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IT/MTRA

Final Report — Volume I of II

Remedial Investigation

Old Midland Products Site
Ola, Arkansas

Prepared in Cooperation with the
Arkansas Department of Pollution Control and Ecology
and the
U.S. Environmental Protection Agency

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EXECUTIVE SUMMARY

IT Corporation (IT), a wholly owned subsidiary of International Technology Corporation, in association with Mehlburger, Tanner, Robinson and Associates (MTRA), completed a remedial investigation of the Old Midland Products Company Site near Ola, Arkansas in Yell County under contract with the Arkansas Department of Pollution Control and Ecology (ADPC&E) through a Cooperative Agreement with the U. S. Environmental Protection Agency (EPA).

Site investigation activities were completed in two phases:

- Phase 1 - September 30 to November 18, 1986, and
- Phase 2 - May 18 to June 4, 1987.

The field and laboratory data collected during the site investigation and the resulting interpretations and conclusions are compiled and documented in the Remedial Investigation Report.

The information presented in the Remedial Investigation Report is being used to identify, assess and develop feasible remedial alternatives for the site which will be presented and documented in a Feasibility Study Report. A remedial alternative will be selected by ADPC&E and EPA and implemented based on the information presented in the Feasibility Study Report in accordance with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986.

Background

The Old Midland Products Company is located near the city of Ola, Arkansas in Yell County. A creosote and pentachlorophenol wood preserving plant and sawmill were operated at the site during the period 1969 to 1979.

The Old Midland Products site has been inspected and investigated by ADPCE and EPA since 1981. Due to the past waste handling/storage practices at the site and the nature of the wastes present, extensive contamination is present in the immediate vicinity of the lagoons and treatment area. Site drainage conditions have resulted in migration of contaminated sediments to and within the on-site intermittent stream. In addition, operation of the lagoons has resulted in contamination of the shallow ground water on-site with a lighter-than-water organic liquid phase and an associated dissolved organic phase.

Access to the site has been restricted, limiting the direct contact threat to public health, but migration of contaminants via ground water and surface water sediment presents a future risk to public health and the environment.

The site was included on the National Priorities List on July 16, 1984 with a Hazard Ranking score of 30.77.

Site Investigation

The site investigation tasks resulted in the collection of field and laboratory data necessary to characterize the contamination, define the extent of contamination, and estimate the volume of contamination present at the site. In addition, data were collected to characterize the hydrogeology, hydrology, demography and ecology of the site to allow assessment of potential contaminant migration and risk to public health and the environment.

The field activities and laboratory testing program included the following:

- Preparation of a surveyed site topographic map;
- Installation of monitor wells;
  - four deep (40 feet), and
  - eight shallow (20 feet);
- Installation of piezometers;
  - six deep (40 feet), and
  - eight shallow (20 feet);
- Completion of soil borings to about 40 feet at two locations, to about 18 feet at nine locations and additional soil borings associated with the monitor wells and piezometer;

- Completion of three exploratory trenches to depths of about 20 feet totaling 540 lineal feet;
- Completion of 23 in-situ falling head, permeability tests;
- Completion of 21 soil particle size analyses and 15 laboratory falling head permeability tests;
- Chemical analysis of 72 soil boring soil samples;
- Sampling and chemical analysis of 138 surface/sub-surface soil samples;
- Sampling and chemical analysis of sediments and water from each of 7 lagoons;
- Air monitoring;
- Sampling and chemical analysis of 22 surface water sediment samples;
- Sampling and chemical analysis of 6 surface water samples;
- Sampling and chemical analysis of 37 ground water samples;
- Completion of a shallow aquifer pumping and recovery test;
- Completion of lagoon sediment stabilization tests; and
- Completion of carbon treatability tests for lagoon water and ground water.

Hydrologic Conditions

The upper 40 feet of soil/rock at the Site contains the following units in order of descending depth:

- Silty clay;
- Iron nodules layer;
- Weathered shale; and
- Unweathered or lightly weathered shale.

The weathered shale and fractured unweathered shale generally represent a single aquifer although vertical stratification of contamination due to

preferential horizontal flow paths between the two units can be expected under nonpumping conditions. The aquifer occurs under semi-confined conditions. At some locations on the south end of the Site the potentiometric surface is seasonally above ground surface. The silty clay overlying the shale appears to be an effective confining layer.

Thickness of the weathered shale ranges from 10 to 25 feet and the top of the weathered shale varies from 4 feet on the south end of the Site to as deep as 15 feet on the north end of the Site. The shallowest water producing intervals occur in the weathered shale at depths of 15 to 20 feet and are generally 3 to 5 feet thick. The overlying soil consists of clay and silty clay. The weathered shale slopes to the northwest.

Measured hydraulic conductivities for the shallow aquifer, within the upper 20 feet of soil/rock, range from 5×10^{-6} to 6×10^{-4} cm/sec with a log average hydraulic conductivity of 2×10^{-4} cm/sec. Measured hydraulic conductivity values for the aquifer within depths of 20 to 40 feet are 7×10^{-6} to 1×10^{-4} cm/sec with a log average hydraulic conductivity of 2×10^{-5} cm/sec.

Transmissivity within the upper 20 feet of soil/rock was estimated to be in the range of 100 to 600 gpd/ft with storativity (a unitless parameter) in the range of 0.006 to 0.01.

The hydraulic gradient is to the northwest with a magnitude of 0.02 to 0.034 (foot/foot). Estimated ground water velocities range from 14 to 48 feet per year with direction to the northwest.

Contaminants Present

Pentachlorophenol (PCP) is the most widespread contaminant at the site followed by polynuclear aromatic compounds (PNA's). Chlorinated dibenzo dioxins and furans are present in the more concentrated wastes (such as lagoon sludges and nonaqueous phase liquid); however, the chlorinated forms present are almost entirely the less toxic forms (i.e., hepta and octa chlorinated forms.) Trace levels of aromatic hydrocarbons were also present, although of limited spatial extent.

Pentachlorophenol was present in surface (0 to 6 inches), subsurface (6 to 12 inches) and deeper soil, drainageway sediments, surface water, ground water, lagoon sediments and lagoon fluids with the following maximum detected concentrations:

- Surface soil 790 ppm;
- Subsurface soil 690 ppm;
- Deeper soil 0.32 ppm;
- Drainageway sediment 9.5 ppm;
- Surface water 12 ppb;
- Ground water (with nonaqueous phase liquid) 12,000 ppm;
- Lagoon sediments 5,900 ppm; and
- Lagoon fluids 0.60 ppm.

Polynuclear aromatic compounds were detected at the Site in surface soil, subsurface soil, deeper soil, drainageway sediments, ground water, lagoon sediments, and lagoon fluids with the following maximum detected concentrations:

- Surface soil, phenanthrene 14,000 ppm;
- Subsurface soil, phenanthrene 220 ppm;
- Deeper soil, phenanthrene 270 ppm;
- Drainageway sediment, anthracene 6.6 ppm;
- Ground water (with nonaqueous phase liquid), fluoranthene 5,100 ppm;
- Lagoon sediments, phenanthrene 38,000 ppm; and
- Lagoon fluids, phenanthrene 2.2 ppm.

PNA's detected at the site include both noncarcinogenic and carcinogenic PNA's:

- Non carcinogenic:
  - phenanthrene;
  - fluorene;
  - acenaphthene;
  - acenaphthylene;
  - anthracene;
  - fluoranthene;
  - naphthalene;

- 2-methyl naphthalene; and
- pyrene.

- Carcinogenic:
  - benzo(a)anthracene;
  - benzo(a)pyrene;
  - benzo(a)fluoranthene;
  - benzo(k)fluoranthene;
  - indeno(1,2,3-cd)pyrene;
  - carbazole; and
  - chrysene.

Chlorinated dibenzo dioxins and furans are present in commercial grade PCP as manufacturing impurities. The forms present at the Site are almost entirely the hepta and octa chlorinated forms which are much less toxic than the tetra, penta, and hexa chlorinated forms. The maximum detected concentrations of dioxins and furans expressed as 2,3,7,8-TCDD equivalents are the following:

- Surface soil 0.095 ppb;
- Subsurface soil 0.0092 ppb;
- Deeper soil 1.35 ppb;
- Ground water (with nonaqueous phase liquid) 15.8 ppt;
- Lagoon sediments 42.8 ppb; and
- Lagoon fluids 0.73 ppt.

A published health assessment for 2,3,7,8-TCDD established a remedial action level of 1.0 ppb in soils in residential areas (Kimbrough et. al.).

Aromatic hydrocarbons detected at the site include benzene, toluene and xylene with the following maximum detected concentrations:

	Benzene	Toluene	Xylene
• surface soil	0.18 ppm	ND	0.031 ppm
• subsurface soil	0.22 ppm	ND	ND
• deeper soil	0.045 ppm	ND	ND
• ground water (with non-aqueous phase liquid)	ND	0.0034 ppm	0.0077 ppm
• lagoon sediments	110 ppm	240 ppm	4,900 ppm
• lagoon fluids	ND	ND	0.0074 ppm

ND = Not Detected

Extent of Contamination

Soil contamination is limited to the area around the lagoons and treatment building and probably also the soil beneath the lagoons. The estimated areas of soil contamination with PCP, the most widespread contaminant, are the following:

- PCP > 1 ppm - 159,000 square feet;
- PCP > 10 ppm - 66,000 square feet;
- PCP > 100 ppm - 30,000 square feet; and
- lagoon area - 29,400 square feet.

Vertical extent is generally one to three feet but beneath the lagoons may extend as deep as 14 feet. Drainageway sediments were contaminated at concentrations of from 1 to 10 ppm PCP from near the northwest perimeter of the lagoon area downstream to south of Old Highway 10, an estimated distance of 1,680 feet.

Ground water contamination within the upper 40 feet of soil/rock is limited to the area with nonaqueous phase liquid in the shallow ground water, an estimated area of 24,000 square feet.

Under static, nonpumping conditions most of the ground water contamination is within the upper 20 feet of soil/rock but, under pumping conditions, would include at least the upper 40 feet of soil/rock.

Investigation of ground water deeper than 40 feet was not within the scope of the RI. No indications of deeper contamination were observed. However, the occurrence of heavier than water nonaqueous phase liquids is possible in wastes from wood treating operations and, if such were present in the lagoons, migration of the heavy phase through the pond bottom and downward through fractured shale is possible. A heavy nonaqueous phase was not identified in the lagoons although sediments from some lagoons did contain adsorbed nonaqueous phase liquids.

Volumes of Contamination

The estimated volume of contaminated soil, drainageway sediments, ground water, lagoon sediments and lagoon fluids are as follows:

- soil (range is due to uncertainty in depth of contamination beneath lagoons)
  - PCP > 1 ppm — 9,000 to 21,000 cubic yards;
  - PCP > 10 ppm — 7,000 to 18,000 cubic yards;
  - PCP > 100 ppm — 4,000 to 16,000 cubic yards;
- drainageway sediments
  - PCP > 1 ppm — 850 cubic yards;
- ground water — 450,000 gallons;
- lagoon sediments
  - lagoon 1 — 250 cubic yards;
  - lagoon 2 — 420 cubic yards;
  - lagoon 3 — 210 cubic yards;
  - lagoon 4 — 70 cubic yards;
  - lagoon 5 — 750 cubic yards;
  - lagoon 6 — 890 cubic yards;
  - lagoon 7 — 180 cubic yards;

  TOTAL VOLUME — 2,770 cubic yards
- lagoon fluids
  - lagoon 1 — 8,800 gallons;
  - lagoon 2 — 37,100 gallons;
  - lagoon 3 — 14,500 gallons;
  - lagoon 4 — 6,000 gallons;
  - lagoon 5 — 340,500 gallons;
  - lagoon 6 — 204,900 gallons; and
  - lagoon 7 — 8,200 gallons.

  TOTAL VOLUME — 620,000 gallons

Public Health Assessment (Endangerment Assessment)

The Remedial Investigation Report includes a combined level one and level two public health assessment (endangerment assessment) (a semi-quantitative public health assessment). The public health assessment or endangerment assessment is semi-quantitative and includes the following:

- Selection of indicator chemicals of concern for the site;

- Assessment of environmental fate and transport of site contaminants;
- Tabulation of applicable, relevant, and appropriate guidelines for indicator chemicals;
- Calculation of exposure concentrations at potential receptor locations for postulated scenarios;
- Assessment of risks to the environment; and
- Evaluation of remediation goals that adequately protect the public health.

Indicator Chemicals

Indicator chemicals were selected to represent the hazards posed by the Site on the basis of concentration, toxicity, prevalence, and persistence. The selected indicator chemicals are:

- PNA's;
  - noncarcinogenic
  - carcinogenic
- PCP;
- chlorinated dibenzo dioxins and furans; and
- benzene (air pathway only).

Environmental Fate and Transport

The environmental fate and transport of contaminants were assessed based on the physical and chemical characteristics of the contaminants.

Each of the listed classes of chemical constituents detected at the site, i.e., PNA's, PCP and volatile aromatic compounds behave differently in the environment.

- Migration of PNA's - Generally, PNA's are highly immobile in soils due to their low water solubility (thus non leachable), their high octanol/water partition coefficient (K_{ow}), and high soil adsorption coefficients (K_{oc}) combined with their resistance to oxidation or hydrolysis. They are usually bound to

particulates and soils, unless there are high enough concentrations of organic solvents present in the soils to allow migration of organic contaminants by nonaqueous phase liquid (NAPL) flow conditions.

PNA's will not volatilize, as indicated by the low vapor pressure, and therefore are not of concern in the air pathway (except as particulate emissions). They are not subject to hydrolysis or oxidation but may be biodegraded by selective soil microorganisms. Usually, PNA's will not be transported in the environment except by physical means such as sediment in surface runoff during storm events.

PNA's have a low mobility index in soil, ranging from -19 to -7.3. A value less than -5 is considered to be immobile.

Consequently, migration of PNA's is expected to be extremely limited.

- Migration of PCP - There is little information on the transport of pentachlorophenol through the environment. The compound has a low vapor pressure and, therefore, is not likely to volatilize readily. It is slightly soluble in water and does adsorb to sediments and soil, and therefore may be transported through soil, surface water, and ground water.

  Pentachlorophenol is degraded by sunlight to lower chlorinated phenols, tetrachlorodihydroxyl benzenes, and non-aromatic fragments. The importance of photodegradation of pentachlorophenol in the environment is unknown. Soil microorganisms have also been found to degrade pentachlorophenol under some conditions. PCP has a soil mobility index of -17 and is therefore considered to be immobile.

- 2,3,7,8-TCDD - This constituent is highly persistent in the soils. The half-life of 2,3,7,8-TCDD in soils has been reported at a range of 1 to 10 years. The low water solubility and high soil adsorption coefficient would indicate that it adsorbs strongly to soils. 2,3,7-8-TCDD is not readily biodegraded. It may be photodegraded in the presence of organic solvents; however, there is no indication of organic solvents in the surface soils. It is resistant to oxidation and hydrolysis. Volatilization of 2,3,7,8-TCDD adsorbed on soils is expected to proceed at a very slow rate due to the extremely low vapor pressure of 2,3,7,8-TCDD. 2,3,7,8-TCDD has a mobility index in soils of -16 and is therefore considered to be immobile.

All of the chemicals of concern are considered to be immobile in the surface soils and shallow soils. Mobility indexes range from -7.3 to -19. Consequently, the constituents are likely to move only as a component of the soils. Factors affecting migration at the site include:

- Migration of surface soils could occur due to soil erosion and mobilization by surface runoff. However, the site is relatively flat with only localized drainageways;
- Surface soils could be transported as air particulates due to wind erosion and/or vehicular traffic over the affected areas;
- Surface soils could be redistributed during any construction or earthmoving activity; and
- Migration of the lighter-than-water nonaqueous phase liquids in the ground water.

Possible Exposure Pathways

Potential exposure pathways and estimated possible future exposures are the following:

Air Pathways

- Volatile Organic Emissions in the breathing zone above the contaminated area:
  - PCP exposure of 9×10^{-5} mg/m^3 is approximately 1,000 times less than the estimated acceptable value. Risk is not significant.
  - Benzene exposure of 49×10^{-3} mg/m^3 is between the 1×10^{-6} and 1×10^{-5} cancer risk level. Risk is insignificant for off-site or infrequent on-site exposure scenarios.
- Particulate Emissions in the breathing zone above the contaminated areas:
  - PCP exposure of 5.4×10^{-3} mg/m^3, more than an order of magnitude less than the estimated acceptable level of 0.092 mg/m^3. Risk is not significant.
  - Carcinogenic PAH's exposure of 0.0005 mg/m^3 is approximately the 10^{-4} incremental cancer risk level based on benzo(a) pyrene. No air dispersion is assumed and thus the estimate is worst case and it is likely that actual air values would dissipate quickly to concentrations below the 10^{-4} cancer risk level.

Dermal Contact and Ingestion of Soil

- Exposure to chemicals via ingestion of soil can occur by inadvertent consumption of soils on the hands, on tools or other objects, from nail biting, consumption of soil itself (pica), or a combination of these routes. The soil ingestion pathway is only important to children playing outdoors in the contaminated soil.

- The Site is not used for residential purposes and Site access is restricted. The most likely soil ingestion and dermal contact scenario is from infrequent trespass by children.
  - PCP daily intake of 0.58×10^{-6} mg/kg is a fraction of the acceptable chemical intake of 0.03 mg/kg.
  - Phenanthrene daily intake of 6.7×10^{-6} mg/kg is a fraction of the acceptable chemical intake of 0.006 mg/kg.

- As a worst case comparison, a daily residential lifetime exposure estimate was calculated for residential use of the Site.
  - PCP daily intake of 9.5×10^{-6} mg/kg is a fraction of the acceptable intake of 0.03 mg/kg.
  - Phenanthrene daily intake of 1.08×10^{-4} mg/kg is a fraction of the acceptable intake of 0.006 mg/kg.

Ground Water Pathway

- Estimated maximum possible concentrations at nearest water wells and property boundary range from 2.1 to 361 ppb for naphthalene, the most mobile constituent in the dissolved phase, well below the health based guideline of 1,800 ppb calculated from the Acceptable Daily Intake.

- Estimated maximum PCP concentrations at nearest water wells and the property boundary assuming no attenuation by the soil are 288 to 1,207 ppb compared to a proposed EPA RMCL of 200 ppb. However, PCP is expected to be highly attenuated by soil and risk is probably not significant, except for migration of the lighter-than-water nonaqueous phase liquid to a receptor.

Surface Water Pathway

- Surface water is not a major pathway at the Site due to low water solubility of the constituents. Possible dermal contact with contaminated sediments is a minor public health risk. Ingestion of contaminated sediments by bottom feeding fishes and bottom dwelling organisms is not considered a significant risk due to the low concentrations of contaminants in the sediments.

The site represents potential future risks to public health and the environment if no actions are implemented to mitigate risks. The existing lighter-than-water nonaqueous phase liquid plume in the shallow ground water and leaching of contaminants from lagoon sediments into the ground water represent the primary risks. Possible past vertical migration of heavier-than-water nonaqueous phase liquid from the lagoons into underlying fractured rock represents a relatively low but undefined risk.

Remedial objectives were developed for source control and for ground water migration control.

The recommended source control remedial objectives are the following:

- For lagoon wastes, soil, surface water and drainage-way sediments - minimize long term threat to human health and the environment; and
- For air-protection of potential onsite workers;
- Surface soils could be redistributed during any construction or earthmoving activity;
- Contaminants could be transported in the ground water primarily as a result of movement of the lighter-than-water nonaqueous phase liquid in the ground water; and
- Lower concentrations of contaminants could be transported in the ground water in the dissolved phase as a result of dissolution of contaminants from the nonaqueous phase or as a result of leakage of lagoon fluid into the aquifer.

The recommended ground water migration control remedial objective is to protect uncontaminated ground water for future use by minimizing migration and spread of contaminants within the aquifer.

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1.0 INTRODUCTION

International Technology Corporation (IT), in association with Mehlburger, Tanner, Robinson and Associates (MTRA), was contracted by the Arkansas Department of Pollution Control and Ecology (ADPCE) under a Cooperative Agreement with the U. S. Environmental Protection Agency (EPA) to complete a remedial investigation (RI)/feasibility study (FS) in accordance with the National Contingency Plan. Site investigation activities were initiated during September 1986. This report documents the remedial investigation activities, describes the nature and extent of contamination resulting from past activities at the site and evaluates the potential hazard to human health and the environment.

This work was completed in accordance with the Work Plan, February 1986, prepared by ADPCE under Cooperative Agreement Assistance No. V-006462-01-0 with the EPA.

1.1 SITE BACKGROUND INFORMATION

The Old Midland Products site is located in Yell County Arkansas, about one-half mile east of Ola, Arkansas (See Figure 1-1). The Site borders the north right-of-way of Highway 10 and extends north to the southern right-of-way of Old Highway 10. A right-of-way for the Rock Island and Pacific Railroad extends through the northern portion of the Site in a northwest to southeast direction.

The Site includes two properties as follows:

- An area of about 2.75 acres owned by W. E. Mullinax which includes the wood treatment building and the waste impoundments; and
- An area of about 35 acres owned by the Plainview-Ola Economic Development Trust Inc. which surrounds the W. E. Mullinax property and extents between the right-of-ways for Highway 10 and Old Highway 10.

A survey map presenting the boundaries and site features is presented as Figure 1-2A. A survey map of the lagoon area is presented as Figure 1-2B.

Old Midland Products Company operated a creosote and pentachlorophenol wood preserving plant and sawmill at the Site during 1969 to 1979.

Review of aerial photographs from 1950, December 12, 1960; October 20, 1966; January 25, 1971; 1974; April 13, 1979; and May 3, 1985 indicates the following site development history:

- The Site was generally undeveloped in 1950;
- By 1960 the Site was generally disturbed and a sawmill appears to have been in operation on the eastern and southern portions of the Site;
- By 1966, use of the Site by the sawmill included most of the area east of the drainageway which extends through the Site;
- The lagoons, treatment building and drip tracks were present in 1971. At that time lagoons 1,3,5 and 6 were present and do not appear to have been interconnected. Stains are visible south of the lagoons;
- All seven lagoons were present in 1979 in essentially their present configuration. Processing tanks are visible at the west end of the treatment building; and
- The office, scales and woodchipper were constructed after April 1979.

Wood treating with creosote and pentachlorophenol (PCP) is performed to preserve the wood from bacterial and insect degradation. The chemicals are generally forced into the wood under pressure resulting in release of lignin and tannin based chemicals from the wood. Oil is sometimes used as a carrier for the preservative. Operations of the Site appear to have involved treatment of wood with creosote and PCP (either singly or in combination) in the building located south of the lagoons (the treatment building). Effluent from the treatment process containing PCP and PNA's appears to have been discharged into Lagoons 1 or 3 or other lagoons via a moveable discharge

pipe. Overflow from the ponds appears to have occassionally occurred with drainage to the intermitten stream to the west of the lagoons. The treated wood was most probably allowed to dry in open areas to the east of west of the lagoons and treatment building.

The treatment building exhibits indications of fire damage, although no specific records of a fire have been discovered. In addition, it is possible that sawdust or straw used to soak up oil around the lagoons and treatment building may occassionally have been burned.

The land owned by the Old Midland Products Company was sold in 1979 to the Plainview - Ola Economic Development Trust, Inc. The First State Bank of Plainview is the lien holder for the Old Midland Products Company.

Findings from a March 5, 1981, site inspection by ADPCE resulted in subsequent sampling and testing for contamination of the site. Results of the testing are summarized in Section 1.2.

ADPCE has received an inquiry concerning possible use of portions of the site for a sawmill. ADPCE and EPA will consider this request following selection of a remedial alternative and finalization of the Record of Decision for the Site.

The Site was first evaluated by the hazard ranking system on October 23, 1981. On December 10, 1983, the site was ranked by EPA and ADPCE for consideration as a Superfund site. The hazard ranking was revised to incorporate additional site data and scored 30.77 on July 16, 1984. The Site was then included on the second update of the National Priorities List.

1.2 SUMMARY OF PREVIOUS INVESTIGATIONS

1.2.1 Investigations Performed

Samples have been collected at the Site during a number of site inspections and investigations by ADPCE and EPA since 1981 as follows:

- March 5, 1981, inspection by ADPCE with collection of water and sludge samples from the lagoons;

- June 24, 1982, EPA Field Investigation Team (FIT) site inspection with collection and analysis of a soil sample from north of the lagoons at the confluence of runoff from the lagoon area with the intermittent stream that runs through the Site;

- January 26, 1983, EPA-FIT investigation collected and analyzed samples of sediment and water from lagoons 1 and 5, sediment and water samples from five locations in drainageways and water samples from the Marcum and Nieley water wells located near the Site;

- April 13, 1984, EPA-FIT sampled and analyzed water from two residential wells (Noake's wells) located north of the Site;

- March 2, 1984, EPA and ADPCE collected and analyzed two soil samples, one from the intermittent stream on-site and one from the runoff path from the lagoon area;

- March 14, 1984, ADPCE sampled and analyzed residues in 2 tanks from the Site;

- May 16, 1984, EPA Emergency Response Team completed an air sampling program at the Site;

- January 28 to February 8, 1985, EPA-FIT installed 8 monitor wells (MW-1S, MW-1D, MW-2S, MW-2D, MW-3S, MW-3D, MW-4S and MW-4D) on-site and collected and analyzed soil samples from 2 depths at each monitor well boring;

- April 12, 1985, ADPCE sampled and analyzed water from the Nieley off-site water well and an on-site monitor well;

- April 30, 1985, ADPCE sampled and analyzed the oil layer in monitor well MW-3s;

- July 7, 1985, EPA-FIT sampled the eight on-site monitor wells, the Marcum and Nieley off-site water wells, collected an upstream and a downstream sediment sample from the intermittent stream, collected water and sediment samples from lagoon 5, collected a water sample from lagoon 6, and collected a sample of stained soil southwest of the lagoons;

- January 9, 1986, EPA Emergency Response Branch sampled and analyzed water from the off-site Marcum residential water well, water from each of the lagoons, water and sediment from runoff south of the lagoons, and water and sediment from three locations in the intermittent stream; and

- May 26-30, 1986, EPA Environmental Response Team sampled and estimated volume of sludge in each of the lagoons.

Data from the samples collected through 1985 are presented in the Final Work Plan for the RI/FS of the Old Midland Products Site, February 1986, by ADPCE. The January 9, 1986, sampling is presented in a February 15, 1986 Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Site Investigation/Removal Action Report by the Technical Assistance Team. The sludge estimates from the May 26-30, 1986, investigation are presented in a memorandum dated July 10, 1986, from the Environmental Response Team.

The following discussion summarizes the results of the previous investigations.

1.2.2 Summary of Results of Previous Investigations

Lagoon Water

Limited analyses of the lagoon water indicated the following general level of contamination: lagoon 3 > lagoon 2 >lagoon 7 and lagoon 1 > lagoon 4 > lagoon 6 and lagoon 5. Organic contaminants found included pentachlorophenol (PCP), polycyclic aromatic hydrocarbons (PAH's) including (fluorene, phenanthrene, fluoranthene, pyrene, chrysene, naphthalene, 2-methyl naphthalene, acenapthene) other phenols (phenol, 2-chlorophenol, 4-chlorophenol, 3-methylphenol, 4-nitrophenol) dibenzofuran, and trace volatile organics (acetone, 2-butanone and methylene chloride which may be present as lab contaminants). The major contaminants are the following:

- PCP at maximum concentration of 940 ppb in lagoon 3 and detected in lagoons 1, 2 and 3;
- Phenanthrene at maximum concentration of 1,300 ppb in lagoon 3 and detected in lagoons 1, 2, 3 and 7;
- Fluoranthene at maximum concentration of 740 ppb in lagoon 3 and detected in lagoons 1, 2, 3 and 7;
- Pyrene at maximum concentration of 400 ppb in lagoon 3 and detected only in lagoon 3;

- Fluorene at maximum concentration of 220 ppb in lagoon 3 and detected in lagoons 2 and 3; and
- Dibenzofuran at maximum concentration of 1,400 ppb in lagoon 4 and detected in lagoons 2, 3 and 4.

Substituted phenols other than PCP were detected primarily in lagoon 7. Naphthalene and substituted naphthalenes were detected only in lagoon 2.

Inorganic Contaminants

Water samples from lagoons 1 and 5, were analyzed for metals. Metals do not appear to be significant contaminants although iron and manganese levels are somewhat elevated: iron 2.2 and 1 ppm and manganese 0.3 and 4.7 ppm, respectively, for lagoons 1 and 5.

Lagoon Sludges

Data was more limited for the lagoon sludges than the lagoon water. The available data indicated high concentrations of PCP, PNA's, dibenzofurans and other organics. Significant levels of chlorinated dibenzodioxins (CDD) and chlorinated dibenzofurans (CDF) were found in the two samples analyzed (both from lagoon 5).

PCP was detected in all samples of lagoon sludge which were analyzed (lagoons 1, 3, 5 and 6) at concentrations ranging from 74 to 58,600 ppm. Detailed organic analyses were available for single samples from lagoons 1, 5 and 6 and indicated the presence of PNA's, trace volatiles, and other organics in the three lagoons. Lagoon 1 contained relatively high concentrations of contaminants, lagoon 5 moderate concentrations and lagoon 6 only trace concentrations. Major contaminants in lagoon 1 were the following:

- PCP 58,630 ppm;
- Acenaphthene 30,668 ppm;
- Fluoranthene 39,668 ppm;
- Naphthalene 7,216 ppm;
- Benzo(a)anthracene 631 ppm;
- Benzo(a)pyrene 207 ppm;
- Benzo(b) and benzo (k)fluoranthene 451 ppm;
- Chrysene 586 ppm;
- Acenaphthylene 108 ppm;
- Anthracene 9,471 ppm;

- Benzo(ghi)perylene 68 ppm;
- Fluorene 2,886 ppm;
- Phenanthrene 9,471 ppm;
- Indeno(1,2,3-c,d)pyrene 77 ppm;
- Pyrene 3,247 ppm;
- Dibenzofuran 3,067 ppm; and
- 2-methylnaphthalene 3,067 ppm.

One sample from lagoon 5 reportedly contained 831 ppm PCB 1242. No other lagoon samples contained detectable PCB. The presence of PCB was not confirmed by other samples and the reported detection of it may have been the result of interference from high concentrations of other constituents.

Two samples of sludge from lagoon 5 were analyzed for chlorinated dibenzofurans and dioxins with the following results:

Isomer or Homolog	Sample 1 (ppb)	Sample 2 (ppb)
2,3,7,8-TCDF	Not Detected (ND)	ND
Total TCDF	37.5	ND
Total PCDF	ND	ND
Total HxCDF	418	254
Total HpCDF	14,200	27,200
Total OCDF	6,790	11,900
2,3,7,8-TCDD	ND	ND
Total TCDD	ND	ND
Total PCDD	8.2	8.3
Total HxCDD	393	296
Total HpCDD	30,900	49,600
Total OCDD	19,600	16,800

The 2,3,7,8-TCDD equivalent values for these samples are 0.73 and 0.95 ppb, respectively.

Soil and Sediments

Soil and sediment samples from runoff paths in the lagoon area and the intermittent stream, although of variable concentration, generally indicated the following:

- Runoff paths from the lagoon area and in the intermittent creek downstream to the railroad right-of-way contained PCP at 5 to 30 ppm range and PNA's in the

1 to 1,000 ppm range. Two samples from the stream reportedly contained PCB at concentrations less than 2 ppm;

- Sediment at the railroad right-of-way contained PNA's at concentrations less than 1 ppm; and
- South of Highway 10 (upstream of the site) only trace levels of volatile organics and in one sample trace PCB were found in the sediment.

A spill area, south of the lagoons, contained PCP at 8,100 ppm, relatively high concentrations of PNA's and 2.7 ppm of ethylbenzene. Chlorinated dibenzofurans and dibenzodioxins analyses of duplicate samples yielded the following results (ppm):

	CONCENTRATION (ppm)	DUPLICATE CONCENTRATION (ppm)
- 2,3,7,8-TCDF	ND	ND
- Total TCDF	ND	ND
- Total PCDF	ND	ND
- Total HxCDF	168	353
- Total HpCDF	18,300	5,120
- Total OCDF	10,700	6,540
- 2,3,7,8-TCDD	ND	ND
- Total TCDD	ND	ND
- Total PCDD	28.4	31.8
- Total HxCDD	252	509
- Total HpCDD	42,700	12,077
- Total OCDD	18,100	26,700

The 2,3,7,8-TCDD equivalent values for these samples are 0.87 and 0.57 ppb, respectively.

Soil samples from the eight monitor well borings (shallow and deep monitor wells MW-1 through MW-4) generally did not contain PCP or PNA's except at the boring at MW-3D which contained PNA's at less than 1 ppm at depths of 10 to 12 feet and 30 to 32 feet.

Surface Water

Surface water samples of runoff from the lagoon area and in the intermittent stream generally indicated the following:

- Runoff from the lagoon area sometimes contained PCP at concentrations less than 1 ppm, PNA's less than 1 ppm and in one case a trace of acetone, and
- Water from the intermittent stream did not contain detectable contaminants except for one sample near Old Highway 10 which contained PNA's at concentrations of 0.7 to 3.3 ppm possibly as a result of automobile oils draining from the highway and a trace of acetone.

Ground Water

Analyses of a single sample of ground water from each of the eight on-site monitor wells and four off-site water wells indicated contamination only at on-site monitor well MW-3S. Results for MW-3S were:

- Trace levels of toluene, 2-hexanone, 4-methyl-2-pentanone, 1, 1, 2, 2-tetrachloroethane, ethylbenzene, and xylenes;
- Naphthalene 920 ppb;
- 2-methylnaphthalene 5,500 ppb;
- Acenaphthene 890 ppb;
- Dibenzofuran 1,200 ppb;
- Fluorene 1,200 ppb;
- PCP 9,200 ppb;
- Phenanthrene 3,400 ppb;
- Anthracene 290 ppb;
- Fluoranthene 1,000 ppb;
- Pyrene 600 ppb;
- Benzo(a)anthracene 200 ppb;
- Chrysene 200 ppb;

- Benzo(b)fluoranthene 200 ppb;
- Methyl naphthalene 1,900 ppb;
- Ethyl naphthalene 2,600 ppb, and
- Dimethyl naphthalene 10,000 ppb.

Analyses of water and a lighter-than-water oil layer from monitor well MW-3S for chlorinated dibenzofurans and dibenzodioxins yielded the following results:

	Oil Layer	Water
2,3,7,8-TCDF	ND	ND
Total TCDF	ND	ND
Total PCDF	ND	ND
Total HxCDF	993 ppb	4.08 ppb
Total HpCDF	107,000 ppb	20.5 ppb
Total OCDF	66,400 ppb	20.5 ppb
2,3,7,8-TCDD	ND	ND
Total TCDD	ND	ND
Total PCDD	ND	ND
Total HxCDD	172 ppb	4.2 ppb
Total HpCDD	197,000 ppb	52.9 ppb
Total OCDD	344,000 ppb	67.4 ppb

The 2,3,7,8-TCDD equivalent values are 3.2 ppb for the oil layer and 0.0028 ppb for the water.

Residues from Tanks

Analyses of residues from Tanks 1 and 2 yielded the following results:

	Tank 1	Tank 1 (Duplicate)	Tank 2
phenanthrene	4.7%	8.5%	12.6%
fluoranthene	2.3%	5.1%	3.2%
naphthalene	2.1%	2.6%	1.7%
anthracene	1.2%	8.6%	12.4%
fluorene	1.3%	1.7%	.5%
benzo(a)anthrancene	0.3%	0.6%	0.8%
PCP	1,360 ppm	1,100 ppm	<10 ppm

1.3 NATURE AND EXTENT OF SITE PROBLEMS

The Old Midland Products site has been inspected and investigated by ADPCE and EPA since 1981. Due to the past waste handling/storage practices at the Site and the nature of the wastes present, extensive contamination is present in the immediate vicinity of the lagoons and treatment area. Site drainage conditions have resulted in migration of contaminated sediments to and within the on-site intermittent stream. In addition, operation of the lagoons has resulted in contamination of the shallow ground water on-site with a lighter-than-water organic (oil) liquid and a dissolved organic phase. A heavier-than-water organic liquid phase has not been detected but is possible at some depth within the ground water.

Access to the Site has been restricted, limiting the direct contact threat to public health but migration of contaminants via ground water and surface water sediment presents a future risk to public health and the environment. Airborne transport of contaminants, primarily as fugitive dust emissions, is also a concern during potential excavation/handling of the contaminated material.

The depth of the waste lagoons and the presence of a usable shallow aquifer in fractured bedrock present a particular risk to ground water. Lagoon 3 and other lagoons may have been excavated into the weathered shale.

The sediment contamination in a stream which flows into a wildlife management area about one mile downstream of the Site also presents a particular concern with migration of contaminants in the surface water pathway.

The lagoons and the surrounding soil represent the bulk of the contaminated material on-site. The lagoons seasonally overflow due to insufficient freeboard. The subsurface nonaqueous phase liquid (oil layer) is the predominant transport media for contaminants in the ground water with the risk of transport of dissolved contaminants extending downgradient from the extent of the oil layer. Contaminated surface facilities including small structures, tanks and other equipment are present at the Site.

Pentachlorophenol and polynuclear aromatic compounds are the major contaminants at the site. Chlorinated dibenzodioxins and dibenzofurans are also present in the hexa, hepta and octa chlorinated forms.

Due to the potential risk to public health and the environment, ADPCE, in cooperation with the EPA, has authorized the site investigation and feasibility studies necessary prior to remediation of the Site. These activities are pursuant to the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

1.4 SUMMARY OF REMEDIAL INVESTIGATION

The purpose of the remedial investigation is to assess the nature, degree, and extent of contamination resulting from past activities at the Site and to evaluate the hazard to human health and the environment to allow identification and evaluation of remedial alternatives during the Feasibility Study. In order to accomplish this it is necessary to characterize the Site in terms of the various wastes present and their respective amounts; lateral and vertical extent of contamination in surface water, ground water, sediments and soils; rate and direction of waste migration; target receptors (population at risk, threatened resources, and sensitive ecosystems); site geology and surface water/ground water hydrology.

A specific work plan for this purpose was developed by ADPCE in cooperation with EPA. This RI report presents the results from implementation of that work plan.

The field activities and laboratory testing program include the following:

- Preparation of a surveyed site topographic map;
- Installation of monitor wells;
  - four deep (40 feet) monitor wells, and
  - eight shallow (20 feet) monitor wells;
- Installation of piezometers
  - six deep (40 feet), and
  - eight shallow (20 feet);

- Completion of soil borings to about 40 feet at two locations, of soil borings to about 18 feet at nine locations and of soil borings in association with the monitor wells and piezometers;
- Completion of three exploratory trenches totaling 540 lineal feet;
- Completion of 23 in-situ falling head, hydraulic conductivity tests;
- Completion of 24 soil particle size analyses and 15 laboratory falling head permeability tests;
- Chemical analysis of 72 soil boring soil samples;
- Sampling and chemical analysis of 138 surface/subsurface soil samples;
- Sampling and chemical analysis of sediments and water from each of 7 lagoons;
- Air monitoring;
- Sampling and chemical analysis of 22 sediment samples;
- Sampling and chemical analysis of 6 surface water samples;
- Sampling and chemical analysis of 37 ground water samples;
- Completion of a shallow aquifer test in monitor well MW-12S to determine hydraulic characterics representative of the Site;
- Completion of lagoon sediment stabilization tests; and
- Completion of carbon treatability tests for lagoon water and ground water.

The Sampling and Analysis program is divided into Phase 1 and Phase 2 programs. The number of soil and water sample analyses of each type in each phase are discussed in sections herein and are summarized in Table 1-1. Phase 1 sampling was performed September 30 to November 18, 1986. Phase 2 sampling was performed from May 18 to June 4, 1987. Table 1-1 lists the analytical parameters for Phase 1 and Phase 2 samples. The data from the sampling and analysis has been used to complete the characterization of the Site.

1.5 OVERVIEW OF REMEDIAL INVESTIGATION REPORT

This RI Report has been organized in similar format to that suggested in Guidance on Remedial Investigations Under CERCLA, EPA, May 1985.

Chapter 1 presents background information, discusses previous investigations and summarizes the Remedial Investigation.

Chapter 2 presents the results from the general investigations of the Site vicinity including demography, land use, natural resources, climatology and site facilities.

Chapter 3 identifies and characterizes the wastes present on the Site.

Chapter 4 characterizes the subsurface conditions at the Site including geology, hydrogeology and contamination extent and migration.

Chapter 5 describes the surface water features and flow paths and discusses surface water contamination and migration.

Chapter 6 presents the air monitoring program and discusses airborne contaminant migration.

Chapter 7 presents the results of an ecological reconnaissance of the area and identifies ecosystems potentially susceptible to impact from contaminant migration from the site.

Chapter 8 presents the Endangerment Assessment including discussions of properties of the contaminants, exposure pathways and concentrations, dose response and risk. Health based goals and potentially applicable or relevant and appropriate requirements for the remedial alternatives are also discussed.

Treatability tests including lagoon and ground water carbon adsorption and lagoon sludge stabilization suitability tests are presented in Chapter 9.

2.0 INVESTIGATION OF SITE FACILITIES AND SURROUNDING FEATURES

Several investigations of site facilities and general surrounding features were completed as part of the RI including the following:

- Demographic description involving compilation and evaluation of U.S. Census Data;
- Land use description utilizing published information and a drive-through reconnaissance of the area;
- Natural resources description utilizing published information;
- Climate description using published information and site monitoring data, and
- Description of existing on-site structures and equipment.

2.1 DEMOGRAPHY

This section describes the 1980 census statistics for the population residing in the vicinity of the Old Midland site. The information is provided to identify potential receptors and ascertain the likelihood of exposure at the boundary of the facility.

The Old Midland Products site falls entirely within Yell County, Arkansas. Yell County is largely rural, and is not subdivided into tracts by the Census Bureau. Figure 2-1 is taken from the Arkansas State Highway and Transportation Department General Highway Map. The Old Midland site is located at the center of the required four-mile radius survey circle. Table 2-1 lists population data abstracted from the census tables. Information on the number of the very young (5 years and under) and the elderly (62 years and over) is provided to represent subpopulations which are generally considered to be more sensitive and "at greater risk" to illness than the population at large. Information on the number of females and males residing in the area is noted since there are sexual differences in susceptibility to various illnesses.

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The town of Ola (1,121 persons) is the only significant population center within the four-mile zone. Specific data was gathered by the Census Bureau for the town of Ola. The closest town boundary is 0.2 miles west of the Site, and the farthest boundary is only 2.25 miles west of the site. Based on a count of approximately 140 housing units shown on highway maps, topographic maps, and aerial photographs, there are approximately 450 additional persons living outside of Ola city limits, but within the four-mile zone. The closest residence are fifty yards to the west, and thirty yards to the northwest of the site boundaries. The nearest residence to the east of the Site is 330 yards away.

Compared to Census data for the nation as a whole Ola has a slightly higher average of females, while the number of very young and elderly are twice the national average. The median age is eleven years higher than the national average.

The Old Midland site vicinity is predominantly rural; however, the majority of the people do not live on farms. The types of employment reflect the town of Ola's inclusion rather than the rural nature of the area. According to the 1980 census only four percent of "employed persons sixteen years and over" list their occupations as "farming, forestry, fishing, and mining". Fifty percent are employed in retail and manufacturing, and fourteen percent are employed in health services. Transportation, entertainment and educational services comprise the remaining employment types. Approximately eighty-one percent of the housing is single family dwelling type. Sixty-two percent of the housing is owner occupied.

Out of the 468 households in Ola, ninety-five percent receive their water from public or private utilities. Four percent use drilled wells, while one percent list their water source as "other". Earlier EPA FIT reports indicate there are five residential wells within one-quarter mile of the site.

2.2 LAND USE

The area immediately surrounding the project site boundary is a mixture of residential, farming, and transportational type activities. To the east of the site is a small unoccuppied piece of land surrounded by a thick wooded

area. The Chicago-Rock Island and Pacific Railroad tracks cuts through the upper one-third of the Site and runs in a general east to west direction. The northeastern portion of the Site (north of the railroad tracks) is bound by a large open and cleared field possibly used as a pasture. Old Highway 10, the approximate northern extent of the Site, is bordered by one residential house, a large open field and a small creek which also runs through the Site from south to north. The northwestern section of the Site (north of the railroad tracks and south of Old Highway 10) is occupied by a house trailer park consisting of about six trailers. Immediately to the west and bordering the Site is a residential home (Mr. Nieley) and a small area of farmland. State Highway 10, the approximate southern extent of the Site, is bordered by a thick wooded area. To the far southwest of the Site and bordering the woods is a residential house with several other homes located even further to the west. On a larger scale the land surrounding the Site includes the City of Ola at one-half mile and a large wood mill at one-quarter of a mile to the west with the Petit Jean River State Wildlife Management Area about three-quarters of a mile to the north.

2.3 NATURAL RESOURCES

Yell County encompasses about 950 square miles. The natural resources of the county include (with the associated total acreage):

- Farmland production (204,297);
- Timber production (412,992), and
- Fish/wildlife habitats (12,367).

According to the 1982 Census of Agriculture about 34% of the county was farmland. Major crops grown on the 26,000 acres of cropland are soybeans, wheat, grain, sorghum and rice. Other farmland production includes livestock and poultry.

Forestland makes up 68% of the county with 14 small sawmills, 2 large sawmills, 6 pulpwood yards and several other wood using industries. Major wood products produced include lumber, crossties, roof trusses, wood turnings, custom cabinets, and hardwood furniture stock. The main tree species are shortleaf pine, white oak, sweetgum, blackgum, post oak, red oak, elm and various hickories.

Yell county includes over 3,000 ponds and several large reservoirs primarily used for sport fishing for large mouth bass, striped bass, and channel catfish. Forests provide habitats and public hunting for deer, squirrels, and wild turkeys. Low land habitats along streams, lakes and ponds in the county support a variety of furbearers including beaver, muskrat, mink, raccoon, gray fox, striped skunk, and coyote.

2.4 CLIMATE

The climate of west-central Arkansas can be characterized as contintental with cool winters and hot summers. Meteorological data for the area is presented in Table 2-2. The temperature and precipitation data are from the weather station at Dardanelle, Arkansas, which is located fourteen miles north of Ola. The wind direction and speed data are from the weather station at Little Rock, Arkansas, which is located fifty-five miles southeast of Ola. Both of these stations are representative of the climate at Ola. Site specific meteorological data collected during the RI are discussed in Section 6.0.

In winter the average temperature is 42°F, and the average daily minimum temperature is 31°F. January is the coldest month, with an average temperature of 39.2°F. July is the hottest month, with an average temperature of 81.7°F. In summer the average temperature is 80°F and the average daily maximum is 91°F. During the summer relative humidity averages seventy-one percent.

The mean annual precipitation is 46.47 inches. Monthly rainfall tends to be greater during the spring (approximately five inches per month), and evenly distributed throughout the remaining seasons (approximately three inches per month). During the winter, ninety-five percent of the precipitation is rain. An average of only 5.1 inches of snow containing only 0.5 inch of precipitation falls each winter. On the average, there are only three days when more than one inch of snow is on the ground. The number of such days varies greatly from year to year. Water discharge records for three level gauges on the Petit Jean River (all upstream from Ola) show higher water levels during the spring. This is due to heavier spring rains, not from melting snowpack. Water records also show that there is a pronounced period of reduced flow during autumn.

Winds in the spring are predominantly from the south at ten miles per hour, while the remaining seasons average eight miles an hour predominantly from the southwest. On an annual basis wind directions are: 32% from the southwest quadrant, 24% from the northeast and southeast quadrants, and 20% from the northwest quadrant. Throughout the year, east winds blow from the Old Midland site toward Ola on the average only fifteen percent of the time.

2.5 EXISTING SITE STRUCTURES AND EQUIPMENT

The Site contains a number of small structures and miscellaneous equipment from the former site operations. The structures and major equipment items are listed in Table 2-3 along with pertinent information for each item. The locations of these items are shown on Figure 2-2.

Several bags of PCP product were discovered in the sawmill building. Some of the bags had torn and leaked onto the concrete floor of the structure. During the RI, the material from the bags was placed in labeled drums along with floor sweepings. The drums were stored in the sawmill building. A wipe sample of the concrete floor was taken to determine the relative amount of PCP remaining on the floor of the structure. A concentration of 49.2 milligrams per square meter was found. Other structures which based on appearance and site history are deemed the most likely to be contaminated with PCP or PNA's are the following:

- Yard office B building;
- Structurally enclosed area inside the sawmill;
- Treatment building and associated equipment, and
- Tanks A, B, C, D, and E.

Collection and analyses of wipe samples from the structures and equipment were not part of the RI scope.

3.0 WASTE IDENTIFICATION AND CHARACTERIZATION

Section 3.1 identifies the types of wastes present at the Site. Section 3.2.1 summarizes the characteristics and volumes of lagoon sediments present at the Site and Section 3.2.2 summarizes the characteristics and volumes of lagoon fluids present at the Site.

Estimated extent and volume of soil contamination are presented in Section 4.3 while the estimated extent and volume of ground water contamination are presented in Section 4.4.

A discussion of the physical/chemical properties affecting mobility, transport, and environmental fate of the waste constituents present is presented in Section 8.2.2. A discussion of the toxicology of the constituents is presented in section 8.2.3.

3.1 TYPES OF WASTES PRESENT

The wastes and materials containing wastes which are present at the Site are the following:

- Lagoon sediments in lagoons 1, 2, 3, 4, 5, 6 and 7 are wastes;
- Lagoon fluids in lagoons 1, 2, 3, 4, 5, 6 and 7 are wastes or contain waste constituents;
- Soils in the vicinity of the lagoons and treatment building contain waste constituents;
- Sediments in the drainageway immediately adjacent to and downstream of the lagoons contain waste constituents;
- A lighter than water oil phase present in shallow ground water immediately downgradient of the lagoons is a waste;
- Shallow ground water within the extent of the lighter than water oil phase contains waste constituents; and

- Buildings and equipment onsite contain waste residues and/or waste constituents, as discussed in Section 2.5.

The highest concentrations of waste constituents are present in the lagoon sediments and probably also in residues on some equipment (although in low volumes). Relatively small areas also exhibit high concentrations of waste constituents in soil.

3.2 LAGOON WASTES

Lagoon wastes include the sediments and the fluids present within the seven lagoons present on the site. The seven lagoons and associated surface areas are the following (See Figure 3-1 for locations):

LAGOON	SURFACE AREA (Square Feet)
• Lagoon 1	1,680
• Lagoon 2	3,300
• Lagoon 3	1,500
• Lagoon 4	360
• Lagoon 5	10,120
• Lagoon 6	10,140
• Lagoon 7	2,190

Calculations for these areas are included in Appendix A.

3.2.1 Lagoon Sediments

3.2.1.1 Characterization

Each of the seven lagoons were sampled to produce two composite sediment samples from each lagoon.

The samples were collected as follows:

- A sampling crew of two persons advanced to the indicated sampling location in a small boat;

- A 2 inch ID PVC pipe was driven through the base of the sediment, twisted and removed while sealing the upper opening of the PVC to maintain suction. The PVC was then cut and the sediment was extruded into a container which was immediately sealed;
- Exposure of samples to the atmosphere was to avoided to minimize loss of volatile compounds;
- Sample jars were sealed and immediately placed in coolers containing packets of frozen gel or ice;
- The thickness of the sediment was measured and recorded, and the visual description of the sediments was recorded;
- A clear plastic pipe of 2 inch ID was also used to obtain a sediment sample and check for visual indication of any heavier than water nonaqueous phase liquid layer;
- The sampling boat was then moved to the next sampling point within the same lagoon;
- The sampling procedure was then repeated and the sample was mixed with previous samples from that same lagoon;
- When the final sample was obtained from a lagoon the composite samples were thoroughly mixed and split into two replicate composite samples. Samples were labeled; and
- Any sampling equipment that was to be reused was decontaminated prior to sampling the next lagoon.

The number of sample locations in each lagoon were as follows:

- Lagoon 1, two locations;
- Lagoon 2, three locations;
- Lagoon 3, two locations;
- Lagoon 4, one location;
- Lagoon 5, three locations;
- Lagoon 6, three locations; and
- Lagoon 7, two locations.

One composite sediment sample (A) from each lagoon was analyzed for the following parameters:

- % chloride;
- % hydrocarbons;
- % nitrogen;
- % sulfur;
- % ash content;
- flash point;
- heat value;
- % organic content, and
- head space analysis.

Table 3-1 presents these results.

The composite sediment samples from each lagoon were analyzed for PCP, phenanthrene and PCB. In addition, full scans for GC-MS identification of organic priority pollutants and analyses for chlorinated dibenzo dioxins and furans were completed for the composite samples from Lagoons 1 and 5. Table 3-2 presents the results of the PCP, phenanthrene, PCB and organic pribrity pollutant analyses. Table 3-3 presents the results of the analyses for chlorinated dibenzo dioxins and furans.

The sediment samples from lagoons 1, 3, and 5 contained observable quantities of oil or other organic liquid although the oil did not separate out as a distinct nonaqueous phase layer.

All seven lagoons contained sediments with relatively high PCP concentrations ranging from 820 ppm in lagoon 4 to 5,900 ppm in lagoon 1. Significant PNA's were also present in all seven lagoons as indicated by phenanthrene concentrations ranging from 480 ppm in one sample from lagoon 1 to 38,000 ppm in one sample from lagoon 3. The samples from lagoons 1 and 5 which were analyzed for organic priority pollutants indicated significant concentrations of other PNA's with total PAH values of 29,390 ppm in lagoon 1 to 5,128 to 5,786 ppm in lagoon 5. Benzene, toluene and xylene were also present in sediments from lagoon 1 and xylenes were present in the sediments from lagoon 5. PCB was not detected in any of the samples analyzed during the RI.

The sediments from lagoons 1 and 5 both contained hexa, hepta and octa congeners of chlorinated dibenzo dioxins but did not contain detectable tetra and penta chlorinated congeners. Lagoon 5 sediment contained detectable concentrations of tetra, penta, hexa, hepta and octa congeners of chlorinated dibenzo furans while the lagoon 1 sediment contained detectable concentrations of the penta, hexa, hepta and octa congeners. It is probable that the sediments in the other lagoons exhibit concentrations of PNA's, dioxins and furans similar to those of lagoons 1 and 5.

3.2.1.2 Estimated Volume

The volume of sediments in each of the seven lagoons were estimated using the lagoon survey data and estimated sediment thickness measurements from the RI sampling and previous investigations.

The following sediment volumes were estimated:

- Lagoon 1, 250 cubic yards;
- Lagoon 2, 420 cubic yards;
- Lagoon 3, 210 cubic yards;
- Lagoon 4, 70 cubic yards;
- Lagoon 5, 750 cubic yards;
- Lagoon 6, 890 cubic yards; and
- Lagoon 7, 180 cubic yards.

TOTAL VOLUME = 2,770 cubic yards

The calculations for these estimates are included in Appendix A.

3.2.2 Lagoon Fluids

3.2.2.1 Characterization

Fluid samples were collected at each location where a sediment sample was collected. The fluid samples were collected by the following procedures.

- The depth of water overlying the sediment was measured using a probe that had foot intervals marked on it and a tape was used to measure the distance between the water surface and the nearest foot marking above the water surface; this measurement was recorded in a field book by the sampling team;

- Duplicate, 10 gallon samples were obtained from each lagoon; these samples were obtained with a point sampler (Kemmerer sampler) at measured depths where sufficient thickness of fluid was present, obtaining equal volumes from each sampling location in a lagoon. Criteria for sampling depths were as follows:
  - less than 3 feet of liquid, grab sample at approximately 1 to 2 foot depth,
  - greater than 3 feet of liquid, equal portions from depths of surface sample, middle of liquid layer, and bottom 1 to 2 feet of liquid;

- The liquid samples from all locations within a given lagoon were composited and split into two duplicate samples;

- Sample jars were sealed and immediately placed in coolers containing packets of frozen gel or ice;

- The samples were labeled with the number of the lagoon, designation of water sample and C or D to indicate the split sample; and

- Sampling information was recorded in the field book.

Fluids were separated from suspended solids by decanting from the samples following settling prior to analysis.

The composite fluid samples were analyzed for PCP, phenanthrene and PCB. A composite fluid sample from lagoon 1 and a composite fluid sample from lagoon 5 were analyzed for organic priority pollutants by GC-MS techniques. These two samples were also analyzed for chlorinated dibenzo dioxins and furans. Table 3-2 summarizes the results of the organic priority pollutant compounds and Table 3-3 summarizes the results of the analyses for chlorinated dibenzo dioxins and furans.

Fluid samples from lagoons 1, 2, 3, 4 and 6 contained detectable concentrations of PCP in the range of 0.0012 to 0.60 mg/l. Phenanthrene was detected in at least one of the two samples from lagoons 1, 2, 3, 5 and 6. Phenanthrene concentration was highest in fluid from lagoon 3 at a concentration of 2.1 mg/l. PCP and phenanthrene were not detected in fluid samples from lagoon 7 and phenanthrene was not detected in the fluid samples

from lagoon 4. PCB was not detected in any lagoon fluid samples. Fluid samples from lagoons 1 and 5 contained a number of PNA's at constituent concentrations less than 1 mg/l and exhibited total PNA concentrations of 2.35 and 0.12 mg/l, respectively. Xylenes were detected in the fluid from lagoon 1 at a concentration of 0.0074.

Dioxin and furan analytical results for fluid samples from lagoons 1 and 5 are included in Table 3-3. Hexa, hepta and octa chlorinated congeners of dibenzo dioxins were present in lagoon 1 at concentrations of 10,167 and 1,780 parts per trillion (ppt), respectively, while hepta and octa congeners were present in lagoon 5 at concentrations of 91.2 and 1,108 ppt, respectively. Hexa, hepta and octa congeners of chlorinated dibenzofurans were present in lagoon 1 at concentrations of 11.9, 46.4, and 66.9 ppt, respectively, and in lagoon 5 at concentrations of 7.0, 285, and 44.3 ppt, respectively.

3.2.2.2 Estimated Volume

The volume of fluids in each of the seven lagoons were estimated from fluid thickness measurements from the RI sampling and previous investigations.

The following fluid volumes were estimated:

- Lagoon 1, 8,800 gallons;
- Lagoon 2, 37,100 gallons;
- Lagoon 3, 14,500 gallons;
- Lagoon 4, 6,000 gallons;
- Lagoon 5, 340,500 gallons;
- Lagoon 6, 204,900 gallons; and
- Lagoon 7, 8,200 gallons.

TOTAL VOLUME - 620,000 gallons

The calculations for these estimates are included in Appendix A.

Phenanthrene was detected as follows:

- Trace concentration of 0.32 ppm at a depth of 20 to 20.3 feet in boring MW-8D;
- 260 ppm at a depth of 15 to 15.4 feet in boring B-1 (an oil layer was present at this depth);
- 6.3 ppm at a depth of 18.5 to 19 feet in boring B-6 (an oil layer was present at this depth); and
- Trace concentration below the quantitation limit of 1.1 ppm at a depth of 18 to 18.5 feet in boring B-7.

Trace concentrations of other PNA's were detected in borings B-6 and B-7 at depths of 18.5 to 19 feet and 18 to 18.5 feet, respectively.

Trace concentrations of volatile organic compounds were detected in soil samples from boring MW-11S located near the lagoons as follows:

- 0.10 ppm trichloroethylene at a depth of 10 to 11 feet; and
- 0.20 ppm trichloroethylene and 0.045 ppm benzene at a depth of 15 to 16.1 feet.

Soil samples from 13 locations, 8 surface/subsurface and 5 from boring MW-11S, were analyzed for chlorinated dibenzo dioxins and furans. The results are included in Table 3-3.

Dioxins were detected as follows:

- Tetra congeners detected only in 1 of 3 replicate analyses from one of five samples from boring MW-11S;
- Penta congeners none detected in any samples;
- Hexa congeners detected only in surface soil sample S-68A at a concentration of 0.71 ppb;
- Hepta congeners detected at 7 of the 13 locations at concentrations of 0.20 to 83.8 ppb with the highest concentrations in surface/subsurface soil sample locations; and
- Octa congeners detected in all 13 locations at concentrations from 0.9 to 816 ppb with the highest concentrations in surface/subsurface samples.

Furans were detected as follows:

- Tetra congeners detected only in 1 of 3 replicate analyses from one of five samples from boring MW-11S;
- Penta congeners none detected in any samples;
- Hexa congeners detected only in surface soil sample S-68A at a concentration of 1.2 ppb;
- Hepta congeners detected in five of the 13 locations at concentrations from 0.10 to 14.3 ppb with the higher concentrations in surface/subsurface soil samples; and
- Octa congeners in seven of the thirteen locations at concentrations from 0.23 to 26.2 ppb with the higher concentrations in the surface/subsurface soil samples.

4.3.2 Extent of Contamination

Figure 4-6a presents the surface (0 to 6 inch depth) and subsurface (6 to 12 inch depth) concentrations of PCP in soil. Figure 4-6b presents isocontraction contours for PCP in soil. Surface areas with PCP contamination are as follows:

- PCP > 1 ppm, 159,000 square feet;
- PCP > 10 ppm, 66,000 square feet; and
- PCP > 100 ppm, 30,000 square feet.

An additional area of about 29,400 square feet located beneath the lagoons is assumed to be contaminated, although sampling and analysis of this soil was not in the RI work scope.

Depth of contamination beneath the lagoons may be as great as follows based on the thickness of the soil zone between the lagoon base and the ground water producing interval:

- Lagoon 1, 7 feet;
- Lagoon 2, 13 feet;
- Lagoon 3, 8 feet;
- Lagoon 4, 14 feet;
- Lagoon 5, 14 feet;
- Lagoon 6, 13 feet; and
- Lagoon 7, 11.5 feet.

In other areas the vertical extent of contamination is expected to generally be limited to the upper 1 to 3 feet. Testing of soil samples from depths below 3 feet in monitor well and soil borings have not detected PCP or PNA's at concentrations above 1 ppm except where an oil layer is present. Where an oil layer is present in the ground water, contamination will also be present in the soil at the interface of the water/oil layer.

4.3.3 Estimated Volume of Contamination

The volume of soil contamination was estimated based on surface/subsurface soil and core sample analyses for PCP, the most widespread contaminant, and the estimated depth of potential contamination beneath the lagoons. The estimated volumes are as follows:

- PCP > 1 ppm (outside of lagoons), 189,000 cubic feet (7,000 cubic yards);
- PCP > 10 ppm (outside of lagoons), 126,000 cubic feet (4,700 cubic yards);
- PCP > 100 ppm (outside of lagoons), 60,000 cubic feet (2,200 cubic yards); and
- Contaminated soil beneath the lagoons, 371,000 cubic feet (13,740 cubic yards).

FROM RI vol 2 of 2 Appendix A:
Lagoon 1: 241 cy sludge
159
6 961
7: 179
3755 cy
≤ 3' overburden
1: 175
2: 132
3 127
4. 6
5: 192
6 334

Thus the ranges of the volume soil contaminated with PCP greater than 1, 10 and 100 ppm including the possible contaminated soil below the lagoons are:

- PCP > 1 ppm 9,000 to 21,000 cubic yards;
- PCP > 10 ppm 7,000 to 18,000 cubic yards; and
- PCP > 100 ppm 4,000 to 16,000 cubic yards.

Calculations for these estimates are included in Appendix A.

4.4 GROUND WATER CONTAMINATION

4.4.1 Characterization of Contamination

Ground water contamination within the upper 40 feet of soil/rock was investigated. The contamination was characterized by the presence of a lighter-than-water nonaqueous phase liquid (oil). Where the oil layer is present, as at well MW-3, PCP concentrations are relatively high depending on the amount of oil present in the sample (concentrations of 130 and 12,000 mg/l in two samples from MW-3S, See Table 4-4). A trace of PCP (0.0012 mg/l) was detected in a sample from monitor well MW-11D.

PAH's are also present where the oil layer is present, as at MW-3S. Total PAH's of 29,244 ppm were detected in a sample containing relatively high oil content and 245 ppm in a sample with relatively little oil.

Trace concentrations of toluene (0.0034 ppm) and xylenes (0.077 ppm) were present in the water sample containing relatively high oil content.

Ground water from wells MW-3S, MW-4S, MW-5S, MW-8S, MW-9S, MW-10S and MW-11S were analyzed for chlorinated dibenzo dioxins and furans. The results of these analyses are included in Table 3-3. Dioxins were detected as follows:

- MW-3S, (containing oil) hepta congener at 26.9 ppt, octa congener at 183 ppt;
- MW-4S octa congener at 27 ppt;

- MW-5S, MW-9S and MW-10S none detected;
- MW-8S, octa congener at 16.2 ppt; and
- MW-11S (3 analyses) hepta congener at 7.4 to 12 ppt, octa congener at 73.8 to 158 ppt, and tetra congener at 14.2 ppt in one of three replicate analyses.

Furans were detected as follows:

- MW-3S hepta congener at 5.1 ppt and octa congener at 7.9 ppt;
- MW-4S, MW-5S, MW-8S, MW-9S, and MW-10S none detected; and
- MW-11S, (three replicate analyses) octa congener at 4 to 7.9 ppt and tetra congener detected in one of three replicate analyses at 14.3 ppt.

The tetra, penta and hexa cogeners of dioxins and furans which are the most toxic forms were absent. Toxicological considerations are discussed in Section 8.2.

No other contaminants were detected in the ground water.

4.4.2 Extent of Contamination

The horizontal extent of shallow ground water contamination is limited to the extent of the lighter-than-water nonaqueous phase liquid (oil) as outlined on Figure 4-1. The area within this plume is about 24,000 square feet.

Although the existing hydraulic gradient is to the north-northwest, the plume appears to have migrated primarily to the west with a slight northward component. The direction of past movement may reflect the following factors:

- Preferential movement of the lighter-than-water oil along upward sloping trends in the contact with the overlying clay aquitard, i.e., the elevation of this surface decreases to the north, tending to inhibit movement in this direction;
- Possible preferential movement along localized higher permeability features such as fractures; and

- Possible historic hydraulic mounding around the lagoons.

The vertical extent of the ground water contamination is estimated to extend from the uppermost water yielding interval (approximate depth of 25 feet) downward to the surface of competent rock (approximate depth of 40 feet). Under the ambient non-pumping conditions the contamination will be limited to the upper portion of this interval. However, under pumping drawdown conditions the contamination will be drawn down to the entire interval of the shallow ground water.

4.4.3 Estimated Volume of Contamination

The estimated volume of shallow ground water contamination is estimated based on the horizontal extent of the oil plume, the thickness of the shallow ground water interval and an assumed porosity of the shale. The estimated volume of contaminated ground water is 450,000 gallons. Calculations for this estimate are included in Appendix A.

4.5 POTENTIAL CONTAMINANT MIGRATION IN GROUND WATER

A plume of lighter-than-water nonaqueous phase liquid is present in the ground water and has resulted in contamination of the ground water in the upper 40 wet of soil/rock within the horizontal extent of that nonaqueous phase. Movement of the nonaqueous phase is the primary means of horizontal migration of contaminants. Migration of dissolved phase contaminants is very limited due to the low-water solubilities of the contaminants and the tendency of the contaminants to be attenuated by soil/rock. Horizontal migration of the nonaqueous phase is expected to generally follow the ground water gradient to the north-northwest, although, locally, structural influences may alter the direction of movement. Rate of migration is expected to be less than the ground water velocities of 14 to 48 feet per year. Horizontal migration of the dissolved phase is assessed in Section 8.2.2.

As illustrated on Figure 4-1, the plume has moved about 200 feet, assuming its source is the center of lagoon 3. The lagoons were constructed between 1966 and 1971 indicating an active source life between 21 and 16 years. Rate of past plume migration would be between 10 and 13 feet per year based on these conditions.

The scope of the RI involved investigating the upper 40 feet of soil/rock. No heavier-than-water nonaqueous phase liquid was found in this interval. No heavier-than-water nonaqueous phase liquid was found in the lagoons as a separate phase, although some of the lagoon sediments did contain an oily liquid absorbed to the solids. The nature of wood treating processes provides possible sources for heavier-than-water nonaqueous liquid phases in the wastes that were placed in the lagoons. If a heavy phase was present it is possible, given the site hydrogeology, that some vertical migration through the base of the ponds and into fractured bedrock could have occurred. There are no data, however, indicating this has occurred. Further downward vertical migration of the dissolved phase and of the lighter-than-water nonaqueous phase liquid is unlikely except if the lighter-than-water phase reaches a deeper pumping well, then the contamination may be drawn deeper at the well.

4.6 WATER WELL INVENTORY

The water well inventory was obtained by compiling water well records from the following sources:

- U.S. Geological Survey files;
- Arkansas Geological Commission files;
- ADPC&E files; and
- Personal communication with homeowners immediately surrounding the site area.

A total of 5 wells are present within a 1,500 foot radius around the Site. The Site encompasses the plant (2 acres) and the area surrounding the plant (additional 35 acres).

Direction of the ground water gradient from the site is to the west-northwest. The closest shallow off-site downgradient water well was identified in the water well inventory to the west-northwest of the site. Due to its proximity to the site and its shallow completion depth in the Atoka formation, this well represents the closest potential receptor point downgradient. The nearest four off-site shallow wells are summarized from the well inventory as follows according to their direction from the site:

- West, northwest - Mr. Nieley and Mrs. Barnes,
- South, southwest - Mr. Marcum, and
- East, northeast - Mr. Noake's (2 wells).

Mr. Nieley's well is used for domestic purposes and is reported to be 80 feet deep. It is located approximately 450 feet west-northwest of the on-site lagoons. Mrs. Barnes well is used for domestic purpose and is reported to be 160 feet deep. It is located 1200 to 1500 feet northwest of the Site (See Figure 4-10).

Mr. Marcum's well is also used for domestic purposes and is reported to be 80 feet deep. It is located upgradient at approximately 800 feet south-southwest of the Site.

Mr. Noake's two wells (one agricultural and one residential) are reported to be 265 feet and 80 feet deep, respectively. Both wells are located approximately 1,200 feet east-northeast of the Site.

4.0 HYDROLOGIC CONDITIONS

This section is organized as follows:

4.1 Summarizes regional geology, hydrogeology and geologic hazards;

4.2 Summarizes the site specific hydrogeologic investigations and describes the site hydrogeology;

4.3 Summarizes the extent, characteristics and volumes of soil contamination;

4.4 Summarizes the extent, characteristics, and volumes of ground water contamination;

4.5 Summarizes the potential for contaminant migration in the ground water; and

4.6 Summarizes the locations and completion information for wells in the vicinity of the site.

Potential contaminant migration in ground water is discussed in Section 8.5.3.

4.1 REGIONAL CONDITIONS

4.1.1 Regional Geology

The Site is located in Yell County in the center of the Arkansas Valley and Ouachita Mountains Regions. Geology of Yell County is dominated by outcrops of the lower and middle Atoka Formation of Pennsylvanian Age. The Atoka Formation consists primarily of interbedded gray/black shale and brownish gray sandstone and siltstone. In the site vicinity the Atoka Formation may be several thousand feet thick, with the shale making up about three-fourths of the thickness.

The shale of the Atoka Formation is commonly micaceous and very dense and has a superficial resemblance to low-grade slate or phyllite. It is gray to black and generally noncalcareous and nonfossiliferous. The sandstone and siltstone beds within the Atoka generally are very tightly cemented and commonly are

quartzitic. The sandstone and siltstone beds range from thin lenses less than an inch thick to massive beds 4 or 5 feet thick. They are generally noncalcareous and nonfossiliferous, tan to gray, and contain black carbonaceous markings on some bedding planes. The above mentioned units of the Atoka Formation are characterized by numerous fractures and joints at relatively shallow depths.

The Site is located within the Arkansas Valley region approximately 10 miles north of the boundary with the Ouachita Mountain region.

The Arkansas Valley region is a synclinorium lying between the gently dipping rocks of the Boston Mountains and the highly folded rocks of the Ouachita Mountains reflecting basic structural components of each. Normal faults are predominant in the northern part of the region and reverse (thrust) faults are predominant in the southern part. The rocks have been contoured and broken by joints, fracture cleavage, and drag folding.

The Ouachita Mountain region is characterized by numerous thrust faults. In general, the faults dip 55 to 65 degrees to the south and have a displacement of approximately 10,000 feet.

The Site is bounded by east-west trending thrust faults approximately 2,300 feet to the north and 1,500 feet to the south. Other major structural features within the site vicinity are the Poteau Syncline with its axis located approximately 2.25 miles north of the Site and the Casa Anticline with its axis located approximately 1.75 miles south of the Site. Average dip of bedding planes range from 25 to 70 degrees to the north-northeast for the southern limb of the syncline and 45 to 70 degrees to the north-northeast for the northern limb of the anticline.

The closest outcrop to the Site is located about 3,200 feet to the east. Strike and dip measurements (N 38° W and 54° NE) at this outcrop correlate with the regional structures previously discussed.

4.1.2 Regional Hydrogeology

Ground water in the Arkansas Valley region occurs in two distinct environments:

- The unconsolidated Quarternary alluvial deposits associated with the Arkansas River and its tributaries; and
- The consolidated deposits that underlie the entire region (primarily the Atoka Formation).

The alluvial deposits include various amounts of clay, silt, sand, and gravel. Ground water, when present, generally occurs under water table conditions. These deposits range in thickness from 0 to 150 feet. Where the maximum thickness of alluvium is 50 feet, the water-bearing zones (the basal part) are adequate only for local domestic use. In areas where the alluvial thickness reaches 150 feet, irrigation wells can produce as much as 2,000 gpm from the sand and gravel within the basal section. No significant water bearing unconsolidated alluvial deposits are present at the Site.

Within the consolidated material (Atoka Formation) ground water occurs under artesian conditions, in secondary openings caused by folding, faulting, and solution such as fractures, joints and faults. The quantity of ground water available in any area depends upon the number, size, and degree of interconnection of the water-bearing openings. Locally, the Atoka Formation yields small quantities of water from joints, fractures, and faults, generally within 150 feet of the ground surface. Wells commonly produce 1 to 10 gpm. In general, shallow wells (less than 100 feet deep) are used as domestic water sources and deeper wells (greater than 100 feet) are used for municipal water supplies in the vicinity of the Site.

Movement of ground water within the unconsolidated alluvial deposits, follows the slope of the water table which typically reflects surface topography. Ground water movement within the consolidated materials is structurally controlled, with movement along interbed openings, faults, joints and fractures towards the synclinal axes and away from the anticlinal axes of folds in this region.

Recharge of ground water in the Arkansas Valley region is primarily through precipitation on outcrops and alluvium. Periods of drought occur during the dry season (late spring to early fall) and result in greater depths to ground water and conversely during the wet season (early fall to late spring) depths to ground water are at a minimum.

Transmissivity values have been estimated for four wells completed in the Atoka Formation (U.S. Geological Survey, unpublished data). Transmissivity values of 1,390 and 2,200 gpd/ft were estimated for two 200-feet deep wells owned by the City of Ola, Arkansas (Ola currently uses surface water for supply). A transmissivity of 50 gpd/ft was estimated for a well with a depth of 52 feet completed within tributary alluvium. A transmissivity of 700 gpd/ft was estimated for a City of Plainview, Arkansas water well completed to a depth of 400 feet in the Atoka Formation. The sustainable pumping rate for this well was estimated to be between 20 and 25 gpm. Drawdown was estimated between wells approximately 1000 feet apart and was determined to be negligible (less than 10 feet) using pumping rates of 30 to 40 gpm.

4.1.3 Regional Geologic Hazards

The Site is bounded by east-west trending thrust faults approximately 2,300 feet to the north and 1,500 feet to the south. No faults are known to intersect the site. Other major structural features within the site vicinity are the Poteau Syncline with its axis located approximately 2.25 miles north of the Site and the Casa Anticline with its axis located approximately 1.75 miles south of the Site. These features are not considered hazards to the Site or the vicinity. The faults are not considered to be active since they were formed during the periods of uplift and folding of the major rock units. Subsidence of unconsolidated materials is also not considered to be a hazard due to the shallow nature of bedrock within this region.

Four published seismic risk maps list the site area as a "Zone I", i.e., an area where only "minor damage" can be expected from earthquake activity. The largest expected earthquake would be of Intensity 6 and could be expected to occur once in approximately 400 years. An earthquake of Intensity 2.5 could be expected in the area with a 10 year frequency.

If events comparable to the New Madrid, Missouri earthquake of 1811-1812 were to recur in the New Madrid area, it is possible that an Intensity 7 shock could be registered in the site area. This would be a worst case scenario and is quite unlikely.

Practical considerations for site damage resulting from any earthquake would be failure of the dikes surrounding the ponds or the possible interconnection of ponds through failure of the separating soil. Such failure could only take place through liquidification and this will not happen for two reasons. The site soils are not sandy and therefore will not liquidify. In addition, the 0.15 g ground motion generated by an Intensity 7 event would most likely not liquidify even sandy soils.

It appears that the maximum earthquake event which could be predicted for the area would not lead to any damage at the Site which would have serious consequences for the existing waste storage facilities.

4.2 SITE HYDROGEOLOGY

4.2.1 Description of Field Investigation

4.2.1.1 Drilling

Twenty-eight drillholes including fourteen piezometers, twelve ground water monitor wells and two soil borings were completed at the Old Midland site between September 30 and November 2, 1986 (during Phase 1 of the RI). An additional nine soil borings were completed between May 18 and 21, 1987 (during Phase 2 of the RI). Figure 4-1 shows the locations of these wells and borings.

Sixteen shallow piezometers and monitor wells (P-1s, P-2s, P-3s, P-4s, P-5s, P-6s, P-7s, P-8s, MW-5s, MW-6s, MW-7s, MW-8s, MW-9, MW-10s, MW-11s and MW-12s) were screened in the "upper" weathered shale occurring in the interval from 13 to 20 feet below ground surface. Ten deep piezometers and monitor wells (P-1d, P-2d, P-3d, P-4d, P-5d, P-6d, MW-8d, MW-9d, MW-10d and MW-11d) were screened within the "lower" unweathered shale at depths ranging from 25 to 38 feet. Two deep borings to depths of about 40 feet (B-1 and B-2) were

completed to provide further stratigraphic control and additional core samples for testing. Twenty three of the twenty six wells were cased with a single string of 2 inch inner diameter (ID) PVC from surface to TD (Total Depth). The amount of 0.01 inch slot screen used in each well/piezometer ranged from 5 to 15 feet. All casing and screen used for monitor wells were flush threaded Schedule 40 PVC with O-ring seals. Casing and screen used for piezometers were Schedule 40 PVC with glued slip couplings. All wells were packed with #2 grade sand around the screen. Several feet of bentonite was placed above the sand as a seal, and the remainder of the well annulus was grouted to the surface with a cement-bentonite grout mixture. A locking five foot section of 4-inch protective steel casing seated in a concrete pad was placed around each well when completed.

Two of the twenty six wells (MW-8s and MW-11s) were cased with a single string of 316 stainless steel and completed in a similar manner as the PVC wells. One well (MW-12s) was cased with a single string of 4 inch diameter (ID) PVC and was utilized as the pumping well in an aquifer test (see subsection 4.2.1.6).

The general drilling and installation procedures for piezometers/monitor wells at the site are detailed below:

- Borehole was advanced with a nominal six-inch diameter auger until the water table was reached, auger refusal occurred or borehole collapse occurred. Soil samples were taken at five foot intervals or at strata changes using clean thin walled tube samplers in cohesive soils or split barrel samplers in noncohesive soils;
- Split barrel samples were obtained by driving with a 140-pound weight free falling a distance of 30 inches; resistance (blow counts) were recorded on six inch intervals;
- When auger drilling was terminated, the borehole was advanced by hydraulic rotary wash drilling using water from the City of Ola supply with a six-inch diameter rock or wing bit;
- Soil sampling occurred at 5 foot intervals or at changes in stratigraphy as described above in soil or highly weathered shale;

- Soil samples were placed in amber glass jars, sealed and immediately placed in coolers containing packets of frozen gel or ice;

- The borehole was terminated when competent rock was encountered or when the geohydrologist supervising the drilling determined that the base of the upper ground water zone had been reached; that is, the water yielding zone within the soil and weathered shale had been penetrated (shallow piezometers/monitor wells);

- When competent rock was encountered, the borehole was advanced to a maximum depth of 40 feet or less at the depth determined by the geohydrologist to be appropriate for the deep piezometers/monitor wells, using rotary wash and NX core barrel for sampling;

- When completion depth for the deep piezometers/wells was reached (maximum depth of 40 feet) the borehole was reamed with a 5 7/8 inch diameter rock bit;

- The borehole was then flushed with clean water (City of Ola water) until the geohydrologist determined that the drilling fluid had been adequately flushed;

- A vented (4 vent holes) PVC or stainless steel cap was placed on the casing stickup;

- The annular space around the screen and approximately 1 foot above the screen (as determined appropriate by the on-site geohydrologist) was filled with a sand filter pack;

- An annular seal of at least 2 feet in thickness (as determined appropriate by the on-site geohydrologist) was placed above the sand pack using bentonite pellets;

- The borehole annulus above the bentonite seal was filled with a cement-bentonite grout placed through a tremmie pipe to within 1 foot of the ground surface. The grout mix was approximately 200 lbs of portland cement and 24 lbs of bentonite per 55 gallons of water or other suitable mix determined in the field by the geohydrologist to be appropriate for site conditions;

- The borehole annulus above the grout was filled with concrete;

- All waste from the drilling operations was placed in labelled drums and stored on-site at the location designated by ADPCE as specified in Section 3.1.6.8 of the Work Plan;

- The drill rig, pumps and lines, and sampling equipment were moved to the decon pad and were thoroughly cleaned with high pressure water/steam and detergent before proceeding to the next borehole;

- After the grout had set the well was developed by bailing and a field hydraulic conductivity test was conducted; and

- A protective 4-inch nominal diameter steel casing five feet in length was placed around the PVC or stainless steel casing and set into a 2-foot depth of concrete. The steel casing extended above the PVC casing and was fitted with a cap. A hardened steel hasp was welded on the side of the casing and cap and a hardened steel long neck lock attached. Four small vent holes were drilled in the protective casing.

The general drilling procedures for the soil borings at the site were as follows:

- The borehole was advanced with a nominal four inch diameter auger until the water table was reached, auger refusal occurred or borehole collapsed occurred. Soil samples were taken at five foot intervals (B-1 and B-2 were completed at 40 and 37.5 feet, respectively) or at strata changes using clean thin walled tube samplers in noncohesive soils. Borings B-1 and B-2 were advanced with hydraulic rotary wash and NX Core barrel drilling following auger refusal;

- Borings B-3 through B-11 were completed between 18.5 and 19.5 feet (See Appendix B for individual boring logs) and were augered drilled with a nominal four-inch diameter auger until the water yielding zone within the soil and weathered shale had been penetrated;

- Split barrel samples were obtained at the water yielding zone (B-3 thru B-11) by driving a 140-pound weight free falling a distance of 30 inches. Resistance (blow counts) were recorded on six inch intervals;

- All wastes from the drilling operations were placed in labelled drums and stored on-site at the location designated by ADPCE as specified in Section 3.1.6.8 of the Work Plan; and

- All borings were grouted with a cement/bentonite slurry mix from total depth to the surface.

Geotechnical lab analyses including 22 soil samples for particle size distribution and 15 soil samples for laboratory vertical permeability measurement are presented in Table 4-1.

Sixty-two soil samples from the Phase 1 borings were analyzed for chemical constituents including 5 for organic priority pollutant compounds and chlorinated dibenzo dioxins and furans and 56 for PCP, phenanthrene and PCB. Table 4-2 presents the results of the organic priority pollutant compound analyses and the PCP, phenanthrene and PCB. Table 3-3 includes the results of the analyses for chlorinated dibenzo dioxins and furans.
Individual boring logs along with well/piezometer construction details are presented in Appendix B.

4.2.1.2 Trenching

A series of exploratory trenches (#1, #2, and #3) totaling 540 lineal feet were excavated to depths of about 20 feet to better characterize the subsurface bedrock. Figure 4-2 shows the locations of these trenches. The trenches were logged by a geohydrologist. Subsurface characteristics described included fractures and joints along the top of the bedrock and within the soil zones, and the potential for ground water movement. Also, wherever possible, the dip and strike of the bedrock surface, joints, and fractures were measured.

Other observations made by the geohydrologist, as applicable, included:

- Description of the formation and rock types;
- Width measurements of joint/fracture openings, noting any secondary mineralization;
- Recording the location and extent of seepage points;
- Recording the degree and extent of weathered bedrock zone; and
- Determination of the extent of fractures and joints within the weathered bedrock.

Field observations were documented with color photography. Individual trench cross-sections are presented in Figures 4-3, 4-4, and 4-5. Results of lab analyses of three soil samples from trench 2 are included in Table 4-2.

4.2.1.3 Surface/Subsurface Soil Sampling

A total of 89 samples (59 surface [0"-6"] and 30 subsurface [6"-12"]) were collected between October 30 and November 10, 1986 (during Phase 1). An additional 49 samples (32 surface and 17 subsurface) were collected (during Phase 2) between May 18 and 21 1987, across the site. See Figure 4-6 for sampling locations.

The on-site sampling locations were selected on a grid system with a 100 foot spacing, adjusted where necessary to accommodate property boundaries, buildings and lagoons. These samples provide spatial distribution of contaminants across the areas which are most susceptible to contamination. Seven off-site locations were sampled along Highway 10 on the south boundary of the site to determine if off-site migration had occurred. Sampling started in the southeast corner where higher levels of contamination were not expected. Generally, every second surface soil location was selected for both surface and subsurface soil sample collection with a slight preference given to locations near the lagoons since overtopping of the lagoons, may have contaminated this area.

Surface and subsurface soil samples were collected by the following procedures:

- The selected location was located by measuring from surveyed markers;
- Samples of about 500 grams were collected with a stainless steel soil sampler at depths of 0 to 6 inches (surface sample) and 6 to 12 inches (subsurface);
- Samples were placed in labeled amber glass sample jars;
- Sample jars were immediately sealed and placed in coolers containing frozen packets of gel or ice;

- A visual description including soil type, indications of contamination, or presence of oil were recorded;
- Samples were preserved and handled in accordance with the procedures in the project QA/QC Plan; and
- The stainless steel auger was decontaminated before proceeding to the next location.

Table 4-3 presents the laboratory analytical results.

4.2.1.4 Ground Water Monitoring

Ground water monitoring included water elevation measurements in the monitoring wells and piezometers, sampling and analysis of monitor wells, and sampling and analysis of two off-site water wells.

Static ground water elevation measurements were made and recorded in all monitor wells and piezometers existing (at the time of measurement) generally on a monthly basis during the remedial investigation. The first ground water elevation measurements were made in July 1986. Ground water elevation contour maps for the shallow and deep wells for November 18, 1986, are presented as Figures 4-7 and 4-8. Additional ground water elevation maps are presented in Appendix C, along with tabulated ground water elevations. Figure 4-9 presents hydrographs for monitor wells 1s and 1d illustrating the seasonal variation in ground water elevations during the RI.

Ground water elevation measurements were made with a calibrated electric probe water level sensor by the following procedures:

- The probe was lowered down the well until the meter dial deflected indicating contact of the probe with the water surface;
- Two replicates were made and considered acceptable when readings didn't vary by more than 0.01 foot;
- The depth of water was referenced to the top of the casing (protective metal casing with cover open or the lip of the PVC). The reading was converted to elevation using the surveyed top of the casing;

- The reading was recorded in the field book with well number, date, time and names of measuring crew;
- The electric probe was rinsed with distilled water after use at each well.

All monitor wells except MW-1D, MW-2D, and MW-4D were first sampled during Phase 1. Each of the new monitor wells was initially sampled following development of the well, but prior to performing the field hydraulic conductivity tests. All monitor wells were sampled as part of Phase 2 between May 28 and June 2, 1987.

Monitor wells were sampled by the following procedures:

- A clean plastic liner was placed on the surface around the well to provide a clean dry surface;
- The well cap was removed and placed in a clean area;
- The static water level was measured as follows with a calibrated M-scope electric probe water level sensor or equivalent instrument:
  - The probe was lowered down the well until the meter dial deflected indicating contact of the probe with the water surface,
  - Two replicate measurements were made to ensure reproducibility,
  - The depth to water was referenced to the top of the casing. This was converted to water level elevation (msl) from the surveyed top of the casing,
  - The probe was rinsed with distilled water after each use,
  - Presence of oil or organics on the probe was recorded, if applicable.
- The volume of water initially contained in the well was calculated from the formula $V_w = (L-H)\ 3.14\ r^2$, where V_w is the volume of water contained in the well in (ft^3), L is the length of the well pipe in ft., H is the depth in ft. from the top of the casing to the water level, and r is the inside radius of the well in ft;
- A volume of water equal to three times the volume of water initially contained in the well was removed by bailing. The estimated number of bails to be removed was calculated from the formula $N = 3V_w/V_b$ where N is

the number of times the well must be bailed, V_b is the capacity of the bailer in cubic feet and V_w is as defined above. Conductivity, temperature and pH of the water bailed was monitored and recorded. The well was not sampled until pH and conductivity of the water had stabilized;

- Bailing was accomplished using an all PVC bailer with a polypropylene cord. A dedicated bailer was used in each well and was suspended in the well for use in future sampling;
- The water bailed from the well was retained in labelled 55 gallon drums;
- The sample was carefully transferred into appropriate containers. Prolonged exposure (of sample) to air and agitation during transfer was avoided. Samples for analysis of volatiles were placed in glass VOA vials with no airspace and with teflon seals;
- Sample jars were immediately sealed and placed in coolers containing packets of frozen gel or ice;
- Samples were identified, handled, preserved and analyzed according to the procedures of the QA/QC Plan;
- Samples were placed in ice chests immediately following sampling; and
- Recordkeeping procedures were in accordance with those specified for water samples in the QA/QC Plan and the Chain-of-Custody procedures.

A lighter-than-water nonaqueous liquid phase (oil) was observed in monitor well MW-3S. No other nonaqueous liquid phase was observed in any monitor well or piezometer.

Table 4-4 presents analytical results for ground water samples from monitor wells.

Two off-site water wells, (See Figure 4-10) the Nieley water well west of the site and the Barnes water well immediately northwest of the site and south of Old Highway 10, were sampled. Samples were obtained by utilizing the existing pumps. Samples were collected after the recorded pH, temperature and conductivity of the water had stabilized. Results are presented in Table 4-

5. The Nieley well is reported to be 80 feet deep while the Barnes well is reported to be 160 feet deep. Both wells are used for domestic purposes.

4.2.1.5 FIELD HYDRAULIC CONDUCTIVITY TESTING

Twenty-three in-situ hydraulic conductivity tests were performed in completed piezometers and monitor wells. All monitor wells and piezometers installed during this project, except for MW-12s, P-7s, and P-8s, were tested. After development, falling head hydraulic conductivity tests were performed as follows:

- Static water levels were measured several times for consistency and accuracy and were recorded;
- Water (City of Ola supply) was added to the riser pipe to a known level (usually the lip of the PVC); and
- Water level measurements were made periodically with a water level indicator until the water level stabilized with all data being recorded.

The hydraulic conductivity estimates were made by the following formula for semiconfined or confined conditions (Cedergren, 1977):

$$K = \frac{R^2 \mathrm{Ln}\,(200)}{2L_3\,(T_2-T_1)}\ \mathrm{Ln}\ \frac{h_1}{h_2}$$

Where: R = radius of standpipe
L_3 = aquifer thickness
h_1 = piezometer head at $T = T_1$
h_2 = piezometer head at $T = T_2$
T = time

Field hydraulic conductivity tests are summarized in Table 4-6. Calculations are included in Appendix A.

4.2.1.6 Aquifer Testing

An aquifer test was conducted on November 15, 1986, to determine the hydraulic characteristics of the shallow ground water zone (the soil/weathered shale

zone at about 20 foot depth). Well MW-12s (Figure 4-1) was installed as the pumping well at a location outside the area of significant ground water contamination that is expected to be a representative of hydrogeologic conditions at the site and is located within 10 feet of an existing piezometer pair (P-5s and P-5d). Two additional observation piezometers (P-7s and P-8s) were installed 20 and 40 feet, respectively, to the northwest of MW-12s and were monitored during the pumping/recovery test. Aquifer parameters estimated from pumping test and recovery data are listed in Table 4-7. Piezometers P-1s and P-1d, at a distance of about 105 feet, and monitor wells MW-9s and MW-9d at a distance of 320 feet, were also monitored. Calculations are included in Appendix A.

The following procedures were followed during the pumping tests:

- Static water levels were recorded in the pumped well as well as the 4 perimeter piezometers immediately prior to the start of the pumping test. In addition, piezometers P-1s and P-1d, 105 feet due east, were also measured;
- The pumped well was equipped with a 3/4-inch totalizing flow meter to measure the pumping rate;
- The submersible pump was set at 18 to 19 feet below the ground surface. The screened interval in the well is 10 to 20 feet;
- All produced water was piped and disposed of in the on-site lagoons;
- Drawdown was monitored in the pumped well and recorded at the Site by a geohydrologist. Water levels in the perimeter piezometers were also checked periodically during testing. An electric probe water level sensor was used for all water level measurements; and
- Flow rate was monitored and recorded.

Drawdown was observed in all perimeter piezometers and at P-1s and P-1d during the test. Drawdown was not observed at MW-9s and MW-9d. Drawdown in the pumping well was 6.2 feet after 5 hours of pumping and remained close to this level during the remaining time span of the test. The test was continued for another 3 hours and 10 minutes for a continuous pumping period of 8 hours 10 minutes.

Seven hundred fifty five and three tenths gallons of water were pumped from Well MW-12S during the pumping test at an average rate of 1.5 gallons per minute. A total drawdown in the pumped well of 6.2 feet was measured over the 8 hour and 10 minute test.

The aquifer test results are discussed in Section 4.2.3.1.

4.2.2 Site Stratigraphy and Structure

Four distinct stratigraphic units were encountered in the subsurface across the site as follows in order of descending depth:

- Silty clay;
- Iron (Fe) nodules;
- Weathered shale, and
- Unweathered or lightly weathered shale.

Figure 4-11 presents locations of geologic cross-sections. Cross-sections A-A' through E-E' (Figures 4-12, 4-13, 4-14, 4-15, and 4-16), and trench cross-sections (Figures 4-3, 4-4, and 4-5) illustrate the stratigraphy across the site. Detailed boring logs are presented in Appendix B.

The silty clay unit includes a thin silty soil layer near the surface with thickness varying up to one foot. Penetrometer readings of the silty clay were measured at 4.5 to 4.5+ tons per square foot (TSF) in most samples across the site which corresponds to very stiff to hard. Several samples exhibited readings ranging from 1.0 to 4.0 TSF (firm to very stiff). Grain size distributions, included in Appendix C, demonstrate that the unit consists mostly of silty clay although sand content of a few samples was as high as 50%. Other characteristics of the silty clay include:

- Colors varying from light tan, light to dark brown, and light grey;
- Light to heavy black organic staining;
- Occasional red mottled areas;
- Scattered organic matter, i.e., roots; and

- Pea size to 1/2 inch diameter scattered iron nodules.

Thickness of the silty clay ranges from 4 feet at MW-1s and MW-1d to 15 feet at MW-6s. Thickness of the silty clay on-site generally increases to the northwest as illustrated by Cross-Sections A-A' and B-B'.

Beneath the silty clay is generally a layer of iron (Fe) nodules. The nodules were encountered throughout most of the site except at MW-4s and MW-4d, MW-11s and MW-11d, P-2s and P-2d and B-2 locations. Characteristics of this layer include:

- Bright to dull red color;
- Very fine texture; and
- Sizes ranging from pea to cobble (3 inches).

Thickness of the iron nodule layer ranges from 1/2 foot at MW-7s, MW-10s, MW-10d and P-6s and P-6d to 1 1/2 feet at MW-9s and MW-9d. The base of the nodules is the contact with the weathered shale.

The weathered shale is present throughout the entire Site. It can be found as shallow as 4 feet below ground surface at MW-1s and MW-1d to as deep as 15 feet at MW-6s. The term "weathered" at the Site refers to the overall degradation of the shale unit at shallow depths. This zone is characterized by the following field observations:

- Tan to brown weathered staining occurring mostly in fractures;
- Highly fractured and varying from slightly brittle to crumbly to semi-plastic;
- The presence of secondary alernation solutions, i.e., altered clays, ("dickite");
- The presence of a thin zone of oxidized ferruginous nodules above the shale; and
- Low structural strength.

Thickness of the weathered shale, based upon the above field observations, ranges from as little as 10 feet at MW-12s to as much as 25 feet at P-4s and P-4d. The depth at which the above field observations no longer are observed is termed the "unweathered" shale for purposes of this report. Figure 4-17 presents a geologic structure contour map for the top of the weathered shale. The top of the weathered shale slopes to the north-northwest. A localized low occurs at well MW-6S.

The unweathered shale is characterized by the following field observations:

- Dominate grey to dark grey color;
- Less fracturing due to weathering processes (both physical and chemical);
- High structural strength; and
- Presence of pyrite and dickite along slippage planes.

Fracturing (slickensides) do occur within the unweathered shale, but are the result of geologic processes (uplifting of the Atoka Formation) and not of weathering processes. Slickensides have a polished surface that results from friction along a slippage plane. This was identified from core samples taken of the unweathered shale. The shale is of undetermined thickness; however, it is first encountered as shallow as 18 feet below ground surface at MW-12s to as deep as 37 feet at P-4s and P-4d based upon the above field observations.

Figure 4-18 presents a geologic structure contour map of the unweathered shale. The top of the unweathered shale follows a similar pattern as that of the weathered shale, decreasing toward the northwest. The top of unweathered shale was more difficult to determine than for the weathered shale due to the gradational nature of the contact with the weathered shale and the fewer available borings of sufficient depth.

4.2.3 Description of Aquifers

The major aquifers at the site are the weathered shale and to a limited extent sections of the unweathered shale which contain abundant structural features

such as joints, fractures and faults. The weathered shale also contains these structural features; however, the water transmitting properties have been enhanced by alternating periods of wetting and drying (seasonal changes), which accelerated the chemical and physical degradation of the shale.

Thickness of the water-bearing portion of weathered shale is estimated to be 3 to 5 feet based on field observations during drilling and trenching. The top of the water-bearing zone (top of weathered shale) ranges in elevation from 352 ft. msl at P-2s to 326 ft. msl at MW-6s. The elevation of the top of the first water-yielding zone (Figure 4-19) ranges from 340 ft. msl near MW-1s and MW-1d to 326 ft. msl at MW-7s, MW-5s, and MW-10s. The elevation of the top of the first water-yielding zone was based on observations made at the time of drilling and trenching. Areas which were described as "dry" in boring logs may yield water very slowly or seasonally during wet periods.

The silty clay zone overlying the weathered shale acts as an aquitard which resists ground water movement. Locally there are sections of silty clay which may be very moist to wet (during wet periods); however, its ability to transmit water is limited. Zones containing larger amounts of organic matter and other features (i.e., roots, pebbles, wood, and small fractures) may transmit water relatively more effectively than the more consistent clay zones.

Thickness of the silty clay layer ranges from 6 feet at P-2s and P-2d to 12 feet at P-4s and P-4d. The surface elevation (top of silty clay) ranges from a high of 358 ft. msl at P-2s and P-2d to a low of 340 ft. msl at MW-5s.

4.2.3.1 Aquifer Properties

As described in Sections 4.2.1.5 and 4.2.1.6, field permeability tests and an aquifer test (including pumping and recovery phases) were performed in piezometers and monitor wells installed during this investigation. A summary of field hydraulic conductivity test results is presented as Table 4-6. Shallow zone hydraulic conductivities range from 5×10^{-6} cm/sec to 6×10^{-4} cm/sec in MW-10s and MW-6s, respectively. The log average hydraulic conductivity for the shallow zone is 2×10^{-4} cm/sec. Within the deeper zone, hydraulic conductivity ranges from 7×10^{-6} cm/sec to 2×10^{-4} cm/sec in MW-9d

and MW-8d, respectively. Log average value for the deeper zone is 2 X 10^{-5} cm/sec.

Table 4-7 lists the results from the aquifer test performed in MW-12s including the pumping phase and the recovery phase of the test. The ranges of transmissivity values calculated at observation wells are 130 gpd/ft to 220 gpd/ft during the pumping phase and 330 gpd/ft to 690 gpd/ft during the recovery phase. The estimated storativity values range from 0.01 to 0.0061. Theis solutions were applied to the pumping phase data, and Jacob's method was applied to the recovery phase data. These values are reasonable considering the confined nature and characteristics of the aquifer. However, the drawdown results indicate some deviations from theory. This is probably due to the transmittal and storage of water in fractures and joints of limited interconnection. Localized depressurization/dewatering probably also contributes to nonideal response.

The nonideal drawdown/recovery response may significantly limit the accuracy of the estimates for storativity due to the sensitivity of this value to small changes in curve matching, but should not have significant impact on validity of transmissivity estimates.

The absence of drawdown at MW-9s and 9d, located approximately 320 feet to the north of the aquifer pump test well (MW-12s), indicates an area of low permeability. Field permeability tests were conducted on MW-9s and 9d and yielded low valves of 1.3 x 10^{-4} and 7.0 x 10^{-6} cm/sec, respectively. This in turn could deflect the movement of the existing plume as it migrates to the west.

4.2.3.2 Potentiometric Surface

Figure 4-7 illustrates the elevation of the potentiometric surface for the shallow piezometers and monitor wells for November 18, 1986. The potentiometric surface decreases toward the northwest indicating ground water flow direction is generally towards the northwest although local variations may exist due to anisotropic subsurface conditions. The potentiometric elevation is generally above the lagoon water surface elevation although seasonal reversals may occur. Figure 4-8 presents the potentiometric map for

estimated porosity of 0.10 and 14 and 24 feet per year were calculated with an estimated porosity of 0.20. The calculations for these estimates are included in Appendix A.

4.3 SOIL CONTAMINATION

4.3.1 Characterization of Contamination

The chemical analyses for 91 surface soil (0 to 6 inch depth) samples and 47 subsurface soil (6 to 12 inch depth) samples are summarized in Table 4-3). The analyses indicate that PCP is the major contaminant present in the shallow soils at the site. Phenanthrene was detected in four samples from locations with visible oil stains at concentrations from 50 to 14,000 ppm. Two of the samples were analyzed for organic priority pollutants and contained detectable concentrations of a number of PNA's as listed in Table 4-3. Total PNA concentrations were 1,655.8 ppm in sample S-75 at 0-6 inch depth and 581.9 ppm in sample S-76 at 6 to 12 inch depth. Pyrene, fluoranthene and acenaphthene were the PAH's present at the highest concentrations in these samples. Three volatile organic compounds benzene, xylenes and trichloroethylene were present in samples S-75 and S-76 at trace concentrations of less than 1 ppm. PCB's were not detected in any of the samples.

The chemical analyses of 71 samples from soil borings and 3 samples from trenches are summarized in Table 4-2. PCP was detected in these samples as follows:

- Trace concentrations of 0.04 to 0.14 ppm at depths of 20 to 40 feet at boring MW-8D;
- Trace concentrations of 0.03 to 0.32 ppm at depths of 5 to 15 feet in boring B-1 (an oil layer was present in this interval);
- Trace concentrations of 0.03 and 0.11 ppm at depths of 1 foot and 10 to 11 feet, respectively, in boring B-2;
- 4.0 ppm at a depth of 18.5 to 19 feet in boring B-6 (an oil layer was present at this depth); and
- Trace concentration below the quantitation limit of 1.1 ppm at a depth of 18 to 18.5 feet in boring B-7.

the deep zone on November 18, 1986. The ground water elevations are generally very similar between the shallow and deeper zones, although localized variations do exist. At MW-2s and MW-2D an anomaly may exist as evidenced by comparisons made of the shallow and deep ground water elevations within the same month and from month to month. The aquifer test of MW-12s indicated a direct interconnection between the shallow and deep ground water. The ground water elevations of the two zones are similiar also indicating hydraulic connection. However, at localized locations, the two zones may not be directly hydraulically interconnected since this is a function of interconnection between fractures and joints.

The steepest ground water gradient (indicated by closely spaced contour lines) appears to be in the south central and southwestern portions of the site.

4.2.3.3 Ground Water Velocity

The movement of ground water through the site is determined primarily by the hydraulic gradients and field permeabilities exhibited within the aquifer. Horizontal migration rates have been estimated from November 1986 data as the following:

- Minimum: 28 and 14 feet per year toward the northwest and
- Maximum: 48 and 24 feet per year toward the northwest.

Maximum and minimum hydraulic gradient values were used in the above velocity calculations. The maximum gradient is about 0.034 foot/foot at the southeast end of the Site. The minimum gradient is about 0.02 foot/foot on the east end of the Site. The log average of 23 falling head permeability tests (1.37 x 10^{-4} cm/sec) was used in the calculations since it is considered a more representative value across a significant portion of the Site than individual point measurements. Two assumed porosity values of 0.10 and 0.20 for shale were utilized. Porosity generally ranges from 0 to 0.10 for shale but doesn't take into consideration fracturing of shale; therefore, an estimate with a higher porosity of 0.20 was also utilized. The estimated minimum and maximum ground water velocities are 28 and 48 feet per year calculated with an

estimated porosity of 0.10 and 14 and 24 feet per year were calculated with an estimated porosity of 0.20. The calculations for these estimates are included in Appendix A.

4.3 SOIL CONTAMINATION

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- Trace concentrations of 0.04 to 0.14 ppm at depths of 20 to 40 feet at boring MW-8D;
- Trace concentrations of 0.03 to 0.32 ppm at depths of 5 to 15 feet in boring B-1 (an oil layer was present in this interval);
- Trace concentrations of 0.03 and 0.11 ppm at depths of 1 foot and 10 to 11 feet, respectively, in boring B-2;
- 4.0 ppm at a depth of 18.5 to 19 feet in boring B-6 (an oil layer was present at this depth); and
- Trace concentration below the quantitation limit of 1.1 ppm at a depth of 18 to 18.5 feet in boring B-7.

Phenanthrene was detected as follows:

- Trace concentration of 0.32 ppm at a depth of 20 to 20.3 feet in boring MW-8D;
- 260 ppm at a depth of 15 to 15.4 feet in boring B-1 (an oil layer was present at this depth);
- 6.3 ppm at a depth of 18.5 to 19 feet in boring B-6 (an oil layer was present at this depth); and
- Trace concentration below the quantitation limit of 1.1 ppm at a depth of 18 to 18.5 feet in boring B-7.

Trace concentrations of other PNA's were detected in borings B-6 and B-7 at depths of 18.5 to 19 feet and 18 to 18.5 feet, respectively.

Trace concentrations of volatile organic compounds were detected in soil samples from boring MW-11S located near the lagoons as follows:

- 0.10 ppm trichloroethylene at a depth of 10 to 11 feet; and
- 0.20 ppm trichloroethylene and 0.045 ppm benzene at a depth of 15 to 16.1 feet.

Soil samples from 13 locations, 8 surface/subsurface and 5 from boring MW-11S, were analyzed for chlorinated dibenzo dioxins and furans. The results are included in Table 3-3.

Dioxins were detected as follows:

- Tetra congeners detected only in 1 of 3 replicate analyses from one of five samples from boring MW-11S;
- Penta congeners none detected in any samples;
- Hexa congeners detected only in surface soil sample S-68A at a concentration of 0.71 ppb;
- Hepta congeners detected at 7 of the 13 locations at concentrations of 0.20 to 83.8 ppb with the highest concentrations in surface/subsurface soil sample locations; and
- Octa congeners detected in all 13 locations at concentrations from 0.9 to 816 ppb with the highest concentrations in surface/subsurface samples.

Furans were detected as follows:

- Tetra congeners detected only in 1 of 3 replicate analyses from one of five samples from boring MW-11S;
- Penta congeners none detected in any samples;
- Hexa congeners detected only in surface soil sample S-68A at a concentration of 1.2 ppb;
- Hepta congeners detected in five of the 13 locations at concentrations from 0.10 to 14.3 ppb with the higher concentrations in surface/subsurface soil samples; and
- Octa congeners in seven of the thirteen locations at concentrations from 0.23 to 26.2 ppb with the higher concentrations in the surface/subsurface soil samples.

4.3.2 Extent of Contamination

Figure 4-6a presents the surface (0 to 6 inch depth) and subsurface (6 to 12 inch depth) concentrations of PCP in soil. Figure 4-6b presents isocontraction contours for PCP in soil. Surface areas with PCP contamination are as follows:

- PCP > 1 ppm, 159,000 square feet;
- PCP > 10 ppm, 66,000 square feet; and
- PCP > 100 ppm, 30,000 square feet.

An additional area of about 29,400 square feet located beneath the lagoons is assumed to be contaminated, although sampling and analysis of this soil was not in the RI work scope.

Depth of contamination beneath the lagoons may be as great as follows based on the thickness of the soil zone between the lagoon base and the ground water producing interval:

- Lagoon 1, 7 feet;
- Lagoon 2, 13 feet;
- Lagoon 3, 8 feet;
- Lagoon 4, 14 feet;
- Lagoon 5, 14 feet;
- Lagoon 6, 13 feet; and
- Lagoon 7, 11.5 feet.

In other areas the vertical extent of contamination is expected to generally be limited to the upper 1 to 3 feet. Testing of soil samples from depths below 3 feet in monitor well and soil borings have not detected PCP or PNA's at concentrations above 1 ppm except where an oil layer is present. Where an oil layer is present in the ground water, contamination will also be present in the soil at the interface of the water/oil layer.

4.3.3 Estimated Volume of Contamination

The volume of soil contamination was estimated based on surface/subsurface soil and core sample analyses for PCP, the most widespread contaminant, and the estimated depth of potential contamination beneath the lagoons. The estimated volumes are as follows:

- PCP > 1 ppm (outside of lagoons), 189,000 cubic feet (7,000 cubic yards);
- PCP > 10 ppm (outside of lagoons), 126,000 cubic feet (4,700 cubic yards);
- PCP > 100 ppm (outside of lagoons), 60,000 cubic feet (2,200 cubic yards); and
- Contaminated soil beneath the lagoons, 371,000 cubic feet (13,740 cubic yards).

FROM RI vol 2 of 2 Appendix A:

Lagoon 1: 241 cy in...
2: 339
3: ...
6: 961
7: 170

2755 cy

5 3' overburden

1: 175
2: 132
3: 127
4: 6
5: 192
6: 334
7: 39

001302

Thus the ranges of the volume soil contaminated with PCP greater than 1, 10 and 100 ppm including the possible contaminated soil below the lagoons are:

- PCP > 1 ppm 9,000 to 21,000 cubic yards;
- PCP > 10 ppm 7,000 to 18,000 cubic yards; and
- PCP > 100 ppm 4,000 to 16,000 cubic yards.

Calculations for these estimates are included in Appendix A.

4.4 GROUND WATER CONTAMINATION

4.4.1 Characterization of Contamination

Ground water contamination within the upper 40 feet of soil/rock was investigated. The contamination was characterized by the presence of a lighter-than-water nonaqueous phase liquid (oil). Where the oil layer is present, as at well MW-3, PCP concentrations are relatively high depending on the amount of oil present in the sample (concentrations of 130 and 12,000 mg/l in two samples from MW-3S, See Table 4-4). A trace of PCP (0.0012 mg/l) was detected in a sample from monitor well MW-11D.

PAH's are also present where the oil layer is present, as at MW-3S. Total PAH's of 29,244 ppm were detected in a sample containing relatively high oil content and 245 ppm in a sample with relatively little oil.

Trace concentrations of toluene (0.0034 ppm) and xylenes (0.077 ppm) were present in the water sample containing relatively high oil content.

Ground water from wells MW-3S, MW-4S, MW-5S, MW-8S, MW-9S, MW-10S and MW-11S were analyzed for chlorinated dibenzo dioxins and furans. The results of these analyses are included in Table 3-3. Dioxins were detected as follows:

- MW-3S, (containing oil) hepta congener at 26.9 ppt, octa congener at 183 ppt;
- MW-4S octa congener at 27 ppt;

- MW-5S, MW-9S and MW-10S none detected;
- MW-8S, octa congener at 16.2 ppt; and
- MW-11S (3 analyses) hepta congener at 7.4 to 12 ppt, octa congener at 73.8 to 158 ppt, and tetra congener at 14.2 ppt in one of three replicate analyses.

Furans were detected as follows:

- MW-3S hepta congener at 5.1 ppt and octa congener at 7.9 ppt;
- MW-4S, MW-5S, MW-8S, MW-9S, and MW-10S none detected; and
- MW-11S, (three replicate analyses) octa congener at 4 to 7.9 ppt and tetra congener detected in one of three replicate analyses at 14.3 ppt.

The tetra, penta and hexa cogeners of dioxins and furans which are the most toxic forms were absent. Toxicological considerations are discussed in Section 8.2.

No other contaminants were detected in the ground water.

4.4.2 Extent of Contamination

The horizontal extent of shallow ground water contamination is limited to the extent of the lighter-than-water nonaqueous phase liquid (oil) as outlined on Figure 4-1. The area within this plume is about 24,000 square feet.

Although the existing hydraulic gradient is to the north-northwest, the plume appears to have migrated primarily to the west with a slight northward component. The direction of past movement may reflect the following factors:

- Preferential movement of the lighter-than-water oil along upward sloping trends in the contact with the overlying clay aquitard, i.e., the elevation of this surface decreases to the north, tending to inhibit movement in this direction;
- Possible preferential movement along localized higher permeability features such as fractures; and

- Possible historic hydraulic mounding around the lagoons.

The vertical extent of the ground water contamination is estimated to extend from the uppermost water yielding interval (approximate depth of 25 feet) downward to the surface of competent rock (approximate depth of 40 feet). Under the ambient non-pumping conditions the contamination will be limited to the upper portion of this interval. However, under pumping drawdown conditions the contamination will be drawn down to the entire interval of the shallow ground water.

4.4.3 Estimated Volume of Contamination

The estimated volume of shallow ground water contamination is estimated based on the horizontal extent of the oil plume, the thickness of the shallow ground water interval and an assumed porosity of the shale. The estimated volume of contaminated ground water is 450,000 gallons. Calculations for this estimate are included in Appendix A.

4.5 POTENTIAL CONTAMINANT MIGRATION IN GROUND WATER

A plume of lighter-than-water nonaqueous phase liquid is present in the ground water and has resulted in contamination of the ground water in the upper 40 wet of soil/rock within the horizontal extent of that nonaqueous phase. Movement of the nonaqueous phase is the primary means of horizontal migration of contaminants. Migration of dissolved phase contaminants is very limited due to the low-water solubilities of the contaminants and the tendency of the contaminants to be attenuated by soil/rock. Horizontal migration of the nonaqueous phase is expected to generally follow the ground water gradient to the north-northwest, although, locally, structural influences may alter the direction of movement. Rate of migration is expected to be less than the ground water velocities of 14 to 48 feet per year. Horizontal migration of the dissolved phase is assessed in Section 8.2.2.

As illustrated on Figure 4-1, the plume has moved about 200 feet, assuming its source is the center of lagoon 3. The lagoons were constructed between 1966 and 1971 indicating an active source life between 21 and 16 years. Rate of past plume migration would be between 10 and 13 feet per year based on these conditions.

The scope of the RI involved investigating the upper 40 feet of soil/rock. No heavier-than-water nonaqueous phase liquid was found in this interval. No heavier-than-water nonaqueous phase liquid was found in the lagoons as a separate phase, although some of the lagoon sediments did contain an oily liquid absorbed to the solids. The nature of wood treating processes provides possible sources for heavier-than-water nonaqueous liquid phases in the wastes that were placed in the lagoons. If a heavy phase was present it is possible, given the site hydrogeology, that some vertical migration through the base of the ponds and into fractured bedrock could have occurred. There are no data, however, indicating this has occurred. Further downward vertical migration of the dissolved phase and of the lighter-than-water nonaqueous phase liquid is unlikely except if the lighter-than-water phase reaches a deeper pumping well, then the contamination may be drawn deeper at the well.

4.6 WATER WELL INVENTORY

The water well inventory was obtained by compiling water well records from the following sources:

- U.S. Geological Survey files;
- Arkansas Geological Commission files;
- ADPC&E files; and
- Personal communication with homeowners immediately surrounding the site area.

A total of 5 wells are present within a 1,500 foot radius around the Site. The Site encompasses the plant (2 acres) and the area surrounding the plant (additional 35 acres).

Direction of the ground water gradient from the site is to the west-northwest. The closest shallow off-site downgradient water well was identified in the water well inventory to the west-northwest of the site. Due to its proximity to the site and its shallow completion depth in the Atoka formation, this well represents the closest potential receptor point downgradient. The nearest four off-site shallow wells are summarized from the well inventory as follows according to their direction from the site:

- West, northwest - Mr. Nieley and Mrs. Barnes,
- South, southwest - Mr. Marcum, and
- East, northeast - Mr. Noake's (2 wells).

Mr. Nieley's well is used for domestic purposes and is reported to be 80 feet deep. It is located approximately 450 feet west-northwest of the on-site lagoons. Mrs. Barnes well is used for domestic purpose and is reported to be 160 feet deep. It is located 1200 to 1500 feet northwest of the Site (See Figure 4-10).

Mr. Marcum's well is also used for domestic purposes and is reported to be 80 feet deep. It is located upgradient at approximately 800 feet south-southwest of the Site.

Mr. Noake's two wells (one agricultural and one residential) are reported to be 265 feet and 80 feet deep, respectively. Both wells are located approximately 1,200 feet east-northeast of the Site.

5.0 SURFACE WATER INVESTIGATION

This section is organized as follows:

- Section 5.1, Summarizes regional surface water features;
- Section 5.2, Describes the surface water and sediment investigation of the Site with extent and characterization of contamination; and
- Section 5.3, Describes the site drainage and potential for flooding;

5.1 REGIONAL SURFACE WATER FEATURES

The Old Midland Products Site is located in the Mid Arkansas Drainage Basin which drains all of Yell County into tributaries of the Arkansas River (See Figure 5-1). The major tributaries in Yell County are the Fourche Le Fave River which drains the area north of the Ola Mountain Ridge. The Site is located in the north drainage area which also includes the City of Ola, Arkansas.

Surface drainage from the Site is collected by several small ditches on the south side of the Little Rock and Western Railroad tracks and passes under the tracks' bed through a single culvert to a drainage channel that passes under Old Highway 10 and then into Keeland Creek. Upstream from this discharge point, Keeland Creek serves as the drainage channel from the City of Ola and the Lake Ola-Dale City water supply reservoir to the west.

Meandering to the east for approximately one mile from the site's discharge point, Keeland Creek then travels north along Sante Fe Ridge into the Petit Jean River State Wildlife Management Area where it joins Mason Creek. The combined creeks travel about 1/2 mile before discharging into the Petit Jean River. The Petit Jean travels north along the boundary between Conway and Yell Counties and then enters the Arkansas River approximately 25 miles from the Old Midland site.

5.2 SITE INVESTIGATIONS

The surface water field investigation included the following:

- A topographic survey to define surface water patterns;
- A stormwater runoff sample collection and chemical analysis program to assess stormwater runoff contamination, and
- A drainageway sediment sample collection and chemical analysis program to assess sediment contamination.

5.2.1 Surface Water Runoff Patterns

Figure 5-2 presents the surface water drainage patterns determined from the topographic survey.

5.2.2 Stormwater Runoff Contamination

5.2.2.1 Sample Collection and Analysis

Stormwater runoff samples were collected from five locations during Phase 2 of the RI. Samples were collected from the following locations (See Figure 5-3).

- SW-1, in main drainageway west of the lagoons where drainage passes near the lagoons;
- SW-2, in main drainageway north of the lagoons;
- SW-3, in main drainageway at confluence with runoff path from the north end of the lagoon area;
- SW-4, in drainageway north of railroad tracks; and
- SW-5 and SW-7 (replicates) in drainageway south of Old Highway 10.

In addition one sample (SW-6) was collected and analyzed during Phase 1 of the RI from standing water along Highway 10, south of the Site. This sample was analyzed for the Phase 1 indicator parameters (PCP, phenanthrene, and PCB).

Sample collection procedures were as follows:

- At least 500 ml of sample was collected and placed in amber glass sample jars;
- Sample jars were immediately sealed and placed in coolers containing frozen gel packets or ice;
- Samples were identified and handled in accordance with the QA/QC Plan; and
- Recordkeeping was in compliance with the QA/QC Plan and the Chain-of-Custody Procedures. Time of sampling and runoff observations were recorded.

5.2.2.2 Contamination

Table 5-1 summarizes the chemical analyses of the surface water samples. PCP was detected at trace concentrations from ~10 to 12 ppb in the five Phase 2 samples. No other contaminants were detected.

The contamination appears to be limited to trace concentrations of PCP in direct stormwater runoff from the area around the lagoon and treatment building where surface soil PCP contamination occurs.

During prolonged periods of heavy precipitation, overflow from the lagoons may occur for brief periods. This would result in temporary discharge of higher concentrations of PCP and PNA's to the site drainageway.

5.2.3 Drainageway Sediment Contamination

5.2.3.1 Sample Collection and Analysis

Sediment samples were collected as follows:

- Samples were collected using a hand operated soil core sampler;
- Samples were collected in the depth interval of 0 to 6 inches;
- At least 500 grams of sample were collected and placed in amber glass sample jars;
- Sample jars were immediately sealed and placed in coolers containing frozen gel packets or ice; and

- All sampling equipment coming into contact with the soil was deconned with soap and water between sampling locations.

Samples were analyzed for PCP and PNA's (Phase 2) indicator parameters. The results are summarized in Table 5-3.

5.2.3.2 Contamination

PCP and PNA's including acenaphthylene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, pyrene, chrysene fluoranthene, fluorene, indeno(1,2,3-cd) pyrene, phenanthrene, pyrene and carbazole were detected at concentrations of less than 10 ppm as presented in Table 5-1.

As illustrated on Figure 5-3 the drainageway sediments are not contaminated at the upstream end of the Site but the drainageway becomes contaminated where it bends eastward near the lagoons and contamination continues north of the lagoons. Trace contamination is present at or near the quantitation limit downstream to at least immediately south of Old Highway 10.

The volume of drainageway sediments with PCP concentration above 1 ppm is estimated to be 23,000 cubic feet or 850 cubic yards. Calculations for this estimate are included in Appendix A.

5.3 SITE DRAINAGE AND FLOOD POTENTIAL

The Old Midland Products site is topographically divided into 3 major drainage sections. These sections in general average from a 2.5% slope at the southern end of the site to a very flat boggy area at the northern end. Some specific site features such as sawdust piles, lagoon berms and facility locations influence the site topography but have not severely altered the drainage tendencies of these runoff areas.

The entire site's runoff converges in a clearly defined drainage channel located approximately in the center of the northern portion of the Site. The channel passes through a culvert under the Little Rock and Western Railroad tracks and then northwesterly under Old Highway 10 and on to Keeland Creek.

Off-site flooding potential caused by runoff from the Site is unlikely due to

the small drainage area involved and the large time of concentration (Tc) required for water from all areas of this site to reach the drainage channel. This large Tc is due to the slight slope and large amount of unimproved and unpaved landscape. Off-site runoff is minimal and confined to approximately 1/4 mile of Highway 10 right-of-way drainage which remains confined to a drainage ditch on the western side of the Site.

On-site localized flooding or ponding occurred after each rain that was observed in low areas throughout the northern portion of the Site. In addition, on-site flooding or surcharging of the main drainage channel was observed during the Site work. This flooding was highly localized within the north central portion of the site and may have been caused by debris damming the railroad culvert or by surcharging of Keeland Creek. The surcharging of the creek was due to the backwater effects from the Corps of Engineers measures on the Arkansas River.

Specific drainage patterns, channel locations and site features are identified on Figure 5-2, and will be further addressed in the following sections.

5.3.1 Eastern Section Drainage

The Eastern section is defined by a berm or small levee on the east. A highway drainage ditch to the south, railroad drainage ditch to the north, and a small swale and ditch bordering the lagoons leading to the main drainage channel on the west. A slight, centrally located ridge divides the flow from this section into two flows, one to the northeast and the other to the northwest. With the exception of a small area in the west which drains to the lagoon area drainage ditch runoff from all the eastern sections eventually flows to the railroad drainage ditch and then westerly to the main drainage ditch. Due to the flatness of this area adjacent to the railroad ditch, significant ponding occurs.

5.3.2 Treatment and Lagoon Area Drainage

This drainage area is bordered on the east by a slight swale which leads to a well defined ditch which follows the northern perimeter of this area and defines its northern border before draining into the main channel. The northern border is the Highway 10 drainage ditch and the western border is

comprised of a slight swale bordering the treatment area which becomes a well defined swale and then enters the western drainage channel. The drainage patterns of this area appear to split the flow to both the east and west swales with significant ponding south of the treatment facility.

Flow in the lagoon system is confined to the lagoons and eventually overflows into the large lagoons (Lagoons 5 and 6). The large eastern lagoon has a clearly defined discharge into the bordering drainage ditch while the western lagoon has no clearly defined discharge path but probably would discharge into the ditch as it turns north.

5.3.3 Western Section Drainage

The borders of this section are the treatment/lagoon swale and ditch which flows into the meandering channel that carries the highway drainage through the Site to the main drainage channel, the Highway 10 ditch to the south, a slight ridge along the property line to the west, and the railroad drainage ditch to the north. The major flow in this section appears to be due to the highway drainage with little additional runoff being collected in this western section during normal rainfall due to the large amount of vegetation. In addition, the top soil is highly absorbant due to large amounts of decomposed organic matter which is very soft and spongey.

6.0 AIR INVESTIGATION

6.1 POTENTIAL SOURCES OF AIR CONTAMINATION

The lagoons containing waste sediments and contaminated fluids, and the contaminated surface soil in the vicinity of the lagoons and the treatment building represent potential sources for release of contaminants to the air.

The major contaminants at the site, PCP and PNA's, are of low volatility and would not be expected to be released by volatilization. Trace contaminants such as aromatic and aliphatic hydrocarbons could potentially be released by volatilization.

Release of PCP, PNA's and other contaminants by fugitive dust emissions is possible during prolonged dry periods. The fluids in the lagoons would prevent dust release from the lagoons. The vegetation and relatively moist soil conditions common at the site will limit dust emissions from the contaminated surface soil.

6.2 DESCRIPTION OF SAMPLING AND ANALYSIS PROGRAM

Previous air sampling at the Site by the EPA Emergency Response Team detected trace concentrations in the air space immediately above soil in the vicinity of the lagoons and treatment building for the following compounds:

- anthracene;
- biphenyls;
- hexane;
- indene;
- methyl styrene;
- naphthalene;
- phenanthrene; and
- phenol.

During field investigation activities which could potentially significantly disturb the soil for Phase 1 of the RI, an ambient air monitoring program was used to monitor for air contamination at the Site.

A complete meteorological station (wind speed, wind direction, relative humidity, temperature, rainfall, and barometric pressure) was operated on-site from October 1986 through September 1987. Wind direction was used in sampling and interpreting air monitoring data during Phase 1 of the RI. The following lab analyses and sampling devices were utilized:

- 4 Hi-Vol samplers with daily samples collected, all filters dessicated and weighed to determine total suspended particulates (TSP). The samplers were located at the west, north, east and south perimeters of the lagoon and treatment area;
- Selected personnel organic vapor monitors during potentially high exposure periods as determined by the health and safety officer;
- Four organic vapor area monitors (low flow) with composites of daily samples analyzed for downwind monitors during work periods for anthracene, biphenyl, hexane, indene, methyl styrene, naphthalene, phenanthrene and phenol. Monitors were located at the west, north, east and south perimeters of the lagoon and treatment area; and
- Assorted Draeger tubes (colorimetric) for phenol, hydrocarbons, and hexane and an organic vapor meter were used by the health and safety officer for monitoring at selected drilling and trenching operations.

6.3 CONCLUSIONS

Table 6-1 summarizes daily precipitation measured at the Site. Table 6-2 presents the total suspended particulate concentrations for the four Hi-Vol particulate samplers. Table 6-3 presents the chemical analyses for air samples. Only trace concentrations of contaminants were detected and in all cases detected concentrations were more than two orders of magnitude less than the ACGIH guidelines. Potential for migration of contaminants in the air is discussed in Section 8.5.1.

7.0 ECOLOGICAL EVALUATION

7.1 SUMMARY OF INVESTIGATION

An ecological evaluation was performed by Hall Environmental Services for IT. The evaluation was performed to describe the ecology of the Site and of the downstream vicinity to assess the likelihood that contamination from the Site might reach and affect sensitive ecological systems.

The investigation involved the following elements:

- review of maps and ecological literature for the area;
- site reconnaissance during December 15-17, 1986, to identify drainageways, vegetation and wildlife in the vicinity; and
- assessment of potential for contamination reaching and affecting wildlife in the Petit Jean River State Wildlife Management Area.

The Hall Environmental Services report is presented in Appendix E.

7.2 SUMMARY OF ECOLOGY OF VICINITY

The site is highly disturbed and is mostly covered with a weedy flora of annuals and native and introduced grasses and forbs. To the east is a woodland composed mostly of apparently planted southern pines, while to the west is a stand of mixed hardwoods and pines, containing mostly shortleaf pine (Pinus echinata).

The drainage for the area is an intermittent stream which exits from the northwest portion of the site and crosses under old highway 10. This stream has intermittent red loamy or sandy silt, without much organic matter and, in places, gravel. In this area the creek is about 5 feet wide at its widest, and was 2 to 4 inches deep with flow during the December 15 to 17, 1986, site reconnaissance.

Tree species noted bordering the stream include winged elm (Ulmus alata), hackberry (Celtis laevigata), red maple (Acer rubrum), ash (Fraxinus sp.), deciduous holly (Ilex decidua), honeylocust (Gleditsia trichanthos), and other species. Additional species included sedges (Cyperus sp.), grasses (Paspalum sp.), and vines, such as honeysuckle (Lonicera sp.), and Rubus. Several small tributaries enter the creek in the segment between Old Highway 10 and Wilson Cemetery Road. The creek is mostly lined by a dense, shrubby, thicket of small trees, shrubs, and vines. At one point, runoff from a "poultry farm" enters the stream, carrying with it a load of nutrients which caused some eutrophic conditions through part of the stream. No fish were noted in this reach, but water insects were noted, as were signs of animal use (racoon and deer).

Upstream of the Wilson Cemetery Road bridge the creek is over 15 feet wide. Soundings from the bridge indicate a depth of over 5 feet. Downstream on this reach, there is at least one beaver dam, with evidence of others. The streamside vegetation was very thick, and the flow of the creek was rather sluggish. Additional species encountered in this reach include red oak (Quercus falcata), black oak (Quercus velutina), American sycamore (Platanus occidentalus), and bottonbush (Cephalanthus occidentalis). Downstream from this bridge, the way became impassable due to high water and dense vegetation.

The creek is an intermittent tributary of Keeland Creek which flows through the Petit Jean River State Wildlife Management Area and ultimately into the Petit Jean River. The Petit Jean Wildlife Management Area is managed by the state of Arkansas mainly to provide populations of waterfowl, deer, other game birds, and fish.

The Santa Fe Reservoir is located on the south side of the Petit Jean River, in Section 25, T5N, R21W, southwest of where Highway 7 crosses the Petit Jean River. The reservoir was created by the construction of a levee one-half mile in length along the river, stretching from the north end of Santa Fe Ridge westward to a spit of high ground.

The impoundment is managed for winter flooding by closing the water control structures on or about October 1 every year. This permits local runoff to back up into the impoundment and into the network of sloughs that runs through the area. Flooding is maintained throughout the waterfowl hunting season, and dewatering is begun immediately after the end of the hunting season.

The impoundment area supports a variety of hardwoods which are not harmed by this regime of intermittent flooding. In fact, this area is characteristically low and wet, and often flooded naturally before the control structures were built. Even after the water is released, flooding may continue for some time because of high water on the Petit Jean River.

7.3 SUMMARY OF POTENTIAL ECOLOGICAL IMPACT

The sampling results from the creek that drains the site indicate that concentrations of PCP's in water leaving the site are about 10-11 ppb. Concentrations in sediment are higher: <10 ppm for PCP and <10 ppm for PNA's. Past releases could have been higher. Based on estimated cross-sectional area, depth, and water velocity, the dilution between the outfall and the Wilson Cemetery Bridge is on the order of 1:5. Assuming that the discharge doubles again when Keeland Creek and Mason Creek join, the dilution is estimated as 1:10 by the time the water reaches the body of the Petit Jean River State Wildlife Management Area Impoundment. This is a conservative estimate, because Mason Creek is larger than Keeland Creek, and because it does not take into account further inflows into Keeland Creek below the Wilson Cemetery Road Bridge.

The rate of movement of sediment will be very slow under most conditions. Even under flooding conditions, the creek has a series of pools and one or more beaver dams which will act as sediment traps. The series of sloughs and ponds in the greentree reservoir will also act as traps. Given the low concentrations and low levels of current input, contaminated sediments are not expected to present a threat to the Petit Jean River State Wildlife Management Area. The reservoir itself can be expected to trap most of what reaches it. Release from the sediments will likely be slow, and the dilution effects mentioned above indicate that when the water is discharged to the Petit Jean River, concentrations can be expected to be below detection limits.

Unless catastrophic releases of highly contaminated water and sediments occur, the level of dilution by other waters (on the order of 1:10) can be expected to minimize any possible effects of the Old Midland Products site on the Petit Jean River State Wildlife Management Area. Assuming that the lagoons are removed, no significant direct contamination of waterfowl or other wildlife should occur.

8.0 ENDANGERMENT ASSESSMENT (PUBLIC HEALTH ASSESSMENT)

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300) requires development of an Endangerment Assessment (EA) at sites listed on the National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. An endangerment assessment, designated a combined Level One and Level Two Public Heath Assessment in the Final Work Plan, was completed for the RI.

The objective of the EA is to identify possible risks to human health and the environment due to exposure to hazardous materials present in the environmental media at these sites. This EA is designed to identify and evaluate those risks from the Old Midland Products Site.

This EA documents the determination of endangerment and serves as the basis for evaluating remedial alternatives in the Feasibility Study (FS). In addition, the EA characterizes one of the selection criteria for the remedial alternatives, namely public health concerns. It establishes the site baseline condition and is an assessment of the risks represented by those baseline conditions assuming no future action.

The principal guidance documents used to prepare this EA are "The Endangerment Assessment Handbook", ICAIR Life Sciences Inc. U. S. Office of Waste Programs Enforcement, draft dated August 1985 (ICAIR, 1985), and the "Superfund Public Health Evaluation Manual", Washington, D.C.: U.S. EPA, Office of Emergency and Remedial Response. Contract No. 68-01-7090 Task 7, EPA 540/1-86/060, October 1986, (prior drafts dated December 18, 1985, and May 22, 1985, were entitled "Superfund Health Assessment Manual") (EPA, 1986).

Specifically the scope and content of the EA include all of the data and information required in a Level 2 EA document (i.e., semi-quantitative in terms of detail) as defined in Chapter 5 of the ICAIR (1985) citation.

Other endangerment assessment guidance documents, health risk assessment reports and references consulted in the preparation of this EA, include:

- Versar (1986) Superfund Exposure Assessment Manual, Draft, Washington, D.C.: U.S. EPA, Office of Emergency and Remedial Response. Contract No. 68-01-6871, draft dated January 14, 1986;
- ICAIR, Life Systems Inc. (1985) Toxicology Handbook: Principles Related to Hazardous Waste Site Investigations, Draft, Washington, D.C.: Environmental Protection Agency, Office of Waste Programs Enforcement, Contract No. 68-01-7037, draft dated August 1985;
- EPA (1984) Endangerment Assessment Guidance, internal memorandum from Lee Thomas, EPA Administrator, to EPA Regional Administrators, Regions I-X;
- EPA (1985) Endangerment Assessment Guidance, Draft, memorandum from J. Winston Porter, EPA Asst. Administrator, dated September 20, 1985;
- EPA (1986) Guideline for Carcinogenic Risk Assessment (Federal Register, September 24, 1986);
- EPA (1986) Guideline for Exposure Assessment (Federal Register, September 24, 1986);
- EPA (1986) Guideline for Mutagenicity Risk Assessment (Federal Register, September 24, 1986);
- EPA (1986) Guideline for Assessment of Chemical Mixtures, (Federal Register, September 24, 1986);
- EPA (1986) Guideline for Assessment of Suspect Developmental Toxicants (Federal Register September 24, 1986);
- U.S. Interagency Staff Group on Carcinogens (1986) "Chemical Carcinogens: A Review of the Science and its Associated Principles", Environmental Health Perspectives, Vol. 67, pp. 201-282.

Section 8.1 summarizes the characterization of the site. The available chemical analytical data are summarized in the context of the EA requirements. Occurrence and distribution of chemical contaminants are described in order to focus on potential exposure pathways.

The hazards associated with the site contaminants are identified in Section 8.2. Chemicals of concern are selected to represent the hazards posed by the site on the basis of concentrations, toxicity, frequency of detection as a measure of prevalence across the site in the various media, and persistence in the environment. The site constituents are specified in terms of acute, subchronic, and chronic toxicity; carcinogenicity; mutagenicity; and potential health consequences.

In Section 8.2, the environmental fate and transport of contaminants through the media are described in site-specific terms. Mobility of the individual constituents is characterized by the chemical and physical properties of the constituents. On the basis of the above, transport and fate of the contaminants are predicted.

Section 8.3 tabulates ARARs, applicable, relevant and appropriate guidelines for indicator chemicals.

Section 8.4 describes the performance of a site-specific exposure assessment. Receptors, both human and environmental, are defined using appropriate descriptions. Pathways for potential exposure are hypothesized and evaluated for plausibility. Exposure concentrations are calculated at the potential receptor locations for the postulated scenarios.

In Section 8.4, an environmental impact analysis is also provided to qualify and quantify the risks faced by environmental biota in the vicinity of the site.

Section 8.5 completes the EA for the "no-action" alternative, characterizing the current risks associated with exposure to the site constituents in the postulated exposure scenarios. Risks are quantified for carcinogenicity and chronic toxicity. This analysis assumes that there will be no future change in transport and migration pathways.

The conclusions derived from the EA are listed in Section 8.5.

blishing goals or objectives for the implementation of remedial
on the FS are actually risk management functions rather than risk
echniques, they are addressed in this report. Section 8.6
et appropriate clean-up goals that adequately protect the public
used in judging the efficacy of the remedial alternatives.

RACTERIZATION, OCCURRENCE AND DISTRIBUTION OF CONSTITUENTS

RI, surface soil, subsurface soil, deeper soil, drainageway
face water, air, ground water, lagoon water, and lagoon sediments
and analyzed. The field investigation and resulting analytical
ribed in Sections 3.0, 4.0, 5.0 and 6.0. The chemical data were
letermine the major constituents which might be of concern with
man health, environmental protection, and remedial objectives.

e Soil (0 to 6 inches) and Subsurface Soil (6 to 12 inches)

cted in surface and subsurface soil in ranges from less than the
nit to 790 mg/kg and from less than the detection limit to 690
tively.

was present in surface and subsurface soil, although much less
an PCP, in ranges from less than the detection limit to 14,000
m less than the detection limit to 220 mg/kg, respectively.

etected in any surface or subsurface soil samples.

priority pollutant compounds were present at concentrations from
detection limits to a maximum of:

	SURFACE (mg/kg)	SUBSURFACE (mg/kg)
naphthalene	1.3	1.0
2-methyl naphthalene	2.5	15.0
acenaphthylene	16.0	3.0
acenapthene	140.0	50.0
dibenzofuran	11.0	20.0
fluorene	23.0	22.0

FACE (mg/kg)
19.0
89.0
30.0
28.0
35.0
16.0
D(1)
ND
0.22
0.40
ND

·1 and B-
tions of
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ions of:

	CONC. (mg/kg)
chrysene	660
benzo(b)+benzo(k)fluoranthene	380
benzo(a)pyrene	150
indeno(1,2,3-cd)pyrene	-
benzo(g,h,i)perylene	-
benzene	110
trichloroethylene	310
toluene	240
xylenes	4,900

Tetra (furans only), hexa and penta forms of chlorinated dibenzo dioxins and dibenzo furans were detected at concentrations above 1 ppb only in lagoon sediments.

8.1.3 Lagoon Water

Lagoon water samples exhibited the following concentration ranges:

	CONC. (mg/kg)
• PCP	0.010 to 0.60
• phenanthrene	ND to 2.2
• naphthalene	0.087 to 0.19
• 2-methyl naphthalene	ND
• acenaphthylene	0.0031 to 0.02
• acenaphthene	0.0051 to 0.30
• dibenzofuran	ND
• fluorene	0.013 to 0.22
• anthracene	ND to 0.029
• fluoranthene	0.01 to 0.16
• pyrene	0.0067 to 0.97
• benzo(a)anthracene	ND to 0.011
• chrysene	0.0017 to 0.017
• benzo(b)+benzo(k)fluoranthene	ND to 0.014
• xylenes	ND to 0.0074

8.1.4 Surface Water

The only contaminant detected in six surface water samples was PCP at concentrations from not detected to 12 ppb.

8.1.5 Ground Water

Contaminants were detected in ground water principally where a free oil phase was present. The following maximum concentrations were found:

CONSTITUENT	CONCENTRATION WITH OIL PRESENT (mg/l)	CONCENTRATION, NO OIL PRESENT (mg/l)
PCP	12,000	0.0012
phenanthrene	5,000	ND
toluene	0.0034	ND
xylenes	0.077	ND
naphthalene	2,300	ND
2-methyl naphthalene	7,300	ND
acenapthylene	96	ND
acenapthene	2,100	ND
dibenzofuran	2,000	ND
fluorene	270	ND
anthracene	1,500	ND
fluoranthene	5,100	ND
pyrene	1,800	ND
benzo(a)anthracene	520	ND
chrysene	670	ND
benzo(b)+benzo(k)fluoranthene	410	ND
benzo(a)pyrene	120	ND
indeno(1,2,3-cd)pyrene	35	ND
benzo(g,h,i)perylene	23	ND

SUMMARY

PCP and PNA's are the major contaminants at the site. Chlorinated dibenzodioxins and dibenzofurans are significant only in the lagoon sediments.

8.2 WASTE CHEMISTRY (HAZARD IDENTIFICATION)

All of the chemicals identified in the course of the remedial investigation sampling along with their corresponding concentrations have been tabulated by environmental media monitored and are presented in Sections 3.0, 4.0, 5.0, and 6.0.

In this section, first the rationale for either selecting or eliminating each of the constituents as an indicator chemical is discussed. Second, behavior of the constituents is characterized, generally by chemical and physical nature, to predict potential for migration to an off-site location where exposure could take place. Third, the toxicity characterization to assess the potential risks to public health and the environment posed by this site is discussed.

8.2.1 Selection of Indicator Chemicals

The "Guidance on Remedial Investigations under CERCLA" (EPA, June 1985), and the "Superfund Public Health Evaluation Manual" (EPA, October 1986) direct that in scoping a sampling and analysis program and preparing a public health evaluation it is important to select chemical contaminants of interest, or indicator chemicals. The indicator chemical selection procedure is designed to identify the "highest risk" chemicals at a site so that the public health evaluation and any subsequent remediation is focused on the chemicals of greatest concern. Conducting the evaluation on a large number of chemical substances may be unnecessarily time consuming and may not enhance the effectiveness of the evaluation. "To avoid unnecessary effort, the Superfund process is based on selected indicator chemicals that pose the greatest potential public health risk at the site. Such indicator chemicals are chosen carefully so that they represent the most toxic, mobile, and persistent chemicals at the site, as well as those present in the largest amounts (ie., the "highest risk chemicals")" (EPA, October 1986).

The factors used to rank chemicals in the indicator chemical selection process are the measured concentrations at the site, the toxicity (human and ecological), and the prevalence (ie. frequency of detection) of the chemicals. Additional factors considered include physical and chemical parameters related to environmental mobility, persistence, bioaccumulation or biomagnification.

8.2.1.1 Polychlorinated Biphenyl (PCB)

Occurrence and Concentration

PCB was detected in one set of samples in the EPA data collected (prior to the RI sampling program). A lagoon sludge sample contained 831.3 mg/kg PCB and one drainageway sediment sample contained PCBs. Due to their detection in the EPA sampling, PCBs were analyzed in Phase 1 of the RI. PCBs were not detected in any media sampled. If PCB is present in the lagoon sludge its presence is likely overwhelmed in composite samples by the presence of PCP and other contaminants and its occurrence is limited. Since PCB was not detected in Phase 1 it was not analyzed further in Phase 2 sampling.

Rationale for Elimination or Selection

PCB does not appear to be prevalent or widely distributed (it was reported in only one set of EPA samples). Its presence was not confirmed in Phase 1 sampling of the RI. It does not appear, based on the analytical data, that the presence of PCBs are representative of past industrial site activities. Consequently, PCB is excluded as an indicator chemical.

8.2.1.2 Volatile Organic Compounds

Three monocyclic aromatic hydrocarbons and one halogenated aliphatic hydrocarbon were detected in the chemical analytical data. These constituents have been screened as reported below.

Benzene

Occurrence and Distribution

Benzene was detected in surface soil, subsurface soil and core samples. A benzene concentration of 0.180 ppm was detected in the surface soil (0 - 6 inch depth). The prevalence of benzene in surface soil samples was one positive detection per four samples analyzed.

In subsurface soil (6 - 12 inch depth) benzene was observed at 0.22 ppm in one of four samples analyzed. Benzene was detected in one of five core samples analyzed at a depth of 15 - 16.1 feet below ground surface at a concentration of 0.045 ppm.

Benzene was not detected in ground water or surface water.

Rationale for Elimination or Selection

Benzene is included as an indicator chemical and due to its presence in surface soil it is assessed in the risk characterization of the ambient air pathway.

Toluene and Xylene

Occurrence and Distribution

Toluene was not detected in soil samples. Both compounds were detected in one of fifteen ground water samples with a toluene concentration of 0.0034 ppm and a xylene concentration of 0.0077 ppm. The positive detection was in monitor well MW-3S. Toluene and xylene were detected together in a single sample where a free oil phase was present.

Xylene was detected in a single surface soil sample at 0.031 ppm. The same sample contained benzene and trichloroethylene.

Rationale for Elimination or Selection

Toluene and xylene are eliminated as indicator chemicals due to low prevalence and low concentration. The toluene concentration detected (0.0034 mg/l) is well below the proposed RMCL of 2 mg/l. The xylene concentration (0.0077 ppm) is also well below the proposed RMCL of 0.044 mg/l. As a result, both compounds are considered to be below levels of toxicological significance in ground water.

Trichloroethylene

Occurrence and Distribution

Trichloroethylene was not detected in ground water. It was detected in one surface soil (out of 3 analyzed) at 0.260 ppm and one subsurface soil sample (out of four analyzed) at 0.400 ppm. When detected it was found with benzene. Trichloroethylene was also detected in one soil boring at depths of 10 - 11 feet and 15 - 16.1 feet below ground surface at concentrations of 0.10 ppm and 0.20 ppm, respectively.

Rationale for Elimination or Selection

Trichloroethylene is eliminated because it is not prevalent or present in the ground water. Benzene is included as an indicator chemical and should adequately assess the risks due to the less carcinogenically potent trichloroethylene. Its presence in an isolated surface soil sample (even at an elevated concentration) should not present a significant pathway for exposure. The soil core samples in which it was detected are remote from human contact.

8.2.1.3 Polynuclear Aromatic Hydrocarbons (PNA's)

Polynuclear aromatic hydrocarbons are associated with the creosote and coal tar pitch and petroleum distillate waste generated in the wood preserving process. Consequently, PNA's are important as indicators of contamination. They were detected in each environmental media sampled, except air - lagoon sediment, lagoon water, surface and subsurface soil, core samples from soil borings, drainageway sediment, and ground water.

PNA's as a group are noted for their characteristic of binding to soil as evidenced by their low water solubility and high log octanol/water partition coefficient.

A notable exception is naphthalene, which has a relatively high water solubility for a PNA (34.4 mg/l at 25°C) and therefore might be detected in ground water.

From a public health perspective, the important PNA's are the ones which are known or probable carcinogens. The non-carcinogenic PNA's typically exhibit low or minimal toxicity. The PNA's as a group are poorly absorbed by the gastrointestinal tract (approximately 50% or less).

Due to their presence in creosote and to their association with fuel oils used as solvents for PCP employed in the wood preserving process practiced on site, the PNA's (carcinogenic and non-carcinogenic) are important from an environmental and contamination distribution perspective. Consequently the PNA group was a major focus of the RI sampling and analysis program.

Non-carcinogenic PNA's

Initially the analytical program focused on phenanthrene as an indicator of PNA's. Later a group of approximately fifteen representative PNA's were analyzed including phenanthrene and other non-carcinogenic PNA's.

Occurrence and Distribution

In Phase 1 sampling, phenanthrene was analyzed in all media. Phenanthrene was detected as follows:

Ground water -	5,000 ppm was detected associated with a free oil phase. Prevalence is low, 1 positive detection out of 35 samples analyzed.

Phenanthrene

During Phase 1, phenanthrene was used as a principal sampling parameter. Phenanthrene is considered to be a non-carcinogenic PNA since there is inadequate evidence to assess or resolve the issue of carcinogenicity. It is a good indicator of PNA's from the environmental perspective since it has a higher water solubility than many other PNA's (1.29 mg/l @ 25°C) and is therefore more environmentally mobile. Phenanthrene was detected as follows:

Surface soil (0-6")	Detected in 3 samples of 90 analyzed. Concentrations observed are: 87; 14,000; and <1.2 ppm.
Subsurface soil (6"-12")	Detected in two samples of 47 analyzed, associated with positive surface soil detection described above. Reported concentrations are 50 and 220 ppm.
Lagoon sediment and water	Phenanthrene was associated with both the sediment and water samples. In sediment the range was 480 to 38,000 ppm. In water the values range from ND to 120 ppm.
Core samples	Phenanthrene was detected in 5 samples out of 75 analyzed. Concentrations range from 0.32 to 270 ppm.

Rationale for Elimination or Selection

Phenanthrene is not eliminated. It will be included as an indicator chemical in the non-carcinogenic PNA class.

Other Non-Carcinogenic PNA's

Other non-carcinogenic PNA's analyzed (in addition to phenanthrene) are:

- fluorene;
- acenaphthene;
- acenaphthylene;
- anthracene;
- fluoranthene;
- naphthalene;
- 2-methyl naphthalene; and
- pyrene.

Occurrence and Distribution

The non-carcinogenic PNA's were detected as follows:

Ground water	Some of these PNA's were associated with a single sample of a free oil phase to a maximum concentration of 7,300 ppm for 2-methyl napthalene.
Surface soil	Non-carcinogenic PNA's were detected at one location at a maximum concentration of 700 ppm for pyrene.
Subsurface soil	Detected at one location, maximum concentration 230 ppm for pyrene.
Lagoon sediment and water	Detected in both sediment and water. Maximum values are for sediment 4,900 ppm for pyrene and in water 0.97 ppm for pyrene.

Rationale for Elimination or Selection

The non-carcinogenic PNA's will be considered as a class of indicator chemicals rather than individually.

Carcinogenic PNA's

The carcinogenic PNA's (known and probable carcinogens) include:

- benzo(A)anthracene;
- benzo(A)pyrene;
- benzo(A)fluoranthene;
- benzo(K)fluoranthene;
- indeno(1,2,3-cd)pyrene;
- dibenzo(a,j)acridine;
- 7-H-dibenzo(c,g)carbazole; and
- chrysene.

There is less strength of evidence, compared to the other PNA's, listed for carcinogenicity of chrysene. It is conservatively included as a potential carcinogen.

Occurrence and Distribution

Carcinogenic PNA's were detected as follows:

Ground water	Some of these PNA's were associated with a single sample of a free oil phase to a maximum concentration of 520 ppm for benzo(A)anthracene.
Surface soil	Detected at one location maximum concentration 99 ppm benzo(A)-anthracene.
Subsurface soil	Detected at one location maximum value of 35 ppm for chrysene.
Lagoon sediment and water	Detected in both sediment and water. In sediment the maximum value observed is 660 ppm for chrysene. In water 0.050 ppm for benzo(A)pyrene.
Core samples	Chrysene and benzo(A)anthracene were detected at concentrations less than 1.0 ppm.

Rationale for Elimination or Selection

The carcinogenic PNA's will be considered as a class of indicator chemicals. This is particularly appropriate since the existing toxicity data for this group is based on benzo(A)pyrene which is the best studied PNA.

Carbazole

Rationale for Elimination or Selection

Carbazole, a PNA, was included as a sampling parameter for Phase 1 although interferences limited quantitation, due to its association with the wood treating process. Carbazole was detected infrequently and at low concentrations relative to other PNA's and is therefore excluded from consideration as an indicator chemical.

8.2.1.4 Pentachlorophenol (PCP)

The chemicals used in wood preservation are pentachlorophenol (PCP) and creosote. PCP is the most widely distributed soil contaminant detected at the Site. Consequently PCP is an appropriate indicator of contamination from the wood treating processes which occurred when the facility was in operation.

Occurrence and Distribution

PCP was detected in all media, except air: surface and subsurface soil, surface water, drainageway sediments, deeper soil samples, cores, lagoon sediment, lagoon water, and ground water.

In ground water PCP was detected in two samples. 12,000 ppm PCP was associated with a free oil layer in well MW-3S in which other contaminants were detected. Another observation of 0.0012 ppm PCP was detected in MW-11D.

Surface soil (0 to 6 inches) range from ND to 790 ppm with a geometric mean value of 9.6 ppm. Subsurface soil (6 to 12 inches) values range from ND to 690 ppm with a geometric mean of 5.1 ppm.

Rationale for Elimination or Selection

PCP is not eliminated. It is prevalent, abundant, toxic, and an indicator of the site operation history. PCP is the major indicator chemical to be considered in the public health evaluation.

8.2.1.5 Chlorinated Dibenzo Dioxins and Dibenzo Furans

PCP is a toxic chemical in its own right. However, in addition to its own toxicity, several impurities are present in commercial grade PCP which are

potent carcinogens. The most toxic of these impurities are the chlorinated dibenzodioxins and dibenzofurans.

Occurrence and Distribution

The dioxins and dibenzofurans are present almost entirely in hepta and octa chlorinated forms. Tetrachloro was detected only as follows:

- 1.2 ppb TCDD and 1.5 ppb TCDF in a soil sample,
- 10.1 ppb TCDF in a lagoon sediment, and
- in one of four replicate ground water samples from a monitor well, 14.3 ppt TCDD and 14.5 ppt TCDF.

Pentachlorinated compounds were detected only as follows:

- 29 to 127 ppb PCDF in lagoon sediments.

Hexachlorinated compounds were detected as follows:

- 0.71 ppb HxCDD in soil;
- 1.2 ppb HxCDF in soil;
- 70.2 to 296 ppb HxCDD in lagoon sediments;
- 116 to 376 ppb HxCDF in lagoon sediments;
- 10 ppt HxCDD in lagoon water; and
- 7.0 to 11.9 ppt HxCDF in lagoon water.

Hepta and octachlorinated compounds were detected with maximum concentrations as follows:

MEDIA	HpCDD	OCDD	HpCDF	OCDF
Soil	83.8 ppb	816 ppb	14.3 ppb	26.2 ppb
Lagoon Sediments	3,490 ppb	19,500 ppb	883 ppb	1,180 ppb
Lagoon Water	167 ppt	1,780 ppt	46.4 ppt	66.9 ppt
Ground Water	26.9 ppt	183 ppt	5.1 ppt	7.9 ppt

Tetra, hexa and penta forms were detected in significant concentrations only in lagoon sediments. No 2,3,7,8-TCDD or 2,3,7,8-TCDF isomers (the most toxicologically potent form) have been reported.

Rationale for Elimination or Selection:

Not eliminated, the public health issues associated with the detected concentrations of chlorinated dioxins and dibenzofurans will be assessed.

8.2.1.6 Summary, Selected Indicator Chemicals

The following target or indicator chemicals have been selected to assess the risks associated with the site:

- PNAs;
  non carcinogenic
  carcinogenic
- PCP;
- Dioxin and dibenzo furans; and
- Benzene.

8.2.2 Environmental Fate and Transport

This section describes the behavior of the identified constituents in the various environmental media and explains the major factors which influence occurrence and distribution patterns presented in the previous section. The Environmental Fate and Transport section assists the process of selecting indicator chemicals.

The objectives of this section are to:

- Group the constituents into categories with similar migration characteristics;
- List pertinent transport parameters based on the physical and chemical nature of the constituents; and
- Couple transport parameter information with relevant site-specific features that affect transport through the on-site air, soils, and water in order to identify the exposure potential associated with each class of constituents.

The predominant chemical class detected is the semi-volatile base/neutral extractable compounds, such as PCP and the PNA's. A few volatile compounds were also detected. Table 8-1 contains a list of physical and chemical parameters that serve to characterize the most likely environmental fate of the constituents present in the various on-site environmental media.

8.2.2.1 Physical and Chemical Characteristics of Identified Compounds

A brief description of transport and mobility related parameters typically used in assessing the behavior of constituents in the environment is presented in Table 8-1. The parameters are briefly described below:

- Water Solubility is the maximum concentration of a chemical that dissolves in pure water at a specific temperature and pH. It is a critical property affecting environmental fate and transport. Chemicals with high water solubility will tend to be transported from soil to ground water and surface water rather than remaining in soil or volatilizing;

- Vapor Pressure is a relative measure of the volatility of a chemical in its pure state and is an important determinant of the rate of volatilization. Values for this parameter, in units of mm Hg, are given for a temperature range of 20 to 30°C. Constituents with high vapor pressure are more likely to migrate from soils and ground water and be transported in air;

- Henry's Law Constant is another parameter important in evaluating air exposure pathways. Values for Henry's Law Constant (H) were calculated using the following equation and the values recorded for solubility, vapor pressure and molecular weight:

$$H(atm\text{-}m^3/mole) = \frac{\text{Vapor Pressure (atm) X Mole Weight (g/mole)}}{\text{Water Solubility } (g/m^3)}$$

- Organic Carbon Partition Coefficient (K_{oc}) is a measure of the tendency for organics to be adsorbed by soil and sediment and is expressed as:

$$K_{oc} = \frac{\text{mg chemical adsorbed/kg organic carbon}}{\text{mg chemical dissolved/liter of solution}}$$

The K_{oc} is chemical specific and is largely independent of soil properties. The higher the K_{oc} value the more adsorbable the compound;

- Octanol-Water Partition Coefficient (K_{ow}) is a measure of how a chemical is distributed at equilibrium between octanol and water. K_{ow} is an important parameter and is used often in the assessment of environmental fate and transport for organic chemicals. High K_{ow} values are generally indicative of a chemical's ability to accumulate in fatty tissues and therefore biomagnify in the food chain. The K_{ow} also helps to determine a chemical's movement from an organic matrix to water and soil. Additionally, K_{ow} is a key variable used in the estimation of other properties;

- Bioconcentration Factor as used in this document is a measure of the tendency for a chemical in water to accumulate in fish tissue. The equilibrium concentration of a chemical in fish can be estimated by multiplying the concentration of the chemical in surface water by the fish bioconcentration factor for that chemical. This parameter is therefore an important determinant for human intake via the aquatic food ingestion route;

- Chemical Half-Lives are used as measures of persistence, or how long a chemical will remain in various environmental media. Table 8-1 presents values for overall half-lives, which are the results of all removal processes (e.g., phase transfer, chemical transformation and biological transformation) acting together rather than a single removal mechanism.

8.2.2.2 Migration Characteristics of the Principal Constituents

Each of the listed classes of chemical constituents detected at the site, i.e., PNA's, PCP, and volatile aromatic compounds, will behave differently in the environment. A short description of their behavior is given below:

- Migration of PNA's - Generally, PNA's are highly immobile in soils due to their low water solubility (thus non leachable). Their high partition coefficient (K_{ow}) and high soil adsorption coefficients (K_{oc}) combined with their resistance to oxidation or hydrolysis are indicative of their persistence in the soil environment. They are usually bound to particulates and soils, unless there are high enough concentrations of organic solvents present in the soils to allow migration of organic contaminants by nonaqueous phase liquid (NAPL) flow conditions (Villaume, 1985);

  PNA's will not volatilize, as indicated by the low vapor pressure, and therefore are not of concern in the air pathway (except as particulate emissions). They are not subject to hydrolysis or oxidation but may be biodegraded by selective soil microorganisms. Usually, PNA's will not be transported in the environment except by physical means such as sediment in surface runoff during storm events;

  PNA's have a low mobility index in soil ranging from -19 to -7.3. A value less than -5 is considered to be immobile;

Consequently, migration of PNA's is expected to be extremely limited;

- Migration of PCP

  There is little information on the transport of PCP through the environment. The compound has a low vapor pressure and, therefore, is not likely to volatilize readily. It is slightly soluble in water and does adsorb to sediments, and therefore may be transported through soil, surface water, and ground water.

  PCP is degraded by sunlight to lower chlorinated phenols, tetrachlorodihydroxyl benzenes, and non-aromatic fragments. The importance of photodegradation of PCP in the environment is unknown. Soil microorganisms have also been found to degrade PCP. However, the compound was persistent in sediments and leaf litter following a spill into a freshwater lake. PCP has a soil mobility index of -17 and is therefore considered to be immobile;

- Migration of 2,3,7,8-TCDD

  This constituent is highly persistent in soil. The half-life of 2,3,7,8-TCDD in soils has been reported at a range of 1 to 10 years. The low water solubility and high soil adsorption coefficient indicate that it adsorbs strongly to soils. 2,3,7,8-TCDD is not readily biodegraded. It may be photodegraded in the presence of organic solvents; however, there is no indication of organic solvents in the surface soils. It is resistant to oxidation and hydrolysis. Volatilization of 2,3,7,8-TCDD adsorbed on soils is very slow due to the extremely low vapor pressure of 2,3,7,8-TCDD. 2,3,7,8-TCDD has a mobility index in soils of -16.0 and is therefore considered to be immobile.

8.2.2.3 Other Factors Affecting Migration

All of the chemicals of concern are considered to have low mobility in the surface soils and shallow soils. Mobility index ranges from -7.3 to -19. Consequently, the constituents are likely to move only as a component of the soils. Factors affecting soil migration at the site include:

- Migration of surface soils due to soil erosion and mobilization by surface runoff. However, the site is relatively flat with only localized drainageways;

- Surface soils could be transported as air particulates due to wind erosion and/or vehicular traffic over the affected areas; and

- Surface soils could be redistributed during any construction or earthmoving activity.

8.2.3 Toxicology of Indicator Chemicals

The chemical constituents detected in the environmental media sampled were screened in the previous section to identify "high risk" parameters (ie. those of most public health and environmental significance). The process is called selection of indicator or target chemicals. The target chemicals are selected to represent existing site conditions. The remaining environmental and public health assessment will focus on the selected indicator chemicals.

This section focuses on the toxicology of the indicator chemicals. All chemicals have some inherent toxicity which can take many forms. These forms can be placed into two categories, acute and chronic toxicity.

Acute effects are those expressed following single or very closely spaced multiple doses, while chronic toxicity is the result of long-term continuous or repeated exposure which causes accumulated and often irreversible damage to target organs. In most circumstances of environmental contamination, chronic toxicity to long-term, low-level chemical exposure is the primary potential hazard.

8.2.3.1 Polynuclear Aromatic Hydrocarbon (PNA's)

Non-carcinogenic PNA's are considered to be practically non-toxic (except in the pure liquid chemical state). Consequently this chemical group has not been studied in detail by the scientific community. There is thus a paucity of chronic toxicity data via the oral route for the non-carcinogenic PNA's, and no data were found for phenanthrene. Appropriate chronic toxicity data for fluoranthene, acenaphthylene and naphthalene (other non-carcinogenic PNA's), however, were found. These toxicological data form the basis of this risk characterization.

Two subchronic animal studies were reported in the literature. A subchronic exposure is defined as a time interval which does not constitute a significant portion of the lifespan of the test animal, generally 30 to 90 days. Knoblock et al (1969) administered acenaphthylene orally in food to rats at a dose level of 0.6 gram acenaphthylene/kg body weight in olive oil for 40 days. This translates into an oral acceptable daily intake (ADI) of 42 mg (chemical)/day, assuming a 1,000 uncertainty factor. Acenaphthene was administered at a dose of 2 grams/kg body weight in olive oil for 32 days resulting in a calculated oral ADI of 140 mg (chemical)/day, assuming a 1,000 uncertainty factor. Treatment with either compound resulted in considerable body weight loss, unspecified changes in the peripheral blood pattern, changes in renal function, and increased serum aminotransferase activities. In addition, rats exposed to acenaphthene had mild morphological damage to the liver and kidneys, changes consistent with mild bronchitis, and localized inflammation of the peribronchial tissue. (EPA, Health Effects Assessment for Polycyclic Aromatic Hydrocarbons (PAHs) PB-134244 September 1984). In order to utilize the animal test data, the postulated exposure was normalized to the study test conditions that generated the health risk parameter.

Application of an uncertainty factor (UF) to experimental animal data is a health protective measure which allows the extrapolation of animal test data to the human population with an added margin of safety to account for such factors as intra- and inter-species variability, the small number of animals tested compared to the size of the exposed population, sensitive human subpopulations, and the possibility of synergistic action between chemicals. In terms of non-carcinogens such as phenanthrene, an uncertainty factor of 1,000 is the most conservative number recommended by the US EPA (Federal Register November 13, 1986, p. 46946). Higher uncertainty factors are sometimes used for carcinogens or to provide an additional margin of safety.

Available oral ADIs established by the US EPA for any non-carcinogenic PNA's were used in the risk calculations. For fluoranthene the value is 0.42 mg/day. The toxicological basis is a mouse study in a chronic time frame with dermal exposure. The study reports a no observed adverse effect level (NOAEL) and higher doses caused histopathological changes in liver and kidney. A chronic exposure concerns a significant portion of the lifespan, and lifetime

exposure is considered to be the full lifetime of the test animal. An uncertainty factor of 1000 is applied by the US EPA to the NOAEL in preparing the 0.42 mg/day ADI for fluoranthene (EPA, May 1984). To be conservative this animal study was used as the basis of the soil ingestion and dermal absorption calculations. This study has a lower ADI than the others described above.

For naphthalene, EPA has established an oral ADI of 18 mg (chemical)/day, (EPA May 1984). An uncertainty factor of 10 is assumed by the US EPA.

The relatively high ADI's and high allowable chemical intake rates support the conclusion from the toxicological literature that non-carcinogenic PNA's are not particularly toxic.

Carcinogenic PNA's

Several individual PNA's have been found to have evidence of carcinogenicity. However, a universal health based risk number for total PNA's is typically assigned which assumes that all of the PNA's have the same carcinogenic potency as benzo(a)pyrene. Benzo(a)pyrene is the best studied PNA from a toxicological perspective. The approach is very health conservative since benzo(a)pyrene is perhaps the most potent of the carcinogenic PNA's. To date there have been no other health risk numbers derived for individual PNA's found to have evidence of toxicity. Concentrations of PNA's corresponding to 10^{-7} to 10^{-6} Cancer Risk for ingestion of drinking water and of soil are included in Table 8-3.

8.2.3.2 Pentachlorophenol (PCP)

Pentachlorophenol is not a carcinogen (known or probable); however, it is a toxic chemical. Human exposure to pentachlorophenol results in local irritation, systemic effects and, in a limited number of people, an allergic response (USEPA Health Advisory, Sept. 30, 1985). Reported effects from chronic exposure include fetotoxicity, chloracne and effects on the liver and kidneys. In addition, pentachlorophenol is highly toxic to aquatic organisms.

Pentachlorophenol is apparently absorbed rapidly from the GI tract following oral, dermal or inhalation exposure. In one study of male Wistar rats virtually all of the administered PCP was absorbed from drinking water. A 3 mg/kg

body weight day NOEL (no observable effects level) for fetoxicity with PCP was derived by EPA. The oral AIC (acceptable chronic intake) is established by EPA as 0.03 mg/kg body weight/day. No inhalation AIC has been established since there is limited data (EPA, May 1984).

The AIC is an estimate of the exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan.

8.2.3.3 Dibenzo Dioxins and Dibenzo Furans

Dioxins and furans are a family of by-products formed under the conditions of synthesis of polychlorinated phenols and products formed therefrom. Of the many isomers and congeners of dioxins and furans, the 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and 2,3,7,8-tetrachlorodibenzo furan (2,3,7,8-TCDF) are of primary concern.

2,3,7,8-TCDD Equivalents

The term dioxin is widely used for the chemical family of 75 chlorinated dibenzo-p-dioxins and quite often the term is meant to imply a single compound, 2,3,7,8-tetrachlorobenzo-p-dioxin (2,3,7,8-TCDD). 2,3,7,8-TCDD is the most toxic of this class of compounds, is a known carcinogen, and is the isomer with the most existing toxicological data.

TCDD Equivalents are defined as the concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) which by itself would be believed to exhibit the same biological potency as a mixture of structurally-related compounds (PCDF/-PCDD) actually present in a sample.

The procedure for calculating equivalents was developed by the New York State Department of Health for estimating the total toxicity of a mixture of PCDF's and PCDD's as part of the development of a re-occupancy criterion for the Binghamton State Office Building (the building experienced a PCB transformer fire in 1981). The procedure calculates the amount of 2,3,7,8-TCDD that would have to be present to exhibit the same toxicity as the measured quantities of each of the various other PCDF's and PCDD's that are present, and sums these calculated amounts of 2,3,7,8-TCDD to obtain an estimate of the TCDD

Equivalents toxicity of the mixture. The procedure assumes certain ratios of toxicity (termed weighting factors) between 2,3,7,8-TCDD and the other PCDF's and PCDD's.

The "Interim Procedures for Estimating Risk Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and -Dibenzofurans (CDDs and CDFs)" (EPA, March 1987) gives EPA's current recommended approach to estimating relative toxicities of CDD's and CDF's. The EPA method is a toxicity equivalence factor (TEF) approach and calculates 2,3,7,8-TCDD equivalents based on the following calculation:

2,3,7,8-TCDD equivalents = [2,3,7,8-TCDD] + 0.01[other Tetra CDD's] + 0.50 [2,3,7,8 Pe CDD's] + 0.005 [other Penta CDD's] + 0.04 [2,3,7,8 Hx CDD's] + 0.0004 [other Hexa CDD's] + 0.001 [2,3,7,8 Hp CDD's] + 0.00001 [other Hepta CDD's] + 0.10 [2,3,7,8 TCDF] + 0.001 [other Tetra CDF's] + 0.10 [2,3,7,8 Pe CDD's] + 0.001 [other Penta CDD's] + 0.01 [2,3,7,8 Hx CDD's] + 0.0001 [other Hexa CDD's] + 0.001 [2,3,7,8 Hp CDF's] + 0.00001 [other Heptas CDF's]

(note: OCDDs have a TEF of zero).

The 2,3,7,8 - TCDD equivalents for dioxin and furan analytical results were calculated by this formula and are presented in Table 8.2. (Section 8.5). Calculations are included in Appendix A.

Table 8-3 includes the 10^{-4} to 10^{-7} Cancer Risk levels for 2,3,7,8-TCDD in drinking water. A concentration of 1 ppb in soil has been calculated to represent a 10^{-6} cancer risk (Kimbrough, R. et al., 1984).

8.2.3.4 Benzene

Many case studies have described a causal relationship between exposure to benzene by inhalation and leukemia in humans.

Applying EPA's criteria for evaluating the overall weight of evidence of carcinogenicity in humans, benzene has been classified by EPA in Group A - Human Carcinogen. This category indicates that there is sufficient evidence

from epidemiological studies to support a causal relationship between an agent and cancer.

The EPA Carcinogen Assessment Group (CAG) has calculated inhalation and oral carcinogenic potency factors for benzene. Both were derived from human epidemiological studies in which significantly increased incidences of leukemia were observed for workers exposed to benzene principally by inhalation.

The inhalation potency is $2.6X10^{-2}$ (mg/kg body weight/day)$^{-1}$ and the oral potency is $5.2X10^{-2}$ (mg/kg/day)$^{-1}$. The concentrations corresponding to calculated $1X10^{-6}$ to 1×10^{-4} cancer risk via inhalation are 0.12 ug/m^3 to 12 ug/m^3 and via oral exposure (eg. drinking water) is 0.68 ug/l to 68 ug/l.

Benzene is examined in the ambient air risk characterization in Section 8.5.1.

8.3 IDENTIFICATION OF APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS), GUIDELINES, STANDARDS AND HEALTH BASED CRITERIA FOR TARGET CHEMICALS

The National Contingency Plan (Federal Register, November 20, 1985) states that "applicable or relevant and appropriate requirements" (ARARs) standards or criteria should be considered when developing remedial actions as part of the RI/FS process. Enforcement agencies give "primary consideration to the selection of those response actions that are effective in preventing or, where prevention is not practicable, minimizing the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health, welfare, or the environment. As a general rule this can be accomplished by pursuing remedies that attain or exceed the requirements of applicable relevant and appropriate federal public health or environmental laws".

"Applicable" requirements are those federal or state program requirements that would be applicable if the site were not a CERCLA facility. The NCP also lists a category of "other federal criteria, advisories, guidance and state standards" which may be used in developing Superfund remedies.

"Relevant and appropriate" requirements while not directly "applicable" are designed to apply to problems sufficiently similar to those encountered at CERCLA sites, that their application is appropriate.

The applicable, relevant and appropriate requirements may be performance or technology-based (e.g. 40 CFR 264, treatment, storage and disposal regulations under RCRA) or contaminant specific health based standards (e.g. Safe Drinking Water Act MCLs).

This section deals with contaminant-specific requirements.

Following the public health evaluation, estimated environmental concentrations of the indicator chemicals selected for the site are compared to applicable, relevant and appropriate environmental standards and criteria.

This section identifies in terms of human exposure the ARARs which exist for air, water, and soil for the target chemicals.

Pentachlorophenol (PCP)

Pentachlorophenol has not been found to be mutagenic or carcinogenic in the studies reviewed. It is currently under study by the National Toxicology Program for its carcinogenic potential. The International Agency for Research on Cancer (IARC) has classified pentachlorophenol in Group 3; inadequate evidence for carcinogenicity in humans, inadequate evidence for carcinogenicity in animals, and inadequate evidence for activity in short term (carcinogenicity) tests.

Pentachlorophenol has been classified in EPA's Group D, according to EPA's Proposed Guidelines for Carcinogen Risk Assessment, based upon inadequate data in animals studies. By the IARC classification Group 1 has the most strength of evidence for carcinogenicity in humans.

Applicable, relevant and appropriate environmental and health based limits for PCP are listed in Table 8.3.

Polynuclear Aromatics (PNA's) or Polycyclic Aromatic Hydrocarbons (PAH's)

The polynuclear aromatics or polycyclic aromatic hydrocarbons are a class of substituted and unsubstituted polycyclic aromatic rings. Their chemical, physical and biological properties vary with their size and shape. Some PNA's are potentially carcinogenic in animals, causing tumors both at the site of application and systematically. Some PNA's are thought to be cancer promoted/initiators or co-carcinogens. The potentially carcinogenic PNA's are generally active in mutagenic assays. Standards (e.g. Safe Drinking Water Act) for mutagenic PNA's are much lower than those for non-mutagenic ones, by a factor of about 100. Recommended safe drinking water levels are 28 ng/l for mixed mutagenic PNAs and 28 µg/l for mixed non-mutagenic PNA's. Additional applicable, relevant and appropriate requirements, guidelines, standards and health based criteria are listed in Table 8-3.

Polychlorinated dibenzo-p-dioxins (PCDD's) and Polychlorinated dibenzofurans (PCDF's)

Several impurities are present in commercial grade PCP, including chlorinated dibenzodioxins and dibenzofurans. The predominant dioxin and furan types in PCP are the hexachloro-p-dibenzodioxins (HxCDD's) and hexachloro-p-dibenzofurans (HxCDF's). Technical PCP available in the U.S. has not been reported to contain TCDD's, TCDF's, PCDD's or PCDF's. The highly toxic 2,3,7,8-tetrachloro dibenzo-p-dioxin has not been found in PCP and due to the methods of synthesis of PCP is not expected to occur (Ahlborg 1980).

Health based guidelines for a mixture of PCDD's and PCDF's are usually given in terms of 2,3,7,8-TCDD equivalents as given in Table 8-3. The method assigns a relative toxicity to each isomer in terms of the toxicity of 2,3,7,8-TCDD. The result is a single value which represents the toxicity of the mixture. The concept is further described in section 8.2.3.3, which discusses the toxicology of dioxins and dibenzo furans.

8.4 EXPOSURE ASSESSMENT

This section provides an assessment of the potential for exposure of receptors on or near the Old Midland site. For identified receptors, a set of hypothetical pathways for exposure are defined. These pathways are assessed as to their plausibility or importance relative to public health or

environmental considerations. Potentially important pathways are identified for subsequent, more detailed, characterization of risk in Section 8.5.

8.4.1 Receptor Definition

The receptor definition provides an estimation of the expected degree of human (or environmental) contact with the indicator chemical constituents. The receptor definition involves the following four steps:

- Identification of exposed populations;
- Characterization of population;
- Analyses of population activities;
- Development of exposure coefficients.

The first step requires comparing data on distribution and potential mobility of site constituents with population data in order to identify those populations (human and environmental) that may potentially or actually be exposed to the indicator chemicals. The second step, population characterization, involves identifying those groups (e.g., infants, elderly, women of child-bearing age, endangered or sensitive wildlife species) which may experience a greater risk than the average population as a result of a given exposure level. The third step, activity analysis, involves an examination of the activities (e.g., employment, recreation) of potentially or actually exposed populations in order to define the level of exposure.

The final step (Section 8.5, Current Risk Characterization) of the receptor definition is the identification of hypothetical exposure coefficients. The exposure coefficient combines information on the frequency and magnitude of contact with constituents to yield a quantitative value of the amount of affected medium contacted per unit of time. Exposure coefficients are developed for each exposure route and are used to calculate the dose incurred. An example of an exposure coefficient would be the average daily intake of drinking water.

8.4.1.1 Land Use and Demographics

The land-use types around the Old Midland site are a mixture of residential, farming, forestry, and transportation. The site is bordered by scattered

permanent residences to the north, west, and southwest, and a small mobile-home park to the northwest. The remainder of the site is bordered by woods and pastures. The Petit Jean River State Wildlife Management Area is located 3/4 mile to the north.

The estimated 1980 population living within four miles of the site is 1,572. Compared to the nation as a whole, this population has a slightly higher average of females, while the number of very young and elderly are twice the national average. The median age is eleven years higher than the national average. Census data is detailed in Table 2-1.

Although the Old Midland site vicinity is predominantly rural, the majority of the people are employed in retail, manufacturing, and health services. Approximately 81% of the housing is single family dwelling type, and 62% of the housing is owner occupied.

8.4.1.2 Water Well Inventory

Out of the 468 households in Ola, 95% receive their water from public utilities. Drilled water wells account for 4%, while 1% list their water source as "other".

A total of five wells are present within a 1,500 foot radius of the site. The direction of the ground water gradient from the site is to the northwest. Three of the wells (two domestic and one agricultural) are located perpendicular to the gradient, while the other two are domestic wells located downgradient. The closest downgradient well is located 450 feet west-northwest of the on-site lagoons. Due to its proximity to the site and its reported shallow 80-foot completion depth in the Atoka formation, this well represents the closest potential receptor point downgradient.

8.4.1.3 Ecology

The flora around the site is composed of woodlands with mixed hardwoods and pines. The intermittent stream that drains the site is lined by a dense thicket of small trees, shrubs, and vines. No signs of stressed vegetation or other symptoms of contamination were noted in or along the intermittent stream or Keeland Creek.

The flora is able to support a wide variety of wildlife. There was evidence seen of racoons, deer, beavers, and waterfowl. The upper segment of the intermittent stream was seen to contain insect life but no fish species, due to the very shallow and interrupted morphology of the stream. The intermittent stream flows into Keeland Creek, which is wide and sluggish, and contains at least one beaver dam.

Keeland Creek flows into the Petit Jean River Wildlife Management Area, which is maintained by the State of Arkansas to provide habitat of waterfowl, other gamebirds, deer, and fish.

Given the low concentrations and low levels of input, migration of contaminated sediments is not expected to present a threat to any ecological receptors.

8.4.2 Potential Exposure Pathways

An exposure pathway is the route a contaminant may take to reach a human or environmental receptor. Known or potential exposure pathways must be evaluated to determine their significance to the identified receptors. Table 8-4 lists potential exposure pathways that are evaluated below.

8.4.2.1 Air

As discussed in Section 6.4., there is minimal current exposure to air emissions from the site, either from volatile emissions or windborne particulates. However, once remediation begins, the excavation and handling of contaminated material could increase emissions and cause some public health concern.

Except for those personnel that will be involved in remediation activities, all the receptors within 1,000 feet of the lagoons via an air pathway are residential. Four residences, housing a total of approximately 10 persons, are located to the west, southwest, and southeast, with the closest being located 450 feet to the west of the lagoons. Based on meteorological data, the wind blows from the lagoons towards each of these residences approximately 24% of the time. The only other "population magnet" is a large lumber mill 2,000 feet to the west, that would likely be occupied only about 8 hours a day.

The air pathway is assessed in detail and the risks are characterized in Section 8.5.1.

8.4.2.2 Soil

Contaminated soils around the lagoons and process facilities can pose a health concern to remediation workers or trespassors via dermal contact or ingestion. This soil pathway is assessed in detail and the risks are characterized in Section 8.5.2.

Public exposure to soil adjacent to the site is probably not of concern as samples have shown no contamination outside the fenced boundaries. Contamination of cropland and subsequent ingestion of food stuffs is also an unlikely scenario as the closest croplands are pastures located more than 450 feet to the east and west of the lagoons.

8.4.2.3 Surface Water

Surface water from the lagoons may enter the intermittent stream via escape or runoff during a storm event.

The closest exposure point for fishing is Keeland Creek, which is 2,000 feet north, and the closest point for contact sports is Keeland Lake, which is 1 1/2 miles north. There are no surface water withdrawal points downstream for potable, agricultural, or industrial use.

The surface water pathway is assessed further and the risks are characterized qualatively in Section 8.5.4.

8.4.2.4 Ground Water

Of particular health concern is the migration of contaminants into the ground water of a usable shallow aquifer beneath the lagoons. The contaminants are not uniformly distributed throughout the ground water due to the low water solubility of most of the contaminants. Rather, a lighter-than-water oil layer is the predominant contaminant source in the ground water, while dissolved contaminants are much less prevalent.

The closest potable well is 450 feet to the west-northwest of the lagoons, and is screened at a depth of 80 feet. The closest agricultural well is 1200 feet to the east-northeast, and is screened at a depth of 265 feet. There are no industrial water wells in the area. Though all the nearby residential and agricultural wells currently show no sign of contaminants, the fractured nature of this aquifer allows for a potential future migration pathway of contaminants. The ground water pathway is assessed in detail and the risks are characterized in Section 8.5.3.

8.5 CURRENT RISK CHARACTERIZATION

This section presents the current risks to human health and the environment resulting from constituents found at the site.

The single fundamental concept which is the foundation of any risk assessment is that for a risk to exist, two conditions must be met: a hazard must be present and an exposure to the hazard must occur. In mathematical terms, risk equals level of toxicity (hazard) times level of exposure (concentration). There is no risk if either factor (hazard or exposure) is not present.

Hazards are described toxicologically in terms of exposure mode and time duration. Modes of exposure are usually categorized as inhalation, ingestion, and direct contact (dermal absorption).

In order to evaluate what endangerment, if any, is currently created by the site, risk estimates (hazard and exposure) were developed for four exposure scenarios.

1. Inhalation of air emissions from the site;
2. Chronic dermal contact and ingestion of surface soils;
3. Potential ingestion of contaminated ground water;
4. Exposure of aquatic organisms in the intermittent stream to site contaminants.

The other pathways discussed in Section 8.4.2 do not appear to present a risk to human health and the environment.

In the risk characterization for scenarios one and two above, the risks of exposure to chemicals resulting in carcinogenic and non-carcinogenic effects are assessed separately. For carcinogens, a numerical estimate of the probability of adverse effects is made. For non-carcinogens, the chronic daily intakes (CDI) are compared to risk reference doses (RfD) or acceptable daily intakes (ADI). The chronic daily intake is the amount of substance taken into the body, per unit body weight, per unit time. RfDs and ADIs are estimates of a long term daily exposure of the general human population to a substance that appears to be without an appreciable risk of deleterious effects.

For the third scenario, the estimated exposure levels are compared to drinking water guidelines.

In scenario four, the surface water and sediment data are qualitatively evaluated in terms of aquatic toxicity measures.

8.5.1 Ambient Air

The ambient air pathway was assessed using methods described in the "Superfund Exposure Assessment Manual" (Versar, 1986). Two sets of calculations were made (see Appendix A). One estimates the volatile organic emission rates from soil contaminated with benzene and PCP and the ambient concentrations of benzene and PCP. The other model estimates respirable particulate emission concentrations from soil contaminated with PCP and the carcinogenic PNA's.

8.5.1.1 Volatile Organic Emissions and Ambient Air Concentrations

The on-site (ie. worst case) ambient air concentrations in a 3-meter breathing zone above the site is estimated and the associated human health risks are characterized.

PCP

Based on the calculations, the estimated ambient air concentration for PCP is $9.46X10^{-5}$ mg/m^3.

An acceptable daily intake via inhalation was derived in order to compare with the estimated ambient PCP concentration. The inhalation value uses the toxicological data which is the basis for setting the oral AIC (as described in section 8.2.3.2). Assuming that a 70 kg man breathes 22.8 m^3 of air per day an acceptable value of 0.092 mg/m^3 is derived (based on an acceptable "body burden" of 0.03 mg/kg/day). The estimated ambient air value is a factor of 1,000 below the calculated acceptable value. PCP however is only moderately volatile, consequently, it is assessed via airborne particulate emission, modeling as well.

Benzene

The calculated ambient air concentration for benzene (assuming an average soil concentration of 100 ppb) is $4.9X10^{-3}$ mg/m^3. The $1X10^{-6}$ incremental cancer risk via inhalation is 0.12 $\mu g/m^3$. The 1×10^{-4} incremental cancer risk is 12.0 $ug \cdot m^3$.

The estimated value is between the $1X10^{-5}$ and the $1X10^{-4}$ cancer risk level on-site and consequently is insignificant from a public health perspective off-site or in an infrequent, on-site, exposure scenario situation.

8.5.1.2 Particulate Emission and Ambient Air Concentration

PCP

The estimated ambient air concentration for PCP, assuming an average soil concentration of 35 ppm, is $5.4X10^{-3}$ mg/m^3. As discussed in Section 8.2.3.2 the derived acceptable level via inhalation is calculated to be 0.092 mg/m^3 (an order of magnitude higher than the predicted value). Consequently via airborne particulate exposure the PCP concentrations are not significant from a health perspective.

Carcinogenic PNA's

The estimated ambient air concentration for the carcinogenic PNA's (assuming an average soil concentration of 3.216 ppm) is 0.0004968 mg/m^3. Based on the toxicity of benzo(A)pyrene, the $1X10^{-6}$ incremental cancer risk via inhalation is 0.0005 $\mu g/m^3$ or 0.00005 mg/m^3 for the 1×10^{-4} risk. The predicted air value is at approximately the 1×10^{-4} incremental cancer risk level. The

calculations of the predicted concentrations are worst case since they assume no air dispersion. It is likely that the actual air concentrations will dissipate quickly to values below the 1×10^{-4} cancer risk level.

8.5.2 Dermal Contact and Ingestion of Surface Soil

Exposure to chemicals via ingestion of soil (and dust) can occur by inadvertent consumption of soils on the hands, on tools or other objects, from nail biting, consumption of soil itself (pica), or a combination of these routes.

The soil ingestion pathway is only important to certain populations-at-risk. For example, children playing outdoors may be exposed to affected soil through dermal absorption or through direct ingestion of soil. If young children have access to a site or an adjacent area with affected surface soil, exposure for this subpopulation via soil ingestion may be an important pathway. Since there are residences near the site, the soil ingestion pathway of human exposure has been assessed.

The contribution to the dose via dermal absorption of the indicator chemicals is considered to be relatively insignificant when compared to the ingestion route. For example, absorption rates of topically administered herbicides and pesticides dissolved in a suitable carrier, ranged from 0.004 to 0.351 percent per hour during the first four hours of exposure (Feldman and Maibach, 1974). Less than 0.2 percent of these heribicdes and pesticides (on an average) would be absorbed due to direct contact. The soil matrix, in which the indicator chemicals are found, serves to slow the chemical absorption rate both via dermal contact and gastrointestinal absorption.

However, the soil ingestion and dermal absorption calculations presented here make the conservative assumption of a 100% absorption factor which overstates the contribution from dermal absorption.

The dermal contact and soil ingestion pathways have been characterized for two exposure scenarios: (1) a short term infrequent trespass scenario, and (2) a residential lifetime soil ingestion scenario. The calculations are presented in Appendix A and the conclusions are summarized in Table 8-5.

It should be noted that the dermal contact scenario does not take into account dermal toxicity and hypersensitivity issues associated with PCP. No appropriate toxicity model was located by which to address these concerns. PCP is dermally active, producing a chloracne condition, and some members of the population are particularly sensitive to this effect (hypersensitive). Dermal toxicity is less likely to occur, however, from contact with PCP contaminated soil than with the undiluted chemical.

8.5.2.1 Infrequent Trespass On-Site Soil Ingestion

It is not likely that a child of six or under would trespass on an industrial site. Therefore, exposure of this age group is not postulated in the on-site soil ingestion scenario.

Frequent ingestion of on-site surface soils is not considered to be a plausible pathway due to limited site access and a lack of trespass motivation (the site is not a recreational facility). An infrequent trespass scenario would be the only feasible exposure pathway and a hypothetical exposure scenario is presumed in order to estimate the health risks associated with ingestion of contaminated soils. Exposure duration and frequency are hypothesized on the basis of general experience and judgment.

Soil ingestion is typically limited to surface soil. The data used to establish the chemical concentration in soil is presented in Table 8-5.

In the on-site soil ingestion scenario, non-carcinogenic PNA's (represented by phenanthrene) and PCP are the principal constituents in site surface soils.

A trespass scenario by a 12-year old is presumed in order to estimate the health risks associated with chronic exposure due to ingestion of soils. The scenario assumes a trespass occurring one time per week for nine months of the year, or 36 exposure events. For the ingestion exposure mode, the time duration of the trespass is not relevant because the ingestion rate of less than 0.1 gram per day is independent of that time.

Calculations of Chronic Daily Intake for Dermal Absorption and Oral Ingestion of Constituents in On-Site Soil - Infrequent Trespass

Existing soil concentrations of specific non-carcinogenic PNA's are compared to the allowable daily intake under the infrequent trespass scenario.

The exposure scenario for on-site soil ingestion is for a 12-year old who visits the site (as a trespasser) once each week for 36 weeks (9 months) out of each year. An oral ingestion of 61 mg of soil is assumed to be consumed per day or per visit. The reference for this adolescent soil ingestion rate is Hawley (1985). The site is visited by the trespasser for a two-year period. The chemical concentration in the soil (which will serve as the exposure source term) was characterized by taking the geometric mean of data obtained from surface soil data. The geometric mean is used to characterize the source term (rather than the arithmetic mean or maximum concentration value) because this statistical parameter has been found to best describe the central tendency of highly skewed data (which is the usual situation in non-uniform environmental contamination data bases).

The assumed chemical concentration in the soil and geometric mean of positive detections (the exposure source term or the soil to which the trespasser is exposed) are 9.5898 ppm for PCP and 109.9624 ppm for phenanthrene. The calculations for health risk for the soil ingestion scenario are presented in Table 8-5.

The second route of human exposure quantified for the direct soil contact pathway is dermal exposure with skin absorption.

For the dermal contact with surface soil scenario, the daily soil contact rate has been estimated by the US EPA at between 0.1 and 0.5 mg of soil/cm^2 of skin surface area (EPA, November 1984, "Risk Analysis for TCDD in Contaminated Soil", Office of Health and Environmental Assessment, EPA6001/8-84/031).

For the risk calculations presented, a daily soil contact rate of 0.3 mg (soil) per cm^2 skin surface area per visit is assumed (this value is midway between the 0.1 and 0.5 mg/cm^2 estimated by the US EPA). The scenario assumes that the skin surface available for direct contact is 2,940 cm^2 (assumes that

the person wears a short-sleeved, open-neck shirt, pants, shoes, and no gloves i.e. a worst case assumption). The chemical absorption via dermal exposure is very conservatively set at 100 percent, although the actual skin absorption factor is lower. The calculations for health risk for the dermal exposure scenario are presented in Table 8-5.

8.5.2.2 Residential Soil Ingestion Scenario

The second scenario is one of daily residential lifetime exposure such as ingestion of surface soil on a residential lot. The scenario is designed to demonstrate the risks of living on the site under existing conditions.

Only oral exposure was calculated since, over a lifetime, this route overwhelms dermal exposure.

Exposure is postulated to occur 36 weeks per year (due to climatic conditions) and for 7 days per week for each of those 36 weeks. The model assumes that exposure occurs from age 0 to age 70.

8.5.2.3 Summary of Soil Ingestion and Dermal Contact Pathways

The results of the calculations are presented in Table 8-5. The chronic daily intake for oral ingestion of PCP and phenathrene, under the trespass and residential scenarios, are a fraction of the acceptable chemical intake. The combined oral and dermal daily intakes calculated for the trespass scenario are also a fraction of the acceptable chemical intakes. The conclusion is that at the existing geometric mean soil concentrations and under a trespass and residential soil ingestion scenario no significant public health risk exists.

8.5.2.4 Chlorinated Dioxin and Dibenzo Furans

Based on the 2,3,7,8-TCDD equivalent calculations presented in Table 8-2, the soils do not contain toxicologically significant concentrations of chlorinated dibenzodioxin and dibenzo furans (2,3,7,8-TCDD equivalents range from 0 to 1.3509 ppb). A value of 1.3509 ppb was found in a subsurface soil boring advanced to drill monitoring well MW-11S (at a depth 19 - 20 feet below ground surface) and therefore not accessible to human contact. Surface soils (0 - 6") range from 0 to 0.0947 ppb 2,3,7,8-TCDD equivalents. Subsurface samples (6 - 12") range from 0 to 0.0092 ppb 2,3,7,8-TCDD equivalents.

By comparison, a value of 1 ppb 2,3,7,8-TCDD was used as a safe residential soil value for the Times Beach, Missouri Superfund site. A 2,3,7,8-TCDD value of 1.2 ppb was the surface soil clean-up criteria for an industrial site in Bluefield, West Virginia (Hazardous Waste Report, July 21, 1986).

The two lagoon sediment samples collected contain elevated concentrations (2,3,7,8-TCDD equivalent of 9.843 and 42.773 ppb in Lagoons 1 and 5 respectively). The sediment is covered with water and is therefore not easily available for human exposure.

In determining the 2,3,7,8-TCDD equivalent the calculations make the conservative assumption that the dioxin and furans detected are in the 2,3,7,8 form, which would tend to overestimate the form.

8.5.3 Ground Water Pathway

8.5.3.1 Transport Model

The potential contaminant concentrations that could eventually reach potential receptors (Mr. Niely and Mrs. Barnes) were evaluated by the following procedures and assumptions:

- Groundwater recovery operations (which would prevent migration and which would remove contaminants) are absent. That is, ground water recovery is not implemented;
- The existing hydraulic gradient (see Figure 4-7) is assumed to be constant;
- Seven lagoon source areas exist within the property boundaries of Old Midland Products;
- Sources are assumed to have contributed contamination to the ground water at a constant rate for 18 years. The lagoons first appeared in 1971, but the site operations reportedly began in 1969;
- Potential concentrations are evaluated at the following receptor points in the downgradient direction:

  - 400 feet (Mr. Niely's well from the source),
  - 1,080 feet (property boundary), and
  - 1,950 feet (Mrs. Barnes well).

- One-dimensional dispersion is modeled using the computer program ODAST and the following assumptions, to estimate the maximum percent total concentrations existing at specified distances from the source areas:

  - steady-state uniform flow,
  - isotropic porous medium,
  - point (finite source),
  - retardation of 1 (no attenuation - worst case for both naphthalene and pentachlorophenol) and 41 for naphthalene (calculated conservative estimate),
  - retardation for pentachlorophenol was not calculated because naphthalene appears to be more mobile in the environment,
  - dispersion coefficients ranging from 0.08 m^2/day to 0.64 m^2/day.

See Table 8-6 for results of the one-dimensional solute transport model.

8.5.3.2 Naphthalene

The predicted downgradient ground water concentrations which might result from lagoon sediment leaching into ground water (and the anticipated timeframe) are presented in Table 8-6. The predicted concentrations for naphthalene range from 2.1 to maximum of 361 ppb (based on retardation factors for ground water of 1 and 41). The minimum amount of time required to reach the maximum concentration is 30 years.

The health based guideline for naphthalene is derived as follows. The ADI is 0.257 mg/kg body weight/day (EPA, May 1984) or 19 mg/kday for 70 kg adult. If two liters of water per day are consumed, and contribution from drinking water is limited to 20%, the allowable concentration in drinking water is 1.8 mg chemical/liter (1,800 µg chemical/liter). The predicted well concentrations for naphthalene are all below the health based guideline for drinking water.

8.5.3.3 Pentachlorophenol

Pentachlorophenol values range from 288 to 1,207 ppb. The minimum amount of time to reach the maximum concentration is 30 years. The predicted values assume a ground water retardation factor of 1 (i.e. no retardation) and therefore are very conservative (i.e. will most probably substantially overestimate the concentration).

The health based guideline for PCP is derived as follows. The ADI oral is 0.03 mg/kg body weight/day (EPA, May 1984) or 2.1 mg/day for a 70 kg adult. Assuming a 20% contribution to the total diet due to drinking water, and a consumption of two liters per day, the allowable concentration in drinking water is 0.21 mg/l (210 µg/l), which is equivalent to the proposed EPA RMCL of 0.2 mg/l (Federal Register November 13, 1985). The future predicted values exceed the allowable concentration in all cases. However, as discussed previously, the predicted values are based on extremely conservative assumptions which tend to overstate the concentrations. It should be noted that at values above 30 µg/liter PCP may impart an unpleasant taste to water.

8.5.3.4 Chlorinated Dioxins and Dibenzo Furans

Ground water samples were typically above the 1×10^{-6} incremental cancer risk via ingestion of 2.2×10^{-9} µg/l, but below the short term drinking water limits (1 day adult exposure 0.0035 µg/l) (Federal Register, November 13, 1985).

One ground water sample out of four replicates (collected from well MW-11S) indicated 15.7574 ppt of 2,3,7,8-TCDD equivalents. The elevated equivalent concentration was found in only one of the four replicates, while the others indicated low equivalents.

The 2,3,7,8-TCDD calculations (Table 8-2) make the conservative assumption that the dioxins and furans detected are in the more toxic 2,3,7,8 form which would tend to overestimate the actual concentration.

8.5.4 Surface Water Pathway

The surface water itself is not a major exposure pathway. This is because the the indicator chemicals (PCP and PNA's) typically have extremely low water solubilities.

More significant as a pathway than the surface water itself is contaminated sediment transported by the surface water. All the indicator chemicals have very high tendencies to be adsorbed strongly to soil and sediment particles, as indicated by the organic carbon partition coefficients. Consequently, they would tend to be transported in sediment rather than dissolve and move with the water.

The possibility of dermal contact with contaminated sediments from the stream bottom or, more likely, from the stream banks is considered to be a minor public health risk considering the observed concentrations of the constituents.

Though the indicator chemicals have high fish bioconcentration factors, and PCP is very toxic to aquatic life, ingestion of contaminated sediments by bottom-feeding fishes or bottom-dwelling organisms is not considered to be a significant risk due to the low observed concentrations of the constituents, as shown in Table 8-7. Also listed in Table 8-7 are the ambient water quality criteria (AWQC) of the indicator chemicals, which provide for the protection of human health, aquatic organims, and drinking water.

8.5.5 Summary and Conclusions

This EA addresses the risks from the Old Midland Products Superfund Site. The site is a former woodtreating facility. Residuals from these activities, PCP and PNA's, are the predominant contaminants at the site. A few trace volatile organics have also been detected. Chlorinated dioxins and dibenzo furans have been found in significant concentrations in lagoon sediments and in one monitoring well.

Indicator chemicals selected to assess the risks associated with the site are as follows:

- PNAs;
  - non carcinogenic,
  - carcinogenic,
- PCP;
- Dioxin and dibenzo furans;
- Benzene (air pathway only).

These compounds were selected based on prevalence, environmental distribution, observed concentrations, and potential toxicological significance.

The environmental media have been surveyed in the RI. Ambient air samples indicate that air quality was well within ACGIH guidelines and near or essentially at background levels for this geographic region. Off-site surface soils and site runoff samples showed minimal influence from the site.

The shallowest water bearing zone shows local concentrations of up to several thousand ppm of some indicator chemicals in a nonaqueous liquid organic phase.

Soil concentrations on-site are characterized by several "hot spots" or spill-like areas which are confined to an area near the lagoons.

Lagoon sediment contains the highest concentrations of contaminants.

Four potential exposure pathways and the possible risks associated with the site in its current condition (and future condition in the case of ground water) have been considered in detail. These include:

1. Volatile organic compound emission and particulate emissions to ambient air;
2. Dermal contact and ingestion of surface soils - a short term trespass and a residential scenario;
3. A one-dimensional ground water model to predict off-site receptor well concentrations for indicator chemicals;
4. An assessment of exposure to aquatic biota from site surface water runoff.

This EA indicates that the Old Midland Products Site as it currently exists (as a secured industrial site) represents no immediate risk to public health or the environment.

The air pathway modeling indicates no health concern due to existing site conditions. The dermal absorption and soil ingestion pathways likewise indicate no present health impact, due to restricted access. The dermal contact pathway, however, does not address the issue of hypersensitivity and dermal toxicity. Some members of the population are particularly sensitive to PCP.

Potential future risks are likely to occur as site conditions and migration pathways change. Of particular importance are the leaching of contaminants from lagoon sediment into ground water, and the presence of an existing contaminant plume.

8.6 GOALS FOR THE FEASIBILITY STUDY

Objectives or qualitative goals for the feasibility study and any subsequent construction/remediation phase for the long term are summarized in Table 8-8. The objectives consider the ground water pathway, lagoon wastes, soil, surface water, drainageway sediments, and air. Development of remedial objectives and quantitative criteria is presented in the Feasibility Study Report.

9.0 SUMMARY OF TREATABILITY TESTS

The RI Work Plan included lagoon sediment stabilization tests and lagoon fluid and ground water carbon adsorption treatability tests to provide data for use in developing remedial alternatives during the FS.

9.1 LAGOON SEDIMENT STABILIZATION TESTS

Composite sediment samples from each lagoon were subjected to solidification testing utilizing fly ash, kiln dust and lime as stabilizing agents. The primary objectives of solidification testing were to evaluate bulk properties and to predict the reaction of the stabilized materials to applied stresses due to handling or traffic loading by dozers, compactors or scrapers. The testing program consisted of mixing measured amounts of composited sludge with measured amounts of fly ash, kiln dust and lime allowing a measured "set time", with testing by a penetrometer. The penetrometer readings were converted into strength parameters. Visual observations were also recorded as part of the testing.

Up to six portions of weighed composited sediment samples from each lagoon were combined with varying ratios of fly ash, kiln dust and lime, singly or in combination. Any large fragments (greater than 1/2 inch) were removed from the sediment prior to mixing. After air drying for designated intervals (up to 24 hours or more, depending on visual observation), a pocket penetrometer was pushed vertically downward into the mixed sample near the center of the surface, and the penetrometer reading was recorded.

The mix ratios and the maximum strength obtained are summarized in Table 9-1. Complete data listings for the tests are included in Appendix F. The sediment from Lagoons 1 and 3 contained oily liquid which appeared to significantly inhibit stabilization.

9.2 CARBON ADSORPTION TREATABILITY TESTS

9.2.1 Fluids Tested

Treatability tests were completed for composite samples of lagoon samples and of ground water for the following:

- Lagoons 1 and 3, composite of 1:1 ratio;
- Lagoons 2 and 7, composite of 1:1 ratio;
- Lagoons 5 and 6, composite of 1:1 ratio;
- Ground water from well MW-3S;
- Ground water, composite of 1:2 ratio from wells MW-3S and MW-11D;
- Ground water, composite of 1:2 ratio from wells MW-3S and MW-11D.

Lagoon 4 was not tested due its small fluid volume. Monitor well MW-3S was tested as it is representative of the more highly contaminated ground water at the site. Mixtures of ground water from wells MW-3S and MW-11D were tested to provide results representative of moderately contaminated ground water which might be recovered and treated during remediation of the site.

9.2.2 Testing Procedures

The treatability test were performed in accordance with the following practice published by the American Society for Testing and Materials (ASTM): "Standard Practices for Determination of Adsorptive capacity of Carbon by Isotherm Technique, ASTM Designation: D3860-79".

The treatability tests included estimating the adsorption capacity of carbon in equilibrim with adsorbable contaminants by contacting the water sample with carbon, determining the contaminants removal, and then using a Freundlich isotherm plot to calculate the carbon adsorption capacity.

The aforementioned ASTM practice is divided into two practices. Practice A is used for waters greater than 10 mg/l adsorbable contaminants while Practice B

is used for waters containing 10 mg/l or less of adsorbable contaminants. The water sample must not contain any immiscible oil. The carbon used in the test was of particle size such that 95 percent passed through U.S. 325-sieve by wet screening or equivalent. The carbon was oven dried prior to testing for three hours at 150°C or overnight at 105°C. Free organic liquid (well MW-3S) was gravity drained from the fluid to be tested. The fluid was filtered through 0.45-micron membrane filter to remove suspended solids prior to testing.

As outlined in these practices, the specific requirements for sample measurements and agitation were followed. Tests were run initially with lagoon samples testing the filtrates for total organic carbon to evaluate overall efficiency of the removal. The tests were then repeated with the filtrate analyzed for the primary contaminant of concern, PCP. Filtrate from the ground water tests were analyzed only for PCP.

9.2.3 Carbon Adsorption Test Results

Table 9-2 summarizes the results of the carbon adsorption treatability tests. The results indicate that the lagoon fluids were effectively treated as indicated by total organic carbon concentrations of less than 1 mg/l in the treated water compared to original concentrations of 50, 14 and 30 mg/l in the three fluids and by the reduction of PCP concentrations to less than 2 ppb by the treatment. The ground water samples were also effectively treated by the carbon as demonstrated by the reduction of PCP concentrations to less than 2 ppb by the treatment.

Table 9-2 includes the weight of PCP adsorbed per unit weight of carbon. The complete test results and adsorption isotherms are included in Appendix G.

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TABLE 1-1
SUMMARY OF CHEMICAL ANALYSES
SOIL AND WATER SAMPLES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE MEDIUM	NUMBER OF SAMPLE LOCATIONS ANALYZED(1) PHASE 1 INDICATOR PARAMETERS(2)	PHASE 2 INDICATOR PARAMETERS(3)	FULL ORGANIC SCANS(4)	TOTAL
Soil				
Surface	55	32	4	91
Subsurface	26	17	4	47
Core (drilling)	57	10	5	72
Ground Water	7	19	11	37
Sediment	0	22	0	22
Surface Water	1	5	0	6
Core (Trenching)	3	0	0	3
TOTAL	149	105	24	278

(1) Does not include duplicates, spikes, and blanks.
(2) PCP, Phenanthene and PCB. Quantitation of carbazole was limited due to analytical references.
(3) PCP, Acenaphthene, Acenaphthylene, Anthracene, Benzo (a) Anthracene, Benzo (a) Pyrene, Benzo (b) Fluoranthene, Benzo (k) Fluoranthene, Chrysene, Dibenzo (a,h) Anthracene, Fluoranthene, Fluorene, Ideno (1,2,3-cd) pyrene, naphthalene, Phenanthrene, Pyrene, and Carbazole.
(4) Organic priority pollutant compounds and chlorinated dibenzo dioxins and furans.

TABLE 2-1
POPULATION WITHIN FOUR MILE RADIUS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

LOCATION	TOTAL POPULATION	FEMALE	MALE	UNDER 5 YEARS	62 YEARS AND OVER	MEDIAN AGE (YRS)
OLA CITY	1,121	606	515	75	323	40.7
Average	54.1%	45.9%	6.7%	28.8%		
OUTSIDE OLA CITY(1)	451	231	219	29	91	34.7
Average(2)		51.3%	48.7%	6.4%	20.3%	
TOTAL	1,572	837	734	104	414	
U.S. Average		51.4%	48.6%	3.5%	13.9%	30.0

(1) Approximated from 182 estimated housing units x 2.48 persons per unit for Ola.
(2) Averages for Yell County, Arkansas.

Source: U. S. Bureau of Census Report No. PHC 80-2-5.

TABLE 2-2
MEAN MONTHLY CLIMATIC DATA
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

	PRECIPITATION[1] (INCHES)		TEMPERATURE[1] (°F)	WIND[2] DIRECTION	SPEED[2] (MPH)
JANUARY	2.84	39.2	S	9	
FEBRUARY	3.08	43.7	SW	9	
MARCH	5.20	51.7	NW	10	
APRIL	4.40	62.3	S	10	
MAY	5.10	70.2	S	8	
JUNE	4.17	77.5	SW	8	
JULY	3.24	81.7	SW	7	
AUGUST	3.25	80.3	SW	7	
SEPTEMBER	3.67	73.9	NE	7	
OCTOBER	3.34	62.9	SW	7	
NOVEMBER	4.42	50.7	SW	8	
DECEMBER	3.76	42.4	SW	9	
ANNUAL	46.47	61.4	SW	8	

Notes:

(1) Dardanelle, Arkansas Climatological Summary, 1951-1980, National Oceanic and Atmospheric Administration

(2) Little Rock, Arkansas Prevailing Wind Direction and Mean Speed, Climatic Atlas of the United States, Environmental Science Service Administration, 1983.

TABLE 2-3
SUMMARY OF EXISTING SITE STRUCTURES AND EQUIPMENT
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

STRUCTURES

FACILITY(1)	SIZE	TYPE
Main Office	830 sf	Wood Frame
Yard Office A	660 sf	Wood Frame
Yard Office B	288 sf	Wood Frame
Storage Trailer	160 sf	Metal/Wood
Maintenance Shop	1,368 sf	Corrugated Metal
Saw Mill:		
- Enclosed Area	5,447 sf	Concrete Slab/ Corrugated Metal
- Shed A	840 sf	Corrugated Metal
- Shed B	910 sf	Corrugated Metal
Wood Storage Shed	1,220 sf	Wood Frame
Water Well A	36 sf	Concrete Block
Water Well B	36 sf	Concrete Block
Treatment Building	3,000 sf	Conconrete Slab/ Corrugated Metal

EQUIPMENT

ITEM(1)	SIZE	MATERIAL
Chipping Mill	4,411 sf	Concrete Slabs/ Steel Structure
Tanks:		
- Tank A	17,000 gal	Coated Steel
- Tank B	8,750 gal	Coated Steel
- Tank C	8,750 gal	Coated Steel
- Tank D	8,750 gal	Coated Steel
- Tank E	8,750 gal	Coated Steel

(1) See Figure 2-2 for locations.
(2) These tanks were used as creosote storage tanks and have been stored on this site in the treatment area.

TABLE 3-1
SUMMARY OF LAGOON SEDIMENT
WASTE CHARACTERIZATION ANALYSES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

PARAMETERS	UNIT MEASURE	LAGOON 1	LAGOON 2	LAGOON 3	LAGOON 4	LAGOON 5	LAGOON 6	LAGOON 7
Nitrogen	WT.%	<0.09	0.15(1)	1.1	0.023	0.37	0.55	0.14
Sulfur	WT.%	1.3	0.24	1.2	0.11	0.39(2)	0.56	0.315
Heat Content	BTU/lb.	10,250	3,230	10,320	320	6,540	7,975(3)	4,520
Chloride	WT.%	1.2	0.69	2.1	0.30	1.0	1.25(4)	0.76
Hydrocarbons	WT.%	99	14	73	5.4	8.0	14	15(5)
Flash Point	F°	(6)	(6)	(6)	(6)	(6)	(6)	(6)
Ash	WT.%	0.41	57	1.0	68(7)	11	12.5	61
Loss @ 105°C	WT.%	84	26	84	23	80	71	26
Organics	WT.%	15	17	15	8.9	8.8	16	13
Moisture	WT.%	61	26	NA(8)	23	82	NA(8)	26
Benzene	mg/kg	43	0.032	64	0.17	1.8	3.4	--
Toluene	mg/kg	120	0.19	110	--	0.99	7.0	0.014
Trichloroethylene	mg/kg	NA(8)	0.21	NA(8)	0.46	NA(8)	NA(8)	0.54
Xylenes	mg/kg	2,000	1.2	1,900	--	17	240	0.65
Chloroform	mg/kg	NA(8)	--	NA(8)	0.13	NA(8)	NA(8)	--
Bromodichloromethane	mg/kg	37	NA	7.0	NA(8)	4.8	4.8	NA

NOTES:
(1) Arithmetic mean of 0.16 and 0.14.
(2) Arithmetic mean of 0.37 and 0.41.
(3) Arithmetic mean of 7950 and 8000.
(4) Arithmetic mean of 1.2 and 1.3.
(5) Arithmetic mean of 13 and 17.
(6) Not Ignitable.
(7) Arithmetic mean of 67 and 69.
(8) NA = Not Analyzed.

DER/OM-T3(1)

TABLE 3-2

SUMMARY OF LAGOON SEDIMENT/WATER SAMPLE
ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

LAGOON NO.	SAMPLE NO.	SAMPLE TYPE	DATE SAMPLED	CONCENTRATION (ppm) PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	MOISTURE WT. %
1	A	Sediment	11/12/86	3,300	7,900	ND[1]	(2)	61
	B	Sediment	11/11/86	2,000	480	ND[1]	NA[4]	26.8
	B[3]	Sediment	11/12/86	5,900	16,000	ND	NA[4]	98.8
	C	Water	11/12/86	0.030	0.068	ND	(5)	-
	D	Water	11/12/86	0.0046	0.81	ND	NA	-
2	A	Sediment	11/11/86	2,500	3,400	ND	NA	26
	B	Sediment	11/11/86	2,500	3,200	ND	NA	33.2
	C	Water	11/12/86	0.010	0.020	ND	NA	-
	D	Water	11/12/86	0.10	ND	ND	NA	-
3	A[3]	Sediment	11/12/86	5,700	38,000	ND	NA	83.8
	B	Sediment	11/12/86	2,500	13,000	ND	NA	98.4
	C	Water	11/12/86	0.31	2.1	ND	NA	-
	D	Water	11/12/86	0.31	2.2	ND	NA	-
4	A	Sediment	11/11/86	820	6,000	ND	NA	23
	C	Water	11/12/86	0.27	ND	ND	NA	-
	D	Water	11/12/86	0.30	ND	ND	NA	-

TABLE 3-2 (Cont'd)

SUMMARY OF LAGOON SEDIMENT/WATER SAMPLE
ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

LAGOON NO.	SAMPLE NO.	SAMPLE TYPE	DATE SAMPLED	CONCENTRATION (ppm) PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	MOISTURE WT. %
5	A(3)	Sediment	11/12/86	3,700	1,850	ND	(6)	82
	B	Sediment	11/12/86	580	790	ND	NA	95.5
	C	Water	11/12/86	0.03	0.068	ND	(7)	-
	D	Water	11/12/86	0.0012	ND	ND	NA	-
6	A	Sediment	11/12/86	2,600	5,700	ND	NA	71.1
	B	Sediment	11/12/86	4,800(8)	5,830(9)	ND	NA	96.1
	C	Water	11/12/86	0.60	3.0	ND	NA	-
	D	Water	11/12/86	0.31	120	ND	NA	-
7	A	Sediment	11/11/86	1,700	1,000	ND	NA	26
	B	Sediment	11/11/86	900	4,200	ND	NA	28.1
	C	Water	11/12/86	0.0072	ND	ND	NA	-
	D	Water	11/12/86	0.44	ND	ND	NA	-

Notes:

(1) ND = Not Detected.
(3) Sample includes oil.
(4) NA = Not Analyzed.
(8) Arithmetic mean of replicate analyses of 5,000 and 4,600 ppm.
(9) Arithmetic mean of replicate analyses of 5,000 and 6,660 ppm.

TABLE 3-2 (Cont'd)

SUMMARY OF LAGOON SEDIMENT/WATER SAMPLE
ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

	Lagoon 1[2] Sediment A (mg/kg)	Lagoon 1[5] Water C (mg/l)	Replicates of Lagoon 5[6] Sediment A (mg/kg)	Lagoon 5[7] Water C (mg/l)
Naphthalene	350	0.19	23/25	0.0087
2-Methyl Naphthalene	1,200	ND	160/210	ND
Acenaphthalene	70	0.020	18/72	0.0031
Acenaphthene	2,700	0.30	280/240	0.0051
Dibenzofuran	2,100	ND	350/410	ND
Fluorene	2,300	0.22	390/520	0.013
Pentachlorophenol	3,300	0.68	3,400/4,000	0.030
Phenathrene	7,900	0.37	1,800/1,900	0.068
Anthracene	2,200	0.029	210/250	ND
Fluoranthene	3,900	0.16	730/800	0.010
Pyrene	4,900	0.97	870/1,000	0.0067
Benzo(a)Anthracene	580	0.011	68/99	ND
Chrysene	660	0.017	220/260	0.0017
Benzo(b)+Benzo(k) Fluoranthene	380	0.014	91	ND
Benzo(a)Pyrene	150	0.050	ND	ND
Benzene	110	ND	ND	ND
Toluene	240	ND	ND	ND
Xylenes	4,900	0.0074	83.	ND
Trichloroethylene	310	ND	ND	ND

DER/OM-T3(3)

TABLE 3-3

SUMMARY OF DIOXIN AND FURAN ANALYSES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

DESIGNATION	SAMPLE NO.	SAMPLE TYPE	DATE SAMPLED	SITE COORDINATES		-----CONCENTRATION OF CONGENER[1]: WATER (ppt) & SOIL (ppb)-----									
						TCDD	PeCDD	HxCDD	HpCDD	OCDD	TCDF	PeCDF	HxCDF	HpCDF	OCDF
MW-3S	GW-30	Ground-water	11/17/86	3+40N	8+25W	ND[2]	ND	ND	26.9	183	ND	ND ND	5.1	7.9	
MW-4S	GW-27	Ground-water	11/17/86	5+90N	5+70W	ND	ND	ND	ND	27	ND	ND ND	ND	ND	
MW-5S	GW-5	Ground-water	11/13/86	9+65N	9+05W	ND	ND	ND	ND	ND	ND	ND ND	ND	ND	
MW-8S	GW-17	Ground-water	11/16/86	6+51N	7+32W	ND	ND	ND	ND	16.2	ND	ND ND	ND	ND	
MW-9S	GW-8	Ground-water	11/14/86	3+82N	9+65W	ND	ND	ND	ND	ND	ND	ND ND	ND	ND	
MW-10S	GW-13	Ground-water	11/14/86	5+95N	9+14W	ND	ND	ND	ND	ND	ND	ND ND	ND	ND	
MW-11S	GW-21	Ground-water	11/17/86	1+91N	6+27W	ND	ND	ND	6.4	97.0	ND	ND ND	ND	2.0	
MW-11S	GW-21A	Ground-water	11/17/86			14.3	ND	ND	7.4	73.8	14.5	ND ND	ND	4.0	
MW-11S	GW-21A	Ground-water	11/17/86			ND	ND	ND	11.2	115	ND	ND ND	ND	7.9	
MW-11S	GW-21A	Ground-water	11/17/86			ND	ND	ND	12.0	158	ND	ND ND	ND	7.4	

TABLE 3-3 (Cont'd)

SUMMARY OF DIOXIN AND FURAN ANALYSES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

DESIGNATION	SAMPLE NO.	SAMPLE TYPE	DATE SAMPLED	SITE COORDINATES	-----CONCENTRATION OF CONGENER[1]: WATER (ppt) & SOIL (ppb)----- TCDD	PeCDD	HxCDD	HpCDD	OCDD	TCDF	PeCDF	HxCDF	HpCDF	OCDF
FB	3	Field Blank (Water)	NA[3]	NA	ND	ND	ND	ND	5.8	ND	ND	ND	ND	
City of Ola Supply	CW-1A	Water	10/22/86	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Niely Well	WW-3	Water	11/11/86	(4)	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Barnes Well	WW-7	Water		(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Lagoon 1	C	Water	11/12/86	NA	ND	ND	10.0	167	1,780	ND	ND	11.9	46.4	66.9
Lagoon 5	C	Water	11/12/86	NA	ND	ND	ND	91.2	1,108	ND	ND	7.0	28.5	44.3
Lagoon 1	A	Sediment	11/12/86	NA	ND	ND	70.2	2,240	18,700	ND	29	116	735	1,180
Lagoon 5	A	Sediment	11/12/886	NA	ND	ND	296	3,490	19,500	10.1	127		376	883	808
MW-11S	SS-1A	Soil	10/31/86	1+91N 6+27W	ND	ND	ND	0.20	2.7	ND	ND	ND	ND	
MW-11S	ST-2B	Soil	10/31/86		ND	ND	ND	ND	9.7	ND	ND	ND	ND	
MW-11S	SS-2B	Soil	10/31/86		ND	ND	ND	ND	0.90	ND	ND	ND	ND	
MW-11S	SS-2C	Soil	10/31/86		ND	ND	ND	ND	2.6	ND	ND	ND	ND	
MW-11S	SS-3A	Soil	10/31/86		ND	ND	ND	0.39	3.6	ND	ND	ND	0.10	0.23

TABLE 3-3 (Cont'd)

SUMMARY OF DIOXIN AND FURAN ANALYSES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE DESIGNATION	SAMPLE NO.	DATE TYPE	SITE SAMPLED	COORDINATES		-----CONCENTRATION OF CONGENER(1): WATER (ppt) & SOIL (ppb)----- TCDD	PeCDL	HxCDD	HpCDD	OCDD	TCDF	PeCDF	HxCDF	HpCDF	OCDF
MW-11S	SS-3A	Soil	10/31/86			ND	ND	ND	0.42	3.2	ND	ND ND	0.54	0.98	
MW-11S	SS-3A	Soil	10/31/86			1.2	ND	ND	0.70	5.1	1.5	ND ND	0.20	0.24	
	S-65A	Soil	11/10/86	6+00N	8+50W	ND	ND	ND	ND	3.0	ND	ND ND	ND	ND	
	S-66A	Soil	11/10/86	6+00N	8+50W	ND	ND	ND	ND	11.5	ND	ND ND	ND	ND	
	S-68A	Soil	11/10/86	6+00N	6+50W	ND	ND	0.71	15.0	140	ND	ND 1.2	4.6	5.5	
	S-69A	Soil	11/10/86	6+00N	6+50W	ND	ND	ND	7.2	85.6	ND	ND ND	2.0	3.5	
	S-75A	Soil	11/10/86	5+00N	6+00W	ND	ND	ND	83.8	816	ND	ND ND	10.9	14.7	
	S-75B	Soil	11/10/86	5+00N	6+00W	ND	ND	ND	50.7	458	ND	ND ND	14.3	26.2	
	S-76A	Soil	11/10/86	5+00N	6+00W	ND	ND	ND	4.9	75.4	ND	ND ND	0.84	1.1	
	S-85A	Soil	11/10/86	5+00N	7+90W	ND	ND	ND	1.0	14.4	ND	ND ND	ND	0.53	
	S-86A	Soil	11/10/86	5+00N	7+90W	ND	ND	ND	1.1	12.8	ND	ND ND	ND	0.43	

Note: (1) Congeners: TCDD, PeCDD, HxCDD, HpCDD and OCDD = tetra, penta, hexa, hepta, and octa chlorinated dibenzodioxins, respectively. TCDF, PeCDF, HxCDF, HpCDF, and OCDF = tetra, penta, hexa, hepta, and octachlorinated dibenzofurans, respectively.
(2) ND = Not Detected.
(3) NA = Not Applicable.
(4) Offsite waterwell located to the west.

TABLE 4-1

SUMMARY OF GEOTECHNICAL TEST DATA
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

DESIGNATION	SAMPLE NO.	SAMPLED DEPTH (FT.)	VERTICAL PERMEABILITY VALUES (CM/SEC)(1)	GRAIN SIZE ANALYSIS
P-1S	ST-2	5.0 - 5.9	3.8×10^{-8}	NA(2)
P-3S	ST-1	0 - 0.8	1×10^{-6}	NA
P-5S	ST-1	0 - 1.3	5.1×10^{-8}	NA
MW-6S	ST-2	5.0 - 6.8'	3×10^{-8}	NA
MW-8S	ST-1	0 - 0.7	4.4×10^{-6}	NA
MW-8D	ST-1	5.0 - 5.6	6.3×10^{-8}	NA
MW-9S	ST-1	0 - 1.8	5.8×10^{-6}	NA
MW-9D	ST-2	5.0 - 5.8	1.8×10^{-8}	NA
MW-10S	ST-2	5.0 - 5.8	3.9×10^{-8}	NA
MW-10D	ST-1	0 - 1.3	4.3×10^{-8}	NA
MW-11S	ST-1	0 - 0.8	5.5×10^{-8}	NA
MW-11S	ST-2	5.0 - 5.8	1.3×10^{-8}	NA
MW-12S	ST-2	5.0 - 5.6	2.2×10^{-8}	NA
B-1	ST-2A	5.0 - 6.0	2.4×10^{-8}	NA
B-2	ST-1	0 - 0.7	4.9×10^{-8}	NA
P-1S	ST-1	0 - 2.0	NA	(3)
P-1S	ST-2	5.9 - 6.1	NA	(3)
P-2S	ST-1	0 - 2.0	NA	(3)
P-2S	ST-2	5.0 - 6.0	NA	(3)
P-3S	ST-1	0 - 0.8	NA	(3)
P-3S	ST-1	0 - 0.8	NA	(3)
P-3S	ST-2	5.0 - 7.0	NA	(3)
P-4S	ST-1	0 - 2.0	NA	(3)
P-4S	ST-2	5.0 - 6.5	NA	(3)
P-5S	ST-1	1.3 - 1.5	NA	(3)
P-5S	ST-2	5.0 - 7.0	NA	(3)
P-6S	ST-1	0 - 2.0	NA	(3)
P-6D	ST-1	5.0 - 7.0	NA	(3)
P-7S	ST-1	0 - 1.5	NA	(3)
P-7S	ST-2	5.0 - 6.0	NA	(3)
P-8S	ST-1	0 - 1.5	NA	(3)
P-8S	ST-2	5.0 - 6.5	NA	(3)
MW-6S	ST-2	5.0 - 6.8	NA	(3)
B-1	ST-1A	0.6 - 0.7	NA	(3)
B-1	ST-2A	5.0 - 6.5	NA	(3)
B-2	ST-1B	0.7 - 0.85	NA	(3)
B-2	ST-1B	5.0 - 7.0'	NA	(3)

NOTES: (1) Falling head permeability test.
(2) NA = Not Analyzed.
(3) See Appendix C for grain size analysis results.

DER/OM-4-TAB(1)

TABLE 4-2

SUMMARY OF CORE SAMPLE ANALYTICAL RESULTS
FROM MONITOR WELLS, BORINGS AND TRENCHES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

DESIG-NATION	SITE COORDINATES	SAMPLE NO.	SAMPLED DEPTH (FT) BELOW GROUND SURFACE	DATE SAMPLED	CONCENTRATION in mg/kg (PPM) PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
MW-5S	9+65N 9+05W	ST-1	0 - 2.0	10/13/86	ND[1]	ND	ND	NA[2]	NA[2]	5.42
		ST-2	5.0 - 6.5	10/13/86	ND	ND	ND	NA	NA	7.35
		SS-1	10.0 - 11.5	10/13/86	ND	ND	ND	NA	NA	4.49
		SS-2	15.0 - 15.5	10/13/86	ND	ND	ND	NA	NA	2.38
		SS-3	20.0 - 20.5	10/13/86	ND	ND	ND	NA	NA	3.04
MW-6S	9+98N 6+50W	ST-1	0 - 2.0	10/14/86	ND	ND	ND	NA	NA	5.77
		ST-2	5.8 - 7.0	10/14/86	ND	ND	ND	NA	NA	5.14
		ST-3	10.0 - 12.0	10/14/86	ND	ND	ND	NA	NA	5.51
		SS-1	15.0 - 15.1	10/14/86	ND	ND	ND	NA	NA	2.26
		SS-2	19.5 - 19.8	10/14/86	ND	ND	ND	NA	NA	1.8[3]
MW-7S	9+84N 5+21W	ST-1	0 - 2.0	10/14/86	ND	ND	ND	NA	NA	6.89
		ST-2	5.0 - 7.0	10/14/86	ND	ND	ND	NA	NA	7.40
		SS-1	10.0 - 11.4	10/14/86	ND	ND	ND	NA	NA	4.74
		SS-2	15.0 - 15.5	10/14/86	ND	ND	ND	NA	NA	1.92

TABLE 4-2 (Cont'd)

SUMMARY OF CORE SAMPLE ANALYTICAL RESULTS
FROM MONITOR WELLS, BORINGS AND TRENCHES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

DESIG-NATION	SITE COORDINATES	SAMPLE NO.	SAMPLED DEPTH (FT) BELOW GROUND SURFACE	DATE SAMPLED	CONCENTRATION in mg/kg (PPM) PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
MW-8S	6+51N 7+33W	ST-1	0.7 - 1.0	10/21/86	ND	ND	ND	NA	NA	11.3
		ST-2	5.0 - 7.0	10/21/86	ND	ND	ND	NA	NA	11.5
		SS-1	10.0 - 10.7	10/21/86	ND	ND	ND	NA	NA	4.95
		SS-2	15.0 - 15.5	10/21/86	ND	ND	ND	NA	NA	3.185(4)
MW-8D	6+45N 7+32W	SS-1	20.0 - 20.3	10/27/86	0.04	0.32	ND	NA	NA	8.94
		C-3A	35.0 - 35.5	10/28/86	0.10	ND	ND	NA	NA	4.39
		C-3B	39.5 - 40.0	10/28/86	0.14	ND	ND	NA	NA	2.43
MW-9S	3+82N 9+65W	ST-1	1.8 - 2.0	10/18/86	ND	ND	ND	NA	NA	1.45
		SS-1	10.0 - 11.5	10/18/86	ND	ND	ND	NA	NA	3.59
		SS-2	15.0 - 16.5	10/18/86	ND	ND	ND	NA	NA	4.46
MW-9D	3+78N 9+60W	ST-1	0 - 2.0	10/18/86	ND	ND	ND	NA	NA	3.17
		ST-2	5.8 - 6.0	10/18/86	ND	ND	ND	NA	NA	2.69(5)
		SS-1	20.0 - 20.8	10/18/86	ND	ND	ND	NA	NA	3.03
MW-10S	5+95N 9+14W	ST-1	0 - 1.0	10/19/86	ND	ND	ND	NA	NA	1.55
		ST-2	5.8 - 6.0	10/19/86	ND	ND	ND	NA	NA	3.18
		SS-1	10.0 - 10.6	10/19/86	ND	ND	ND	NA	NA	2.98
		SS-2	15.0 - 15.3	10/19/86	ND	ND	ND	NA	NA	2.48

TABLE 4-2 (Cont'd)

SUMMARY OF CORE SAMPLE ANALYTICAL RESULTS
FROM MONITOR WELLS, BORINGS AND TRENCHES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

					CONCENTRATION in mg/kg (PPM)					
DESIG-NATION	SITE COORDINATES	SAMPLE NO.	SAMPLED DEPTH (FT) BELOW GROUND SURFACE	DATE SAMPLED	PCP	PHENANTHRENE	FULL ORGANIC PCB	SCAN	PNA INDICATORS	MOISTURE WT. %
MW-11S	1+91N 6+27W	ST-1A	0.8 - 1.0	10/31/86	ND	ND	ND	NA	NA	16.5
		ST-1B	0.8 - 1.0	10/31/86	ND	ND	ND	NA	NA	16.2(6)
		ST-2A	5.8 - 6.0	10/31/86	ND	ND	ND	ND	NA	NA
		SS-1	10.0 - 11.0	10/31/86	ND	ND	ND	(7)	NA	NA
		SS-2	15.0 - 16.1	10/31/86	ND	ND	ND	ND	NA	NA
		SS-2A	15.0 - 16.1	10/31/86	ND	ND	ND	(8)	NA	NA
		SS-3	19.0 - 19.7	10/31/86	ND	ND	ND	ND	NA	NA
MW-11D	1+89N 6+33W	C-1	30.0 - 30.2	10/30/86	ND	ND	ND	NA	NA	2.80
		C-2	35.0 - 35.1	10/30/86	ND	ND	ND	NA	NA	2.90
		C-2B	39.7 - 40.0	10/30/86	ND	ND	ND	NA	NA	4.58
MW-12S	0+65N 9+50W	ST-1	0 - 2.0	11/01/86	ND	ND	ND	NA	NA	5.12
		ST-1A	0 - 2.0	11/01/86	ND	ND	ND	NA	NA	5.47
		ST-2A	5.6 - 5.8	11/01/86	ND	ND	ND	NA	NA	4.37
		SS-1	10.0 - 11.0	11/01/86	ND	ND	ND	NA	NA	5.63
		SS-2	15.0 - 15.8	11/01/86	ND	ND	ND	NA	NA	5.20

TABLE 4-2 (Cont'd)

SUMMARY OF CORE SAMPLE ANALYTICAL RESULTS
FROM MONITOR WELLS, BORINGS AND TRENCHES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

DESIG-NATION	SITE COORDINATES		SAMPLE NO.	SAMPLED DEPTH (FT) BELOW GROUND SURFACE	DATE SAMPLED	CONCENTRATION in mg/kg (PPM) PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
B-1	2+80N	8+40W	ST-1B	0.7 - 0.8	10/29/86	ND	ND	ND	NA	NA	6.57[9]
			ST-2B	5.0 - 6.0	10/29/86	0.03	ND	ND	NA	NA	3.61
			SS-1	10.0 - 11.0	10/29/86	0.07	ND	ND	NA	NA	2.325[10]
			SS-2A	15.0 - 15.4	10/29/86	0.32	260[11]	ND	NA	NA	17.3
			C-1	25.0 - 25.3	10/29/86	ND	ND	ND	NA	NA	0.862
			C-2	30.0 - 30.3	10/29/86	ND	ND	ND	NA	NA	0.874
			C-3	35.0 - 35.3	10/29/86	ND	ND	ND	NA	NA	3.36
			C-3A	39.7 - 40.0	10/29/86	ND	ND	ND	NA	NA	1.11
B-2	7+25N	5+25W	ST-1A	0.85 - 1.0	10/28/86	0.03	ND	ND	NA	NA	10.3
			ST-2A	5.0 - 7.0	10/28/86	ND	ND	ND	NA	NA	4.75
			SS-1	10.0 - 11.0	10/28/86	0.11	ND	ND	NA	NA	8.79
			SS-2	15.0 - 15.5	10/28/86	ND	ND	ND	NA	NA	7.90
			SS-3	20.0 - 20.3	10/28/86	ND	ND	ND	NA	NA	2.22
			C-1	30.0 - 30.5	10/28/86	ND	ND	ND	NA	NA	11.4
			C-2	35.0 - 35.2	10/28/86	ND	ND	ND	NA	NA	1.90
B-3	2+20N	8+50W	S-1	19.0 - 19.5	05/18/87	ND	ND	NA	NA	ND	10.43
B-4	2+50N	8+50W	S-1	19.0 - 19.5	05/18/87	ND	ND	NA	NA	ND	11.05
B-5	2+80N	8+80W	S-1	19.0 - 19.5	05/18/87	ND	ND	NA	NA	ND	9.66
B-6	3+20N	8+80W	S-1	18.5 - 19.0	05/19/87	4.0	6.3	NA	NA	(12)	10.13
B-7	4+10N	8+40W	S-1	18.0 - 18.5	05/19/87	<1.1	<1.1	NA	NA	(12)	11.46
B-8	3+70N	9+00W	S-1	18.0 - 18.5	05/19/87	ND	ND	NA	NA	ND	10.36

TABLE 4-2 (Cont'd)

SUMMARY OF CORE SAMPLE ANALYTICAL RESULTS
FROM MONITOR WELLS, BORINGS AND TRENCHES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

				CONCENTRATION in mg/kg (PPM)						
DESIG-NATION	SITE COORDINATES	SAMPLE NO.	SAMPLED DEPTH (FT) BELOW GROUND SURFACE	DATE SAMPLED	PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
B-9	5+50N 6+10W	S-1	18.0 - 18.5	05/20/87	ND	ND	NA	NA		11.52
B-10	5+30N 7+75W	S-1	18.0 - 18.5	05/20/87	ND	ND	NA	NA	ND	11.01
B-11	3+80N 8+70W	S-1	18.0 - 18.5	05/21/87	ND	ND	NA	NA	ND	11.8
B-11	3+80N 8+70W	S-2	18.0 - 18.5	05/21/87	ND	ND	NA	NA	(13)	11.7
Trench 2	NA(14)	150/7	(14)	01/15/86	ND	ND	ND	NA	NA	11.7
Trench 2	NA(14)	150/9	(14)	10/15/86	ND	ND	ND	NA	NA	4.42
Trench 2	NA(14)	200/2	(14)	10/15/86	ND	ND	ND	NA	NA	5.55

Notes: (1) ND = Not Detected.
(2) NA = Not Analyzed.
(3) Arithmetic mean of 1.84 and 1.75%.
(4) Arithmetic mean of 3.23 and 3.14%.
(5) Arithmetic mean of 2.68 and 2.70%.
(6) Arithmetic mean of 16.0 and 16.4%.
(7) Volatiles: Trichloroethylene = 0.10 ppm
Semivolatiles: ND.
(8) Volatiles: Trichloroethylene = 0.20 ppm
Benzene = 0.045 ppm
Semivolatiles: ND.
(9) Arithmetic mean of 6.54 and 6.60%.
(10) Arithmetic mean of 2.30 and 2.35%.
(11) Arithmetic mean of duplicate samples of 250 and 270 ppm.
(12) Concentrations listed below are for Borings B-6/B-7, respectively.
Acenaphthene = 1.7/ND
Anthracene = <1.0/ND
Benzo(a)anthracene = <1.0/ND
Chrysene = <1.0/ND
Fluoranthene = 1.1/ND
Fluorene = 3.1/ND
Naphthalene = 2.5/<1.1
Pyrene = 1.1/<1.1.
(13) Naphthalene = <1.2.
ilable.

TABLE 4-3

SUMMARY OF SURFACE/SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE NO.	SAMPLE DEPTH	SITE COORDINATES	DATE SAMPLED	-CONCENTRATION in mg/kg (ppm)- PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
S-1	0-6"	0+00N 0+50W	10/30/86	ND(1)	ND	ND	NA(2)	NA(2)	14.7
S-2	6"-12"	0+00N 0+50W	10/30/86	ND	ND	ND	NA	NA	12.9
S-3	0+6"	1+00N 0+50W	10/30/86	ND	ND	ND	NA	NA	12.2
S-4	0+6"	2+00N 0+60W	10/30/86	ND	ND	ND	NA	NA	11.4
S-5	0-6"	3+00N 1+00W	10/30/86	ND	ND	ND	NA	NA	10.8
S-6	6"-12"	3+00N 1+00W	10/30/86	ND	ND	ND	NA	NA	11.3
S-7	0-6"	5+00N 1+50W	10/30/86	ND	ND	ND	NA	NA	11.3
S-8	6"-12"	5+00N 1+50W	10/30/86	ND	ND	ND	NA	NA	10.2
S-9	0-6"	4+00N 1+50W	10/30/86	ND	ND	ND	NA	NA	10.8
S-10	0-6"	2+00N 1+50W	10/31/86	ND	ND	ND	NA	NA	10.9
S-11	0-6"	1+00N 1+50W	10/31/86	ND	ND	ND	NA	NA	9.59
S-12	6"-12"	1+00N 1+50W	10/31/86	ND	ND	ND	NA	NA	8.80
S-13	0-6"	0+00N 1+50W	10/31/86	ND	ND	ND	NA	NA	14.6
S-14	0-6"	3+00N 2+00W	10/31/86	ND	ND	ND	NA	NA	9.62
S-15	0-6"	6+00N 2+50W	10/31/86	0.24	ND	ND	NA	NA	15.3
S-16	6"-12"	6+00N 2+50W	10/30/86	ND	ND	ND	NA	NA	14.0
S-17	0-6"	5+00N 2+50W	10/30/86	ND	ND	ND	NA	NA	15.3
S-18	0-6"	4+00N 2+50W	10/30/86	ND	ND	ND	NA	NA	7.17
S-19	6"-12"	4+00N 2+50W	10/31/86	ND	ND	ND	NA	NA	16.8
S-20	0-6"	2+00N 2+50W	10/31/86	ND	ND	ND	NA	NA	11.9
S-21	6"-12"	2+00N 2+50W	10/31/86	ND	ND	ND	NA	NA	12.2
S-22	0-6"	1+00N 2+50W	11/01/86	ND	ND	ND	NA	NA	12.9

TABLE 4-3 (Cont'd)

SUMMARY OF SURFACE/SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE NO.	SAMPLE DEPTH	SITE COORDINATES	DATE SAMPLED	-CONCENTRATION in mg/kg (ppm)- PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
S-23	0-6"	0+00N 2+50W	11/01/86	ND	ND	ND	NA	NA	13.3
S-24	6"-12"	0-00N 2+50W	11/01/86	ND	ND	ND	NA	NA	12.8
S-25	0-6"	0+75S 2+50W	11/01/86	ND	ND	ND	NA	NA	16.5
S-26	0-6"	3+00N 3+00W	11/01/86	0.35	ND	ND	NA	NA	20.8
S-27	6"-12"	3+00N 3+00W	11/01/86	0.28	ND	ND	NA	NA	17.2
S-28	0-6"	0+00N 3+50W	11/01/86	ND	ND	ND	NA	NA	8.52
S-29	0-6"	1+00N 3+50W	11/01/86	ND	ND	ND	NA	NA	5.97
S-30	0-6"	2+00N 3+50W	11/01/86	ND	ND	ND	NA	NA	9.77
S-31	0-6"	5+00N 3+50W	11/01/86	ND	ND	ND	NA	NA	9.63
S-32	6"-12"	5+00N 3+50W	11/01/86	ND	ND	ND	NA	NA	8.59
S-33	0-6"	6+00N 3+50W	11/01/86	ND	ND	ND	NA	NA	15.8
S-34	0-6"	4+00N 4+00W	11/01/86	ND	ND	ND	NA	NA	11.0
S-35	6"-12"	4+00N 4+00W	11/01/86	ND	ND	ND	NA	NA	12.4
S-36	0-6"	3+00N 4+00W	11/01/86	ND	ND	ND	NA	NA	9.0
S-37	0-6"	6+00N 4+50W	11/01/86	ND	ND	ND	NA	NA	11.2
S-38	6"-12"	6+00N 4+00W	11/01/86	ND	ND	ND	NA	NA	11.1
S-39	0-6"	5+00N 4+50W	11/01/86	ND	ND	ND	NA	NA	6.94(3)
S-40	0-6"	2+00N 4+50W	11/03/86	4.1	ND	ND	NA	NA	12.4
S-41	0-6"	1+00N 4+50W	11/30/86	5.2	ND	ND	NA	NA	16.3

TABLE 4-3 (Cont'd)

SUMMARY OF SURFACE/SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE NO.	SAMPLE DEPTH	SITE COORDINATES	DATE SAMPLED	-CONCENTRATION in mg/kg (ppm)- PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
S-42	6"-12"	1+00N 4+50W	11/03/86	4.2	ND	ND	NA	NA	13.9
S-43	0-6"	0+00N 4+50W	11/03/86	1.2	ND	ND	NA	NA	14.8
S-44	0-6"	4+00N 5+00W	11/03/86	ND	ND	ND	NA	NA	13.4
S-45	0-6"	3+00N 5+00W	11/03/86	2.2	ND	ND	NA	NA	27.1
S-46	6"-12"	3+00N 5+00W	11/03/86	1.3	ND	ND	NA	NA	14.8
S-47	0-6"	6+00N 5+50W	11/03/86	0.57	ND	ND	NA	NA	20.8
S-48	0-6"	1+00N 5+50W	11/03/86	260	ND	ND	NA	NA	14.7
S-49	0-6"	0+00N 5+50W	11/03/86	1.5	ND	ND	NA	NA	18.0
S-50	6"-12"	0+00N 5+50W	11/03/86	1.5	ND	ND	NA	NA	15.9
S-51	0-6"	0-75N 6+00W	11/03/86	ND	ND	ND	NA	NA	18.1
S-52	0-6"	0+00N 6+50W	11/03/86	0.82	ND	ND	NA	NA	20.85(4)
S-53	0-6"	1+00 6+50W	11/03/86	360	ND	ND	NA	NA	18.4
S-54	6"-12"	1+00N 6+50	11/03/86	220	ND	ND	NA	NA	17.9
S-55	0-6"	0+00N 7+50W	11/03/86	0.29	ND	ND	NA	NA	25.2
S-56	6"-12"	0+00N 7+50W	11/03/86	0.57	ND	ND	NA	NA	23.3
S-57	0-6"	0+00N 8+50W	11/03/86	1.8	ND	ND	NA	NA	11.5
S-58	0-6"	1+00N 8+50W	11/03/86	10	ND	ND	NA	NA	10.6
S-59	6"-12"	1+00N 8+60W	11/03/86	ND	ND	ND	NA	NA	16.0

TABLE 4-3 (Cont'd)

SUMMARY OF SURFACE/SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE NO.	SAMPLE DEPTH	SITE COORDINATES	DATE SAMPLED	-CONCENTRATION in mg/kg (ppm)- PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
S-60	0-6"	2+00N 8+50W	11/03/86	2.2	ND	ND	NA	NA	14.4
S-61	0-6"	3+00N 8+50W	11/03/86	37	ND	ND	NA	NA	17.5
S-62	6"-12"	3+00N 8+50W	11/03/86	4.6	ND	ND	NA	NA	14.7
S-63	0-6"	4+00N 8+50W	11/03/86	40	ND	ND	NA	NA	16.1
S-64	0-6"	5+00N 8+50W	11/10/86	ND	ND	ND	NA	NA	15.4
S-65	0-6"	6+00N 8+50W	11/10/86	ND	ND	ND	ND	NA	17.1
S-66	6"-12"	6+00N 8+50W	11/10/86	ND	ND	ND	ND	NA	17.6
S-67	0-6"	6+00N 7+50W	11/10/86	160	ND	ND	NA	NA	26.9
S-68	0-6"	6+00N 6+50W	111/10/86	ND	ND	ND	ND	NA	20.2
S-69	6"-12"	6+00N 6+50W	11/10/86	ND	ND	ND	ND	NA	17.5
S-70	0-6"	2+00N 5+50W	11/10/86	43	ND	ND	NA	NA	15.1
S-71	6"-12"	2+00N 5+50W	11/10/86	9.9	ND	ND	NA	NA	14.7
S-72	0-6"	3+00N 5+90W	11/10/86	790	ND	ND	NA	NA	16.7
S-73	0-6"	4+00N 6+00W	11/10/86	10	ND	ND	NA	NA	32.4
S-74	6"-12"	4+00N 6+00W	11/10/86	3.8	ND	ND	NA	NA	19.8
S-75	0-6"	5+00N 6+00W	11/10/86	110	87	ND	(5)	NA	30.9
S-76	6"-12"	5+00N 6+00W	11/10/86	45	50	ND	(5)	NA	18.2
S-77	0-6"	2+00N 6+50W	11/10/86	200	ND	ND	NA	NA	16.8

TABLE 4-3 (Cont'd)

SUMMARY OF SURFACE/SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE NO.	SAMPLE DEPTH	SITE COORDINATES	DATE SAMPLED	-CONCENTRATION in mg/kg (ppm)- PCE	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
S-78	6"-12"	2+00N 6+50W	11/10/86	690	ND	ND	NA	NA	17.2
S-79	0-6"	2+00N 7+50W	11/10/86	690	ND	ND	NA	NA	19.4
S-80	6"-12"	2+00N 7+50W	11/10/86	330	ND	ND	NA	NA	16.1
S-81	0-6"	3+00N 7+50W	11/10/86	130	ND	ND	NA	NA	17.9
S-82	6"-12"	3+00N 7+50W	11/10/86	450	ND	ND	NA	NA	20.5
S-83	0-6"	4+00N 7+90W	11/10/86	ND	ND	ND	NA	NA	13.1
S-84	6"-12"	4+00N 7+90W	11/10/86	ND	ND	ND	NA	NA	12.0
S-85	0-6"	5+00N 7+90W	11/10/86	ND	ND	ND	ND	NA	17.6
S-86	6"-12"	5+00N 7+90W	11/10/86	ND	ND	ND	ND	NA	17.6
S-87	0-6"	1+00N 7+50W	11/03/87	77	14,000	ND	NA	NA	17.5
S-88	6"-12"	1+00N 7+50W	11/03/87	0.66	220	ND	NA	NA	15.2
S-89	0-6"	3+00N 5+50W	05/18/87	<1.1 (6)	ND	NA	NA	ND	10.86
S-90	6"-12"	3+00N 5+50W	05/18/87	ND	ND	NA	NA	ND	9.99
S-91	0-6"	4+50N 5+50W	05/18/87	ND	ND	NA	NA	ND	10.28
S-92	6"-12"	4+50N 5+50W	05/18/87	ND	ND	NA	NA	ND	10.52
S-93	0-6"	8+50N 7+00W	05/18/87	<7.3	ND	NA	NA	ND	72.65
S-95	0-6"	8+00N 3+30W	05/18/87	ND	ND	NA	NA	ND	10.81
S-96	0-6"	5+00N 11+30W	05/19/87	ND	ND	NA	NA	ND	10.97
S-97	0-6"	6+50N 11+60W	05/19/87	ND	ND	NA	NA	ND	10.82

TABLE 4-3 (Cont'd)

SUMMARY OF SURFACE/SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE NO.	SAMPLE DEPTH	SITE COORDINATES	DATE SAMPLED	-CONCENTRATION in mg/kg (ppm)- PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
S-98	0-6"	8+00N 11+90W	05/19/87	ND	ND	NA	NA	ND	10.61
S-99	0-6"	9+50N 12+20W	05/19/87	ND	ND	NA	NA	ND	9.95
S-100	0-6"	1+50N 10+00W	05/19/87	ND	ND	NA	NA	ND	10.74
S-101	0-6"	2+50N 10+00W	05/91/87	ND	ND	NA	NA	ND	10.97
S-102	0-6"	3+50N 10+00W	05/19/87	ND	ND	NA	NA	(7)	12.33
S-103	0-6"	5+50N 10+00W	05/19/87	ND	ND	NA	NA	ND	12.02
S-104	0-6"	8+00N 10+30W	05/19/87	ND	ND	NA	NA	ND	11.79
S-105	0-6"	9+00N 9+00W	05/19/87	ND	ND	NA	NA	ND	11.78
S-106	0-6"	1+00N 3+80W	05/19/87	ND	ND	NA	NA	ND	11.47
S-107	0-6"	2+70N 4+30W	05/19/87	<1.1	ND	NA	NA	ND	10.55
S-108	6"-12"	2+70N 4+30W	05/19/87	<1.1	ND	NA	NA	ND	10.96
S-109	0-6"	8+80N 6+00W	05/20/87	ND	ND	NA	NA	ND	11.49
S-110	6"-12"	8+80N 6+00W	05/20/87	ND	ND	NA	NA	ND	10.69
S-111	0-6"	8+80N 6+00W	05/20/87	ND	ND	NA	NA	ND	11.24
S-112	6"-12"	8+80N 6+00W	05/20/87	ND	ND	NA	NA	ND	10.98
S-113	0-6"	0+00N 6+00W	5/20/87	ND	ND	NA	NA	ND	24.8
S-114	6"-12"	0+00N 6+00W	5/20/87	ND	ND	NA	NA	ND	11.98
S-115	0-6"	0+00N 6+00W	5/20/87	<1.2	ND	NA	NA	(8)	11.96
S-116	6"-12"	0+00N 6+00W	5/20/87	ND	ND	NA	NA	ND	11.84

TABLE 4-3 (Cont'd)

SUMMARY OF SURFACE/SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE NO.	SAMPLE DEPTH	SITE COORDINATES	DATE SAMPLED	-CONCENTRATION in mg/kg (ppm)- PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT %
S-117	0-6"	0+00N 7+00W	5/20/87	ND	ND	NA	NA	ND	11.86
S-118	6"-12"	0+00N 7+00W	5/20/87	ND	ND	NA	NA	ND	11.6
S-119	0-6"	0+00N 7+00W	5/20/87	ND	ND	NA	NA	ND	11.9
S-120	0-6"	0+00N 8+00W	5/20/87	ND	ND	NA	NA	ND	10.6
S-121	6"-12"	0+00N 8+00W	5/20/87	ND	ND	NA	NA	ND	11.0
S-122	0-6"	0+60S 6+50W	5/20/87	ND	ND	NA	NA	ND	24.2
S-123	0+6"	1+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	10.8
S-124	6"-12"	1+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	10.6
S-125	0-6"	2+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	10.6
S-126	6"-12"	2+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	10.4
S-127	0-6"	3+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	11.1
S-128	6"-12"	3+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	10.6
S-129	0-6"	5+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	11.3
S-130	6"-12"	5+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	11.1
S-131	0-6"	7+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	11.0
S-132	6"-12"	7+00N 9+00W	5/21/87	ND	ND	NA	NA	ND	11.0
S-133	0-6"	6+50N 8+00W	5/21/87	ND	ND	NA	NA	ND	11.7
S-134	6"-12"	6+50N 8+00W	5/21/87	ND	ND	NA	NA	ND	11.6

TABLE 4-3 (Cont'd)

SUMMARY OF SURFACE/SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE NO.	SAMPLE DEPTH	SITE COORDINATES	DATE SAMPLED	-CONCENTRATION in mg/kg (ppm)- PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	PNA INDICATORS	MOISTURE WT. %
S-135	0-6"	6+50N 7+00W	5/21/87	ND	ND	NA	NA	ND	11.0
S-136	6"-12"	6+50N 7+00W	5/21/87	ND	ND	NA	NA	ND	11.1
S-137	0-6"	6+50N 6+00W	5/21/87	ND	ND	NA	NA	ND	11.3
S-138	6"-12"	6+50N 6+00W	5/21/87	ND	ND	NA	NA	ND	11.4

NOTES: (1) ND = Not Detected.
(2) NA = Not Analyzed.
(3) Arithmetic mean of 6.70 and 7.18%.
(4) Arithmetic mean of 20.8 and 20.9%.
(5) Concentrations listed below are for S-75/S-76, respectively.

Volatiles: Benzene = 0.18/0.22 ppm
Trichloroethylene = 0.26/0.40 ppm
Xylene = 0.031/ND ppm

Semivolatiles: Naphthalene = 1.3/1.0 ppm
2-methyl Naphthalene = 2.5/15 ppm
Acenaphthylene = 16/3.0 ppm
Acenaphthene = 140/50 ppm
Dibenzofuran = 11/20 ppm
Fluorene = 23/22 ppm
Anthracene = 41/19 ppm
Fluoranthene = 320/89 ppm
Pyrene = 700/230 ppm
Benzo(a)anthracene = 99/28 ppm
Chrysene = 85/35 ppm
Benzo(b) + benzo(k)fluoranthene = 77/16 ppm
Benzo(a) Pyrene = 25/3.9 ppm
Indeno (1,2,3-cd) Pyrene = 15/ND ppm
Benzo (g,h,i) Perylene = 13/ND ppm

(6) < indicates the compound is present at a concentration below the listed quantitation limit.
(7) Carbazole concentration of <1.2 ppm.
(8) Pyrene concentration of <1.2 ppm.

TABLE 4-4

SUMMARY OF ON-SITE MONITOR WELL GROUND WATER
ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

DESIGNATION	SITE COORDINATES		DATE(S) SAMPLED	CONCENTRATIONS in mg/kg (ppm) PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	OTHER PNA INDICATORS
MW-1S	0+80N	4+70W	11/17/86	ND(1)	ND	ND	NA(2)	NA
			05/28/87	ND	ND	NA	NA	ND
MW-1D	0+80N	4+70W	05/28/87	ND	ND	NA	NA	ND
MW-2S	4+00N	5+40W	11/17/86	ND	ND	ND	NA	NA
			05/28/87	ND	ND	NA	NA	ND
MW-2D	4+00N	5+40W	05/28/87	ND	ND	NA	NA	ND
MW-3S	3+40N	8+25W	11/17/86	12,000	5,000	ND	(3)	NA
			05/30/87	130	90	NA	NA	(4)
MW-3D	3+40N	8+25W	11/17/86	ND	ND	ND	NA	NA
			05/28/87	ND	0.013	NA	NA	(5)

TABLE 4-4 (Continued)

SUMMARY OF ON-SITE MONITOR WELL GROUND WATER
ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

				CONCENTRATIONS in mg/kg (ppm)				
DESIGNATION	SITE COORDINATES		DATE(S) SAMPLED	PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	OTHER PNA INDICATORS
MW-4S	5+90N	5+70W	11/17/86	ND	ND	ND	ND	NA
			05/28/87	ND	ND	NA	NA	ND
MW-4D	5+90N	5+70W	05/28/87	ND	ND	ND	ND	ND
MW-5S	9+65N	9+05W	11/13/86	ND	ND	ND	NA	NA
			12/17/86	ND	ND	ND	ND	NA
			06/01/87	ND	ND	NA	NA	ND
MW-6S	9+98N	6+50W	12/17/86	ND	ND	ND	NA	NA
			06/01/87	ND	ND	NA	NA	ND
MW-7S	9+84N	5+21W	11/13/86	ND	ND	ND	NA	NA
			06/02/87	ND	ND	NA	NA	ND
MW-8S	6+51N	7+32W	11/16/86	ND	ND	ND	ND	NA
			06/02/87	ND	ND	NA	NA	ND

TABLE 4-4 (Continued)

SUMMARY OF ON-SITE MONITOR WELL GROUND WATER
ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

			CONCENTRATIONS in mg/kg (ppm)				
DESIGNATION	SITE COORDINATES	DATE(S) SAMPLED	PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	OTHER PNA INDICATORS
MW-8D	6+45N 7+31W	11/16/86	ND	ND	ND	NA	NA
		06/02/87	ND	ND	NA	NA	ND
MW-9S	3+82N 9+65W	11/14/86	ND	ND	ND	ND	NA
		06/01/87	ND	ND	NA	NA	ND
MW-9D	3+78N 9+60W	11/14/86	ND	ND	ND	NA	NA
		05/31/87	ND	ND	NA	NA	ND
MW-10S	5+95N 9+14W	11/14/86	ND	ND	ND	ND	NA
		05/31/87	ND	ND	NA	NA	ND
MW-10D	5+97N 9+21W	11/14/87	ND	ND	ND	NA	NA
		05/31/87	ND	ND	NA	NA	ND
MW-11S	1+91N 6+27W	11/17/87	ND	ND	ND	ND	NA
		12/17/87	ND	ND	ND	ND	NA
		05/31/87	ND	ND	NA	NA	ND

TABLE 4-4 (Continued)

SUMMARY OF ON-SITE MONITOR WELL GROUND WATER
ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

DESIGNATION	SITE COORDINATES	DATE(S) SAMPLED	CONCENTRATIONS in mg/kg (ppm) PCP	PHENANTHRENE	PCB	FULL ORGANIC SCAN	OTHER PNA INDICATORS
MW-11D	1+89N 6+33W	11/17/86	0.0012	ND	ND	NA	NA
		05/31/87	ND	ND	NA	NA	ND

Notes:
(1) ND = Not Detected
(2) NA = Not Analyzed
(3) Semivolatiles:
Naphthalene = 2300 ppm
2-methyl naphthalene = 7300 ppm
Acenaphthylene = 96 ppm
Acenaphthene = 2100 ppm
Dibenzofuran = 2000 ppm
Fluorene = 270 ppm
Anthracene = 1500 ppm
Fluoranthene = 5100 ppm
Pyrene = 1800 ppm
Benzo(a)Anthracene = 520 ppm
Chrysene = 670 ppm
Benzo(b)+Benzo(k)Fluoranthene = 410 ppm
Benzo(a)pyrene = 120 ppm
Indeno (1,2,3-cd)pyrene = 35 ppm
Benzo(g,h,i)perylene = 23 ppm
Volatiles:
Toluene = 0.0034 ppm
Xylenes = 0.077 ppm

(4) Semivolatiles:
Acenaphthene = 27 ppm
Acenaphthylene = ND
Anthracene = 11 ppm
Benzo(a)anthracene = <10 ppm
Benzo(b)fluoranthene = <10 ppm
Benzo(k)fluoranthene = <10 ppm
Benzo(a)pyrene = ND
Benzo(g,h,i)perylene = ND
Chrysene = <10 ppm
Dibenzo (a,h)anthracene = ND
Fluoranthene = 29 ppm
Fluorene = 38 ppm
Indeno (1,2,3-cd) pyrene = ND
Naphthalene = 28 ppm
Pyrene = 22 ppm
Carbazole = ND

(5) Semivolatiles:
Fluoranthene = <0.01 ppm
Fluorene = <0.01 ppm
Pyrene = <0.01 ppm
Other PNA indicators were ND (Not Detected).

DER/OM-4-XTAB

TABLE 4-5
SUMMARY OF FULL ORGANIC SCAN ANALYSES
OFF-SITE WATER WELLS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

WELL OWNER	DATE SAMPLED	LOCATION	VOLATILES (PPB)	SEMIVOLATILES (PPB)
Mr. Niely	11/11/86	400 Ft. West of Lagoons	ND(1)	ND(1)
Mrs. Barnes	11/11/86	1,950 Ft. North of Lagoons	ND(1)	ND(1)

NOTES: (1) ND = None Detected.

DER/OM-4-TAB(2)

TABLE 4-6

SUMMARY OF HYDRAULIC CONDUCTIVITY FIELD MEASUREMENTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

WELL OR PIEZOMETER DESIGNATION	HYDRAULIC CONDUCTIVITY (CM/SEC)
P-1s	5.1×10^{-4}
P-1d	1.2×10^{-5}
P-2s	3.6×10^{-4}
P-2d	7.5×10^{-6}
P-3s	3.4×10^{-4}
P-3d	1.0×10^{-4}
P-4s	2.5×10^{-4}
P-4d	1.3×10^{-5}
P-5s	1.2×10^{-4}
P-5d	1.4×10^{-4}
P-6s	5.8×10^{-5}
P-6d	3.2×10^{-5}
MW-5s	1.0×10^{-5}
MW-6s	5.6×10^{-4}
MW-7s	3.4×10^{-4}
MW-8s	3.1×10^{-4}
MW-8d	1.8×10^{-4}
MW-9s	1.3×10^{-4}
MW-9d	7.0×10^{-6}
MW-10s	4.6×10^{-6}
MW-10d	9.0×10^{-6}
MW-11s	1.6×10^{-4}
MW-11d	1.5×10^{-5}

TABLE 4-7

SUMMARY OF AQUIFER TEST RESULTS, WELL MW-12S
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

Pumping Phase

OBSERVATION PIEZOMETER OR WELL	TRANSMISSIVITY (GPD/FT)	STORATIVITY	DISTANCE FROM PUMPING WELL R (FT)
P-5s	220	0.01	10
P-5d	150	0.006	10.8
P-7s	220	0.006	20
P-8s	130	0.0004	40
P-1s	140	0.001	105
P-1d	220	0.01	110

Recovery Phase

OBSERVATION PIEZOMETER OR WELL	TRANSMISSIVITY (GPD/FT)	STORATIVITY	DISTANCE FROM PUMPING WELL R (FT)
MW-12s	320	NA(1)	0
P-5s	690	NA	10
P-5d	330	NA	10.8
P-7s	590	NA	20
P-8s	510	NA	40

Notes:
(1) NA = Not Applicable.

TABLE 5-1
SUMMARY OF SEDIMENT AND SURFACE WATER
SAMPLE ANALYTICAL RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

Concentration in mg/kg (ppm) for Sediment Samples and in ug/l (ppb) for Surface Water Samples

SAMPLE	DATE SAMPLED	SITE COORDINATES	ACENAPHTHENE	ACENAPHTHYLENE	ANTHRACENE	BENZO(a) ANTHRACENE	BENZO(b) FLUORANTHENE	BENZO(k) FLUORANTHENE	BENZO(a) PYRENE	BENZO(g,h,i) PERYLENE	CHRYSENE	DIBENZO(a,h) ANTHRACENE	FLUORANTHENE	FLUORENE	INDENO (1,2,3-cd) PYRENE	NAPHTHALENE	PHENANTHRENE	PCB	PYRENE	PCP	CARBAZOLE	MOISTURE WT %
Sed-1	05/22/87	0+00N 8+60W	ND(1)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA(2)	ND	ND	ND	18.4
Sed-2	05/22/87	3+00N 10+00W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	21.1
Sed-3	05/22/87	3+50N 9+50W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	13.09
Sed-4	05/22/87	3+80N 8+70W	ND	ND	ND	ND	ND	ND	ND	ND	<1.2	ND	<1.2	ND	ND	ND	ND	NA	<1.2	ND	ND	11.9
Sed-5	05/22/87	4+00N 9+80W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	12.2
Sed-6	05/22/87	4+30N 8+60W	ND	<1.2	3.6	1.2	2.1	ND	<1.2	ND	2.4	ND	4.3	<1.2	<1.2	ND	<1.2	NA	5.1	9.5	1.6	11.9
Sed-7	05/22/87	5+50N 8+70W	ND	ND	<1.1	ND	<1.1	ND	ND	ND	<1.1	ND	<1.1	ND	ND	ND	ND	NA	<1.1	1.8	ND	11.3
Sed-8	05/22/87	6+40N 8+70W	ND	<1.3	6.6	<1.3	1.3	ND	<1.3	ND	1.3	ND	1.5	<1.3	ND	ND	<1.3	NA	1.9	5.9	2.1	13.0
Sed-9	05/22/87	6+30N 7+40W	ND	ND	ND	ND	ND	<1.2	ND	ND	<1.2	ND	<1.2	ND	ND	ND	ND	NA	<1.2	1.2	ND	12.0
Sed-10	05/22/87	7+00N 7+50W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	NA
Sed-11	05/26/87	7+50N 7+70W	ND	ND	ND	ND	<1.3	ND	ND	ND	<1.3	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	13.1
Sed-12	05/26/87	8+30N 7+80W	ND	ND	ND	ND	<1.4	ND	ND	ND	<1.4	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	13.78
Sed-13	05/26/87	8+30N 7+80W	ND	ND	ND	ND	<1.3	ND	ND	ND	<1.3	ND	<1.3	ND	ND	ND	ND	NA	<1.3	<1.3	ND	12.71
Sed-14	05/26/87	9+50N 7+80W	ND	ND	ND	ND	ND	ND	ND	ND	<1.3	ND	<1.3	ND	ND	ND	ND	NA	ND	<1.3	ND	12.75
Sed-15	05/26/87	9+50N 7+80W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	<1.4	ND	ND	ND	ND	NA	ND	<1.4	ND	14.26
Sed-16	05/26/87	10+00N 7+50W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	14.00
Sed-17	05/26/87	10+30N 10+90W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	14.43
Sed-18	05/26/87	10+00N 6+50W	ND	ND	<1.8	ND	<1.8	ND	ND	ND	<1.8	ND	<1.8	ND	ND	ND	ND	NA	<1.8	<1.8	ND	17.5
Sed-19	05/27/87	11+50N 7+30W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	12.34
Sed-20	05/27/87	12+70N 7+00W	ND	ND	ND	ND	<1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	<1.3	ND	12.77
Sed-21	05/27/87	13+70N 6+50W	ND	ND	ND	ND	ND	ND	ND	ND	<1.3	ND	<1.3	ND	ND	ND	ND	NA	<1.3	<1.3	ND	13.0
Sed-22	05/27/87	15+40N 6+30W	ND	ND	ND	ND	<1.3	<1.3	ND	ND	<1.3	ND	<1.3	ND	ND	ND	ND	NA	ND	<1.3	ND	12.9
Sed-23	05/27/87	15+80N 5+80W	ND	ND	ND	ND	ND	ND	ND	ND	<1.4	ND	ND	ND	ND	ND	ND	NA	<1.4	<1.4	ND	14.1
Sed-24	05/27/87	(3)	ND	ND	ND	ND	<1.2	ND	ND	ND	<1.2	ND	<1.2	ND	ND	ND	ND	NA	ND	<1.2	ND	12.16
									Surface Water Samples (in ppb)													
SW-1	05/27/87	4+50N 8+50W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	<11	ND	(5)
SW-2	05/27/87	6+30N 8+70W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	12	ND	(5)
SW-3	05/27/87	8+20N 7+70W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	12	ND	(5)
SW-4	05/27/87	8+20N 7+70W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	11	ND	(5)
SW-5	05/27/87	12+00N 7+00W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	<10	ND	(5)
SW-6	10/31/86	0+75S 8+50W	NA(4)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND	NA	ND	ND	(5)
SW-7	05/27/87	14+50N 6+30W	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	(5)

Notes: (1) ND = Not Detected.
(2) NA = Not Analyzed.
(3) Located approximately 120 ft. to the north of Sed-23 sample location and beyond the limits of the site coordinate system.
(4) <Compound is present at concentration below the indicated quantitation limit.
(5) Not Applicable.

DER/OM-T5(1)

TABLE 6-1
SUMMARY OF DAILY PRECIPITATION MEASUREMENTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

DAY	OCT(86)	NOV	DEC	JAN(87)	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP(87)
1	-	-	0.07	0.01	0.49	-	-	-	-			
2	-	-	-	-	-	-	0.02	0.02	-			
3	-	-	-	0.52	-	-	-	-	-			
4	1.17	1.46	-	0.71	-	-	-	0.03	-			
5	-	0.02	-	0.01	0.01	-	-	-	-			
6	-	0.04	-	-	-	-	-	-	-			
7	0.02	0.19	3.51	-	-	-	-	-	-			
8	2.00	0.02	0.59	-	-	-	-	-	-			
9	0.06	-	0.01	1.05	-	-	-	-	-			
10	-	0.95	-	-	-	-	-	-	-			
11	-	0.04	-	-	-	-	-	-	-			
12	1.00	0.01	-	-	-	-	-	-	-			
13	0.09	-	-	0.02	-	-	0.60	-	-			
14	-	-	0.02	0.01	0.69	-	0.23	-	-			
15	-	-	0.07	0.03	1.23	-	0.01	-				
16	-	-	-	0.03	-	-	-	-				
17	-	-	-	0.31	0.10	1.49	-	-				
18	-	-	-	0.38	-	-	-	0.03				
19	-	0.12	-	0.01	-	-	-	-				
20	-	-	-	-	0.07	-	-					
21	-	-	-	-	-	-	-	-				
22	0.24	0.02	-	-	0.10	-	-					
23	0.71	0.02	0.05	-	-	0.83	-	-				
24	0.20	0.10	-	-	-	0.01	-					
25	0.01	0.96	-	0.14	-	-	-	-				
26	-	-	-	-	0.20	-	-					
27	-	-	-	-	1.18	-	-	-				
28	-	-	-	-	0.61	-	-	-				
29	-	-	-	0.02	NA	0.53	-	-				
30	-	-	-	-	NA	0.11	-	-				
31	-	NA	-	-	NA	-	NA	-				
MONTH	5.50	3.95	4.32	3.25	4.68	2.97	0.86	0.08				

(1)NA = Not Applicable.

DER/OM-6-TAB

TABLE 6-2
SUMMARY OF TOTAL SUSPENDED PARTICULATE CONCENTRATIONS
HI-VOLUME AIR SAMPLERS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

ATE (1986)	WIND CONDITIONS FOR SAMPLING PERIOD	TOTAL SUSPENDED PARTICULATE CONCENTRATION ( )g/m^3) WEST SAMPLER	NORTH SAMPLER	EAST SAMPLER	SOUTH SAMPLER
10/03	33.3% S, 29.2% SSW, SW; 3 mph	39.8	40.4	37.8	93.5
10/04	25% WSW, 20.8% SW, 16.6% SSW, W; 2 mph	24.6	22.5	21.0	30.6
10/05	50% Calm, 12.5% NE, W, SW; 1 mph	16.9	17.2	20.4	21.5
10/06	50% Calm, 25% SE, 12.5% NNE; 1 mph	21.5	19.7	24.4	40.5
10/07	91.6% Calm, <0.5 mph	29.8	28.2	34.8	61.2
10/08	45.8% Calm, 16.6% ESE, 12.5% E; 2 mph	22.1	19.7	23.0	47.4
10/13	37.5% Calm, 50% W, 12.5% SSE; 2.5 mph	17.3	12.5	14.3	30.6
10/14	50% Calm, 25% W, 12.5% WSW, SW; 1.5 mph	24.0	19.0	20.0	47.2
10/15	67% Calm, 8.3% NW, SSE; 1 mph	28.0	21.0	24.4	62.0
10/16	25% WSW, 12.5% SW, W, 8.3% WNW, 4.2% S, SE, ESE; 0.5 mph	32.5	24.5	29.2	85.5
10/17	54.2% Calm, 16.6% S, 12.3% SW, 4.2% SSE, ESE, WSW; <0.25 mph	44.1	35.1	47.6	104.2
10/18	91.6% Calm, 8.3% NE; <0.25 mph	44.2	40.8	50.5	85.1
10/19	29.2% SE, 25% Calm, 12.5% ENE, ESE, 8.3% NNW, 4.2% SSE, E, S; <0.25 mph	41.9	39.3	51.8	91.5
10/20	20.8% SE, 16.6% SSE, Calm 8.3% ENE, NNW, 4.2% S, SW, WSW, ESE, E, N, NNE; 0.5 mph	68.3	60.1	87.5	119.6
10/21	41.6% Calm, 12.5% SSE, S, 8.3% SE, ESE, 4.2% SSW, ENE, NE, NNW; 1 mph	63.4	59.7	70.5	110.1
10/22	25% ENE, 16.6% E, 8.3% SSE, SSW, SE, W, 4.2% S, ESE, NE NNW, NW, Calm; <0.25 mph	51.8	44.2	53.3	82.7
10/27	37.5% Calm, 20.8% W, 12.5% WSW, S, 4.2% SW, ENE, NW, WNW; 1 mph	29.4	30.2	30.8	62.0

TABLE 6-2
(Continued)

R SAMPLING PERIOD	TOTAL SUSPENDED PARTICULATE CONCENTRATION ()g/m^3) WEST SAMPLER	NORTH SAMPLER	EAST SAMPLER	SOUTH SAMPLER
.5% S, SSE, 8.3%	34.9	32.2	34.4	71.1
.3% SW, 4.2% S,	43.9	35.5	39.8	83.4
.3% ENE, 4.2% ESE,	46.8	43.3	47.3	100.4
	44.4	40.7	46.5	85.5
NE, NNW, 4.2% N,	44.3	39.5	48.1	86.1
E, 8.3% Calm;	41.7	40.6	44.8	74.9

TABLE 6-3
CHEMICAL ANALYSES OF AIR SAMPLES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

ORGANIC VAPOR MONITOR SAMPLES

CONSTITUENT	ACGIH GUIDELINE (ppm)	PERIOD 10-3 TO 10-8	BLANK	% RECOVERY	PERIOD 10-13 TO 10-23	BLANK	% RECOVERY	PERIOD 10-27 TO 11-03
Biphenyl	0.2	<0.0011	<0.0018	88.5	<0.00055	<0.0017	93.2	ND
Hexane	50.	<0.0048	<.005	80.0	<0.0025	<0.0048	96.0	<0.0033
Methyl Styrene	50.	<0.064	<.066	75.2	<0.034	<0.064	186.0	<0.045
Phenol	5.	0.00015	<.00035	92.2	0.00018	<0.00035	82.1	.00019
Indene	10.	0.000021	0.00053	98.0	.000025	<0.00012	90.1	<0.000032
Naphthalene	10.	0.00096	0.001	114.6	.00088	0.0010	227.	0.00086
Phenanthrene	0.03	<0.000010	<0.0002	38.3	<.000002	<0.00002	46.	<0.0000028
Anthracene	0.03	<0.0000049	<.000015	30.9	<.000003	<0.000098	38.6	<0.0000034

PERSONNEL MONITOR SAMPLES

CONSTITUENT	ACGIH GUIDELINE (ppm)	10-22-86	10-30-86	10-30-86	11-12-86	11-12-86
Biphenyl	0.2	<0.011	NA(1)	<0.0023	NA	NA
Phenol	5	<0.003	<0.0015	0.0032	<0.0015	<0.0016
Indene	10	<0.0011	0.00065	<0.00070	0.0022	0.0016
Naphthalene	10	<0.0098	0.0063	0.0062	0.0078	0.0078
Phenanthrene	0.03	<0.00018	<0.00010	<0.00012	<0.000089	<0.000091
Anthracene	0.03	<0.000085	0.000031	<0.000056	<0.000043	<0.000044

(1)NA = Not Applicable.

DER/OM-6-TAB(4)

TABLE 8-1
PHYSICAL, CHEMICAL, AND ENVIRONMENTAL FATE PROPERTIES OF CONSTITUENTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS
(Page 1 of 2)

CLASS	CONSTITUENT	WATER (20-30°C) SOLUBILITY (MG/L)	VAPOR (20-30°C) PRESSURE (MM HG)	HENRY'S LAW CONSTANT	K_{OC} ML/G	MOL. WT.	LOG K_{OW}	FISH BCF[1] (L/KG)	HALF-LIFE IN AIR (DAYS)	HALF-LIFE IN SURFACE WATER (DAYS)	BOILING POINT (°C)	SPECIFIC GRAVITY	FLASH POINT (°C)
PNA[2]	ACENAPHTHENE	3.42	1.55×10^{-3}	9.2×10^{-5}	4600	154	4	242	-	-	278	1.024	-
PNA	ACENAPHTHYLENE	3.93	.029	.00143	2500	152	3.70	-	5.5	0.125	265-275	0.8988	-
PNA	ANTHRACENE	.0446	1.95×10^{-4}	1.02×10^{-3}	1.4×10^{4}	178	4.45	760	<1	-	340	1.25	121
VOLATILE	BENZENE	1750	95.2	.00559	83	78	2.12	5.2	6.0	1.0-6.0	80.1	0.8765	-11
PNA	BENZO(A)ANTHRACENE	.0057	2.2×10^{-8}	1.16×10^{-6}	1.38×10^{6}	228	5.6	-	5.5	0.1-5.0	435	-	-
PNA	BENZO(A)PYRENE	.0012	5.6×10^{-9}	1.55×10^{-6}	5.5×10^{6}	252	6.06	-	1.0-6.0	0.4	310	-	-
PNA	BENZO(B)FLUORANTHENE	.014	5.0×10^{-7}	1.19×10^{-5}	5.5×10^{5}	252	6.06	-	5.5	1.0-2.0	-	-	-
PNA	BENZO(G,H,I)PERYLENE	7.0×10^{-4}	1.03×10^{-10}	5.34×10^{-8}	1.6×10^{6}	276	6.51	-	-	-	-	-	-
PNA	BENZO(K)FLUORANTHENE	.0043	5.10×10^{-7}	3.94×10^{-5}	5.5×10^{5}	252	6.06	-	-	-	-	-	-
	CARBAZOLE	-	-	-	-	167	3.29	115	-	-	355	1.10	-
PNA	CHRYSENE	.0018	6.3×10^{-9}	1.05×10^{-6}	2.0×10^{5}	228	5.61	-	5.5	0.2	448	1.274	-
FURAN	DIBENZOFURAN (DIPHENYLENE OXIDE)	-	6.8×10^{-6}	-	-	168	5.30	3.2×10^{4}	-	-	288	5.8	-
PNA	FLUORANTHENE	.206	5.0×10^{-6}	6.46×10^{-6}	3.8×10^{-4}	202	4.90	1150	5.5	1.0-2.0	375	1.252	-
PNA	FLUORENE	1.69	7.1×10^{-4}	6.42×10^{-5}	7300	166	4.20	1300	-	-	295	1.202	-
PNA	INDENO(1,2,3-CD) PYRENE	5.3×10^{-4}	1.0×10^{-10}	6.86×10^{-8}	1.6×10^{6}	276	6.50	-	5.50	.0208-2.08	536	-	-
PNA	2-METHYL NAPHTHALENE	Insoluble	-	-	-	142	-	30 - 190	-	-	241	0.994	-
PNA	NAPHTHALENE	31.7	0.082	-	-	128	3.37	20-80	0.7	0.3	218	1.152	79
	PENTACHLOROPHENOL	14	1.1×10^{-4}	2.75×10^{-6}	5.3×10^{4}	266	5.01	770	21	5	310	1.978	-

[1] BCF = BIOCONCENTRATION FACTOR
[2] PNA = POLYNUCLEAR AROMATIC HYDROCARBONS ARE BASE/NEUTRAL COMPOUNDS.

DER/OM-8-TAB(5)

TABLE 8-1

PHYSICAL, CHEMICAL, AND ENVIRONMENTAL FATE PROPERTIES OF OLD MIDLAND CONSTITUENTS

CLASS	CONSTITUENT	WATER (20-30°C) SOLUBILITY (MG/L)	VAPOR (20-30°C) PRESSURE (MM HG)	HENRY'S LAW CONSTANT	K_{OC} ML/G	MOL. WT.	LOG K_{OW}	FISH BCF[1] (L/KG)	HALF-LIFE IN AIR (DAYS)	HALF-LIFE IN SURFACE WATER (DAYS)	BOILING POINT (°C)	SPECIFIC GRAVITY	FLASH POINT (°C)
PNA	PHENANTHRENE	1.0	$6.8X10^{-4}$	$1.59X10^{-4}$	$1.4X10^{4}$	178	4.46	2630	<1	0.38-2.0	340	1.025	-
PNA	PYRENE	0.132	$2.5X10^{-6}$	$5.04X10^{-6}$	$3.8X10^{4}$	202	4.88	-	.08 - 2	-	404	1.271	-
DIOXIN	TCDD	.0002	$1.7X10^{-6}$	$3.6X10^{-3}$	$3.3X10^{6}$	322	6.72	5000	-	365-730	500	-	-
VOLATILE	TOLUENE	535	28.1	.00637	300	92	2.73	10.7	1.3	0.17	111	0.8669	4
VOLATILE	TRICHLOROETHYLENE	1100	57.9	.0091	126	131	2.38	10.6	3.7	1.0-90.0	86.7	1.4649	32
VOLATILE	XYLENE (m)	146	6	-	240	106	3.2	23.6	0.5	1.5 - 9	139	0.864	29

REFERENCES:

Clements Assoc. (1985)
Sax (1979)
EPA (September 1984)
EPA (June 1986)
EPA (October 1986)
Versar (Jan. 14, 1986)
Verschueren (1983)

(1) BCF = BIOCONCENTRATION FACTOR.
(2) PNA = POLYNUCLEAR AROMATIC HYDROCARBONS ARE BASE/NEUTRAL COMPOUNDS.

DER/OM-8-TAB(6)

TABLE 8-2

CHLORINATED DIOXIN AND FURAN CONCENTRATIONS IN TERMS OF 2,3,7,8-TCDD EQUIVALENTS[1]
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS
(PAGE 1 OF 3)

DESIGNATION	SAMPLE NO.	DEPTH OF SAMPLE (FT)	SAMPLE TYPE	CONCENTRATION WATER (PPT) AND SOIL (PPB) 2,3,7,8 - TCDD EQUIVALENT[2]
MW-3S	GW-30	--	Groundwater	0.0320
MW-4S	GW-27	--	Groundwater	0
MW-5S	GW-5	--	Groundwater	ND
MW-8S	GW-17	--	Groundwater	0
MW-9S	GW-8	--	Groundwater	ND
MW-10S	GW-13	--	Groundwater	ND
MW-11S[4]	GW-21	--	Groundwater	0.0064
MW-11S[4]	GW-21A	--	Groundwater	15.7574
MW-11S[4]	GW-21A	--	Groundwater	0.0112
MW-11S[4]	GW-21A	--	Groundwater	0.0120
FB	3	--	Field Blank (Water)	0
City of Ola Supply	CW-1A	--	Water	ND
Niely Well	WW-3	--	Water	ND
Barnes Well	WW-7	--	Water	ND
Lagoon 1	C	--	Water	0.7324
Lagoon 5	C	--	Water	0.1897
Lagoon 1	A	~1[3]	Sediment	9.843
Lagoon 5	A	4.5[3]	Sediment	42.773
MW-11S	SS-1A	10-11	Soil	0.0002
MW-11S	ST-2B	5-7	Soil	0

1)

TABLE 8-2
(Cont'd)
CHLORINATED DIOXIN AND FURAN
CONCENTRATIONS IN TERMS OF
2,3,7,8-TCDD EQUIVALENTS(1)
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS
(PAGE 2 OF 3)

DESIGNATION	SAMPLE NO.	DEPTH OF SAMPLE (FT)	SAMPLE TYPE	CONCENTRATION WATER (PPT) AND SOIL (PPB) 2,3,7,8 - TCDD EQUIVALENT(2)
MMW-11S	SS-2B	15-16	Soil	0
MW-11S	SS-2C	15-16	Soil	0
MW-11S	SS-3A	19-20	Soil	0.0005
MW-11S	SS-3A	19-20	Soil	0.0010
MW-11S	SS-3A	19-20	Soil	1.3509
--	S-65A	0-0.5	Soil	0
--	S-66A	0.5-1	Soil	0
--	S-68A	0-0.5	Soil	0.0600
--	S-69A	0.5-1	Soil	0.0092
--	S-75A	0-0.5	Soil	0.0947
--	S-75B	0-0.5	Soil	0.0650
--	S-76A	0.5-1	Soil	0.0057
--	S-85A	0-0.5	Soil	0.0010
--	S-86A	0.5-1	Soil	0.0011

TABLE 8-2
(Cont'd)

CHLORINATED DIOXIN AND FURAN
CONCENTRATIONS IN TERMS OF
2,3,7,8-TCDD EQUIVALENTS(1)
OLD MIDLAND PRODUCTS SITE
PAGE (3 OF 3)

Note: (1) Calculations assume that ND = Not Detected is zero and that dioxins and furans present are in the 2, 3, 7,8 form.

(2) Dioxins	Isomer or Toxicity Equivalent Factor
2,3,7,8-TCDD	1.0
other TCDDs	0.01
2,3,7,8-PeCDD	0.5
other PeCDDs	0.005
2,3,7.8 - HxCDD	0.04
other HxCDDs	0.0004
2,3,7.8 - HpCDD	0.001
other - HpCDDs	0.00001
OCDD	0
Furans	
2,3,7,8 - TCDF	0.1
other TCDFs	0.001
2,3,7,8 - PeCDF	0.1
other PeCDFs	0.001
2,3,7,8 - HxCDF	0.01
other HxCDFs	0.0001
2,3,7,8 - HpCDF	0.001
other HpCDFs	0.00001
OCDF	0
2,3,7,8-TCDD	Equivalent Total

(3) Depth of water covering sediment.
(4) Replicate samples.

Reference: EPA (March 1987) "Interim Procedure for Estimating Risks Associated with Exposure to Mixtures of Chlorinated Dibenzo - P - Dioxins and Dibenzofurans (CDD's and CDF's) EPA/625/3-87/012

pp. 2 and 3

TABLE 8-3
CONTAMINANT - SPECIFIC ARARs
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS
(Page 1 of 3)

CHEMICAL	MEDIA	LIMIT	EXPOSURE SCENARIO	APPLICABILITY AND RESTRICTIONS	REFERENCE
Pentachlorophenol (PCP)	Air	0.5 mg/m^3	Occupational Exposure	Time weighted averaged 8-hour day.	NIOSH/OSHA
PCP	Combined Routes- Air, Drinking Water and Food	1.1 mg/l	AADI	Adjusted acceptable daily intake, converts "no effect" level to terms measurable in terms of drinking water quality.	Federal Register November 13, 1985
PCP	Drinking Water Contribution Only	0.2 mg/l	RMCL	Health based "goal" not an enforceable standard.	Safe Drinking Water Act/ National Primary Drinking Water Regulations Proposed (Fed. Reg. Nov. 13, 1985)
PCP	Drinking Water	1.0 mg/l	1 Day Exposure	Allowable intake by 10 kg child.	Safe Drinking Water Act Health Advisory
PCP		0.3 mg/l	10 Day Exposure	Allowable intake by 10 kg child.	
PCP	Drinking Water	3.5 mg/l 1.1 mg/l	1 Day Exposure 10 Day Exposure	Allowable intake by 70 kg adult.	Safe Drinking Water Act Health Advisory
PCP	Water Quality	1.01 mg/l	Human Health Criterion	Minimum water quality criteria for water which can be taken into a public water supply system.	Clean Water Act, Water Quality Criteria Documents (Fed. Register Nov. 28, 1980)
PCP	Water Quality	0.1 X LC_{50}	Aquatic Life	Allowable exposure to aquatic life.	Arkansas Water Quality Regulation No. 2

TABLE 8-3
CONTAMINANT - SPECIFIC ARARs
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

CHEMICAL	MEDIA	LIMIT	EXPOSURE SCENARIO	APPLICABILITY AND RESTRICTIONS	REFERENCE
PCP	Leachate	3.6 mg/l	Proposed TCLP regulatory level, result of specific leachate generation test.	At or above this regulatory limit it is thought that an unacceptably high level of ground water contamination might result from improper waste management.	Proposed expansion of RCRA Toxicity Characteristic 40 CFR 261 (Federal Register June 13, 1986)
Polynuclear Aromatics (PNAs)	Drinking Water	280 ng/l 28 ng/l 2.8 ng/l 0.28 ng/l	10^{-4} Cancer Risk 10^{-5} Cancer Risk 10^{-6} Cancer Risk 10^{-7} Cancer Risk	Estimates of the carcinogenic risks associated with lifetime exposure to various concentrations of carcinogenic PNAs in water. Conservatively assumes that all PNAs have the same carcinogenic potency of benzo(a) pyrene.	EPA Ambient Water Quality Criteria Nov. 28, 1980)
PNAs	Water Quality	0.01 X LC_{50}	Aquatic Life	Allowable exposure to aquatic life.	Arkansas Water Quality Regulation No. 2.
Benzo(a) pyrene no other PNAs	Soil	4 ppb 400 ppb	10^{-6} Cancer Risk 10^{-4} Cancer Risk	Exposure to dust and soils in residential areas.	Information contained in EPA memo entitled "Alternate Concentration Limits for Dioxin Ground Water Contamination at Wood Preserving Sites" from Cate Jenkins to Bob Stewart, Table 6 (based on equation formulated by New York State Department of Health)

TABLE 8-3
CONTAMINANT - SPECIFIC ARARs
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS
(Page 3 of 3)

CHEMICAL	MEDIA	LIMIT	EXPOSURE SCENARIO	APPLICABILITY AND RESTRICTIONS	REFERENCE
2,3,7,8-TCDD	Water Quality Criteria Drinking Water	Drinking Water 1.3×10^{-6} ug/l	10^{-4} Cancer Risk (Extrapolated)	Ingestion of contaminated water and contaminated aquatic organisms.	EPA, Federal Register (Feb. 15, 1984)
		1.3×10^{-7} ug/l	10^{-5} Cancer Risk		
		1.3×10^{-8} ug/l	10^{-6} Cancer Risk		
		1.3×10^{-9} ug/l	10^{-7} Cancer Risk		

DER/OM-8-TAB(13)

TABLE 8-4
POTENTIAL PATHWAYS FOR CONTAMINANT MIGRATION
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

Transport/Exposure Medium	Exposure Point	Exposure Route
Air	• On-site (e.g., exposure to plant personnel or remediation workers)	Inhalation
	• Nearest residence to source	Inhalation
	• Nearest population magnet (e.g., shopping center, school, industrial park)	Inhalation
	• Other residence/population at point of highest concentration	Inhalation
	• 1,000 feet from a unit boundary to a receptor	Inhalation
Soil	• On-site (e.g., worker exposure or trespass scenario)	Dermal, ingestion
	• Immediately adjacent to site (if site is restricted)	Dermal, ingestion
	• Nearest cropland	Ingestion (food)
Ground Water	• Nearest potable well (private or public)	Ingestion, dermal inhalation
	• Nearest agricultural well	Inhalation, ingestion (food), dermal
	• Nearest well for other uses (e.g., industrial)	Inhalation, dermal
Surface Water	• Withdrawal point for potable use	Ingestion, dermal, inhalation
	• Withdrawal point for agricultural use	Inhalation, ingestion (food), dermal
	• Withdrawal point for other uses (e.g., industrial)	Inhalation, dermal
	• Nearest point for swimming/contact sports	Ingestion, dermal
	• Nearest point for fishing	Ingestion (food)
	• Surface water body closest to a hazardous waste facility	Ingestion, dermal inhalation

Source: EPA (1986).

DER/OM-8-TAB(4)

TABLE 8-5
NON-CARCINOGENIC
RISK CHARACTERIZATION FOR
DERMAL CONTACT AND ORAL INGESTION
SOIL EXPOSURE VIA TRESPASS AND
RESIDENTIAL SCENARIOS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

EXPOSURE SCENARIO	CHEMICAL	INTAKE PATHWAY	CHEMICAL CONCENTRATION MG(CHEM)/KG(SOIL)	CDI* MG (CHEMICAL)/ KG (BODY WEIGHT) DAY	ADI**/BODY WEIGHT MG (CHEMICAL)/ KG (BODY WEIGHT) DAY	CDI AS % OF ADI/BODY WEIGHT CDI (100%) ADI/BODY WEIGHT
1. 2 Year limited trespass by 11-12 year old	PCP	oral ingestion	9.5898	0.0378×10^{-6}	30.0×10^{-3}	0.0001%
		dermal absorption		0.5464×10^{-6}	30.0×10^{-3}	0.0018%
		total		0.5842×10^{-6}	30.0×10^{-3}	0.0019%
	Phenanthrene	oral ingestion	109.9624	0.4334×10^{-6}	6.0×10^{-3}	0.0072%
		dermal absorption		6.2657×10^{-6}	6.0×10^{-3}	0.1044%
		total		6.6991×10^{-6}	6.0×10^{-3}	0.1117%
2. Residential Soil-lifetime	PCP	oral ingestion	9.5898	9.4555×10^{-6}	30.0×10^{-3}	0.0315
		dermal absorption	--	not calculated	--	not calculated
	Phenanthrene	oral ingestion	109.9624	108.4229×10^{-6}	6.0×10^{-3}	1.8070
		dermal absorption	--	not calculated	--	not calculated

NOTES:

* CDI, daily chemical intake based on exposure scenario.
** ADI, acceptable daily intake.

DER/OM-8-TAB(8)

TABLE 8-6
PREDICTED GROUNDWATER CONCENTRATIONS
AT DOWNGRADIENT OBSERVATION POINTS[1]
FOR NAPHTHALENE AND PENTACHLOROPHENOL
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

POINT SOURCE LOCATION	DISTANCE (FT.) FROM POINT SOURCE TO OBSERVATION POINT DOWNGRADIENT	RETARDATION FACTOR USED IN COMPUTER GROUNDWATER MODEL	MAXIMUM % TOTAL CONCENTRATION RANGE ASSUMING VARIOUS DISPERSION COEFFICIENTS (M^2/DAY)			PREDICTED LEACHATE CONCENTRATIONS IN PPM	MAXIMUM GROUNDWATER CONCENTRATION (PPB) AT OBSERVATION POINT ASSUMING VARIOUS DISPERSION COEFFICIENTS (M^2/DAY)		
			0.08	0.32	0.64		0.08	0.32	0.64
NAPHTHALENE									
7 On-Site Lagoons	400 (Mr. Nisly's Well)	1[2]	88	62	52	0.4103[4]	361	253	213
	1,080 (Property Boundary)	1[2]	64	38	29	0.4103[4]	262	156	119
	1,950 (Mrs. Barnes Well)	1[2]	51	27	21	0.4103[4]	209	111	86
7 On-Site Lagoons	400 (Mr. Nisly's Well)	41[3]	3.09	1.78	1.44	0.4103[4]	13.0	7.3	6.0
	1,080 (Property Boundary)	41[3]	1.8	0.96	0.73	0.4103[4]	7.4	4.0	3.0
	1,950 (Mrs. Barnes Well)	41[3]	1.3	0.69	0.51	0.4103[4]	5.3	2.8	2.1
PENTACHLOROPHENOL[5]									
7 On-Site Lagoons	400 (Mr. Nisly's Well)	1[2]	88	62	52	1.372[4]	1,207	850	713
	1,080 (Property Boundary)	1[2]	64	38	29	1.372[4]	878	521	398
	1,950 (Mrs. Barnes Well)	1[2]	51	27	21	1.372[4]	699	370	288

NOTES:
(1) Based upon a computer evaluation of one dimensional contaminant transport.
(2) Retardation factor of 1 (No Attenuation) was used as a worse case scenario for naphthalene and pentachlorophenol.
(3) Retardation factor of 41 was calculated for naphthalene (conservative estimate).
(4) Predicted leachate concentrations were calculated based upon existing lagoon laboratory data for naphthalene and pentachlorophenol.
(5) A retardation factor (conservative estimate) was not calculated for pentachlorophenol.
(6) + 50 years.

TABLE 8-7
STREAM SEDIMENT AND WATER CONCENTRATIONS
VS. AQUATIC TOXICITY OF INDICATOR CHEMICALS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

INDICATOR CHEMICAL	HIGHEST SEDIMENT CONCENTRATION (MG/KG)	HIGHEST WATER CONCENTRATION (UG/L)	TOXICITY CONCENTRATION FOR AQUATIC ORGANISMS (UG/L)	AMBIENT WATER QUALITY CRITERIA	FISH BCF (L/KG)
CP	9.5	12	55 and 32(1)	1.01 mg/l	770
PAH's	5.1	ND	300(2)	0 (2.8 ng/l)(3)	2630 (phenanthrene)

1) Acute and chronic concentrations for freshwater aquatic life.
2) Value presented is the lowest observed adverse effect level reported for saltwater organisms. No fresh water organism data were found in the literature.
3) Corresponds to midpoint of risk range for carcinogens.

REFERENCES:

EPA (October 1986)
EPA (May 1986)

ER:OM-8-TAB(9)

TABLE 8-8
FEASIBILITY STUDY OBJECTIVES
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

PATHWAY:	Ground Water
OBJECTIVE:	Protect uncontaminated ground water for future use, minimizing migration and spread of contaminants within the aquifer.
PATHWAY:	Lagoon Wastes
OBJECTIVE:	Minimize long term threat to human health and the environment.
PATHWAY:	Soil
OBJECTIVE:	Minimize long term threat to human health and the environment.
PATHWAY:	Surface Water
OBJECTIVE:	Minimize long term threat to human health and the environment.
PATHWAY:	Drainageway Sediments
OBJECTIVE:	Minimize long term threat to human health and the environment.
PATHWAY:	Air
OBJECTIVE:	Protection of potential workers on-site.

DER/OM-8-TAB(10)

TABLE 9-1
SUMMARY OF LAGOON SEDIMENT STABILIZATION TEST RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

LAGOON	-- WEIGHT RATIO OF MIX AGENT -- TO LAGOON SEDIMENT				EQUILIBRIUM PENETROMETER VALUE	SHEAR STRENGTH (TSF)(1)	DESCRIPTION	TIME (HOURS) TO ACHIEVE EQUILIBRIUM STRENGTH
	FLY ASH	CEMENT KILN DUST	LIME	WATER				
1	0.6	0.6	0	0	0.3	0.08	Very Soft	46
	0	1.0	0	0	0.3	0.08	Very Soft	46
	0	0	0.6	0	0	0	Very Soft	NA(2)
	.3	0	0.3	0	0	0	Very Soft	NA
	.4	0	0.5	0	0	0	Very Soft	NA
	0	0.8	0	0	1.2	0.38	Firm	4
2	0.2	0.1	0	0.1	1.8	0.58	Stiff	22
	0	0.3	0	0.1	1.3	0.40	Firm	20
	0	0	0.3	0.15	1.3	0.40	Firm	20
	0.15	0.15	0.15	0	1.6	0.48	Firm	24
	0.2	0.20	0.10	0.1	1.3	0.40	Firm	26
	0	0	0	0.05	1.3	0.40	Firm	20
3	0.6	0.4	0	0	0.3	0.08	Very Soft	48
	0	0.7	0	0.05	0	0	Very Soft	NA
	0	0	0.8	0.05	0	0	Very Soft	NA
	0.4	0	0.6	0.1	0.3	0.08	Very Soft	48
	0.3	0	0.6	0.1	0	0	Very Soft	NA
	0	1.0	0	0.1	0.5	0.15	Soft	48
4	0.2	0.1	0	0.06	4.3	1.33	Very Stiff	30
	0	0.5	0.16	0.10	1.5	0.46	Firm	70
	0	0	0.6	0.36	0	0	Very Soft	NA
	0.3	0	0.3	0.22	4.5	1.50	Hard	24
	0.25	0	0.6	0.44	4.5	1.50	Hard	22
	0	0.2	0	0.06	4.5	1.50	Hard	92
5	0.2	0.6	0	0	2.5	0.78	Stiff	48
	0	0.95	0	0	2.0	0.62	Stiff	48
	0	0	0.6	0	0	0	Very Soft	NA
	0.3	0	0.5	0.1	1.0	0.31	Firm	6
	0.2	0	0.4	0	0	0	Very Soft	NA
	0	0.9	0	0	2.3	0.70	Stiff	48
6	.4	0.2	0	0	1.5	0.46	Firm	46
	0	0.6	0	0	1.5	0.46	Firm	46
	0	0	0.6	0.05	0	0	Very Soft	NA
	0.3	0	0.3	0	0	0	Very Soft	NA
	0.4	0	0.35	0	1.3	0.40	Firm	46
	0	0.75	0	0	2.5	0.78	Stiff	46

TABLE 9-1
(Continued)

LAGOON	FLY ASH	CEMENT KILN DUST	LIME	WATER	EQUILIBRIUM PENETROMETER VALUE	SHEAR STRENGTH (TSF)(1)	DESCRIPTION	TIME (HOURS) TO ACHIEVE EQUILIBRIUM STRENGTH
7	0.1	0.05	0	0	0.8	0.24	Soft	20
	0	0.3	0	0.1	0.8	0.24	Soft	4
	0	0	0.3	0.1	0	0	Very Soft	NA
	0.15	0	0.15	0.15	1.2	0.38	Firm	18
	0.2	0	0.1	0.1	1.7	0.54	Firm	18
	0	0.2	0	0.1	1.0	0.31	Firm	4

(1)TSF = Tons per Square Foot.
(2)NA = Not Applicable.

DER/OM-9-TAB

TABLE 9-2

SUMMARY OF CARBON TREATABILITY TEST RESULTS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

SAMPLE FLUID											
Lagoon No. 1 and No. 3	C, mg/l	0.12	<0.002	<0.002	<0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002
	V,l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	(C)V, mg		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	X, mg		0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
	X/M, mg/g		1.2	0.60	0.30	0.12	0.060	0.030	0.012	0.0060	0.0030
Lagoon No. 2 and No. 7	C, mg/l	0.28	0.0050	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	V, l	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	(C) V, mg		0.0020	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	X, mg		0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	X/M, mg/g		2.1	1.1	0.52	0.22	0.11	0.055	0.022	0.011	0.0054
Lagoon No. 5 and No. 6	C, mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Monitoring Well 3S Ground Water	C, mg/l	2.2	0.28	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	V, l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	(C) v, mg		0.14	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	X, mg	0.96	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
	X/M, mg/g		19	11	5.5	2.2	1.1	0.55	0.22	0.11	0.055

DER/OM-9-TAB(3)

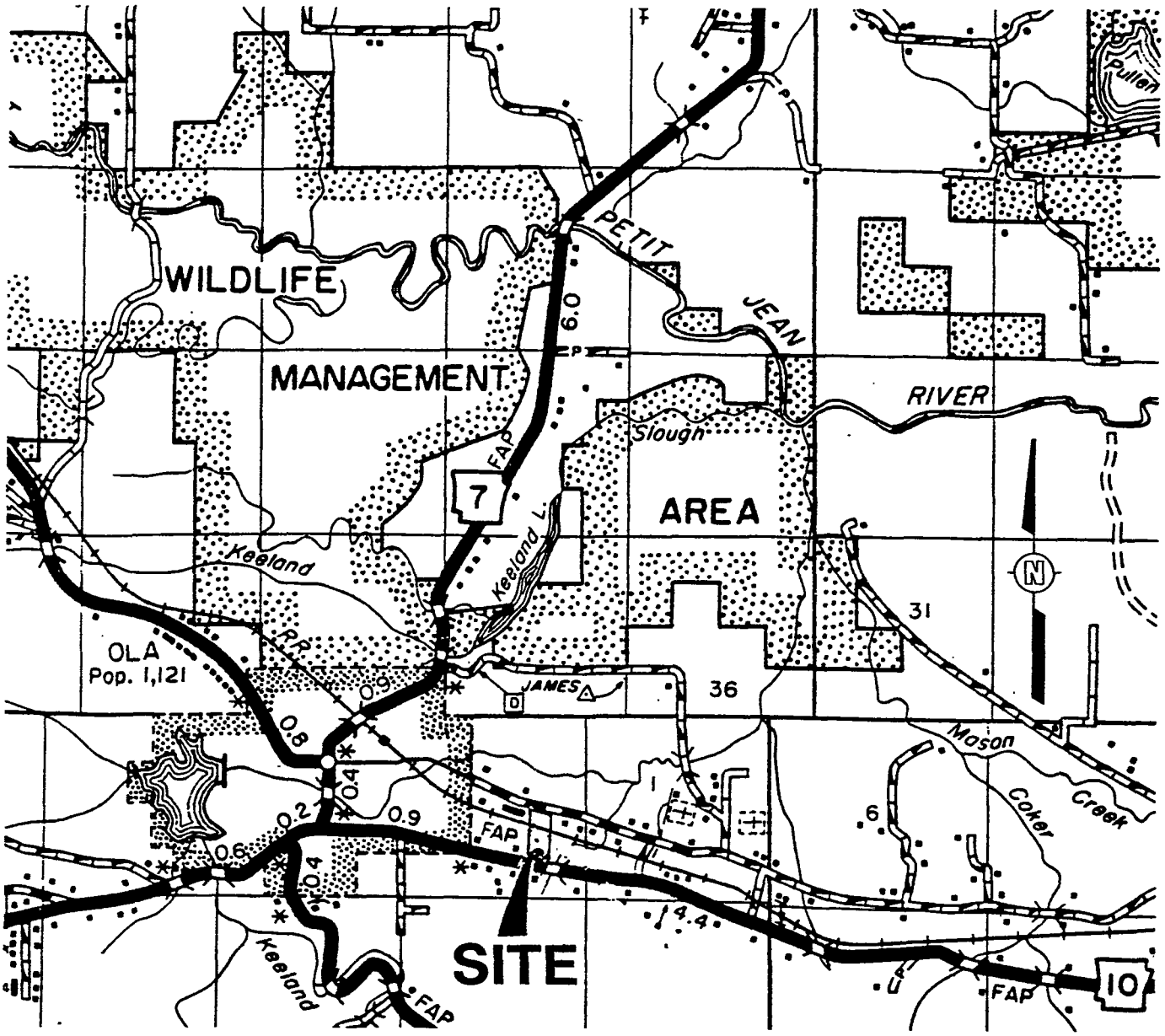
TABLE 9-2
(Continued)

SAMPLE FLUID											
Monitor Well 3S and 11S ground water (1 to 2 ratio)	C, mg/l	1.9	0.056	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	V, l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	(C) V, mg		0.028	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	X, mg		0.92	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
	X/M, mg/g		18	9.5	4.8	1.9	0.95	0.48	0.19	0.095	0.048
Monitor Well 3S and 11S ground water (1 to 2 ratio)	C, mg/l	1.5	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	V, l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	(C) V, mg		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	X, mg		0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	X/M, mg/g		15	7.5	3.8	1.5	0.75	0.38	0.15	0.075	0.038

Method: ASTM D3860, EPA Method 604

NOTES: C=PCP concentration, X=PCP adsorbed, (C) V=PCP remaining in sample, V = Fluid Volume in l, M=weight of Carbon used.

DER/OM-9-TAB(4)



MILES
0
1

ARKANSAS

FIGURE 1-1

SITE LOCATION MAP
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

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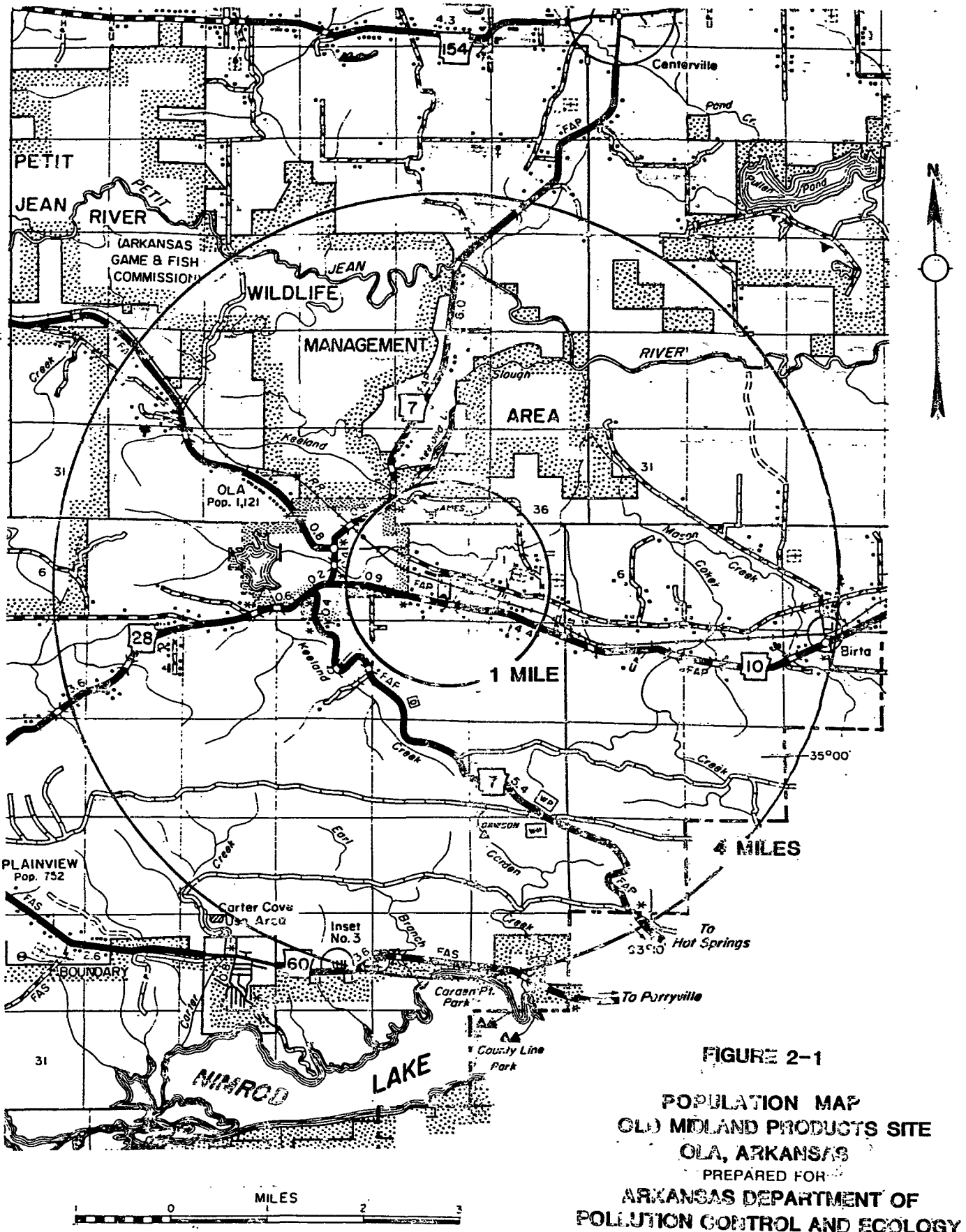

FIGURE 2-1

POPULATION MAP
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS
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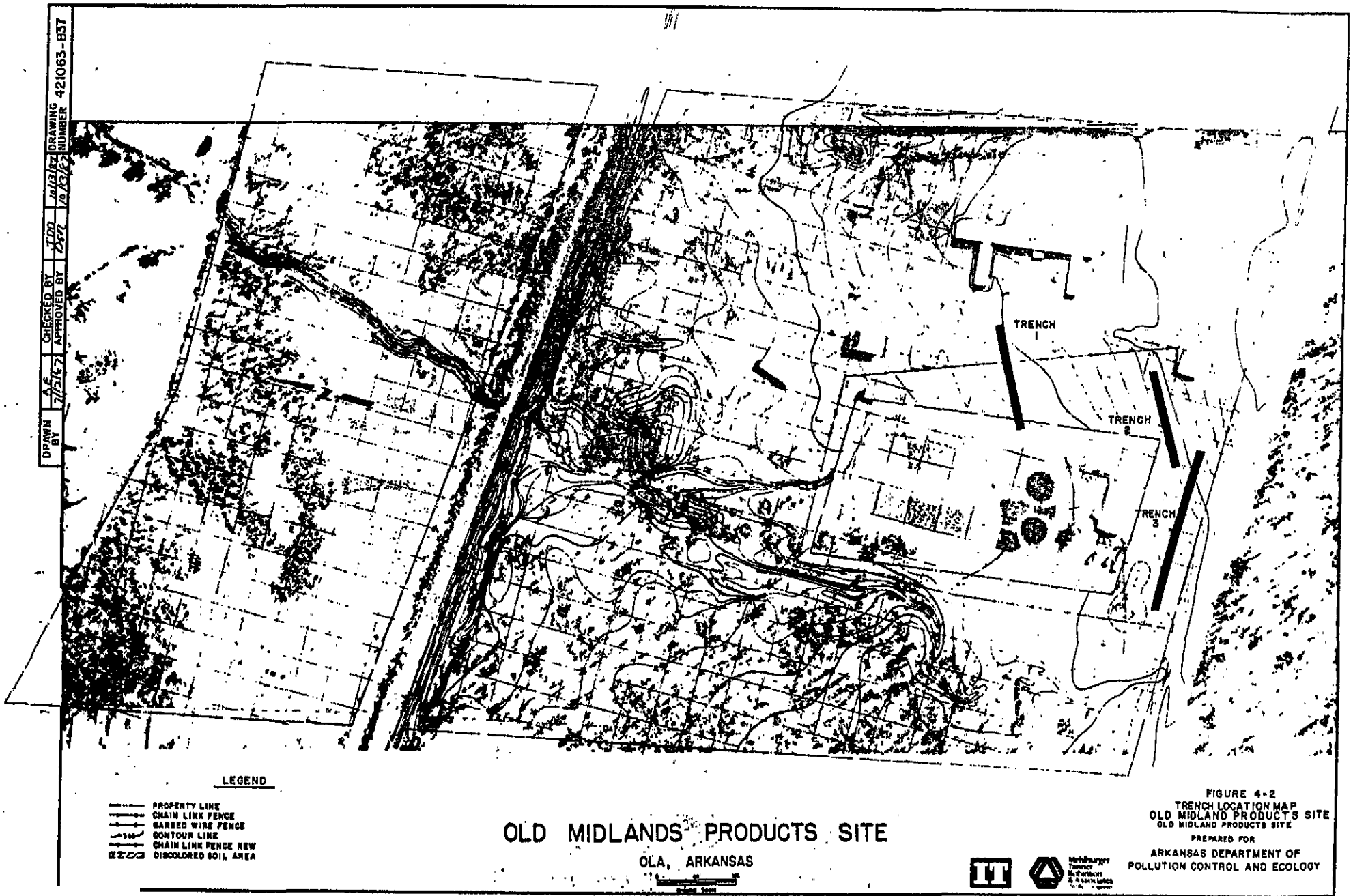

FIGURE 4-2
TRENCH LOCATION MAP
OLD MIDLAND PRODUCTS SITE
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001425

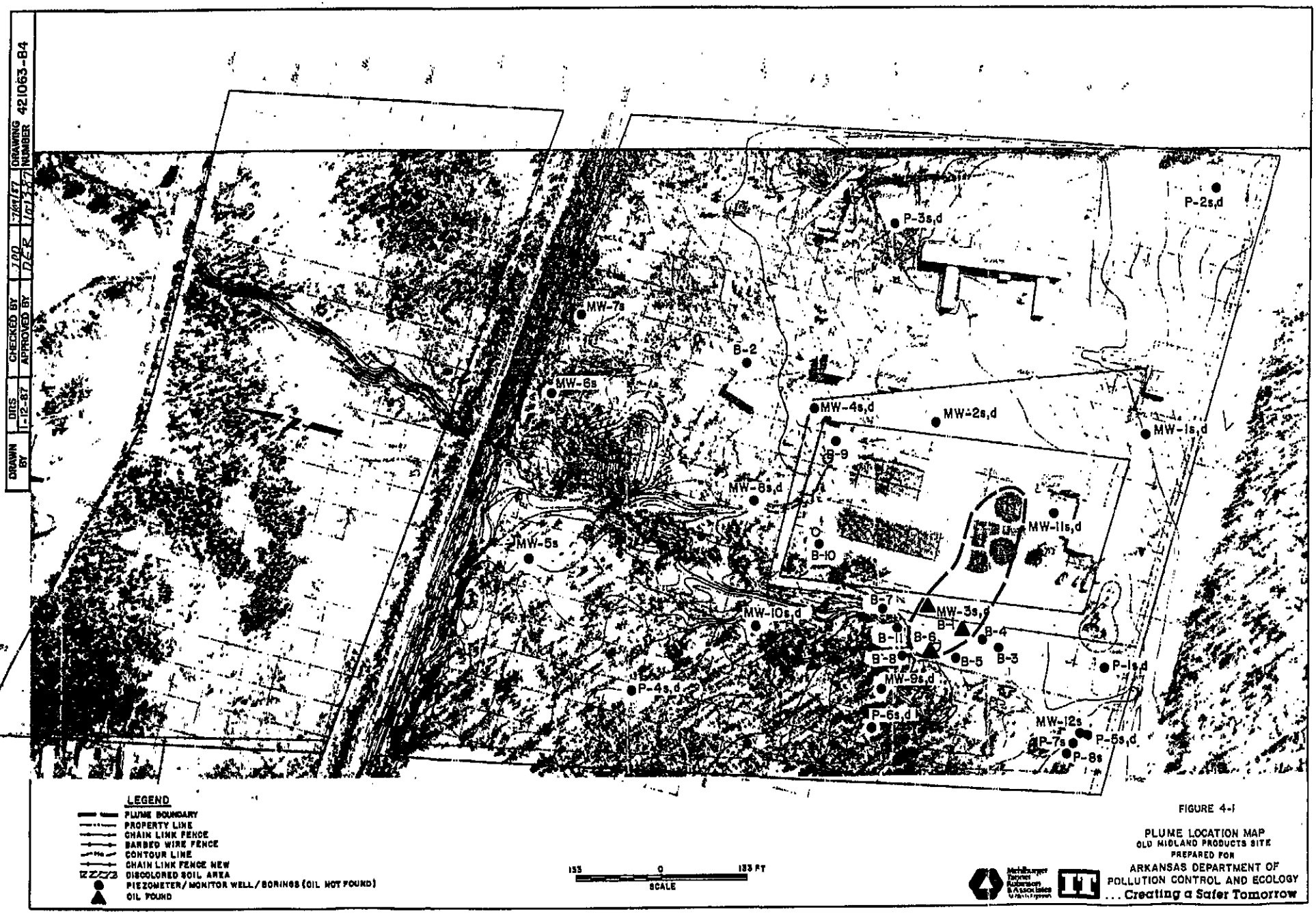

FIGURE 4-1

PLUME LOCATION MAP
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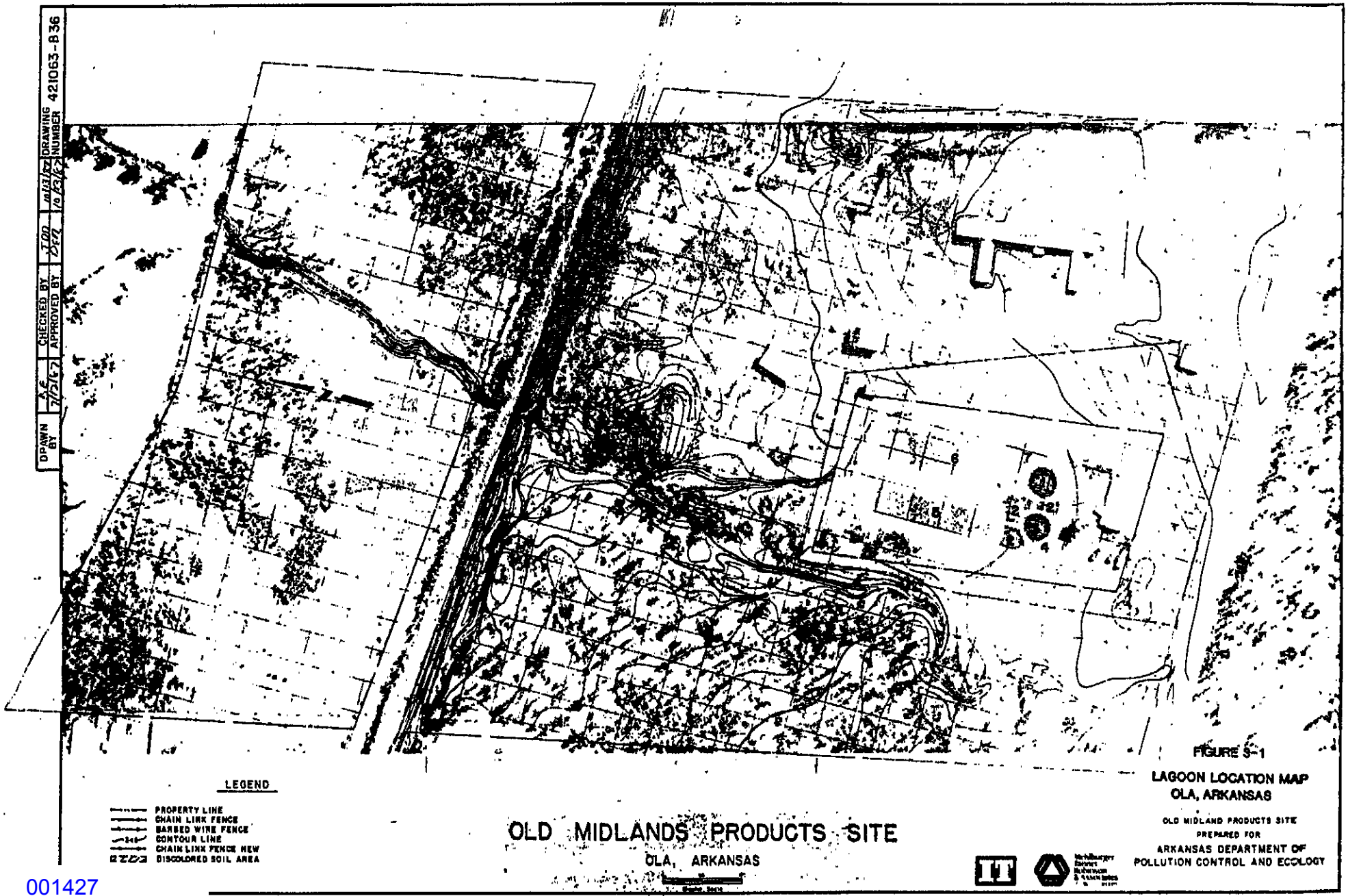
DRAWN BY
CHECKED BY
APPROVED BY
DRAWING NUMBER 421063-836
LEGEND
PROPERTY LINE
CHAIN LINK FENCE
BARBED WIRE FENCE
CONTOUR LINE
CHAIN LINK FENCE NEW
DISCOLORED SOIL AREA
OLD MIDLANDS PRODUCTS SITE
OLA, ARKANSAS
FIGURE 5-1
LAGOON LOCATION MAP
OLA, ARKANSAS
OLD MIDLAND PRODUCTS SITE
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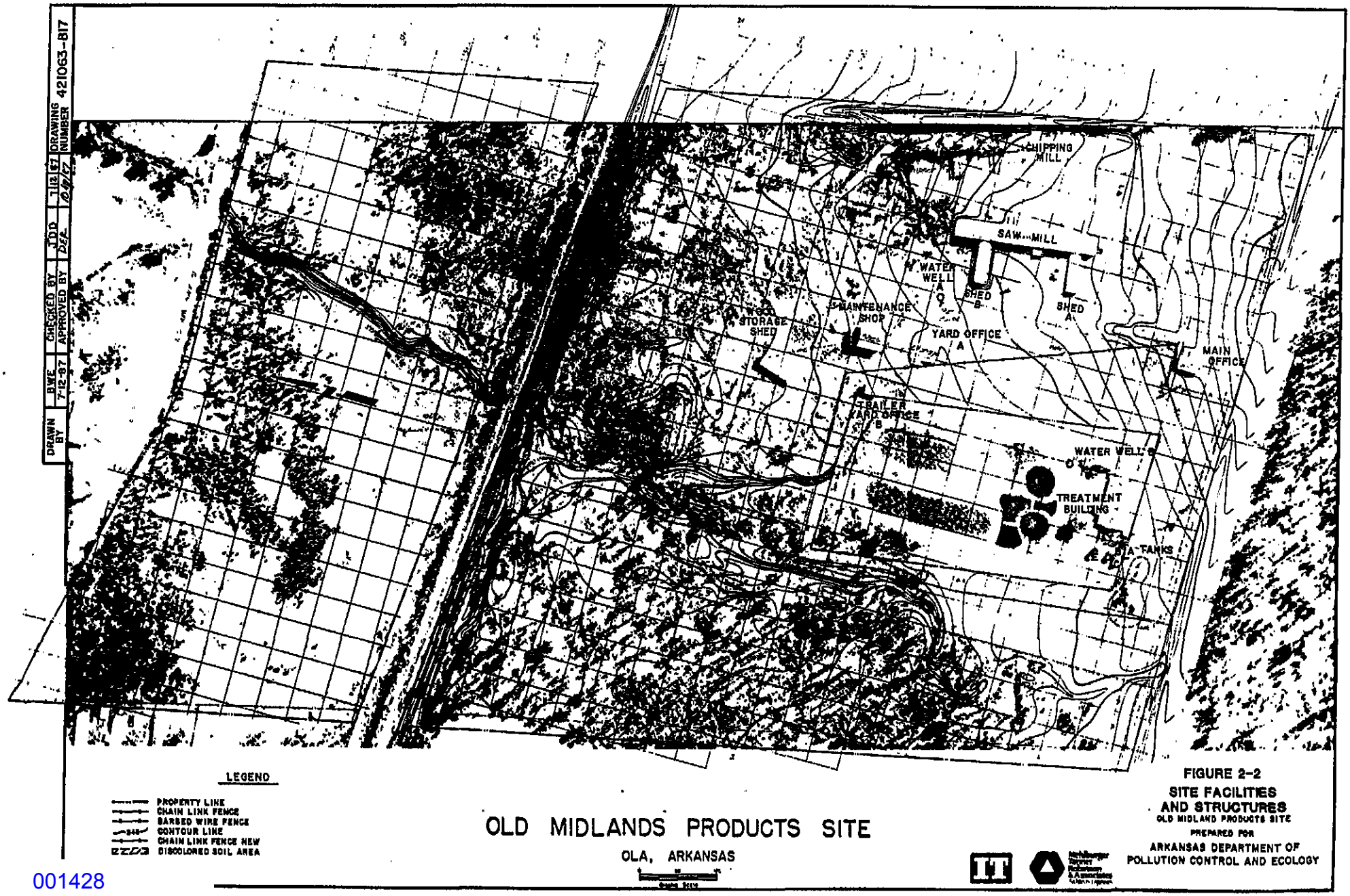
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BME
7-12-87
CHECKED BY
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JDD
DRAWING NUMBER
421063-817
CHIPPING MILL
SAW MILL
WATER WELL A
SHED B
SHED A
WOOD STORAGE SHED
MAINTENANCE SHOP
YARD OFFICE A
MAIN OFFICE
TRAILER YARD OFFICE B
WATER WELL B
TREATMENT BUILDING
TANKS
LEGEND
PROPERTY LINE
CHAIN LINK FENCE
BARBED WIRE FENCE
CONTOUR LINE
CHAIN LINK FENCE NEW
DISCOLORED SOIL AREA
OLD MIDLANDS PRODUCTS SITE
OLA, ARKANSAS
FIGURE 2-2
SITE FACILITIES AND STRUCTURES
OLD MIDLAND PRODUCTS SITE
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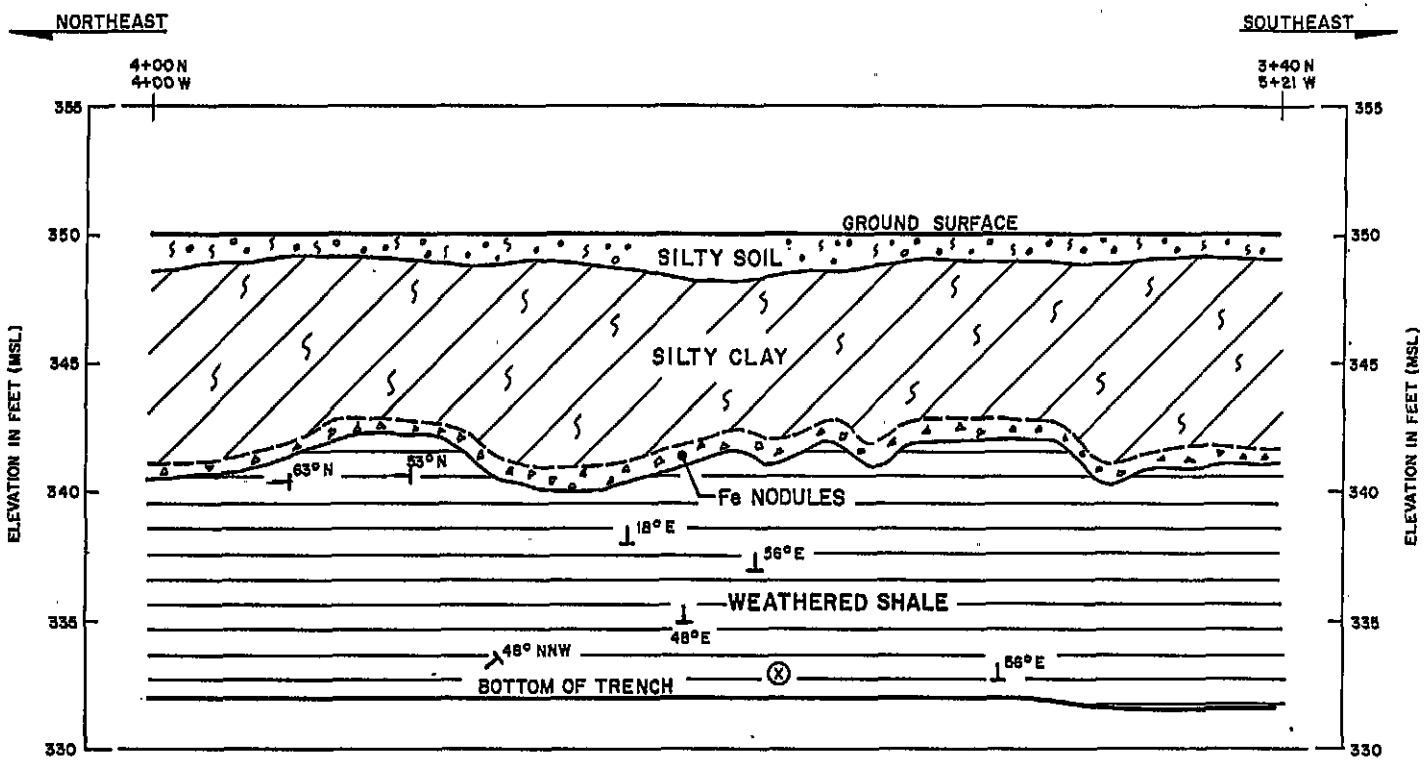
001428



LEGEND

⊗ GROUND WATER SEEPAGE OBSERVED AT THIS POINT DURING EXCAVATION.

18°E MEASURED DIRECTION AND DIP OF BEDDING PLANE AT THIS LOCATION

THE TRENCH SECTIONS REPRESENT INTERPRETATIONS MADE FROM FIELD DATA COLLECTED FROM WITHIN THE EXCAVATED TRENCHES (TRENCH 1 AND TRENCH 2) AND FROM OBSERVATIONS MADE FROM THE SURFACE ADJACENT TO THE TRENCHES (TRENCHES 2 AND 3). GROUND SURFACE ELEVATIONS SHOWN ARE PRETRENCHING ELEVATIONS.

5 0 5 FT
VERTICAL SCALE

15 0 15 FT
HORIZONTAL SCALE

FIGURE 4-3

TRENCH 1 CROSS-SECTION
REMEDIAL INVESTIGATION REPORT
OLD MIDLAND PRODUCTS SITE

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10/13/87
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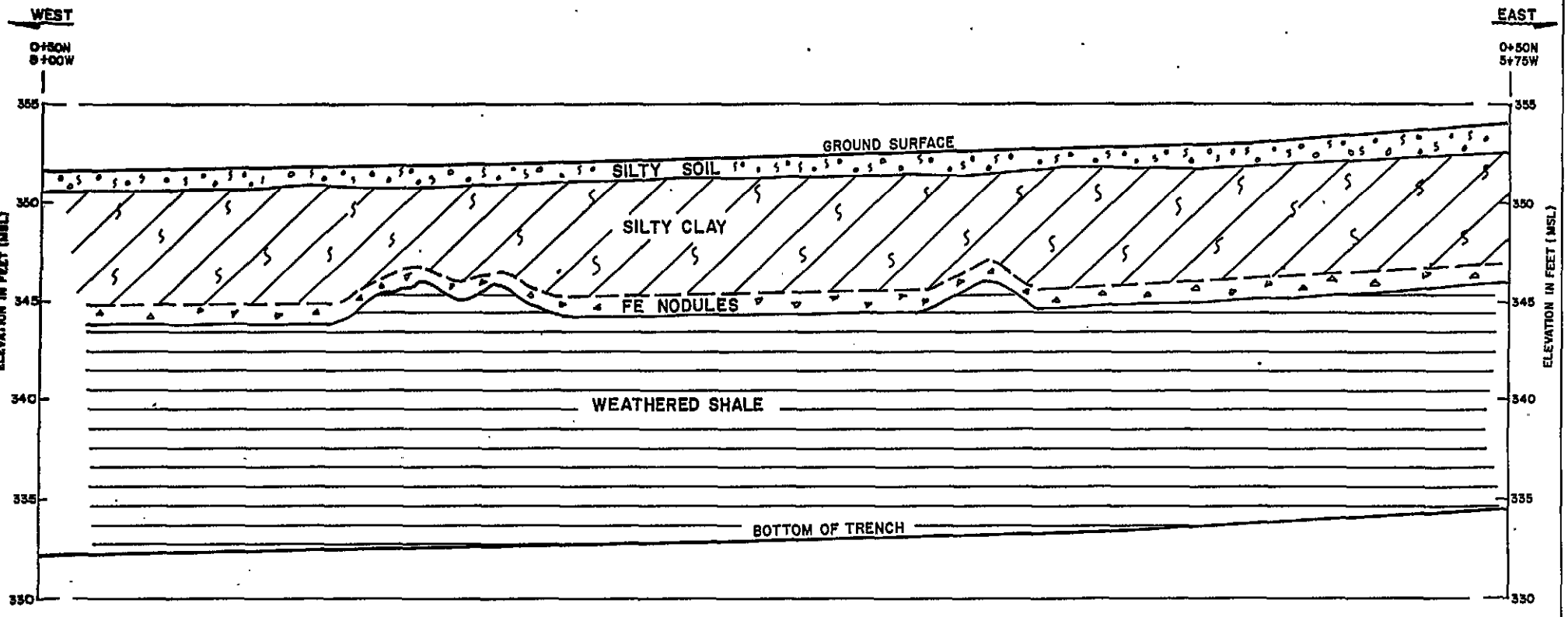

THE TRENCH SECTIONS REPRESENT INTERPRETATIONS MADE FROM FIELD DATA COLLECTED FROM WITHIN THE EXCAVATED TRENCHES (TRENCH 1 AND TRENCH 2) AND FROM OBSERVATIONS MADE FROM THE SURFACE ADJACENT TO THE TRENCHES (TRENCHES 2 AND 3). GROUND SURFACE ELEVATIONS SHOWN ARE PRETRENCHING ELEVATIONS.

5 0 5 FT
VERTICAL SCALE

15 0 15 FT
HORIZONTAL SCALE

FIGURE 4-4
TRENCH 2 CROSS-SECTION
REMEDIAL INVESTIGATION REPORT
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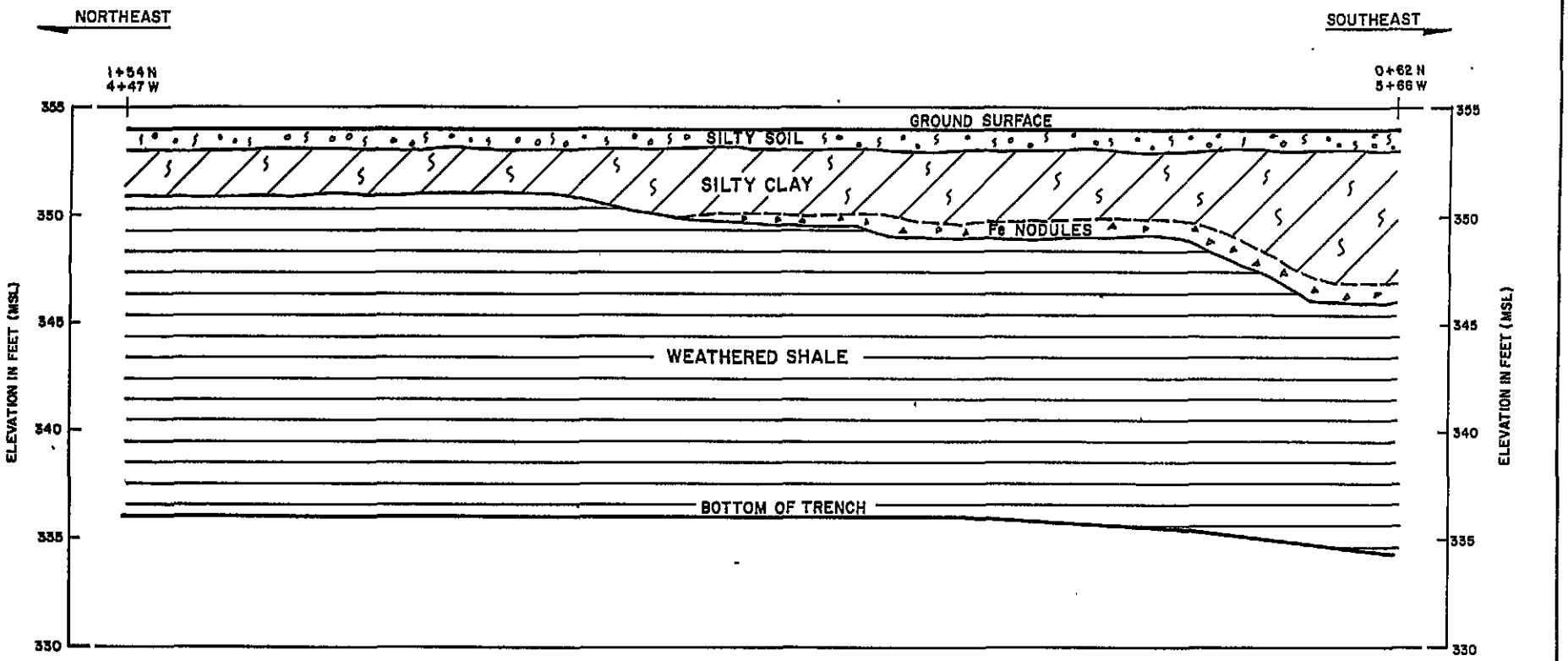

NOTE 1: WEATHERED SHALE BECOMING LESS WEATHERED TO THE NORTHEAST

THE TRENCH SECTIONS REPRESENT INTERPRETATIONS MADE FROM FIELD DATA COLLECTED FROM WITHIN THE EXCAVATED TRENCHES (TRENCH 1 AND TRENCH 2) AND FROM OBSERVATIONS MADE FROM THE SURFACE ADJACENT TO THE TRENCHES (TRENCHES 2 AND 3). GROUND SURFACE ELEVATIONS SHOWN ARE PRETRENCHING ELEVATIONS.

5 0 5 FT
VERTICAL SCALE

15 0 15 FT
HORIZONTAL SCALE

FIGURE 4-5

TRENCH 3 CROSS-SECTION
REMEDIAL INVESTIGATION REPORT
OLD MIDLAND PRODUCTS SITE

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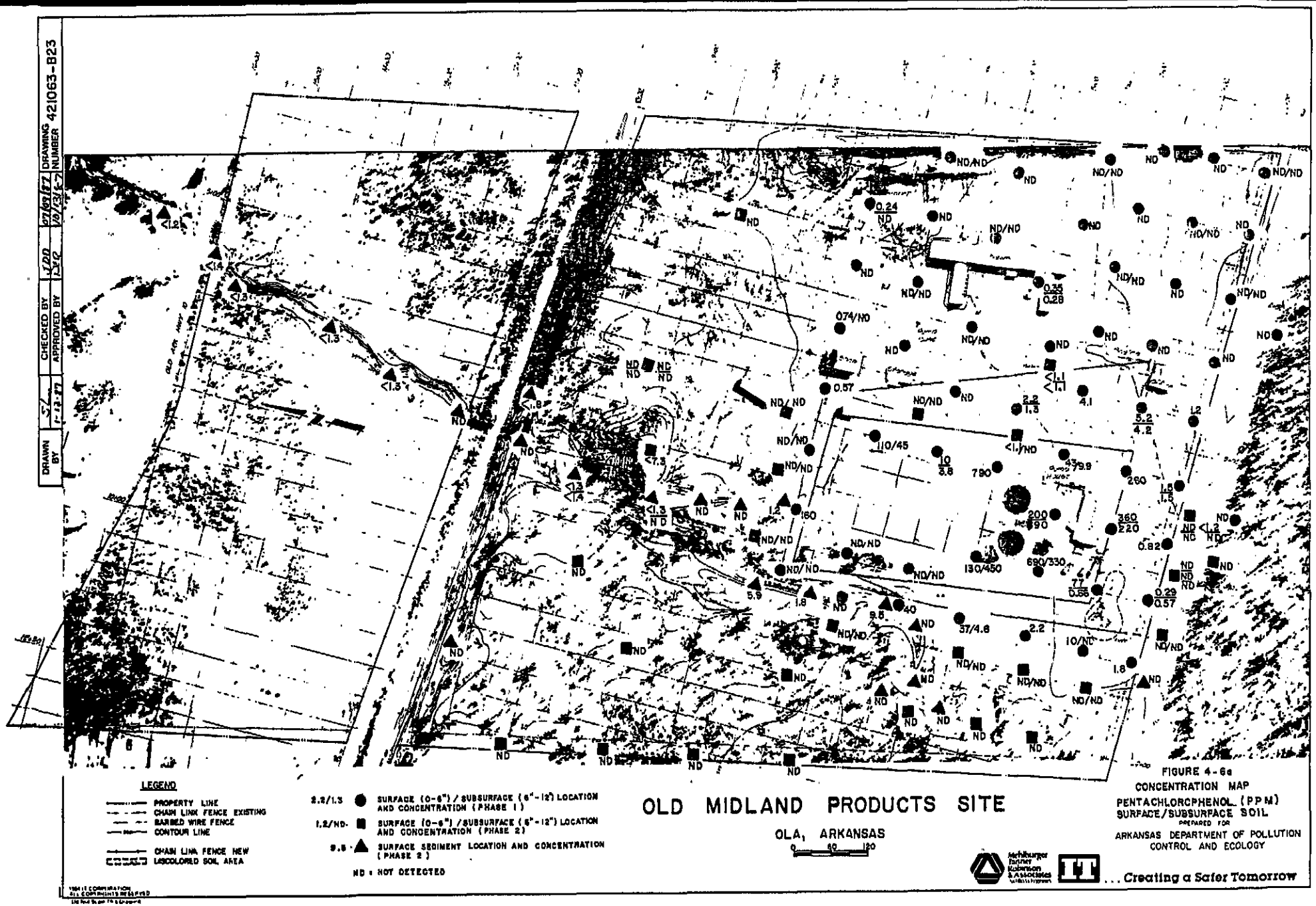

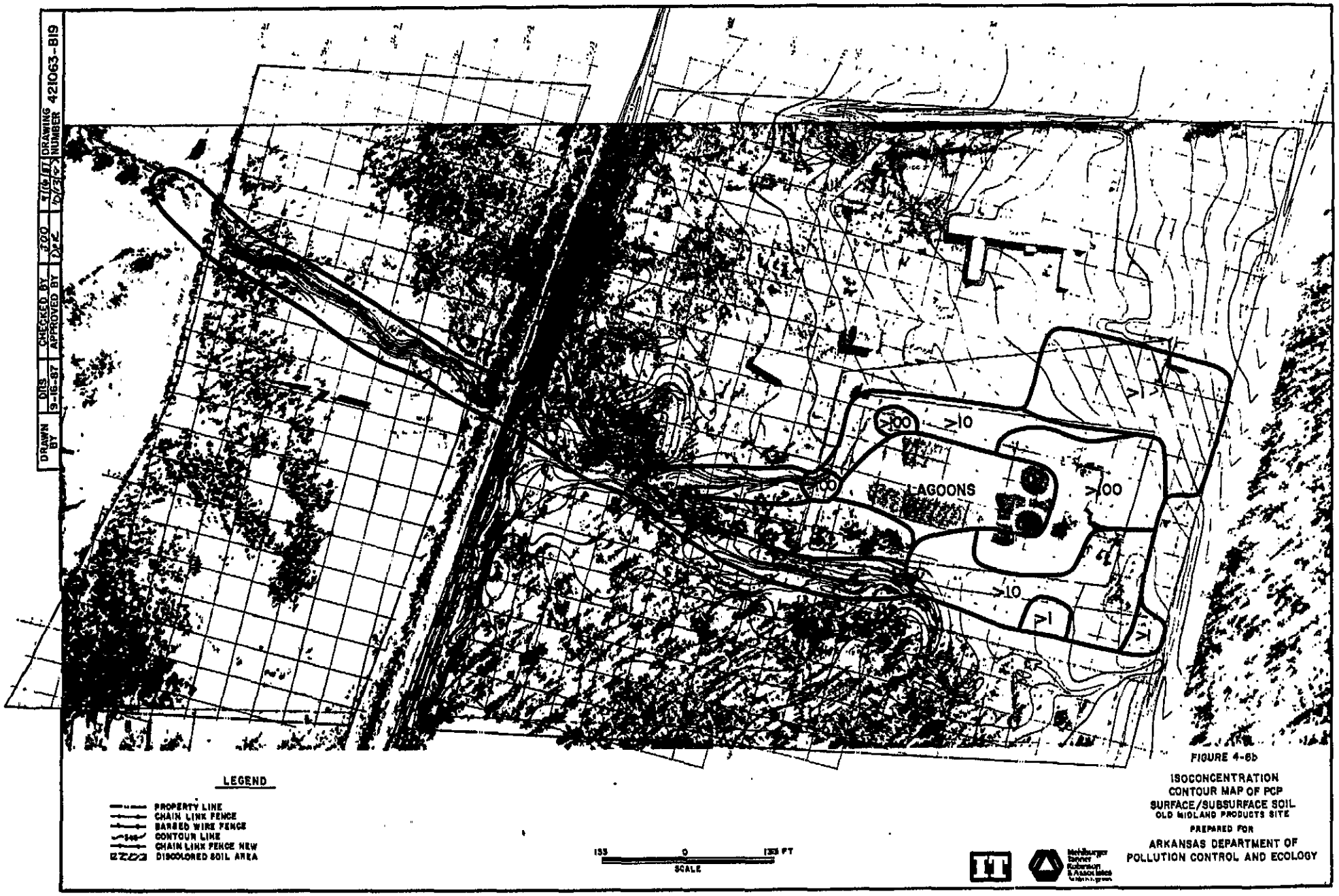

FIGURE 4-6b

ISOCONCENTRATION CONTOUR MAP OF PCP SURFACE/SUBSURFACE SOIL
OLD MIDLAND PRODUCTS SITE

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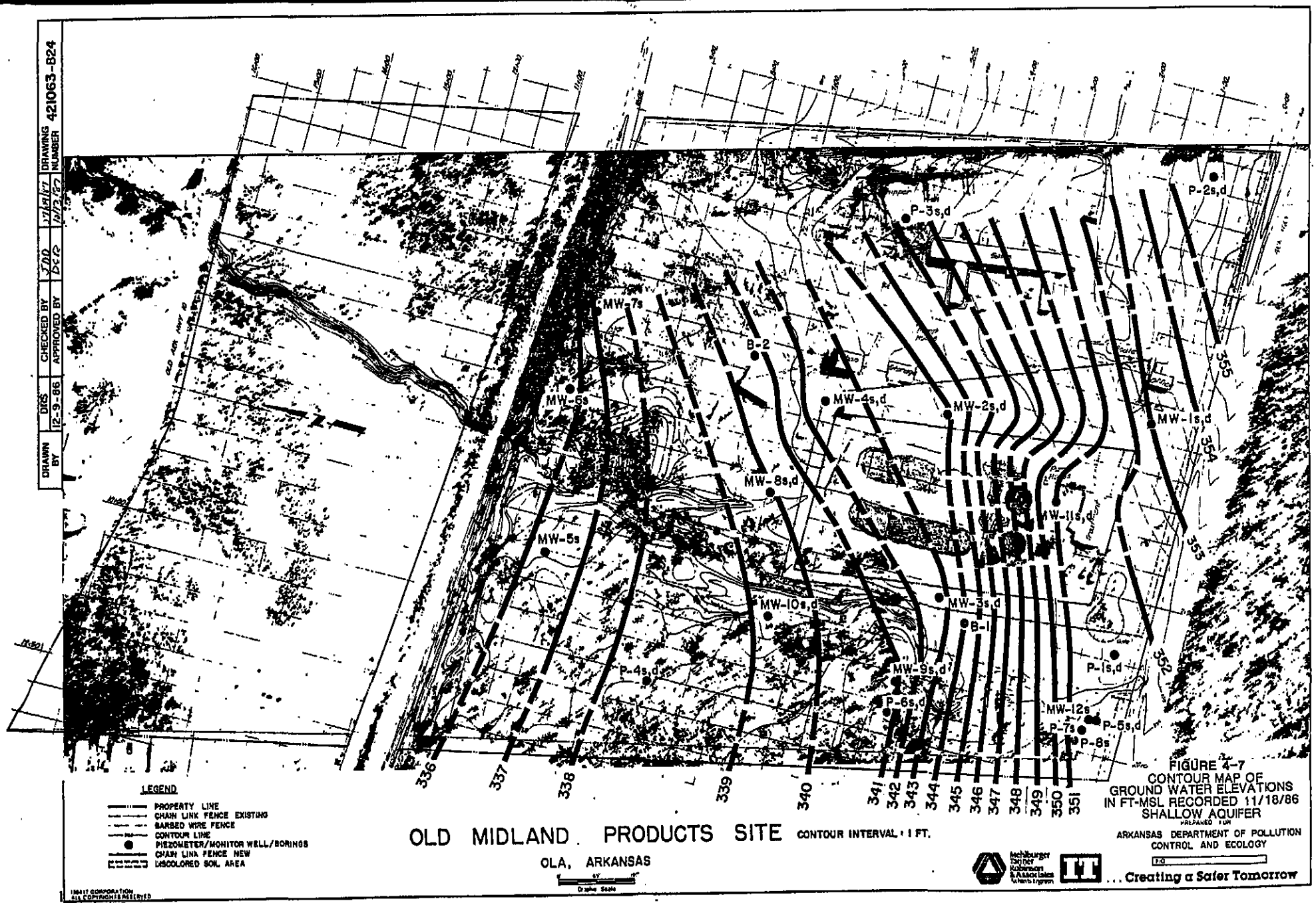
ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY


DRAWN BY
DRS
12-9-86
CHECKED BY
APPROVED BY
DRAWING NUMBER
421063-B24
MW-7s
B-2
MW-6s
MW-4s,d
MW-2s,d
P-3s,d
P-2s,d
MW-1s,d
MW-8s,d
MW-5s
MW-11s,d
MW-10s,d
MW-3s,d
B-1
P-4s,d
MW-9s,d
P-1s,d
P-6s,d
MW-12s
P-7s
P-5s,d
P-8s
355
354
353
352
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
LEGEND
PROPERTY LINE
CHAIN LINK FENCE EXISTING
BARBED WIRE FENCE
CONTOUR LINE
PIEZOMETER/MONITOR WELL/BORINGS
CHAIN LINK FENCE NEW
DISCOLORED SOIL AREA
OLD MIDLAND PRODUCTS SITE
CONTOUR INTERVAL = 1 FT.
OLA, ARKANSAS
FIGURE 4-7
CONTOUR MAP OF
GROUND WATER ELEVATIONS
IN FT-MSL RECORDED 11/18/86
SHALLOW AQUIFER
PREPARED FOR
ARKANSAS DEPARTMENT OF POLLUTION
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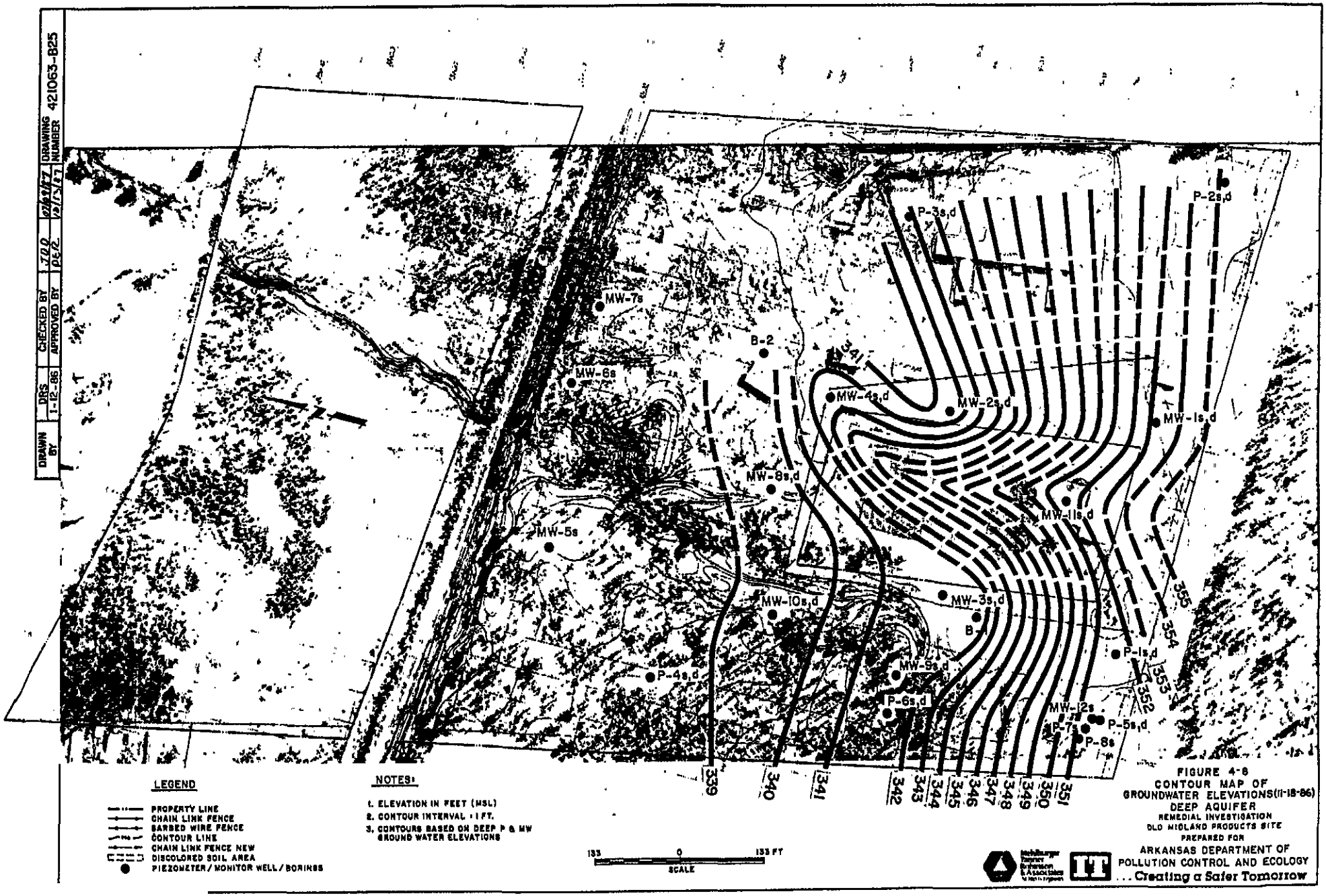

FIGURE 4-8
CONTOUR MAP OF GROUNDWATER ELEVATIONS(11-18-86)
DEEP AQUIFER
REMEDIAL INVESTIGATION
OLD MIDLAND PRODUCTS SITE
PREPARED FOR
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		APPROVED BY	DCR	10/13/87	

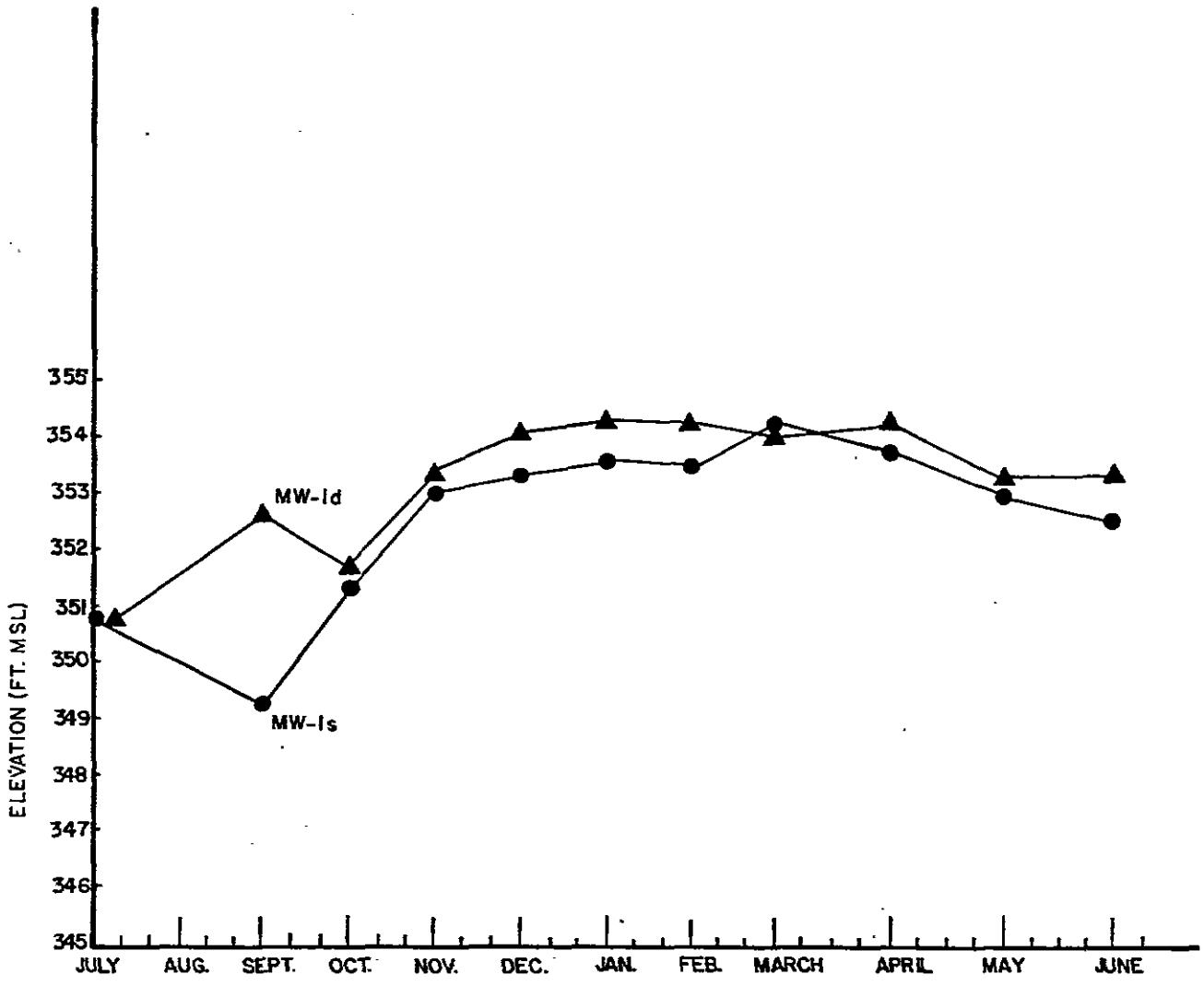

FIGURE 4-9

HYDROGRAPH OF MW-1s&d
JULY,1986-JUNE,1987
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

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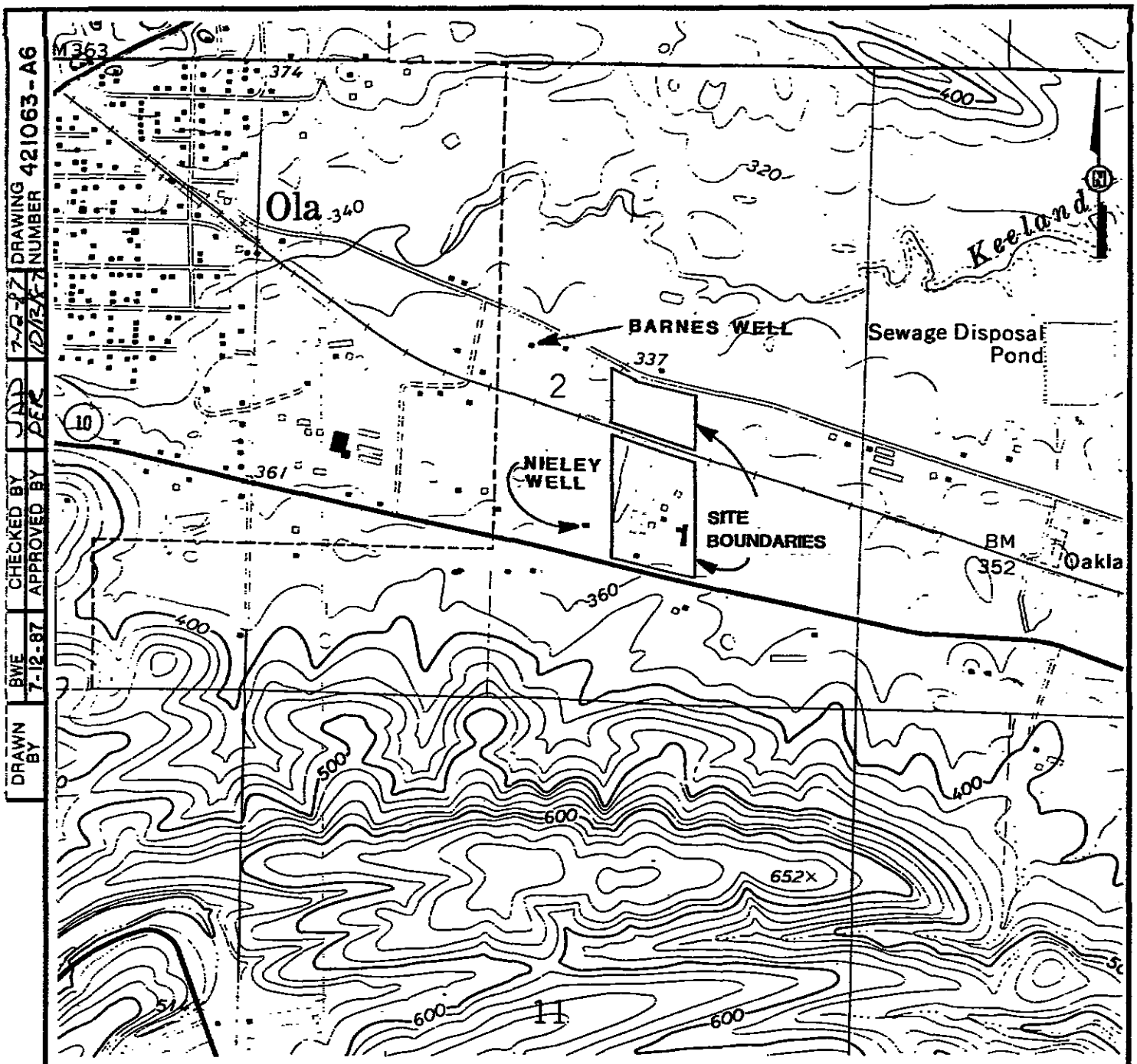

FIGURE 4-10

OFF-SITE WATER WELLS
OLD MIDLAND PRODUCTS SITE
OLA, ARKANSAS

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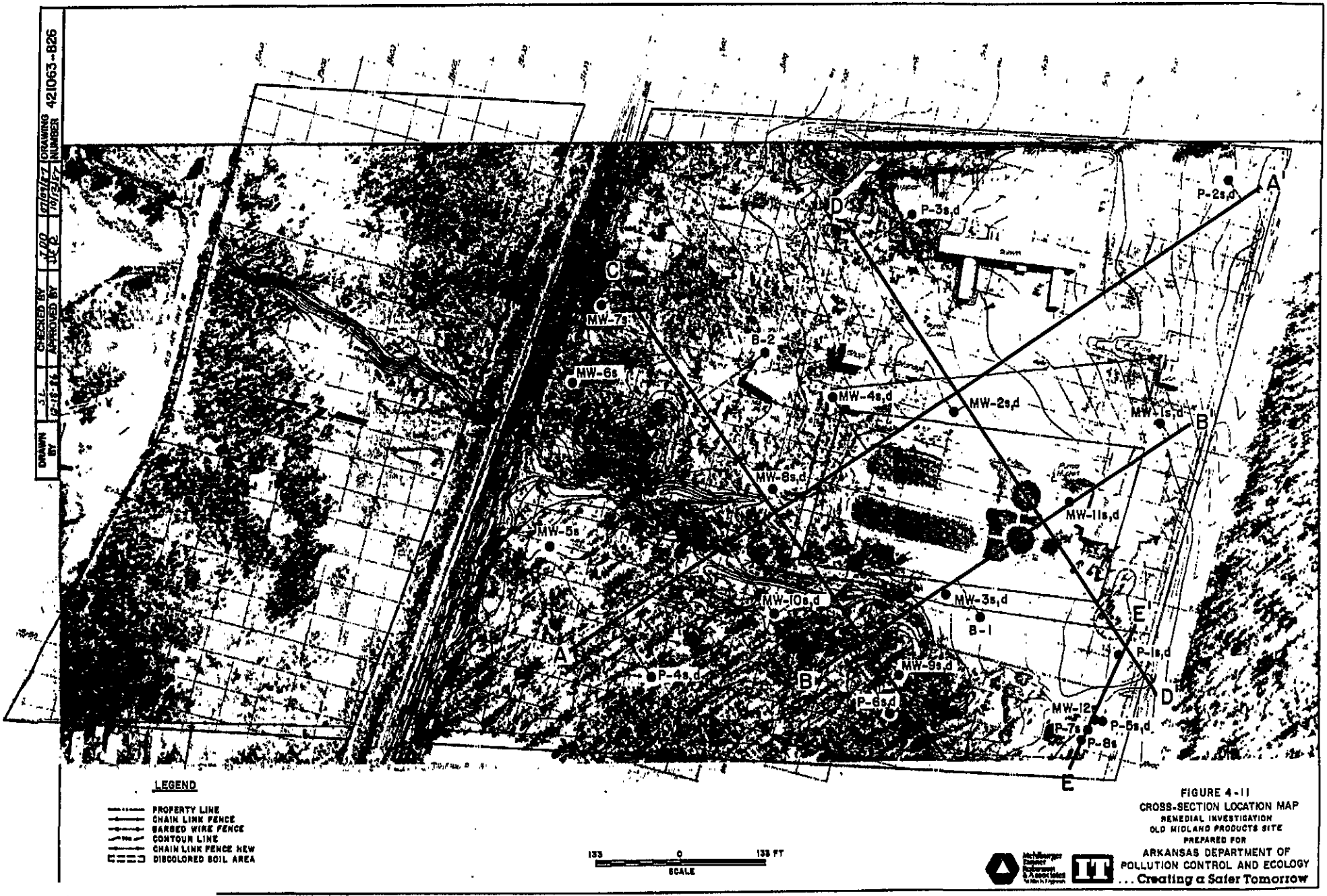

FIGURE 4-11
CROSS-SECTION LOCATION MAP
REMEDIAL INVESTIGATION
OLD MIDLAND PRODUCTS SITE
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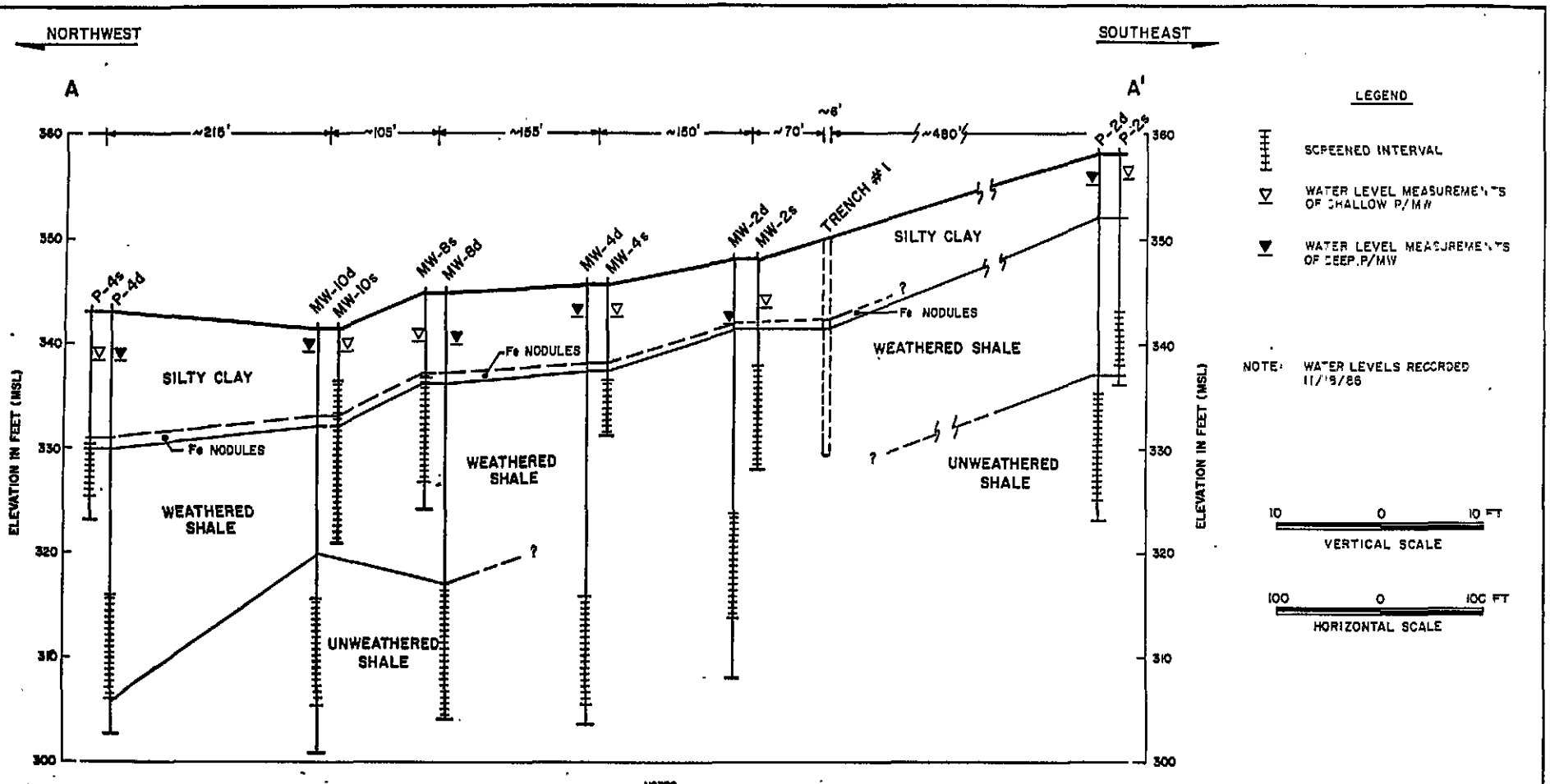

THE BORING LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED. SUBSURFACE CONDITIONS AND WATER LEVELS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BORING LOCATIONS. ALSO THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THESE BORING LOCATIONS.

THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN THE BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE BORINGS AND IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE BORINGS MAY VARY FROM THE INDICATED.

NOTES:

1. HORIZONTAL DISTANCES BETWEEN BORINGS SHOWN ON THE SECTIONS ARE PROJECTED ONTO A STRAIGHT LINE REPRESENTING THE CROSS-SECTIONAL AREA PRESENTED. ACTUAL SURFACE DISTANCES BETWEEN BORINGS MAY VARY FROM PROJECTED DISTANCES SHOWN ON THESE SECTIONS AND THE CROSS-SECTION LOCATION MAP.
2. GROUND SURFACE ELEVATIONS SHOWN ON SECTIONS REPRESENT ELEVATIONS AT THE INDIVIDUAL BORING LOCATIONS WHICH MAY VARY FROM THE GROUND SURFACE ELEVATIONS ALONG THE SECTION LINES SHOWN ON THE CROSS-SECTION LOCATION MAP.
3. BORING LOGS OF MONITOR WELLS MW-1 THROUGH MW-4 REPRESENT OUR INTERPRETATION OF BORING LOGS PREPARED BY OTHERS AND PRESENTED IN AN EARLIER REPORT.

FIGURE 4-12
GEOLOGIC CROSS-SECTION A-A'
REMEDIAL INVESTIGATION REPORT
OLD MIDLAND PRODUCTS SITE

PREPARED FOR

ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY

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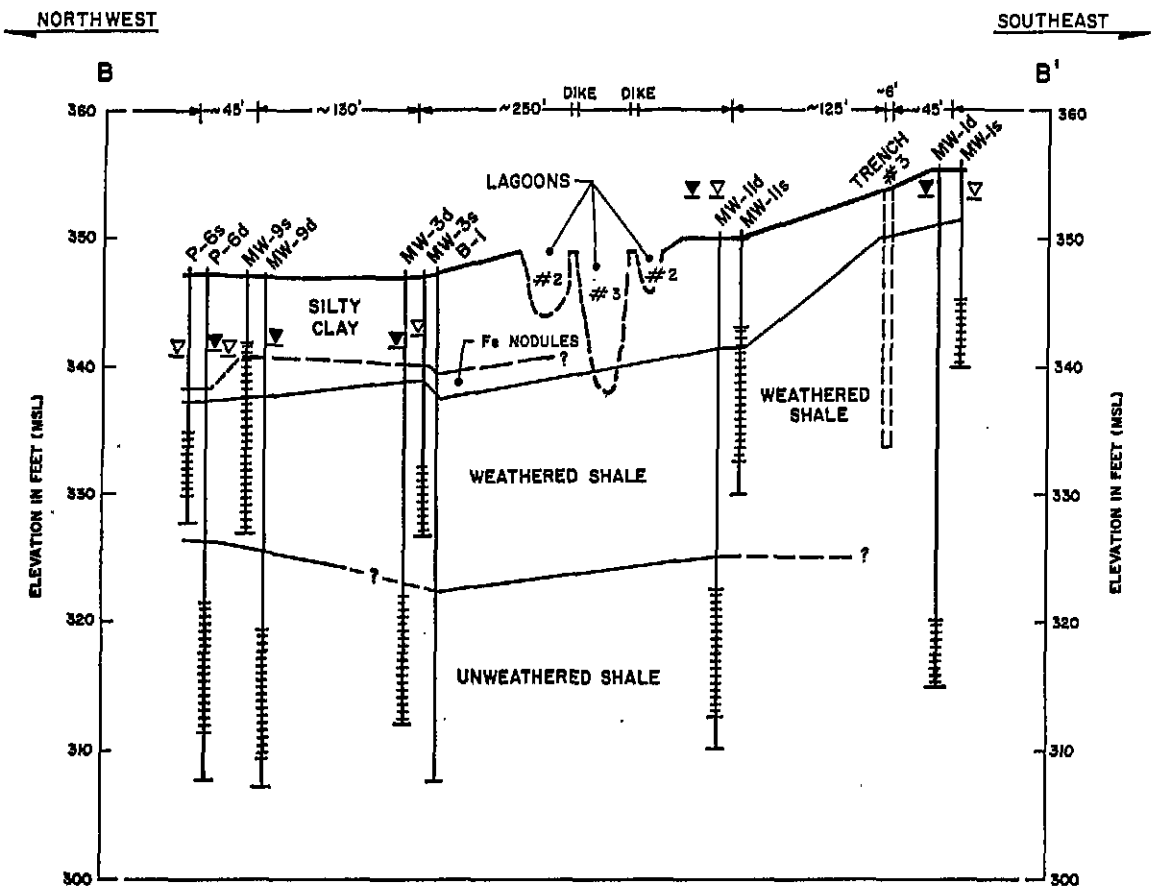
	12-16-86	APPROVED BY	DMC		



LEGEND

- SCREENED INTERVAL
- WATER LEVEL MEASUREMENTS OF SHALLOW P/MW
- WATER LEVEL MEASUREMENTS OF DEEP P/MW

NOTE: WATER LEVELS RECORDED 11/18/86

10 0 10 FT
VERTICAL SCALE

100 0 100 FT
HORIZONTAL SCALE

THE BORING LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED. SUBSURFACE CONDITIONS AND WATER LEVELS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BORING LOCATIONS. ALSO THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THESE BORING LOCATIONS.

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2. GROUND SURFACE ELEVATIONS SHOWN ON SECTIONS REPRESENT ELEVATIONS AT THE INDIVIDUAL BORING LOCATIONS WHICH MAY VARY FROM THE GROUND SURFACE ELEVATIONS ALONG THE SECTION LINES SHOWN ON THE CROSS-SECTION LOCATION MAP.
3. BORING LOGS OF MONITOR WELLS MW-1 THROUGH MW-4 REPRESENT OUR INTERPRETATION OF BORING LOGS PREPARED BY OTHERS AND PRESENTED IN AN EARLIER REPORT.

FIGURE 4-13
GEOLOGIC CROSS-SECTION B-B'
REMEDIAL INVESTIGATION REPORT
OLD MIDLAND PRODUCTS SITE

PREPARED FOR

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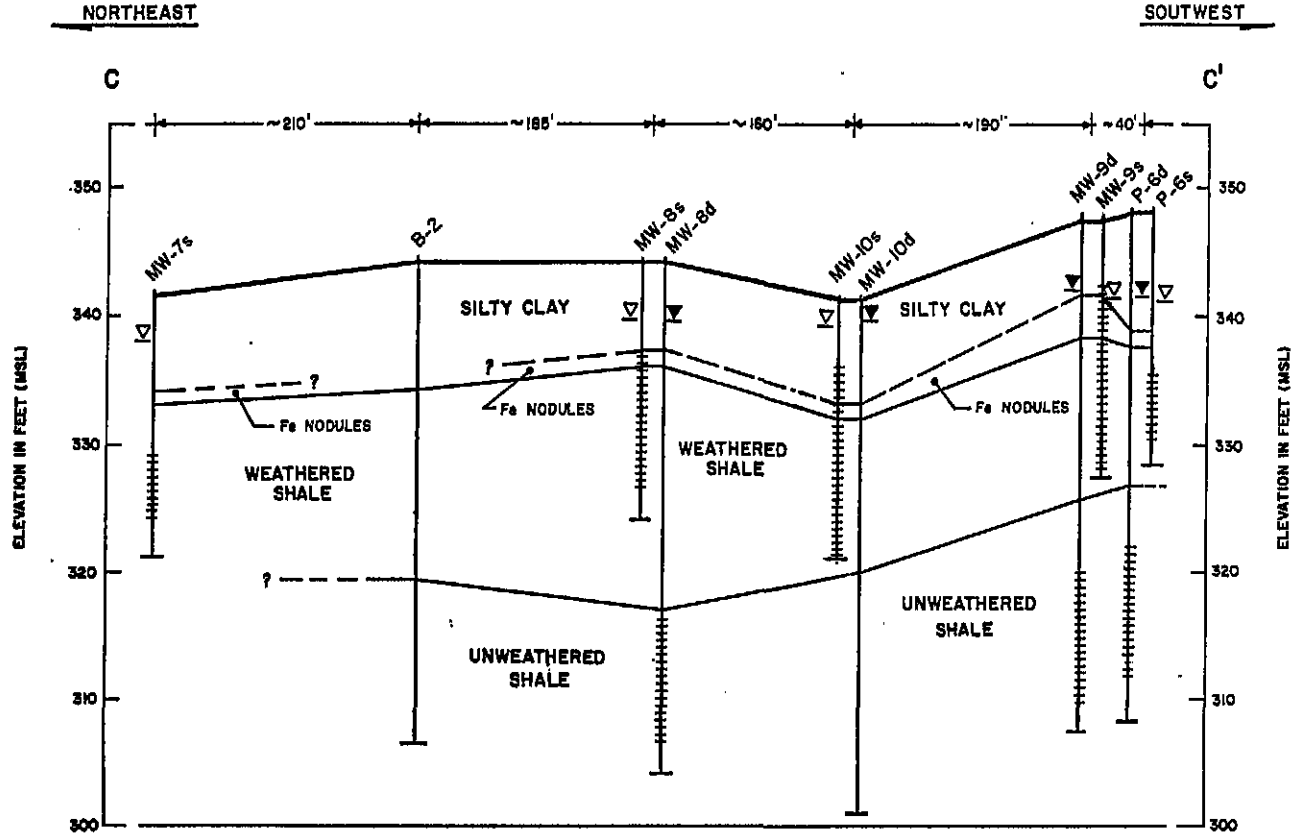

LEGEND

SCREENED INTERVAL

WATER LEVEL MEASUREMENTS OF SHALLOW P/MW

WATER LEVEL MEASUREMENTS DEEP P/MW

NOTE: WATER LEVELS RECORDED 11/18/86

10 0 10 FT
VERTICAL SCALE

100 0 100 FT
HORIZONTAL SCALE

THE BORING LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED. SUBSURFACE CONDITIONS AND WATER LEVELS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BORING LOCATIONS. ALSO THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THESE BORING LOCATIONS.

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NOTES:

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2. GROUND SURFACE ELEVATIONS SHOWN ON SECTIONS REPRESENT ELEVATIONS AT THE INDIVIDUAL BORING LOCATIONS WHICH MAY VARY FROM THE GROUND SURFACE ELEVATIONS ALONG THE SECTION LINES SHOWN ON THE CROSS-SECTION LOCATION MAP.
3. BORING LOGS OF MONITOR WELLS MW-1 THROUGH MW-4 REPRESENT OUR INTERPRETATION OF BORING LOGS PREPARED BY OTHERS AND PRESENTED IN AN EARLIER REPORT.

FIGURE 4-14
GEOLOGIC CROSS-SECTION C-C'
REMEDIAL INVESTIGATION REPORT
OLD MIDLAND PRODUCTS SITE

PREPARED FOR

ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY

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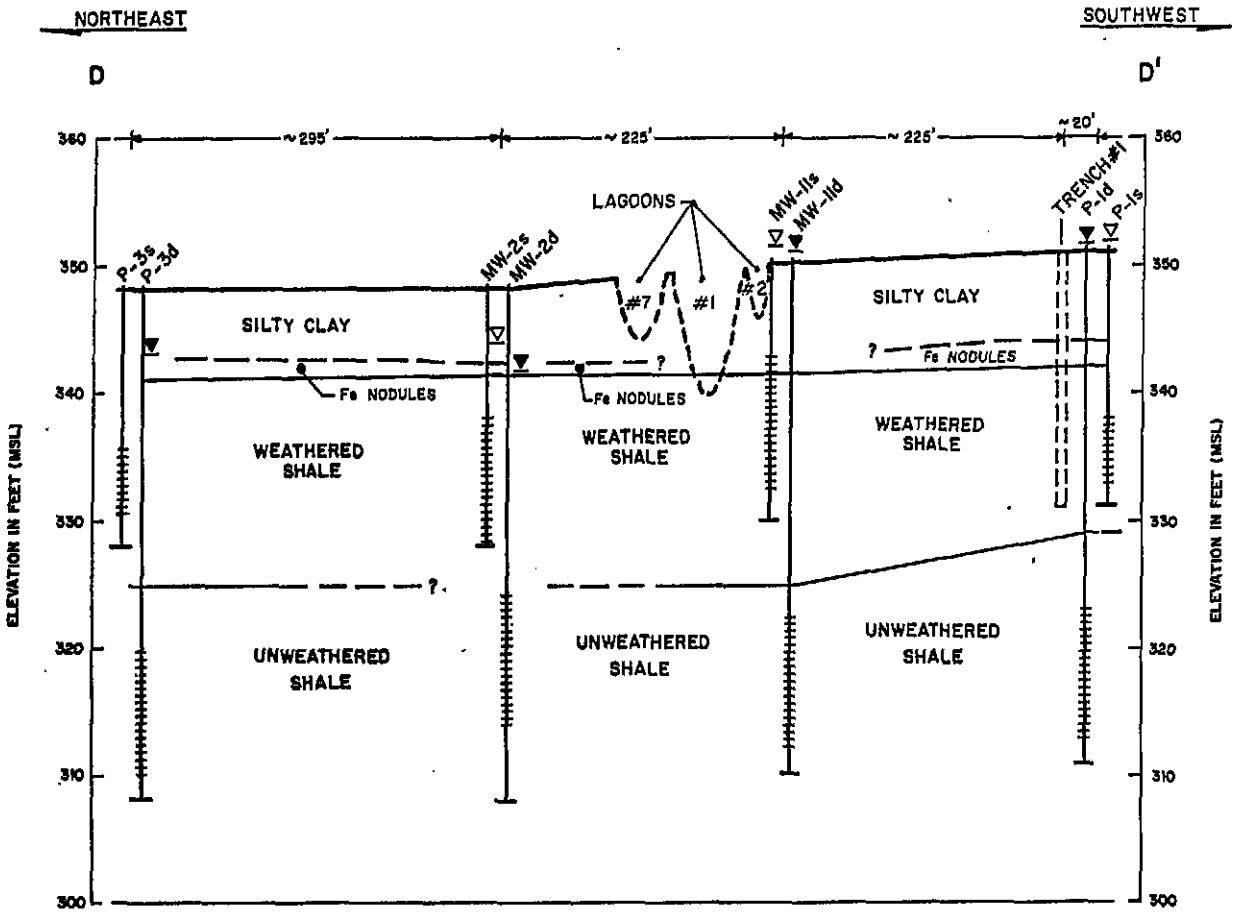

LEGEND

SCREENED INTERVAL

WATER LEVEL MEASUREMENTS OF SHALLOW P/MW

WATER LEVEL MEASUREMENTS DEEP P/MW

NOTE: WATER LEVELS RECORDED 11/18/86

10 0 10 FT
VERTICAL SCALE

100 0 100 FT
HORIZONTAL SCALE

THE BORING LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED. SUBSURFACE CONDITIONS AND WATER LEVELS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BORING LOCATIONS. ALSO THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THESE BORING LOCATIONS.

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2. GROUND SURFACE ELEVATIONS SHOWN ON SECTIONS REPRESENT ELEVATIONS AT THE INDIVIDUAL BORING LOCATIONS WHICH MAY VARY FROM THE GROUND SURFACE ELEVATIONS ALONG THE SECTION LINES SHOWN ON THE CROSS-SECTION LOCATION MAP.
3. BORING LOGS OF MONITOR WELLS MW-1 THROUGH MW-4 REPRESENT OUR INTERPRETATION OF BORING LOGS PREPARED BY OTHERS AND PRESENTED IN AN EARLIER REPORT.

FIGURE 4-15
GEOLOGIC CROSS-SECTION D-D'
REMEDIAL INVESTIGATION REPORT
OLD MIDLAND PRODUCTS SITE

PREPARED FOR

ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY

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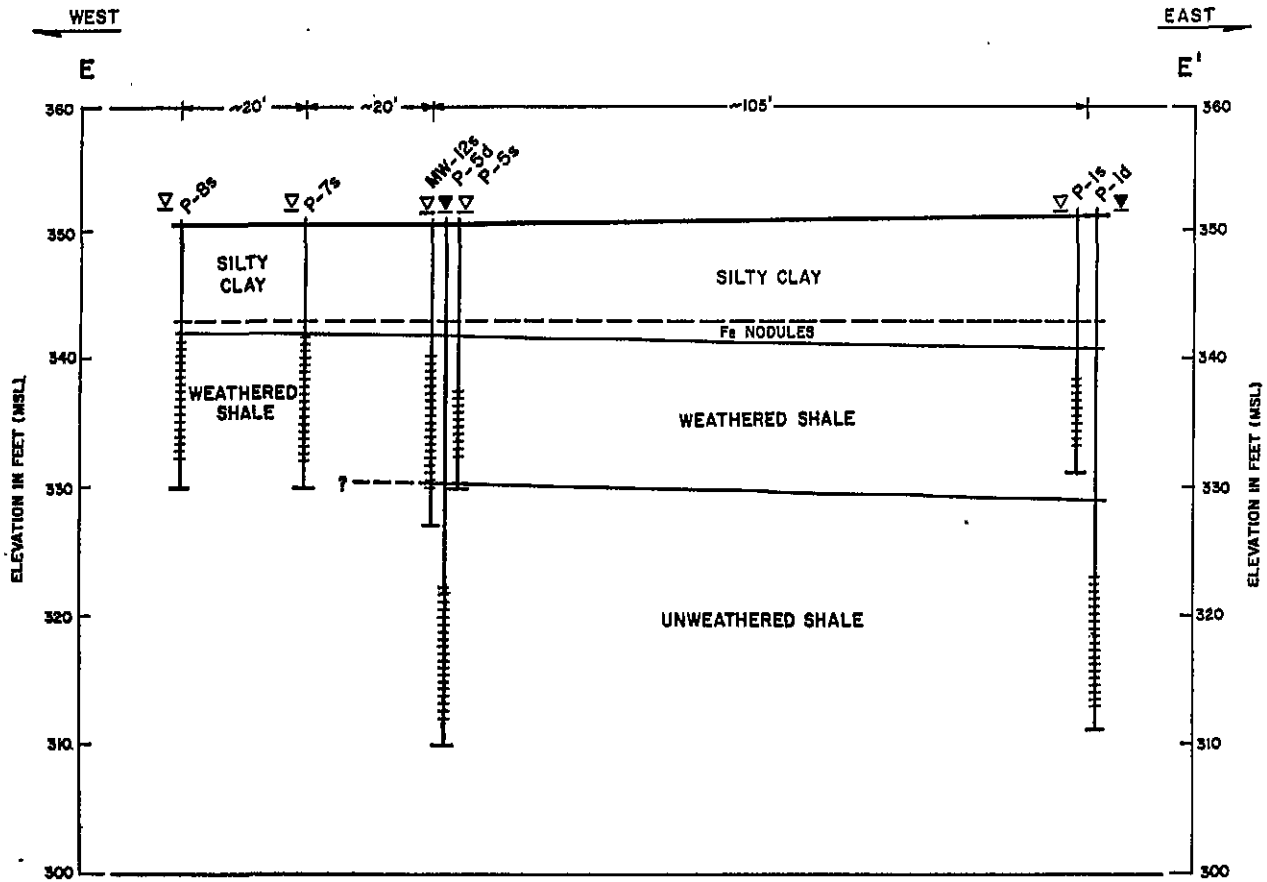

LEGEND

SCREENED INTERVAL

WATER LEVEL MEASUREMENTS OF SHALLOW P/MW

WATER LEVEL MEASUREMENTS OF DEEP P/MW

NOTE: WATER LEVELS RECORDED 11/18/86

10 0 10 FT
VERTICAL SCALE

20 0 20 FT
HORIZONTAL SCALE

THE BORING LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED. SUBSURFACE CONDITIONS AND WATER LEVELS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BORING LOCATIONS. ALSO THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THESE BORING LOCATIONS.

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2. GROUND SURFACE ELEVATIONS SHOWN ON SECTIONS REPRESENT ELEVATIONS AT THE INDIVIDUAL BORING LOCATIONS WHICH MAY VARY FROM THE GROUND SURFACE ELEVATIONS ALONG THE SECTION LINES SHOWN ON THE CROSS-SECTION LOCATION MAP.
3. BORING LOGS OF MONITOR WELLS MW-1 THROUGH MW-4 REPRESENT OUR INTERPRETATION OF BORING LOGS PREPARED BY OTHERS AND PRESENTED IN AN EARLIER REPORT.

FIGURE 4-16
GEOLOGIC CROSS-SECTION E-E'
REMEDIAL INVESTIGATION REPORT
OLD MIDLAND PRODUCTS SITE

PREPARED FOR

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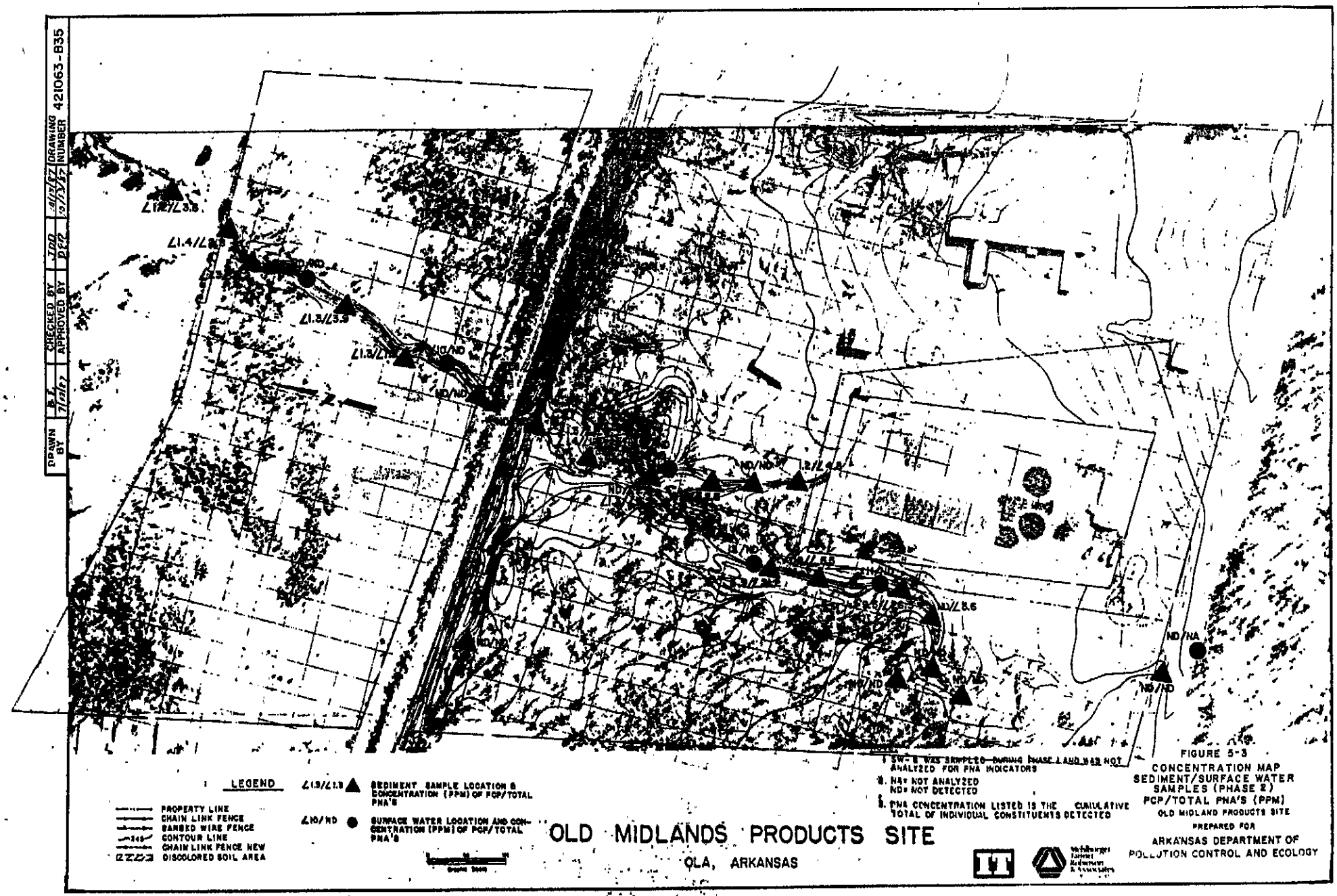
DRAWING NUMBER 421063-B35
DRAWN BY
CHECKED BY
APPROVED BY
DATE
SCALE
LEGEND
PROPERTY LINE
CHAIN LINK FENCE
BARBED WIRE FENCE
CONTOUR LINE
CHAIN LINK FENCE NEW
DISCOLORED SOIL AREA
SEDIMENT SAMPLE LOCATION & CONCENTRATION (PPM) OF PCP/TOTAL PNA'S
SURFACE WATER LOCATION AND CONCENTRATION (PPM) OF PCP/TOTAL PNA'S
OLD MIDLANDS PRODUCTS SITE
OLA, ARKANSAS
1 SW-8 WAS SAMPLED DURING PHASE 1 AND WAS NOT ANALYZED FOR PNA INDICATORS
NA= NOT ANALYZED
ND= NOT DETECTED
§ PNA CONCENTRATION LISTED IS THE CUMULATIVE TOTAL OF INDIVIDUAL CONSTITUENTS DETECTED
FIGURE 5-3
CONCENTRATION MAP
SEDIMENT/SURFACE WATER SAMPLES (PHASE 2)
PCP/TOTAL PNA'S (PPM)
OLD MIDLAND PRODUCTS SITE
PREPARED FOR
ARKANSAS DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY

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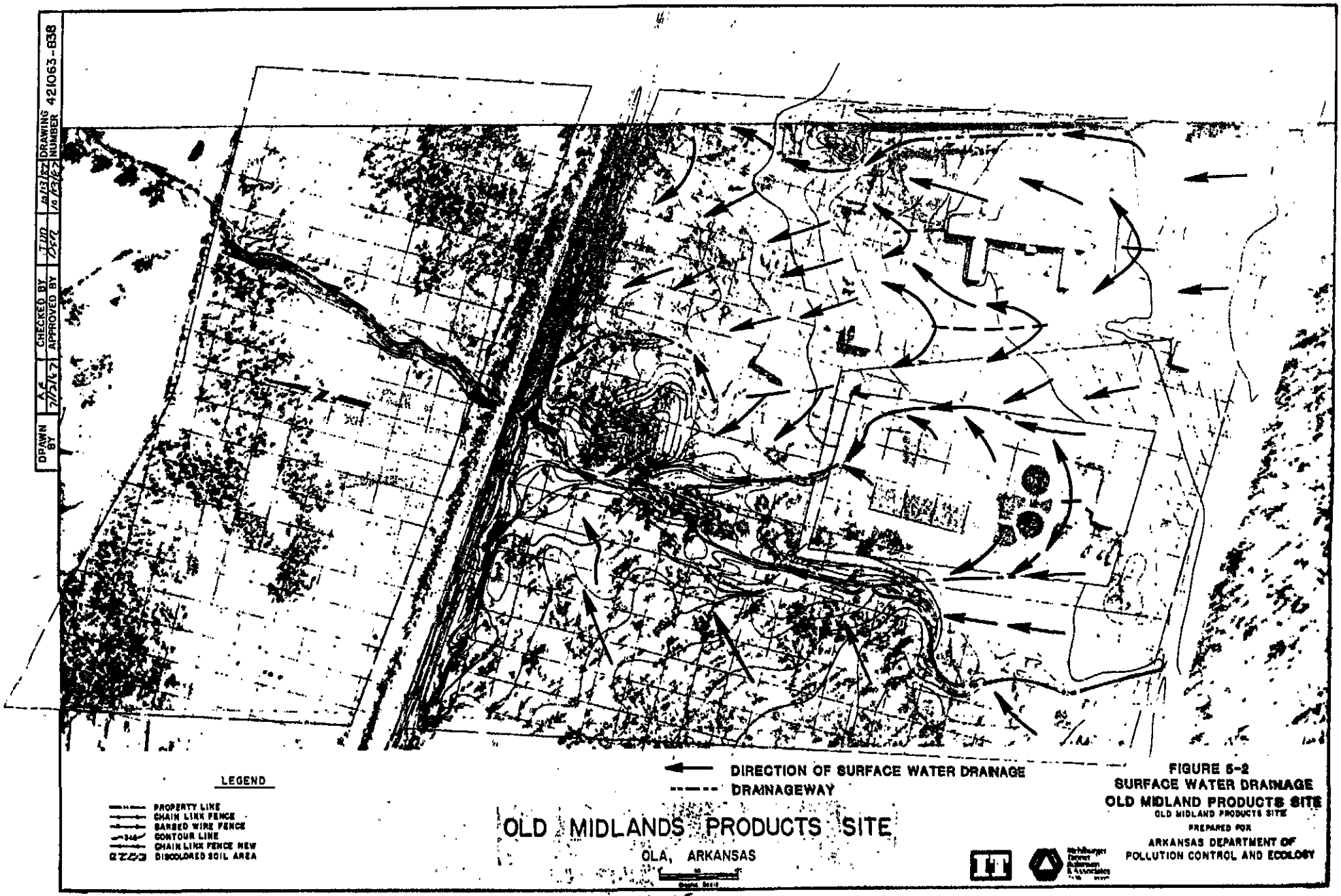
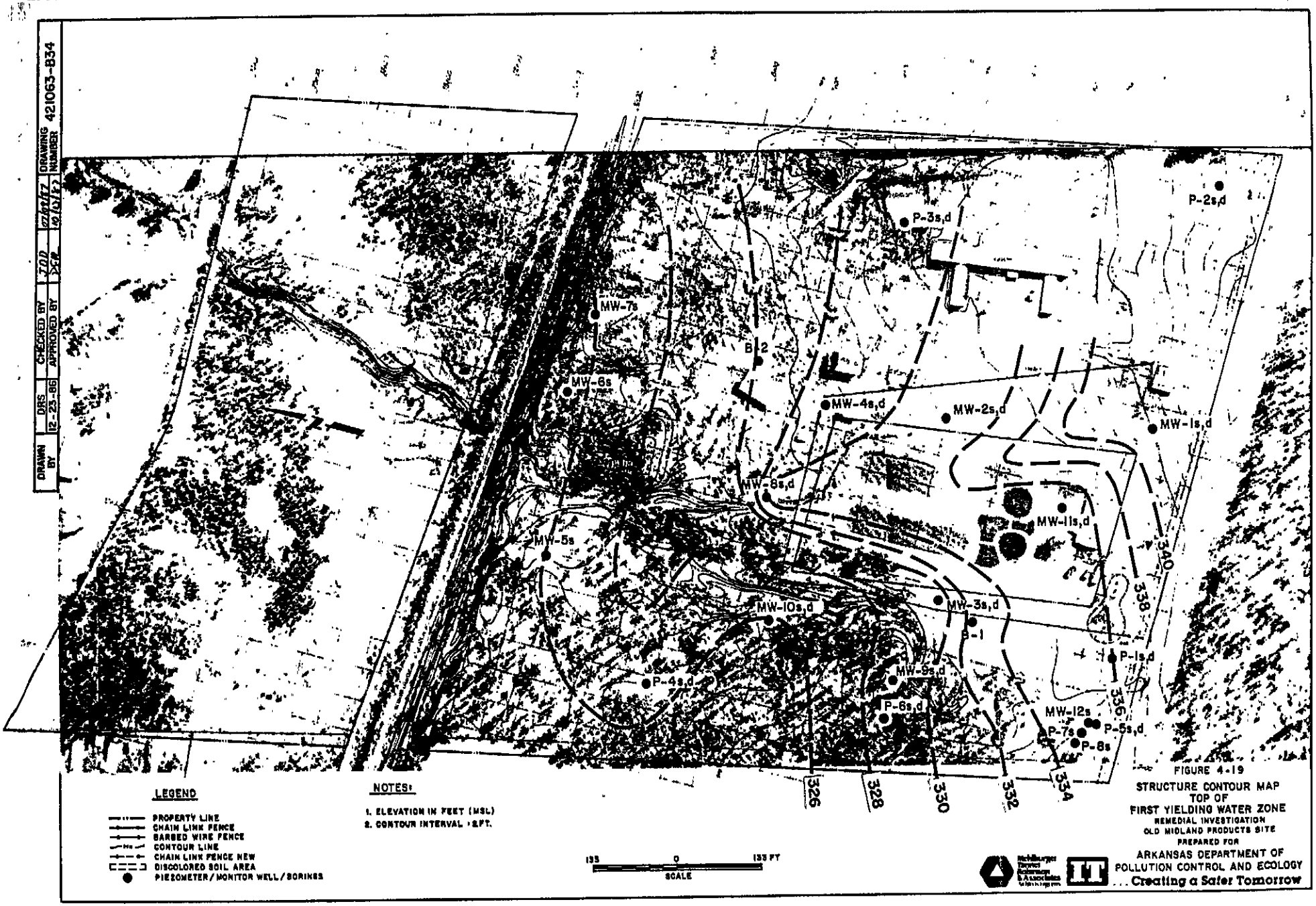


FIGURE 5-2
SURFACE WATER DRAINAGE
OLD MIDLAND PRODUCTS SITE
OLD MIDLAND PRODUCTS SITE
PREPARED FOR
ARKANSAS DEPARTMENT OF
POLLUTION CONTROL AND ECOLOGY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DRS
12-23-86
CHECKED BY
JDD
APPROVED BY
DCB
DRAWING NUMBER
421063-834
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P-3s,d
MW-7s
B-2
MW-6s
MW-4s,d
MW-2s,d
MW-1s,d
MW-8s,d
MW-11s,d
MW-5s
340
338
MW-10s,d
MW-3s,d
B-1
P-1s,d
MW-9s,d
P-4s,d
336
P-6s,d
MW-12s
P-7s
P-5s,d
P-8s
326
328
330
332
334
LEGEND
PROPERTY LINE
CHAIN LINK FENCE
BARBED WIRE FENCE
CONTOUR LINE
CHAIN LINK FENCE NEW
DISCOLORED SOIL AREA
PIEZOMETER/MONITOR WELL/BORINGS
NOTES:
1. ELEVATION IN FEET (MSL)
2. CONTOUR INTERVAL 2 FT.
135
0
135 FT
SCALE
FIGURE 4-19
STRUCTURE CONTOUR MAP
TOP OF
FIRST YIELDING WATER ZONE
REMEDIAL INVESTIGATION
OLD MIDLAND PRODUCTS SITE
PREPARED FOR
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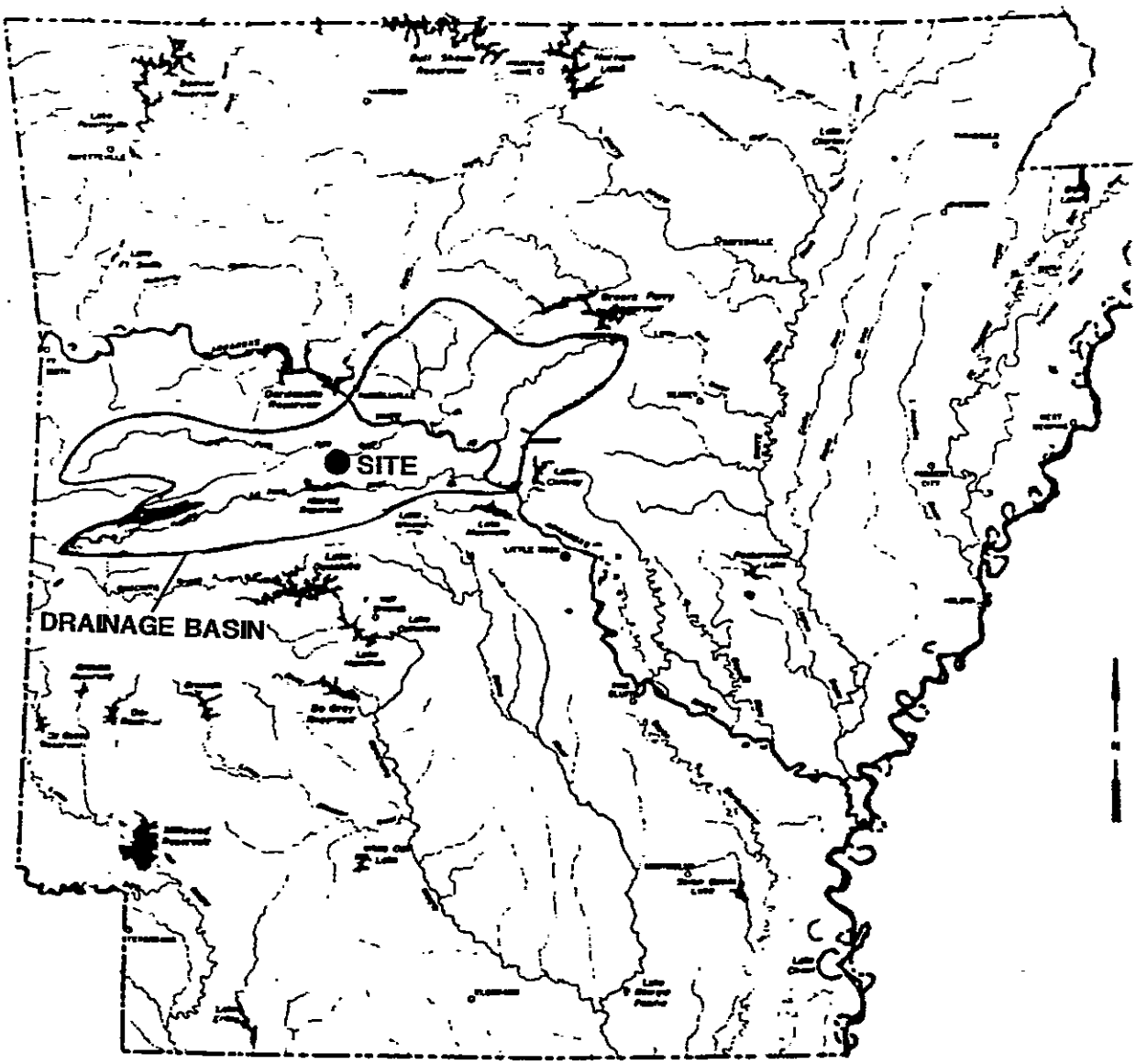

FIGURE 5-1

DRAINAGE BASIN
OLD MIDLAND PRODUCTS SI
OLA, ARKANSAS
PREPARED FOR
ARKANSAS DEPARTMENT
OF POLLUTION
CONTROL AND ECOLOGY

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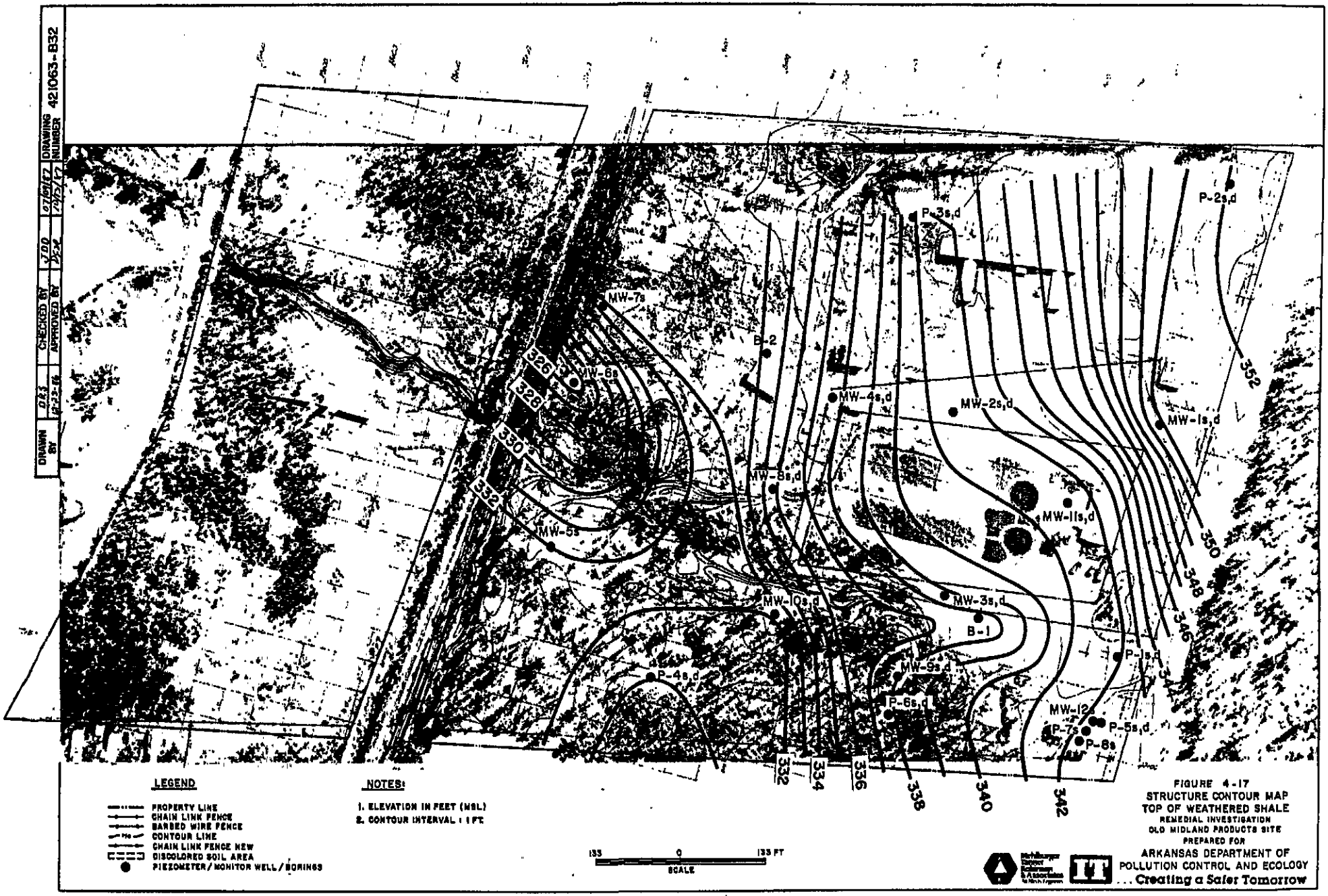

FIGURE 4-17
STRUCTURE CONTOUR MAP
TOP OF WEATHERED SHALE
REMEDIAL INVESTIGATION
OLD MIDLAND PRODUCTS SITE
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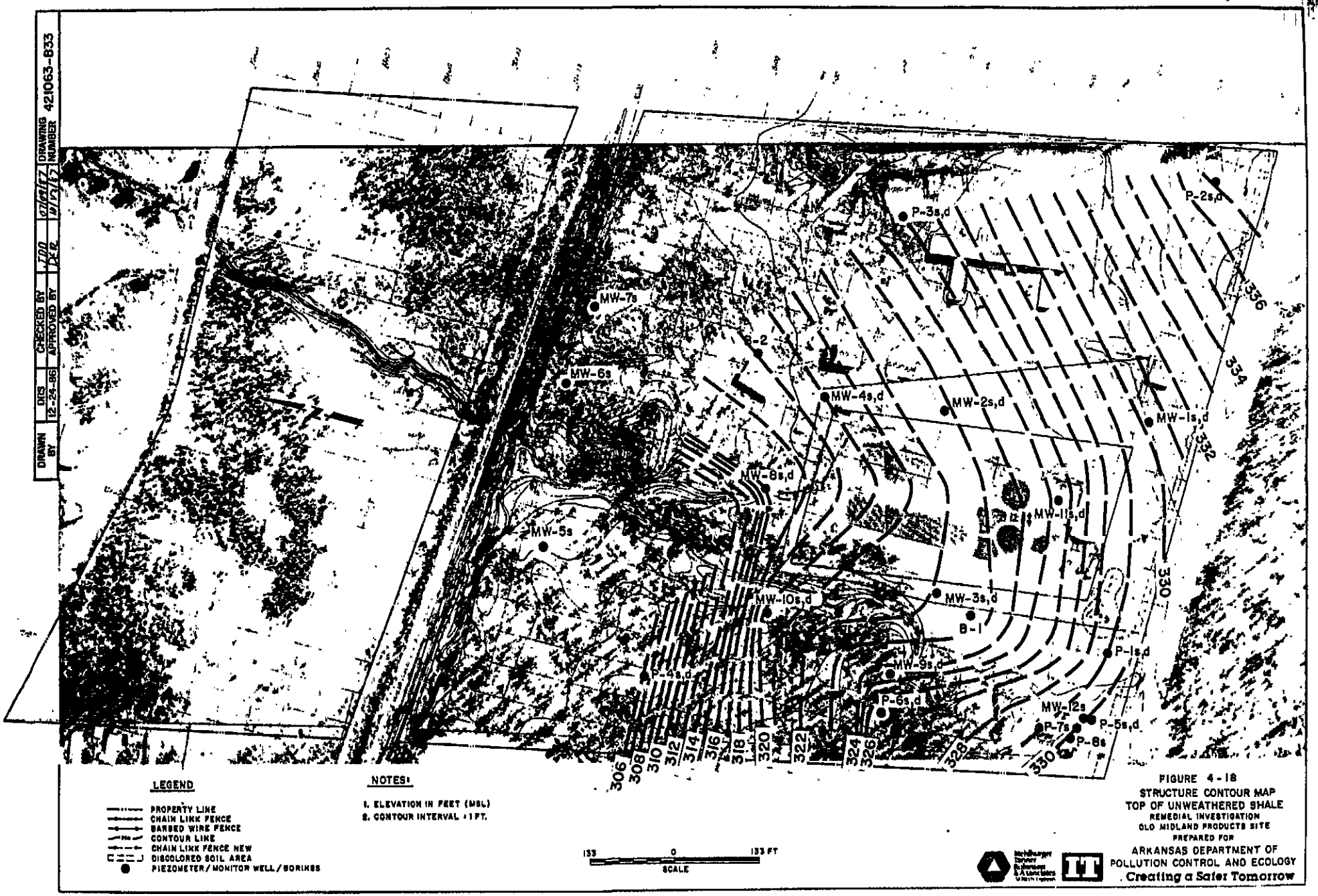

FIGURE 4-18
STRUCTURE CONTOUR MAP
TOP OF UNWEATHERED SHALE
REMEDIAL INVESTIGATION
OLD MIDLAND PRODUCTS SITE
PREPARED FOR
ARKANSAS DEPARTMENT OF
POLLUTION CONTROL AND ECOLOGY