure model. The pressure increase for the Tokio was approximately 338 psi and for the James approximately 650 psi. The predicted time until pressures in the injection zones decay to near native reservoir pressures is less than 5 years, based on extending the THWELLS model for a period of 5 years past cessation of injection. The predicted position of the waste fronts in the Tokio and James injection intervals projected 10 years into the future are as follows:

	Radius of Plume	Total Years of Injection
Tokio	1,205 feet	10

	Radius of Plume	Total Years of Injection
James	1,460 feet	10

DOW has prepared and will maintain and comply with the following post-closure care plan. DOW will, if applicable:

1. Continue and complete any cleanup action required under rules and regulations of ADEQ.
2. Continue to conduct any ground water monitoring required under the permit until pressure in the injection zone decays to the point that the well's cone of influence no longer intersects the base of the lower most USDW.
3. Submit a survey plat to the local zoning authority as designated by the ADEQ Director, and to the Regional Administrator of EPA Region VI as designated by the Director.
4. Provide appropriate notification and information to the Arkansas Oil and Gas Commission and local authorities to enable the Arkansas Oil and Gas Commission and local authorities to impose appropriate conditions on subsequent drilling activities that may penetrate the well's confining or injection zone.
5. Retain, for a period of three years following well closure, records reflecting the nature, composition and volume of all injected fluids.
6. Record a notation on the deed within 60 days after approval of the Closure Plan by the ADEQ Director, which is normally examined during a title search that will perpetually provide any potential purchaser of the property the following information:

    a. The fact that land has been used to manage non-hazardous waste;

b. The name and address of the state agency or local authority with which the plat was filed, as well as the Little Rock address of the UIC Unit of the ADEQ to which the Closure Report was submitted;

c. The type and volume of waste injected, the injection interval(s) into which it was injected; and the period over which injection occurred.

DOW estimates that no additional expenditures beyond those required to plug the well will be necessary to carry out the currently applicable post-closure requirements.

TABLE II - 1

SURFACE OWNERS SURROUNDING PROPOSED DWD No. 1 LOCATED IN SE 1/4 NW1/4, SECTION 18. TOWNSHIP 17 SOUTH, RANGE 21 WEST

(Per 1997 Surface Assessments)

<u>12-17-22</u>

30.00 acs SS NE 1/4 SE 1/4 40.00 acs NW 1/4 SE 1/4 40.00 acs SE 1/4 SE 1/4	Deltic farm & Timber Company, Inc. 200 Peach Street El Dorado, AR 71730 (Ph: 870-864-6595)
3.85 acs NE 1/4 SE 1/4	Samuel R. Sanders and Shirley Sanders P.O. Box 561 Cotton Valley, LA 71018 (Ph: 318-832-4362)
3.85 acs NE 1/4 SE 1/4	Malcolm Bridges; Ann Bridges (Brother & Sister) 2170 Columbia Rd 275 Magnolia, AR 71753 (Ph: 870-234-3418)
2.30 acs NE 1/4 SE 1/4	John P. Jack and Dorothy Jack 2021 Columbia Rd 27-S Magnolia, AR 71753 (Ph: 870-234-2320)
40.00 acs NW 1/4 SE 1/4	Allen H. Kitchens 5013 N. 25th Rd Arlington, VA 22207 (Ph: 703-536-93 10)

<u>13-17-22</u>

40.00 acs NE 1/4 NE 1/4 E 33 - 1/3 acs SE 1/4 NE 1/4	Deltic farm & Timber Company, Inc. 200 Peach Street El Dorado, AR 71730 (Ph: 870-864-6595)
40.00 acs NW 1/4 NE 1/4 40.00 acs SW 1/4 NE 1/4 W 6-1/3 acs SE 1/4 NE 1/4 N 16.67 acs NE 1/4 NW 1/4	Allen H. Kitchens 5013 N. 25th Rd Arlington, VA 22207 (Ph: 703-536-93 10)

TABLE II - 1 (continued)

13-17-22 Cont'd

40.00 acs NE 1/4 SE 1/4 40.00 acs SE 1/4 SE 1/4		Albemarle Corporation Attn: Lloyd Crasto-Plant Manager P.O. Box 729 Magnolia, AR 71754-0729 (Ph: 870-235-6265)
40.00 acs NW 1/4 SE 1/4 40.00 acs SW 1/4 SE 1/4		Arnold Faulk 1531 Columbia RD 29 Magnolia, AR 71753 (Ph: 870-234-1573)
S 23.33 acs NW 1/4 NW 1/4 40.00 acs SE 1/4 NW 1/4	1/5	Virginia R. Campbell 436 Highland Drive Forrest City, AR 72353 (Ph: 870-633-2434)
	1/5	Ann C. Mount 4528 N 2nd Street Arlington, VA 22203 (Ph: 703-527-2234)
	1/5	Robert Rhea 5 17 North 11th Street Cherokee, IA 51012
	1/5	Frank Rhea 13505 West 34th Ave Golden, CO 80401
	1/20	Tanyss Rhea Martula 277 Bay Road Hadley, MA 01035 (Ph: 413-584-7729)
	1/20	John W. Rhea, III 2721 Westminster Dallas, TX 75205 (Ph: 214-739-2558)

TABLE II - 1 (continued)

13-17-22 Cont'd		
	1/20	Elena Leard RR8 Box 423P Mountain Home, AR 72653 (PH: 870-430-5833)
	1/20	Roberta Rhea Amundson 2935 NW 23rd Drive Gainesville, FL 32605 (PH: 352-335-1986)
5.0 acs NE 1/4 SW 1/4		Estelle Holley 157 Columbia Rd 275 Magnolia, AR 71753
15.00 acs E 1/2 S 1/2 NE 1/4 SW 1/4 & N 1/2 W 1/2 S 1/2 NE 1/4 SW 1/4		Luna Sharp C/o Otis Forte RT 1, Box 257 Magnolia, AR 71753
18.00 acs N 1/2 NE 1/4 SW 1/4		Aubrey Sharp C/o Clarice Harris 2501 9th Street Muskegon Heights, MI 49444
2.00 acs NWC NE 1/4 SW 1 /4		Essie Sharp Estate C/o Carolyn Page 14903 Western Ave San Leandro, CA 94578
24-17-22		
34.00 acs NE 1/4 NE 1/4		Albemarle Corporation Attn: Lloyd Crasto-Plant Manager P.O. Box 729 Magnolia, AR 71754-0729 (Ph: 870-235-6265)
6.00 acs ES NE 1/4 NE 1/4		Souter Family Revocable Trust Mary Ruth Bussey and Yvonne Souter Allen Co-Trustees P.O. Box 230 Sapula, OK 74066

TABLE II - 1 (continued)

24-17-22 Cont'd

N 5.00 acs NW 1/4 NE 1/4		Arnold Faulk 1531 Columbia RD 29 Magnolia, AR 71753 (Ph: 870-234-1573)

7-17-21

30.14 acs SW 1/4 SW 1/4 12.00 acs WS S 1/2 SE 1/4 SW 1/4	1/8	The Greg Bennett Company P.O. Box 940 Magnolia, AR 71754-0940 (Ph: 870-234-6177)
	7/8	Robert Woodmore Estate C/o Christene W. Courtney 470 Columbia Rd 151 Magnolia, AR 71753 (Ph: 870-234-4639)
9.33 acs SE 1/4 SW 1/4 24.70 acs NW 1/4 SE 1/4 2.64 acs SWC NE 1/4 SE 1/4 36.92 acs SW 1/4 SE 1/4 4.13 acs SE 1/4 SE 1/4		Albemarle Corporation Attn: Lloyd Crasto-Plant Manager P.O. Box 729 Magnolia, AR 71754-0729 (Ph: 870-235-6265)
18.67 acs SE 1/4 SW 1/4 18.79 acs S 1/2 NE 1/4 SW 1/4 7.26 acs NE 1/4 SE 1/4 19.50 acs NW 1/4 SE 1/4 17.50 acs NW 1/4 SE 1/4 40.00 acs SW 1/4 NE 1/4		T.U. Fallin, Jr. 1115 Honeysuckle Street Magnolia, AR 71753 (Ph: 870-234-3064)
18.50 acs N 1/2 NE 1/4 SW 1/4 22.64 acs NW 1/4 SW 1/4 6.50 acs NW 1/4 SW 1/4 24.58 acs SW 1/4 NW 1/4 6.00 acs SW 1/4 NW 1/4 34.50 acs SE 1/4 NW 1/4 3.56 acs SE 1/4 NW 1/4		The Greg Bennett Company P.O. Box 940 Magnolia, AR 71754-0940 (Ph: 870-234-6177)

TABLE II - 1 (continued)

7-17-21 Cont'd

8.04 acs NE 1/4 SE 1/4	Peggy Rhoads (Don) 402 North Hazel Street Magnolia, AR 71753 (Ph: 870-234-1896)

8-17-21

40.00 acs NW 1/4 SW 1/4 40.00 acs SW 1/4 SW 1/4	James W. Parham (Sue) P.O. Box 803 Magnolia, AR 71754-0803 (Ph: 870-234-4763)

17-17-21

11.32 acs NE 1/4 NW 1/4	James W. Parham (Sue) P.O. Box 803 Magnolia, AR 71754-0803 (Ph: 870-234-4763)
28.68 acs NE 1/4 NW 1/4 40.00 acs NW 1/4 NW 1/4 19.89 acs SW 1/4 NW 1/4 10.00 acs NWC NE 1/4 SW 1/4 1.90 acs WS NW 1/4 SW 1/4	Albemarle Corporation Attn: Lloyd Crasto-Plant Manager P.O. Box 729 Magnolia, AR 71754-0729 (Ph: 870-235-6265)
40.00 acs SW 1/4 NW 1/4 30.00 acs NW 1/4 SW 1/4 38.00 acs NW 1/4 SW 1/4 40.00 acs SW 1/4 SW 1/4	Souter Family Revocable Trust Mary Ruth Bussey and Yvonne Souter Allen Co-Trustees P.O. Box 230 Sapula, OK 74066
4.11 acs SE 1/4 NW 1/4	Homes Near Missionary Baptist Church 1190 Hwy 371 S Magnolia, AR 71753 (Ph: 870-234-7186)

TABLE II - 1 (continued)

17-17-21 Cont'd

2.00 acs SE 1/4 NW 1/4	Lizzie Rudd Rosie Mae Green C/o Carrie Tarkington P.O. Box 1197 Magnolia, AR 71754
1.50 acs SW 1/4 NW 1/4	Minor Lewis C/o Ann Lewis 1250 Hwy 371 S Magnolia, AR 71753 (Ph: 870-234-2154)
.50 acs SE 1/3 NW 1/4	Rudolph L. Harris, et ux 1252 Hwy 132 Magnolia, AR 71753
10.00 acs SE 14 NW 1/4	Elve C. Bradford 1263 Hwy 371 S Magnolia, AR 71753 (Ph: 870-234-7827)
2.00 acs SE 1/4 NW 1/4	Gurdine Jones C/o Leanne Curry 2921 Columbia RD 27S Magnolia, AR 71753

18-17-21

S 38.94	acs NE 1/4 NE 1/4		Albemarle Corporation Attn: Lloyd Crasto-Plant Manager P.O. Box 729 Magnolia, AR 71754-0729 (Ph: 870-235-6265)
2.00	acs NWC NW 1/4 NE 1/4		
16.10	acs N 1/2 NW 1/4 NE 1/4		
20.00	acs S 1/2 NW 1/4 NE 1/4		
27.07	acs SW 1/4 NE 1/4		
40.00	acs SE 1/4 NE 1/4		
9.66	acs NE 1/4 NW 1/4	17/60	
30.44	acs NE 1/4 NW 1/4		
28.84	acs NW 1/4 NW 1/4	17/60	
23.37	acs SE 1/4 NW 1/4		
9.66	acs SE 1/4 NW 1/4	17/60	
40.00	acs NE 1/4 NW 1/4		
37.75	acs SE 1/4 SW 1/4		
40.00	acs NE 1/4 SW 1/4		
37.75	acs SE 1/4 SW ¼		

TABLE II - 1 (continued)

18-17-21 Cont'd

40.00 acs NE 1/4 SW 1/4 32.79 acs NW 1/4 SE 1/4 10.25 acs SW 1/4 NE 1/4 5.00 acs SE 1/4 SE 1/4 10.28 acs SE 1/4 SE 1/4		Albemarle Corporation Attn: Lloyd Crasto-Plant Manager P.O. Box 729 Magnolia, AR 71754-0729 (Ph: 870-235-6265)
N 1.06 acs NE 1/4 NE 1/4		James W. Parham (Sue) P.O. Box 803 Magnolia, AR 71754-0803 (Ph: 870-234-4763)
2.68 acs SW 1/4 NE 1/4 2.21 acs NW 1/4 SE 1/4		Tetra-Chlor Inc. P.O. Box 73087 Houston, TX 77273
9.66 acs WS NE 1/4 NW 1/4 28.84 acs NW 1/4 NW 1/4 28.84 acs SW 1/4 NW 1/4 9.66 acs SE 1/4 NW 1/4	9/12 9/12 9/12 9/12	Otha Carter, et al C/o Marzell Carter 911 Patton Street Magnolia, AR 71753
7.08 acs SE 1/4 NW 1/4		Dow Chemical Company C/o Laurie Aucoin P.O. Box 150 Plaquemine, LA 70765
28.32 acs SW 1/4 SW 1/4 2.25 acs SE 1/4 SW 1/4 5.00 acs SS NW 1/4 SE 1/4 40.00 acs SW 1/4 SE 1/4 6.72 acs W 1/2 SE 1/4 SE 1/4 18.00 acs NE Pt SE 1/4 SE 1/4		Souter Family Revocable Trust Mary Ruth Bussey and Yvonne Souter Allen Co-Trustees P.O. Box 230 Sapula, OK 74066

19-17-21

40.0 acs NE 1/4 NE 1/4 39.00 acs NW 1/4 NE 1/4 1.00 acs NW 1/4 NE 1/4	79/84 79/84	Souter Family Revocable Trust Mary Ruth Bussey and Yvonne Souter Allen Co-Trustees P.O. Box 230 Sapula, OK 74066

TABLE II - 1 (continued)

<u>19-17-21 Cont'd</u>

40.00 acs NE 1/4 NE 1/4	5/84	Lee Formby Estate
39.00 acs NW 1/4 NE 1/4	5/84	c/o Dianne Formby 4 Ardmore Drive Little Rock, AR 72209 (Ph: 501-562-5410)

<u>20-17-21</u>

4.00 acs NW1/4 NW 1/4	Souter Family Revocable Trust Mary Ruth Bussey and Yvonne. Souter Allen Co-Trustees P.O. Box 230 Sapula, OK 74066

<u>LEASEHOLD</u> (underlying Albemarle property as seen in Figure II-1)

Albemarle Corporation	Albemarle Corporation Attn: Lloyd Crasto-Plant Manager P.O. Box 729 Magnolia, AR 71754-0729 (Ph: 870-235-6265)

Abbreviations:

SS = south strip
ES = east strip
WS = west strip

TABLE III-1

TABULATION OF NON-FRESHWATER ARTIFICIAL PENETRATIONS WITHIN 0.5 MILES OF DWD #1

Dow Chemical Company
Magnolia, Arkansas

Map ID No.	Operator - Lease Name - Well No.		Distance from DOW well	Date Drilled Date Plugged	Total Depth	Size	Casing Strings Top	Casing Strings Depth	Sacks Cement	Current Status
1	Dow Chemical-Ethyl Corp.-Albemarle	#1	1354'	3/23/65	8,500'	13 3/8"	0"	1492'	1340	Active
	Dow Fee					9 5/8"	0"	8494'	3117	SWD-Injection
3	Dow Chemical-Ethyl Corp.-Albemarle	#1	1638'	9/4/70	8,338'	13 3/8"	0'	543'	510	Active
	Joe Carter (BSW)					9 5/8"	0'	4534'	1395	Brine Supply
						5 1/2"	0'	8155'	1550	
4	Kendall Oil & Gas		2561'	1/24/34	3,110'	NA	NA	NA	NA	Dry Hole
	#1 Fullenwider									Abandoned

NA – well information not available.

TABLE III-2
TABULATION OF FRESHWATER ARTIFICIAL PENETRATIONS WITHIN 1/4-MILE OF DOW FACILITY BOUNDARY

Dow Chemical Company
Magnolia, Arkansas

Map No.	Owner	Well Name	Date Drilled	Well Depth (feet)	Diameter (inches)	Screen (feet)	Water Level (feet)	Date Measured	Use	Chemical Analysis
1	Dow Chemical	Water Supply Well	9/9/71	81	30	-	30	9/9/71	IND	NA
2	Dow Chemical	Water Supply Well for Drilling Carter #1 Brine Well	6/14/74	430	4	425-430	181	6/14/74	IND	NA
3	Dow Chemical	Water Supply Well for Dow #1 Brine Well	6/13/74	438	4	433-438	184	6/13/74	IND	NA
4	David Faulk		6/7/77	47	4	37-47	21	6/7/77	D	NA
5	David Faulk		6/20/75	46	4	40-46	15	6/20/75	D	NA
6	Dow Chemical	Water Supply Well for Jameson #1 Brine Well	10/24/83	445	4	425-445	240	10/24/83	IND	NA

D = Domestic
IND = Industrial
NA = Information not available

TABLE IV-1

Seismic Activity Recorded Within a 50-Km Radius of the West Plant

Dow Chemical Company
Magnolia, Arkansas

SEISMICITY WITHIN 50 KM OF 33.259N 93.319W

Fri Apr 21 11:34:50 2000

Radial Search

NGDC EARTHQUAKE DATA FILE

SOURCE DUP	DATE YR	MO	DY	TIME HR	MN	SEC	LOCATION LATITUDE	LONGITUDE	DEPTH KM	MAGNITUDES Mb	Ms	OTHER	LOCAL	INT MAP	INT MAX	DTSVNWUI	F-E	CE	Q/N	DISTANCE KM
TEI	1988	12	12	13	10	32.91	33.109N	92.978W	16				2.50 ML TEI				502		8	36
TEI	1987	08	11	20	31	03.21	33.105N	92.889W	5				2.00 ML TEI				502		3	44

Note: TEI = Tennessee Earthquake Information Center, TN, USA
ML = Local magnitude
F-E = Flinn-Engdahl geographic region number (502 = Arkansas)
Q/N = Quality/number of stations

Source: NOAA, 2000.

TERRA DYNAMICS INC

Table IV-2
Dow Chemical Company
UIC Permit
Well Control for Detailed Mapping
Structure and Net Thickness

TDI Ref.	Operator	Lease and Well	Location	Kelly Bushing Elevation	Base of Wilcox (KB) - USDW	Top of Confining Zone (KB) - Nacatoch	Top of Injection Zone (KB) - Saratoga	Top of Injection Interval (KB) - Tokio	Top of Injection Interval (KB) - James	Base of Wilcox (USDW) Datum	Top Confining Zone (CZ) Datum	Top Injection Zone (IZ) Saratoga Datum	Top Injection Interval (II) Tokio Datum	Tokio Net Sand Thickness in feet	Top Injection Interval (II) James Datum	James Net Sand Thickness in feet
DWD-1	Dow Chemical	DWD-1	18-17S-21W	-						-	-	-	-	-	-	-
1	Brazos Oil & Gas	Dow #1	18-17S-21W	309	NL	2110	2220	2928	4380	NL	-1801	-1911	-2619	54	-4071	50
2	Arkansas Fuel Oil	Dismukes #1	18-17S-21W	273	1291	2040	2173	2860	4302	-1018	-1767	-1900	-2587	51	-4029	37
3	Dow Chemical	Joe Carter #1	18-17S-21W	342	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
4	Kendall O & G	Fullenwider #1	13-17S-22W	-	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
5	Moore Trust	Fullenwider #1	12-17S-22W	-	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
6	Dow Chemical	Ford #1	12-17S-22W	353	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
7	Bradham	Huffman #1	6-17S-21W	354	1264	2100	2217	2908	4361	-910	-1746	-1863	-2554	42	-4007	44
8	Janlyn Oil	Dickson #1	5-17S-21W	340	1289	2077	2193	2894	4323	-949	-1737	-1853	-2554	44	-3983	39
9	Dow Chemical	Rogers #1	5-17S-21W	333	1250	2053	2170	2880	4308	-917	-1720	-1837	-2547	55	-3975	41
10	Phillips Petroleum	Askew #1	4-17S-21W	293	1220	2030	2148	2830	4240	-927	-1737	-1855	-2537	42	-3947	37
11	Harvey Petroleum	McCown #1	4-17S-21W	269	1212	1987	2103	2811	4204	-943	-1718	-1834	-2542	61	-3935	39
12	Dow Chemical	Nana McCown #1	4-17S-21W	282	NL	2002	2119	2823	4210	NL	-1720	-1837	-2541	45	-3928	36
13	Lawton-Partee	Volentine #1	5-17S-21W	310	NL	2037	2165	2859	4241	NL	-1727	-1855	-2549	52	-3931	24
14	Walters	Helen Green #1	4-17S-21W	331	1272	2060	2171	2858	4240	-941	-1729	-1840	-2527	62	-3909	33
15	Standard Oil	Petty Stave #1	4-17S-21W	264	1220	2003	2115	2804	4184	-956	-1739	-1851	-2540	51	-3920	33
16	Bradham	Warnock Unit #1	3-17S-21W	271	NL	2010	2125	2820	4180	NL	-1739	-1854	-2549	31	-3909	33
17	Dow Chemical	Smith #1	3-17S-21W	298	NL	2018	2133	2835	4180	NL	-1720	-1835	-2537	58	-3882	42
18	Magale	Wilson Estate #1	10-17S-21W	296	1225	2021	2145	2848	NDE	-929	-1725	-1849	-2552	64	NDE	-
19	Kilroy of Texas	Mary Bird #1	10-17S-21W	267	1173	2002	2120	2818	4160	-906	-1735	-1853	-2551	65	-3893	39
20	Equity Oil	Magale #1	10-17S-21W	-	1159	1993	2110	2813	4150	-	-	-	-	63	-	38
21	J.W. Love	Stager #1	9-17S-21W	-	NL	2004	2118	2803	4180	NL	-	-	-	57	-	41
22	Eason Oil	Helen Green #1-9	9-17S-21W	293	1260	2010	2130	2830	4213	-967	-1717	-1837	-2537	51	-3920	44
23	Monexco	Verna Nipper #1	9-17S-21W	260	1235	2020	2128	2827	4200	-975	-1760	-1868	-2567	47	-3940	36
24	Dklst & Phillips	Nipper #1	9-17S-21W	277	1252	2021	2141	2844	4218	-975	-1744	-1864	-2567	47	-3941	41
25	Dow Chemical	Nipper #1	9-17S-21W	284	1262	2047	2153	2854	4222	-978	-1763	-1869	-2570	52	-3938	36
26	Dow Chemical	Dow Fee #2	15-17S-21W	275	1210	2024	2155	2845	4208	-935	-1749	-1880	-2570	81	-3933	37
27	Dow Chemical	Nipper et al #2	9-17S-21W	298	1278	2047	2170	2867	4243	-980	-1749	-1872	-2569	48	-3945	36
28	Arkansas Fuel Oil	Dennis #1	8-17S-21W	307	NL	2079	2192	2890	4272	NL	-1772	-1885	-2583	31	-3965	39
29	Petrofunds	Sorrels #1	8-17S-21W	284	1253	2023	2150	2847	4231	-969	-1739	-1866	-2563	42	-3947	47
30	Dow Chemical	Weber BSW #1	8-17S-21W	289	NL	NL	NL	NL	4229	NL	NL	NL	NL	-	-3940	37

Notes: NDE - log not deep enough, NL - not logged over interval.

TERRA DYNAMICS INC
ENVIRONMENTAL SERVICES

Table IV-2
Dow Chemical Company
UIC Permit
Well Control for Detailed Mapping
Structure and Net Thickness

TDI Ref.	Operator	Lease and Well	Location	Kelly Bushing Elevation	Base of Wilcox (KB) - USDW	Top of Confining Zone (KB) - Nacatoch	Top of Injection Zone (KB) - Saratoga	Top of Injection Interval (KB) - Tokio	Top of Injection Interval (KB) - James	Base of Wilcox (USDW) Datum	Top Confining Zone (CZ) Datum	Top Injection Zone (IZ) Saratoga Datum	Top Injection Interval (II) Tokio Datum	Tokio Net Sand Thickness in feet	Top Injection Interval (II) James Datum	James Net Sand Thickness in feet
31	Doran&Braddock	Volentine #1	8-17S-21W	297	1261	2045	2157	2840	4250	-964	-1748	-1860	-2543	62	-3953	39
32	Dow Chemical	McAnulty BSW #1	8-17S-21W	323	1280	2061	2180	2882	4293	-957	-1738	-1857	-2559	51	-3970	37
33	Dorant Bradock	Fallin #1	7-17S-21W	337	1268	2093	2212	2892	4328	-931	-1756	-1875	-2555	47	-3991	38
34	Dow Chemical	Parham BSW #2	7-17S-21W	309	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
35	Dow Chemical	Whitehead #1	8-17S-21W	292	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
36	Dow Chemical	Parham #1	17-17S-21W	307	1280	2100	2200	2890	4310	-973	-1793	-1893	-2583	80	-4003	39
37	Huggs & Webb	McMath #1	16-17S-21W	254	1192	2032	2154	2857	4243	-938	-1778	-1900	-2603	49	-3989	52
38	Frankel & Frankel	Ulma Edwards #1	16-17S-21W	259	1228	2045	2172	2880	4280	-969	-1786	-1913	-2621	41	-4021	37
39	Kilroy of Texas	Edwards #1	16-17S-21W	251	1210	2040	2162	2863	4272	-959	-1789	-1911	-2612	55	-4021	41
40	Dow Chemical	Souter SWD #1	20-17S-21W	260	1240	2076	2200	2901	4380	-980	-1816	-1940	-2641	51	-4120	35
41	Dow Chemical	F.W. Souter #3	21-17S-21W	256	1230	2079	2200	2902	4380	-974	-1823	-1944	-2646	34	-4124	38
42	Pritchard	Stewart #1	21-17S-21W	-	1231	2059	2180	2880	4330	-	-	-	-	73	-	44
43	Dow Chemical	Butler SWD #1	22-17S-21W	275	1280	2068	2188	2894	4290	-1005	-1793	-1913	-2619	65	-4015	58
44	Arkla	Scantland #1	21-17S-21W	245	1246	2081	2208	2918	4425	-1001	-1836	-1963	-2673	53	-4180	56
45	-	-	20-17S-21W	-	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
46	Clements Energy	D & D #1	20-17S-21W	252	1260	2093	2218	2917	4466	-1008	-1841	-1966	-2665	56	-4214	47
47	Jack Stack	Warnock #1	29-17S-21W	244	1280	2111	2237	2961	4600	-1036	-1867	-1993	-2717	42	-4356	32
48	Dow Chemical	Atkinson #1	30-17S-21W	255	1322	2137	2262	2964	4698	-1067	-1882	-2007	-2709	63	-4443	42
49	Thrasher	Souter #1	19-17S-21W	286	1332	2130	2247	2934	4540	-1046	-1844	-1961	-2648	91	-4254	41
50	Dow Chemical	Deloach #1	24-17S-22W	316	1320	2157	2278	2960	4602	-1004	-1841	-1962	-2644	75	-4286	28
51	Dow Chemical	Aubrey Sharp #1	13-17S-22W	340	1340	2158	2280	2980	4586	-1000	-1818	-1940	-2640	64	-4246	51
52	Kilroy Co.	Leloch #1	23-17S-22W	326	1310	2170	2295	3013	4690	-984	-1844	-1969	-2687	62	-4364	45
53	Dow Chemical	F.W. Souter #2	23-17S-22W	355	1313	2190	2317	3020	4697	-958	-1835	-1962	-2665	56	-4342	47
54	Tiger Oil	F.W. Souter #1	27-17S-22W	324	NL	2240	2368	3071	5013	NL	-1916	-2044	-2747	53	-4689	56
55	Dow Chemical	F.W. Souter #4SW	22-17S-22W	332	1320	2170	2300	3018	4740	-988	-1838	-1968	-2686	43	-4408	51
56	Dow Chemical	Jennie Lovell #1S	21-17S-22W	314	1286	2154	2280	2994	4804	-972	-1840	-1966	-2680	26	-4490	52
57	Sinclair-Prairie	Souter #1	15-17S-22W	327	NL	NL	NL	NL	4630	NL	NL	NL	NL	-	-4303	58
58	America Petrofina	Mary R. Dennis #1	15-17S-22W	328	1270	2128	2250	2960	4558	-942	-1800	-1922	-2632	63	-4230	53
59	Davis Brothers	Powers #1	14-17S-22W	356	1305	2140	2263	2975	4560	-949	-1784	-1907	-2619	65	-4204	52
60	Dow Chemical	Woodward #2	11-17S-22W	362	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
61	Dow Chemical	Holms #1	11-17S-22W	350	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-

Notes: NDE - log not deep enough, NL - not logged over interval.

Table IV-2
Dow Chemical Company
UIC Permit
Well Control for Detailed Mapping
Structure and Net Thickness

TDI Ref.	Operator	Lease and Well	Location	Kelly Bushing Elevation	Base of Wilcox (KB) - USDW	Top of Confining Zone (KB) - Nacatoch	Top of Injection Zone (KB) - Saratoga	Top of Injection Interval (KB) - Tokio	Top of Injection Interval (KB) - James	Base of Wilcox (USDW) Datum	Top Confining Zone (CZ) Datum	Top Injection Zone (IZ) Saratoga Datum	Top Injection Interval (II) Tokio Datum	Tokio Net Sand Thickness in feet	Top Injection Interval (II) James Datum	James Net Sand Thickness in feet
62	Dow Chemical	Kitchens SWS #1	12-17S-22W	361	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
63	Dow Chemical	Ellison #1	10-17S-22W	345	NL	NL	NL	NL	NL	NL	NL	NL	NL	-	NL	-
64	Lion Oil Refining	Robertson #1	10-17S-22W	291	1130	2022	2150	2870	4442	-839	-1731	-1859	-2579	57	-4151	37
65	Hilburn Ind.	Longino #1	2-17S-22W	335	NL	2090	2210	2902	4430	NL	-1755	-1875	-2567	62	-4095	48
66	Par Oil	Byrd #1	2-17S-22W	296	1190	2040	2168	2854	4396	-894	-1744	-1872	-2558	31	-4100	47
67	Clements Energy	Hudgons #1	3-17S-22W	-	1172	2030	2172	2862	4412	-	-	-	-	45	-	58
68	Clements Energy	Greer #1	3-17S-22W	272	NL	1990	2110	2830	4357	NL	-1718	-1838	-2558	47	-4085	41
69	Clements Energy	Greer #3	3-17S-22W	266	1120	2023	2128	2820	4388	-854	-1757	-1862	-2554	31	-4122	29
70	Sidney-Fost	Henry #1	4-17S-22W	270	1180	1977	2110	2781	4400	-910	-1707	-1840	-2511	64	-4130	37
71	First Energy	Aldridge #1	4-17S-22W	294	NL	1965	2100	2804	4380	NL	-1671	-1806	-2510	66	-4086	46
72	Janlyn Oil	Partee #1	33-16S-22W	270	1133	1988	2100	2770	4361	-863	-1718	-1830	-2500	69	-4091	34

Notes: NDE - log not deep enough, NL - not logged over interval.

TABLE IV-3

RESERVOIR PROPERTIES CHART
PROPOSED DWD #1

Dow Chemical Company
Magnolia, Arkansas

		INJECTION ZONE	
	CONTAINMENT INTERVAL	**TOKIO INJECTION INTERVAL**	**JAMES INJECTION INTERVAL**
STRATIGRAPHIC UNIT	Saratoga-Marlbrook-Annona and Ozan-Brownstown	Tokio Sands	James Lime
APPROX. SUBSURFACE INTERVAL (ft)	2,220 - 2,930 BKB	2,930 - 3,115 BKB	4,380 - 4,490 BKB
APPROX. TOTAL THICKNESS (ft)	710	185 (55 net sand)	110 (50 net sand)
DOMINANT LITHOLOGIES	Chalk, Sand, Silt, Shale	Sand, Shale	Sand, Lime, Shale
BOTTOM HOLE PRESSURE (psia)	-	1,205 @ 2,915'	1,875 @ 4,365'
PRESSURE GRADIENT (psi/ft)	0.413	0.413	0.430
NATIVE BRINE SPECIFIC GRAVITY	--	1.05	1.13
FRACTURE GRADIENT (psi/ft)	0.74 psi/ft	0.74 psi/ft	0.78 psi/ft
BOTTOM HOLE TEMPERATURE (°F)	NA	118	144
TEMPERATURE GRADIENT (°F/ft)	0.018	0.018	0.018
PERMEABILITY (md) (whole cores)	NA	13 - 1,504	11 - 1,168
POROSITY (%) (whole cores)	NA	25 - 33	15 - 28

TABLE V-1

PRESSURE MODEL INPUT PARAMETERS TOKIO AND JAMES INJECTION INTERVALS

Dow Chemical Corporation
West Plant
Magnolia, Arkansas

Parameter	Tokio Injection Interval	James Injection Interval
Transmissivity (T)	337 gpd/ft	173 gpd/ft
Flow Capacity (FC_{ave})	11,000 md-ft	5,750 md-ft
Saturated Thickness (h_{ave})	55 feet	50 feet
Storativity	4.00E-5	2.73E-5
Bottomhole Pressure (psia)	1,205 psia @ 2,915' BGL	1,875 psia @ 4,365 ft BGL
Intrinsic Permeability (k)	200 md	115 md
Formation Fluid Viscosity (μ)	0.67 cp at 118°F	0.68 cp at 144°F
Total Compressibility (Ct)	6 x 10^{-6}/psi	6 x 10^{-6}/psi
Porosity (ϕ)	0.28	0.21
Well Radius	0.29 feet	0.29 feet

TABLE V-2

COMPARISON OF PRESSURE BUILDUP RESULTS THWELLS MODEL VS MATTHEWS AND RUSSELL FORMULA

Dow Chemical Corporation
West Plant
Magnolia, Arkansas

Distances from Injection Well and at Nearby Artificial Penetrations	THWELLS Model Result (psi)	Matthews and Russell Formula Result (psi)
Injecting 100 gpm into Tokio		
One foot from Dow Well	338	338
At Art. Pen. No. 1	126	126
At Art. Pen. No. 3	120	120
At Art. Pen. No. 4	107	107
Injecting 100 gpm into James		
One foot from Dow Well	650	648
At Art. Pen. No. 1	237	236
At Art. Pen. No. 3	226	225
At Art. Pen. No. 4	200	199

TABLE VI-1

WASTE MANAGEMENT INFORMATION FOR PLANT DISPOSAL WELL DWD-1

Dow Chemical Company
Magnolia, Arkansas

Waste	*Source*	*Volume (gal./year)*
1. Wastes generated during closure of the well and associated facilities that are compatible with permitted wastes, reservoir and the well.	on-site	see note below(1)
2. Wastewater having a pH of not less than 3.0 or not greater than 12.0, from the following waste streams: a. Ground water from french drain systems and shallow recovery wells b. Boilerhouse blowdown, cooling tower overflow, and non-contact process water c. Rainfall from curbed areas and sumps d. Product spills and wash water from the management of those spills.	on-site	√52,560,000(2)
3. Other associated wastes such as groundwater and rainfall contaminated by the above authorized wastes, spills of the above authorized wastes, and wash waters and solutions used in cleaning and servicing the waste disposal well system equipment which are compatible with the permitted waste streams, reservoir and well materials.	on-site	see note below(3)

Note: (1) the generation of waste stream No. 1 will occur as a one-time-only waste and the volume of waste generated will be minuscule in comparison to the other wastes injected
(2) Volume stated is based on proposed maximum injection rate of 100 gpm.
(3) Wastestream No. 3 is non-continuous. The volume of waste generated by wastestream No. 3 will be minuscule in comparison to the other wastes injected.

TABLE VI-2

PROPOSED INJECTATE WASTE STREAM HAZARDOUS CONSTITUENT CONCENTRATIONS

Dow Chemical Corporation
West Plant
Magnolia, Arkansas

Constituent	Measured Concentration [1]	Hazardous Level
Ethylene dichloride (D028)	not detected	0.5 mg/l [2]
Ethylene dibromide (U067)	not detected	0.028 mg/l [3]
Dibromochloropropane (U066)	not detected	0.11 mg/l [3]

[1] See Appendix I, L5 stripper effluent
[2] 40 CFR 261.24 Toxicity Characteristic
[3] 40 CFR 268.40 Treatment Standards for Hazardous Wastes

√

TABLE VII-1

INJECTION WELL MONITORING AND REPORTING REQUIREMENTS

Dow Chemical Company
West Plant

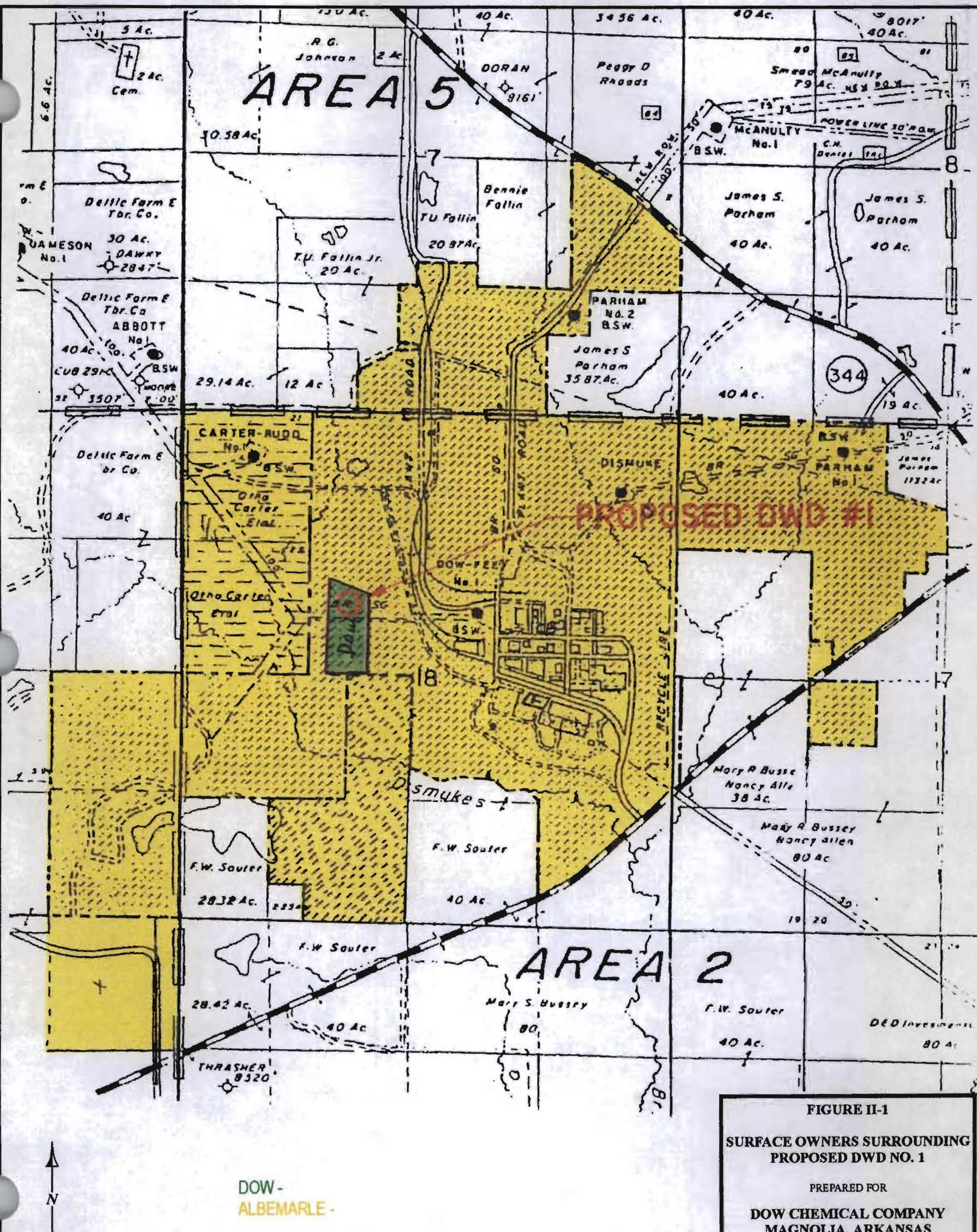
Condition	Measurement Frequency	Specific Measurements to be Reported	When Reported to ADEQ
Annulus Pressure	Continuously Recorded	Instantaneous Minimum, Minimum Differential	Quarterly
Analysis of Fluid Injected	Annually Sampled	Selected Metals, Base/Neutral and Acid Organic Compounds, Pesticides, and PCBs	Annually
Injection Tubing Pressure	Continuously Recorded	Instantaneous Maximum, Monthly Average	Quarterly
Injection Flow Rate	Continuously Recorded	Instantaneous Maximum, Monthly Average	Quarterly
Cumulative Volume of Fluid Injected	Calculated and Recorded Daily	Monthly Total	Quarterly
Temperature of Fluid Injected	Continuously Recorded	Upon Request	Upon Request
pH of Fluid Injected	Continuously Recorded	Minimum pH	Quarterly
Exceedance of Annulus Pressure or Injection Pressure Limits	Every Incident	Description of Event	Quarterly or Within 24 Hours of Incident if Well Integrity is Suspect
Any Alarm or Shutdowns	Every Incident	Any Event Which Results in Significant Failure	Within 24 Hours of Incident if Well Integrity is Suspect
Changes in Volume of Annular Fluid	Continuously Recorded	Upon Request	Upon Request
Bottom Hole Pressure	Annually	Direct Measurement	Annually

TABLE VII-1 (Continued)

INJECTION WELL MONITORING AND REPORTING REQUIREMENTS

Dow Chemical Company
West Plant

Condition	**Measurement Frequency**	**Specific Measurements to be Reported**	**When Reported to ADEQ**
Pressure Fall Off	Annually as Part of MIT	Pressure Fall Off Over Sufficient Time Span to Generate Curve	Annually
Newly Constructed/Newly Discovered Wells in AOR	Annually	Location and Tabulation of Data	Annually
Mechanical Integrity of:			
a) Longstring Casing, Injection Tube, and Annular Seal	Annually	Results of Pressure Test	Within 30 Working Days of Test Completion
b) Bottom Hole Cement by RA Tracer Survey	Every 5 years	RA Tracer Log Evaluation	Within 30 Working Days of Test Completion
Any Well Workover	Time of Work	Workover Report of Field Activities and Reason for Workover	Within 30 Working Days of Test Completion
Any other Required Test of the Injection Well	Time of Work	Test Results	Within 30 Working Days of Test Completion



Source: Walk Haydel, 1999.

FIGURE II-1

SURFACE OWNERS SURROUNDING PROPOSED DWD NO. 1

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By: A. BELL, CPG,RG	Drawing No.: 99177.F1
Designed By: A. BELL, CPG,RG	Date: 3/30/01
Checked By:	Job No.: 99-177

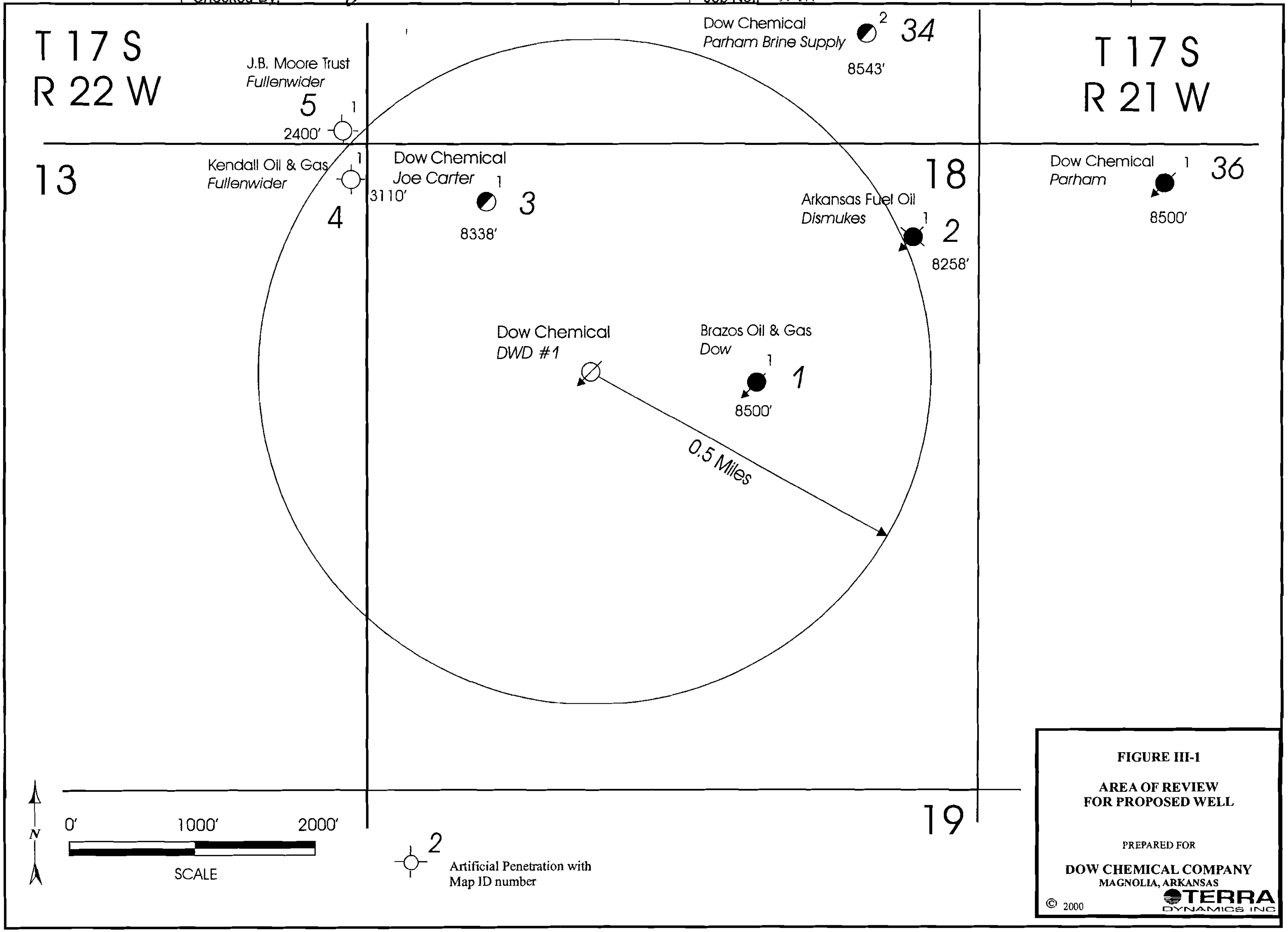


FIGURE III-1

AREA OF REVIEW FOR PROPOSED WELL

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

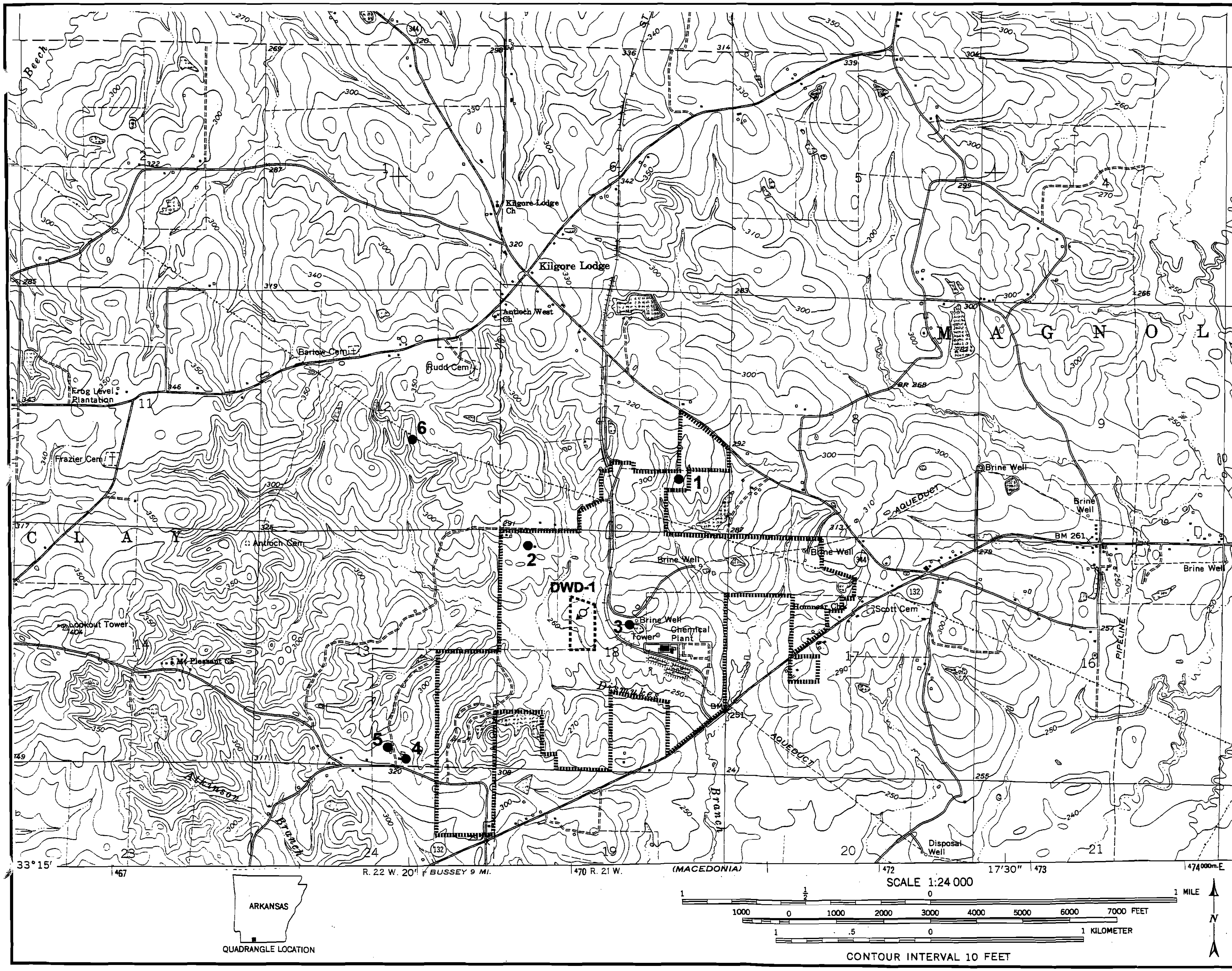


FIGURE III-2

FACILITY BOUNDARIES AN ADJACENT WATERS TOPOGRAPHIC MAP

DOW CHEMICAL COMPAN Magnolia, Arkansas

DWD-1 Proposed Injection Well

● Area Water Wells

West Plant Boundary

DOW Property

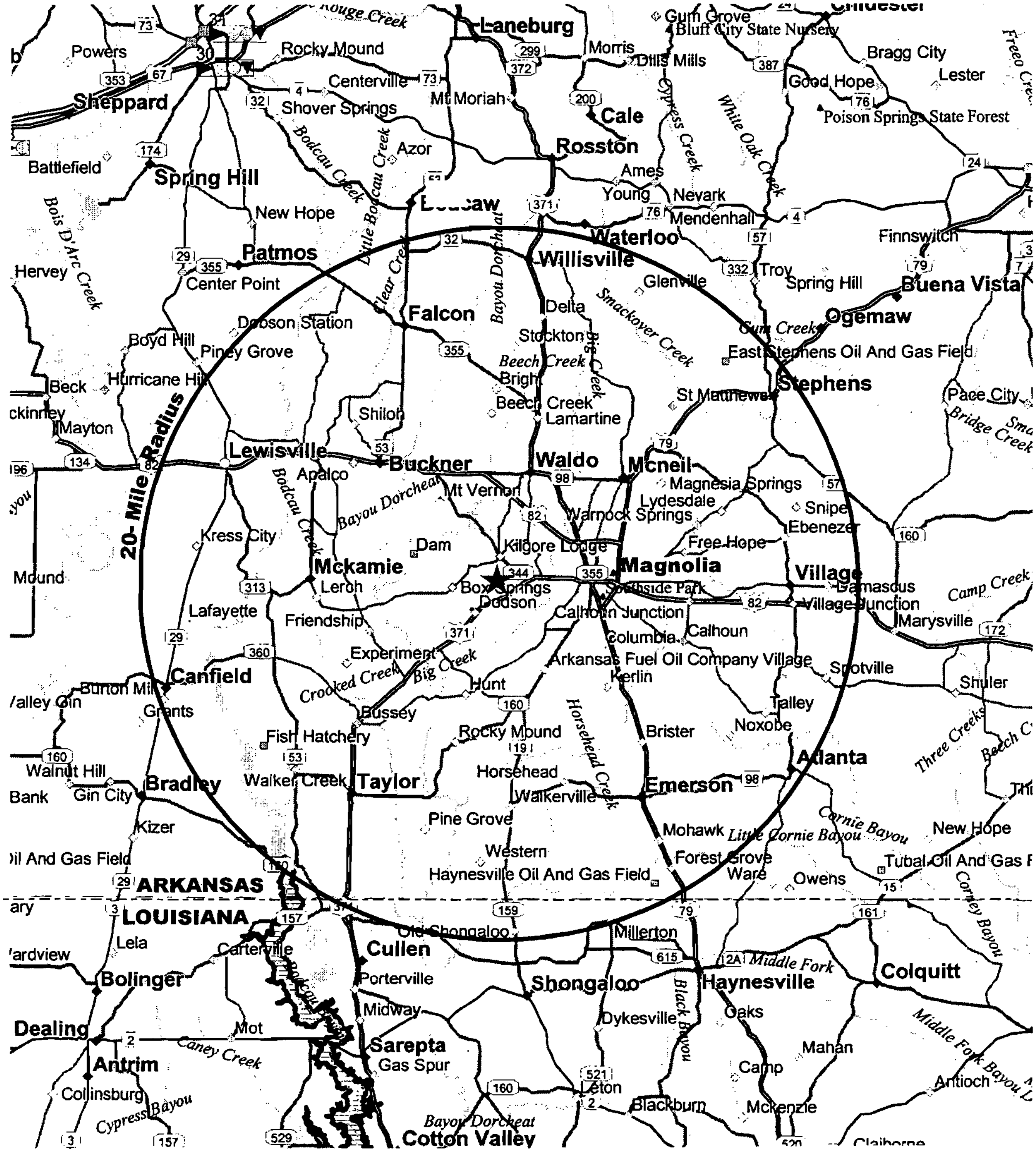
Map Source: USGS 7.5-Minute Waldo, Arkansas, Quadrangle Map

TERRA DYNAMICS IN

DRAWN BY: A. BELL	DATE: 5/5/00
CHECKED BY: P. GRANT	SCALE: As Indicat
DRAWING NO.:99177b.cdr	JOB NO.: 99-177

Drawing No.: 99177.F1
Date: 4-27-00
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By:



N

★ West Plant Site

Scale 1:500,000 (at center)
10 Miles

Map Source: DeLorme Street Atlas USA, 1998.

FIGURE IV-1

REGIONAL STUDY AREA LOCATION MAP

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawing No.: 99177.F2
Date: 3-31-00, Revised 12-6-00
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By:

ERA	SYSTEM	SERIES	GROUP	FORMATION	HYDROLOGIC UNIT
CENOZOIC	QUATERNARY			Alluvium	Alluvial Aquifer
	TERTIARY	Eocene	Claiborne	Cockfield	
				Cook Mountain	
				Sparta	Sparta Aquifer
				Cane River	
			Wilcox		Base USDW
		Paleocene	Midway		
MESOZOIC	UPPER CRETACEOUS	Gulf	Navarro	Arkadelphia	
				Nacatoch	Confining Zone
			Taylor	Saratoga	Top Injection Zone
				Marlbrook	
				Annona	
				Ozan	
			Austin	Brownstown	
				Tokio	Injection Interval
			Woodbine	Eagle Ford Shale	
				Tuscaloosa	
	LOWER CRETACEOUS	Comanche	Trinity	Glen Rose Equiv.- James Lm.	Injection Interval
		Coahuila	Nuevo Leon	Hosston	Lower Confining Zone
	JURASSIC	Upper Jurassic	Cotton Valley		
				Buckner	
				Smackover	
	TRIASSIC			Eagle Mills	
PALEOZOIC					

Modified from Ragsdale, 1987 and Golden Environmental Services, 1993.

FIGURE IV-2

STRATIGRAPHIC COLUMN AND HYDROLOGIC UNITS SOUTHERN ARKANSAS

PREPARED FOR

DOW CHEMICAL COMPANY MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By:	Ann Bell, CPG, RG
Designed By:	Ann Bell, CPG, RG
Checked By:	

Drawing No.: 99-177.F3
Date: 3-31-00, Revised 12-7-00
Job No.: 99-177

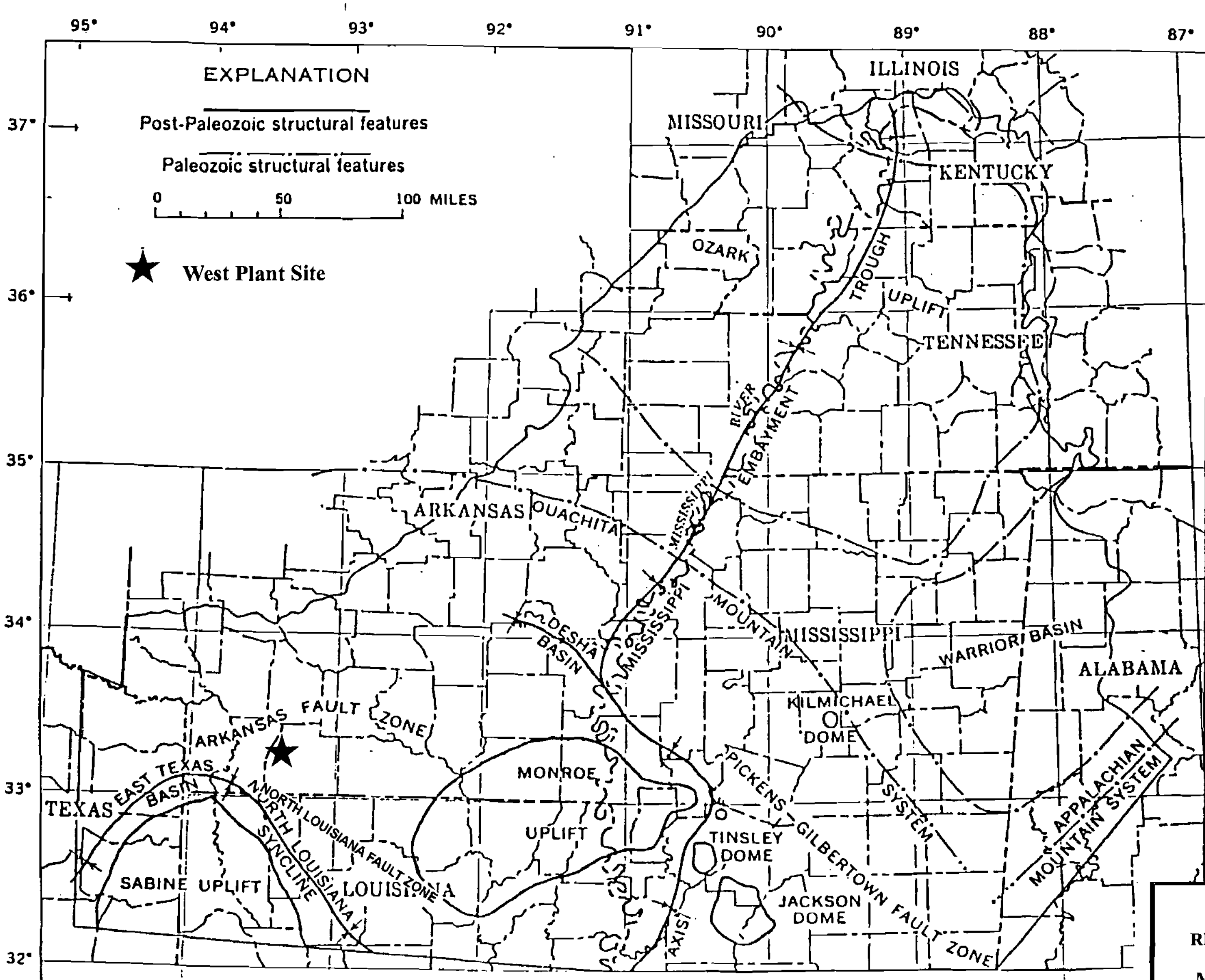


FIGURE 9.—Structure map of the Mississippi embayment.

FIGURE IV-3

REGIONAL TECTONIC MAP OF THE MISSISSIPPI EMBAYMENT

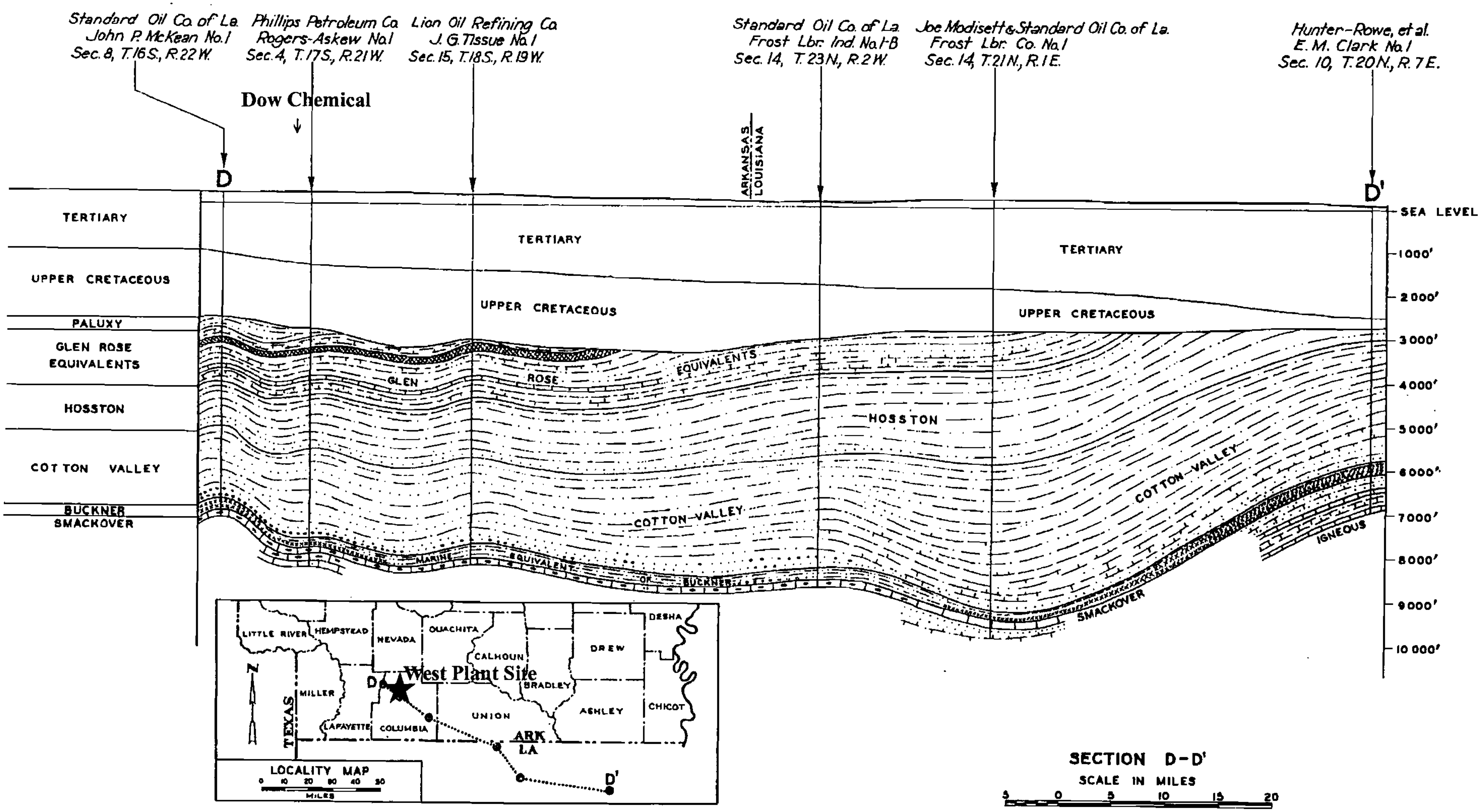
PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Sources: Cushing, Boswell, and Hosman, 1964; Dutton et al, 1993.

Drawn By: Ann Bell, CPG, RG	Drawing No.: 99177.F4
Designed By: Ann Bell, CPG, RG	Date: 4-27-00
Checked By:	Job No.: 99-177



STRUCTURE SECTION
THROUGH SOUTHERN ARKANSAS INTO NORTHEASTERN LOUISIANA

FIGURE IV-4

REGIONAL WEST-EAST STRUCTURAL CROSS SECTION OF LOWER CRETACEOUS

PREPARED FOR

DOW CHEMICAL COMPANY MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Source: Imlay, 1940.

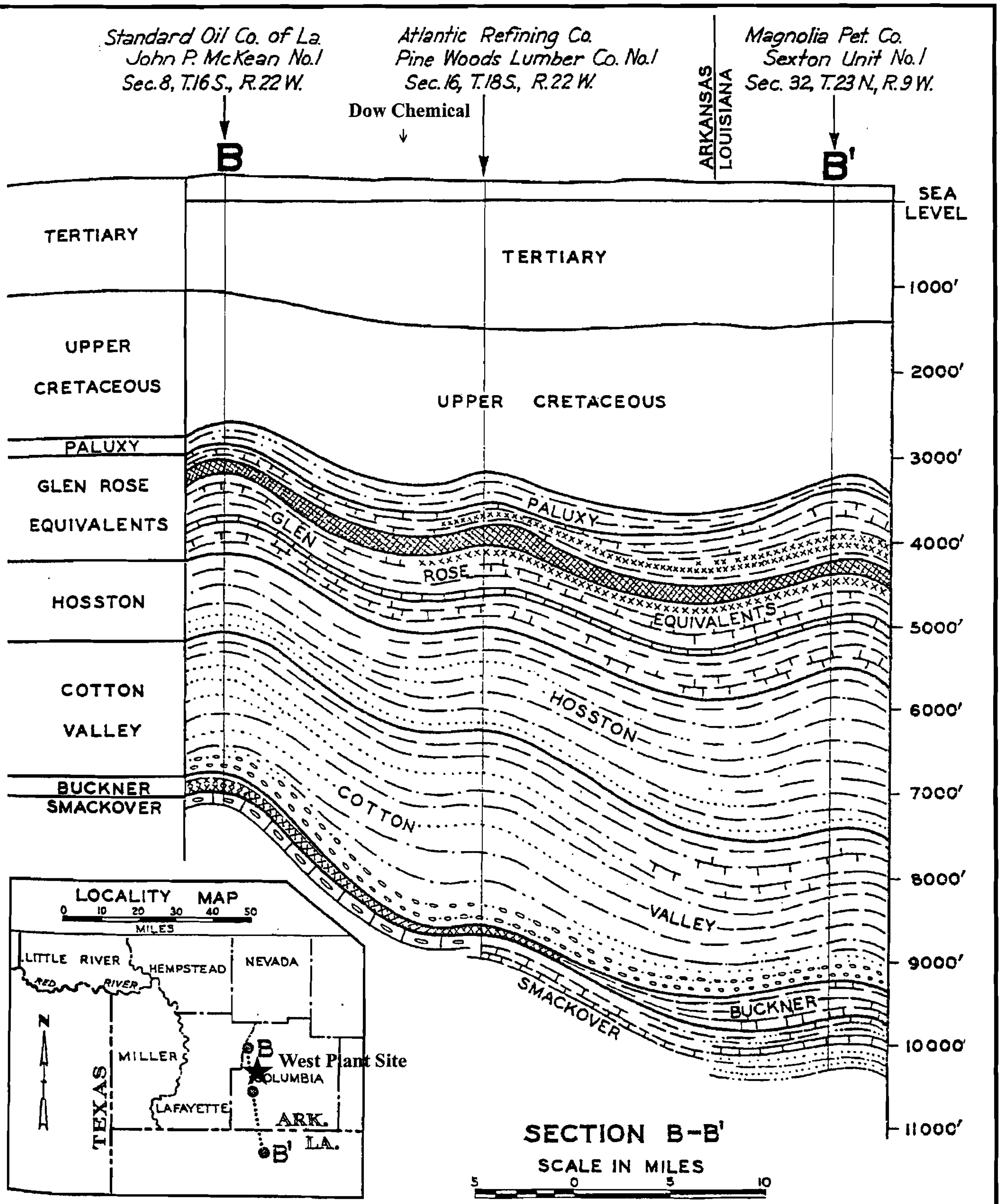


FIGURE IV-5

REGIONAL NORTH-SOUTH STRUCTURAL CROSS SECTION OF LOWER CRETACEOUS

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Source: Imlay, 1940.

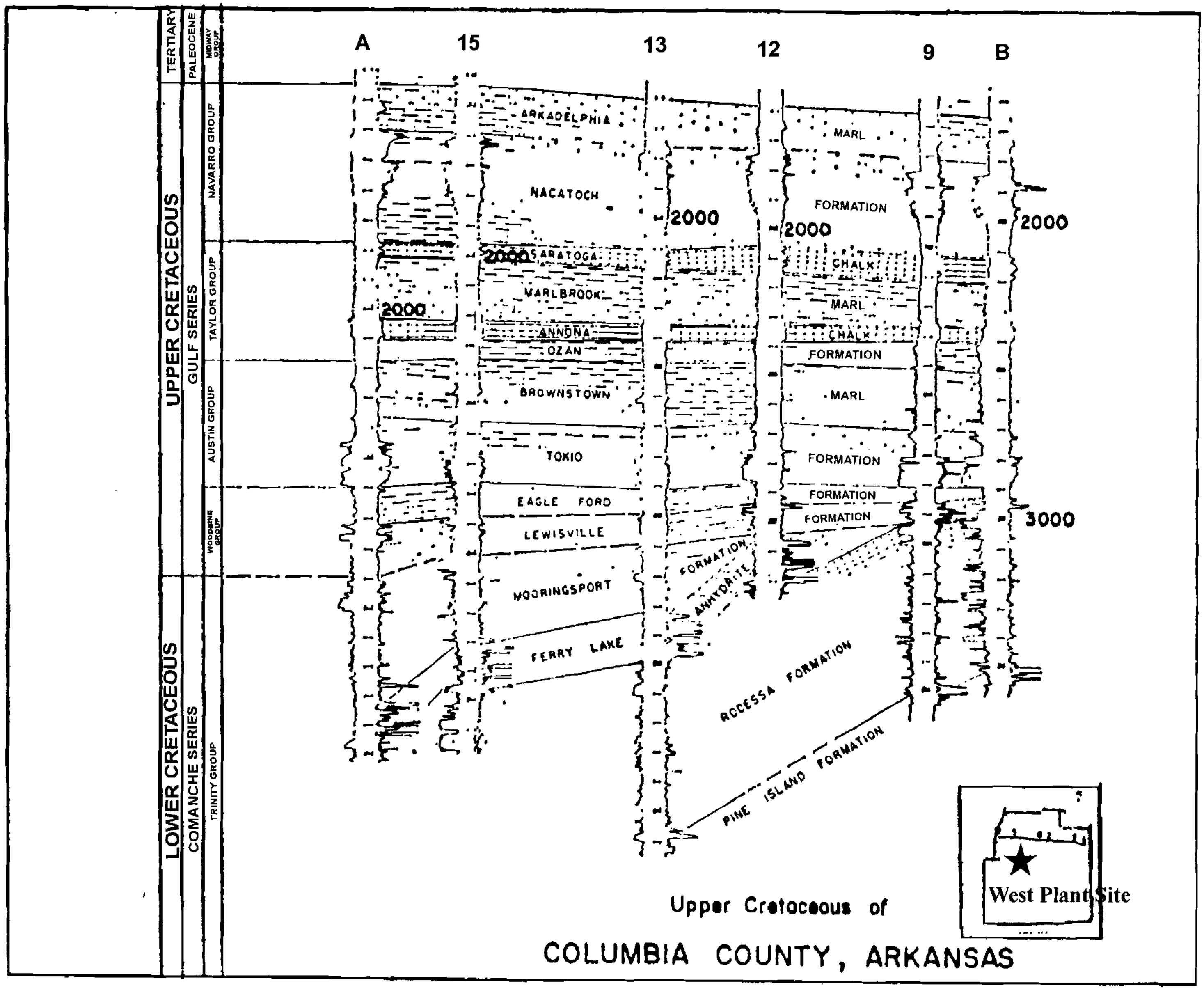
Drawing No.: 99177.F5
Date: 4-14-00
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By:

Drawn By:	Ann Bell, CPG, RG
Designed By:	Ann Bell, CPG, RG
Checked By:	

Drawing No.: 99177.F6
Date: 4-27-00, Revised 12-6-00
Job No.: 99-177

Dow Chemical



Source: Dolloff et al, 1967.

FIGURE IV-6

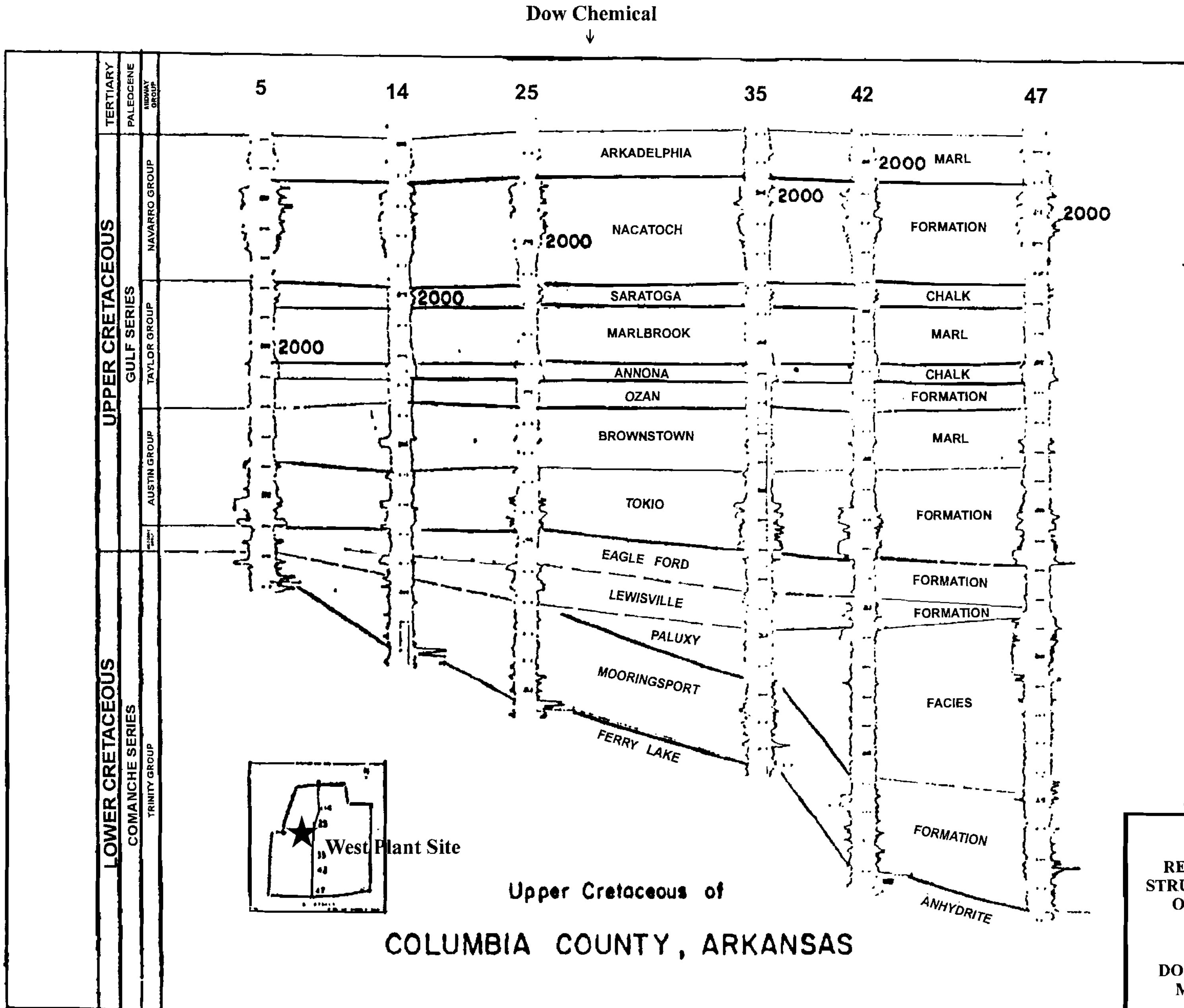
REGIONAL WEST-EAST STRUCTURAL CROSS SECTION OF UPPER CRETACEOUS

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By: Ann Bell, CPG, RG	Drawing No.: 99177.F7
Designed By: Ann Bell, CPG, RG	Date: 4-27-00, Revised 12-6-00
Checked By: DE	Job No.: 99-177



Source: Dolloff et al, 1967.

FIGURE IV-7

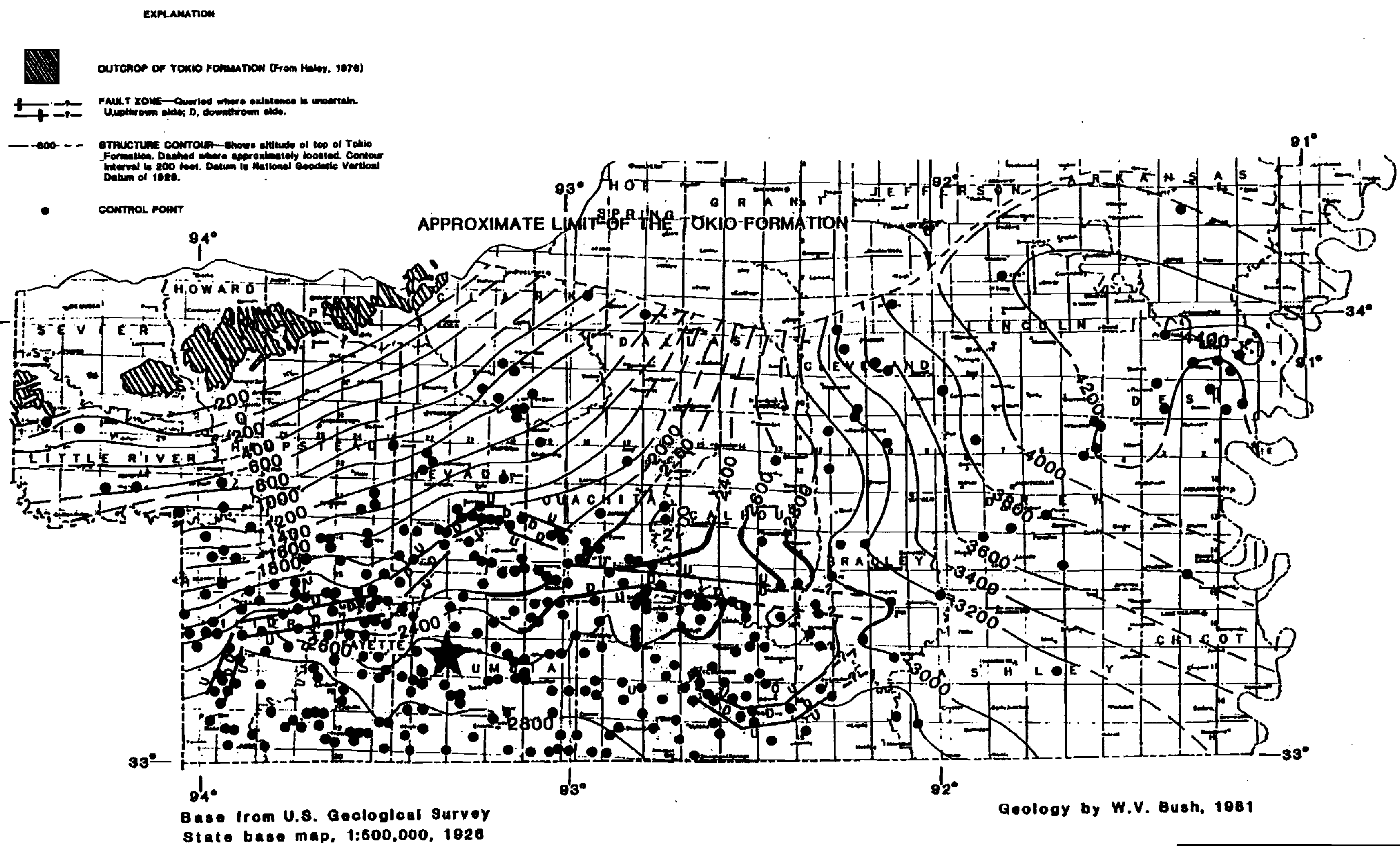
REGIONAL NORTH-SOUTH STRUCTURAL CROSS SECTION OF UPPER CRETACEOUS

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By: Ann Bell, CPG, RG	Drawing No.: 99177.F8
Designed By: Ann Bell, CPG, RG	Date: 4-27-00
Checked By:	Job No.: 99-177



STRUCTURE OF TOP OF THE TOKIO FORMATION

★ West Plant Site

Source: Petersen et al, 1985.

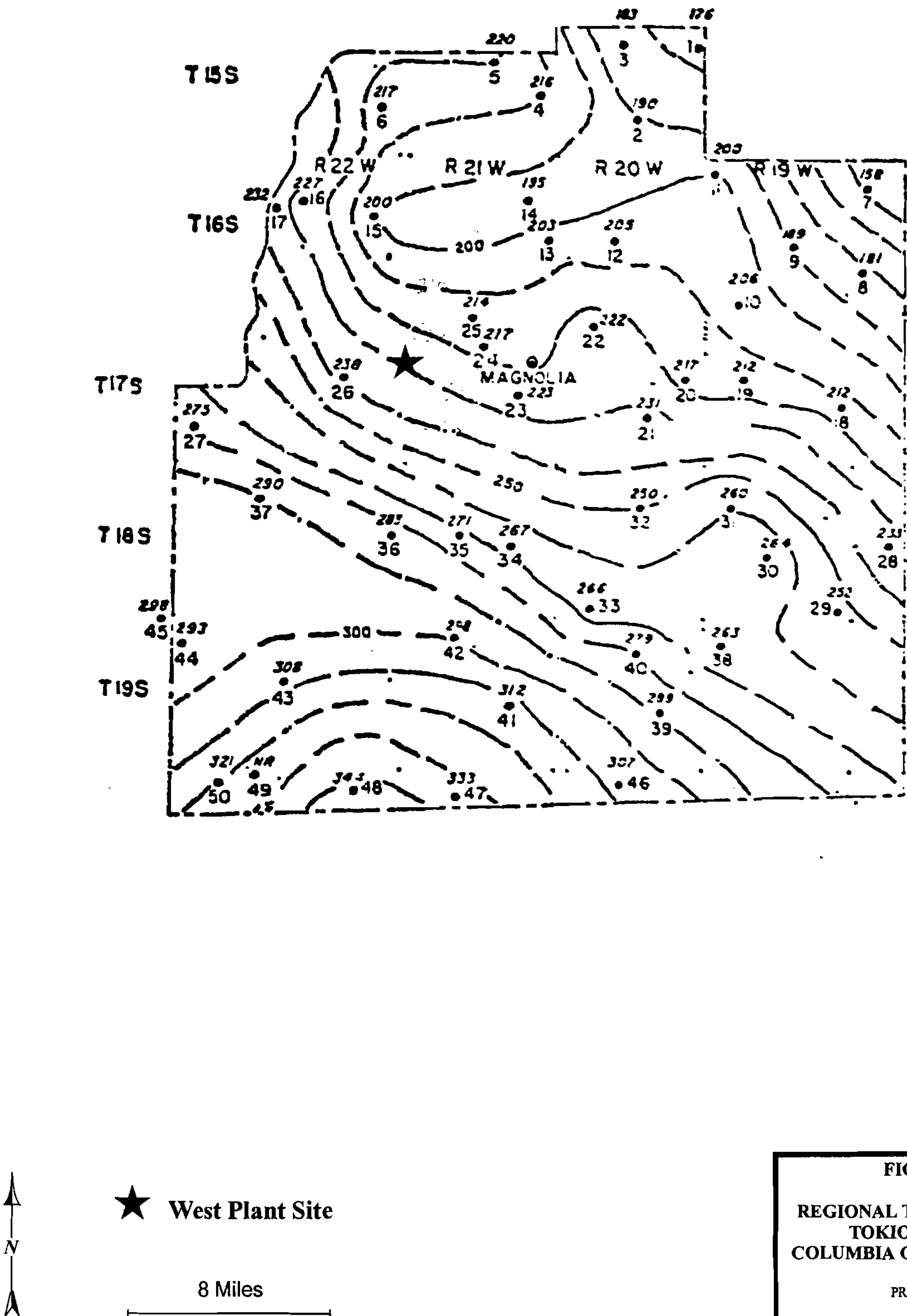
FIGURE IV-8

REGIONAL STRUCTURE ON TOP OF THE TOKIO FORMATION IN SOUTHERN ARKANSAS

PREPARED FOR

DOW CHEMICAL COMPANY MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC



Drawing No.: 99177.F9
Date: 5-1-00
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By:

FIGURE IV-9

REGIONAL THICKNESS OF THE TOKIO FORMATION COLUMBIA COUNTY, ARKANSAS

PREPARED FOR

DOW CHEMICAL COMPANY MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Source: Dolloff et al, 1967.

Drawn By: Ann Bell, CPG, RG	Drawing No.: 99177.F10
Designed By: Ann Bell, CPG, RG	Date: 5-3-00
Checked By:	Job No.: 99-177

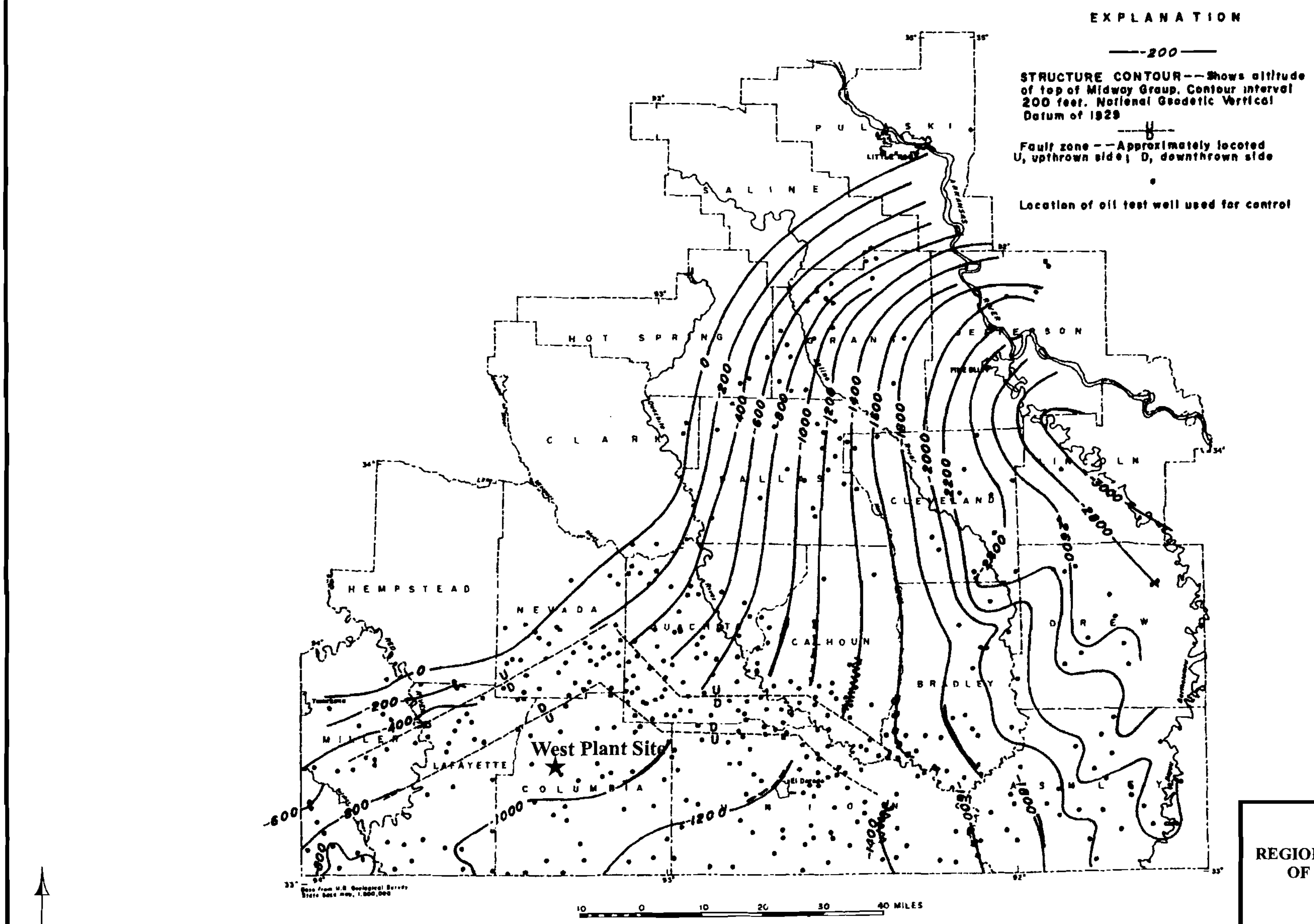


FIGURE IV-10

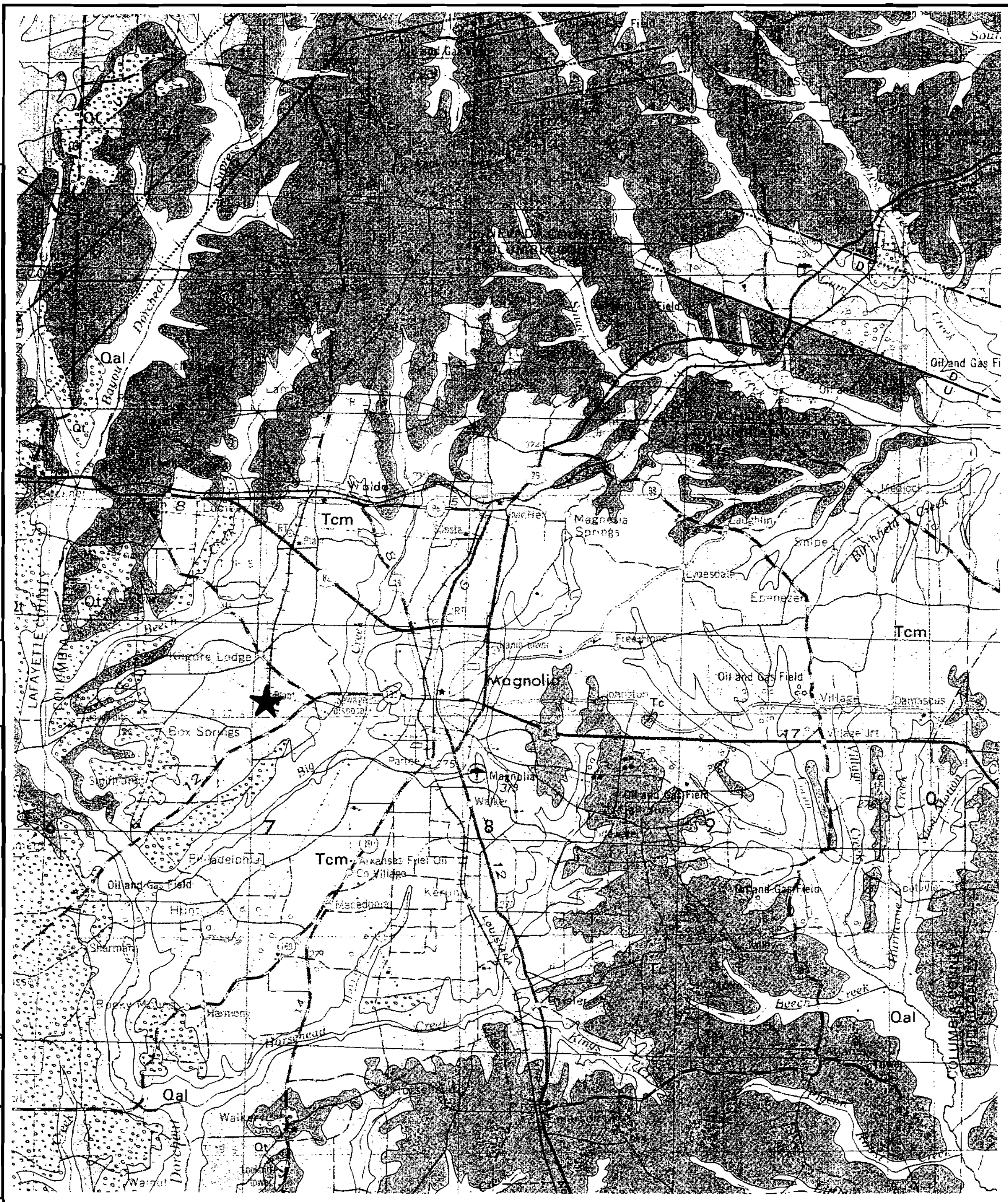
REGIONAL STRUCTURE ON TOP OF THE MIDWAY GROUP (BASE OF USDW)

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Source: Terry et al, 1986.



N

★ **West Plant Site**

5 Miles

EXPLANATION

Qal	Alluvium
Qt	Terrace Deposits
Tc	Cockfield Formation
Tcm	Cook Mountain Formation
Ts	Sparta Sand

Source: Hosman, 1982.

FIGURE IV-11

SURFACE GEOLOGY OF COLUMBIA COUNTY

PREPARED FOR

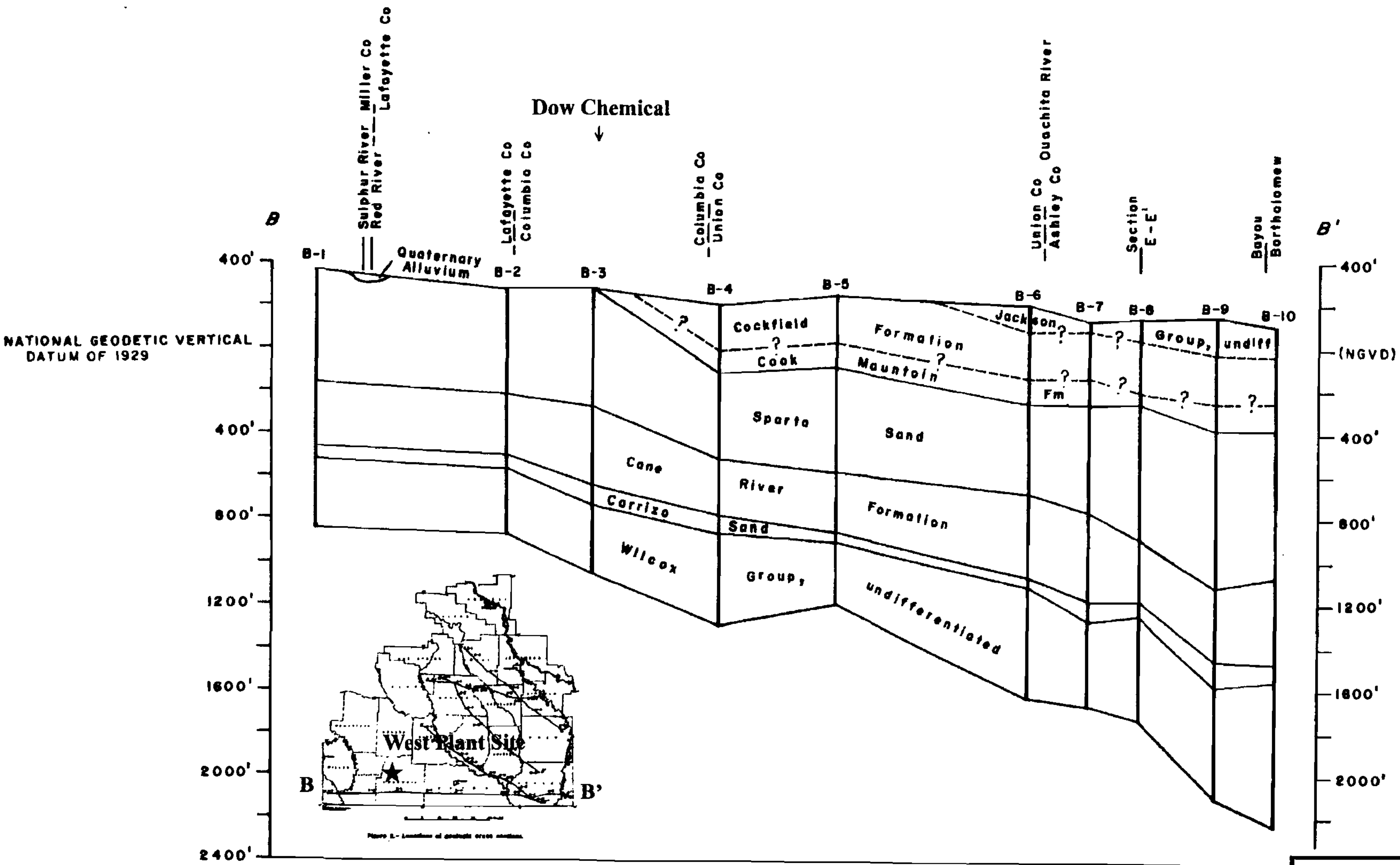
DOW CHEMICAL COMPANY MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawing No.: 99177.F11
Date: 5-15-00
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By: RJ

Drawn By: Ann Bell, CPG, RG	Drawing No.: 99177.F12
Designed By: Ann Bell, CPG, RG	Date: 5-3-00
Checked By: [initials]	Job No.: 99-177



Source: Terry et al, 1986.

FIGURE IV-12

REGIONAL WEST - EAST HYDROLOGIC CROSS SECTION

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawing No.: 99177.F13
Date: 5-1-00
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By:

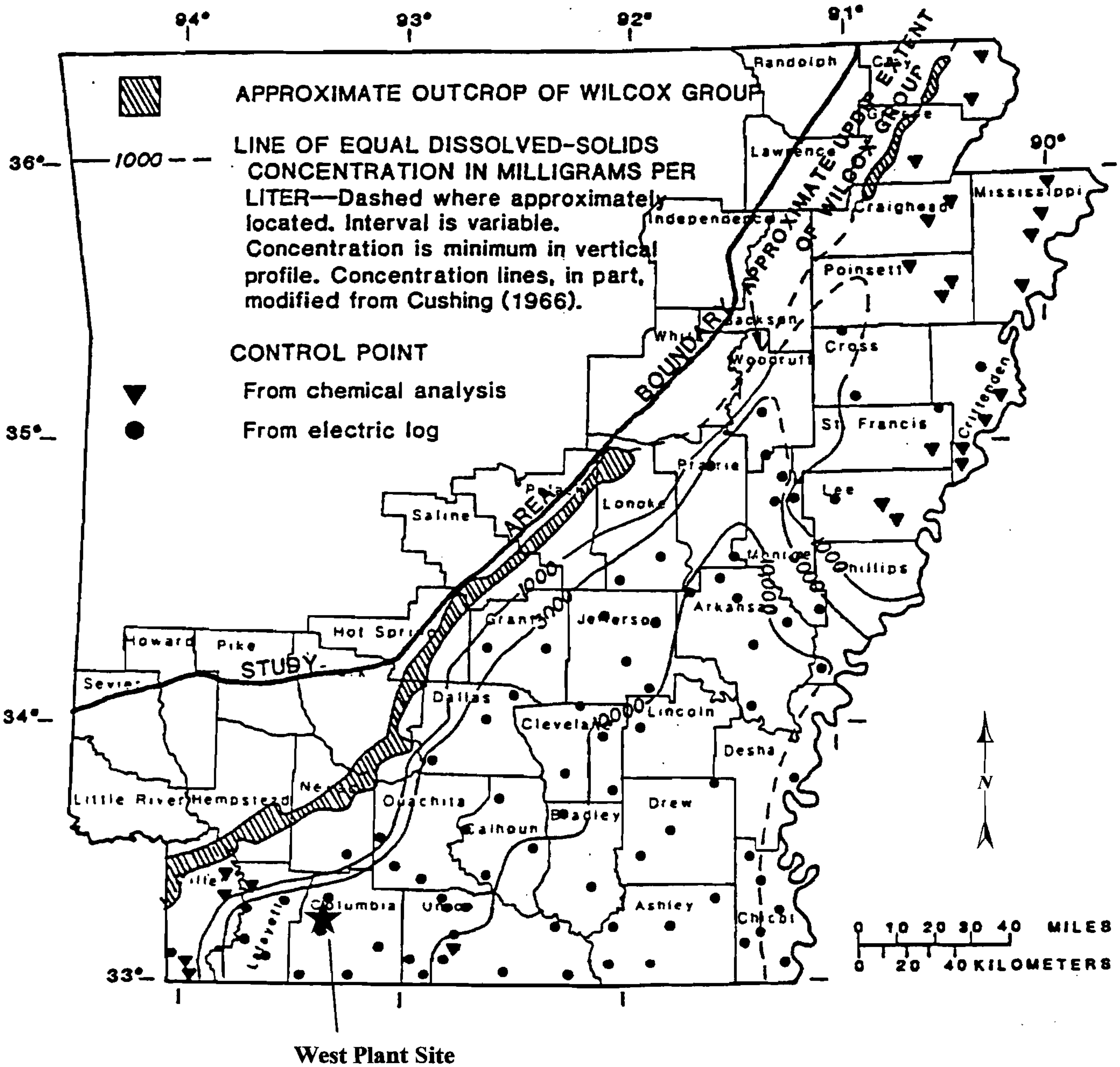


FIGURE IV-13

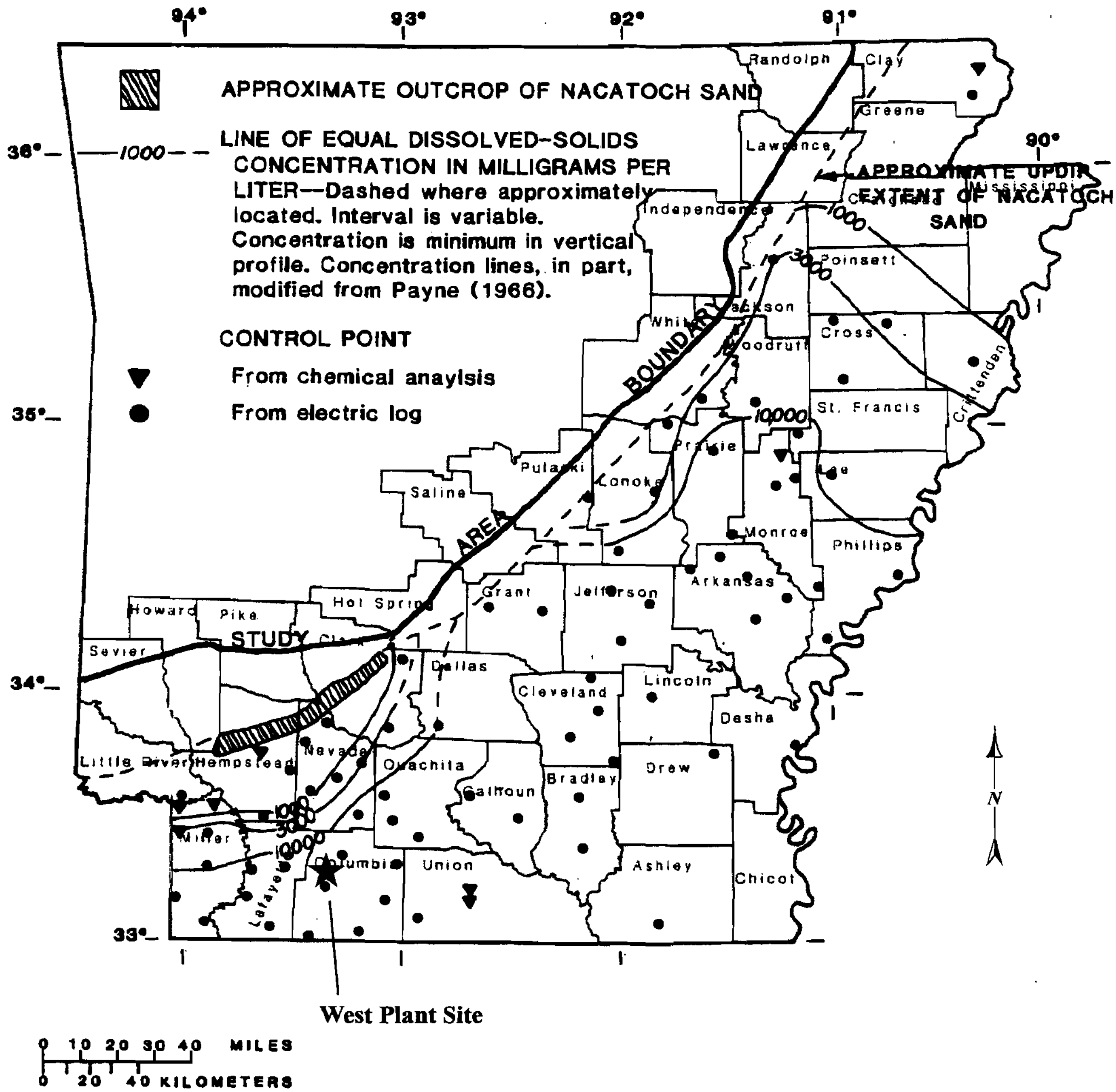
DISSOLVED SOLIDS CONCENTRATION IN THE WILCOX GROUP

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Source: Petersen et al, 1985.



Source: Petersen et al, 1985.

FIGURE IV-14

DISSOLVED SOLIDS CONCENTRATION IN THE NACATOCH SAND

PREPARED FOR

DOW CHEMICAL COMPANY MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawing No.: 99177.F14
Date: 5-16-00
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By:

Drawn By: Ann Bell, CPG, RG	Drawing No.: 99177.F15
Designed By: Ann Bell, CPG, RG	Date: 4-27-00
Checked By: [initials]	Job No.: 99-177

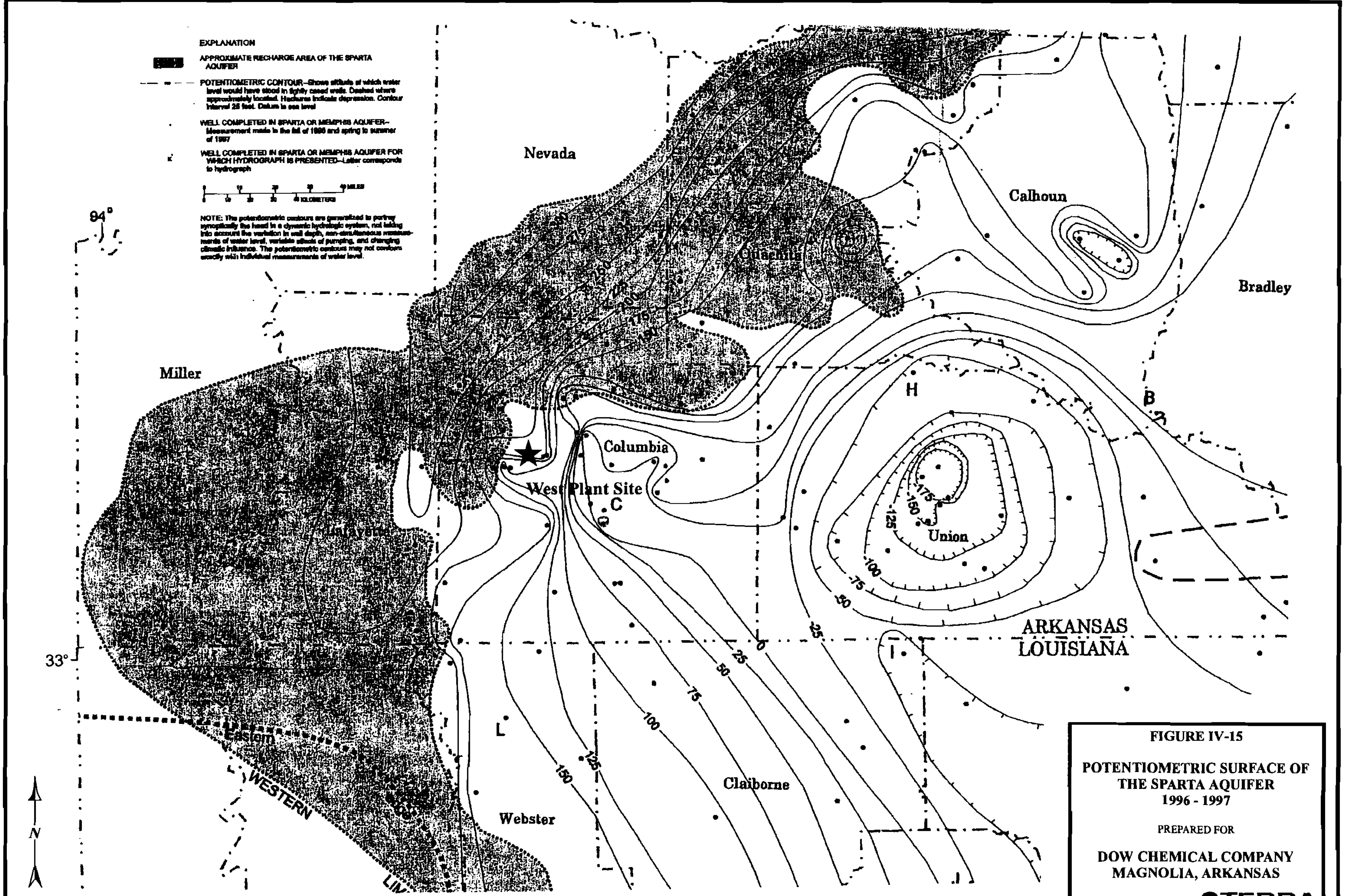


FIGURE IV-15

POTENTIOMETRIC SURFACE OF THE SPARTA AQUIFER 1996 - 1997

PREPARED FOR

DOW CHEMICAL COMPANY MAGNOLIA, ARKANSAS

 TERRA DYNAMICS INC

Source: Joseph, 1997.

Drawn By: A. BELL, CPG, RG	Drawing No.: 99177.F16
Designed By: A. BELL, CPG, RG	Date: 5-3-00
Checked By:	Job No.: 99-177

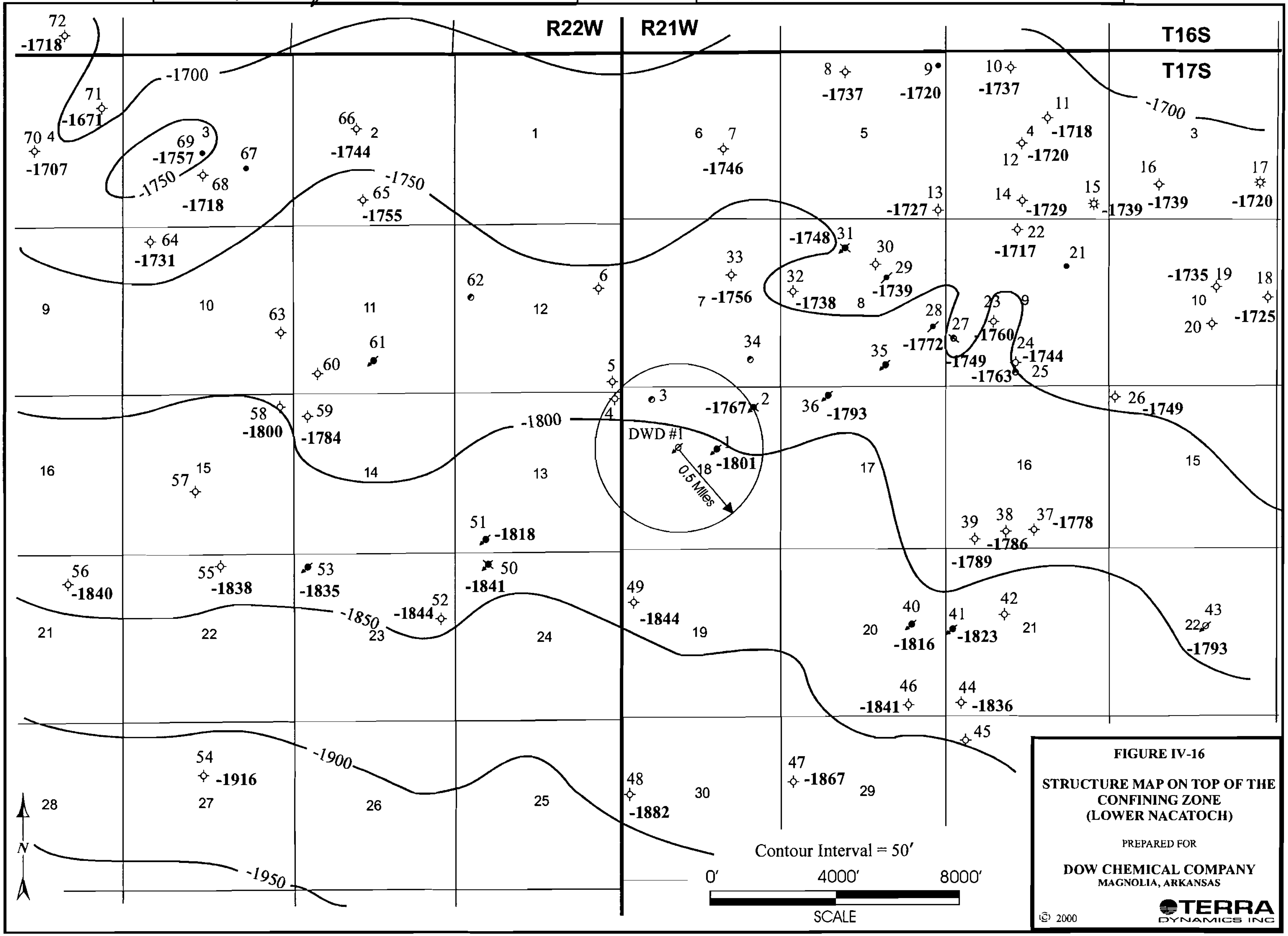


FIGURE IV-16

STRUCTURE MAP ON TOP OF THE CONFINING ZONE (LOWER NACATOCH)

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By: A. BELL, CPG, RG	Drawing No.: 99177.F17
Designed By: A. BELL, CPG, RG	Date: 4-17-00
Checked By:	Job No.: 99-177

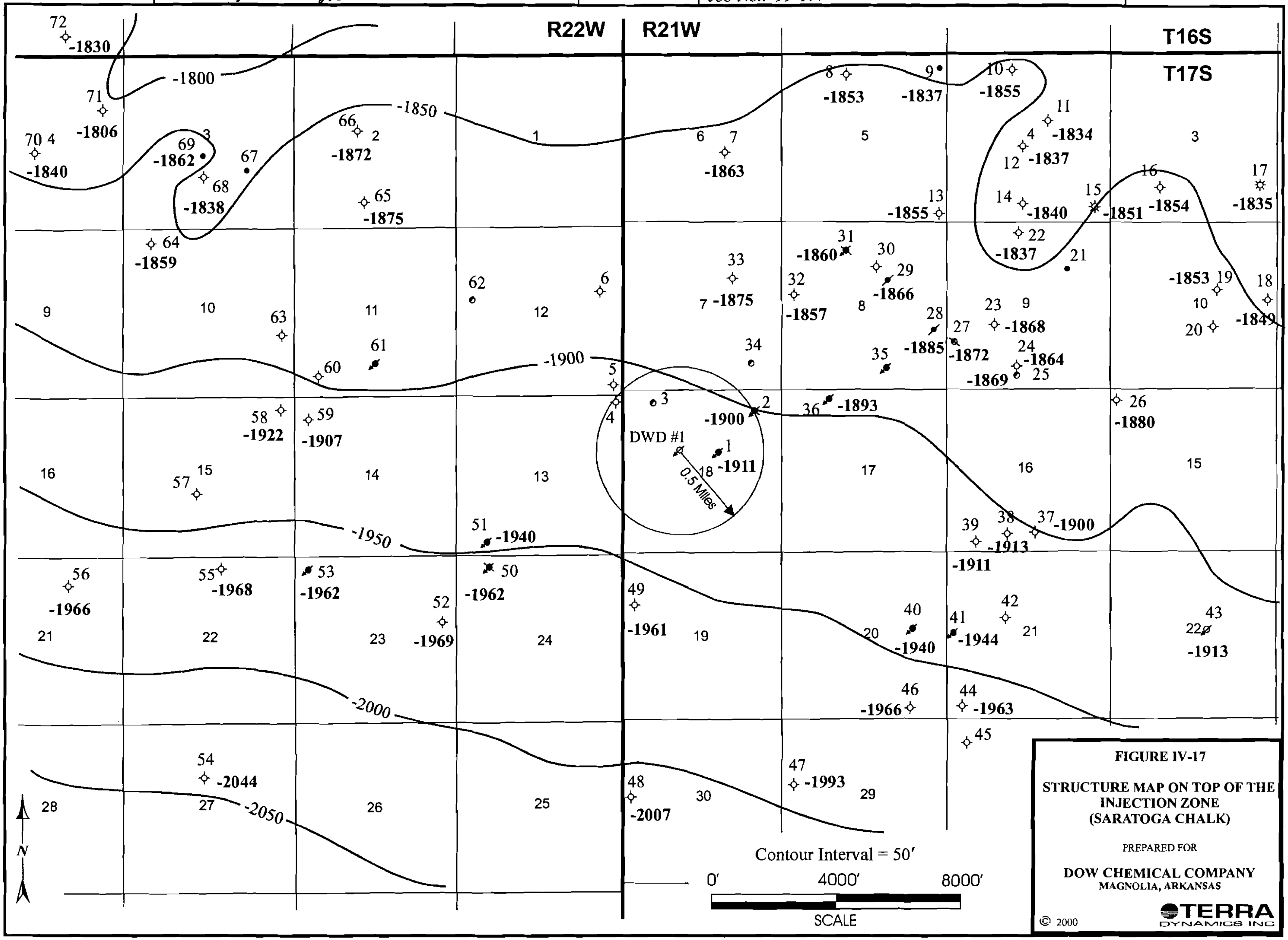


FIGURE IV-17

STRUCTURE MAP ON TOP OF THE INJECTION ZONE (SARATOGA CHALK)

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By: A. BELL, CPG, RG	Drawing No.: 99177.F18
Designed By: A. BELL, CPG, RG	Date: 4-5-00
Checked By: [signature]	Job No.: 99-177

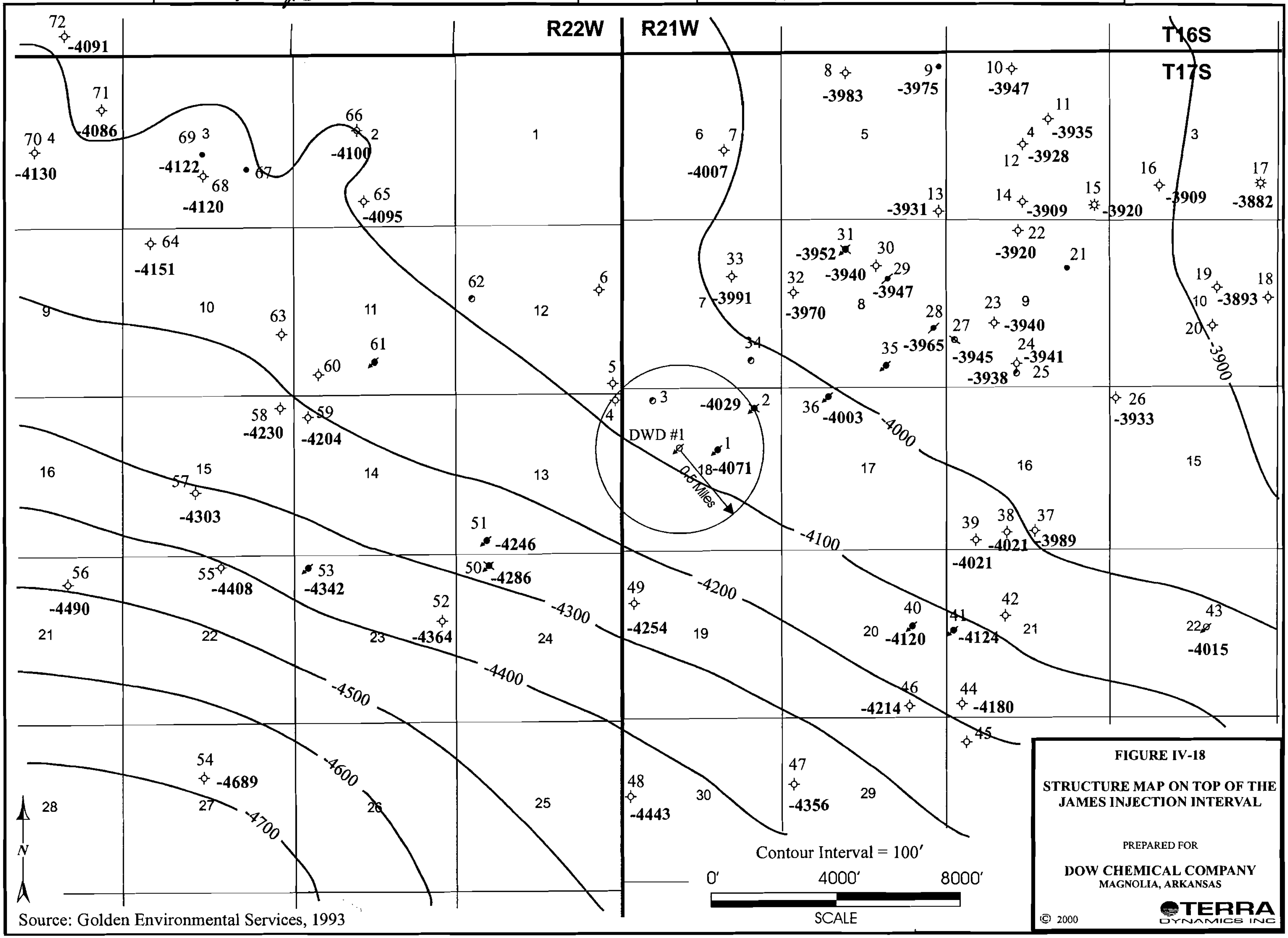


FIGURE IV-18

STRUCTURE MAP ON TOP OF THE JAMES INJECTION INTERVAL

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By: A. BELL, CPG, RG	Drawing No.: 99177.F19
Designed By: A. BELL, CPG, RG	Date: 4-13-00
Checked By:	Job No.: 99-177

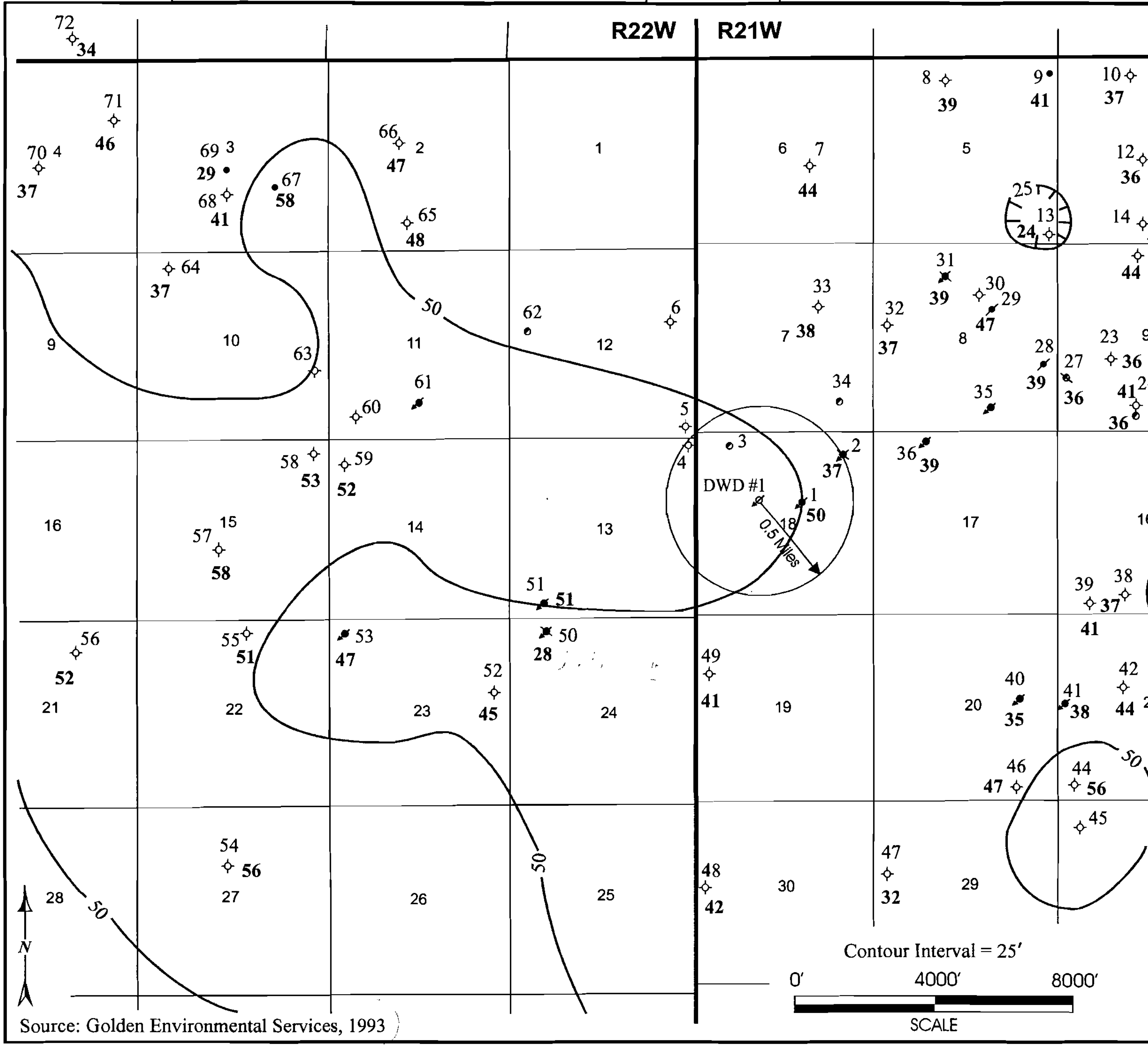


FIGURE IV-19

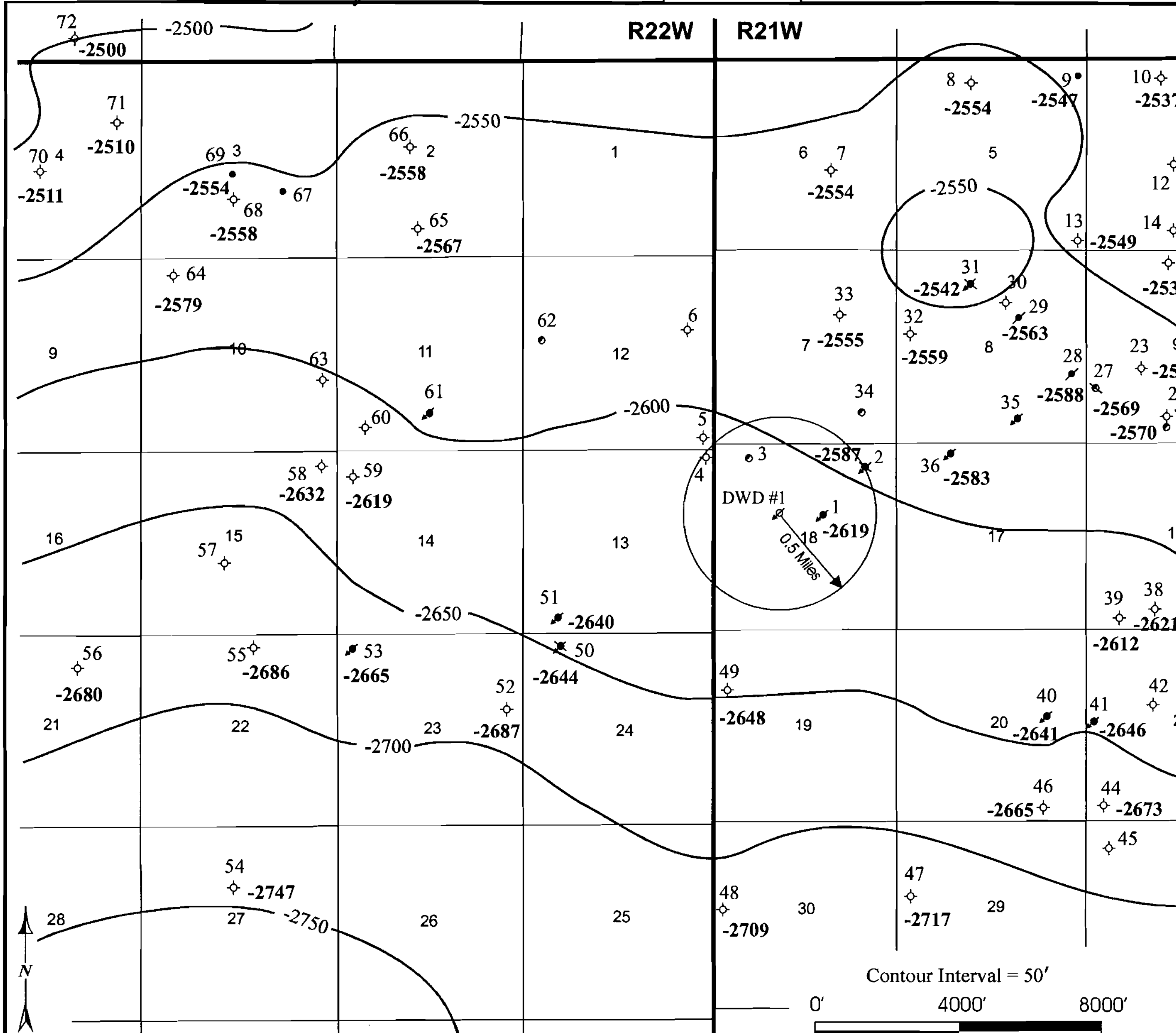
NET SAND ISOPACH OF THE JAMES INJECTION INTERVAL

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By: A. BELL, CPG, RG	Drawing No.: 99177.F20
Designed By: A. BELL, CPG, RG	Date: 4-5-00
Checked By: JR	Job No.: 99-177



Source: Golden Environmental Services, 1993

FIGURE IV-20

STRUCTURE MAP ON TOP OF THE TOKIO INJECTION INTERVAL

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

Drawn By: A. BELL, CPG, RG	Drawing No.: 99177.F21
Designed By: A. BELL, CPG, RG	Date: 4-12-00
Checked By:	Job No.: 99-177

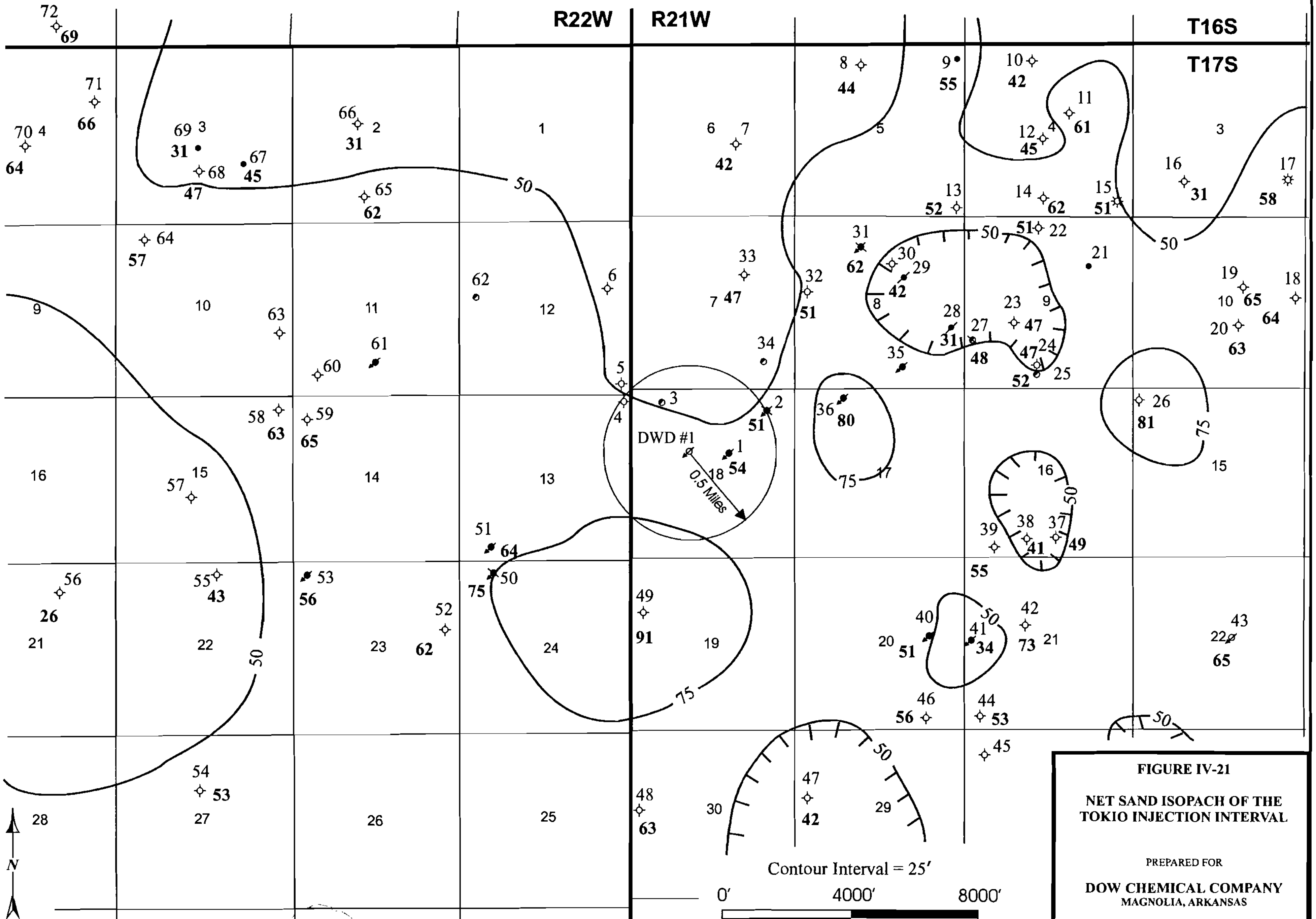


FIGURE IV-21

NET SAND ISOPACH OF THE TOKIO INJECTION INTERVAL

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Source: Golden Environmental Services, 1993

Drawn By: Ann Bell, CPG, RG	Drawing No.: 99177.F22
Designed By: Ann Bell, CPG, RG	Date: 3/31/00
Checked By: PRG	Job No.: 99-177

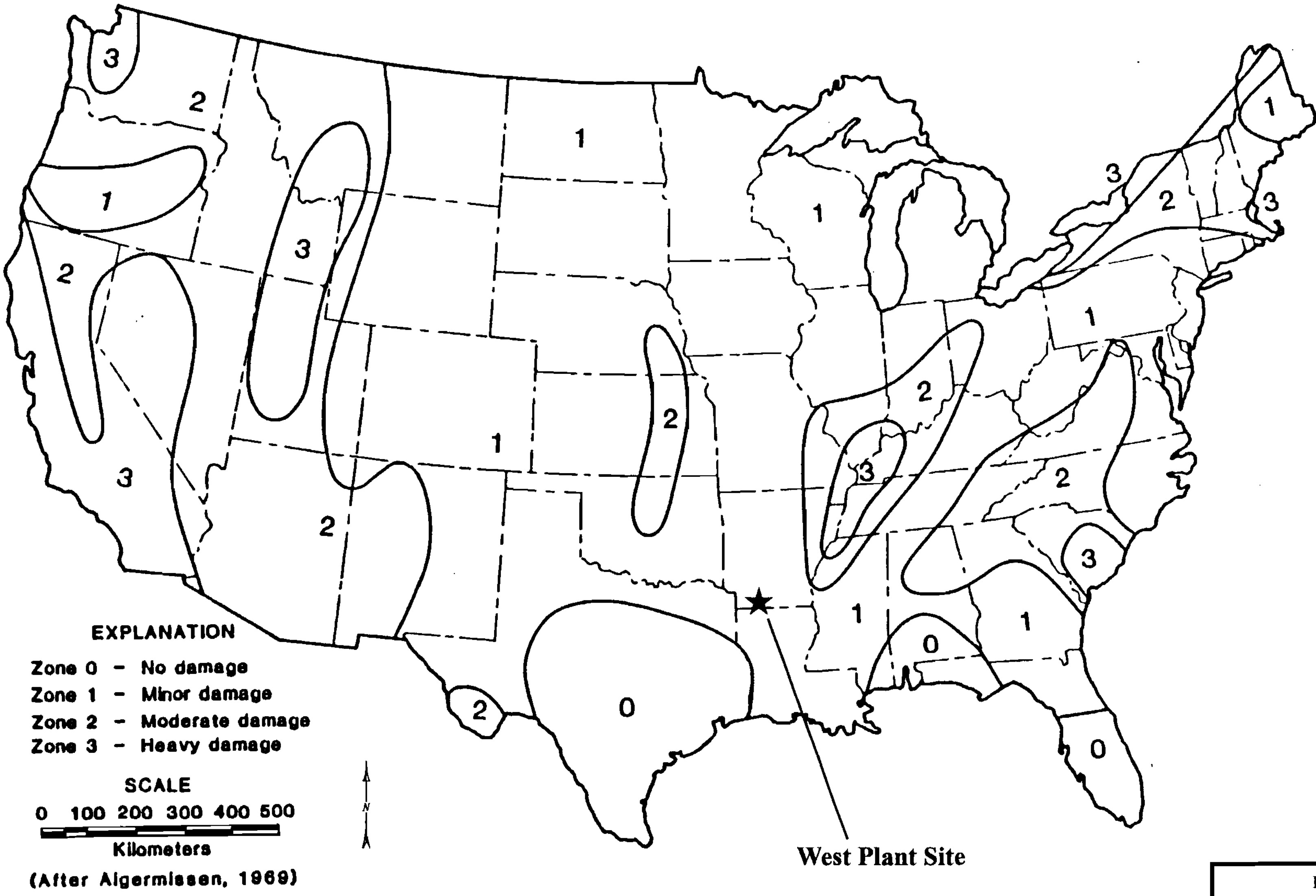


FIGURE IV-22

SEISMIC RISK MAP OF THE UNITED STATES

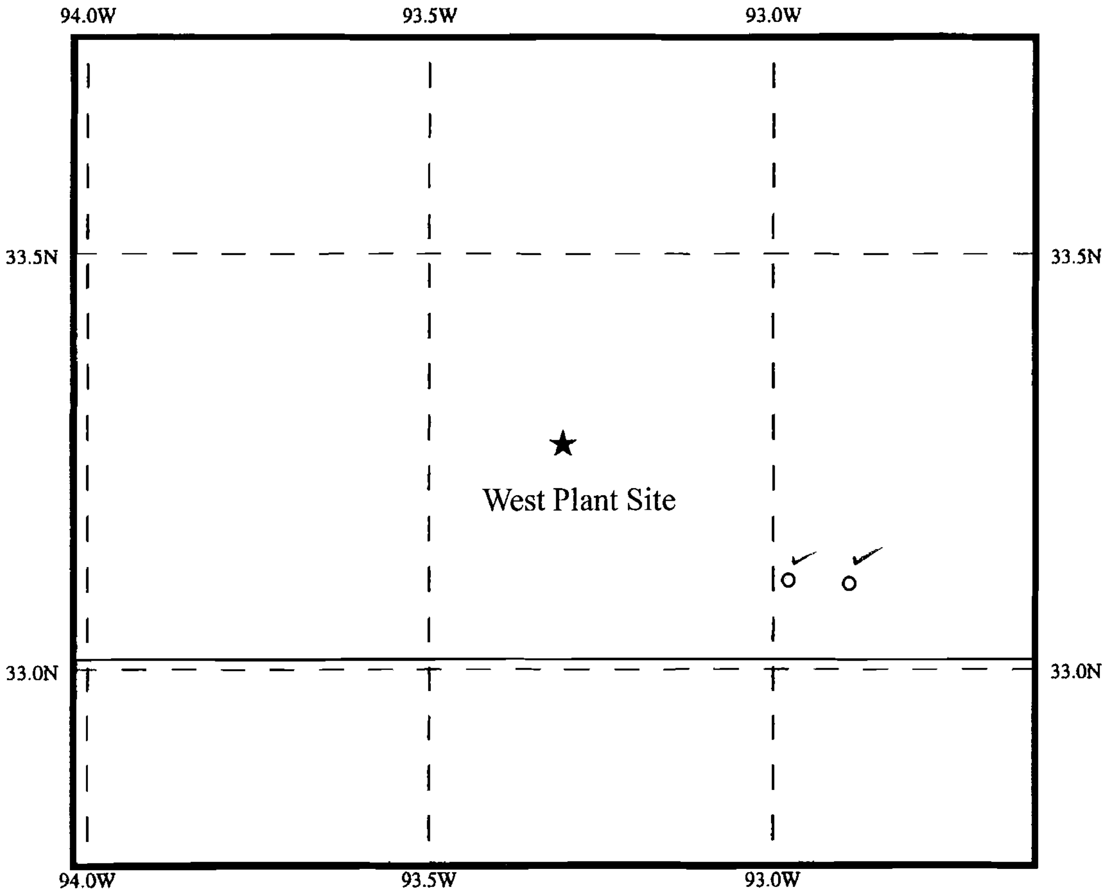
PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By: Ann Bell, CPG, RG	Drawing No.: 99-177.F23
Designed By: Ann Bell, CPG, RG	Date: 5-2-00, Revised 12-7-00
Checked By:	Job No.: 99-177

SEISMICITY WITHIN 50 KM OF 33.259N 93.319W



MAGNITUDES

0.1 - 1.9 · 2.0 - 2.9 · 3.0 - 3.4 · 3.5 - 3.9 · 4.0 - 4.4 · 4.5 - 4.9 · 5.0 - 5.4 · > 5.4

2 Earthquakes Plotted

SCALE 25 km 15 mi

NO INTENSITY OR MAGNITUDE

INTENSITIES

I-III · IV · V · VI · VII · VIII · IX · X-XII

NATIONAL GEOPHYSICAL DATA CENTER / NOAA BOULDER, CO, 80303

FIGURE IV-23

SEISMIC ACTIVITY WITHIN A 50-KM RADIUS OF THE WEST PLANT

PREPARED FOR

DOW CHEMICAL COMPANY MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Source: NOAA, 2000.

Drawn By: A. BELL, CPG, RG	Drawing No.: 99177.F27
Designed By: A. BELL, CPG, RG	Date: 5-25-00
Checked By:	Job No.: 99-177

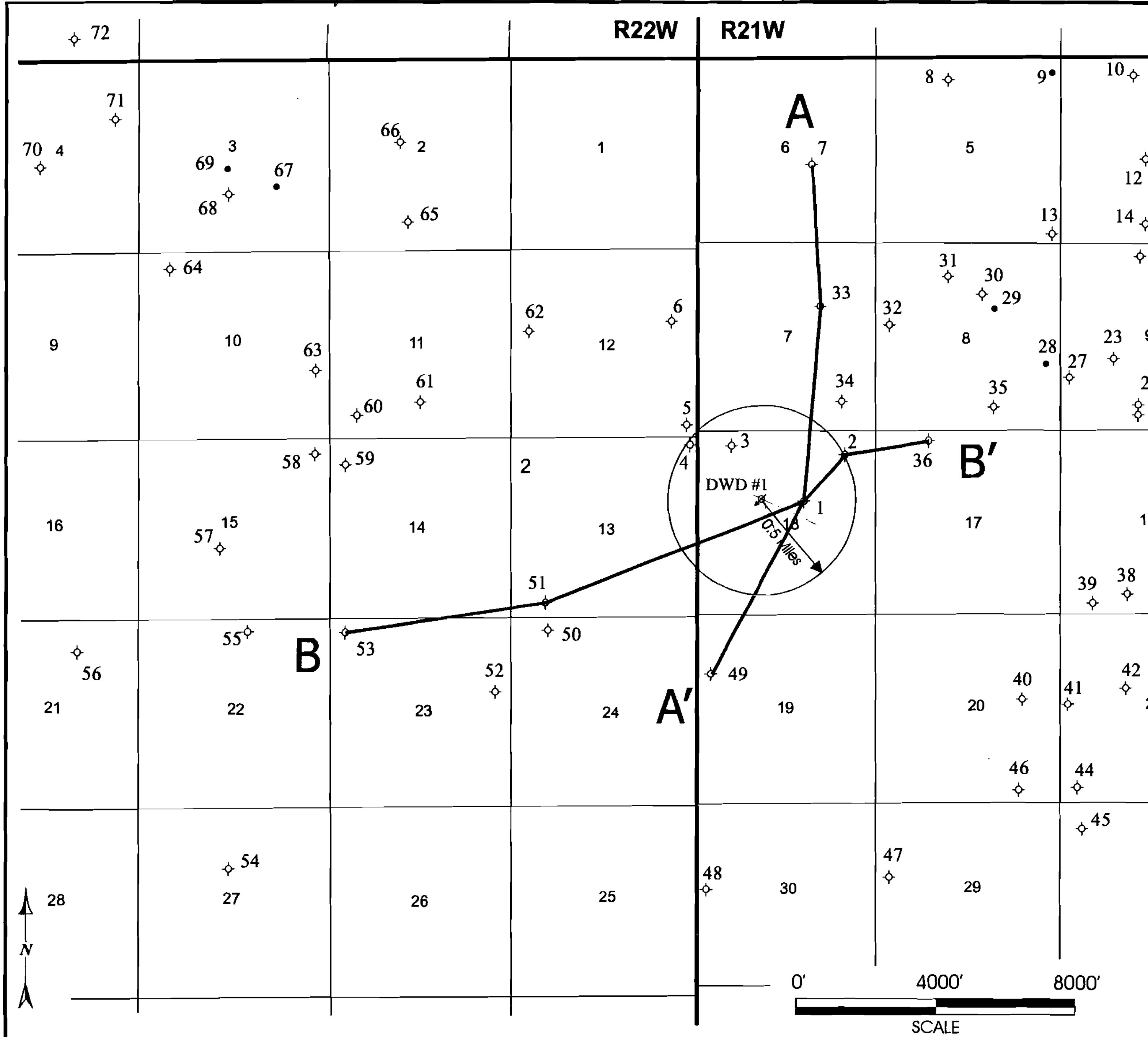


FIGURE IV-26

MAP SHOWING LOCATION
OF CROSS-SECTIONS
A-A' AND B-B'

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawing No.: 99177.F27
Date: 12-20-00
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By:

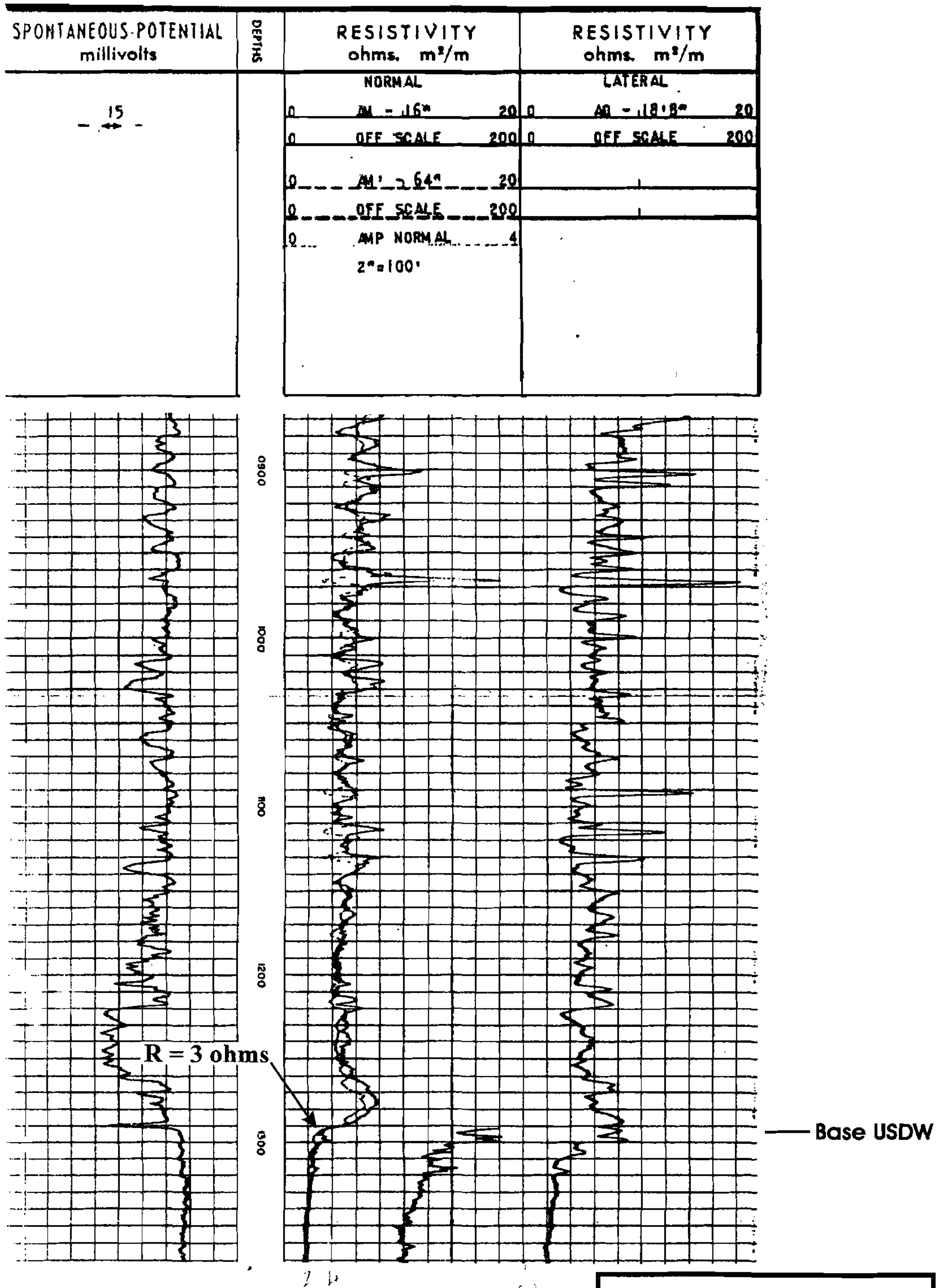


FIGURE IV-27

BASE OF USDW DETERMINATION
PT DISMUKES HEIRS #1
ELECTRIC LOG

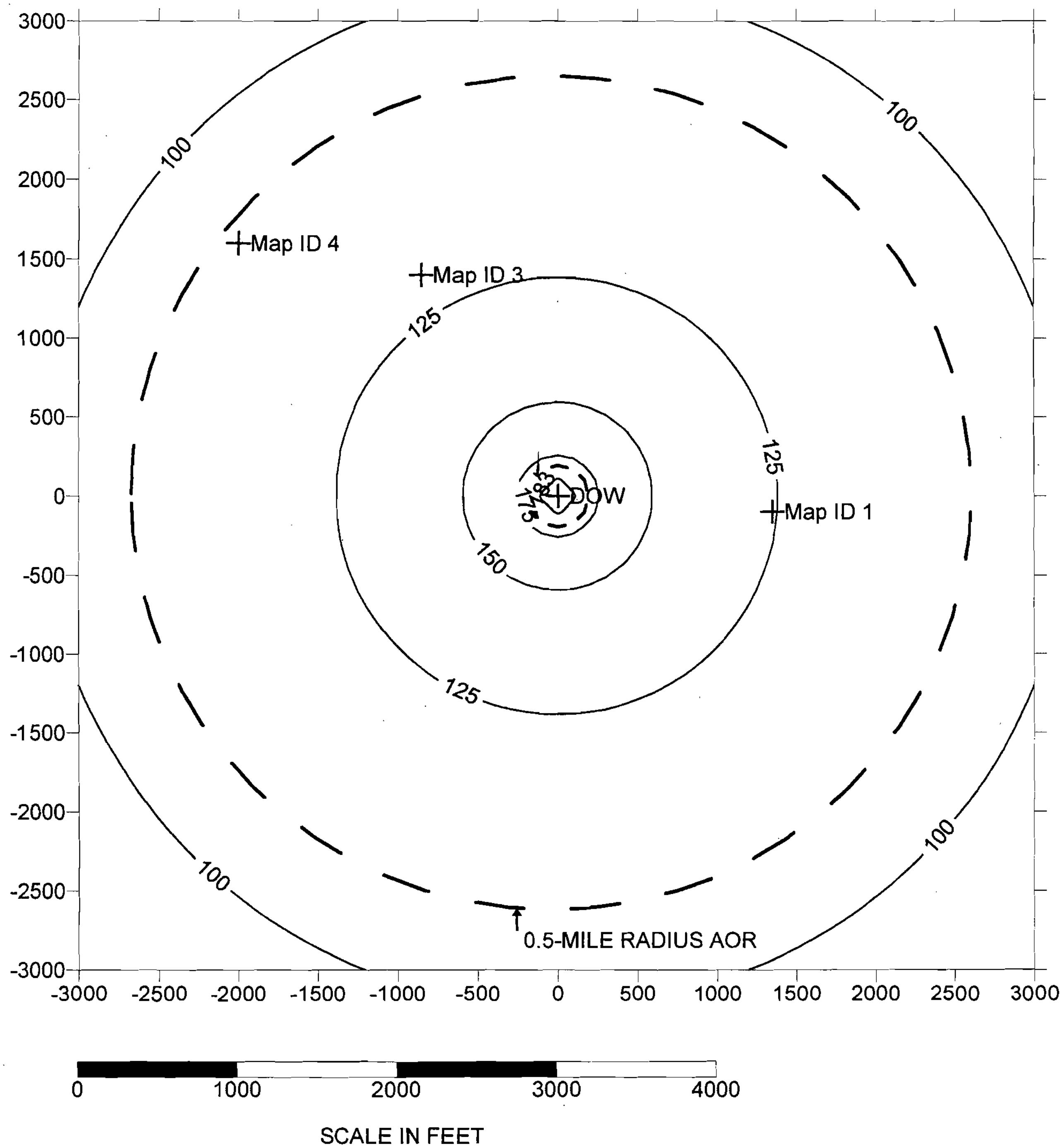
PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawing No.:	99-177.F24
Date:	5-18-00
Job No.:	99-177
Drawn By:	PG
Designed By:	PG
Checked By:	AEB

TOKIO PRESSURE INCREASE AFTER 10 YEARS INJECTING AT 100 GPM



Cone of Endangerment = 183 psi

FIGURE V-1

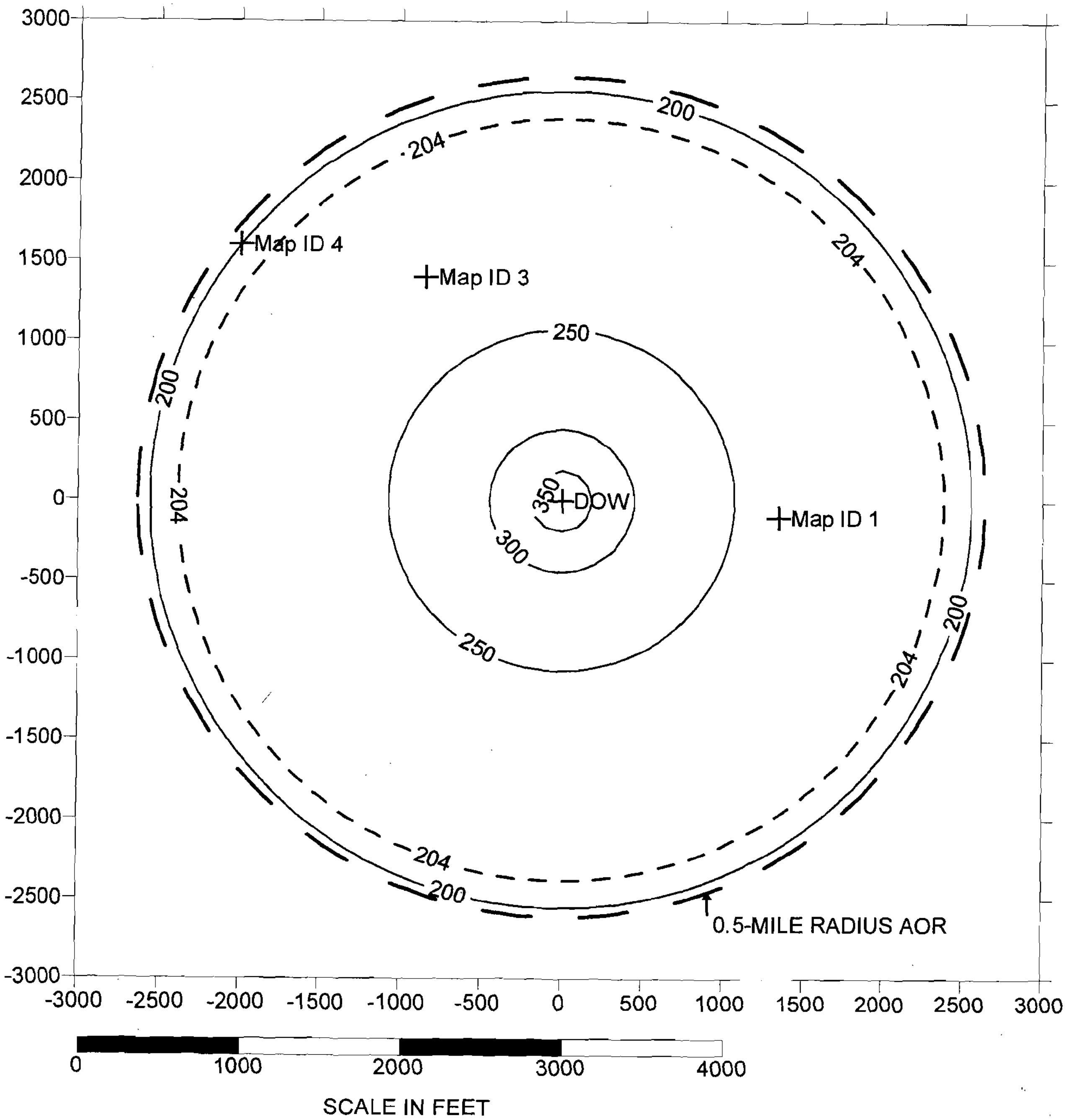
PRESSURE INCREASE IN THE TOKIO INJECTION INTERVAL AFTER 10 YEARS OF INJECTION AT 100 GPM

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

JAMES PRESSURE INCREASE AFTER 10 YEARS INJECTING AT 100 GPM



Cone of Endangerment = 204 psi

Drawing No.: 99-177.F25
Date: 5-18-00
Job No.: 99-177

Drawn By: PG
Designed By: PG
Checked By: AEB

FIGURE V-2

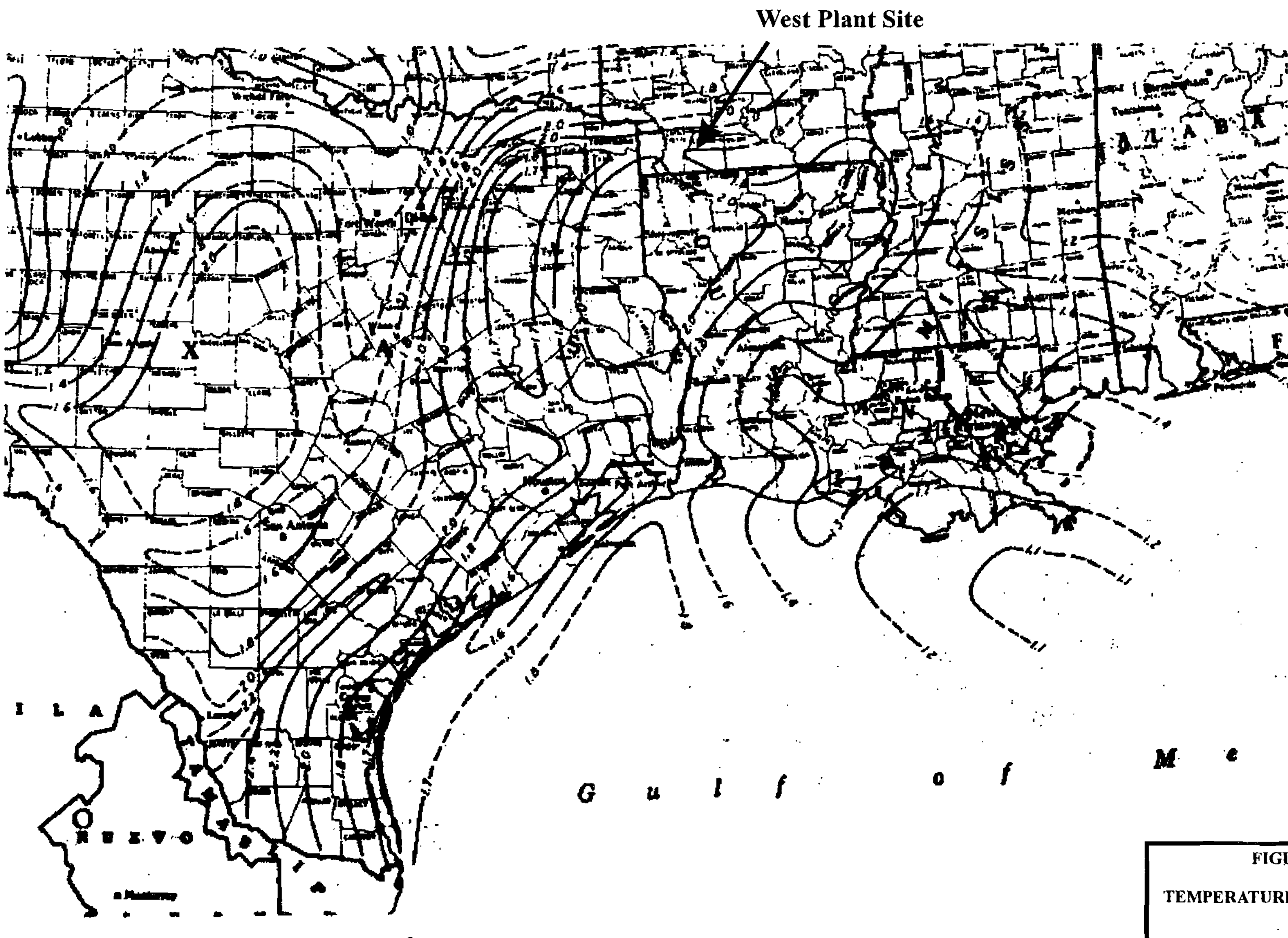
PRESSURE INCREASE IN THE JAMES INJECTION INTERVAL AFTER 10 YEARS OF INJECTION AT 100 GPM

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawn By: Ann Bell, CPG, RG	Drawing No.: 99-177.F28
Designed By: Ann Bell, CPG, RG	Date: 2-2-01
Checked By: Phil Grant, CPG, RG	Job No.: 99-177



Gradients in °F/100 feet

Source: Western Company of North America, 1980.

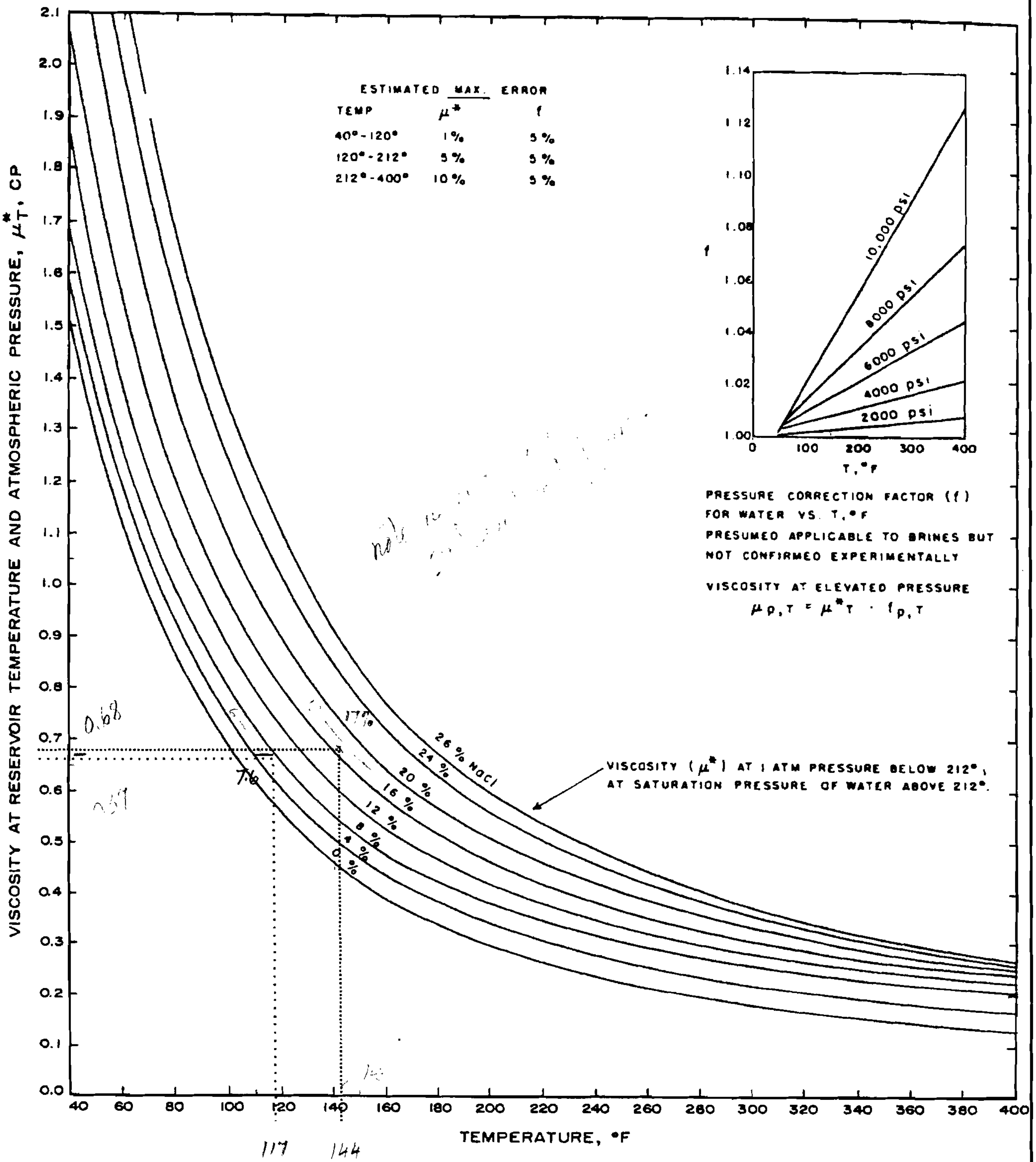
FIGURE V-3

TEMPERATURE GRADIENT MAP

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC



Drawing No.: 99177.F29
Date: 2-2-01
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By: Phil Grant, CPG, RG

········· Tokio Formation

················ James Lime Member

Source: Earlougher, 1977.

FIGURE V-4

VISCOSITY NOMOGRAPH

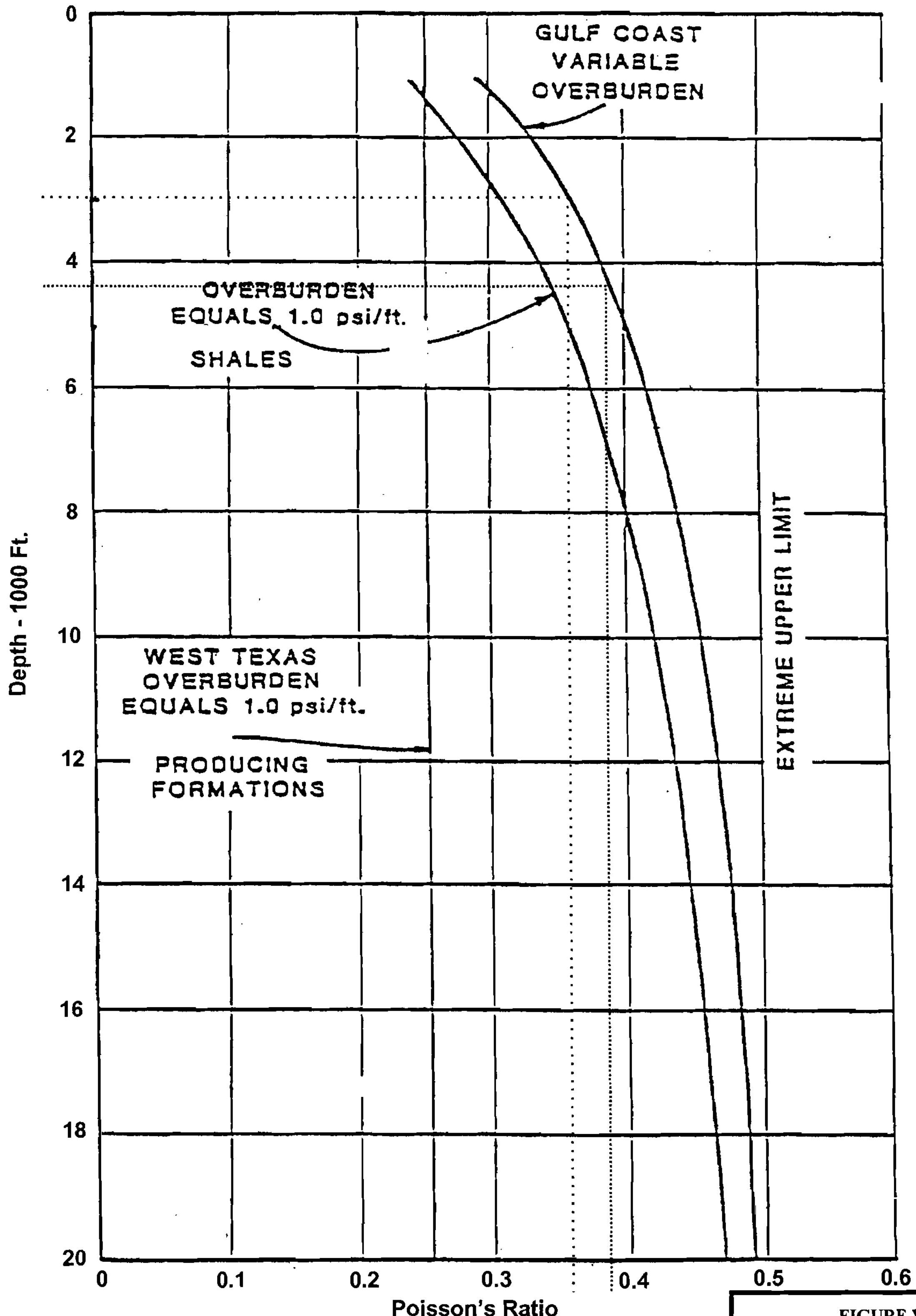
PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

TERRA DYNAMICS INC

Drawing No.: 99177.F30
Date: 2-13-01
Job No.: 99-177

Drawn By: Ann Bell, CPG, RG
Designed By: Ann Bell, CPG, RG
Checked By: Phil Grant, CPG, RG



Variations of Poisson's ratio with depth

········· Tokio Formation

.... James Lime Member

Source: Eaton, 1974.

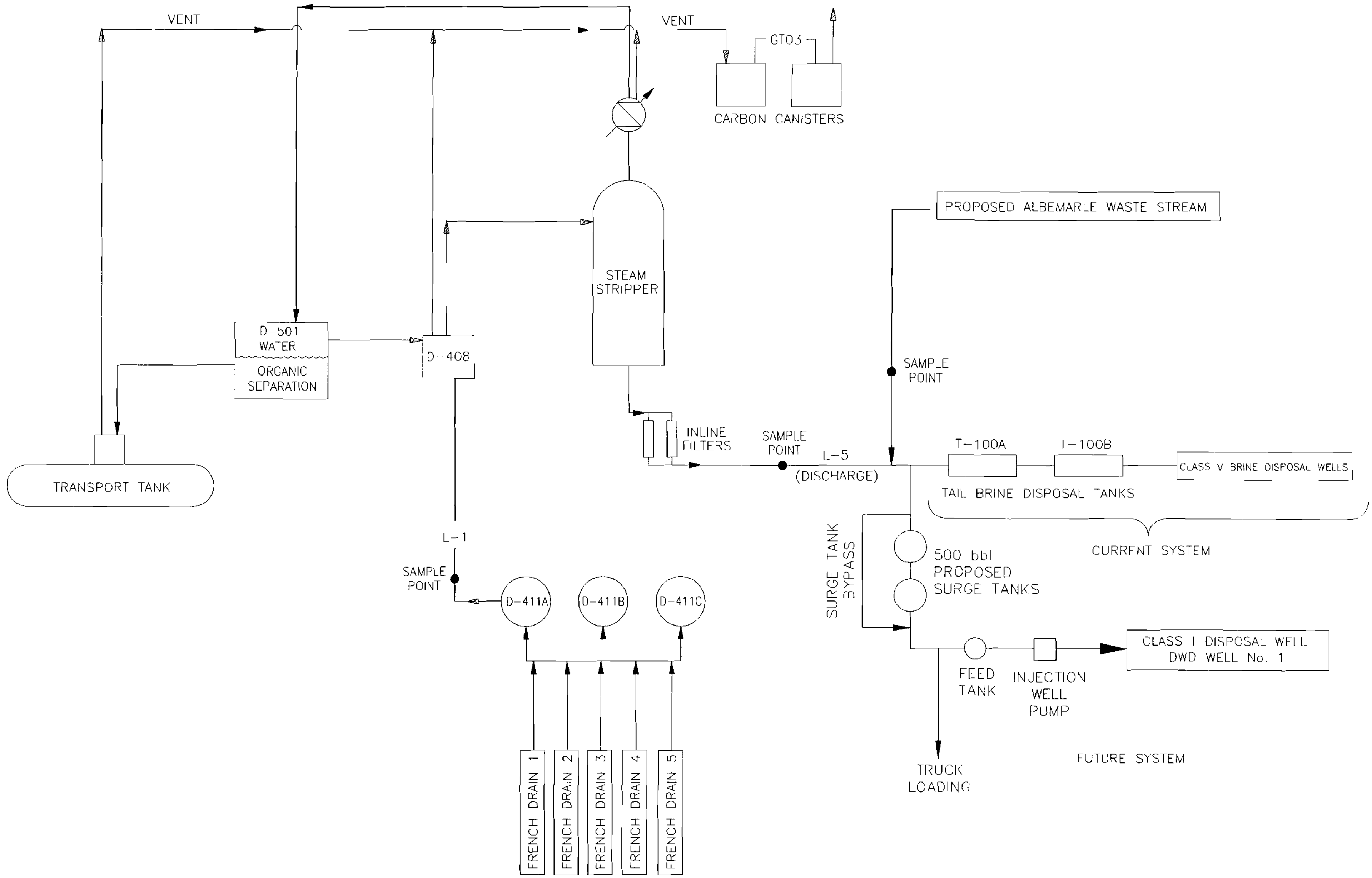
FIGURE V-5

POISSON'S RATIO DETERMINATIONS

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

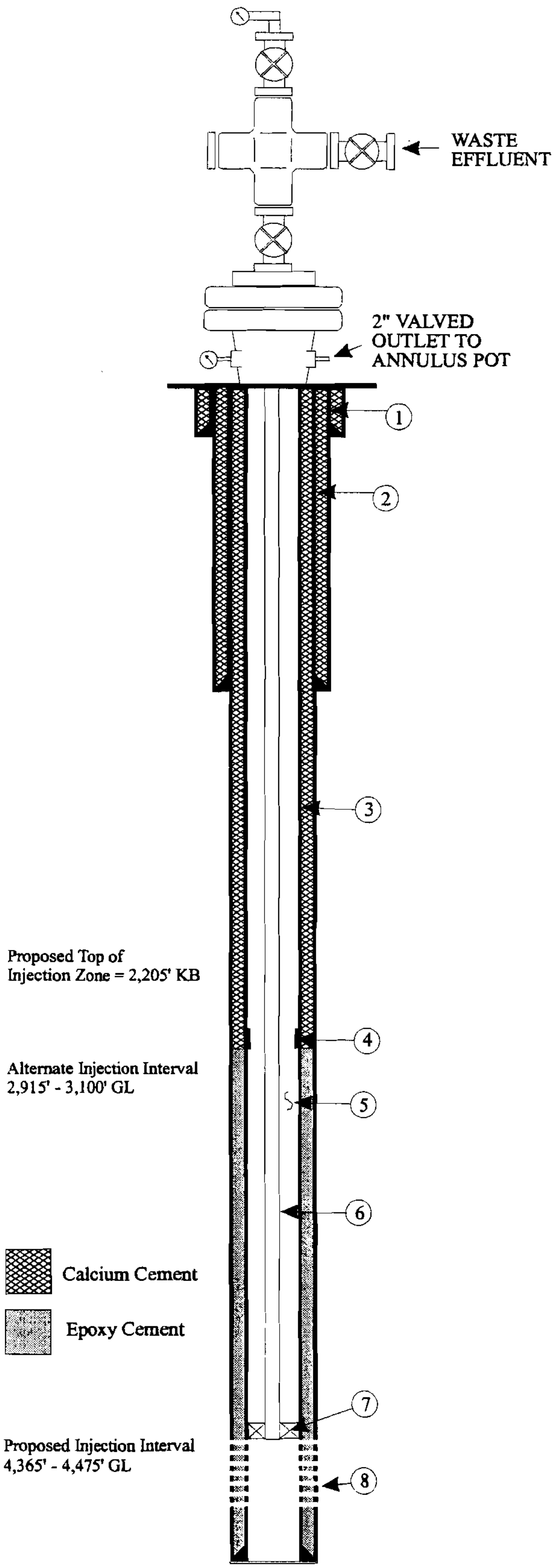
 TERRA DYNAMICS INC



RAV_A0001.CDR PLOT:1=1

URS
Radian

FIGURE VI-1
WASTE DISPOSAL FLOW DIAGRAM



Total Depth = 4,600'±

All depths relative to ground level (GL) elevation and will be corrected to kelly bushing (KB) elevation according to rig selected for this project

BELOW GROUND DETAIL

1. **CONDUCTOR PIPE:** 16", set to 60'±. Cemented with 10 yards of cement and topped off with ready mix.

2. **SURFACE CASING:** 11 3/4", 47 lb/ft, K-55, ST&C set to 1,400'± in 14 3/4" hole. Cemented to surface with Class "H" lite lead cement and Class "H" tail cement.

3. **LONGSTRING CASING:** Mixed string of 7 5/8", 26.4 lb/ft, N-80 (or equivalent), LTC-8rd and 7 5/8", corrosion resistant alloy (CRA) with ST-L flush joint connections set to 4,600'± in 10 5/8" hole as follows:

Surface to 2,800'±	- 7 5/8", 26.4 lb/ft, N-80, LTC-8rd
2,800'± to 3,200'±	- 7 5/8", CRA, ST-L connections
3,200'± to 4,250'±	- 7 5/8", 26.4 lb/ft, N-80, LTC-8rd
4,250'± to 4,600'±	- 7 5/8", CRA, ST-L connections

Note: The carbon steel-to-CRA sections will be connected by appropriately-designed corrosion protection joints.

7 5/8" mixed casing cemented to surface as follows:

First Stage: - Epseal synthetic cement from 4,600'± to 2,700'±.
Second Stage:
Lead Slurry: - Class "H" lite from 2,100'± to surface.
Tail Slurry: - Class "H" from 2,700'± to 2,100'±.

4. **STAGE TOOL:** 7 5/8" mechanical-type at 2,700'±.

5. **ANNULUS FLUID:** Inhibited water.

6. **INJECTION TUBING:** 3 1/2", TFC Red Box 2,000 psi, with Nexus Veil Lining set with GPS Model "12" CRA latching seal assembly into packer at 4,300'±.

7. **PACKER:** 3 1/2" x 7 5/8", GPS Model "12" CRA retrievable packer set at 4,300'±.

8. **PERFORATIONS:** (4 shots/ft)
As indicated from logs, approximately 4,365' - 4,475'±

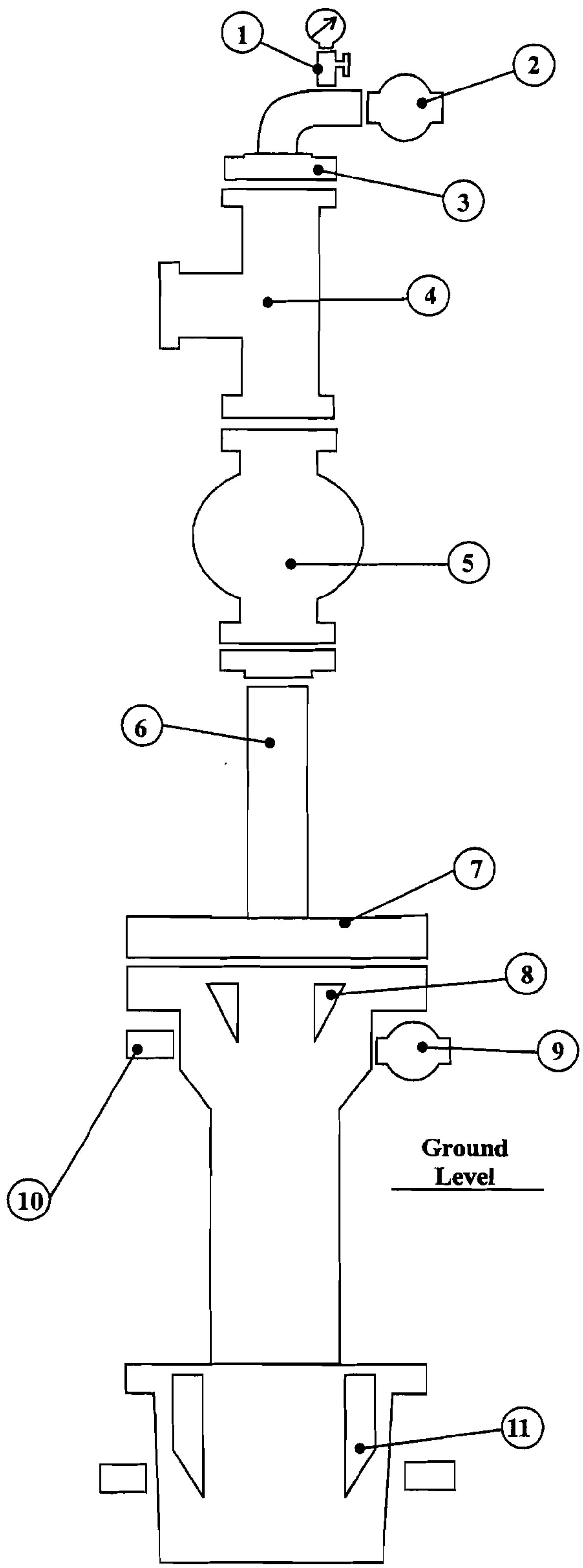
FIGURE VII-1

TERRA DYNAMICS INC

PROPOSED COMPLETION SCHEMATIC
OF PLANT DISPOSAL WELL
DWD NO. 1

PREPARED FOR
DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

DRAWN BY: A. Bell	SCALE:	DATE: 5/23/00
DESIGNED BY: R.F. Bielenda	N.T.S.	JOB NO. 99-177
CHECKED BY:		



1. ½" Needle Valve
   With 0-2,000 psi gauge
2. 2" Ball Valve
3. Flange
4. 3" Flow Tee
5. 3", 600 psi, Auto Valve
6. 3 1/2" Landing Joint
7. 7 5/8" x 3 1/2" Tubinghead
8. 7 5/8" x 3 1/2" Tubing Hanger
9. 2" Valve (Annulus Monitoring System)
10. 2" Bull Plug
11. 11 3/4" x 7 5/8" Bradenhead
    with 2" plugged ports

FIGURE VII-2

TERRA DYNAMICS INC

PROPOSED WELLHEAD CONSTRUCTION
SCHEMATIC OF DISPOSAL WELL
DWD-1

PREPARED FOR
DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

DRAWN BY:	A. BELL	SCALE:	DATE:	5/23/00
DESIGNED BY:	R. MCGOWEN	N.T.S.	JOB NO.	99-177
CHECKED BY:	RM			

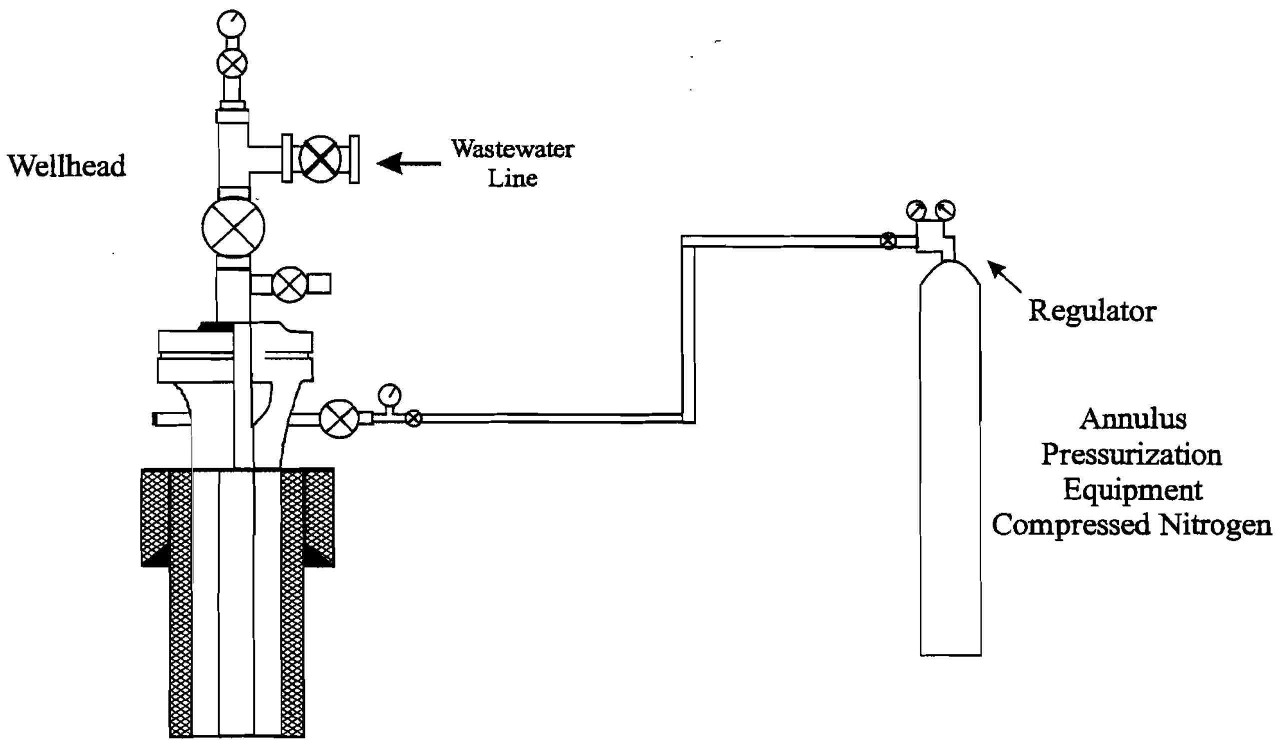


FIGURE VII-3

TERRA DYNAMICS INC

WELLHEAD ANNULUS MONITORING SYSTEM
FOR DISPOSAL WELL DWD-1

PREPARED FOR

DOW CHEMICAL COMPANY
MAGNOLIA, ARKANSAS

DRAWN BY: A. BELL	SCALE:	DATE: 5/17/00	
DESIGNED BY: R.F.BIELENDA	Not to Scale	JOB NO.: 99-177	
CHECKED BY: [signature]			

APPENDIX A

Financial Assurance

The Dow Chemical Company
Midland, Michigan 48674

2030 Dow Center
March 29, 2000

Manny Santos, Torrance Plant
Greg Dubitsky, Pittsburg Plant
Chuck Watson, Allyn's Point
Cynthia Walaitis-Dunn, Dalton
Darryl Sanderson, Louisiana Division
Ivy Dupree, Angus Chemical Co.
Jerry Lachapelle, UIC Terminals
Chris Streeter, Michigan Division
Chuck Selander, Salzburg Landfill
Ben Baker, Nashua
Sheila Burke, Hampshire
Madhukar Shah, Deer Park
Steve Beisser, LaPorte Facility
Bennie Goddard, Texas Operations

FINANCIAL ASSURANCE - FINAL SUBMITTALS

Attached please find a copy of the 1999 financial assurance submittal for your site. If you have any questions, please contact me at 517-636-6774.

Pam LeVasseur

Pam LeVasseur
EH&S Legal Department
Phone: 517-636-6774
Fax: 517-638-9636
E-Mail: pjlevasseur@dow.com

March 28, 2000

The Dow Chemical Company
Midland, Michigan 48674

Ms. Bliss Higgins
Louisiana DEQ
Office of Environmental Services
P. O. Box 82135
Baton Rouge, LA 70884-2135

I am the chief financial officer of The Dow Chemical Company, 2030 Dow Center, Midland, Michigan 48674. This letter is in support of the use of the financial test to demonstrate financial responsibility for liability coverage and closure and/or post-closure care as specified in Chapter 37 of the Louisiana Hazardous Waste Regulations (LHWR).

The firm identified above is the owner or operator of the following facilities for which liability coverage is being demonstrated through the financial test specified in Chapter 37 LHWR:

EPA I.D. #	NAME	ADDRESS
	Region I	
LAD008187080	The Dow Chemical Co. Louisiana Division	PO Box 150 Plaquemine, LA 70764
	Sudden Insurance = $5M **Nonsudden Insurance = $10M**	
LAD020597597	Angus Chemical Co. Sterlington Facility	PO Box 1325 Sterlington, LA 71280
	Sudden Insurance = $5M	

The firm identified above is the owner or operator of the following facilities in states other than Louisiana for which liability coverage is being demonstrated through a test equivalent or substantially equivalent to the financial test specified in Chapter 37 of the LHWR.

	Region I	
CTD001159730	The Dow Chemical Co. Allyn's Point Plant	Route 12 Gales Ferry, CT 06335
	Sudden Insurance = $2M **Nonsudden Insurance = $6M**	

	Region IV	
GAD045929643	The Dow Chemical Co. Dalton Plant	1468 Prosser Drive, SE Dalton, GA 30720
	Sudden Insurance = $2M **Nonsudden Insurance = $6M**	
	Region V	
MID980617435	The Dow Chemical Co. Salzburg Landfill	Salzburg & Waldo Roads Midland, MI 48640
	Sudden Insurance = $3M **Nonsudden Insurance = $6M**	
MID000724724	The Dow Chemical Co. Midland Plant	1261 Building Midland, MI 48674
	Sudden Insurance = $3M **Nonsudden Insurance = $6M**	
	Region VI	
TXD000017756	The Dow Chemical Co. LaPorte Facility	PO Box 687 LaPorte, TX 77571
	Sudden Insurance = $2M **Nonsudden Insurance = $6M**	
TXD008092793	The Dow Chemical Co. Texas Operations	B-1226 Freeport, TX 77541
	Sudden Insurance = $2M **Nonsudden Insurance = $6M**	
	Region IX	
CAD009547050	The Dow Chemical Co. Torrance Plant	305 Crenshaw Boulevard Torrance, CA 90503
	Sudden Insurance = $2M **Nonsudden Insurance = $6M**	
CAD076528678	The Dow Chemical Co. Pittsburg Plant	PO Box 1398 Pittsburg, CA 94565
	Sudden Insurance = $2M **Nonsudden Insurance = $6M**	

1. The firm identified above owns or operates the following facilities for which financial assurance for closure or post-closure care is demonstrated through the financial test specified in Chapters 37 and 43 LHWR. The current closure and/or post-closure cost estimates covered by the test are shown for each facility:

LAD008187080	The Dow Chemical Co. Louisiana Division	PO Box 150 Plaquemine, LA 70764
	Closure Cost = $3,646,305 **Post-Closure Cost = $431,032**	

2. The firm identified above guarantees, through the guarantee specified in Chapters 37 and 43 LHWR, the closure and post-closure care and plugging and abondonment costs for the following facilities owned or operated by its subsidiaries. The current cost estimates for the closure or post-closure care so guaranteed are shown for each facility:

LAD020597597	Angus Chemical Co. Sterlington Facility	PO Box 1325 Sterlington, LA 71280
	Closure Costs = $101,911	
92-2-WD	**Plugging & Abandonment Costs = $202,092**	

3. In States other than Louisiana, this firm is demonstrating financial assurance for the closure or post-closure care of the following facilities through the use of a test equivalent or substantially equivalent to the financial test specified in Chapters 37 and 43 LHWR. The current closure and/or post-closure cost estimates covered by such a test are shown for each facility:

	Region I	
CT001159730	The Dow Chemical Co. Allyn's Point	Route 12 Gales Ferry, CT 06335
	Closure = $149,647	
	Region IV	
NHD048724173	Hampshire Chemical Corp. Nashua	2 East Spit Brook Road Nashua, NH 03060-5633
	Closure = $225,480	
DES-HW-SP-97-001	**Corrective Action = $30,441**	
GAD045929643	The Dow Chemical Co. Dalton Plant	1468 Prosser Dr., SE Dalton, GA 30720
	Post-Closure = $3,480,216	

Region V

MID000724724	The Dow Chemical Co. MI Division/Midland Plant **Closure = $98,627,888** **Post-Closure = $2,030,413**	1261 Building Midland, MI 48674
MID980617435	The Dow Chemical Co. MI Division/Salzburg Plant **Closure = $1,428,618** **Post-Closure = $1,305,462**	Salzburg & Waldo Roads Midland, MI 48640

Region VI

TXD00017756	The Dow Chemical Co. LaPorte Facility **Closure = $110,844** **Post-Closure = $6,587,441**	PO Box 687 LaPorte, TX 77571
TXD008092793	The Dow Chemical Co. Texas Operations **Closure = $63,964,345** **Post-Closure = $18,759,310**	B-1226 Freeport, TX 77541
WDW-222 WDW-223	Hampshire Chemical Corp. Deer Park Facility **Closure = $194,783** **Closure = $194,783**	739 Battleground Road Deer Park, TX 77536

Region IX

CAD009547050	The Dow Chemical Co. Torrance Plant **Closure = $406,216**	305 Crenshaw Blvd. Torrance, CA 90503
CAD076528678	The Dow Chemical Co. Pittsburg Plant **Closure Cost = $4,966,558** **Post-Closure Cost = $13,977,177**	PO Box 1398 Pittsburg, CA 94565

4. The firm identified above owns or operates the following hazardous waste management facilities for which financial assurance for closure or, if a disposal facility, post-closure care, is not demonstrated either to the U.S. EPA or to a State through the financial test or any other financial assurance mechanisms in Chapters 37 and 43 LHWR or equivalent or substantially equivalent State mechanisms. The current closure and/or post-closure cost estimates not covered by such financial assurance are shown for each facility:

None.

5. This firm is the owner or operator of the following UIC facilities for which financial assurance for plugging and abandonment is required under part 144 by the Louisiana Department of Natural Resources. The current closure cost estimates as required by LADNR are shown for each facility:

None.

This firm is required to file a Form 10-K with the Securities and Exchange Commission (SEC) for the latest fiscal year.

The fiscal year of this firm ends on December 31st. The figures for the following items marked with an asterisk are derived from this firm's independently audited, year-end financial statements for the latest completed fiscal year, ended December 31, 1999.

Part C. Closure or Post-Closure Care and Liability Coverage

ALTERNATIVE II

		(In Millions of Dollars)
1.	Sum of current closure and post-closure cost estimates (total of all cost estimates listed above).	$221
2.	Amount of annual aggregate liability coverage to be demonstrated	$15
3.	Sum of lines 1 and 2	$236
4.	Current bond rating of most recent issuance of the firm and name of rating service.	A (Moody's)
5.	Date of issuance of bond.	December 13, 1999
6.	Date of maturity of bond.	December 1, 2029
7.*	Tangible net worth (if any portion of the closure or post-closure cost estimates is included in "total liabilities" on your financial statements you may add that portion to this line).	$6,305
8.*	Total assets in U.S. (required only if less than 90 percent of assets are located in the U.S.)	$10,664

		YES	NO
9.	Is line 7 at least $10 million?	X	
10.	Is line 7 at least 6 times line 3?	X	
11.*	Are at least 90% of assets located in the U.S.? If not, complete line 12.		X
12.	Is line 8 at least 6 times line 3?	X	

I hereby certify that the wording of this letter is identical to the wording specified in LAC 33:VII.727.A.2.i.iv.(e).

J. P. Reinhard
Executive Vice President
and Chief Financial Officer
The Dow Chemical Company

March 28, 2000

PMB/pjl

Deloitte &
Touche

Deloitte & Touche LLP
Suite 400
3320 Ridgecrest Drive
Midland, Michigan 48642

Telephone: (517) 631-2370
Facsimile: (517) 631-4485

INDEPENDENT ACCOUNTANTS' REPORT ON APPLYING AGREED-UPON PROCEDURES

The Dow Chemical Company
Midland, Michigan

We have performed the procedures included in the Code of Federal Regulations (CFR), Title 40, Part 264, Section 143 (40 CFR 264.143), which were agreed to by the Environmental Protection Agency, the Louisiana Department of Environmental Quality – Office of Environmental Services, and The Dow Chemical Company ("Dow"), solely to assist the specified parties in evaluating management's assertion about Dow's compliance with the financial test option as of December 31, 1999, included in the accompanying letter dated March 28, 2000 from Mr. J. P. Reinhard of Dow. This agreed-upon procedures engagement was performed in accordance with standards established by the American Institute of Certified Public Accountants. The sufficiency of these procedures is solely the responsibility of the specified parties. Consequently, we make no representation regarding the sufficiency of the procedures described below either for the purpose for which this report has been requested or for any other purpose.

The procedures that we performed and related findings are as follows:

> We recomputed from, or reconciled to, the audited consolidated financial statements of Dow as of and for the year ended December 31, 1999, on which we have issued our report dated February 9, 2000, the information included in items 7, 8, and 11 under the caption Alternative II in the letter referred to above and noted no differences.

We were not engaged to, and did not, perform an examination, the objective of which would be the expression of an opinion on the accompanying letter dated March 28, 2000. Accordingly, we do not express such an opinion. Had we performed additional procedures, other matters might have come to our attention that would have been reported to you.

This report is intended solely for the information and use of the board of directors and management of Dow and the specified parties listed in the first paragraph, and is not intended to be and should not be used by anyone other than these specified parties.

Deloitte & Touche LLP

March 28, 2000

Deloitte Touche
Tohmatsu

The Dow Chemical Company
Midland, Michigan 48674

SOLID WASTE FACILITY LETTER FROM THE CHIEF FINANCIAL OFFICER
(Liability Coverage, Closure, and/or Post-Closure)

Ms. Bliss Higgins
Louisiana Department of Environmental Quality
Office of Environmental Services
P. O. Box 82135
Baton Rouge, Louisiana 70884-2135

Dear Madam:

I am the chief financial officer of The Dow Chemical Company. This letter is in support of this firm's use of the financial test to demonstrate financial responsibility for liability coverage, closure and post-closure, as specified in LAC 33: VII.727.A.1 and A.2.

1. The firm identified above is the permit holder of the following solid waste facilities, whether in Louisiana or not, for which liability coverage is being demonstrated through the financial test specified in LAC 33:VII.727.A.1. The amount of annual aggregate liability coverage covered by the test is shown for each facility:

Block 80 Industrial Solid Waste Landfill, Plaquemine LA	$1,000,000.00

2. The firm identified above is the permit holder of the following solid waste facilities, whether in Louisiana or not, for which financial assurance for closure and post-closure is demonstrated through a financial test similar to that specified in LAC 33:VII.727.A.2. or other forms of self-insurance. The current closure and post-closure cost estimates covered by the test are shown for each facility:

Facility and Location	Closure	Post-Closure Care
Block 80 Industrial Solid Waste Landfill, Plaquemine, LA	$5,234,342	$ 33,055

3. This firm guarantees through a corporate guarantee similar to that specified in LAC 33:VII.727.A.1. and 2, closure and post-closure care of the following solid waste facilities, whether in Louisiana or not, of which Angus Chemical Company are a subsidiary of this firm.

The amount of annual aggregate liability coverage covered by the guarantee for each facility and/or the current cost estimates for the closure and/or post-closure care so guaranteed is shown for each facility:

Facility and Location	**Closure**	**Post-Closure Care**
Waste Water Treatment Plant Lagoons, P-0067, Sterlington, LA	$523,485	$274,963

This firm is the owner or operator of the following solid waste facilities, whether in Louisiana or not, for which financial assurance for liability coverage, closure and/or post-closure care is not demonstrated either to the U.S. Environmental Protection Agency or to a state through a financial test or any other financial assurance mechanism similar to those specified in LAC 33:VII.727.A.1. and/or 2. The current closure and post-closure cost estimates not covered by such financial assurance are shown for each facility:

None.

This firm is required to file a Form 10-K with the Securities and Exchange Commission (SEC) for the latest fiscal year.

The fiscal year of this firm ends on December 31st. The figures for the following items marked with an asterisk are derived from this firm's independently audited, year-end financial statements for the latest completed year, ended December 31, 1999.

Part C. Closure or Post-Closure Care and Liability Coverage

ALTERNATIVE II

(In Millions of Dollars)

1.	Sum of current closure and post-closure cost estimates (total of all cost estimates listed above).	$6.1
2.	Amount of annual aggregate liability coverage to be demonstrated	$1
3.	Sum of lines 1 and 2	$7.1
4.	Current bond rating of most recent issuance of the firm and name of rating service.	A (Moody's)
5.	Date of issuance of bond.	December 13, 1999
6.	Date of maturity of bond.	December 1, 2029
7.*	Tangible net worth (if any portion of the closure or post-closure cost estimates is included in "total liabilities" on your financial statements you may add that portion to this line).	$6,305
8.*	Total assets in U.S. (required only if less than 90 percent of assets are located in the U.S.)	$10,664

		YES	NO
9.	Is line 7 at least $10 million?	X	
10.	Is line 7 at least 6 times line 3?	X	
11.*	Are at least 90% of assets located in the U.S.? If not, complete line 12.		X
12.	Is line 8 at least 6 times line 3?	X	

I hereby certify that the wording of this letter is identical to the wording specified in LAC 33:VII.727.A.2.i.iv.(e).

J. P. Reinhard
Executive Vice President
and Chief Financial Officer
The Dow Chemical Company

March 28, 2000

PMB/pjl

Deloitte &
Touche

Deloitte & Touche LLP
Suite 400
3320 Ridgecrest Drive
Midland, Michigan 48642

Telephone: (517) 631-2370
Facsimile: (517) 631-4485

INDEPENDENT ACCOUNTANTS' REPORT ON APPLYING AGREED-UPON PROCEDURES

The Dow Chemical Company
Midland, Michigan

We have performed the procedures included in the Code of Federal Regulations (CFR), Title 40, Part 264, Section 143 (40 CFR 264.143), which were agreed to by the Environmental Protection Agency, the Louisiana Department of Environmental Quality – Office of Environmental Services, and The Dow Chemical Company ("Dow"), solely to assist the specified parties in evaluating management's assertion about Dow's compliance with the financial test option as of December 31, 1999, included in the accompanying letter dated March 28, 2000 from Mr. J. P. Reinhard of Dow. This agreed-upon procedures engagement was performed in accordance with standards established by the American Institute of Certified Public Accountants. The sufficiency of these procedures is solely the responsibility of the specified parties. Consequently, we make no representation regarding the sufficiency of the procedures described below either for the purpose for which this report has been requested or for any other purpose.

The procedures that we performed and related findings are as follows:

> We recomputed from, or reconciled to, the audited consolidated financial statements of Dow as of and for the year ended December 31, 1999, on which we have issued our report dated February 9, 2000, the information included in items 7, 8, and 11 under the caption Alternative II in the letter referred to above and noted no differences.

We were not engaged to, and did not, perform an examination, the objective of which would be the expression of an opinion on the accompanying letter dated March 28, 2000. Accordingly, we do not express such an opinion. Had we performed additional procedures, other matters might have come to our attention that would have been reported to you.

This report is intended solely for the information and use of the board of directors and management of Dow and the specified parties listed in the first paragraph, and is not intended to be and should not be used by anyone other than these specified parties.

Deloitte & Touche LLP

March 28, 2000

APPENDIX B

AOR Well Records

NON-FRESHWATER
ARTIFICIAL PENETRATIONS

ARTIFICIAL PENETRATION REVIEW

MAP ID NO. 1

Status: Operating

Operator: Dow Chemical -Ethyl Corp / Albemarle

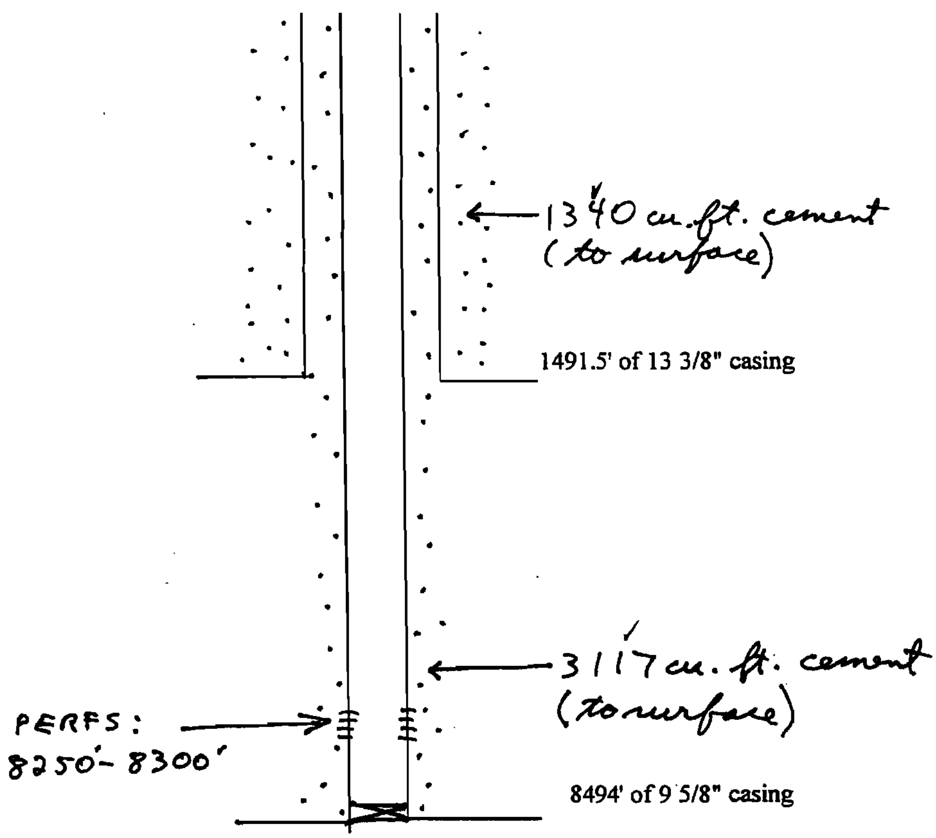
Forms: AOGC-3

Lease: Dow Fee

Distance from Injector: 1,354' √

Well #: 1

Well Diagram



Potential Problems:

NONE

5M—5-63—53798—Ark.P.&L.Co. AOGC-2-(56)

ARKANSAS OIL AND GAS COMMISSION
El Dorado, Arkansas

Serial No. O.W.SW

Notice of Intention to Drill For Oil or Gas

(This application to drill must be accompanied by a remittance of $50.00)

Date January 13, 1965

Name of Operator Brazos Oil and Gas Company Division of The Dow Chemical Co.

Send Permit to: Street P. O. Box 22468

City Houston

State Texas 77027

Lease Name Dow Well No. 1

Acres in lease 80

Number of acres in and description of drilling unit 40 acres being SW/4 of NE/4 Section 18, T-17-S, R-21-W

Location of proposed well in drilling unit (give in feet) 660' east of west line and 660' north of south line NE/4

Section 18 Township 17-S Range 21-W

County Columbia Field Wildcat

Distance and direction from the nearest town 4-1/2 miles west Magnolia

Distance from proposed location to nearest drilling, completed or applied for well 6800 feet

Rotary or cable tools Rotary Date work will start January 20, 1965

Name of drilling or workover contractor Will notify later

Depth to be drilled 8300 feet

Formation you propose to complete in Smackover Limestone

Remarks: The proposed well is being drilled as a brine producer. Oil or gas production is not anticipated.

Approved by [illegible] 1-14-65

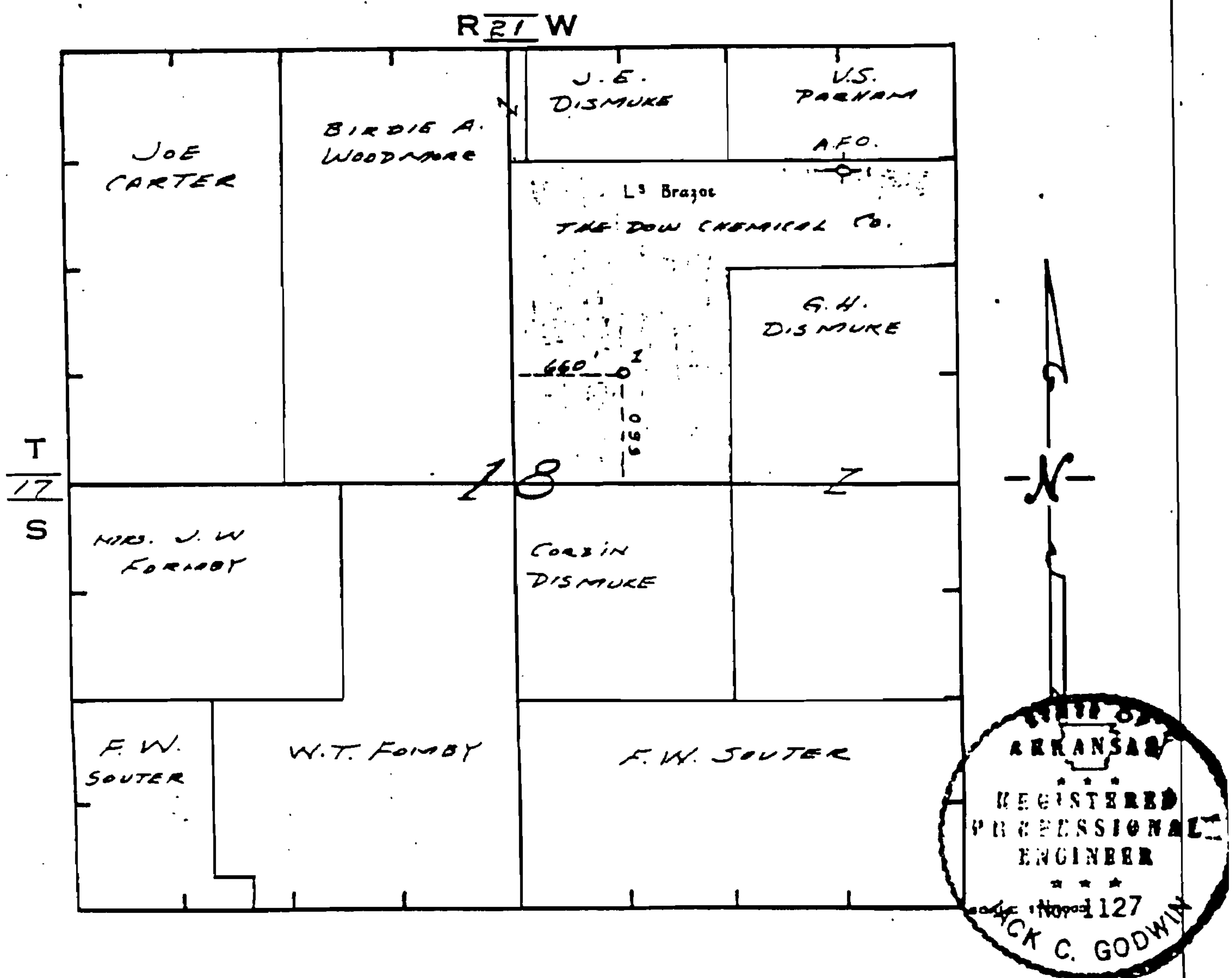
CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

[signature]

LOCATION PLAT
SHOWING

No. 1 Dow
660 FT. North & 660 FT. East of SW corner NE¼
Section 18, T17S, R21W, Columbia County, Ark
For
Brazos Oil & Gas Company,
A Division of The Dow Chemical Company



SURVEYORS NOTE:
I CERTIFY THAT THE ABOVE PLAT WAS PREPARED FROM AN ACTUAL SURVEY MADE ON THE GROUND.

Jack C. Godwin
SURVEYOR

GODWIN ENGINEERING CO.
1501 N. MOSBY EL DORADO, ARK.

Jan 6, 1965 Job No. S-4569

6 Houston
1 J. Vestal
1 Munger

AOGC-3-(56)

B.W.

STATE OF ARKANSAS
OIL AND GAS COMMISSION
El Dorado, Arkansas

Well Completion and Recompletion Report

(Instructions: See Reverse Side)

Notice: This form must be completed and filed prior to allowable being granted.

Wilson Lodge **WELL DESCRIPTION** BRAZOS OIL & GAS CO. DIVISION OF THE DOW CHEMICAL CO.

Field ~~Wildcat~~ Producer Brine

Pool Completed In Smackover Lime Water Supply Well

Lease Name Dow No. 1 Address: Street P. O. Box 22468

Exact Location 660' from south and west Line NE/4

City Houston

Sec 18 Twp 17-S Rge 21-W

County Columbia

State Texas 77027

Date Commenced 2/1/65

Date Completed 3/23/65

Elevation 309' KB

Total Depth Drilled 8500' Smackover T.D.

Electric Log Run: Yes x No

Electric Log Filed: Yes x No

RECEIVED
JAN 2 6 1966
Arkansas Oil & Gas Commission

CASING, TUBING, PERFORATING AND COMPLETION PROGRAM USED IN WELL

Conductor: (Size & Wt.) 20" - 1/4" Wall set at 37 ft. w/ 4 yards concrete

Surface: (Size & Wt.) 13-3/8", 48# and 54.5# set at 1491.5 ft. w/ 1340 cu ft

Intermediate: (Size & Wt.) -- set at -- ft. w/ -- sks.

Production: (Size & Wt.) 9-5/8", 43.5# and 47# set at 8494 ft. w/ 3117 cu ft

Tubing: (Size & Wt.) 5-1/2" 15.5# set at 2579 ft.

Perforations: Size 0.56" No. Per Foot 2

Perforated Intervals: 8250' - 8300'

Acidized: Yes x No ; Interval 8250' - 8300' w/ gals.

Fractured: Yes No x ; Interval w/ lbs. of sand; bbls. of oil.

LEASE DATA

1. Number of wells located on this lease, including this well 2
2. Tank battery to which this well is connected: Existing Not applicable New --
3. Liquid production from this well is sold to (Not applicable (Address
4. Disposition of gas from this well: Vented x Fuel Sold
   If sold, to whom
   Address

PRODUCTION

Date of Test 3/29/65 - 5/3/65 Actual Length of Time Tested 64 days

Type Well: Flowing Gas Lift Pump x

Tubing Pressure 50 psi Casing Pressure nil Choke Size none

Net Oil Produced 0 bbls. Gas Produced 70 MCF % BSW -- GOR Infinite

Gravity Oil -- BHP Recorded 3650 psi

Net Oil in 24 Hours -- Open Flow Potential Not applicable MCF

Purpose of this test: Original Completion -- Workover -- Recompletion --

Allowable Requested None Water Supply Well

RF

REMARKS:

Please use reverse side of this page for all pertinent remarks.

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

Marion Lewis Jr.

Dow No. 1 was drilled to test the brine productive capabilities of Smackover Limestone. Approximately 129,400 barrels of brine were produced from this well during the test period. All brine produced was re-injected into the Dow No. 1 SWD, which is located on the same lease.

/

INSTRUCTIONS:

The Well Completion Test Form, WITH ALL INFORMATION REQUESTED THEREON FILLED IN, shall be filed not later than five (5) days after the test is completed, and should the operator fail to file a test form in an acceptable form within the five (5) days as specified, then the effective date of the allowable resulting from such test shall not extend back more than five (5) days prior to receipt and acceptance of the test form. This five-day provision shall govern regardless of whether the test is taken during the month in which it is received or any prior month.

Any test form resulting from a retest of an oil well which is received after the fifteenth (15th) of the month shall not be used as the basis for the establishing a new allowable before the issuance of the proration schedule for the next succeeding month.

January 14, 1965

Mr. Maurice Lewis, Jr.
Brazos Oil and Gas Company
3636 Richmond Avenue
Houston 27, Texas

Dear Mr. Lewis:

We have received your Notice of Intention to Drill your Dow #1 well located 660 feet East of the West Line and 660 feet North of the South Line of the Northeast quarter of Section 18, Township 17 South, Range 21 West, Columbia County, Arkansas. Your application complies with all of our regulations with regard to this matter. Therefore, please consider this letter as your authority to proceed with the drilling of this well.

In drilling this well, it will be necessary that the Minimum Casing Requirements, here in Arkansas, be complied with, and which are shown on the sheet attached hereto. It will also be necessary that the setting and cementing of the surface pipe be witnessed by an engineer of this office. The form attached hereto also lists the engineer who will witness the setting of this pipe and also gives his name and office number where he can be reached.

As per our discussion of this matter, we will hold this permit and all associated correspondence confidential until we hear further from you.

Yours very truly,

Edward A. Albares

EAA:vs

Enclosure

DOW CHEMICAL U.S.A.

POST OFFICE BOX 520
MAGNOLIA, ARKANSAS 71753
501 · 235-2300

May 14, 1984

Mr. David Morrow
Arkansas Oil and Gas Commission
314 East Oak Street
El Dorado, Arkansas 71730-5896

RE: Dow Fee No. 1 Reinjection Well Permit

Dear Mr. Morrow:

Item No. 3

There are no wells nor public freshwater wells within the one-half mile radius. Dow does have the Sparta Sand freshwater monitor well on the Dow Fee No. 1 location.

A Foxboro M/40PR 0-300 psig pressure recorder with circular seven-day chart is used to record the annulus pressure of the reinjection well. The annulus pressure will normally be run approximately two to three times the reinjection tubing pressure of 50 psig maximum.

Should you have further questions or need additional information, please call me at 501-235-2300.

Thank you.

Sincerely,

Jim Ball

Jim Ball

mp

RECEIVED
MAY 15 1984
ARKANSAS OIL & GAS COMMISSION

ARKANSAS
OIL AND GAS
COMMISSION

314 East Oak Street ■ El Dorado, Arkansas 71730

Ph. 501 862-4965

William E. Wright
Director

May 21, 1984

Mr. J. O. Ball
Dow Chemical Company
P.O. Box 520
Magnolia, Arkansas 71753

Re: Dow Fee #1
Sec. 18 - 17S - 21W
Kilgore Lodge Field
Columbia County, Arkansas

Dear Sir:

Please refer to your application to inject produced salt water into the above named well. The proposed water is to be from the combined stream of produced brine water.

Disposal shall be required to be down the tubing string with a packer set immediately above the proposed disposal zone. Provisions to monitor the annulus between the tubing and casing strings shall also be required.

You propose to install the packer in the well by the end of 1984.

Injection pressures shall be confined to such pressures which will not fracture the confining beds of the authorized disposal zone.

Further, only water from the applied for and approved wells shall be authorized for disposal into the proposed SWD well. The injection water volume and surface pressures must be reported monthly on Form 14, Salt Water Disposal Report.

This letter will be your authority to conduct the operations covered by your application. Your attention is directed to the necessity of compliance with the provisions of Rule C-7 of the General Rules and Regulations.

It is requested that upon completion of this system, that this office be notified so someone from this office can observe pressure testing of the annulus of the injection well.

Yours truly,

John G. Ragsdale
Underground Injection Section

JGR:mrt

cc: Dept. of Pollution
Control & Ecology
P.O. Box 851
El Dorado, AR 71730

Well File

Rev. 1-1-84

ARKANSAS OIL AND GAS COMMISSION
314 EAST OAK STREET
EL DORADO, ARKANSAS 71730-5896

APPLICATION TO INJECT SALT WATER/ENHANCED RECOVERY FLUID

OPERATOR The Dow Chemical Company U.S.A.
Address:
STREET P. O. Box 520 CITY Magnolia STATE Arkansas ZIP 71753

Person responsible for operations J. O. Ball

TELEPHONE: 501-235-2370

1. This application is for approval to inject (X) produced salt water ( ) enhanced recovery fluid into the

(Zone) Smackover Lime, at a depth interval of 8250' - 8300'

feet sub-surface, in the (Well) Dow Fee #1

Located 660' from south & west line NE/4

of Section 18 Township 17-S Range 21-W.

in Kilgore Lodge Field, Columbia County, Arkansas.

This zone (is) (~~XXXXXX~~) known to be productive of oil or gas.

Depth to base of fresh water and water containing less than 10,000 P.P.M. total dissolved solids is ~~600~~ 1300 feet.

2. (Complete either (A) or (B) as applicable.)

A. (X) This well is a completed well and will be converted to injection service; it is cased and cemented as indicated below;

(Size) 13-3/8" Surface casing set at 1491.5' feet with 1340 cu. ft. ~~sacks~~

(Size) 9-5/8" production casing set at 8494 feet with 3117 cu. ft. ~~sacks~~.

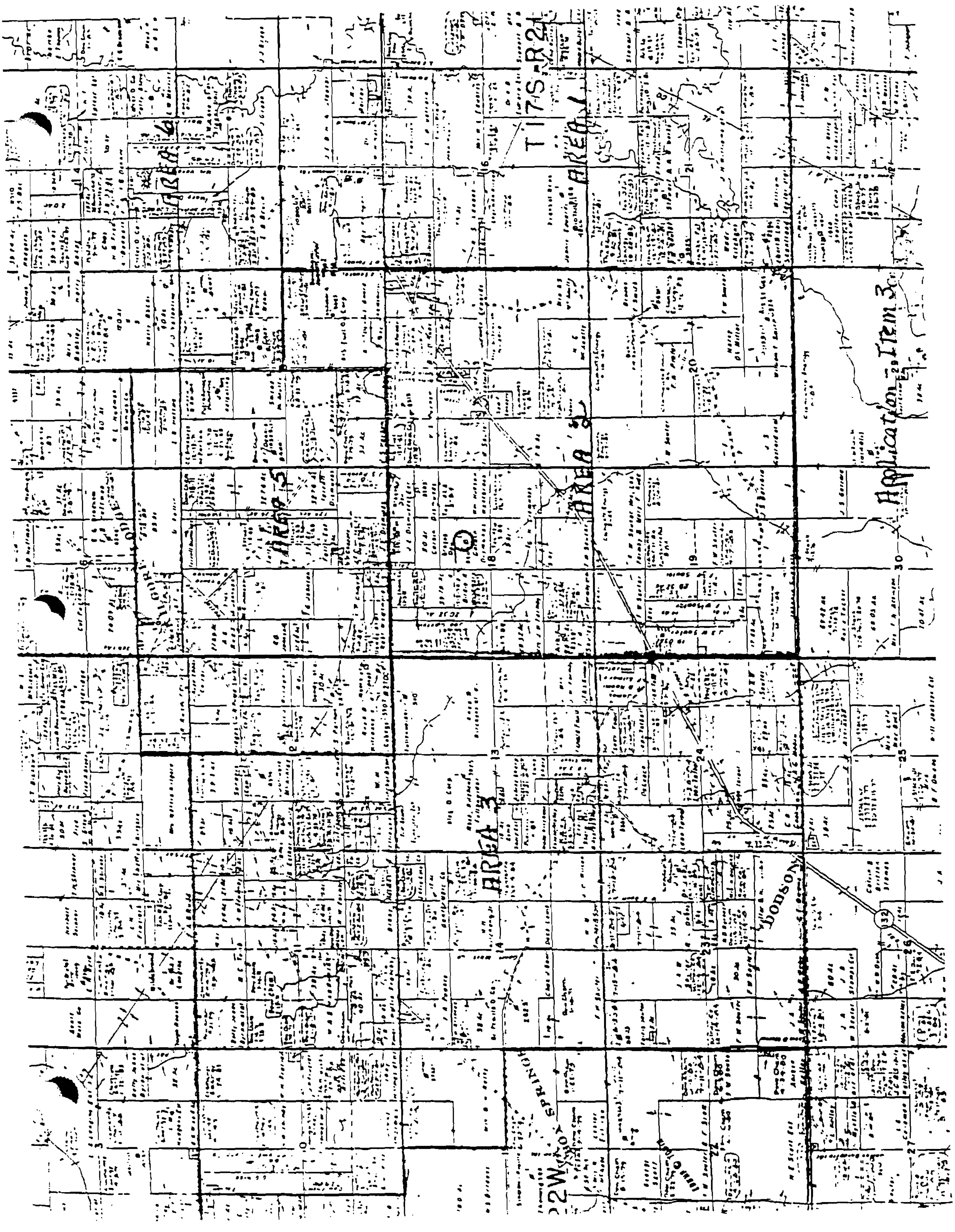
(Size) 7" injection tubing set at 8452.1 feet with packer set at ____ ft.

All available logs and tests are enclosed: Yes ____; No XX
LOGS ARE ALREADY ON FILE

Description of the hole/bit size is enclosed: Yes XX; No ____
SEE ITEM IN ATTACHMENTS

Total depth of the well is 8500 feet.

B. ( ) This well will be drilled for injection service and a regular fee drilling application will be submitted. We plan to case and cement the well as indicated below:

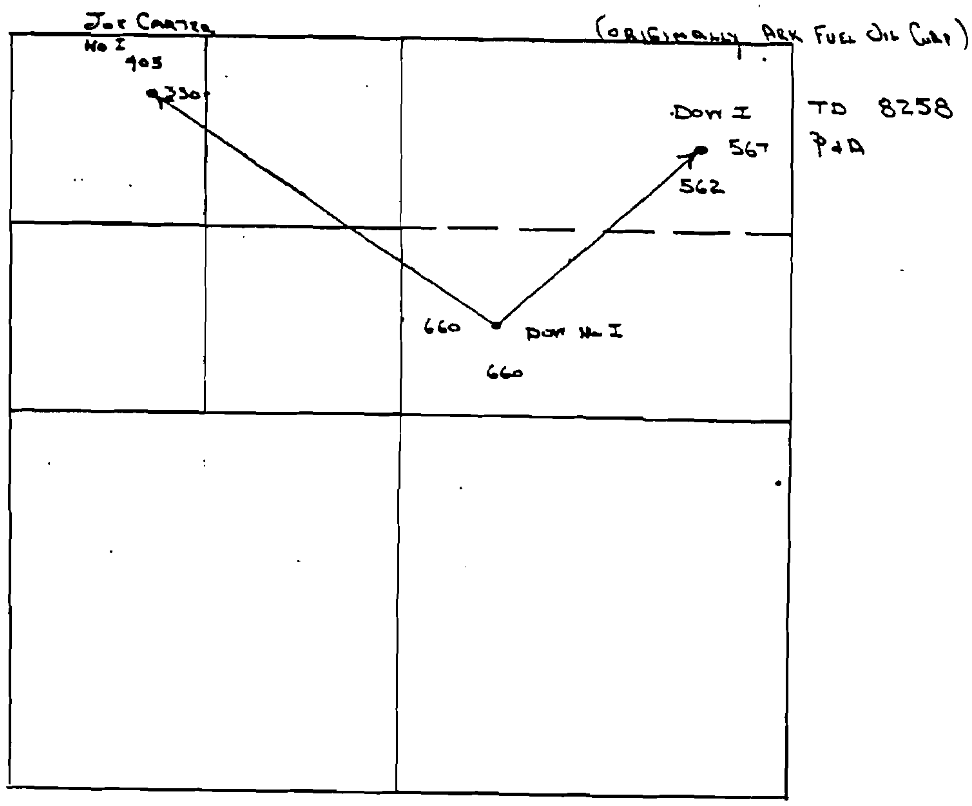

T17S R2W
AREA 1
AREA 2
AREA 3
AREA 5
AREA 6
Application Item 3

ITEM #5

Produced salt water from this well will be a portion of the combined production of Dow Chemicals salt water production wells. No other operations, leases, or wells will be involved.

Dow Chem. Co. | 660' FS&WL NE 1/4 | 18-17S-21W

Scale - 1 Block = 264'



STATE OF ARKANSAS
314 EAST OAK STREET
OIL AND GAS COMMISSION
El Dorado, Arkansas 71730 — 5896

RECEIVED (56)
AUG 30 1984
ARKANSAS OIL & GAS COMMISSION

Well Completion and Recompletion Report

(Instructions: See Reverse Side)

Notice: This form must be completed and filed prior to allowable being granted.

WELL DESCRIPTION

Field: Kilgore-Lodge
Name of Operator: Dow Chemical U.S.A.
Pool Completed In: Smackover
Lease Name: Dow Fee No. 1
Address: Street: P. O. Box 520
Exact Location: 660' FSL & 660' FWL NE/4
City: Magnolia
State: Arkansas 71753
Sec. 18 Twp. 17S Rge. 21W
County: Columbia
Date Commenced: 2/1/65
Date Completed: 3/23/65 * 5/21/84 Recompletion
Elevation: 309 KB
Total Depth Drilled: 8500'
Electric Log Run: Yes x No ____
Electric Log Filed: Yes x No ____

CASING, TUBING, PERFORATING AND COMPLETION PROGRAM USED IN WELL

Conductor: (Size & Wt.) ____ set at ____ ft. w/ ____ sks.
Surface: (Size & Wt.) ____ set at ____ ft. w/ ____ sks.
Intermediate: (Size & Wt.) ____ set at ____ ft. w/ ____ sks.
Production: (Size & Wt.) ____ set at ____ ft. w/ ____ sks.
* Tubing: (Size & Wt.) 7" - 26# set at 8452.1 ft.
Perforations: Size ____ No. Per Foot ____
Perforated Intervals: 8250 - 8300'

Acidized: Yes ____ No ____: Interval ____ w/ ____ gals.
Fractured: Yes ____ No ____: Interval ____ w/ ____ lbs.
of sand: ____ bbls. of oil.

RECOMPLETION WORK COMPLETED 5/21/84 FOR REINJECTION

LEASE DATA

1. Number of wells located on this lease, including this well ____
2. Tank battery to which this well is connected: Existing ____ New ____
3. Liquid production from this well is sold to (____
(Address ____
4. Disposition of gas from this well: Vented ____ Fuel ____ Sold ____
If sold, to whom ____
Address ____

PRODUCTION

Date of Test ____ Actual Length of Time Tested ____
Type Well: Flowing ____ Gas Lift ____ Pump ____
Tubing Pressure ____ Casing Pressure ____ Choke Size ____
Net Oil Produced ____ bbls. Gas Produced ____ MCF % BSW ____ GOR ____
Gravity Oil ____ BHP Recorded ____
Net Oil in 24 Hours ____ Open Flow Potential ____ MCF
Purpose of this test: Original Completion ____ Workover ✓ Recompletion ____
Allowable Requested ____

REMARKS:
Please use reverse side of this page for all pertinent remarks.

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

J. O. Ball
J. O. Ball, Brine Field Supervisor

AOGC-4—(56)
ADC-CDC—2990

Arkansas Oil and Gas Commission

314 EAST OAK STREET
EL DORADO, ARKANSAS 71730-5896

Producers Certificate of Compliance and Authorization to Transport Oil or Gas from Lease

Well Dow Fee No. 1 (Sec.) 18 (Twp.) 17S (Rge.) 21W County Columbia

Operator Ethyl Corporation Field Kilgore Lodge

Address all correspondence concerning this form to: Ethyl Corporation

Street P. O. Box 729 City Magnolia State AR 71753

The above named operator hereby authorizes N/A
(Name of First Purchaser)

Whose principal place of business is
(Street) (City) (State)

And whose field address is

To transport ____% of the Oil ( ) Gas ( ) produced from the lease designated above until further notice.

Other transporters transporting oil from this lease are:

____ (Name of Transporter) ____% ____ (Name of Transporter) ____%

narks:

Change of operators from Dow Chemical U.S.A. to Ethyl Corporation.

RECEIVED
JUN 08 1987
ARKANSAS OIL & GAS COMMISSION

The undersigned certifies that this report has been examined by me and to the best of my knowledge is true, correct, complete and that the rules and regulations of the Arkansas Oil and Gas Commission have been complied with except as noted above and that the transporter(s) is (are) authorized to transport the percentage of oil produced from the above described property and that this authorization will be valid until further notice of the transporter named herein or until cancelled by the Arkansas Oil and Gas Commission.

Executed this the 13th day of May 19 87

APPROVED: June 11, 1987
ARKANSAS OIL & GAS COMMISSION
Shirley Knight

No. Z 537

ETHYL CORPORATION
(Company or Operator)
L C Reynolds
(Affiant)
L. C. Reynolds
Field Manager

Well: BRAZOS O&G DIV. OF DOW CHEMICAL CO. #1 Dow
Loc'n: Sec 18-17S-21W, C SW NE, 3 5/8 mi W/Magnolia

Result: BRINE SUPPLY

Spud: 2-1-65; Comp: 3-23-65; Elev: 309' KB; TD: 8500'; C/Wheless Drlg. Co.
Casing: 20" 37'/4 yds, 13 3/8" 1492'/1340 cf, 9 5/8" 8494'/3117 cf
Prod Zone: (Smk) prod thru perf 8250-8300'
IP: NA TP 50#, BHPSI 3650#
Comp Info: TD 8500' (12¼" hole), ran logs, set 9 5/8" csg, perf 100/8250-8300' (Smk), A/, swung 5½" tbg 2579' w/240 HP downhole pump
Tops: No Info
Note: Plant officially dedicated 1-18-66

Date: 2-8-66 Card No.: 1 Ark

ARTIFICIAL PENETRATION REVIEW

MAP ID NO. 2

Status P & A

Operator Dow Chemical - Ethyl Corp/Albemarle

Forms AOCH-11 & -12

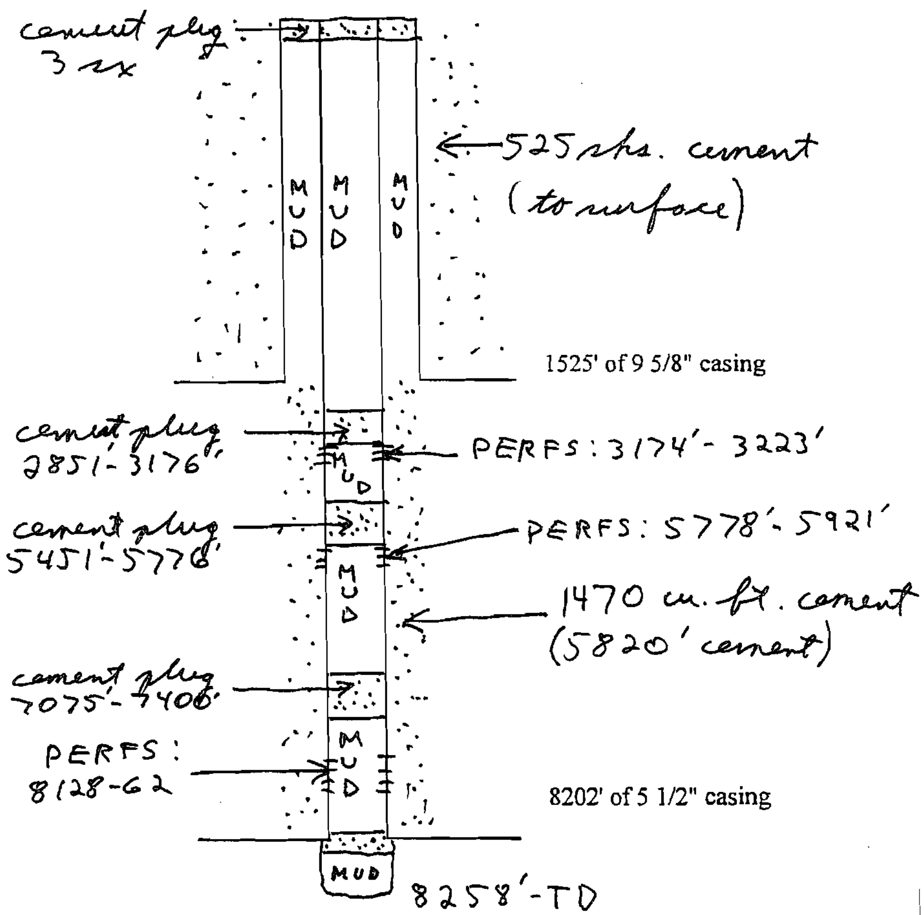
Lease P.T. Dismukes Heirs No. 1

Distance from Injector 2850'

Well # 1

Dow No. 1 SWD

Well Diagram



Potential Problems:

NONE

6M—1-59—146428—C.-McB.

ARKANSAS OIL AND GAS COMMISSION
El Dorado, Arkansas

RECEIVED
APR 17 1959
Arkansas Oil & Gas Commission

Serial No. 16463

Notice of Intention to Drill For Oil or Gas

(This application to drill must be accompanied by a remittance of $50.00)

Date April 16, 1959

Name of Operator Arkansas Fuel Oil Corporation

Send Permit to: Street P. O. Box 1117

City Shreveport

State Louisiana

Lease Name P. T. Dismukes Heirs Well No. 1

Acres in lease 80

Number of acres in and description of drilling unit 80 acres, being the N½ of the NE¼ of Section 18, Township 17 South, Range 21 West,

Location of proposed well in drilling unit (give in feet) 562 feet FSL and 567 feet FEL of N½ of NE¼ of Section 18

Section 18 Township 17S Range 21W

County Columbia Field Kilgore Lodge

Distance and direction from the nearest town Approximately 4 miles West of Magnolia

Distance from proposed location to nearest drilling, completed or applied for well First well on lease

Rotary or cable tools Rotary Date work will start At once

Name of drilling or workover contractor Unknown

Depth to be drilled 8900'

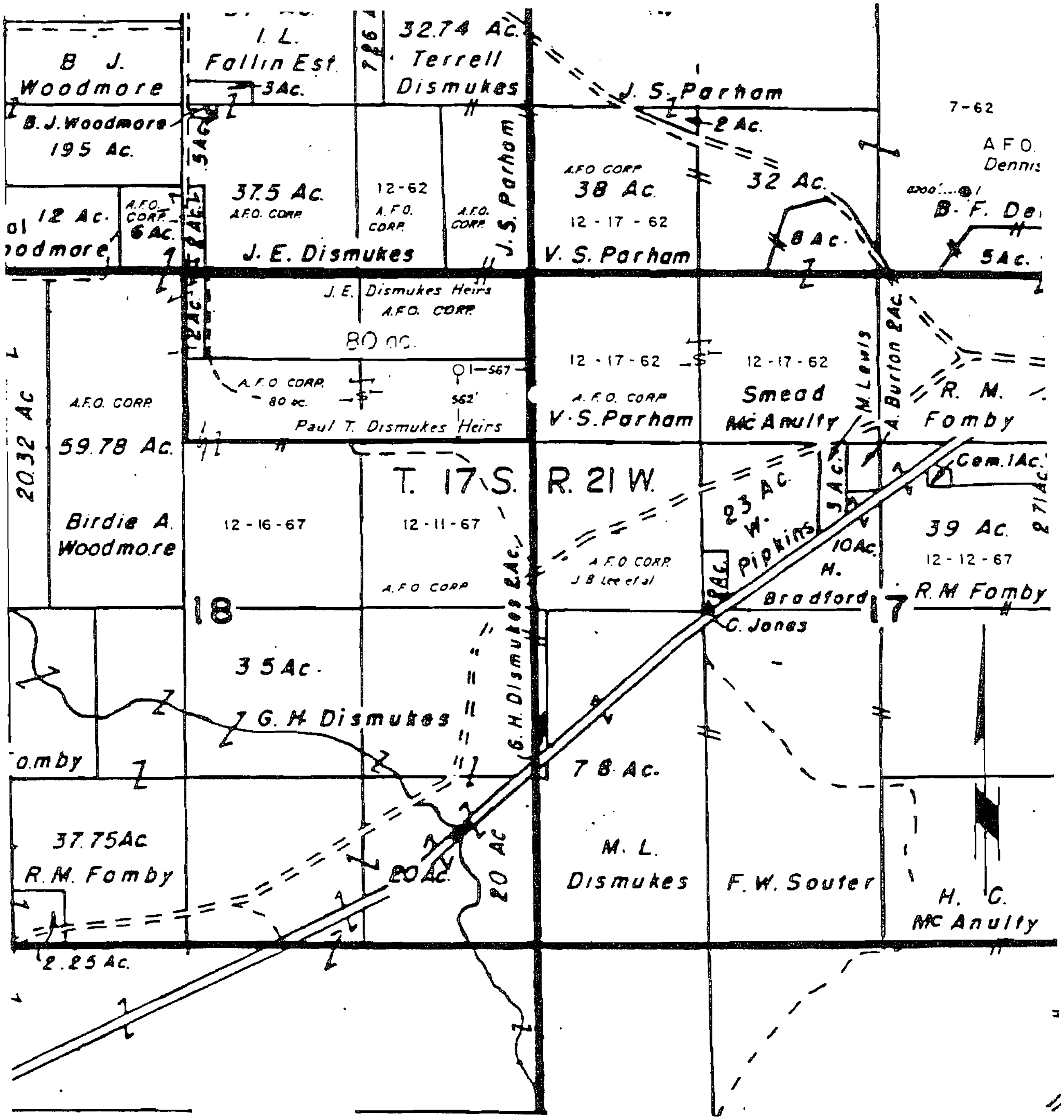
Formation you propose to complete in Smackover Lime

Remarks:

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

Charles R. Mitchell



PLAT SHOWING LOCATION OF THE PROPOSED ARKANSAS FUEL OIL CORPORATION,
NO. 1 PAUL T. DISMUKES HEIRS WELL,
LOCATED IN THE N½ OF THE NE¼ OF SECTION 18, T. 17S - R. 21W,
COLUMBIA COUNTY, ARKANSAS.

STATE OF LOUISIANA
PARISH OF CADDO

I hereby certify that this plat is true and correct and that the above location is correctly shown with reference to recognized property lines on the ground.

S. D. Armstrong

S. D. Armstrong, Chief Civil Engineer
Arkansas Fuel Oil Corporation

SUBSCRIBED AND SWORN to before me this the 16th day of April, 1959

STATE OF ARKANSAS
OIL AND GAS COMMISSION
El Dorado, Arkansas

RECEIVED

Well Completion and Recompletion Report

(Instructions: See Reverse Side)

Notice: This form must be completed and filed prior to allowable being granted.

WELL DESCRIPTION

Field: Kilgore Lodge
Producer: Arkansas Fuel Oil Corp
Pool Completed In: Smackover Lime
Lease Name: P. T. Dismuke Heirs No. 1
Address: Street: Box 698
Exact Location: 562' N 567' W of S E Corner N ½ of NE ¼
City: Smackover
Sec. 18 Twp. 17 Rge. 21
County: Columbia
State: Arkansas
Date Commenced: 5-20-1959
Date Completed: 6-25-1959
Elevation: Gr 262.4
Total Depth Drilled: 8258
Electric Log Run: Yes yes No
Electric Log Filed: Yes No

CASING, TUBING, PERFORATING AND COMPLETION PROGRAM USED IN WELL

Conductor: (Size & Wt.) none set at ft. w/ sks.
Surface: (Size & Wt.) 9-5/8" set at 1525.5 ft. w/ 525 sks.
Intermediate: (Size & Wt.) none set at ft. w/ sks.
Production: (Size & Wt.) none set at ft. w/ sks.
Tubing: (Size & Wt.) none set at ft.
Perforations: Size No. Per Foot
Perforated Intervals:

Acidized: Yes No X; Interval w/ gals.
Fractured: Yes No X; Interval w/ lbs. of sand; bbls. of oil.

LEASE DATA

1. Number of wells located on this lease, including this well: one
2. Tank battery to which this well is connected: Existing none New
3. Liquid production from this well is sold to (none
   (Address
4. Disposition of gas from this well: Vented none Fuel Sold
   If sold, to whom
   Address

PRODUCTION DATA

Date of Test: no test run Actual Length of Time Tested
Type Well: Flowing dry Gas Lift dry Pump dry
Tubing Pressure Casing Pressure Choke Size
Net Oil Produced bbls. Gas Produced MCF % BSW GOR
Gravity Oil BHP Recorded
Net Oil in 24 Hours: dry Open Flow Potential MCF
Purpose of this test: Original Completion Workover Recompletion
Allowable Requested: none

REMARKS:

Please use reverse side of this page for all pertinent remarks. dry hole

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

5M—12-58—145066—C.-McB.

AOGC-11-(56)

ARKANSAS OIL AND GAS COMMISSION
El Dorado, Arkansas

APPLICATION TO PLUG

(Must be Accompanied by Remittance of Fifteen ($15) Dollars)

Serial No. 16 463

Date 6-25-1959

File Original Three Full Days Prior To Beginning Plugging Operations
And Notify Offset Lease Holders

Operator Arkansas Fuel Oil Corporation

Field Kilgore Lodge

County Columbia

Operator's Address: Street Box 698

City Smackover

State Arkansas

Lease Name P. T. Dismuke Heirs Well No. 1

Location 562' N 567' W of SE Corner N ½ of N. E. ¼

Section 18 Township 17 Range 21

Character of well (Oil, Gas or Dry) dry

Date you wish to plug 6-25-1959

Total Depth of Well 8258'

Name of party plugging well Halliburton Oil Well Cementing Co.

Address: Street

City Haynesville

State Louisiana

AOGC-2(56) filed by Arkansas Fuel Oil Corp Date filed April 16, 1959

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

[signature] Dist. Supt.
Arkansas Fuel Oil Corp

6M—12-66—146067—C.-McB.

AOGC-12(56)

Arkansas Oil and Gas Commission
EL DORADO, ARKANSAS

PLUGGING RECORD

(Within five days after the plugging of any well has been accomplished, the owner or operator thereof shall file this form with the Commission, setting forth in detail the method used in plugging the well.)

SEE — REVERSE SIDE FOR PLUGGING REQUIREMENTS AND COMPLY THEREWITH.

Operator Arkansas Fuel Oil Corporation Field Kilgore Lodge

Address all correspondence concerning this Pool Smackover Lime

form to: Arkansas Fuel Oil Corp County Columbia

Street Box 698 City Smackover State Arkansas

Lease P. T. Dismuke Heirs Well No. 1 Sec 18 Twp 17 Rge 21

Date well was plugged June 25th Total Depth of well 8258

Was well filled with mud-laden fluid, according to regulations of the Commission? yes

How much mud applied? Halliburton pumps Were plugs used? yes If so, show all shoulders left for casing, depth of each, and size of casing, size and kind of plugs used, and depths placed. Also amount of cement

Plugged from 0'-16' with 8 sx cement. Filled to 1463' with mud then plugged to 1525 w/ 25 sks cement. Filled with mud to 8044' then plugged to 8114 with 25 sacks cement. Balance hole filled with mud.

Was notice given before plugging, to all available adjoining lease and land owners as required?

yes

INFORMATION ON CASING RECLAIMED FROM WELL

SIZE	RECOVERED FROM WELL		LEFT IN WELL	
	Feet	Inches	Feet	Inches
9-5/8"	~~1525~~xx	xxxx	1525.5	

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

[signature] Dist. Supt.

Arkansas Fuel Oil Corp

BRAZOS

BRAZOS OIL AND GAS COMPANY
DIVISION OF THE DOW CHEMICAL COMPANY
3636 RICHMOND AVENUE • P. O. BOX 22468
HOUSTON 27, TEXAS

January 26, 1965

Mr. Edward A. Albares
Director of Production and Conservation
Arkansas Oil & Gas Commission
El Dorado, Arkansas

Dear Mr. Albares:

In accordance with our telephone conversation January 15, 1965, we are requesting permission for a trial test disposal of approximately 500,000 barrels of Smackover brine over a 90 day time period in one of four salt water bearing formations.

We propose to re-enter the Arkansas Fuel Oil Corporation - P. T. Dismukes Heirs No. 1 dry hole in the NE/4 of the NE/4 Section 18, T-17-S, R-21-E, Columbia County and attempt to make a disposal well in one of the intervals listed below:

Formation	Interval (Subsea)
Nacatosh Ss.	1555 - 1780
Tokio Ss.	2615 - 2960
Lo Hoston Ss.	4907 - 5677
Smackover Lst.	7835 - 8025

The elevation of the electrical survey datum is 273 feet.

We would attempt, upon re-entering the Dismukes well, to clean it out to a total depth of 8258 feet, run 5-1/2-inch casing to 3270 feet and cement it from total depth to the surface. Then we would run 2-inch tubing to total depth, cement it in place and pack it off in the base of the 5-1/2-inch casing. The 2-inch string would be used for a fluid level observation string and brine disposal would be accomplished through the 2-inch 5-1/2-inch annulus into the Tokio or Nacatosh Sandstone. If we were unable to dispose of the volume required in one of these two intervals, we may need to use the fluid observation string for disposal and inject into the Smackover or Lower Hoston formations. For this reason, we are requesting approval for a trial test disposal in these four formations so that our operations may be pursued without delay once we have a rig on location.

Also, in completing the producing well, the No. 1 Dow in the center of the SW/4 of the NW/4 in the same section, we plan to leave the Nacatosh sandstone open behind the 9-5/8-inch casing and if we need this additional capacity for disposal, we request authority to proceed with this phase of the operation.

We are enclosing a list of the landowners and lessees within a one-half mile distance of the disposal and the production well, plats showing the location of the disposal and production well and a copy of the electrical survey of the Arkansas Fuel Oil - Dismukes No. 1 well showing the proposed disposal intervals. If there is additional information that you need for this request, please call the undersigned collect at A. C. 713 MO 6-0261, Houston, Texas.

Yours very truly,

BRAZOS OIL AND GAS COMPANY
Division of The Dow Chemical Co.

Maurice Lewis, Jr.

Maurice Lewis, Jr.
Superintendent, Drilling and Production

MLjr/mc

Enc. - 6 (2) Owner Lists
(2) Plats
(2) Electrical Surveys

January 29, 1965

Mr. Maurice Lewis, Jr.
Superintendent, Drilling and
Production
Brazos Oil and Gas Company
3636 Richmond Avenue
Houston 27, Texas

Dear Mr. Lewis:

In reply to your letter of January 26, 1965, concerning your request for temporary disposal of 500,000 barrels of salt water over a 90 day test period, I have reviewed this matter with Mr. O. C. Bailey, Chairman of our Commission, and he is of the same opinion as I am, that there would be no purpose in advertising this particular application as there are no producing wells within a one-half mile radius and most of the minerals in the immediate vicinity of this well, are still owned by the land owners.

Therefore, please consider this letter as your authority to proceed with the disposal of salt water into the Nacatoch, Tokio and Lower Hosston or Smackover Lime Formations, as outlined in your letter of application.

When a determination is made, we would appreciate being advised as to what success was had in going back into the Dismukes #1 well.

If any additional information is needed concerning this matter, please let us know.

Yours very truly,

Edward A. Albares
Director

EAA:vs

January 26, 1966

Brazos Oil and Gas Company
3636 Richmond Avenue
Houston 27, Texas

Att: Mr. Maurice Lewis, Jr.

Gentlemen:

Attached please find Application for Salt Water Disposal which should be filed for your Dow #1 SWD well in the Kilgore Lodge Field.

After reviewing the previous records with regard to this well, it is felt that a new application should be filed in order to make the disposal on a permanent basis rather than a temporary or trial basis.

Yours very truly,

W. E. Wright
Geologist

WEW:vs

Enclosure

AOGC-3-(56)

STATE OF ARKANSAS
OIL AND GAS COMMISSION
El Dorado, Arkansas

Well Completion and Recompletion Report

(Instructions: See Reverse Side)

Notice: This form must be completed and filed prior to allowable being granted.

Orig. Ark Fuel Oil - Dismuke Hn. #1 **WELL DESCRIPTION**

BRAZOS OIL & GAS CO. DIVISION OF THE DOW CHEMICAL CO.

Field: Wildcat
Producer: Brine Disposal Well
Pool Completed In: Tokio, Lo. Hoston, Smackover
Lease Name: Dow No. 1SWD
Address: Street: P. O. Box 22468
Exact Location: 561' WEL and 106' SNL S/2, N/2, NE/4
City: Houston
Sec. 18 Twp. 17 S Rge. 21 W
County: Columbia
State: Texas 77027
Date Commenced: 2/28/65
Date Completed: 3/25/65
Elevation: 263' ground
Total Depth Drilled: 8203' redrilled
Electric Log Run: Yes ___ No X
Electric Log Filed: Yes ___ No X

RECEIVED
JAN 27 1966
Arkansas Oil & Gas Commission

CASING, TUBING, PERFORATING AND COMPLETION PROGRAM USED IN WELL

Conductor: (Size & Wt.) Unknown set at ___ ft. w/ ___ sks.
Surface: (Size & Wt.) 9-5/8" Unknown weight set at 1525 ft. w/ 523 sks.
Intermediate: (Size & Wt.) None set at -- ft. w/ -- sks.
Production: (Size & Wt.) 5-1/2" set at 8202 ft. w/ 1470 cu ft.
Tubing: (Size & Wt.) 2", 4.5# set at 8125 ft.
Perforations: Size 0.46" No. Per Foot 2
Perforated Intervals: 3174', 3178', 3183', 3190', 3196', 3199', 3204', 3211', 3219' & 3223 (Tokio) 5778, 5796, 5808, 5817, 5840, 5848, 5856, 5862, 5880, 5916, 5921 (Lo. Host 8128-8162 (Smackover)
Acidized: Yes x No ___; Interval 8128' - 8162', 3174' - 3223' w/ 5,000 15,000 gals.
Fractured: Yes x No ___; Interval 5778' - 5921' w/ 20,000 lbs. of sand; 855 678 bbls. of ~~oil~~ water.

LEASE DATA

1. Number of wells located on this lease, including this well 2
2. Tank battery to which this well is connected: Existing Not applicable New --
3. Liquid production from this well is sold to (Not applicable
   (Address --
4. Disposition of gas from this well: Vented -- Fuel -- Sold --
   If sold, to whom --
   Address --

PRODUCTION

Date of Test Not applicable Actual Length of Time Tested --
Type Well: Flowing -- Gas Lift -- Pump --
Tubing Pressure -- Casing Pressure -- Choke Size --
Net Oil Produced -- bbls. Gas Produced -- MCF % BSW ___ GOR ___
Gravity Oil -- BHP Recorded 3263 psi
Net Oil in 24 Hours -- Open Flow Potential -- MCF
Purpose of this test: Original Completion x Workover ___ Recompletion ___
Allowable Requested Not applicable

REMARKS:

Please use reverse side of this page for all pertinent remarks.

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

[signature]

This well was originally drilled as the Arkansas Fuel Oil Corporation, P. T. Dismukes Heirs Well No. 1, re-entered and re-drilled as Dow No. 1 SWD.

INSTRUCTIONS:

The Well Completion Test Form, WITH ALL INFORMATION REQUESTED THEREON FILLED IN, shall be filed not later than five (5) days after the test is completed, and should the operator fail to file a test form in an acceptable form within the five (5) days as specified, then the effective date of the allowable resulting from such test shall not extend back more than five (5) days prior to receipt and acceptance of the test form. This five-day provision shall govern regardless of whether the test is taken during the month in which it is received or any prior month.

Any test form resulting from a retest of an oil well which is received after the fifteenth (15th) of the month shall not be used as the basis for the establishing a new allowable before the issuance of the proration schedule for the next succeeding month.

THE DOW CHEMICAL COMPANY

BOX 520
PHONE 501 - CE 4-2677
MAGNOLIA, ARKANSAS 71753

November 27, 1968

Arkansas Oil & Gas Commission
314 East Oak Street
El Dorado, Arkansas 71730

Attn: W. E. Wright

Gentlemen:

Regarding the status of Dow No. 1 SWD well located 562' FSL & 567' FEL N/2 of NE¼ Section 18, 17-S, 21-W. This well is temporarily abandoned and to the best of my knowledge has been since before March, 1967.

If we change the status on this well we will notify you.

Yours truly,

R. O. Vinson
R. O. Vinson
Supt. Development & Research

na

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DEC 2 1968
ARKANSAS OIL & GAS COMMISSION

5-15-69

Mr. Vinson advised that there are no plans for using well at this time. If it is used in the future, the conservation assessment of $25.00 per year shall apply.

R. W. Duncan

5M—7-67—38653—PP&SCo. AOGC-11-(56)

ARKANSAS OIL AND GAS COMMISSION
El Dorado, Arkansas

APPLICATION TO PLUG

WSW (Must be Accompanied by Remittance of Fifteen ($15) Dollars)

Serial No. ~~[illegible]~~

Date 5 - 24 - 83

File Original Three Full Days Prior To Beginning Plugging Operations And Notify Offset Lease Holders

Operator Dow Chemical USA

Field Kilgore Lodge

County Columbia, ~~Arkansas~~

Operator's Address: Street P.O. Box 520

City Magnolia

State Arkansas 71753

Lease Name ~~Brine Disposal~~ - ~~Dismuke~~ ~~[illegible]~~ Well No. 1

Location 561' FEL - 106' FNL - S½ - N½ - NE¼

N2 FSL - 567 FEL N½ NE¼

Section 18 Township 17S Range 21W

Character of well (Oil, Gas or Dry)

Date you wish to plug 6/10/83

Total Depth of Well 8203'

Name of party plugging well Dow Chemical USA

Address: Street

City Magnolia

State Arkansas

AOGC-2(56) filed by Date filed

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

RECEIVED
JUN 02 1983
ARKANSAS OIL & GAS COMMISSION

James O. Ball

Ralph C. [illegible]

Arkansas Oil and Gas Commission

EL DORADO, ARKANSAS

PLUGGING RECORD

(Within five days after the plugging of any well has been accomplished, the owner or operator thereof shall file this ..n with the Commission, setting forth in detail the method used in plugging the well.)

SEE — REVERSE SIDE FOR PLUGGING REQUIREMENTS AND COMPLY THEREWITH.

Operator Dow Chemical USA Field Kilgore Lodge

Tokio , Lo Hoston

Address all correspondence concerning this Pool Smackover SWD

form to: Dow Chemical USA County Columbia

Street ____ City Magnolia State Arkansas

Lease Brine Disposal Well No. 1 Sec. 18 Twp. 17S Rge. 21W

Date well was plugged June 23, 1983 Total Depth of well 8203

Was well filled with mud-laden fluid, according to regulations of the Commission? Yes

How much mud applied? filled Were plugs used? Yes If so, show all shoulders left for casing, depth of each, and size of casing, size and kind of plugs used, and depths placed. Also amount of ..ent and rock cement plugs from 7075-7400 5451-5776 2851-3176; 3 sk plug in top of 5½"

Was notice given before plugging, to all available adjoining lease and land owners as required? Yes

INFORMATION ON CASING RECLAIMED FROM WELL

SIZE	RECOVERED FROM WELL		LEFT IN WELL	
	Feet	Inches	Feet	Inches
13 3/8	None Recovered		Unknown	
9 5/8	None Recovered		1525	
5 1/2	None Recovered		8202	

SK

ME

Dak

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my ..ledge is true, correct and complete.

RECEIVED
JUL 06 1983

Earl W. Lockett

Earl W. Lockett

AOGC-4 (56)
ADC CDC-2996

Arkansas Oil and Gas Commission

311 EAST OAK STREET
EL DORADO, ARKANSAS 71730-5896

Producers Certificate of Compliance and Authorization to Transport Oil or Gas from Lease

Well Dismukes No. 1 (Sec.) 18 (Twp.) 17S (Rge.) 21W County Columbia

Operator Ethyl Corporation Field Kilgore Lodge

Address all correspondence concerning this form to: Ethyl Corporation

Street P. O. Box 729 City Magnolia State AR 71753

The above named operator hereby authorizes N/A (Name of First Purchaser)

Whose principal place of business is ______ (Street) ______ (City) ______ (State)

And whose field address is ______

To transport ______% of the Oil ( ) Gas ( ) produced from the lease designated above until further notice.

Other transporters transporting oil from this lease are:

______ (Name of Transporter) ______% ______ (Name of Transporter) ______%

Remarks:

Change of operators from Dow Chemical U.S.A. to Ethyl Corporation.

RECEIVED
JUN 08 1987
ARKANSAS OIL & GAS COMMISSION

The undersigned certifies that this report has been examined by me and to the best of my knowledge is true, correct, complete and that the rules and regulations of the Arkansas Oil and Gas Commission have been complied with except as noted above and that the transporter(s) is (are) authorized to transport the percentage of oil produced from the above described property and that this authorization will be valid until further notice of the transporter named herein or until cancelled by the Arkansas Oil and Gas Commission.

Executed this the 13th day of May 19 87

APPROVED: June 11, 1987
ARKANSAS OIL & GAS COMMISSION
By [signature]
No. 3561

ETHYL CORPORATION (Company or Operator)
[signature] (Affiant)
L. C. Reynolds
Field Manager

ARKANSAS OIL AND GAS COMMISSION

PLUGGING REPORT FOR ABONDONED PRODUCING WELL

COMPANY Dow Chemical Company WELL NAME & NO. Dow # 1 SWD

LOCATION 562' fsl 567' of n½ of ne¼ SEC. 18 TWP. 17 s RGE. 21 w

COUNTY Columbia FIELD Kilgore Lodge CONTRACTOR

CASING PROGRAM Yes PERFORATIONS

SURFACE 9- 5-8 1525'

PRODUCTION 5½ - 8202'

TUBING

PRODUCTION PLUG SET AT 7400-7025 FEET, WITH 50 SKS WORK DONE BY

Dowell

DATE 6/23/83

WITNESSED BY Steve Klippert

FRESH WATER PLUG SET AT ~~5442~~ 5776-5442 FEET, WITH 50 sks WORK DONE BY

Dowell

DATE 6/23/83

PLUGGED IN TOP OF SURFACE CASING WITH

WITNESSED BY Steve Klippert

REMARKS: Form 11 received 6/2/83

plug 3170-2837 with 50 sKs - Dowell

plug in top with 5 sKs

Columbia County Arkansas Kilgore Lodge Bromine Plant 18-17S-21W

Well: BRAZOS O&G CO. #1 Dow-SWD **Result:** SWDW

Loc'n: Sec 18-17S-21W, 562' FSL, 567' FEL N½ NE

Beg WO: 2-28-65; Comp: 3-25-65; Elev: 262' grd, 274' DF; TD: 8203'; OTD: 8258'
Casing: 9 5/8" ~~1550', 5½"~~ 8202'/1470 cf
Inj. Zone: (Tus, L. Hoss, CV & Smk) prod thru perf 3174-3223', 5778-5921' & 8128-62'
IR: NA BHPSI 3263#
Comp IFNα: Orig drld by Ark. Fuel Oil Co. as #1 P. T. Dismukes Heirs, D&A 6-25-59, TD 8258', EL/T: Smk 8114'. NEW WORK: CO and/or re-drld to 8203', set 5½" csg, perf 72/8128-62' (Smk), A/5000 gals, perf 2/5778', 2/5796', 2/5808', 2/5817', 2/5840', 2/5848', 2/5856', 2/5862', 2/5880', 2/5916', 2/5921' (L. Hoss & CV), frac w/20,000# sd & 855 bbls water; perf 2/3174', 2/3178', 2/3183', 2/3190', 2/3196', 2/3199', 2/3204', 2/3211', 2/3219', 2/3223' (Tus), frac w/15,000# sd & 678 bbls water, swung 2" tbg 8125'
Tons: No Info

Date: 2-8-66 **Card No.:** 2 Ark

Well: Arkansas Fuel Oil Corp #1 P. T. Dismukes Heirs **Result:** DGA
Loc'n: Sec 18-17S-21W, 562' FSL, 567' FEL N 1/2 NE, 3/4 mi W-SW/discovery

Spud: 5-20-59 Comp: 6-25-59 Elev: 274' 262' Grd TD: 8258' C/Montgomery Drlg Co.

Casing: 9 5, 8" 1550'

Prod Zone: None

IP: None

Comp Info: S/T: Tus 3185', MA 3650-3770'; Crd 4619-49', rec 30' sh w/strks sd, NS; S/T: TP 4710', CV 5920', Drld to 8170', ran EL & ML, took 19 SWS 2891-4397'. NS, (Dowell, Inc took over at this point): Crd 8170-98', rec 26' li, ool, sly PGP, NS; Crd 8198-8258', rec 50' li, ool, dse, NS; TD 8258', ran EL.

Tops: (Elec Log) B/An 2495', Tus 3167', MA 3644-3802', TP 4697', CV 5900', Smk 8114'

Geo Rinehart's Oil Reports Date: 7-2-59 Card No.: 4 Ark

ARTIFICIAL PENETRATION REVIEW

MAP ID NO. 3

Status ~~Operating~~

Operator Dow Chemical-Ethyl Corp/Albemarle

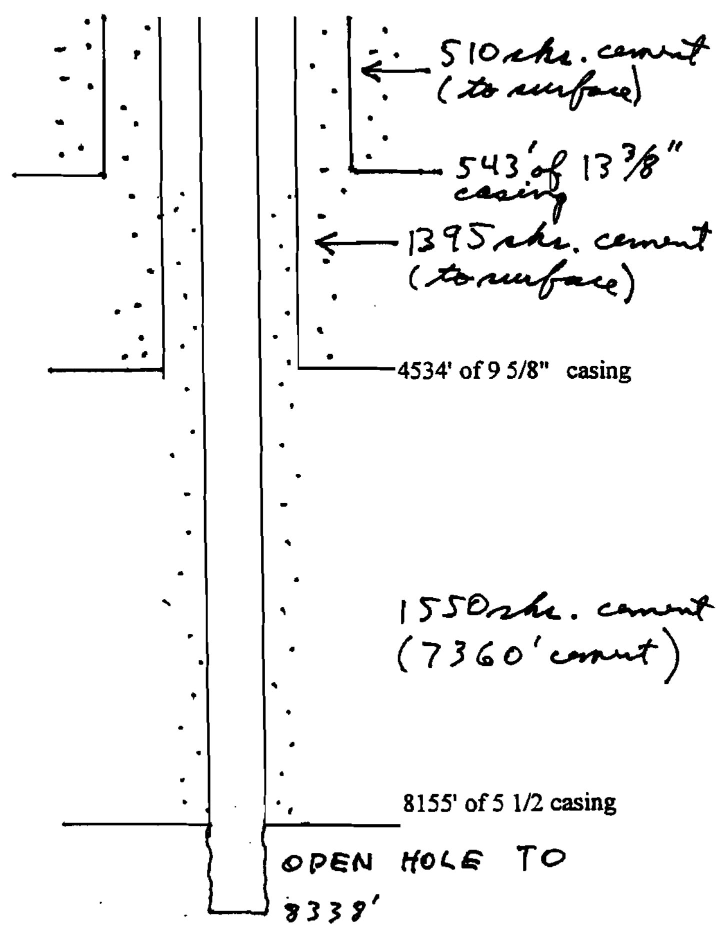
Forms AOGC-3

Lease Joe Carter

Distance from Injector 1,638'

Well # 1

Well Diagram



Potential Problems:

NONE

AOGC-2-(56)

03 027 10,051

ARKANSAS OIL AND GAS COMMISSION
El Dorado, Arkansas

Serial No. 31,643

Notice of Intention to Drill For Oil or Gas

(This application to drill must be accompanied by a remittance of $50.00)

Date May 11, 1970

Name of Operator The Dow Chemical Company

Send Permit to: Street P. O. Box 520

City Magnolia

State Arkansas 71753

Lease Name Joe Carter Well No. 1

Acres in lease 77

Number of acres in and description of drilling unit 77

Location of proposed well (Must agree with Surveyor's Plat) 405' from North Line - 330' from East Line of NW 1/4 NW 1/4

Section 18 Township 17-S Range 21 W

County Columbia Field Kilgore Lodge

Distance and direction from the nearest town 4 Miles West of Magnolia

Distance from proposed location to nearest drilling, completed or applied for well 1/2 Mile

Rotary or cable tools Rotary Date work will start 5-20-70

Name of drilling or workover contractor Noble Drilling Company

Depth to be drilled 8,500'

Formation you propose to complete in Smackover

Remarks: Carter - Rudd No. 1 - Brine Supply

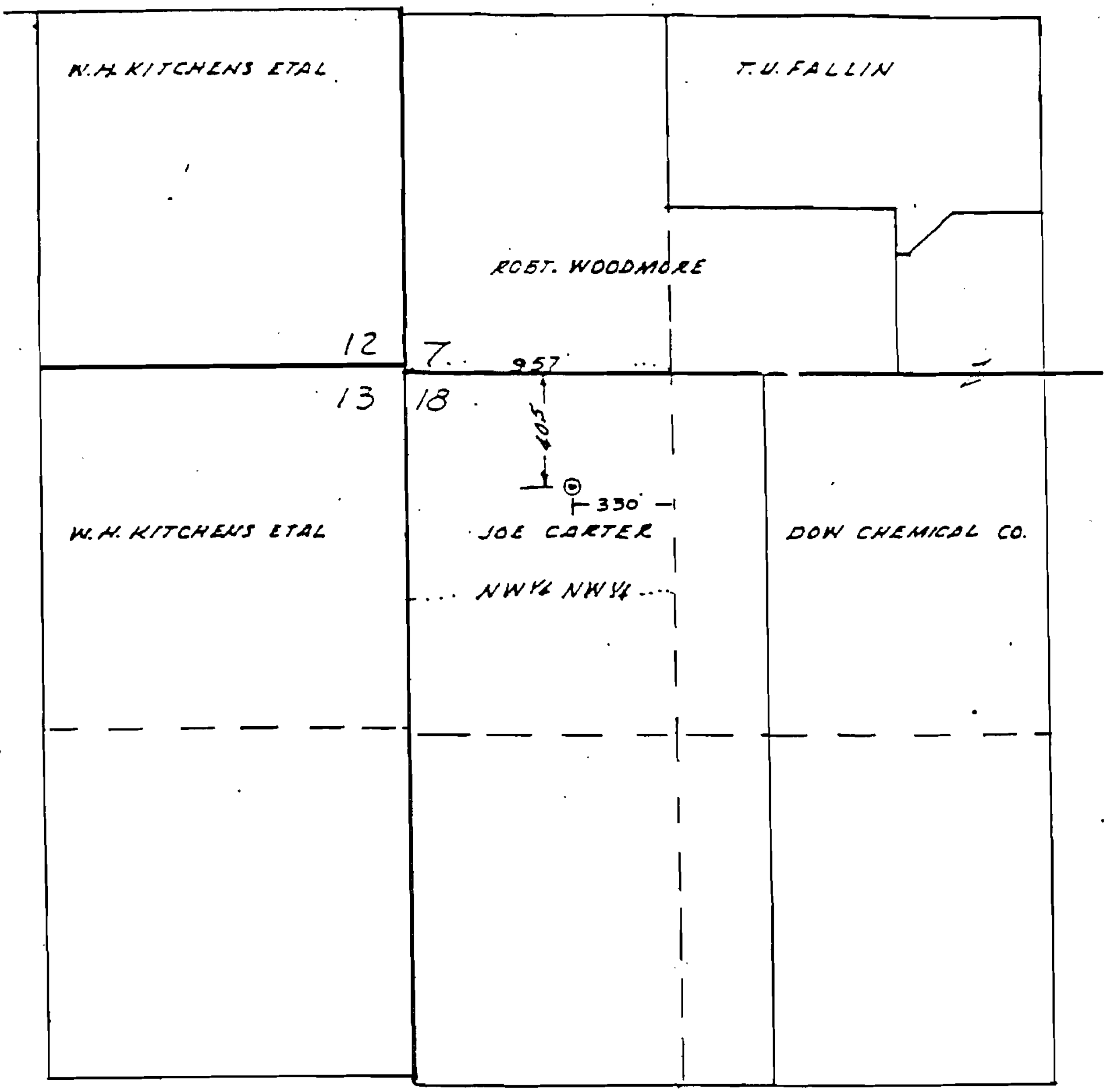
RD

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

M. M. Sorenson

M. M. Sorenson
Superintendent of Operations



WELL LOCATION PLAT

OPERATOR DOW CHEMICAL CO.

WELL NAME CARTER-RUDD NO. 1

LOCATION 405' FROM THE N. LINE & 330' FROM THE E. LINE OF NW¼ NW¼ SECT. 18-T17S-R21W
COLUMBIA CO., ARK.

The location shown hereon was staked from a ground survey made MAY 11, 1970 1970.

Scale 1" = 600'

R.L.S. 464

CRISP SURVEYING SERVICE
216 S. Washington St.
Magnolia, Ark.

NOBLE DRILLING CORPORATION
CENTRAL DIVISION
1205 BECK BUILDING
PHONE 423-3554
SHREVEPORT, LA. 71101

July 29, 1970

Arkansas Oil & Gas Commission
314 East Oak Street
El Dorado, Arkansas 71730

Gentlemen: Attention: Mr. R. A. Dumas

This company has been conducting contract drilling operations for Dow Chemical Company at a location slightly North of their plant which is located six miles West of Magnolia. On July 26, 1970, a wall on the reserve pit gave way and released fresh water and drilling mud into a small creek, which at this point runs North and South to the East of the Dow plant. Every effort was made to stop the flow and it is not believed a great amount of material escaped into the stream. Subsequent to this Dow pumped a large amount of fresh water to flush the material down stream and avoid any possible damage to adjacent properties in the immediate area.

As a point of information, the type of drilling mud used contained only 1700 parts per million of chloride. This percentage was further greatly reduced by the mingling in the reserve pit of the large amount of fresh water and small quantity of drilling mud. No oil or brine water had been used and so there was none in the reserve pit at the time the wall broke.

We have checked the adjacent properties in the immediate area, have secured an analysis of the drilling mud and based upon these considerations, believe that no actual damage occurred.

Please be assured that this company is doing everything possible to reduce the potential of pollution damage from any source. If there is anything further that we can do to be of assistance please advise.

Very truly yours

NOBLE DRILLING CORPORATION

R. G. Fugler

R. G. Fugler
Division Manager

RGF:ey

cc: Arkansas Pollution Control Commission
Dow Chemical

This letter confirms phone conversation with Mr. Fugler on July 2[illegible], 1970.

[illegible]

21613'

AOGC-3-(56)

STATE OF ARKANSAS
OIL AND GAS COMMISSION
El Dorado, Arkansas

Well Completion and Recompletion Report

(Instructions: See Reverse Side)

BW.

Notice: This form must be completed and filed prior to allowable being granted.

WELL DESCRIPTION

Field: Kilgore Lodge — Name of Operator: The Dow Chemical Company

Pool Completed In: Smackover Lime

Lease Name: Joe Carter (BSW) No. 1 — Address: Street: Box 520

Exact Location: 405' FNL, 330' FEL NW 1/4 NW 1/4 — City: Magnolia

Sec. 18 Twp. 17S S Rge. 21W

County: Columbia — State: Arkansas

Date Commenced: 5/22/70

Date Completed: 9/4/70

Elevation: 281 ft. Grd.

Total Depth Drilled: 8338

Electric Log Run: Yes X No

Electric Log Filed: Yes No X . Enclosed

RECEIVED
OCT 1 1976
ARKANSAS OIL & GAS COMMISSION

CASING, TUBING, PERFORATING AND COMPLETION PROGRAM USED IN WELL

Conductor: (Size & Wt.) 20" x 5/16th set at 40 ft. w/ 6 yd sks.

Surface: (Size & Wt.) 13 3/8", 48# set at 543 ft. w/ 510 sks.

Intermediate: (Size & Wt.) 9 5/8", 40# set at 4534 ft. w/ 1395 sks.

Production: (Size & Wt.) (Liner) 5 1/2", 17# set at 8155 ft. w/ 1550 sks.

Tubing: (Size & Wt.) set at ft.

Perforations: Size No. Per Foot

Perforated Intervals: Open Hole 8155' - 8338'

Acidized: Yes X No ; Interval 8155-8338 w/ 10000 gals.

Fractured: Yes No X ; Interval w/ lbs. of sand; bbls. of oil.

LEASE DATA

1. Number of wells located on this lease, including this well 1
2. Tank battery to which this well is connected: Existing pipeline New
3. Liquid production from this well is sold to (processed in operator's plant (Address
4. Disposition of gas from this well: Vented X Fuel Sold
   If sold, to whom
   Address

PRODUCTION

Date of Test: not applicable — Actual Length of Time Tested

Type Well: Flowing Gas Lift Pump

Tubing Pressure Casing Pressure Choke Size

Net Oil Produced bbls. Gas Produced MCF % BSW GOR

Gravity Oil BHP Recorded

Net Oil in 24 Hours Open Flow Potential MCF

Purpose of this test: Original Completion Workover Recompletion

Allowable Requested

REMARKS:

Please use reverse side of this page for all pertinent remarks.

CERTIFICATE

I declare under the penalties of perjury that this report has been examined by me and to the best of my knowledge is true, correct and complete.

R. C. Vaughn

AOGC-4-(36)
AOC CDC-2990

Arkansas Oil and Gas Commission

311 EAST OAK STREET
EL DORADO, ARKANSAS 71730-5896

Producers Certificate of Compliance and Authorization to Transport Oil or Gas from Lease

Well Carter No. 1 (Sec.) 18 (Twp.) 17S (Rge.) 21W County Columbia

Operator Ethyl Corporation Field Kilgore Lodge

Address all correspondence concerning this form to: Ethyl Corporation

Street P. O. Box 729 City Magnolia State AR 71753

The above named operator hereby authorizes N/A (Name of First Purchaser)

Whose principal place of business is (Street) (City) (State)

And whose field address is

To transport ____% of the Oil ( ) Gas ( ) produced from the lease designated above until further notice.

Other transporters transporting oil from this lease are:

(Name of Transporter) ____% (Name of Transporter) ____%

Remarks:

Change of operators from Dow Chemical U.S.A. to Ethyl Corporation.

RECEIVED
JUN 08 1987
ARKANSAS OIL & GAS COMMISSION

The undersigned certifies that this report has been examined by me and to the best of my knowledge is true, correct, complete and that the rules and regulations of the Arkansas Oil and Gas Commission have been complied with except as noted above and that the transporter(s) is (are) authorized to transport the percentage of oil produced from the above described property and that this authorization will be valid until further notice of the transporter named herein or until cancelled by the Arkansas Oil and Gas Commission.

Executed this the 13th day of May 19 87.

APPROVED June 11 1987
ARKANSAS OIL & GAS COMMISSION
By [signature]
No. 3549

ETHYL CORPORATION
(Company or Operator)
L C Reynolds
(Affiant)
L. C. Reynolds
Field Manager

MAP ID NO. 4

Status: P & A

Operator: Kendall Oil & Gas

Forms: NA

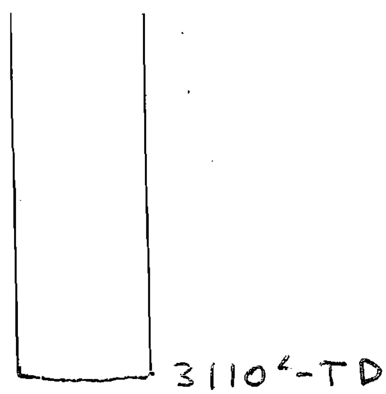
Lease: Rhea, Kitchen & Fullenwider

Distance from Injector: 2,561'

Well #: 1

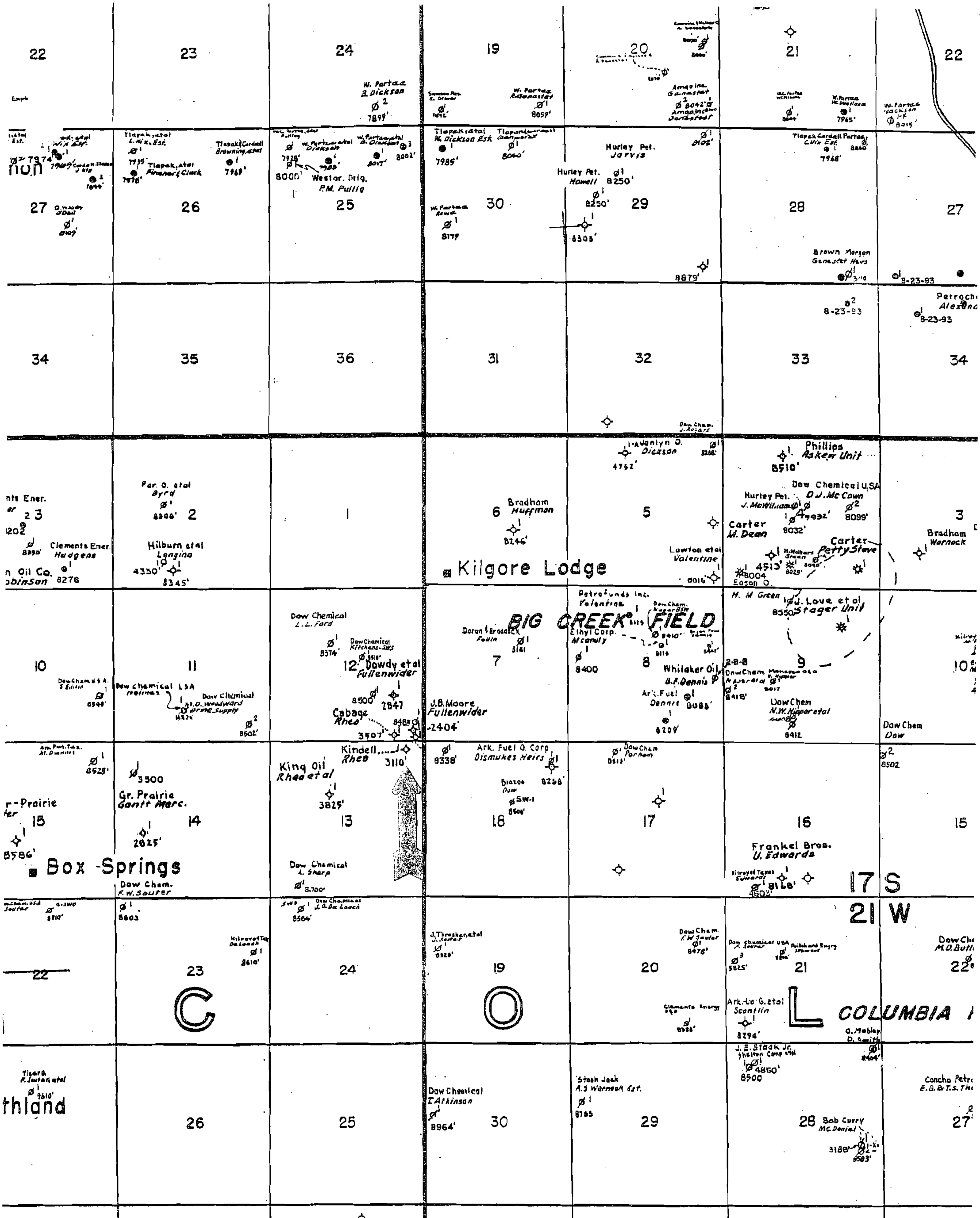
Well Diagram

Tokio @ 2975' in proposed well.



Potential Problems:

NONE



SOURCE: TOBIN, 1994

Well Data

Well Report

*** Well Header ***
(NORTH LOUISIANA - S. ARKANSAS - HISTORICAL WELL)

```
API Nbr: 03027013760000 State: ARKANSAS              County: COLUMBIA
Oper: KENDALL                                        Oper Code: 459044
Well: 1                Lease: DITCHENS-REA-ETAL
AAPG Prov: ARKLA BASIN                               Prov Code: 230
Field: WILDCAT                                       Field Code:  054687
Prop Source Code: PETROLEUM INFORMATION/DWIGHTS

Meridian: FIFTH PRINCIPAL MERIDIAN 1815               Meridian Code: 05
Twp:     17.0S  Rng:    22.0W    SEC:   13.0          Spot:
Source: TBNAD27                  Lat:      33.27030   Long:     -93.32719

Contr:                  Tools: CABLE                 Rig Nbr:

Drlr Depth: 3110  FT    TVD:                         Form @ TD:

Spud Date: 01/01/1934   Date Well Added: 01/01/1934 Abnd Date:
Comp Date: 01/24/1934   Last Update: 08/12/2000     TD Reached:
Final Status: D&A       Pool:
Initial Well Class: NEW FIELD WILDCAT
Final Well Class: NEW FIELD WILDCAT-DRY (INCLUDING TEMPORARILY ABANDONED WELL)
```

*** Proposed Bottom Hole Location ***

*** Actual Bottom Hole Location ***

*** Casing/Liner/Tubing ***

*** Formation Tops/Bases ***

*** Fault Data ***

*** Core Description ***

*** Formation Test Data ***

Well Report

*** Log Surveys ***

*** Drilling Shows ***

*** Porosity Zone ***

*** Drilling Data ***

*** Miscellaneous Data ***

*** Deviation Data ***

*** Directional Survey ***

*** Horizontal Drilling Data ***

*** Drilling Progress Narrative ***

Form C-1

CALVERT-McBRIDE PRINTING CO., FT. SMITH, ARK.

DEPARTMENT OF CONSERVATION AND INSPECTION

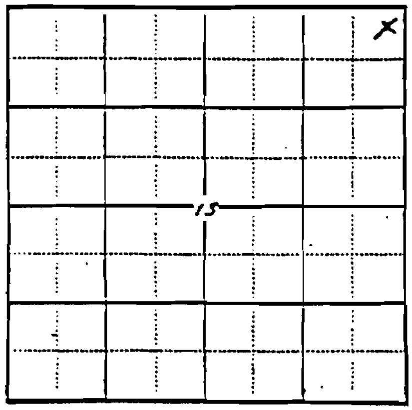
Application for Permit to Drill, Deepen, Abandon, or Plug and Perforate ✓

Serial No. 6295

NORTH

NW¼ NE¼

10-Acre Sub-Division, 660 Ft. Each Way



SW¼ SE¼

SINGLE SECTION PLAT

640 Acres

Mark Well Accurately on Section Plat Shown Above

Two typewritten copies of the log of each well on Department forms must be filed with this office not later than ten days after completion of drilling.

(1) Date 4-21, 19

NOTICE—To drill, deepen, abandon or perforate in Arkansas without first securing a written permit is infraction of the law and subject to prosecution.

(2) County Columbia

(3) Farm Rhea, Kitchen & Fuller etc Well No. 1

(4) Sec. 13 T. 17 R. 22

(5) Land Owner Rhea, Kitchen & Fuller

(6) Owner of Well Kendall Oil & Gas

(7) Address Waldo, Arkansas
Box 171

(8) Permit to Drill
Drill, Deepen, Abandon, Plug and Perforate

(9) Oil, Gas or Test Well Test

(10) Location of Well, in feet, from some corner of the Section 200' S of N Line; 150' of E Line - NE Cor NE¼ NE¼ Sec 13, T17 R22

(11) Send Permit to W. O. Hudgens
Name
Box 171 Waldo Ark.
Address

DEPARTMENT OF CONSERVATION AND INSPECTION

LIEN ON CASING TO GUARANTEE PROPER PLUGGING AND ABANDON

Serial No. 6295 Date 3-28-32

The Undersigned agrees that should Kendall Oil + Gas Co. Lease Fullenwider

Well No. 1, Sec. 13, Twp. 17, R. 22,

Location 200' S of N. Line, 150' W " E " } NE Cr. NE 1/4 of NE 1/4, County Columbia

be not plugged, when finally abandoned, in accordance with the law and rules of the State Board of Conservation, the State is given a lien on all casing in the well; and should the well be not plugged by the owner on final abandonment, the Commissioner of Conservation and Inspection, or his agents, may enter on the premises, plug the well and pull the casing therefrom. The Department of Conservation and Inspection shall retain the sum of $200.00 for plugging the well, plus the cost of pulling the casing, and shall pay to the then owner of the well the proceeds of the sale of the salvaged casing in excess of said $200.00 plus the cost of pulling the casing.

This 1st day of April, 1932

Kendall Oil and Gas Co

By [signature]

Sec.-Treas

ARTIFICIAL PENETRATION REVIEW

MAP ID NO. 5

Status P & A

Operator J.B. Moore Trust

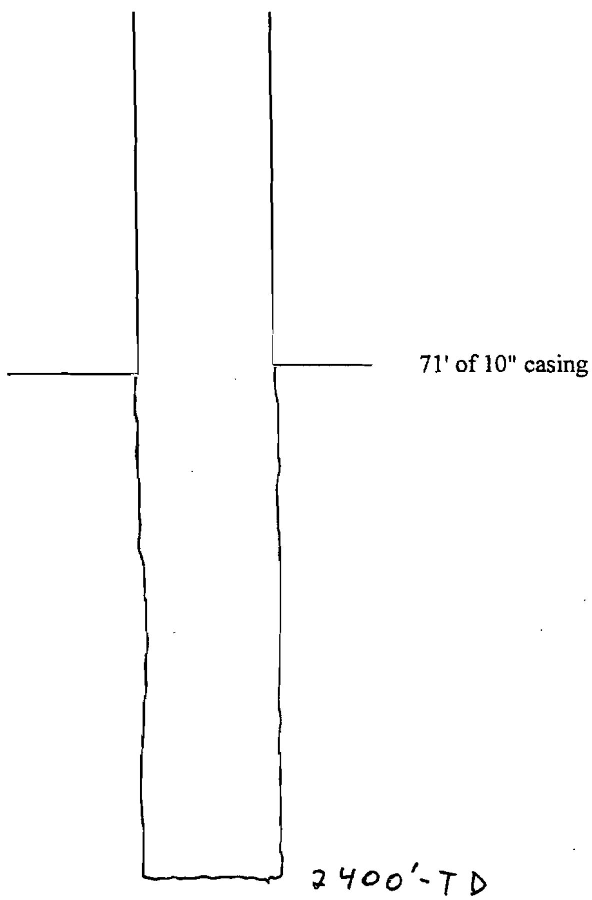
Forms AR Railroad Comm

Lease Fullenwider - Rhea - Kitchen

Distance from Injector 2810'

Well # 1

Well Diagram



Potential Problems:

NONE

Form A

ARKANSAS RAILROAD COMMISSION

CONSERVATION DIVISION

Application for Permit to Drill, Deepen, Abandon, or Plug and Perforate

Serial No. 3092

NORTH

NW¼ NE¼

12

SW¼ SE¼

10-Acre Sub-Division, 660 Ft. Each Way

SINGLE SECTION PLAT

640 Acres

Mark Well Accurately on Section Plat Shown Above

Two typewritten copies of the log of each well on Department forms must be filed with this office not later than ten days after completion of drilling.

(1) Date Nov. 4 1924 , 19

NOTICE—To drill, deepen, abandon or perforate a in Arkansas without first securing a written permit infraction of the law and subject to prosecution.

(2) County Columbia

(3) Farm .... Well No. 1

(4) Sec. 17 T. 17 R. 22

(5) Land Owner Fulenwider-Rhea-Kit

(6) Owner of Well J. B. Moore,

(7) Address Magnolia

A

(8) Permit to Drill

Drill, Deepen, Abandon, Plug and Per

(9) Oil, Gas or Test Well Test

(10) Location of Well in feet from some corn the Section 200 ft North an 200 ft West SE, Cor, SE, SE

(11) Send Permit to J. B. Moore

Name

Magnolia - Ark

Address

Well: Fullenwider #1 Moore et al
Loca: 200NW SE/c Sec. 12-17S-22W

Result: Dry

Elev:		PRODUCTION:
TD 2400'		Dry & Abandoned
		RECORD: SPUD 11/10/24 COMP 1/20/25
		10" 71'; 6" 2161'
		Csg. Pld.

OIL REPORTS

WATER WELL RECORDS

MAP ID. NO. 1

STATE OF ARKANSAS

Report of Water Well Construction

County in which well is located: [illegible]

(Please print or type)

OWNER OF WELL [illegible]
WELL CONTRACTOR [illegible]
CONTRACTOR LICENSE NO. [illegible]
NAME OF DRILLER [illegible]
DRILLER REGISTRATION NO. [illegible]
DATE WELL WAS COMPLETED [illegible] 9 71 (MO. DAY YR.)

Well is near Hwy. 132 road, approximately 2 miles N NE E SE S SW (W) NW of [illegible] (TOWN ETC.)
Section 7, Township [illegible], Range [illegible]
Directions for reaching well (use permanent landmarks) [illegible]

1. Total Depth of Well 81 ft.
2. Water Producing Formation: From 30 ft. To 81 ft.
3. Method of Construction:
Rotary ____ Cable ____ Driven ____ Jetted ____ Bored ✓ Dug ____
4. Water Level Below Land Surface 30 ft. ft.
5. Gallons per Hour [illegible]
6. Well disinfected with HTH [illegible]
7. Cased to 81 ft. with 30 Diameter [illegible] Casing
8. Cemented from ____ ft. to ____ ft.
9. Casing Perforated from 30 ft. to 81 ft.
10. Well Backfilled with: [illegible] (SAND, CLAY, CEMENT, MUD) from 0 ft. to 10 ft.
11. Gravel Pack from 10 ft. to 81 ft.
12. Screen Diameter: ____ inches from ____ ft. to ____ ft.
13. Type Screen ____ Fittings ____ Slot Size ____
14. Use of Well: DOMESTIC ____ IRRIGATION ____ MUNICIPAL ____ OTHER [illegible]

Description and Color of Formation: (Sand, Shale, Sandstone, etc.)

Description	From	To
[illegible]	0	12
[illegible]	12	30
[illegible]	30	81

Remarks:

Signed: [illegible]

Date: [illegible] (MONTH) 9 (DAY) 71 (YEAR)

Mail to: Committee on Water Well Construction – Room 151, State Capitol – Little Rock, Arkansas 72203

GEOLOGY COPY

MAP ID. NO. 2

WATER SUPPLY WELL FOR DRILLING
CARTER NO. 1 BRINEWELL

NEW WELL [Y] REPLACEMENT WELL [ ]

STATE OF ARKANSAS
Report of Water Well Construction

County in which well is located: COLUMBIA

(Please print or type)

OWNER OF WELL: DOW CHEMICAL #
WELL CONTRACTOR: HAMLIN + NOLTE
CONTRACTOR LICENSE NO.: C1054
NAME OF DRILLER: CONRAD L. HAMLIN
DRILLER REGISTRATION NO.: D2096
DATE WELL WAS COMPLETED: JUNE (MO.) 14 (DAY) 74 (YR.)

Well is near 172 road, approximately 4 miles N NE E SE S SW (W) NW of ______ (TOWN, ETC.)
Section 18, Township 17S, Range 21W.
Directions for reaching well: (use permanent landmarks) BY JOE CARTER BRINE WELL #1

1. Total Depth of Well 430
2. Water Producing Formation: From 425 ft. To 430 ft.
3. Method of Construction: Rotary X Cable ___ Driven ___ Jetted ___ Bored ___ Dug ___
4. Water Level Below Land Surface 181 ft.
5. Gallons per Hour ______ Gallons per Minute 5
6. Well disinfected with HTH
7. Cased to 425 ft. with 4" Diameter GALV. Casing
8. Cemented from 0 ft. to 20 ft.
9. Casing Perforated from ______ ft. to ______ ft.
10. Well Backfilled with: CEMENT MUD GRAVEL (SAND, CLAY, CEMENT, MUD) from 0 ft. to 430 ft.
11. Gravel Pack from 400 ft. to 425 ft.
12. Screen Diameter: 4" inches from 425 ft. to 430 ft.
13. Type Screen STAINLESS Fittings ______ Slot Size .018
14. Use of Well: ___ DOMESTIC ___ IRRIGATION ___ MUNICIPAL X OTHER

Description and Color of Formation: (Sand, Shale, Sandstone, etc.)

Description and Color of Formation	Depths in Feet From	To
CLAY	0	8
FINE SAND	8	44
BROWN CLAY	44	168
SANDY SHALE	168	190
GRAY CLAY	190	332
SANDY SHALE	332	358
FINE SAND	358	365
SANDY CLAY	365	405
SAND	405	411
GRAY CLAY	411	424
FINE SAND	424	430

Remarks: BROWN CLAY 430 485

Signed: Conrad L. Hamlin

Date: JUNE (MONTH) 14 (DAY) 74 (YEAR)

Mail to: Committee on Water Well Construction — 3815 W. Roosevelt Road — Little Rock, Arkansas 72204

GEOLOGY COPY

FORM NO. WD-1

74

MAP ID. NO. 3

WATER SUPPLY WELL FOR DOW NO. 1 BRINE WELL

NEW WELL [X] REPLACEMENT WELL [ ]

STATE ARKANSAS
Report of Water Well Construction

County in which well is located: COLUMBIA

(Please print or type)

OWNER OF WELL: DOW CHEMICAL Co.
WELL CONTRACTOR: HAMLIN & NOLTE
CONTRACTOR LICENSE NO. C1054
NAME OF DRILLER: CONRAD L. HAMLIN
DRILLER REGISTRATION NO. D2096
DATE WELL WAS COMPLETED: JUNE (MO.) 13 (DAY) 74 (YR.)

Well is near 132 road, approximately 5 miles N NE E SE S SW (W) NW of MAGNOLIA (TOWN, ETC.)
Section 18, Township 17S, Range 21W
Directions for reaching well: (use permanent landmarks) BY DOW #1 BRINE WELL

1. Total Depth of Well 438
2. Water Producing Formation: From 433 ft. To 438 ft.
3. Method of Construction: Rotary X Cable ___ Driven ___ Jetted ___ Bored ___ Dug ___
4. Water Level Below Land Surface 184 ft.
5. Gallons per Hour ___ Gallons per Minute 5
6. Well disinfected with HTH
7. Cased to 433 ft. with 4 Diameter GALV. Casing
8. Cemented from 0 ft. to 20 ft.
9. Casing Perforated from ___ ft. to ___ ft.
10. Well Backfilled with: CEMENT MUD GRAVEL (SAND, CLAY, CEMENT, MUD) from 0 ft. to 438 ft.
11. Gravel Pack from 415 ft. to 433 ft.
12. Screen Diameter: 4" inches from 433 ft. to 438 ft.
13. Type Screen STAINLESS Fittings ___ Slot Size .018
14. Use of Well: DOMESTIC ___ IRRIGATION ___ MUNICIPAL ___ OTHER X

Description and Color of Formation: (Sand, Shale, Sandstone, etc.)

Formation	Depths in Feet From	To
WHITE & RED CLAY	0	28
GRAY CLAY	28	130
SANDY SHALE	130	157
GRAY CLAY	157	295
SAND	295	310
GRAY CLAY	310	320
MED SAND	320	346
SANDY CLAY	346	395
SANDY CLAY	395	419
SAND	419	427
GRAY CLAY	427	432
MED SAND	432	442
GRAY CLAY	442	452

Remarks:

Signed: Conrad L. Hamlin

Date: JUNE (MONTH) 13 (DAY) 74 (YEAR)

Mail to: Committee on Water Well Construction — 3815 W. Roosevelt Road — Little Rock, Arkansas 72204

GEOLOGY COPY

FORM NO. WR-1

MAP ID. NO. 4

NEW WELL [X] REPLACEMENT WELL [ ]

STATE OF ARKANSAS
Report of Water Well Construction

County in which well is located: Columbia

(Please print or type)

OWNER OF WELL David Faulk
WELL CONTRACTOR Hamlin-Nelte W.W.
CONTRACTOR LICENSE NO. C 1059
NAME OF DRILLER Cecil Nelte
DRILLER REGISTRATION NO. D 2097
DATE WELL WAS COMPLETED 6 (MO) 7 (DAY) 77 (YR)

Well is near St 132 road, approximately 3 miles N NE E SE S SW (W) NW of Magnolia (Branch)
Section 13 Township 17S Range 22W

Directions for reaching well: (use permanent landmarks)

1. Total Depth of Well 47
2. Water Producing Formation: From 15 ft. To 48 ft.
3. Method of Construction: Rotary X Cable ___ R.C. ___ Driven ___ Jetted ___ Bored ___
4. Water Level Below Land Surface 21' ft.
5. Gallons per Hour ___ Gallons per Minute 10
6. Well disinfected with HTH
7. Cased to 37 ft. with 4' Diameter PVC Casing
8. Cemented from ___ ft. to ___ ft.
9. Casing Perforated from ___ ft. to ___ ft.
10. Well Backfilled with: Sand & Cement (SAND, CLAY, CEMENT, MUD) from 0 ft. to 35 ft.
11. Gravel Pack from 35 ft. to 47 ft.
12. Screen Diameter: 4 inches from 37 ft. to 47 ft.
13. Type Screen PVC Fittings ___ Slot Size .020
14. Use of Well: X DOMESTIC ___ IRRIGATION ___ MUNICIPAL ___ OTHER ___

Description and Color of Formation: (Sand, Shale, Sandstone, etc.)

Description and Color of Formation	From	To
Red Sandy Clay	0	15
Fine Sand w/clay Lyrs	15	48
Gray Clay	48	50

RECEIVED
JUN 20 1977
COMMITTEE ON WATER WELL CONSTRUCTION

Remarks:

This well is guaranteed against defective material or workmanship for a period of 1 year

Signed: Cecil Nelte

Date: 6-7-77 (MONTH / DAY / YEAR)

Mail to: Committee on Water Well Construction — 3815 W. Roosevelt Road — Little Rock, Arkansas 72204

FORM NO. WW-1

MAP ID NO. 5

STATE OF ARKANSAS
Report of Water Well Construction

NEW WELL ☐ REPLACEMENT WELL ☐

County in which well is located: [illegible]

(Please print or type)

OWNER OF WELL [illegible]
WELL CONTRACTOR [illegible]
CONTRACTOR LICENSE NO. [illegible]
NAME OF DRILLER [illegible]
DRILLER REGISTRATION NO. [illegible]
DATE WELL WAS COMPLETED [illegible] (MO.) [illegible] (YR.)

Well is near [illegible] road, approximately [illegible] miles N NE E SE S SW W NW of [illegible] (TOWN, ETC.)
Section [illegible] Township [illegible] Range [illegible]
Directions for reaching well:
(use permanent landmarks)

1. Total Depth of Well 76
2. Water Producing Formation: From [illegible] ft. to [illegible] ft.
3. Method of Construction:
Rotary [illegible] Cable ___ Driven ___ Jetted ___ Bored ___ Dug ___
4. Water Level Below Land Surface [illegible] ft.
5. Gallons per Hour [illegible] Gallons per Minute
6. Well disinfected with [illegible]
7. Cased to [illegible] ft. with [illegible] Diameter [illegible] Casing
8. Cemented from ___ ft. to ___ ft.
9. Casing Perforated from ___ ft. to ___ ft.
10. Well Backfilled with: [illegible] from [illegible] ft. to [illegible] ft.
(SAND, CLAY, CEMENT, MUD)
11. Gravel Pack from ___ ft. to [illegible] ft.
12. Screen Diameter:
[illegible] inches from [illegible] ft. to [illegible] ft.
13. Type Screen [illegible] Fittings [illegible] Slot Size [illegible]
14. Use of Well:
[illegible] DOMESTIC ___ IRRIGATION ___ MUNICIPAL ___ OTHER

Description and Color of Formation: (Sand, Shale, Sandstone, etc.)

Formation	Depths in Feet From	To
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Remarks:

Signed: [illegible]

Date: [illegible] (MONTH) [illegible] (DAY) [illegible] (YEAR)

Mail to: Committee on Water Well Construction — 3815 W. Roosevelt Road — Little Rock, Arkansas 72204

MAP ID NO. 6

WATER SUPPLY WELL FOR JAMESON NO.1 BRINE WELL

STATE OF ARKANSAS

REPORT OF WATER WELL CONSTRUCTION

New Well X Work-over Well ____ Replacement Well ____

County Columbia (in which well is located)

Owner of Well Dow Chem Co.

Contractor Hamlin - Nolte WW c 1054

Driller Name and No. Cecil Nolte D2097

Date Well was Completed 10-24-83

Well is near Ark 132 NW1/4 SE1/4 Road

Section 12 Township 17S Range 22W

Directions for Reaching Well: Inquire at Office (use permanent landmark)

For Direction and Key

Well # Jameson #1

1. Total Depth of Well 445 Ft.
2. Water Producing Formation: From 420 Ft. To 445 Ft.
3. Water Level Below Land Surface 240
4. Gallons per Hour 420
5. Well Disinfected with HTH
6. Casing to 425 Ft.
7. Cased with 4" Diameter Galv. Casing
8. Cemented from 0 Ft. to 80 Ft.
9. Use of Well: Domestic ____ Irrigation ____ Municipal ____ Other X

Industry

Description and Color of Formation (sand, shale, sandstone, etc.)	Depths in feet from	to
Red Sandy Clay	0	12
Sand	12	44
Gray Clay w/sand strks	44	316
Very Fine Sand w/clay strks	316	344
Gray Clay w Very Fine Sand strks	344	420
Fine Sand w/clay strks	420	445
Gray Clay	445	468
Brown Shale	468	480

Remarks:

Signed: Cecil Nolte Date: 10-24-83

Form No. AWD-3

Mail to: Committee on Water Well Construction, 2915 So. Pine Street, Little Rock, Arkansas 72204

GEOLOGY COPY

APPENDIX C

Whole Core Reports, Brine Analyses, and Logs from Tokio & James Formations

WHOLE CORE REPORTS

Core Report for SWD 1-M

P E T R O L E U M   C O R I   S E R V I C E S, I N C

CORE ANALYSIS REPORT

FOR

ETHYL CORPORATION
NO. 61 BSW
MAGNOLIA FIELD
COLUMBIA COUNTY, ARKANSAS

PETROLEUM CORE SERVICES, INC.

415 Lake Street
Shreveport, Louisiana 71101
(318) 222-0000
FAX (318) 227-0939

101 Whitehead Drive
Magnolia, Arkansas
(501) 234-1198

Ethyl Corporation
P. O. Box 1890
Magnolia, Ar 71753
Attn: Mr. Floyd Green

Subject: Core Analysis
No. 61 BSW
Magnolia Field
Columbia Cty, Ar

Dear Mr. Green:

Diamond coring equipment and water base mud were used to core the subject well. The core was sampled by an employee of Petroleum Core Services, under the direction of a representative of the operator. The samples were preserved in waxed boxes and delivered to our Magnolia laboratory where the analysis was performed. The results are presented in tabular form on pages one and two and graphically on the enclosed Correlation Coregraph.

Tokio formation was analyzed from 2825.0 to 2932.0 feet for permeability and porosity to be used in a storage project. No interpretation of the data was necessary. A permeability versus porosity plot (shown on page three) was drawn for the analyzed zone. A least squares best-fit line was drawn through the data. While the permeability versus porosity relationship is good for the cored zone, the best-fit line should be used with caution in correlative zones or in different zones within this well.

Thank you for this opportunity to be of service.

Very truly yours,

Raymond Bruce, Jr.

Raymond Bruce, Jr.

PETROLEUM CORE SERVICES, INC

ETHYL CORPORATION
NO. 61 BSW
MAGNOLIA FIELD
COLUMBIA COUNTY, ARKANSAS

DATE : 13-MAY-91
FORMATION : AS NOTED
DRLG. FLUID: WATER BASE MUD

FILE NO. : C910505
LABORATORY : MAGNOLIA, AR
API WELL NO.:
CORES : DIA CONV

CONVENTIONAL CORE ANALYSIS

SMP NO.	DEPTH FEET	PERM(Ka) MD	FLD POR	OIL% PORE	WTR% PORE	OIL% BULK	GAS% BULK	DESCRIPTION
	2825.0-2875.0 CORE NO. 1 CUT 50 FT REC 50 FT (TOKIO FORMATION)							
1	2825.0 -27.0	0.22	13.0	0.5	93.5	0.1	0.8	SD VFG ASHY S/LIG S/LMY N ODR N FLU
2	2827.0 -29.0	0.26	14.4	0.4	91.2	0.1	1.2	SD VFG ASHY S/LIG S/LMY N ODR N FLU
3	2829.0 -31.0	0.01	13.0	0.4	82.2	0.1	2.3	LIGNITE
4	2831.0 -33.0	96	24.8	0.2	51.8	0.1	11.9	SD VFG ASHY LIG S/PYR N ODR N FLU
5	2833.0 -35.0	0.06	18.3	0.6	90.0	0.1	1.7	SD VFG ASHY S/LIG N ODR N FLU
6	2835.0 -37.0	0.37	16.5	0.7	89.7	0.1	1.6	SD VFG ASHY SHY V/LIG N ODR N FLU
7	2837.0 -39.0	0.01	21.4	0.5	78.8	0.1	4.4	LIGNITE
8	2839.0 -41.0	0.01	22.9	0.4	93.2	0.1	1.5	LIGNITE
9	2841.0 -43.0	0.01	13.6	0.4	84.7	0.1	2.0	LIGNITE
10	2843.0 -45.0	0.26	16.7	0.4	91.3	0.1	1.4	SD VFG ASHY SHY LIG N ODR N FLU
11	2845.0 -47.0	0.22	17.1	0.9	88.9	0.2	1.8	SD VFG ASHY SHY S/LIG N ODR N FLU
12	2847.0 -49.0	0.01	17.5	0.3	93.2	0.1	1.1	SD VFG ASHY SHY S/LIG N ODR N FLU
13	2849.0 -51.0	0.31	18.8	0.3	67.7	0.1	6.0	SD VFG ASHY S/LIG N ODR N FLU
14	2851.0 -53.0	0.08	13.9	0.4	86.0	0.1	1.9	SD VFG ASHY LIG/LAM N ODR N FLU
15	2853.0 -55.0	0.32	18.2	0.3	79.1	0.1	3.7	SD VFG ASHY LIG/LAM N ODR N FLU
16	2855.0 -57.0	0.9	16.9	0.3	90.0	0.1	1.6	SD VFG ASHY LIG/LAM N ODR N FLU
17	2857.0 -59.0	4.5	20.9	0.3	52.0	0.1	10.0	SD VFG ASHY LIG/LAM N ODR N FLU
18	2859.0 -61.0	1.0	17.3	0.3	52.6	0.1	8.1	SD VFG ASHY LIG/LAM N ODR N FLU
19	2861.0 -63.0	3.4	22.7	0.5	61.7	0.1	8.6	SD VFG ASHY LIG/LAM N ODR N FLU
20	2863.0 -65.0	45	24.7	0.4	58.0	0.1	10.3	SD VFG ASHY LIG/LAM N ODR N FLU
21	2865.0 -67.0	138	27.3	0.4	52.4	0.1	12.9	SD FG S/ASHY LIG N ODR N FLU
22	2867.0 -69.0	9.1	24.5	0.4	54.1	0.1	11.1	SD VF-FG S/ASHY LIG N ODR N FLU
23	2869.0 -71.0	73	25.9	0.3	54.6	0.1	11.7	SD VFG ASHY LIG/LAM N ODR N FLU
24	2871.0 -73.0	0.17	21.6	0.4	64.5	0.1	7.6	SD VFG ASHY LIG/LAM N ODR N FLU
25	2873.0 -75.0	0.06	20.3	0.3	81.1	0.1	3.8	SD VFG ASHY LIG/LAM N ODR N FLU

PETROLEUM CORE SERVICES, INC

ETHYL CORPORATION
NO. 61 BSW
MAGNOLIA FIELD
COLUMBIA COUNTY, ARKANSAS

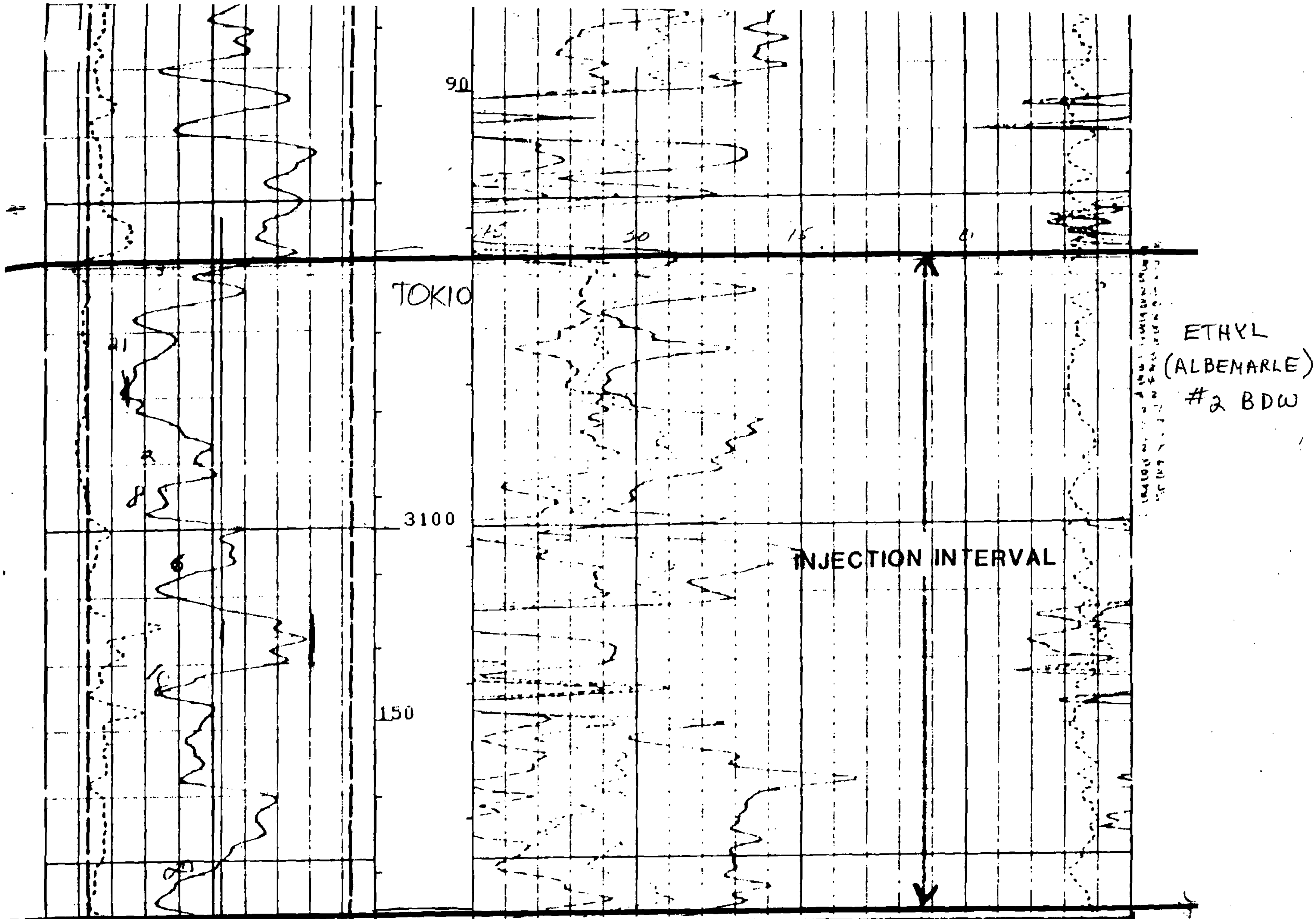
DATE : 13-MAY-91
FORMATION : AS NOTED
DRLG. FLUID: WATER BASE MUD

FILE NO. : C910505
LABORATORY : MAGNOLIA, AR
API WELL NO.:
CORES : DIA CONV

CONVENTIONAL CORE ANALYSIS

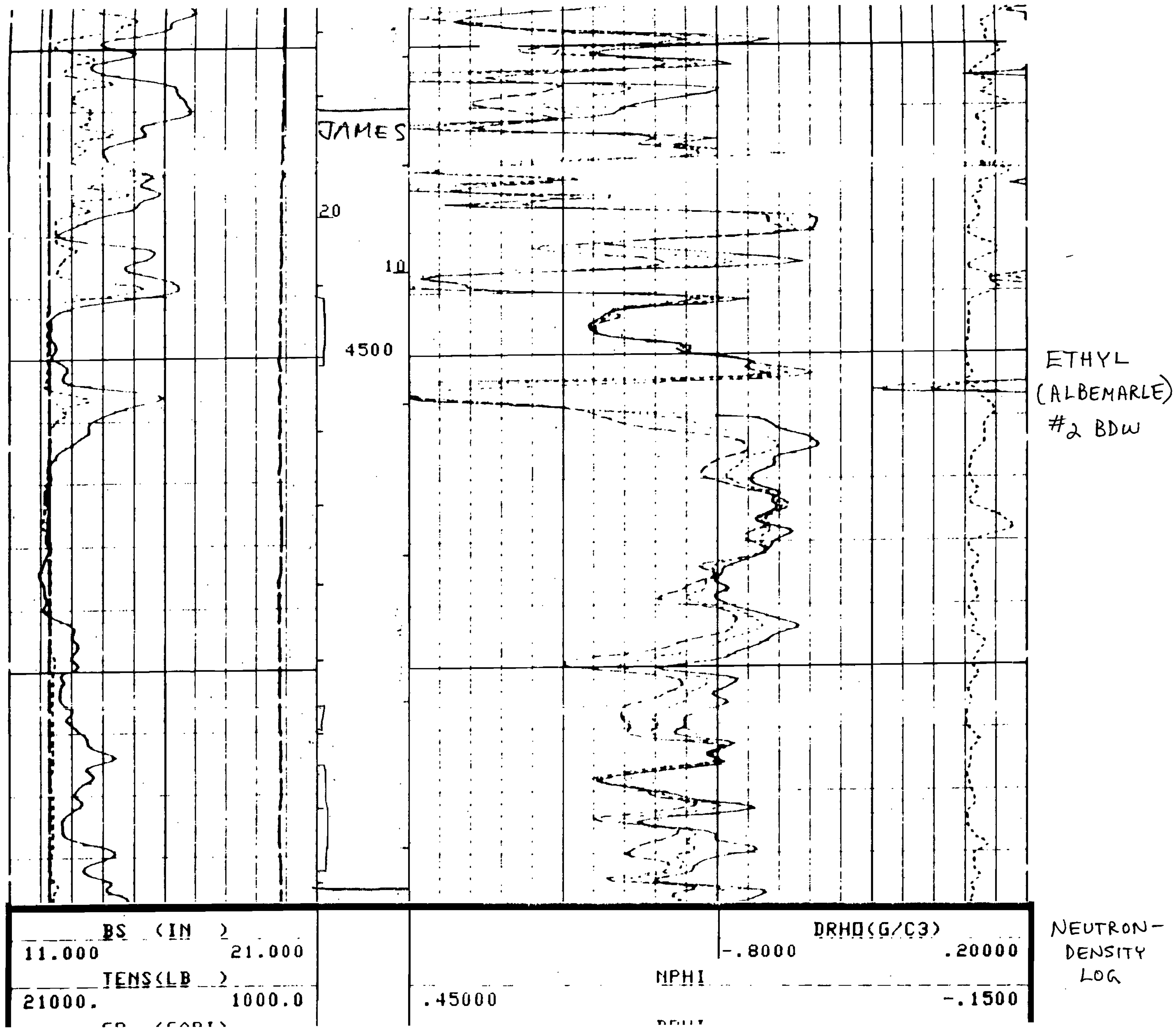
SMP NO.	DEPTH FEET	PERM(Ka) MD	FLD POR	OIL% PORE	WTR% PORE	OIL% BULK	GAS% BULK	DESCRIPTION
	2875.0-2935.0	CORE NO. 2					CUT 60 FT	REC 57 FT
26	2875.0 -77.0	152	28.5	0.2	49.4	0.1	14.4	SD F-MG S/ASHY S/LIG N ODR N FLU
27	2877.0 -79.0	97	26.5	0.2	59.4	0.1	10.7	SD F-MG S/ASHY S/LIG N ODR N FLU
28	2879.0 -81.0	13	23.4	0.0	58.0	0.0	9.8	SD F-MG S/ASHY S/LIG SSHY N ODR N FLU
29	2881.0 -83.0	55	27.6	0.2	57.5	0.1	11.7	SD F-MG S/ASHY S/LIG SSHY N ODR N FLU
30	2883.0 -85.0	0.25	21.9	0.1	65.0	0.0	7.6	SD F-MG ASHY SSHY N ODR N FLU
31	2885.0 -87.0	2.7	24.1	0.0	66.2	0.0	8.1	SD F-MG ASHY N ODR N FLU
32	2887.0 -89.0	2.8	22.4	0.0	48.1	0.0	11.6	SD F-MG ASHY N ODR N FLU
33	2889.0 -91.0	81	28.6	0.0	55.7	0.0	12.7	SD F-MG ASHY N ODR N FLU
34	2891.0 -93.0	136	30.5	0.0	70.9	0.0	8.9	SD F-MG ASHY N ODR N FLU
35	2893.0 -95.0	148	29.1	0.0	42.1	0.0	16.8	SD F-MG ASHY N ODR N FLU
36	2895.0 -97.0	66	28.8	0.0	54.8	0.0	13.0	SD F-MG ASHY N ODR N FLU
37	2897.0 -99.0	103	32.7	0.0	57.5	0.0	13.9	SD F-MG ASHY N ODR N FLU
38	2899.0 - 1.0	26	25.9	0.0	53.5	0.0	12.1	SD F-MG ASHY SSHY N ODR N FLU
39	2901.0 - 3.0	108	27.8	0.0	66.2	0.0	9.4	SD FG ASHY N ODR N FLU
40	2903.0 - 5.0	122	30.5	0.0	52.2	0.0	14.6	SD FG ASHY N ODR N FLU
41	2905.0 - 7.0	146	32.0	0.0	50.7	0.0	15.8	SD FG ASHY N ODR N FLU
42	2907.0 - 9.0	200	31.8	0.0	57.2	0.0	13.6	SD FG ASHY N ODR N FLU
43	2909.0 -11.0	236	30.6	0.0	58.5	0.0	12.7	SD FG ASHY N ODR N FLU
44	2911.0 -13.0	460	31.7	0.0	65.0	0.0	11.1	SD FG ASHY N ODR N FLU
45	2913.0 -15.0	446	32.5	0.0	56.1	0.0	14.3	SD FG ASHY N ODR N FLU
46	2915.0 -17.0	688	34.0	0.0	56.0	0.0	14.9	SD FG ASHY N ODR N FLU
47	2917.0 -19.0	207	31.2	0.0	57.0	0.0	13.4	SD FG ASHY N ODR N FLU
48	2919.0 -21.0	162	28.8	0.0	54.7	0.0	13.0	SD FG S/ASHY SHY/LAM N ODR N FLU
49	2921.0 -23.0	233	30.5	0.0	53.0	0.0	14.3	SD FG S/ASHY SSHY N ODR N FLU
50	2923.0 -25.0	322	31.9	0.0	51.7	0.0	15.4	SD FG S/ASHY SSHY N ODR N FLU
51	2925.0 -27.0	446	28.8	0.0	69.2	0.0	8.8	SD FG S/ASHY SSHY N ODR N FLU
52	2927.0 -29.0	261	28.7	0.0	56.7	0.0	12.4	SD FG S/ASHY SSHY N ODR N FLU
53	2929.0 -31.0	618	30.2	0.0	65.8	0.0	10.3	SD FG S/ASHY SSHY N ODR N FLU
54	2931.0 -32.0	1504	32.9	0.0	61.9	0.0	12.5	SD FG S/ASHY SSHY N ODR N FLU
	2932.0 -35.0							LOST CORE

2932'
2825'
107'



BS (IN) 11.000 — 21.000		DRHO(G/C3) -.8000 — .20000
TENS(LB) 21000. — 1000.0	NPHI .45000	-.1500
GR (GAPI) 0.0 — 150.00	DPHI .45000	-.1500

NEUTRON-DENSITY LOG


JAMES
20
10
4500
ETHYL
(ALBEMARLE)
#2 BDW
BS (IN)
11.000
21.000
TENS(LB)
21000.
1000.0
DRHO(G/C3)
-.8000
.20000
NPHI
.45000
-.1500
NEUTRON-
DENSITY
LOG

P E T R O L E U M   C O R E   S E R V I C E S,   I N C

2

GREAT LAKE CHEMICAL
SWD NO. 1 "M"
SCHULER-WILKS
UNION COUNTY, ARKANSAS

DATE : 07-JAN-1990
FORMATION :
DRLG. FLUID: WATER BASE MUD

FILE NO. : S900101
LABORATORY : MAGNOLIA
API WELL NO.:
CORES : SCHLUMBERGER

SIDEWALL CORE ANALYSIS

REC IN	DEPTH FEET	PERM(Ka) MD	FLD POR	OIL% PORE	WTR% PORE	DESCRIPTION	
1.0	2086.0	175.0	26.7	0.0	68.6	SD VFG SHY(LAM) NO ODR NO FLU	
0.5	2088.0	2.1	17.4	0.0	68.9	LS XLN SHY(LAM) NO ODR NO FLU	
1.0	2090.0	189.0	27.6	0.0	69.2	SD VFG SSHY SSLTY NO ODR NO FLU	
0.8	2092.0	181.0	29.7	0.0	80.5	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.8	2094.0	174.0	27.9	0.0	85.5	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.7	2096.0	203.0	28.1	0.0	84.4	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.5	2098.0	221.0	29.7	0.0	87.2	SD VFG SSHY S/ASHY NO ODR NO FLU	
1.0	2100.0	64.0	22.1	0.0	82.4	SD VFG SSHY LMY NO ODR NO FLU	
0.8	2102.0	197.0	28.1	0.0	87.5	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.5	2104.0	351.0	30.9	0.0	80.4	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.8	2106.0	286.0	29.7	0.0	81.5	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.5	2108.0	305.0	29.3	0.0	86.3	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.5	2110.0	295.0	28.4	0.0	80.0	SD VFG SSHY S/ASHY NO ODR NO FLU	
1.0	2112.0	368.0	29.8	0.0	87.3	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.8	2114.0	412.0	31.5	0.0	85.1	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.9	2116.0	376.0	29.3	0.0	85.3	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.8	2118.0	336.0	28.6	0.0	81.7	SD VFG SSHY S/ASHY NO ODR NO FLU	
1.0	2120.0	368.0	29.4	0.0	87.4	SD VFG SSHY S/ASHY NO ODR NO FLU	
0.9	2124.0	72.0	25.3	0.0	82.3	SD VFG SSHY LMY NO ODR NO FLU	
1.0	2126.0	21.0	22.5	0.0	80.4	SD VFG SLTY NO ODR NO FLU	
0.6	2822.0	511.0	29.7	0.0	80.0	SD VFG SSLTY NO ODR NO FLU	BLOSSOM
0.5	2824.0	601.0	31.4	0.0	76.9	SD VFG SSLTY NO ODR NO FLU	
1.0	2826.0	311.0	27.4	0.0	68.3	SD VFG SSLTY NO ODR NO FLU	
0.3	2828.0	517.0	29.6	0.0	71.4	SD VFG SSLTY NO ODR NO FLU	
1.0	2992.0	118.0	25.6	0.0	77.6	SD VF-FG ASHY NO ODR NO FLU	TOKIO
0.5	2996.0	524.0	30.4	0.0	79.2	SD VF-FG ASHY NO ODR NO FLU	
0.5	3000.0	5.6	22.2	0.0	72.7	SD VFG V/ASHY LIG NO ODR NO FLU	
0.5	3006.0	8.5	24.1	0.0	86.5	SD VFG SHY NO ODR NO FLU	

PETROLEUM CORE SERVICES, INC

GREAT LAKE CHEMICAL
SWD NO. 1 "M"
SCHULER-WILKS
UNION COUNTY, ARKANSAS

DATE : 07-JAN-1990
FORMATION :
DRLG. FLUID: WATER BASE MUD

FILE NO. : S900101
LABORATORY : MAGNOLIA
API WELL NO.:
CORES : SCHLUMBERGER

SIDEWALL CORE ANALYSIS

REC IN	DEPTH FEET	PERM(Ka) MD	FLD POR	OIL% PORE	WTR% PORE	DESCRIPTION
0.5	3012.0	13.0	23.1	0.0	91.2	SD VFG SHY SLTY NO ODR NO FLU
0.4	3018.0	216.0	27.5	0.0	72.7	SD VFG SSHY NO ODR NO FLU
0.6	3026.0	495.0	31.5	0.0	63.4	SD VFG SSHY NO ODR NO FLU
0.5	3036.0	219.0	28.1	0.0	62.5	SD VFG SSHY LIG(LAM) NO ODR NO FLU
1.0	3040.0	183.0	27.8	0.0	65.0	SD VFG SSHY LIG(LAM) NO ODR NO FLU
0.6	3042.0	241.0	28.4	0.0	74.1	SD FG SSLTY NO ODR NO FLU
1.0	3044.0	174.0	27.2	0.0	69.4	SD FG SLTY S/ASHY NO ODR NO FLU
0.5	3046.0	100.0	28.2	0.0	64.8	SD FG SLTY S/ASHY NO ODR NO FLU
1.0	3076.0	X 6.7	21.3	0.0	66.7	SD VFG SLTY LIG(LAM) NO ODR NO FLU
0.4	3080.0	714.0	29.8	0.0	70.6	SD FG CLN NO ODR NO FLU
0.5	3086.0	751.0	30.1	0.0	83.3	SD VF-FG CLN NO ODR NO FLU
0.6	3092.0	67.0	23.6	0.0	84.5	SD VFG ASHY SLTY NO ODR NO FLU

TOKIO

PETROLEUM CORE SERVICES, INC

Page No.

GREAT LAKES CHEMICAL
SWD NO. 1 "M"
SCHULER-WILKS FIELD
UNION COUNTY, ARKANSAS

DATE : 07-JAN-1990
FORMATION :
DRLG. FLUID: WATER BASE MUD

FILE NO. : S900101
LABORATORY : MAGNOLIA
API WELL NO.:
CORES : SCHLUMBERGER

porosity $\frac{486.5}{18} = 27.0\%$

SIDEWALL CORE ANALYSIS

3104'
-2992'
112'

(or) porosity where Ka>10 $\frac{418.9}{15} = 27.9\%$

REC IN	DEPTH FEET	PERM(Ka) MD	FLD POR	OIL% PORE	WTR% PORE	DESCRIPTION
1.0	3098.0	402.0	27.2	0.0	79.2	SD VF-FG SSLTY NO ODR NO FLU
0.4	3104.0	1121.0	30.4	0.0	71.4	SD FG SSHY NO ODR NO FLU
0.7	3347.0	63.0	23.2	0.0	94.3	SD VFG SSLTY NO ODR NO FLU
1.0	3349.0	4.0	18.5	0.0	82.4	SD VFG VSHY LMY PYR NO ODR NO FLU
0.7	3351.0	9.0	21.9	0.0	91.1	SD VFG SHY SLTY PYR NO ODR NO FLU
0.7	3352.0	112.0	24.8	0.0	83.9	SD VFG SSLTY NO ODR NO FLU
0.9	3356.0	62.0	21.1	0.0	79.3	SD VFG SLTY NO ODR NO FLU
0.8	3362.0	117.0	25.0	0.0	77.4	SD VFG SSLTY NO ODR NO FLU
0.6	3366.0	1421.0	28.0	0.0	71.7	SD VF-FG CLN NO ODR NO FLU
0.6	3372.0	824.0	28.2	0.0	85.2	SD VFG CLN NO ODR NO FLU
0.4	3376.0	1021.0	29.2	0.0	83.3	SD VF-FG CLN NO ODR NO FLU
0.6	3520.0	232.0	26.9	0.0	84.6	SD VFG SSLTY NO ODR NO FLU
1.0	3522.0	× 6.0	19.7	0.0	63.2	SD VFG SHY LIG PYR NO ODR NO FLU
1.0	3524.0	167.0	25.3	0.0	83.3	SD VFG SSLTY NO ODR NO FLU
1.0	3528.0	162.0	25.3	0.0	88.3	SD VFG SSLTY NO ODR NO FLU

TOKIO

GLEN ROSE

James Ls [illegible] identified here

James Lime 240' thick in #1619
7, 3528-3347 = 181' here

if porosities where Ka > 10 used.
average $\frac{257.}{10}$ - 25.7%

C O R E   L A B O R A T O R I E S,   I N C.

Company : ETHYL CORPORATION
Well : BRINE DISPOSAL WELL NO. 2
Location : SEC 18-18S-18W
Co,State : COLUMBIA COUNTY, ARKANSAS

Field : ETHYL FIELD
Formation : JAMES LIME
Coring Fluid : WATER BASE MUD
Elevation :

File : 57167-10068
Date : 3-FEB-88
API No. :
Analysts: ALLEN/BROWNLEE

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH	PERMEABILITY (HORIZONTAL) Kair	POROSITY (FLUIDS)	SATURATION (PORE VOLUME) OIL	SATURATION (PORE VOLUME) WATER	SATURATION (BULK VOLUME) OIL	SATURATION (BULK VOLUME) GAS	PROBABLE PRODUCTION	DESCRIPTION
	ft	md	%	%	%	%	%		
		4485.0-4545.0	CORE NO. 1	CUT 60 FT		REC 57 FT			
1	4485.0- 86.0	<0.01	4.2	0.0	81.2	0.0	0.8	LOW PERM	SHALE LMY FOSS NO ODR NO FLU
2	4486.0- 87.0	<0.01	4.0	0.0	84.5	0.0	0.6	LOW PERM	SHALE LMY FOSS NO ODR NO FLU
3	4487.0- 88.0	0.02	6.1	0.0	80.2	0.0	1.2	LOW PERM	LS XLN SHY FOSS NO ODR NO FLU
4	4488.0- 89.0	<0.01	2.5	0.0	63.9	0.0	0.9	LOW PERM	LS XLN SHY FOSS NO ODR NO FLU
5	4489.0- 90.0	<0.01	2.3	0.0	68.1	0.0	0.7	LOW PERM	LS XLN SHY FOSS NO ODR NO FLU
6	4490.0- 91.0	0.08	12.3	0.0	94.4	0.0	0.7	LOW PERM	SHALE FOSS S/LMY NO ODR NO FLU
7	4491.0- 92.0	0.25	10.1	0.0	96.9	0.0	0.3	LOW PERM	SHALE FOSS S/LMY NO ODR NO FLU
8	4492.0- 93.0	0.03	9.8	0.0	82.0	0.0	1.8	LOW PERM	SHALE FOSS S/LMY NO ODR NO FLU
9	4493.0- 94.0	0.09	4.7	0.0	95.0	0.0	0.2	LOW PERM	SHALE FOSS S/LMY NO ODR NO FLU
10	4494.0- 95.0	<0.01	3.7	0.0	84.6	0.0	0.6	LOW PERM	SHALE FOSS S/LMY NO ODR NO FLU
11	4495.0- 96.0	<0.01	6.0	0.0	92.1	0.0	0.5	LOW PERM	SHALE FOSS S/LMY NO ODR NO FLU
12	4496.0- 97.0	0.05	11.5	0.0	93.0	0.0	0.8	LOW PERM	SHALE FOSS S/LMY NO ODR NO FLU
13	4497.0- 98.0	0.42	6.5	0.0	89.4	0.0	0.7	LOW PERM	LS XLN SHY FOSS NO ODR NO FLU
14	4498.0- 99.0	3.33	10.1	0.0	58.6	0.0	4.2	WATER	LS XLN SNDY SHY FOSS NO ODR NO FLU
15	4499.0- 00.0	190.	20.0	0.0	84.4	0.0	3.1	WATER	SD VFG SSHY S/FOSS NO ODR NO FLU
16	4500.0- 01.0	247.	25.4	0.0	87.6	0.0	3.2	WATER	SD VFG S/LMY SSHY(LAM) S/FOSS NO ODR NO FLU
17	4501.0- 02.0	300.	26.0	0.0	88.4	0.0	3.0	WATER	SD VFG S/LMY SSHY(LAM) S/FOSS NO ODR NO FLU
18	4502.0- 03.0	294.	27.4	0.0	87.0	0.0	3.6	WATER	SD VFG S/LMY SSHY(LAM) S/FOSS NO ODR NO FLU
19	4503.0- 04.0	276.	24.5	0.0	79.5	0.0	5.0	WATER	SD VFG S/LMY SSHY(LAM) S/FOSS NO ODR NO FLU
20	4504.0- 05.0	326.	25.3	0.0	84.5	0.0	3.9	WATER	SD VFG S/LMY SSHY(LAM) S/FOSS NO ODR NO FLU
21	4505.0- 06.0	0.74	12.3	0.0	53.3	0.0	5.7	LOW PERM	SD VFG S/LMY SSHY(LAM) S/FOSS NO ODR NO FLU
22	4506.0- 07.0	375.	25.7	0.0	70.7	0.0	7.5	WATER	SD VFG S/LMY SSHY(LAM) S/FOSS NO ODR NO FLU
23	4507.0- 08.0	0.18	9.6	0.0	30.6	0.0	6.7	LOW PERM	SD VFG S/LMY SSHY(LAM) S/FOSS NO ODR NO FLU
24	4508.0- 09.0	0.11	9.7	0.0	55.8	0.0	4.3	LOW PERM	SD VFG S/LMY SSHY(LAM) S/FOSS NO ODR NO FLU
25	4509.0- 10.0	0.79	14.4	0.0	46.7	0.0	7.7	LOW PERM	SD VFG LMY SHY(LAM) S/FOSS NO ODR NO FLU

2453.73

C O R E   L A B O R A T O R I E S,   I N C.

Company : ETHYL CORPORATION
Well : BRINE DISPOSAL WELL NO. 2

Field : ETHYL FIELD
Formation : JAMES LIME

File : 57167-10068
Date : 3-FEB-88

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH ft	PERMEABILITY (HORIZONTAL) Kair md	POROSITY (FLUIDS) %	SATURATION (PORE VOLUME) OIL %	SATURATION (PORE VOLUME) WATER %	SATURATION (BULK VOLUME) OIL %	SATURATION (BULK VOLUME) GAS %	PROBABLE PRODUCTION	DESCRIPTION
26	4510.0- 11.0	0.05	5.8	0.0	61.5	0.0	2.2	LOW PERM	SD VFG LMY SHY(LAM) S/FOSS NO ODR NO FLU
27	4511.0- 12.0	0.03	3.4	0.0	69.1	0.0	1.1	LOW PERM	SHALE FOSS NO ODR NO FLU
28	4512.0- 13.0	0.34	8.2	0.0	82.9	0.0	1.4	LOW PERM	SHALE FOSS NO ODR NO FLU
29	4513.0- 14.0	0.82	8.0	0.0	83.1	0.0	1.4	LOW PERM	SHALE FOSS NO ODR NO FLU
30	4514.0- 15.0	0.02	4.4	0.0	83.4	0.0	0.7	LOW PERM	SHALE FOSS NO ODR NO FLU
31	4515.0- 16.0	0.79	3.5	0.0	72.6	0.0	1.0	LOW PERM	SHALE FOSS NO ODR NO FLU
32	4516.0- 17.0	0.76	6.9	0.0	79.0	0.0	1.5	LOW PERM	SHALE LIME(NOD) NO ODR NO FLU
33	4517.0- 18.0	0.12	7.7	0.0	88.1	0.0	0.9	LOW PERM	SHALE LIME(NOD) NO ODR NO FLU
34	4518.0- 19.0	0.03	5.1	0.0	92.1	0.0	0.4	LOW PERM	SHALE LIME(NOD) NO ODR NO FLU
35	4519.0- 20.0	0.05	3.8	0.0	88.8	0.0	0.4	LOW PERM	SHALE LIME(NOD) NO ODR NO FLU
36	4520.0- 21.0	0.02	3.1	0.0	82.6	0.0	0.5	LOW PERM	LS XLN SSNDY SHY(LAM) S/FOSS NO ODR NO FLU
37	4521.0- 22.0	<0.01	4.8	0.0	75.3	0.0	1.2	LOW PERM	LS XLN SHY(LAM) S/FOSS NO ODR NO FLU
38	4522.0- 23.0	0.02	7.4	0.0	52.4	0.0	3.5	LOW PERM	LS XLN SHY(LAM) S/FOSS NO ODR NO FLU
39	4523.0- 24.0	0.17	8.7	0.0	63.7	0.0	3.2	LOW PERM	LS XLN SHY(LAM) S/FOSS VUG NO ODR NO FLU
40	4524.0- 25.0	0.07	10.4	0.0	55.2	0.0	4.7	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
41	4525.0- 26.0	0.16	12.5	0.0	53.3	0.0	5.8	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
42	4526.0- 27.0	0.10	10.4	0.0	56.4	0.0	4.5	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
43	4527.0- 28.0	0.05	11.5	0.0	50.2	0.0	5.7	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
44	4528.0- 29.0	0.05	9.8	0.0	49.5	0.0	4.9	LOW PERM	LS XLN SSNDY SSHY(LAM) STYL FOSS NO ODR NO FLU
45	4529.0- 30.0	0.01	8.2	0.0	43.4	0.0	4.6	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
46	4530.0- 31.0	0.03	8.5	0.0	47.3	0.0	4.5	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
47	4531.0- 32.0	0.04	5.3	0.0	48.6	0.0	2.7	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
48	4532.0- 33.0	0.04	7.8	0.0	48.6	0.0	4.0	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
49	4533.0- 34.0	0.32	13.0	0.0	45.2	0.0	7.1	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
50	4534.0- 35.0	3.00	12.6	0.0	47.0	0.0	6.7	WATER	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
51	4535.0- 36.0	1.10	11.3	0.0	50.2	0.0	5.6	WATER	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
52	4536.0- 37.0	0.39	10.5	0.0	42.1	0.0	6.1	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
53	4537.0- 38.0	2.30	15.3	0.0	48.9	0.0	7.8	WATER	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
54	4538.0- 39.0	0.43	11.1	0.0	51.8	0.0	5.3	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU

C O R E   L A B O R A T O R I E S,   I N C.

Company : ETHYL CORPORATION
Well : BRINE DISPOSAL WELL NO. 2

Field : ETHYL FIELD
Formation : JAMES LIME

File : 57167-10068
Date : 3-FEB-88

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH ft	PERMEABILITY (HORIZONTAL) Kair md	POROSITY (FLUIDS) %	SATURATION (PORE VOLUME) OIL %	SATURATION (PORE VOLUME) WATER %	SATURATION (BULK VOLUME) OIL %	SATURATION (BULK VOLUME) GAS %	PROBABLE PRODUCTION	DESCRIPTION
55	4539.0- 40.0	0.47	13.5	0.0	43.0	0.0	7.7	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
56	4540.0- 41.0	0.74	13.9	0.0	40.5	0.0	8.3	LOW PERM	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
57	4541.0- 42.0	4.50	14.9	0.0	40.1	0.0	8.9	WATER	LS XLN SSNDY SSHY(LAM) FOSS NO ODR NO FLU
	4542.0- 45.0								LOST CORE
		4543.0-4605.0 CORE NO. 2 CUT 60 FT REC 62 FT							
58	4543.0- 44.0	1.11	15.0	0.0	84.8	0.0	2.3	WATER	LS XLN SSNDY FOSS NO ODR NO FLU
59	4544.0- 45.0	0.75	14.6	0.0	52.1	0.0	7.0	LOW PERM	LS XLN SSNDY FOSS NO ODR NO FLU
60	4545.0- 46.0	1.30	13.3	0.0	58.9	0.0	5.5	WATER	LS XLN SSNDY FOSS NO ODR NO FLU
61	4546.0- 47.0	0.62	11.6	0.0	41.7	0.0	6.8	LOW PERM	LS XLN SSNDY FOSS PP/VUG NO ODR NO FLU
62	4547.0- 48.0	2.75	10.5	0.0	41.6	0.0	6.1	WATER	LS XLN SSNDY FOSS CALC XLS PP/VUG NO ODR NO FLU
63	4548.0- 49.0	<0.01	5.4	0.0	43.1	0.0	3.1	LOW PERM	LS XLN SSNDY FOSS CALC XLS NO ODR NO FLU
64	4549.0- 50.0	0.08	7.1	0.0	63.6	0.0	2.6	LOW PERM	LS XLN SSHY SSNDY NO ODR NO FLU
65	4550.0- 51.0	0.12	7.3	0.0	55.1	0.0	3.3	LOW PERM	LS XLN SHY SSNDY NO ODR NO FLU
66	4551.0- 52.0	0.04	6.8	0.0	63.5	0.0	2.5	LOW PERM	LS XLN SHY SSNDY NO ODR NO FLU
67	4552.0- 53.0	0.12	8.1	0.0	48.6	0.0	4.2	LOW PERM	LS XLN SSHY(X-BED) SNDY NO ODR NO FLU
68	4553.0- 54.0	0.45	11.1	0.0	51.9	0.0	5.3	LOW PERM	LS XLN SSHY(X-BED) SNDY NO ODR NO FLU
69	4554.0- 55.0	0.04	12.7	0.0	51.3	0.0	6.2	LOW PERM	LS XLN SNDY NO ODR NO FLU
70	4555.0- 56.0	0.78	14.2	0.0	67.8	0.0	4.6	LOW PERM	LS XLN SNDY NO ODR NO FLU
71	4556.0- 57.0	155.	24.9	0.0	74.8	0.0	6.3	WATER	SD VFG SLTY S/CALC NO ODR NO FLU
72	4557.0- 58.0	36.0	15.5	0.0	55.8	0.0	6.9	WATER	SD VFG NO ODR NO FLU
73	4558.0- 59.0	0.07	12.9	0.0	46.6	0.0	6.9	LOW PERM	LS XLN SSHY SNDY NO ODR NO FLU
74	4559.0- 60.0	0.10	12.1	0.0	60.3	0.0	4.8	LOW PERM	LS XLN SSHY SNDY NO ODR NO FLU
75	4560.0- 61.0	0.08	10.5	0.0	41.4	0.0	6.2	LOW PERM	LS XLN SSHY SNDY NO ODR NO FLU
76	4561.0- 62.0	0.80	13.5	0.0	46.2	0.0	7.2	LOW PERM	SD VFG SSHY LMY NO ODR NO FLU
77	4562.0- 63.0	1.60	10.1	0.0	48.2	0.0	5.2	WATER	SD VFG SSHY LMY NO ODR NO FLU
78	4563.0- 64.0	3.80	16.4	0.0	71.7	0.0	4.7	WATER	SD VFG SSHY S/CALC NO ODR NO FLU
79	4564.0- 65.0	22.0	17.3	0.0	66.0	0.0	5.9	WATER	SD VFG SSHY S/CALC NO ODR NO FLU

C O R E   L A B O R A T O R I E S ,   I N C.

Company : ETHYL CORPORATION
Well : BRINE DISPOSAL WELL NO. 2

Field : ETHYL FIELD
Formation : JAMES LIME

File : 57167-10068
Date : 3-FEB-88

C O R E   A N A L Y S I S   R E S U L T S

SAMPLE NUMBER	DEPTH ft	PERMEABILITY (HORIZONTAL) Kair md	POROSITY (FLUIDS) %	SATURATION (PORE VOLUME) OIL %	SATURATION (PORE VOLUME) WATER %	SATURATION (BULK VOLUME) OIL %	SATURATION (BULK VOLUME) GAS %	PROBABLE PRODUCTION	DESCRIPTION
80	4565.0- 66.0	5.80	11.7	0.0	61.0	0.0	4.6	WATER	SD VFG SSHY S/CALC NO ODR NO FLU
81	4566.0- 67.0	4.70	15.0	0.0	55.3	0.0	6.7	WATER	SD VFG SSHY S/CALC NO ODR NO FLU
82	4567.0- 68.0	88.0	28.0	0.0	71.4	0.0	8.0	WATER	SD VFG NO ODR NO FLU
83	4568.0- 69.0	1.40	13.6	0.0	64.5	0.0	4.8	WATER	SD VFG (WELL-CEM) NO ODR NO FLU
84	4569.0- 70.0	0.31	13.2	0.0	55.2	0.0	5.9	LOW PERM	SD VFG LMY NO ODR NO FLU
85	4570.0- 71.0	66.0	17.9	0.0	60.3	0.0	7.1	WATER	SD VFG NO ODR NO FLU
86	4571.0- 72.0	26.0	18.7	0.0	59.7	0.0	7.5	WATER	SD VFG NO ODR NO FLU
87	4572.0- 73.0	0.05	9.5	0.0	47.3	0.0	5.0	LOW PERM	LS XLN SLTY NO ODR NO FLU
88	4573.0- 74.0	92.0	16.7	0.0	61.0	0.0	6.5	WATER	SD VFG S/CALC NO ODR NO FLU
89	4574.0- 75.0	1168.	26.2	0.0	72.9	0.0	7.1	WATER	SD VFG S/CALC NO ODR NO FLU
90	4575.0- 76.0	253.	27.1	0.0	72.6	0.0	7.4	WATER	SD VFG NO ODR NO FLU
91	4576.0- 77.0	31.0	18.4	0.0	68.1	0.0	5.9	WATER	SD VFG NO ODR NO FLU
92	4577.0- 78.0	18.0	19.4	0.0	63.3	0.0	7.1	WATER	SD VFG LMY NO ODR NO FLU
93	4578.0- 79.0	0.09	12.9	0.0	54.5	0.0	5.9	LOW PERM	SD VFG LMY NO ODR NO FLU
94	4579.0- 80.0	0.03	10.6	0.0	50.9	0.0	5.2	LOW PERM	SD VFG SLTY CALC NO ODR NO FLU
95	4580.0- 81.0	11.0	17.2	0.0	65.5	0.0	5.9	WATER	SD VFG SSHY(X-BED) S/CALC NO ODR NO FLU
96	4581.0- 82.0	168.	21.5	0.0	68.0	0.0	6.9	WATER	SD VFG S/CALC NO ODR NO FLU
97	4582.0- 83.0	0.27	10.8	0.0	45.0	0.0	5.9	LOW PERM	SD VFG LMY NO ODR NO FLU
98	4583.0- 84.0	<0.01	8.3	0.0	48.4	0.0	4.3	LOW PERM	SD VFG LMY NO ODR NO FLU
99	4584.0- 85.0	5.65	18.4	0.0	68.2	0.0	5.9	WATER	SD VFG CALC NO ODR NO FLU
100	4585.0- 86.0	<0.01	2.7	0.0	58.6	0.0	1.1	LOW PERM	LS XLN SHY(lam) SNDY NO ODR NO FLU
101	4586.0- 87.0	<0.01	1.9	0.0	27.9	0.0	1.4	LOW PERM	LS XLN SNDY NO ODR NO FLU
102	4587.0- 88.0	19.0	20.4	0.0	65.2	0.0	7.1	WATER	SD VFG SSHY(lam) NO ODR NO FLU
103	4588.0- 89.0	0.24	16.6	0.0	59.2	0.0	6.8	LOW PERM	SD VFG S/CALC NO ODR NO FLU
104	4589.0- 90.0	207.	23.9	0.0	68.3	0.0	7.6	WATER	SD VFG S/CALC NO ODR NO FLU
105	4590.0- 91.0	<0.01	6.0	0.0	63.8	0.0	2.2	LOW PERM	LS XLN SSHY SLTY NO ODR NO FLU
106	4591.0- 92.0	0.06	6.0	0.0	55.4	0.0	2.7	LOW PERM	LS XLN SNDY NO ODR NO FLU
107	4592.0- 93.0	<0.01	3.4	0.0	53.6	0.0	1.6	LOW PERM	LS XLN SNDY NO ODR NO FLU
108	4593.0- 94.0	4.60	5.6	0.0	77.7	0.0	1.3	FRACTURE	LS XLN SSHY SNDY NO ODR NO FLU

2170.25

porosity
$\frac{487.4}{22} = 22.2\%$

CORE LABORATORIES, INC.

Company : ETHYL CORPORATION
Well : BRINE DISPOSAL WELL NO. 2
Field : ETHYL FIELD
Formation : JAMES LIME
File : 57167-10068
Date : 3-FEB-88

CORE ANALYSIS RESULTS

SAMPLE NUMBER	DEPTH ft	PERMEABILITY (HORIZONTAL) Kair md	POROSITY (FLUIDS) %	SATURATION (PORE VOLUME) OIL %	SATURATION (PORE VOLUME) WATER %	SATURATION (BULK VOLUME) OIL %	SATURATION (BULK VOLUME) GAS %	PROBABLE PRODUCTION	DESCRIPTION
109	4594.0- 95.0	0.51	8.2	0.0	45.6	0.0	4.4	LOW PERM	SD VFG SLTY S/CALC NO ODR NO FLU
110	4595.0- 96.0	0.81	14.5	0.0	76.2	0.0	3.5	LOW PERM	SD VFG SHY(lam) SLTY NO ODR NO FLU
111	4596.0- 97.0	0.02	7.4	0.0	60.6	0.0	2.9	LOW PERM	SD VFG SHY(lam) SLTY NO ODR NO FLU
112	4597.0- 98.0	<0.01	1.7	0.0	46.9	0.0	0.9	LOW PERM	LS XLN XLN CALC NO ODR NO FLU
113	4598.0- 99.0	0.20	9.3	0.0	72.0	0.0	2.6	LOW PERM	LS XLN NO ODR NO FLU
114	4599.0- 00.0	<0.01	5.7	0.0	95.3	0.0	0.3	LOW PERM	LS XLN SNDY NO ODR NO FLU
115	4600.0- 01.0	<0.01	4.3	0.0	80.1	0.0	0.9	LOW PERM	SD VFG VSHY LMY NO ODR NO FLU
116	4601.0- 02.0	<0.01	5.7	0.0	83.8	0.0	0.9	LOW PERM	SD VFG VSHY LMY NO ODR NO FLU
117	4602.0- 03.0	<0.01	3.3	0.0	77.8	0.0	0.7	LOW PERM	SD VFG VSHY LMY NO ODR NO FLU
118	4603.0- 04.0	<0.01	9.9	0.0	93.8	0.0	0.6	LOW PERM	SD VFG VSHY LMY NO ODR NO FLU
119	4604.0- 05.0	<0.01	6.3	0.0	86.7	0.0	0.8	LOW PERM	SD VFG VSHY LMY NO ODR NO FLU

Permeability Perforated - 4895.53

11
1
6
22
8
48

BRINE ANALYSES

Western Atlas International

CORE LABORATORIES

WATER ANALYSIS

File 388020

Company Ethyl Corporation Well Name ______ Sample No. 1

Formation Tokio Depth ______ Sampled From ______

Location ______ Field ______ County ______ State AR

Date Sampled Feb. 28, 1988 Date Analyzed March 16-20, 1988 Analyst N.B. Rubio

Total Dissolved Solids 78231 ✓ mg/L calculated

Sp. Gr. 1.0532 @ 72.3 °F

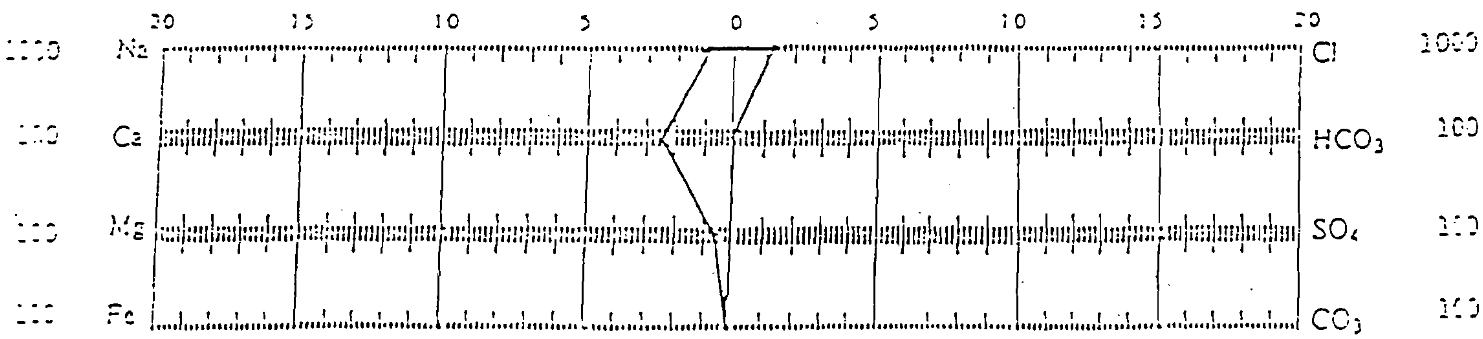
Resistivity 0.0974 ohm-meters @ 72.3 °F measured

1.05376 @ 20 °C (68°F)

Total Sulfide ______

pH 5.94 @ 72.2 °F Hydrogen Sulfide Absent

Constituents	meq/L	mg/L	Constituents	meq/L	mg/L
Sodium	1050.02	24140.0	Chloride	1360.71	48234.9
Calcium	245.72	4924.2	Bicarbonate	1.15	70.3
Magnesium	64.40	782.9	Sulfate	0.00	0.0
Iron	0.96	26.8	Carbonate	0.00	0.0
Barium	0.76	52.0	Hydroxide	0.00	0.0



Scale: meq/L

78231 + 420 = 78651.1

STRONTIUM BY ANALYSIS = 420 mg/l (9.59 meq/l)

CONDUCTIVITY = 102669 umhos/cm

...ric Analysis T.O.C. = 0.91 mg/l

T.O.X. = 0.05 mg/l

Western Atlas International

A Litton/Dresser Company

CORE LABORATORIES

WATER ANALYSIS

File 388020

Company Ethvl Corporation Well Name Sample No. 2

Formation James/Lime Depth Sampled From

Location Field County State AR

Date Sampled Feb. 28 1988 Date Analyzed March 16-20, 1988 Analyst N.B. Rubio

Total Dissolved Solids 185022 mg/L calculated

Sp. Gr. 1.1272 @ 72.1 °F

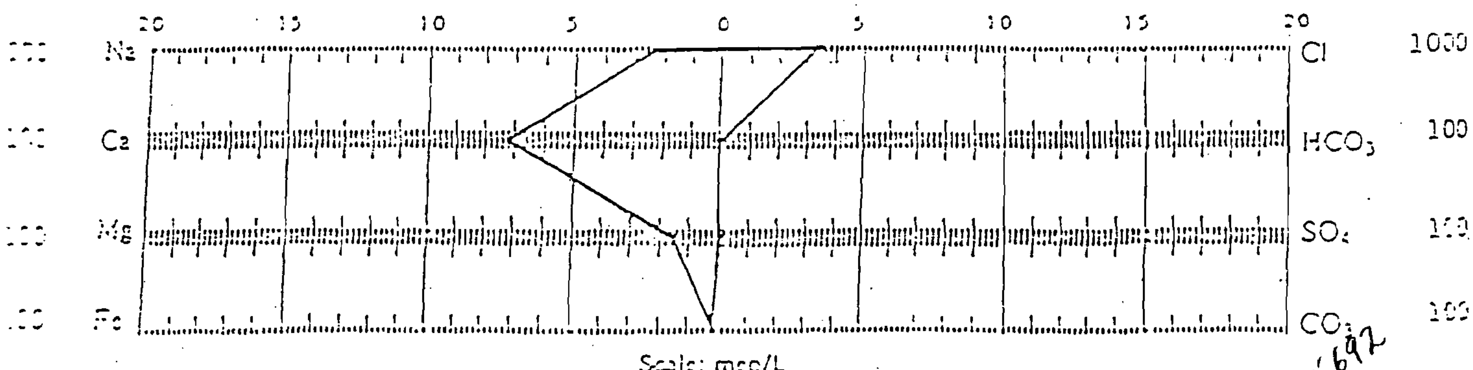
Resistivity 0.0673 ohm-meters @ 72.1 °F measured

1.12773 @ 20 °C (68°F)

Total Sulfide

pH 6.04 @ 72.1 °F Hydrogen Sulfide Absent

Constituents	meq/L	mg/L	Constituents	meq/L	mg/L
Sodium	2353.71	54111.8	Chloride	3210.88	113820.6
Calcium	720.31	14435.0	Bicarbonate	2.51	153.2
Magnesium	149.60	1818.7	Sulfate	12.75	612.4
Iron	2.52	70.5	Carbonate	0.00	0.0
Barium	0.00	0.0	Hydroxide	0.00	0.0



Scale: meq/L

STRONTIUM BY ANALYSIS = 670 mg/l (15.29 meq/l)

CONDUCTIVITY = 148588 umhos/cm

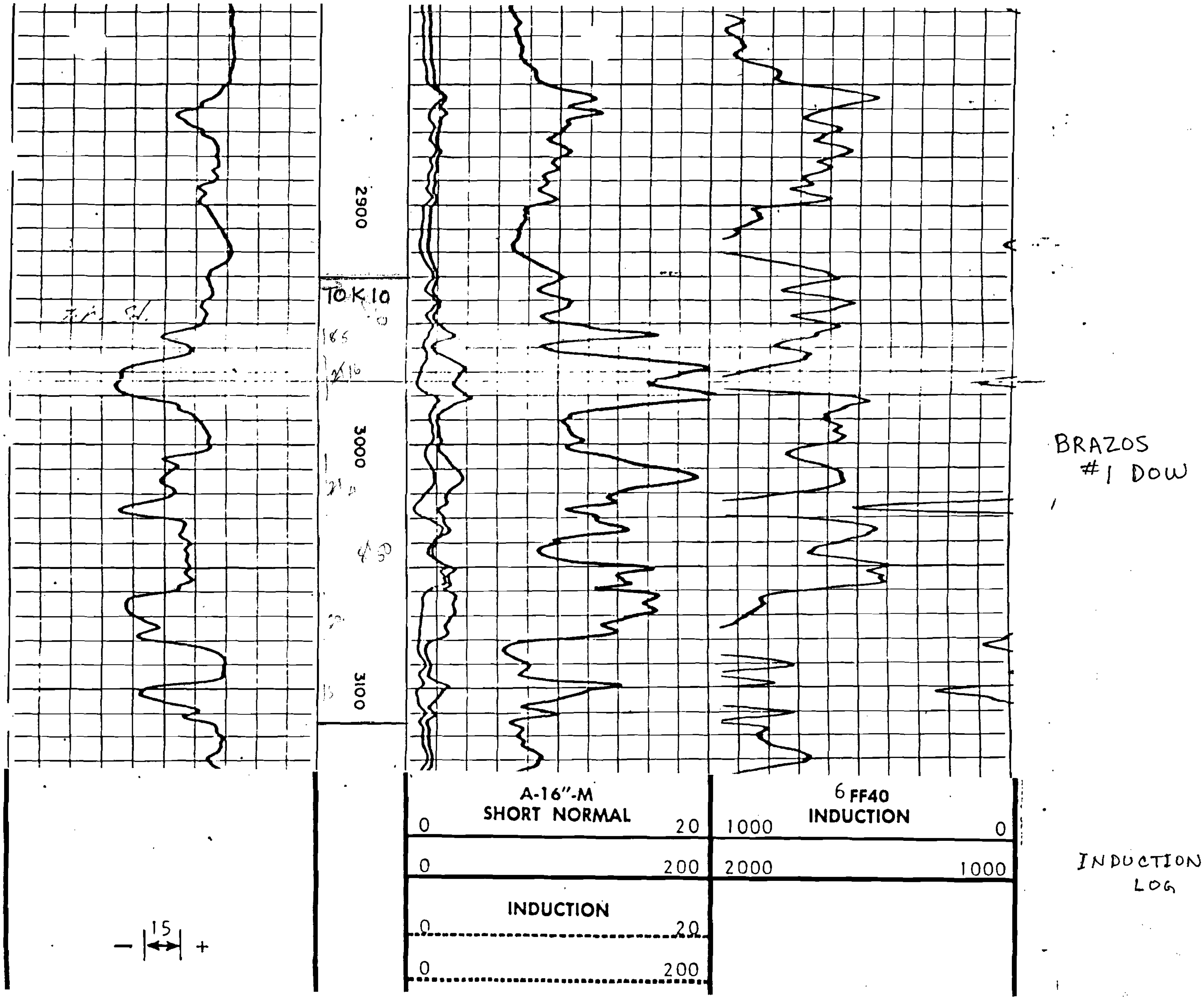
T.O.C. = 502 mg/l

T.O.X. = 0.05 mg/l

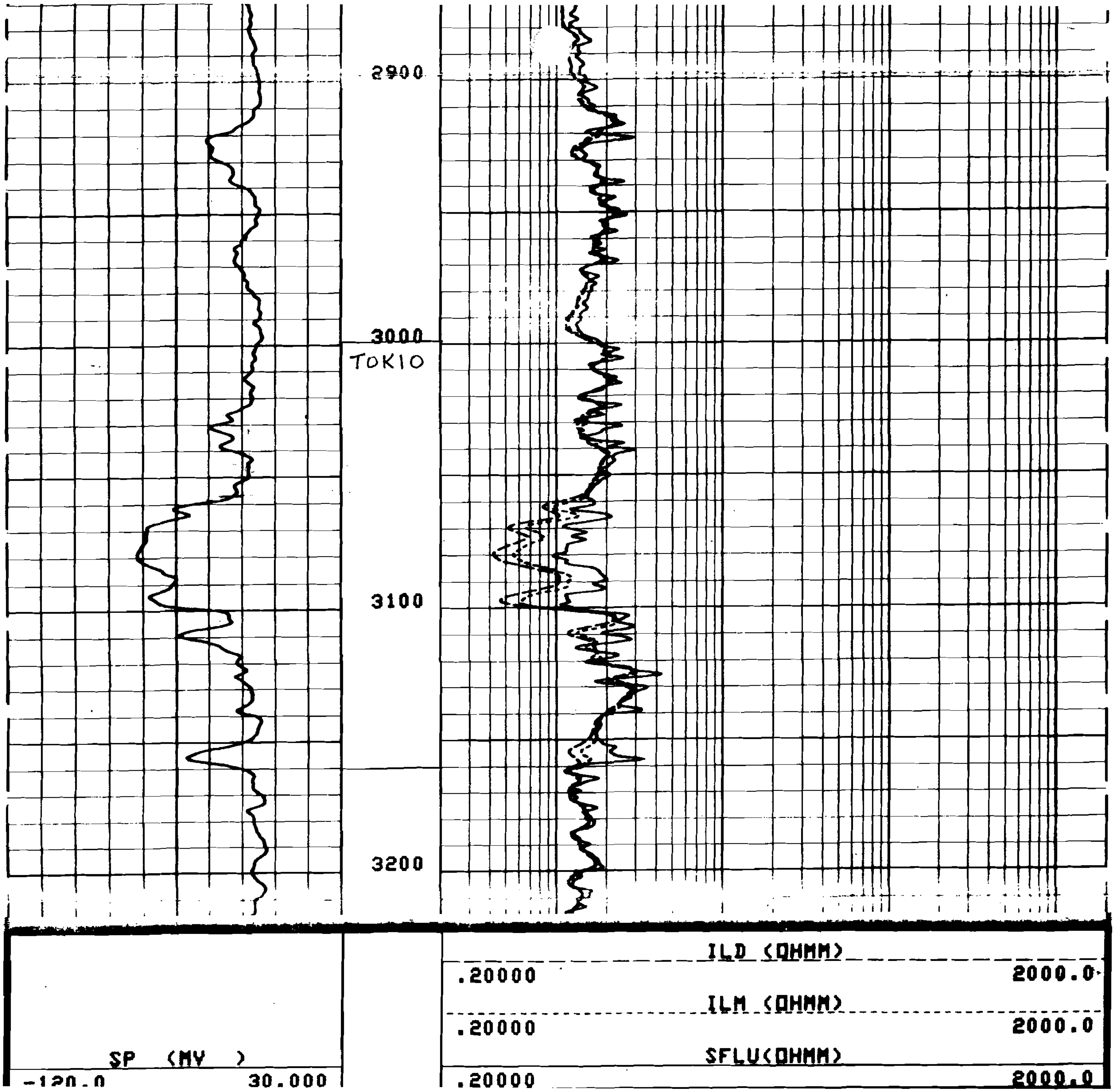
185022+670= 185692

...tric Analysis

LOG SECTIONS FOR
TOKIO AND JAMES FORMATIONS

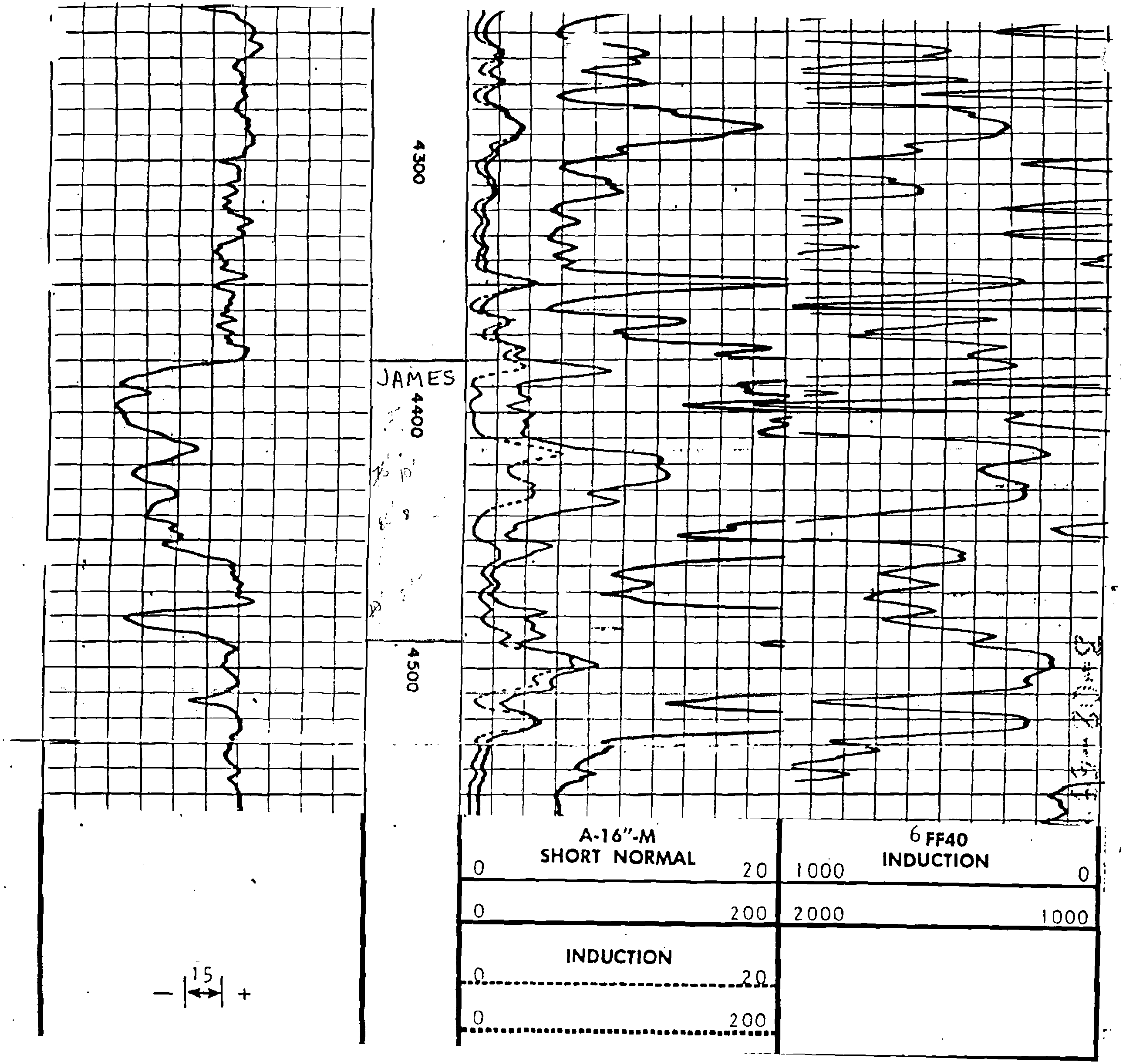


BRAZOS
#1 DOW
INDUCTION LOG
2900
TOKIO
3000
3100
A-16"-M
SHORT NORMAL
0 20
0 200
6FF40
INDUCTION
1000 0
2000 1000
INDUCTION
0 20
0 200
15



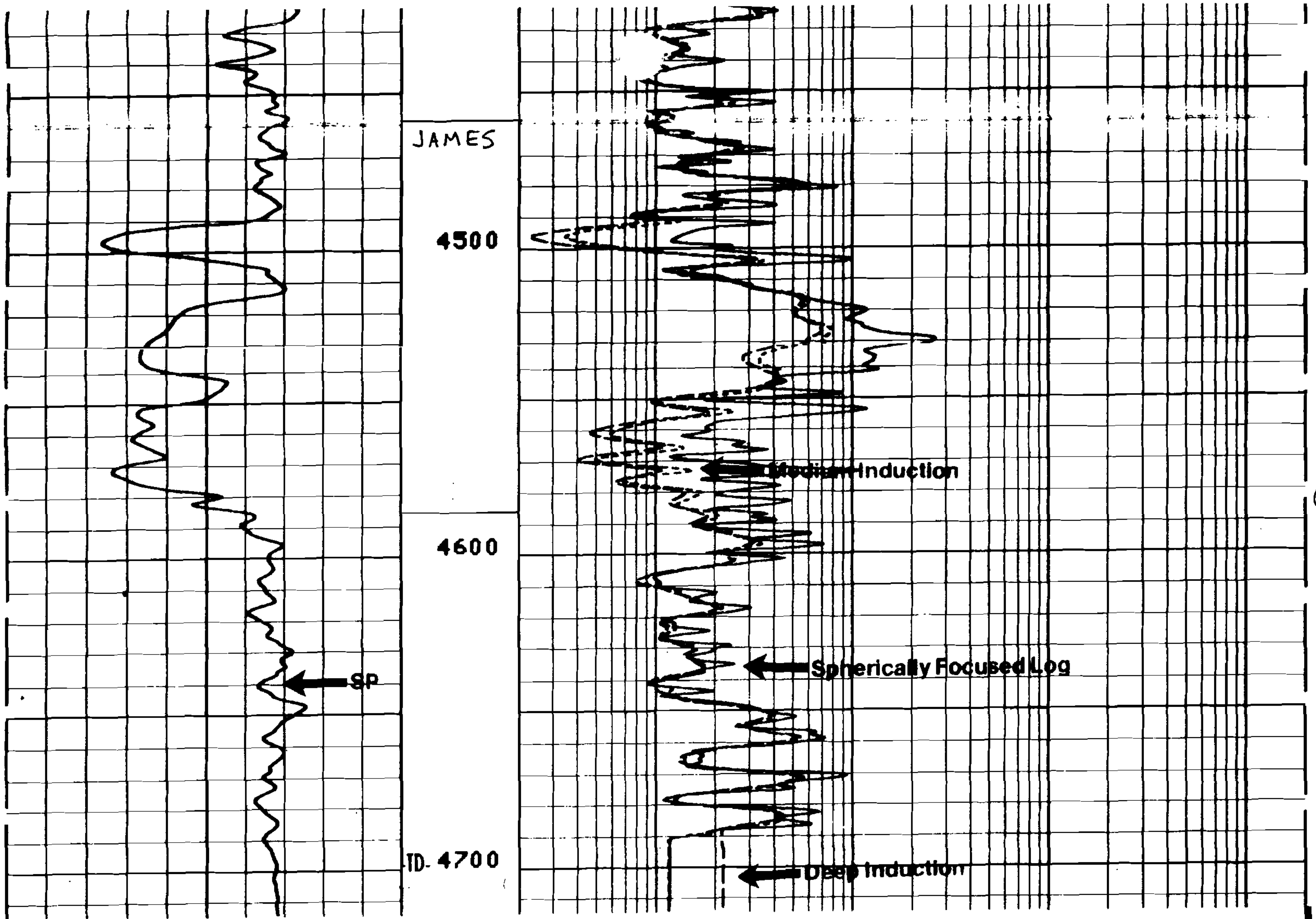
ETHYL
(ALBEMARLE)
#2 BDW

INDUCTION
LOG



BRAZOS
#1 DOW

INDUCTION
LOG



ETHYL
(ALBEMARLE)
#2 BDW

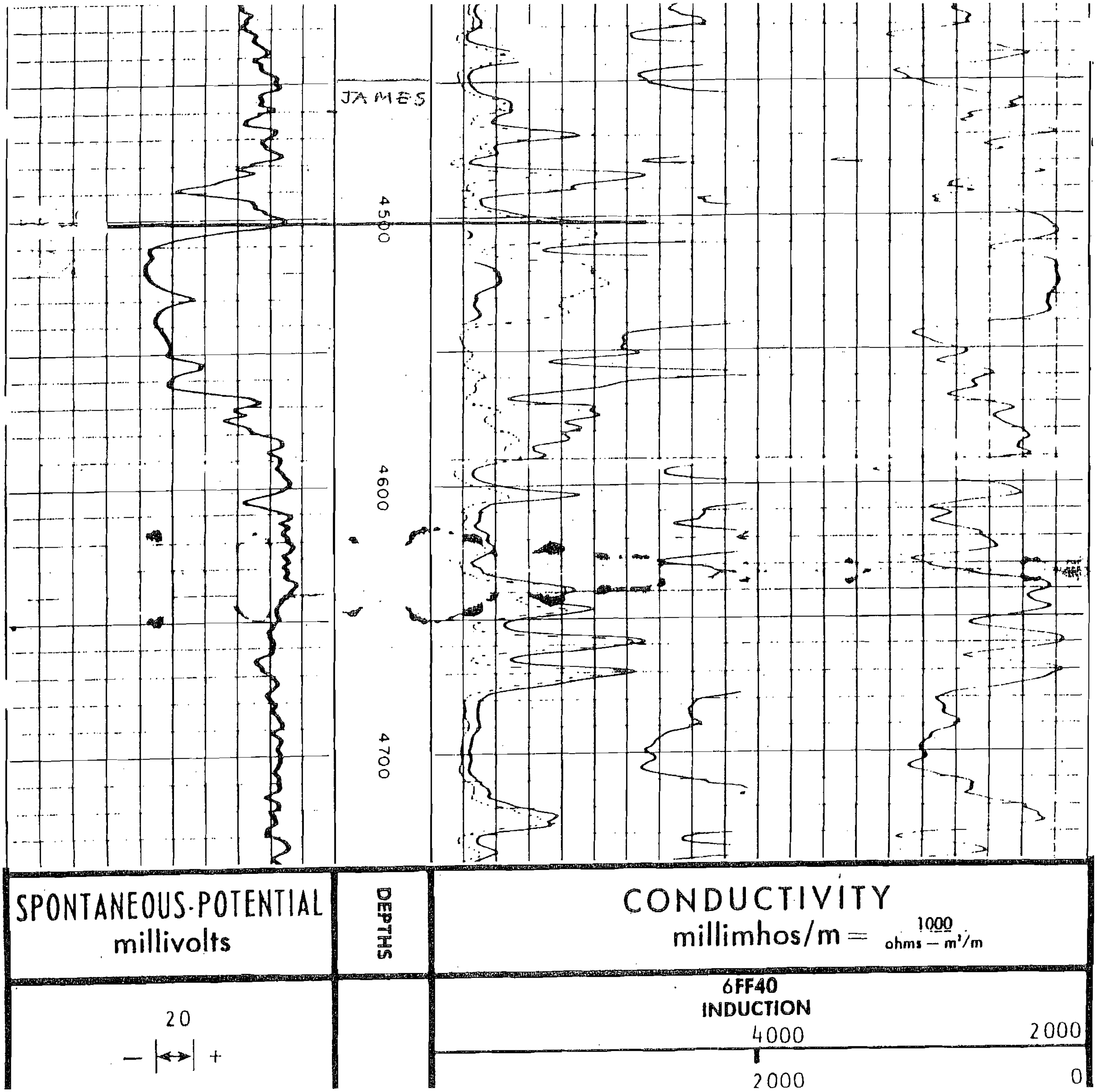
CP 30.22 FILE 6 06-FEB-88 14:15

INPUT FILES
3

DATA ACQUIRED
06-FEB-88 12:26

INDUCTION LOG

	ILD (OHMM)	
	.20000	2000.0
	ILM (OHMM)	
	.20000	2000.0
SP (MV)	SFLU(OHMM)	
-120.0 30.000	.20000	2000.0



ETHYL
(ALBEMARLE)
13 BDW

INDUCTION
LOG

APPENDIX D

Well Log – Dow #1

COUNTY COLUMBIA
FIELD or LOCATION WILDCAT
WELL DOW #1
COMPANY BRAZOS OIL & GAS

SCHLUMBERGER INDUCTION-ELECTRICAL LOG

SCHLUMBERGER WELL SURVEYING CORPORATION
Houston, Texas

COMPANY BRAZOS OIL & GAS COMPANY ①

WELL DOW #1

FIELD ~~WILDCAT~~ Kilgore Lodge

COUNTY COLUMBIA STATE ARKANSAS

LOCATION 660'N 660'E OF SW/C NE/4

Sec. 18 Twp. 17S Rge. 21W

Other Services: ✓FDL-SL-✓MLC

Permanent Datum: 13-3/8" BHF, Elev. 294.1
Log Measured From K.B. 15.20 Ft. Above Perm. Datum
Drilling Measured From SAME

Elev.: K.B. 309.3
D.F. 307.7
G.L. 292.8

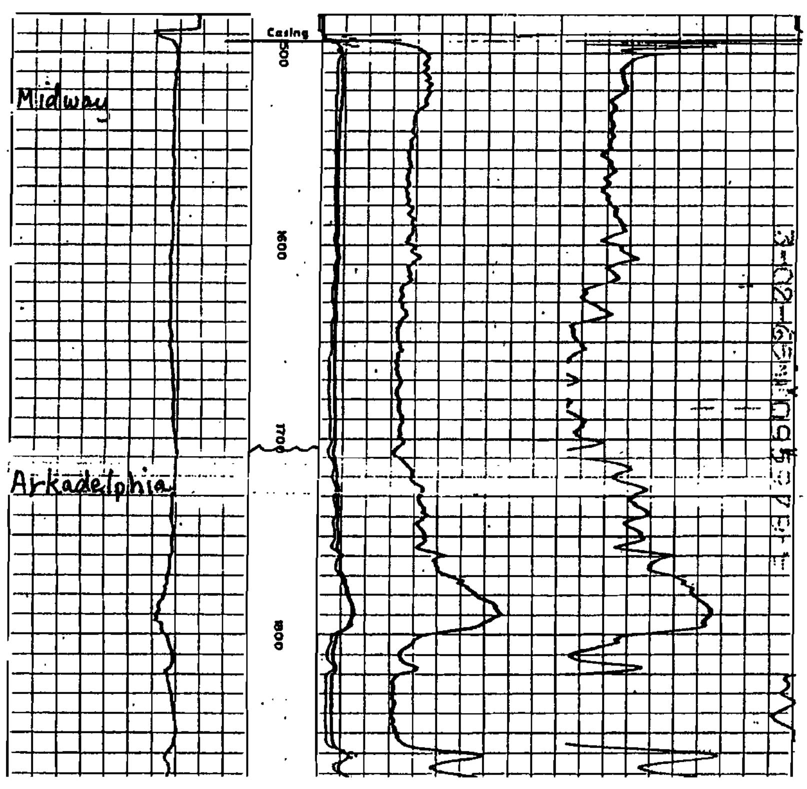
Date	2-28-65		
Run No.	ONE		
Depth—Driller	8500		
Depth—Logger	8509	RECEIVED	
Btm. Log Interval	8508		
Top Log Interval	1492		
Casing—Driller	13-3/8 @ 1492	@ JAN 26 1966	@
Casing—Logger	1492		
Bit Size	12-1/4"	Arkansas Oil & Gas Commission	
Type Fluid in Hole	GEL.-Q-BROXIN-CAUS.-8% OIL		
Dens. | Visc.	10.0 | 44		
pH | Fluid Loss	10.0 | 6 ml	ml	ml
Source of Sample	CIRCULATED		
R_m @ Meas. Temp.	1.1 @ 83 °F	@ °F	@ °F
R_{mf} @ Meas. Temp.	.34 @ 174 °F	@ °F	@ °F
R_{mc} @ Meas. Temp.	.8 @ 174 °F	@ °F	@ °F
Source: R_{mf} | R_{mc}	C | C		
R_m @ BHT	.54 @ 174 °F	@ °F	@ °F
Time Since Circ.	4 HOURS		
Max. Rec. Temp.	174 °F	°F	°F
Equip. | Location	3818 | MAG		
Recorded By	ELLISON		
Witnessed By			

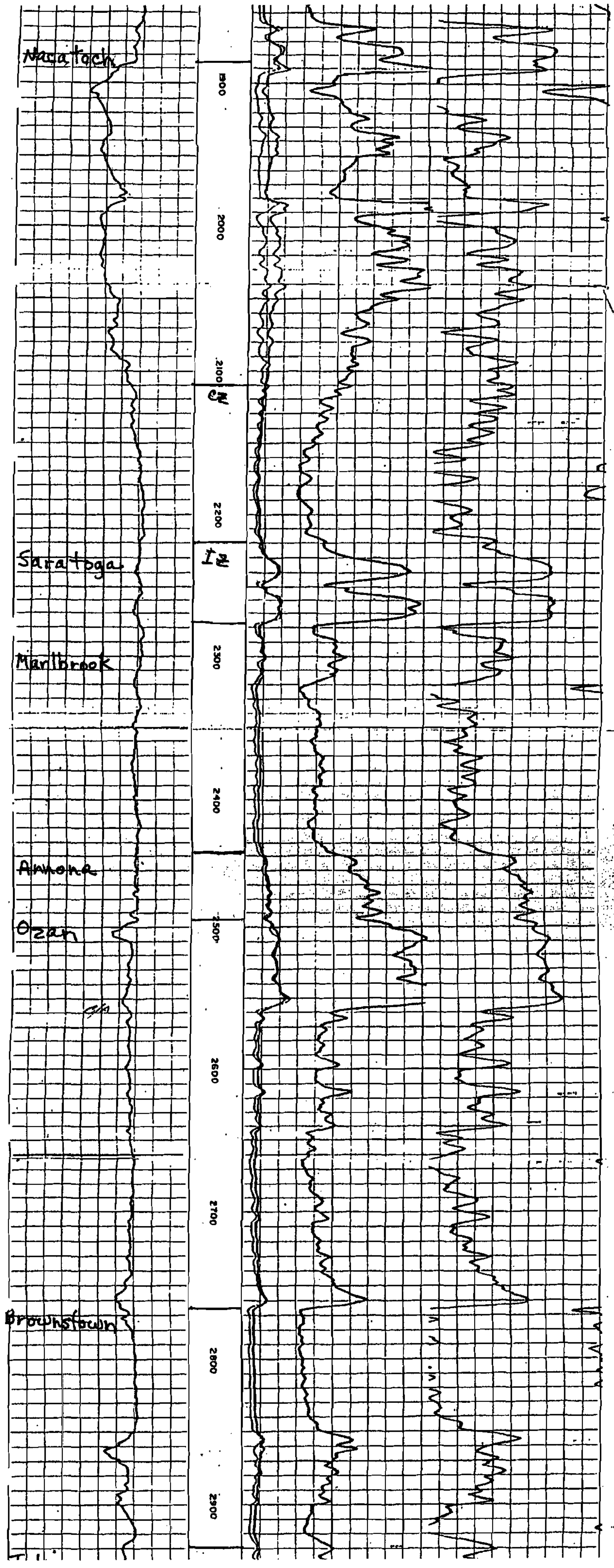
REMARKS

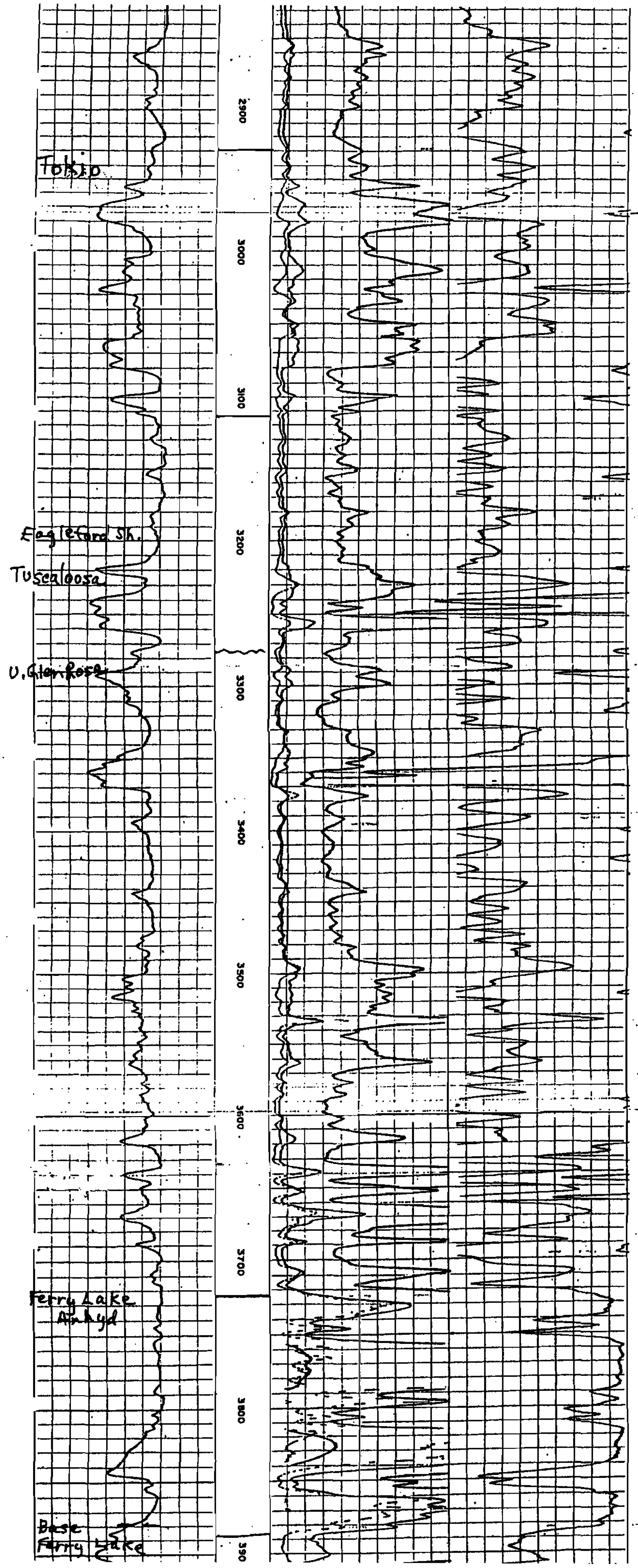
Changes in Mud Type or Additional Samples			Scale Changes			
Date | Sample No.			Type Log	Depth	Scale Up Hole	Scale Down Hole
Depth—Driller						
Type Fluid in Hole						
Dens. | Visc.						
ph | Fluid Loss	ml	ml				
Source of Sample			Equipment Data			
R_m @ Meas. Temp.	@ °F	@ °F	Run No.	Tool Type	Tool Position	Other
R_{mf} @ Meas. Temp.	@ °F	@ °F				
R_{mc} @ Meas. Temp.	@ °F	@ °F				
Source: R_{mf} | R_{mc}						
R_m @ BHT	@ °F	@ °F				
R_{mf} @ BHT	@ °F	@ °F				
R_{mc} @ BHT	@ °F	@ °F				

Run No.:	ONE
C.D.:	USED
S.O.:	1½
Equip. Used: CART. No.:	F-253
PANEL No.:	F-371
SONDE No.:	M-211
S.B.R.:	1.0

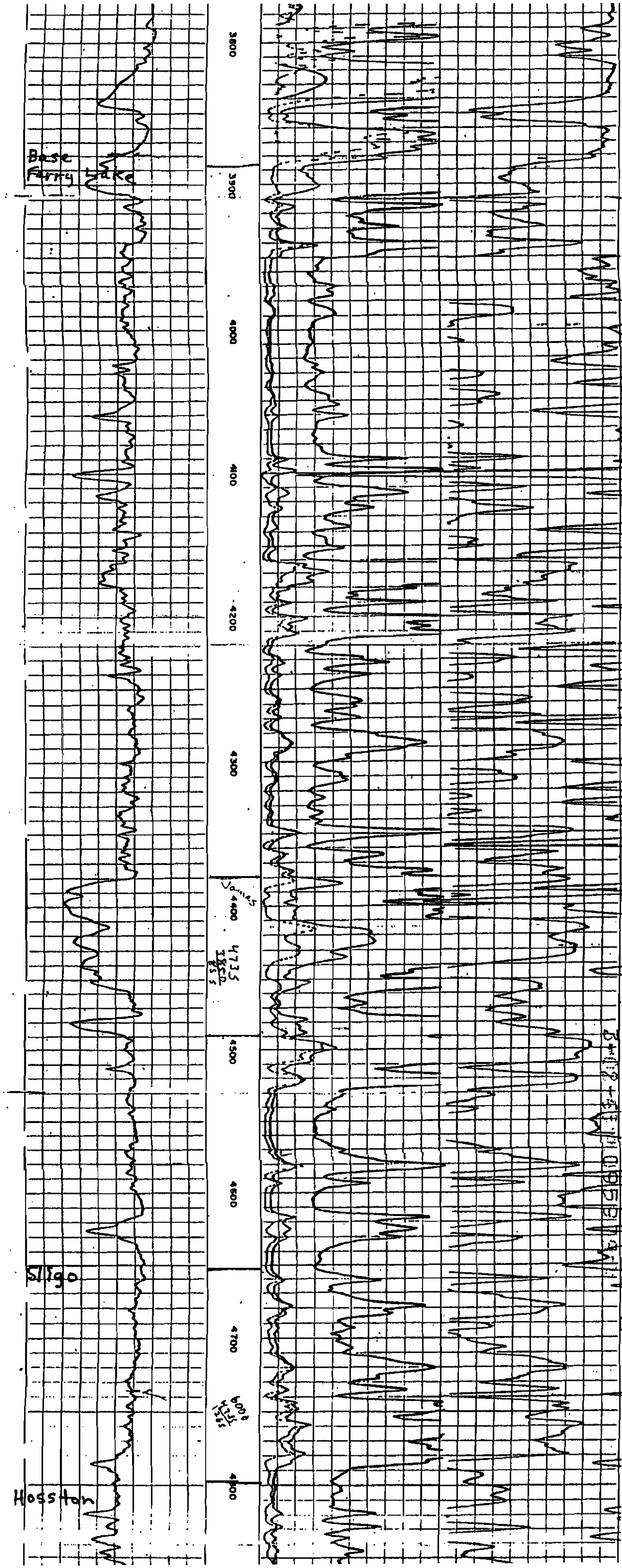
SPONTANEOUS POTENTIAL millivolts	DEPTHS	RESISTIVITY ohms-m²/m	CONDUCTIVITY millimhos/m = 1000/ohms-m²/m
− |←15→| +	4655 / 309 / 4346	A-16"-M SHORT NORMAL: 0 – 20; 0 – 200	.6 FF40 INDUCTION: 1000 – 0; 2000 – 1000
		INDUCTION: 0 – 20; 0 – 200	




Nacatoch
1900
2000
2100
2200
Saratoga
Marlbrook
2300
2400
Annona
Ozan
2500
2600
2700
Brownstown
2800
2900



Tokio
Eagleford Sh.
Tuscaloosa
U. Glen Rose
Ferry Lake
Anhyd
Base
Ferry Lake
2900
3000
3100
3200
3300
3400
3500
3600
3700
3800


Base
Ferry Lake
3800
3900
4000
4200
4300
James
4400
4500
4600
Sligo
4700
4800
Hosston

APPENDIX E

James Lime BHP Survey – 1988

HAYNES_ILLE wire line SERV_E, INC.

P.O. BOX 710 HAYNESVILLE, LA 71038

Telephone (318) 624-0339; If No Answer, Call (318) 624-1651 or 624-2221

SUBSURFACE PRESSURE SURVEY

Company Ethyl Corp. Lease Waste Water Disposal Well No. 2 - James

Field Kerlin Reservoir ______ Datum ______

Test Date Feb. 23, 1988 Well Status Shut In Hours Shut In ______

Tubing ______ End 4438 Packer ______ S.N. ______ Perfs. 4491-4501 4550-4590

Depth From M.G.	Pressure PSIG	Pressure Difference	Gradient psi/Ft.
0	0		
1000	244	244	.244
2000	733	489	.489
3000	1213	480	.480
3500	1457	244	.488
4000	1695	238	.476
4526	1954	259	.492

Tubing Press. 0

Casing Press.

Top of Fluid 500'

Temp. at 4526 Ft. 164 °F

Elev. RKB. M.G.

Last Test Date Initial

Press. Last Test

Press. This Test 1954

Pressure Change

Inst. No. 37699

Tested By DH

Calcu. By RR

Remarks

APPENDIX F

Tokio Formation Reservoir Pressure Modeling

CA^ CULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC NONLEAKY CONFINED
A .FER WITH MULTIPLE PRODUCTION AND INJECTION WELLS

---

pressure increase in Tokio after 10 yrs at 100 gpm

********************************** INPUT DATA **********************************

TRANSMISSIVITY = 337 [gpd/ft]

STORAGE COEFFICIENT = .00004

REGIONAL FLOW GRADIENT
(positive--downwards--in flow direction) = 0

REGIONAL FLOW DIRECTION
(horizontal angle in degrees
counter-clockwise from positive x-axis) = 0

REGIONAL FLOW OFFSET AT ORIGIN
(positive in downwards direction) = 0 [ft]

WELL NO. 1

```
                    X-COORDINATE  =  0 [ft]
                    Y-COORDINATE  =  0 [ft]
          PUMPING/INJECTION RATE  = -100 [gpm]
START TIME OF PUMPING/INJECTION  =  0 [day]
```

----------------- Pressure in psi -- Time in [days] ----------------------

X-coordinate observation well = 1 [ft]
Y-coordinate observation well = 0 [ft]

time	pressure	time	pressure	time	pressure	time	pressure
3653.000	338.116						

C^^CULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC NONLEAKY CONFINED
A IFER WITH MULTIPLE PRODUCTION AND INJECTION WELLS

---

pressure increase in Tokio after 10 yrs at 100 gpm

********************************** INPUT DATA **********************************

TRANSMISSIVITY = 337 [gpd/ft]

STORAGE COEFFICIENT = .00004

REGIONAL FLOW GRADIENT
(positive--downwards--in flow direction) = 0

REGIONAL FLOW DIRECTION
(horizontal angle in degrees
counter-clockwise from positive x-axis) = 0

REGIONAL FLOW OFFSET AT ORIGIN
(positive in downwards direction) = 0 [ft]

WELL NO. 1

```
                        X-COORDINATE  =  0 [ft]
                        Y-COORDINATE  =  0 [ft]
              PUMPING/INJECTION RATE  = -100 [gpm]
   START TIME OF PUMPING/INJECTION  =  0 [day]
```

******************************** RESULTS FOR TIME = 3653 *******************

THWELLS - PAGE 3

------------------------------ Pressure in psi ------------------------------

Y [ft]	<- X [ft] ->					
	-3000	-2900	-2800	-2700	-2600	-2500
-3000.00	0.9197E+02	0.9246E+02	0.9295E+02	0.9344E+02	0.9393E+02	0.9441E+02
-2900.00	0.9246E+02	0.9297E+02	0.9348E+02	0.9399E+02	0.9449E+02	0.9500E+02
-2800.00	0.9295E+02	0.9348E+02	0.9400E+02	0.9453E+02	0.9506E+02	0.9558E+02
-2700.00	0.9344E+02	0.9399E+02	0.9453E+02	0.9508E+02	0.9562E+02	0.9617E+02
-2600.00	0.9393E+02	0.9449E+02	0.9506E+02	0.9562E+02	0.9619E+02	0.9675E+02
-2500.00	0.9441E+02	0.9500E+02	0.9558E+02	0.9617E+02	0.9675E+02	0.9734E+02
-2400.00	0.9490E+02	0.9550E+02	0.9610E+02	0.9671E+02	0.9732E+02	0.9793E+02
-2300.00	0.9537E+02	0.9599E+02	0.9662E+02	0.9725E+02	0.9788E+02	0.9852E+02
-2200.00	0.9584E+02	0.9648E+02	0.9713E+02	0.9778E+02	0.9844E+02	0.9910E+02
-2100.00	0.9631E+02	0.9697E+02	0.9764E+02	0.9832E+02	0.9900E+02	0.9969E+02
-2000.00	0.9676E+02	0.9745E+02	0.9814E+02	0.9884E+02	0.9955E+02	0.1003E+03
-1900.00	0.9721E+02	0.9792E+02	0.9863E+02	0.9936E+02	0.1001E+03	0.1008E+03
-1800.00	0.9765E+02	0.9838E+02	0.9912E+02	0.9987E+02	0.1006E+03	0.1014E+03
-1700.00	0.9808E+02	0.9883E+02	0.9959E+02	0.1004E+03	0.1012E+03	0.1020E+03
-1600.00	0.9849E+02	0.9926E+02	0.1001E+03	0.1009E+03	0.1017E+03	0.1025E+03
-1500.00	0.9889E+02	0.9969E+02	0.1005E+03	0.1013E+03	0.1022E+03	0.1030E+03
'00.00	0.9928E+02	0.1001E+03	0.1009E+03	0.1018E+03	0.1026E+03	0.1035E+03
,00.00	0.9965E+02	0.1005E+03	0.1013E+03	0.1022E+03	0.1031E+03	0.1040E+03
-1200.00	0.9999E+02	0.1009E+03	0.1017E+03	0.1026E+03	0.1036E+03	0.1045E+03
-1100.00	0.1003E+03	0.1012E+03	0.1021E+03	0.1030E+03	0.1040E+03	0.1049E+03
-1000.00	0.1006E+03	0.1015E+03	0.1024E+03	0.1034E+03	0.1044E+03	0.1054E+03
-900.00	0.1009E+03	0.1018E+03	0.1028E+03	0.1037E+03	0.1047E+03	0.1058E+03
-800.00	0.1012E+03	0.1021E+03	0.1031E+03	0.1040E+03	0.1051E+03	0.1061E+03
-700.00	0.1014E+03	0.1023E+03	0.1033E+03	0.1043E+03	0.1054E+03	0.1064E+03
-600.00	0.1016E+03	0.1026E+03	0.1036E+03	0.1046E+03	0.1056E+03	0.1067E+03
-500.00	0.1018E+03	0.1027E+03	0.1037E+03	0.1048E+03	0.1059E+03	0.1070E+03
-400.00	0.1019E+03	0.1029E+03	0.1039E+03	0.1050E+03	0.1060E+03	0.1072E+03
-300.00	0.1020E+03	0.1030E+03	0.1040E+03	0.1051E+03	0.1062E+03	0.1073E+03
-200.00	0.1021E+03	0.1031E+03	0.1041E+03	0.1052E+03	0.1063E+03	0.1075E+03
-100.00	0.1022E+03	0.1032E+03	0.1042E+03	0.1053E+03	0.1064E+03	0.1075E+03
0.00	0.1022E+03	0.1032E+03	0.1042E+03	0.1053E+03	0.1064E+03	0.1075E+03
100.00	0.1022E+03	0.1032E+03	0.1042E+03	0.1053E+03	0.1064E+03	0.1075E+03
200.00	0.1021E+03	0.1031E+03	0.1041E+03	0.1052E+03	0.1063E+03	0.1075E+03
300.00	0.1020E+03	0.1030E+03	0.1040E+03	0.1051E+03	0.1062E+03	0.1073E+03
400.00	0.1019E+03	0.1029E+03	0.1039E+03	0.1050E+03	0.1060E+03	0.1072E+03
500.00	0.1018E+03	0.1027E+03	0.1037E+03	0.1048E+03	0.1059E+03	0.1070E+03
600.00	0.1016E+03	0.1026E+03	0.1036E+03	0.1046E+03	0.1056E+03	0.1067E+03
700.00	0.1014E+03	0.1023E+03	0.1033E+03	0.1043E+03	0.1054E+03	0.1064E+03
800.00	0.1012E+03	0.1021E+03	0.1031E+03	0.1040E+03	0.1051E+03	0.1061E+03

[ft] <- X [ft] ->

[ft]	-3000	-2900	-2800	-2700	-2600	-2500
900.00	0.1009E+03	0.1018E+03	0.1028E+03	0.1037E+03	0.1047E+03	0.1058E+03
1000.00	0.1006E+03	0.1015E+03	0.1024E+03	0.1034E+03	0.1044E+03	0.1054E+03
1100.00	0.1003E+03	0.1012E+03	0.1021E+03	0.1030E+03	0.1040E+03	0.1049E+03
1200.00	0.9999E+02	0.1009E+03	0.1017E+03	0.1026E+03	0.1036E+03	0.1045E+03
1300.00	0.9965E+02	0.1005E+03	0.1013E+03	0.1022E+03	0.1031E+03	0.1040E+03
1400.00	0.9928E+02	0.1001E+03	0.1009E+03	0.1018E+03	0.1026E+03	0.1035E+03
1500.00	0.9889E+02	0.9969E+02	0.1005E+03	0.1013E+03	0.1022E+03	0.1030E+03
1600.00	0.9849E+02	0.9926E+02	0.1001E+03	0.1009E+03	0.1017E+03	0.1025E+03
1700.00	0.9808E+02	0.9883E+02	0.9959E+02	0.1004E+03	0.1012E+03	0.1020E+03
1800.00	0.9765E+02	0.9838E+02	0.9912E+02	0.9987E+02	0.1006E+03	0.1014E+03
1900.00	0.9721E+02	0.9792E+02	0.9863E+02	0.9936E+02	0.1001E+03	0.1008E+03
2000.00	0.9676E+02	0.9745E+02	0.9814E+02	0.9884E+02	0.9955E+02	0.1003E+03
2100.00	0.9631E+02	0.9697E+02	0.9764E+02	0.9832E+02	0.9900E+02	0.9969E+02
2200.00	0.9584E+02	0.9648E+02	0.9713E+02	0.9778E+02	0.9844E+02	0.9910E+02
2300.00	0.9537E+02	0.9599E+02	0.9662E+02	0.9725E+02	0.9788E+02	0.9852E+02
2400.00	0.9490E+02	0.9550E+02	0.9610E+02	0.9671E+02	0.9732E+02	0.9793E+02
2500.00	0.9441E+02	0.9500E+02	0.9558E+02	0.9617E+02	0.9675E+02	0.9734E+02
2600.00	0.9393E+02	0.9449E+02	0.9506E+02	0.9562E+02	0.9619E+02	0.9675E+02
2700.00	0.9344E+02	0.9399E+02	0.9453E+02	0.9508E+02	0.9562E+02	0.9617E+02
2800.00	0.9295E+02	0.9348E+02	0.9400E+02	0.9453E+02	0.9506E+02	0.9558E+02
[illegible]00.00	0.9246E+02	0.9297E+02	0.9348E+02	0.9399E+02	0.9449E+02	0.9500E+02
[illegible]00.00	0.9197E+02	0.9246E+02	0.9295E+02	0.9344E+02	0.9393E+02	0.9441E+02

Y [ft] <- X [ft] ->

Y [ft]	-2400	-2300	-2200	-2100	-2000	-1900
-3000.00	0.9490E+02	0.9537E+02	0.9584E+02	0.9631E+02	0.9676E+02	0.9721E+02
-2900.00	0.9550E+02	0.9599E+02	0.9648E+02	0.9697E+02	0.9745E+02	0.9792E+02
-2800.00	0.9610E+02	0.9662E+02	0.9713E+02	0.9764E+02	0.9814E+02	0.9863E+02
-2700.00	0.9671E+02	0.9725E+02	0.9778E+02	0.9832E+02	0.9884E+02	0.9936E+02
-2600.00	0.9732E+02	0.9788E+02	0.9844E+02	0.9900E+02	0.9955E+02	0.1001E+03
-2500.00	0.9793E+02	0.9852E+02	0.9910E+02	0.9969E+02	0.1003E+03	0.1008E+03
-2400.00	0.9854E+02	0.9916E+02	0.9977E+02	0.1004E+03	0.1010E+03	0.1016E+03
-2300.00	0.9916E+02	0.9980E+02	0.1004E+03	0.1011E+03	0.1017E+03	0.1023E+03
-2200.00	0.9977E+02	0.1004E+03	0.1011E+03	0.1018E+03	0.1024E+03	0.1031E+03
-2100.00	0.1004E+03	0.1011E+03	0.1018E+03	0.1025E+03	0.1032E+03	0.1039E+03
-2000.00	0.1010E+03	0.1017E+03	0.1024E+03	0.1032E+03	0.1039E+03	0.1046E+03
-1900.00	0.1016E+03	0.1023E+03	0.1031E+03	0.1039E+03	0.1046E+03	0.1054E+03
-1800.00	0.1022E+03	0.1030E+03	0.1038E+03	0.1046E+03	0.1054E+03	0.1062E+03
-1700.00	0.1028E+03	0.1036E+03	0.1044E+03	0.1053E+03	0.1061E+03	0.1070E+03
-1600.00	0.1033E+03	0.1042E+03	0.1051E+03	0.1059E+03	0.1068E+03	0.1077E+03
-1500.00	0.1039E+03	0.1048E+03	0.1057E+03	0.1066E+03	0.1075E+03	0.1085E+03
-1400.00	0.1044E+03	0.1054E+03	0.1063E+03	0.1073E+03	0.1082E+03	0.1092E+03
[illegible]00.00	0.1050E+03	0.1059E+03	0.1069E+03	0.1079E+03	0.1089E+03	0.1100E+03

[ft]	<- X [ft] ->					
	-2400	-2300	-2200	-2100	-2000	-1900
-1200.00	0.1055E+03	0.1065E+03	0.1075E+03	0.1085E+03	0.1096E+03	0.1107E+03
-1100.00	0.1059E+03	0.1070E+03	0.1080E+03	0.1091E+03	0.1102E+03	0.1114E+03
-1000.00	0.1064E+03	0.1075E+03	0.1085E+03	0.1097E+03	0.1108E+03	0.1120E+03
-900.00	0.1068E+03	0.1079E+03	0.1090E+03	0.1102E+03	0.1114E+03	0.1127E+03
-800.00	0.1072E+03	0.1083E+03	0.1095E+03	0.1107E+03	0.1119E+03	0.1132E+03
-700.00	0.1075E+03	0.1087E+03	0.1099E+03	0.1111E+03	0.1124E+03	0.1138E+03
-600.00	0.1079E+03	0.1090E+03	0.1103E+03	0.1115E+03	0.1129E+03	0.1142E+03
-500.00	0.1081E+03	0.1093E+03	0.1106E+03	0.1119E+03	0.1132E+03	0.1146E+03
-400.00	0.1083E+03	0.1096E+03	0.1108E+03	0.1122E+03	0.1135E+03	0.1150E+03
-300.00	0.1085E+03	0.1098E+03	0.1110E+03	0.1124E+03	0.1138E+03	0.1153E+03
-200.00	0.1087E+03	0.1099E+03	0.1112E+03	0.1126E+03	0.1140E+03	0.1155E+03
-100.00	0.1087E+03	0.1100E+03	0.1113E+03	0.1127E+03	0.1141E+03	0.1156E+03
0.00	0.1088E+03	0.1100E+03	0.1113E+03	0.1127E+03	0.1141E+03	0.1156E+03
100.00	0.1087E+03	0.1100E+03	0.1113E+03	0.1127E+03	0.1141E+03	0.1156E+03
200.00	0.1087E+03	0.1099E+03	0.1112E+03	0.1126E+03	0.1140E+03	0.1155E+03
300.00	0.1085E+03	0.1098E+03	0.1110E+03	0.1124E+03	0.1138E+03	0.1153E+03
400.00	0.1083E+03	0.1096E+03	0.1108E+03	0.1122E+03	0.1135E+03	0.1150E+03
500.00	0.1081E+03	0.1093E+03	0.1106E+03	0.1119E+03	0.1132E+03	0.1146E+03
600.00	0.1079E+03	0.1090E+03	0.1103E+03	0.1115E+03	0.1129E+03	0.1142E+03
700.00	0.1075E+03	0.1087E+03	0.1099E+03	0.1111E+03	0.1124E+03	0.1138E+03
800.00	0.1072E+03	0.1083E+03	0.1095E+03	0.1107E+03	0.1119E+03	0.1132E+03
900.00	0.1068E+03	0.1079E+03	0.1090E+03	0.1102E+03	0.1114E+03	0.1127E+03
1000.00	0.1064E+03	0.1075E+03	0.1085E+03	0.1097E+03	0.1108E+03	0.1120E+03
1100.00	0.1059E+03	0.1070E+03	0.1080E+03	0.1091E+03	0.1102E+03	0.1114E+03
1200.00	0.1055E+03	0.1065E+03	0.1075E+03	0.1085E+03	0.1096E+03	0.1107E+03
1300.00	0.1050E+03	0.1059E+03	0.1069E+03	0.1079E+03	0.1089E+03	0.1100E+03
1400.00	0.1044E+03	0.1054E+03	0.1063E+03	0.1073E+03	0.1082E+03	0.1092E+03
1500.00	0.1039E+03	0.1048E+03	0.1057E+03	0.1066E+03	0.1075E+03	0.1085E+03
1600.00	0.1033E+03	0.1042E+03	0.1051E+03	0.1059E+03	0.1068E+03	0.1077E+03
1700.00	0.1028E+03	0.1036E+03	0.1044E+03	0.1053E+03	0.1061E+03	0.1070E+03
1800.00	0.1022E+03	0.1030E+03	0.1038E+03	0.1046E+03	0.1054E+03	0.1062E+03
1900.00	0.1016E+03	0.1023E+03	0.1031E+03	0.1039E+03	0.1046E+03	0.1054E+03
2000.00	0.1010E+03	0.1017E+03	0.1024E+03	0.1032E+03	0.1039E+03	0.1046E+03
2100.00	0.1004E+03	0.1011E+03	0.1018E+03	0.1025E+03	0.1032E+03	0.1039E+03
2200.00	0.9977E+02	0.1004E+03	0.1011E+03	0.1018E+03	0.1024E+03	0.1031E+03
2300.00	0.9916E+02	0.9980E+02	0.1004E+03	0.1011E+03	0.1017E+03	0.1023E+03
2400.00	0.9854E+02	0.9916E+02	0.9977E+02	0.1004E+03	0.1010E+03	0.1016E+03
2500.00	0.9793E+02	0.9852E+02	0.9910E+02	0.9969E+02	0.1003E+03	0.1008E+03
2600.00	0.9732E+02	0.9788E+02	0.9844E+02	0.9900E+02	0.9955E+02	0.1001E+03
2700.00	0.9671E+02	0.9725E+02	0.9778E+02	0.9832E+02	0.9884E+02	0.9936E+02

[ft] <- X [ft] ->

[ft]	-2400	-2300	-2200	-2100	-2000	-1900
2800.00	0.9610E+02	0.9662E+02	0.9713E+02	0.9764E+02	0.9814E+02	0.9863E+02
2900.00	0.9550E+02	0.9599E+02	0.9648E+02	0.9697E+02	0.9745E+02	0.9792E+02
3000.00	0.9490E+02	0.9537E+02	0.9584E+02	0.9631E+02	0.9676E+02	0.9721E+02

Y [ft] <- X [ft] ->

Y [ft]	-1800	-1700	-1600	-1500	-1400	-1300
-3000.00	0.9765E+02	0.9808E+02	0.9849E+02	0.9889E+02	0.9928E+02	0.9965E+02
-2900.00	0.9838E+02	0.9883E+02	0.9926E+02	0.9969E+02	0.1001E+03	0.1005E+03
-2800.00	0.9912E+02	0.9959E+02	0.1001E+03	0.1005E+03	0.1009E+03	0.1013E+03
-2700.00	0.9987E+02	0.1004E+03	0.1009E+03	0.1013E+03	0.1018E+03	0.1022E+03
-2600.00	0.1006E+03	0.1012E+03	0.1017E+03	0.1022E+03	0.1026E+03	0.1031E+03
-2500.00	0.1014E+03	0.1020E+03	0.1025E+03	0.1030E+03	0.1035E+03	0.1040E+03
-2400.00	0.1022E+03	0.1028E+03	0.1033E+03	0.1039E+03	0.1044E+03	0.1050E+03
-2300.00	0.1030E+03	0.1036E+03	0.1042E+03	0.1048E+03	0.1054E+03	0.1059E+03
-2200.00	0.1038E+03	0.1044E+03	0.1051E+03	0.1057E+03	0.1063E+03	0.1069E+03
-2100.00	0.1046E+03	0.1053E+03	0.1059E+03	0.1066E+03	0.1073E+03	0.1079E+03
[illegible]00.00	0.1054E+03	0.1061E+03	0.1068E+03	0.1075E+03	0.1082E+03	0.1089E+03
[illegible]00.00	0.1062E+03	0.1070E+03	0.1077E+03	0.1085E+03	0.1092E+03	0.1100E+03
-1800.00	0.1070E+03	0.1078E+03	0.1087E+03	0.1095E+03	0.1103E+03	0.1110E+03
-1700.00	0.1078E+03	0.1087E+03	0.1096E+03	0.1104E+03	0.1113E+03	0.1121E+03
-1600.00	0.1087E+03	0.1096E+03	0.1105E+03	0.1114E+03	0.1123E+03	0.1132E+03
-1500.00	0.1095E+03	0.1104E+03	0.1114E+03	0.1124E+03	0.1134E+03	0.1143E+03
-1400.00	0.1103E+03	0.1113E+03	0.1123E+03	0.1134E+03	0.1144E+03	0.1155E+03
-1300.00	0.1110E+03	0.1121E+03	0.1132E+03	0.1143E+03	0.1155E+03	0.1166E+03
-1200.00	0.1118E+03	0.1130E+03	0.1141E+03	0.1153E+03	0.1165E+03	0.1177E+03
-1100.00	0.1126E+03	0.1138E+03	0.1150E+03	0.1163E+03	0.1175E+03	0.1189E+03
-1000.00	0.1133E+03	0.1145E+03	0.1158E+03	0.1172E+03	0.1186E+03	0.1200E+03
-900.00	0.1139E+03	0.1153E+03	0.1166E+03	0.1181E+03	0.1195E+03	0.1210E+03
-800.00	0.1146E+03	0.1160E+03	0.1174E+03	0.1189E+03	0.1205E+03	0.1221E+03
-700.00	0.1152E+03	0.1166E+03	0.1181E+03	0.1197E+03	0.1213E+03	0.1231E+03
-600.00	0.1157E+03	0.1172E+03	0.1188E+03	0.1204E+03	0.1221E+03	0.1240E+03
-500.00	0.1161E+03	0.1177E+03	0.1193E+03	0.1210E+03	0.1229E+03	0.1248E+03
-400.00	0.1165E+03	0.1181E+03	0.1198E+03	0.1216E+03	0.1235E+03	0.1255E+03
-300.00	0.1168E+03	0.1185E+03	0.1202E+03	0.1220E+03	0.1240E+03	0.1261E+03
-200.00	0.1170E+03	0.1187E+03	0.1205E+03	0.1223E+03	0.1243E+03	0.1265E+03
-100.00	0.1172E+03	0.1189E+03	0.1206E+03	0.1225E+03	0.1246E+03	0.1267E+03
0.00	0.1172E+03	0.1189E+03	0.1207E+03	0.1226E+03	0.1246E+03	0.1268E+03
100.00	0.1172E+03	0.1189E+03	0.1206E+03	0.1225E+03	0.1246E+03	0.1267E+03
200.00	0.1170E+03	0.1187E+03	0.1205E+03	0.1223E+03	0.1243E+03	0.1265E+03
300.00	0.1168E+03	0.1185E+03	0.1202E+03	0.1220E+03	0.1240E+03	0.1261E+03
400.00	0.1165E+03	0.1181E+03	0.1198E+03	0.1216E+03	0.1235E+03	0.1255E+03
500.00	0.1161E+03	0.1177E+03	0.1193E+03	0.1210E+03	0.1229E+03	0.1248E+03
[illegible]00.00	0.1157E+03	0.1172E+03	0.1188E+03	0.1204E+03	0.1221E+03	0.1240E+03

[ft] <- X [ft] ->

	-1800	-1700	-1600	-1500	-1400	-1300
700.00	0.1152E+03	0.1166E+03	0.1181E+03	0.1197E+03	0.1213E+03	0.1231E+03
800.00	0.1146E+03	0.1160E+03	0.1174E+03	0.1189E+03	0.1205E+03	0.1221E+03
900.00	0.1139E+03	0.1153E+03	0.1166E+03	0.1181E+03	0.1195E+03	0.1210E+03
1000.00	0.1133E+03	0.1145E+03	0.1158E+03	0.1172E+03	0.1186E+03	0.1200E+03
1100.00	0.1126E+03	0.1138E+03	0.1150E+03	0.1163E+03	0.1175E+03	0.1189E+03
1200.00	0.1118E+03	0.1130E+03	0.1141E+03	0.1153E+03	0.1165E+03	0.1177E+03
1300.00	0.1110E+03	0.1121E+03	0.1132E+03	0.1143E+03	0.1155E+03	0.1166E+03
1400.00	0.1103E+03	0.1113E+03	0.1123E+03	0.1134E+03	0.1144E+03	0.1155E+03
1500.00	0.1095E+03	0.1104E+03	0.1114E+03	0.1124E+03	0.1134E+03	0.1143E+03
1600.00	0.1087E+03	0.1096E+03	0.1105E+03	0.1114E+03	0.1123E+03	0.1132E+03
1700.00	0.1078E+03	0.1087E+03	0.1096E+03	0.1104E+03	0.1113E+03	0.1121E+03
1800.00	0.1070E+03	0.1078E+03	0.1087E+03	0.1095E+03	0.1103E+03	0.1110E+03
1900.00	0.1062E+03	0.1070E+03	0.1077E+03	0.1085E+03	0.1092E+03	0.1100E+03
2000.00	0.1054E+03	0.1061E+03	0.1068E+03	0.1075E+03	0.1082E+03	0.1089E+03
2100.00	0.1046E+03	0.1053E+03	0.1059E+03	0.1066E+03	0.1073E+03	0.1079E+03
2200.00	0.1038E+03	0.1044E+03	0.1051E+03	0.1057E+03	0.1063E+03	0.1069E+03
2300.00	0.1030E+03	0.1036E+03	0.1042E+03	0.1048E+03	0.1054E+03	0.1059E+03
2400.00	0.1022E+03	0.1028E+03	0.1033E+03	0.1039E+03	0.1044E+03	0.1050E+03
2500.00	0.1014E+03	0.1020E+03	0.1025E+03	0.1030E+03	0.1035E+03	0.1040E+03
2600.00	0.1006E+03	0.1012E+03	0.1017E+03	0.1022E+03	0.1026E+03	0.1031E+03
[illegible]00.00	0.9987E+02	0.1004E+03	0.1009E+03	0.1013E+03	0.1018E+03	0.1022E+03
[illegible]00.00	0.9912E+02	0.9959E+02	0.1001E+03	0.1005E+03	0.1009E+03	0.1013E+03
2900.00	0.9838E+02	0.9883E+02	0.9926E+02	0.9969E+02	0.1001E+03	0.1005E+03
3000.00	0.9765E+02	0.9808E+02	0.9849E+02	0.9889E+02	0.9928E+02	0.9965E+02

Y [ft] <- X [ft] ->

	-1200	-1100	-1000	-900	-800	-700
-3000.00	0.9999E+02	0.1003E+03	0.1006E+03	0.1009E+03	0.1012E+03	0.1014E+03
-2900.00	0.1009E+03	0.1012E+03	0.1015E+03	0.1018E+03	0.1021E+03	0.1023E+03
-2800.00	0.1017E+03	0.1021E+03	0.1024E+03	0.1028E+03	0.1031E+03	0.1033E+03
-2700.00	0.1026E+03	0.1030E+03	0.1034E+03	0.1037E+03	0.1040E+03	0.1043E+03
-2600.00	0.1036E+03	0.1040E+03	0.1044E+03	0.1047E+03	0.1051E+03	0.1054E+03
-2500.00	0.1045E+03	0.1049E+03	0.1054E+03	0.1058E+03	0.1061E+03	0.1064E+03
-2400.00	0.1055E+03	0.1059E+03	0.1064E+03	0.1068E+03	0.1072E+03	0.1075E+03
-2300.00	0.1065E+03	0.1070E+03	0.1075E+03	0.1079E+03	0.1083E+03	0.1087E+03
-2200.00	0.1075E+03	0.1080E+03	0.1085E+03	0.1090E+03	0.1095E+03	0.1099E+03
-2100.00	0.1085E+03	0.1091E+03	0.1097E+03	0.1102E+03	0.1107E+03	0.1111E+03
-2000.00	0.1096E+03	0.1102E+03	0.1108E+03	0.1114E+03	0.1119E+03	0.1124E+03
-1900.00	0.1107E+03	0.1114E+03	0.1120E+03	0.1127E+03	0.1132E+03	0.1138E+03
-1800.00	0.1118E+03	0.1126E+03	0.1133E+03	0.1139E+03	0.1146E+03	0.1152E+03
-1700.00	0.1130E+03	0.1138E+03	0.1145E+03	0.1153E+03	0.1160E+03	0.1166E+03
-1600.00	0.1141E+03	0.1150E+03	0.1158E+03	0.1166E+03	0.1174E+03	0.1181E+03
[illegible]00.00	0.1153E+03	0.1163E+03	0.1172E+03	0.1181E+03	0.1189E+03	0.1197E+03

[ft] <- X [ft] ->

	-1200	-1100	-1000	-900	-800	-700
-1400.00	0.1165E+03	0.1175E+03	0.1186E+03	0.1195E+03	0.1205E+03	0.1213E+03
-1300.00	0.1177E+03	0.1189E+03	0.1200E+03	0.1210E+03	0.1221E+03	0.1231E+03
-1200.00	0.1190E+03	0.1202E+03	0.1214E+03	0.1226E+03	0.1238E+03	0.1249E+03
-1100.00	0.1202E+03	0.1215E+03	0.1229E+03	0.1242E+03	0.1255E+03	0.1267E+03
-1000.00	0.1214E+03	0.1229E+03	0.1243E+03	0.1258E+03	0.1273E+03	0.1287E+03
-900.00	0.1226E+03	0.1242E+03	0.1258E+03	0.1274E+03	0.1291E+03	0.1307E+03
-800.00	0.1238E+03	0.1255E+03	0.1273E+03	0.1291E+03	0.1309E+03	0.1327E+03
-700.00	0.1249E+03	0.1267E+03	0.1287E+03	0.1307E+03	0.1327E+03	0.1348E+03
-600.00	0.1259E+03	0.1279E+03	0.1300E+03	0.1322E+03	0.1345E+03	0.1369E+03
-500.00	0.1268E+03	0.1290E+03	0.1313E+03	0.1337E+03	0.1363E+03	0.1390E+03
-400.00	0.1276E+03	0.1299E+03	0.1324E+03	0.1350E+03	0.1378E+03	0.1409E+03
-300.00	0.1283E+03	0.1307E+03	0.1333E+03	0.1361E+03	0.1392E+03	0.1426E+03
-200.00	0.1288E+03	0.1313E+03	0.1340E+03	0.1369E+03	0.1402E+03	0.1439E+03
-100.00	0.1291E+03	0.1316E+03	0.1344E+03	0.1375E+03	0.1409E+03	0.1448E+03
0.00	0.1292E+03	0.1317E+03	0.1345E+03	0.1377E+03	0.1411E+03	0.1451E+03
100.00	0.1291E+03	0.1316E+03	0.1344E+03	0.1375E+03	0.1409E+03	0.1448E+03
200.00	0.1288E+03	0.1313E+03	0.1340E+03	0.1369E+03	0.1402E+03	0.1439E+03
300.00	0.1283E+03	0.1307E+03	0.1333E+03	0.1361E+03	0.1392E+03	0.1426E+03
400.00	0.1276E+03	0.1299E+03	0.1324E+03	0.1350E+03	0.1378E+03	0.1409E+03
500.00	0.1268E+03	0.1290E+03	0.1313E+03	0.1337E+03	0.1363E+03	0.1390E+03
600.00	0.1259E+03	0.1279E+03	0.1300E+03	0.1322E+03	0.1345E+03	0.1369E+03
700.00	0.1249E+03	0.1267E+03	0.1287E+03	0.1307E+03	0.1327E+03	0.1348E+03
800.00	0.1238E+03	0.1255E+03	0.1273E+03	0.1291E+03	0.1309E+03	0.1327E+03
900.00	0.1226E+03	0.1242E+03	0.1258E+03	0.1274E+03	0.1291E+03	0.1307E+03
1000.00	0.1214E+03	0.1229E+03	0.1243E+03	0.1258E+03	0.1273E+03	0.1287E+03
1100.00	0.1202E+03	0.1215E+03	0.1229E+03	0.1242E+03	0.1255E+03	0.1267E+03
1200.00	0.1190E+03	0.1202E+03	0.1214E+03	0.1226E+03	0.1238E+03	0.1249E+03
1300.00	0.1177E+03	0.1189E+03	0.1200E+03	0.1210E+03	0.1221E+03	0.1231E+03
1400.00	0.1165E+03	0.1175E+03	0.1186E+03	0.1195E+03	0.1205E+03	0.1213E+03
1500.00	0.1153E+03	0.1163E+03	0.1172E+03	0.1181E+03	0.1189E+03	0.1197E+03
1600.00	0.1141E+03	0.1150E+03	0.1158E+03	0.1166E+03	0.1174E+03	0.1181E+03
1700.00	0.1130E+03	0.1138E+03	0.1145E+03	0.1153E+03	0.1160E+03	0.1166E+03
1800.00	0.1118E+03	0.1126E+03	0.1133E+03	0.1139E+03	0.1146E+03	0.1152E+03
1900.00	0.1107E+03	0.1114E+03	0.1120E+03	0.1127E+03	0.1132E+03	0.1138E+03
2000.00	0.1096E+03	0.1102E+03	0.1108E+03	0.1114E+03	0.1119E+03	0.1124E+03
2100.00	0.1085E+03	0.1091E+03	0.1097E+03	0.1102E+03	0.1107E+03	0.1111E+03
2200.00	0.1075E+03	0.1080E+03	0.1085E+03	0.1090E+03	0.1095E+03	0.1099E+03
2300.00	0.1065E+03	0.1070E+03	0.1075E+03	0.1079E+03	0.1083E+03	0.1087E+03
2400.00	0.1055E+03	0.1059E+03	0.1064E+03	0.1068E+03	0.1072E+03	0.1075E+03
2500.00	0.1045E+03	0.1049E+03	0.1054E+03	0.1058E+03	0.1061E+03	0.1064E+03

[ft]	<- X [ft] ->					
	-1200	-1100	-1000	-900	-800	-700
2600.00	0.1036E+03	0.1040E+03	0.1044E+03	0.1047E+03	0.1051E+03	0.1054E+03
2700.00	0.1026E+03	0.1030E+03	0.1034E+03	0.1037E+03	0.1040E+03	0.1043E+03
2800.00	0.1017E+03	0.1021E+03	0.1024E+03	0.1028E+03	0.1031E+03	0.1033E+03
2900.00	0.1009E+03	0.1012E+03	0.1015E+03	0.1018E+03	0.1021E+03	0.1023E+03
3000.00	0.9999E+02	0.1003E+03	0.1006E+03	0.1009E+03	0.1012E+03	0.1014E+03

Y [ft]	<- X [ft] ->					
	-600	-500	-400	-300	-200	-100
-3000.00	0.1016E+03	0.1018E+03	0.1019E+03	0.1020E+03	0.1021E+03	0.1022E+03
-2900.00	0.1026E+03	0.1027E+03	0.1029E+03	0.1030E+03	0.1031E+03	0.1032E+03
-2800.00	0.1036E+03	0.1037E+03	0.1039E+03	0.1040E+03	0.1041E+03	0.1042E+03
-2700.00	0.1046E+03	0.1048E+03	0.1050E+03	0.1051E+03	0.1052E+03	0.1053E+03
-2600.00	0.1056E+03	0.1059E+03	0.1060E+03	0.1062E+03	0.1063E+03	0.1064E+03
-2500.00	0.1067E+03	0.1070E+03	0.1072E+03	0.1073E+03	0.1075E+03	0.1075E+03
-2400.00	0.1079E+03	0.1081E+03	0.1083E+03	0.1085E+03	0.1087E+03	0.1087E+03
-2300.00	0.1090E+03	0.1093E+03	0.1096E+03	0.1098E+03	0.1099E+03	0.1100E+03
[illegible]00.00	0.1103E+03	0.1106E+03	0.1108E+03	0.1110E+03	0.1112E+03	0.1113E+03
[illegible]00.00	0.1115E+03	0.1119E+03	0.1122E+03	0.1124E+03	0.1126E+03	0.1127E+03
-2000.00	0.1129E+03	0.1132E+03	0.1135E+03	0.1138E+03	0.1140E+03	0.1141E+03
-1900.00	0.1142E+03	0.1146E+03	0.1150E+03	0.1153E+03	0.1155E+03	0.1156E+03
-1800.00	0.1157E+03	0.1161E+03	0.1165E+03	0.1168E+03	0.1170E+03	0.1172E+03
-1700.00	0.1172E+03	0.1177E+03	0.1181E+03	0.1185E+03	0.1187E+03	0.1189E+03
-1600.00	0.1188E+03	0.1193E+03	0.1198E+03	0.1202E+03	0.1205E+03	0.1206E+03
-1500.00	0.1204E+03	0.1210E+03	0.1216E+03	0.1220E+03	0.1223E+03	0.1225E+03
-1400.00	0.1221E+03	0.1229E+03	0.1235E+03	0.1240E+03	0.1243E+03	0.1246E+03
-1300.00	0.1240E+03	0.1248E+03	0.1255E+03	0.1261E+03	0.1265E+03	0.1267E+03
-1200.00	0.1259E+03	0.1268E+03	0.1276E+03	0.1283E+03	0.1288E+03	0.1291E+03
-1100.00	0.1279E+03	0.1290E+03	0.1299E+03	0.1307E+03	0.1313E+03	0.1316E+03
-1000.00	0.1300E+03	0.1313E+03	0.1324E+03	0.1333E+03	0.1340E+03	0.1344E+03
-900.00	0.1322E+03	0.1337E+03	0.1350E+03	0.1361E+03	0.1369E+03	0.1375E+03
-800.00	0.1345E+03	0.1363E+03	0.1378E+03	0.1392E+03	0.1402E+03	0.1409E+03
-700.00	0.1369E+03	0.1390E+03	0.1409E+03	0.1426E+03	0.1439E+03	0.1448E+03
-600.00	0.1394E+03	0.1418E+03	0.1442E+03	0.1463E+03	0.1480E+03	0.1492E+03
-500.00	0.1418E+03	0.1448E+03	0.1477E+03	0.1504E+03	0.1528E+03	0.1544E+03
-400.00	0.1442E+03	0.1477E+03	0.1513E+03	0.1550E+03	0.1583E+03	0.1607E+03
-300.00	0.1463E+03	0.1504E+03	0.1550E+03	0.1598E+03	0.1646E+03	0.1685E+03
-200.00	0.1480E+03	0.1528E+03	0.1583E+03	0.1646E+03	0.1718E+03	0.1787E+03
-100.00	0.1492E+03	0.1544E+03	0.1607E+03	0.1685E+03	0.1787E+03	0.1922E+03
0.00	0.1496E+03	0.1550E+03	0.1615E+03	0.1700E+03	0.1820E+03	0.2024E+03
100.00	0.1492E+03	0.1544E+03	0.1607E+03	0.1685E+03	0.1787E+03	0.1922E+03
200.00	0.1480E+03	0.1528E+03	0.1583E+03	0.1646E+03	0.1718E+03	0.1787E+03
300.00	0.1463E+03	0.1504E+03	0.1550E+03	0.1598E+03	0.1646E+03	0.1685E+03
[illegible]00.00	0.1442E+03	0.1477E+03	0.1513E+03	0.1550E+03	0.1583E+03	0.1607E+03

Y [ft] <- X [ft] ->

Y [ft]	-600	-500	-400	-300	-200	-100
500.00	0.1418E+03	0.1448E+03	0.1477E+03	0.1504E+03	0.1528E+03	0.1544E+03
600.00	0.1394E+03	0.1418E+03	0.1442E+03	0.1463E+03	0.1480E+03	0.1492E+03
700.00	0.1369E+03	0.1390E+03	0.1409E+03	0.1426E+03	0.1439E+03	0.1448E+03
800.00	0.1345E+03	0.1363E+03	0.1378E+03	0.1392E+03	0.1402E+03	0.1409E+03
900.00	0.1322E+03	0.1337E+03	0.1350E+03	0.1361E+03	0.1369E+03	0.1375E+03
1000.00	0.1300E+03	0.1313E+03	0.1324E+03	0.1333E+03	0.1340E+03	0.1344E+03
1100.00	0.1279E+03	0.1290E+03	0.1299E+03	0.1307E+03	0.1313E+03	0.1316E+03
1200.00	0.1259E+03	0.1268E+03	0.1276E+03	0.1283E+03	0.1288E+03	0.1291E+03
1300.00	0.1240E+03	0.1248E+03	0.1255E+03	0.1261E+03	0.1265E+03	0.1267E+03
1400.00	0.1221E+03	0.1229E+03	0.1235E+03	0.1240E+03	0.1243E+03	0.1246E+03
1500.00	0.1204E+03	0.1210E+03	0.1216E+03	0.1220E+03	0.1223E+03	0.1225E+03
1600.00	0.1188E+03	0.1193E+03	0.1198E+03	0.1202E+03	0.1205E+03	0.1206E+03
1700.00	0.1172E+03	0.1177E+03	0.1181E+03	0.1185E+03	0.1187E+03	0.1189E+03
1800.00	0.1157E+03	0.1161E+03	0.1165E+03	0.1168E+03	0.1170E+03	0.1172E+03
1900.00	0.1142E+03	0.1146E+03	0.1150E+03	0.1153E+03	0.1155E+03	0.1156E+03
2000.00	0.1129E+03	0.1132E+03	0.1135E+03	0.1138E+03	0.1140E+03	0.1141E+03
2100.00	0.1115E+03	0.1119E+03	0.1122E+03	0.1124E+03	0.1126E+03	0.1127E+03
2200.00	0.1103E+03	0.1106E+03	0.1108E+03	0.1110E+03	0.1112E+03	0.1113E+03
2300.00	0.1090E+03	0.1093E+03	0.1096E+03	0.1098E+03	0.1099E+03	0.1100E+03
[illegible]00.00	0.1079E+03	0.1081E+03	0.1083E+03	0.1085E+03	0.1087E+03	0.1087E+03
[illegible]00.00	0.1067E+03	0.1070E+03	0.1072E+03	0.1073E+03	0.1075E+03	0.1075E+03
2600.00	0.1056E+03	0.1059E+03	0.1060E+03	0.1062E+03	0.1063E+03	0.1064E+03
2700.00	0.1046E+03	0.1048E+03	0.1050E+03	0.1051E+03	0.1052E+03	0.1053E+03
2800.00	0.1036E+03	0.1037E+03	0.1039E+03	0.1040E+03	0.1041E+03	0.1042E+03
2900.00	0.1026E+03	0.1027E+03	0.1029E+03	0.1030E+03	0.1031E+03	0.1032E+03
3000.00	0.1016E+03	0.1018E+03	0.1019E+03	0.1020E+03	0.1021E+03	0.1022E+03

Y [ft] <- X [ft] ->

Y [ft]	0	100	200	300	400	500
-3000.00	0.1022E+03	0.1022E+03	0.1021E+03	0.1020E+03	0.1019E+03	0.1018E+03
-2900.00	0.1032E+03	0.1032E+03	0.1031E+03	0.1030E+03	0.1029E+03	0.1027E+03
-2800.00	0.1042E+03	0.1042E+03	0.1041E+03	0.1040E+03	0.1039E+03	0.1037E+03
-2700.00	0.1053E+03	0.1053E+03	0.1052E+03	0.1051E+03	0.1050E+03	0.1048E+03
-2600.00	0.1064E+03	0.1064E+03	0.1063E+03	0.1062E+03	0.1060E+03	0.1059E+03
-2500.00	0.1075E+03	0.1075E+03	0.1075E+03	0.1073E+03	0.1072E+03	0.1070E+03
-2400.00	0.1088E+03	0.1087E+03	0.1087E+03	0.1085E+03	0.1083E+03	0.1081E+03
-2300.00	0.1100E+03	0.1100E+03	0.1099E+03	0.1098E+03	0.1096E+03	0.1093E+03
-2200.00	0.1113E+03	0.1113E+03	0.1112E+03	0.1110E+03	0.1108E+03	0.1106E+03
-2100.00	0.1127E+03	0.1127E+03	0.1126E+03	0.1124E+03	0.1122E+03	0.1119E+03
-2000.00	0.1141E+03	0.1141E+03	0.1140E+03	0.1138E+03	0.1135E+03	0.1132E+03
-1900.00	0.1156E+03	0.1156E+03	0.1155E+03	0.1153E+03	0.1150E+03	0.1146E+03
[illegible]0.00	0.1172E+03	0.1172E+03	0.1170E+03	0.1168E+03	0.1165E+03	0.1161E+03
-[illegible]00.00	0.1189E+03	0.1189E+03	0.1187E+03	0.1185E+03	0.1181E+03	0.1177E+03

Y [ft] <- X [ft] ->

Y [ft]	0	100	200	300	400	500
-1600.00	0.1207E+03	0.1206E+03	0.1205E+03	0.1202E+03	0.1198E+03	0.1193E+03
-1500.00	0.1226E+03	0.1225E+03	0.1223E+03	0.1220E+03	0.1216E+03	0.1210E+03
-1400.00	0.1246E+03	0.1246E+03	0.1243E+03	0.1240E+03	0.1235E+03	0.1229E+03
-1300.00	0.1268E+03	0.1267E+03	0.1265E+03	0.1261E+03	0.1255E+03	0.1248E+03
-1200.00	0.1292E+03	0.1291E+03	0.1288E+03	0.1283E+03	0.1276E+03	0.1268E+03
-1100.00	0.1317E+03	0.1316E+03	0.1313E+03	0.1307E+03	0.1299E+03	0.1290E+03
-1000.00	0.1345E+03	0.1344E+03	0.1340E+03	0.1333E+03	0.1324E+03	0.1313E+03
-900.00	0.1377E+03	0.1375E+03	0.1369E+03	0.1361E+03	0.1350E+03	0.1337E+03
-800.00	0.1411E+03	0.1409E+03	0.1402E+03	0.1392E+03	0.1378E+03	0.1363E+03
-700.00	0.1451E+03	0.1448E+03	0.1439E+03	0.1426E+03	0.1409E+03	0.1390E+03
-600.00	0.1496E+03	0.1492E+03	0.1480E+03	0.1463E+03	0.1442E+03	0.1418E+03
-500.00	0.1550E+03	0.1544E+03	0.1528E+03	0.1504E+03	0.1477E+03	0.1448E+03
-400.00	0.1615E+03	0.1607E+03	0.1583E+03	0.1550E+03	0.1513E+03	0.1477E+03
-300.00	0.1700E+03	0.1685E+03	0.1646E+03	0.1598E+03	0.1550E+03	0.1504E+03
-200.00	0.1820E+03	0.1787E+03	0.1718E+03	0.1646E+03	0.1583E+03	0.1528E+03
-100.00	0.2024E+03	0.1922E+03	0.1787E+03	0.1685E+03	0.1607E+03	0.1544E+03
0.00	0.1409E+04	0.2024E+03	0.1820E+03	0.1700E+03	0.1615E+03	0.1550E+03
100.00	0.2024E+03	0.1922E+03	0.1787E+03	0.1685E+03	0.1607E+03	0.1544E+03
200.00	0.1820E+03	0.1787E+03	0.1718E+03	0.1646E+03	0.1583E+03	0.1528E+03
300.00	0.1700E+03	0.1685E+03	0.1646E+03	0.1598E+03	0.1550E+03	0.1504E+03
400.00	0.1615E+03	0.1607E+03	0.1583E+03	0.1550E+03	0.1513E+03	0.1477E+03
500.00	0.1550E+03	0.1544E+03	0.1528E+03	0.1504E+03	0.1477E+03	0.1448E+03
600.00	0.1496E+03	0.1492E+03	0.1480E+03	0.1463E+03	0.1442E+03	0.1418E+03
700.00	0.1451E+03	0.1448E+03	0.1439E+03	0.1426E+03	0.1409E+03	0.1390E+03
800.00	0.1411E+03	0.1409E+03	0.1402E+03	0.1392E+03	0.1378E+03	0.1363E+03
900.00	0.1377E+03	0.1375E+03	0.1369E+03	0.1361E+03	0.1350E+03	0.1337E+03
1000.00	0.1345E+03	0.1344E+03	0.1340E+03	0.1333E+03	0.1324E+03	0.1313E+03
1100.00	0.1317E+03	0.1316E+03	0.1313E+03	0.1307E+03	0.1299E+03	0.1290E+03
1200.00	0.1292E+03	0.1291E+03	0.1288E+03	0.1283E+03	0.1276E+03	0.1268E+03
1300.00	0.1268E+03	0.1267E+03	0.1265E+03	0.1261E+03	0.1255E+03	0.1248E+03
1400.00	0.1246E+03	0.1246E+03	0.1243E+03	0.1240E+03	0.1235E+03	0.1229E+03
1500.00	0.1226E+03	0.1225E+03	0.1223E+03	0.1220E+03	0.1216E+03	0.1210E+03
1600.00	0.1207E+03	0.1206E+03	0.1205E+03	0.1202E+03	0.1198E+03	0.1193E+03
1700.00	0.1189E+03	0.1189E+03	0.1187E+03	0.1185E+03	0.1181E+03	0.1177E+03
1800.00	0.1172E+03	0.1172E+03	0.1170E+03	0.1168E+03	0.1165E+03	0.1161E+03
1900.00	0.1156E+03	0.1156E+03	0.1155E+03	0.1153E+03	0.1150E+03	0.1146E+03
2000.00	0.1141E+03	0.1141E+03	0.1140E+03	0.1138E+03	0.1135E+03	0.1132E+03
2100.00	0.1127E+03	0.1127E+03	0.1126E+03	0.1124E+03	0.1122E+03	0.1119E+03
2200.00	0.1113E+03	0.1113E+03	0.1112E+03	0.1110E+03	0.1108E+03	0.1106E+03
2300.00	0.1100E+03	0.1100E+03	0.1099E+03	0.1098E+03	0.1096E+03	0.1093E+03

Y [ft]	<- X [ft] ->					
	0	100	200	300	400	500
2400.00	0.1088E+03	0.1087E+03	0.1087E+03	0.1085E+03	0.1083E+03	0.1081E+03
2500.00	0.1075E+03	0.1075E+03	0.1075E+03	0.1073E+03	0.1072E+03	0.1070E+03
2600.00	0.1064E+03	0.1064E+03	0.1063E+03	0.1062E+03	0.1060E+03	0.1059E+03
2700.00	0.1053E+03	0.1053E+03	0.1052E+03	0.1051E+03	0.1050E+03	0.1048E+03
2800.00	0.1042E+03	0.1042E+03	0.1041E+03	0.1040E+03	0.1039E+03	0.1037E+03
2900.00	0.1032E+03	0.1032E+03	0.1031E+03	0.1030E+03	0.1029E+03	0.1027E+03
3000.00	0.1022E+03	0.1022E+03	0.1021E+03	0.1020E+03	0.1019E+03	0.1018E+03

Y [ft]	<- X [ft] ->					
	600	700	800	900	1000	1100
-3000.00	0.1016E+03	0.1014E+03	0.1012E+03	0.1009E+03	0.1006E+03	0.1003E+03
-2900.00	0.1026E+03	0.1023E+03	0.1021E+03	0.1018E+03	0.1015E+03	0.1012E+03
-2800.00	0.1036E+03	0.1033E+03	0.1031E+03	0.1028E+03	0.1024E+03	0.1021E+03
-2700.00	0.1046E+03	0.1043E+03	0.1040E+03	0.1037E+03	0.1034E+03	0.1030E+03
-2600.00	0.1056E+03	0.1054E+03	0.1051E+03	0.1047E+03	0.1044E+03	0.1040E+03
[illegible]00.00	0.1067E+03	0.1064E+03	0.1061E+03	0.1058E+03	0.1054E+03	0.1049E+03
-[illegible]00.00	0.1079E+03	0.1075E+03	0.1072E+03	0.1068E+03	0.1064E+03	0.1059E+03
-2300.00	0.1090E+03	0.1087E+03	0.1083E+03	0.1079E+03	0.1075E+03	0.1070E+03
-2200.00	0.1103E+03	0.1099E+03	0.1095E+03	0.1090E+03	0.1085E+03	0.1080E+03
-2100.00	0.1115E+03	0.1111E+03	0.1107E+03	0.1102E+03	0.1097E+03	0.1091E+03
-2000.00	0.1129E+03	0.1124E+03	0.1119E+03	0.1114E+03	0.1108E+03	0.1102E+03
-1900.00	0.1142E+03	0.1138E+03	0.1132E+03	0.1127E+03	0.1120E+03	0.1114E+03
-1800.00	0.1157E+03	0.1152E+03	0.1146E+03	0.1139E+03	0.1133E+03	0.1126E+03
-1700.00	0.1172E+03	0.1166E+03	0.1160E+03	0.1153E+03	0.1145E+03	0.1138E+03
-1600.00	0.1188E+03	0.1181E+03	0.1174E+03	0.1166E+03	0.1158E+03	0.1150E+03
-1500.00	0.1204E+03	0.1197E+03	0.1189E+03	0.1181E+03	0.1172E+03	0.1163E+03
-1400.00	0.1221E+03	0.1213E+03	0.1205E+03	0.1195E+03	0.1186E+03	0.1175E+03
-1300.00	0.1240E+03	0.1231E+03	0.1221E+03	0.1210E+03	0.1200E+03	0.1189E+03
-1200.00	0.1259E+03	0.1249E+03	0.1238E+03	0.1226E+03	0.1214E+03	0.1202E+03
-1100.00	0.1279E+03	0.1267E+03	0.1255E+03	0.1242E+03	0.1229E+03	0.1215E+03
-1000.00	0.1300E+03	0.1287E+03	0.1273E+03	0.1258E+03	0.1243E+03	0.1229E+03
-900.00	0.1322E+03	0.1307E+03	0.1291E+03	0.1274E+03	0.1258E+03	0.1242E+03
-800.00	0.1345E+03	0.1327E+03	0.1309E+03	0.1291E+03	0.1273E+03	0.1255E+03
-700.00	0.1369E+03	0.1348E+03	0.1327E+03	0.1307E+03	0.1287E+03	0.1267E+03
-600.00	0.1394E+03	0.1369E+03	0.1345E+03	0.1322E+03	0.1300E+03	0.1279E+03
-500.00	0.1418E+03	0.1390E+03	0.1363E+03	0.1337E+03	0.1313E+03	0.1290E+03
-400.00	0.1442E+03	0.1409E+03	0.1378E+03	0.1350E+03	0.1324E+03	0.1299E+03
-300.00	0.1463E+03	0.1426E+03	0.1392E+03	0.1361E+03	0.1333E+03	0.1307E+03
-200.00	0.1480E+03	0.1439E+03	0.1402E+03	0.1369E+03	0.1340E+03	0.1313E+03
-100.00	0.1492E+03	0.1448E+03	0.1409E+03	0.1375E+03	0.1344E+03	0.1316E+03
0.00	0.1496E+03	0.1451E+03	0.1411E+03	0.1377E+03	0.1345E+03	0.1317E+03
[illegible]0.00	0.1492E+03	0.1448E+03	0.1409E+03	0.1375E+03	0.1344E+03	0.1316E+03
200.00	0.1480E+03	0.1439E+03	0.1402E+03	0.1369E+03	0.1340E+03	0.1313E+03

Y [ft] <- X [ft] ->

Y [ft]	600	700	800	900	1000	1100
300.00	0.1463E+03	0.1426E+03	0.1392E+03	0.1361E+03	0.1333E+03	0.1307E+03
400.00	0.1442E+03	0.1409E+03	0.1378E+03	0.1350E+03	0.1324E+03	0.1299E+03
500.00	0.1418E+03	0.1390E+03	0.1363E+03	0.1337E+03	0.1313E+03	0.1290E+03
600.00	0.1394E+03	0.1369E+03	0.1345E+03	0.1322E+03	0.1300E+03	0.1279E+03
700.00	0.1369E+03	0.1348E+03	0.1327E+03	0.1307E+03	0.1287E+03	0.1267E+03
800.00	0.1345E+03	0.1327E+03	0.1309E+03	0.1291E+03	0.1273E+03	0.1255E+03
900.00	0.1322E+03	0.1307E+03	0.1291E+03	0.1274E+03	0.1258E+03	0.1242E+03
1000.00	0.1300E+03	0.1287E+03	0.1273E+03	0.1258E+03	0.1243E+03	0.1229E+03
1100.00	0.1279E+03	0.1267E+03	0.1255E+03	0.1242E+03	0.1229E+03	0.1215E+03
1200.00	0.1259E+03	0.1249E+03	0.1238E+03	0.1226E+03	0.1214E+03	0.1202E+03
1300.00	0.1240E+03	0.1231E+03	0.1221E+03	0.1210E+03	0.1200E+03	0.1189E+03
1400.00	0.1221E+03	0.1213E+03	0.1205E+03	0.1195E+03	0.1186E+03	0.1175E+03
1500.00	0.1204E+03	0.1197E+03	0.1189E+03	0.1181E+03	0.1172E+03	0.1163E+03
1600.00	0.1188E+03	0.1181E+03	0.1174E+03	0.1166E+03	0.1158E+03	0.1150E+03
1700.00	0.1172E+03	0.1166E+03	0.1160E+03	0.1153E+03	0.1145E+03	0.1138E+03
1800.00	0.1157E+03	0.1152E+03	0.1146E+03	0.1139E+03	0.1133E+03	0.1126E+03
1900.00	0.1142E+03	0.1138E+03	0.1132E+03	0.1127E+03	0.1120E+03	0.1114E+03
2000.00	0.1129E+03	0.1124E+03	0.1119E+03	0.1114E+03	0.1108E+03	0.1102E+03
2100.00	0.1115E+03	0.1111E+03	0.1107E+03	0.1102E+03	0.1097E+03	0.1091E+03
[illegible]00.00	0.1103E+03	0.1099E+03	0.1095E+03	0.1090E+03	0.1085E+03	0.1080E+03
[illegible]00.00	0.1090E+03	0.1087E+03	0.1083E+03	0.1079E+03	0.1075E+03	0.1070E+03
2400.00	0.1079E+03	0.1075E+03	0.1072E+03	0.1068E+03	0.1064E+03	0.1059E+03
2500.00	0.1067E+03	0.1064E+03	0.1061E+03	0.1058E+03	0.1054E+03	0.1049E+03
2600.00	0.1056E+03	0.1054E+03	0.1051E+03	0.1047E+03	0.1044E+03	0.1040E+03
2700.00	0.1046E+03	0.1043E+03	0.1040E+03	0.1037E+03	0.1034E+03	0.1030E+03
2800.00	0.1036E+03	0.1033E+03	0.1031E+03	0.1028E+03	0.1024E+03	0.1021E+03
2900.00	0.1026E+03	0.1023E+03	0.1021E+03	0.1018E+03	0.1015E+03	0.1012E+03
3000.00	0.1016E+03	0.1014E+03	0.1012E+03	0.1009E+03	0.1006E+03	0.1003E+03

Y [ft] <- X [ft] ->

Y [ft]	1200	1300	1400	1500	1600	1700
-3000.00	0.9999E+02	0.9965E+02	0.9928E+02	0.9889E+02	0.9849E+02	0.9808E+02
-2900.00	0.1009E+03	0.1005E+03	0.1001E+03	0.9969E+02	0.9926E+02	0.9883E+02
-2800.00	0.1017E+03	0.1013E+03	0.1009E+03	0.1005E+03	0.1001E+03	0.9959E+02
-2700.00	0.1026E+03	0.1022E+03	0.1018E+03	0.1013E+03	0.1009E+03	0.1004E+03
-2600.00	0.1036E+03	0.1031E+03	0.1026E+03	0.1022E+03	0.1017E+03	0.1012E+03
-2500.00	0.1045E+03	0.1040E+03	0.1035E+03	0.1030E+03	0.1025E+03	0.1020E+03
-2400.00	0.1055E+03	0.1050E+03	0.1044E+03	0.1039E+03	0.1033E+03	0.1028E+03
-2300.00	0.1065E+03	0.1059E+03	0.1054E+03	0.1048E+03	0.1042E+03	0.1036E+03
-2200.00	0.1075E+03	0.1069E+03	0.1063E+03	0.1057E+03	0.1051E+03	0.1044E+03
-2100.00	0.1085E+03	0.1079E+03	0.1073E+03	0.1066E+03	0.1059E+03	0.1053E+03
[illegible]00.00	0.1096E+03	0.1089E+03	0.1082E+03	0.1075E+03	0.1068E+03	0.1061E+03
-1900.00	0.1107E+03	0.1100E+03	0.1092E+03	0.1085E+03	0.1077E+03	0.1070E+03

Y [ft]	<- X [ft] -> 1200	1300	1400	1500	1600	1700
-1800.00	0.1118E+03	0.1110E+03	0.1103E+03	0.1095E+03	0.1087E+03	0.1078E+03
-1700.00	0.1130E+03	0.1121E+03	0.1113E+03	0.1104E+03	0.1096E+03	0.1087E+03
-1600.00	0.1141E+03	0.1132E+03	0.1123E+03	0.1114E+03	0.1105E+03	0.1096E+03
-1500.00	0.1153E+03	0.1143E+03	0.1134E+03	0.1124E+03	0.1114E+03	0.1104E+03
-1400.00	0.1165E+03	0.1155E+03	0.1144E+03	0.1134E+03	0.1123E+03	0.1113E+03
-1300.00	0.1177E+03	0.1166E+03	0.1155E+03	0.1143E+03	0.1132E+03	0.1121E+03
-1200.00	0.1190E+03	0.1177E+03	0.1165E+03	0.1153E+03	0.1141E+03	0.1130E+03
-1100.00	0.1202E+03	0.1189E+03	0.1175E+03	0.1163E+03	0.1150E+03	0.1138E+03
-1000.00	0.1214E+03	0.1200E+03	0.1186E+03	0.1172E+03	0.1158E+03	0.1145E+03
-900.00	0.1226E+03	0.1210E+03	0.1195E+03	0.1181E+03	0.1166E+03	0.1153E+03
-800.00	0.1238E+03	0.1221E+03	0.1205E+03	0.1189E+03	0.1174E+03	0.1160E+03
-700.00	0.1249E+03	0.1231E+03	0.1213E+03	0.1197E+03	0.1181E+03	0.1166E+03
-600.00	0.1259E+03	0.1240E+03	0.1221E+03	0.1204E+03	0.1188E+03	0.1172E+03
-500.00	0.1268E+03	0.1248E+03	0.1229E+03	0.1210E+03	0.1193E+03	0.1177E+03
-400.00	0.1276E+03	0.1255E+03	0.1235E+03	0.1216E+03	0.1198E+03	0.1181E+03
-300.00	0.1283E+03	0.1261E+03	0.1240E+03	0.1220E+03	0.1202E+03	0.1185E+03
-200.00	0.1288E+03	0.1265E+03	0.1243E+03	0.1223E+03	0.1205E+03	0.1187E+03
-100.00	0.1291E+03	0.1267E+03	0.1246E+03	0.1225E+03	0.1206E+03	0.1189E+03
0.00	0.1292E+03	0.1268E+03	0.1246E+03	0.1226E+03	0.1207E+03	0.1189E+03
100.00	0.1291E+03	0.1267E+03	0.1246E+03	0.1225E+03	0.1206E+03	0.1189E+03
200.00	0.1288E+03	0.1265E+03	0.1243E+03	0.1223E+03	0.1205E+03	0.1187E+03
300.00	0.1283E+03	0.1261E+03	0.1240E+03	0.1220E+03	0.1202E+03	0.1185E+03
400.00	0.1276E+03	0.1255E+03	0.1235E+03	0.1216E+03	0.1198E+03	0.1181E+03
500.00	0.1268E+03	0.1248E+03	0.1229E+03	0.1210E+03	0.1193E+03	0.1177E+03
600.00	0.1259E+03	0.1240E+03	0.1221E+03	0.1204E+03	0.1188E+03	0.1172E+03
700.00	0.1249E+03	0.1231E+03	0.1213E+03	0.1197E+03	0.1181E+03	0.1166E+03
800.00	0.1238E+03	0.1221E+03	0.1205E+03	0.1189E+03	0.1174E+03	0.1160E+03
900.00	0.1226E+03	0.1210E+03	0.1195E+03	0.1181E+03	0.1166E+03	0.1153E+03
1000.00	0.1214E+03	0.1200E+03	0.1186E+03	0.1172E+03	0.1158E+03	0.1145E+03
1100.00	0.1202E+03	0.1189E+03	0.1175E+03	0.1163E+03	0.1150E+03	0.1138E+03
1200.00	0.1190E+03	0.1177E+03	0.1165E+03	0.1153E+03	0.1141E+03	0.1130E+03
1300.00	0.1177E+03	0.1166E+03	0.1155E+03	0.1143E+03	0.1132E+03	0.1121E+03
1400.00	0.1165E+03	0.1155E+03	0.1144E+03	0.1134E+03	0.1123E+03	0.1113E+03
1500.00	0.1153E+03	0.1143E+03	0.1134E+03	0.1124E+03	0.1114E+03	0.1104E+03
1600.00	0.1141E+03	0.1132E+03	0.1123E+03	0.1114E+03	0.1105E+03	0.1096E+03
1700.00	0.1130E+03	0.1121E+03	0.1113E+03	0.1104E+03	0.1096E+03	0.1087E+03
1800.00	0.1118E+03	0.1110E+03	0.1103E+03	0.1095E+03	0.1087E+03	0.1078E+03
1900.00	0.1107E+03	0.1100E+03	0.1092E+03	0.1085E+03	0.1077E+03	0.1070E+03
2000.00	0.1096E+03	0.1089E+03	0.1082E+03	0.1075E+03	0.1068E+03	0.1061E+03
2100.00	0.1085E+03	0.1079E+03	0.1073E+03	0.1066E+03	0.1059E+03	0.1053E+03

Y [ft] <- X [ft] ->

	1200	1300	1400	1500	1600	1700
2200.00	0.1075E+03	0.1069E+03	0.1063E+03	0.1057E+03	0.1051E+03	0.1044E+03
2300.00	0.1065E+03	0.1059E+03	0.1054E+03	0.1048E+03	0.1042E+03	0.1036E+03
2400.00	0.1055E+03	0.1050E+03	0.1044E+03	0.1039E+03	0.1033E+03	0.1028E+03
2500.00	0.1045E+03	0.1040E+03	0.1035E+03	0.1030E+03	0.1025E+03	0.1020E+03
2600.00	0.1036E+03	0.1031E+03	0.1026E+03	0.1022E+03	0.1017E+03	0.1012E+03
2700.00	0.1026E+03	0.1022E+03	0.1018E+03	0.1013E+03	0.1009E+03	0.1004E+03
2800.00	0.1017E+03	0.1013E+03	0.1009E+03	0.1005E+03	0.1001E+03	0.9959E+02
2900.00	0.1009E+03	0.1005E+03	0.1001E+03	0.9969E+02	0.9926E+02	0.9883E+02
3000.00	0.9999E+02	0.9965E+02	0.9928E+02	0.9889E+02	0.9849E+02	0.9808E+02

Y [ft] <- X [ft] ->

	1800	1900	2000	2100	2200	2300
-3000.00	0.9765E+02	0.9721E+02	0.9676E+02	0.9631E+02	0.9584E+02	0.9537E+02
-2900.00	0.9838E+02	0.9792E+02	0.9745E+02	0.9697E+02	0.9648E+02	0.9599E+02
-2800.00	0.9912E+02	0.9863E+02	0.9814E+02	0.9764E+02	0.9713E+02	0.9662E+02
700.00	0.9987E+02	0.9936E+02	0.9884E+02	0.9832E+02	0.9778E+02	0.9725E+02
00.00	0.1006E+03	0.1001E+03	0.9955E+02	0.9900E+02	0.9844E+02	0.9788E+02
-2500.00	0.1014E+03	0.1008E+03	0.1003E+03	0.9969E+02	0.9910E+02	0.9852E+02
-2400.00	0.1022E+03	0.1016E+03	0.1010E+03	0.1004E+03	0.9977E+02	0.9916E+02
-2300.00	0.1030E+03	0.1023E+03	0.1017E+03	0.1011E+03	0.1004E+03	0.9980E+02
-2200.00	0.1038E+03	0.1031E+03	0.1024E+03	0.1018E+03	0.1011E+03	0.1004E+03
-2100.00	0.1046E+03	0.1039E+03	0.1032E+03	0.1025E+03	0.1018E+03	0.1011E+03
-2000.00	0.1054E+03	0.1046E+03	0.1039E+03	0.1032E+03	0.1024E+03	0.1017E+03
-1900.00	0.1062E+03	0.1054E+03	0.1046E+03	0.1039E+03	0.1031E+03	0.1023E+03
-1800.00	0.1070E+03	0.1062E+03	0.1054E+03	0.1046E+03	0.1038E+03	0.1030E+03
-1700.00	0.1078E+03	0.1070E+03	0.1061E+03	0.1053E+03	0.1044E+03	0.1036E+03
-1600.00	0.1087E+03	0.1077E+03	0.1068E+03	0.1059E+03	0.1051E+03	0.1042E+03
-1500.00	0.1095E+03	0.1085E+03	0.1075E+03	0.1066E+03	0.1057E+03	0.1048E+03
-1400.00	0.1103E+03	0.1092E+03	0.1082E+03	0.1073E+03	0.1063E+03	0.1054E+03
-1300.00	0.1110E+03	0.1100E+03	0.1089E+03	0.1079E+03	0.1069E+03	0.1059E+03
-1200.00	0.1118E+03	0.1107E+03	0.1096E+03	0.1085E+03	0.1075E+03	0.1065E+03
-1100.00	0.1126E+03	0.1114E+03	0.1102E+03	0.1091E+03	0.1080E+03	0.1070E+03
-1000.00	0.1133E+03	0.1120E+03	0.1108E+03	0.1097E+03	0.1085E+03	0.1075E+03
-900.00	0.1139E+03	0.1127E+03	0.1114E+03	0.1102E+03	0.1090E+03	0.1079E+03
-800.00	0.1146E+03	0.1132E+03	0.1119E+03	0.1107E+03	0.1095E+03	0.1083E+03
-700.00	0.1152E+03	0.1138E+03	0.1124E+03	0.1111E+03	0.1099E+03	0.1087E+03
-600.00	0.1157E+03	0.1142E+03	0.1129E+03	0.1115E+03	0.1103E+03	0.1090E+03
-500.00	0.1161E+03	0.1146E+03	0.1132E+03	0.1119E+03	0.1106E+03	0.1093E+03
-400.00	0.1165E+03	0.1150E+03	0.1135E+03	0.1122E+03	0.1108E+03	0.1096E+03
-300.00	0.1168E+03	0.1153E+03	0.1138E+03	0.1124E+03	0.1110E+03	0.1098E+03
-200.00	0.1170E+03	0.1155E+03	0.1140E+03	0.1126E+03	0.1112E+03	0.1099E+03
00.00	0.1172E+03	0.1156E+03	0.1141E+03	0.1127E+03	0.1113E+03	0.1100E+03
0.00	0.1172E+03	0.1156E+03	0.1141E+03	0.1127E+03	0.1113E+03	0.1100E+03

Y [ft] <- X [ft] ->

Y [ft]	1800	1900	2000	2100	2200	2300
100.00	0.1172E+03	0.1156E+03	0.1141E+03	0.1127E+03	0.1113E+03	0.1100E+03
200.00	0.1170E+03	0.1155E+03	0.1140E+03	0.1126E+03	0.1112E+03	0.1099E+03
300.00	0.1168E+03	0.1153E+03	0.1138E+03	0.1124E+03	0.1110E+03	0.1098E+03
400.00	0.1165E+03	0.1150E+03	0.1135E+03	0.1122E+03	0.1108E+03	0.1096E+03
500.00	0.1161E+03	0.1146E+03	0.1132E+03	0.1119E+03	0.1106E+03	0.1093E+03
600.00	0.1157E+03	0.1142E+03	0.1129E+03	0.1115E+03	0.1103E+03	0.1090E+03
700.00	0.1152E+03	0.1138E+03	0.1124E+03	0.1111E+03	0.1099E+03	0.1087E+03
800.00	0.1146E+03	0.1132E+03	0.1119E+03	0.1107E+03	0.1095E+03	0.1083E+03
900.00	0.1139E+03	0.1127E+03	0.1114E+03	0.1102E+03	0.1090E+03	0.1079E+03
1000.00	0.1133E+03	0.1120E+03	0.1108E+03	0.1097E+03	0.1085E+03	0.1075E+03
1100.00	0.1126E+03	0.1114E+03	0.1102E+03	0.1091E+03	0.1080E+03	0.1070E+03
1200.00	0.1118E+03	0.1107E+03	0.1096E+03	0.1085E+03	0.1075E+03	0.1065E+03
1300.00	0.1110E+03	0.1100E+03	0.1089E+03	0.1079E+03	0.1069E+03	0.1059E+03
1400.00	0.1103E+03	0.1092E+03	0.1082E+03	0.1073E+03	0.1063E+03	0.1054E+03
1500.00	0.1095E+03	0.1085E+03	0.1075E+03	0.1066E+03	0.1057E+03	0.1048E+03
1600.00	0.1087E+03	0.1077E+03	0.1068E+03	0.1059E+03	0.1051E+03	0.1042E+03
1700.00	0.1078E+03	0.1070E+03	0.1061E+03	0.1053E+03	0.1044E+03	0.1036E+03
1800.00	0.1070E+03	0.1062E+03	0.1054E+03	0.1046E+03	0.1038E+03	0.1030E+03
1900.00	0.1062E+03	0.1054E+03	0.1046E+03	0.1039E+03	0.1031E+03	0.1023E+03
2000.00	0.1054E+03	0.1046E+03	0.1039E+03	0.1032E+03	0.1024E+03	0.1017E+03
2100.00	0.1046E+03	0.1039E+03	0.1032E+03	0.1025E+03	0.1018E+03	0.1011E+03
2200.00	0.1038E+03	0.1031E+03	0.1024E+03	0.1018E+03	0.1011E+03	0.1004E+03
2300.00	0.1030E+03	0.1023E+03	0.1017E+03	0.1011E+03	0.1004E+03	0.9980E+02
2400.00	0.1022E+03	0.1016E+03	0.1010E+03	0.1004E+03	0.9977E+02	0.9916E+02
2500.00	0.1014E+03	0.1008E+03	0.1003E+03	0.9969E+02	0.9910E+02	0.9852E+02
2600.00	0.1006E+03	0.1001E+03	0.9955E+02	0.9900E+02	0.9844E+02	0.9788E+02
2700.00	0.9987E+02	0.9936E+02	0.9884E+02	0.9832E+02	0.9778E+02	0.9725E+02
2800.00	0.9912E+02	0.9863E+02	0.9814E+02	0.9764E+02	0.9713E+02	0.9662E+02
2900.00	0.9838E+02	0.9792E+02	0.9745E+02	0.9697E+02	0.9648E+02	0.9599E+02
3000.00	0.9765E+02	0.9721E+02	0.9676E+02	0.9631E+02	0.9584E+02	0.9537E+02

Y [ft] <- X [ft] ->

Y [ft]	2400	2500	2600	2700	2800	2900
-3000.00	0.9490E+02	0.9441E+02	0.9393E+02	0.9344E+02	0.9295E+02	0.9246E+02
-2900.00	0.9550E+02	0.9500E+02	0.9449E+02	0.9399E+02	0.9348E+02	0.9297E+02
-2800.00	0.9610E+02	0.9558E+02	0.9506E+02	0.9453E+02	0.9400E+02	0.9348E+02
-2700.00	0.9671E+02	0.9617E+02	0.9562E+02	0.9508E+02	0.9453E+02	0.9399E+02
-2600.00	0.9732E+02	0.9675E+02	0.9619E+02	0.9562E+02	0.9506E+02	0.9449E+02
-2500.00	0.9793E+02	0.9734E+02	0.9675E+02	0.9617E+02	0.9558E+02	0.9500E+02
-2400.00	0.9854E+02	0.9793E+02	0.9732E+02	0.9671E+02	0.9610E+02	0.9550E+02
-2300.00	0.9916E+02	0.9852E+02	0.9788E+02	0.9725E+02	0.9662E+02	0.9599E+02
-2200.00	0.9977E+02	0.9910E+02	0.9844E+02	0.9778E+02	0.9713E+02	0.9648E+02
-2100.00	0.1004E+03	0.9969E+02	0.9900E+02	0.9832E+02	0.9764E+02	0.9697E+02

Y [ft] <- X [ft] ->

Y [ft]	2400	2500	2600	2700	2800	2900
-2000.00	0.1010E+03	0.1003E+03	0.9955E+02	0.9884E+02	0.9814E+02	0.9745E+02
-1900.00	0.1016E+03	0.1008E+03	0.1001E+03	0.9936E+02	0.9863E+02	0.9792E+02
-1800.00	0.1022E+03	0.1014E+03	0.1006E+03	0.9987E+02	0.9912E+02	0.9838E+02
-1700.00	0.1028E+03	0.1020E+03	0.1012E+03	0.1004E+03	0.9959E+02	0.9883E+02
-1600.00	0.1033E+03	0.1025E+03	0.1017E+03	0.1009E+03	0.1001E+03	0.9926E+02
-1500.00	0.1039E+03	0.1030E+03	0.1022E+03	0.1013E+03	0.1005E+03	0.9969E+02
-1400.00	0.1044E+03	0.1035E+03	0.1026E+03	0.1018E+03	0.1009E+03	0.1001E+03
-1300.00	0.1050E+03	0.1040E+03	0.1031E+03	0.1022E+03	0.1013E+03	0.1005E+03
-1200.00	0.1055E+03	0.1045E+03	0.1036E+03	0.1026E+03	0.1017E+03	0.1009E+03
-1100.00	0.1059E+03	0.1049E+03	0.1040E+03	0.1030E+03	0.1021E+03	0.1012E+03
-1000.00	0.1064E+03	0.1054E+03	0.1044E+03	0.1034E+03	0.1024E+03	0.1015E+03
-900.00	0.1068E+03	0.1058E+03	0.1047E+03	0.1037E+03	0.1028E+03	0.1018E+03
-800.00	0.1072E+03	0.1061E+03	0.1051E+03	0.1040E+03	0.1031E+03	0.1021E+03
-700.00	0.1075E+03	0.1064E+03	0.1054E+03	0.1043E+03	0.1033E+03	0.1023E+03
-600.00	0.1079E+03	0.1067E+03	0.1056E+03	0.1046E+03	0.1036E+03	0.1026E+03
-500.00	0.1081E+03	0.1070E+03	0.1059E+03	0.1048E+03	0.1037E+03	0.1027E+03
-400.00	0.1083E+03	0.1072E+03	0.1060E+03	0.1050E+03	0.1039E+03	0.1029E+03
-300.00	0.1085E+03	0.1073E+03	0.1062E+03	0.1051E+03	0.1040E+03	0.1030E+03
-200.00	0.1087E+03	0.1075E+03	0.1063E+03	0.1052E+03	0.1041E+03	0.1031E+03
-100.00	0.1087E+03	0.1075E+03	0.1064E+03	0.1053E+03	0.1042E+03	0.1032E+03
0.00	0.1088E+03	0.1075E+03	0.1064E+03	0.1053E+03	0.1042E+03	0.1032E+03
100.00	0.1087E+03	0.1075E+03	0.1064E+03	0.1053E+03	0.1042E+03	0.1032E+03
200.00	0.1087E+03	0.1075E+03	0.1063E+03	0.1052E+03	0.1041E+03	0.1031E+03
300.00	0.1085E+03	0.1073E+03	0.1062E+03	0.1051E+03	0.1040E+03	0.1030E+03
400.00	0.1083E+03	0.1072E+03	0.1060E+03	0.1050E+03	0.1039E+03	0.1029E+03
500.00	0.1081E+03	0.1070E+03	0.1059E+03	0.1048E+03	0.1037E+03	0.1027E+03
600.00	0.1079E+03	0.1067E+03	0.1056E+03	0.1046E+03	0.1036E+03	0.1026E+03
700.00	0.1075E+03	0.1064E+03	0.1054E+03	0.1043E+03	0.1033E+03	0.1023E+03
800.00	0.1072E+03	0.1061E+03	0.1051E+03	0.1040E+03	0.1031E+03	0.1021E+03
900.00	0.1068E+03	0.1058E+03	0.1047E+03	0.1037E+03	0.1028E+03	0.1018E+03
1000.00	0.1064E+03	0.1054E+03	0.1044E+03	0.1034E+03	0.1024E+03	0.1015E+03
1100.00	0.1059E+03	0.1049E+03	0.1040E+03	0.1030E+03	0.1021E+03	0.1012E+03
1200.00	0.1055E+03	0.1045E+03	0.1036E+03	0.1026E+03	0.1017E+03	0.1009E+03
1300.00	0.1050E+03	0.1040E+03	0.1031E+03	0.1022E+03	0.1013E+03	0.1005E+03
1400.00	0.1044E+03	0.1035E+03	0.1026E+03	0.1018E+03	0.1009E+03	0.1001E+03
1500.00	0.1039E+03	0.1030E+03	0.1022E+03	0.1013E+03	0.1005E+03	0.9969E+02
1600.00	0.1033E+03	0.1025E+03	0.1017E+03	0.1009E+03	0.1001E+03	0.9926E+02
1700.00	0.1028E+03	0.1020E+03	0.1012E+03	0.1004E+03	0.9959E+02	0.9883E+02
1800.00	0.1022E+03	0.1014E+03	0.1006E+03	0.9987E+02	0.9912E+02	0.9838E+02
1900.00	0.1016E+03	0.1008E+03	0.1001E+03	0.9936E+02	0.9863E+02	0.9792E+02

Y [ft] <- X [ft] ->

Y [ft]	2400	2500	2600	2700	2800	2900
2000.00	0.1010E+03	0.1003E+03	0.9955E+02	0.9884E+02	0.9814E+02	0.9745E+02
2100.00	0.1004E+03	0.9969E+02	0.9900E+02	0.9832E+02	0.9764E+02	0.9697E+02
2200.00	0.9977E+02	0.9910E+02	0.9844E+02	0.9778E+02	0.9713E+02	0.9648E+02
2300.00	0.9916E+02	0.9852E+02	0.9788E+02	0.9725E+02	0.9662E+02	0.9599E+02
2400.00	0.9854E+02	0.9793E+02	0.9732E+02	0.9671E+02	0.9610E+02	0.9550E+02
2500.00	0.9793E+02	0.9734E+02	0.9675E+02	0.9617E+02	0.9558E+02	0.9500E+02
2600.00	0.9732E+02	0.9675E+02	0.9619E+02	0.9562E+02	0.9506E+02	0.9449E+02
2700.00	0.9671E+02	0.9617E+02	0.9562E+02	0.9508E+02	0.9453E+02	0.9399E+02
2800.00	0.9610E+02	0.9558E+02	0.9506E+02	0.9453E+02	0.9400E+02	0.9348E+02
2900.00	0.9550E+02	0.9500E+02	0.9449E+02	0.9399E+02	0.9348E+02	0.9297E+02
3000.00	0.9490E+02	0.9441E+02	0.9393E+02	0.9344E+02	0.9295E+02	0.9246E+02

Y [ft] <- X [ft] ->

Y [ft]	3000
-3000.00	0.9197E+02
-2900.00	0.9246E+02
300.00	0.9295E+02
/00.00	0.9344E+02
-2600.00	0.9393E+02
-2500.00	0.9441E+02
-2400.00	0.9490E+02
-2300.00	0.9537E+02
-2200.00	0.9584E+02
-2100.00	0.9631E+02
-2000.00	0.9676E+02
-1900.00	0.9721E+02
-1800.00	0.9765E+02
-1700.00	0.9808E+02
-1600.00	0.9849E+02
-1500.00	0.9889E+02
-1400.00	0.9928E+02
-1300.00	0.9965E+02
-1200.00	0.9999E+02
-1100.00	0.1003E+03
-1000.00	0.1006E+03
-900.00	0.1009E+03
-800.00	0.1012E+03
-700.00	0.1014E+03
-600.00	0.1016E+03
-500.00	0.1018E+03
-400.00	0.1019E+03
-300.00	0.1020E+03
00.00	0.1021E+03

Y [ft]	<- X [ft] ->
	3000
-100.00	0.1022E+03
0.00	0.1022E+03
100.00	0.1022E+03
200.00	0.1021E+03
300.00	0.1020E+03
400.00	0.1019E+03
500.00	0.1018E+03
600.00	0.1016E+03
700.00	0.1014E+03
800.00	0.1012E+03
900.00	0.1009E+03
1000.00	0.1006E+03
1100.00	0.1003E+03
1200.00	0.9999E+02
1300.00	0.9965E+02
1400.00	0.9928E+02
1500.00	0.9889E+02
1600.00	0.9849E+02
1700.00	0.9808E+02
1800.00	0.9765E+02
[illegible]00.00	0.9721E+02
00.00	0.9676E+02
2100.00	0.9631E+02
2200.00	0.9584E+02
2300.00	0.9537E+02
2400.00	0.9490E+02
2500.00	0.9441E+02
2600.00	0.9393E+02
2700.00	0.9344E+02
2800.00	0.9295E+02
2900.00	0.9246E+02
3000.00	0.9197E+02

APPENDIX G

James Formation Reservoir Pressure Modeling

****************************** THWELLS ******************************* PAGE 1

CA CULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC NONLEAKY CONFINED
A FER WITH MULTIPLE PRODUCTION AND INJECTION WELLS

---

pressure increase in James after 10 yrs at 100 gpm

********************************** INPUT DATA **********************************

TRANSMISSIVITY = 173 [gpd/ft]

STORAGE COEFFICIENT = .0000273

REGIONAL FLOW GRADIENT
(positive--downwards--in flow direction) = 0

REGIONAL FLOW DIRECTION
(horizontal angle in degrees
counter-clockwise from positive x-axis) = 0

REGIONAL FLOW OFFSET AT ORIGIN
(positive in downwards direction) = 0 [ft]

```
WELL NO. 1

                         X-COORDINATE  =  0 [ft]
                         Y-COORDINATE  =  0 [ft]
               PUMPING/INJECTION RATE  = -100 [gpm]
   START TIME OF PUMPING/INJECTION  =  0 [day]
```

------------------ Pressure in psi -- Time in [days] ----------------------

X-coordinate observation well = 1 [ft]
Y-coordinate observation well = 0 [ft]

time	pressure	time	pressure	time	pressure	time	pressure
3653.000	650.467						

C^' CULATION OF DRAWDOWN IN A HOMOGENEOUS, ISOTROPIC NONLEAKY CONFINED
A :FER WITH MULTIPLE PRODUCTION AND INJECTION WELLS

---

pressure increase in James after 10 yrs at 100 gpm

************************************ INPUT DATA ************************************

TRANSMISSIVITY = 173 [gpd/ft]

STORAGE COEFFICIENT = .0000273

REGIONAL FLOW GRADIENT
(positive--downwards--in flow direction) = 0

REGIONAL FLOW DIRECTION
(horizontal angle in degrees
counter-clockwise from positive x-axis) = 0

REGIONAL FLOW OFFSET AT ORIGIN
(positive in downwards direction) = 0 [ft]

WELL NO. 1

```
                    X-COORDINATE  =  0 [ft]
                    Y-COORDINATE  =  0 [ft]
          PUMPING/INJECTION RATE  = -100 [gpm]
START TIME OF PUMPING/INJECTION  =  0 [day]
```

******************************** RESULTS FOR TIME = 3653 ******************
THWELLS - PAGE 3

------------------------------ Pressure in psi ------------------------------

Y [ft] <- X [ft] ->

Y [ft]	-3000	-2900	-2800	-2700	-2600	-2500
-3000.00	0.1710E+03	0.1720E+03	0.1729E+03	0.1739E+03	0.1748E+03	0.1758E+03
-2900.00	0.1720E+03	0.1729E+03	0.1739E+03	0.1749E+03	0.1759E+03	0.1769E+03
-2800.00	0.1729E+03	0.1739E+03	0.1750E+03	0.1760E+03	0.1770E+03	0.1780E+03
-2700.00	0.1739E+03	0.1749E+03	0.1760E+03	0.1770E+03	0.1781E+03	0.1792E+03
-2600.00	0.1748E+03	0.1759E+03	0.1770E+03	0.1781E+03	0.1792E+03	0.1803E+03
-2500.00	0.1758E+03	0.1769E+03	0.1780E+03	0.1792E+03	0.1803E+03	0.1815E+03
-2400.00	0.1767E+03	0.1779E+03	0.1790E+03	0.1802E+03	0.1814E+03	0.1826E+03
-2300.00	0.1776E+03	0.1788E+03	0.1800E+03	0.1813E+03	0.1825E+03	0.1837E+03
-2200.00	0.1785E+03	0.1798E+03	0.1810E+03	0.1823E+03	0.1836E+03	0.1849E+03
-2100.00	0.1794E+03	0.1807E+03	0.1820E+03	0.1833E+03	0.1847E+03	0.1860E+03
-2000.00	0.1803E+03	0.1817E+03	0.1830E+03	0.1844E+03	0.1858E+03	0.1871E+03
-1900.00	0.1812E+03	0.1826E+03	0.1840E+03	0.1854E+03	0.1868E+03	0.1883E+03
-1800.00	0.1821E+03	0.1835E+03	0.1849E+03	0.1864E+03	0.1879E+03	0.1894E+03
-1700.00	0.1829E+03	0.1843E+03	0.1858E+03	0.1873E+03	0.1889E+03	0.1904E+03
-1600.00	0.1837E+03	0.1852E+03	0.1867E+03	0.1883E+03	0.1899E+03	0.1915E+03
-1500.00	0.1845E+03	0.1860E+03	0.1876E+03	0.1892E+03	0.1908E+03	0.1925E+03
[illegible]00.00	0.1852E+03	0.1868E+03	0.1884E+03	0.1901E+03	0.1918E+03	0.1935E+03
[illegible]00.00	0.1859E+03	0.1876E+03	0.1892E+03	0.1909E+03	0.1927E+03	0.1945E+03
-1200.00	0.1866E+03	0.1883E+03	0.1900E+03	0.1917E+03	0.1935E+03	0.1954E+03
-1100.00	0.1873E+03	0.1890E+03	0.1907E+03	0.1925E+03	0.1944E+03	0.1963E+03
-1000.00	0.1879E+03	0.1896E+03	0.1914E+03	0.1932E+03	0.1951E+03	0.1971E+03
-900.00	0.1884E+03	0.1902E+03	0.1920E+03	0.1939E+03	0.1958E+03	0.1978E+03
-800.00	0.1889E+03	0.1907E+03	0.1926E+03	0.1945E+03	0.1965E+03	0.1985E+03
-700.00	0.1894E+03	0.1912E+03	0.1931E+03	0.1951E+03	0.1971E+03	0.1992E+03
-600.00	0.1897E+03	0.1916E+03	0.1935E+03	0.1955E+03	0.1976E+03	0.1997E+03
-500.00	0.1901E+03	0.1920E+03	0.1939E+03	0.1960E+03	0.1980E+03	0.2002E+03
-400.00	0.1904E+03	0.1923E+03	0.1943E+03	0.1963E+03	0.1984E+03	0.2006E+03
-300.00	0.1906E+03	0.1925E+03	0.1945E+03	0.1966E+03	0.1987E+03	0.2009E+03
-200.00	0.1907E+03	0.1927E+03	0.1947E+03	0.1968E+03	0.1989E+03	0.2012E+03
-100.00	0.1908E+03	0.1928E+03	0.1948E+03	0.1969E+03	0.1990E+03	0.2013E+03
0.00	0.1909E+03	0.1928E+03	0.1948E+03	0.1969E+03	0.1991E+03	0.2013E+03
100.00	0.1908E+03	0.1928E+03	0.1948E+03	0.1969E+03	0.1990E+03	0.2013E+03
200.00	0.1907E+03	0.1927E+03	0.1947E+03	0.1968E+03	0.1989E+03	0.2012E+03
300.00	0.1906E+03	0.1925E+03	0.1945E+03	0.1966E+03	0.1987E+03	0.2009E+03
400.00	0.1904E+03	0.1923E+03	0.1943E+03	0.1963E+03	0.1984E+03	0.2006E+03
500.00	0.1901E+03	0.1920E+03	0.1939E+03	0.1960E+03	0.1980E+03	0.2002E+03
600.00	0.1897E+03	0.1916E+03	0.1935E+03	0.1955E+03	0.1976E+03	0.1997E+03
700.00	0.1894E+03	0.1912E+03	0.1931E+03	0.1951E+03	0.1971E+03	0.1992E+03
800.00	0.1889E+03	0.1907E+03	0.1926E+03	0.1945E+03	0.1965E+03	0.1985E+03

[ft] <- X [ft] ->

	-3000	-2900	-2800	-2700	-2600	-2500
900.00	0.1884E+03	0.1902E+03	0.1920E+03	0.1939E+03	0.1958E+03	0.1978E+03
1000.00	0.1879E+03	0.1896E+03	0.1914E+03	0.1932E+03	0.1951E+03	0.1971E+03
1100.00	0.1873E+03	0.1890E+03	0.1907E+03	0.1925E+03	0.1944E+03	0.1963E+03
1200.00	0.1866E+03	0.1883E+03	0.1900E+03	0.1917E+03	0.1935E+03	0.1954E+03
1300.00	0.1859E+03	0.1876E+03	0.1892E+03	0.1909E+03	0.1927E+03	0.1945E+03
1400.00	0.1852E+03	0.1868E+03	0.1884E+03	0.1901E+03	0.1918E+03	0.1935E+03
1500.00	0.1845E+03	0.1860E+03	0.1876E+03	0.1892E+03	0.1908E+03	0.1925E+03
1600.00	0.1837E+03	0.1852E+03	0.1867E+03	0.1883E+03	0.1899E+03	0.1915E+03
1700.00	0.1829E+03	0.1843E+03	0.1858E+03	0.1873E+03	0.1889E+03	0.1904E+03
1800.00	0.1821E+03	0.1835E+03	0.1849E+03	0.1864E+03	0.1879E+03	0.1894E+03
1900.00	0.1812E+03	0.1826E+03	0.1840E+03	0.1854E+03	0.1868E+03	0.1883E+03
2000.00	0.1803E+03	0.1817E+03	0.1830E+03	0.1844E+03	0.1858E+03	0.1871E+03
2100.00	0.1794E+03	0.1807E+03	0.1820E+03	0.1833E+03	0.1847E+03	0.1860E+03
2200.00	0.1785E+03	0.1798E+03	0.1810E+03	0.1823E+03	0.1836E+03	0.1849E+03
2300.00	0.1776E+03	0.1788E+03	0.1800E+03	0.1813E+03	0.1825E+03	0.1837E+03
2400.00	0.1767E+03	0.1779E+03	0.1790E+03	0.1802E+03	0.1814E+03	0.1826E+03
2500.00	0.1758E+03	0.1769E+03	0.1780E+03	0.1792E+03	0.1803E+03	0.1815E+03
2600.00	0.1748E+03	0.1759E+03	0.1770E+03	0.1781E+03	0.1792E+03	0.1803E+03
2700.00	0.1739E+03	0.1749E+03	0.1760E+03	0.1770E+03	0.1781E+03	0.1792E+03
2800.00	0.1729E+03	0.1739E+03	0.1750E+03	0.1760E+03	0.1770E+03	0.1780E+03
900.00	0.1720E+03	0.1729E+03	0.1739E+03	0.1749E+03	0.1759E+03	0.1769E+03
000.00	0.1710E+03	0.1720E+03	0.1729E+03	0.1739E+03	0.1748E+03	0.1758E+03

Y [ft] <- X [ft] ->

	-2400	-2300	-2200	-2100	-2000	-1900
-3000.00	0.1767E+03	0.1776E+03	0.1785E+03	0.1794E+03	0.1803E+03	0.1812E+03
-2900.00	0.1779E+03	0.1788E+03	0.1798E+03	0.1807E+03	0.1817E+03	0.1826E+03
-2800.00	0.1790E+03	0.1800E+03	0.1810E+03	0.1820E+03	0.1830E+03	0.1840E+03
-2700.00	0.1802E+03	0.1813E+03	0.1823E+03	0.1833E+03	0.1844E+03	0.1854E+03
-2600.00	0.1814E+03	0.1825E+03	0.1836E+03	0.1847E+03	0.1858E+03	0.1868E+03
-2500.00	0.1826E+03	0.1837E+03	0.1849E+03	0.1860E+03	0.1871E+03	0.1883E+03
-2400.00	0.1838E+03	0.1850E+03	0.1862E+03	0.1874E+03	0.1885E+03	0.1897E+03
-2300.00	0.1850E+03	0.1862E+03	0.1875E+03	0.1887E+03	0.1900E+03	0.1912E+03
-2200.00	0.1862E+03	0.1875E+03	0.1888E+03	0.1901E+03	0.1914E+03	0.1927E+03
-2100.00	0.1874E+03	0.1887E+03	0.1901E+03	0.1915E+03	0.1928E+03	0.1942E+03
-2000.00	0.1885E+03	0.1900E+03	0.1914E+03	0.1928E+03	0.1943E+03	0.1957E+03
-1900.00	0.1897E+03	0.1912E+03	0.1927E+03	0.1942E+03	0.1957E+03	0.1972E+03
-1800.00	0.1909E+03	0.1924E+03	0.1940E+03	0.1955E+03	0.1971E+03	0.1987E+03
-1700.00	0.1920E+03	0.1936E+03	0.1952E+03	0.1969E+03	0.1985E+03	0.2002E+03
-1600.00	0.1931E+03	0.1948E+03	0.1965E+03	0.1982E+03	0.1999E+03	0.2017E+03
-1500.00	0.1942E+03	0.1960E+03	0.1977E+03	0.1995E+03	0.2013E+03	0.2032E+03
-1400.00	0.1953E+03	0.1971E+03	0.1989E+03	0.2008E+03	0.2027E+03	0.2046E+03
00.00	0.1963E+03	0.1982E+03	0.2001E+03	0.2020E+03	0.2040E+03	0.2061E+03

[ft]	<- X [ft] ->					
	-2400	-2300	-2200	-2100	-2000	-1900
-1200.00	0.1973E+03	0.1992E+03	0.2012E+03	0.2032E+03	0.2053E+03	0.2074E+03
-1100.00	0.1982E+03	0.2002E+03	0.2023E+03	0.2044E+03	0.2066E+03	0.2088E+03
-1000.00	0.1991E+03	0.2012E+03	0.2033E+03	0.2055E+03	0.2077E+03	0.2101E+03
-900.00	0.1999E+03	0.2020E+03	0.2042E+03	0.2065E+03	0.2088E+03	0.2113E+03
-800.00	0.2007E+03	0.2028E+03	0.2051E+03	0.2074E+03	0.2099E+03	0.2124E+03
-700.00	0.2013E+03	0.2036E+03	0.2059E+03	0.2083E+03	0.2108E+03	0.2134E+03
-600.00	0.2019E+03	0.2042E+03	0.2066E+03	0.2091E+03	0.2117E+03	0.2144E+03
-500.00	0.2025E+03	0.2048E+03	0.2072E+03	0.2098E+03	0.2124E+03	0.2152E+03
-400.00	0.2029E+03	0.2053E+03	0.2077E+03	0.2103E+03	0.2130E+03	0.2158E+03
-300.00	0.2032E+03	0.2056E+03	0.2081E+03	0.2108E+03	0.2135E+03	0.2164E+03
-200.00	0.2035E+03	0.2059E+03	0.2084E+03	0.2111E+03	0.2139E+03	0.2168E+03
-100.00	0.2036E+03	0.2061E+03	0.2086E+03	0.2113E+03	0.2141E+03	0.2170E+03
0.00	0.2037E+03	0.2061E+03	0.2087E+03	0.2113E+03	0.2141E+03	0.2171E+03
100.00	0.2036E+03	0.2061E+03	0.2086E+03	0.2113E+03	0.2141E+03	0.2170E+03
200.00	0.2035E+03	0.2059E+03	0.2084E+03	0.2111E+03	0.2139E+03	0.2168E+03
300.00	0.2032E+03	0.2056E+03	0.2081E+03	0.2108E+03	0.2135E+03	0.2164E+03
400.00	0.2029E+03	0.2053E+03	0.2077E+03	0.2103E+03	0.2130E+03	0.2158E+03
500.00	0.2025E+03	0.2048E+03	0.2072E+03	0.2098E+03	0.2124E+03	0.2152E+03
600.00	0.2019E+03	0.2042E+03	0.2066E+03	0.2091E+03	0.2117E+03	0.2144E+03
700.00	0.2013E+03	0.2036E+03	0.2059E+03	0.2083E+03	0.2108E+03	0.2134E+03
800.00	0.2007E+03	0.2028E+03	0.2051E+03	0.2074E+03	0.2099E+03	0.2124E+03
900.00	0.1999E+03	0.2020E+03	0.2042E+03	0.2065E+03	0.2088E+03	0.2113E+03
1000.00	0.1991E+03	0.2012E+03	0.2033E+03	0.2055E+03	0.2077E+03	0.2101E+03
1100.00	0.1982E+03	0.2002E+03	0.2023E+03	0.2044E+03	0.2066E+03	0.2088E+03
1200.00	0.1973E+03	0.1992E+03	0.2012E+03	0.2032E+03	0.2053E+03	0.2074E+03
1300.00	0.1963E+03	0.1982E+03	0.2001E+03	0.2020E+03	0.2040E+03	0.2061E+03
1400.00	0.1953E+03	0.1971E+03	0.1989E+03	0.2008E+03	0.2027E+03	0.2046E+03
1500.00	0.1942E+03	0.1960E+03	0.1977E+03	0.1995E+03	0.2013E+03	0.2032E+03
1600.00	0.1931E+03	0.1948E+03	0.1965E+03	0.1982E+03	0.1999E+03	0.2017E+03
1700.00	0.1920E+03	0.1936E+03	0.1952E+03	0.1969E+03	0.1985E+03	0.2002E+03
1800.00	0.1909E+03	0.1924E+03	0.1940E+03	0.1955E+03	0.1971E+03	0.1987E+03
1900.00	0.1897E+03	0.1912E+03	0.1927E+03	0.1942E+03	0.1957E+03	0.1972E+03
2000.00	0.1885E+03	0.1900E+03	0.1914E+03	0.1928E+03	0.1943E+03	0.1957E+03
2100.00	0.1874E+03	0.1887E+03	0.1901E+03	0.1915E+03	0.1928E+03	0.1942E+03
2200.00	0.1862E+03	0.1875E+03	0.1888E+03	0.1901E+03	0.1914E+03	0.1927E+03
2300.00	0.1850E+03	0.1862E+03	0.1875E+03	0.1887E+03	0.1900E+03	0.1912E+03
2400.00	0.1838E+03	0.1850E+03	0.1862E+03	0.1874E+03	0.1885E+03	0.1897E+03
2500.00	0.1826E+03	0.1837E+03	0.1849E+03	0.1860E+03	0.1871E+03	0.1883E+03
2600.00	0.1814E+03	0.1825E+03	0.1836E+03	0.1847E+03	0.1858E+03	0.1868E+03
2700.00	0.1802E+03	0.1813E+03	0.1823E+03	0.1833E+03	0.1844E+03	0.1854E+03

[ft]	<- X [ft] ->					
	-2400	-2300	-2200	-2100	-2000	-1900
2800.00	0.1790E+03	0.1800E+03	0.1810E+03	0.1820E+03	0.1830E+03	0.1840E+03
2900.00	0.1779E+03	0.1788E+03	0.1798E+03	0.1807E+03	0.1817E+03	0.1826E+03
3000.00	0.1767E+03	0.1776E+03	0.1785E+03	0.1794E+03	0.1803E+03	0.1812E+03

Y [ft]	<- X [ft] ->					
	-1800	-1700	-1600	-1500	-1400	-1300
-3000.00	0.1821E+03	0.1829E+03	0.1837E+03	0.1845E+03	0.1852E+03	0.1859E+03
-2900.00	0.1835E+03	0.1843E+03	0.1852E+03	0.1860E+03	0.1868E+03	0.1876E+03
-2800.00	0.1849E+03	0.1858E+03	0.1867E+03	0.1876E+03	0.1884E+03	0.1892E+03
-2700.00	0.1864E+03	0.1873E+03	0.1883E+03	0.1892E+03	0.1901E+03	0.1909E+03
-2600.00	0.1879E+03	0.1889E+03	0.1899E+03	0.1908E+03	0.1918E+03	0.1927E+03
-2500.00	0.1894E+03	0.1904E+03	0.1915E+03	0.1925E+03	0.1935E+03	0.1945E+03
-2400.00	0.1909E+03	0.1920E+03	0.1931E+03	0.1942E+03	0.1953E+03	0.1963E+03
-2300.00	0.1924E+03	0.1936E+03	0.1948E+03	0.1960E+03	0.1971E+03	0.1982E+03
-2200.00	0.1940E+03	0.1952E+03	0.1965E+03	0.1977E+03	0.1989E+03	0.2001E+03
-2100.00	0.1955E+03	0.1969E+03	0.1982E+03	0.1995E+03	0.2008E+03	0.2020E+03
000.00	0.1971E+03	0.1985E+03	0.1999E+03	0.2013E+03	0.2027E+03	0.2040E+03
900.00	0.1987E+03	0.2002E+03	0.2017E+03	0.2032E+03	0.2046E+03	0.2061E+03
-1800.00	0.2003E+03	0.2019E+03	0.2035E+03	0.2051E+03	0.2066E+03	0.2081E+03
-1700.00	0.2019E+03	0.2036E+03	0.2053E+03	0.2069E+03	0.2086E+03	0.2103E+03
-1600.00	0.2035E+03	0.2053E+03	0.2071E+03	0.2088E+03	0.2106E+03	0.2124E+03
-1500.00	0.2051E+03	0.2069E+03	0.2088E+03	0.2108E+03	0.2127E+03	0.2146E+03
-1400.00	0.2066E+03	0.2086E+03	0.2106E+03	0.2127E+03	0.2147E+03	0.2168E+03
-1300.00	0.2081E+03	0.2103E+03	0.2124E+03	0.2146E+03	0.2168E+03	0.2190E+03
-1200.00	0.2096E+03	0.2119E+03	0.2141E+03	0.2165E+03	0.2188E+03	0.2212E+03
-1100.00	0.2111E+03	0.2134E+03	0.2158E+03	0.2183E+03	0.2208E+03	0.2234E+03
-1000.00	0.2125E+03	0.2149E+03	0.2175E+03	0.2201E+03	0.2228E+03	0.2255E+03
-900.00	0.2138E+03	0.2164E+03	0.2191E+03	0.2218E+03	0.2247E+03	0.2276E+03
-800.00	0.2150E+03	0.2177E+03	0.2205E+03	0.2235E+03	0.2265E+03	0.2296E+03
-700.00	0.2161E+03	0.2190E+03	0.2219E+03	0.2250E+03	0.2282E+03	0.2316E+03
-600.00	0.2172E+03	0.2201E+03	0.2232E+03	0.2264E+03	0.2298E+03	0.2333E+03
-500.00	0.2181E+03	0.2211E+03	0.2243E+03	0.2276E+03	0.2312E+03	0.2349E+03
-400.00	0.2188E+03	0.2219E+03	0.2252E+03	0.2287E+03	0.2324E+03	0.2363E+03
-300.00	0.2194E+03	0.2226E+03	0.2260E+03	0.2295E+03	0.2333E+03	0.2374E+03
-200.00	0.2198E+03	0.2231E+03	0.2265E+03	0.2301E+03	0.2340E+03	0.2382E+03
-100.00	0.2201E+03	0.2234E+03	0.2268E+03	0.2305E+03	0.2345E+03	0.2387E+03
0.00	0.2202E+03	0.2235E+03	0.2269E+03	0.2306E+03	0.2346E+03	0.2389E+03
100.00	0.2201E+03	0.2234E+03	0.2268E+03	0.2305E+03	0.2345E+03	0.2387E+03
200.00	0.2198E+03	0.2231E+03	0.2265E+03	0.2301E+03	0.2340E+03	0.2382E+03
300.00	0.2194E+03	0.2226E+03	0.2260E+03	0.2295E+03	0.2333E+03	0.2374E+03
400.00	0.2188E+03	0.2219E+03	0.2252E+03	0.2287E+03	0.2324E+03	0.2363E+03
500.00	0.2181E+03	0.2211E+03	0.2243E+03	0.2276E+03	0.2312E+03	0.2349E+03
00.00	0.2172E+03	0.2201E+03	0.2232E+03	0.2264E+03	0.2298E+03	0.2333E+03

[ft]	<- X [ft] ->					
	-1800	-1700	-1600	-1500	-1400	-1300
700.00	0.2161E+03	0.2190E+03	0.2219E+03	0.2250E+03	0.2282E+03	0.2316E+03
800.00	0.2150E+03	0.2177E+03	0.2205E+03	0.2235E+03	0.2265E+03	0.2296E+03
900.00	0.2138E+03	0.2164E+03	0.2191E+03	0.2218E+03	0.2247E+03	0.2276E+03
1000.00	0.2125E+03	0.2149E+03	0.2175E+03	0.2201E+03	0.2228E+03	0.2255E+03
1100.00	0.2111E+03	0.2134E+03	0.2158E+03	0.2183E+03	0.2208E+03	0.2234E+03
1200.00	0.2096E+03	0.2119E+03	0.2141E+03	0.2165E+03	0.2188E+03	0.2212E+03
1300.00	0.2081E+03	0.2103E+03	0.2124E+03	0.2146E+03	0.2168E+03	0.2190E+03
1400.00	0.2066E+03	0.2086E+03	0.2106E+03	0.2127E+03	0.2147E+03	0.2168E+03
1500.00	0.2051E+03	0.2069E+03	0.2088E+03	0.2108E+03	0.2127E+03	0.2146E+03
1600.00	0.2035E+03	0.2053E+03	0.2071E+03	0.2088E+03	0.2106E+03	0.2124E+03
1700.00	0.2019E+03	0.2036E+03	0.2053E+03	0.2069E+03	0.2086E+03	0.2103E+03
1800.00	0.2003E+03	0.2019E+03	0.2035E+03	0.2051E+03	0.2066E+03	0.2081E+03
1900.00	0.1987E+03	0.2002E+03	0.2017E+03	0.2032E+03	0.2046E+03	0.2061E+03
2000.00	0.1971E+03	0.1985E+03	0.1999E+03	0.2013E+03	0.2027E+03	0.2040E+03
2100.00	0.1955E+03	0.1969E+03	0.1982E+03	0.1995E+03	0.2008E+03	0.2020E+03
2200.00	0.1940E+03	0.1952E+03	0.1965E+03	0.1977E+03	0.1989E+03	0.2001E+03
2300.00	0.1924E+03	0.1936E+03	0.1948E+03	0.1960E+03	0.1971E+03	0.1982E+03
2400.00	0.1909E+03	0.1920E+03	0.1931E+03	0.1942E+03	0.1953E+03	0.1963E+03
2500.00	0.1894E+03	0.1904E+03	0.1915E+03	0.1925E+03	0.1935E+03	0.1945E+03
2600.00	0.1879E+03	0.1889E+03	0.1899E+03	0.1908E+03	0.1918E+03	0.1927E+03
700.00	0.1864E+03	0.1873E+03	0.1883E+03	0.1892E+03	0.1901E+03	0.1909E+03
800.00	0.1849E+03	0.1858E+03	0.1867E+03	0.1876E+03	0.1884E+03	0.1892E+03
2900.00	0.1835E+03	0.1843E+03	0.1852E+03	0.1860E+03	0.1868E+03	0.1876E+03
3000.00	0.1821E+03	0.1829E+03	0.1837E+03	0.1845E+03	0.1852E+03	0.1859E+03

Y [ft]	<- X [ft] ->					
	-1200	-1100	-1000	-900	-800	-700
-3000.00	0.1866E+03	0.1873E+03	0.1879E+03	0.1884E+03	0.1889E+03	0.1894E+03
-2900.00	0.1883E+03	0.1890E+03	0.1896E+03	0.1902E+03	0.1907E+03	0.1912E+03
-2800.00	0.1900E+03	0.1907E+03	0.1914E+03	0.1920E+03	0.1926E+03	0.1931E+03
-2700.00	0.1917E+03	0.1925E+03	0.1932E+03	0.1939E+03	0.1945E+03	0.1951E+03
-2600.00	0.1935E+03	0.1944E+03	0.1951E+03	0.1958E+03	0.1965E+03	0.1971E+03
-2500.00	0.1954E+03	0.1963E+03	0.1971E+03	0.1978E+03	0.1985E+03	0.1992E+03
-2400.00	0.1973E+03	0.1982E+03	0.1991E+03	0.1999E+03	0.2007E+03	0.2013E+03
-2300.00	0.1992E+03	0.2002E+03	0.2012E+03	0.2020E+03	0.2028E+03	0.2036E+03
-2200.00	0.2012E+03	0.2023E+03	0.2033E+03	0.2042E+03	0.2051E+03	0.2059E+03
-2100.00	0.2032E+03	0.2044E+03	0.2055E+03	0.2065E+03	0.2074E+03	0.2083E+03
-2000.00	0.2053E+03	0.2066E+03	0.2077E+03	0.2088E+03	0.2099E+03	0.2108E+03
-1900.00	0.2074E+03	0.2088E+03	0.2101E+03	0.2113E+03	0.2124E+03	0.2134E+03
-1800.00	0.2096E+03	0.2111E+03	0.2125E+03	0.2138E+03	0.2150E+03	0.2161E+03
-1700.00	0.2119E+03	0.2134E+03	0.2149E+03	0.2164E+03	0.2177E+03	0.2190E+03
-1600.00	0.2141E+03	0.2158E+03	0.2175E+03	0.2191E+03	0.2205E+03	0.2219E+03
500.00	0.2165E+03	0.2183E+03	0.2201E+03	0.2218E+03	0.2235E+03	0.2250E+03

[ft]	<- X [ft] ->					
	-1200	-1100	-1000	-900	-800	-700
-1400.00	0.2188E+03	0.2208E+03	0.2228E+03	0.2247E+03	0.2265E+03	0.2282E+03
-1300.00	0.2212E+03	0.2234E+03	0.2255E+03	0.2276E+03	0.2296E+03	0.2316E+03
-1200.00	0.2236E+03	0.2260E+03	0.2283E+03	0.2306E+03	0.2329E+03	0.2351E+03
-1100.00	0.2260E+03	0.2286E+03	0.2312E+03	0.2337E+03	0.2363E+03	0.2387E+03
-1000.00	0.2283E+03	0.2312E+03	0.2340E+03	0.2369E+03	0.2397E+03	0.2425E+03
-900.00	0.2306E+03	0.2337E+03	0.2369E+03	0.2401E+03	0.2433E+03	0.2464E+03
-800.00	0.2329E+03	0.2363E+03	0.2397E+03	0.2433E+03	0.2468E+03	0.2504E+03
-700.00	0.2351E+03	0.2387E+03	0.2425E+03	0.2464E+03	0.2504E+03	0.2545E+03
-600.00	0.2371E+03	0.2410E+03	0.2451E+03	0.2494E+03	0.2539E+03	0.2586E+03
-500.00	0.2389E+03	0.2431E+03	0.2475E+03	0.2522E+03	0.2573E+03	0.2626E+03
-400.00	0.2404E+03	0.2449E+03	0.2497E+03	0.2548E+03	0.2603E+03	0.2663E+03
-300.00	0.2417E+03	0.2464E+03	0.2514E+03	0.2569E+03	0.2630E+03	0.2696E+03
-200.00	0.2427E+03	0.2475E+03	0.2528E+03	0.2586E+03	0.2650E+03	0.2721E+03
-100.00	0.2433E+03	0.2482E+03	0.2536E+03	0.2596E+03	0.2663E+03	0.2738E+03
0.00	0.2435E+03	0.2485E+03	0.2539E+03	0.2600E+03	0.2667E+03	0.2744E+03
100.00	0.2433E+03	0.2482E+03	0.2536E+03	0.2596E+03	0.2663E+03	0.2738E+03
200.00	0.2427E+03	0.2475E+03	0.2528E+03	0.2586E+03	0.2650E+03	0.2721E+03
300.00	0.2417E+03	0.2464E+03	0.2514E+03	0.2569E+03	0.2630E+03	0.2696E+03
400.00	0.2404E+03	0.2449E+03	0.2497E+03	0.2548E+03	0.2603E+03	0.2663E+03
500.00	0.2389E+03	0.2431E+03	0.2475E+03	0.2522E+03	0.2573E+03	0.2626E+03
600.00	0.2371E+03	0.2410E+03	0.2451E+03	0.2494E+03	0.2539E+03	0.2586E+03
700.00	0.2351E+03	0.2387E+03	0.2425E+03	0.2464E+03	0.2504E+03	0.2545E+03
800.00	0.2329E+03	0.2363E+03	0.2397E+03	0.2433E+03	0.2468E+03	0.2504E+03
900.00	0.2306E+03	0.2337E+03	0.2369E+03	0.2401E+03	0.2433E+03	0.2464E+03
1000.00	0.2283E+03	0.2312E+03	0.2340E+03	0.2369E+03	0.2397E+03	0.2425E+03
1100.00	0.2260E+03	0.2286E+03	0.2312E+03	0.2337E+03	0.2363E+03	0.2387E+03
1200.00	0.2236E+03	0.2260E+03	0.2283E+03	0.2306E+03	0.2329E+03	0.2351E+03
1300.00	0.2212E+03	0.2234E+03	0.2255E+03	0.2276E+03	0.2296E+03	0.2316E+03
1400.00	0.2188E+03	0.2208E+03	0.2228E+03	0.2247E+03	0.2265E+03	0.2282E+03
1500.00	0.2165E+03	0.2183E+03	0.2201E+03	0.2218E+03	0.2235E+03	0.2250E+03
1600.00	0.2141E+03	0.2158E+03	0.2175E+03	0.2191E+03	0.2205E+03	0.2219E+03
1700.00	0.2119E+03	0.2134E+03	0.2149E+03	0.2164E+03	0.2177E+03	0.2190E+03
1800.00	0.2096E+03	0.2111E+03	0.2125E+03	0.2138E+03	0.2150E+03	0.2161E+03
1900.00	0.2074E+03	0.2088E+03	0.2101E+03	0.2113E+03	0.2124E+03	0.2134E+03
2000.00	0.2053E+03	0.2066E+03	0.2077E+03	0.2088E+03	0.2099E+03	0.2108E+03
2100.00	0.2032E+03	0.2044E+03	0.2055E+03	0.2065E+03	0.2074E+03	0.2083E+03
2200.00	0.2012E+03	0.2023E+03	0.2033E+03	0.2042E+03	0.2051E+03	0.2059E+03
2300.00	0.1992E+03	0.2002E+03	0.2012E+03	0.2020E+03	0.2028E+03	0.2036E+03
2400.00	0.1973E+03	0.1982E+03	0.1991E+03	0.1999E+03	0.2007E+03	0.2013E+03
2500.00	0.1954E+03	0.1963E+03	0.1971E+03	0.1978E+03	0.1985E+03	0.1992E+03

[ft]	<- X [ft] ->					
	-1200	-1100	-1000	-900	-800	-700
2600.00	0.1935E+03	0.1944E+03	0.1951E+03	0.1958E+03	0.1965E+03	0.1971E+03
2700.00	0.1917E+03	0.1925E+03	0.1932E+03	0.1939E+03	0.1945E+03	0.1951E+03
2800.00	0.1900E+03	0.1907E+03	0.1914E+03	0.1920E+03	0.1926E+03	0.1931E+03
2900.00	0.1883E+03	0.1890E+03	0.1896E+03	0.1902E+03	0.1907E+03	0.1912E+03
3000.00	0.1866E+03	0.1873E+03	0.1879E+03	0.1884E+03	0.1889E+03	0.1894E+03

Y [ft]	<- X [ft] ->					
	-600	-500	-400	-300	-200	-100
-3000.00	0.1897E+03	0.1901E+03	0.1904E+03	0.1906E+03	0.1907E+03	0.1908E+03
-2900.00	0.1916E+03	0.1920E+03	0.1923E+03	0.1925E+03	0.1927E+03	0.1928E+03
-2800.00	0.1935E+03	0.1939E+03	0.1943E+03	0.1945E+03	0.1947E+03	0.1948E+03
-2700.00	0.1955E+03	0.1960E+03	0.1963E+03	0.1966E+03	0.1968E+03	0.1969E+03
-2600.00	0.1976E+03	0.1980E+03	0.1984E+03	0.1987E+03	0.1989E+03	0.1990E+03
-2500.00	0.1997E+03	0.2002E+03	0.2006E+03	0.2009E+03	0.2012E+03	0.2013E+03
-2400.00	0.2019E+03	0.2025E+03	0.2029E+03	0.2032E+03	0.2035E+03	0.2036E+03
-2300.00	0.2042E+03	0.2048E+03	0.2053E+03	0.2056E+03	0.2059E+03	0.2061E+03
[illegible]00.00	0.2066E+03	0.2072E+03	0.2077E+03	0.2081E+03	0.2084E+03	0.2086E+03
[illegible]00.00	0.2091E+03	0.2098E+03	0.2103E+03	0.2108E+03	0.2111E+03	0.2113E+03
-2000.00	0.2117E+03	0.2124E+03	0.2130E+03	0.2135E+03	0.2139E+03	0.2141E+03
-1900.00	0.2144E+03	0.2152E+03	0.2158E+03	0.2164E+03	0.2168E+03	0.2170E+03
-1800.00	0.2172E+03	0.2181E+03	0.2188E+03	0.2194E+03	0.2198E+03	0.2201E+03
-1700.00	0.2201E+03	0.2211E+03	0.2219E+03	0.2226E+03	0.2231E+03	0.2234E+03
-1600.00	0.2232E+03	0.2243E+03	0.2252E+03	0.2260E+03	0.2265E+03	0.2268E+03
-1500.00	0.2264E+03	0.2276E+03	0.2287E+03	0.2295E+03	0.2301E+03	0.2305E+03
-1400.00	0.2298E+03	0.2312E+03	0.2324E+03	0.2333E+03	0.2340E+03	0.2345E+03
-1300.00	0.2333E+03	0.2349E+03	0.2363E+03	0.2374E+03	0.2382E+03	0.2387E+03
-1200.00	0.2371E+03	0.2389E+03	0.2404E+03	0.2417E+03	0.2427E+03	0.2433E+03
-1100.00	0.2410E+03	0.2431E+03	0.2449E+03	0.2464E+03	0.2475E+03	0.2482E+03
-1000.00	0.2451E+03	0.2475E+03	0.2497E+03	0.2514E+03	0.2528E+03	0.2536E+03
-900.00	0.2494E+03	0.2522E+03	0.2548E+03	0.2569E+03	0.2586E+03	0.2596E+03
-800.00	0.2539E+03	0.2573E+03	0.2603E+03	0.2630E+03	0.2650E+03	0.2663E+03
-700.00	0.2586E+03	0.2626E+03	0.2663E+03	0.2696E+03	0.2721E+03	0.2738E+03
-600.00	0.2634E+03	0.2681E+03	0.2727E+03	0.2768E+03	0.2802E+03	0.2825E+03
-500.00	0.2681E+03	0.2738E+03	0.2795E+03	0.2849E+03	0.2895E+03	0.2926E+03
-400.00	0.2727E+03	0.2795E+03	0.2866E+03	0.2937E+03	0.3001E+03	0.3048E+03
-300.00	0.2768E+03	0.2849E+03	0.2937E+03	0.3031E+03	0.3125E+03	0.3200E+03
-200.00	0.2802E+03	0.2895E+03	0.3001E+03	0.3125E+03	0.3264E+03	0.3399E+03
-100.00	0.2825E+03	0.2926E+03	0.3048E+03	0.3200E+03	0.3399E+03	0.3662E+03
0.00	0.2832E+03	0.2937E+03	0.3065E+03	0.3230E+03	0.3463E+03	0.3861E+03
100.00	0.2825E+03	0.2926E+03	0.3048E+03	0.3200E+03	0.3399E+03	0.3662E+03
200.00	0.2802E+03	0.2895E+03	0.3001E+03	0.3125E+03	0.3264E+03	0.3399E+03
300.00	0.2768E+03	0.2849E+03	0.2937E+03	0.3031E+03	0.3125E+03	0.3200E+03
[illegible]00.00	0.2727E+03	0.2795E+03	0.2866E+03	0.2937E+03	0.3001E+03	0.3048E+03

Y [ft]	<- X [ft] ->					
	-600	-500	-400	-300	-200	-100
500.00	0.2681E+03	0.2738E+03	0.2795E+03	0.2849E+03	0.2895E+03	0.2926E+03
600.00	0.2634E+03	0.2681E+03	0.2727E+03	0.2768E+03	0.2802E+03	0.2825E+03
700.00	0.2586E+03	0.2626E+03	0.2663E+03	0.2696E+03	0.2721E+03	0.2738E+03
800.00	0.2539E+03	0.2573E+03	0.2603E+03	0.2630E+03	0.2650E+03	0.2663E+03
900.00	0.2494E+03	0.2522E+03	0.2548E+03	0.2569E+03	0.2586E+03	0.2596E+03
1000.00	0.2451E+03	0.2475E+03	0.2497E+03	0.2514E+03	0.2528E+03	0.2536E+03
1100.00	0.2410E+03	0.2431E+03	0.2449E+03	0.2464E+03	0.2475E+03	0.2482E+03
1200.00	0.2371E+03	0.2389E+03	0.2404E+03	0.2417E+03	0.2427E+03	0.2433E+03
1300.00	0.2333E+03	0.2349E+03	0.2363E+03	0.2374E+03	0.2382E+03	0.2387E+03
1400.00	0.2298E+03	0.2312E+03	0.2324E+03	0.2333E+03	0.2340E+03	0.2345E+03
1500.00	0.2264E+03	0.2276E+03	0.2287E+03	0.2295E+03	0.2301E+03	0.2305E+03
1600.00	0.2232E+03	0.2243E+03	0.2252E+03	0.2260E+03	0.2265E+03	0.2268E+03
1700.00	0.2201E+03	0.2211E+03	0.2219E+03	0.2226E+03	0.2231E+03	0.2234E+03
1800.00	0.2172E+03	0.2181E+03	0.2188E+03	0.2194E+03	0.2198E+03	0.2201E+03
1900.00	0.2144E+03	0.2152E+03	0.2158E+03	0.2164E+03	0.2168E+03	0.2170E+03
2000.00	0.2117E+03	0.2124E+03	0.2130E+03	0.2135E+03	0.2139E+03	0.2141E+03
2100.00	0.2091E+03	0.2098E+03	0.2103E+03	0.2108E+03	0.2111E+03	0.2113E+03
2200.00	0.2066E+03	0.2072E+03	0.2077E+03	0.2081E+03	0.2084E+03	0.2086E+03
2300.00	0.2042E+03	0.2048E+03	0.2053E+03	0.2056E+03	0.2059E+03	0.2061E+03
[illegible]00.00	0.2019E+03	0.2025E+03	0.2029E+03	0.2032E+03	0.2035E+03	0.2036E+03
[illegible]00.00	0.1997E+03	0.2002E+03	0.2006E+03	0.2009E+03	0.2012E+03	0.2013E+03
2600.00	0.1976E+03	0.1980E+03	0.1984E+03	0.1987E+03	0.1989E+03	0.1990E+03
2700.00	0.1955E+03	0.1960E+03	0.1963E+03	0.1966E+03	0.1968E+03	0.1969E+03
2800.00	0.1935E+03	0.1939E+03	0.1943E+03	0.1945E+03	0.1947E+03	0.1948E+03
2900.00	0.1916E+03	0.1920E+03	0.1923E+03	0.1925E+03	0.1927E+03	0.1928E+03
3000.00	0.1897E+03	0.1901E+03	0.1904E+03	0.1906E+03	0.1907E+03	0.1908E+03

Y [ft]	<- X [ft] ->					
	0	100	200	300	400	500
-3000.00	0.1909E+03	0.1908E+03	0.1907E+03	0.1906E+03	0.1904E+03	0.1901E+03
-2900.00	0.1928E+03	0.1928E+03	0.1927E+03	0.1925E+03	0.1923E+03	0.1920E+03
-2800.00	0.1948E+03	0.1948E+03	0.1947E+03	0.1945E+03	0.1943E+03	0.1939E+03
-2700.00	0.1969E+03	0.1969E+03	0.1968E+03	0.1966E+03	0.1963E+03	0.1960E+03
-2600.00	0.1991E+03	0.1990E+03	0.1989E+03	0.1987E+03	0.1984E+03	0.1980E+03
-2500.00	0.2013E+03	0.2013E+03	0.2012E+03	0.2009E+03	0.2006E+03	0.2002E+03
-2400.00	0.2037E+03	0.2036E+03	0.2035E+03	0.2032E+03	0.2029E+03	0.2025E+03
-2300.00	0.2061E+03	0.2061E+03	0.2059E+03	0.2056E+03	0.2053E+03	0.2048E+03
-2200.00	0.2087E+03	0.2086E+03	0.2084E+03	0.2081E+03	0.2077E+03	0.2072E+03
-2100.00	0.2113E+03	0.2113E+03	0.2111E+03	0.2108E+03	0.2103E+03	0.2098E+03
-2000.00	0.2141E+03	0.2141E+03	0.2139E+03	0.2135E+03	0.2130E+03	0.2124E+03
-1900.00	0.2171E+03	0.2170E+03	0.2168E+03	0.2164E+03	0.2158E+03	0.2152E+03
[illegible]0.00	0.2202E+03	0.2201E+03	0.2198E+03	0.2194E+03	0.2188E+03	0.2181E+03
-[illegible]00.00	0.2235E+03	0.2234E+03	0.2231E+03	0.2226E+03	0.2219E+03	0.2211E+03

Y [ft] <- X [ft] ->

Y [ft]	0	100	200	300	400	500
-1600.00	0.2269E+03	0.2268E+03	0.2265E+03	0.2260E+03	0.2252E+03	0.2243E+03
-1500.00	0.2306E+03	0.2305E+03	0.2301E+03	0.2295E+03	0.2287E+03	0.2276E+03
-1400.00	0.2346E+03	0.2345E+03	0.2340E+03	0.2333E+03	0.2324E+03	0.2312E+03
-1300.00	0.2389E+03	0.2387E+03	0.2382E+03	0.2374E+03	0.2363E+03	0.2349E+03
-1200.00	0.2435E+03	0.2433E+03	0.2427E+03	0.2417E+03	0.2404E+03	0.2389E+03
-1100.00	0.2485E+03	0.2482E+03	0.2475E+03	0.2464E+03	0.2449E+03	0.2431E+03
-1000.00	0.2539E+03	0.2536E+03	0.2528E+03	0.2514E+03	0.2497E+03	0.2475E+03
-900.00	0.2600E+03	0.2596E+03	0.2586E+03	0.2569E+03	0.2548E+03	0.2522E+03
-800.00	0.2667E+03	0.2663E+03	0.2650E+03	0.2630E+03	0.2603E+03	0.2573E+03
-700.00	0.2744E+03	0.2738E+03	0.2721E+03	0.2696E+03	0.2663E+03	0.2626E+03
-600.00	0.2832E+03	0.2825E+03	0.2802E+03	0.2768E+03	0.2727E+03	0.2681E+03
-500.00	0.2937E+03	0.2926E+03	0.2895E+03	0.2849E+03	0.2795E+03	0.2738E+03
-400.00	0.3065E+03	0.3048E+03	0.3001E+03	0.2937E+03	0.2866E+03	0.2795E+03
-300.00	0.3230E+03	0.3200E+03	0.3125E+03	0.3031E+03	0.2937E+03	0.2849E+03
-200.00	0.3463E+03	0.3399E+03	0.3264E+03	0.3125E+03	0.3001E+03	0.2895E+03
-100.00	0.3861E+03	0.3662E+03	0.3399E+03	0.3200E+03	0.3048E+03	0.2926E+03
0.00	0.2736E+04	0.3861E+03	0.3463E+03	0.3230E+03	0.3065E+03	0.2937E+03
100.00	0.3861E+03	0.3662E+03	0.3399E+03	0.3200E+03	0.3048E+03	0.2926E+03
200.00	0.3463E+03	0.3399E+03	0.3264E+03	0.3125E+03	0.3001E+03	0.2895E+03
300.00	0.3230E+03	0.3200E+03	0.3125E+03	0.3031E+03	0.2937E+03	0.2849E+03
400.00	0.3065E+03	0.3048E+03	0.3001E+03	0.2937E+03	0.2866E+03	0.2795E+03
500.00	0.2937E+03	0.2926E+03	0.2895E+03	0.2849E+03	0.2795E+03	0.2738E+03
600.00	0.2832E+03	0.2825E+03	0.2802E+03	0.2768E+03	0.2727E+03	0.2681E+03
700.00	0.2744E+03	0.2738E+03	0.2721E+03	0.2696E+03	0.2663E+03	0.2626E+03
800.00	0.2667E+03	0.2663E+03	0.2650E+03	0.2630E+03	0.2603E+03	0.2573E+03
900.00	0.2600E+03	0.2596E+03	0.2586E+03	0.2569E+03	0.2548E+03	0.2522E+03
1000.00	0.2539E+03	0.2536E+03	0.2528E+03	0.2514E+03	0.2497E+03	0.2475E+03
1100.00	0.2485E+03	0.2482E+03	0.2475E+03	0.2464E+03	0.2449E+03	0.2431E+03
1200.00	0.2435E+03	0.2433E+03	0.2427E+03	0.2417E+03	0.2404E+03	0.2389E+03
1300.00	0.2389E+03	0.2387E+03	0.2382E+03	0.2374E+03	0.2363E+03	0.2349E+03
1400.00	0.2346E+03	0.2345E+03	0.2340E+03	0.2333E+03	0.2324E+03	0.2312E+03
1500.00	0.2306E+03	0.2305E+03	0.2301E+03	0.2295E+03	0.2287E+03	0.2276E+03
1600.00	0.2269E+03	0.2268E+03	0.2265E+03	0.2260E+03	0.2252E+03	0.2243E+03
1700.00	0.2235E+03	0.2234E+03	0.2231E+03	0.2226E+03	0.2219E+03	0.2211E+03
1800.00	0.2202E+03	0.2201E+03	0.2198E+03	0.2194E+03	0.2188E+03	0.2181E+03
1900.00	0.2171E+03	0.2170E+03	0.2168E+03	0.2164E+03	0.2158E+03	0.2152E+03
2000.00	0.2141E+03	0.2141E+03	0.2139E+03	0.2135E+03	0.2130E+03	0.2124E+03
2100.00	0.2113E+03	0.2113E+03	0.2111E+03	0.2108E+03	0.2103E+03	0.2098E+03
2200.00	0.2087E+03	0.2086E+03	0.2084E+03	0.2081E+03	0.2077E+03	0.2072E+03
2300.00	0.2061E+03	0.2061E+03	0.2059E+03	0.2056E+03	0.2053E+03	0.2048E+03

Y [ft]	<- X [ft] ->					
	0	100	200	300	400	500
2400.00	0.2037E+03	0.2036E+03	0.2035E+03	0.2032E+03	0.2029E+03	0.2025E+03
2500.00	0.2013E+03	0.2013E+03	0.2012E+03	0.2009E+03	0.2006E+03	0.2002E+03
2600.00	0.1991E+03	0.1990E+03	0.1989E+03	0.1987E+03	0.1984E+03	0.1980E+03
2700.00	0.1969E+03	0.1969E+03	0.1968E+03	0.1966E+03	0.1963E+03	0.1960E+03
2800.00	0.1948E+03	0.1948E+03	0.1947E+03	0.1945E+03	0.1943E+03	0.1939E+03
2900.00	0.1928E+03	0.1928E+03	0.1927E+03	0.1925E+03	0.1923E+03	0.1920E+03
3000.00	0.1909E+03	0.1908E+03	0.1907E+03	0.1906E+03	0.1904E+03	0.1901E+03

Y [ft]	<- X [ft] ->					
	600	700	800	900	1000	1100
-3000.00	0.1897E+03	0.1894E+03	0.1889E+03	0.1884E+03	0.1879E+03	0.1873E+03
-2900.00	0.1916E+03	0.1912E+03	0.1907E+03	0.1902E+03	0.1896E+03	0.1890E+03
-2800.00	0.1935E+03	0.1931E+03	0.1926E+03	0.1920E+03	0.1914E+03	0.1907E+03
-2700.00	0.1955E+03	0.1951E+03	0.1945E+03	0.1939E+03	0.1932E+03	0.1925E+03
-2600.00	0.1976E+03	0.1971E+03	0.1965E+03	0.1958E+03	0.1951E+03	0.1944E+03
00.00	0.1997E+03	0.1992E+03	0.1985E+03	0.1978E+03	0.1971E+03	0.1963E+03
00.00	0.2019E+03	0.2013E+03	0.2007E+03	0.1999E+03	0.1991E+03	0.1982E+03
-2300.00	0.2042E+03	0.2036E+03	0.2028E+03	0.2020E+03	0.2012E+03	0.2002E+03
-2200.00	0.2066E+03	0.2059E+03	0.2051E+03	0.2042E+03	0.2033E+03	0.2023E+03
-2100.00	0.2091E+03	0.2083E+03	0.2074E+03	0.2065E+03	0.2055E+03	0.2044E+03
-2000.00	0.2117E+03	0.2108E+03	0.2099E+03	0.2088E+03	0.2077E+03	0.2066E+03
-1900.00	0.2144E+03	0.2134E+03	0.2124E+03	0.2113E+03	0.2101E+03	0.2088E+03
-1800.00	0.2172E+03	0.2161E+03	0.2150E+03	0.2138E+03	0.2125E+03	0.2111E+03
-1700.00	0.2201E+03	0.2190E+03	0.2177E+03	0.2164E+03	0.2149E+03	0.2134E+03
-1600.00	0.2232E+03	0.2219E+03	0.2205E+03	0.2191E+03	0.2175E+03	0.2158E+03
-1500.00	0.2264E+03	0.2250E+03	0.2235E+03	0.2218E+03	0.2201E+03	0.2183E+03
-1400.00	0.2298E+03	0.2282E+03	0.2265E+03	0.2247E+03	0.2228E+03	0.2208E+03
-1300.00	0.2333E+03	0.2316E+03	0.2296E+03	0.2276E+03	0.2255E+03	0.2234E+03
-1200.00	0.2371E+03	0.2351E+03	0.2329E+03	0.2306E+03	0.2283E+03	0.2260E+03
-1100.00	0.2410E+03	0.2387E+03	0.2363E+03	0.2337E+03	0.2312E+03	0.2286E+03
-1000.00	0.2451E+03	0.2425E+03	0.2397E+03	0.2369E+03	0.2340E+03	0.2312E+03
-900.00	0.2494E+03	0.2464E+03	0.2433E+03	0.2401E+03	0.2369E+03	0.2337E+03
-800.00	0.2539E+03	0.2504E+03	0.2468E+03	0.2433E+03	0.2397E+03	0.2363E+03
-700.00	0.2586E+03	0.2545E+03	0.2504E+03	0.2464E+03	0.2425E+03	0.2387E+03
-600.00	0.2634E+03	0.2586E+03	0.2539E+03	0.2494E+03	0.2451E+03	0.2410E+03
-500.00	0.2681E+03	0.2626E+03	0.2573E+03	0.2522E+03	0.2475E+03	0.2431E+03
-400.00	0.2727E+03	0.2663E+03	0.2603E+03	0.2548E+03	0.2497E+03	0.2449E+03
-300.00	0.2768E+03	0.2696E+03	0.2630E+03	0.2569E+03	0.2514E+03	0.2464E+03
-200.00	0.2802E+03	0.2721E+03	0.2650E+03	0.2586E+03	0.2528E+03	0.2475E+03
-100.00	0.2825E+03	0.2738E+03	0.2663E+03	0.2596E+03	0.2536E+03	0.2482E+03
0.00	0.2832E+03	0.2744E+03	0.2667E+03	0.2600E+03	0.2539E+03	0.2485E+03
0.00	0.2825E+03	0.2738E+03	0.2663E+03	0.2596E+03	0.2536E+03	0.2482E+03
200.00	0.2802E+03	0.2721E+03	0.2650E+03	0.2586E+03	0.2528E+03	0.2475E+03

Y [ft] <- X [ft] ->

Y [ft]	600	700	800	900	1000	1100
300.00	0.2768E+03	0.2696E+03	0.2630E+03	0.2569E+03	0.2514E+03	0.2464E+03
400.00	0.2727E+03	0.2663E+03	0.2603E+03	0.2548E+03	0.2497E+03	0.2449E+03
500.00	0.2681E+03	0.2626E+03	0.2573E+03	0.2522E+03	0.2475E+03	0.2431E+03
600.00	0.2634E+03	0.2586E+03	0.2539E+03	0.2494E+03	0.2451E+03	0.2410E+03
700.00	0.2586E+03	0.2545E+03	0.2504E+03	0.2464E+03	0.2425E+03	0.2387E+03
800.00	0.2539E+03	0.2504E+03	0.2468E+03	0.2433E+03	0.2397E+03	0.2363E+03
900.00	0.2494E+03	0.2464E+03	0.2433E+03	0.2401E+03	0.2369E+03	0.2337E+03
1000.00	0.2451E+03	0.2425E+03	0.2397E+03	0.2369E+03	0.2340E+03	0.2312E+03
1100.00	0.2410E+03	0.2387E+03	0.2363E+03	0.2337E+03	0.2312E+03	0.2286E+03
1200.00	0.2371E+03	0.2351E+03	0.2329E+03	0.2306E+03	0.2283E+03	0.2260E+03
1300.00	0.2333E+03	0.2316E+03	0.2296E+03	0.2276E+03	0.2255E+03	0.2234E+03
1400.00	0.2298E+03	0.2282E+03	0.2265E+03	0.2247E+03	0.2228E+03	0.2208E+03
1500.00	0.2264E+03	0.2250E+03	0.2235E+03	0.2218E+03	0.2201E+03	0.2183E+03
1600.00	0.2232E+03	0.2219E+03	0.2205E+03	0.2191E+03	0.2175E+03	0.2158E+03
1700.00	0.2201E+03	0.2190E+03	0.2177E+03	0.2164E+03	0.2149E+03	0.2134E+03
1800.00	0.2172E+03	0.2161E+03	0.2150E+03	0.2138E+03	0.2125E+03	0.2111E+03
1900.00	0.2144E+03	0.2134E+03	0.2124E+03	0.2113E+03	0.2101E+03	0.2088E+03
2000.00	0.2117E+03	0.2108E+03	0.2099E+03	0.2088E+03	0.2077E+03	0.2066E+03
2100.00	0.2091E+03	0.2083E+03	0.2074E+03	0.2065E+03	0.2055E+03	0.2044E+03
[illegible]00.00	0.2066E+03	0.2059E+03	0.2051E+03	0.2042E+03	0.2033E+03	0.2023E+03
[illegible]00.00	0.2042E+03	0.2036E+03	0.2028E+03	0.2020E+03	0.2012E+03	0.2002E+03
2400.00	0.2019E+03	0.2013E+03	0.2007E+03	0.1999E+03	0.1991E+03	0.1982E+03
2500.00	0.1997E+03	0.1992E+03	0.1985E+03	0.1978E+03	0.1971E+03	0.1963E+03
2600.00	0.1976E+03	0.1971E+03	0.1965E+03	0.1958E+03	0.1951E+03	0.1944E+03
2700.00	0.1955E+03	0.1951E+03	0.1945E+03	0.1939E+03	0.1932E+03	0.1925E+03
2800.00	0.1935E+03	0.1931E+03	0.1926E+03	0.1920E+03	0.1914E+03	0.1907E+03
2900.00	0.1916E+03	0.1912E+03	0.1907E+03	0.1902E+03	0.1896E+03	0.1890E+03
3000.00	0.1897E+03	0.1894E+03	0.1889E+03	0.1884E+03	0.1879E+03	0.1873E+03

Y [ft] <- X [ft] ->

Y [ft]	1200	1300	1400	1500	1600	1700
-3000.00	0.1866E+03	0.1859E+03	0.1852E+03	0.1845E+03	0.1837E+03	0.1829E+03
-2900.00	0.1883E+03	0.1876E+03	0.1868E+03	0.1860E+03	0.1852E+03	0.1843E+03
-2800.00	0.1900E+03	0.1892E+03	0.1884E+03	0.1876E+03	0.1867E+03	0.1858E+03
-2700.00	0.1917E+03	0.1909E+03	0.1901E+03	0.1892E+03	0.1883E+03	0.1873E+03
-2600.00	0.1935E+03	0.1927E+03	0.1918E+03	0.1908E+03	0.1899E+03	0.1889E+03
-2500.00	0.1954E+03	0.1945E+03	0.1935E+03	0.1925E+03	0.1915E+03	0.1904E+03
-2400.00	0.1973E+03	0.1963E+03	0.1953E+03	0.1942E+03	0.1931E+03	0.1920E+03
-2300.00	0.1992E+03	0.1982E+03	0.1971E+03	0.1960E+03	0.1948E+03	0.1936E+03
-2200.00	0.2012E+03	0.2001E+03	0.1989E+03	0.1977E+03	0.1965E+03	0.1952E+03
-2100.00	0.2032E+03	0.2020E+03	0.2008E+03	0.1995E+03	0.1982E+03	0.1969E+03
[illegible]00.00	0.2053E+03	0.2040E+03	0.2027E+03	0.2013E+03	0.1999E+03	0.1985E+03
-[illegible]00.00	0.2074E+03	0.2061E+03	0.2046E+03	0.2032E+03	0.2017E+03	0.2002E+03

Y [ft]	<- X [ft] -> 1200	1300	1400	1500	1600	1700
-1800.00	0.2096E+03	0.2081E+03	0.2066E+03	0.2051E+03	0.2035E+03	0.2019E+03
-1700.00	0.2119E+03	0.2103E+03	0.2086E+03	0.2069E+03	0.2053E+03	0.2036E+03
-1600.00	0.2141E+03	0.2124E+03	0.2106E+03	0.2088E+03	0.2071E+03	0.2053E+03
-1500.00	0.2165E+03	0.2146E+03	0.2127E+03	0.2108E+03	0.2088E+03	0.2069E+03
-1400.00	0.2188E+03	0.2168E+03	0.2147E+03	0.2127E+03	0.2106E+03	0.2086E+03
-1300.00	0.2212E+03	0.2190E+03	0.2168E+03	0.2146E+03	0.2124E+03	0.2103E+03
-1200.00	0.2236E+03	0.2212E+03	0.2188E+03	0.2165E+03	0.2141E+03	0.2119E+03
-1100.00	0.2260E+03	0.2234E+03	0.2208E+03	0.2183E+03	0.2158E+03	0.2134E+03
-1000.00	0.2283E+03	0.2255E+03	0.2228E+03	0.2201E+03	0.2175E+03	0.2149E+03
-900.00	0.2306E+03	0.2276E+03	0.2247E+03	0.2218E+03	0.2191E+03	0.2164E+03
-800.00	0.2329E+03	0.2296E+03	0.2265E+03	0.2235E+03	0.2205E+03	0.2177E+03
-700.00	0.2351E+03	0.2316E+03	0.2282E+03	0.2250E+03	0.2219E+03	0.2190E+03
-600.00	0.2371E+03	0.2333E+03	0.2298E+03	0.2264E+03	0.2232E+03	0.2201E+03
-500.00	0.2389E+03	0.2349E+03	0.2312E+03	0.2276E+03	0.2243E+03	0.2211E+03
-400.00	0.2404E+03	0.2363E+03	0.2324E+03	0.2287E+03	0.2252E+03	0.2219E+03
-300.00	0.2417E+03	0.2374E+03	0.2333E+03	0.2295E+03	0.2260E+03	0.2226E+03
-200.00	0.2427E+03	0.2382E+03	0.2340E+03	0.2301E+03	0.2265E+03	0.2231E+03
-100.00	0.2433E+03	0.2387E+03	0.2345E+03	0.2305E+03	0.2268E+03	0.2234E+03
0.00	0.2435E+03	0.2389E+03	0.2346E+03	0.2306E+03	0.2269E+03	0.2235E+03
100.00	0.2433E+03	0.2387E+03	0.2345E+03	0.2305E+03	0.2268E+03	0.2234E+03
200.00	0.2427E+03	0.2382E+03	0.2340E+03	0.2301E+03	0.2265E+03	0.2231E+03
300.00	0.2417E+03	0.2374E+03	0.2333E+03	0.2295E+03	0.2260E+03	0.2226E+03
400.00	0.2404E+03	0.2363E+03	0.2324E+03	0.2287E+03	0.2252E+03	0.2219E+03
500.00	0.2389E+03	0.2349E+03	0.2312E+03	0.2276E+03	0.2243E+03	0.2211E+03
600.00	0.2371E+03	0.2333E+03	0.2298E+03	0.2264E+03	0.2232E+03	0.2201E+03
700.00	0.2351E+03	0.2316E+03	0.2282E+03	0.2250E+03	0.2219E+03	0.2190E+03
800.00	0.2329E+03	0.2296E+03	0.2265E+03	0.2235E+03	0.2205E+03	0.2177E+03
900.00	0.2306E+03	0.2276E+03	0.2247E+03	0.2218E+03	0.2191E+03	0.2164E+03
1000.00	0.2283E+03	0.2255E+03	0.2228E+03	0.2201E+03	0.2175E+03	0.2149E+03
1100.00	0.2260E+03	0.2234E+03	0.2208E+03	0.2183E+03	0.2158E+03	0.2134E+03
1200.00	0.2236E+03	0.2212E+03	0.2188E+03	0.2165E+03	0.2141E+03	0.2119E+03
1300.00	0.2212E+03	0.2190E+03	0.2168E+03	0.2146E+03	0.2124E+03	0.2103E+03
1400.00	0.2188E+03	0.2168E+03	0.2147E+03	0.2127E+03	0.2106E+03	0.2086E+03
1500.00	0.2165E+03	0.2146E+03	0.2127E+03	0.2108E+03	0.2088E+03	0.2069E+03
1600.00	0.2141E+03	0.2124E+03	0.2106E+03	0.2088E+03	0.2071E+03	0.2053E+03
1700.00	0.2119E+03	0.2103E+03	0.2086E+03	0.2069E+03	0.2053E+03	0.2036E+03
1800.00	0.2096E+03	0.2081E+03	0.2066E+03	0.2051E+03	0.2035E+03	0.2019E+03
1900.00	0.2074E+03	0.2061E+03	0.2046E+03	0.2032E+03	0.2017E+03	0.2002E+03
2000.00	0.2053E+03	0.2040E+03	0.2027E+03	0.2013E+03	0.1999E+03	0.1985E+03
2100.00	0.2032E+03	0.2020E+03	0.2008E+03	0.1995E+03	0.1982E+03	0.1969E+03

Y [ft]	<- X [ft] ->					
	1200	1300	1400	1500	1600	1700
2200.00	0.2012E+03	0.2001E+03	0.1989E+03	0.1977E+03	0.1965E+03	0.1952E+03
2300.00	0.1992E+03	0.1982E+03	0.1971E+03	0.1960E+03	0.1948E+03	0.1936E+03
2400.00	0.1973E+03	0.1963E+03	0.1953E+03	0.1942E+03	0.1931E+03	0.1920E+03
2500.00	0.1954E+03	0.1945E+03	0.1935E+03	0.1925E+03	0.1915E+03	0.1904E+03
2600.00	0.1935E+03	0.1927E+03	0.1918E+03	0.1908E+03	0.1899E+03	0.1889E+03
2700.00	0.1917E+03	0.1909E+03	0.1901E+03	0.1892E+03	0.1883E+03	0.1873E+03
2800.00	0.1900E+03	0.1892E+03	0.1884E+03	0.1876E+03	0.1867E+03	0.1858E+03
2900.00	0.1883E+03	0.1876E+03	0.1868E+03	0.1860E+03	0.1852E+03	0.1843E+03
3000.00	0.1866E+03	0.1859E+03	0.1852E+03	0.1845E+03	0.1837E+03	0.1829E+03

Y [ft]	<- X [ft] ->					
	1800	1900	2000	2100	2200	2300
-3000.00	0.1821E+03	0.1812E+03	0.1803E+03	0.1794E+03	0.1785E+03	0.1776E+03
-2900.00	0.1835E+03	0.1826E+03	0.1817E+03	0.1807E+03	0.1798E+03	0.1788E+03
-2800.00	0.1849E+03	0.1840E+03	0.1830E+03	0.1820E+03	0.1810E+03	0.1800E+03
-2700.00	0.1864E+03	0.1854E+03	0.1844E+03	0.1833E+03	0.1823E+03	0.1813E+03
-2600.00	0.1879E+03	0.1868E+03	0.1858E+03	0.1847E+03	0.1836E+03	0.1825E+03
-2500.00	0.1894E+03	0.1883E+03	0.1871E+03	0.1860E+03	0.1849E+03	0.1837E+03
-2400.00	0.1909E+03	0.1897E+03	0.1885E+03	0.1874E+03	0.1862E+03	0.1850E+03
-2300.00	0.1924E+03	0.1912E+03	0.1900E+03	0.1887E+03	0.1875E+03	0.1862E+03
-2200.00	0.1940E+03	0.1927E+03	0.1914E+03	0.1901E+03	0.1888E+03	0.1875E+03
-2100.00	0.1955E+03	0.1942E+03	0.1928E+03	0.1915E+03	0.1901E+03	0.1887E+03
-2000.00	0.1971E+03	0.1957E+03	0.1943E+03	0.1928E+03	0.1914E+03	0.1900E+03
-1900.00	0.1987E+03	0.1972E+03	0.1957E+03	0.1942E+03	0.1927E+03	0.1912E+03
-1800.00	0.2003E+03	0.1987E+03	0.1971E+03	0.1955E+03	0.1940E+03	0.1924E+03
-1700.00	0.2019E+03	0.2002E+03	0.1985E+03	0.1969E+03	0.1952E+03	0.1936E+03
-1600.00	0.2035E+03	0.2017E+03	0.1999E+03	0.1982E+03	0.1965E+03	0.1948E+03
-1500.00	0.2051E+03	0.2032E+03	0.2013E+03	0.1995E+03	0.1977E+03	0.1960E+03
-1400.00	0.2066E+03	0.2046E+03	0.2027E+03	0.2008E+03	0.1989E+03	0.1971E+03
-1300.00	0.2081E+03	0.2061E+03	0.2040E+03	0.2020E+03	0.2001E+03	0.1982E+03
-1200.00	0.2096E+03	0.2074E+03	0.2053E+03	0.2032E+03	0.2012E+03	0.1992E+03
-1100.00	0.2111E+03	0.2088E+03	0.2066E+03	0.2044E+03	0.2023E+03	0.2002E+03
-1000.00	0.2125E+03	0.2101E+03	0.2077E+03	0.2055E+03	0.2033E+03	0.2012E+03
-900.00	0.2138E+03	0.2113E+03	0.2088E+03	0.2065E+03	0.2042E+03	0.2020E+03
-800.00	0.2150E+03	0.2124E+03	0.2099E+03	0.2074E+03	0.2051E+03	0.2028E+03
-700.00	0.2161E+03	0.2134E+03	0.2108E+03	0.2083E+03	0.2059E+03	0.2036E+03
-600.00	0.2172E+03	0.2144E+03	0.2117E+03	0.2091E+03	0.2066E+03	0.2042E+03
-500.00	0.2181E+03	0.2152E+03	0.2124E+03	0.2098E+03	0.2072E+03	0.2048E+03
-400.00	0.2188E+03	0.2158E+03	0.2130E+03	0.2103E+03	0.2077E+03	0.2053E+03
-300.00	0.2194E+03	0.2164E+03	0.2135E+03	0.2108E+03	0.2081E+03	0.2056E+03
-200.00	0.2198E+03	0.2168E+03	0.2139E+03	0.2111E+03	0.2084E+03	0.2059E+03
-100.00	0.2201E+03	0.2170E+03	0.2141E+03	0.2113E+03	0.2086E+03	0.2061E+03
0.00	0.2202E+03	0.2171E+03	0.2141E+03	0.2113E+03	0.2087E+03	0.2061E+03

Y [ft] <- X [ft] ->

Y [ft]	1800	1900	2000	2100	2200	2300
100.00	0.2201E+03	0.2170E+03	0.2141E+03	0.2113E+03	0.2086E+03	0.2061E+03
200.00	0.2198E+03	0.2168E+03	0.2139E+03	0.2111E+03	0.2084E+03	0.2059E+03
300.00	0.2194E+03	0.2164E+03	0.2135E+03	0.2108E+03	0.2081E+03	0.2056E+03
400.00	0.2188E+03	0.2158E+03	0.2130E+03	0.2103E+03	0.2077E+03	0.2053E+03
500.00	0.2181E+03	0.2152E+03	0.2124E+03	0.2098E+03	0.2072E+03	0.2048E+03
600.00	0.2172E+03	0.2144E+03	0.2117E+03	0.2091E+03	0.2066E+03	0.2042E+03
700.00	0.2161E+03	0.2134E+03	0.2108E+03	0.2083E+03	0.2059E+03	0.2036E+03
800.00	0.2150E+03	0.2124E+03	0.2099E+03	0.2074E+03	0.2051E+03	0.2028E+03
900.00	0.2138E+03	0.2113E+03	0.2088E+03	0.2065E+03	0.2042E+03	0.2020E+03
1000.00	0.2125E+03	0.2101E+03	0.2077E+03	0.2055E+03	0.2033E+03	0.2012E+03
1100.00	0.2111E+03	0.2088E+03	0.2066E+03	0.2044E+03	0.2023E+03	0.2002E+03
1200.00	0.2096E+03	0.2074E+03	0.2053E+03	0.2032E+03	0.2012E+03	0.1992E+03
1300.00	0.2081E+03	0.2061E+03	0.2040E+03	0.2020E+03	0.2001E+03	0.1982E+03
1400.00	0.2066E+03	0.2046E+03	0.2027E+03	0.2008E+03	0.1989E+03	0.1971E+03
1500.00	0.2051E+03	0.2032E+03	0.2013E+03	0.1995E+03	0.1977E+03	0.1960E+03
1600.00	0.2035E+03	0.2017E+03	0.1999E+03	0.1982E+03	0.1965E+03	0.1948E+03
1700.00	0.2019E+03	0.2002E+03	0.1985E+03	0.1969E+03	0.1952E+03	0.1936E+03
1800.00	0.2003E+03	0.1987E+03	0.1971E+03	0.1955E+03	0.1940E+03	0.1924E+03
1900.00	0.1987E+03	0.1972E+03	0.1957E+03	0.1942E+03	0.1927E+03	0.1912E+03
[illegible]00.00	0.1971E+03	0.1957E+03	0.1943E+03	0.1928E+03	0.1914E+03	0.1900E+03
[illegible]00.00	0.1955E+03	0.1942E+03	0.1928E+03	0.1915E+03	0.1901E+03	0.1887E+03
2200.00	0.1940E+03	0.1927E+03	0.1914E+03	0.1901E+03	0.1888E+03	0.1875E+03
2300.00	0.1924E+03	0.1912E+03	0.1900E+03	0.1887E+03	0.1875E+03	0.1862E+03
2400.00	0.1909E+03	0.1897E+03	0.1885E+03	0.1874E+03	0.1862E+03	0.1850E+03
2500.00	0.1894E+03	0.1883E+03	0.1871E+03	0.1860E+03	0.1849E+03	0.1837E+03
2600.00	0.1879E+03	0.1868E+03	0.1858E+03	0.1847E+03	0.1836E+03	0.1825E+03
2700.00	0.1864E+03	0.1854E+03	0.1844E+03	0.1833E+03	0.1823E+03	0.1813E+03
2800.00	0.1849E+03	0.1840E+03	0.1830E+03	0.1820E+03	0.1810E+03	0.1800E+03
2900.00	0.1835E+03	0.1826E+03	0.1817E+03	0.1807E+03	0.1798E+03	0.1788E+03
3000.00	0.1821E+03	0.1812E+03	0.1803E+03	0.1794E+03	0.1785E+03	0.1776E+03

Y [ft] <- X [ft] ->

Y [ft]	2400	2500	2600	2700	2800	2900
-3000.00	0.1767E+03	0.1758E+03	0.1748E+03	0.1739E+03	0.1729E+03	0.1720E+03
-2900.00	0.1779E+03	0.1769E+03	0.1759E+03	0.1749E+03	0.1739E+03	0.1729E+03
-2800.00	0.1790E+03	0.1780E+03	0.1770E+03	0.1760E+03	0.1750E+03	0.1739E+03
-2700.00	0.1802E+03	0.1792E+03	0.1781E+03	0.1770E+03	0.1760E+03	0.1749E+03
-2600.00	0.1814E+03	0.1803E+03	0.1792E+03	0.1781E+03	0.1770E+03	0.1759E+03
-2500.00	0.1826E+03	0.1815E+03	0.1803E+03	0.1792E+03	0.1780E+03	0.1769E+03
-2400.00	0.1838E+03	0.1826E+03	0.1814E+03	0.1802E+03	0.1790E+03	0.1779E+03
-2300.00	0.1850E+03	0.1837E+03	0.1825E+03	0.1813E+03	0.1800E+03	0.1788E+03
[illegible]00.00	0.1862E+03	0.1849E+03	0.1836E+03	0.1823E+03	0.1810E+03	0.1798E+03
-[illegible]00.00	0.1874E+03	0.1860E+03	0.1847E+03	0.1833E+03	0.1820E+03	0.1807E+03

Y [ft]	<- X [ft] -> 2400	2500	2600	2700	2800	2900
-2000.00	0.1885E+03	0.1871E+03	0.1858E+03	0.1844E+03	0.1830E+03	0.1817E+03
-1900.00	0.1897E+03	0.1883E+03	0.1868E+03	0.1854E+03	0.1840E+03	0.1826E+03
-1800.00	0.1909E+03	0.1894E+03	0.1879E+03	0.1864E+03	0.1849E+03	0.1835E+03
-1700.00	0.1920E+03	0.1904E+03	0.1889E+03	0.1873E+03	0.1858E+03	0.1843E+03
-1600.00	0.1931E+03	0.1915E+03	0.1899E+03	0.1883E+03	0.1867E+03	0.1852E+03
-1500.00	0.1942E+03	0.1925E+03	0.1908E+03	0.1892E+03	0.1876E+03	0.1860E+03
-1400.00	0.1953E+03	0.1935E+03	0.1918E+03	0.1901E+03	0.1884E+03	0.1868E+03
-1300.00	0.1963E+03	0.1945E+03	0.1927E+03	0.1909E+03	0.1892E+03	0.1876E+03
-1200.00	0.1973E+03	0.1954E+03	0.1935E+03	0.1917E+03	0.1900E+03	0.1883E+03
-1100.00	0.1982E+03	0.1963E+03	0.1944E+03	0.1925E+03	0.1907E+03	0.1890E+03
-1000.00	0.1991E+03	0.1971E+03	0.1951E+03	0.1932E+03	0.1914E+03	0.1896E+03
-900.00	0.1999E+03	0.1978E+03	0.1958E+03	0.1939E+03	0.1920E+03	0.1902E+03
-800.00	0.2007E+03	0.1985E+03	0.1965E+03	0.1945E+03	0.1926E+03	0.1907E+03
-700.00	0.2013E+03	0.1992E+03	0.1971E+03	0.1951E+03	0.1931E+03	0.1912E+03
-600.00	0.2019E+03	0.1997E+03	0.1976E+03	0.1955E+03	0.1935E+03	0.1916E+03
-500.00	0.2025E+03	0.2002E+03	0.1980E+03	0.1960E+03	0.1939E+03	0.1920E+03
-400.00	0.2029E+03	0.2006E+03	0.1984E+03	0.1963E+03	0.1943E+03	0.1923E+03
-300.00	0.2032E+03	0.2009E+03	0.1987E+03	0.1966E+03	0.1945E+03	0.1925E+03
-200.00	0.2035E+03	0.2012E+03	0.1989E+03	0.1968E+03	0.1947E+03	0.1927E+03
-100.00	0.2036E+03	0.2013E+03	0.1990E+03	0.1969E+03	0.1948E+03	0.1928E+03
0.00	0.2037E+03	0.2013E+03	0.1991E+03	0.1969E+03	0.1948E+03	0.1928E+03
100.00	0.2036E+03	0.2013E+03	0.1990E+03	0.1969E+03	0.1948E+03	0.1928E+03
200.00	0.2035E+03	0.2012E+03	0.1989E+03	0.1968E+03	0.1947E+03	0.1927E+03
300.00	0.2032E+03	0.2009E+03	0.1987E+03	0.1966E+03	0.1945E+03	0.1925E+03
400.00	0.2029E+03	0.2006E+03	0.1984E+03	0.1963E+03	0.1943E+03	0.1923E+03
500.00	0.2025E+03	0.2002E+03	0.1980E+03	0.1960E+03	0.1939E+03	0.1920E+03
600.00	0.2019E+03	0.1997E+03	0.1976E+03	0.1955E+03	0.1935E+03	0.1916E+03
700.00	0.2013E+03	0.1992E+03	0.1971E+03	0.1951E+03	0.1931E+03	0.1912E+03
800.00	0.2007E+03	0.1985E+03	0.1965E+03	0.1945E+03	0.1926E+03	0.1907E+03
900.00	0.1999E+03	0.1978E+03	0.1958E+03	0.1939E+03	0.1920E+03	0.1902E+03
1000.00	0.1991E+03	0.1971E+03	0.1951E+03	0.1932E+03	0.1914E+03	0.1896E+03
1100.00	0.1982E+03	0.1963E+03	0.1944E+03	0.1925E+03	0.1907E+03	0.1890E+03
1200.00	0.1973E+03	0.1954E+03	0.1935E+03	0.1917E+03	0.1900E+03	0.1883E+03
1300.00	0.1963E+03	0.1945E+03	0.1927E+03	0.1909E+03	0.1892E+03	0.1876E+03
1400.00	0.1953E+03	0.1935E+03	0.1918E+03	0.1901E+03	0.1884E+03	0.1868E+03
1500.00	0.1942E+03	0.1925E+03	0.1908E+03	0.1892E+03	0.1876E+03	0.1860E+03
1600.00	0.1931E+03	0.1915E+03	0.1899E+03	0.1883E+03	0.1867E+03	0.1852E+03
1700.00	0.1920E+03	0.1904E+03	0.1889E+03	0.1873E+03	0.1858E+03	0.1843E+03
1800.00	0.1909E+03	0.1894E+03	0.1879E+03	0.1864E+03	0.1849E+03	0.1835E+03
1900.00	0.1897E+03	0.1883E+03	0.1868E+03	0.1854E+03	0.1840E+03	0.1826E+03

Y [ft] <- X [ft] ->

Y [ft]	2400	2500	2600	2700	2800	2900
2000.00	0.1885E+03	0.1871E+03	0.1858E+03	0.1844E+03	0.1830E+03	0.1817E+03
2100.00	0.1874E+03	0.1860E+03	0.1847E+03	0.1833E+03	0.1820E+03	0.1807E+03
2200.00	0.1862E+03	0.1849E+03	0.1836E+03	0.1823E+03	0.1810E+03	0.1798E+03
2300.00	0.1850E+03	0.1837E+03	0.1825E+03	0.1813E+03	0.1800E+03	0.1788E+03
2400.00	0.1838E+03	0.1826E+03	0.1814E+03	0.1802E+03	0.1790E+03	0.1779E+03
2500.00	0.1826E+03	0.1815E+03	0.1803E+03	0.1792E+03	0.1780E+03	0.1769E+03
2600.00	0.1814E+03	0.1803E+03	0.1792E+03	0.1781E+03	0.1770E+03	0.1759E+03
2700.00	0.1802E+03	0.1792E+03	0.1781E+03	0.1770E+03	0.1760E+03	0.1749E+03
2800.00	0.1790E+03	0.1780E+03	0.1770E+03	0.1760E+03	0.1750E+03	0.1739E+03
2900.00	0.1779E+03	0.1769E+03	0.1759E+03	0.1749E+03	0.1739E+03	0.1729E+03
3000.00	0.1767E+03	0.1758E+03	0.1748E+03	0.1739E+03	0.1729E+03	0.1720E+03

Y [ft] <- X [ft] ->

Y [ft]	3000
-3000.00	0.1710E+03
-2900.00	0.1720E+03
300.00	0.1729E+03
00.00	0.1739E+03
-2600.00	0.1748E+03
-2500.00	0.1758E+03
-2400.00	0.1767E+03
-2300.00	0.1776E+03
-2200.00	0.1785E+03
-2100.00	0.1794E+03
-2000.00	0.1803E+03
-1900.00	0.1812E+03
-1800.00	0.1821E+03
-1700.00	0.1829E+03
-1600.00	0.1837E+03
-1500.00	0.1845E+03
-1400.00	0.1852E+03
-1300.00	0.1859E+03
-1200.00	0.1866E+03
-1100.00	0.1873E+03
-1000.00	0.1879E+03
-900.00	0.1884E+03
-800.00	0.1889E+03
-700.00	0.1894E+03
-600.00	0.1897E+03
-500.00	0.1901E+03
-400.00	0.1904E+03
-300.00	0.1906E+03
00.00	0.1907E+03

Y [ft]	<- X [ft] ->
	3000
-100.00	0.1908E+03
0.00	0.1909E+03
100.00	0.1908E+03
200.00	0.1907E+03
300.00	0.1906E+03
400.00	0.1904E+03
500.00	0.1901E+03
600.00	0.1897E+03
700.00	0.1894E+03
800.00	0.1889E+03
900.00	0.1884E+03
1000.00	0.1879E+03
1100.00	0.1873E+03
1200.00	0.1866E+03
1300.00	0.1859E+03
1400.00	0.1852E+03
1500.00	0.1845E+03
1600.00	0.1837E+03
1700.00	0.1829E+03
1800.00	0.1821E+03
[illegible]00.00	0.1812E+03
[illegible]00.00	0.1803E+03
2100.00	0.1794E+03
2200.00	0.1785E+03
2300.00	0.1776E+03
2400.00	0.1767E+03
2500.00	0.1758E+03
2600.00	0.1748E+03
2700.00	0.1739E+03
2800.00	0.1729E+03
2900.00	0.1720E+03
3000.00	0.1710E+03

APPENDIX H

Matthews and Russell Formula Calculations

APPENDIX H

VERIFICATION OF THWELLS MODEL BY CALCULATION OF TOKIO SAND PRESSURE INCREASE USING THE MATTHEWS AND RUSSELL FORMULA

(100 gpm into Dow well)

Dow Chemical Corporation
Magnolia, Arkansas

FORMULA:

$$\Delta P = 162.6 \sum_{n=1}^{m} (Q_n\, \beta\, \mu / kh)\left[\log \left\{ k\, t_n / \phi\, \mu\, c_t\, r_n^{\,2} \right\} - 3.23 \right]$$

COMMON INPUTS:

β	=	1.0
μ	=	0.67 cp
k	=	200 md
h	=	55 ft
ϕ	=	0.28
c_t	=	$6.0 \times 10^{-6}\ psi^{-1}$
Q	=	100 gpm total for 10 years

VARIABLE INPUTS:

Q	=	100 gpm (3,429 BPD) for
T	=	3653 days = 87,672 hrs
R	=	variable for each problem. Dow Well Model coordinates (0, 0)

REDUCTION OF TERMS:

$162.6\, Q_n\, \beta\, \mu / kh \quad = \quad 162.6(Q_n)\,(1.0)\,(0.67\ cp) / (200\ md)(55\ feet)$

$\qquad\qquad = \quad 9.90 \times 10^{-3}\, Q_n$

$k\, t_n / \phi\, \mu\, c_t\, r^2_{\ n} \quad = \quad (200\ md)\, t_n / (0.28)\,(0.67\ cp)\,(6.0 \times 10\text{-}6)\ \ r^2_{\ n}$

$\qquad\qquad = \quad 1.777 \times 10^8\, t_n / r^2_{\ n}$

PROBLEM ONE: Pressure 1.0 Foot from Dow well (0, 0) After 3653 Days of Injection.
THWELLS coordinates (1, 0)

R = 1.0 foot

$$\Delta P = (9.90 \times 10^{-3})(3429 \text{ BPD}) \left[\log \left\{(1.777 \times 10^{8})(87672 \text{ hrs})/(1 \text{ ft})^{2}\right\} -3.23\right]$$

ΔP = 338 psi MATTHEWS AND RUSSELL

ΔP = 338 psi THWELLS

PROBLEM TWO: Pressure at Art. Pen. No. 1 After 3653 Days of Injection.
THWELLS coordinates (1350, -100)

R = 1354 feet

$$\Delta PNo1 = (9.90 \times 10^{-3})(3429 \text{ BPD}) \left[\log \left\{(1.777 \times 10^{8})(87672 \text{ hrs})/(1354 \text{ ft})^{2}\right\} -3.23\right]$$

ΔPNo1 = 126 MATTHEWS AND RUSSELL

ΔPNo1 = 126 psi THWELLS

PROBLEM THREE: Pressure at Art. Pen. No. 3 After 3653 Days of Injection.
THWELLS coordinates (-850, 1400)

R = 1638 feet

$$\Delta PNo3 = (9.90 \times 10^{-3})(3429 \text{ BPD}) \left[\log \left\{(1.777 \times 10^{8})(87672 \text{ hrs})/(1638 \text{ ft})^{2}\right\} -3.23\right]$$

ΔPNo3 = 120 psi MATTHEWS AND RUSSELL

ΔPNo3 = 120 psi THWELLS

PROBLEM FOUR: Pressure at Art. Pen. No. 4 After 3653 Days of Injection.
THWELLS coordinates (-2000, 1600)

R = 2561 feet

$$\Delta PNo4 = (9.90 \times 10^{-3})(3429 \text{ BPD}) \left[\log \left\{(1.777 \times 10^{8})(87672 \text{ hrs})/(2561 \text{ ft})^{2}\right\} -3.23\right]$$

ΔPNo4 = 107 psi MATTHEWS AND RUSSELL

ΔPNo4 = 107 psi THWELLS

APPENDIX H (Cont.)

VERIFICATION OF THWELLS MODEL BY CALCULATION OF JAMES SAND PRESSURE INCREASE USING THE MATTHEWS AND RUSSELL FORMULA

(100 gpm into Dow well)

Dow Chemical Corporation
Magnolia, Arkansas

FORMULA:

$$\Delta P = 162.6 \sum_{n=1}^{m} (Q_n \beta \mu / kh) \left[\log \left\{ k t_n / \phi \mu c_t r_n^2 \right\} - 3.23 \right]$$

COMMON INPUTS:

β	=	1.0
μ	=	0.68 cp
k	=	115 md
h	=	50 ft
ϕ	=	0.21
c_t	=	6.0×10^{-6} psi^{-1}
Q	=	100 gpm total for 10 years

VARIABLE INPUTS:

Q	=	100 gpm (3,429 BPD) for
T	=	3653 days = 87,672 hrs
R	=	variable for each problem. Dow Well Model coordinates (0, 0)

REDUCTION OF TERMS:

$$162.6\, Q_n\, \beta\, \mu / kh \quad = \quad 162.6(Q_n)\,(1.0)\,(0.68 \text{ cp}) / (115 \text{ md})(50 \text{ feet})$$

$$= \quad 1.92 \times 10^{-2}\, Q_n$$

$$k\, t_n / \phi\, \mu\, c_t\, r^2_n \quad = \quad (115 \text{ md})\, t_n / (0.21)\,(0.68 \text{ cp})\,(6.0 \times 10\text{-}6)\ r^2_n$$

$$= \quad 1.342 \times 10^8\, t_n / r^2_n$$

PROBLEM ONE: Pressure 1.0 Foot from Dow well (0, 0) After 3653 Days of Injection. THWELLS coordinates (1, 0)

R = 1.0 foot

$$\Delta P = (1.92 \times 10^{-2})(3429 \text{ BPD}) \left[\log \left\{(1.342 \times 10^{8})(87672 \text{ hrs})/(1 \text{ ft})^2\right\} -3.23 \right]$$

ΔP = 648 psi MATTHEWS AND RUSSELL

ΔP = 650 psi THWELLS

PROBLEM TWO: Pressure at Art. Pen. No. 1 After 3653 Days of Injection. THWELLS coordinates (1350, -100)

R = 1354 feet

$$\Delta PNo1 = (1.92 \times 10^{-2})(3429 \text{ BPD}) \left[\log \left\{(1.342 \times 10^{8})(87672 \text{ hrs})/(1354 \text{ ft})^2\right\} -3.23 \right]$$

$\Delta PNo1$ = 236 MATTHEWS AND RUSSELL

$\Delta PNo1$ = 237 psi THWELLS

PROBLEM THREE: Pressure at Art. Pen. No. 3 After 3653 Days of Injection. THWELLS coordinates (-850, 1400)

R = 1638 feet

$$\Delta PNo3 = (1.92 \times 10^{-2})(3429 \text{ BPD}) \left[\log \left\{(1.342 \times 10^{8})(87672 \text{ hrs})/(1638 \text{ ft})^2\right\} -3.23 \right]$$

$\Delta PNo3$ = 225 psi MATTHEWS AND RUSSELL

$\Delta PNo3$ = 226 psi THWELLS

PROBLEM FOUR: Pressure at Art. Pen. No. 4 After 3653 Days of Injection. THWELLS coordinates (-2000, 1600)

R = 2561 feet

$$\Delta PNo4 = (1.92 \times 10^{-2})(3429 \text{ BPD}) \left[\log \left\{(1.342 \times 10^{8})(87672 \text{ hrs})/(2561 \text{ ft})^2\right\} -3.23 \right]$$

$\Delta PNo4$ = 199 psi MATTHEWS AND RUSSELL

$\Delta PNo4$ = 200 psi THWELLS

APPENDIX I

Wastestream Analyses

L5 Stripper Effluent

STL Austin

Laboratory Analysis Report

May 22, 2000

Trey Fortenberry
Radian International LLC
8550 United Plaza Bl.
Suite 601
Baton Rouge, LA 70809

(225)231-5742 (Business)

RE: Laboratory Reference: Quarterly Water Sampling [20005104] Raven

Dear Trey Fortenberry:

STL Austin received samples with a request for the analytical fractions listed below.
Results for the indicated analytical fractions and associated quality control data are enclosed in this report.

Fraction	Status	Reported	Approval Signature - Title
Water Lab	ENCLOSED	05/22/2000	[signature] LM 5/23/00

STL Austin appreciates your business and looks forward to serving you again. If you have any questions concerning your report or need any additional information, please call me at (512)310-5202 or fax inquiries to (512)244-0160.

Sincerely,

Linda Voigt /RZ

Linda Bendele Voigt
Client Services/Project Manager

SECTION II
Report Summ[illegible]s

Water Lab

Client Name: Raven
Client Code: RAVEN

Project Name: Quarterly Water Sampling [20005104] Raven
Facility Name:

Workorder Summary

Client Sample ID	Lab Sample ID	Sample Matrix	Method Citation	Method Description
BDMW0120000504	2000510401	Aqueous	EPA 300.0	Anions by IC
BDMW0320000504	2000510402	Aqueous	EPA 300.0	Anions by IC
BDMW0520000504	2000510403	Aqueous	EPA 300.0	Anions by IC
BDMW0720000504	2000510404	Aqueous	EPA 300.0	Anions by IC
BDMW07DUP20000504	2000510405	Aqueous	EPA 300.0	Anions by IC
BDMW0920000504	2000510407	Aqueous	EPA 300.0	Anions by IC
FB20000504	2000510408	Aqueous	EPA 300.0	Anions by IC
L120000504	2000510409	Aqueous	EPA 300.0	Anions by IC
L520000504	2000510410	Aqueous	EPA 300.0	Anions by IC
MW2420000504	2000510411	Aqueous	EPA 300.0	Anions by IC
MW2520000504	2000510412	Aqueous	EPA 300.0	Anions by IC
MW2620000504	2000510413	Aqueous	EPA 300.0	Anions by IC
MW2720000504	2000510414	Aqueous	EPA 300.0	Anions by IC
MW2820000504	2000510417	Aqueous	EPA 300.0	Anions by IC
SFD520000504	2000510418	Aqueous	EPA 300.0	Anions by IC
SFD420000504	2000510419	Aqueous	EPA 300.0	Anions by IC
SB20000504	2000510420	Aqueous	EPA 300.0	Anions by IC

Water Lab

Protocol Summary

Client Sample ID	Lab Sample ID	Date & Time Collected	Date & Time Received	Prep Batch ID	Date & Time Prepared	Analysis Batch ID	Date & Time Analyzed	Hold Time Spec Prep Spec	Prep Actual	Analysis Spec	Analysis Actual
Method: EPA 300.0											
BDMW0120000504	2000510401	05/04/00 14:55	05/06/00 10:00	5004	05/19/00 00:43	5004	05/19/00 00:43	28D	15D	28D	15D
BDMW0320000504	2000510402	05/04/00 15:30	05/06/00 10:00	5004	05/19/00 00:53	5004	05/19/00 00:53	28D	15D	28D	15D
BDMW0520000504	2000510403	05/04/00 16:05	05/06/00 10:00	5004	05/19/00 01:03	5004	05/19/00 01:03	28D	15D	28D	15D
BDMW0720000504	2000510404	05/04/00 16:45	05/06/00 10:00	5004	05/19/00 01:12	5004	05/19/00 01:12	28D	15D	28D	15D
BDMW07DUP20000504	2000510405	05/04/00 16:45	05/06/00 10:00	5004	05/19/00 01:22	5004	05/19/00 01:22	28D	15D	28D	15D
BDMW0920000504	2000510407	05/04/00 17:15	05/06/00 10:00	5004	05/19/00 01:31	5004	05/19/00 01:31	28D	15D	28D	15D
FB20000504	2000510408	05/04/00 16:55	05/06/00 10:00	5004	05/19/00 01:41	5004	05/19/00 01:41	28D	15D	28D	15D
L120000504	2000510409	05/04/00 15:00	05/06/00 10:00	5004	05/19/00 01:51	5004	05/19/00 01:51	28D	15D	28D	15D
L520000504	2000510410	05/04/00 15:15	05/06/00 10:00	5004	05/19/00 02:00	5004	05/19/00 02:00	28D	15D	28D	15D
MW2420000504	2000510411	05/04/00 11:10	05/06/00 10:00	5004	05/19/00 02:48	5004	05/19/00 02:48	28D	15D	28D	15D
MW2520000504	2000510412	05/04/00 11:55	05/06/00 10:00	5004	05/19/00 02:58	5004	05/19/00 02:58	28D	15D	28D	15D
MW2620000504	2000510413	05/04/00 12:15	05/06/00 10:00	5004	05/19/00 03:07	5004	05/19/00 03:07	28D	15D	28D	15D
MW2720000504	2000510414	05/04/00 13:00	05/06/00 10:00	5004	05/19/00 00:15	5004	05/19/00 00:15	28D	15D	28D	15D
MW2820000504	2000510417	05/04/00 13:55	05/06/00 10:00	5004	05/19/00 03:17	5004	05/19/00 03:17	28D	15D	28D	15D
SFD520000504	2000510418	05/04/00 17:30	05/06/00 10:00	5004	05/19/00 03:27	5004	05/19/00 03:27	28D	15D	28D	15D
SFD420000504	2000510419	05/04/00 18:00	05/06/00 10:00	5004	05/19/00 03:36	5004	05/19/00 03:36	28D	15D	28D	15D
SB20000504	2000510420	05/04/00 18:00	05/06/00 10:00	5004	05/19/00 03:46	5004	05/19/00 03:46	28D	15D	28D	15D

SECTION III
Comments a… …lag Definitions

Water Lab

Standard Data Qualifiers

Flag	Definition
J	Result > or = MDL and <PQL
NA	Not analyzed/Not available
ND	Not detected at the specified reporting limit
Q	Result does not meet tolerance in Protocol Specification
U	Result less than sample specific method detection limit

Analyst Comments

Flag	Affected Sample	Method	Comment

Sample Condition Comments

Affected Sample	Comment

SECTION IV
Analytical R ts

Water Lab
EPA 300.0

field blank

feed to steam stripper

discharge from steam stripper to fuel brine

Client Sample ID	FB20000504	L120000504	L520000504
Lab Sample ID	2000510408	2000510409	2000510410
Matrix	Aqueous	Aqueous	Aqueous
Reported As	Received	Received	Received
% Moisture	NA	NA	NA
Date/Time Collected	05/04/2000 16:55	05/04/2000 15:00	05/04/2000 15:15
Date/Time Prepared	05/19/2000 01:41	05/19/2000 01:51	05/19/2000 02:00
Date/Time Analyzed	05/19/2000 01:41	05/19/2000 01:51	05/19/2000 02:00
Dilution Factor	1.0000	1000.0000	1000.0000
Instrument	DX300	DX300	DX300
Units	mg/L	mg/L	mg/L

Parameter	CAS	Conc	Flag	DL	RL	Conc	Flag	DL	RL	Conc	Flag	DL	RL
Chloride	16887-00-6	0.168	J	0.00699	0.000	5800		6.99	0.000	5050		6.99	0.000

STL Austin

Laboratory Analysis Report

May 22, 2000

Trey Fortenberry
Radian International LLC
8550 United Plaza Bl.
Suite 601
Baton Rouge, LA 70809

(225)231-5742 (Business)

RE: Laboratory Reference: Quarterly Water Sampling [20005103] Raven

Dear Trey Fortenberry:

STL Austin received samples with a request for the analytical fractions listed below.
Results for the indicated analytical fractions and associated quality control data are enclosed in this report.

Fraction	Status	Reported	Approval Signature - Title
MS-VOA	ENCLOSED	05/22/2000	[illegible] 5/24/00

STL Austin appreciates your business and looks forward to serving you again. If you have any questions concerning your report or need any additional information, please call me at (512)310-5202 or fax inquiries to (512)244-0160.

Sincerely,

Linda Voigt / B

Linda Bendele Voigt
Client Services/Project Manager

SECTION I
Table of Contents

MS-VOA

Client Name: Raven
Client Code: RAVEN

Project Name: Quarterly Water Sampling [20005103] Raven
Facility Name:

Workorder Summary

Client Sample ID	Lab Sample ID	Sample Matrix	Method Citation	Method Description
BDMW0120000504	2000510301	Aqueous	SW8260B	Volatiles by GC/MS
BDMW0320000504	2000510302	Aqueous	SW8260B	Volatiles by GC/MS
BDMW0520000504	2000510303	Aqueous	SW8260B	Volatiles by GC/MS
BDMW0720000504	2000510304	Aqueous	SW8260B	Volatiles by GC/MS
BDMW07DUP20000504	2000510305	Aqueous	SW8260B	Volatiles by GC/MS
BDMW0920000504	2000510306	Aqueous	SW8260B	Volatiles by GC/MS
FB20000504	2000510307	Aqueous	SW8260B	Volatiles by GC/MS
TRIP BLANK	2000510308	Aqueous	SW8260B	Volatiles by GC/MS
L120000504	2000510309	Aqueous	SW8260B	Volatiles by GC/MS
L520000504	2000510310	Aqueous	SW8260B	Volatiles by GC/MS
MW2420000504	2000510311	Aqueous	SW8260B	Volatiles by GC/MS
MW2520000504	2000510312	Aqueous	SW8260B	Volatiles by GC/MS
MW2620000504	2000510313	Aqueous	SW8260B	Volatiles by GC/MS
MW2720000504	2000510314	Aqueous	SW8260B	Volatiles by GC/MS
MW2820000504	2000510317	Aqueous	SW8260B	Volatiles by GC/MS
SFD52000504	2000510318	Aqueous	SW8260B	Volatiles by GC/MS
SFD42000504	2000510319	Aqueous	SW8260B	Volatiles by GC/MS
SB20000504	2000510320	Aqueous	SW8260B	Volatiles by GC/MS

SECTION II
Report Summaries

MS-VOA

Protocol Summary

Client Sample ID	Lab Sample ID	Date & Time Collected	Date & Time Received	Prep Batch ID	Date & Time Prepared	Analysis Batch ID	Date & Time Analyzed	Hold Time Spec Prep Spec	Hold Time Spec Prep Actual	Hold Time Spec Analysis Spec	Hold Time Spec Analysis Actual
Method: SW8260B											
BDMW0120000504	2000510301	05/04/00 14:55	05/06/00 10:00	4951	05/16/00 13:35	4951	05/16/00 13:35	14D	12D	14D	12D
BDMW0320000504	2000510302	05/04/00 15:30	05/06/00 10:00	4951	05/16/00 14:02	4951	05/16/00 14:02	14D	12D	14D	12D
BDMW0520000504	2000510303	05/04/00 16:05	05/06/00 10:00	4951	05/16/00 14:29	4951	05/16/00 14:29	14D	12D	14D	12D
BDMW0720000504	2000510304	05/04/00 16:45	05/06/00 10:00	4951	05/16/00 14:56	4951	05/16/00 14:56	14D	12D	14D	12D
BDMW07DUP20000504	2000510305	05/04/00 16:45	05/06/00 10:00	4951	05/16/00 15:24	4951	05/16/00 15:24	14D	12D	14D	12D
BDMW0920000504	2000510306	05/04/00 17:15	05/06/00 10:00	4951	05/16/00 15:51	4951	05/16/00 15:51	14D	12D	14D	12D
BDMW0920000504	2000510306	05/04/00 17:15	05/06/00 10:00	4999	05/17/00 22:26	4999	05/17/00 22:26	14D	13D	14D	13D
FB20000504	2000510307	05/04/00 16:55	05/06/00 10:00	4951	05/16/00 16:18	4951	05/16/00 16:18	14D	12D	14D	12D
FB20000504	2000510307	05/04/00 16:55	05/06/00 10:00	4999	05/17/00 19:16	4999	05/17/00 19:16	14D	13D	14D	13D
TRIP BLANK	2000510308		05/06/00 10:00	4974	05/16/00 18:57	4974	05/16/00 18:57				
L120000504	2000510309	05/04/00 15:00	05/06/00 10:00	4951	05/16/00 16:46	4951	05/16/00 16:46	14D	12D	14D	12D
L120000504	2000510309	05/04/00 15:00	05/06/00 10:00	4999	05/17/00 23:50	4999	05/17/00 23:50	14D	13D	14D	13D
L520000504	2000510310	05/04/00 15:00	05/06/00 10:00	4951	05/16/00 17:14	4951	05/16/00 17:14	14D	12D	14D	12D
L520000504	2000510310	05/04/00 15:00	05/06/00 10:00	4999	05/17/00 19:43	4999	05/17/00 19:43	14D	13D	14D	13D
MW2420000504	2000510311	05/04/00 11:10	05/06/00 10:00	4951	05/16/00 18:09	4951	05/16/00 18:09	14D	12D	14D	12D
MW2420000504	2000510311	05/04/00 11:10	05/06/00 10:00	4999	05/17/00 20:10	4999	05/17/00 20:10	14D	13D	14D	13D
MW2520000504	2000510312	05/04/00 11:55	05/06/00 10:00	4951	05/16/00 18:36	4951	05/16/00 18:36	14D	12D	14D	12D
MW2520000504	2000510312	05/04/00 11:55	05/06/00 10:00	4999	05/17/00 20:38	4999	05/17/00 20:38	14D	13D	14D	13D
MW2620000504	2000510313	05/04/00 12:15	05/06/00 10:00	4951	05/16/00 19:04	4951	05/16/00 19:04	14D	12D	14D	12D
MW2720000504	2000510314	05/04/00 13:00	05/06/00 10:00	4974	05/16/00 19:25	4974	05/16/00 19:25	14D	12D	14D	12D
MW2720000504	2000510314	05/04/00 13:00	05/06/00 10:00	4999	05/17/00 23:23	4999	05/17/00 23:23	14D	13D	14D	13D
MW2820000504	2000510317	05/04/00 13:55	05/06/00 10:00	4951	05/16/00 19:31	4951	05/16/00 19:31	14D	12D	14D	12D

SECTION II
Report Summaries

MS-VOA

Protocol Summary continued -

Method: SW8260B continued -

Client Sample ID	Lab Sample ID	Date & Time Collected	Date & Time Received	Prep Batch ID	Date & Time Prepared	Analysis Batch ID	Date & Time Analyzed	Hold Time Spec Prep Spec	Prep Actual	Analysis Spec	Analysis Actual
MW2820000504	2000510317	05/04/00 13:55	05/06/00 10:00	4999	05/17/00 22:55	4999	05/17/00 22:55	14D	13D	14D	13D
SFD52000504	2000510318	05/04/00 17:30	05/06/00 10:00	4951	05/16/00 19:59	4951	05/16/00 19:59	14D	12D	14D	12D
SFD52000504	2000510318	05/04/00 17:30	05/06/00 10:00	4999	05/17/00 21:05	4999	05/17/00 21:05	14D	13D	14D	13D
SFD42000504	2000510319	05/04/00 18:00	05/06/00 10:00	4974	05/16/00 20:49	4974	05/16/00 20:49	14D	12D	14D	12D
SFD42000504	2000510319	05/04/00 18:00	05/06/00 10:00	4999	05/17/00 21:32	4999	05/17/00 21:32	14D	13D	14D	13D
SB20000504	2000510320	05/04/00 18:00	05/06/00 10:00	4974	05/16/00 21:17	4974	05/16/00 21:17	14D	12D	14D	12D
SB20000504	2000510320	05/04/00 18:00	05/06/00 10:00	4999	05/17/00 21:59	4999	05/17/00 21:59	14D	13D	14D	13D

SECTION III
Comments and Flag Definitions

MS-VOA

Standard Data Qualifiers

Flag	Definition
B	Analyte detected in method blank and concentration > MDL
E	Analyte concentration exceeded calibration range
J	Result > or = MDL and <PQL
NA	Not analyzed/Not available
ND	Not detected at the specified reporting limit
Q	Result does not meet tolerance in Protocol Specification
R	Result reported elsewhere
U	Result less than sample specific method detection limit
V	Carryover suspected.

Analyst Comments

Flag	Affected Sample	Method	Comment
X	L120000504	SW8260B	Analyte diluted out in reanalysis.

Sample Condition Comments

Affected Sample	Comment

SECTION IV
Analytical Res...s

MS-VOA
SW8260B

Client Sample ID	L520000504	MW2420000504	MW2420000504
Lab Sample ID	2000510310	2000510311	2000510311
Matrix	Aqueous	Aqueous	Aqueous
Reported As	Received	Received	Received
% Moisture	NA	NA	NA
Date/Time Collected	05/04/2000 15:00	05/04/2000 11:10	05/04/2000 11:10
Date/Time Prepared	05/17/2000 19:43	05/16/2000 18:09	05/17/2000 20:10
Date/Time Analyzed	05/17/2000 19:43	05/16/2000 18:09	05/17/2000 20:10
Dilution Factor	1.0000	1.0000	1.0000
Instrument	MSDB	MSDB	MSDB
Units	ug/L	ug/L	ug/L

Parameter	CAS	Conc	Flag	DL	RL	Conc	Flag	DL	RL	Conc	Flag	DL	RL
1-Bromo-2-chloroethane	107-04-0	ND		0.0469	0.000	ND		0.0469	0.000	ND		0.0469	0.000
1,2-Dibromo-3-chloropropane	96-12-8	ND		1.18	0.000	9.80	V	1.18	0.000	9.18		1.18	0.000
1,2-Dibromoethane	106-93-4	ND		0.0713	0.000	1.92	V	0.0713	0.000	1.29		0.0713	0.000
1,2-Dichloroethane	107-06-2	ND		0.0619	0.000	0.737	V	0.0619	0.000	0.366	J	0.0619	0.000

SECTION IV
Analytical Res
Surrogates

MS-VOA
SW8260B

Client Sample ID	L520000504	MW2420000504	MW2420000504
Lab Sample ID	2000510310	2000510311	2000510311
Matrix	Aqueous	Aqueous	Aqueous
Reported As	Received	Received	Received
% Moisture	NA	NA	NA
Date/Time Collected	05/04/2000 15:00	05/04/2000 11:10	05/04/2000 11:10
Date/Time Prepared	05/17/2000 19:43	05/16/2000 18:09	05/17/2000 20:10
Date/Time Analyzed	05/17/2000 19:43	05/16/2000 18:09	05/17/2000 20:10
Dilution Factor	1.0000	1.0000	1.0000
Instrument	MSDB	MSDB	MSDB
Units	ug/L	ug/L	ug/L

Surrogate Compound	% Recovery	Limits	F	% Recovery	Limits	F	% Recovery	Limits	F
1-Bromo-4-fluorobenzene	92	77-117		93	77-117		95	77-117	
1,2-Dichloroethane-d4	107	61-143		102	61-143		104	61-143	
Toluene-d8	95	87-113		96	87-113		94	87-113	

Albemarle Grab Sample

ANALYTICAL RESULTS

PERFORMED BY

GULF COAST ANALYTICAL LABORATORIES, INC.

REPORT DATE: 11/17/1999

GCAL REPORT NO: 9907433

DELIVER TO	DOW CHEMICAL COMPANY PO BOX 150 BUILDING 3502 E. PLAQUEMINE, LA 70764-0150
ATTENTION	RICHARD DURHAM
CLIENT ID	0082

SAMPLE CROSS-REFERENCE

SAMPLE IDENTIFICATION

Sample#	Matrix	Sample ID	Sample Date	Receive Date
9911080025	WATER	358329	11/04/1999	11/05/1999 13:52

CASE NARRATIVE

Client: DOW CHEMICAL COMPANY **Group No:** 9907433
Date: 11/17/1999

ORGANIC QUALITY CONTROL CRITERIA:

Holding Times: All holding times were within method criteria.

Method Blanks: All method blanks were within quality control criteria.

Instrument Calibration: Both the initial and continuing calibrations were within method quality control criteria.

Surrogate Spikes: All surrogate recoveries were within quality control criteria.

Matrix Spike/Matrix Spike Duplicate (MS/MSD): All MS/MSD recoveries were found to be within quality control limits.

Internal Standard Responses: All internal standard responses met method quality control criteria.

Analysis Comments: No unusual analytical problems were encountered during the analysis of these samples.

INORGANIC QUALITY CONTROL CRITERIA:

Holding Times: All holding times were within method criteria.

Method Blanks: All method blanks were found to be within quality control criteria.

Spike/Duplicate (S/D): The spike recoveries for Potassium, Calcium, Magnesium and Sodium is reported as not applicable because the sample concentration is greater than four times the spike concentration.

The RPD for duplicate Mercury analysis is above the control limit; however, this RPD is not applicable because the batch duplicate sample concentration is less than five times the detection limit.

The RPD for duplicate Sulfide analysis is above the control limit; however, this RPD is not applicable because the batch duplicate sample concentration is less than five times the detection limit.

All other S/D recoveries were within quality control criteria.

Laboratory Control Samples: All LCS analyses met quality control criteria.

Client: DOW CHEMICAL COMPANY **Group No:** 9907433
Date: 11/17/1999

INORGANIC QUALITY CONTROL CRITERIA:

Calibration Verifications: All ICV, ICB, CCV, CCB analyses met all quality control criteria.

Analysis Comments: In the Metals ICP analysis, a chemical or physical interference necessitated a 5-fold dilution. This is reflected in the higher detection limits reported.

In the analysis for Potassium and Sodium, the samples had to be diluted in order to bracket their concentrations within the limits of the calibration curves. Accordingly, the detection limits have been multiplied by the dilution factors.

No other unusual analytical problems were encountered during the analysis of these samples.

GULF COAST ANALYTICAL LABORATORIES, INC.

LABORATORY ENDORSEMENT

Sample receipt at Gulf Coast Analytical Laboratories, Inc. is documented for your designated sample(s). Chain-of-custody documentation, if provided, is included in this report.

Sample analysis was performed in accordance with Environmental Protection Agency protocol or other approved methods as designated in this report. All Quality Control criteria were found to be within Method Control Limits unless otherwise noted in the Case Narrative of this report. All results reported are to be considered Wet Weight Results unless dry weight determinations are made and the Case Narrative includes a statement that results are reported on a Dry Weight Basis.

REPORT QUALIFIERS

<DL	RESULT IS LESS THAN THE DETECTION LIMIT
DO	PARAMETER WAS DILUTED OUT
fld **	PARAMETER WAS PERFORMED IN THE FIELD
MI	MATRIX INTERFERENCE
NA	NOT APPLICABLE
ND	NOT DETECTED
subc **	ANALYSIS WAS SUBCONTRACTED
TNTC	TOO NUMEROUS TO COUNT
00:00	TIME NOT PROVIDED OR MIDNIGHT

** These fields will appear in the analyst column

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SCOTT A. BAILEY
OPERATIONS MANAGER

This Report Contains 17 Pages.

SAMPLE ANALYSIS

SAMPLE IDENTIFICATION

Sample#	Matrix	Sample ID	Sample Date	Receive Date
9911080025	WATER	358329	11/04/1999	11/05/1999 13:52

METHOD SUMMARY

Test	Method	Prep Date	Analysis Date
HSL-Semivolatiles (8270) Water	8270	11/08/1999 14:00	11/09/1999 19:28
HSL-Volatiles (8260) Water	8260(HSL)		11/13/1999 15:44
Mercury	SW7470A	11/09/1999 11:51	11/10/1999 10:44
Potassium	7610	11/09/1999 11:51	11/11/1999 12:48
Sodium	7770	11/09/1999 11:51	11/10/1999 12:34
Metals by EPA Method 6010	6010B	11/09/1999 11:51	11/11/1999 08:28
Flashpoint	1010		11/09/1999 11:00
Reactivity Cyanide	7.3.3.2	11/09/1999 09:00	11/09/1999 21:26
Reactivity Sulfide	7.3.4.2	11/09/1999 09:00	11/10/1999 10:30
pH	4500 H+B		11/08/1999 11:30

ANALYTICAL RESULTS

Metals Analyses	Result	Unit	Detection Limit	Dilution	QC Batch	By
Mercury	0.0009	(mg/L Hg)	0.0002	1	110436	jdt
Potassium	259	(mg/L K)	10	50	110500	jdt
Sodium	4910	(mg/L Na)	200	200	110433	jdt

Miscellaneous Analyses	Result	Unit	Detection Limit	Dilution	QC Batch	By
Flashpoint	>212	(DEG F)	50	1	110385	roy
pH	8.58	(Units)	2	1	110299	olt
Reactivity Cyanide	<DL	(mg/L CN)	0.1	1	110397	bmc
Reactivity Sulfide	128	(mg/L S)	80	1	110452	hlo

HSL-Semivolatiles (8270) Water	Result	Unit	Detection Limit	Dilution	QC Batch	By
Phenol	<DL	(ug/L)	10	1	110439	ejb
bis(2-Chloroethyl)ether	<DL	(ug/L)	10	1	110439	ejb
2-Chlorophenol	<DL	(ug/L)	10	1	110439	ejb
1,3-Dichlorobenzene	<DL	(ug/L)	10	1	110439	ejb
1,4-Dichlorobenzene	<DL	(ug/L)	10	1	110439	ejb
Benzyl Alcohol	<DL	(ug/L)	10	1	110439	ejb
1,2-Dichlorobenzene	<DL	(ug/L)	10	1	110439	ejb
2-Methylphenol	<DL	(ug/L)	10	1	110439	ejb
bis(2-Chloroisopropyl)ether	<DL	(ug/L)	10	1	110439	ejb
3 & 4-Methylphenol	<DL	(ug/L)	10	1	110439	ejb
N-Nitroso-di-n-propylamine	<DL	(ug/L)	10	1	110439	ejb

SAMPLE ANALYSIS

SAMPLE# 9911080025 CONTINUED

ANALYTICAL RESULTS

HSL-Semivolatiles (8270) Water	Result	Unit	Detection Limit	Dilution	QC Batch	By
Hexachloroethane	<DL	(ug/L)	10	1	110439	ejb
Nitrobenzene	<DL	(ug/L)	10	1	110439	ejb
Isophorone	<DL	(ug/L)	10	1	110439	ejb
2-Nitrophenol	<DL	(ug/L)	10	1	110439	ejb
2,4-Dimethylphenol	<DL	(ug/L)	10	1	110439	ejb
Benzoic Acid	<DL	(ug/L)	50	1	110439	ejb
bis(2-Chloroethoxy)methane	<DL	(ug/L)	10	1	110439	ejb
2,4-Dichlorophenol	<DL	(ug/L)	10	1	110439	ejb
1,2,4-Trichlorobenzene	<DL	(ug/L)	10	1	110439	ejb
Naphthalene	<DL	(ug/L)	10	1	110439	ejb
4-Chloroaniline	<DL	(ug/L)	10	1	110439	ejb
Hexachlorobutadiene	<DL	(ug/L)	10	1	110439	ejb
4-Chloro-3-Methylphenol	<DL	(ug/L)	10	1	110439	ejb
2-Methylnaphthalene	<DL	(ug/L)	10	1	110439	ejb
Hexachlorocyclopentadiene	<DL	(ug/L)	10	1	110439	ejb
2,4,6-Trichlorophenol	<DL	(ug/L)	10	1	110439	ejb
2,4,5-Trichlorophenol	<DL	(ug/L)	10	1	110439	ejb
2-Chloronaphthalene	<DL	(ug/L)	10	1	110439	ejb
2-Nitroaniline	<DL	(ug/L)	50	1	110439	ejb
Dimethylphthalate	<DL	(ug/L)	10	1	110439	ejb
Acenaphthylene	<DL	(ug/L)	10	1	110439	ejb
2,6-Dinitrotoluene	<DL	(ug/L)	10	1	110439	ejb
3-Nitroaniline	<DL	(ug/L)	50	1	110439	ejb
Acenaphthene	<DL	(ug/L)	10	1	110439	ejb
2,4-Dinitrophenol	<DL	(ug/L)	50	1	110439	ejb
4-Nitrophenol	<DL	(ug/L)	50	1	110439	ejb
Dibenzofuran	<DL	(ug/L)	10	1	110439	ejb
2,4-Dinitrotoluene	<DL	(ug/L)	10	1	110439	ejb
Diethylphthalate	<DL	(ug/L)	10	1	110439	ejb
4-Chlorophenyl-phenylether	<DL	(ug/L)	10	1	110439	ejb
Fluorene	<DL	(ug/L)	10	1	110439	ejb
4-Nitroaniline	<DL	(ug/L)	50	1	110439	ejb
4,6-Dinitro-o-Cresol	<DL	(ug/L)	50	1	110439	ejb
N-Nitrosodiphenylamine (Note)	<DL	(ug/L)	10	1	110439	ejb
4-Bromophenyl-phenylether	<DL	(ug/L)	10	1	110439	ejb
Hexachlorobenzene	<DL	(ug/L)	10	1	110439	ejb
Pentachlorophenol	<DL	(ug/L)	50	1	110439	ejb
Phenanthrene	<DL	(ug/L)	10	1	110439	ejb
Anthracene	<DL	(ug/L)	10	1	110439	ejb
Di-n-butylphthalate	<DL	(ug/L)	10	1	110439	ejb
Fluoranthene	<DL	(ug/L)	10	1	110439	ejb
Pyrene	<DL	(ug/L)	10	1	110439	ejb
Butylbenzylphthalate	<DL	(ug/L)	10	1	110439	ejb
3,3'-Dichlorobenzidine	<DL	(ug/L)	20	1	110439	ejb
Benzo(a)anthracene	<DL	(ug/L)	10	1	110439	ejb
Chrysene	<DL	(ug/L)	10	1	110439	ejb

Note: N-Nitrosodiphenylamine decomposes in the GC inlet and cannot be separated from Diphenylamine

SAMPLE ANALYSIS

SAMPLE# 9911080025 CONTINUED

ANALYTICAL RESULTS

HSL-Semivolatiles (8270) Water	Result	Unit	Detection Limit	Dilution	QC Batch	By
bis(2-Ethylhexyl)phthalate	<DL	(ug/L)	10	1	110439	ejb
Di-n-octyl phthalate	<DL	(ug/L)	10	1	110439	ejb
Benzo(b)fluoranthene	<DL	(ug/L)	10	1	110439	ejb
Benzo(k)fluoranthene	<DL	(ug/L)	10	1	110439	ejb
Benzo(a)pyrene	<DL	(ug/L)	10	1	110439	ejb
Indeno(1,2,3-cd)pyrene	<DL	(ug/L)	10	1	110439	ejb
Dibenzo(a,h)anthracene	<DL	(ug/L)	10	1	110439	ejb
Benzo(ghi)perylene	<DL	(ug/L)	10	1	110439	ejb
Carbazole	<DL	(ug/L)	10	1	110439	ejb
Surrogate(s)	*%Recovery*		*LIMITS*			
Nitrobenzene-d5	91		43-110			
2-Fluorobiphenyl	95		16-128			
Terphenyl-d14	74		47-121			
Phenol-d6	44		10-76			
2-Fluorophenol	63		24-96			
2,4,6-Tribromophenol	133		19-133			

HSL-Volatiles (8260) Water	Result	Unit	Detection Limit	Dilution	QC Batch	By
Chloromethane	<DL	(ug/L)	50	10	110607	mlk
Bromomethane	<DL	(ug/L)	50	10	110607	mlk
Vinyl chloride	<DL	(ug/L)	50	10	110607	mlk
Chloroethane	<DL	(ug/L)	50	10	110607	mlk
Methylene chloride	<DL	(ug/L)	100	10	110607	mlk
Acetone	1250	(ug/L)	250	10	110607	mlk
Carbon disulfide	<DL	(ug/L)	50	10	110607	mlk
1,1-Dichloroethylene	<DL	(ug/L)	50	10	110607	mlk
1,1-Dichloroethane	<DL	(ug/L)	50	10	110607	mlk
Total 1,2-Dichloroethene	<DL	(ug/L)	50	10	110607	mlk
Chloroform	<DL	(ug/L)	50	10	110607	mlk
1,2-Dichloroethane	<DL	(ug/L)	50	10	110607	mlk
Methyl ethyl ketone	<DL	(ug/L)	250	10	110607	mlk
1,1,1-Trichloroethane	<DL	(ug/L)	50	10	110607	mlk
Carbon tetrachloride	<DL	(ug/L)	50	10	110607	mlk
Vinyl Acetate	161	(ug/L)	50	10	110607	mlk
Dichlorobromomethane	<DL	(ug/L)	50	10	110607	mlk
1,2-Dichloropropane	<DL	(ug/L)	50	10	110607	mlk
cis-1,3-Dichloropropene	<DL	(ug/L)	50	10	110607	mlk
Trichloroethene	<DL	(ug/L)	50	10	110607	mlk
Chlorodibromomethane	<DL	(ug/L)	50	10	110607	mlk
1,1,2-Trichloroethane	<DL	(ug/L)	50	10	110607	mlk
Benzene	<DL	(ug/L)	50	10	110607	mlk
trans-1,3-Dichloropropene	<DL	(ug/L)	50	10	110607	mlk
Bromoform	<DL	(ug/L)	50	10	110607	mlk
4-Methyl-2-pentanone	<DL	(ug/L)	50	10	110607	mlk
2-Hexanone	<DL	(ug/L)	50	10	110607	mlk

SAMPLE ANALYSIS

SAMPLE# 9911080025 CONTINUED

ANALYTICAL RESULTS

HSL-Volatiles (8260) Water	Result	Unit	Detection Limit	Dilution	QC Batch	By
Tetrachloroethylene	<DL	(ug/L)	50	10	110607	mlk
1,1,2,2-Tetrachloroethane	<DL	(ug/L)	50	10	110607	mlk
Toluene	<DL	(ug/L)	50	10	110607	mlk
Chlorobenzene	<DL	(ug/L)	50	10	110607	mlk
Ethylbenzene	<DL	(ug/L)	50	10	110607	mlk
Styrene	<DL	(ug/L)	50	10	110607	mlk
Total Xylene	<DL	(ug/L)	50	10	110607	mlk
cis-1,2-Dichloroethene	<DL	(ug/L)	50	10	110607	mlk
trans-1,2-Dichloroethene	<DL	(ug/L)	50	10	110607	mlk
O-Xylene	<DL	(ug/L)	50	10	110607	mlk
M & P Xylene	<DL	(ug/L)	50	10	110607	mlk
Surrogate(s)	***%Recovery***		***LIMITS***			
1,2-Dichloroethane-d5	76		76-128			
Toluene-d8	106		83-112			
4-Bromofluorobenzene	98		78-115			

Metals by EPA Method 6010	Result	Unit	Detection Limit	Dilution	QC Batch	By
Silver	<DL	(mg/L)	0.05	5	110497	kad
Aluminum	<DL	(mg/L)	1	5	110497	kad
Arsenic	<DL	(mg/L)	0.2	5	110497	kad
Barium	1.48	(mg/L)	0.05	5	110497	kad
Beryllium	<DL	(mg/L)	0.025	5	110497	kad
Calcium	2020	(mg/L)	0.25	5	110497	kad
Cadmium	<DL	(mg/L)	0.025	5	110497	kad
Cobalt	<DL	(mg/L)	0.05	5	110497	kad
Chromium	<DL	(mg/L)	0.05	5	110497	kad
Copper	<DL	(mg/L)	0.125	5	110497	kad
Iron	0.296	(mg/L)	0.25	5	110497	kad
Magnesium	190	(mg/L)	0.25	5	110497	kad
Manganese	1.64	(mg/L)	0.075	5	110497	kad
Nickel	<DL	(mg/L)	0.2	5	110497	kad
Lead	<DL	(mg/L)	0.075	5	110497	kad
Antimony	<DL	(mg/L)	0.3	5	110497	kad
Selenium	<DL	(mg/L)	0.2	5	110497	kad
Thallium	<DL	(mg/L)	0.1	5	110497	kad
Vanadium	<DL	(mg/L)	0.1	5	110497	kad
Zinc	<DL	(mg/L)	0.1	5	110497	kad

QUALITY CONTROL SUMMARY

Report#: 9907433

Parameter	Units	METHOD BLANK		LABORATORY CONTROL STANDARD			DUPLICATE			SPIKE		
		Result	Detection Limit	Spiked Amount	Recovered Amount	Percent Recovery	Result 1	Result 2	RPD	Spiked Amount	Recovered Amount	Percent Recovery
QC Batch 110299												
pH	(Units)			5.00	5.00	100	8.58	8.57	0			
QC Batch 110385												
Flashpoint	(DEG F)			81	81	100	>212	>212				
QC Batch 110397												
Reactivity Cyanide	(mg/L CN)	<DL	0.1	0.050	0.042	84	<DL	<DL				
QC Batch 110433												
Sodium	(mg/L Na)	<DL	1	5.00	5.08	102	4910	4670	5	5.00	NA	
QC Batch 110436												
Mercury	(mg/L Hg)	<DL	0.0002	0.00500	0.00444	89	0.0009	0.0007	25 *	0.00500	0.00463	93
QC Batch 110439												
2-Chlorophenol	(ug/L)	<DL	10	100	83.5	84						
Acenaphthene	(ug/L)	<DL	10	100	86.3	86						
2,4-Dichlorophenol	(ug/L)	<DL	10	100	86.6	87						
Acenaphthylene	(ug/L)	<DL	10	100	85.8	86						
2,4-Dimethylphenol	(ug/L)	<DL	10	100	87.2	87						
Anthracene	(ug/L)	<DL	10	100	87.6	88						
4,6-Dinitro-o-Cresol	(ug/L)	<DL	50	100	93.9	94						
2,4-Dinitrophenol	(ug/L)	<DL	50	100	80.2	80						
Benzo(a)anthracene	(ug/L)	<DL	10	100	86.4	86						
2-Nitrophenol	(ug/L)	<DL	10	100	87.6	88						
Benzo(a)pyrene	(ug/L)	<DL	10	100	87.8	88						
4-Nitrophenol	(ug/L)	<DL	50	100	36.1	36						
Benzo(b)fluoranthene	(ug/L)	<DL	10	100	92.2	92						
4-Chloro-3-Methylphenol	(ug/L)	<DL	10	100	78.7	79						
Benzo(ghi)perylene	(ug/L)	<DL	10	100	88.2	88						
Pentachlorophenol	(ug/L)	<DL	50	100	89.4	89						
Benzo(k)fluoranthene	(ug/L)	<DL	10	100	78.5	78						

*Outside QC Limits - See Narrative

QUALITY CONTROL SUMMARY

Report#: 9907433

Parameter	Units	METHOD BLANK Result	Detection Limit	LABORATORY CONTROL STANDARD Spiked Amount	Recovered Amount	Percent Recovery	DUPLICATE Result 1	Result 2	RPD	SPIKE Spiked Amount	Recovered Amount	Percent Recovery
Phenol	(ug/L)	<DL	10	100	45.8	46						
bis(2-Chloroethoxy)methane	(ug/L)	<DL	10	100	85.7	86						
2,4,6-Trichlorophenol	(ug/L)	<DL	10	100	89.3	89						
bis(2-Chloroethyl)ether	(ug/L)	<DL	10	100	84.1	84						
2,4,5-Trichlorophenol	(ug/L)	<DL	10	100	92.0	92						
bis(2-Chloroisopropyl)ether	(ug/L)	<DL	10	100	83.3	83						
2-Methylphenol	(ug/L)	<DL	10	100	69.6	70						
bis(2-Ethylhexyl)phthalate	(ug/L)	<DL	10	100	80.5	80						
4-Bromophenyl-phenylether	(ug/L)	<DL	10	100	93.5	94						
Butylbenzylphthalate	(ug/L)	<DL	10	100	78.5	78						
2-Chloronaphthalene	(ug/L)	<DL	10	100	91.9	92						
Benzoic Acid	(ug/L)	<DL	50	100	22.1	22						
4-Chlorophenyl-phenylether	(ug/L)	<DL	10	100	83.5	84						
Chrysene	(ug/L)	<DL	10	100	86.8	87						
Dibenzo(a,h)anthracene	(ug/L)	<DL	10	100	87.5	88						
Carbazole	(ug/L)	<DL	10									
1,2-Dichlorobenzene	(ug/L)	<DL	10	100	83.2	83						
1,3-Dichlorobenzene	(ug/L)	<DL	10	100	84.8	85						
1,4-Dichlorobenzene	(ug/L)	<DL	10	100	84.3	84						
3,3'-Dichlorobenzidine	(ug/L)	<DL	20	100	87.6	88						
Diethylphthalate	(ug/L)	<DL	10	100	79.6	80						
Dimethylphthalate	(ug/L)	<DL	10	100	82.0	82						
Di-n-butylphthalate	(ug/L)	<DL	10	100	85.7	86						
3 & 4-Methylphenol	(ug/L)	<DL	10	100	65.0	65						
2,4-Dinitrotoluene	(ug/L)	<DL	10	100	80.0	80						
2,6-Dinitrotoluene	(ug/L)	<DL	10	100	81.8	82						
Di-n-octyl phthalate	(ug/L)	<DL	10	100	77.4	77						
Fluoranthene	(ug/L)	<DL	10	100	85.4	85						
Fluorene	(ug/L)	<DL	10	100	81.0	81						
Hexachlorobenzene	(ug/L)	<DL	10	100	91.4	91						
Hexachlorobutadiene	(ug/L)	<DL	10	100	93.6	94						
Hexachlorocyclopentadiene	(ug/L)	<DL	10	100	93.2	93						
Hexachloroethane	(ug/L)	<DL	10	100	87.4	87						
Indeno(1,2,3-cd)pyrene	(ug/L)	<DL	10	100	88.4	88						

QUALITY CONTROL SUMMARY

Report#: 9907433

Parameter	Units	METHOD BLANK Result	Detection Limit	LABORATORY CONTROL STANDARD Spiked Amount	Recovered Amount	Percent Recovery	DUPLICATE Result 1	Result 2	RPD	SPIKE Spiked Amount	Recovered Amount	Percent Recovery
Isophorone	(ug/L)	<DL	10	100	89.4	89						
Naphthalene	(ug/L)	<DL	10	100	85.2	85						
Nitrobenzene	(ug/L)	<DL	10	100	85.9	86						
N-Nitroso-di-n-propylamine	(ug/L)	<DL	10	100	79.0	79						
N-Nitrosodiphenylamine **	(ug/L)	<DL	10	100	94.2	94						
Phenanthrene	(ug/L)	<DL	10	100	88.0	88						
Pyrene	(ug/L)	<DL	10	100	69.9	70						
1,2,4-Trichlorobenzene	(ug/L)	<DL	10	100	89.9	90						
4-Chloroaniline	(ug/L)	<DL	10	100	82.7	83						
2-Methylnaphthalene	(ug/L)	<DL	10	100	84.5	84						
2-Nitroaniline	(ug/L)	<DL	50	100	86.4	86						
3-Nitroaniline	(ug/L)	<DL	50	100	81.9	82						
Dibenzofuran	(ug/L)	<DL	10	100	86.7	87						
4-Nitroaniline	(ug/L)	<DL	50	100	78.0	78						
Benzyl Alcohol	(ug/L)	<DL	10	100	108	108						
QC Batch 110452												
Reactivity Sulfide	(mg/L S)	<DL	80	791	385	49	128	80	46 *			
QC Batch 110497												
Silver	(mg/L)	<DL	0.01	0.250	0.237	95	<DL	<DL		0.250	0.247	99
Aluminum	(mg/L)	<DL	0.2	10.0	9.76	98	<DL	<DL		10.0	9.69	97
Arsenic	(mg/L)	<DL	0.04	2.50	2.45	98	<DL	<DL		2.50	2.58	103
Barium	(mg/L)	<DL	0.01	10.0	9.60	96	0.505	0.522	3	10.0	9.36	94
Beryllium	(mg/L)	<DL	0.005	0.250	0.255	102	<DL	<DL		0.250	0.255	102
Calcium	(mg/L)	<DL	0.05	5.00	4.92	98	46.1	47.8	4	5.00	NA	
Cadmium	(mg/L)	<DL	0.005	0.250	0.245	98	<DL	<DL		0.250	0.243	97
Cobalt	(mg/L)	<DL	0.01	2.50	2.44	98	<DL	<DL		2.50	2.35	94
Chromium	(mg/L)	<DL	0.01	1.00	0.995	100	<DL	<DL		1.00	0.995	100
Copper	(mg/L)	<DL	0.02	1.25	1.19	95	<DL	<DL		1.25	1.22	98
Iron	(mg/L)	<DL	0.03	5.00	4.84	97	1.08	1.25	15	5.00	4.74	95
Magnesium	(mg/L)	<DL	0.03	5.00	4.72	94	40.3	41.6	3	5.00	NA	
Manganese	(mg/L)	<DL	0.015	2.50	2.49	100	0.042	0.044	5	2.50	2.38	95
Nickel	(mg/L)	<DL	0.04	2.50	2.45	98	<DL	<DL		2.50	2.35	94

*Outside QC Limits - See Narrative

QUALITY CONTROL SUMMARY

Report#: 9907433

Parameter	Units	METHOD BLANK Result	METHOD BLANK Detection Limit	LABORATORY CONTROL STANDARD Spiked Amount	LABORATORY CONTROL STANDARD Recovered Amount	LABORATORY CONTROL STANDARD Percent Recovery	DUPLICATE Result 1	DUPLICATE Result 2	DUPLICATE RPD	SPIKE Spiked Amount	SPIKE Recovered Amount	SPIKE Percent Recovery
Lead	(mg/L)	<DL	0.015	2.50	2.46	98	<DL	<DL		2.50	2.35	94
Antimony	(mg/L)	<DL	0.06	2.50	2.46	98	<DL	<DL		2.50	2.50	100
Selenium	(mg/L)	<DL	0.04	2.50	2.47	99	<DL	<DL		2.50	2.47	99
Thallium	(mg/L)	<DL	0.02	2.50	2.43	97	<DL	<DL		2.50	2.18	87
Vanadium	(mg/L)	<DL	0.02	2.50	2.49	100	<DL	<DL		2.50	2.55	102
Zinc	(mg/L)	<DL	0.01	2.50	2.45	98	0.014	<DL		2.50	2.50	100
QC Batch 110500												
Potassium	(mg/L K)	<DL	0.2	5.00	4.34	87	259	268	3	5.00	NA	
QC Batch 110607												
Benzene	(ug/L)	<DL	5	50	44.3	89						
Bromoform	(ug/L)	<DL	5	50	47.2	94						
Carbon tetrachloride	(ug/L)	<DL	5	50	47.9	96						
Chlorobenzene	(ug/L)	<DL	5	50	47.2	94						
Chlorodibromomethane	(ug/L)	<DL	5	50	50.2	100						
Chloroethane	(ug/L)	<DL	5	50	47.7	95						
Chloroform	(ug/L)	<DL	5	50	44.4	89						
Dichlorobromomethane	(ug/L)	<DL	5	50	45.9	92						
O-Xylene	(ug/L)	<DL	5	50	45.9	92						
M & P Xylene	(ug/L)	<DL	5	100	90.0	90						
1,1-Dichloroethane	(ug/L)	<DL	5	50	42.8	86						
1,2-Dichloroethane	(ug/L)	<DL	5	50	45.8	92						
1,1-Dichloroethylene	(ug/L)	<DL	5	50	47.0	94						
1,2-Dichloropropane	(ug/L)	<DL	5	50	41.9	84						
Ethylbenzene	(ug/L)	<DL	5	50	46.2	92						
Bromomethane	(ug/L)	<DL	5	50	41.2	82						
Chloromethane	(ug/L)	<DL	5	50	40.7	81						
Methylene chloride	(ug/L)	<DL	10	50	41.6	83						
1,1,2,2-Tetrachloroethane	(ug/L)	<DL	5	50	45.3	91						
Tetrachloroethylene	(ug/L)	<DL	5	50	46.0	92						
Toluene	(ug/L)	<DL	5	50	45.2	90						
1,1,1-Trichloroethane	(ug/L)	<DL	5	50	46.3	93						
1,1,2-Trichloroethane	(ug/L)	<DL	5	50	44.9	90						

QUALITY CONTROL SUMMARY

Report#: 9907433

Parameter	Units	METHOD BLANK Result	METHOD BLANK Detection Limit	LABORATORY CONTROL STANDARD Spiked Amount	LABORATORY CONTROL STANDARD Recovered Amount	LABORATORY CONTROL STANDARD Percent Recovery	DUPLICATE Result 1	DUPLICATE Result 2	DUPLICATE RPD	SPIKE Spiked Amount	SPIKE Recovered Amount	SPIKE Percent Recovery
Trichloroethene	(ug/L)	<DL	5	50	43.3	87						
Vinyl chloride	(ug/L)	<DL	5	50	39.7	79						
Styrene	(ug/L)	<DL	5	50	46.2	92						
Total Xylene	(ug/L)	<DL	5									
trans-1,3-Dichloropropene	(ug/L)	<DL	5	50	43.1	86						
trans-1,2-Dichloroethene	(ug/L)	<DL	5	50	41.6	83						
Carbon disulfide	(ug/L)	<DL	5	50	45.0	90						
Methyl ethyl ketone	(ug/L)	<DL	25	50	57.0	114						
Acetone	(ug/L)	<DL	25	50	36.9	74						
Vinyl Acetate	(ug/L)	<DL	5	50	52.7	105						
2-Hexanone	(ug/L)	<DL	5	50	39.0	78						
4-Methyl-2-pentanone	(ug/L)	<DL	5	50	41.3	83						
Total 1,2-Dichloroethene	(ug/L)	<DL	5									
cis-1,3-Dichloropropene	(ug/L)	<DL	5	50	43.5	87						
cis-1,2-Dichloroethene	(ug/L)	<DL	5	50	43.2	86						

3C

WATER SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: GCAL Contract:

Lab Code: Case No.: SVW879 SAS No.: SDG No.: SVW879

Matrix Spike - EPA Sample No.: 9911050057

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC. LIMITS REC.
Phenol +	500	21.0	230	42	5-112
2-Chlorophenol	500	0.000	392	78	23-134
1,4-Dichlorobenzene +	500	0.000	397	79	20-124
N-Nitroso-di-n-propylam	500	0.000	378	76	1-230
1,2,4-Trichlorobenzene	500	0.000	426	85	44-142
4-Chloro-3-Methylphenol	500	0.000	348	70	22-147
Acenaphthene +	500	17.0	421	81	47-145
4-Nitrophenol ++	500	0.000	171	34	1-132
2,4-Dinitrotoluene	500	0.000	380	76	39-139
Pentachlorophenol +	500	0.000	409	82	14-176
Pyrene	500	0.000	324	65	52-115

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
Phenol +	500	193	34	21	42	5-112
2-Chlorophenol	500	337	67	15	40	23-134
1,4-Dichlorobenzene +	500	345	69	14	28	20-124
N-Nitroso-di-n-propylam	500	332	66	14	38	1-230
1,2,4-Trichlorobenzene	500	367	73	15	28	44-142
4-Chloro-3-Methylphenol	500	307	61	14	42	22-147
Acenaphthene +	500	370	71	13	31	47-145
4-Nitrophenol ++	500	158	32	6	50	1-132
2,4-Dinitrotoluene	500	341	68	11	38	39-139
Pentachlorophenol +	500	364	73	12	50	14-176
Pyrene	500	298	60	8	31	52-115

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 11 outside limits
Spike Recovery: 0 out of 22 outside limits

COMMENTS: SVW879

FORM 3
WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Lab Name: GCAL Contract:

Lab Code: Case No.: 9907509 SAS No.: SDG No.: 9907509

Matrix Spike - Sample No.: CPTW

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC. LIMITS REC.
1,1-Dichloroethene +	250	132	401	108	61-145
Trichloroethene	250	33.2	280	99	71-120
Benzene	250	0.000	238	95	76-127
Toluene +	250	0.000	232	93	76-125
Chlorobenzene ++	250	5.65	248	97	75-130

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS RPD	QC LIMITS REC.
1,1-Dichloroethene +	250	384	101	7	14	61-145
Trichloroethene	250	283	100	1	14	71-120
Benzene	250	252	101	6	11	76-127
Toluene +	250	234	94	1	13	76-125
Chlorobenzene ++	250	261	102	5	13	75-130

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

COMMENTS: 1W826-219

Dow / C082 / 9901433 / Due 11/12/99

Chain of Custody Record

Page ___ of ___

PROJECT	
Magnolia ARKANSAS	
SITE	West Plant
PREPARED BY (Signature)	Todd Jacobson

ANALYSES: VOA; SEMI-VOA; Total Metals (RCRA); RCRA Characteristics; Ignitability; Corrosivity; REACTIVITY

FIELD SAMPLE I.D.	SAMPLE MATRIX	DATE/TIME	MS/MSD	NO. OF CONTAINERS	VOA	SEMI-VOA	Total Metals (RCRA)	RCRA Characteristics	Ignitability	Corrosivity	REACTIVITY				REMARKS 991108-
358329	H_2O	11/4/99		~~6~~ 7	2	2	1	2	→	→	→				-25

REMARKS Dow P.O. # 31282292 MSI 244786

RELINQUISHED BY:	DATE	TIME
Todd Jacobson	11/5	1200

RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	RELINQUISHED BY:	DATE	TIME

LAB USE ONLY

RECEIVED FOR LABORATORY BY:	DATE	TIME	AIRBILL NO.	OPENED BY:	DATE	TIME	TEMP°C	SEAL #	CONDITION
[signature]	11/5	1352							

REMARKS:

IEG-4FH3-86-30337coc.FH5