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Hazardous Waste Ground-Water Task Force

Evaluation of Sunflower Army Ammunition Plant DeSoto, Kansas

EPA United States Environmental Protection Agency

STATE OF KANSAS

DEPARTMENT OF HEALTH AND ENVIRONMENT

UPDATE

The two active RCRA units, the Carbide Treatment Area and the Coal Pile Runoff Area are currently undergoing closure. On July 1, 1987, closure plans for both areas were approved.

SAAP has indicated it will attempt to clean close both areas.

Recent data from 1987 indicates a number of concerns involving specific parameters still remain. These include:

CONCENTRATIONS EXCEEDING ACTION LEVELS
GROUNDWATER SAMPLES COLLECTED OCT-DEC 1987
SUNFLOWER AAP

POND A & POWERHOUSE LAGOONS:

WELL NO.	PARAMETER	CONCENTRATION DETECTED	ACTION LEVEL	FILTERED/ UNFILTERED
MW44	lead	0.027 mg/L	0.025 mg/L	U
	cadmium	6.000 ug/L	5.000 ug/L	U
MW46	lead	0.037 mg/L	0.025 mg/L	U
	lead	0.034 mg/L	0.025 mg/L	F
MW49	cadmium	10.000 ug/L	5.000 ug/L	U
MW55	lead	0.070 mg/L	0.025 mg/L	F
MW55	lead	0.148 mg/L	0.025 mg/L	U

NITROGUANIDINE/CARBIDE AREA:

MW5	ammonia	0.32 mg/L	0.3 mg/L	U

These values indicate the need for further assessment before a determination can be addressed on clean closure.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

HAZARDOUS WASTE GROUNDWATER TASK FORCE

GROUNDWATER MONITORING EVALUATION

SUNFLOWER ARMY AMMUNITION PLANT
DESOTO, KANSAS

MAY 25, 1988

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INTRODUCTION

Concerns have recently been expressed about whether hazardous waste treatment, storage, and disposal facilities (TSDFs) are complying with the groundwater monitoring requirements promulgated under the Resource Conservation and Recovery Act (RCRA). Regulations promulgated under RCRA address TSDF operations, including groundwater monitoring, to ensure immediate detection of any hazardous waste or constituents released to the environment. Of specific concern is the ability of existing or proposed groundwater monitoring systems to detect contaminant releases from waste management units. To evaluate these systems and determine the current compliance status, the Administrator of the Environmental Protection Agency (EPA) established an Hazardous Waste Groundwater Task Force (Task Force). The Task Force comprises personnel from the EPA Office of Solid Waste and Emergency Response; Office of Enforcement and Compliance Monitoring; National Enforcement Investigations Center (NEIC); Regional Offices; and State regulatory agencies. The Task Force is conducting in-depth, on-site investigations of TSDFs with the following key objectives:

* Determine compliance with interim status groundwater monitoring requirement of 40 CFR 265, as promulgated under RCRA or the state equivalent (where the State have received RCRA authorization).

* Determine if the groundwater at the facility contains hazardous waste or constituents.

Sunflower Army Ammunition Plant (SAAP) is located three miles south of DeSoto, Kansas, approximately thirty miles southwest of Kansas City, Missouri. The on-site inspection was conducted from November 10 through 21, 1986.

In general, the evaluation comprised a review of State, Federal and facility records and files; a site inspection and laboratory analyses and evaluation of groundwater and surface water samples. Task Force personnel evaluated compliance with applicable groundwater monitoring requirements as defined in Subpart F of 40 CFR 265 and equivalent Kansas regulations (KAR 28-31-8).

Specifically evaluated were the adequacy of the facility's groundwater sampling and analysis plan; the site assessment plan; the monitoring well design, construction and location. Additionally, analytical data from the sampling event were scrutinized. Additionally, past and current solid waste management units were also evaluated.

The Kansas Department of Health and Environment (KDHE) received final authorization in October 1985. Kansas' standards for hazardous waste TSDFs incorporate those defined in 40 CFR 264, 265, and 266 as in effect on November 1, 1986. Because federal standard for TSDFs are adopted by reference into Kansas' regulations, the facility's regulated surface impoundments have been subject to Federal interim status requirements since promulgation.

BACKGROUND

SAAP is a federally-owned, contractor operated plant which manufactures propellant on a limited basis. The plant has been in operation since January 2, 1943. Several waste management units exist at SAAP. These Include:

1) NQ/Carbide Area
2) Coal Pile Runoff Pond
3) Ash/Sanitary Landfill
4) Nitroglycerin Area
5) Sulfuric Acid Regeneration Lagoons
6) Paste Blender Pond

Of these six, only the NQ/Carbide Area and the Coal Pile Runoff Pond are subject to RCRA regulations.

SUMMARY OF FINDINGS AND CONCLUSIONS

Findings and conclusions presented herein reflect conditions that existed at Sunflower AAP in November 1986.

GROUND WATER MONITORING UNDER INTERIM STATUS

Initially, sixty groundwater monitoring wells were installed around six general waste management areas in 1981 to satisfy the RCRA deadline of November 1981.

Subsequently, four areas were determined to be exempt from RCRA requirements and removed from the facility's Part A. The remaining two units are currently monitored pursuant to 40 CFR 265, Subpart F standards.

GROUNDWATER ASSESSMENT PROGRAM

In February 1983, Sunflower AAP notified KDHE that, based upon analytical data, hazardous waste or hazardous waste constituents may have been released to groundwater beneath the site. Two groundwater assessment plans were prepared in April 1983 for the two RCRA regulated units. These plans were subsequently modified to reflect the inconsistent occurrence of contaminants in groundwater. In final form, the assessment plans describe a phased assessment program of confirmation sampling and analysis to be followed by appropriate remedial action, including monitoring well network modification where action levels are exceeded.

Concentrations of hazardous waste or waste constituents detected at SAAP are found in Appendix I. As a result of further sampling, SAAP confirmed the values of the constituents did not exceed action levels established under the assessment plan. Therefore, as permitted under 265.93(d)(a), SAAP resumed detection monitoring. However, the action levels in the assessment plan are based on health standards for hazardous constituents, where available. The plans are inconsistent with 40 CFR 265.93(d)(?), which requires determination of the rate and extent of migration and concentration of hazardous waste or hazardous waste constituents in the groundwater, independent of any "action level."

Groundwater Sampling and Analysis Plans

Sunflower AAP's Sampling and Analysis Plans prepared by the U.S. Army Environmental Hygiene Agency (USAEHA) for munitions plants across the country, are included in the facility's groundwater assessment plans.

Because Sunflower AAP's groundwater sampling and analysis plans lack site-specific detailed descriptions of sample collection and handling protocols, chain-of-custody procedures, and laboratory analytical methods, the plans are do not comply with regulatory requirements pursuant to 40 CFR 265.92.

TASK FORCE SAMPLING AND MONITORING DATA EVALUATION

During the inspection, Task Force personnel collected samples from a body of standing water and from sixteen groundwater monitoring wells, eight of which are located near RCRA-regulated surface impoundments. The remaining eight monitoring wells are situated near solid waste management units exempt from RCRA interim status regulations. The surface water sample was collected due to an oily sheen observed on its surface. Analytical data from the Task Force and Sunflower AAP samples were evaluated and compared with Sunflower AAP data from previous sampling events.

Evaluation and comparison of analytical data from the Task Force and SAAP (Appendix V) samples collected from monitoring wells in the NQ/Carbide area indicate the presence of cyanide (0.01 mg/l in well MW-3.

Analytical data from the monitoring wells in the powerhouse/industrial waste treatment area (coal pile runoff area) indicate no detectable release from this area.

The surface water sample taken near the pond adjacent to well 81-52 showed no evidence of a release.

Historical data, however, has indicated contamination. Additionally, due to the location and screen size of both upgradient and downgradient wells, the detection monitoring system, and the assessment plan are unable to adequately detect contamination from specific units or to determine its rule and extent.

TECHNICAL

REPORT

INVESTIGATION METHODS

The Hazardous Waste Groundwater Task Force investigation of Sunflower Army Ammunition Plant comprised the following activities:

* A comprehensive review and evaluation of existing records, files and documents from EPA Region VII, Kansas Department of Health and Environment, and Sunflower Army Ammunition Plant (SAAP);

* A preliminary site visit during August 21-22, 1986;

* An onsite inspection from November 10 through November 21, 1986;

* An evaluation of the offsite contract analytical laboratories, procedures utilized by the facility via a document review; and

* Analytical data from groundwater monitoring wells and surface water.

RECORDS AND DOCUMENT REVIEW

Pertinent records, files and documents from EPA Region VII and KDHE were reviewed prior to and during the onsite inspection to determine the scope of facility production activities and waste management practices employed at the site, construction details of waste management units, and the groundwater monitoring program. During the inspection, facility records and documents were reviewed to verify information and to determine compliance with applicable interim status recordkeeping requirements. Where necessary, facility documents were photocopied for the Task Force during the inspection.

Those documents and records reviewed prior to and during the inspection include the Groundwater Sampling and Analysis Plan; the phased Groundwater Quality Assessment Plans; past groundwater analytical data; groundwater monitoring well construction and installation diagrams; boring logs; groundwater monitoring inspection reports; facility geologic reports, facility permits and permit applications; waste management unit construction and operation reports; installation reports describing previous and current waste management units and practices; and operating reports which describe wastes generated at the facility, disposition and approximate quantities.

FACILITY INSPECTION

The onsite installation inspection was performed to verify monitoring well locations; to inspect visible well components; to identify waste management units, both past and present; pollution control practices; and surface drainage channels. Sunflower AAP representatives provided the Task Force with historical and current information pertaining to installation operations, waste management practices, and waste management units, typical monitoring well performance, and groundwater sampling procedures employed by the sampling team.

FACILITY DESCRIPTION

Sunflower AAP encompasses nearly 10,000 acres approximately three miles south of DeSoto, Johnson County, Kansas (Figure 1). The facility, which is federally owned and contractor-operated, manufactures propellants. The operating contractor is Hercules, Incorporated. A sulfuric acid plant located on-site is currently operated by a separate contractor, Koch Industries, Inc., for use by the military. Currently, the facility, operating at limited capacity, is producing nitroguanidine, the third base of a triple-base propellant. The plant has the capability of producing single- and double-base propellants. Between March 1943 and March 1947, explosives were produced at Sunflower. Since March 1951, propellants have been produced on a discontinuous basis. During periods of nonproduction, the facility is maintained on stand-by status.

Process wastes generated from the production of explosives, propellants, and propellant constituents have been managed or disposed of on-site in numerous surface impoundments, land treatment areas, and landfills since operations were initiated.

Sunflower AAP submitted an original notification of its hazardous waste activities as a fully-regulated generator, transporter and treatment/storage/disposal facility under interim status regulations on November 17, 1980. EPA issued the facility an EPA identification number, KS3213820878. Several amended Part A Permit Applications were subsequently submitted to revise, correct and clarify descriptions of hazardous wastes and regulated units.

Discharges from Sunflower AAP surface impoundments to surface water streams are permitted under the National Pollutant Discharge Elimination System (NPDES) program, permit number KS-84-FF-2.

Because process wastes management units have received hazardous wastes as defined in 40 CFR 261, Sunflower is subject to groundwater monitoring requirements under RCRA. Initially, sixty groundwater monitoring wells were installed at six separate waste management areas during September, October, and November, 1981, to satisfy RCRA requirements. As new surface impoundments and landfill areas have been constructed, additional monitoring wells have been installed.

Waste management units that have been identified across SAAP, and the regulatory status of each, are briefly described below. Process and waste management areas, as well as monitoring well locations, are depicted on Figures 2.

Waste Management Units Subject to RCRA Interim Status Regulation

° The Nitroguanidine/Carbide Area consists of gravel pads. Runoff from this area generally flows down a ditch into a non-discharging, unlined pond. Treatment of calcium carbide waste was accomplished by spreading the wastes on the limestone gravel pads and applying water. During treatment, acetylene gas was formed and discharged to the atmosphere; runoff was collected in the non-discharging pond. The runoff may have contained some cyanide. Because the treatment resulted in the generation of acetylene gas, the waste treated on the pads was considered to be reactive during treatment and regulated as a characteristic (D003) waste pursuant to 40 CFR 261.23. Approximately 1.5 tons of waste calcium carbide was treated at this site.

The triangular pond has an areal surface of approximately 41,800 square feet and a capacity of 209,000 cubic feet. Nine groundwater monitoring wells, the location of which are depicted on Figure 4, were installed in this area in 1981. The pond is subject to RCRA hazardous waste interim status standards as a waste pile.

° The #1 Coal Pile Runoff Pond (Pond #165-7) receives surface water runoff from Sunflower's stockpiled coal supply. Pond #165-7 is the first in a series of four lagoons through which treated (neutralized) coal pile runoff and boiler blowdown is passed prior to discharge to Kill Creek under NPDES permit. Pond #165-7 is also one of seven surface impoundments in the Power House/Industrial Waste Treatment Area, none of the rest of which are subject to RCRA regulations.

Pond #165-7 was constructed and placed into service during July 1981 to intercept discharge from stockpiled coal for neutralization and settling of coal fines. The pond, which measures 50' x 70' x 15', has an areal surface of 3500 feet and a capacity of 70,000 cubic feet.

Because the coal pile runoff has occasionally exhibited low pH values and requires neutralization, the surface impoundment is subject to RCRA hazardous waste requirements. Depending upon origin, accumulated coal fines may also contain significant quantities of metals. Eleven groundwater monitoring wells were installed around the area in 1981. Adjacent ash lagoons and Pond A, which are exempt from RCRA regulations, are also monitored by the aforementioned network of eleven wells. Monitoring wells and surface impoundment locations are depicted on Figure 5.

Pre-RCRA Solid Waste Management Units

° The Ash and Sanitary Landfills, as well as the Contaminated Waste Processor (CWP) areas are monitored by a network of fourteen groundwater monitoring wells (Figure 8). The landfills reportedly have received no RCRA-regulated wastes during operation.

° The Nitroglycerin Area is monitored by a network of sixteen groundwater monitoring wells (Figure 9). Nitroglycerin process wastewaters, which are corrosive (both acidic and alkaline), were discharged through open drainage channels to Pyotts's Pond for pH adjustment prior to discharge to Kill Creek. Nitroglycerin-contaminated solid wastes were disposed of by open burning onsite. The nitroglycerin production was terminated prior to November 1980.

° The Sulfuric Acid Regeneration (SAR) area is monitored by six groundwater monitoring wells (Figure 10). Regeneration of spent sulfuric acid results in the generation of corrosive wastewater which is neutralized prior to discharge to evaporation lagoons.

° The F-Line Paste Blender area contains two surface impoundments which were employed as holding (settling) ponds for propellant-contaminated wastewaters. Wastewater from this area was ultimately discharged to Kill Creek. Four groundwater monitoring wells (Figure 11) were installed in the area in 1981. Production in the Paste Blender area was discontinued prior to November 1980.

SITE HYDROLOGY

GEOLOGY

In order to properly design and install an adequate groundwater monitoring program at any facility, a comprehensive site characterization and subsurface investigation must be accomplished. Sunflower AAP initiated a program of site characterization based upon previous subsurface investigations and a comprehensive literature search. Foundation investigations, on-going plant modifications, and extensive monitoring well installation have resulted in a relatively well-defined geologic environment at the facility.

Sunflower AAP, situated approximately 3 miles southwest of DeSoto, Kansas, encompasses approximately 15 square miles of northwest Johnson County, Kansas. The facility lies in the Attenuated Drift Border Division of the Dissected Till Plains Section of the Central Lowlands Province. Maximum topographic relief displayed across the site is approximately 180 feet.

Physiography, Topography, and Surface Drainage

SAAP is located on the border between the Dissected Till Plains and the Osage Plains sections of the Central Lowlands physiographic province. Maximum topographic relief is approximately 180 feet from a low along Kill Creek in the northeastern corner to a high in the south-central portion of the installation. Surface water drainage is to either Spoon and Kill Creeks in the east or Captain Creek in the west for most of the installation. These creeks flow to the Kansas River, which is located two to three miles north of the plant. Drainage for a small part of the northwest corner of SAAP is northward to unnamed, intermittent streams which flow directly to the Kansas River. The nitroguanidine area is located on the drainage divide between this area and the Captain Creek drainage area.

Regional Geology

Sedimentary bedrock units of Cambrian, Ordovician, Devonian, Mississippian, and Pennsylvanian age overlie Precambrian rock in Johnson County. The Pennsylvanian age rocks which outcrop in the county are of the Missourian and Virgilian Stages. The near-surface bedrock units at SAAP, in ascending order, are the Wyandotte Limestone and Bonner Springs Shale formations of the Kansas City, Group; the Plattsburg Limestone,

Vilas Shale, and Stanton Limestone formations of the Lansing Group; and the Stranger formation of the Douglas Group. General descriptions of formation members and their average thickness at SAAP are presented in Figure 13.

Johnson County is located in a regional geologic structure called the Prairie Plains monocline. The bedrock dips to the northwest at approximately 15 to 20 feet per mile. In the vincinity of SAAP, a gently undulating anticlinal/synclinal structure, striking north-northwesterly, is superimposed on the regional structure.

Overlying the bedrock in Johnson County are unconsolidated glacial, fluvial, lacustrine, and aeolian deposits of Pleistocene age. These unconsolidated sediments are largely glacial till and undifferentiated fluvial and lacustrine deposits of the Kansan Stage. Recent alluvium along the Kansas River and its tributaries are Wisconsinan and Recent in age. In northwestern Johnson County, including the western portion of SAAP, the basal part of the Kansan Stage deposits are commonly sand or sand and gravel. This sand and gravel was deposited as glacial outwash and, possibly, as lacustrine sediments in glacial lakes. Figure 12 is a geologic map of the SAAP vicinity.

Regional Groundwater Hydrology

The principal unconsolidated sediment aquifers in Johnson County are Kansas River valley alluvium and undiferentiated fluvial deposits in tributary stream valleys. In addition to these Wisconsinan deposits, Kansan fluvial and lascustrine deposits also yield small quantities of water in some locations. Wells in the Kansas River Valley alluvium can yield 1,000 gpm or more. Wells in tributary valleys normally yield one to 10 gpm. However, wells in some parts of the Captain and Cedar Creek valleys could probably yield greater quantities because of sandy sediments. On SAAP, the Kansan deposits in the western portion of the installation would yield quantities of water depending on the thickness of the sand or sand and gravel layer and also the thickness of the saturated zone. Recharge of these aquifers is through infiltration of local precipitation.

The bedrock in Johnson County generally does not yield significant quantities of usable water. In some localities, wells in the Wyandotte Limestone and the Ireland Sandstone Member of the Lawrence formation yield 10 to 40 gpm. The Lawrence formation overlies the Stranger formation in the Douglas Group; however, the Stranger formation is the most recent bedrock strata identified in monitoring well borings at SAAP. Certain black or very dark and fissile shales, including the Eudora Shale, are capable of yielding up to 20 gpm of water that may be saline. Sandstone beds in certain bedrock units, including the Rock Lake and Vilas Shales, may also yield small quantities of water, generally less than five gpm. In addition to the rock units mentioned, wells installed into the zone of weathering in near-surface limestones and shales will yield small quantities of water because of increased secondary permeability in this zone due to fractures, joints, and bedding planes. Recharge of these shallow bedrock aquifers is by infiltration of local precipitation through overlying unconsolidated material.

There are no water supply wells on SAAP. The plant water supply is obtained from wells located north of the installation in the Kansas River Valley alluvium.

Monitoring Well Drilling Procedures

At each of the monitoring well sites, two holes were drilled. Initially, a cable tool drill, producing a 6" x 2' cylindrical soil sample, was employed in order to classify overburden materials and to accurately determine depth at which top of bedrock occurs. These holes were subsequently backfilled with sand opposite pervious zones and with a bentonite-sand mix opposite impervious zones; a positive seal of bentonite pellets was placed between backfill zones.

Adjacent to each cable tool boring, a second boring was drilled by rotary methods to a predetermined bedrock unit. However, in some cases where distinct aquifers were present in the overburden, borings were terminated at the overburden-bedrock interface.

In order to accurately determine statigraphic sequence and elevations of geologic contacts and to identify rock units most likely to be in the uppermost aquifer, bedrock in the first boring at each of the general areas, except at the Contaminated Waste Disposal Area, was continuously cored with 6" core barrel.

Efforts to minimize introduction of pollutants into the groundwater system during the drilling phase of well installation included the following:

(1) exclusive use of clean, treated water from the plant's water distribution system as a drilling fluid with total omission of drill fluid additives.

(2) use of clean and grease-free drilling tools.

(3) flushing of all rotary-drilled holes upon completion of drilling by circulating clean water until the return water becomes clear.

Well Construction and Development

Sunflower Monitoring wells were constructed of 4-inch I.D., schedule 40 PVC casing and slotted, 4-inch I.D., PVC well screen with solvent-welded couplings and bottom cap. A slot opening of 0.035" was selected to retain approximately 95 percent of the filter-pack material, the gradation of which was recommended by the state. The screened interval of the well extended to one foot above the bedrock/overburden interface or to one foot above any permeable zones in the overburden. Filter pack was placed in the annular space between the screen and the drill hole to a depth one foot above the top of the screened portion of the well. The filter pack was of the approximate following gradation:

Sieve Size	% Retained
#4	12
#8	62
#16	93
#30	98
#50	99
#100	100

A one-foot thick seal of bentonite pellets was placed above the filter pack, and the annulus grouted to the surface. Grout consisted of 4 lbs. bentonite and 7.5 gallons of water per 94-pound sack of Portland cement.

Each well was completed with a steel protective pipe at the ground surface. The protective pipe was surrounded by a 2' x 4" concrete pad into which was imbedded a brass survey medallion. Refer to figure 2, a typical well construction diagram.

Wells were developed by surging and bailing. Wells which were readily bailed dry were further developed by introducing a clean water and continuing surging and bailing. Wells which could not be bailed dry were pumped after development until a minimum of ten casing volumns of water had been removed from the well.

Appendix IV shows installation diagrams for each of the sixty wells.

Due to the relative scarcity of groundwater in the area, the Kansas Department of Health and Environment (KDHE) recommended a design to intercept as much groundwater as possible at each well location. In order to accomplish this, all potential water bearing zones in a boring were screened. Although this procedure may result in mixing of waters from different strata, it was considered necessary in order to insure sufficient quantities for sampling purposes. It also results in the inability to distinguish hydrostatic head relationships for different strata.

Monitoring Well Network

1. The nitroguanidine area and the carbide impoundment are located on a topographic high which separates the Captain Creek drainage area from the area drained by unnamed creeks flowing northward toward the Kansas River. A total of nine monitoring wells are located at this site. Well #MW-8 is listed as an upgradient well while wells MW 1, 2, 3, 4, 5, 6, 7, and 9 are listed as downgradient wells. The bedrock units dip gently to the west-southwest. The uppermost bedrock units are the Weston Shale at the locations of monitoring wells MW05 through MW08 and the South Bend Limestone at the remaining well locations. The unconsolidated overburden ranges in thickness from 12.3 feet at monitoring well MW07 to 43.2 feet at MW09. The overburden materials are Kansas State deposits consisting primarily of clay, silty clay, and sandy clay, with a layer of sand and/or clayey sand as the basal part

overlying bedrock. The thickness of the sand layer is variable, ranging from zero at monitoring well MW07 and only 1 foot at MW05, to greater than 10 feet at wells MW03, MW06, and MW09. Monitoring well MW03 is located adjacent to the carbide impoundment, and the boring for this well revealed an overburden of 37.8 feet with nearly 12 feet of sand overlying bedrock.

Monitoring well MW03 was screened in the sand and clayey sand overlying bedrock. All other wells were installed with screens extending from near the top of the sand layer to the uppermost part of the Vilas Shale. The wells installed into bedrock ranged from 71 to 90 feet in depth and had screen lengths from 45 to 69 feet. The well casings are 4-inch-ID, schedule-40 PVC piope and have 4-inch-ID PVC screens with a slot size of 0.035 inch. Filter pack material was placed into the annular space between the screen and the drill hole wall from the bottom of the hole to one foot above the top of the screen. A one foot bentonite seal was placed above the filter pack, and the annulus above this was grouted to the surface. The wells were developed by surging, bailing, and pumping. The screening of monitoring wells through both the unconsolidated overburden and the bedrock was recommended by the State of Kansas, Department of Health and Environment, to insure that adequate water could be obtained from the wells when sampling. However, this design allows mixing of water from different strata and does not permit the measuring of piezometric head for each water-bearing unit separately. The water level measurements obtained are a composite of actual piezometric heads for the permeable strata penetrated by the bore hole. Water level measurements show the composite piezometric head to be above the top of the sand layer for all wells. During periods of low rainfall, the water table will probably be lower and the sand may not be fully saturated. This site is located on a topographic high, and groundwater flow is probably radial from the site. Monitoring well MW08's screen placement precludes its use as an upgradient well. As shown in its well log in Appendix IV, well MW-81-8 is screened through a number of formations, both unconsolidated and consolidated. Total screen length approaches 63 feet. All nine monitoring wells yield sufficient water such that they cannot be pumped dry with a low-volume sampling pump of the bladder type.

2. The topographic slope at the powerhouse lagoons/coal pile impoundments is eastward, with surface water drainage and discharge from the impoundments (all impoundments and Pond A) flowing to Pond B, located 2,000 feet to the east. Overflow from Pond B is to Kill Creek, located another 2,500 feet eastward. A total of 11 groundwater monitoring wells are located around the powerhouse impoundments, ash impoundments, and Pond A.

The powerhouse impoundments are located on the anticline ridge of the local anticlinal/synclinal structure which strikes in a northwesterly direction. The bedrock surface slopes generally eastward in this vicinity, with slope at the powerhouse impoundment site being toward the southeast. The uppermost bedrock units are the Vilas Shale and the Spring Hill Limestone. The unconsolidated overburden is generally 10 feet or less in thickness and consists of clays. Exceptions are the sites of upgradient wells MW41 and MW42, where a thicker overburden occurs, with sand as the basal portion overlying bedrock. Prior to construction of the impoundments, several

undisturbed samples of the clay overburden were obtained, and laboratory permeability tests were run with results indicating permeability of 10^{-6} to 10^{-4} cm/sec.

There are 11 RCRA monitoring wells in this area. MW41 and 42 are upgradient wells; MW43, 44, 45, 46, 47, 48, 49, 50, and 55 are downgradient wells. Monitoring wells were generally constructed with screens from near the bedrock surface to the Bonner Springs Shale or the Farley Member of the Wyandotte Limestone. Monitoring wells MW41 and MW42 were screened through both bedrock and the overlying sand; MW41 was screened over a shorter interval than other wells and extended only 5 feet into bedrock. The wells ranged from 36.3 feet (MW41) to 69.0 feet (MW43) in depth, with screen lengths ranging from 27 to 63 feet. The wells were constructed as described in paragraph 6a(4). Monitoring wells MW43, MW45, MW47, and MW55 produce very little water and can be pumped dry with a low volume sampling pump of the bladder type. These four wells recharge very slowly and do not recover completely during a 24-hour period following pumping. Other wells yield greater amounts of water. Figure 10 is a contour map of the piezometric surface. As discussed previously, the measurements will represent a composite head for permeable strata because of well design. The contour map indicates groundwater flow generally toward the east.

As in the carbide area, the upgradient wells are unacceptable. Not only do they intercept multiple formations, but they monitor different formations than the downgradient wells.

Upon completion of the monitoring well network, water levels were determined, plotted, and contoured. Direction of groundwater flow at each of the six sites was accomplished by construction of flow lines normal to piezometric contours, as shown in Figures 6 through 11. From this information, specific wells were established as hydraulically upgradient or downgradient. Generally, the groundwater surface was determined to roughly reflect surface topography.

Ash/Sanitary Landfill Area

Eleven monitoring wells, MW 81-10 through MW 82-29 and MW 81-60, were installed in the landfill area.

Direction of groundwater movement, as shown in Figure 8, is generally westward. Based on this premise, MW 81-17 and -18 would appear to be obvious choices for hydraulically upgradient wells.

Contaminated Waste Disposal Facility

Three wells, MW-81-57, -58, -59, were installed at the CWD facility, which lies hydraulically downgradient from the Ash/ Sanitary Landfill (see Figure 8).

Groundwater flows generally westward to Captain Creek.

If the impoundment is considered to be a contamination source, MW 81-57 would be designated the hydraulically upgradient well; MW 81-58, downgradient.

GROUNDWATER MONITORING UNDER INTERIM STATUS

REGULATORY BACKGROUND

In order to comply with RCRA hazardous waste regulatory deadline of November 1981, Sunflower AAP initially installed sixty groundwater monitoring wells which were configured to essentially encircle specified waste management units because aquifer characteristics and hydraulic parameters were unknown.

Following installation, groundwater gradients could be determined; and if the monitoring well network at any location was determined to be inadequate, modifications could be made. Based upon subsequent KDHE review, Sunflower AAP's RCRA groundwater monitoring well networks were considered adequate and no modifications have been required.

Sunflower AAP submitted its original Part A Permit Application in November 1980. Included in the application were six hazardous waste areas initially identified as requiring groundwater monitoring pursuant to RCRA hazardous waste regulations.

Subsequent Part A applications were submitted to reflect agreements among the facility, KDHE and EPA, regarding the status of hazardous wastes and waste management units at the site. Following negotiations between Sunflower AAP and EPA/KDHE during December 1982, the facility submitted amended Part A permit applications, in October 1983 and October 1984, which removed all but two waste management units subject to groundwater monitoring requirements - the Nitroguanidine (NQ)/Carbide Area and the Powerhouse Lagoon (Coal Pile Runoff Pond) - from the facility's Part A.

On February 17, 1983, SAAP submitted a notification indicating groundwater monitoring wells in the six waste management areas showed concentrations of certain drinking water parameters exceeding MCL's (maximum contaminant level). See Appendix 3 for the specific parameters and their corresponding values. Additionally, in the t-test results from chemical analyses run in May and June 1985, specific conductance and pH from various wells around the nitroguanidine/carbide Area failed as did pH for two wells at the Powerhouse/Industrial Waste Treatment Area.

In September 1984, KDHE conducted a RCRA groundwater monitoring inspection. The purpose of the inspection was to evaluate the facility groundwater monitoring program and to determine the facility rationale for submitting two Groundwater Assessment Plans when analytical data submitted to KDHE suggested that hazardous wastes or hazardous waste constituents had been released to groundwater at all six sites with groundwater monitoring wells in place. KDHE concluded that, because the omitted waste management units were not regulated under RCRA, the submitted groundwater assessment plans were all that could be required at that time.

In October 1984, KDHE approved a Groundwater Assessment Plan for each of the two areas. The assessment plans, revised in February 1985, are designed to be implemented in phases due to the sporatic occurrence of detected groundwater contamination at the site. The Assessment Plans are provided in Appendix II.

Phase I of the Assessment Plans sets Action Levels for specific waste constituents for each area; Phase II requires additional evaluation and monitoring wells, the scope of which must be documented and approved prior to implementation. Initially, groundwater analytical data failed statistical evaluation for indicator parameters - specifically, pH and specific conductivity. Upon resampling, however, indicator parameters passed statistical tests. Specific waste constituents unique to each site were also evaluated; however, any constituent detected during the event when statistical failures occurred was undetected upon resampling. Therefore, the Phased Groundwater Sampling Plans were approved by KDHE as appropriate for the facility. With respect to 40 CFR 265 Subpart F, the facility has reinstated an indicator evaluation program pursuant to 40 CFR 265.93(e)(6).

From information collected and data generated during this evaluation, full compliance with 40 CFR 265 Subpart F was achieved.

Adequacy of Monitoring Networks

Pursuant to RCRA interim status requirements, the uppermost aquifer beneath the site must be monitored (40 CFR 265.90). As defined in 40 CFR 260.10, an aquifer is a "geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs." An uppermost aquifer is defined as "an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary." Sunflower's identification and monitoring program of the uppermost aquifer beneath the site may have been ambitious. In an apparent effort to intercept sufficient groundwater for sampling purposes, monitoring wells interconnect multiple, possibly discreet, water-bearing strata.

This has resulted in the inability of the wells both upgradient and downgradient, to adequately portray the groundwater quality of the upper aquifer. Additionally, due to the distance between the monitoring wells and the regulated units, it is infeasible to determine whether the units are affecting groundwater quality. As required under 265.91, the downgradient monitoring wells should be polaced so as to immediately detect any statistically significant amounts of hazardous waste.

SAAP's assessment plan does not meet the requirements of 265.93(d) since the present monitoring system is incapable of determining the extent, both horizontally and vertically, and concentration of hazardous waste parameters.

Of particular concern is the inability of SAAP to adequately address the origin of specific parameters found in both upgradient and downgradient wells such as: the presence of low concentrations of cyanide in NQ/Carbide Area monitoring wells, the design of which introduces significant dilution potential. Sunflower's detection limit for cyanide is 0.01 milligram per liter (mg/l); the Action Level is 0.2 mg/l (based upon EPA's Interim Primary Drinking Water Standards).

* In November 1984, cyanide (at 0.16 mg/l) was detected in MW 81-4 , a well screened across the overburden/bedrock interface and several bedrock strata. At the same time, cyanide was not detected in MW 81-3, a monitoring well completed in overburden.

* In May 1985, cyanide was detected in MW 81-8 at a concentration of 0.03 mg/l.

* In November 1985, cyanide was detected in MW 81-8 and MW 81-7 at 0.06 and 0.05, respectively.

The historical levels of Selenium in wells 41, 42, 43, 44, 45, 46, 47, 50, and 55 and,

The levels of both chromium, arsenic, and lead found in wells monitoring the powerhouse.

GROUND WATER SAMPLING AND ANALYSIS PLAN

Sunflower AAP has adopted a generic Sampling and Analysis Plan -- U.S. Army Groundwater Monitoring and Assessment Program - Instructions For Collection, Preparation and Shipment of Samples (September 1981) -developed by the U.S. Army Environmental Hygiene Agency (USAEHA), Aberdeen Proving Ground, Maryland. Subsequent sampling procedures were developed by USAEHA and included in the facility's Phased Groundwater Assessment Program.

Supplemental sampling procedures were later developed for incorporation into Sunflower's Phased Groundwater Assessment Program. Additional modifications were recently prepared by Hercules, Inc. for use by the sampling team which carefully describe use, calibration and cleaning of equipment used at the facility.

Sunflower's Sampling and Analysis Plans are inadequate. The facility's Sampling and Analysis Plans are appended to this report (see Appendix II). Specifically, Sampling and Analysis Plan deficiencies include the following:

1. The plan has not been updated to reflect changes in Army directives and regulations. Current data sheets are absent.

2. Detailed descriptions of analytical procedures and laboratory QA/QC procedures are absent.

3. Routine determination of well depths is not specified.

4. Static water levels are specified to be determined to the nearest 0.1 foot. However, Sunflower AAP's current procedures require that water levels be determined to the nearest 0.01 foot, as recommended by EPA protocols.

GROUNDWATER ASSESSMENT PLANS

Incorporated in the Groundwater Assessment Plans are Action Levels for specific constituents for each of the two areas. Action Levels are set at 10 times the detection limit for specific constituents for which health based standards are unknown or reflect health standards, if available. Action Levels are provided in Table 3. The action levels must be exceeded for SAAP to implement groundwater assessment investigation pursuant to 40 CFR 265.93(d)(4). However, these plans are inconsistent with 40 CFR 265.93(d)(4) which requires determination of groundwater determination, independent of any action level.

LABORATORY EVALUATION

Sunflower AAP's sampling and analytical activities are initiated and coordinated through the U.S. Army Environmental Hygiene Agency (USAEHA), Aberdeen Proving Ground, Maryland. All sample containers are prepared and provided by USAEHA on a predetermined schedule. All samples are returned to USAEHA following the sampling event. USAEHA analyzes groundwater samples for melamine, urea, and nitroguanidine in-house; all other parameters are sent to the following contract laboratories:

Century Laboratory Thoroughfare, New Jersey	TOX, TOC, Specific Conductivity
Bionetics Laboratories Silver Spring, Maryland	Cyanide; Nitrates, Nitrites, Ammonia; Ba, As, Cd, Cr, Ag, Hg, Se
Hittman Laboratories Silver Spring, Maryland	Ba, As, Cd, Cr, Ag, Hg, Se plus Fe, Mn, Na, Cl, Sulfates, Phenols

During a preparatory interview with USEHA representatives, Region VII analytical chemists scheduled to perform the audit determined that the Quality Assurance Program employed by USEHA is more comprehensive than that in-place in Region VII. Therefore, the laboratory audit, which is a review of laboratory documentation and programs provided, was eliminated from this CME.

SUNFLOWER ARMY AMMUNITION PLANT SAMPLING PROCEDURES

Due to an air compressor malfuntion, the Sunflower AAP sampling team was unable to provide a field demonstration of facility sampling protocols. However, a description of sampling procedures was provided, a summary of which follows:

1. In order to determine static water levels for evaluation of a groundwater flow condition Sunflower AAP's sampling team determines all static water levels prior to the purging and sampling of any well. Static water levels are determined immediately prior to purging each well. A Soil Test™ water probe, the probe of which contains lead, is employed. Decontamination is accomplished by rinsing the unit, with particular attention to the probe and cable, with one gallon of deionized water prior to and following each well.

2. A geofilter™ Bladder Pump is used to purge and sample each monitoring well. The pump and associated air and discharge lines are cleaned prior to use by running approximately one gallon of deionized water through the system. The exterior of air and discharge lines is rinsed with approximately one gallon of water. Because the pump is driven by the air compressor, a demonstration was not performed.

3. Typically, the samplers removed 1.5 to 2 well volumes, depending upon drawdown, from each well. Many wells recover very slowly. Water levels are determined during the event and recorded in Sunflower's permanent record so that relative well performance over time can be determined. Specific conductivity and pH are measured at five-gallon intervals, or two-gallon intervals for shallow or low-yield wells; upon stablization, the purging process is complete. Monitoring wells are not purged to dryness because some water must remain in the well to operate the pump. The pump is set near, but above, the monitoring well bottom.

4. Field parameters are determined with instruments, all of which are corrected, where appropriate, for temperature variations. All instruments are calibrated monthly in the facility's onsite instrument laboratory. Specific conductivity is measured with a VSI™ meter; pH is determined with a Beckman pH Meter, which during sampling, is calibrated daily.

5. Purged water is discharged on the ground some distance away from the well. Generally, the team purges a day ahead of sample collection to allow low-yield wells to recharge, generally not an acceptable EPA practice.

6. A trained and experienced Sunflower AAP sampling team of two employees performs RCRA groundwater monitoring sampling events. The team explained that, although their procedures were carefully described and practiced, they were unfamiliar with a specific, step-by-step plan which precisely defines field procedures.

7. In order to ship groundwater samples via overnight delivery to USAEHA, Aberdeen Proving Ground, Maryland, groundwater sampling is terminated early each day. Sample preparation is performed in the facility laboratory. All sample bottles and preservatives are shipped to Sunflower from USAEHA for each sampling event. All samples are preserved as appropriate, packed, secured and iced in insulated shuttles for shipment.

8. Chain-of-Custody records are generated upon completion of sampling and included in the shuttle for shipment. A photocopy of the facility's chain-of-custody form is included in the sampling and Analysis Plans (Appendix II).

9. The sampling team meticulously records all field data and conditions on field sheets which are to become part of the permanent record maintained at the site. These records are reviewed during subsequent sampling events to determine if well performance has altered. The sampling team was quite familiar with typical well performance.

10. Because groundwater quality at RCRA regulated units has not been grossly impacted, the order of sampling is determined by logistics to take full advantage of limited field time each day.

11. The facility's Sampling and Analysis Plan, prepared by USAEHA in 1981 is a plan prepared for Army ammunition plants requiring groundwater monitoring. The plan has been modified by USAEHA for supplemental plans which are included in facility assessment plans.

Sample Collection and Analysis

Facility sampling team members received split samples from EPA, and prepared to demonstrate sampling procedures typically employed by the facility. However, euipment malfunction precluded a full field demonstration.

The sampling component of the investigation comprised two key activities:

* Determination of static water levels and well depths in all monitoring wells onsite installed since 1980, and

* Collection of groundwater samples from sixteen monitoring wells and one surface water sample.

Water level measurements were taken to evaluate the direction of groundwater flow and to calculate the volume of water in each well. Due to the size of the site and the number of discrete waste management units, the facility's groundwater monitoring well system monitors multiple units as opposed to specific units. No groundwater data is available for areas which lie between waste management units (which would monitor specific units.

A single surface water sample was collected in an abandoned trough in the T Line Paste Blender Pond Area due to an observation of an oily film.

SAAP collected a full set of split samples for all monitoring wells sampled by EPA.

All monitoring wells were purged and sampled with dedicated Teflon bailers provided by EPA's contractor, Allied Technologies, Inc. To expedite determination of groundwater level data and collection of samples, two field teams were formed. All water levels were determined prior to the purging and sampling to any one well. Groundwater samples were collected utilizing the following procedures:

1. The SAAP representative unlocked the steel protective casing and removed the PVC well cap.

2. The EPA contractor monitored the open wellhead for chemical vapor using either an HNu meter or an Organic Vapor Analyzer (OVA).

3. The EPA contractor measured the depth to water using a well probe (Johnson Watermarker), the probe tip of which is lead.

4. Although a steel tape was prepared for determination of well depth, apparently inadequate weights were affixed and the bottom of wells could not be accurately measured. Therefore, well depths were determined with the electric well probe. All measurements were referenced to a marked point at the top of the PVC casing, the elevation of which had been previously surveyed and recorded. A 2' x 2' x 4" concrete pad, into which location coordinates and surveyed elevation are permanently marked, surrounds each groundwater monitoring well.

5. The well probe was retrieved and decontaminated after each well with a pesticide-grade hexane wipe followed by a distilled water rinse and dry wipe.

6. The PVC well cap was replaced and the steel protective casing was locked by the SAAP participant.

7. Task Force personnel then calculated well volume using water column height and well casing radius.

8. To sample each well, the SAAP aprticipant unlocked the steel protective casing and uncapped the PVC well. The EPA contractor then purged each well by bailing a minimum of three water column volumes, or until dry. Water was discharged into a five-gallon plastic bucket that had been calibrated in gallons and accumulated in plastic drums placed at each well site by SAAP for subsequent disposal. For this event the facility provided drums for the management of purged well water. However, SAAP personnel typically discharge evacuated well water on the ground some distance away from the well head.

9. The EPA contractor collected sample aliquot for determination of field parameters (temperature, turbidity, specific conductance, and pH) minimally at the beginning and conclusion of each purge to evaluate effectiveness of well evacuation.

10. The EPA contractor filled sample containers employing both the procedure and order specified in Tables 1 and 2. Split samples were achieved by filling approximately one-third of each bottle for the Task Force and SAAP, respectively. The process was repeated until each container was filled.

11. All samples were immediately placed in insulated coolers.

12. Following completion of sampling at a given well, EPA contract participants returned to a staging area for sample preservation, if required, and for filtering of the dissolved metal aliquot. Sample preservation procedures are provided in Table 1.

13. Quality control samples (duplicates) were collected from monitoring wells MW 81-36 and M@ 81-41 upon completion of the groundwater smapling. The field blank, however, was collected later at MW 81-42, chosen due to the dusty conditions prevalent at the site and the proximity to the coal pile.

14. The sample of surface water was collected with a jar and extension sampling arm from ponded water near MW 81-52. This body of surface water ultimately discharges to Kill Creek. A complete set of parameters was collected; SAAP received split samples.

EVALUATION OF MONITORING DATA FOR INDICATIONS OF HAZARDOUS WASTE RELEASE

In order to evaluate indications of release of hazardous wastes or hazardous waste constituents from waste management units at Sunflower AAP, an analysis of monitoring data has been performed. Evaluated were results/analytical reports from the November 1986 sampling inspection as well as previous facility data. Appended to this document are analytical data, as well as analytical methods employed for the November 1986 sampling event. (Appendix V). For each of the two RCRA-regulated areas, data indicate the following:

1. NQ/Carbide Area: Four of the existing nine montoring wells were samples during November 1986, one of which NW 81-03, is located immediately adjacent to and hydraulically downgradient from the surface impoundment. Of the network of nine wells, MW 81-03 is the singular overburden well and is constructed with the shortest screen (approximately 20 feet). Due to its location and depth, analytical data from MW 81-03 should be closely monitored for indications of release.

SAAP data from the November 1986 sampling also indicated cyanide at the detection level of 0.01 mg/l in MW 81-03. Review of previous Sunflower data indicate that cyanide has randomly been detected in other monitoring wells across the area but this is the first occurrence of cyanide in MW 81-03. In all cases, cyanide concentrations are slightly above or at detection levels and below health-based maximum concentrations of 0.2 milligrams per liter (mg/l).

2. Power House Lagoon Area (Coal Pile Runoff Pond): Task Force and SAAP data from the four monitoring wells sampled in this area, two of which are upgradient, indicate levels below MCL values which are constituents of concern. One should note that SAAP data indicate the presence of cyanide in the two upgradient wells, MW 81-41 and 42, at .02 mg/l for each well. Task Force data does not report the occurrence of cyanide in either of these two wells.

For the four Solid Waste Management Areas (SWMUs) data evaluation is as follows:

1. Ash/Sanitary Landfill: Although this area is exempt from RCRA interim status requirements, analytical data indicate release of wastes to groundwater. Task Force data suggest that total lead (0.09 mg/l) was detected in MW 81-13. SAAP data confirms the presence of lead, with November 1986 analytical data reporting lead at 4.030 mg/l.

Task Force data also suggest (qualitatively) the presence in MW 81-13 of TCE at .0028 mg/l and Furan at .190 mg/l. Task Force data from MW 81-12 also suggest the presence of Toluene at 0.0024 mg/l and Furan at 0.036 mg/l, qualitatively, and selenium at 0.04 mg/l (the maximum allowable concentration under RCRA is 0.01 mg/l). Because these data strongly suggest releases of hazardous waste or hazardous waste constituents, the Task Force recommends that Ash/Sanitary Landfill be closely scrutinized for releases of hazardous waste or hazardous waste constituents to the environment.

2. Nitroglycerin (NG) Area: Task Force analytical data from the two monitoring wells sampled in the NG area indicate the presence of two explosive compounds, RDX and HMX, in the groundwater. SAAP data does not confirm this because the reported concentrations from Task Force data are below facility detection limits.

Task Force data suggest the presence of HMX at .050 mg/l was reported in MW 81-31 at .011 mg/l. Relatively high concentrations of sulfates were reported in MW 81-29 and -38 at 425 mg/l and 320 mg/l, respectively. It is recommended that the NP area be evaluated under RCRA authorities granted under HSWA of 1984.

3. Sulfuric Acid Regeneration (SAR) Lagoons: The singular monitoring well (MW 81-36, sampled in the SAR area was selected due to an oily-appearing sediment observed on the well probe when retrieved from sounding monitoring well depth. Samples collected were turbid (4NTU). Analytical data from this well indicate no significant contamination, although elevated sulfate levels were detected.

4. F-Line Paste Blender Pond Area: Monitoring well MW 81-54 was selected for sampling to determine if hazardous wastes or hazardous waste constituents have been released to groundwater beneath the ponds. Based upon analytical data, releases are not indicated.

UPDATE

The two active RCRA units, the Carbide Treatment Area and the Coal Pile Runoff Area are currently undergoing closure. On July 1, 1987, closure plans for both areas were approved.

SAAP has indicated it will attempt to clean close both areas.

Recent data from 1987 indicates a number of concerns involving specific parameters still remain. These include:

CONCENTRATIONS EXCEEDING ACTION LEVELS
GROUNDWATER SAMPLES COLLECTED OCT-DEC 1987
SUNFLOWER AAP

POND A & POWERHOUSE LAGOONS:

WELL NO.	PARAMETER	CONCENTRATION DETECTED	ACTION LEVEL	FILTERED/ UNFILTERED
MW44	lead	0.027 mg/L	0.025 mg/L	U
	cadmium	6.000 ug/L	5.000 ug/L	U
MW46	lead	0.037 mg/L	0.025 mg/L	U
	lead	0.034 mg/L	0.025 mg/L	F
MW49	cadmium	10.000 ug/L	5.000 ug/L	U
MW55	lead	0.070 mg/L	0.025 mg/L	F
MW55	lead	0.148 mg/L	0.025 mg/L	U

NITROGUANIDINE/CARBIDE AREA:

MW5	ammonia	0.32 mg/L	0.3 mg/L	U

These values indicate the need for further assessment before a determination can be addressed on clean closure.

E X H I B I T S

FIGURES 1 thru 14

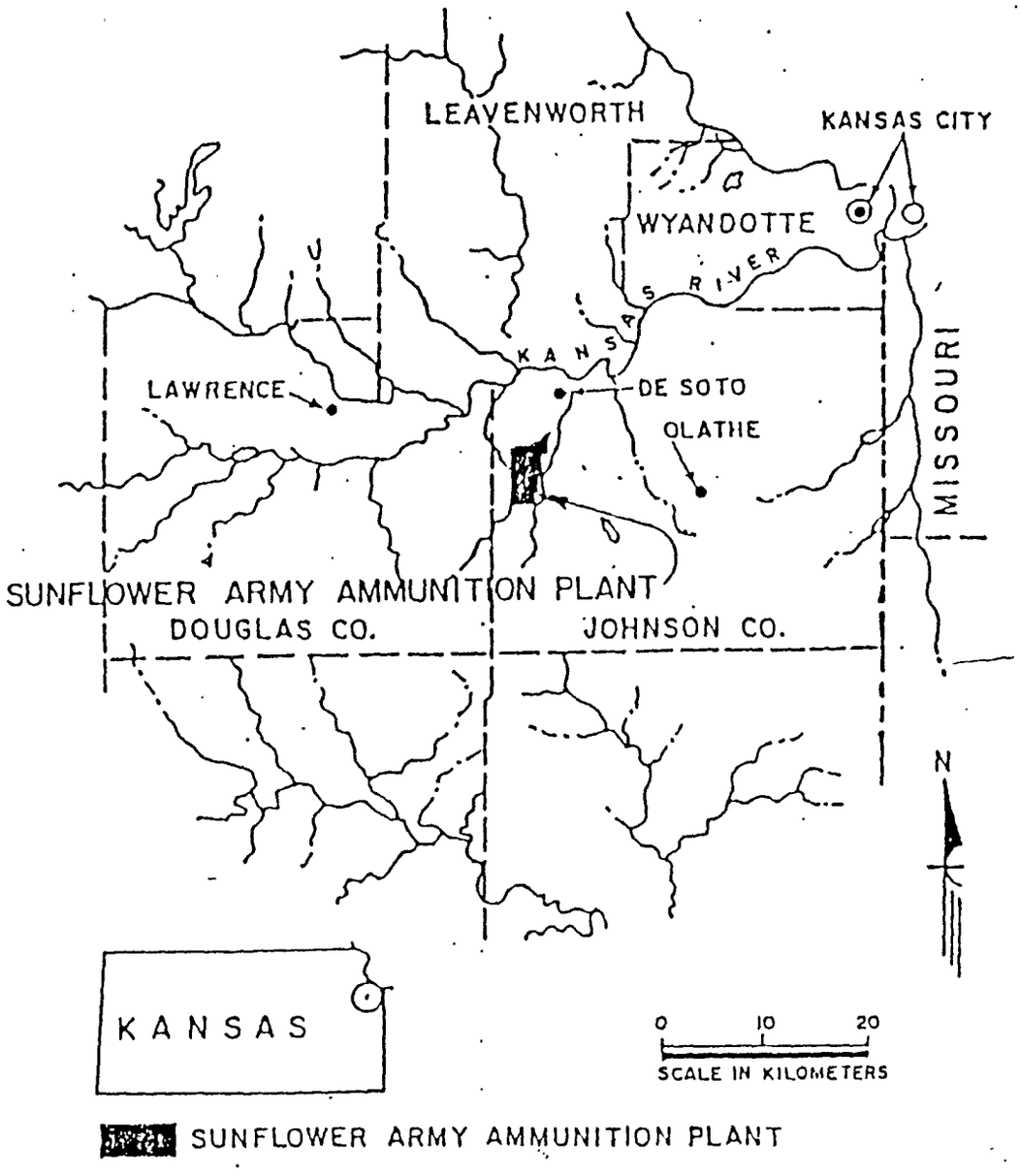


Figure 1. Location of Sunflower AAP Within the State of Kansas

FIGURE I

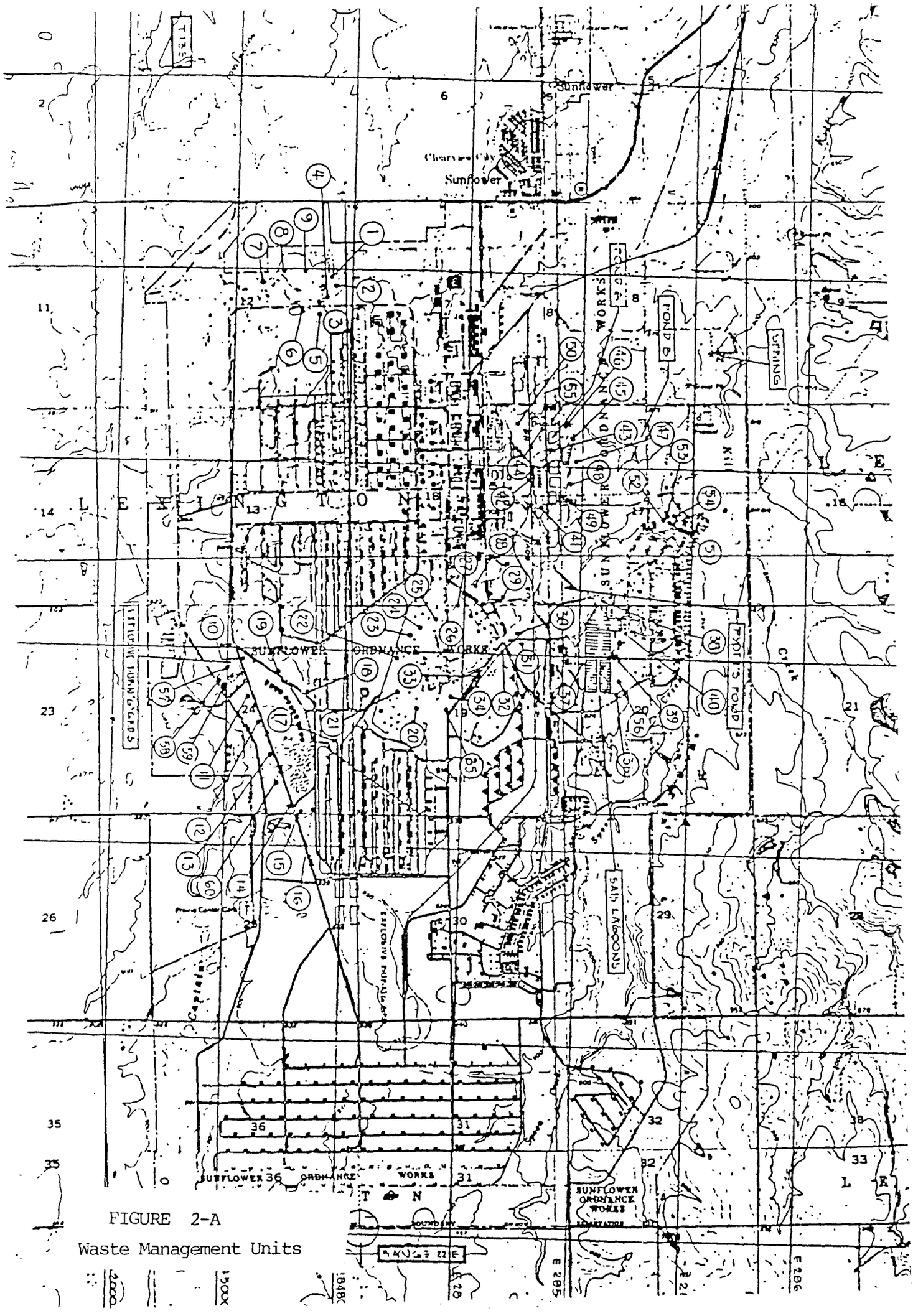


FIGURE 2-A

Waste Management Units

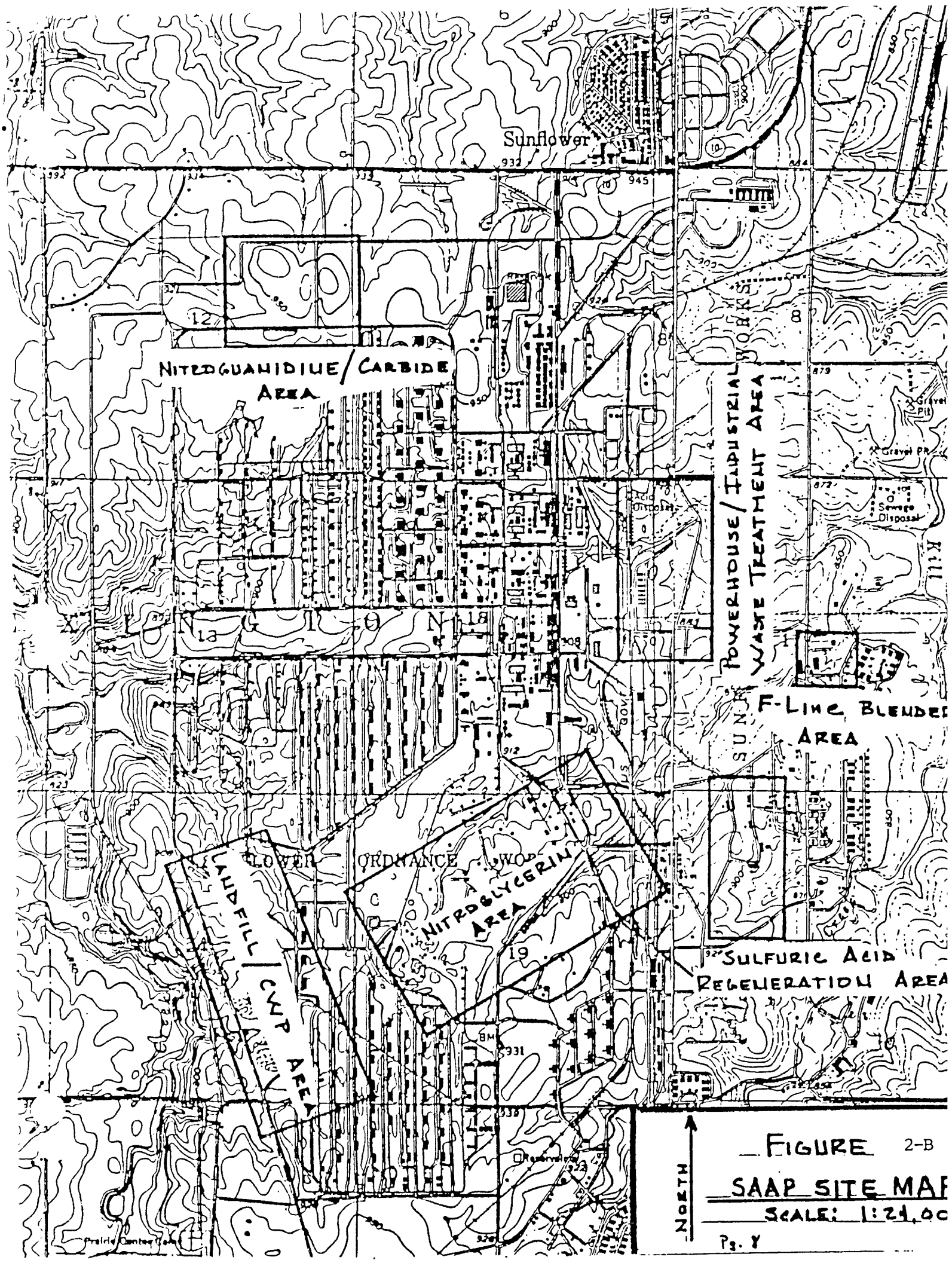


FIGURE 2-B

SAAP SITE MAP

SCALE: 1:24,000

Pg. 8

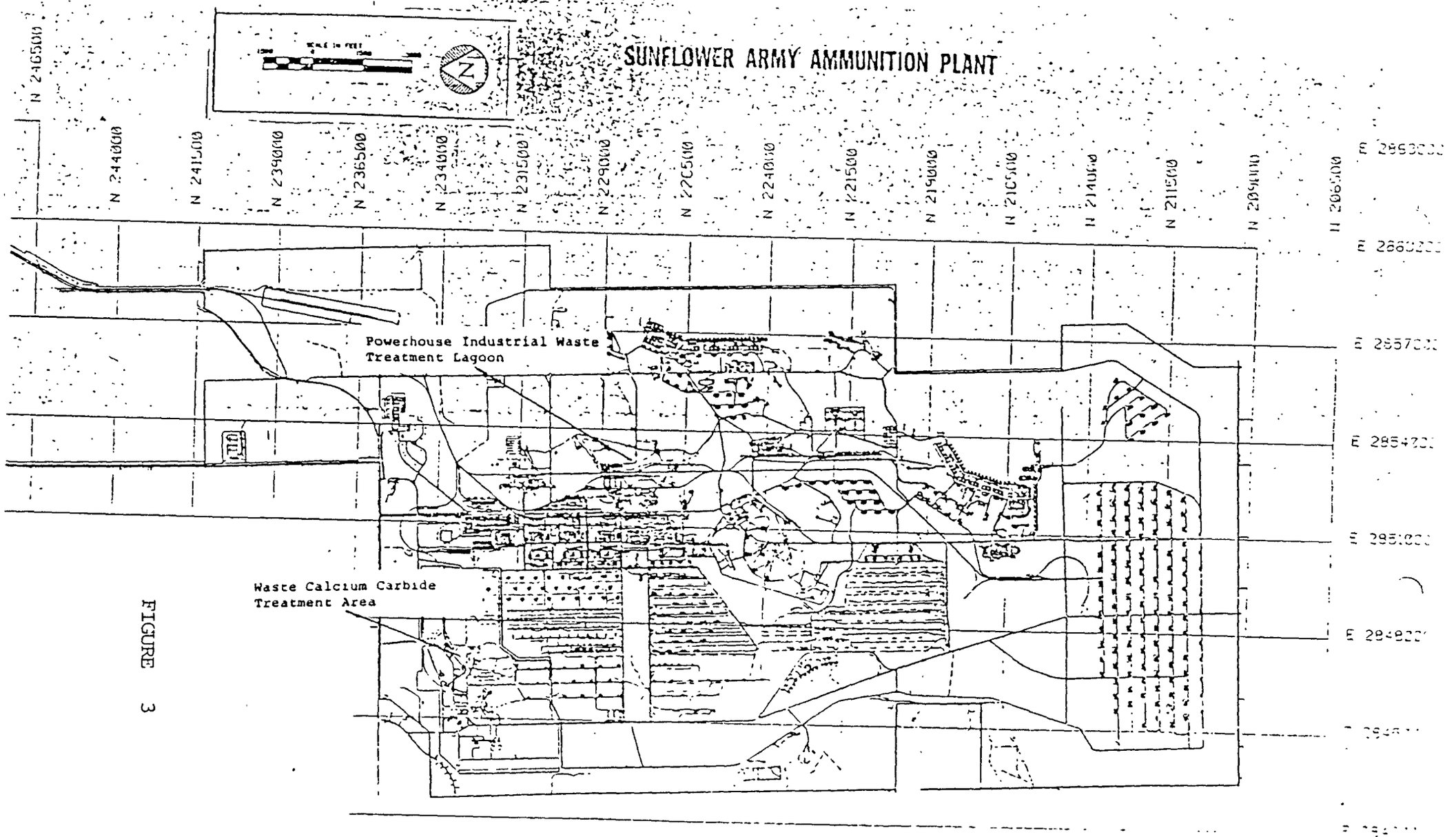

SUNFLOWER ARMY AMMUNITION PLANT
Powerhouse Industrial Waste
Treatment Lagoon
Waste Calcium Carbide
Treatment Area

FIGURE 3

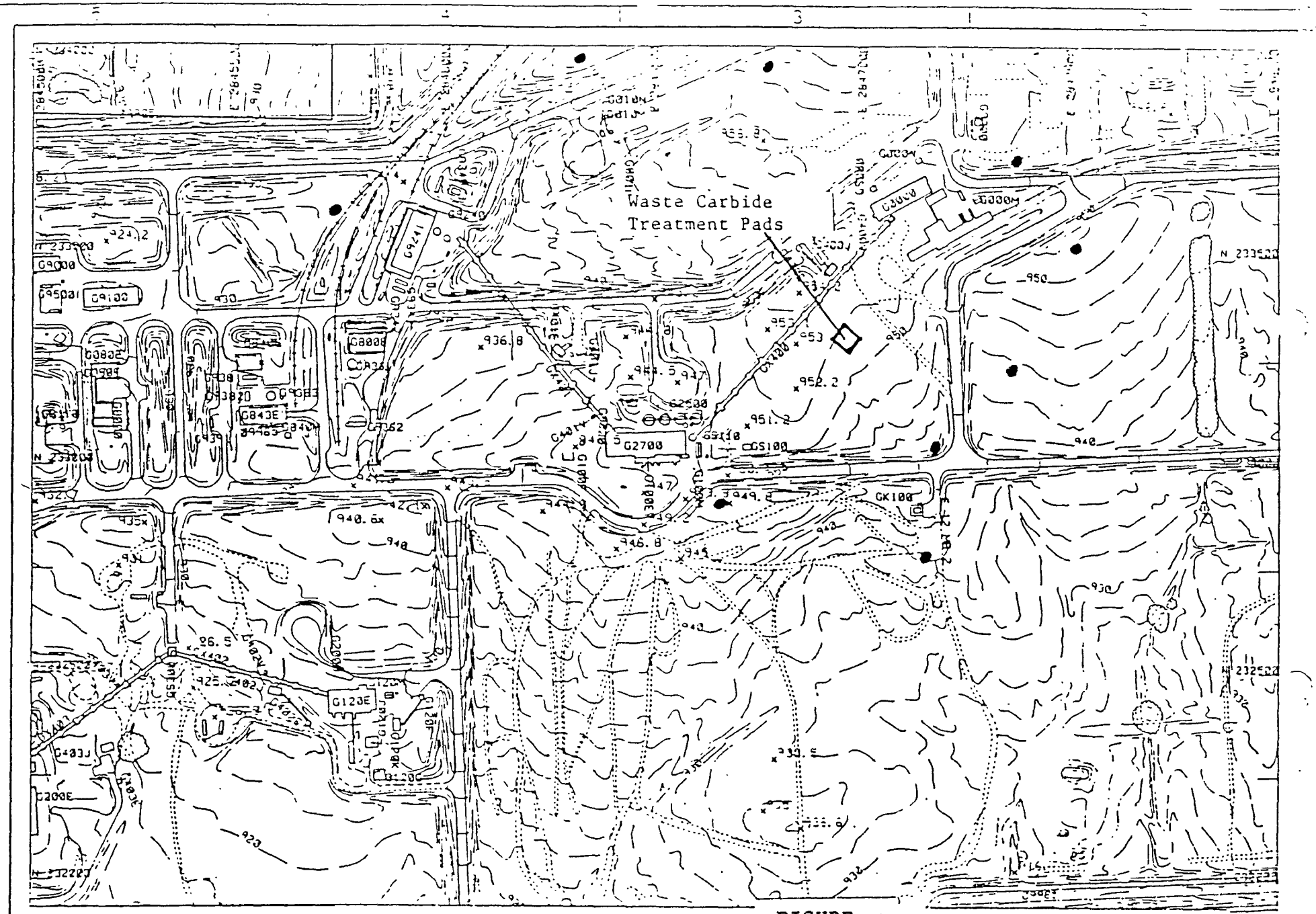


FIGURE 4

WASTE CALCIUM CARBIDE TREATMENT AREA
AND GROUNDWATER MONITORING WELLS

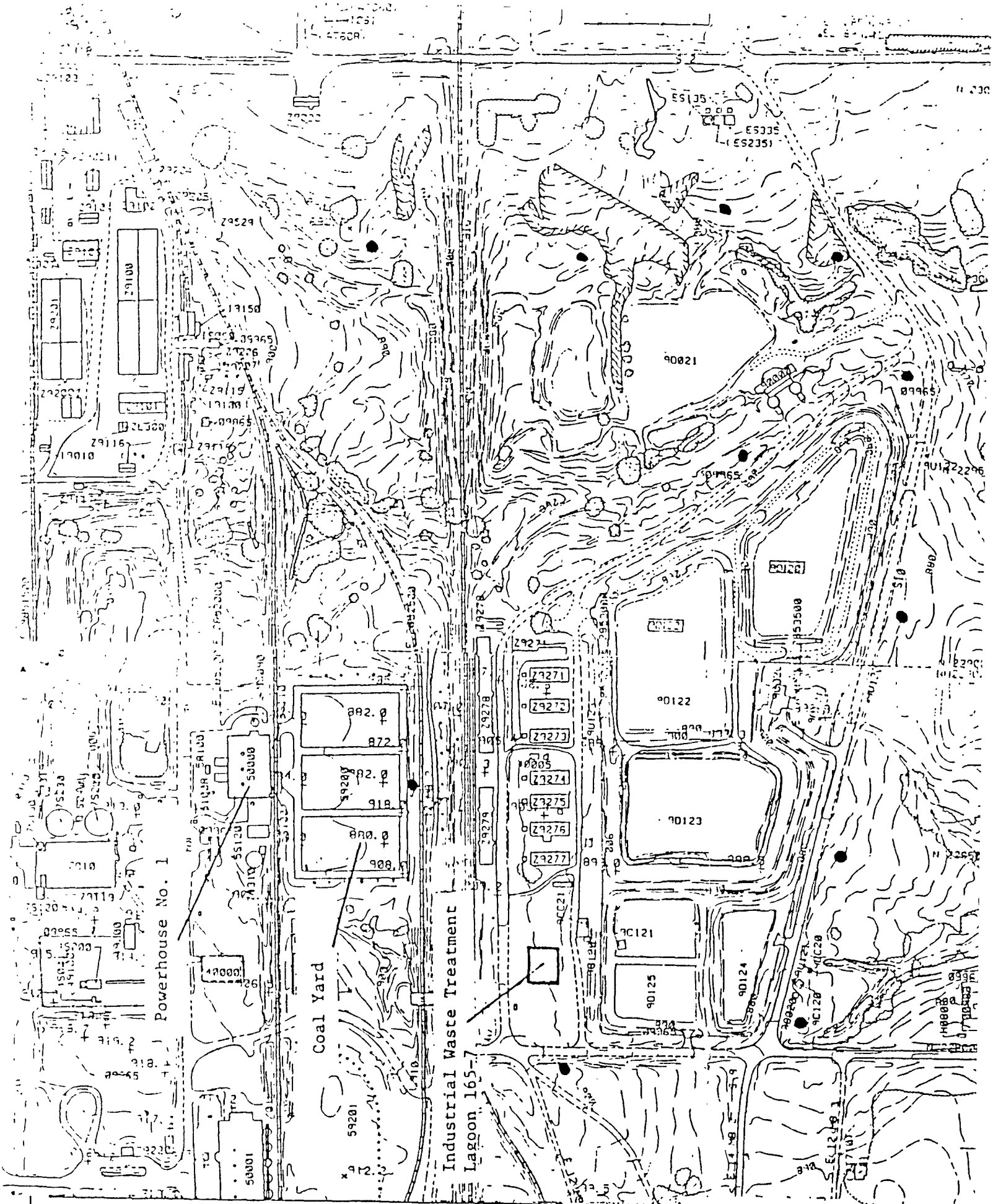


FIGURE 5

POWERHOUSE INDUSTRIAL WASTE TREATMENT
LAGOON AND GROUNDWATER MONITORING WELLS
SUNFLOWER ARMY AMMUNITION PLANT

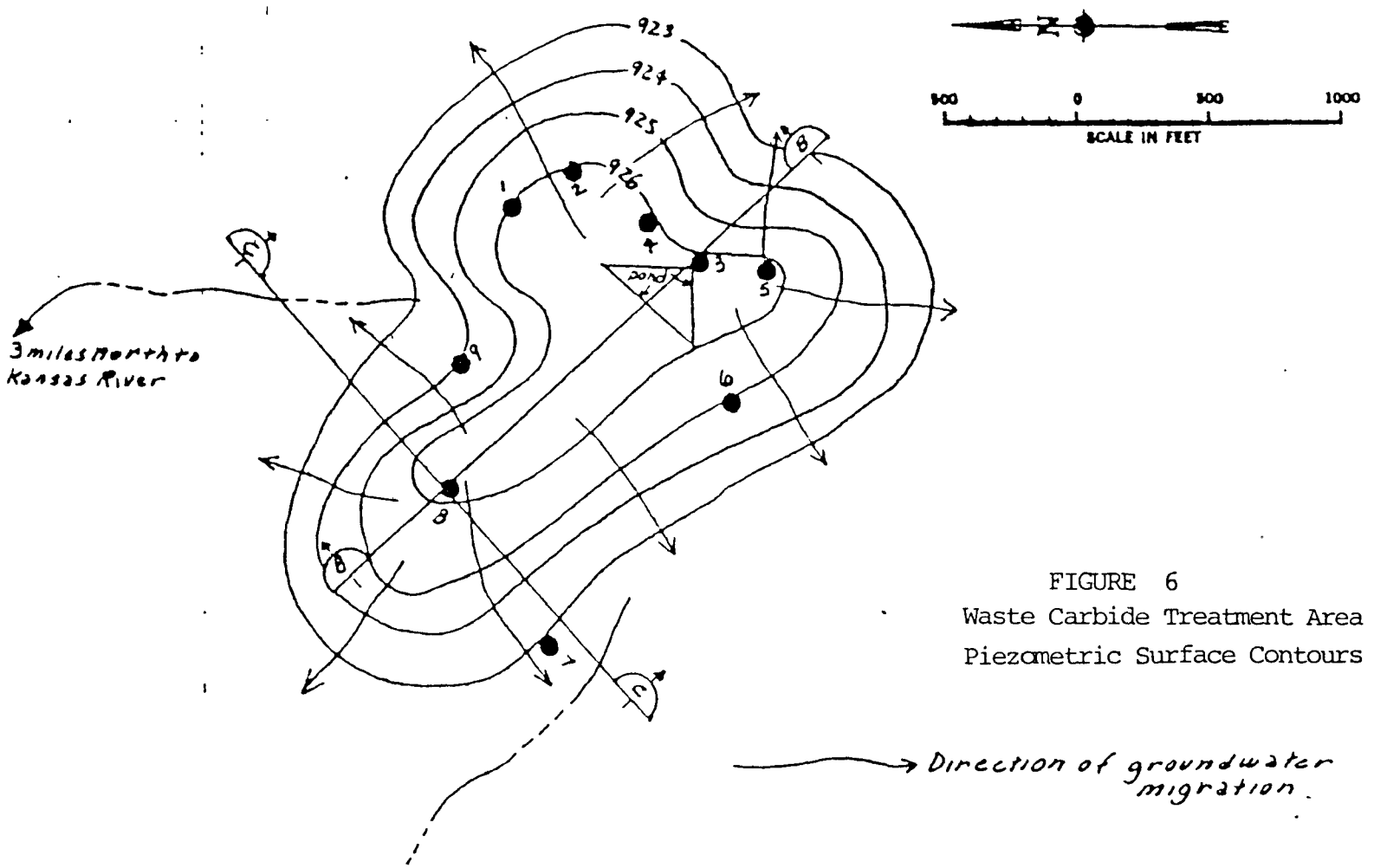
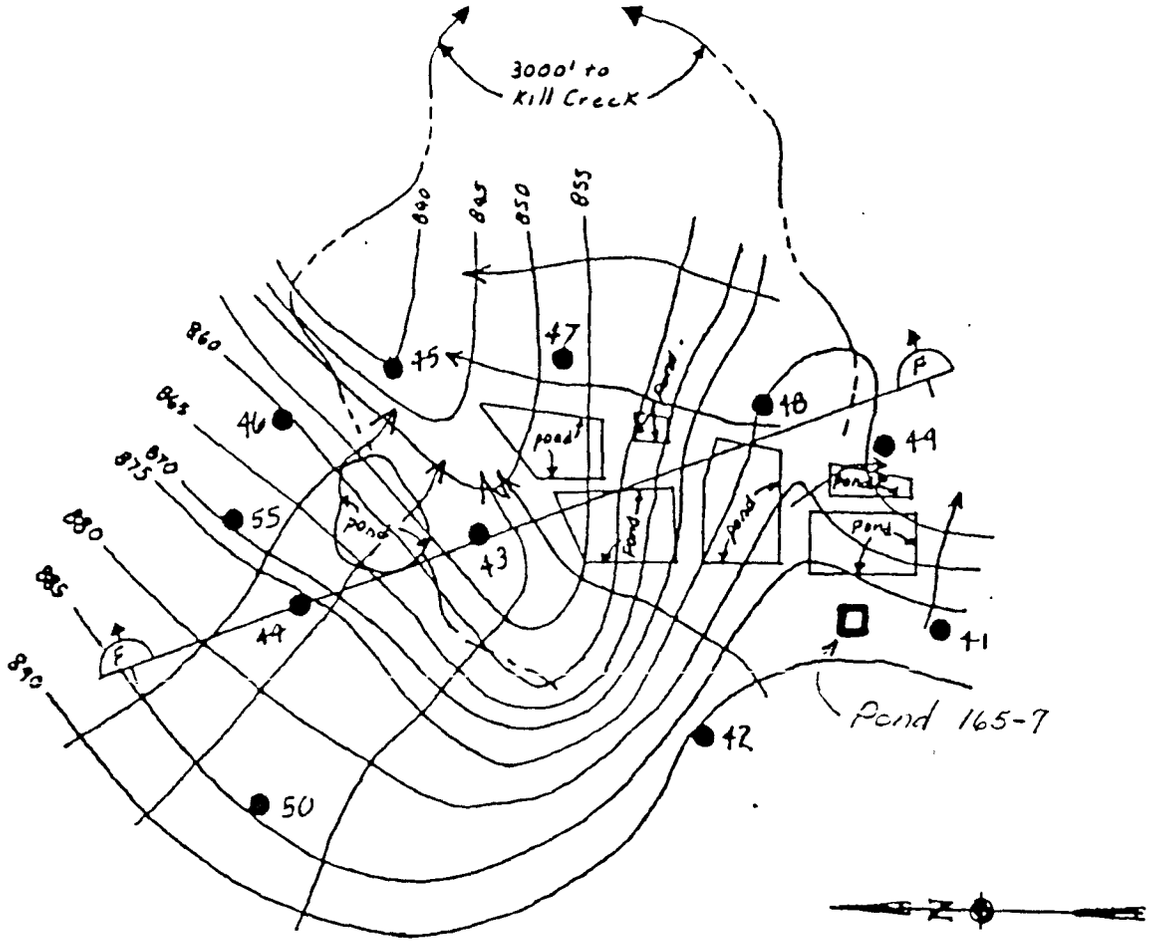
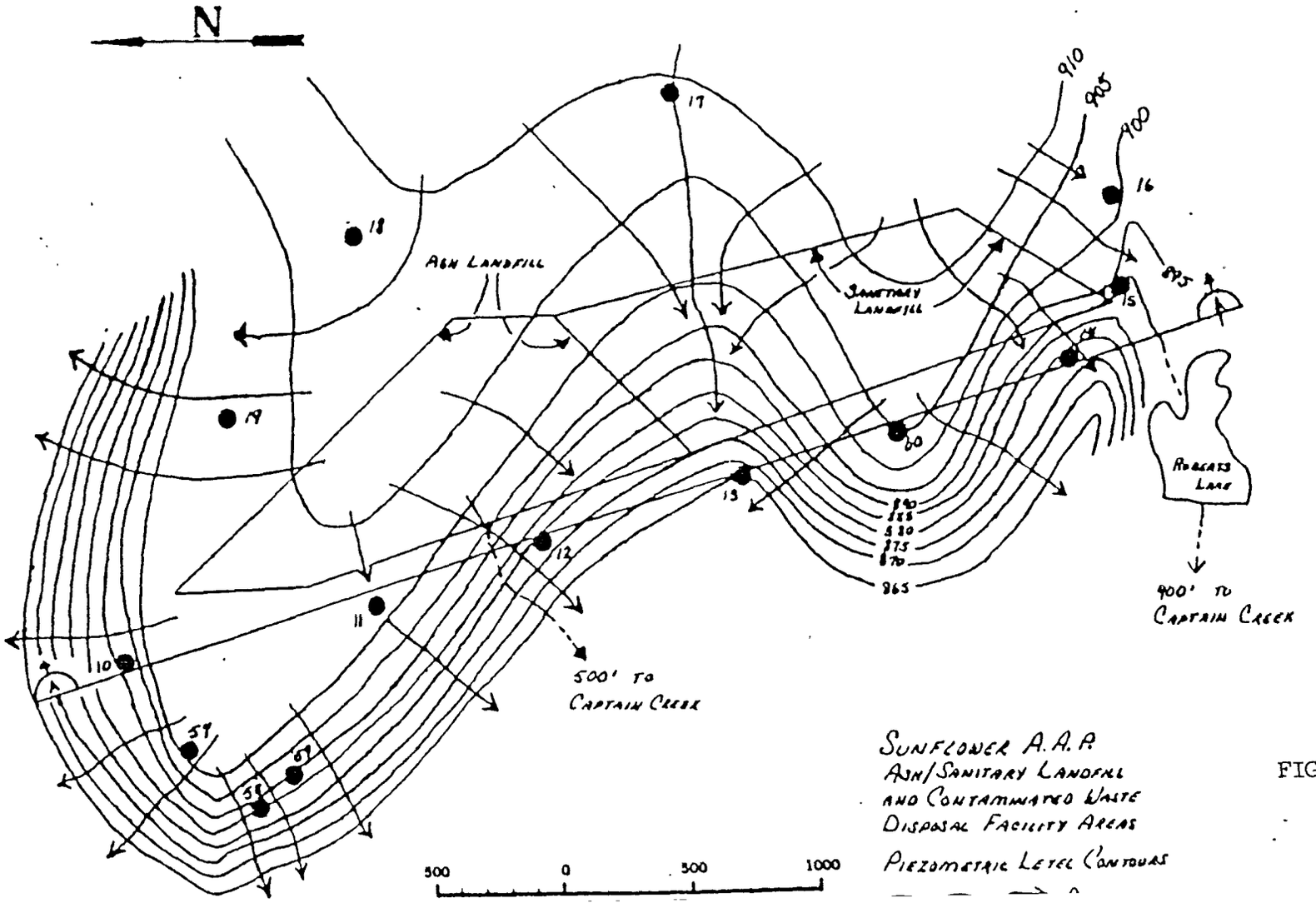


FIGURE 6
Waste Carbide Treatment Area
Piezometric Surface Contours



500 0 500 1000
SCALE IN FEET

Ash Lagoon Area
Piezometric surface Contours



SUNFLOWER A.A.P.
ASH/SANITARY LANDFILL
AND CONTAMINATED WASTE
DISPOSAL FACILITY AREAS

PIEZOMETRIC LEVEL CONTOURS

FIGURE 8

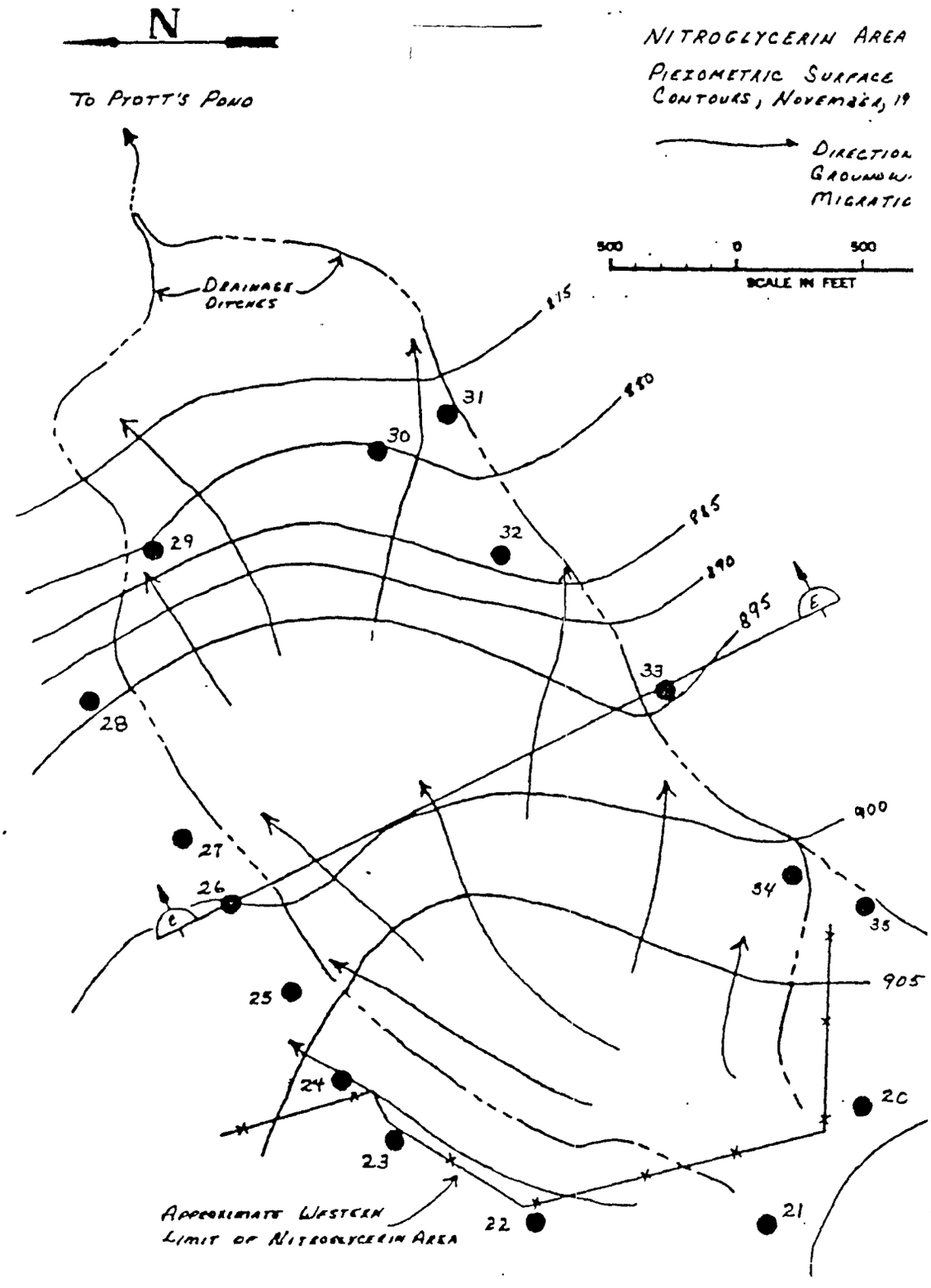

N
NITROGLYCERIN AREA
PIEZOMETRIC SURFACE
CONTOURS, NOVEMBER, 19
DIRECTION
GROUNDW
MIGRATIC
500
0
500
SCALE IN FEET
TO PROTT'S POND
DRAINAGE
DITCHES
875
880
885
890
895
900
905
31
30
29
32
33
28
27
26
34
35
25
24
23
22
21
20
APPROXIMATE WESTERN
LIMIT OF NITROGLYCERIN AREA

FIGURE 9

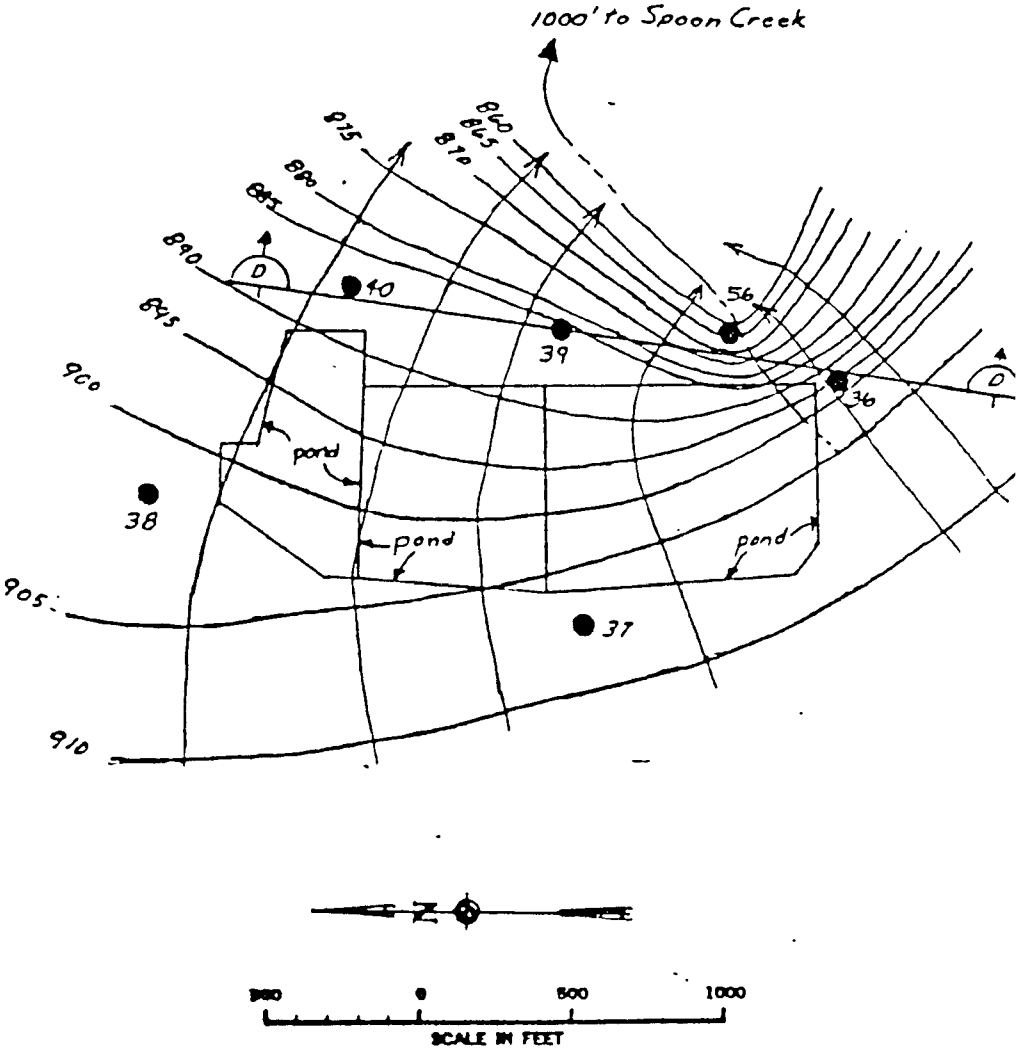
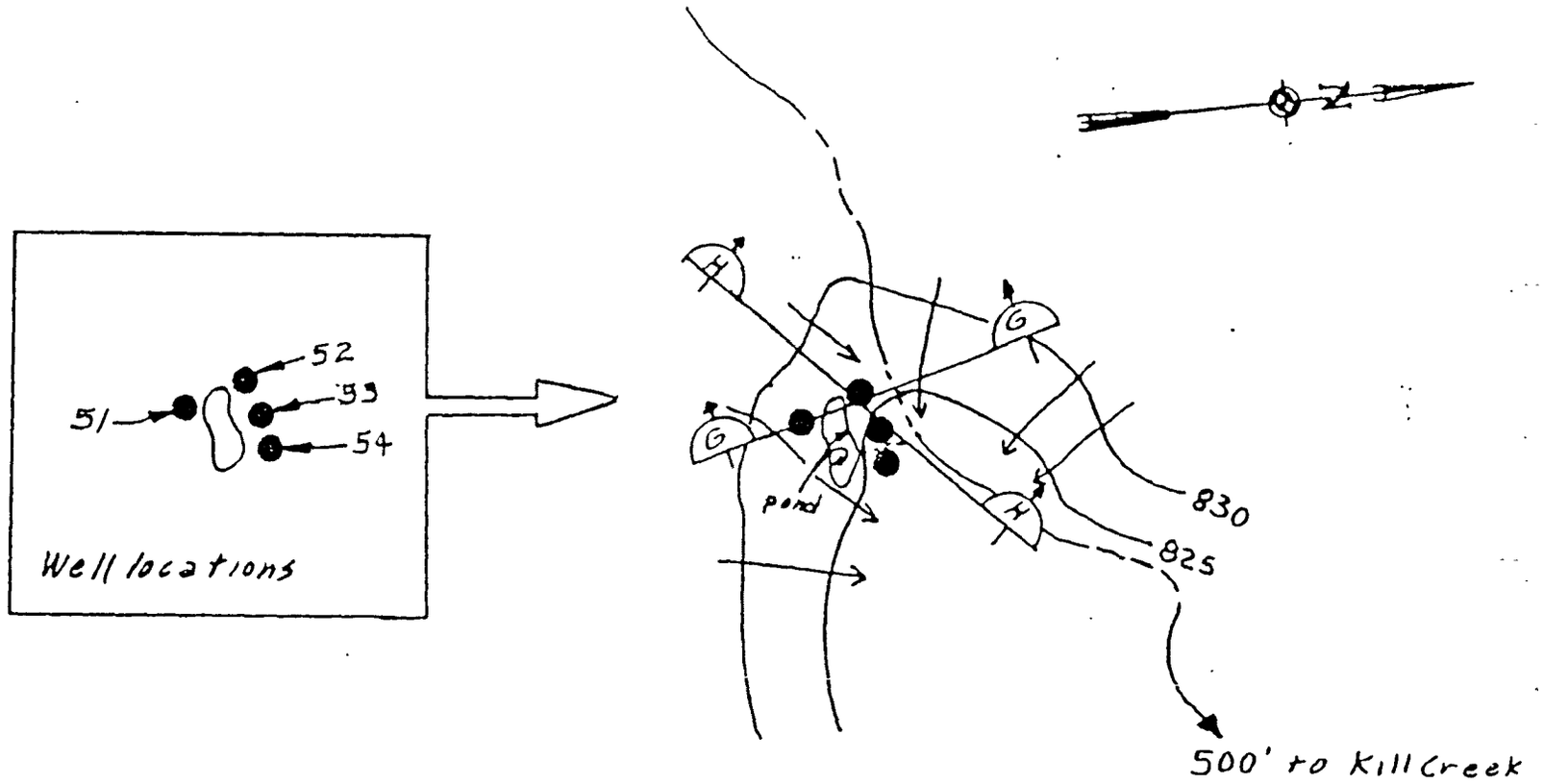


FIGURE 10

Sulfuric Acid Rege
ation Area
Piezometric leve
direction of groundwa
migration

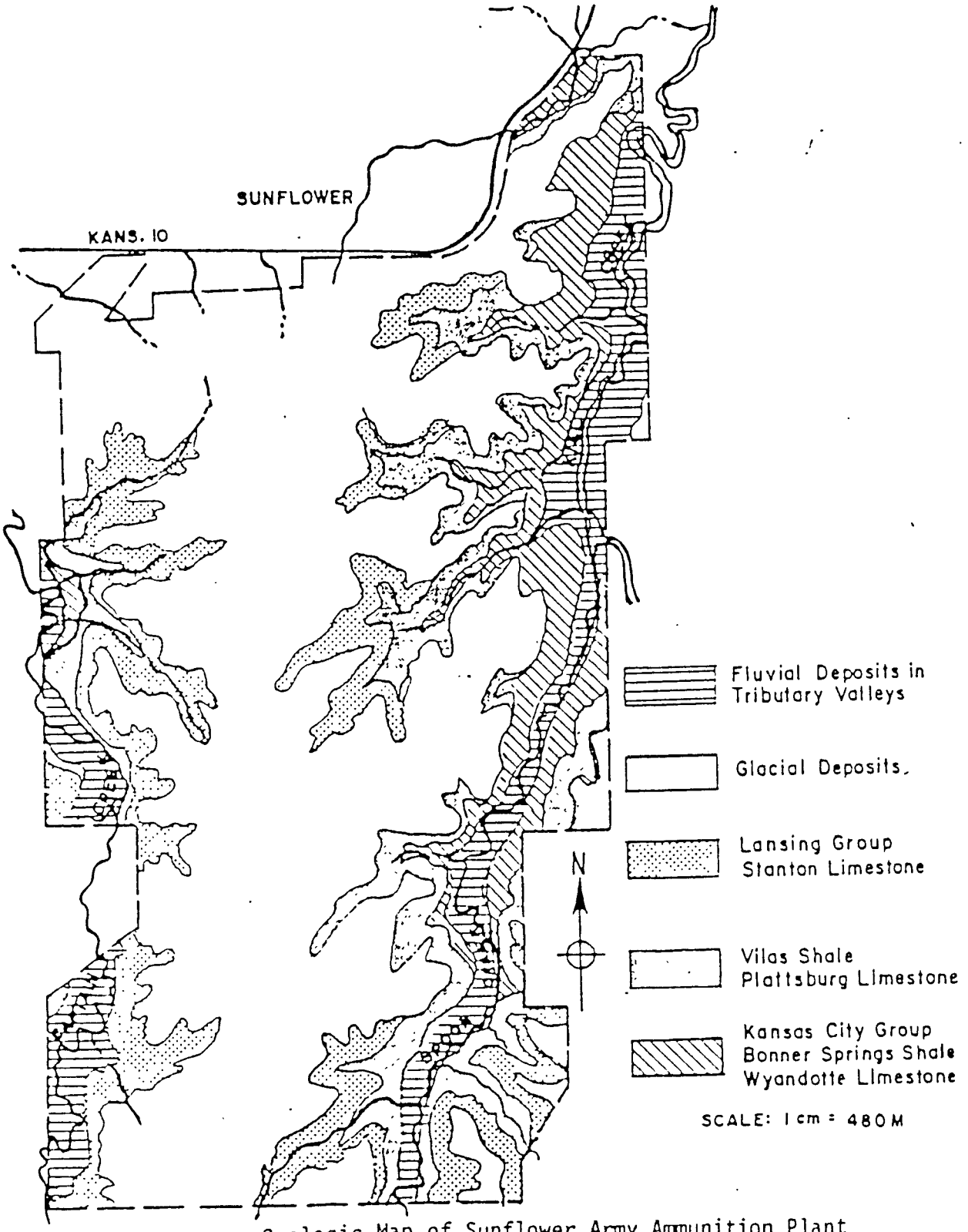


500 0 500 1000

SCALE IN FEET

Paste Blender Pond Area
Piezometric Surface Contour
Direction of groundwater migration

FIGURE 11



Geologic Map of Sunflower Army Ammunition Plant

FIGURE 12

SUNFLOWER ARMY AMMUNITION PLANT

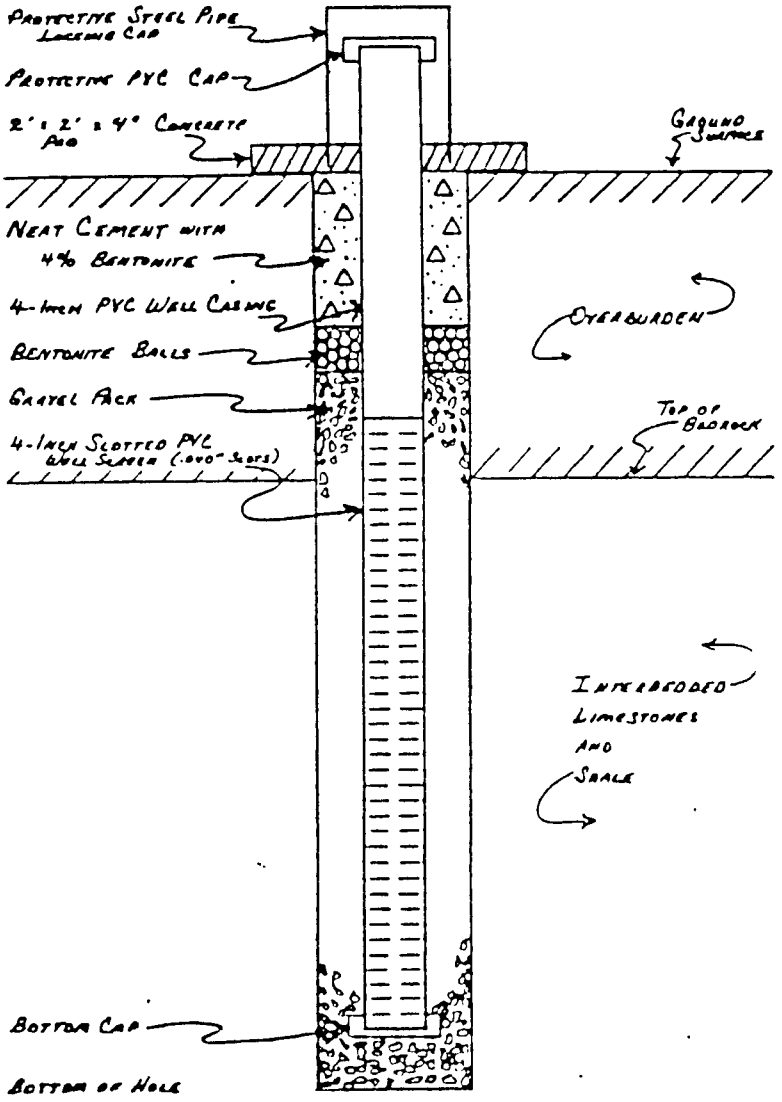
GENERAL GEOLOGIC COLUMN

System	Stage	Group	Formation	Member or Zone	Symbol	Avg Thickness	General Description
PENNSYLVANIAN	VIRGILIAN	DOUGLAS	STRANGER	WESTON	We	*	SHALE: soft, clayey, dark gray to gray, occasional ironstone concretions, weathers green brown to green gray
	MISSOURIAN	LANSING	STANTON	SOUTH BEND	Sb	3.5	LIMESTONE: moderately hard, finely crystalline, medium to thick bedded, fossiliferous, gray to brownish gray
				ROCK LAKE	Rl	5.4	UPPER SANDSTONE: fine grained, argillaceous, gray, 0.2' coal seam locally at base. LOWER SHALE: soft, clayey, dark gray, locally 1' limestone separates sandstone and shale
				STONER	St	14.6	LIMESTONE: moderately hard, finely crystalline, medium to thick bedded, light tannish gray, contains numerous wavy gray shale partings.
				EUDORA	Eu	6.9	SHALE: soft, platey to fissile, carbonaceous, black, upper 2' commonly dark gray.
				CAPTAIN CREEK	Cc	7.0	LIMESTONE: moderately hard, finely crystalline, medium bedded, light tannish gray, thin wavy argillaceous parting zones common throughout.
			VILAS		Vi	15.3	SHALE: soft, platey, micaceous, dark gray with fine-grained sandstone and siltstone interbeds.
			PLATTSBURG	SPRING HILL	Sh	24.2	UPPER LIMESTONE: moderately hard, granular, argillaceous, dark gray, upper 5' commonly dark brown with white mottling. LOWER LIMESTONE: (lower 1/2 to 1/3 of member) moderately hard, finely crystalline light gray
				HICKORY CR	Hc	0.82	SHALE: soft, platey, fossiliferous, dark gray
				MERRIAM	Me	7.4	LIMESTONE: moderately hard, finely crystalline, medium bedded. upper 2' to 3' contains clay-filled worm borings and is light gray. Lower 2' to 4' is light tannish gray and is fossiliferous. Limestones separated by very dark gray, platey, calcareous shale ranging from a parting to 1' in thickness
		KANSAS CITY (ZARAH SUBGROUP)	BONNER SPRINGS		Bs	4.3	SHALE: soft, calcareous, silty, dark gray is occasionally a fine grained argillaceous sandstone, dark gray to greenish gray
			WYANDOTTE	FARLEY	Fa	17.2	LIMESTONE: moderately hard, finely crystalline to crystalline, medium bedded, light tannish gray, contains crystalline calcite rugs and stringers and numerous wavy gray shale partings. Locally, upper 1' to 3' is gray or brownish gray, highly fossiliferous zone.
				ISLAND CREEK	Ic	1.0	SHALE: soft, fossiliferous, calcareous, dark gray.
				ARGENTINE	Ar	19.6	LIMESTONE: moderately hard, thin to medium bedded, finely crystalline to crystalline, light tannish gray with bluish gray mottling, containing numerous wavy, dark gray shale partings.
				QUINDARO	Qu	*	SHALE: soft, calcareous, dark gray to black. Upper 6' carbonaceous and fissile, silty in lower parts

* not totally penetrated

FIGURE 13

NOTE: Overburden on cross-sectional drawings is represented by "OB"



Typical Well Construction Diagram
(no scale)

FIGURE 14

TABLES

1. Order of sample collection, Aliquots; Containers; and Preservation list for Samples collected at Sunflower Army Ammunition Plant

2. Groundwater Analytical Parameters for Sunflower Army Ammunition Plant

3. Groundwater Assessment Contaminant Action Levels

TABLE I

Order of Sample Collections And Ppreservation
List for Water Samples Collected at the
SUNFLOWER ARMY AMMUNITION PLANT

Parameters	#/Type of Sample Container	Preservation	Comments
Volatile Organics	2/40 ml glass vials	Cool, 4°	No Head Space
Purgeable Organic Carbon (POC)	1/40 ml glass vial teflon septa	H_2SO_4 to pH<2 Cool, 4°	
Purgeable Organic Halogens (POX)	1/40 ml glass vial teflon septa		
Acid Extractables Base/Neutral Extractables	4/1 liter amber glass bottles	Cool, 4°	
Pesticides/PCBs	4/1 liter amber glass bottles	Cool, 4°	
Metals (Total)	1/1 liter Polyethylene bottles	HNO_3 to pH<2 Cool, 4°	
Total Organic Carbon (TOC)	1/120 ml glass jar teflon septa	H_2SO_4 to pH<2 Cool, 4°	
Total Organic Halogens (TOX)	1/1 liter amber glass bottle	Cool, 4°	No Head Space
Phenolics	1/1 liter amber	H_2SO_4 to pH<2	
Cyanide	1/1 liter Polyethylene bottle	NaOH to pH<12 Cool, 4°	
Nitrates & Ammonia	1/1 liter Polyethylene bottle	H_2SO_4 to pH<2 Cool, 4°	Nitrates must be analyzed w/in 48 hours if Cl is present
Chlorides Sulfates Fluorides Alkalinity	1/1 liter Polyethylene bottle	Cool, 4°	
Explosives	1/1 liter amber glass	Cool, 4°C	

TABLE 2

Groundwater Analytical Parameters For SUNFLOWER ARMY AMMUNITION PLANT

Hazardous Substance List

VOLATILES

chloromethane
bromomethane
vinyl chloride
chloroethane
methylene chloride
acetone
carbon disulfide
1,1-dichloroethene
1,1-dichloroethane
trans-1,2-dichloroethene
chloroform
1,2-dichloroethane
2-butanone
1,1,1-trichloroethane
carbon tatrachloride
vinyl acetate
bromodichloromethane
1,1,2,2,tetrachloroethane
1,2-dichloropropane
trans-1,3-dichloropropene
trichloroethane
dibromochloromethane
1,1,2-trichloroethane
benzene
cis-1,3-dichloropropene
2-chloroethylvinylether
bromoform
2-hexanone
4-methyl-2-pentanone
tetrachloroethene
toluene
chlorobenzene
ethylbenzene
styrene

SEMI-VOLATILE COMPOUNDS

acenaphthene
2,4-dinitrophenol
bis(2-choroethyl)ether
2-chlorophenol
1,3-dichlorobenzene
1,4-dichlorobenzene
benzyl alcohol
1,2-dichlorobenzene
2-methylphenol
bis(2-chloroisopropyl)ether
4-methylphenol
n-nitroso-di-n-propylamine
hexachloroethane
nitrobenzene
isophorone
2-nitrophenol
2,4-dimethylphenol
benzoic acid
bis(2-chloroethoxy)methane
2,4-dichlorophenol
1,2,4-Trichlorobenzene
naphthalene
4-chloroaniline
hexachlorobutadiene
phenol
4-nitrophenol
dibenzofuran
2,4-dinitrotoluene
2,6-dinitrotoluene
diethylphthalate
4-chlorophenyl-phenylether
fluorene
4-nitroaniline
4,6-dinitro-2-methylphenol
n-nitrosodiphenylamine(1)
4-bromophenyl-phenylether
hexachlorobenzene
pentachlorophenol
phenanthrene
anthracene
di-n-butylphthalate
fluoranthene
benzidine
pyrene
butylbenzylphthalate
3,3-dichlorobenzidine
benzo(a)anthracene
bis(2-ethylhexyl)phthalate

TABLE 2 (Cont.)

Groundwater Analytical Parameters For
SUNFLOWER ARMY AMMUNITION PLANT

Hazardous Substance List

SEMI-VOLATILE COMPOUNDS

2-chloronaphthalene
2-nitroaniline
dimethyl phthalate
acenaphthylene
ideno(1,2,3-cd)pyrene
dibenz(a,h)anthracene
benzo(g,h,t)perylene
3-nitroaniline

PESTICIDES/PCBs

alpha-BHC
delta-BHC
heptachlor
heptachlor epoxide
dieldrin
endrin
4,4-DDD
endosulfan sulfate
methoxychlor
chlordane
arochlor-1016
aroclor-1232
aroclor-1248
aroclor-1260
beta-BHC
gamma-BHC(lindane)
aldrin
endosulfan I
4,4-DDE
endosulfan II
endrin aldehyde
4,4-DDT
endrin ketone
toxaphene
aroclor-1221
aroclor-1242
arclor-1254

METALS AND OTHERS

aluminum
antimony
arsenic
barium
beryllium
cadmium
calcium
chromium
cobalt
copper
iron
lead
cyanide
ammonia
chloride
nitrate
purgeable organic carbon
purgeable organic halide
magnesium
manganese
mercury
nickel
potassium
selenium
silver
sodium
thallium
tin
vanadium
zinc
percent solids (%)
sulfates
total organic carbon
total organic halide
total phenols

EXPLOSIVES

DNT (Dinitrotoluene)
TNT (Trinitrotoluene)
RDX (Cyclonite; cyclotrimethylenetrinitramine)
HMX (Cyclotetramethylenetetranitramine)
Nitroglycerin
Ammonium Nitrate

TABLE 3

Power House/Industrial Waste Treatment Impoundments

Parameter	Concentrations (mg/l) Historical Values[a]	Health Criteria[b]	Action Concentration[c]
Arsenic	ND - 0.01	0.05	0.025
Barium	ND - 0.8	1.0	1.0
Cadmium	ND - 0.002	0.01	0.005
Chromium	ND - 0.018	0.05	0.025
Lead	ND - 0.025	0.05	0.025
Mercury	ND - 0.0002	0.002	0.001
Selenium	ND - 0.016	0.01	0.01
Silver	ND - 0.01	0.05	0.025
Sulfate	- 500	---	---
Chloride	- 500	---	---

a - Results for unfiltered samples.
b - Environmental Protection Agency Interim Primary Drinking Water Standards.
c - Concentrations in filtered samples for metals.

Nitroguanidine/Carbide Impoundment

Parameter	Concentrations (mg/l) Historical Values	Health Criteria	Action Concentration
NO_2+NO_3 as N	- 8.0	10.0[a]	10.0
Ammonia as N	- 0.13	---	10.0
Cyanide	- 0.16	0.2[b]	0.2
Urea	ND	---	10.0
Melamine	ND	---	10.0

a - Environmental Protection Agency National Interim Primary Drinking Water Standard.

b - Environmental Protection Agency, Water Quality Criteria Documents (Availability), Federal Register, p79318-79379 28 November 1980.

APPENDIX I

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 04/01/84	Reference: 4b-AAS-09;10
Sampling Program: Other	Comments: MW1-9 sampled 4/3-4/26.

Parameter	Units	Detection Limit	MW1	MW2	MW3	M
Chloride	ppb	1000.000	14000	17000	11000	1
Cond a	umhos/cm	1000.000	660	603	730	
Fe	ppb	100.000	170	130	180	
GWL	Ft	-	928.9	929.2	929.4	9
Mn	ppb	30.000	ND	ND	52	
Na	ppb	1000.000	58000	60000	63000	5
pH		-	7.2	7.1	6.7	
Phenol	ppb	10.000	ND	ND	ND	
SO4	ppb	2000.000	1.76E5	1.88E5	1.6E5	4
TOC a	ppb	100.000	60000	60000	69000	
TOX a	ppb	10.000	11	11	20	

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 04/01/84 Sampling Program: Other	Reference: 4b-AAS-09;10 Comments: MW1-9 sampled 4/3-4/26.

Parameter	Units	Detection Limit	MW9
Chloride	ppb	1000.000	3200
Cond a	umhos/cm	1000.000	493
Fe	ppb	100.000	87
GWL	Ft	-	929.8
Mn	ppb	30.000	47
Na	ppb	1000.000	13000
pH		-	7.1
Phenol	ppb	10.000	ND
SO4	ppb	2000.000	9000
TOC a	ppb	100.000	1000
TOX a	ppb	10.000	16

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-5700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 04/13/84	Reference: 4b-AAS-09;10
Sampling Program: Other	Comments: Sampled 4/13-4/17.

Parameter	Units	Detection Limit	MW41	MW42	MW43	M
Chloride	ppb	1000.000	40000	ND	5300	
Cond a	umhos/cm	1000.000	1315	1178	660	
Fe	ppb	100.000	120	320	500	
GWL	Ft	-	885.4	893.7	891.1	8
Mn	ppb	30.000	36	42	39	
Na	ppb	1000.000	72000	59000	37000	(
pH		-	7.0	7.1	7.2	
Phenol	ppb	10.000	ND	ND	ND	
SO4	ppb	2000.000	4.61E5	3.55E5	1.12E5	1
TOC a	ppb	100.000	2000	2000	2000	
TOX a	ppb	10.000	15	ND	ND	

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 04/13/84	Reference: 4b-AAS-09;10
Sampling Program: Other	Comments: Sampled 4/13-4/17.

Parameter	Units	Detection Limit	MW49	MW50	MW55
Chloride	ppb	1000.000	9800	67000	3000
Cond a	umhos/cm	1000.000	760	995	518
Fe	ppb	100.000	300	100	1290
GWL	Ft	-	875.3	886.7	874.6
Mn	ppb	30.000	ND	ND	49
Na	ppb	1000.000	47000	38000	31000
pH		-	7.2	6.8	7.5
Phenol	ppb	10.000	ND	ND	ND
SO4	ppb	2000.000	1.24E5	2.41E5	64000
TOC a	ppb	100.000	2800	1800	3300
TOX a	ppb	10.000	ND	11	12

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/02/84	Reference: 4b-AAS-09
Sampling Program: Semi-annually	Comments: Sampled 4/27-5/31.

Parameter	Units	Detection Limit	MW10	MW11	MW12	M
Chloride	ppb	1000.000	5600	5100	3500	2
Cond a	umhos/cm	1000.000	393	330	3780	
Fe	ppb	100.000	630	310	150	
GWL	Ft	-	903.2	904.0	889.1	8
Mn	ppb	30.000	ND	600	ND	
Na	ppb	1000.000	23000	13000	21000	2
pH		-	7.1	6.7	7.0	
Phenol	ppb	10.000	ND	ND	ND	
SO4	ppb	2000.000	63000	25000	43000	1
TOC a	ppb	100.000	1000	3000	3500	
TOX a	ppb	10.000	16	12	ND	

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 05/02/84	Reference: 4b-AAS-09
Sampling Program: Semi-annually	Comments: Sampled 4/27-5/31.

Parameter	Units	Detection Limit	MW18	MW19	MW58	M
Chloride	ppb	1000.000	39000	39400	8800	1
Cond a	umhos/cm	1000.000	1020	783	1095	
Fe	ppb	100.000	260	ND	810	
GWL	Ft	-	909.5	906.4	873.8	8
Mn	ppb	30.000	ND	36	37	
Na	ppb	1000.000	7000		135000	26
pH		-	6.9	7.0	6.9	
Phenol	ppb	10.000	ND	82000	ND	
SO4	ppb	2000.000	94000	51000	43000	19
TOC a	ppb	100.000	6000	4500	4000	
TOX a	ppb	10.000	16	ND	11	

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/14/84	Reference: 4b-AAS-09
Sampling Program: Semi-annually	Comments: Sampled 5/14-5/30.

Parameter	Units	Detection Limit	MW20	MW21	MW22	M
Chloride	ppb	1000.000	5600	4400	7400	
Cond a	umhos/cm	1000.000	600	660	753	
Fe	ppb	100.000	ND	190	ND	
GWL	Ft	-	910.3	910.1	908.8	9
Mn	ppb	30.000	ND	ND	ND	
Na	ppb	1000.000	28000	39000	55000	4
pH		-	7.0	6.9	6.9	
Phenol	ppb	10.000	ND	ND	ND	
SO4	ppb	2000.000	44000	46000	95000	6
TOC a	ppb	100.000	2300	2000	3000	
TOX a	ppb	10.000	ND	ND	ND	

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/31/84	Reference: 4b-AAS-09
Sampling Program: Semi-annually	Comments: Sampled 5/31-6/14.

Parameter	Units	Detection Limit	MW36	MW37	MW38	M
Chloride	ppb	1000.000	14000	45000	70000	4
Cond a	umhos/cm	1000.000	935	2088	1283	
Fe	ppb	100.000	110	ND	140	
GWL	Ft	-	898.1	908.7	901.8	8
Mn	ppb	30.000	ND	ND	61	
Na	ppb	1000.000	57000	1.66E5	1.47E5	1.
pH		-	7.2	6.7	7.3	
Phenol	ppb	10.000	ND	ND	10	
SO4	ppb	2000.000	1.74E5	6.08E5	2.69E5	3.
TOC a	ppb	100.000	2300	3000	2500	
TOX a	ppb	10.000	11	ND	18	

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/31/84	Reference: 4b-AAS-09
Sampling Program: Semi-annually	Comments: Sampled 5/31-6/14.

Parameter	Units	Detection Limit	MW54	MW56
Chloride	ppb	1000.000	7500	9000
Cond a	umhos/cm	1000.000	585	820
Fe	ppb	100.000	ND	160
GWL	Ft	-	823.6	877.2
Mn	ppb	30.000	510	41
Na	ppb	1000.000	13000	38000
pH		-	6.8	7.0
Phenol	ppb	10.000	ND	ND
SO4	ppb	2000.000	29000	1.54E5
TOC a	ppb	100.000	3500	3000
TOX a	ppb	10.000	14	32

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 11/12/84	Reference: 4b-AAS-08
Sampling Program: Semi-annually	Comments: Sampled 11/12-11/19.

Parameter	Units	Detection Limit	MW49	MW50	MW55
Ag	ppb	25.000	ND	ND	ND
As	ppb	10.000	ND	ND	ND
Ba	ppb	300.000	ND	ND	ND
Cd	ppb	1.000	ND	ND	ND
Cond a	umhos/cm	1000.000	618	1076	600
Cr	ppb	10.000	1	ND	ND
GWL	Ft	-	872.9	882.5	870.8
Hg	ppb	0.200	ND	ND	ND
Pb	ppb	5.000	ND	ND	ND
pH		-	6.7	6.9	7.2
Se	ppb	5.000	ND	ND	ND
SO4	ppb	2000.000	68000	2.74E5	90000

		MW41	MW42	MW43	MW44	MW45	MW46
Ag	ppb	25.000	ND	ND	ND		
As	ppb	10.000	ND	ND	ND		
Ba	ppb	300.000	ND	ND	ND		
Cd	ppb	1.000	ND	ND	ND		
Cond a	umhos/cm	1000.000	1313	1038	575		
Cr	ppb	10.000	3	2	ND		
GWL	Ft	-	882.5	892.0	887.43		8
Hg	ppb	0.200	ND	ND	ND		
Pb	ppb	5.000	ND	ND	ND		
pH		-	6.3	6.9	6.9		
Se	ppb	5.000	ND	ND	ND		
SO4	ppb	2000.000	4.75E5	3.16E5	1.13E5		1.

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 01/03/85	Reference: 4a-AAS-01
Sampling Program: Semi-annually	Comments:

Parameter	Units	Detection Limit	MW42
GWL	Ft	-	893.6

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 05/17/85	Reference: 4c-AAS-01
Sampling Program: Semi-annually	Comments:

Parameter	Units	Detection Limit	MW1	MW2	MW3	M
GWL	Ft	-	931.20	931.39	931.50	93

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/17/85	Reference: 4c-AAS-01
Sampling Program: Semi-annually	Comments:

Parameter	Units	Detection Limit	MW9
GWL	Ft	-	930.47

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 05/21/85	Reference: 4b-AAS-13;15
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW1	MW2
GWL	Ft	-	931.3	931.4

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)79[illegible]-6700

SAMPLING

Sample Date: 05/22/85	Reference: 4b-AAS-13;15
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit

			MW1	MW2
AmmoniaN	ppb	50.000	150	190
Chloride	ppb	1000.000	14000	17000
Cond a	umhos/cm	1000.000	600	690
Cond b	umhos/cm	1000.000	590	700
Cond c	umhos/cm	1000.000	600	700
Cond d	umhos/cm	1000.000	600	690
Cyanide	ppb	10.000	ND	ND
Fe	ppb	100.000	100	ND
Fe dis	ppb	100.000	ND	ND
GuanNO3	ppb	500.000	ND	ND
Melamine	ppb	500.000	ND	ND
Mn	ppb	30.000	ND	ND
Mn dis	ppb	30.000	ND	ND
Na	ppb	1000.000	50000	74000
Na dis	ppb	1000.000	57000	56000
Nitrate	ppb	-	4970	5270
NQ	ppb	100.000	ND	ND
NQ dis	ppb	100.000	ND	ND
pH F a		-	7.10	7.20
pH F b		-	7.10	7.20
pH F c		-	7.10	7.20
pH F d		-	7.10	7.20
Phenol	ppb	10.000	ND	ND
SO4	ppb	2000.000	44000	39000
TOC a	ppb	100.000	2200	1700
TOC b	ppb	100.000	2300	1700
TOC c	ppb	100.000	2200	1700
TOC d	ppb	100.000	2200	1500
TOX a	ppb	10.000	ND	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 05/22/85	Reference: 4b-AAS-13;15
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW1	MW2
TOX b	ppb	10.000	ND	ND
TOX c	ppb	10.000	ND	ND
TOX d	ppb	10.000	ND	ND
Urea	ppb	100.000	ND	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/23/85	Reference: 4b-AAS-13;15
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW3	MW4	MW6
AmmoniaN	ppb	50.000	50	50	90
Chloride	ppb	1000.000	12000	13000	18000
Cond a	umhos/cm	1000.000	850	660	600
Cond b	umhos/cm	1000.000	840	660	600
Cond c	umhos/cm	1000.000	860	660	610
Cond d	umhos/cm	1000.000	850	650	610
Cyanide	ppb	10.000	ND	ND	ND
Fe	ppb	100.000	100	250	240
Fe dis	ppb	100.000	ND	ND	ND
GuanNO3	ppb	500.000	ND	ND	ND
GWL	Ft	-	931.6	931.5	931.9
Melamine	ppb	500.000	ND	ND	ND
Mn	ppb	30.000	ND	ND	ND
Mn dis	ppb	30.000	ND	ND	ND
Na	ppb	1000.000	49000	68000	87000
Na dis	ppb	1000.000	51000	47000	87000
Nitrate	ppb	-	3250	4550	2570
NQ	ppb	100.000	ND	ND	ND
NQ dis	ppb	100.000	ND	ND	ND
pH F a		-	6.80	6.90	6.90
pH F b		-	6.80	6.90	6.90
pH F c		-	6.80	6.90	6.90
pH F d		-	6.80	6.90	6.90
Phenol	ppb	10.000	ND	ND	ND
SO4	ppb	2000.000	139000	41000	32000
TOC a	ppb	100.000	6700	2100	3700
TOC b	ppb	100.000	6600	2100	3700
TOC c	ppb	100.000	6800	2100	3900
TOC d	ppb	100.000	6400	2100	3700

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 05/23/85	Reference: 4b-AAS-13;15
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW3	MW4	MW6
TOX a	ppb	10.000	ND	ND	23
TOX b	ppb	10.000	ND	ND	18
TOX c	ppb	10.000	ND	ND	20
TOX d	ppb	10.000	ND	ND	18
Urea	ppb	100.000	ND	ND	NA

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/28/85	Reference: 4b-AAS-13;15
Sampling Program: Semi-annually	Comments: 4a-01. GWL taken on 5/29/85.

Parameter	Units	Detection Limit	MW5
AmmoniaN	ppb	50.000	50
Chloride	ppb	1000.000	5000
Cond a	umhos/cm	1000.000	500
Cond b	umhos/cm	1000.000	500
Cond c	umhos/cm	1000.000	490
Cond d	umhos/cm	1000.000	500
Cyanide	ppb	10.000	ND
Fe	ppb	100.000	270
Fe dis	ppb	100.000	ND
GuanNO3	ppb	500.000	ND
GWL	Ft	-	931.5
Melamine	ppb	500.000	ND
Mn	ppb	30.000	65
Mn dis	ppb	30.000	ND
Na	ppb	1000.000	39000
Na dis	ppb	1000.000	40000
Nitrate	ppb	-	4040
NQ	ppb	100.000	ND
NQ dis	ppb	100.000	ND
pH F a		-	6.60
pH F b		-	6.60
pH F c		-	6.60
pH F d		-	6.60
Phenol	ppb	10.000	ND
SO4	ppb	2000.000	15000
TOC a	ppb	100.000	1600
TOC b	ppb	100.000	1500
TOC c	ppb	100.000	1500
TOC d	ppb	100.000	1500

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 05/28/85	Reference: 4b-AAS-13;15
Sampling Program: Semi-annually	Comments: 4a-01. GWL taken on 5/29/85.

Parameter	Units	Detection Limit	MW5
TOX a	ppb	10.000	ND
TOX b	ppb	10.000	ND
TOX c	ppb	10.000	ND
TOX d	ppb	10.000	ND
Urea	ppb	100.000	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/29/85	Reference: 4b-AAS-13;15
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW7	MW8	MW9
AmmoniaN	ppb	50.000	50	110	80
Chloride	ppb	1000.000	7000	13000	7000
Cond a	umhos/cm	1000.000	600	600	400
Cond b	umhos/cm	1000.000	600	600	390
Cond c	umhos/cm	1000.000	610	590	400
Cond d	umhos/cm	1000.000	600	600	400
Cyanide	ppb	10.000	ND	30	ND
Fe	ppb	100.000	490	1170	ND
Fe dis	ppb	100.000	ND	ND	ND
GuanNO3	ppb	500.000	ND	ND	ND
GWL	Ft	-	927.1	921.2	930.2
Melamine	ppb	500.000	ND	ND	ND
Mn	ppb	30.000	46	ND	ND
Mn dis	ppb	30.000	ND	ND	ND
Na	ppb	1000.000	76000	66000	53000
Na dis	ppb	1000.000	76000	66000	53000
Nitrate	ppb	-	1000	2000	2250
NQ	ppb	100.000	ND	ND	ND
NQ dis	ppb	100.000	ND	ND	ND
pH F a		-	7.00	7.00	6.90
pH F b		-	7.00	7.00	6.90
pH F c		-	7.00	7.00	6.90
pH F d		-	7.00	7.00	6.90
Phenol	ppb	10.000	ND	ND	ND
SO4	ppb	2000.000	34000	16000	26000
TOC a	ppb	100.000	8100	1400	1800
TOC b	ppb	100.000	8100	1300	1700
TOC c	ppb	100.000	8000	1300	1800
TOC d	ppb	100.000	7900	1400	1800

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/29/85	Reference: 4b-AAS-13;15
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW7	MW8	MW9
TOX a	ppb	10.000	ND	ND	ND
TOX b	ppb	10.000	ND	ND	ND
TOX c	ppb	10.000	ND	ND	ND
TOX d	ppb	10.000	ND	ND	ND
Urea	ppb	100.000	ND	ND	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 05/30/85	Reference: 4c-AAS-01
Sampling Program: Semi-annually	Comments:

Parameter	Units	Detection Limit	MW41	MW42	MW43	M
GWL	Ft	-	884.45	893.42	888.30	87

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 05/30/85 Sampling Program: Semi-annually	Reference: 4c-AAS-01 Comments:

Parameter	Units	Detection Limit	MW49	MW50	MW55
GWL	Ft	-	872.98	883.39	872.20

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 06/03/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW42
Ag	ppb	25.000	ND
Ag dis	ppb	25.000	ND
As	ppb	10.000	ND
As dis	ppb	10.000	ND
Ba	ppb	300.000	ND
Ba dis	ppb	300.000	ND
Cd	ppb	1.000	ND
Cd dis	ppb	1.000	ND
Chloride	ppb	1000.000	69000
Cond a	umhos/cm	1000.000	1400
Cond b	umhos/cm	1000.000	1400
Cond c	umhos/cm	1000.000	1400
Cond d	umhos/cm	1000.000	1400
Cr	ppb	10.000	ND
Cr dis	ppb	10.000	ND
Fe	ppb	100.000	110
Fe dis	ppb	100.000	120
GWL	Ft	-	893.6
Hg	ppb	0.200	ND
Hg dis	ppb	0.200	ND
Mn	ppb	30.000	ND
Mn dis	ppb	30.000	ND
Na	ppb	1000.000	68000
Na dis	ppb	1000.000	66000
Pb	ppb	5.000	6
Pb dis	ppb	5.000	ND
pH F a		-	6.80
pH F b		-	7.00
pH F c		-	7.00

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 06/03/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW42
pH F d		-	7.00
Phenol	ppb	10.000	ND
Se	ppb	5.000	ND
Se dis	ppb	5.000	ND
SO4	ppb	2000.000	318000
TOC a	ppb	100.000	1300
TOC b	ppb	100.000	1300
TOC c	ppb	100.000	1200
TOC d	ppb	100.000	1400
TOX a	ppb	10.000	ND
TOX b	ppb	10.000	ND
TOX c	ppb	10.000	ND
TOX d	ppb	10.000	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 06/05/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW41	MW49
Ag	ppb	25.000	ND	ND
Ag dis	ppb	25.000	ND	ND
As	ppb	10.000	ND	ND
As dis	ppb	10.000	ND	ND
Ba	ppb	300.000	ND	ND
Ba dis	ppb	300.000	ND	ND
Cd	ppb	1.000	ND	ND
Cd dis	ppb	1.000	ND	ND
Chloride	ppb	1000.000	37000	10000
Cond a	umhos/cm	1000.000	1390	610
Cond b	umhos/cm	1000.000	1390	600
Cond c	umhos/cm	1000.000	1400	600
Cond d	umhos/cm	1000.000	1390	600
Cr	ppb	10.000	25	6
Cr dis	ppb	10.000	6	6
Fe	ppb	100.000	240	1640
Fe dis	ppb	100.000	ND	ND
GWL	Ft	-	884.5	875.6
Hg	ppb	0.200	ND	0.3
Hg dis	ppb	0.200	ND	ND
Mn	ppb	30.000	ND	75
Mn dis	ppb	30.000	ND	ND
Na	ppb	1000.000	304000	156000
Na dis	ppb	1000.000	298000	147000
Pb	ppb	5.000	ND	ND
Pb dis	ppb	5.000	ND	ND
pH F a		-	7.00	7.10
pH F b		-	7.00	7.10
pH F c		-	7.00	7.20

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 06/05/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW41	MW49
pH F d		-	7.00	7.20
Phenol	ppb	10.000	ND	ND
Se	ppb	5.000	ND	ND
Se dis	ppb	5.000	ND	ND
SO4	ppb	2000.000	445000	89000
TOC a	ppb	100.000	1900	4000
TOC b	ppb	100.000	1800	4000
TOC c	ppb	100.000	1900	4100
TOC d	ppb	100.000	1900	4000
TOX a	ppb	10.000	17	22
TOX b	ppb	10.000	14	19
TOX c	ppb	10.000	18	22
TOX d	ppb	10.000	17	19

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 06/06/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW50
Ag	ppb	25.000	ND
Ag dis	ppb	25.000	ND
As	ppb	10.000	ND
As dis	ppb	10.000	ND
Ba	ppb	300.000	ND
Ba dis	ppb	300.000	ND
Cd	ppb	1.000	ND
Cd dis	ppb	1.000	ND
Chloride	ppb	1000.000	52000
Cond a	umhos/cm	1000.000	900
Cond b	umhos/cm	1000.000	900
Cond c	umhos/cm	1000.000	900
Cond d	umhos/cm	1000.000	900
Cr	ppb	10.000	ND
Cr dis	ppb	10.000	ND
Fe	ppb	100.000	950
Fe dis	ppb	100.000	ND
GWL	Ft	-	884.6
Hg	ppb	0.200	ND
Hg dis	ppb	0.200	ND
Mn	ppb	30.000	37
Mn dis	ppb	30.000	ND
Na	ppb	1000.000	35000
Na dis	ppb	1000.000	39000
Pb	ppb	5.000	ND
Pb dis	ppb	5.000	ND
pH F a		-	7.00
pH F b		-	7.00
pH F c		-	7.00

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 06/06/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW50
pH F d		-	7.00
Phenol	ppb	10.000	ND
Se	ppb	5.000	6
Se dis	ppb	5.000	7
SO4	ppb	2000.000	290000
TOC a	ppb	100.000	5100
TOC b	ppb	100.000	5100
TOC c	ppb	100.000	5200
TOC d	ppb	100.000	5200
TOX a	ppb	10.000	ND
TOX b	ppb	10.000	ND
TOX c	ppb	10.000	ND
TOX d	ppb	10.000	ND

	MW45		
Ag	ppb	25.000	ND
Ag dis	ppb	25.000	ND
As	ppb	10.000	ND
As dis	ppb	10.000	ND
Ba	ppb	300.000	ND
Ba dis	ppb	300.000	ND
Cd	ppb	1.000	ND
Cd dis	ppb	1.000	ND
Chloride	ppb	1000.000	142000
Cond a	umhos/cm	1000.000	1190
Cond b	umhos/cm	1000.000	1200
Cond c	umhos/cm	1000.000	1190
Cond d	umhos/cm	1000.000	1200
Cr	ppb	10.000	ND
Cr dis	ppb	10.000	ND
Fe	ppb	100.000	790
Fe dis	ppb	100.000	ND
GWL	Ft	-	870.0
Hg	ppb	0.200	ND
Hg dis	ppb	0.200	ND
Mn	ppb	30.000	62
Mn dis	ppb	30.000	ND
Na	ppb	1000.000	56000
Na dis	ppb	1000.000	80000
Pb	ppb	5.000	ND
Pb dis	ppb	5.000	ND
pH F a		-	7.20
pH F b		-	7.20
pH F c		-	7.20

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 06/10/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW43	MW47	MW48
Ag	ppb	25.000	ND	ND	ND
Ag dis	ppb	25.000	ND	ND	ND
As	ppb	10.000	ND	ND	ND
As dis	ppb	10.000	ND	ND	ND
Ba	ppb	300.000	ND	ND	ND
Ba dis	ppb	300.000	ND	ND	ND
Cd	ppb	1.000	ND	ND	ND
Cd dis	ppb	1.000	ND	ND	ND
Chloride	ppb	1000.000	7800	327000	177000
Cond a	umhos/cm	1000.000	590	900	1440
Cond b	umhos/cm	1000.000	590	900	1430
Cond c	umhos/cm	1000.000	590	900	1430
Cond d	umhos/cm	1000.000	600	890	1440
Cr	ppb	10.000	2	4	ND
Cr dis	ppb	10.000	ND	ND	ND
Fe	ppb	100.000	1120	2370	440
Fe dis	ppb	100.000	ND	ND	ND
GWL	Ft	-	889.8	879.1	875.5
Hg	ppb	0.200	ND	ND	ND
Hg dis	ppb	0.200	ND	ND	ND
Mn	ppb	30.000	144	37	43
Mn dis	ppb	30.000	ND	87	75
Na	ppb	1000.000	90000	183000	179000
Na dis	ppb	1000.000	75000	56000	98000
Pb	ppb	5.000	ND	ND	7
Pb dis	ppb	5.000	ND	ND	ND
pH F a		-	7.10	7.20	7.10
pH F b		-	7.10	7.20	7.10
pH F c		-	7.10	7.20	7.20

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 06/10/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW43	MW47	MW48
pH F d		-	6.90	7.20	7.10
Phenol	ppb	10.000	ND	ND	ND
Se	ppb	5.000	ND	ND	ND
Se dis	ppb	5.000	ND	ND	ND
SO4	ppb	2000.000	100000	118000	58000
TOC a	ppb	100.000	2200	2400	1600
TOC b	ppb	100.000	2200	2300	1600
TOC c	ppb	100.000	2300	2400	1600
TOC d	ppb	100.000	2100	2500	1600
TOX a	ppb	10.000	ND	ND	15
TOX b	ppb	10.000	ND	ND	13
TOX c	ppb	10.000	ND	ND	13
TOX d	ppb	10.000	ND	11	14

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 06/11/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW44	MW46	MW55
Ag	ppb	25.000	ND	ND	ND
Ag dis	ppb	25.000	ND	ND	ND
As	ppb	10.000	ND	ND	ND
As dis	ppb	10.000	ND	ND	ND
Ba	ppb	300.000	ND	ND	ND
Ba dis	ppb	300.000	ND	ND	ND
Cd	ppb	1.000	ND	ND	ND
Cd dis	ppb	1.000	ND	ND	ND
Chloride	ppb	1000.000	3000	31000	14000
Cond a	umhos/cm	1000.000	890	810	600
Cond b	umhos/cm	1000.000	900	820	600
Cond c	umhos/cm	1000.000	900	810	610
Cond d	umhos/cm	1000.000	900	810	600
Cr	ppb	10.000	ND	ND	3
Cr dis	ppb	10.000	ND	ND	ND
Fe	ppb	100.000	220	630	2730
Fe dis	ppb	100.000	ND	ND	120
GWL	Ft	-	878.7	860.9	872.7
Hg	ppb	0.200	0.4	ND	ND
Hg dis	ppb	0.200	ND	ND	ND
Mn	ppb	30.000	31	31	137
Mn dis	ppb	30.000	ND	NA	ND
Na	ppb	1000.000	71000	147000	57000
Na dis	ppb	1000.000	92000	132000	87000
Pb	ppb	5.000	ND	ND	ND
Pb dis	ppb	5.000	ND	ND	ND
pH F a		-	7.00	7.40	7.40
pH F b		-	7.00	7.40	7.40
pH F c		-	7.00	7.40	7.40

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 06/11/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW44	MW46	MW55
pH F d		-	7.00	7.40	7.40
Phenol	ppb	10.000	ND	ND	ND
Se	ppb	5.000	ND	ND	ND
Se dis	ppb	5.000	ND	ND	ND
SO4	ppb	2000.000	157000	90000	92000
TOC a	ppb	100.000	3600	3700	4300
TOC b	ppb	100.000	3500	3800	4400
TOC c	ppb	100.000	3700	3700	4500
TOC d	ppb	100.000	3700	3900	4300
TOX a	ppb	10.000	ND	ND	ND
TOX b	ppb	10.000	ND	ND	ND
TOX c	ppb	10.000	ND	ND	ND
TOX d	ppb	10.000	ND	ND	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913) 791-6700

SAMPLING

Sample Date: 06/12/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 06/12/85	Reference: 4b-AAS-13
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW45
pH F d		-	7.10
Phenol	ppb	10.000	ND
Se	ppb	5.000	ND
Se dis	ppb	5.000	ND
SO4	ppb	2000.000	212000
TOC a	ppb	100.000	2700
TOC b	ppb	100.000	2600
TOC c	ppb	100.000	2800
TOC d	ppb	100.000	2700
TOX a	ppb	10.000	ND
TOX b	ppb	10.000	ND
TOX c	ppb	10.000	ND
TOX d	ppb	10.000	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 07/09/85 Sampling Program: Quarterly	Reference: 4b-AAS-14 Comments: 4a-01

Parameter	Units	Detection Limit	MW41	MW42
GWL	Ft	-	883.1	892.1

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 07/29/85 Sampling Program: Quarterly	Reference: 4b-AAS-12 Comments: 03 sampled 7/30; 04 sampled 8/1.

Parameter	Units	Detection Limit	85-01	85-02	85-03	8
Cond a	umhos/cm	1000.000	725	1240	600	
GWL	Ft	-	900.5	902.8	892.4	8
pH		-	7.2	7.1	6.9	
SO4	ppb	2000.000	76100	7.19E5	48200	1.

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 11/13/85 Sampling Program: Semi-annually	Reference: 4c-AAS-01 Comments:

Parameter	Units	Detection Limit	MW1	MW2	MW3	M
GWL	Ft	-	929.64	930.05	930.16	93

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 11/13/85	Reference: 4c-AAS-01
Sampling Program: Semi-annually	Comments:

Parameter	Units	Detection Limit	MW45	MW46	MW47	M
GWL	Ft	-	879.11	862.25	879.67	87

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 11/13/85 Sampling Program: Semi-annually	Reference: 4c-AAS-01 Comments:

Parameter	Units	Detection Limit	MW6	MW7	MW8	M
GWL	Ft	-	930.32	927.21	929.56	92

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 11/18/85 Sampling Program: Semi-annually	Reference: 4b-AAS-14 Comments: 4a-01

Parameter	Units	Detection Limit	MW1	MW5
GWL	Ft	-	930.7	931.2

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 11/19/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW2
GWL	Ft	-	930.8

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (91^)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 11/20/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW1	MW2	MW5	M
AmmoniaN	ppb	50.000	60	60	40	
Cond a	umhos/cm	1000.000	620	650	300	
Cond b	umhos/cm	1000.000	620	650	300	
Cond c	umhos/cm	1000.000	620	650	300	
Cond d	umhos/cm	1000.000	610	640	310	
Cyanide	ppb	10.000	ND	ND	ND	
GWL	Ft	-	NA	NA	NA	9
Melamine	ppb	500.000	ND	ND	ND	
Nitrate	ppb	-	5460	5350	3940	
NQ	ppb	100.000	ND	ND	ND	
pH F a		-	7.10	6.60	6.90	
pH F b		-	7.10	6.60	6.90	
pH F c		-	7.10	6.60	6.90	
pH F d		-	7.10	6.60	6.90	
TOC a	ppb	100.000	1200	1600	1400	
TOC b	ppb	100.000	1100	1400	1500	
TOC c	ppb	100.000	1100	1500	1400	
TOC d	ppb	100.000	1200	1300	1400	
TOX a	ppb	10.000	ND	ND	ND	
TOX b	ppb	10.000	ND	ND	ND	
TOX c	ppb	10.000	ND	ND	ND	
TOX d	ppb	10.000	ND	ND	ND	
Urea	ppb	100.000	ND	ND	ND	

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 11/21/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW4	MW9
AmmoniaN	ppb	50.000	60	30
Cond a	umhos/cm	1000.000	600	360
Cond b	umhos/cm	1000.000	600	370
Cond c	umhos/cm	1000.000	600	370
Cond d	umhos/cm	1000.000	610	370
Cyanide	ppb	10.000	ND	ND
GWL	Ft	-	930.5	929.7
Melamine	ppb	500.000	ND	ND
Nitrate	ppb	-	4290	2620
NQ	ppb	100.000	ND	ND
pH F a		-	6.90	6.60
pH F b		-	6.90	6.60
pH F c		-	6.90	6.60
pH F d		-	6.90	6.60
TOC a	ppb	100.000	2000	1500
TOC b	ppb	100.000	1900	1500
TOC c	ppb	100.000	1900	1400
TOC d	ppb	100.000	1900	1500
TOX a	ppb	10.000	ND	ND
TOX b	ppb	10.000	ND	ND
TOX c	ppb	10.000	ND	ND
TOX d	ppb	10.000	ND	ND
Urea	ppb	100.000	ND	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 11/22/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW8
GWL	Ft	-	926.1

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 11/25/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW7	MW8
AmmoniaN	ppb	50.000	20	20
Cond a	umhos/cm	1000.000	790	610
Cond b	umhos/cm	1000.000	790	600
Cond c	umhos/cm	1000.000	790	600
Cond d	umhos/cm	1000.000	790	600
Cyanide	ppb	10.000	50	60
GWL	Ft	-	928.3	NA
Melamine	ppb	500.000	ND	ND
Nitrate	ppb	-	990	2200
NQ	ppb	100.000	ND	ND
pH F a		-	7.00	7.00
pH F b		-	7.00	7.00
pH F c		-	7.00	7.00
pH F d		-	7.00	7.00
TOC a	ppb	100.000	1700	1300
TOC b	ppb	100.000	1700	1300
TOC c	ppb	100.000	1700	1200
TOC d	ppb	100.000	1700	1200
TOX a	ppb	10.000	ND	ND
TOX b	ppb	10.000	ND	ND
TOX c	ppb	10.000	ND	ND
TOX d	ppb	10.000	ND	ND
Urea	ppb	100.000	ND	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.
Address: 103rd Street
Box 640
City/ZIP: DeSoto, KS 66018

FCID: KS3213820878
Contact: Beverly Mohler
Phone: (913)791-6700

SAMPLING

Sample Date: 12/03/85
Sampling Program: Semi-annually

Reference: 4b-AAS-14
Comments: 4a-01

Parameter	Units	Detection Limit	MW3
AmmoniaN	ppb	50.000	50
Cond a	umhos/cm	1000.000	960
Cond b	umhos/cm	1000.000	960
Cond c	umhos/cm	1000.000	960
Cond d	umhos/cm	1000.000	970
Cyanide	ppb	10.000	ND
GWL	Ft	-	930.9
Melamine	ppb	500.000	ND
Nitrate	ppb	-	3140
NQ	ppb	100.000	ND
pH F a		-	7.20
pH F b		-	7.20
pH F c		-	7.20
pH F d		-	7.20
TOC a	ppb	100.000	2300
TOC b	ppb	100.000	2300
TOC c	ppb	100.000	2200
TOC d	ppb	100.000	2200
TOX a	ppb	10.000	ND
TOX b	ppb	10.000	ND
TOX c	ppb	10.000	ND
TOX d	ppb	10.000	ND
Urea	ppb	100.000	ND

GROUND WATER SAMPLING RESULTS

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 05/14/84	Reference: 4b-AAS-09
Sampling Program: Semi-annually	Comments: Sampled 5/14-5/30.

Parameter	Units	Detection Limit	MW28	MW29	MW30	M
Chloride	ppb	1000.000	13000	22000	15000	1
Cond a	umhos/cm	1000.000	1035	1150	853	
Fe	ppb	100.000	570	4300	5600	
GWL	Ft	-	894.9	886.9	887.3	8
Mn	ppb	30.000	ND	53	ND	
Na	ppb	1000.000	90000	85000	86000	2
pH		-	7.2	6.9	7.2	
Phenol	ppb	10.000	ND	ND	ND	
SO4	ppb	2000.000	1.5E5	2.52E5	1.93E5	2
TOC a	ppb	100.000	3300	4000	3800	
TOX a	ppb	10.000	11	13	ND	

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 12/04/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW41	MW42
Ag	ppb	25.000	ND	ND
Ag dis	ppb	25.000	ND	ND
As	ppb	10.000	21	18
As dis	ppb	10.000	27	20
Ba	ppb	300.000	ND	ND
Ba dis	ppb	300.000	ND	ND
Cd	ppb	1.000	ND	ND
Cd dis	ppb	1.000	ND	ND
Cond a	umhos/cm	1000.000	1500	1180
Cond b	umhos/cm	1000.000	1490	1180
Cond c	umhos/cm	1000.000	1500	1190
Cond d	umhos/cm	1000.000	1500	1180
Cr	ppb	10.000	ND	ND
Cr dis	ppb	10.000	ND	ND
GWL	Ft	-	884.4	892.9
Hg	ppb	0.200	ND	ND
Hg dis	ppb	0.200	ND	ND
Pb	ppb	5.000	ND	ND
Pb dis	ppb	5.000	ND	ND
pH F a		-	7.00	7.00
pH F b		-	7.00	7.00
pH F c		-	7.00	7.00
pH F d		-	7.00	7.00
Se	ppb	5.000	8	7
Se dis	ppb	5.000	19	ND
SO4	ppb	2000.000	506000	362000
TOC a	ppb	100.000	1500	1600
TOC b	ppb	100.000	1500	1600
TOC c	ppb	100.000	1500	1600

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 12/04/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW41	MW42
TOC d	ppb	100.000	1500	1600
TOX a	ppb	10.000	ND	ND
TOX b	ppb	10.000	ND	ND
TOX c	ppb	10.000	ND	ND
TOX d	ppb	10.000	ND	ND

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 12/05/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01. GWL taken on 12/04/85 for

Parameter	Units	Detection Limit	MW47	MW49
Ag	ppb	25.000	ND	ND
Ag dis	ppb	25.000	ND	ND
As	ppb	10.000	14	20
As dis	ppb	10.000	ND	ND
Ba	ppb	300.000	ND	ND
Ba dis	ppb	300.000	ND	ND
Cd	ppb	1.000	1	ND
Cd dis	ppb	1.000	ND	ND
Cond a	umhos/cm	1000.000	1140	620
Cond b	umhos/cm	1000.000	1140	620
Cond c	umhos/cm	1000.000	1140	610
Cond d	umhos/cm	1000.000	1140	610
Cr	ppb	10.000	ND	ND
Cr dis	ppb	10.000	ND	ND
GWL	Ft	-	879.4	876.6
Hg	ppb	0.200	ND	ND
Hg dis	ppb	0.200	ND	ND
Pb	ppb	5.000	ND	ND
Pb dis	ppb	5.000	ND	ND
pH F a		-	7.20	7.20
pH F b		-	7.20	7.20
pH F c		-	7.20	7.20
pH F d		-	7.20	7.20
Se	ppb	5.000	ND	ND
Se dis	ppb	5.000	ND	ND
SO4	ppb	2000.000	56000	61000
TOC a	ppb	100.000	1200	2300
TOC b	ppb	100.000	1100	2400
TOC c	ppb	100.000	1200	2400

GROUND WATER SAMPLING RESUL

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 12/05/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01. GWL taken on 12/04/85 fo

Parameter	Units	Detection Limit	MW47	MW49
TOC d	ppb	100.000	1100	2300
TOX a	ppb	10.000	ND	ND
TOX b	ppb	10.000	ND	ND
TOX c	ppb	10.000	ND	ND
TOX d	ppb	10.000	ND	ND

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 12/09/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW43	MW46
Ag	ppb	25.000	ND	ND
Ag dis	ppb	25.000	ND	ND
As	ppb	10.000	ND	ND
As dis	ppb	10.000	ND	ND
Ba	ppb	300.000	ND	ND
Ba dis	ppb	300.000	ND	ND
Cd	ppb	1.000	ND	ND
Cd dis	ppb	1.000	ND	ND
Cond a	umhos/cm	1000.000	730	1100
Cond b	umhos/cm	1000.000	740	1090
Cond c	umhos/cm	1000.000	740	1090
Cond d	umhos/cm	1000.000	740	1100
Cr	ppb	10.000	ND	ND
Cr dis	ppb	10.000	ND	ND
GWL	Ft	-	890.7	861.2
Hg	ppb	0.200	ND	ND
Hg dis	ppb	0.200	ND	ND
Pb	ppb	5.000	ND	ND
Pb dis	ppb	5.000	ND	ND
pH F a		-	7.50	7.40
pH F b		-	7.50	7.40
pH F c		-	7.50	7.40
pH F d		-	7.50	7.40
Se	ppb	5.000	ND	ND
Se dis	ppb	5.000	ND	ND
SO4	ppb	2000.000	98000	114000
TOC a	ppb	100.000	1300	900
TOC b	ppb	100.000	1300	900
TOC c	ppb	100.000	1300	1000

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 12/09/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW43	MW46
TOC d	ppb	100.000	1300	900
TOX a	ppb	10.000	ND	ND
TOX b	ppb	10.000	ND	ND
TOX c	ppb	10.000	ND	ND
TOX d	ppb	10.000	ND	ND

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 12/10/85	Reference: 4a-AAS-01
Sampling Program: Semi-annually	Comments:

Parameter	Units	Detection Limit	MW48
Ag	ppb	25.000	ND
Ag dis	ppb	25.000	ND
As	ppb	10.000	ND
As dis	ppb	10.000	ND
Ba	ppb	300.000	ND
Ba dis	ppb	300.000	ND
Cd	ppb	1.000	ND
Cd dis	ppb	1.000	ND
Cond a	umhos/cm	1000.000	2000
Cond b	umhos/cm	1000.000	1980
Cond c	umhos/cm	1000.000	2000
Cond d	umhos/cm	1000.000	2000
Cr	ppb	10.000	ND
Cr dis	ppb	10.000	ND
GWL	Ft	-	877.3
Hg	ppb	0.200	ND
Hg dis	ppb	0.200	ND
Pb	ppb	5.000	ND
Pb dis	ppb	5.000	ND
pH F a		-	7.30
pH F b		-	7.30
pH F c		-	7.30
pH F d		-	7.30
Se	ppb	5.000	ND
Se dis	ppb	5.000	ND
SO4	ppb	2000.000	159000
TOC a	ppb	100.000	1200
TOC b	ppb	100.000	1100
TOC c	ppb	100.000	1200

GROUND WATER SAMPLING RESUL

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 12/10/85	Reference: 4a-AAS-01
Sampling Program: Semi-annually	Comments:

Parameter	Units	Detection Limit	MW48
TOC d	ppb	100.000	1100
TOX a	ppb	10.000	12
TOX b	ppb	10.000	11
TOX c	ppb	10.000	14
TOX d	ppb	10.000	14

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 12/11/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW45	MW55
Ag	ppb	25.000	ND	ND
Ag dis	ppb	25.000	ND	ND
As	ppb	10.000	ND	ND
As dis	ppb	10.000	ND	ND
Ba	ppb	300.000	ND	ND
Ba dis	ppb	300.000	ND	ND
Cd	ppb	1.000	ND	ND
Cd dis	ppb	1.000	ND	ND
Cond a	umhos/cm	1000.000	1330	790
Cond b	umhos/cm	1000.000	1320	780
Cond c	umhos/cm	1000.000	1320	780
Cond d	umhos/cm	1000.000	1330	780
Cr	ppb	10.000	ND	ND
Cr dis	ppb	10.000	ND	ND
GWL	Ft	-	872.6	873.8
Hg	ppb	0.200	ND	ND
Hg dis	ppb	0.200	ND	ND
Pb	ppb	5.000	ND	ND
Pb dis	ppb	5.000	ND	ND
pH F a		-	7.30	7.40
pH F b		-	7.30	7.40
pH F c		-	7.30	7.40
pH F d		-	7.30	7.40
Se	ppb	5.000	ND	7
Se dis	ppb	5.000	ND	6
SO4	ppb	2000.000	224000	111000
TOC a	ppb	100.000	2600	1700
TOC b	ppb	100.000	2600	1700
TOC c	ppb	100.000	2600	1500

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 12/11/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW45	MW55
TOC d	ppb	100.000	2600	1700
TOX a	ppb	10.000	17	ND
TOX b	ppb	10.000	15	ND
TOX c	ppb	10.000	13	ND
TOX d	ppb	10.000	15	ND

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 12/12/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW44	MW50
Ag	ppb	25.000	ND	ND
Ag dis	ppb	25.000	ND	ND
As	ppb	10.000	ND	ND
As dis	ppb	10.000	ND	ND
Ba	ppb	300.000	ND	ND
Ba dis	ppb	300.000	ND	ND
Cd	ppb	1.000	ND	ND
Cd dis	ppb	1.000	ND	ND
Cond a	umhos/cm	1000.000	1080	980
Cond b	umhos/cm	1000.000	1080	980
Cond c	umhos/cm	1000.000	1090	980
Cond d	umhos/cm	1000.000	1080	970
Cr	ppb	10.000	ND	ND
Cr dis	ppb	10.000	ND	ND
GWL	Ft	-	881.1	886.9
Hg	ppb	0.200	ND	ND
Hg dis	ppb	0.200	ND	ND
Pb	ppb	5.000	ND	ND
Pb dis	ppb	5.000	ND	ND
pH F a		-	7.20	7.00
pH F b		-	7.20	7.00
pH F c		-	7.20	7.00
pH F d		-	7.20	7.00
Se	ppb	5.000	ND	ND
Se dis	ppb	5.000	ND	ND
SO4	ppb	2000.000	30000	263000
TOC a	ppb	100.000	3500	1500
TOC b	ppb	100.000	3400	1400
TOC c	ppb	100.000	3500	1500

GROUND WATER SAMPLING RESUL:

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 12/12/85	Reference: 4b-AAS-14
Sampling Program: Semi-annually	Comments: 4a-01

Parameter	Units	Detection Limit	MW44	MW50
TOC d	ppb	100.000	3600	1500
TOX a	ppb	10.000	15	ND
TOX b	ppb	10.000	18	ND
TOX c	ppb	10.000	18	ND
TOX d	ppb	10.000	17	ND

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 11/14/86	Reference: 4b-AAS-16
Sampling Program: Semi-annually	Comments: When lab rpts confict w/compute

Parameter	Units	Detection Limit	MW16	MW41	MW42
2,4-DNT	ppb	1.000	ND	ND	ND
2,6-DNT	ppb	1.000	ND	ND	ND
Acetone	ppb	-	NA	NA	14
Ag	ppb	25.000	NA	8	NA
Al	ppb	-	NA	8050	2630
AmmoniaN	ppb	50.000	NA	ND<100	ND<100
As	ppb	10.000	NA	NA	NA
Ba	ppb	300.000	NA	179	89
Br	ppb	-	NA	NA	NA
Ca	ppb	-	NA	172000	191000
Cd	ppb	1.000	NA	NA	NA
Chloride	ppb	1000.000	NA	34000	75000
Co	ppb	-	NA	9	NA
Cr	ppb	10.000	NA	15	12
Cu	ppb	-	NA	NA	NA
Fe	ppb	100.000	NA	6730	3530
HMX	ppb	10.000	ND	ND<1	ND
K	ppb	-	NA	1850	1610
MeCl	ppb	-	NA	NA	NA
Mg	ppb	-	NA	34900	38400
Mn	ppb	30.000	NA	73	244
Na	ppb	1000.000	NA	75200	79400
NGlycern	ppb	10.000	ND	ND	ND
Nitrate	ppb	-	NA	1100	600
Pb	ppb	5.000	NA	9.4	8.1
Phenol	ppb	10.000	NA	NA	NA
RDX	ppb	1.000	ND	ND	ND
Se	ppb	5.000	NA	NA	NA
SO4	ppb	2000.000	NA	400000	370000

GROUND WATER SAMPLING RESUL

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 11/14/86	Reference: 4b-AAS-16
Sampling Program: Semi-annually	Comments: When lab rpts confict w/compute

Parameter	Units	Detection Limit	MW16	MW41	MW42
TNT	ppb	-	ND<1	ND<1	ND<1
TOC a	ppb	100.000	NA	1900	1500
TOX a	ppb	10.000	NA	11	9.4
TranDCEE	ppb	-	NA	NA	NA
V	ppb	-	NA	NA	NA
Zn	ppb	-	NA	43	32

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 11/14/86	Reference: 4b-AAS-16
Sampling Program: Semi-annually	Comments: When lab rpts confict w/compute

Parameter	Units	Detection Limit
2,4-DNT	ppb	1.000
2,6-DNT	ppb	1.000
Acetone	ppb	-
Ag	ppb	25.000
Al	ppb	-
AmmoniaN	ppb	50.000
As	ppb	10.000
Ba	ppb	300.000
Br	ppb	-
Ca	ppb	-
Cd	ppb	1.000
Chloride	ppb	1000.000
Co	ppb	-
Cr	ppb	10.000
Cu	ppb	-
Fe	ppb	100.000
HMX	ppb	10.000
K	ppb	-
MeCl	ppb	-
Mg	ppb	-
Mn	ppb	30.000
Na	ppb	1000.000
NGlycern	ppb	10.000
Nitrate	ppb	-
Pb	ppb	5.000
Phenol	ppb	10.000
RDX	ppb	1.000
Se	ppb	5.000
SO4	ppb	2000.000

GROUND WATER SAMPLING RESUL

GENERAL

Site Name: Sunflower Army Ammunition Plt. Address: 103rd Street Box 640 City/ZIP: DeSoto, KS 66018	FCID: KS3213820878 Contact: Beverly Mohler Phone: (913)791-6700

SAMPLING

Sample Date: 11/14/86	Reference: 4b-AAS-16
Sampling Program: Semi-annually	Comments: When lab rpts confict w/compute

Parameter	Units	Detection Limit
TNT	ppb	-
TOC a	ppb	100.000
TOX a	ppb	10.000
TranDCEE	ppb	-
V	ppb	-
Zn	ppb	-

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 11/20/86	Reference: 4b-AAS-16
Sampling Program: Semi-annually	Comments: Rec.date used; when lab rpts cor

Parameter	Units	Detection Limit	MW17	MW29	MW31
2,4-DNT	ppb	1.000	ND	ND	ND
2,6-DNT	ppb	1.000	ND	ND	ND
Acetone	ppb	-	NA	NA	NA
Ag	ppb	25.000	NA	NA	NA
Al	ppb	-	7910	1160	173
AmmoniaN	ppb	50.000	ND<100	ND<100	200
As	ppb	10.000	5	NA	NA
Ba	ppb	300.000	300	92	275
Br	ppb	-	NA	NA	NA
Ca	ppb	-	67000	149000	167000
Cd	ppb	1.000	NA	0.4	NA
Chloride	ppb	1000.000	10000	26000	12000
Co	ppb	-	NA	NA	NA
Cr	ppb	10.000	16	NA	NA
Cu	ppb	-	23	NA	NA
Fe	ppb	100.000	7700	1200	6890
HMX	ppb	10.000	ND	50	ND
K	ppb	-	2200	1330	1200
MeCl	ppb	-	NA	NA	NA
Mg	ppb	-	14900	34400	19900
Mn	ppb	30.000	202	34	3940
Na	ppb	1000.000	53500	106000	29500
NGlycern	ppb	10.000	ND	ND	ND
Nitrate	ppb	-	11200	400	ND<100
Pb	ppb	5.000	14.5	4.1	NA
RDX	ppb	1.000	ND	ND	11
Se	ppb	5.000	11.9	NA	NA
SO4	ppb	2000.000	59000	425000	320000
TNT	ppb	-	ND<1	ND<1	ND<1

GROUND WATER SAMPLING RESULT

GENERAL

Site Name: Sunflower Army Ammunition Plt.	FCID: KS3213820878
Address: 103rd Street	Contact: Beverly Mohler
Box 640	Phone: (913)791-6700
City/ZIP: DeSoto, KS 66018	

SAMPLING

Sample Date: 11/20/86	Reference: 4b-AAS-16
Sampling Program: Semi-annually	Comments: Rec.date used; when lab rpts cor

Parameter	Units	Detection Limit	MW17	MW29	MW31
TOC a	ppb	100.000	1300	4900	3700
TOX a	ppb	10.000	9.2	23	14
V	ppb	-	NA	NA	NA
Zn	ppb	-	70	23	26

APPENDIX II

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UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010

GROUND-WATER QUALITY ASSESSMENT PLAN NO. 38-26-0461-84
NITROGUANIDINE/CARBIDE AREA
SUNFLOWER ARMY AMMUNITION PLANT
DESOTO, KANSAS
12-15 APRIL 1983

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WASTE
MANAGEMENT

Distribution limited to US Government agencies only; protection of privileged information evaluating another command; Mar 84. Other requests for this document must be referred to Commander, Sunflower Army Ammunition Plant, DeSoto, KS 66018.

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

Mr. Nemeth/lr/AUTOVON
584-2024

REPLY TO
ATTENTION OF
HSHB-ES/WP

- 4 APR 1984

SUBJECT: Ground-water Quality Assessment Plan No. 38-26-0461-84, Nitroguanidine/Carbide Area, Sunflower Army Ammunition Plant, DeSoto, Kansas, 12-15 April 1983

Commander
US Army Materiel Development
and Readiness Command
ATTN: DRCSG
5001 Eisenhower Avenue
Alexandria, VA 22333

1. The purpose of the inclosed report is to serve as a ground-water quality assessment plan for a detailed field study pursuant to Title 40, Code of Federal Regulations (CFR), 1983 rev, Section 265.93, Preparation, Evaluation and Response. Implementation of the plan will determine if ground-water contamination exists and, if so, will enable definition of the problem to include rate of movement, extent, and concentration of hazardous wastes or hazardous waste constituents in the ground water.

2. The plan includes descriptions of regional and site-specific geohydrology, hazardous waste activities at the sites, existing ground-water quality information, and work to be accomplished to meet the objectives of the assessment.

3. Implementation of a ground-water quality assessment plan will include USAEHA coordination and development of a scope of work with representatives of the Huntsville Division, US Army Corps of Engineers. The field work and ground-water quality assessment report will be completed by a contract through the Huntsville Division.

FOR THE COMMANDER:

1 Incl
as

NELSON H. LUND, P.E.
Colonel, MSC
Director, Environmental Quality

CF:
Cdr, HSC (HSCL-P)
Cdr, DARCOMI&SA (DRCIS-RI-IC) (2 cy)
Cdr, AMCCOM [DRSMC-SG(R)/DRSMC-ISE(R)] (2 cy)
DIVENGR, USAEDH (HNDED-PM) (2 cy)
Cdr, SAAP (3 cy)

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DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

REPLY TO ATTENTION OF

HSHB-ES/WP

GROUND-WATER QUALITY ASSESSMENT PLAN NO. 38-26-0461-84
NITROGUANIDINE/CARBIDE AREA
SUNFLOWER ARMY AMMUNITION PLANT
DESOTO, KANSAS
12-15 APRIL 1983

1. AUTHORITY. Letter, DRCSG-S, HQ DARCOM, 3 January 1983, subject: USAEHA Mission Services, FY 83, with initial indorsement, HSPA-P, HQ HSC, 7 January 1983

2. REFERENCES. See Appendix A for a listing of references.

3. PURPOSE. This document is a plan for the accomplishment of a ground-water quality assessment study at Sunflower AAP. This plan has been prepared to meet the requirements of the State of Kansas, Department of Health and Environment, Hazardous Waste Management Standards and Regulations (reference 1). The purpose of this ground-water quality assessment is to determine the extent, concentration, and rate of movement of hazardous wastes and hazardous waste constituents in the ground water. The site being addressed by this plan is the nitroguanidine/carbide area surface impoundment.

4. GENERAL.

a. Abbreviations. See Appendix B for a listing of abbreviations used in this report.

b. Personnel Contacted.

(1) Mr. Thomas Stutz, Commander's Representative, Sunflower AAP.

(2) Mr. James Turrentine, Chief Engineer, Sunflower AAP.

(3) Mr. Larry Johnson, Senior Process Engineer, Hercules, Inc.

(4) Ms. Beverly Mohler, Engineer, Hercules, Inc.

(5) Mr. Mike Robbinson, Hercules, Inc.

c. Location and Mission. Sunflower AAP is located near DeSoto, Kansas, approximately 30 miles west of Kansas City, in northwestern Johnson County (see Figure 1). Sunflower AAP is approximately 15 square miles in size. The plant is Government-owned, contractor-operated (Hercules, Inc.) with the primary mission of manufacturing propellants and smokeless powder.

d. Background. A total of nine monitoring wells were installed at this site in 1981 by the CE. The location, depth, and number of wells were determined cooperatively by the CE and the State of Kansas. Four quarters of ground-water quality data have been obtained as required by regulations (reference 1). This plan will be implemented if indicator parameter data for

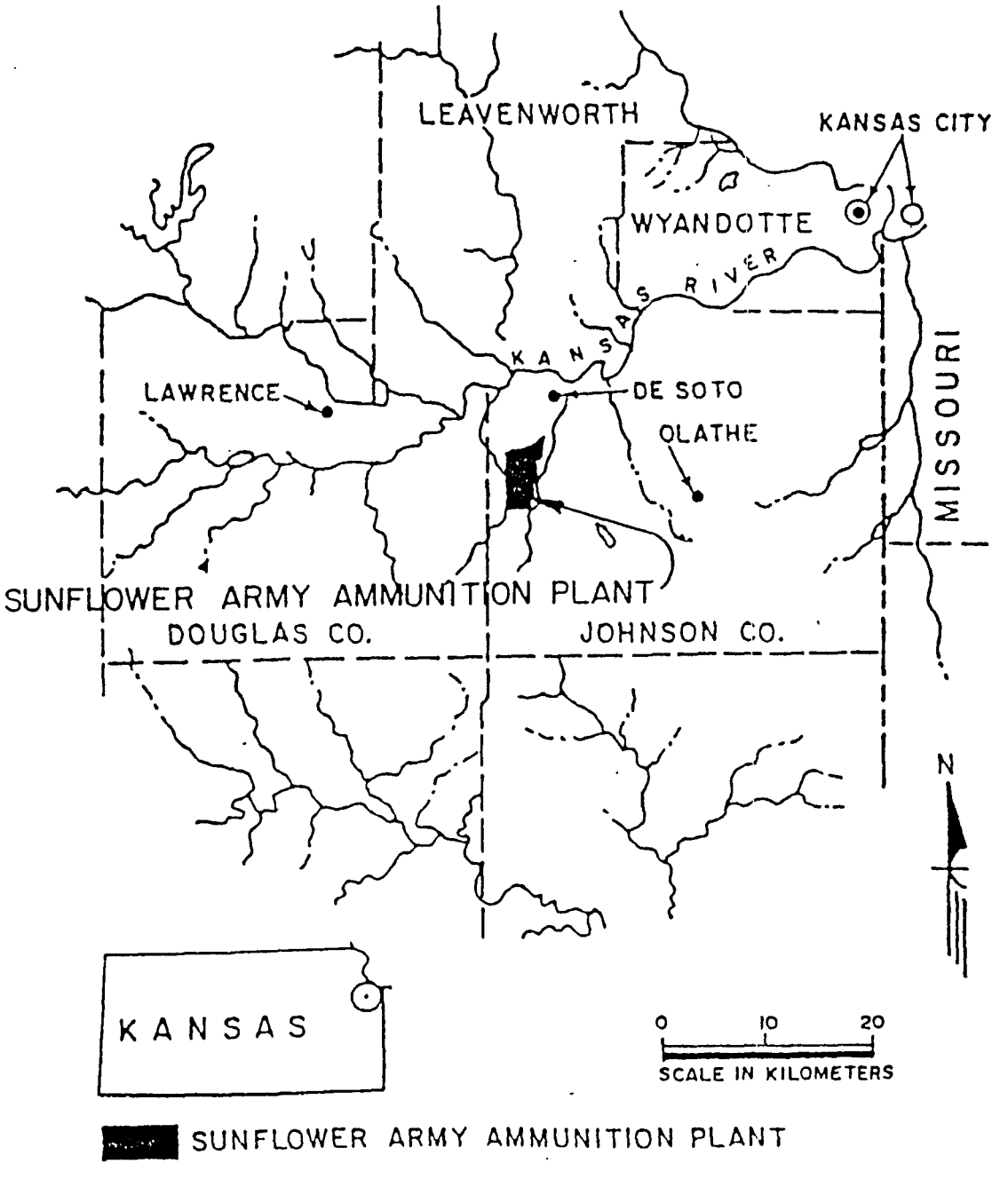

Figure 1. Location of Sunflower AAP Within the State of Kansas

downgradient wells to be gathered in future semiannual monitoring show significantly higher (or lower for pH) concentrations than first-year data from upgradient wells. The comparison to identify significant concentration differences will be made using statistical testing as required by regulation. Data from first-year routine ground-water quality monitoring have shown no direct evidence of ground-water contamination from the site.

5. DISCUSSION OF REGIONAL SETTING.

a. Physiography, Topography, and Surface Drainage. Sunflower AAP is located on the border between the Dissected Till Plains and the Osage Plains sections of the Central Lowlands physiographic province. Maximum topographic relief is approximately 180 feet from a low along Kill Creek in the northeastern corner to a high in the south-central portion of the installation. Surface water drainage is to either Spoon and Kill Creeks in the east or Captain Creek in the west for most of the installation (see Figure 2). These creeks flow to the Kansas River, which is located 2 to 3 miles north of the plant. Drainage for a small part of the northwest corner of Sunflower AAP is northward to unnamed, intermittent streams which flow directly to the Kansas River. The nitroguanidine area is located on the drainage divide between this area and the Captain Creek drainage area.

b. Regional Geology.

(1) Sedimentary bedrock units of Cambrian, Ordovician, Devonian, Mississippian, and Pennsylvanian age overlie Precambrian rock in Johnson County (reference 2). The Pennsylvanian age rocks which outcrop in the county are of the Missourian and Virgilian Stages. The near-surface bedrock units at Sunflower AAP, in ascending order, are the Wyandotte Limestone and Bonner Springs Shale formations of the Kansas City Group; the Plattsburg Limestone, Vilas Shale, and Stanton Limestone formations of the Lansing Group; and the Stranger formation of the Douglas Group. General descriptions of formation members and their average thickness at Sunflower AAP are presented in Figure 3.

(2) Johnson County is located in a regional geologic structure called the Prairie Plains monocline. The bedrock dips to the northwest at approximately 15 to 20 feet per mile. In the vicinity of Sunflower AAP, a gently undulating anticlinal/synclinal structure, striking north-northwesterly, is superimposed on the regional structure (reference 3).

(3) Overlying the bedrock in Johnson County are unconsolidated glacial, fluvial, lacustrine, and aeolian deposits of Pleistocene age. These unconsolidated sediments are largely glacial till and undifferentiated fluvial and lacustrine deposits of the Kansan Stage. Recent alluvium along the Kansas River and its tributaries are Wisconsinan and Recent in age. In northwestern Johnson County, including the western portion of Sunflower AAP,

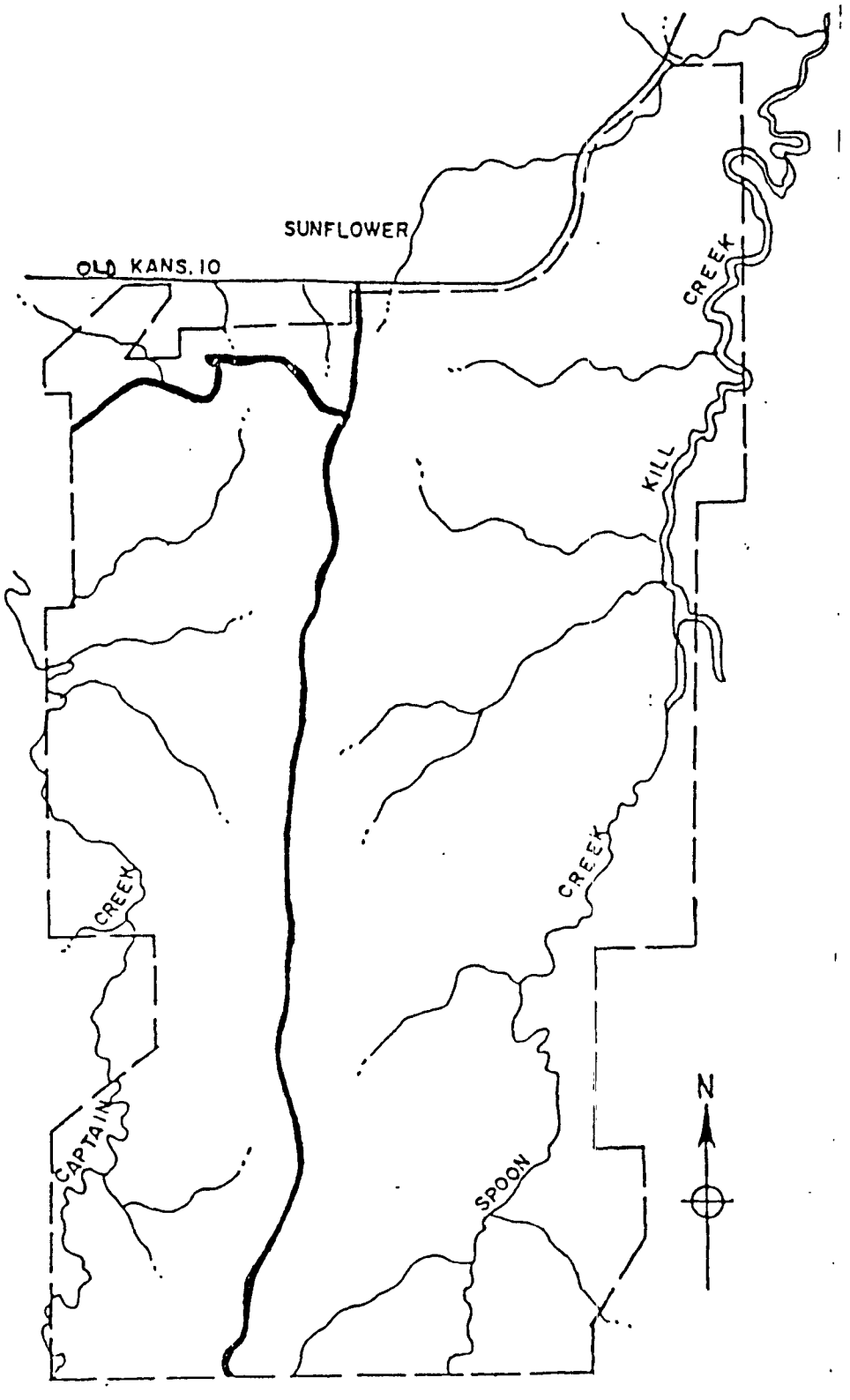

Figure 2. Drainage Basins of Sunflower AAP

SUNFLOWER ARMY AMMUNITION PLANT

GENERAL GEOLOGIC COLUMN

System	Stage	Group	Formation	Member or Zone		Ave Thickness	General Description
PENNSYLVANIAN	VIRGILIAN	DOUGLAS	STRANGER	WESTON		*	SHALE: soft, clayey, dark gray to gray, occasional ironstone concretions, weathers green brown to green gray
	MISSOURIAN	LANSING	STANTON	SOUTH BEND		3.5	LIMESTONE: moderately hard, finely crystalline, medium to thick bedded, fossiliferous, gray to brownish gray
				ROCK LAKE		5.4	UPPER SANDSTONE: fine grained, argillaceous, gray, 0.2' coal seam locally at base. LOWER SHALE: soft, clayey, dark gray, locally 1' limestone separates sandstone and shale
				STONER		14.6	LIMESTONE: moderately hard, finely crystalline, medium to thick bedded, light tannish gray, contains numerous wavy gray shale partings.
				EUDORA		6.9	SHALE: soft, platey to fissile, carbonaceous, black, upper 2' commonly dark gray.
				CAPTAIN CREEK		7.0	LIMESTONE: moderately hard, finely crystalline, medium bedded, light tannish gray, thin wavy argillaceous parting zones common throughout.
			VILAS			15.3	SHALE: soft, platey, micaceous, dark gray with fine-grained sandstone and siltstone interbeds.
			PLATTSBURG	SPRING HILL		24.2	UPPER LIMESTONE: moderately hard, granular, argillaceous, dark gray, upper 5' commonly dark brown with white mottling. LOWER LIMESTONE: (lower ½ to ⅓ of member) moderately hard, finely crystalline light gray
				HICKORY CK		0.82	SHALE: soft, platey, fossiliferous, dark gray
				MERRIAM		7.4	LIMESTONE: moderately hard, finely crystalline, medium bedded. upper 2' to 3' contains clay-filled worm borings and is light gray. Lower 2' to 4' is light tannish gray and is fossiliferous. Limestones separated by very dark gray, platey, calcareous shale ranging from a parting to 1' in thickness
		KANSAS CITY (ZARAH SUBGROUP)	BONNER SPRINGS			4.3	SHALE: soft calcareous, silty, dark gray is occasionally a fine grained argillaceous sandstone, dark gray to greenish gray
			WYANDOTTE	FARLEY		17.2	LIMESTONE: moderately hard, finely crystalline to crystalline, medium bedded, light tannish gray, contains crystalline calcite rugs and stringers and numerous wavy gray shale partings. Locally, upper 1' to 3' is gray or brownish gray, highly fossiliferous zone.
				ISLAND CREEK		1.0	SHALE: soft, fossiliferous, calcareous, dark gray.
				ARGENTINE		17.6	LIMESTONE: moderately hard, thin to medium bedded, finely crystalline to crystalline, light tannish gray with bluish gray mottling, containing numerous wavy, dark gray shale partings.
				QUINDARO		*	SHALE: soft, calcareous, dark gray to black. Upper 6' carbonaceous and fissile, silty in lower parts

* not totally penetrated

Figure 3. Sunflower AAP Bedrock Stratigraphy

the basal part of the Kansan Stage deposits are commonly sand or sand and gravel. This sand and gravel was deposited as glacial outwash and, possibly, as lacustrine sediments in glacial lakes. Figure 4 is a geologic map of the Sunflower AAP vicinity.

c. Regional Ground-water Hydrology.

(1) The principal unconsolidated sediment aquifers in Johnson County are Kansas River valley alluvium and undifferentiated fluvial deposits in tributary stream valleys. In addition to these Wisconsinan deposits, Kansan fluvial and lacustrine deposits also yield small quantities of water in some locations. Wells in the Kansas River Valley alluvium can yield 1,000 gpm or more. Wells in tributary valleys normally yield 1 to 10 gpm. However, wells in some parts of the Captain and Cedar Creek valleys could probably yield greater quantities because of sandy sediments (reference 2). On Sunflower AAP, the Kansan deposits in the western portion of the installation would yield quantities of water depending on the thickness of the sand or sand and gravel layer and also the thickness of the saturated zone. Recharge of these aquifers is through infiltration of local precipitation.

(2) The bedrock in Johnson County generally does not yield significant quantities of usable water. In some localities, wells in the Wyandotte Limestone and the Ireland Sandstone Member of the Lawrence formation yield 10 to 40 gpm. The Lawrence formation overlies the Stranger formation in the Douglas Group; however, the Stranger formation is the most recent bedrock strata identified in monitoring well borings at Sunflower AAP. Certain black or very dark and fissile shales, including the Eudora Shale, are capable of yielding up to 20 gpm of water that may be saline. Sandstone beds in certain bedrock units, including the Rock Lake and Vilas Shales, may also yield small quantities of water, generally less than 5 gpm. In addition to the rock units mentioned, wells installed into the zone of weathering in near-surface limestones and shales will yield small quantities of water because of increased secondary permeability in this zone due to fractures, joints, and bedding planes. Recharge of these shallow bedrock aquifers is by infiltration of local precipitation through overlying unconsolidated material.

(3) There are no water supply wells on Sunflower AAP. The plant water supply is obtained from wells located north of the installation in the Kansas River Valley alluvium.

6. SITE DESCRIPTION.

a. The carbide treatment wastewater impoundment is in the nitroguanidine manufacturing area which is located in the northwest portion of Sunflower AAP (see Figure 5). This unlined surface impoundment is triangular and approximately 270 ft by 270 ft by 380 ft with a maximum depth of about 8 ft.

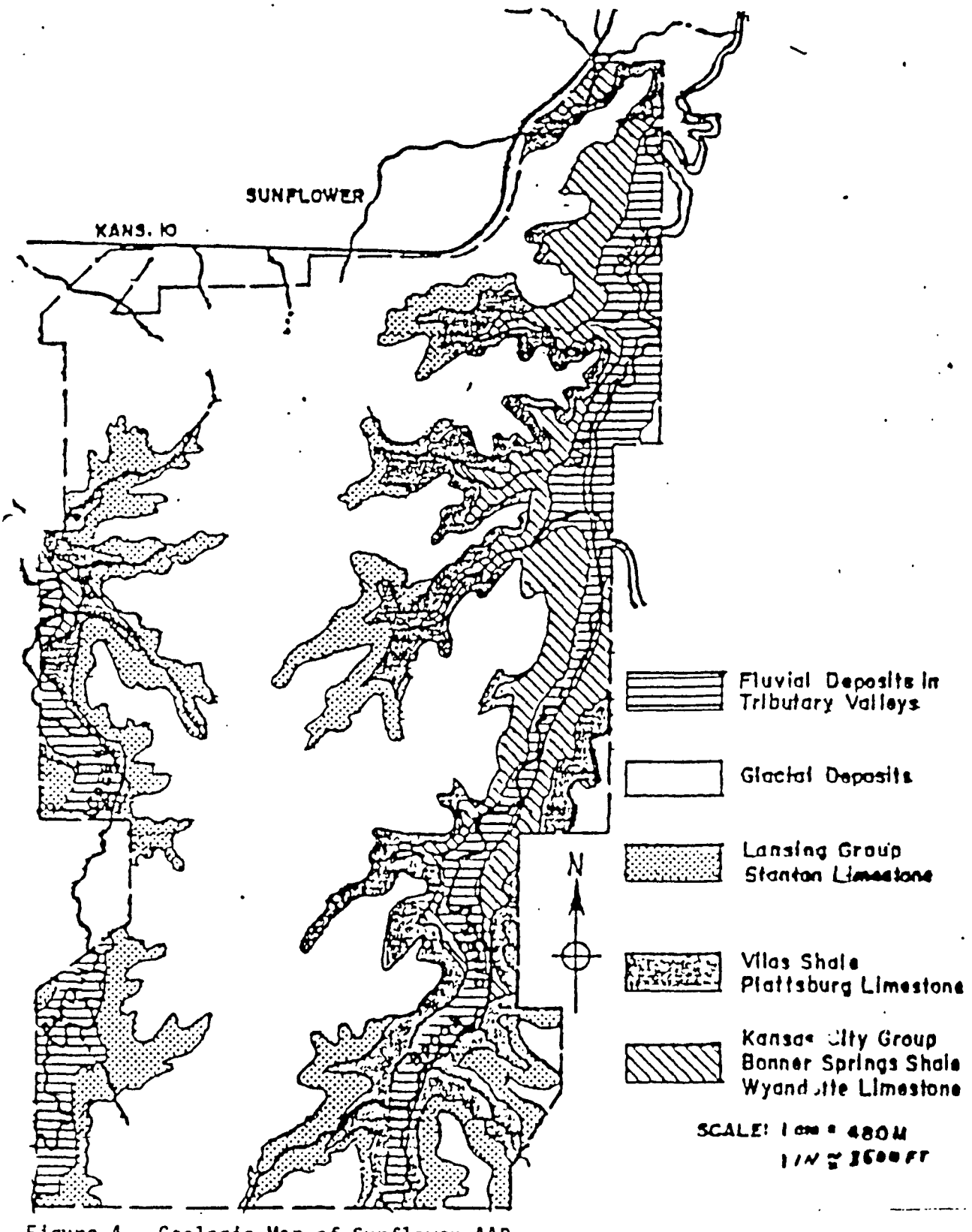

Figure 4. Geologic Map of Sunflower AAP

b. In the manufacture of nitroguanidine, calcium carbide and nitrogen are combined in the presence of fluorspar (catalyst) to produce calcium cyanamide. A solid waste material which is primarily calcium carbide, but which also contains calcium cyanamide and fluorspar, is treated by spreading on the ground surface and spraying with water. The water and calcium carbide react to form calcium hydroxide and acetylene. The acetylene is evolved as a gas. Runoff from the treatment pad area is into the adjacent surface impoundment. The impoundment receives runoff only from the treatment pad area and does not overflow. The surface impoundment was constructed in 1980 for this new manufacturing facility, and the amount of carbide waste treated included approximately 100 pounds during 1981 and 3,000 pounds during 1982.

c. The nitroguanidine area and the carbide impoundment are located on a topographic high which separates the Captain Creek drainage area from the area drained by unnamed creeks flowing northward toward the Kansas River (see Figure 6). A total of nine monitoring wells are located at this site (see Figure 7). The bedrock units dip gently to the west-southwest (see Figure 8). Figure 9 is a top-of-bedrock contour map for the area. The uppermost bedrock units are the Weston Shale at the locations of monitoring wells MW05 through MW08 and the South Bend Limestone at the remaining well locations. The unconsolidated overburden ranges in thickness from 12.3 ft at monitoring well MW07 to 43.2 ft at MW09. The overburden materials are Kansas Stage deposits consisting primarily of clay, silty clay, and sandy clay, with a layer of sand and/or clayey sand as the basal part overlying bedrock (see boring logs, Appendix C). The thickness of the sand layer is variable, ranging from zero at monitoring well MW07 and only 1 ft at MW05, to greater than 10 ft at wells MW03, MW06, and MW09. Monitoring well MW03 is located adjacent to the carbide impoundment, and the boring for this well revealed an overburden of 37.8 ft with nearly 12 ft of sand overlying bedrock.

d. Monitoring well MW03 was screened in the sand and clayey sand overlying bedrock. All other wells were installed with screens extending from near the top of the sand layer to the uppermost part of the Vilas Shale. The wells installed into bedrock ranged from 71 to 90 ft in depth and had screen lengths from 45 to 69 ft (see well installation drawings, Appendix C). The well casings are 4-inch-ID, schedule-40 PVC pipe and have 4-inch-ID PVC screens with a slot size of 0.035 inch. Filter pack material was placed into the annular space between the screen and the drill hole wall from the bottom of the hole to 1 ft above the top of the screen. A 1 ft bentonite seal was placed above the filter pack, and the annulus above this was grouted to the surface. The wells were developed by surging, bailing, and pumping. The screening of monitoring wells through both the unconsolidated overburden and the the bedrock was recommended by the State of Kansas, Department of Health and Environment, to insure that adequate water could be obtained from the wells when sampling. However, this design allows mixing of water from different strata and does not permit the measuring of piezometric head for each water-bearing unit separately. The water level measurements obtained

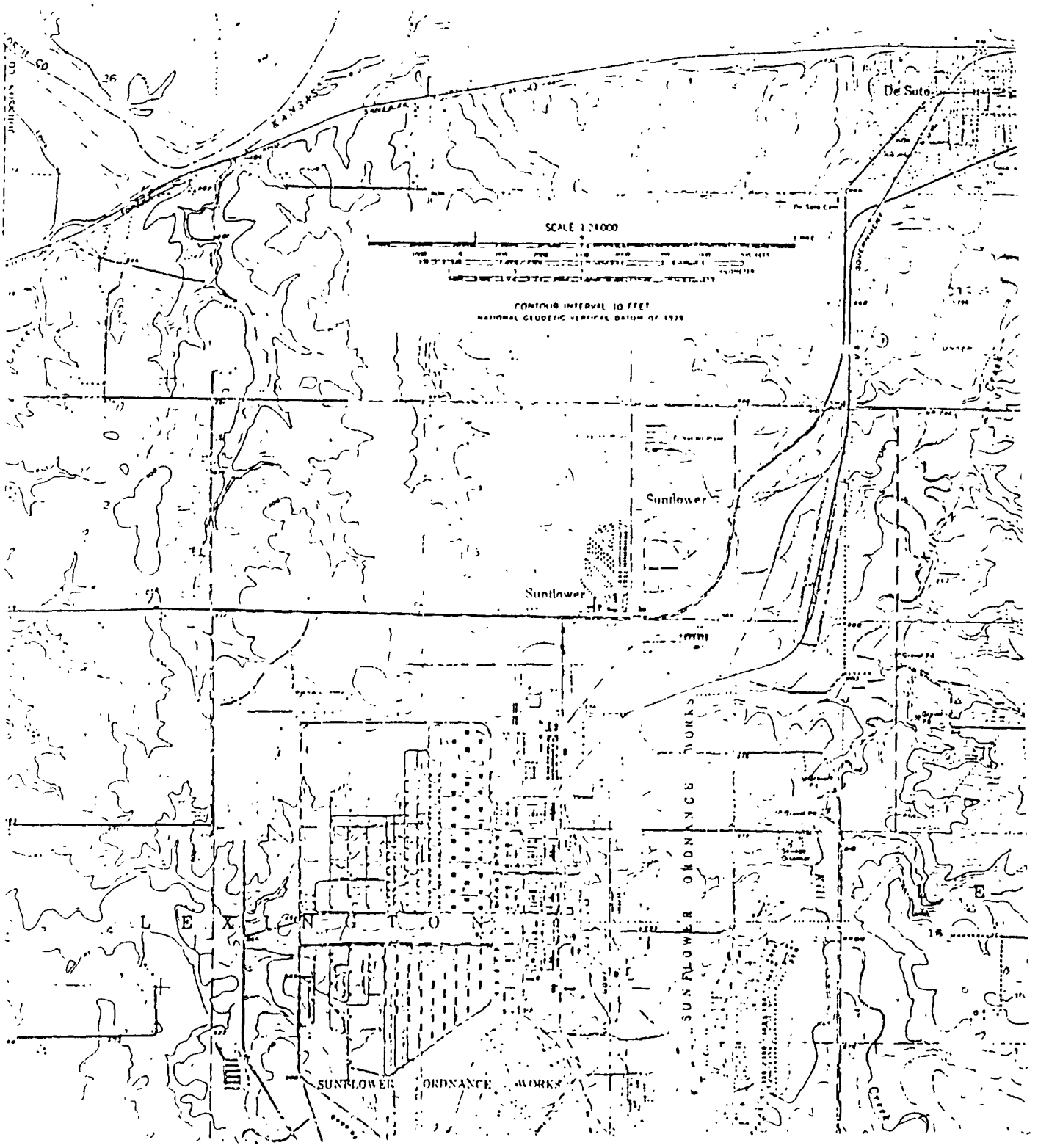

Figure 6. Topographic Map

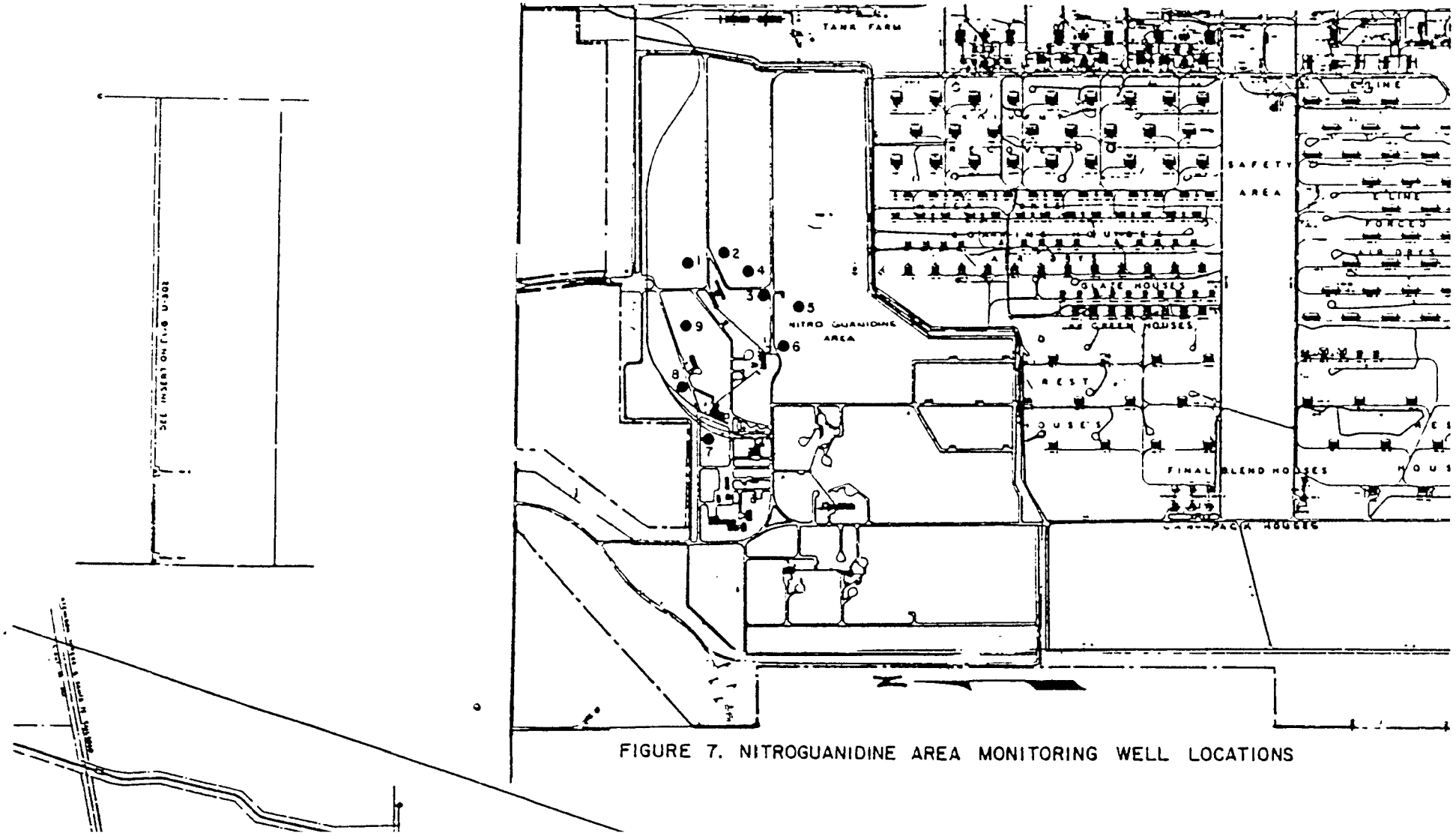

FIGURE 7. NITROGUANIDINE AREA MONITORING WELL LOCATIONS

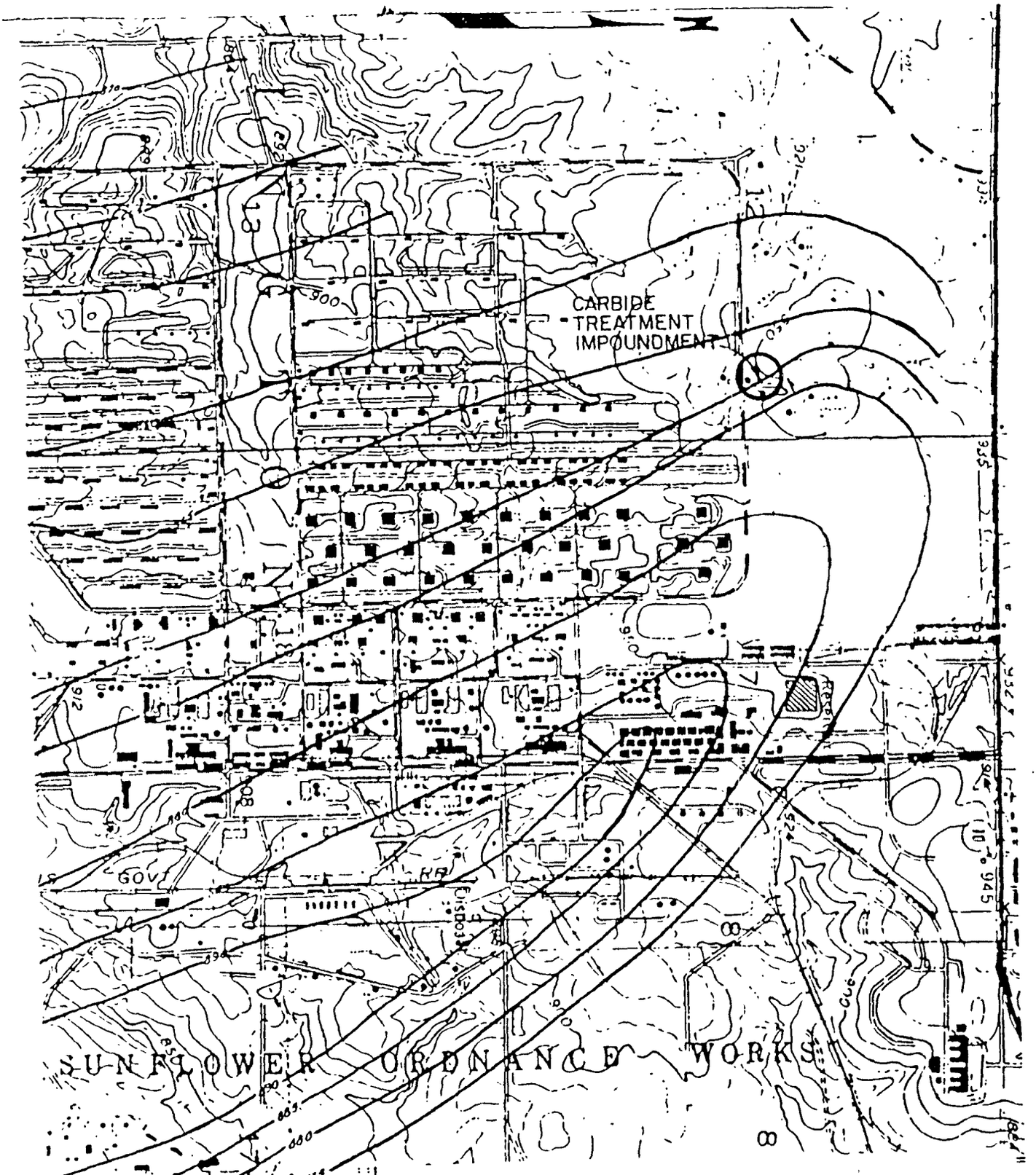

FIGURE 8. BEDROCK STRUCTURE CONTOUR MAP
(FROM REFERENCE 3)
CONTOURS ON TOP OF VILAS SHALE

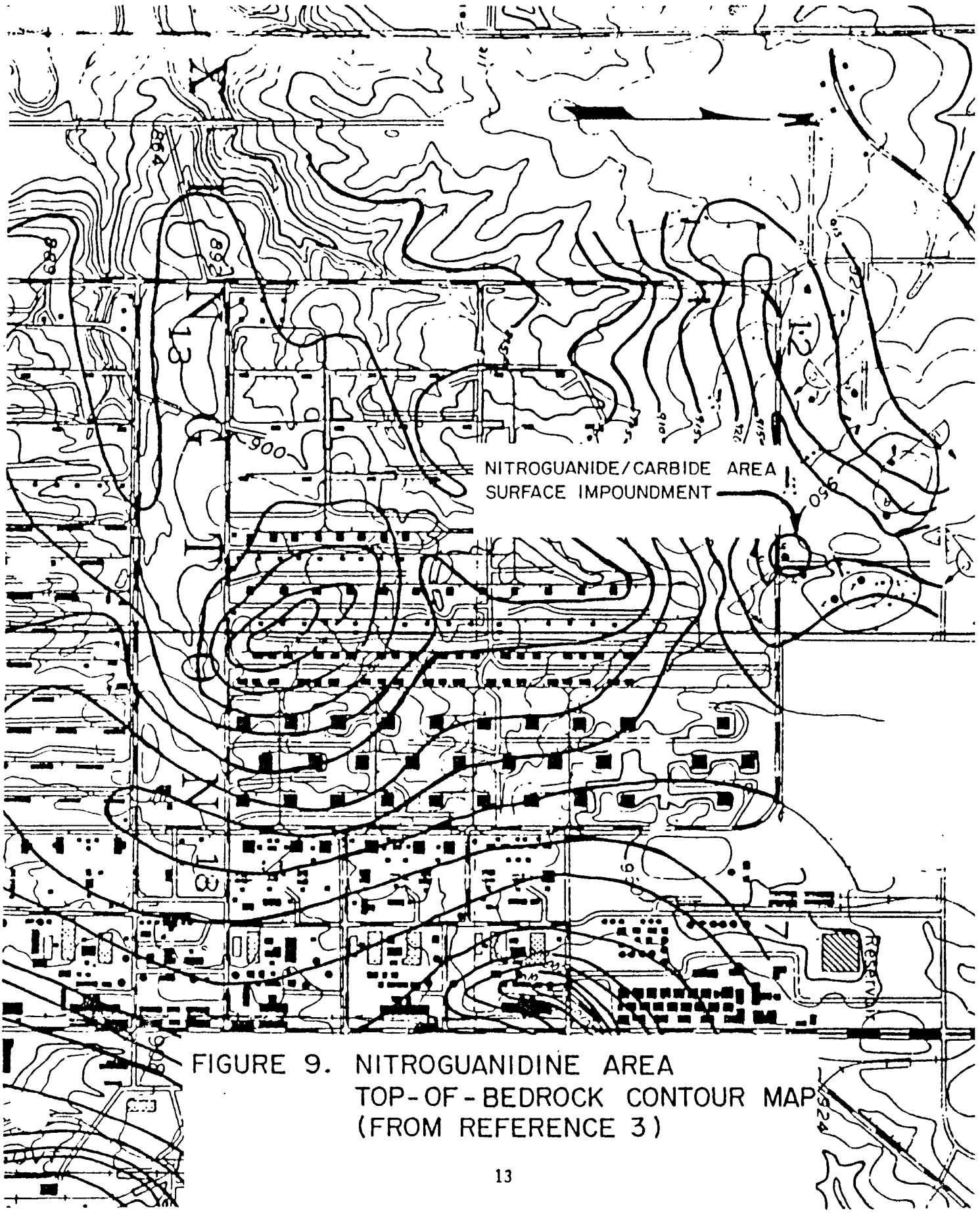

FIGURE 9. NITROGUANIDINE AREA
TOP-OF-BEDROCK CONTOUR MAP
(FROM REFERENCE 3)

will be a composite of actual piezometric heads for the permeable strata penetrated by the bore hole. Significant differences in the piezometric head of water in the overburden and the upper bedrock units are not expected at this site, and the use of composite head measurements is probably acceptable. However, there are probably significant differences in hydraulic conductivity and ground-water flow rates among strata. Water level measurements show the composite piezometric head to be above the top of the sand layer for all wells. During periods of low rainfall, the water table will probably be lower and the sand may not be fully saturated. This site is located on a topographic high, and ground-water flow is probably radial from the site. Monitoring well MW08 is most appropriate as a background well. Monitoring well MW03, being adjacent to the carbide impoundment, should certainly intercept any contaminated ground water from the impoundment. All nine monitoring wells yield sufficient water such that they cannot be pumped dry with a low-volume sampling pump of the bladder type.

7. CHEMICAL ANALYSIS DATA.

a. Ground-water samples have been collected from the monitoring wells and analyzed for parameters specified by regulations (reference 1). The sampling frequency was quarterly during the first year of monitoring to establish baseline data. The parameters specified by regulation include NIPDWR parameters; indicators of ground-water quality, including iron, manganese, sodium, chloride, phenol, and sulfate; and indicators of ground-water contamination including pH, specific conductance, TOC, and TOX. The analytical results are tabulated in Appendix D. First-quarter analytical work was performed by Wilson Laboratories and second through fourth-quarter analyses were performed by Century Environmental Testing Laboratories, Inc.

b. First-year ground-water quality data for the nine wells from this area show pesticides and most heavy metals to be nondetectable. Fluoride and nitrate/nitrite as N levels are uniform for all wells and below NIPDWR standards. Specific conductance and TOC levels are also uniform, with specific conductance levels ranging from roughly 300 to 800 umhos/cm and TOC levels fluctuating seasonally from levels of <10 mg/L to levels ranging from 40 to 75 mg/L. With the type of wastes at this site, the best indicators of ground-water contamination from among the parameters measured would be nitrate/nitrite as N, pH, and specific conductance. Samples from monitoring well MW03, located adjacent to the carbide impoundment, do not show elevated levels of these parameters.

8. PLAN OF ACTION.

a. Phase 1.

(1) This ground-water quality assessment plan will be implemented when a significant increase (or pH decrease) is detected between first-year upgradient well data and current data for a downgradient well for an indicator parameter and results have been confirmed by resampling and

analysis. Significant difference is defined as rejection of the hypothesis that the means of the two data sets are equal when the Student's t-test at the 0.01 level of significance is used. The first step of the assessment will be the analysis of ground-water samples from existing wells to determine if hazardous wastes or hazardous waste constituents are present in the ground water. If hazardous wastes or hazardous waste constituents are not detected, the assessment will proceed no further. However, if ground-water contamination is detected, additional work will be performed to determine the extent, rate of movement, and concentration of contaminants in the ground water. This additional work (Phase 2) is described in paragraph 8b. Sampling and sample preparation procedures specified in Appendix E will be employed during this assessment.

(2) The waste material entering the carbide impoundment is runoff from the carbide treatment pad. At this pad, waste material consisting of calcium carbide, calcium cyanamide, fluorspar, and carbon is treated by spraying with water. The fluorspar and carbon are not hazardous and will not be discussed further. The calcium carbide reacts with the water, producing calcium hydroxide and acetylene which is evolved as a gas:

$$CaC_2 + 2H_2O \longrightarrow HC \equiv CH + Ca(OH)_2 + \text{heat}$$

The calcium cyanamide is not stable in water, and the principal degradation products are expected to be calcium hydroxide and nitrogen compounds. One of the commercial uses of calcium cyanamide is as a fertilizer. The nitrogen compounds formed would include urea, ammonia, nitrite, and nitrate. It is possible that some melamine might also be formed. Intermediate degradation products not stable in water include calcium hydrogen cyanamide, cyanamide, and possibly dicyandiamide.

(3) To determine if hazardous wastes or hazardous waste constituents are in the ground water, samples from all existing wells will be analyzed for urea, ammonia, nitrite, nitrate, melamine, and cyanide. Sunflower AAP personnel have stated that cyanide has been identified in the impoundment; however, review of literature does not indicate that cyanide is a possible degradation product. Analysis for cyanide will be performed to confirm or deny its existence. Specific conductance and pH will also be measured when samples are taken because of the calcium hydroxide formed when the wastes degrade. Urea and melamine will be determined using the analytical methods of Appendix F. The other analyses will be performed using published methodology (EPA or Standard Methods, references 4 and 5).

(4) Those analyses performed by USAEHA will be accomplished using appropriate quality assurance procedures. These procedures include analyses of standards, duplicates, spikes, and blanks. In addition, blind QC samples and EPA or commercial reference standards will be analyzed to further ensure quality of analytical results. Procedures will also be employed for sample

control and data management in the laboratory. When analytical work is performed by a contract laboratory, the laboratory will be required to comply with the quality assurance procedures outlined in reference 6.

(5) With the type of waste materials at this site, pH and specific conductance are expected to be useful as indicators of possible ground-water contamination. The hazardous waste constituents or their degradation products will not be detectable by the indicator parameters TOC and TOX.

b. Phase 2.

(1) General. If Phase 1 work described in paragraph 8a determines that hazardous wastes or hazardous waste constituents have entered the ground water, additional work (Phase 2) will be performed to determine the extent, rate of movement, and concentration of contaminants in the ground water. This additional work will involve drilling additional monitoring wells, performing aquifer tests, and analyzing water samples to determine contaminant concentrations.

(2) The principal flow of ground water at this site is in the sand overlying the bedrock. Initially, 12 monitoring wells will be installed at six locations. At each location, both a shallow overburden and a deeper bedrock well will be installed. Shallow overburden wells will be installed in borings made to bedrock and will be screened in the interval from top of bedrock to the top of the sand or clayey sand layer. Where the sand layer is very thin or does not exist, the top of the screen will be placed at the top of the water table (or historical high water table if wells are installed during a dry period). Proposed locations for these wells are shown on Figure 10. These initial six locations have been selected primarily to obtain site ground-water hydrology information.

(3) Soil samples will be taken at intervals of not more than 5 ft in the overburden, with at least one sample from the sand or clayey sand above bedrock. Selected samples will be tested to classify the soil. Tests to be performed include laboratory permeability, grain size distribution, Atterburg limits, moisture content, density, and porosity.

(4) Aquifer tests will be performed for the six shallow wells to determine hydraulic conductivity. Rising or falling head (slug) tests will initially be performed. If the hydraulic conductivity and saturated thickness are found to be adequate to perform a pump test, such a test will be performed to obtain additional estimates of hydraulic conductivity. The location for such a test will be chosen after the other initial Phase 2 work has been completed. The hydraulic conductivity estimates obtained from aquifer tests will be used along with water table gradient and soils testing data to estimate ground-water flow direction and rate of movement (linear velocity).

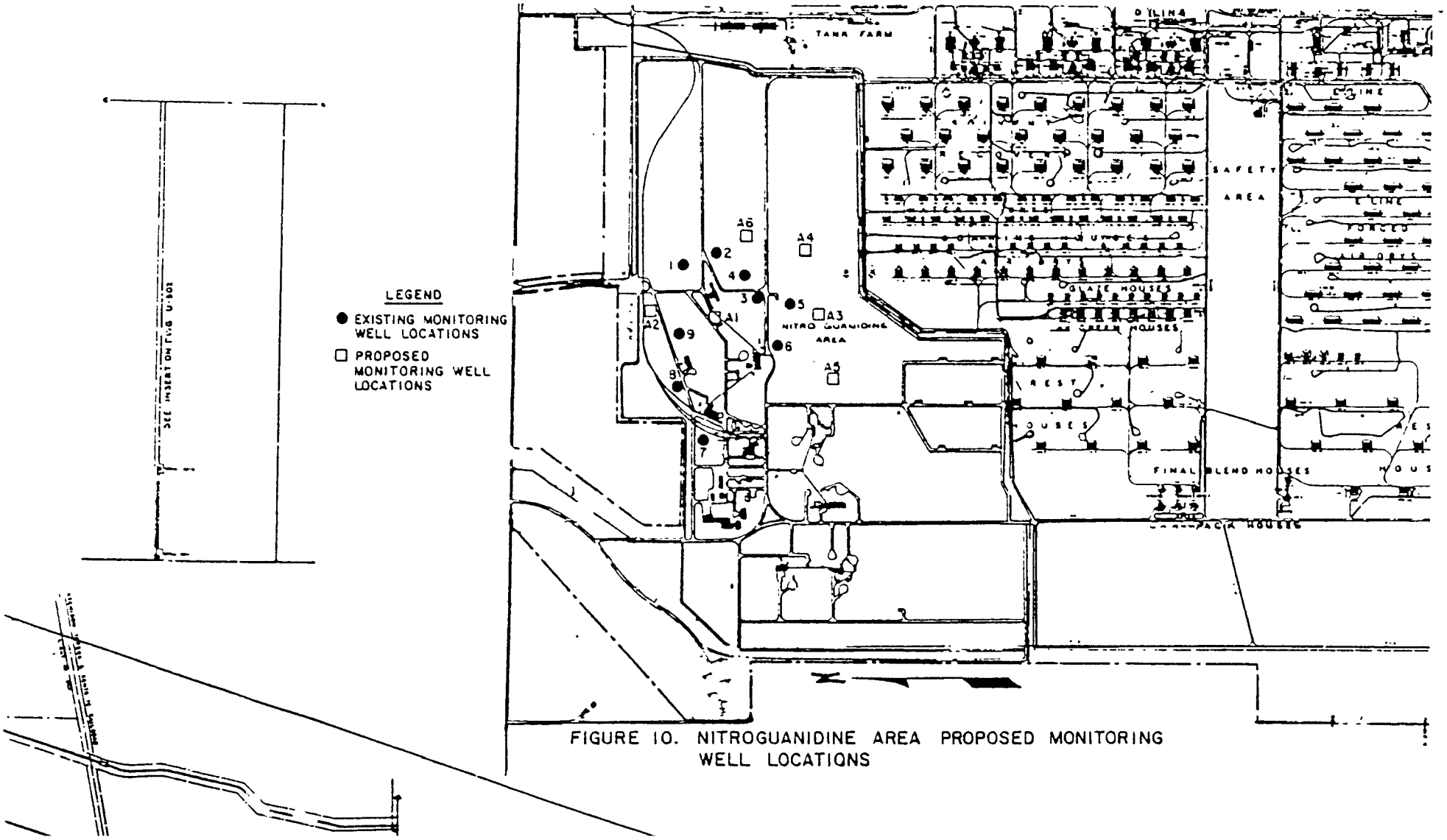

FIGURE 10. NITROGUANIDINE AREA PROPOSED MONITORING WELL LOCATIONS

(5) Chemical analysis data from Phase 1 of the assessment may be useful in determining ground-water flow direction. If ground-water contamination is found in samples from existing wells other than MW03, the proposed well locations shown in Figure 10 may be changed and several additional shallow wells may be added as appropriate.

(6) Bedrock wells will be constructed by drilling to the top of the Vilas Shale and casing the hole to bedrock. The bedrock wells are expected to have small yields. After completion, the wells will be pumped until clear water is produced, and the maximum yield of each well will be determined. Any wells which yield more than 10 gpm will be pumped with a pneumatic packer-pump unit to identify those strata yielding significant water and the yield of each.

(7) Piezometric measurements will be obtained for the shallow overburden wells and for the bedrock wells. In addition, piezometric measurements will be obtained for separate strata for any bedrock well with a higher yield. It is expected that at least the upper bedrock units are hydraulically connected to the unconsolidated sand aquifer and that there will not be piezometric differences between these strata.

(8) Rising or falling head (slug) tests will be performed with the bedrock wells to obtain an estimate of hydraulic conductivity. This estimated hydraulic conductivity, along with hydraulic gradients and estimates of bedrock porosity, will be used to estimate ground-water flow velocity. Only ranges of possible flow velocity will be estimated because the hydraulic conductivity and the porosity values used for the calculations will be only rough estimates and will probably vary significantly among the separate bedrock strata. Conservative (worst case) estimates will be made with the primary intent being comparison with estimates obtained for the overlying sand. The hydraulic conductivity of, and flow velocities in, the sand are expected to be greater than that of the bedrock strata. If this is true, the extent of ground-water contamination will be determined by flow in the sands (where sands exist).

(9) Water samples will be obtained from existing wells, shallow wells, and from bedrock wells. Analysis will be performed for the contaminants found during Phase 1. When sampling the bedrock wells, a pneumatic packer-pump unit will be used to obtain samples from separate units individually.

c. Phase 3. After the Phase 2 work has been completed, additional wells will be installed as needed to determine the "extent" of ground-water contamination. The location, number, and depth of wells will be determined after the initial Phase 2 work is completed. Better estimates of ground-water contaminant movement rates and information concerning flow in separate strata will also be obtained through actual observations of contamination extent and flow times.

d. Drilling and Well Installation.

(1) Drilling Method. The drilling of shallow wells to be screened in the overburden material will be by use of cable tool or hollow-stem auger techniques. Borings into bedrock will be accomplished using rotary techniques with only water as a drilling fluid.

(2) Well Specifications. The well casing for shallow overburden wells will be 4-inch-ID PVC pipe with threaded joints. The well screen will be preslotted PVC pipe with a slot size of 0.035 inch. A uniform and complete filling of the annular space with sandpack, bentonite pellets, and grout should be achieved. The sand will be clean, texturally larger than the slot size of the screen, and fill the annular space to approximately 3 ft above the top of the screen. A bentonite seal will be installed above the sandpack. The seal should be 2 ft of tamped bentonite-water mixture (bentonite pellets should be used because bentonite powder will bridge the annular space as soon as it contacts moisture.) Then a grout mixture of premixed cement, 3-percent bentonite powder, and water should be pumped into the annular space from the top of the bentonite seal to the ground surface.

(3) Well Protection. Each well will be covered with a vented cap. A protective casing, a section of steel pipe larger in diameter than the PVC casing, should be placed into the cement grout. It should be fitted with a hinged cap with lock.

(4) Survey of Wells. Each well will be located with reference to vertical and horizontal control by survey methods.

(5) Well Development. Each well will be fully developed as soon as practical after installation but no sooner than 48 hours following the placement of the cement grout. Development will be accomplished with a surge block and a bailer until the water removed from the well is clear. As a minimum, each well should have 5 volumes of water pumped or bailed as part of development. The development equipment will be washed with clean water before each use to prevent cross contamination from one well to another.

9. ADDITIONAL INFORMATION.

a. Implementation. Implementation of this ground-water quality assessment will include coordination through normal Army command channels. Phase 1 sampling will be done by Sunflower AAP personnel, and Phase 1 chemical analysis will be performed by this Agency. Phase 2 and Phase 3 work will be completed by contract through the Huntsville Division CE.

b. Schédule. The estimated schedule of work completion will be as follows:

(1) Phase 1 completion - 3 months after review of assessment plan by State of Kansas Department of Health and Environment has been completed.

(2) Phase 2 contract award - 4 months after Phase 1 completion.

(3) Phase 2 initial work completion - 5 months after contract award.

(4) Phase 3 work to determine "extent" of ground-water contamination completion - 9 months after contract award.

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Chief, Waste Disposal Engineering Division

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UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010

GROUND-WATER QUALITY ASSESSMENT PLAN NO. 38-26-0264-84
POWER HOUSE/INDUSTRIAL WASTE TREATMENT AREA
SUNFLOWER ARMY AMMUNITION PLANT
DESOTO, KANSAS
12-15 APRIL 1983

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MANAGEMENT

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DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

Mr. Nemeth/csp/AUTOVON
584-2024

REPLY TO
ATTENTION OF
HSHB-ES/WP

4 APR 1984

SUBJECT: Ground-water Quality Assessment Plan No. 38-26-0264-84, Power House/Industrial Waste Treatment Area, Sunflower Army Ammunition Plant, DeSoto, Kansas, 12-15 April 1983

Commander
US Army Materiel Development
and Readiness Command
ATTN: DRCSG
5001 Eisenhower Avenue
Alexandria, VA 22333

1. The purpose of the inclosed report is to serve as a ground-water quality assessment plan for a detailed field study pursuant to Title 40, Code of Federal Regulations (CFR), 1983 rev, Section 265.93, Preparation, Evaluation and Response. Implementation of the plan will determine if ground-water contamination exists and, if so, will enable definition of the problem to include rate of movement, extent, and concentration of hazardous wastes or hazardous waste constituents in the ground water.

2. The plan includes descriptions of regional and site-specific geohydrology, hazardous waste activities at the sites, existing ground-water quality information, and work to be accomplished to meet the objectives of the assessment.

3. Implementation of a ground-water quality assessment plan will include USAEHA coordination and development of a scope of work with representatives of the Huntsville Division, US Army Corps of Engineers. The field work and ground-water quality assessment report will be completed by a contract through the Huntsville Division.

FOR THE COMMANDER:

James T. Stutz LTC, PE

1 Incl
as

NELSON H. LUND, P.E.
Colonel, MSC
Director, Environmental Quality

CF:
Cdr, HSC (HSCL-P)
Cdr, AMCCOM [DRSMC-SG(R)/DRSMC-ISE(R)] (2 cy)
Cdr, DARCOMI&SA (DRCIS-RI-IC) (2 cy)
DIVENGR, USAEDH (HNDED-PM) (2 cy)
Cdr, SAAP (3 cy)

Ground-water Quality Assessment Plan No. 38-26-0264-84, 12-15 Apr 83

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DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

REPLY TO
ATTENTION OF

HSHB-ES/WP

GROUND-WATER QUALITY ASSESSMENT PLAN NO. 38-26-0264-84
POWER HOUSE/INDUSTRIAL WASTE TREATMENT AREA
SUNFLOWER ARMY AMMUNITION PLANT
DESOTO, KANSAS
12-15 APRIL 1983

1. AUTHORITY. Letter, DRCSG-S, HQ DARCOM, 3 January 1983, subject: USAEHA Mission Services, FY 83, with initial indorsement, HSPA-P, HQ, HSC, 7 January 1983.

2. REFERENCES. See Appendix A for a listing of references.

3. PURPOSE. This document is a plan for the accomplishment of a ground-water quality assessment study at Sunflower AAP. This plan has been prepared to meet the requirements of the State of Kansas, Department of Health and Environment, Hazardous Waste Management Standards and Regulations (reference 1). The purpose of this ground-water quality assessment is to determine the extent, concentration, and rate of movement of hazardous wastes and hazardous waste constituents in the ground water. The site being addressed by this plan is the power house/IWT area surface impoundments.

4. GENERAL.

a. Abbreviations. See Appendix B for a listing of abbreviations used in this report.

b. Personnel Contacted.

(1) Mr. Thomas Stutz, Commander's Representative, Sunflower AAP.

(2) Mr. James Turrentine, Chief Engineer, Sunflower AAP.

(3) Mr. Larry Johnson, Senior Process Engineer, Hercules, Inc.

(4) Ms. Beverly Mohler, Engineer, Hercules, Inc.

(5) Mr. Mike Robbinson, Hercules, Inc.

c. Location and Mission. Sunflower AAP is located near DeSoto, Kansas, approximately 30 miles west of Kansas City, in northwestern Johnson County (see Figure 1). Sunflower AAP is approximately 15 square miles in size. The plant is Government-owned, contractor-operated (Hercules, Inc.) with the prim y mission of manufacturing propellants and smokeless powder.

d. Background. A total of 11 monitoring wells were installed at this site in 1981 by the CE. The location, depth, and number of wells were determined cooperatively by the CE and the State of Kansas. Four quarters of ground-water quality data have been obtained as required by regulations (reference 1). This plan will be implemented if indicator parameter data for

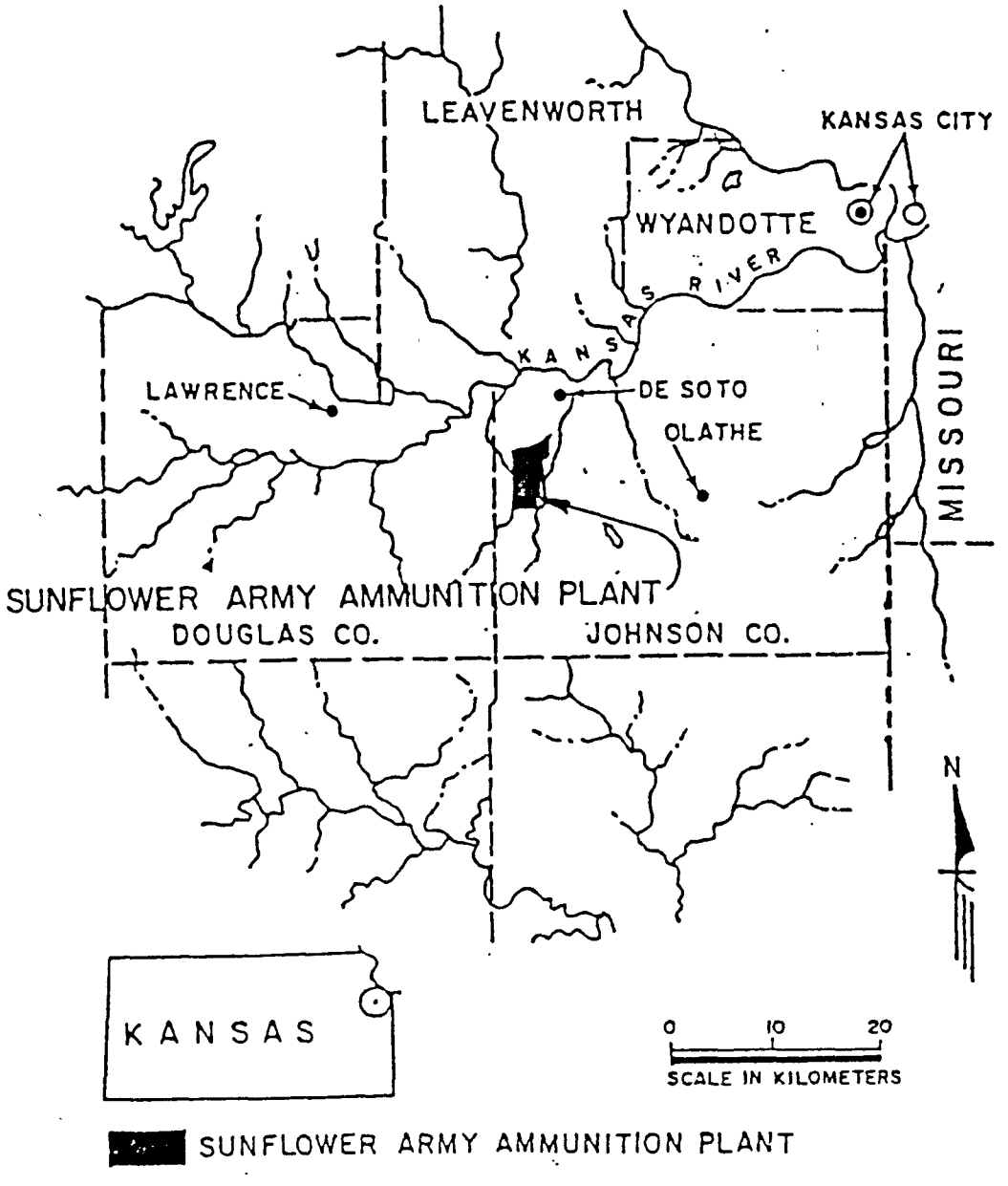

Figure 1. Location of Sunflower AAP Within the State of Kansas

downgradient wells to be gathered in future semiannual monitoring show significantly higher (or lower for pH) concentrations than first-year data from upgradient wells. The comparison to identify significant concentration differences will be made using statistical testing as required by regulation. Data from first-year routine ground-water quality monitoring have shown no direct evidence of ground-water contamination from the site.

5. DISCUSSION OF REGIONAL SETTING.

a. Physiography, Topography, and Surface Drainage. Sunflower AAP is located on the border between the Dissected Till Plains and the Osage Plains sections of the Central Lowlands physiographic province. Maximum topographic relief is approximately 180 feet from a low along Kill Creek in the northeastern corner to a high in the south-central portion of the installation. Surface water drainage is to either Spoon and Kill Creeks in the east or Captain Creek in the west for most of the installation (see Figure 2). These creeks flow to the Kansas River, which is located 2 to 3 miles north of the plant. Drainage for a small part of the northwest corner of Sunflower AAP is northward to unnamed, intermittent streams which flow directly to the Kansas River. The power house/IWT surface impoundments are within the Kill Creek drainage basin.

b. Regional Geology.

(1) Sedimentary bedrock units of Cambrian, Ordovician, Devonian, Mississippian, and Pennsylvanian age overlie Precambrian rock in Johnson County (reference 2). The Pennsylvanian age rocks which outcrop in the county are of the Missourian and Virgilian Stages. The near-surface bedrock units at Sunflower AAP, in ascending order, are the Wyandotte Limestone and Bonner Springs Shale formations of the Kansas City Group; the Plattsburg Limestone, Vilas Shale, and Stanton Limestone formations of the Lansing Group; and the Stranger formation of the Douglas Group. General descriptions of formation members and their average thickness at Sunflower AAP are presented in Figure 3.

(2) Johnson County is located in a regional geologic structure called the Prairie Plains monocline. The bedrock dips to the northwest at approximately 15 to 20 feet per mile. In the vicinity of Sunflower AAP, a gently undulating anticlinal/synclinal structure, striking north-northwesterly, is superimposed on the regional structure (reference 3).

(3) Overlying the bedrock in Johnson County are unconsolidated glacial, fluvial, lacustrine, and aeolian deposits of Pleistocene age. These unconsolidated sediments are largely glacial till and undifferentiated fluvial and lacustrine deposits of the Kansan Stage. Recent alluvium along the Kansas River and its tributaries are Wisconsinan and Recent in age. In northwestern Johnson County, including the western portion of Sunflower AAP,

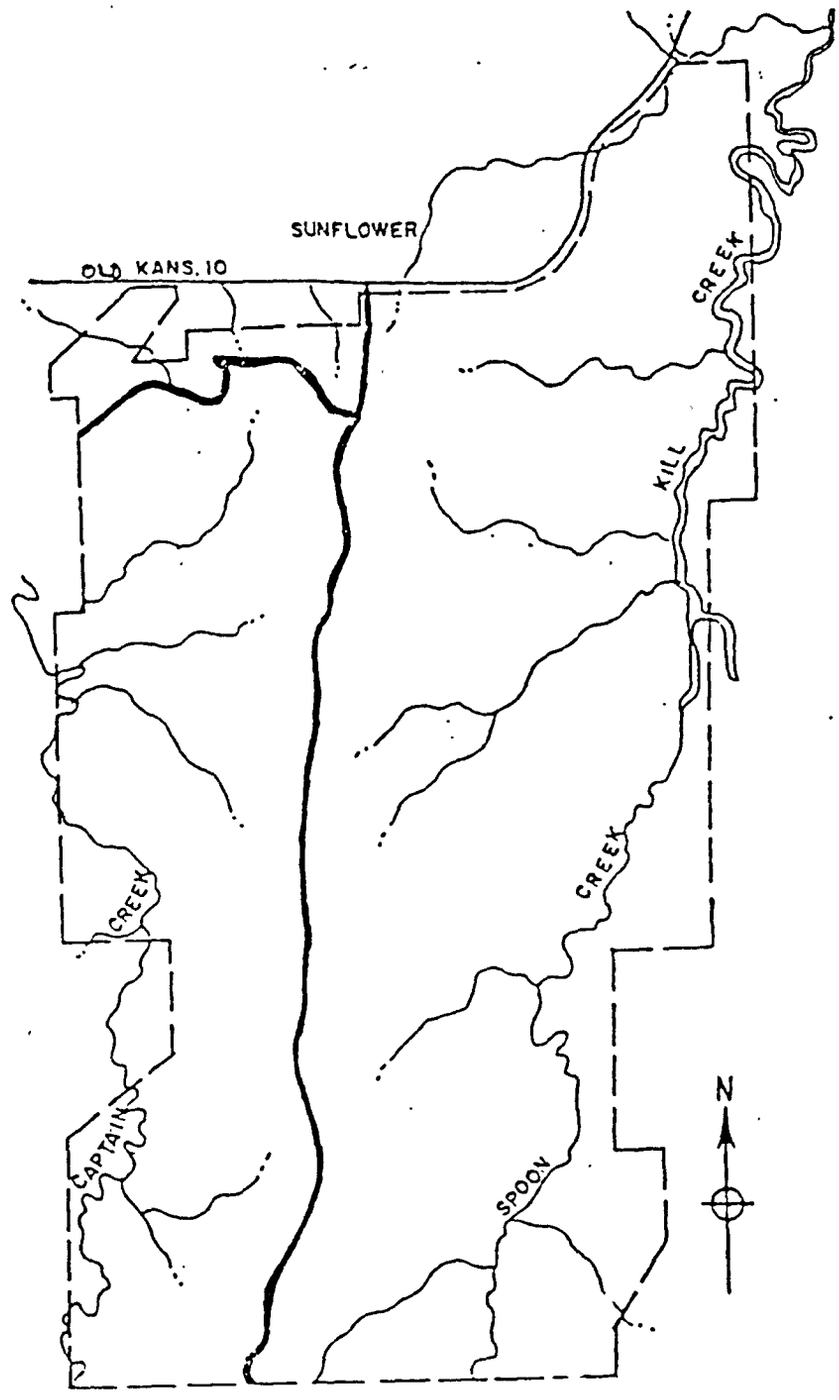

Figure 2. Drainage Basins of Sunflower AAP

SUNFLOWER ARMY AMMUNITION PLANT

GENERAL GEOLOGIC COLUMN

System	Stage	Group	Formation	Member or Zone		Avg Thickness	General Description
PENNSYLVANIAN	VIRGILIAN	DOUGLAS	STRANGER	WESTON		*	SHALE: soft, clayey, dark gray to gray, occasional ironstone concretions, weathers green brown to green gray
	MISSOURIAN	LANSING	STANTON	SOUTH BEND		3.5	LIMESTONE: moderately hard, finely crystalline, medium to thick bedded, fossiliferous, gray to brownish gray
				ROCK LAKE		5.4	UPPER SANDSTONE: fine grained, argillaceous, gray, 0.2' coal seam locally at base. LOWER SHALE: soft, clayey, dark gray, locally 1' limestone separates sandstone and shale
				STONER		14.6	LIMESTONE: moderately hard, finely crystalline, medium to thick bedded, light tannish gray, contains numerous wavy gray shale partings.
				EUDORA		6.9	SHALE: soft, platey to fissile, carbonaceous, black, upper 2' commonly dark gray.
				CAPTAIN CREEK		7.0	LIMESTONE: moderately hard, finely crystalline, medium bedded, light tannish gray, thin wavy argillaceous parting zones common throughout.
			VILAS			15.3	SHALE: soft, platey, micaceous, dark gray with fine-grained sandstone and siltstone interbeds.
			PLATTSBURG	SPRING HILL		24.2	UPPER LIMESTONE: moderately hard, granular, argillaceous, dark gray, upper 5' commonly dark brown with white mottling. LOWER LIMESTONE: (lower 1/2 to 1/3 of member) moderately hard, finely crystalline light gray
				HICKORY CR		0.82	SHALE: soft, platey, fossiliferous, dark gray
				MERRIAM		7.4	LIMESTONE: moderately hard, finely crystalline, medium bedded. upper 2' to 3' contains clay-filled worm borings and is light gray. Lower 2' to 4' is light tannish gray and is fossiliferous. Limestones separated by very dark gray, platey, calcareous shale ranging from a parting to 1' in thickness
		KANSAS CITY (ZARAH SUBGROUP)	BONNER SPRINGS			4.3	SHALE: soft, calcareous, silty, dark gray is occasionally a fine grained argillaceous sandstone, dark gray to greenish gray
			WYANDOTTE	FARLEY		17.2	LIMESTONE: moderately hard, finely crystalline to crystalline, medium bedded, light tannish gray, contains crystalline calcite rugs and stringers and numerous wavy gray shale partings. Locally, upper 1' to 3' is gray or brownish gray, highly fossiliferous zone.
				ISLAND CREEK		1.0	SHALE: soft, fossiliferous, calcareous, dark gray.
				ARGENTINE		12.6	LIMESTONE: moderately hard, thin to medium bedded, finely crystalline to crystalline, light tannish gray with bluish gray mottling, containing numerous wavy, dark gray shale partings.
				QUINDARO		*	SHALE: soft, calcareous, dark gray to black. Upper 6' carbonaceous and fissile, silty in lower parts

* not totally penetrated

Figure 3. Sunflower AAP Bedrock Stratigraphy

Ground-water Quality Assessment Plan No. 38-26-0264-84, 12-15 Apr 83

the basal part of the Kansan Stage deposits are commonly sand or sand and gravel. This sand and gravel was deposited as glacial outwash and, possibly, as lacustrine sediments in glacial lakes. Figure 4 is a geologic map of the Sunflower AAP vicinity.

c. Regional Ground-water Hydrology.

(1) The principal unconsolidated sediment aquifers in Johnson County are Kansas River valley alluvium and undifferentiated fluvial deposits in tributary stream valleys. In addition to these Wisconsinan deposits, Kansan fluvial and lacustrine deposits also yield small quantities of water in some locations. Wells in the Kansas River Valley alluvium can yield 1,000 gpm or more. Wells in tributary valleys normally yield 1 to 10 gpm. However, wells in some parts of the Captain and Cedar Creek valleys could probably yield greater quantities because of sandy sediments (reference 2). On Sunflower AAP, the Kansan deposits in the western portion of the installation would yield quantities of water depending on the thickness of the sand or sand and gravel layer and also the thickness of the saturated zone. Recharge of these aquifers is through infiltration of local precipitation.

(2) The bedrock in Johnson County generally does not yield significant quantities of usable water. In some localities, wells in the Wyandotte Limestone and the Ireland Sandstone Member of the Lawrence formation yield 10 to 40 gpm. The Lawrence formation overlies the Stranger formation in the Douglas Group; however, the Stranger formation is the most recent bedrock strata identified in monitoring well borings at Sunflower AAP. Certain black or very dark and fissile shales, including the Eudora Shale, are capable of yielding up to 20 gpm of water that may be saline. Sandstone beds in certain bedrock units, including the Rock Lake and Vilas Shales, may also yield small quantities of water, generally less than 5 gpm. In addition to the rock units mentioned, wells installed into the zone of weathering in near-surface limestones and shales will yield small quantities of water because of increased secondary permeability in this zone due to fractures, joints, and bedding planes. Recharge of these shallow bedrock aquifers is by infiltration of local precipitation through overlying unconsolidated material.

(3) There are no water supply wells on Sunflower AAP. The plant water supply is obtained from wells located north of the installation in the Kansas River Valley alluvium.

6. SITE DESCRIPTION.

a. The IWT surface impoundments are located east of Power House 154-1 in the north-central portion of the Sunflower AAP (see Figure 5). The three unlined impoundments are less than 2 acres in size and are located adjacent to three larger impoundments which receive boiler ash from the power plant.

Pond A, which receives neutralized acid wastes, is also located nearby. Pond A and the ash lagoons are not RCRA-regulated units. However, the monitoring well network at this site was designed to address all of these impoundments. The IWT impoundments were constructed in 1979.

b. The IWT impoundments receive runoff from a paved coal storage yard and boiler blowdown water from Power Houses 154-1 and 154-3. The boiler blowdown water is slightly alkaline but is not a RCRA hazardous waste. The coal-pile runoff water is a RCRA hazardous waste because of its low pH (corrosive). The wastewater enters the first IWT impoundment via an industrial sewer. The coal fines settle in this impoundment, and the pH is raised to 2.5 or greater by adding sodium hydroxide (NaOH). The water is then released manually to the second impoundment where NaOH addition raises the pH to a range of 10.5 to 11.5. Pond aerators provide mixing and dissolved oxygen for precipitation of iron. Suspended solids settle and the water then flows into a third IWT impoundment where further settling occurs. Flow from the third impoundment is by overflow or manual release to a final treatment facility where any necessary final pH adjustment is made before discharge. A carbon dioxide system is used for pH adjustment of alkaline wastewater in the IWT impoundments. The water flows into Pond B after discharge from the IWT system.

c. The topographic slope at the IWT impoundments is eastward, with surface water drainage and discharge from the impoundments (all impoundments and Pond A) flowing to Pond B, located 2,000 ft to the east. Overflow from Pond B is to Kill Creek, located another 2,500 ft eastward (see Figure 6). A total of 11 ground-water monitoring wells are located around the IWT impoundments, ash impoundments, and Pond A (see Figure 7).

d. The IWT impoundments are located on the anticline ridge of the local anticlinal/synclinal structure which strikes in a northwesterly direction (see Figure 8). The bedrock surface slopes generally eastward in this vicinity, with slope at the IWT impoundment site being toward the southeast (see Figure 9). The uppermost bedrock units are the Vilas Shale and the Spring Hill Limestone. The unconsolidated overburden is generally 10 ft or less in thickness and consists of clays. Exceptions are the sites of upgradient wells MW41 and MW42, where a thicker overburden occurs, with sand as the basal portion overlying bedrock (see boring logs, Appendix C). Prior to construction of the impoundments, several undisturbed samples of the clay overburden were obtained, and laboratory permeability tests were run with results indicating permeability of 10^{-6} to 10^{-4} cm/sec.

e. Monitoring wells were generally constructed with screens from near the bedrock surface to the Bonner Springs Shale or the Farley Member of the Wyandotte Limestone. Monitoring wells MW41 and MW42 were screened through both bedrock and the overlying sand; MW41 was screened over a shorter interval than other wells and extended only 5 ft into bedrock. The wells

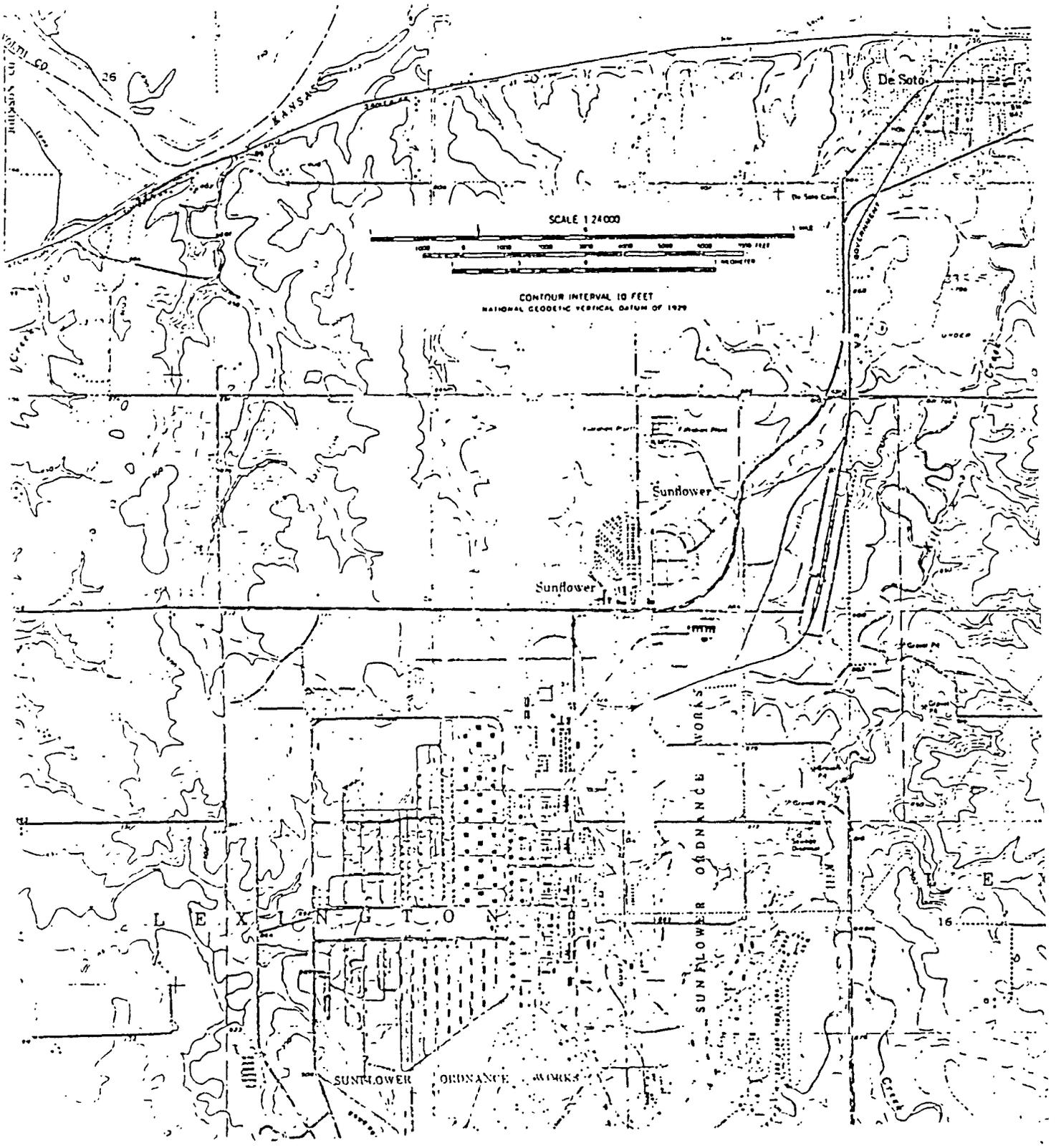

Figure 6. Topographic Map

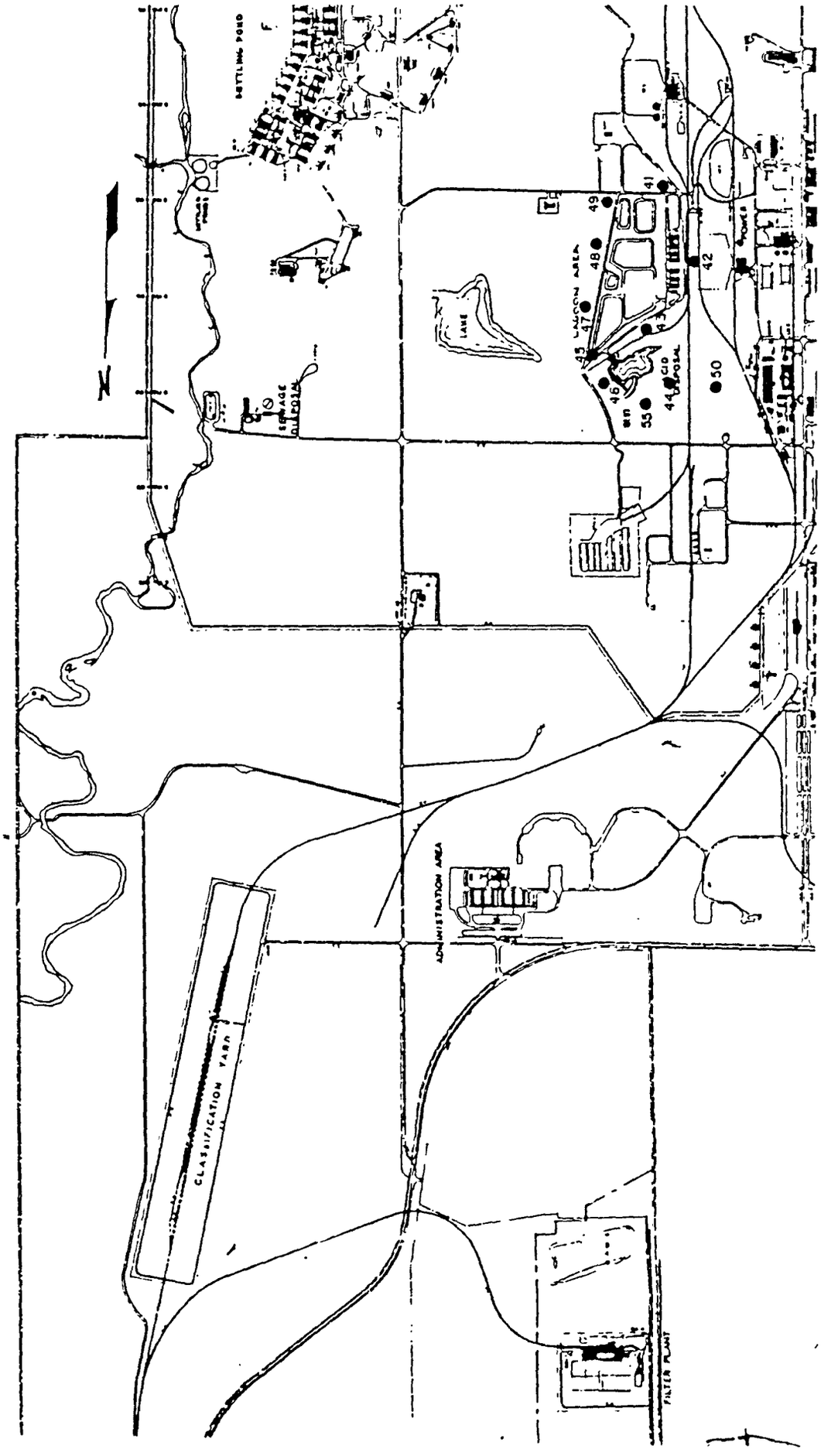

FIGURE 7. POWER PLANT AREA MONITORING WELL LOCATIONS

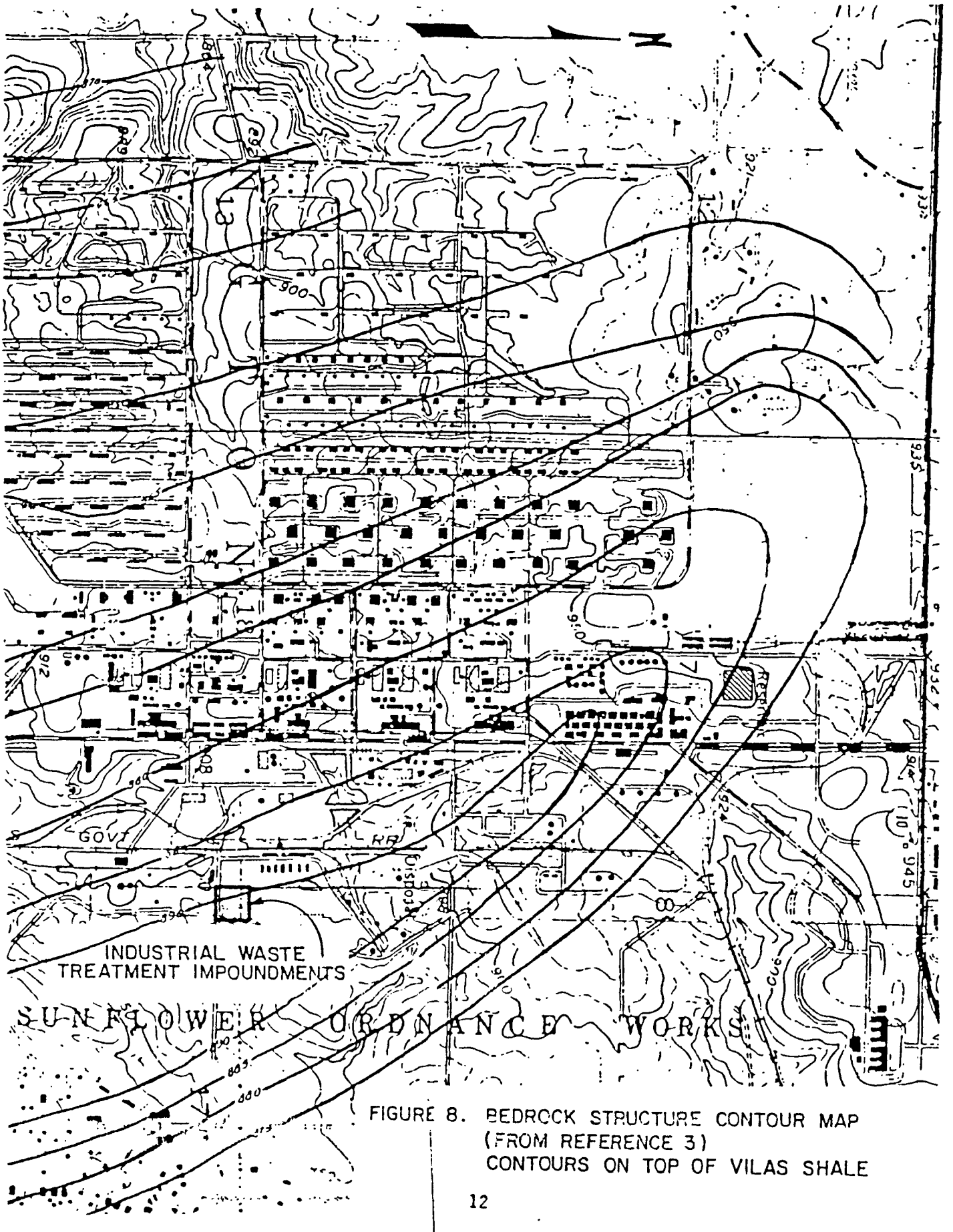

FIGURE 8. BEDROCK STRUCTURE CONTOUR MAP
(FROM REFERENCE 3)
CONTOURS ON TOP OF VILAS SHALE

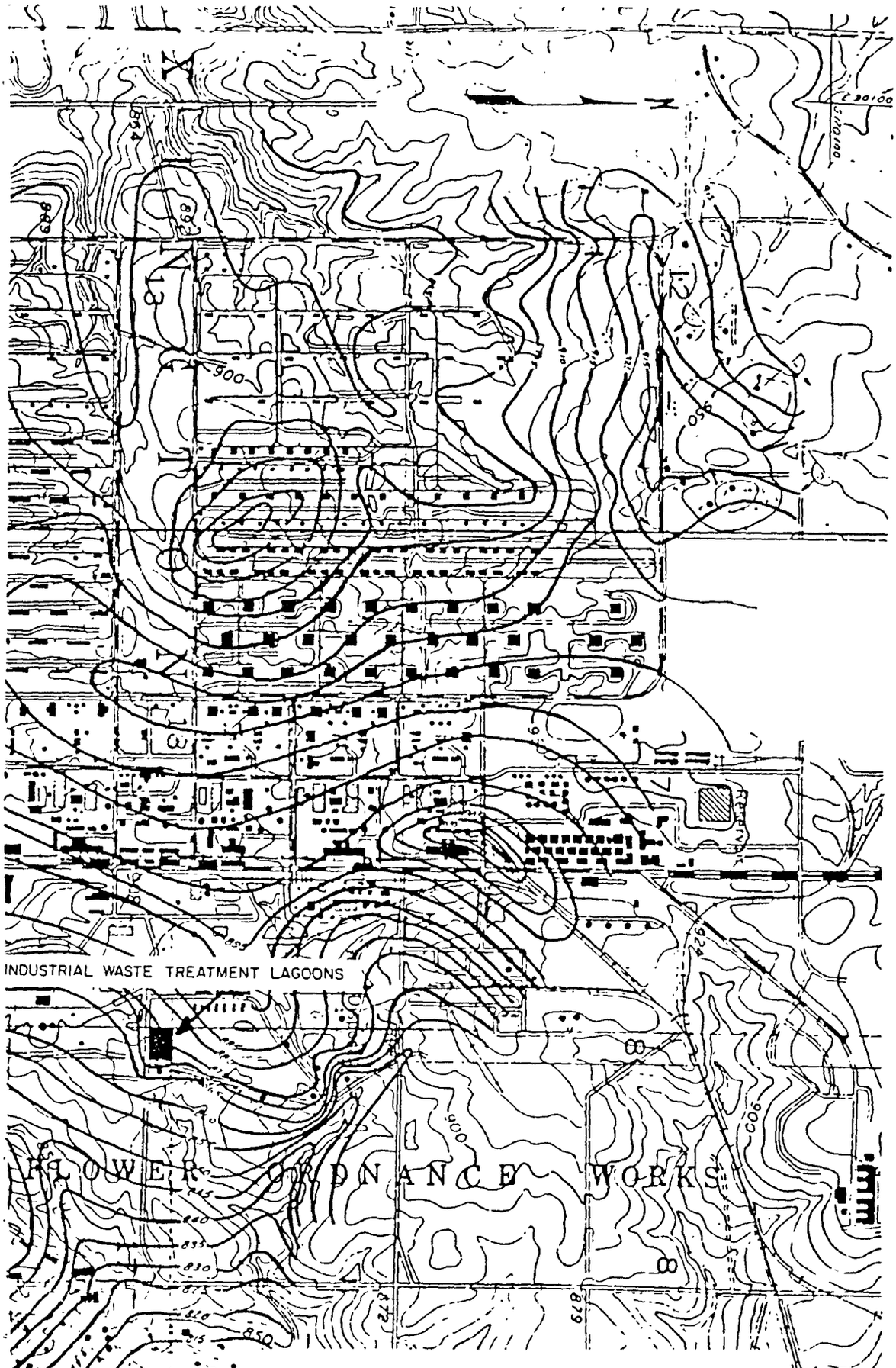

FIGURE 9. POWER PLANT AREA TOP-OF-BEDROCK CONTOUR MAP (FROM REFERENCE 3)

ranged from 36.3 ft (MW41) to 69.0 ft (MW43) in depth, with screen lengths ranging from 27 to 63 ft. The wells were constructed as described in paragraph 6a(4) (see well installation drawings, Appendix C). Monitoring wells MW43, MW45, MW47, and MW55 produce very little water and can be pumped dry with a low-volume sampling pump of the bladder type. These four wells recharge very slowly and do not recover completely during a 24-hour period following pumping. Other wells yield greater amounts of water. Figure 10 is a contour map of the piezometric surface. As discussed previously, the measurements will represent a composite head for permeable strata because of well design. The contour map indicates ground-water flow generally toward the east.

7. CHEMICAL ANALYSIS DATA.

a. Ground-water samples have been collected from the monitoring wells and analyzed for parameters specified by regulations (reference 1). The sampling frequency was quarterly during the first year of monitoring to establish baseline data. The parameters specified by regulation include NIPDWR parameters; indicators of ground-water quality, including iron, manganese, sodium, chloride, phenol, and sulfate; and indicators of ground-water contamination including pH, specific conductance, TOC, and TOX. The analytical results are tabulated in Appendix D. First-quarter analytical work was performed by Wilson Laboratories and second through fourth-quarter analyses were performed by Century Environmental Testing Laboratories, Inc.

b. First-year ground-water quality data for the 11 wells in this area show that NIPDWR standards were exceeded only for fluoride (two samples from MW46 and one sample from MW55) and nitrate/nitrite as N (one sample from MW41 and three samples from MW44). Monitoring well MW41 is an upgradient well and MW44, MW46, and MW55 are north of Pond A and not near the IWT impoundments. The best indicator parameters from among those measured would be pH, specific conductance, sulfate, and metals. Heavy metals were generally not detected, and when they were, only trace levels were found. Specific conductance ranged from approximately 500 to 1,500 umhos/cm, with samples from upgradient wells MW41 and MW42 being among those with the highest levels. Sulfate was elevated somewhat in samples from well MW50 and upgradient wells MW41 and MW42. Monitoring well MW50 is constructed at a site with several feet of coal fill above the natural ground surface, MW42 is adjacent to the coal pile which was previously unpaved, and MW41 is downgradient of the coal pile area. Monitoring well MW49, adjacent to and downgradient from the IWT impoundments, showed no evidence of ground-water contamination.

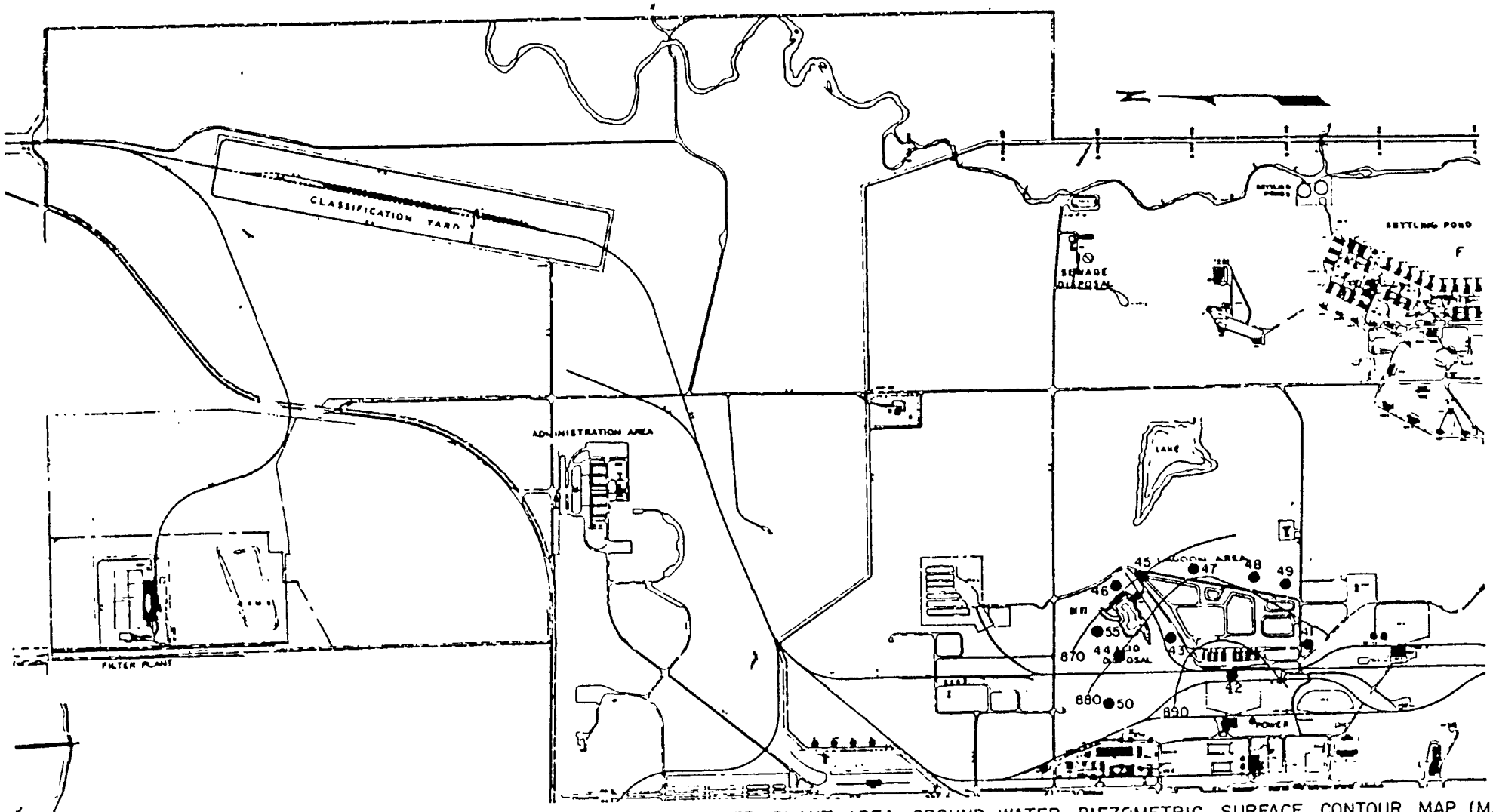

FIGURE 10. POWER PLANT AREA GROUND-WATER PIEZOMETRIC SURFACE CONTOUR MAP (MAY 1983)

8. PLAN OF ACTION.

a. Phase 1.

(1) General. This ground-water quality assessment plan will be implemented when a significant increase (or pH decrease) is detected between first-year upgradient well data and current data for a downgradient well for an indicator parameter and results have been confirmed by resampling and analysis. Significant difference is defined as rejection of the hypothesis that the means of the two data sets are equal when the Student's t-test at the 0.01 level of significance is used. The first step of the assessment will be the analysis of ground-water samples from existing wells to determine if hazardous wastes or hazardous waste constituents are present in the ground water. If hazardous wastes or hazardous waste constituents are not detected, the assessment will proceed no further. However, if ground-water contamination is detected, additional work will be performed to determine the extent, rate of movement, and concentration of contaminants in the ground water. This additional work (Phase 2) is described in paragraph 8b. Sampling and sample preparation procedures specified in Appendix E will be employed during this assessment.

(2) The RCRA hazardous waste material entering the IWT impoundments is coal-pile runoff. The characteristics and constituents of this waste include low pH, high specific conductance, and elevated levels of sulfate and metals. To determine if hazardous waste constituents are contaminating the ground water, samples from existing wells will be analyzed for sulfate, arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. The analytical methods of either reference 4 or 5 will be used.

(3) Those analyses performed by the USAEHA will be accomplished using appropriate quality assurance procedures. These procedures include analyses of standards, duplicates, spikes, and blanks. In addition, blind QC samples and EPA or commercial reference standards will be analyzed to further ensure quality of analytical results. Procedures will also be employed for sample control and data management in the laboratory. When analytical work is performed by a contract laboratory, the laboratory will be required to comply with the quality assurance procedures outlined in reference 6.

(4) Specific conductance and pH will be useful as indicators of possible ground-water contamination at this site. The hazardous waste constituents will not be detectable by the indicator parameters TOC and TOX.

b. Phase 2.

(1) General. If Phase 1 work described in paragraph 8a determines that hazardous wastes or hazardous waste constituents have entered the ground water, additional work (Phase 2) will be performed to determine the extent,

rate of movement, and concentration of contaminants in the ground water. This additional work will involve drilling additional monitoring wells, performing aquifer tests, and analyzing water samples to determine contaminant concentrations.

(2) Initially, monitoring wells will be installed at six locations near the IWT impoundments (see Figure 11). At these locations, a well will be drilled to the Farley Member of the Wyandotte Limestone and will be cased to bedrock. In addition, a shallow monitoring well will be installed in the overburden material at each of these six sites, except where the overburden consists only of low permeability clays. These shallow wells will be screened from the water table to bedrock. Borings for existing monitoring wells have shown sands only at sites MW41 and MW42. The borings at lower elevations east and downgradient of the IWT impoundments showed the overburden to consist only of clays.

(3) Soil samples will be taken at intervals of not more than 5 ft in the overburden. Selected samples will be tested, with tests to include laboratory permeability, grain size distribution, Atterburg limits, moisture content, density, and porosity.

(4) After completion, the bedrock wells will be pumped until clear water is produced, and the maximum yield of each will be determined. The wells are expected to have very small yields. If any wells are found to have a yield of greater than 10 gpm, a pneumatic packer-pump unit will be used to identify higher yield strata and the yield of each.

(5) Piezometric measurements will be obtained for each well. For any higher yield bedrock wells, measurements will be obtained for separate strata.

(6) Rising or falling head aquifer tests will be performed for each bedrock well to obtain estimates of hydraulic conductivity. These will be used along with hydraulic gradient information and estimates of porosity to arrive at a range of possible ground-water flow velocities.

(7) Aquifer tests will not be performed for any shallow overburden wells unless they are found to lie in a downgradient direction and the water samples obtained from them show ground-water contamination. If such tests are determined to be necessary, pump tests or rising or falling head tests will be performed as appropriate for the situation.

(8) Water samples will be obtained from existing and newly constructed wells. Samples will be analyzed for the contaminants identified during Phase 1 of the study. Any bedrock wells found to produce contaminated water will be resampled using a pneumatic packer or packer-pump unit to obtain information concerning depth of contamination (if well yields are adequate).

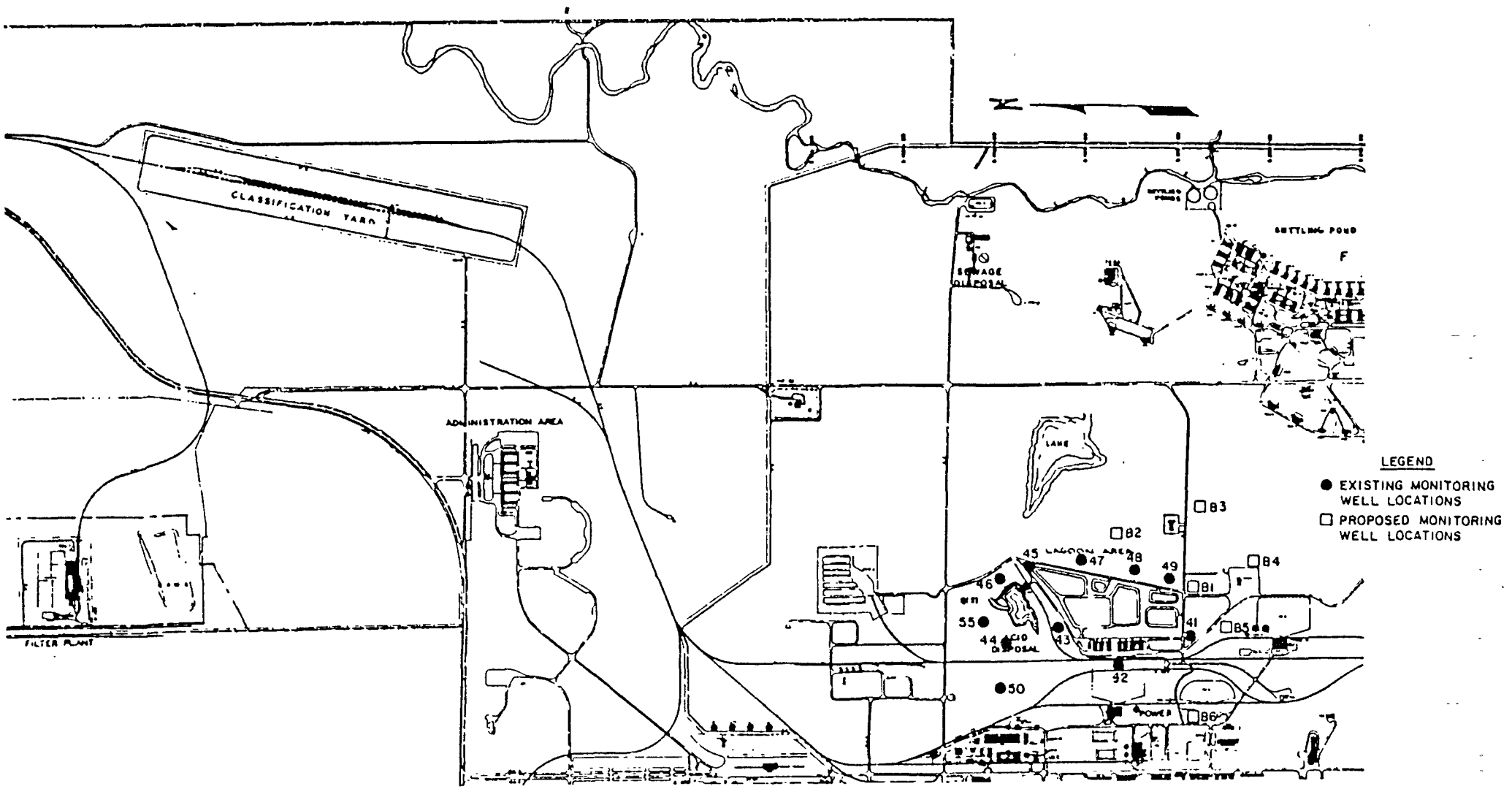

FIGURE 11. POWER PLANT AREA PROPOSED MONITORING WELL LOCATIONS

c. Phase 3. When the Phase 2 work described above is completed, additional wells will be installed as appropriate to determine the extent of ground-water contamination. The location, depth, and number of these wells will depend upon results obtained from the initial work. Better estimates of ground-water contaminant flow rate may be possible based upon actual observations of contaminant extent and flow times. However, defining ground-water contamination from the IWT impoundments is likely to be complicated by other possible sources such as the adjacent ash impoundments and the coal pile, itself, which was unlined prior to the late 1970's.

d. Drilling and Well Installation.

(1) Drilling Method. The drilling of shallow wells to be screened in the overburden material will be by use of cable tool or hollow-stem auger techniques. Borings into bedrock will be accomplished using rotary techniques with only water as a drilling fluid.

(2) Well Specifications. The well casing for shallow overburden wells will be 4-inch-ID PVC pipe with threaded joints. The well screen will be preslotted PVC pipe with a slot size of 0.035 inch. A uniform and complete filling of the annular space with sandpack, bentonite pellets, and grout should be achieved. The sand will be clean, texturally larger than the slot size of the screen, and fill the annular space to approximately 3 ft above the top of the screen. A bentonite seal will be installed above the sandpack. The seal should be 2 ft of tamped bentonite-water mixture (bentonite pellets should be used because bentonite power will bridge the annular space as soon as it contacts moisture.) Then a grout mixture of premixed cement, 3-percent bentonite power, and water should be pumped into the annular space from the top of the bentonite seal to the ground surface.

(3) Well Protection. Each well will be covered with a vented cap. A protective casing, a section of steel pipe larger in diameter than the PVC casing, should be placed into the cement grout. It should be fitted with a hinged cap with lock.

(4) Survey of Wells. Each well will be located with reference to vertical and horizontal control by survey methods.

(5) Well Development. Each well will be fully developed as soon as practical after installation but no sooner than 48 hours following the placement of the cement grout. Development will be accomplished with a surge block and a bailer until the water removed from the well is clear. As a minimum, each well should have five volumes of water pumped or bailed as part of development. The development equipment will be washed with clean water before each use to prevent cross contamination from one well to another.

9. ADDITIONAL INFORMATION.

a. Implementation. Implementation of this ground-water quality assessment will include coordination through normal Army command channels. Phase 1 sampling will be done by Sunflower AAP personnel, and Phase 1 chemical analysis will be performed by this Agency. Phase 2 and Phase 3 work will be completed by contract through the Huntsville Division CE.

b. Schedule. The estimated schedule of work completion will be as follows:

(1) Phase 1 completion - 3 months after review of assessment plan by State of Kansas Department of Health and Environment has been completed.

(2) Phase 2 contract award - 4 months after Phase 1 completion.

(3) Phase 2 initial work completion - 5 months after contract award.

(4) Phase 3 work to determine "extent" of ground-water contamination completion - 9 months after contract award.

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US ARMY GROUND-WATER MONITORING AND ASSESSMENT PROGRAM

INSTRUCTIONS

FOR

COLLECTION,

PREPARATION AND SHIPMENT

OF SAMPLES

US ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MD
SEPTEMBER 1981

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Instr for Collection, Prep and Shpmt of Samples

I. PURPOSE. This document is written to provide guidance to personnel at US Army installations who will be sampling ground-water monitoring wells. It has been prepared primarily to assist those installations which are being provided support by the US Army Environmental Hygiene Agency (USAEHA) in meeting monitoring requirements at sanitary landfills and hazardous waste landfills and surface impoundments.

II. GENERAL. Sections III through VI and Section VIII of this document provide instructions on collection and preparation of samples and data reporting. Section VII provides information on chemical analysis methods. The contents of this document may be used by installations monitoring hazardous waste landfills and surface impoundments to prepare the Sampling and Analysis Plan required by regulation (40 CFR 265.92).

Questions concerning these instructions or sampling and sample preparation should be referred to Mr. Gary Nemeth, Geotechnical Engineering Services Branch, Waste Disposal Engineering Division, this Agency, AV 584-2024 or (301) 671-2024.

III. SAMPLE CONTAINERS. The USAEHA will provide all sample containers to be used for shipment of samples. The only sample containers to be provided by the installation are the 1-gallon plastic jugs to be used to hold the samples prior to filtering. The number of sample containers needed for each well sample will depend on the number of parameters and filtering and preservation requirements. Inclosure 1 identifies the parameters and the eight separate containers which will be used when samples are taken from hazardous waste site monitoring wells. Inclosure 2 lists containers which will normally be provided for parameter groups which may be required at sanitary landfills or at hazardous waste sites with special parameter requirements. Only containers provided by USAEHA should be used. These containers will be properly cleaned and prelabeled with installation name, site identification, parameters and preservation information. The containers will normally be shipped by USAEHA with all those required for sampling one well in one box. The boxes should be kept by the installation because some will be used as shipping boxes for samples. Under some circumstances containers of a different size than those shown in Inclosures 1 and 2 will be used. These substitutions will be made because volume requirements will depend upon the number of parameters to be measured.

IV. SAMPLING AND FIELD OBSERVATIONS.

A. Water Level Measurement. Prior to sampling a well the water level must be measured and recorded on the field data log sheet. When the field crew visits the well they should have information available concerning well depth, depth to top of screen, and screen length. Water levels are most commonly measured with a clean steel tape. The tape should be lowered into the well until the end is a couple feet below the water surface. The wetted

length is measured when the tape is removed; and this measurement is subtracted from the length lowered into the well. This depth to water from the top of casing should be recorded. The length of casing above the ground surface should then be subtracted to obtain the desired value of depth to water from ground surface. The same value for length of casing above ground should be used each time water level is measured in the well, unless the casing length is modified. The depth measurements should be to the nearest tenth of a foot. If the portion of the tape which has been wetted is difficult to determine, chalk may be placed on the tape to make reading easier. Inks should not be used on the tape. If the tape must be weighted, a material such as stainless steel should be used. An electric water level probe may be used instead of a steel tape. Its advantages are convenience and not having to know prior to measurement the approximate depth to water. If the well is found to be dry, this should be noted on the log sheet. If the depth to water is found to be below the bottom of the screened interval, the well should also be considered dry and not sampled. This situation may occur in wells where the bottom portion of the well is not screened and holds water after water table levels drop below the screened interval. The steel tape, or electric probe, should be rinsed thoroughly with fresh tap water or distilled water prior to use in another well. A tape or probe which has been in contact with soil at the well site should not be lowered into a well until it has been rinsed clean. If contamination by oil or grease is evident, soapy water or acetone should be used for cleaning, followed by tap water rinsing.

B. Well Purging. All monitoring wells must be pumped or bailed prior to sampling to insure that samples are representative of the ground water and do not contain water which has been standing in the casing. For this monitoring program at least five volumes of water in the well casing should be removed. However, for a low yield well which does not quickly recharge as it is pumped, the well should be pumped or bailed dry and the sample then obtained as soon as the well recharges. When calculating the amount of water which must be purged, subtract depth to water (from ground surface) from the total depth of the well and then multiply by 0.16 for a 2-inch well, 0.37 for a 3-inch well, or 0.65 for a 4-inch well to obtain the volume of standing water in the well. The amount pumped prior to sampling should be recorded on the field data log sheet (Inclosures 3 and 4). The depth at which the pump should be set when purging a well will depend upon well construction details, water depth in the well, and well recharge rate. For a well which does not recharge as it is pumped, the pump intake should be as deep as possible in the well, but not so deep as to pick up the sediment which has accumulated in the well bottom. In wells which recharge as they are pumped, the pump intake should be about 5 feet below the surface of the water in the well. The pump will have to be lowered if the water level in the well drops during pumping. Pumping in this manner will insure that the water which has been standing in the well will be efficiently removed and a representative sample taken. The only exception to these pumping depth instructions will be those few

situations where the monitoring wells have more than one screened interval or a sediment trap.[1] When a well contains a sediment trap the final portion of purged water should be pumped from within the sediment trap section (do not lower pump into sediment in the bottom of the trap). When a well is constructed with more than one screen, the purged water should be pumped from the unscreened sections, beginning with the uppermost. Manufacturer's literature should be consulted to obtain specific instructions concerning the operation of sampling pumps. Questions may also be referred to the Geotechnical Engineering Services Branch, Waste Disposal Engineering Division, US Army Environmental Hygiene Agency, AUTOVON 584-2024. When pumping or sampling a well great care must be exercised to insure that contaminants are not introduced into the well or a sample. A sampler or sample tubing, or a bailer or bailer cable must not be allowed to contact the ground or a dirty surface in a vehicle or sampling equipment box. Plastic sheeting may be used to rest hoses, lines, and samplers upon. New sheeting should be used for each well sampled. Sampling equipment must be thoroughly cleaned before it is placed in its storage case. In those situations when there is windblown dust at the sampling site, it will be impossible to obtain a good sample. Sampling should be postponed until a more favorable time.

C. Sampling.

1. The sample containers in which unfiltered water is to be shipped should be filled first (see Inclosures 1 and 2). These containers should be rinsed several times with a small amount of water pumped from the well prior to filling (except for samples for grease and oil analysis). All of these containers (except grease and oil) must be filled to overflowing so that no headspace remains. Samples should be protected from light and kept cool from the time they are collected. Sample container labels should be completed using a waterproof pen before they are filled when the container is dry. The portion of the sample which must be filtered should be collected in polyethylene gallon bottles. For hazardous waste site wells monitored during 1981 and 1982 two of these gallon containers should be filled. The number required at sanitary landfill wells depends upon the parameters (see Inclosure 2). These containers should also be rinsed and filled to overflowing. Containers should be labeled with a waterproof pen. Sample containers should be filled in a manner which does not agitate or aerate the sample. This is important to prevent loss of volatile contaminants, and to prevent chemistry changes due to either CO_2 loss with pH increase or oxygenation of the sample. Containers are filled to overflowing for the same reasons. Some wells which do not recharge while they are pumped may not

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[1] A sediment trap is an unscreened section at the bottom of the well.

produce enough sample at one time. This situation will occur most frequently for hazardous waste site wells because more sample is required than at most sanitary landfills. The needed water should be obtained as soon as the well recharges.

2. Samples should be taken to the place where they will be filtered and preserved as soon as possible after sampling; and definitely within an hour or two.

3. Sampling equipment must be thoroughly cleaned between sampling at each well. This may normally be accomplished by rinsing thoroughly with tap water. At least 2-3 gallons of water should be pumped through the tubing and pump with each rinsing. If a bailer is used, it should be rinsed three times with tap water and then rinsed three times with distilled water. In those cases where a sampler becomes contaminated by pumping oily or greasy water, it should be rinsed first with soapy water and then rinsed thoroughly with clean water. It may be necessary to disassemble a pump to effectively clean it of oil and grease. Acetone rinsing is an effective method of removing oil and grease contamination, but should not be used unless it is certain that the materials used to construct the pump or bailer will not be affected. The USAEHA will advise an installation when special solvent cleaning of sampling equipment is considered necessary.

4. Deviations from the procedures specified above should be noted on the field data log sheet. Observations concerning the condition of the well, odor and color of the water should also be noted. Note if the well was found uncapped and also note the condition of the grout seal around the well.

D. Sampling Schedule and Sequence. Because of shipping and laboratory restrictions, all sampling and shipment of samples must be accomplished on either a Monday or Tuesday of the week. Those installations with many sites to be monitored may have to conduct sampling over a period of several weeks. However, all wells at each site to be monitored must be sampled the same day. When sampling wells at a site, the upgradient (and presumably uncontaminated) well or wells should be sampled first followed by the downgradient wells (or wells potentially contaminated).

V. SAMPLE PREPARATION.

A. Work Area Requirements. The work area, preferably a laboratory, must be cleaned and must be an area where there has not been any large-scale chemical usage. Pesticide mix areas or areas used to handle explosives are not acceptable. Specific requirements for the work area include:

1. 110-volt electricity,

2. minimum of 10 linear feet of working bench space,

3. complete sample filtration system,

4. pH meter with accessories (if pH measurement required),

5. distilled water,

6. cleaning supplies including nitric acid and acetone,

7. chemical preservative ampules (provided by USAEHA), and

8. Sample kits containing appropriate containers (provided by USAEHA).

B. Sample Storage. Samples should be placed in a cool, dark place (preferably a refrigerator) until ready for shipment. Those containers filled in the field should be placed into such storage as soon as they are brought to the work area. The polyethylene gallon containers should also be kept in cool and dark storage when not being used. When containers are received from sample collectors they should be checked for proper labeling.

C. pH Measurement. The sample pH should be measured as soon as possible after the sample is taken. When a sample is exposed to the air the pH level may change. This change is primarily due to loss of dissolved CO_2 from the sample. A pH measurement taken at the work area soon after the sample is taken will normally be more accurate than a field measurement as long as a significant pH change has not occurred. Visible evidence of precipitate forming in the sample between the time of sample collection and the time of pH measurement at the work area would indicate that the pH has changed and that an accurate measurement would have to be taken in the field as soon as the sample is taken. To be sure that accurate measurements are being obtained, it is recommended that pH measurements also be taken in the field with a portable meter during the initial sampling periods. For those sites where pH is not a required parameter (some sanitary landfills), it is recommended that pH be measured if an installation has a meter. For hazardous waste sites, pH measurement of four portions of the same sample are required. Sanitary landfill samples will only require one measurement. The following instructions should be followed when measuring pH.

1. Initially calibrate the pH meter in accordance with the manufacturers' specifications. The internal filling solution should cover the internal reference element in the combination electrode.

2. Standardize the meter with two buffer solutions, either pH 4.00 and 7.00, or 7.00 and 9.00. If samples are expected to be acidic, the lower range should be used. The buffer solutions should be placed into 150-mL beakers for measurement, and enough should be used so that the electrode is submerged at least 1 inch. The buffer and sample temperatures should be nearly the same when measurements are made. Ground water temperatures are

normally about 10°C. Therefore, the buffer solutions should be cooled to approximately this temperature before use. If pH measurements of the buffer solutions do not agree with the known values, either some instrument adjustment is necessary, or the buffer solution is contaminated and should be replaced. In this situation, follow the instructions in the instrument manual. When making measurements on samples or buffer solutions, the liquid in the beaker should be stirred slightly using a magnetic stirrer and stirring bar.

3. Pour a portion of the unfiltered sample from the gallon polyethylene jug into a clean 150-mL beaker. Measure and record the temperature on the field data logsheet. Adjust the temperature compensation setting on the meter to the temperature of the sample in accordance with the instrument manual. Measure and record the pH. The measurement should be to the nearest 0.1 pH unit. For hazardous waste sites, portions of the sample should be placed into four beakers and measurements recorded for each. If any of the four replicate measurements differ from the others by more than 0.3 pH units, perform the measurements again using new sample portions in different beakers. If pH measurements are made in the field, stirring with a magnetic stirrer and cooling the buffer solutions will not be practical and the meter may not be adjustable for temperature. Simply standardize the meter using the buffer solutions, measure and record sample temperature and pH.

4. Rinse the electrode with distilled water from a squeeze bottle every time the electrode is removed from the solution and blot dry before dipping into the next solution. After an oily sample is measured, rinse the electrode with acetone from a squeeze bottle and then rinse with distilled water.

5. Known and unknown control samples will be periodically sent by USAEHA to the installation for pH measurement. Measure a known control sample after every 20 sample measurements, or more often, and note results on the reverse side of the field data logsheet upon which the previous sample pH measurement was recorded. If the measured value is not within 10 percent of the known value, an instrument buffer or contamination problem is likely. This problem must be resolved before any further pH measurements are taken. Also repeat all sample measurements back to the last control sample or since the last standardization measurement. Unknown control samples should be measured when they are received and results reported to USAEHA.

6. Cleaning of beakers prior to use should be performed in accordance with instructions in Section V.F.

D. Filtering. Filtering may be performed by any one of three procedures. The first one being described is the most common type utilizing a standard vacuum pump and an all glass system. It consists of the pump, 1-liter filtering flask, ground glass base, 300-mL funnel, spring clamp,

forcep, prefilters, and membrane filters. The order for assembling the filtering system is as indicated below:

1. The tubulated ground glass base is fitted over the 1-liter flask.

2. A membrane filter is carefully placed over the fritted glass area of the base and then overlaid by a prefilter. The prefilter and membrane filter shall be handled with forceps.

3. The funnel is placed on top of the prefilter and fastened to the base by the spring clamp.

4. Vacuum tubing is connected from the vacuum pump to the side arm nipple of the base.

5. The pump is turned on and sample is gently poured into the funnel. The filtration rate is dependent on the nature of the sample. It may be necessary to replace the filters if they are fairly well clogged or if the filtration rate is extremely slow. If this is done, great care must be exercised so as not to contaminate the sample and not allow any suspended matter to enter the already filtered portion.

The second filtration procedure which may be used is performed with the "Millipore Hazardous Waste Filtration System." It uses compressed nitrogen instead of a vacuum pump. Large volumes can be filtered in a relatively short time period with this system. If this system is purchased, a detailed manual will be provided by the company. If, however, problems arise with the system, USAEHA will assist in resolving them. This system also uses the membrane filters and prefilters, only they are much larger than those with the vacuum system because of the larger filtration surface area. The third filtration procedure is also based on compressing a liquid sample through a membrane filter using nitrogen gas. Also with this procedure large volumes can be filtered in a relatively short time period. The procedure is known as the Barrel Pressure Filtering Apparatus and is manufactured by Leonard Mold and Die Works. The instructions are fairly simple and are inclosed with the purchased equipment. The USAEHA will assist if any problems develop with the equipment. The membrane filters must be soaked in distilled water for 24 hours prior to using. They should also be handled only with the purchased forceps, never with one's fingers. Care must be exercised when handling the membrane filter to avoid making any tears or pin holes. Before a sample bottle is filled with a filtered sample, it should be rinsed once with a small amount of the filtered sample and then that portion discarded. Sample bottles should not be rinsed or cleaned in any other manner because they will have been appropriately cleaned by USAEHA prior to shipment. Smaller containers should be filled before the large 1-gallon cubitaner for radiochemistry parameters. All containers should be filled to nearly full, but not overflowing because perservative must be added to some. The samples

for each site being monitored should be filtered beginning with the upgradient well(s) to minimize the possibility of cross contamination problems. The filtering apparatus should be cleaned between samples as instructed in Section V.F.

E. Sample Preservation.

1. The sample should be preserved with the chemicals listed in Inclosures 1 and 2. The acid ampules and sodium hydroxide tablets will be provided by USAEHA as required.

2. Care must be exercised when breaking and emptying the ampules so as to minimize contamination and alleviate chemical spillage on the sampler's hands and clothes. Disposable gloves shall be worn to help protect the hands. It is imperative that no mixup among the chemical ampules occurs and that they are separated from each other when being opened. The broken ampules must be properly discarded. Ampules will be color coded for identification.

3. Sample preservation requirements will also be stated on the container labels to minimize error. The chemical preservative, filtering and cooling requirements will be identified on the appropriate container labels. All containers, including those to which preservative has not been added, should be checked to insure that they have been dated and initialed. The dates placed on the containers and field data log sheets must be Julian dates consisting of five digits. These can be taken from many calenders. The Julian date consists of two digits to identify the year and three digits to identify the day of the year. Example: 81292 is the Julian date for 19 Oct 81.

4. The time from sampling until filtering and preservation is complete must be kept as short as possible. If the sampling rate is faster than samples can be filtered and preserved, sampling should be paced so that samples do not set more than an hour awaiting preparation.

5. If many wells are to be sampled, it will probably be best to have two persons taking samples and two persons preparing samples simultaneously. If only a few wells are to be sampled, two persons could take the samples and then return to the work area and prepare them.

F. Glassware and Equipment Cleaning.

1. Proper cleaning of glassware and equipment is essential to obtaining accurate ground-water quality analytical results. Beakers and the filtration system must be rinsed thoroughly with tap water and then rinsed three times with distilled water between each sample. If any glassware or equipment becomes coated with an oily residue it should be rinsed with acetone using a

500-mL squeeze bottle and then washed thoroughly with hot detergent water prior to the tap water and distilled water rinsings. It is imperative that no acetone or detergent remain on the apparatus after the water rinsings.

2. In addition to the above rinsings, all parts of the filtration system (except prefilters and membrane filters) shall be rinsed with a 50 percent nitric acid solution between samples from different facilities. If only one facility is being monitored, the acid rinse should precede the first sample. After the 50 percent nitric acid rinsing, the apparatus must be thoroughly rinsed with tap water and then rinsed three times with distilled water. All traces of the nitric acid must be removed. The 50 percent nitric acid solution (nitric acid mixed with distilled water on a one to one basis) should be made up in the rigid, leakproof, 1-gallon size, polyproplene jug purchased by the installation. The disposable rubber gloves should be worn when making up this solution. First fill the jug half-way with distilled water. To it, carefully add concentrated nitric acid to near the top. Cap and mix gently. The solution will become hot, but the jug will withstand the thermal shock. This solution should be labeled and protected from all sampling bottles. Rubber gloves should also be worn when rinsing the filtering system.

3. More frequent 50 percent nitric acid solution rinsings are not desired because they are time consuming and because of the risk of acid residue affecting nitrate analysis results. In some situations USAEHA may direct that the acid rinsing be performed between all samples (such as for sites with heavy metal ground-water contamination).

4. These instructions do not include procedures to be used to protect against cross contamination with organic compounds because these sample portions are not going to be filtered (pesticides, herbicides, total organic halogen). In those special cases where samples for organics analysis will be filtered, special cleaning instructions will be provided by USAEHA. This cleaning will normally involve cleaning with acetone or other organic solvents.

VI. SAMPLE SHIPMENT.

A. Packaging. All glass sample containers must be enclosed in their styrofoam packing and this packing wrapped with tape. Insulated coolers must be used as shipping containers for those sample portions which must be kept cool (see Inclosures 1 and 2). To maintain a low temperature during shipping, several reuseable ice packs should be placed in the cooler with the samples. Those sample portions which do not require cooling (metals and radiochemistry parameters) may be shipped to the lab in the cardboard shipping containers used to ship the containers to the installation. Those installations with only a few wells and no radiochemistry analysis requirements may find it as convenient and no more costly to ship all sample containers in the coolers.

B. Shipping Times.

1. Those sample portions which must be kept cool shall normally be shipped such that they are delivered to the laboratory within 2 days of shipment. The exception is those few sample portions which have parameters with very short holding times. These must be shipped so that they are delivered to the laboratory within 24 hours and are identified in Inclosure 2. The routine hazardous waste site monitoring does not require 24 hour shipping. However, such shipping may be required if analysis for special parameters is required or if 2 day shipping is found to be unsatisfactory for some parameter. The cardboard shipping containers with metals and radiochemistry analysis samples may be shipped in any manner which will insure delivery within 7 days. If any samples arrive at the laboratory late and holding times can not be met, the samples will be discarded and the installation instructed to resample. If these instructions are followed, holding times specified in 40 CFR Part 136, 18 December 1979 Federal Register, pages 75028-75052, will be complied with.

2. All samples taken during any one day and which require cooling must be prepared, packaged, and shipped the same day. The metals and radiochemistry samples may be shipped the following day if it is more convenient. Because of laboratory scheduling restrictions, all samples shipped in coolers must arrive not later than Thursday. This means that coolers must be shipped on Monday or Tuesday, or Wednesday if 24-hour shipping is used. If samples arrive at the laboratory on a Friday or Saturday, and analysis can not be performed soon enough to meet holding times, the samples will be discarded and resampling will be necessary.

3. The cost for shipping of samples to the laboratory and for return shipment of empty coolers with the reuseable ice packs must be paid by the installation. Paperwork for return shipment must be inclosed in the coolers when they are shipped to the laboratory. Because there are no time restrictions, the return of coolers by expensive "special" shipment is not necessary.

4. During the first year of this monitoring program, most analyses will be performed by Century Environmental Testing Laboratories, Thorofare, NJ (near Camden). Shipping to that laboratory should be considered when preparing shipping cost estimates.

C. Chain of Custody Control. Regulations require that sample chain of custody records be maintained. Inclosure 5 is the record form which will be used and Inclosure 6 is a sample of a completed form. Four copies (including original) of the form must be completed for each shipping container. Either carbon paper or a copier machine may be used. One copy should be held while the original and two copies are enclosed in the shipping container with the samples. The forms should be placed in a plastic protector to keep them from

getting wet. When the laboratory custodian receives the samples, that individual will sign all copies of the form. The original will be returned to the installation where it must be held on file. A second copy will be sent to Commander, US Army Environmental Hygiene Agency, ATTN: HSE-ES-S/Gary Nemeth, Aberdeen Proving Ground, MD 21010. The remaining copy will be held by the laboratory custodian.

VII. CHEMICAL ANALYSIS.

A. Analytical Procedures. The analytical procedures to be employed during this monitoring program are listed in Inclosure 7. The methods of analysis for specific hazardous wastes will be identified as necessary in assessment plans prepared by USAEHA.

B. Quality Control. A quality control program will be strictly followed by the laboratory to insure the validity of all results. The USAEHA will maintain quality control data records.

C. Bacterial Analysis. Coliform bacteria analysis will be performed onsite by US Army Health Services Command medical activities or centers. The MEDDACs/MEDCENs will attempt to schedule their visit such that they are onsite when sampling for other parameters is performed. Sampling equipment must be made available for their use.

VIII. SCHEDULING AND DATA REPORTING.

A. Scheduling. To insure a reasonably uniform flow of samples into the laboratory, USAEHA will schedule sampling by installations. This schedule will be established in coordination with installation personnel, and there will be some flexibility to meet installation specific requirements. Approximately 3-4 weeks prior to sampling, USAEHA will formally notify the installation environmental coordinator of the scheduled sampling by mailing a listing similar to Inclosure 8. This listing will identify the installation, the facilities to be monitored, the wells to be sampled, the analytical parameters, the installation address, the laboratory address to which samples are to be shipped and the USAEHA address to which log sheets are to be sent. The parameters listed on the notification will be grouped by common sample container. Sample containers will be shipped to the installation environmental coordinator about 2-3 weeks prior to the scheduled sampling date. The scheduled date will always be a Monday or a Tuesday and will identify the week when samples are to be taken. If is necessary for the installation to postpone sampling, telephone notification should be given to Mr. Gary Nemeth, AV 584-2024, USAEHA. Similarly, USAEHA will notify the installation if laboratory scheduling problems require postponement of sampling.

B. Field Data Log Sheets. Notify USAEHA of sample shipment the day following shipment. Copies of field data log sheets should also be mailed to USAEHA immediately after shipment of samples. USAEHA will provide blank chain of custody forms and field data logsheets.

C. Data Reporting. The USAEHA will mail a tabulation of chemical analysis results, with interpretation, to the major command and installation 1-2 weeks after receipt of raw data from the laboratory. With an expected laboratory turn-around time of 4 weeks, data will normally be received by the major command/installation about 7 weeks after sampling. If the data indicates a serious problem requiring some type of action by the installation, or if an assessment is required, the major command and installation will be notified telephonically. Installation personnel are responsible for reporting data to regulatory authorities. In many situations a copy of the data tabulation provided by USAEHA may be forwarded to meet requirements. However, some states have developed special forms for data reporting.

D. Resampling. Resampling may be necessary for a variety of reasons. Resampling will normally be directed by USAEHA through telephone contact with the installation's environmental coordinator. In those situations where resampling is desired because of indicated ground-water contamination problems the major command will also be notified.

Preparation of Ground-Water Samples from ls Around Hazardous Waste Sites

Parameter Group	Container Size & Type	Field Preparation	Chemical Preservation	Refrigeration at 4°C using Metal Cooler and 2-3 ice packs	Sp il Shipment requiring 24 hour Delivery Time
Radiochemistry	1-gallon cubitaner, enclosed in a cardboard box	Filtered	Add 10 ml Nitric Acid Use the large red color-coded ampule	NO	NO
Pesticides Herbicides	1-quart glass bottle narrow neck w/teflon-lined cap, enclosed in a styrofoam pack	Unfiltered	NONE	YES	NO
Total Organic Halogen	Completely filled in a 1-quart glass bottle, narrow neck w/teflon-lined cap, enclosed in a styrofoam pack	Unfiltered	NONE	YES	NO
Metals	16-ounce wide mouth polyethylene bottle	Filtered	Add 2.5 ml Nitric Acid Use the small red color-coded ampule	NO	NO
Specific Conductance	16-ounce wide mouth polyethylene bottle	Unfiltered	NONE	YES	NO
Nitrate/Nitrite Phenol Total Organic Carbon	16-ounce glass bottle, narrow neck w/teflon-lined cap enclosed in a styrofoam pack	Filtered	Add 2 ml Sulfuric Acid Use the yellow color-coded ampule	YES	NO
Mercury	4-ounce wide mouth polyethylene bottle, enclosed in a qt cubitaner box *	Filtered	Add Nitric Acid-Dichromate Solution Use the ampule marked Nitric Acid-Dichromate	NO	NO
Fluoride Sulfate Chloride	4-ounce wide mouth polyethylene bottle, enclosed in a qt. cubitaner box *	Filtered	NONE	YES	NO

* 4/4-ounce bottles will fit in the provided qt. cubitaner box.

Inclosure 1

Preparation of Ground Water Samples Wells Around Sanitary Landill Sites

A. For Most Commonly Required Parameter Groupings

Parameter Group	Container Size & Type	Field Preparation	Chemical Preservation	Refrigeration at 4 °C using metal cooler & 2-3 ice packs	Special Shipment Requiring 24 hour Delivery Time
Metals (individually listed) and/or Hardness	16-oz wide mouth polyethylene bottle	Filtered	Add 2.5 ml Nitric Acid Use the small red color-coded ampule	NO	NO
Any or all of the following: TDS, TS, TSS pH[1], Turbidity Specific Conductance, Alkalinity, and Acidity	32-ounce wide mouth polyethylene bottle	Unfiltered	NONE	YES	YES, if pH and Turbidity are required
Any or all of the following: Chloride, Sulfate, Fluoride and Color	16-ounce wide mouth polyethylene bottle	Filtered	NONE	YES	YES, if Color is required
If any of the additional parameters are required: Surfactants, Nitrate, Nitrite, and Orthophosphate	Substitute a 32-ounce wide mouth polyethylene bottle for the 16-ounce one				
Any or all of the following: Phenol, COD, and TOC	16-ounce glass bottle, narrow neck, with teflon-lined cap, enclosed in a styrofoam pack	Filtered	Add 2 ml Sulfuric Acid Use the yellow color-coded ampule	YES	NO

B. Less Commonly Required Parameter Groupings

Mercury	4-ounce wide mouth polyethylene bottle, enclosed in a qt. cubitaner box [2]	Filtered	Add Nitric Acid-Dichromate Solution Use the ampule marked Nitric Acid-Dichromate	NO	NO
Radiochemistry	1-gallon cubitaner enclosed in a cardboard box	Filtered	Add 10 ml Nitric Acid Use the large red color-coded ampule	NO	NO
BOD	1-quart glass bottle, narrow neck with teflon-lined cap, enclosed in a styrofoam pack	Filtered	NONE	YES	YES

[1] - a field pH may also be required

Inclosure 2

Parameter Group	Container Size and Type	Field Preparation	Chemical Preservation	Refrigeration at 4°C using metal cooler & 2-3 ice packs	Special Shipment Requiring 24 hour Delivery time
Cyanide	4-ounce wide mouth polyethylene bottle enclosed in a qt. cubitaner box [2]	Filtered	Add 1 pellet of Sodium Hydroxide	YES	NO
Any or all of the following: Nitrate/Nitrite, Ammonia, TKN, and Total Phosphate	16-ounce wide mouth polyethylene bottle	Filtered	Add 2 ml Sulfuric Acid Use the yellow color-coded ampule	YES	NO
Pesticides, Herbicides	1-quart glass bottle, narrow neck, with teflon-lined cap, enclosed in a styrofoam pack	Unfiltered	NONE	YES	NO
Special Organics	1-amber glass gallon jug & two 40 ml vials completely filled	Unfiltered	NONE	YES	NO
Oil and Grease	32-ounce wide mouth glass bottle with teflon-lined cap, enclosed is a styrofoam pack	Unfiltered	Add 2 ml Sulfuric Acid Use the yellow colored-coded ampule	YES	NO
Odor and/or Taste	1-quart glass bottle, narrow neck, with teflon-lined cap, enclosed in a styrofoam pack	Unfiltered	NONE	YES	YES
Hexavalent Chromium	8-ounce wide mouth polyethylene bottle	Filtered	NONE	YES	YES
Sulfide	4-ounce wide mouth polyethylene bottle enclosed in a qt. cubitaner box	Filtered	0.5 ml. zinc Acetate solution	YES	NO

[2] - 4/4-ounce bottles will fit in the provided qt. cubitaner box

GROUND-WATER MONITORING
FIELD DATA LOGSHEET

INSTALLATION: _____ WELL ID: _ _ _ _ _

DATE: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
day month year Julian

DEPTH TO WATER FROM TOP OF CASING: _ _ _ . _ FT

LENGTH OF CASING ABOVE GROUND SURFACE: _ _ . _ FT

DEPTH TO WATER FROM GROUND SURFACE: _ _ _ . _ FT

TIME OF MEASUREMENT: _ _ _ _ HRS

METHOD OF MEASUREMENT:

INSIDE DIAMETER OF CASING: _ _ . _ INCHES

PUMPING/SAMPLING METHOD:

AMOUNT OF WATER PUMPED PRIOR TO SAMPLING: _ _ _ GALLONS

IF TIME ALLOWED FOR WELL TO RECHARGE BEFORE SAMPLING:
TIME OF SAMPLING: _ _ _ _ HRS
DEPTH TO WATER PRIOR TO SAMPLING:
(FROM TOP OF CASING) _ _ _ . _ FT

AMOUNT OF SAMPLE COLLECTED
(LIST CONTAINERS FILLED):

FIELD MEASUREMENTS(IF PERFORMED):
_ _ _ °C °F
temperature
pH: _ _ . _
_ _ . _
_ _ . _
_ _ . _
_ _ . _

4 REPLICA
MEASUREME
A HAZARDO
WASTE SIT

pH METER TYPE AND MODEL:

NOTES CONCERNING CONDITION OF WELL, ODOR AND COLOR OF WATER, DEVIATIONS FROM SPECIFIED SAMPLING PROCEDURES, AND OTHER OBSERVATIONS:

SAMPLE COLLECTOR'S NAME:

WORK AREA MEASUREMENTS(IF PERFORMED): _ _ _ °C °F
temperature
pH: _ _ . _
_ _ . _
_ _ . _
_ _ . _

4 REPLICAT
MEASUREMEN
A HAZARDOU
WASTE SITE

pH METER TYPE AND MODEL:

FILTERING METHOD:

TIME WHEN FILTERING AND PRESERVATION IS COMPLETED: _ _ _ _ HRS

NOTES CONCERNING USE OF ANY SPECIAL PROCEDURES OR DEVIATIONS FROM SPECIFIED PROCEDURES

COMMENTS AND OBSERVATIONS(CONTINUE ON REVERSE SIDE IF ADDITIONAL SPACE IS NEEDED):

SAMPLE PREPARER'S NAME:
Lwl 3

INSTALLATION: _____ WELL ID: _ _ _ _ _

DATE: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
day month year Julian

DEPTH TO WATER FROM TOP OF CASING: _ _ _ . _ FT

LENGTH OF CASING ABOVE GROUND SURFACE: _ _ . _ FT

DEPTH TO WATER FROM GROUND SURFACE: _ _ _ . _ FT

TIME OF MEASUREMENT: _ _ _ _ HRS

METHOD OF MEASUREMENT:

INSIDE DIAMETER OF CASING: _ _ . _ INCHES

PUMPING/SAMPLING METHOD:

AMOUNT OF WATER PUMPED PRIOR TO SAMPLING: _ _ _ GALLONS

IF TIME ALLOWED FOR WELL TO RECHARGE BEFORE SAMPLING:

TIME OF SAMPLING: _ _ _ _ HRS

DEPTH TO WATER PRIOR TO SAMPLING:
(FROM TOP OF CASING) _ _ _ . _ FT

AMOUNT OF SAMPLE COLLECTED
(LIST CONTAINERS FILLED):

FIELD MEASUREMENTS(IF PERFORMED):

_ _ _ °C °F
temperature

pH: _ _ . _
_ _ . _
_ _ . _
_ _ . _

4 REPLI
MEASURE
A HAZAR
WASTE S

pH METER TYPE AND MODEL:

NOTES CONCERNING CONDITION OF WELL, ODOR AND COLOR OF WATER, DEVIATIONS FROM SPECIFI
SAMPLING PROCEDURES, AND OTHER OBSERVATIONS:

SAMPLE COLLECTOR'S NAME:

WORK AREA MEASUREMENTS(IF PERFORMED): _ _ _ °C °F
temperature

pH: _ _ . _
_ _ . _
_ _ . _
_ _ . _

4 REPLIC
MEASUREM
A HAZARD
WASTE SI

pH METER TYPE AND MODEL:

FILTERING METHOD:

TIME WHEN FILTERING AND PRESERVATION IS COMPLETED: _ _ _ _ HRS

NOTES CONCERNING USE OF ANY SPECIAL PROCEDURES OR DEVIATIONS FROM SPECIFIED PROCEDUR

COMMENTS AND OBSERVATIONS(CONT'UE ON REVERSE SIDE IF ADDITIONAL SPACE IS NEEDED):

SAMPLE PREPARER'S NAME:

Incl 3

FIELD DATA LOGSHEET

INSTALLATION: Big Valley Army Depot WELL ID: LF4 _ _

DATE: 19 OCT 81 (day month year) 81292 (Julian)

DEPTH TO WATER FROM TOP OF CASING: 25.1 FT

LENGTH OF CASING ABOVE GROUND SURFACE: 2.2 FT

DEPTH TO WATER FROM GROUND SURFACE: 22.9 FT

TIME OF MEASUREMENT: 1310 HRS

METHOD OF MEASUREMENT: steel tape

INSIDE DIAMETER OF CASING: 2.0 INCHES

PUMPING/SAMPLING METHOD: geofitler pump

AMOUNT OF WATER PUMPED PRIOR TO SAMPLING: 17 GALLONS

IF TIME ALLOWED FOR WELL TO RECHARGE BEFORE SAMPLING:

TIME OF SAMPLING: ____ HRS

DEPTH TO WATER PRIOR TO SAMPLING: (FROM TOP OF CASING) ____ FT

AMOUNT OF SAMPLE COLLECTED (LIST CONTAINERS FILLED):

1 qt pest/herb

1 qt TOX

2 one gal containers

16 oz spec cond

FIELD MEASUREMENTS (IF PERFORMED):

____ °C °F temperature

pH: ___.__

___.__

___.__

___.__

4 REPLIC MEASUREM A HAZARD WASTE SI

pH METER TYPE AND MODEL:

NOTES CONCERNING CONDITION OF WELL, ODOR AND COLOR OF WATER, DEVIATIONS FROM SPECIFIE SAMPLING PROCEDURES, AND OTHER OBSERVATIONS:

organic solvent odor, no unusual color

SAMPLE COLLECTOR'S NAME: Joe Jackson

WORK AREA MEASUREMENTS (IF PERFORMED): 12 °C °F temperature

pH: 6.7

6.7

6.7

6.8

4 REPLICA MEASUREME A HAZARDO WASTE SIT

pH METER TYPE AND MODEL: nonportable; Fisher Accumet

FILTERING METHOD: Vacuum

TIME WHEN FILTERING AND PRESERVATION IS COMPLETED: 1500 HRS

NOTES CONCERNING USE OF ANY SPECIAL PROCEDURES OR DEVIATIONS FROM SPECIFIED PROCEDURE

none

COMMENTS AND OBSERVATIONS (CONTINUE ON REVERSE SIDE IF ADDITIONAL SPACE IS NEEDED):

solvent odor apparent in sample, possibly TCE.

SAMPLE PREPARER'S NAME: John Brown

Incl 4A

FIELD DATA WORKSHEET

INSTALLATION: Big Bang AAP WELL ID: RW6 __

DATE: 20 Oct 81 (day / month / year) 81293 (Julian)

DEPTH TO WATER FROM TOP OF CASING: __ 7.2 FT

LENGTH OF CASING ABOVE GROUND SURFACE: __ 1.9 FT

DEPTH TO WATER FROM GROUND SURFACE: __ 5.3 FT

TIME OF MEASUREMENT: 1420 HRS

METHOD OF MEASUREMENT: steel tape

INSIDE DIAMETER OF CASING: __ 2.0 INCHES

PUMPING/SAMPLING METHOD: PVC bailer

AMOUNT OF WATER PUMPED PRIOR TO SAMPLING: __ 2 GALLONS bailed dry

IF TIME ALLOWED FOR WELL TO RECHARGE BEFORE SAMPLING:

TIME OF SAMPLING: 0730 HRS 21 Oct 81

DEPTH TO WATER PRIOR TO SAMPLING: (FROM TOP OF CASING) __ 7.4 FT

AMOUNT OF SAMPLE COLLECTED (LIST CONTAINERS FILLED):

1 qt pest/herb
1 qt TOX
16 oz cond
1 gal jug filled, 2nd one third filled

FIELD MEASUREMENTS (IF PERFORMED):

___ °C °F temperature

pH: __.__ 4 REPLIC
__.__ MEASUREM
__.__ A HAZARD
__.__ WASTE SI
__.__

pH METER TYPE AND MODEL:

NOTES CONCERNING CONDITION OF WELL, ODOR AND COLOR OF WATER, DEVIATIONS FROM SPECIFIE SAMPLING PROCEDURES, AND OTHER OBSERVATIONS:
Returned to well at 1700 hrs 20 Oct; well had not recharged - DTW
Water has a yellow color and an organic odor. Grout seal around
is cracked and well casing is loose in hole.

SAMPLE COLLECTOR'S NAME: Charlie Brown

WORK AREA MEASUREMENTS (IF PERFORMED): 10 °C °F temperature

pH: 5.9 4 REPLICA
5.9 MEASUREME
5.9 A HAZARDO
5.9 WASTE SITI
5.9

pH METER TYPE AND MODEL: nonportable; Beckman 3500

FILTERING METHOD: Vacuum

TIME WHEN FILTERING AND PRESERVATION IS COMPLETED: 0950 HRS

NOTES CONCERNING USE OF ANY SPECIAL PROCEDURES OR DEVIATIONS FROM SPECIFIED PROCEDURES
Insufficient sample to fill radiochemistry container initially. Samp
obtained another gallon jug full late morning 21 Oct 81. Filtered and
preserved by 1300 hrs.

COMMENTS AND OBSERVATIONS (CONTINUE ON REVERSE SIDE IF ADDITIONAL SPACE IS NEEDED):

Organic odor and bright yellow color in filtered sample

pH audit sample results on reverse

SAMPLE PREPARER'S NAME: Jerry Smith

Incl 4B

US ARMY GROUND-WATER MONITORING AND ASSESSMENT PROGRAM

CHAIN OF CUSTODY RECORD

CONTAINER LISTING

SAMPLING DATE	WELL ID	CONTAINER (PARAMETERS)

	SIGNATURE	DATE/TIME	ORGANIZATI
SAMPLE COLLECTOR			
SAMPLE PREPARER			
LABORATORY CUSTODIAN			

METHOD OF SHIPMENT:

COMMENTS:

Incl 5

US ARMY GROUND-WATER MONITORING AND ASSESSMENT PROGRAM

CHAIN OF CUSTODY RECORD

CONTAINER LISTING

SAMPLING DATE	WELL ID	CONTAINER (PARAMETERS)
21 Oct 81	RW6	pest/herb
	"	TOH
	"	Cond
	"	NO_3/NO_2, Phenol, TOC
	"	F, Cl, SO_4
	RW4, RW3	TOH
	" "	pest/herb
	" "	Cond
	" "	NO_3/NO_2, Phenol, TOC
	" "	F, Cl, SO_4
	RW1, RW2 RW3, RW4, RW6	Hg

	SIGNATURE	DATE/TIME	ORGANIZATION
SAMPLE COLLECTOR	Charlie Brown	21 Oct 81/0830 hrs	BIG BANG AA
SAMPLE PREPARER	Jerry Smith	21 Oct 81/0930 hrs	"
LABORATORY CUSTODIAN			

METHOD OF SHIPMENT: UPS Blue Label

COMMENTS:

Page 6

PARAMETER	PRIMARY METHODOLOGY	ALTERNATE METHODOL
Acidity	305.1	
Alkalinity	310.1	
Hardness EDTA	130.2	
Total Solids	160.3	
Total Suspended Solids	160.2	
Total Dissolved Solids	160.1	
Chloride	325.2	325.3
Sulfate	375.2	375.1
Surfactants	425.1	
Chemical Oxygen Demand	410.4	Ampule Method [3]
Turbidity	180.1	
Color	110.2	
Endrin	Methods for Organochlorine[4]	
Lindane	Methods for Organochlorine	
Toxaphane	Methods for Organochlorine	
Methoxychlor	Methods for Organochlorine	
2, 4-D	Methods for Organochlorine	
2, 4, 5, T-P (Silvex)	Methods for Organochlorine	
Oil & Grease	413.2	
Biochemical Oxygen Demand	405.1	
Gross Alpha	SM[5] 703	
Radium-226	SM 706	
Radium-228	SM 705	
Gross Beta	SM 703	
Strontium-90	SM 704	
Tritium	SM 707	

PARAMETER	PRIMARY METHODOLOGY	ALTERNATE METHODO
Uranium	Laser [6]	
Taste	SM 211A	
Acid Extractable Organics	FR[7] 625	FR 604
Base/Neutral Extractable Organics	FR 625	
Pesticide & PCB Extractable Organics	FR 625	
Volatile Organics	FR 624	FR 601
pH	150.1	
Odor	SM[8] (Quality)	140.1
Nitrate	353.2 (with and without Reduction Steps)	353.1
Cyanide	335.3	
Sulfide	376.2	
Nickel	200.0, 249.1	
Vanadium	200.0, 286.2	
Antimony	200.0, 204.2	
Beryllium	200.0, 210.1	
Thallium	200.0, 279.1	
Hexavalent Chromium	218.4	

1 - The selected alternate methods will be on an infrequent basis only if a need aris

2 - Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268, March 1979. All the methods listed are from this methods manual except for those individually marked with preletters.

3 - "Ampule Method", Chemical Oxygen Demand, Oceanography International Corporation, College Station, TX 77840, April 1978.

4 - "Methods for Organochlorine Pesticides and Chlorophenoxy Acid Herbicides in Drinking Water and Raw Source Water", available from ORD Publications, CERI, EPA, Cincinnati, OH 45268, July 1978.

5 - Standard Methods for the Examination of Water and Wastewater, 14th ed., American Public Health Association, Amercian Water Works Association, Water Pollution Control Federation, Washington, DC 20036, 1975.

6 - "Laser Induced Phosphorescence Procedure for Uranium", Radiation Management Corp, Philadelphia, PA 19104, 1981.

7 - EPA methods listed in Federal Register, Vol. 44, No. 233, Guidelines Establishing Test Procedures for the Analysis of Pollutants; Proposed Regulations, Monday, December 3, 1979.

8 - Standard Methods for the Examination of Water, Sewage, and Industrial Wastes, 10th ed., American Public Health Association, American Water Works Association, Federation of Sewage & Industrial Wastes Associations, New York 19 NY, 1955.

..... EXAMPLE .....

SCHEDULED SAMPLING AND ANALYSIS

Big Bang AAP
Red Water Lagoon
Sludge Basin
Landfill

Scheduled Sampling: 19 Oct 81

16 Wells: RW1, RW2, RW3, RW4, RW6, SB1, SB2, SB3, SB4, SB5, LF1, LF2, LF3, LF4, LF5, LF6

Ba	Endrin	TOX(4)	Gross Alpha
As	Lindane		Gross Beta
Cd	Toxaphene		
Cr	Methoxychlor		
Pb	2,4-D		
Se	Silvex		
Ag			
Na			
Mn			
Fe			
NO_2/NO_3	Spec Cond(4)	F	Hg
Phenol		Cl	
TOC(4)		SO_4	

Commander
Big Bang AAP
Attn: SARBB-FE-E
Westwood, USA

Century Environmental Testing Laboratories, Inc.
1501 Grandview Avenue
MidAtlantic Park
Thorofare, NJ 08086

Commander
US Army Environmental Hygiene Agency
Attn: HSE-ES-S/Gary Nemeth
Aberdeen Proving Ground, MD 21010
AV 584-2024, (301) 671-2024

SUPPLEMENT 1

TO

US ARMY GROUND-WATER MONITORING
AND ASSESSMENT PROGRAM

INSTRUCTIONS
FOR
COLLECTION
PREPARATION AND SHIPMENT
OF SAMPLES

US ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MD
APRIL 1982

Paragraph V.E.

6. Ground-water samples requiring analysis for any or all of the following explosives: 2,4,6-TNT, 2,4-DNT, 2,6-DNT, RDX, HMX, and Tetryl should be filtered (0.45 micron membrane filter) and then transferred to a clean 16-ounce glass bottle (narrow neck w/teflon-lined cap enclosed in a styrofoam pack). After transferring the sample to the bottle, add 10% sulfuric acid (H_2SO_4) drop-wise to obtain a sample pH of 4-5. If the sample already has a pH in the 3-6 range, don't add any acid to it. A commercial pH paper roll having an expanded scale range from about pH 3 to 7 can be used for this measurement. It is inoperative not to overacidify the sample. The H_2SO_4 should be prepared from a reagent grade or "more pure" grade concentrated H_2SO_4; a 10% concentration is achieved by adding 10 parts H_2SO_4 to 90 parts distilled or deionized water. In most cases, a full bottle of sample is not necessary. If difficulty results in obtaining a fairly full bottle, 100-200 milliliters of sample will be sufficient for explosive analysi

7. Ground-water samples requiring analysis for volatile organic compounds, whether they are halogenated organics or purgeable non-halogenated aromatic or aliphatic compounds, must be collected in the specially designed and cleaned 40 ml glass vial equipped with a teflon-faced silicone septum and screw cap. These samples must be collected right at the sampling well immediately after extracting the samples from the well. Special care must be taken to insure completely filled vials, so that no bubbles or head space occurs. Also, the teflon-lined side of the septum must face the sample. It is imperative that these vials not be used for any other purpose, and if a vial is accidently soiled, it should not be used. A sample blank vial containing the installation's organic free water should accompany every batch of volatile organic samples.

8. The filled sample containers for explosives, volatile organics, pesticides/herbicides, and any other samples for organics analysis must be kept cold and protected from light.

Paragraph V.F.

5. The filtering apparatus used for filtering samples for the explosive parameters should be rinsed with reagent grade acetone or equivalent and then thoroughly rinse with distilled or deionized water between each sample filtering. It is important that no acetone be left on the apparatus as it may come in contact with the membran filter and dissolve it.

Paragraph VI.B.

5. Samples for explosives or volatile organics analysis must be shipped as soon as possible after sampling (within 24 hours) and a 24 hour delivery service must be ed. These samples will be analyzed either by USAEHA or the contract laboratory on a case by case basis.

APPENDIX III

HERCULES AEROSPACE DIVISION
HERCULES INCORPORATED
SUNFLOWER ARMY AMMUNITION PLANT
P O BOX 549 DeSOTO KANSAS 66018

RECEIVED
BUREAU OF
ENVIRONMENTAL
SANITATION

February 17, 1983

Contracting Officer's Representative
Sunflower Army Ammunition Plant
P. O. Box 640
DeSoto, Kansas 66018

Subject: Calendar Year 1981 and 1982 Hazardous Waste Annual Reports

Reference: Memorandum of December 20, 1982, from John Paul Goetz, Chief Hazardous Waste Management Section, State of Kansas

Dear Sir:

Attached are copies of the subject reports for calendar years 1981 and 1982, which include generator, storage and disposal reports. Available monitoring well water level measurements, analyses and a list of monitoring well data for those wells which exceed one or more of the primary drinking water standards are also attached.

We are unable to fully comply with the requirement for submittal of groundwater monitoring data (page 3, para. 2 of the reference letter). The information will not be available until after the quarterly samples have been taken and analyzed, and the results received at SFAAP from USAEHA. There are twenty-three wells yet to be sampled. Depending on the weather and accessibility to the monitoring sites, the fourth quarter samples for these wells should be completed by March 17, 1983.

The attached reports cover only the hazardous waste which was generated by Hercules Incorporated, the operating contractor's activities. The report does not reflect any hazardous waste activities which may have been conducted by Government leases at this installation.

Please forward this data to regulatory agencies as required and forward a copy of your submittal to this office.

Very truly yours,

T. F. Newsome,
Vice President & General Manager

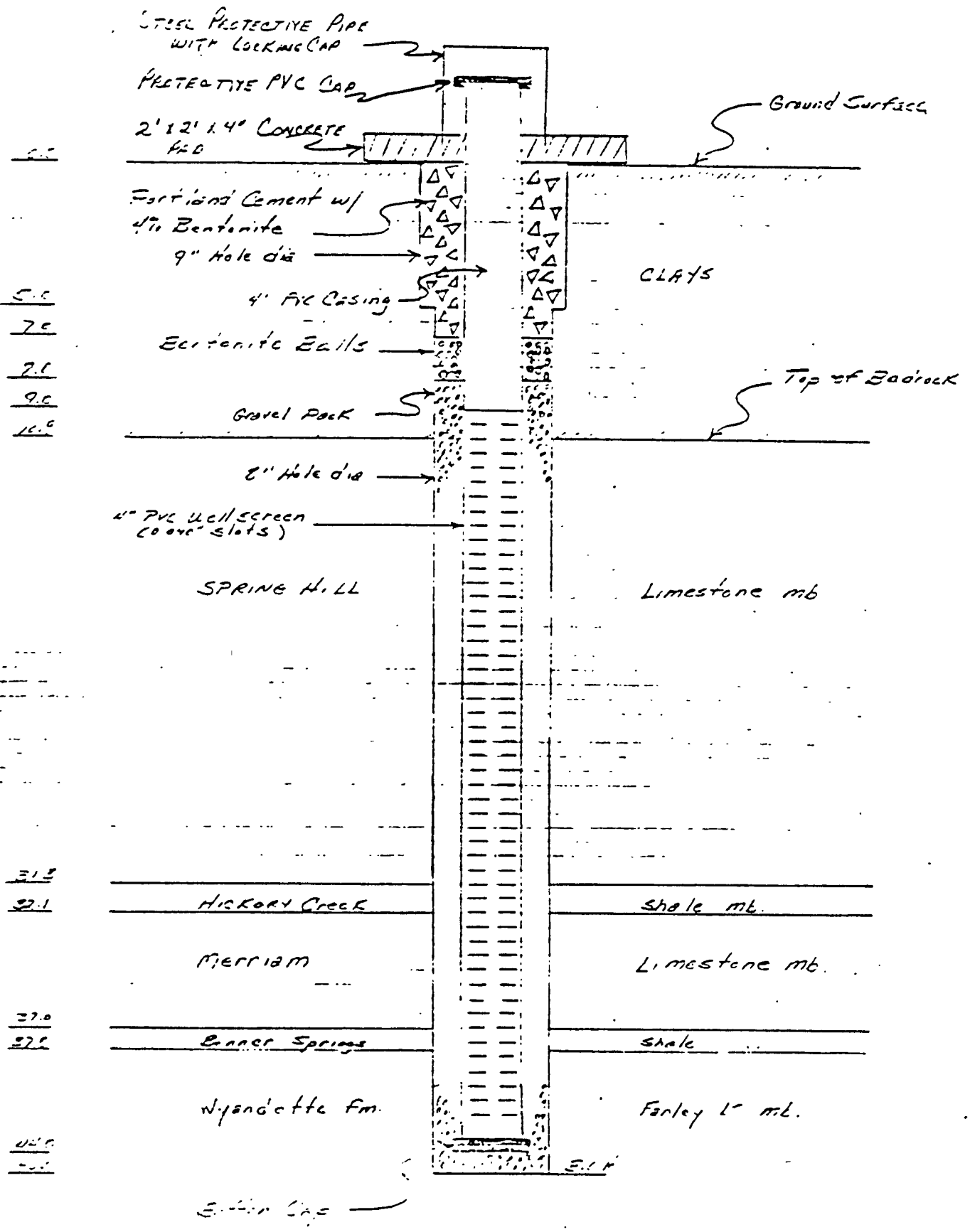
TFN/SHZ/WLJohnson:bks
Attachments: a/s

February 15, 1983

Sunflower Army Ammunition Plant

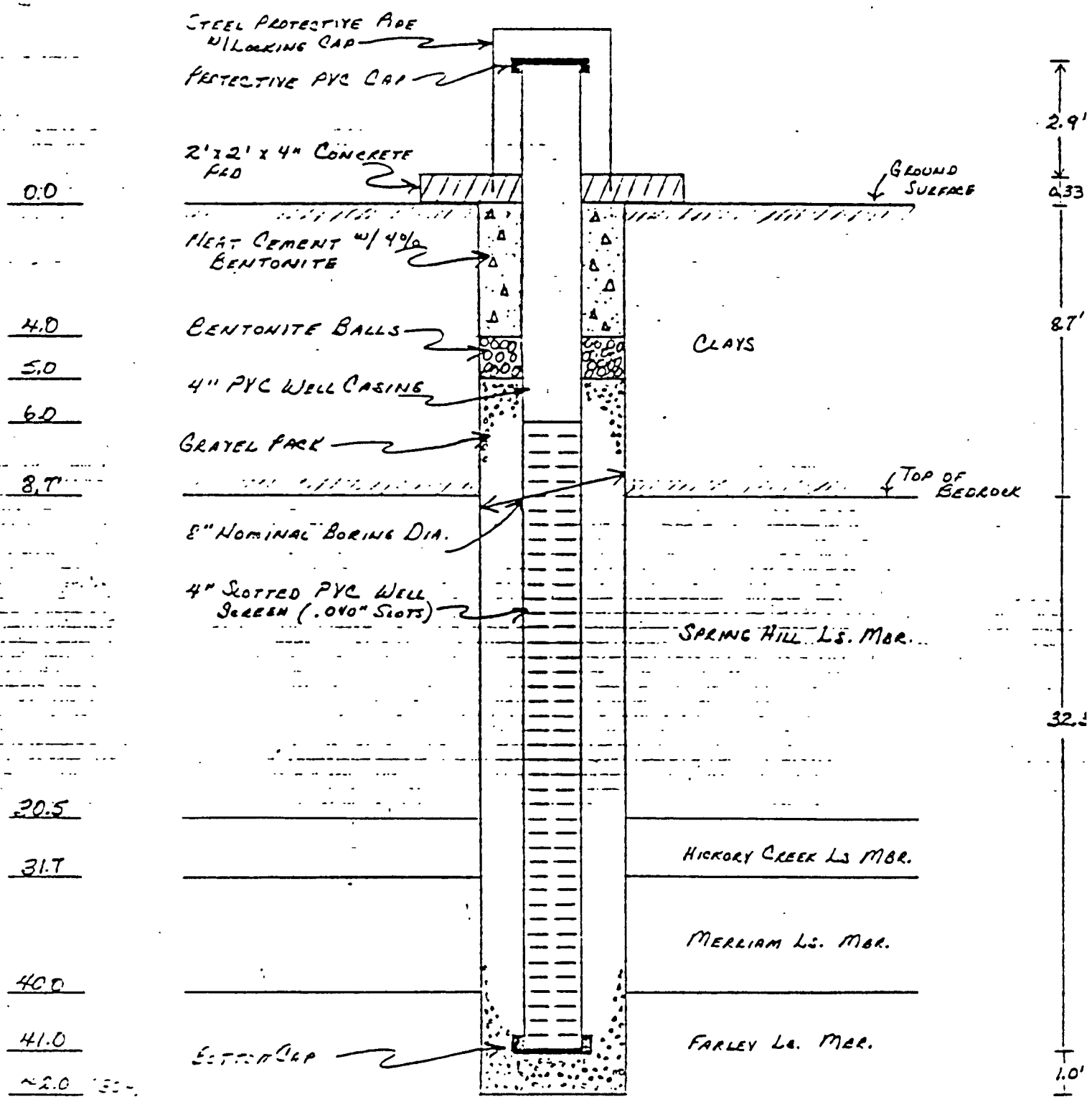
MONITORING WELLS EXCEEDING PRIMARY DRINKING WATER STANDARDS

Well No.	Sample Round No.	Parameter Exceeded	Concentration
81-3	1	Lead	0.065 mg/L
81-4	2	Fecal Coliform	32/100 mls
81-8	2	Fecal Coliform	5/100 mls
81-9	2	Fecal Coliform	TNTC
81-11	2	Fecal Coliform	25/100 ml
81-12	1	Gross Alpha	24 ± 7 p Ci/L
81-13	1	Gross Alpha	40.3 ± 31.6 p Ci/L
81-13	2	Gross Alpha	27.3 p Ci/L
81-15	1	Nitrate-Nitrite (as N)	66.0 mg/L
81-17	1	Nitrate-Nitrite (as N)	12.0 mg/L
81-17	2	Nitrate-Nitrite (as N)	12.0 mg/L
81-17	3	Nitrate-Nitrite (as N)	14.0 mg/L
81-17	3	Selenium	0.02 mg/L
81-30	1	Fecal Coliform	300/100 mls
81-30	3	Selenium	0.015 mg/L
81-35	1	Fecal Coliform	6/100 mls
81-35	1	Lead	0.20 mg/L
81-36	1	Cadmium	0.08 mg/L
81-37	1	Nitrate-Nitrite (as N)	12.0 mg/L
81-37	2	Nitrate-Nitrite (as N)	14.0 mg/L
81-37	3	Nitrate-Nitrite (as N	17.0 mg/L
81-37	3	Selenium	0.034 mg/L
81-39	1	Lead	0.3 mg/L
81-40	1	Cadmium	0.04 mg/L
81-40	3	Selenium	0.011 mg/L
81-40	1	Gross Alpha	52 ± 25 p Ci/L
81-40	2	Gross Alpha	<18.30 p Ci/L
81-40	2	Rodium	6.0 p Ci/L
81-56	2	Chromium	0.06 mg/L
81-56	1	Lead	0.30 mg/L
81-44	1	Nitrate-Nitrite (as N)	68.0 mg/L
81-44	2	Nitrate-Nitrite (as N)	56.0 mg/L
81-44	3	Nitrate-Nitrite (as N)	22.0 mg/L
81-45	1	Fecal Coliform	10/100 mls
81-46	2	Fluoride	5.0 mg/L
81-55	3	Fluoride	5.0 mg/L
81-55	1	Lead	0.055 mg/L
81-59	1	Barium	1.33 mg/L
81-59	1	Cadmium	0.02 mg/L
81-59	1	Gross Alpha	32.6 ± 8 p Ci/L
81-59	2	Gross Alpha	18.80 p Ci/L
81-59	2	Uranium	19.0 p Ci/L
81-59	2	Strontium 90	0.5 p Ci/L


Steel Protective Pipe with Locking Cap
Protective PVC Cap
2'x2'x4" Concrete Pad
Ground Surface
Portland Cement w/ 4% Bentonite
9" Hole dia
CLAYS
4" PVC Casing
Bentonite Balls
Top of Bedrock
Gravel Pack
8" Hole dia
4" PVC Well Screen (0.010" slots)
SPRING HILL
Limestone mb
Hickory Creek
Shale mb.
Merriam
Limestone mb.
Bonner Springs
Shale
Wyandotte Fm.
Farley Ls mb.
Bottom Cap

NOT TO SCALE

INSTALLATION DIAGRAM
SUNFLOWER AAP
ASH LAGOONS AREA



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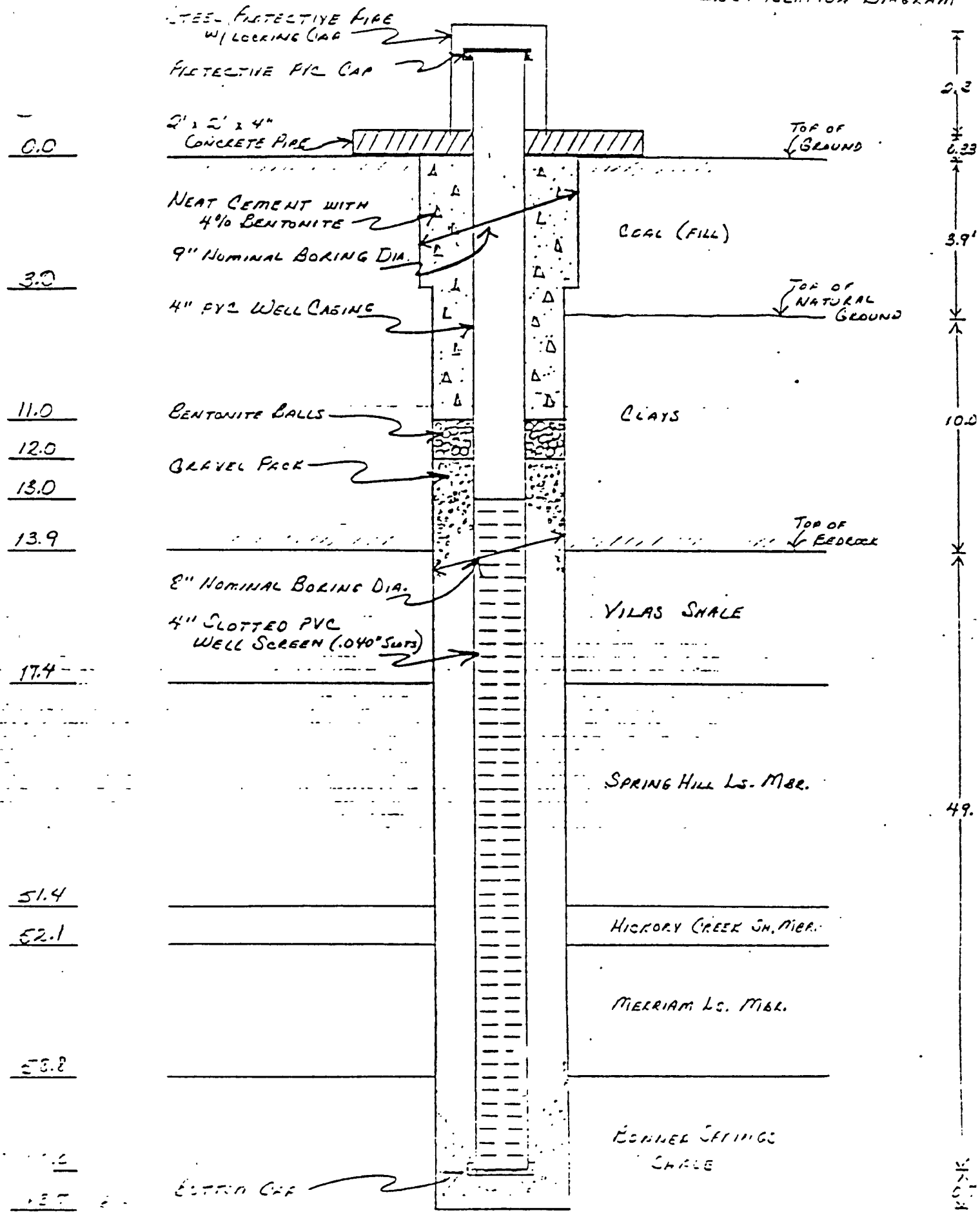
INSTALLATION DIAGRAM



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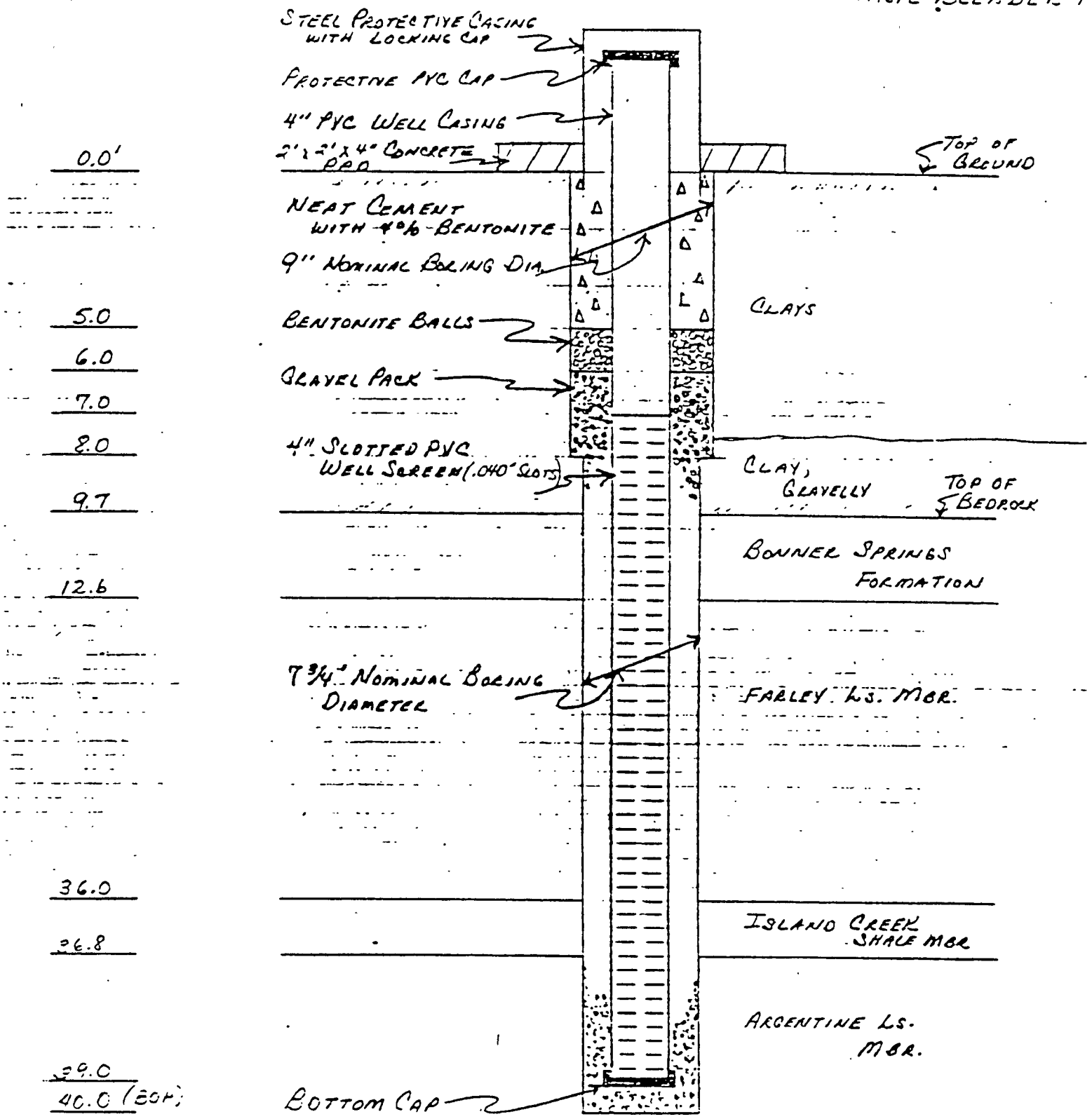
PASTE BLENDER



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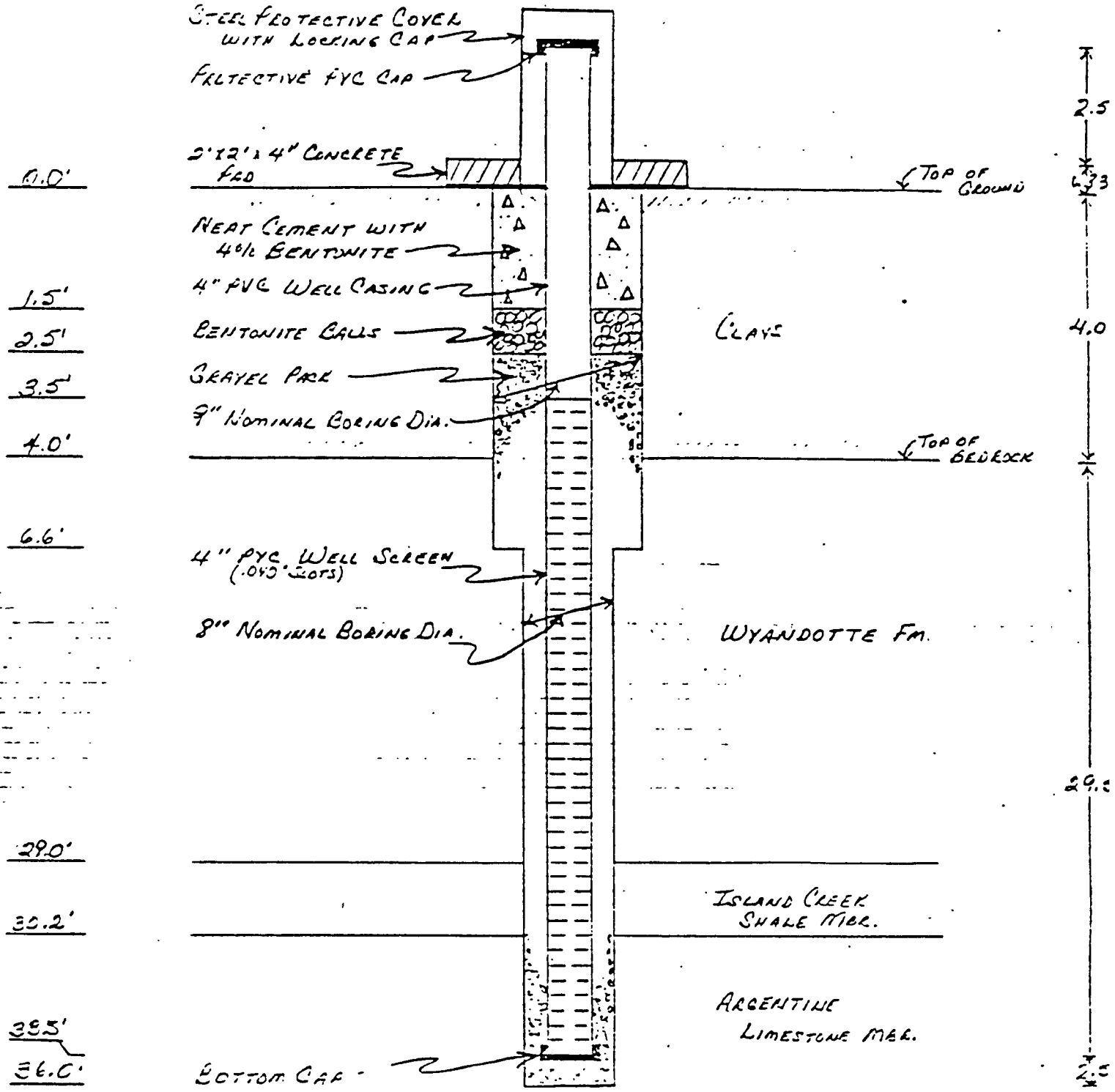
PASTE BLENDER PONDS



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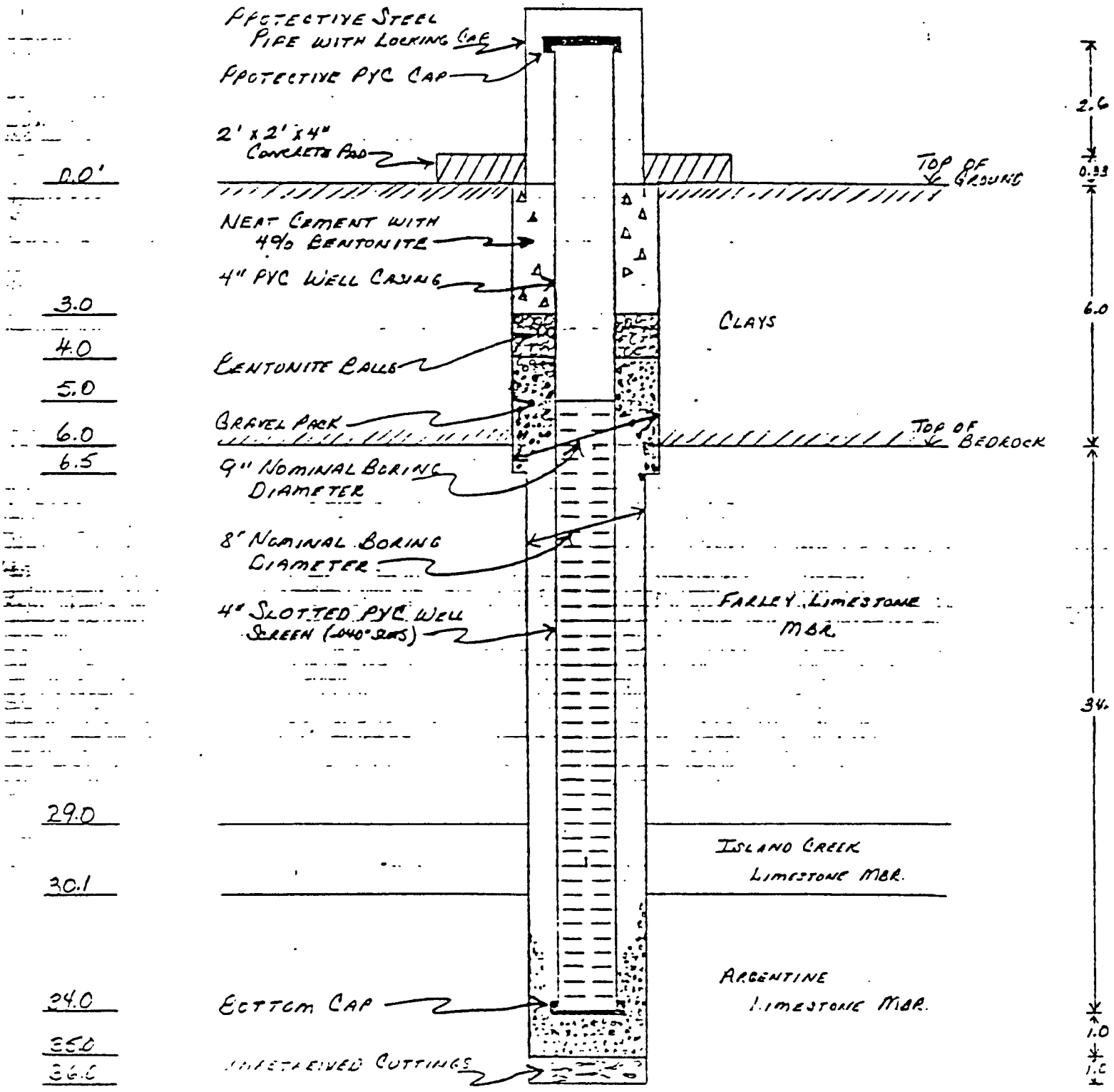

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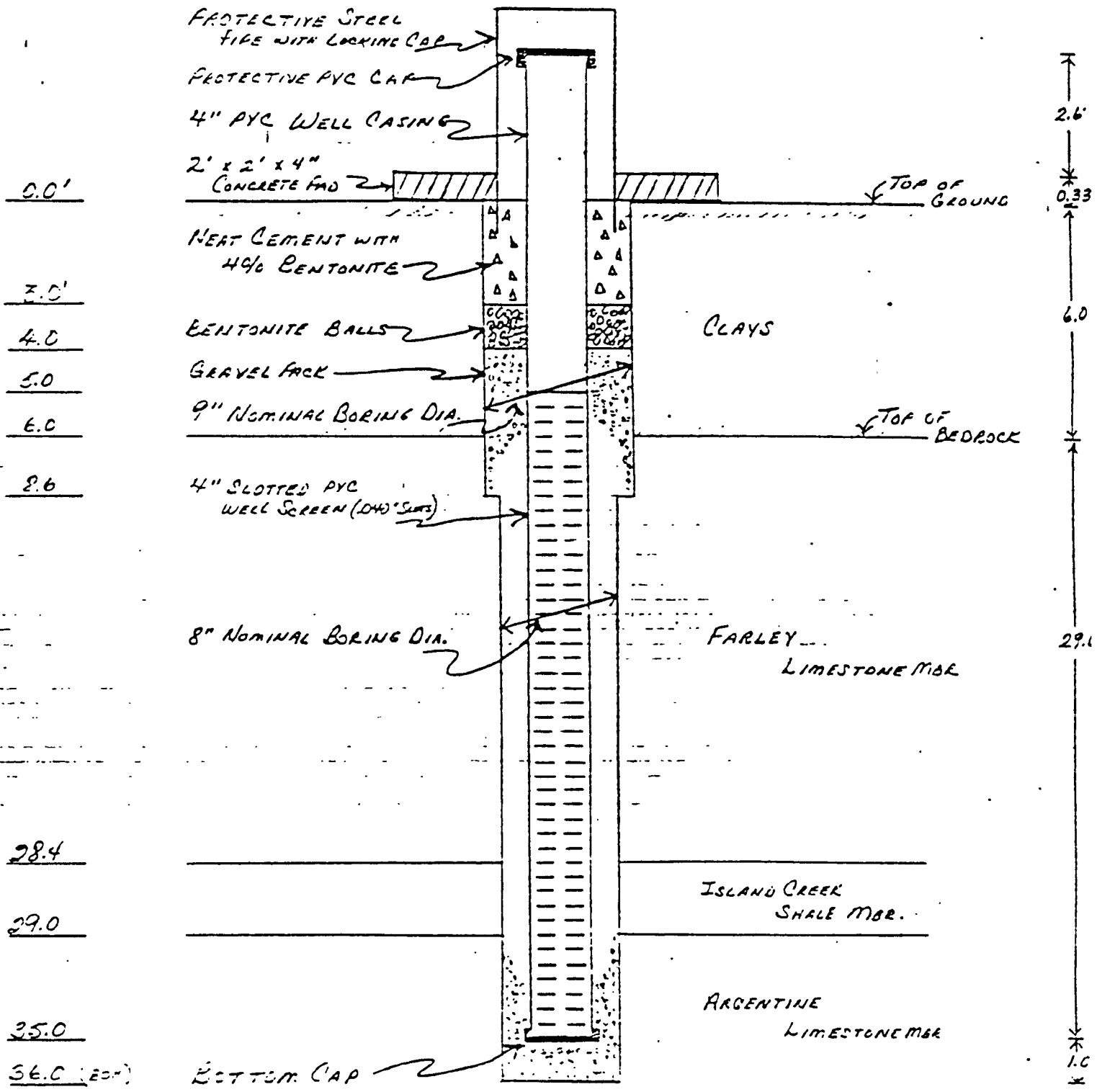
PASTE BLENDER AREA



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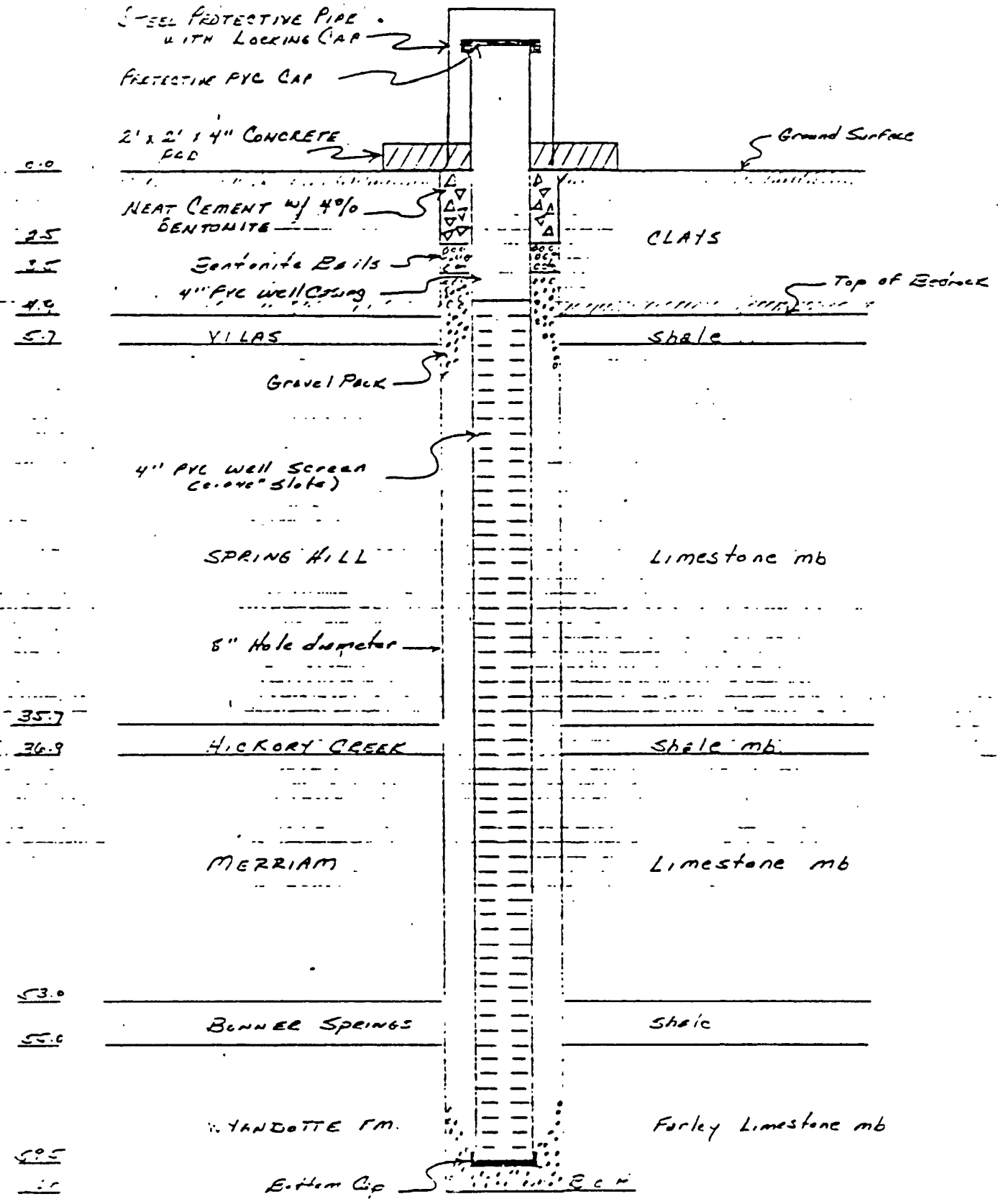
ACI. LAGOONS



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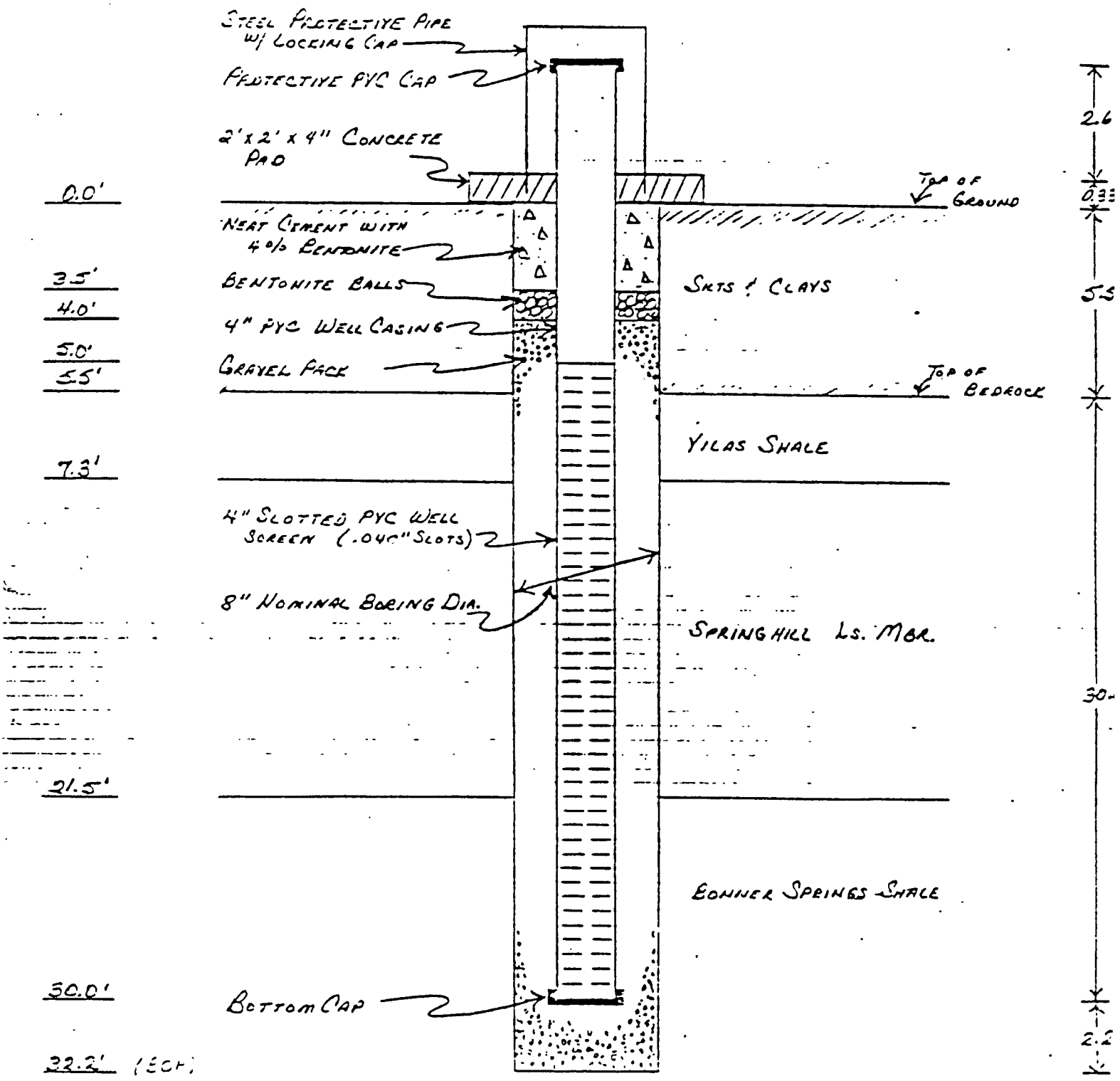

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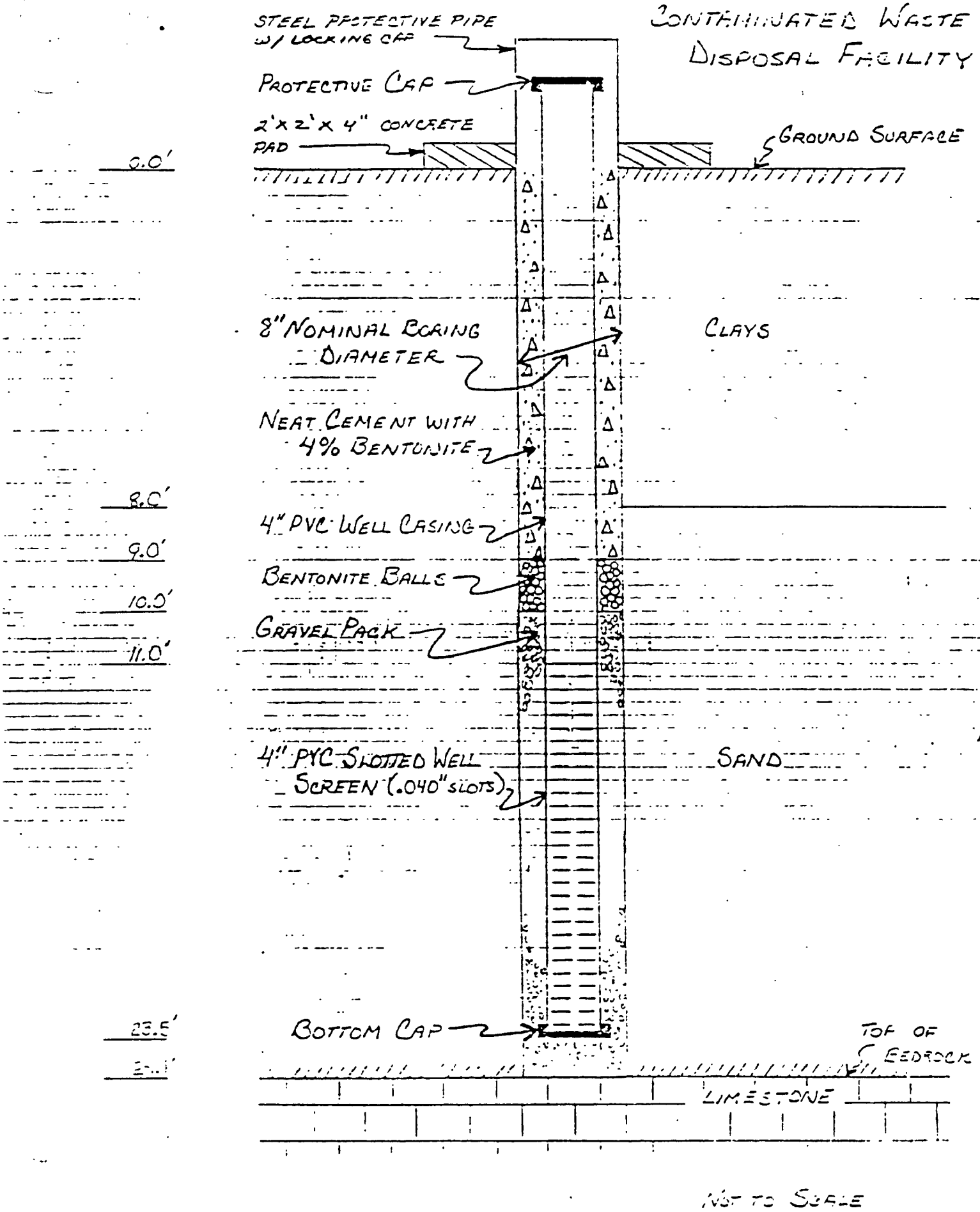

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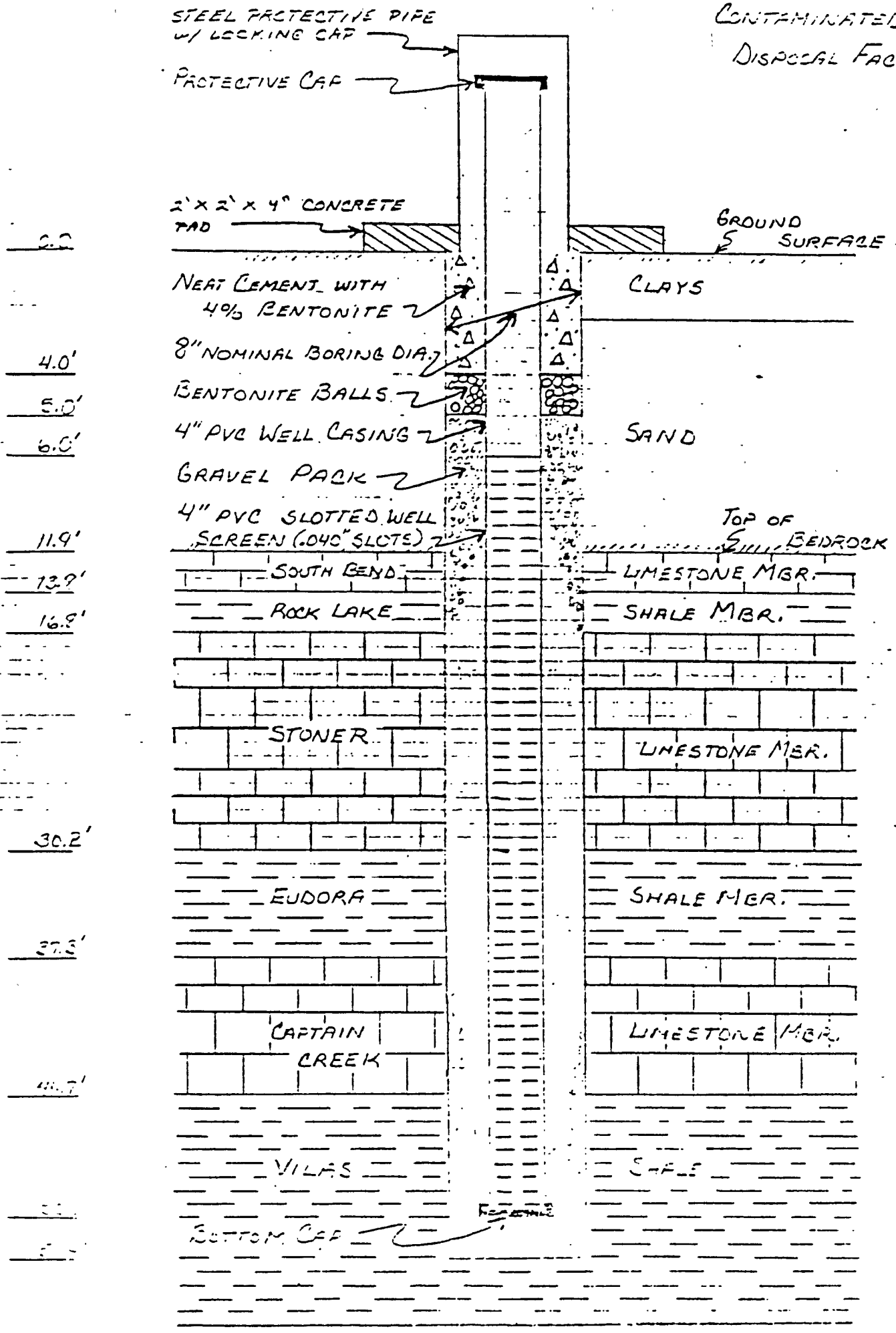
DISPOSAL FACILI



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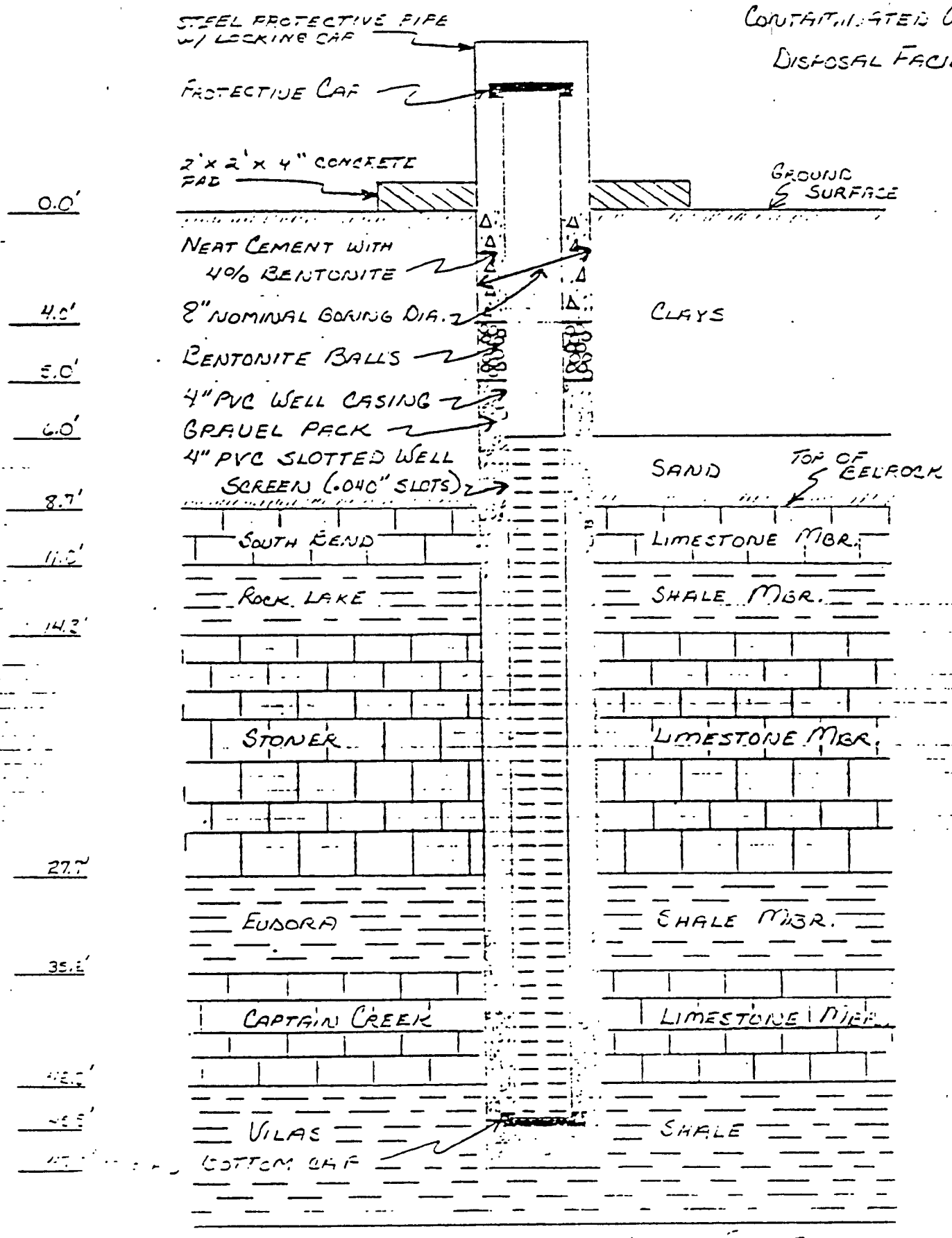

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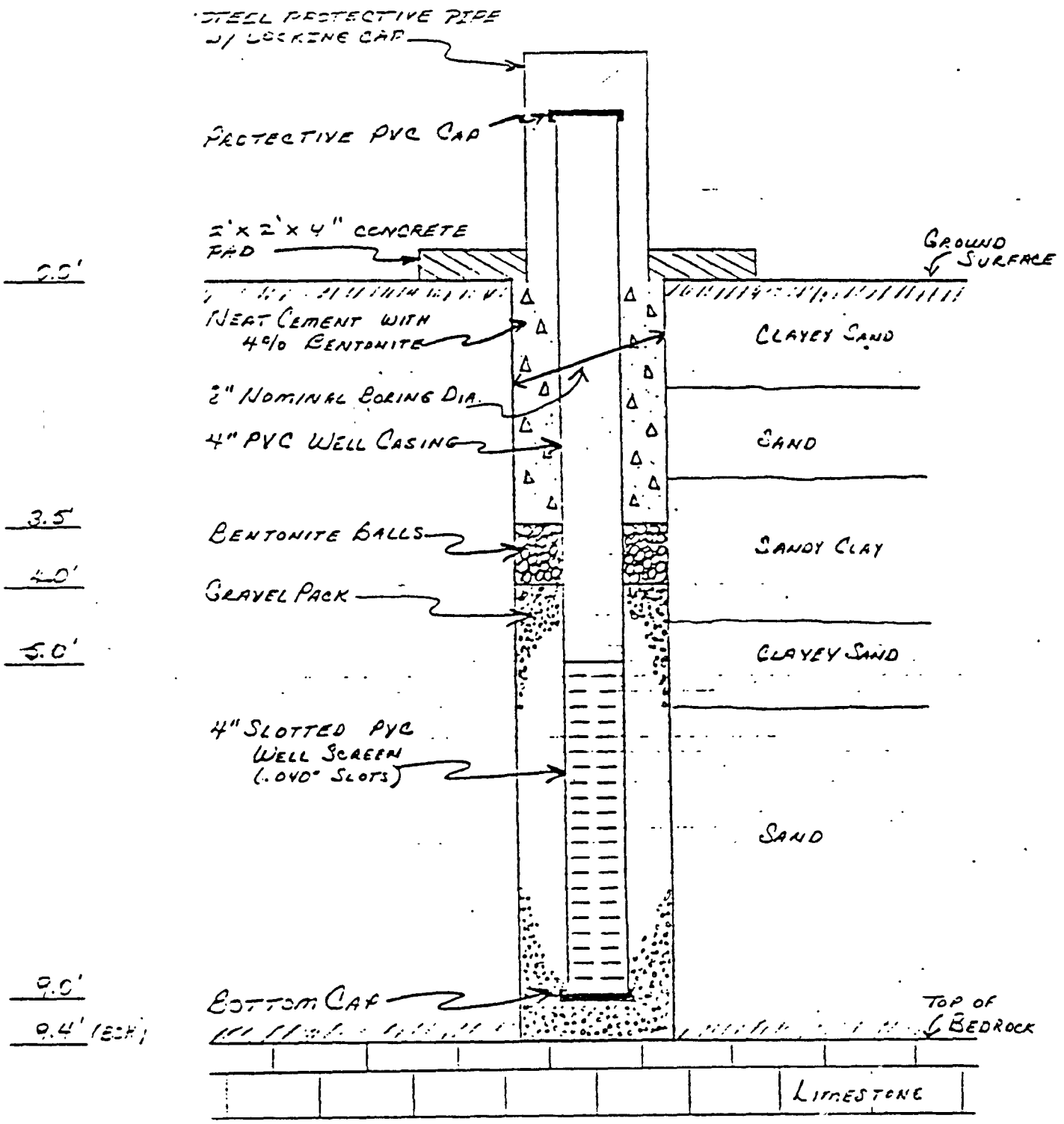
ASH/SANITARY LANDFILL



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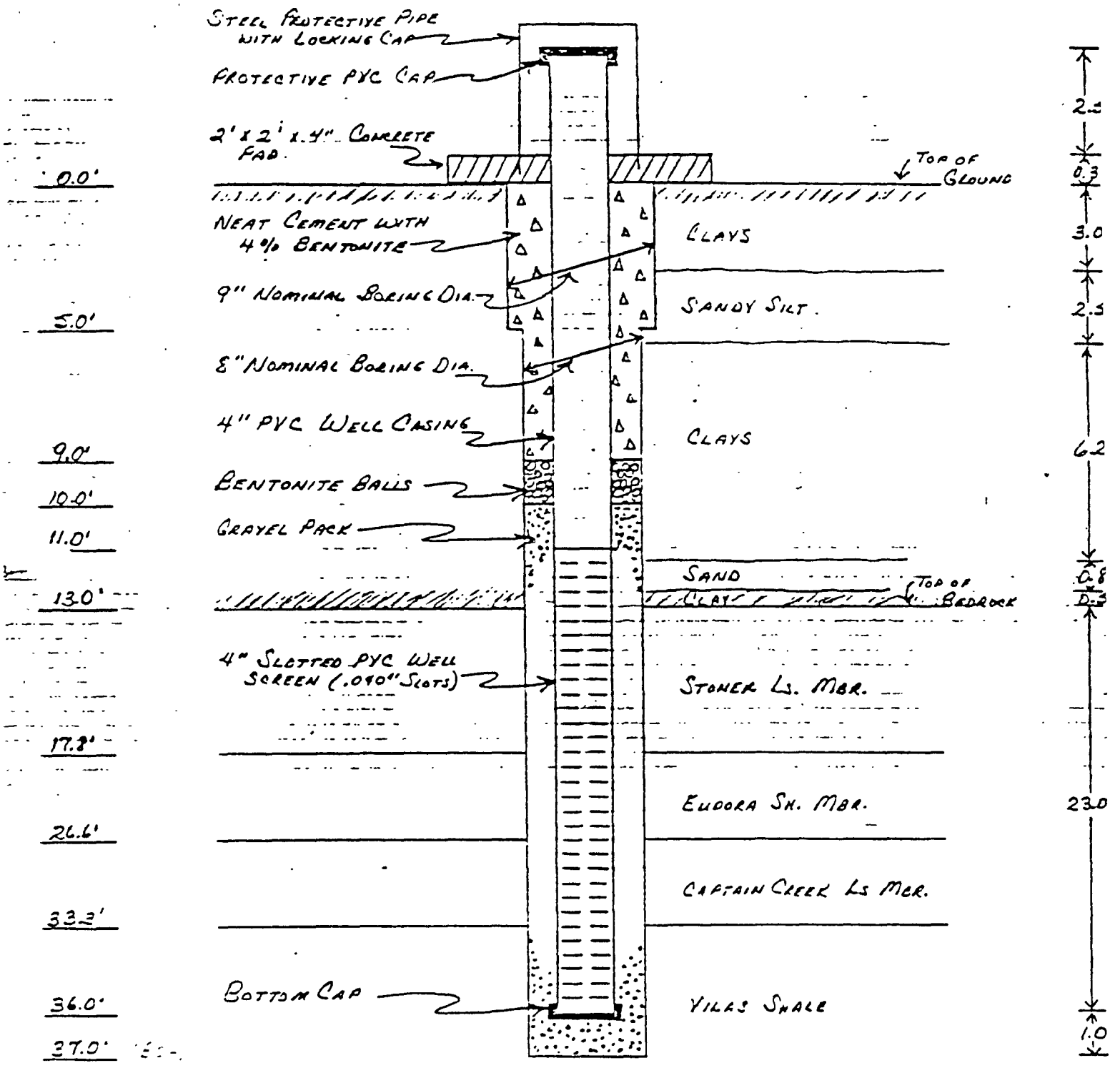

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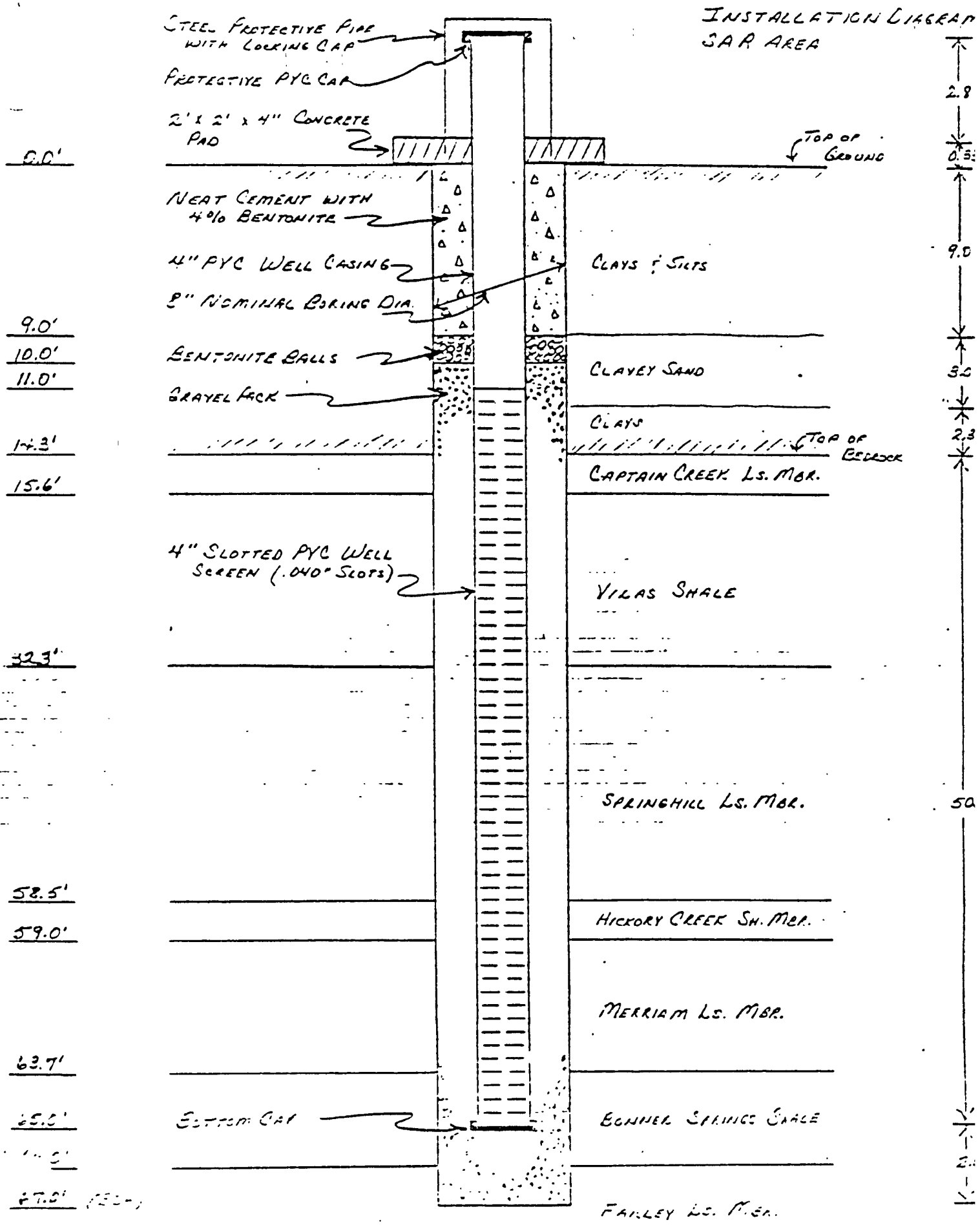

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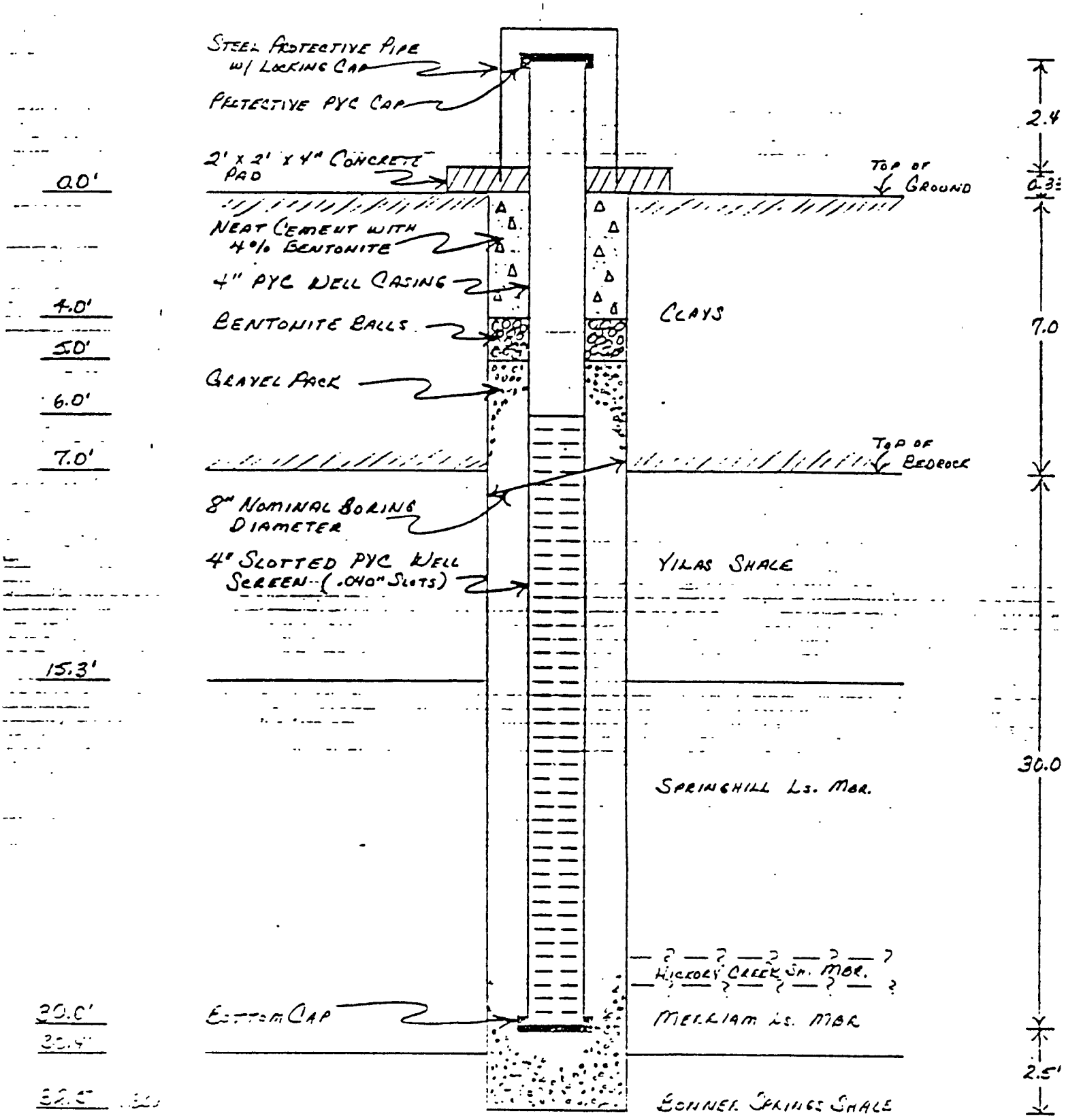

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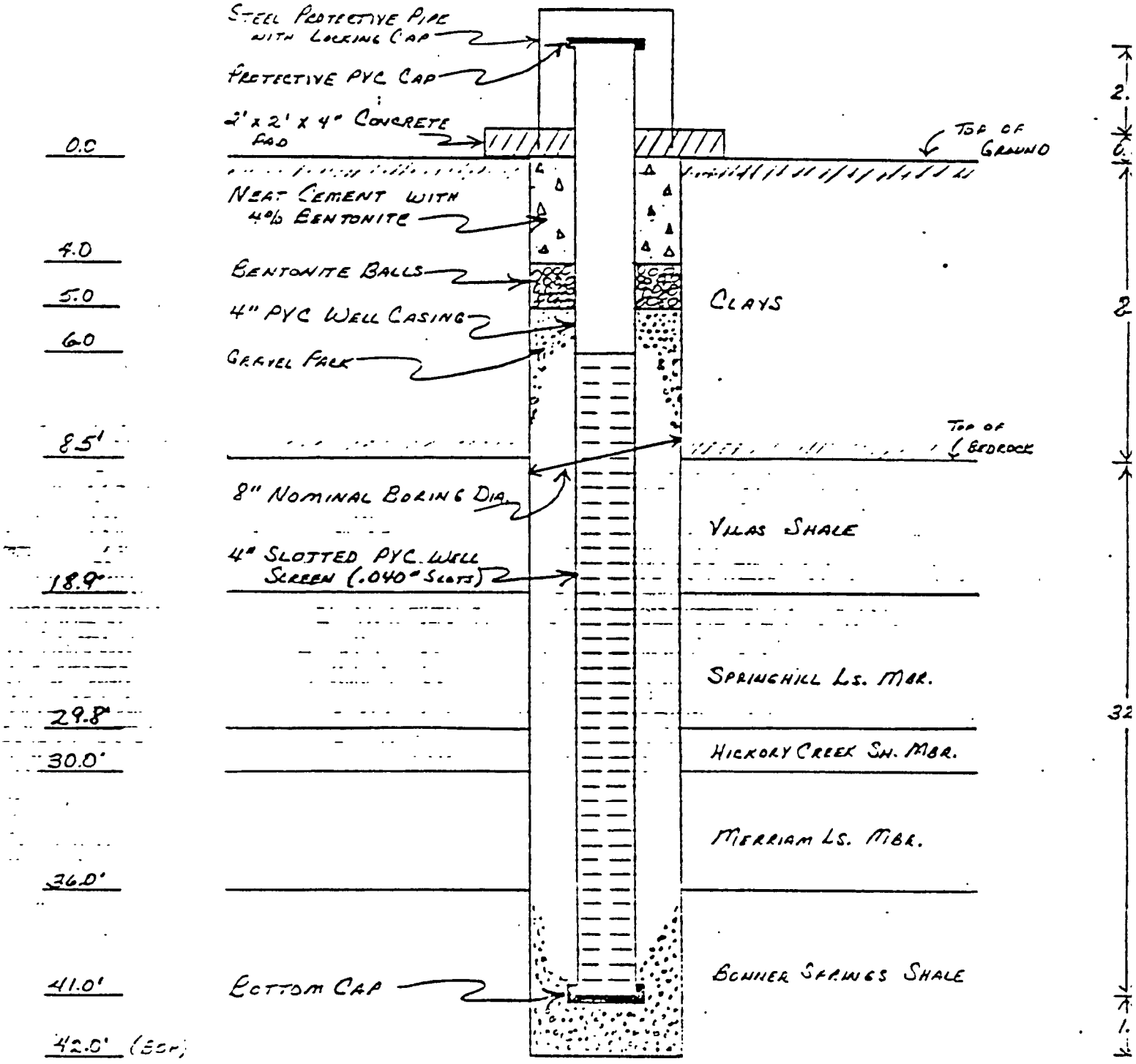

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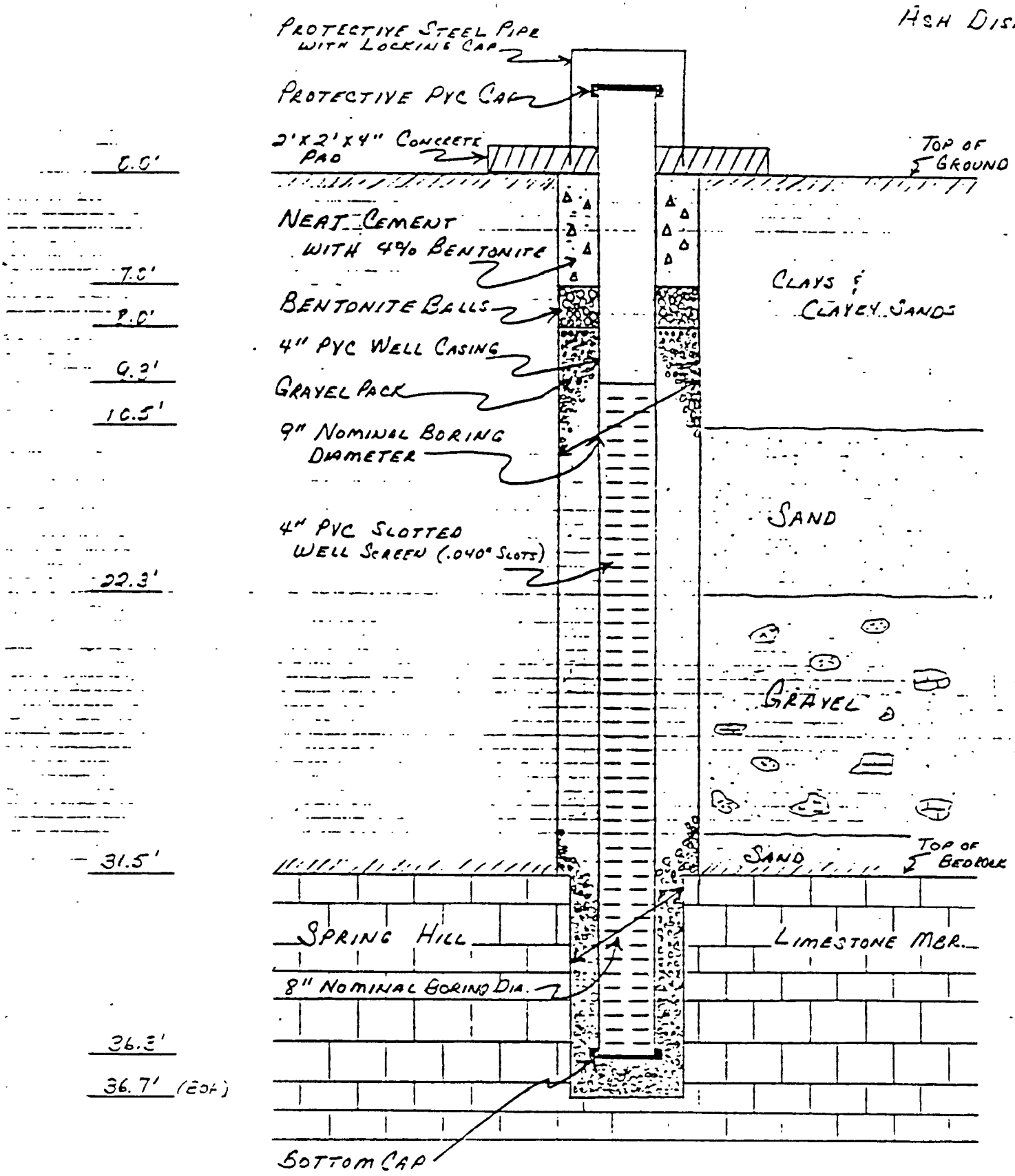

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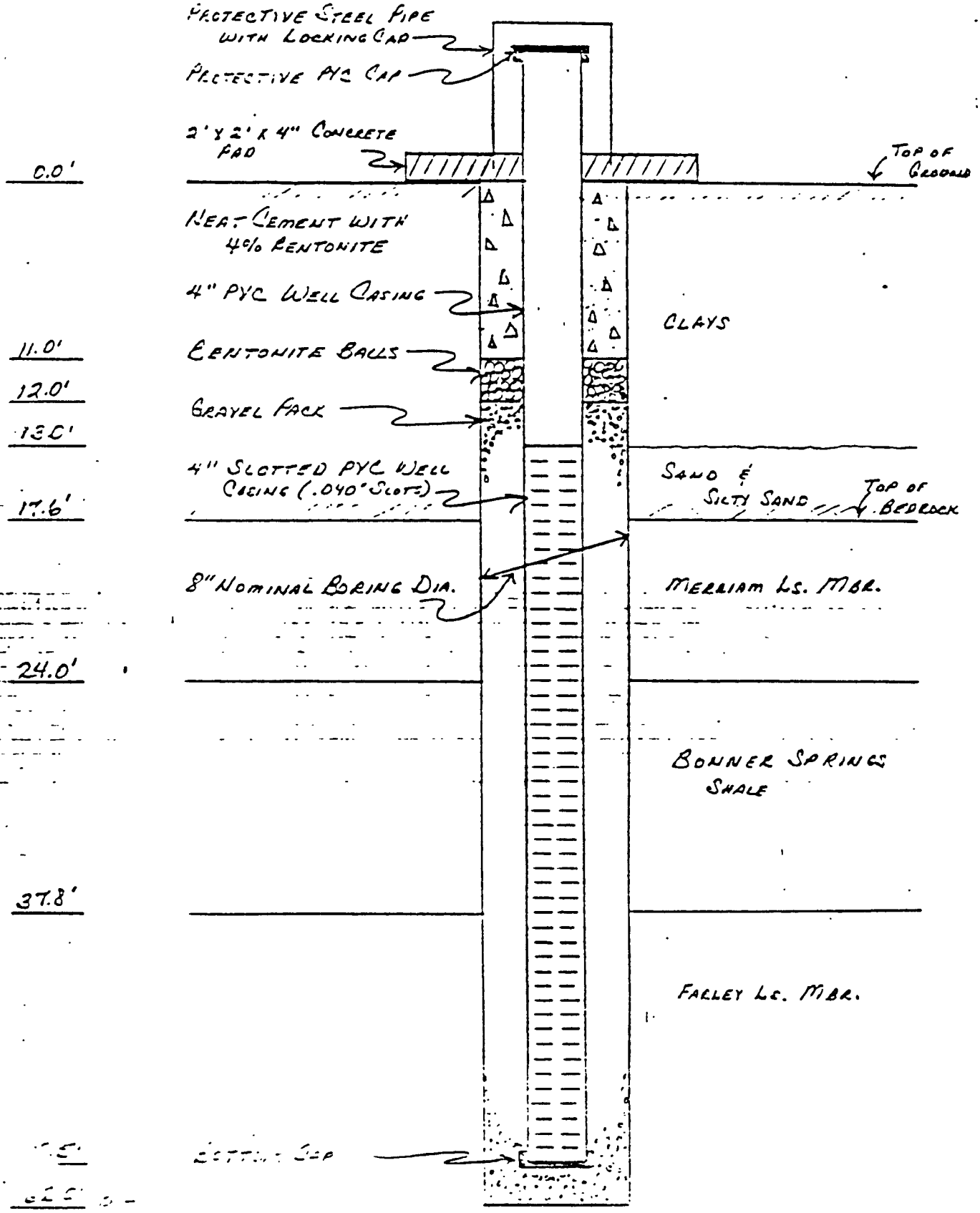
MW 81-42
SUNFLOWER AAP
INSTALLATION DIAGR.
ASH LAGOONS



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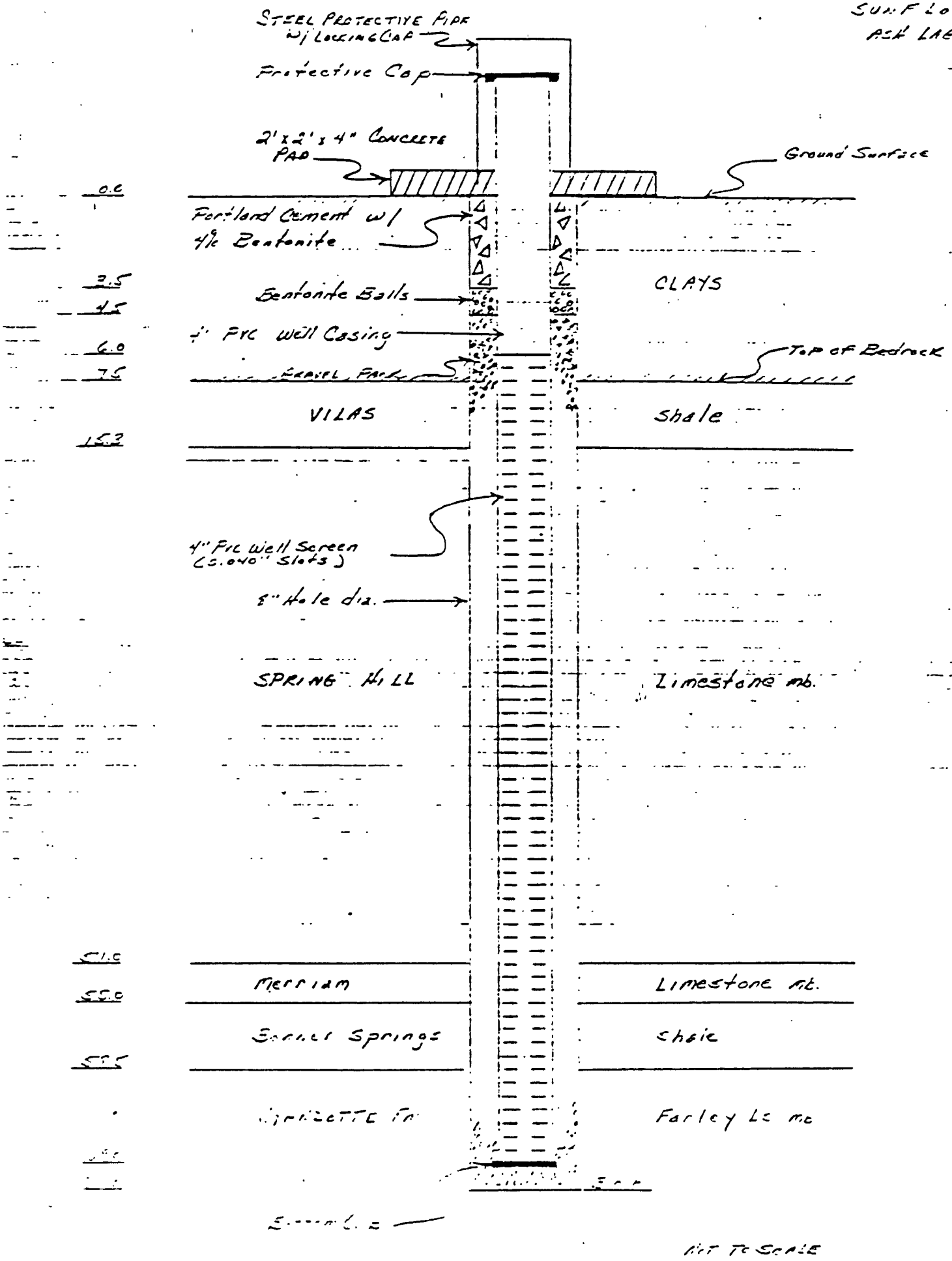
ASH LAGOONS



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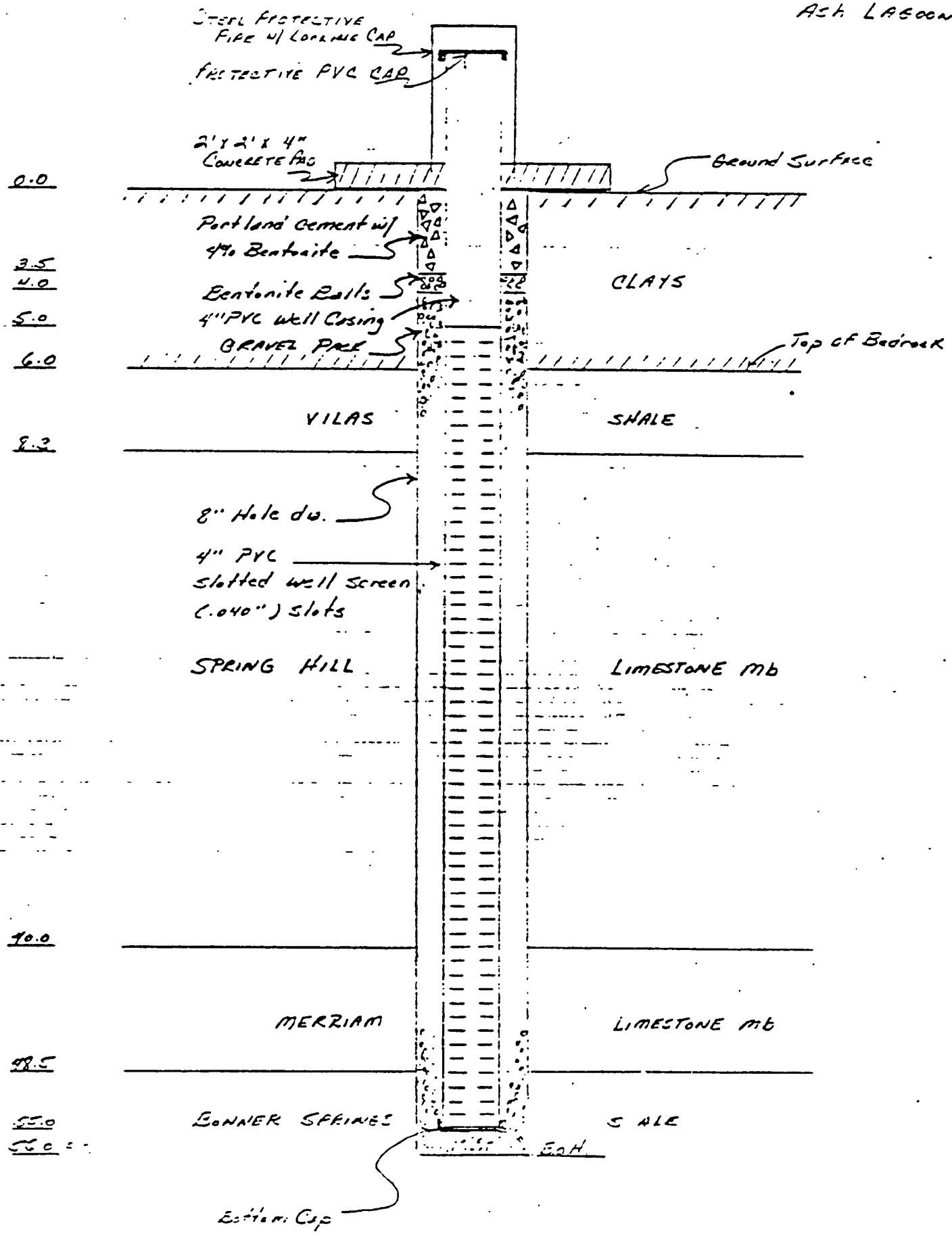
ASH LAGOONS



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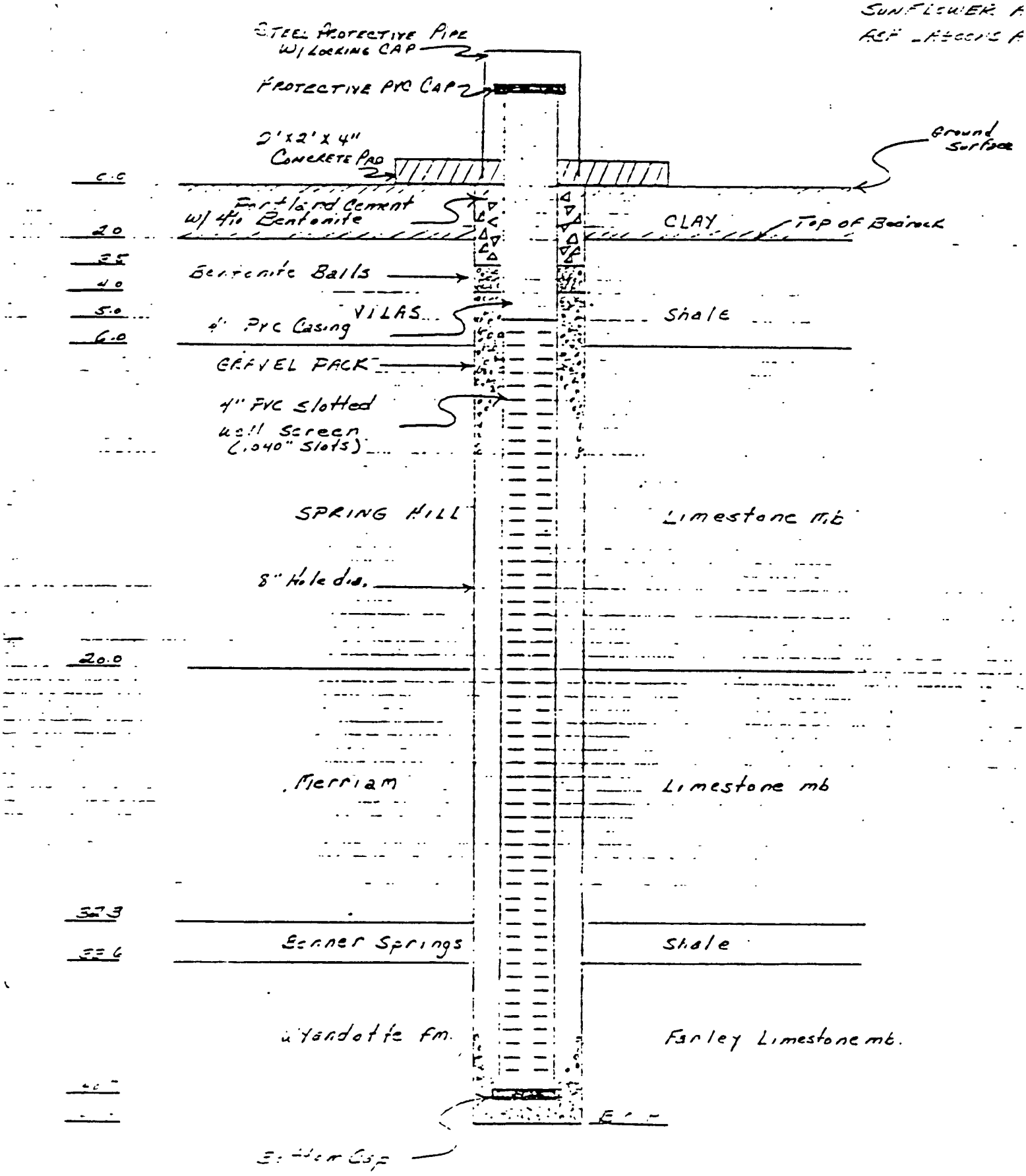

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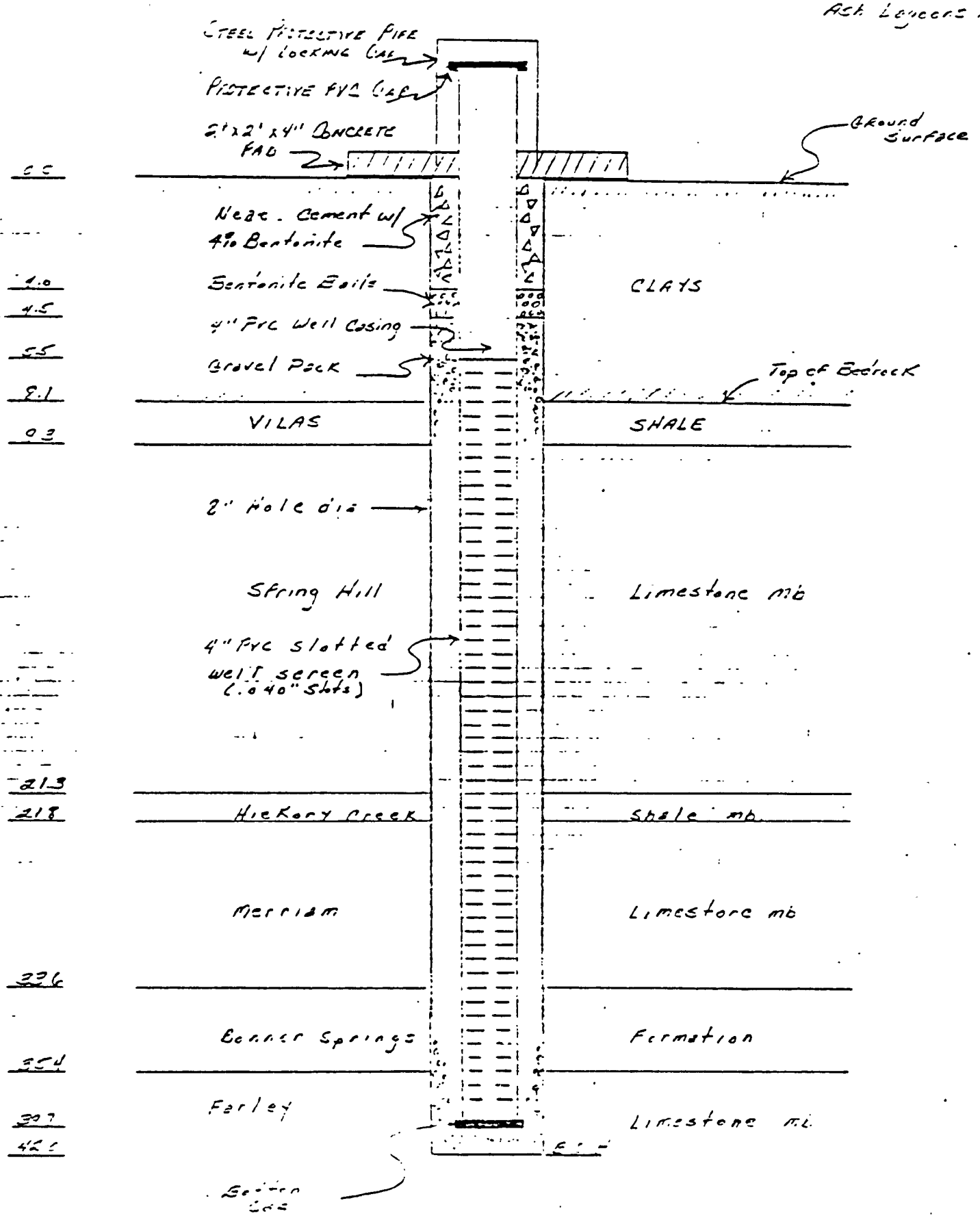

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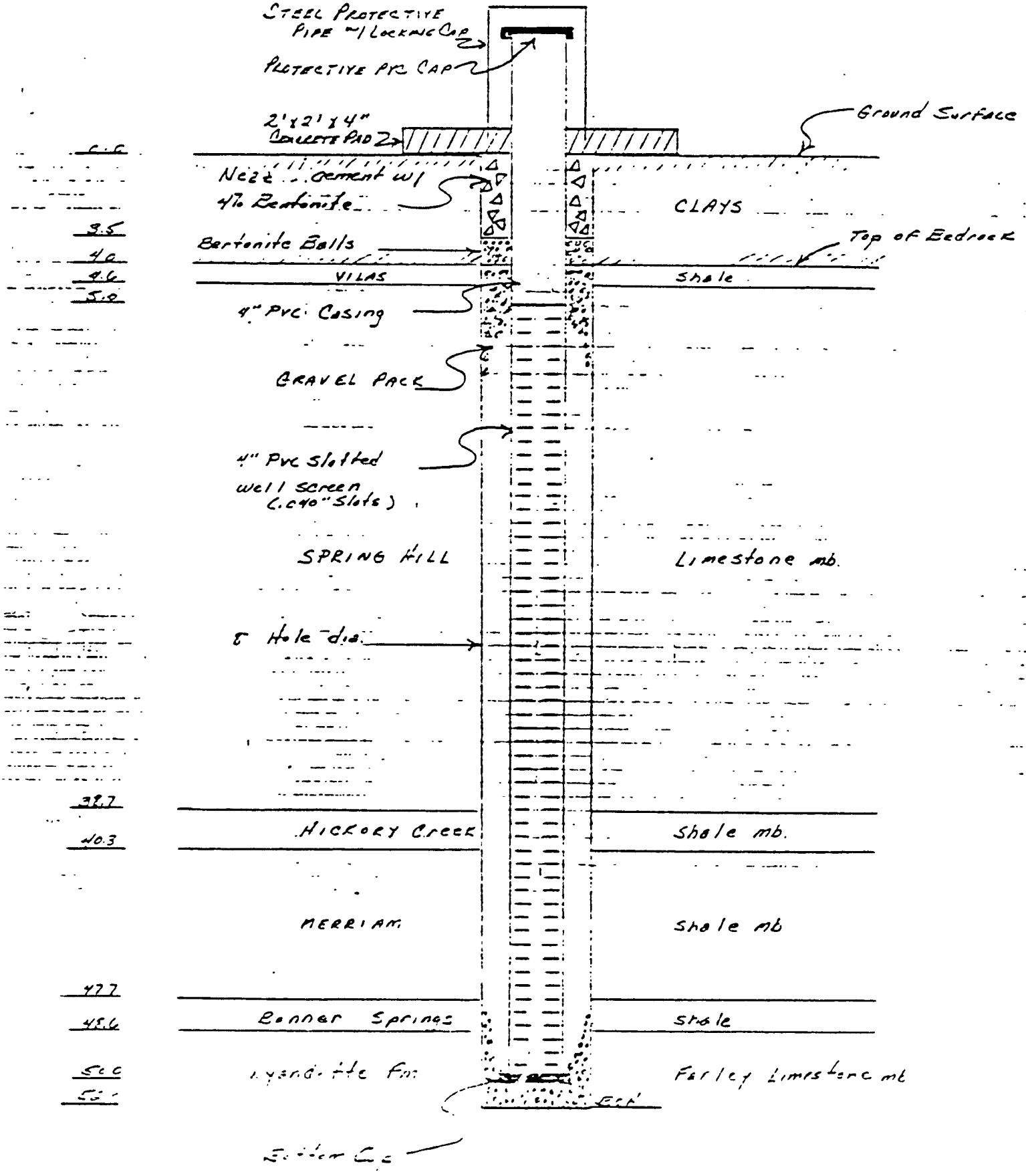
ASH LAGOONS A



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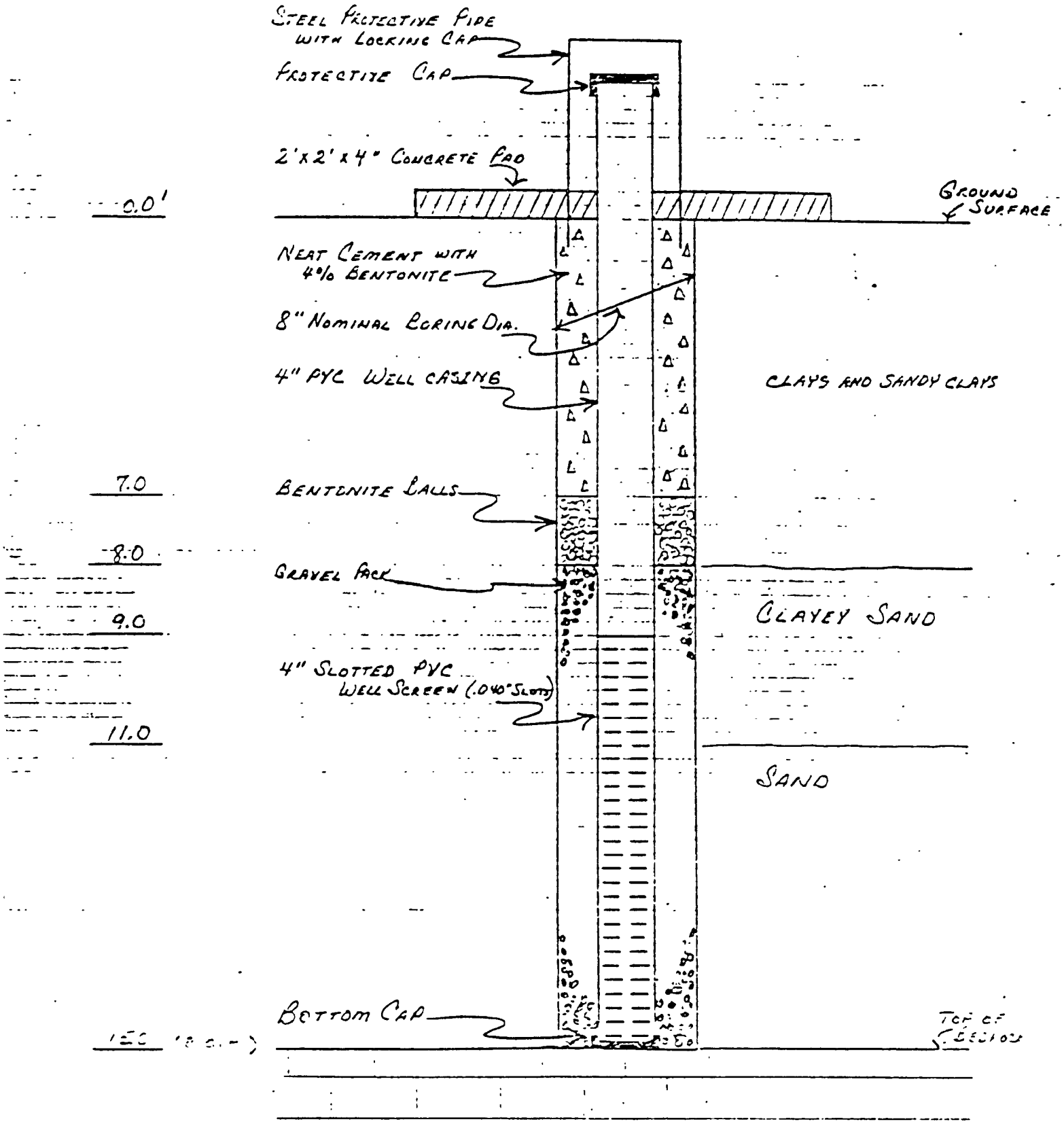
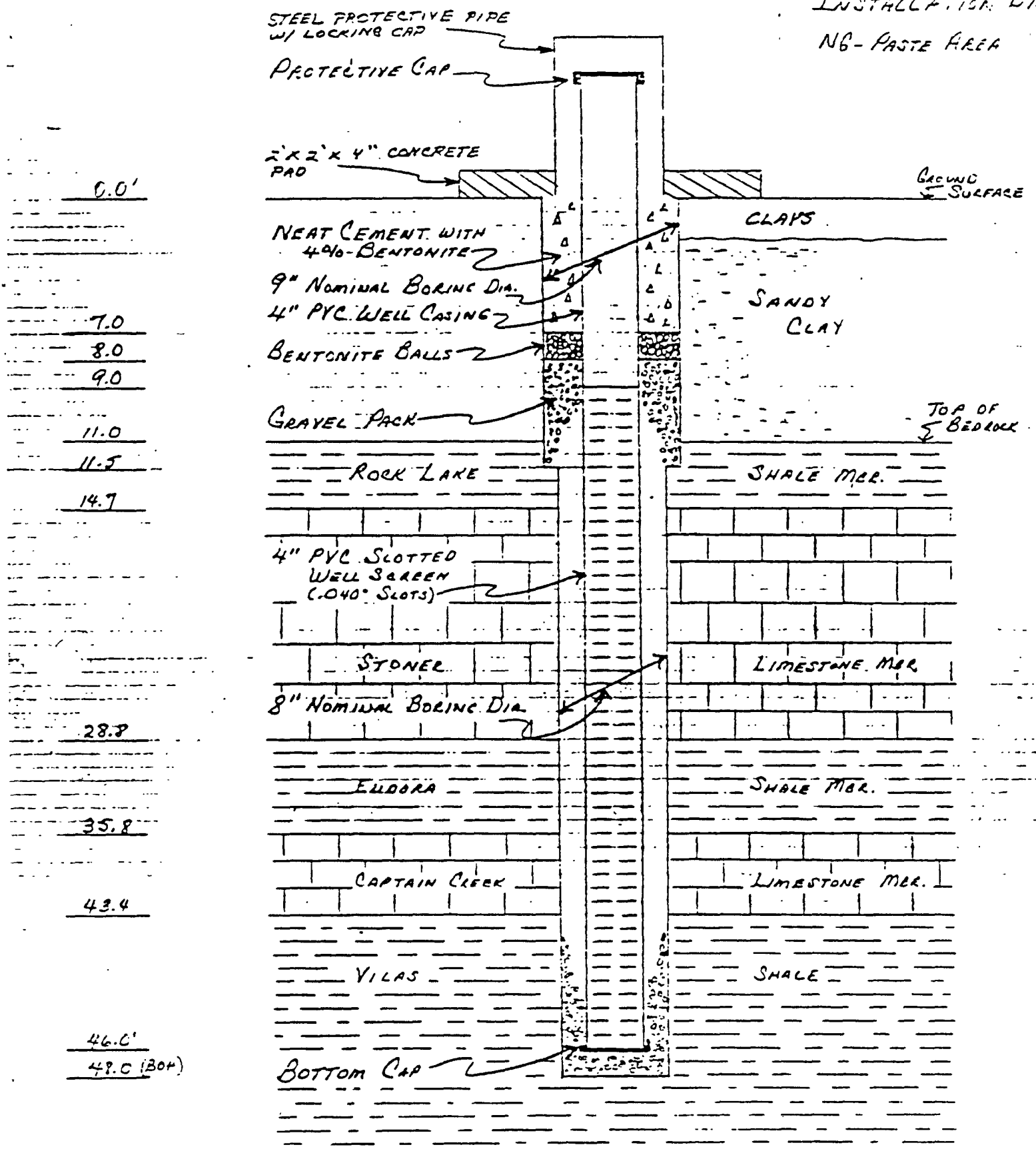
NITROGLYCERIN/PASTE A



INSTALLATION C1
NG-PASTE AREA



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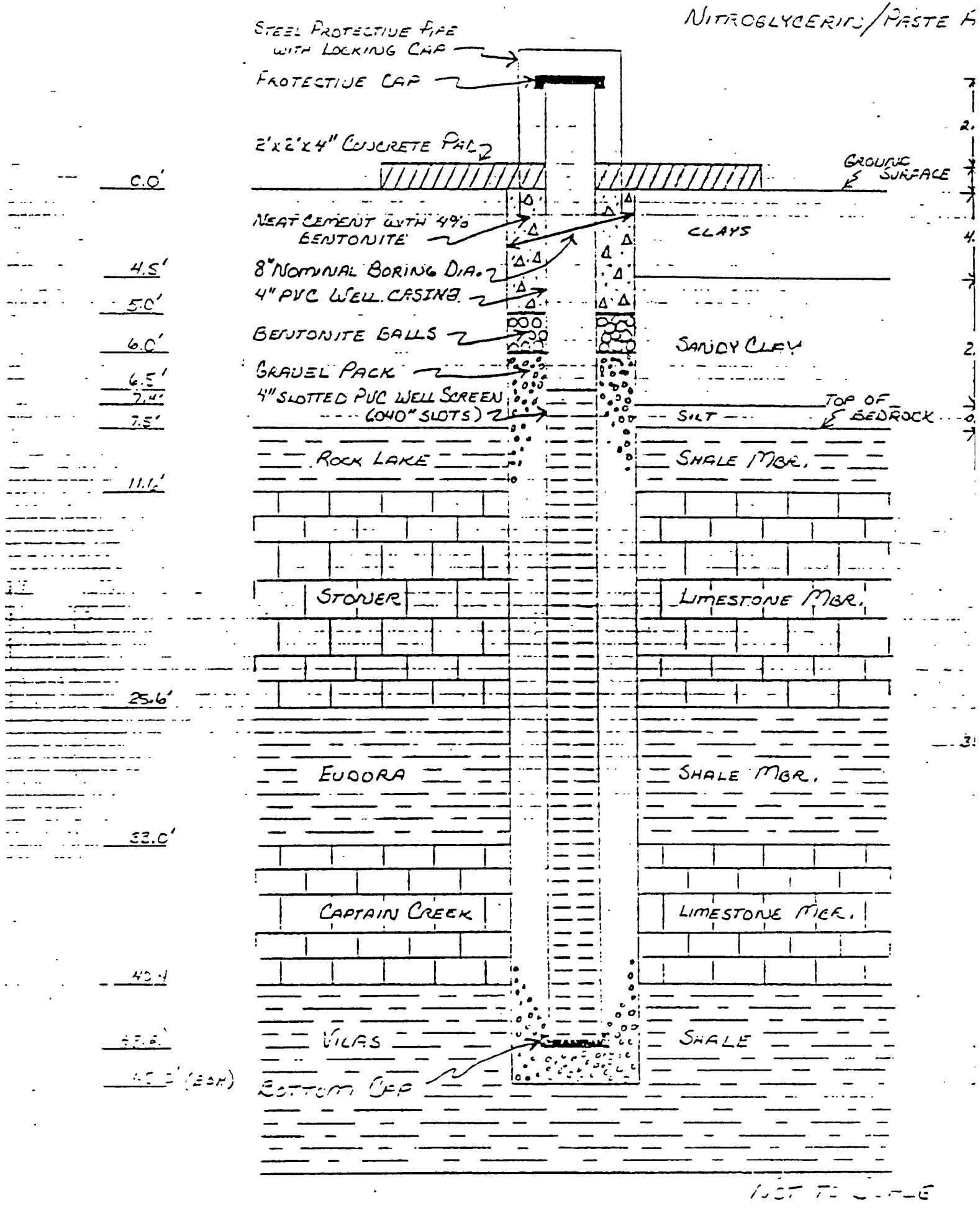
MW 81-26

SUNFLOWER AAP

NITROGLYCERIN/PASTE A



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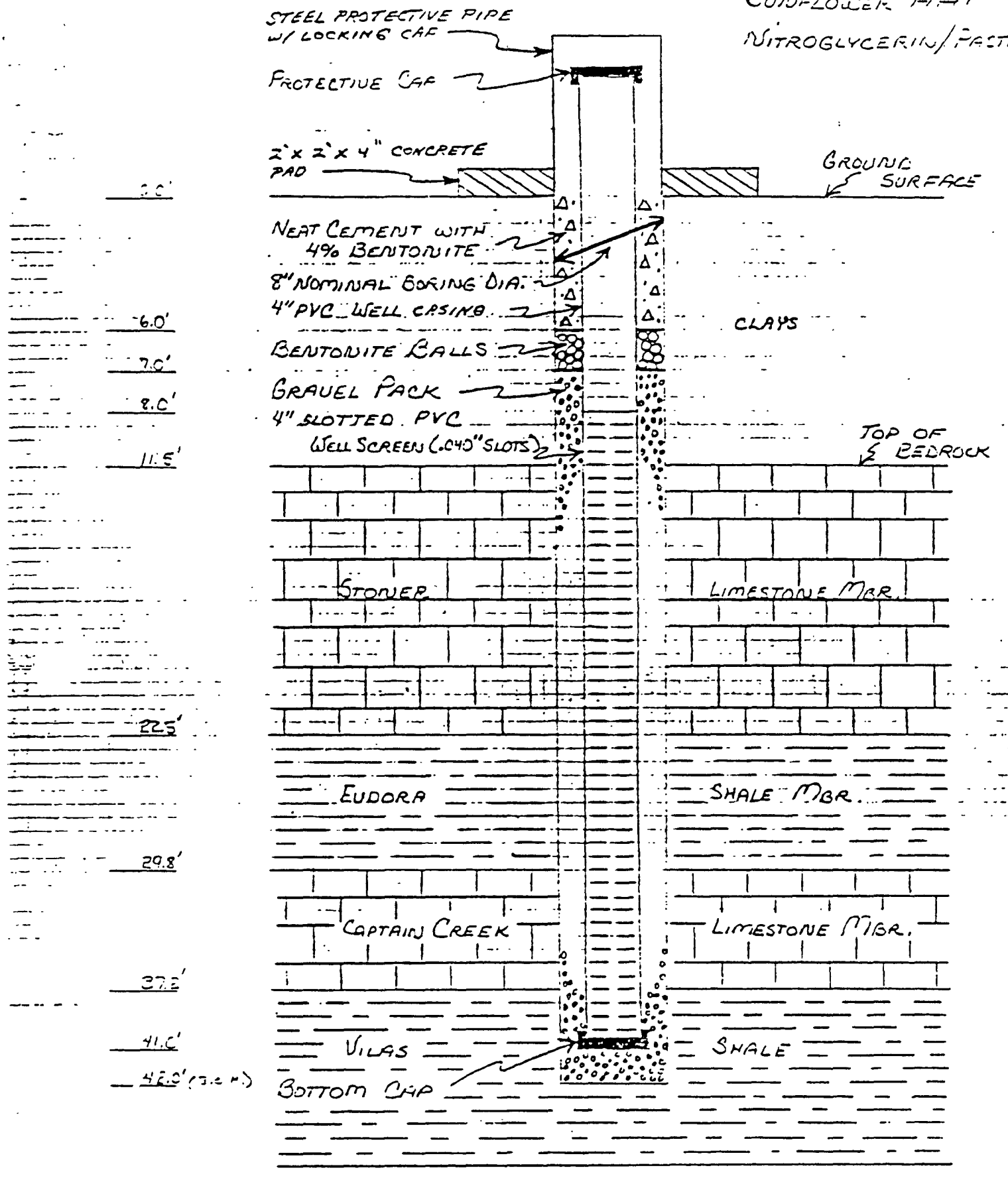
NITROGLYCERIN/PASTE



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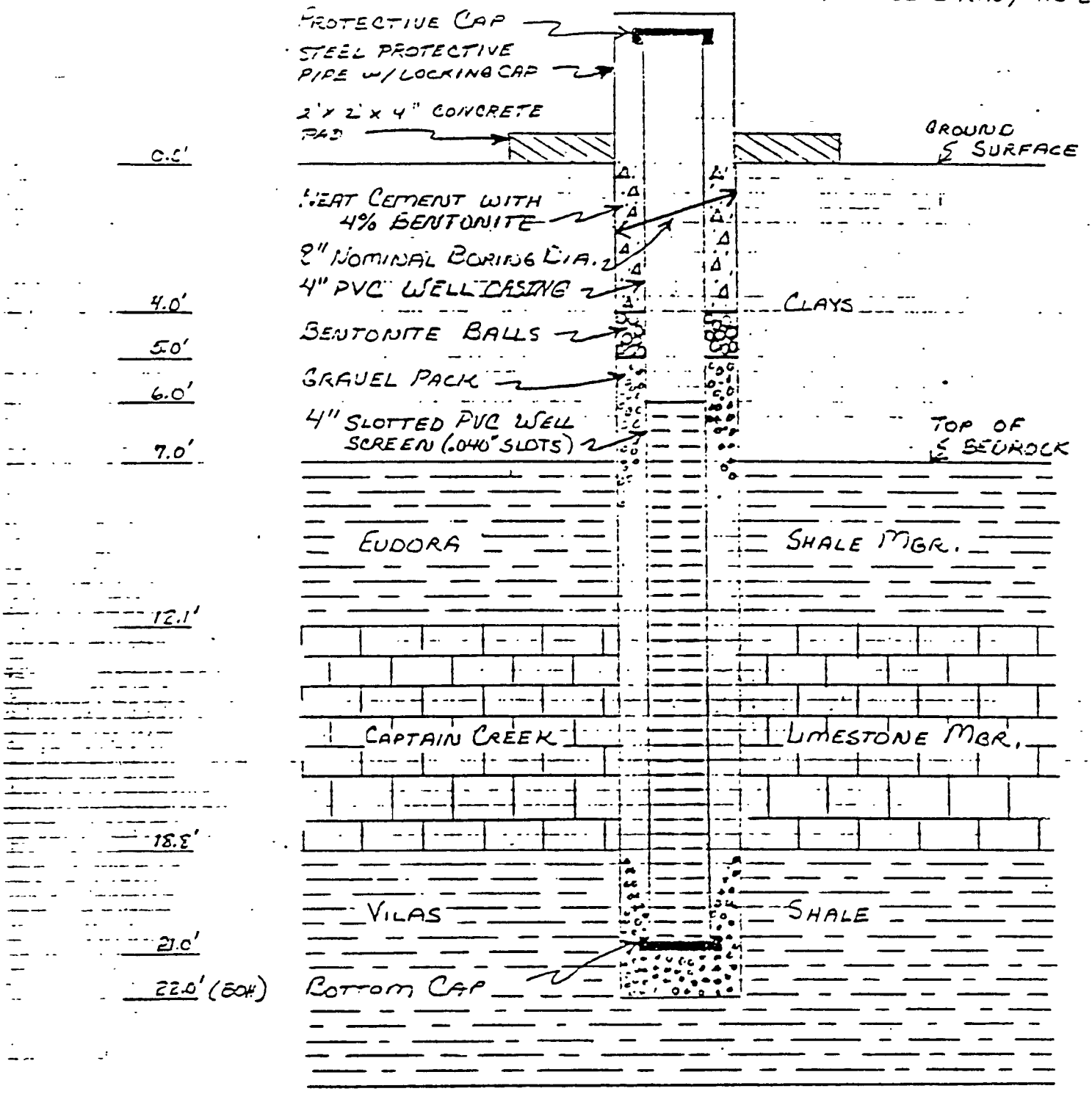
MW 81-28

SUNFLOWER AAP

NITROGLYCERIN/PASTE AREA



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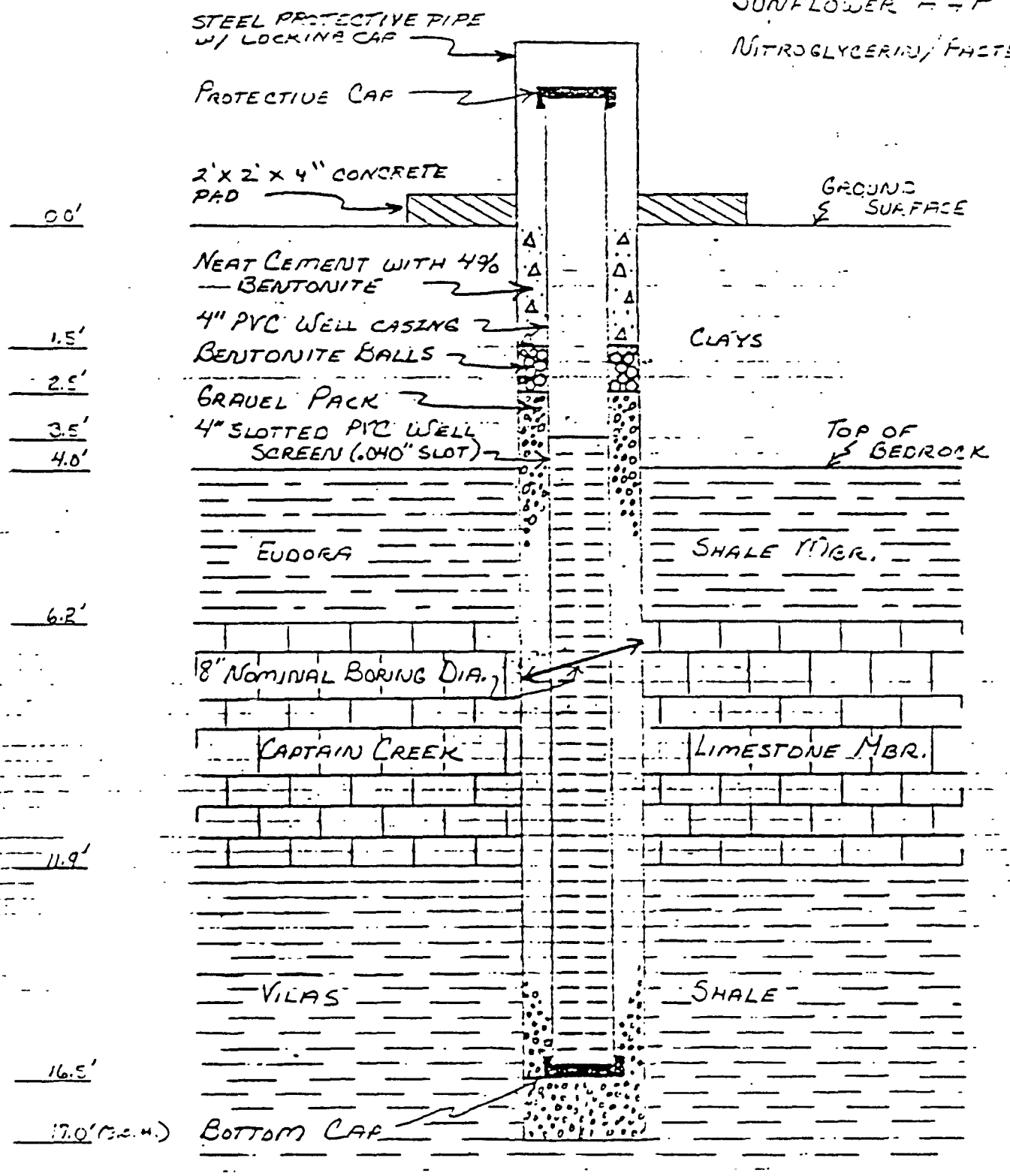
SUNFLOWER A&P

NITROGLYCERIN/PACTE AR



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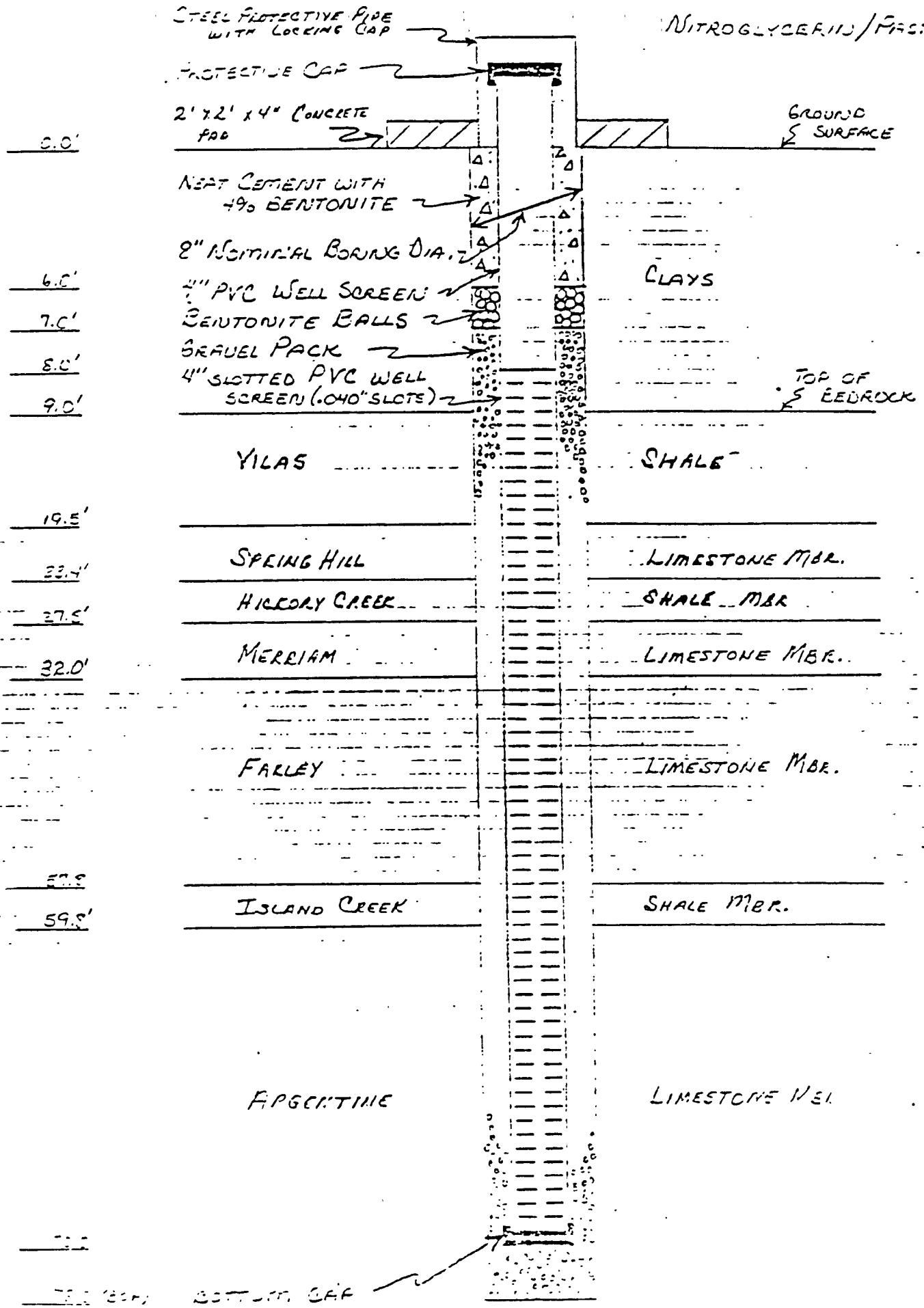
MW 81-30

SUNFLOWER AAP

NITROGLYCERIN/PASTE I-

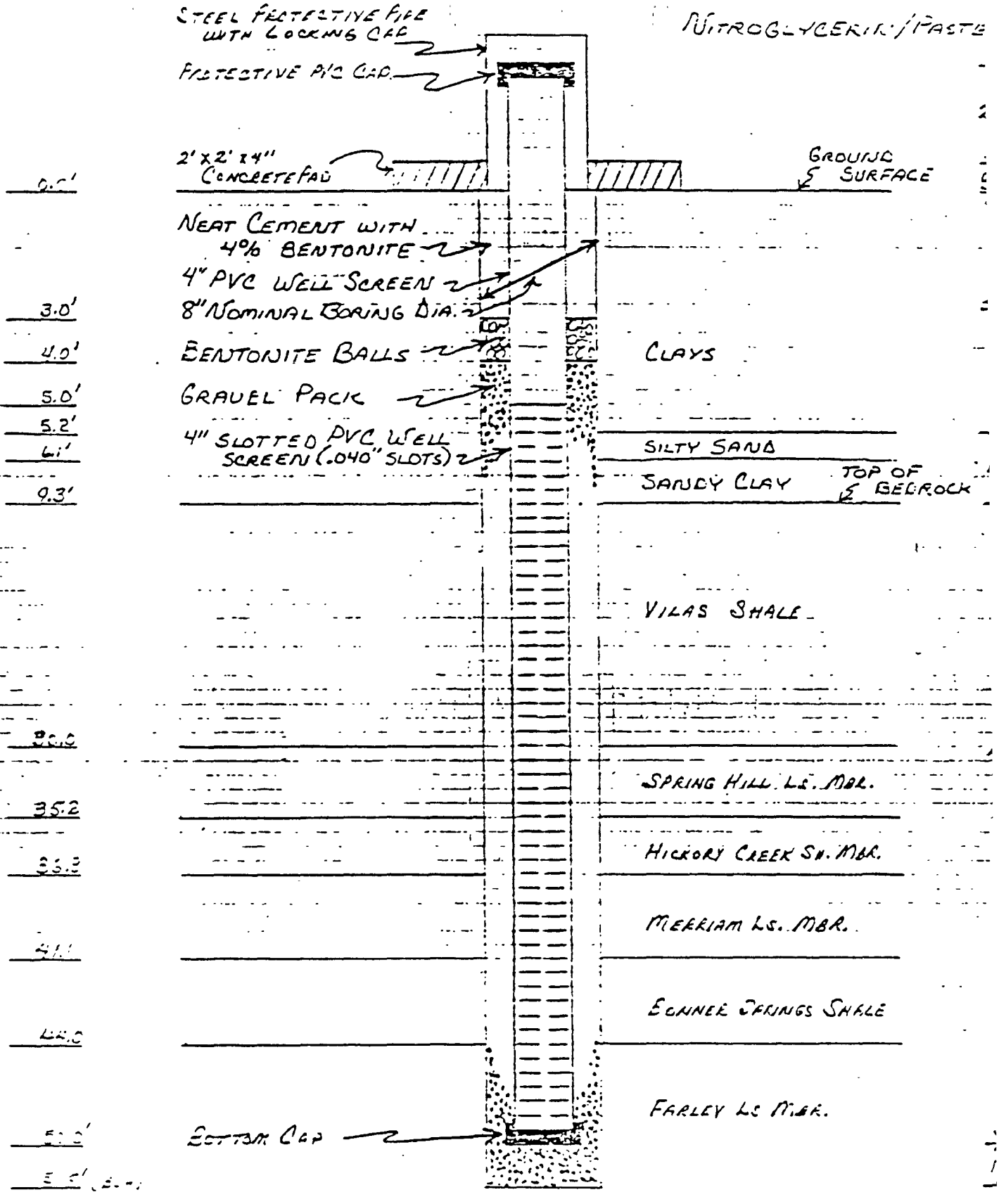


NOT TO SCALE

MW 81-31

SUNFLOWER AAP

NITROGLYCERIN/PASTE

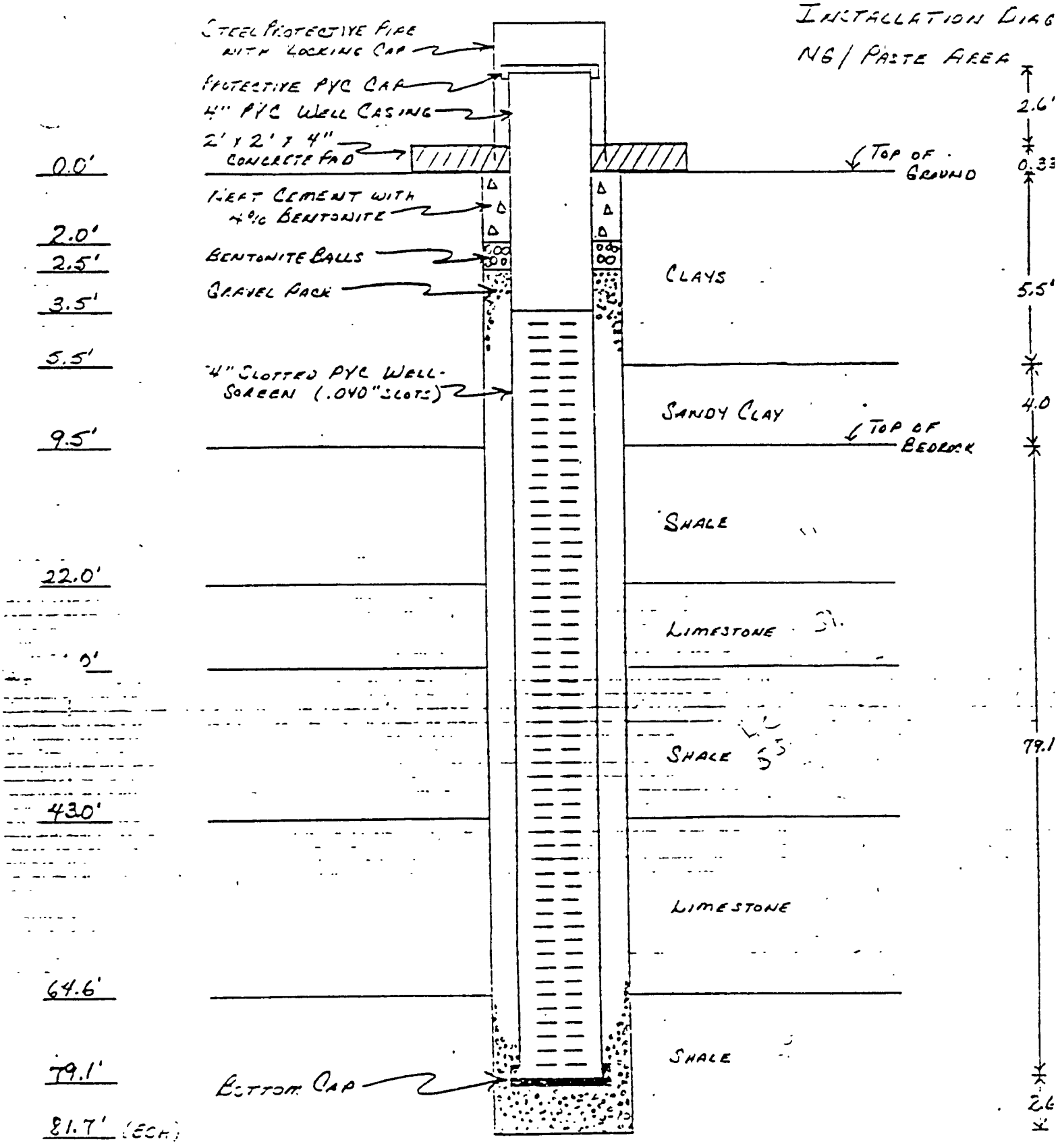


NOT TO SCALE

MW 21-32

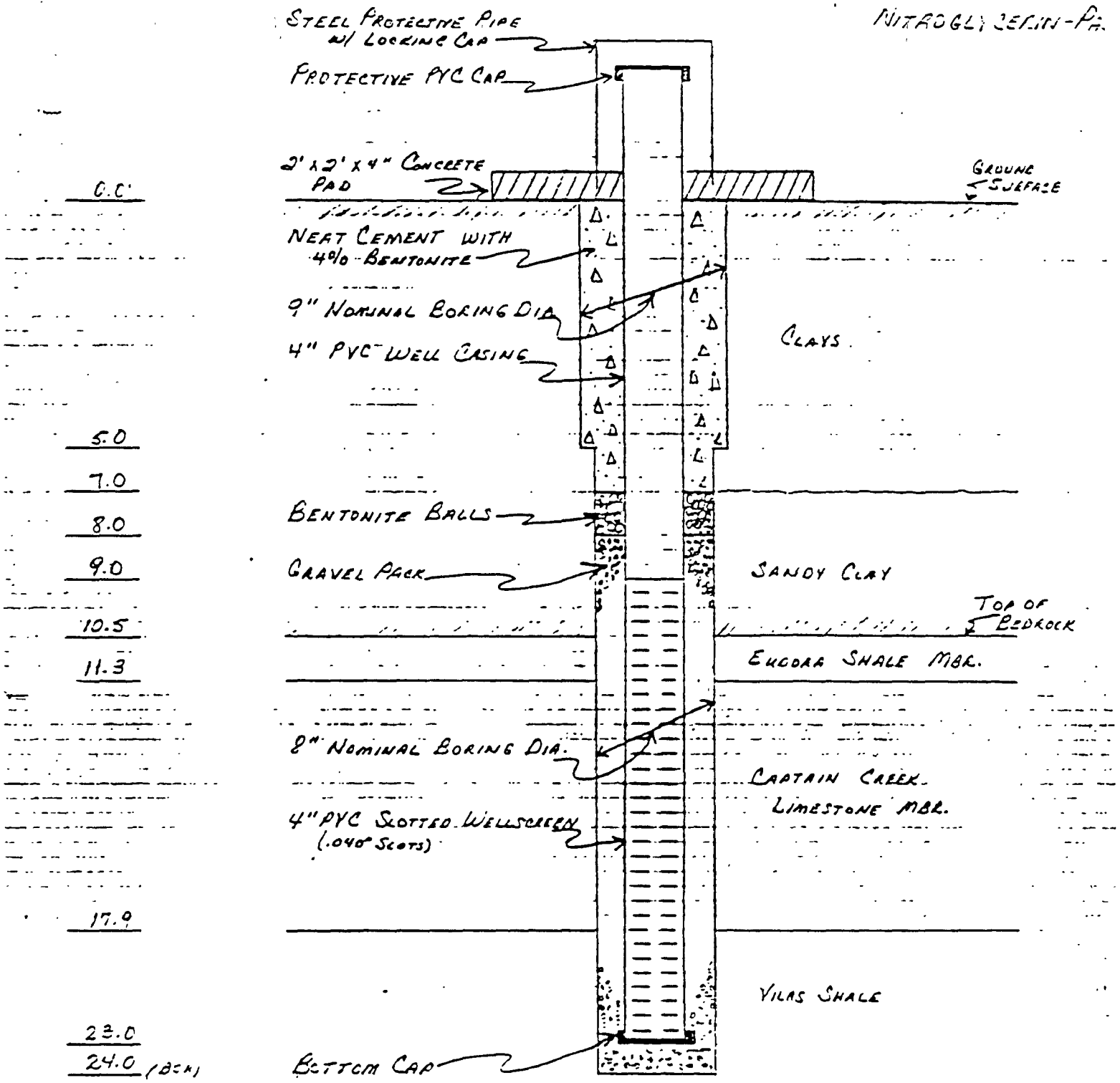
INSTALLATION DIAG

NG / PASTE AREA



NOT TO SCALE

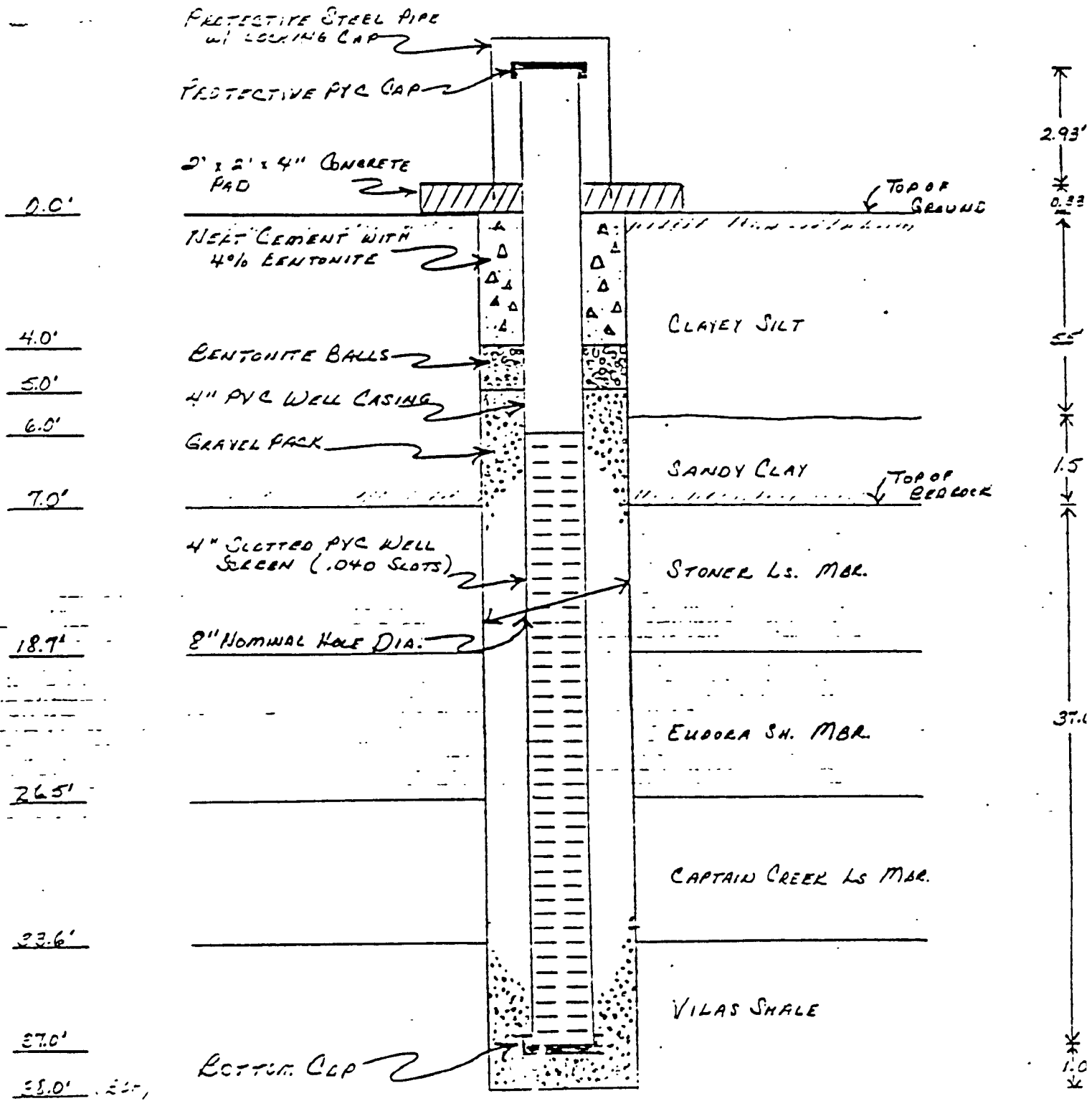
MW 81-32
INSTALLATION L
NITROGLYCERIN-PA



NOT TO SCALE

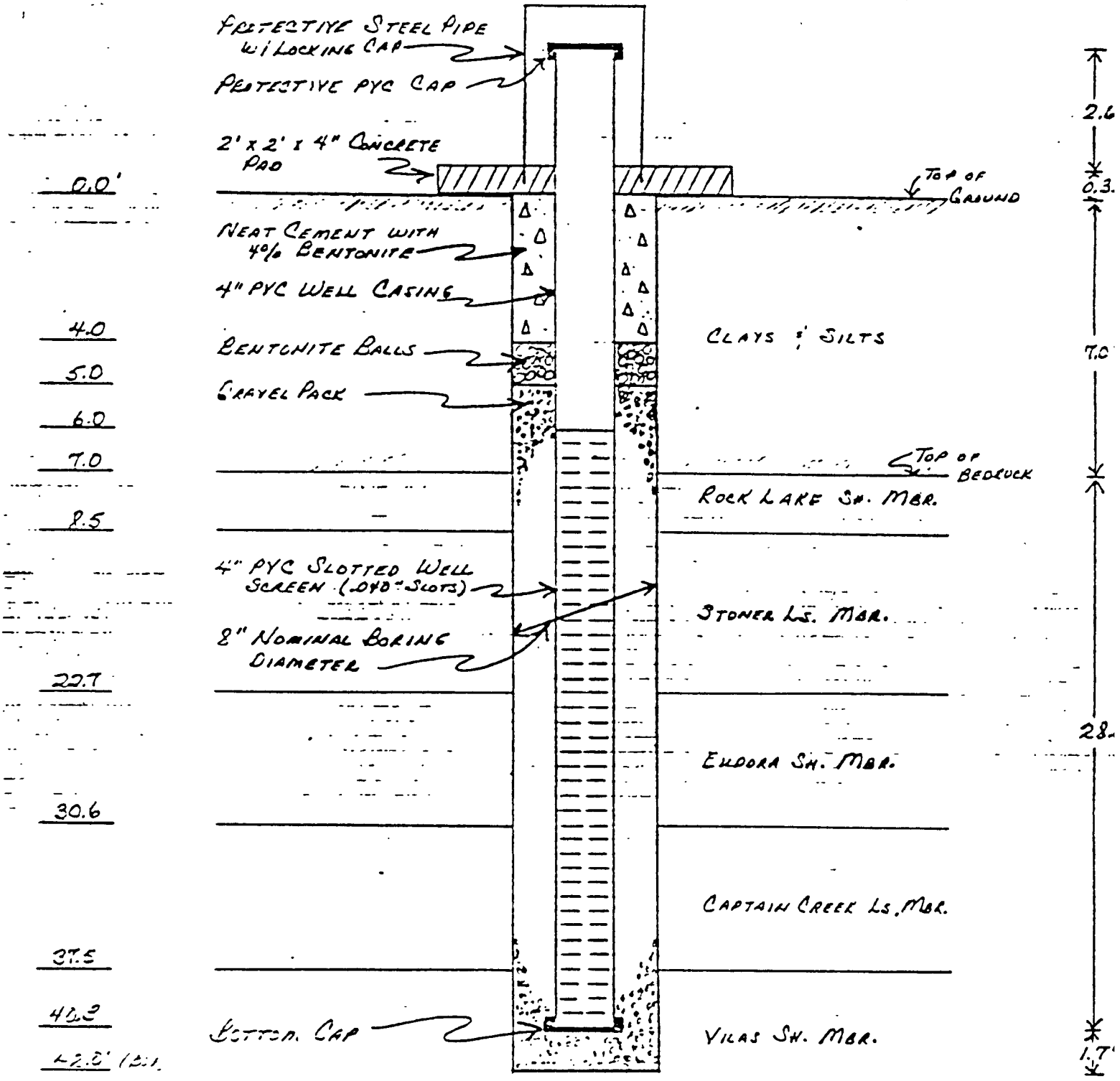
INSTALLATION DIAGR

NITROGLYCERIN/PASTE A



NOT TO SCALE

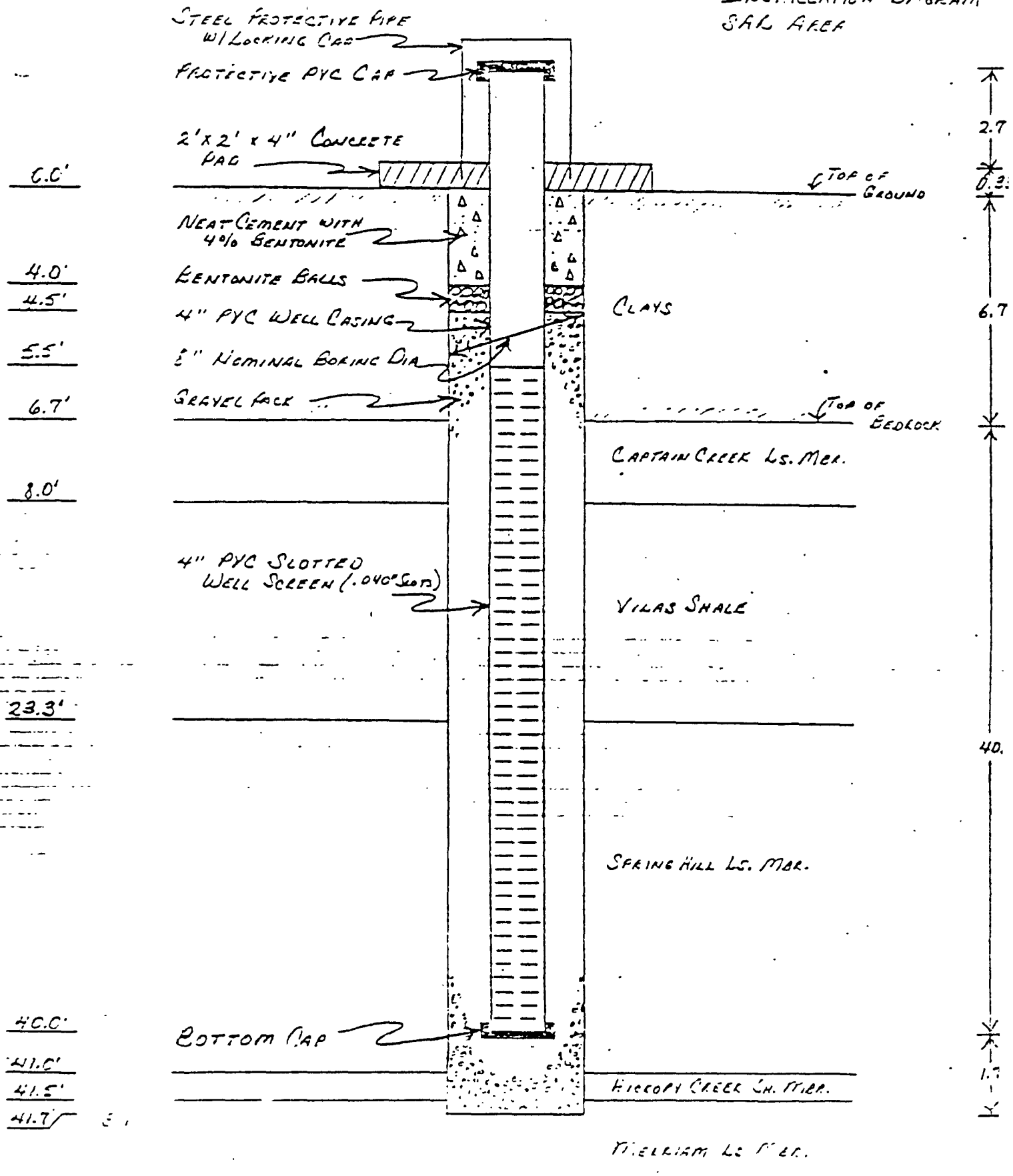
INSTALLATION DIAGRA
NITROGLYCERIN / PAST



NOT TO SCALE

MW 81-36

SUNFLOWER AAP
INSTALLATION DIAGRAM
SAL AREA

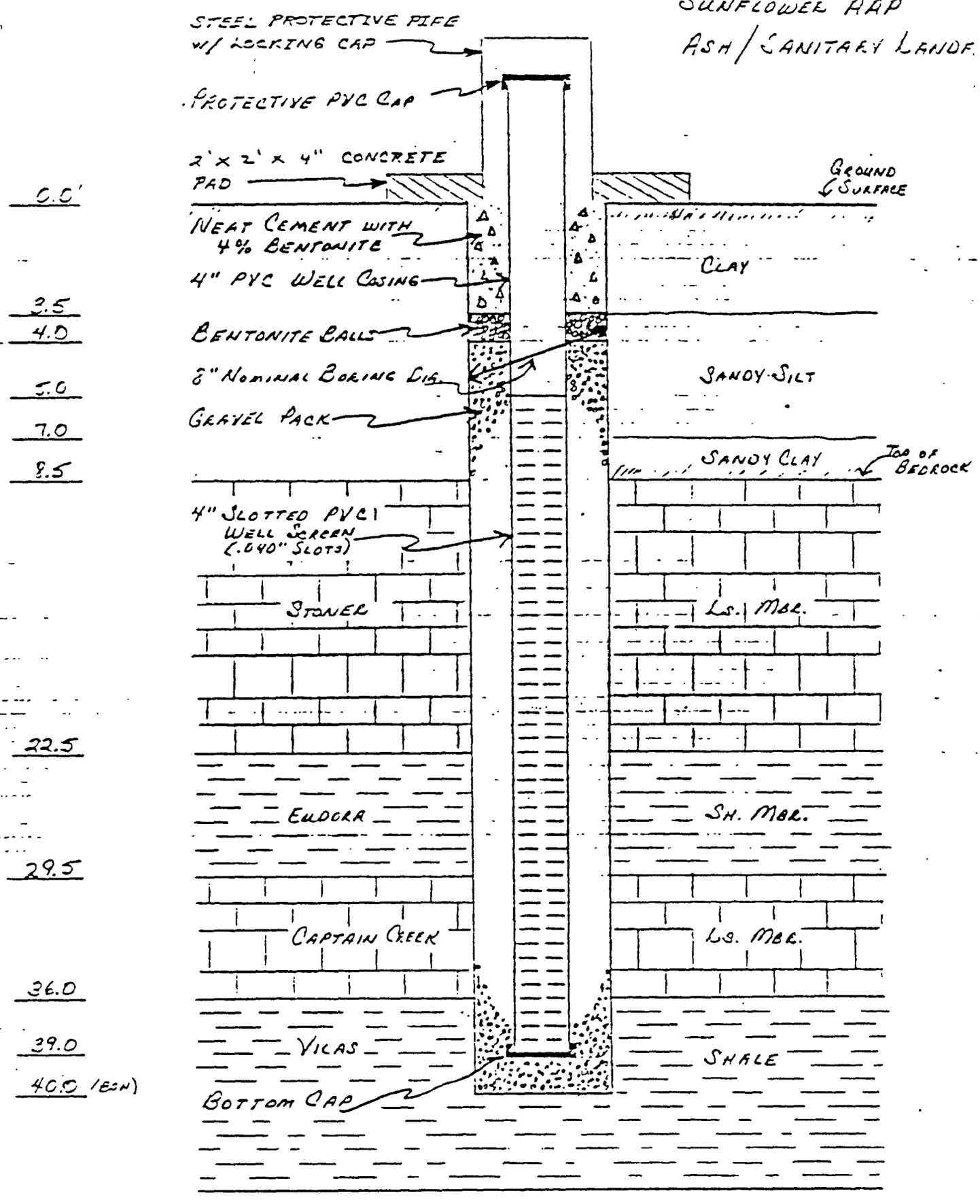


NOT TO SCALE

MW 81-16

SUNFLOWER AAP

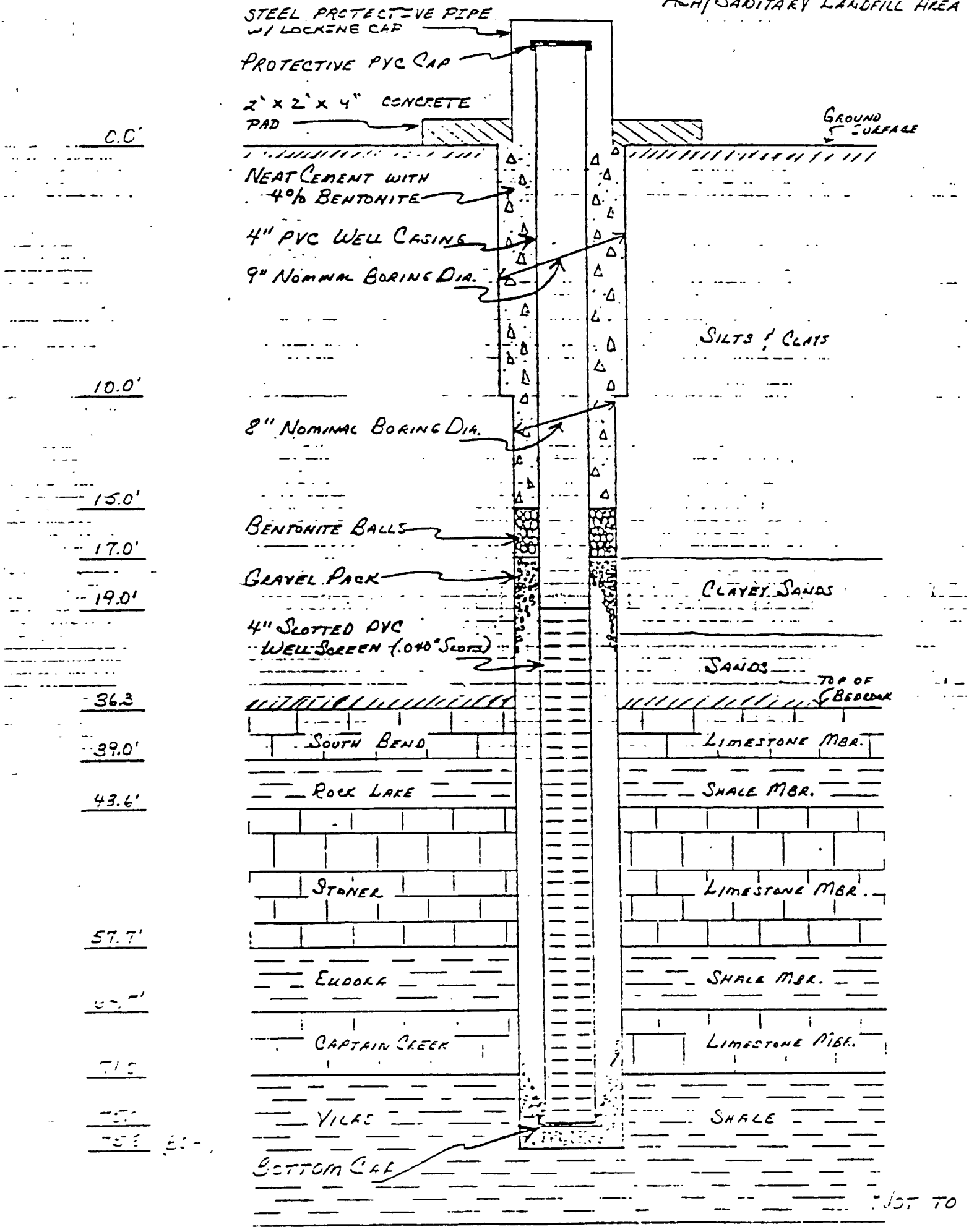
ASH / SANITARY LANDF.



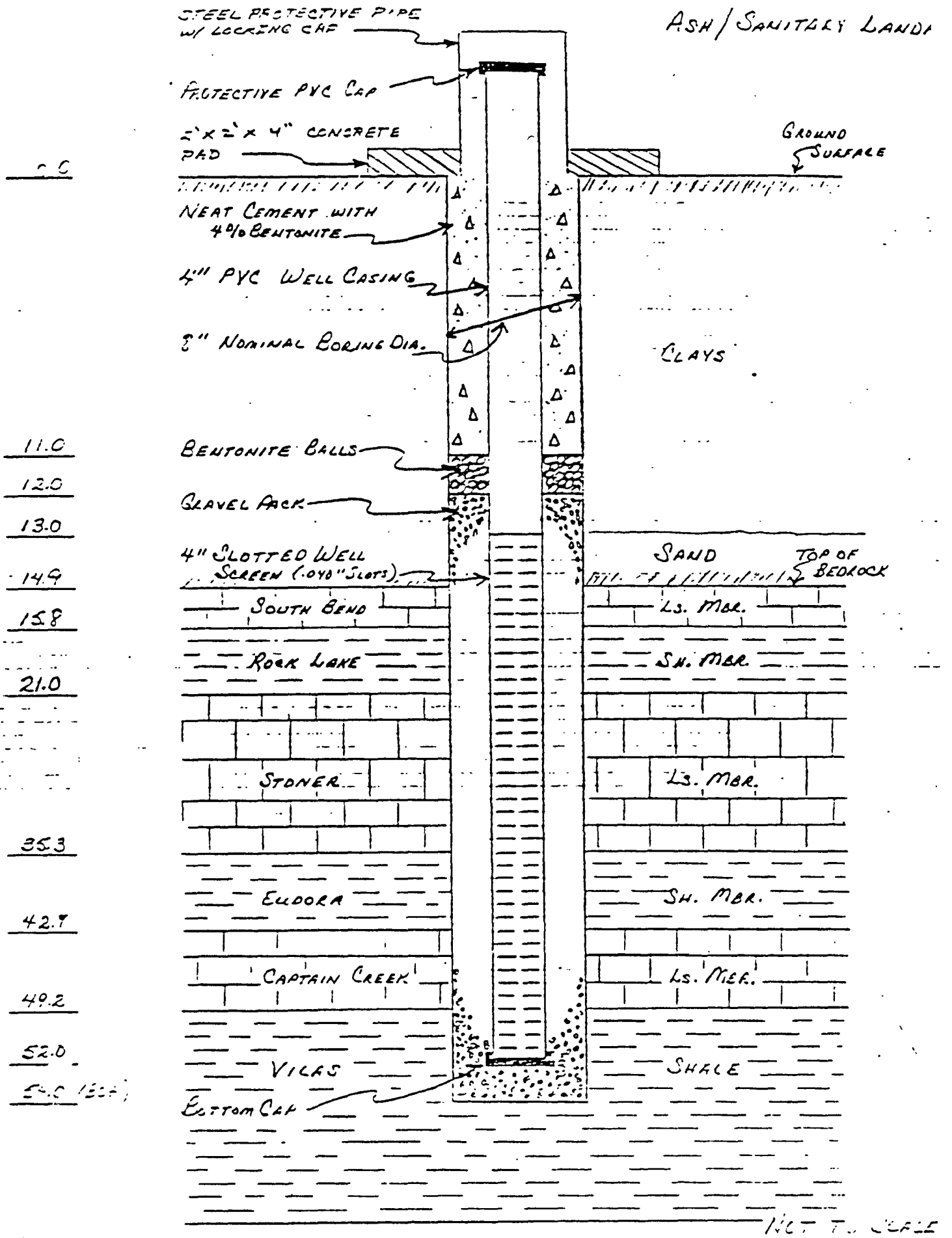
NOT TO SCALE

SUNFLOWER AAP

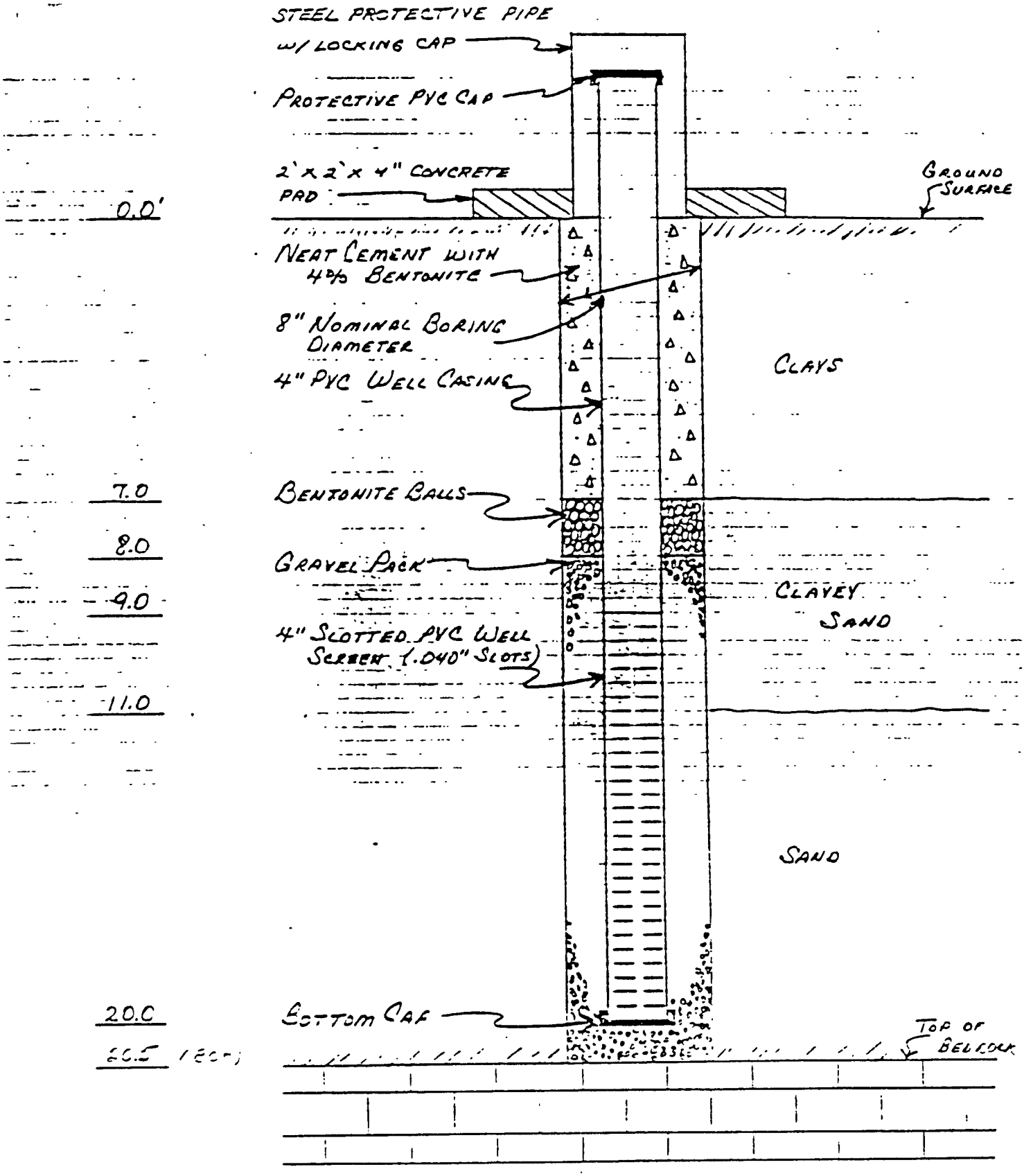
ASH/SANITARY LANDFILL AREA



SUNFLOWER A.A.P.
ASH / SANITARY LANDI



SUNFLOWER AAP
ASH/SANITARY LANDFIL

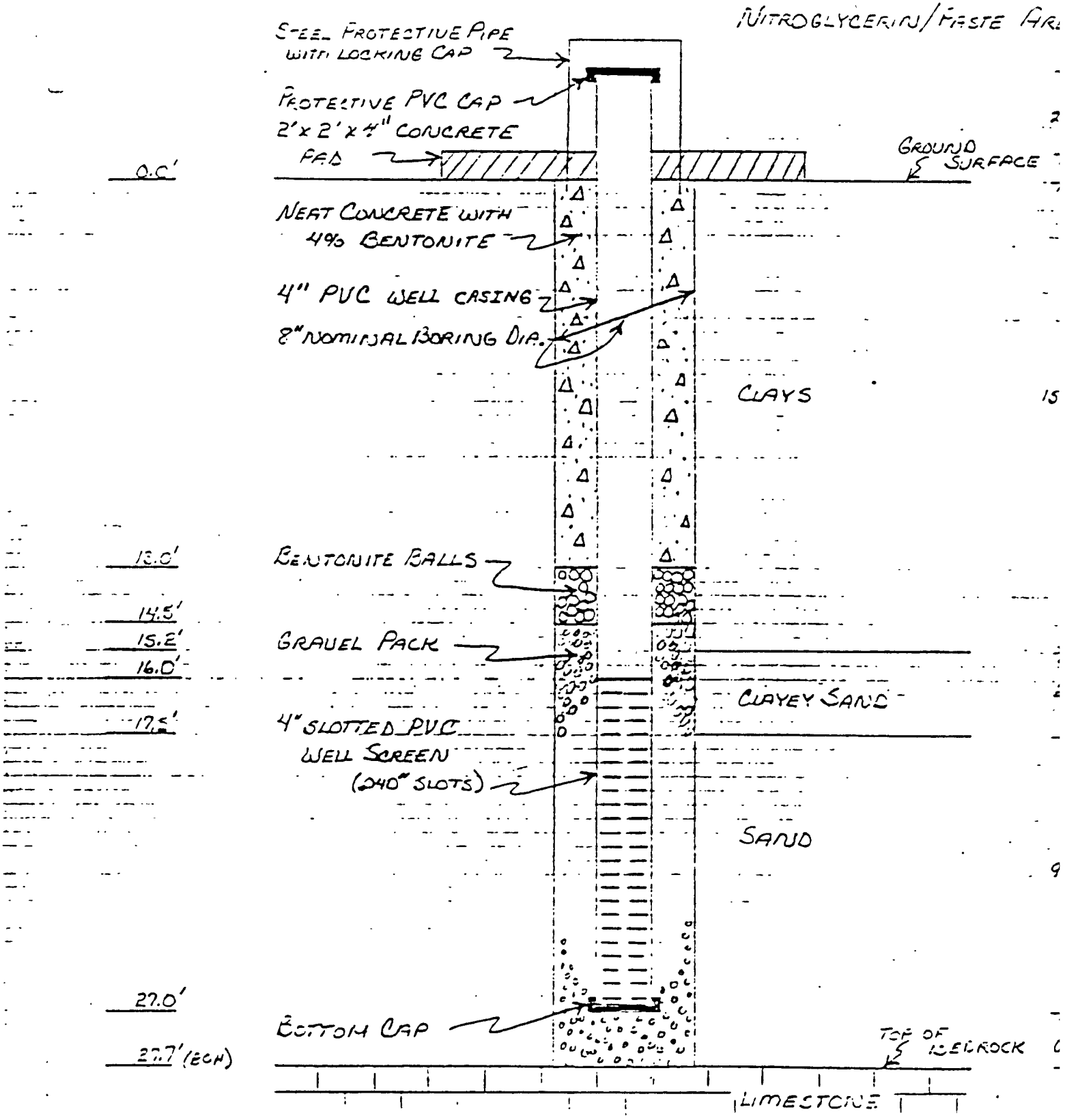


NOT TO SCALE

MW 81-20

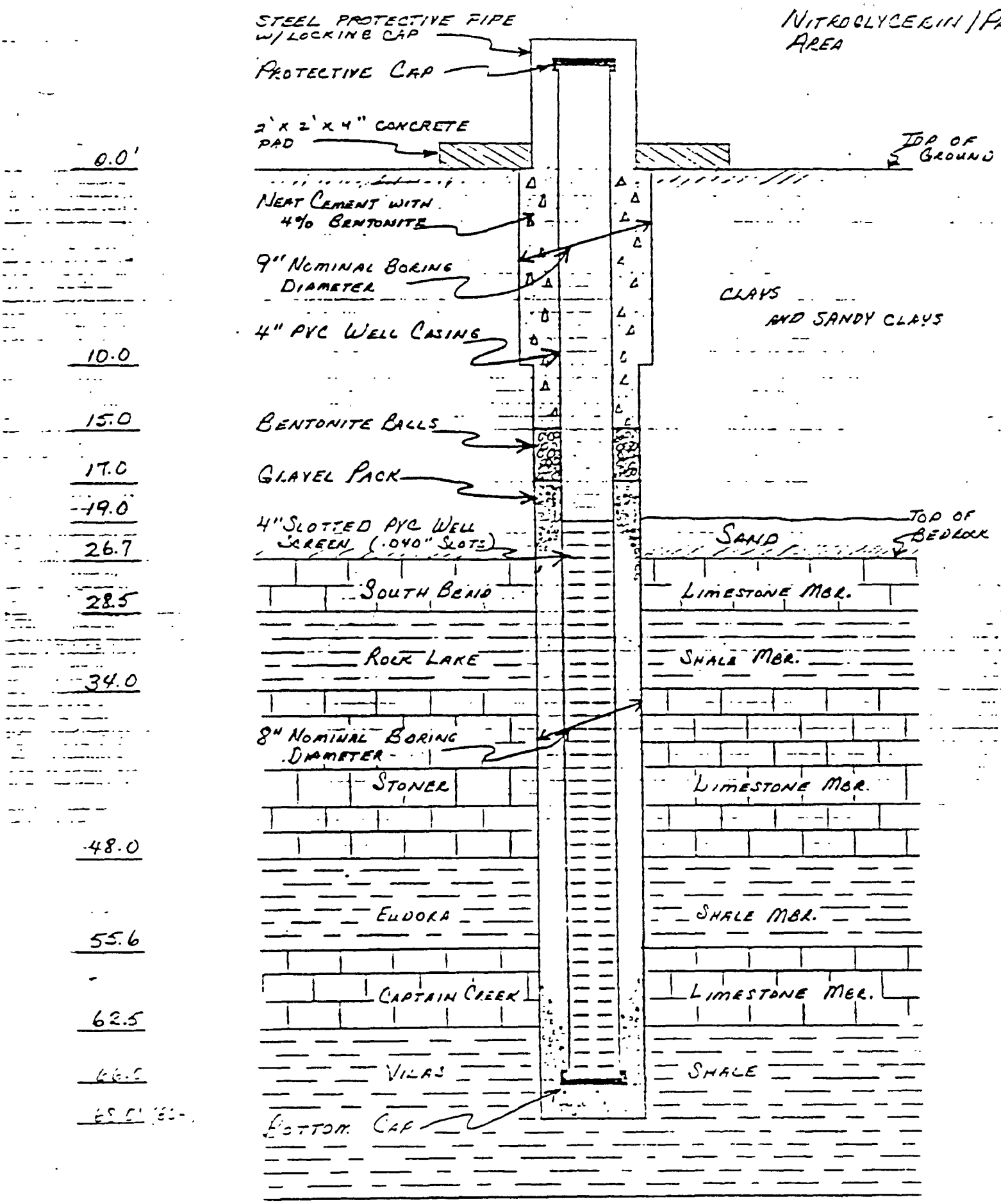
SUNFLOWER AAP

NITROGLYCERIN/PASTE AREA



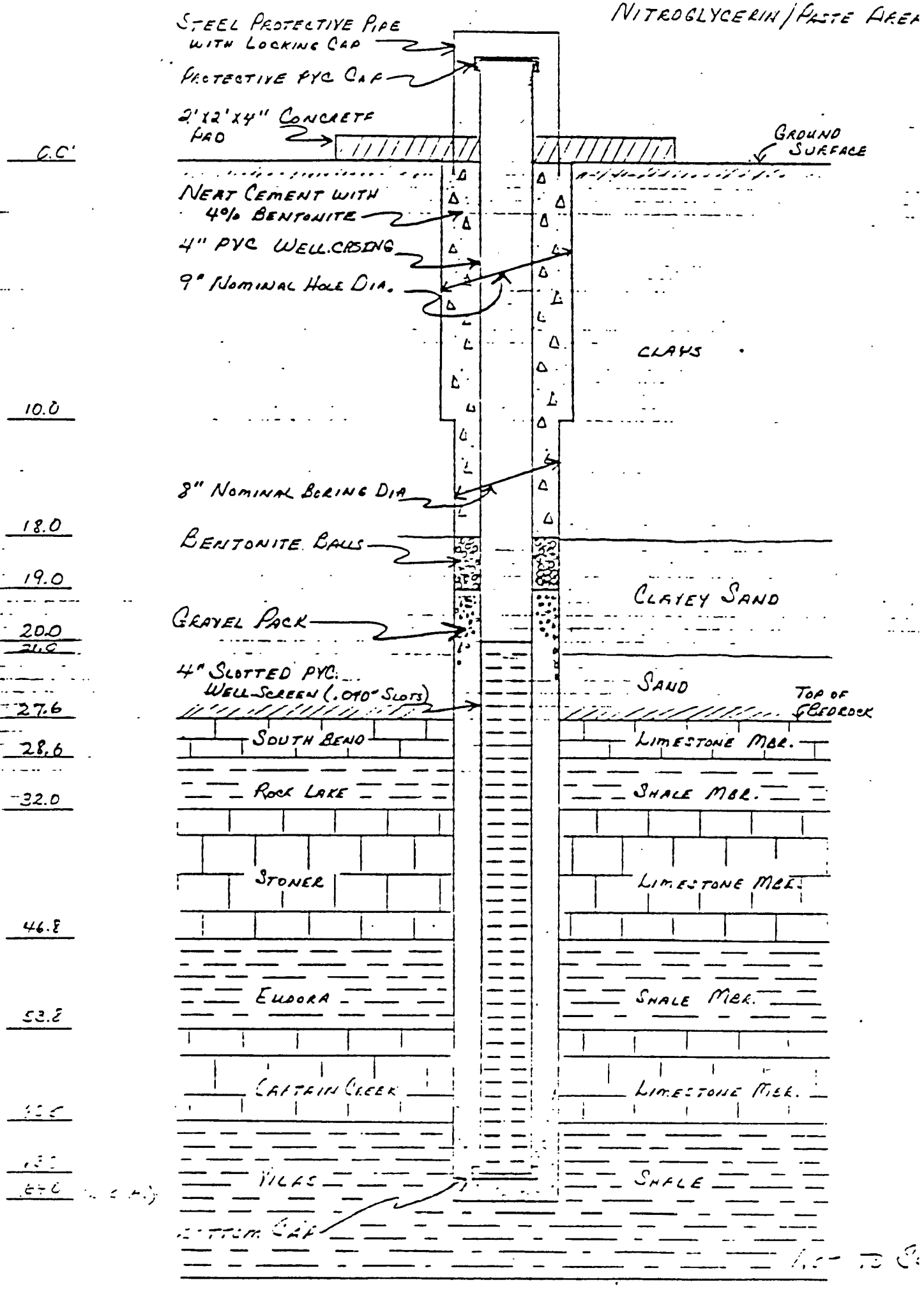
NOT TO SCALE

MW 81-21
SUNFLOWER AP
NITROGLYCERIN / PA
AREA

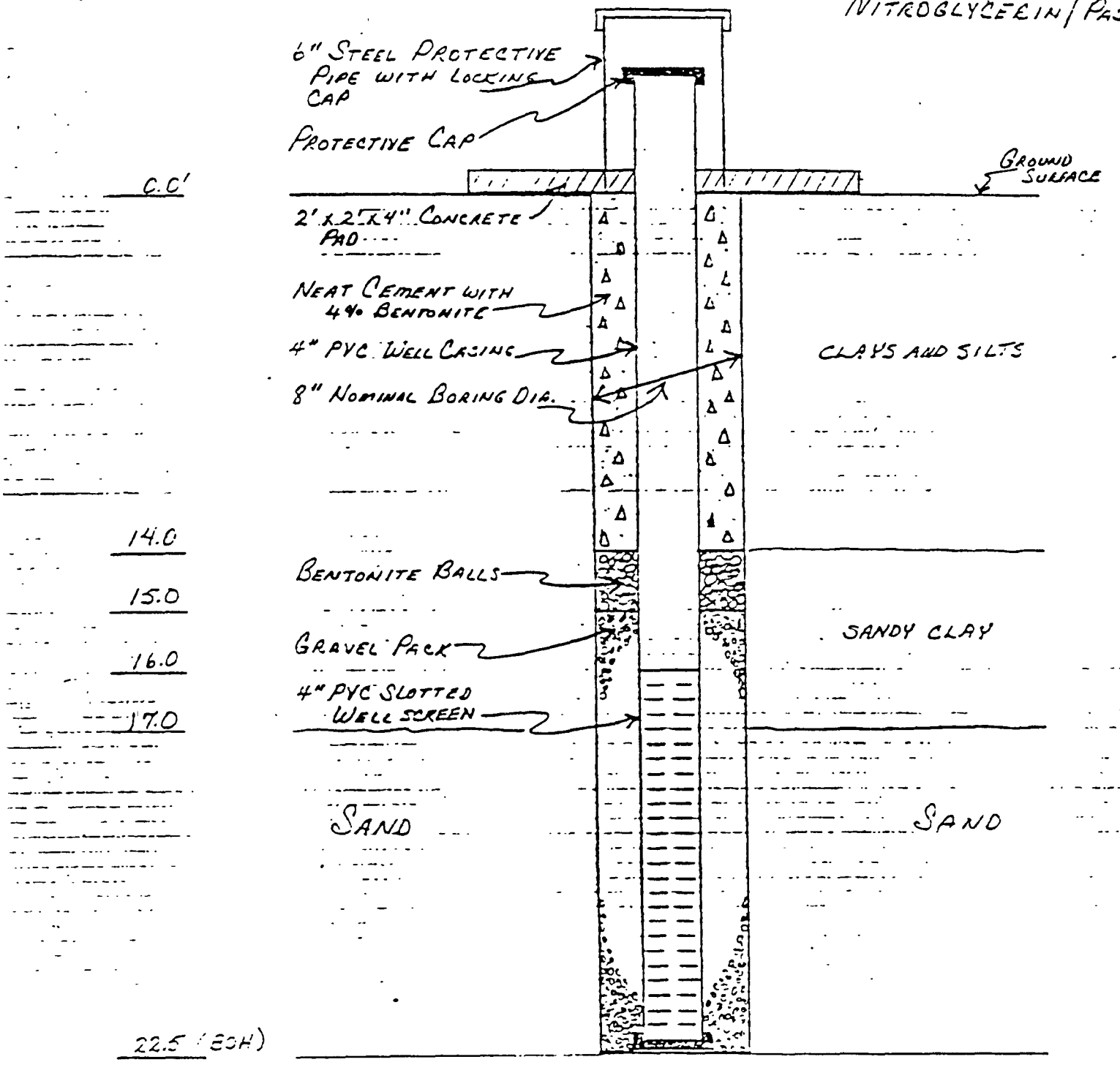


NOT TO SCA

MW 01-22
SUNFLOWER AAP
NITROGLYCERIN/PASTE AREA

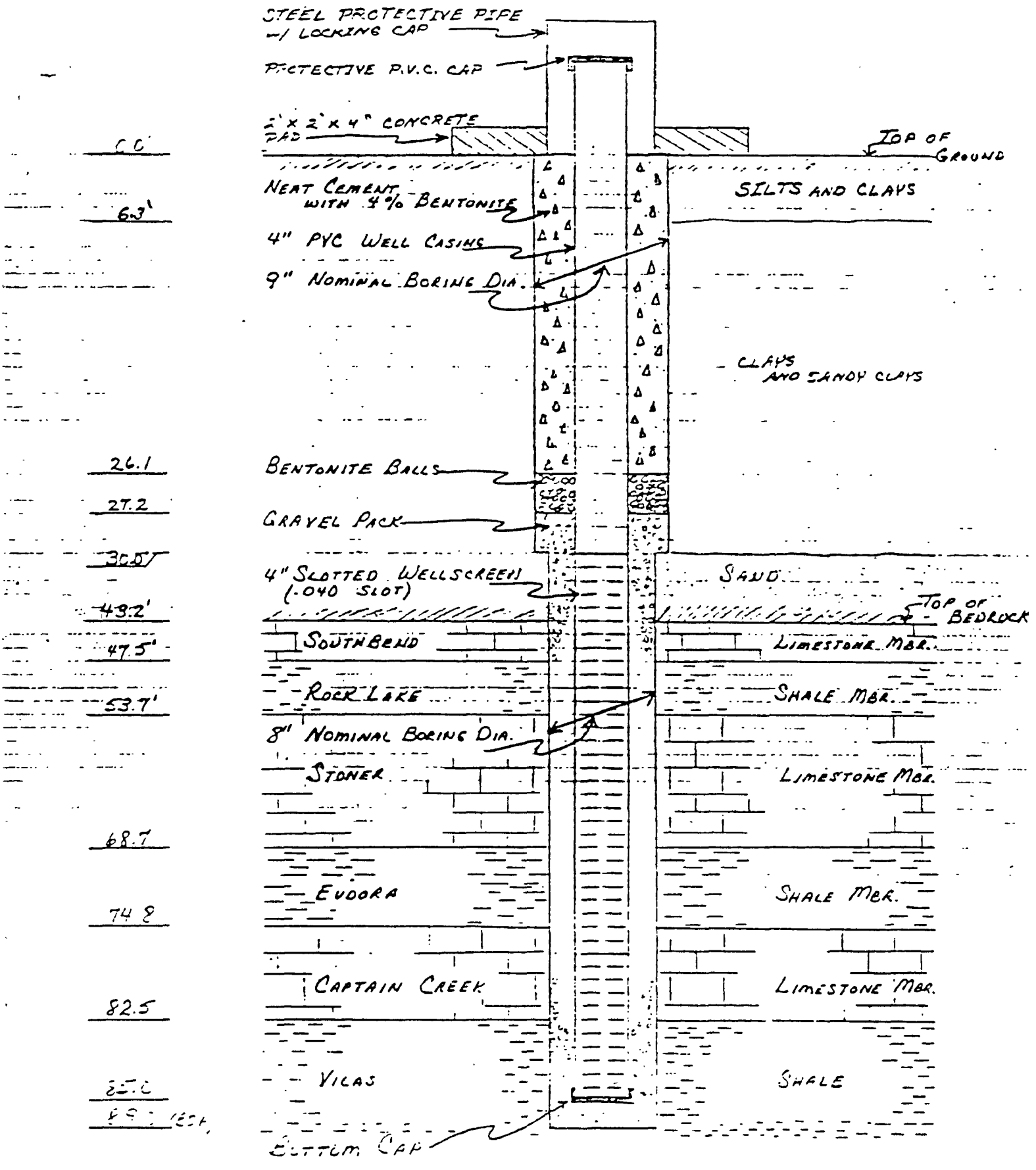


SUNFLOWER AAP
NITROGLYCERIN/PASTE



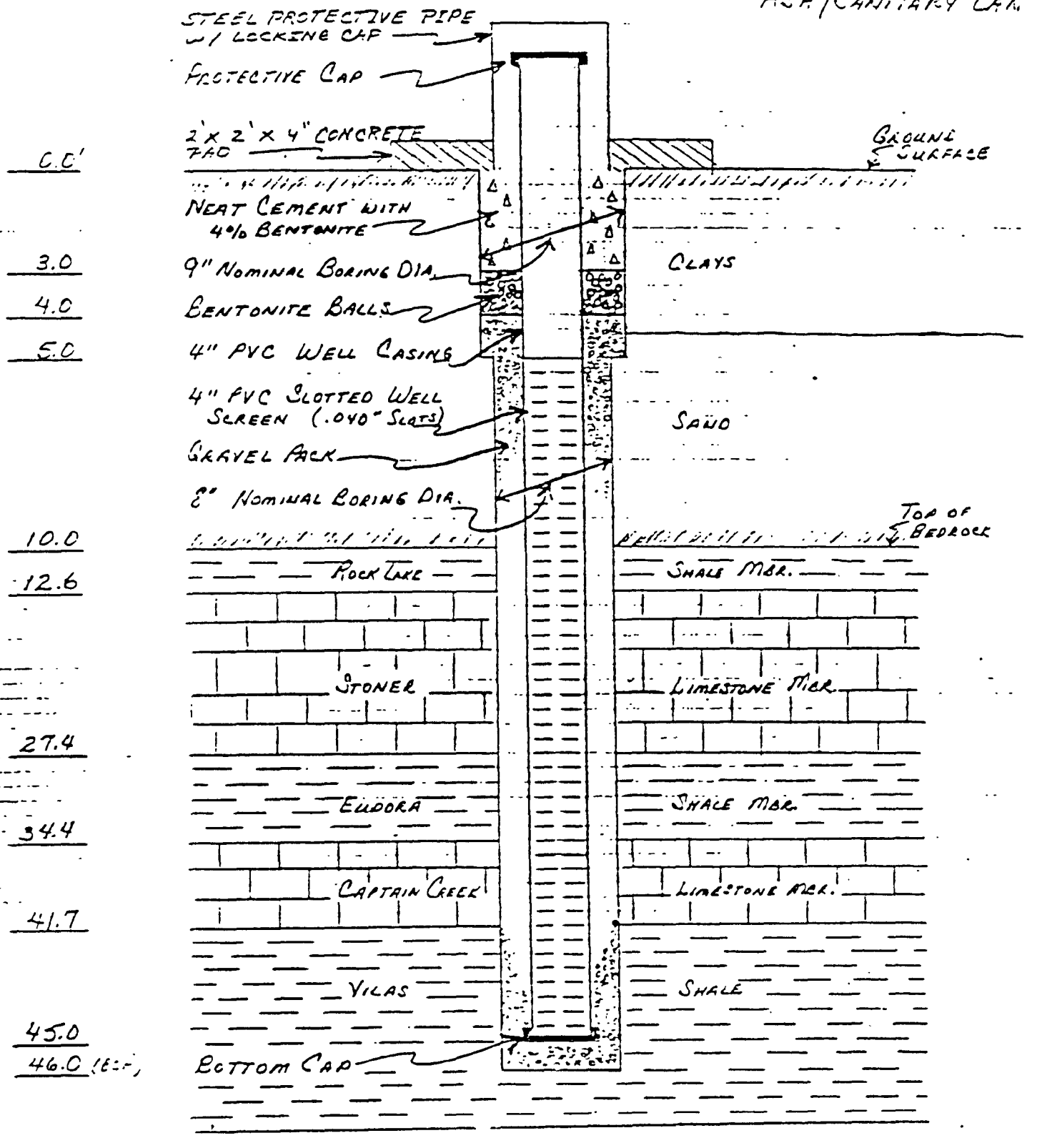
NOT TO SCALE

SUNFLOWER
CARBIDE AR.

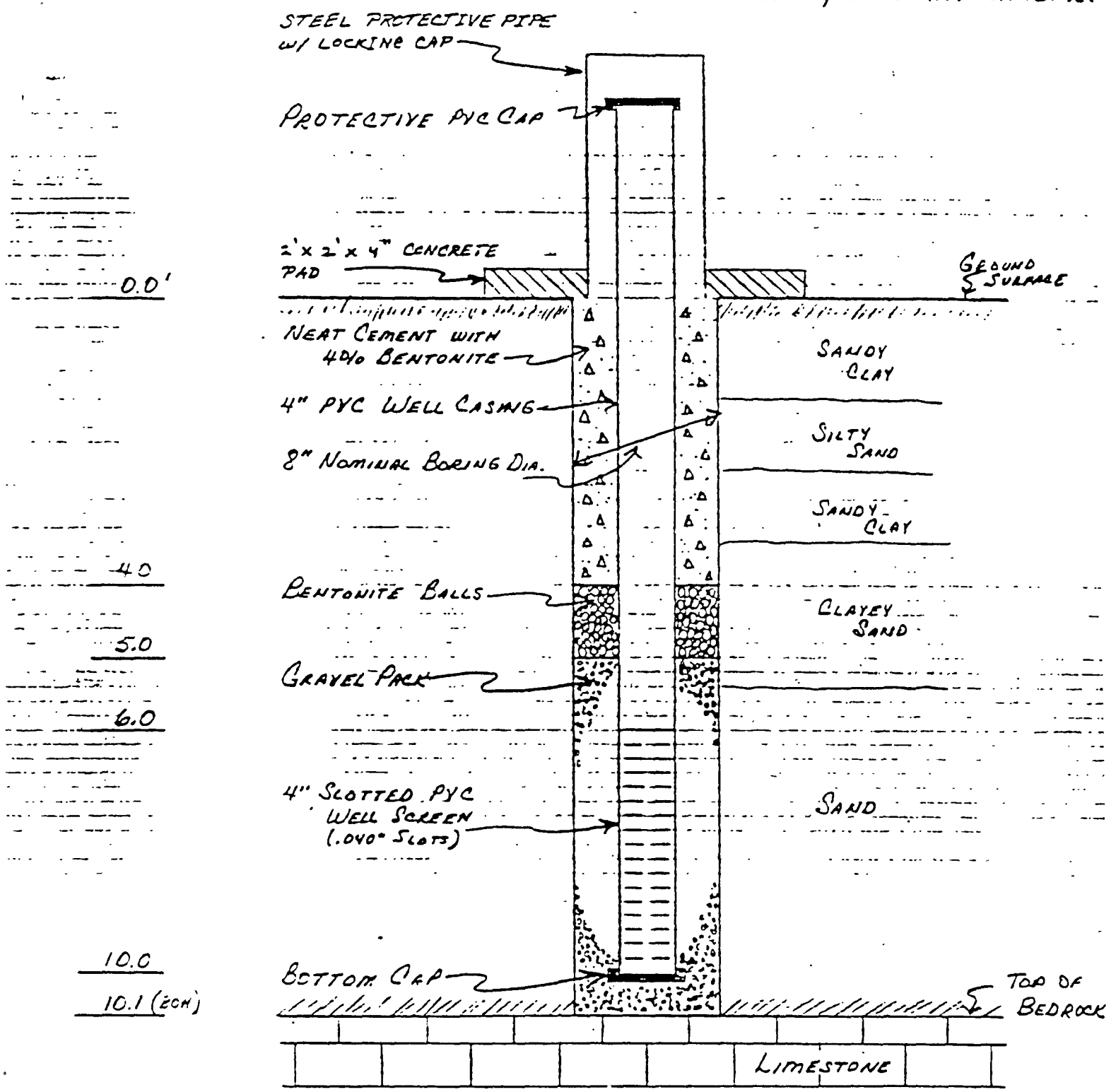


No Scale

MW 81-10
SUNFLOWER AAP
ASH/SANITARY LAN.

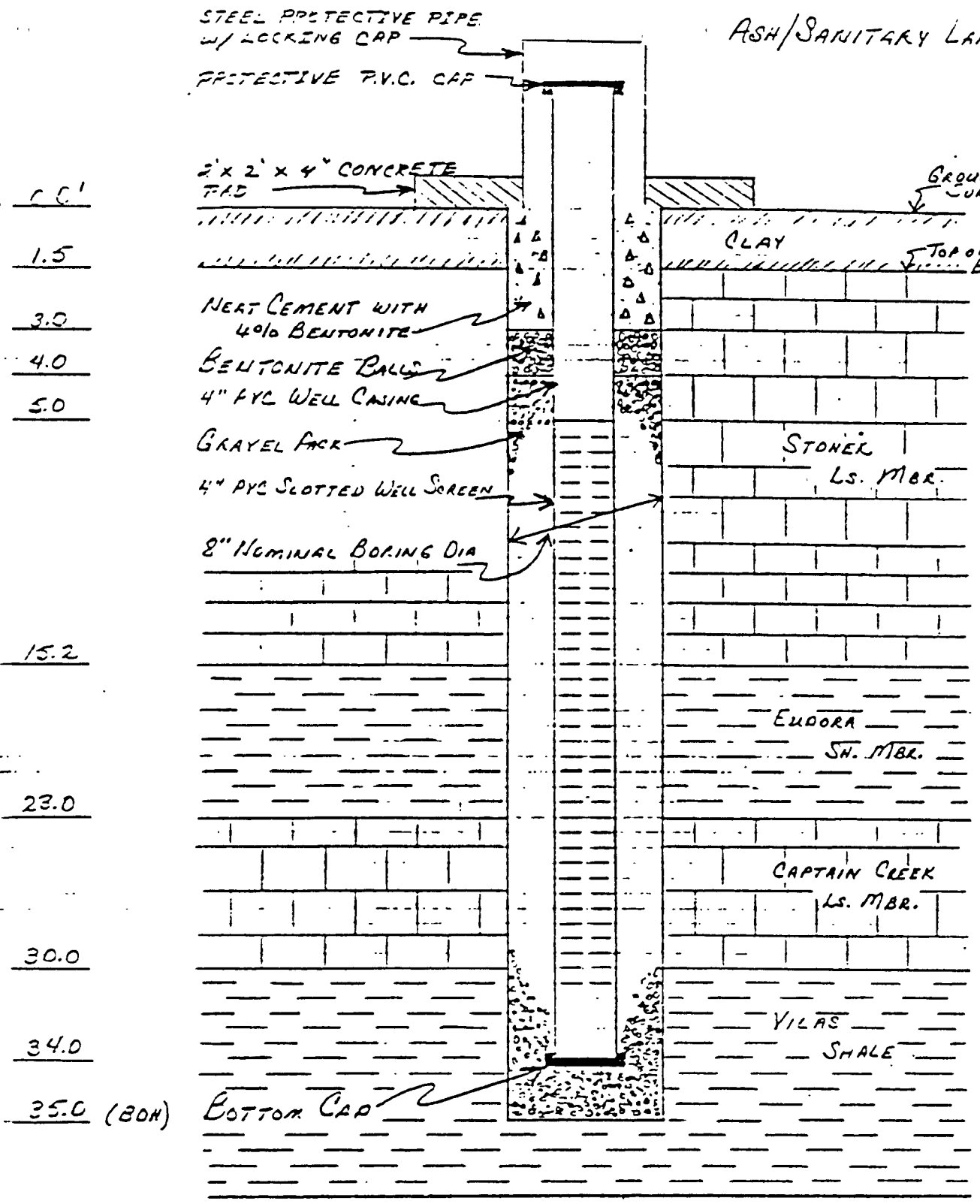


MW 81-11
SUNFLOWER AAP
ASH / SANITARY LANDFILL



NOT TO SCALE

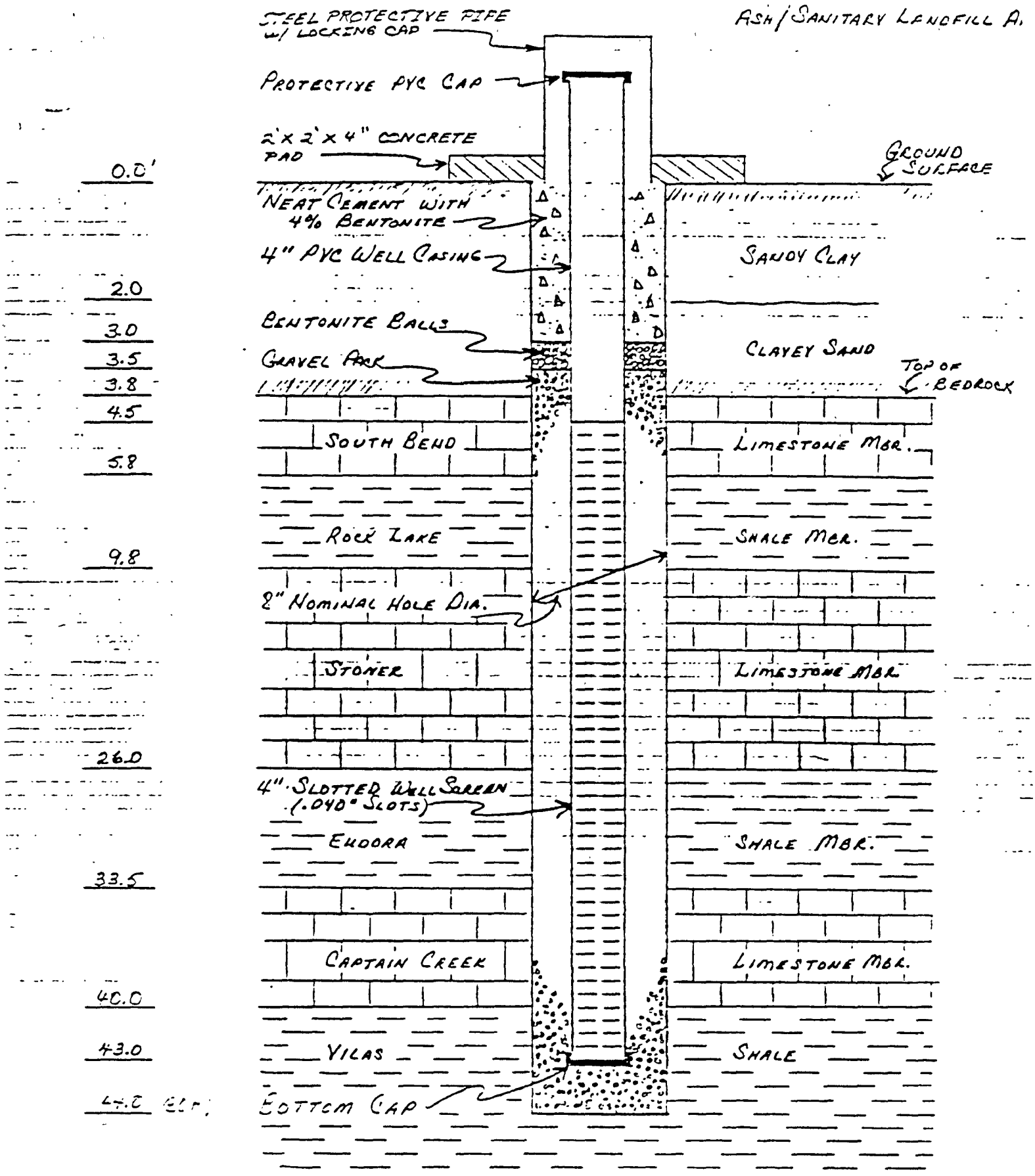
SUNFLOWER AAP
ASH/SANITARY LANDFILL



NOT TO SCALE

SUNFLOWER KAP

ASH/SANITARY LANDFILL A.

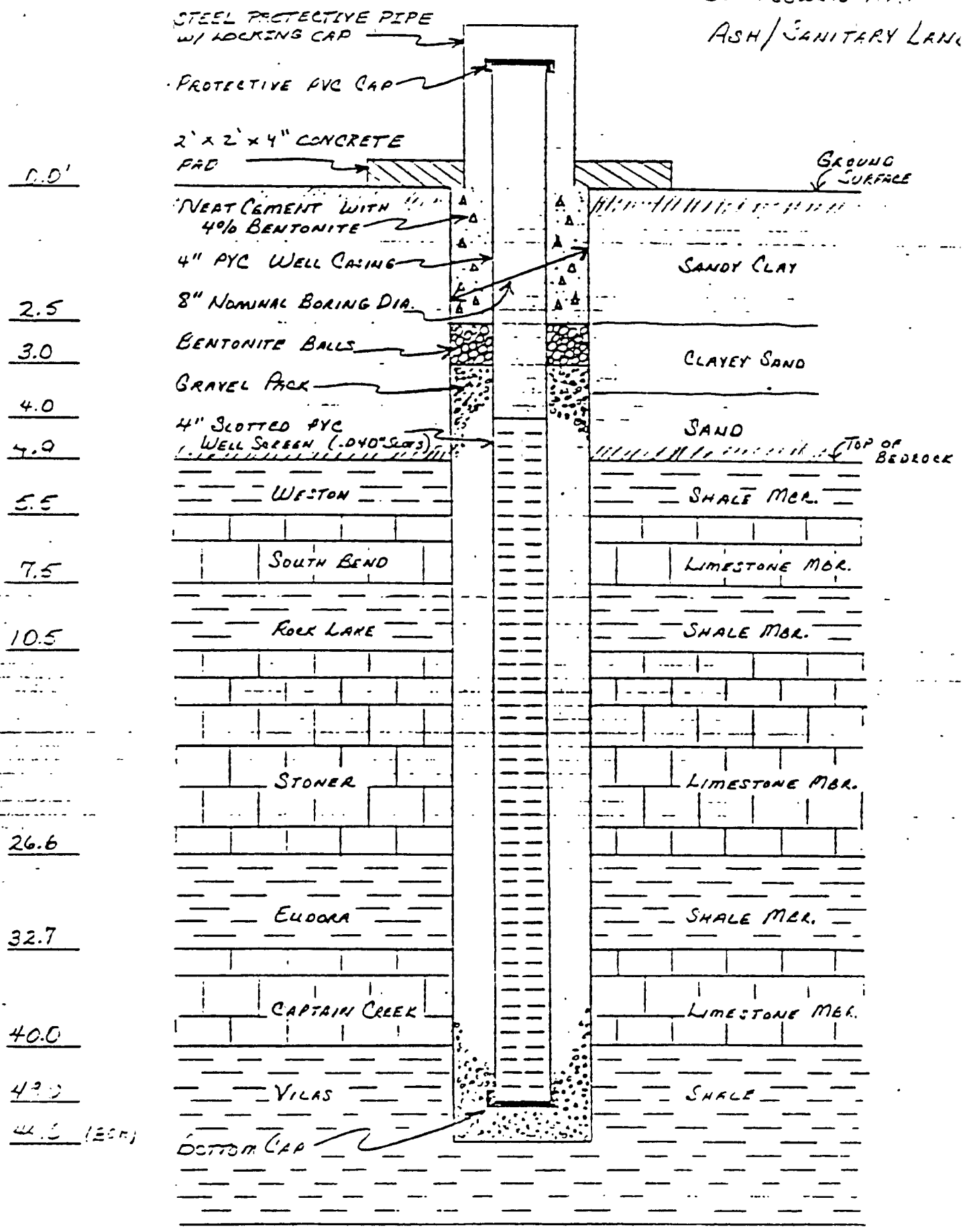


NOT TO SCALE

MW 01-14

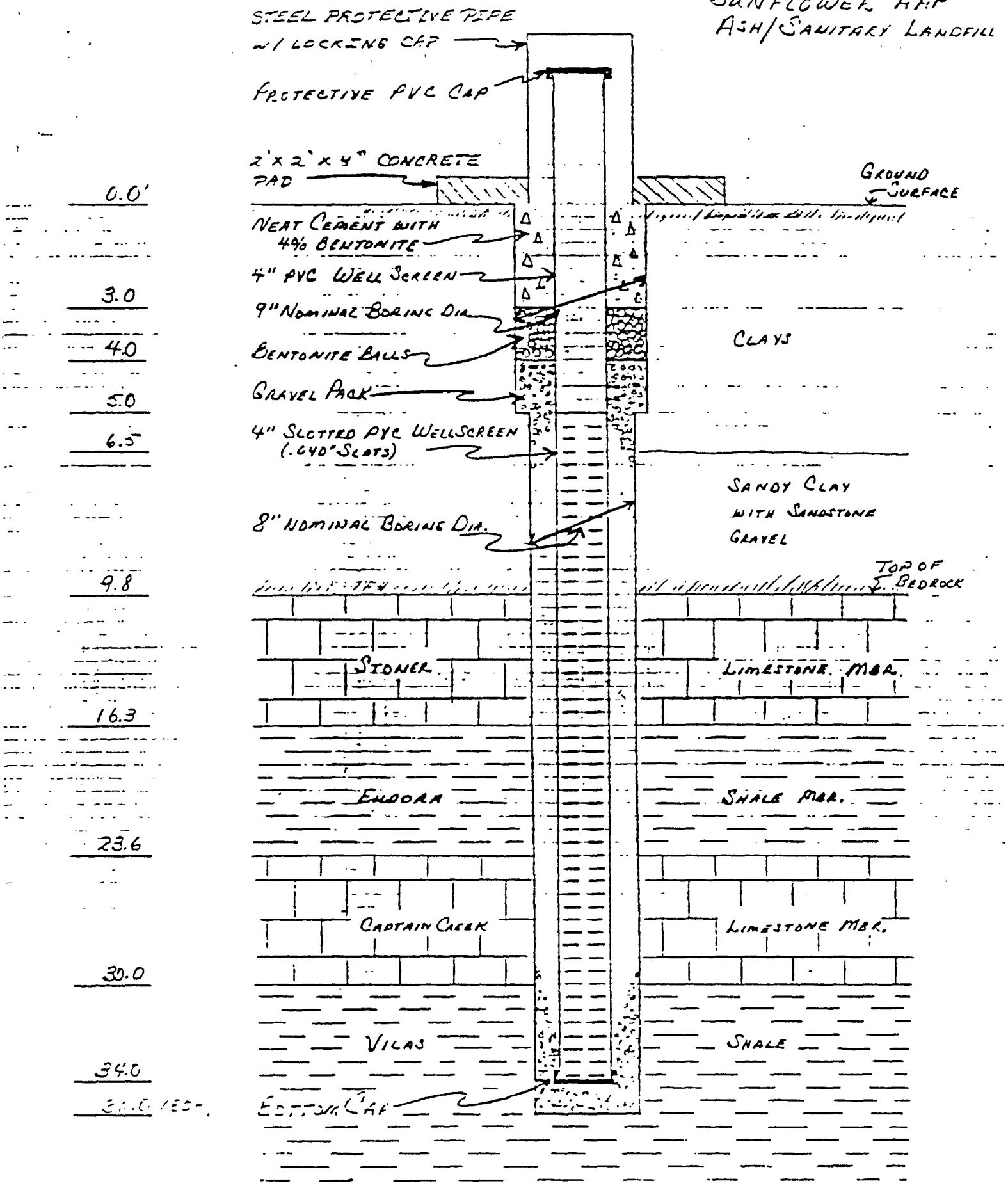
SUNFLOWER AAP

ASH/SANITARY LAND



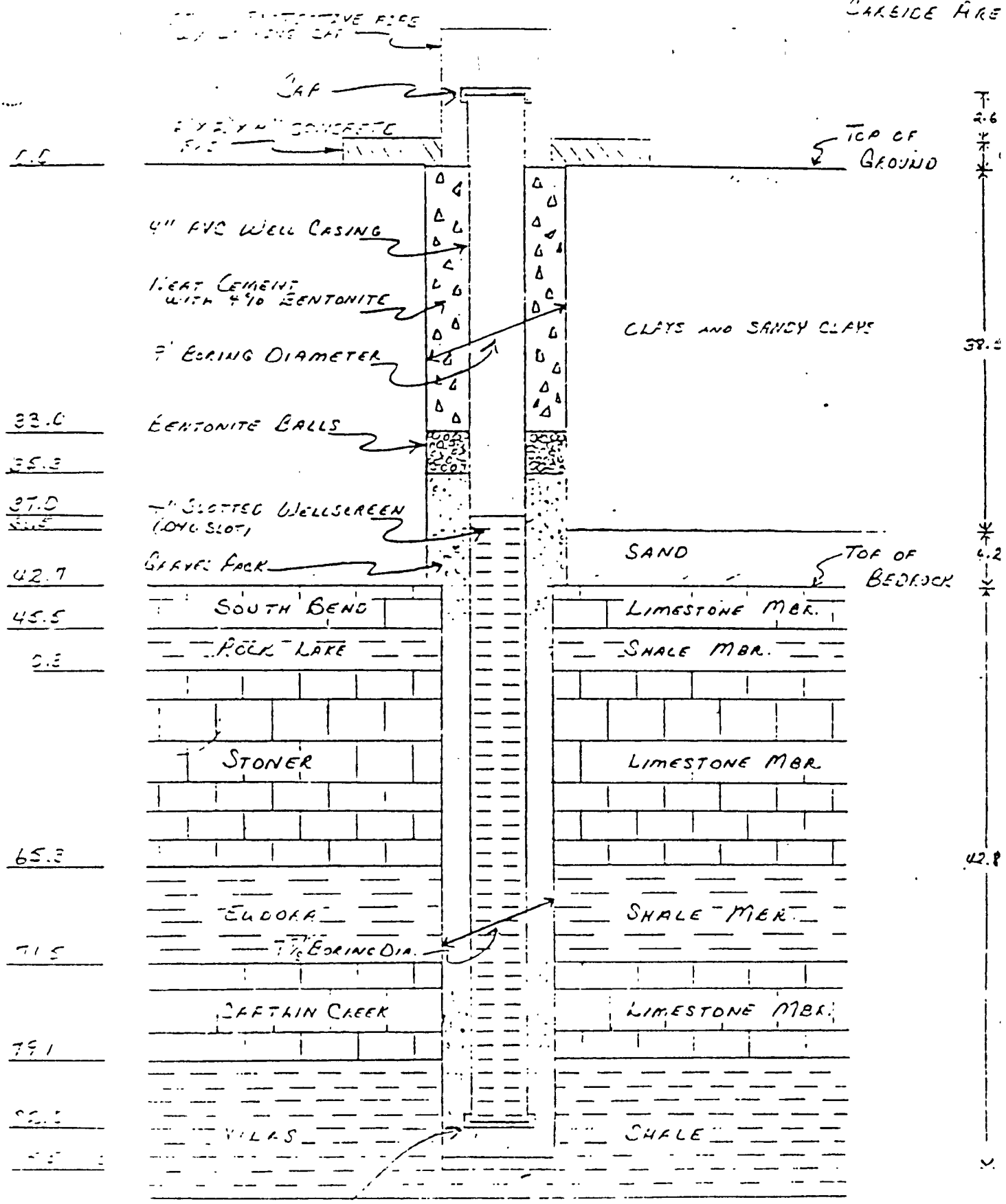
NOT TO SCA

SUNFLOWER AAP
ASH/SANITARY LANDFILL



NOT TO SCALE

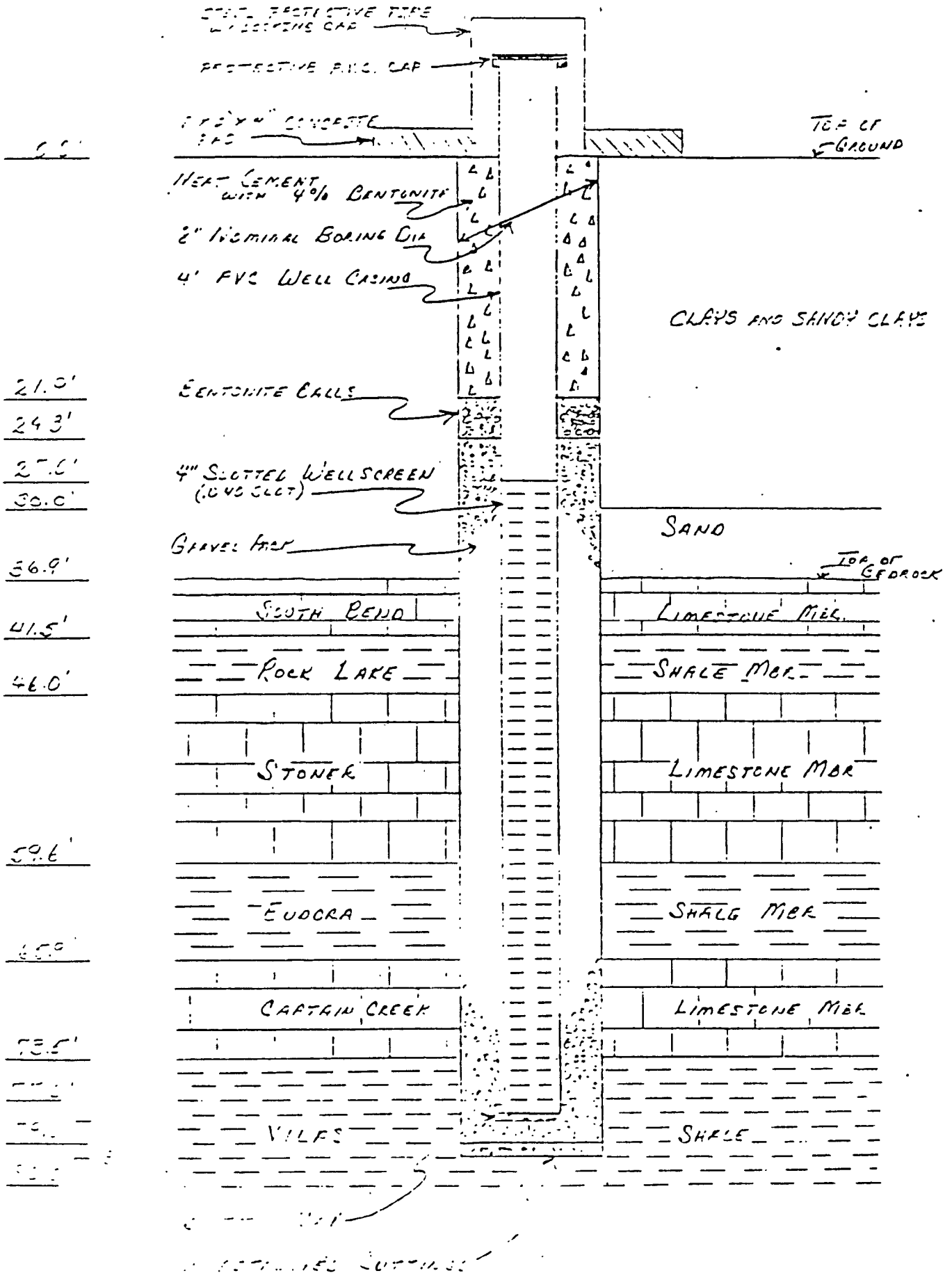
APPENDIX IV

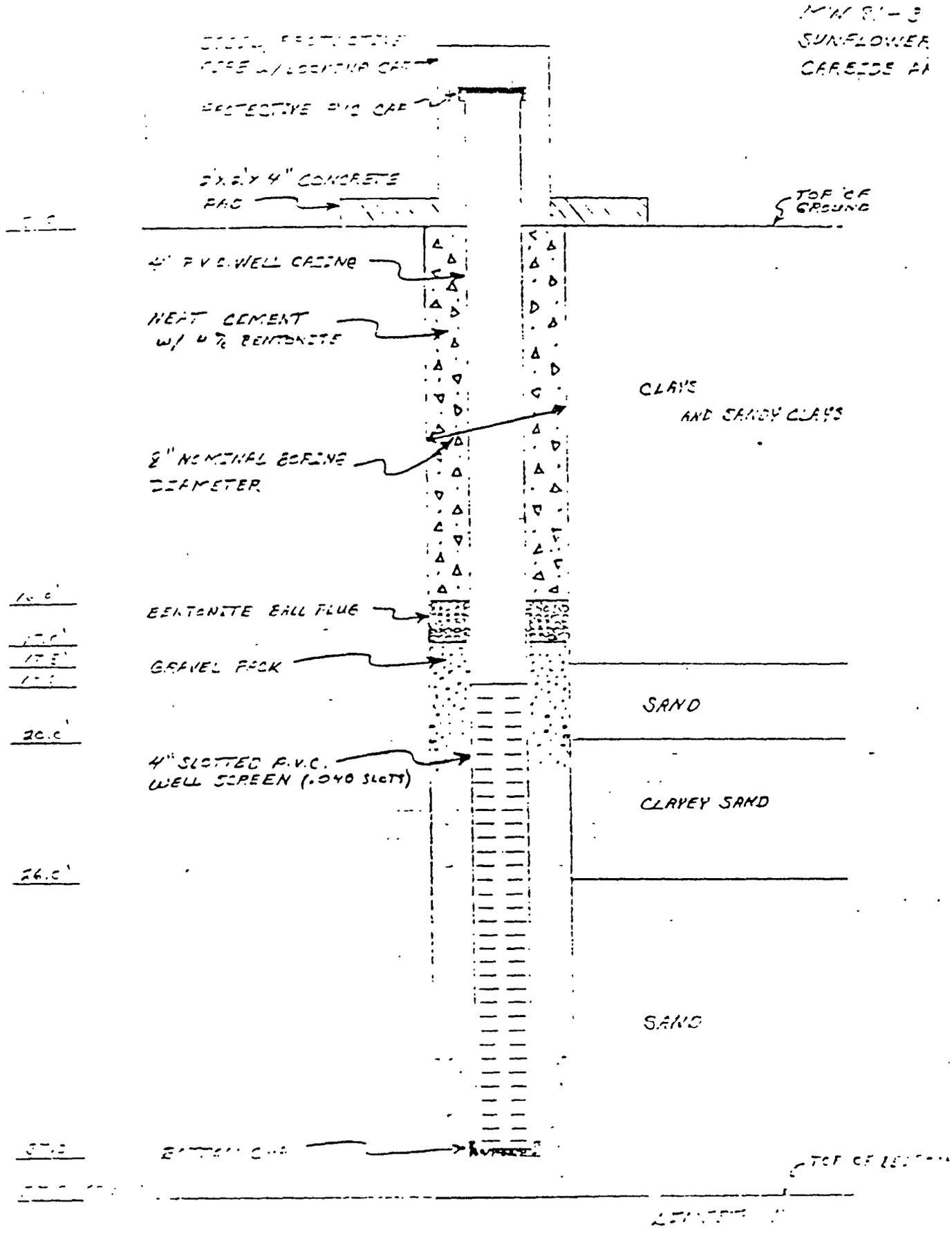

Cap
Top of Ground
4" PVC Well Casing
Neat Cement with 4% Bentonite
7" Boring Diameter
Clays and Sandy Clays
33.0
Bentonite Balls
35.3
37.0
Slotted Wellscreen
Gravel Pack
Sand
Top of Bedrock
42.7
South Bend
Limestone Mbr.
45.5
Rock Lake
Shale Mbr.
Stoner
Limestone Mbr.
65.3
Eudora
Shale Mbr.
71.5
7 1/2 Boring Dia.
Saffain Creek
Limestone Mbr.
79.1
Vilas
Shale
2.6
39.2
4.2
42.8

Appendix I

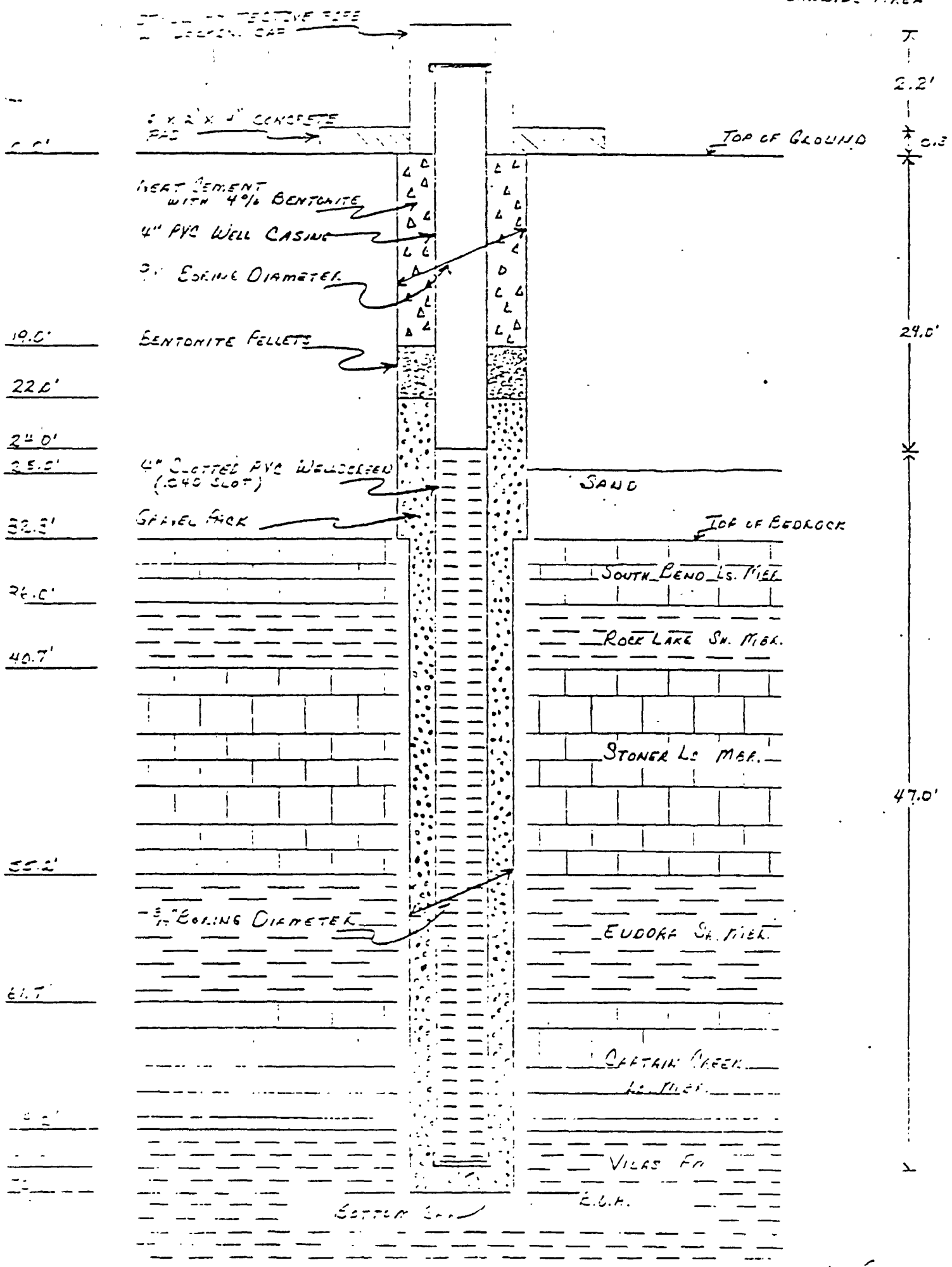
SUNFLOWE

CARBIDE AR

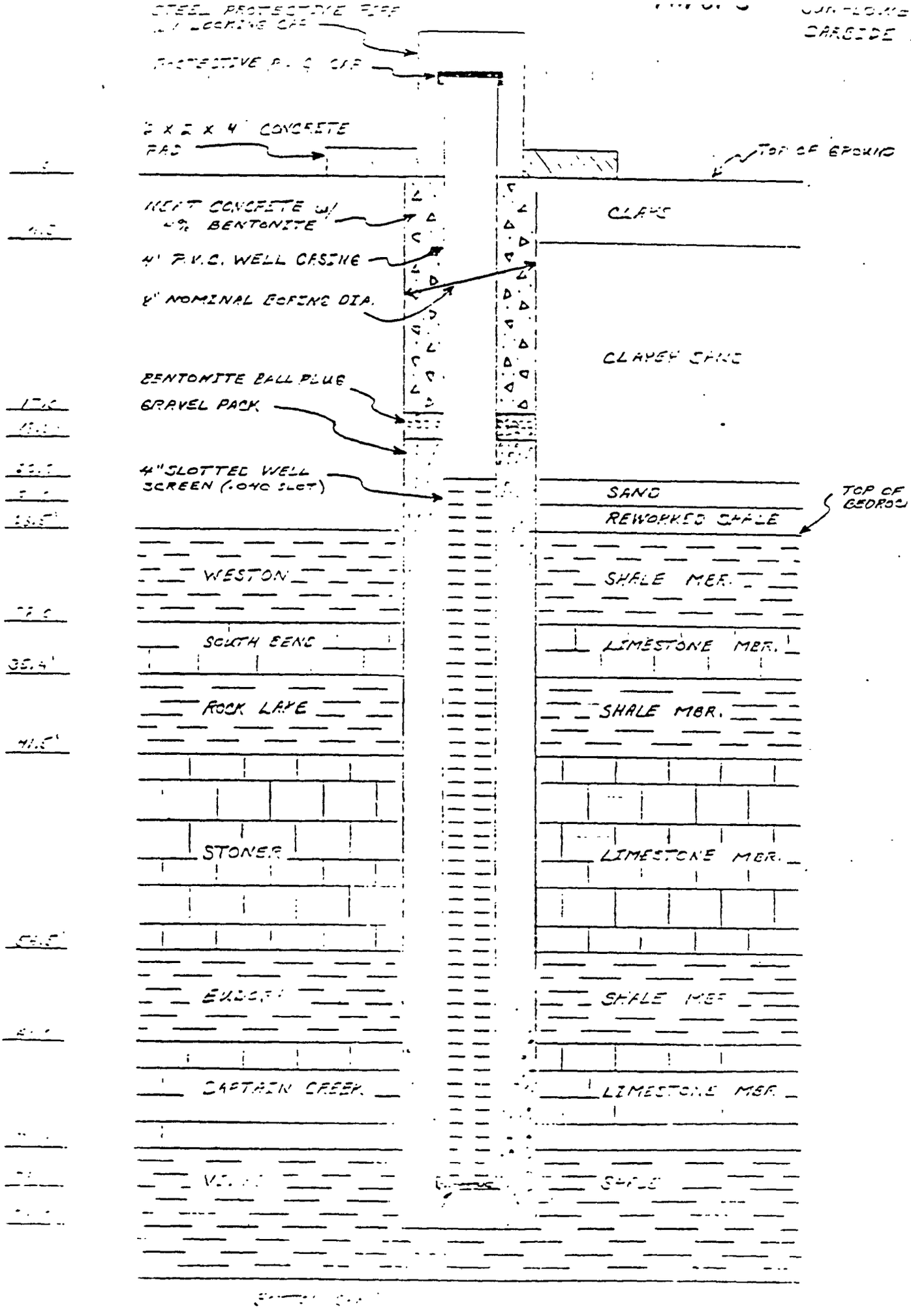



SUNFLOWER
PROTECTIVE PIPE
2'x2'x4" CONCRETE PAD
TOP OF GROUND
4" P.V.C. WELL CASING
NEAT CEMENT w/ 4% BENTONITE
CLAYS AND SANDY CLAYS
8" NOMINAL BORING DIAMETER
BENTONITE BALL PLUG
GRAVEL PACK
SAND
20.0'
4" SLOTTED P.V.C. WELL SCREEN (.040 SLOTS)
CLAYEY SAND
26.0'
SAND

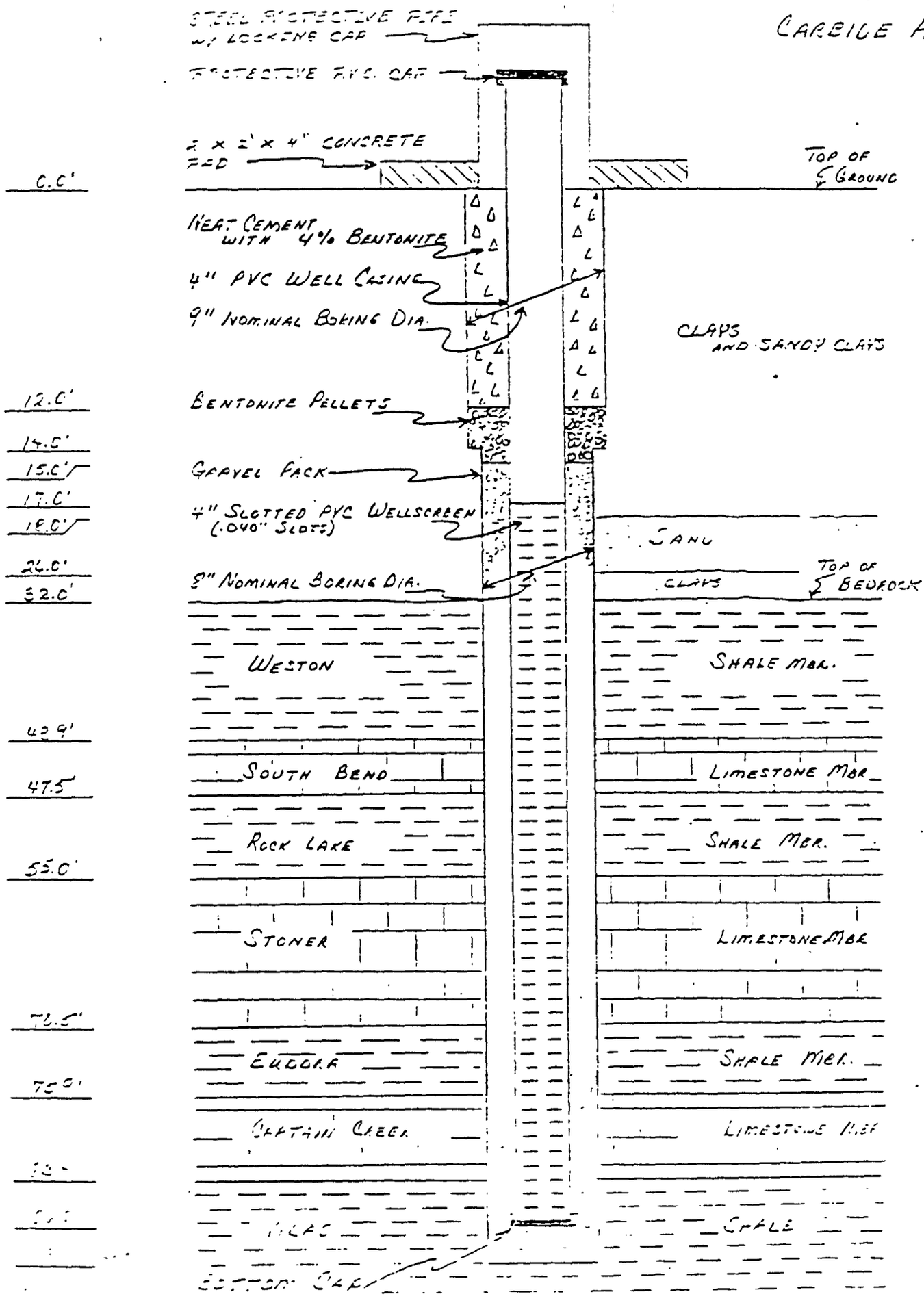
SUNFLOWER AA
CARBIDE AREA



1:3 SCALE


STEEL PROTECTIVE PIPE
PROTECTIVE P. C. CAP
2 X 2 X 4' CONCRETE PAD
TOP OF GROUND
NEAT CONCRETE w/ 4% BENTONITE
4" P.V.C. WELL CASING
8" NOMINAL BORING DIA.
CLAYS
CLAYEY SAND
BENTONITE BALL PLUG
GRAVEL PACK
4" SLOTTED WELL SCREEN (.040 SLOT)
SAND
REWORKED SHALE
TOP OF BEDROCK
WESTON
SHALE MBR.
SOUTH BEND
LIMESTONE MBR.
ROCK LAKE
SHALE MBR.
STONER
LIMESTONE MBR.
SHALE MBR.
CAPTAIN CREEK
LIMESTONE MBR.
SHALE

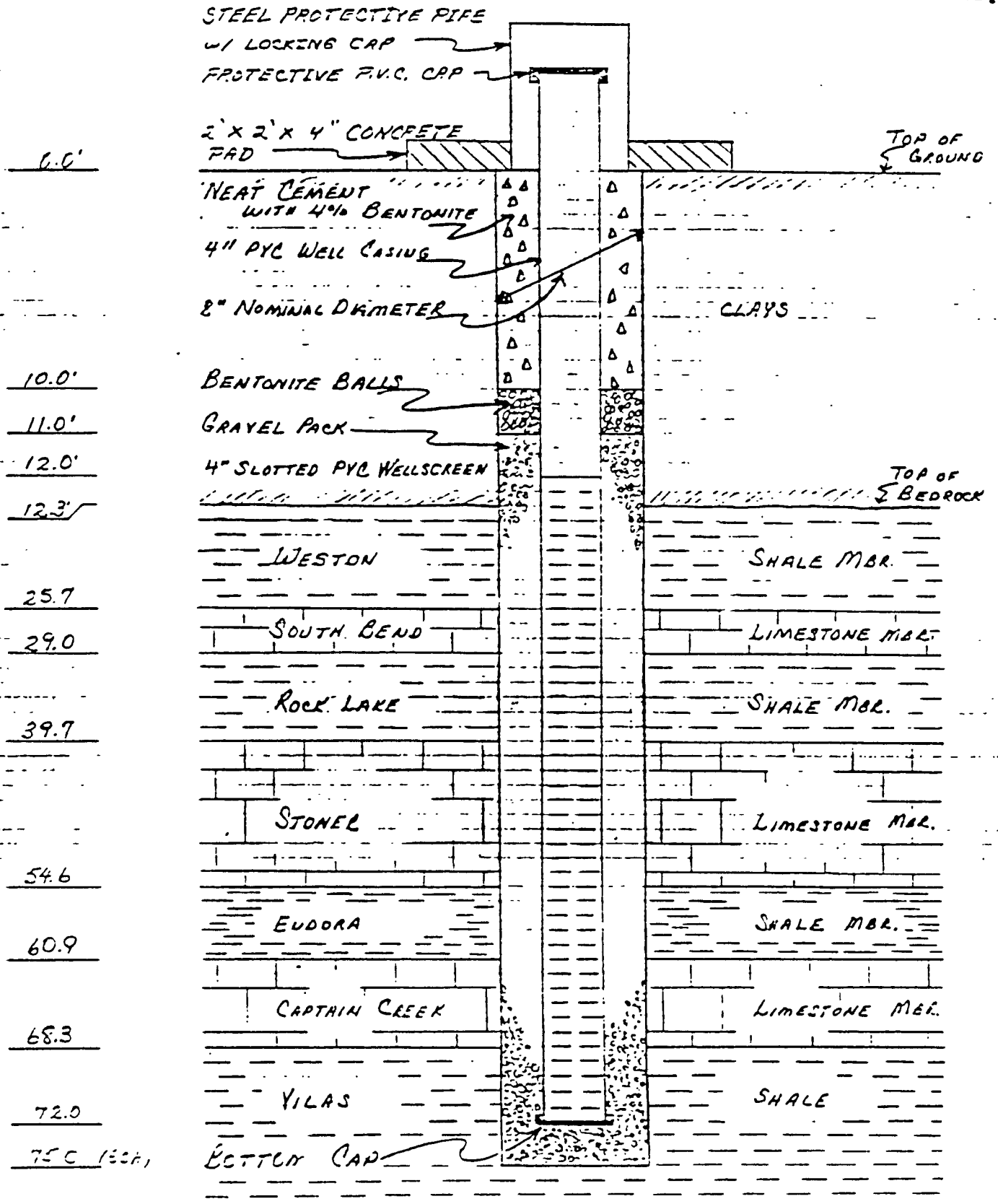
MW 81-6
SUNFLOWER A
CARBIDE ARE



NO SCALE

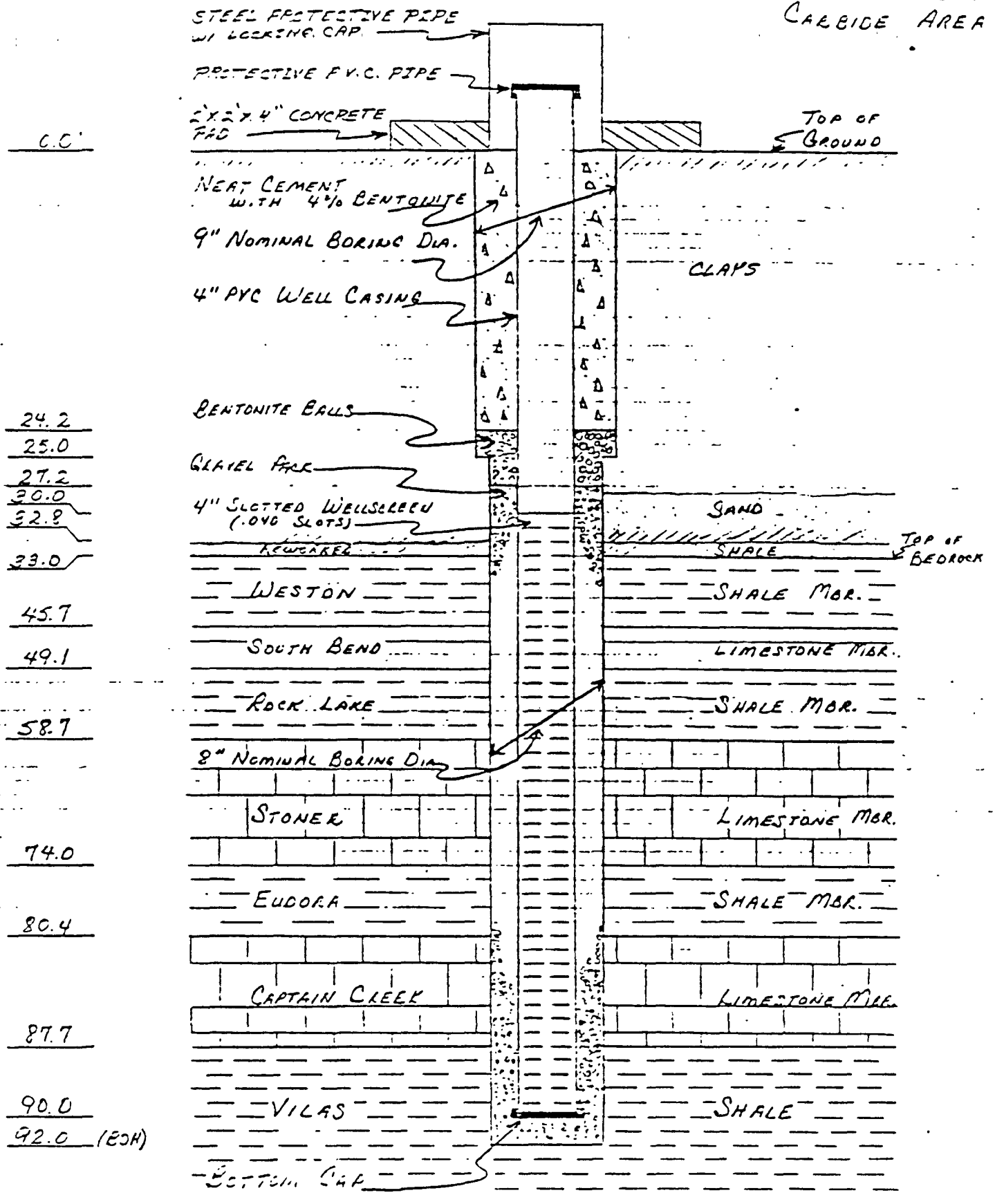
MW 81-7

SUNFLOWER AAP
CARBIDE AREA



No Seal

SUNFLOWER A
CARBIDE AREA



SITE: SITE 3A SUNFLOWER AMMUNITION PLANT, DESOTO, KS
CASE NO: 6531/P/1944HQ

SAMPLE NO:	Q1413/M0A703	Q1414/M0A704	Q1415/M0A705	Q1420/M0A710
SAMPLE LOCATION:	WELL-40	WELL-42	SURFACE	WELL-13
SAMPLE TYPE:	GW-LOW	GW-LOW	GW-LOW	GW-LOW
INORG. AMMONIA NITROGEN				NR
INDIC. BROMIDE				
CHLORIDE	12000	75000	12000	24000
CYANIDE				
NITRATE NITROGEN	80	400	1600	700
NITRITE NITROGEN				
POC				1000
POX				NR
SULFATE	52000	370000	81000	170000
TOC	2500	1500	1600	1900
TOTAL PHENOLS				NR
TOX	13	9.4	11	NR

ALL CONCENTRATIONS ARE IN ug/L.

DEPARTMENT OF THE ARMY
SUNFLOWER ARMY AMMUNITION PLANT
• PO BOX 640
DESOTO, KANSAS 66018-0640

REPLY TO
ATTENTION OF

July 20, 1987

Environmental Office

SUBJECT: Analysis of Monitoring Well Samples from Split Samples Taken in November 1986

Mr. Michael Sanderson
Chief, RCRA Branch
U.S. Environmental Protection Agency
Region VII
726 Minnesota Avenue
Kansas City, Kansas 66101

Dear Mr. Sanderson:

The letter is in response to a telephone request on June 29, 1987 by Ms. Carol McKinney for our analysis of the subject samples.

The analysis requested is enclosed. Please provide a copy of your analysis of the subject samples by July 31, 1987.

Please contact Mr. Don Storment at (913) 749-6884 if you have any questions concerning this matter.

Sincerely,

Thomas G. Stutz

THOMAS G. STUTZ
Civilian Executive Assistant

Enclosure

Copies Furnished:

Cdr, AMCCOM, ATTN: AMSMC-ISE
Hercules Incorporated (wo/encl)

RECEIVED
JUL 22 1987
PRMT SECTION

RECEIVED
JUL 22 1987
USEPA, RCRA Branch

RUN DATE: 05 MAR 87

INSTALLATION: SUNFLOWER AAP, KS

SITE: EPA SPLIT SAMPLING

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	MW2	MW3	MW6	MW8	MW12	MW13	MW17
ARSENIC	11 NOV 86	.010	MGL		ND		ND			
ARSENIC	12 NOV 86	.010	MGL	ND						
ARSENIC	14 NOV 86	.010	MGL			ND				
ARSENIC	17 NOV 86	.010	MGL							ND
ARSENIC	19 NOV 86	.010	MGL					ND	.023 C	
BARIUM	11 NOV 86	.30	MGL		ND		ND			
BARIUM	12 NOV 86	.30	MGL	ND						
BARIUM	14 NOV 86	.30	MGL			ND				
BARIUM	17 NOV 86	.30	MGL							ND
BARIUM	19 NOV 86	.30	MGL					ND	.36 C	
CADMIUM	11 NOV 86	.001	MGL		ND		ND			
CADMIUM	12 NOV 86	.001	MGL	ND						
CADMIUM	14 NOV 86	.001	MGL			ND				
CADMIUM	17 NOV 86	.001	MGL							ND
CADMIUM	19 NOV 86	.001	MGL					ND	.002 C	
CHROMIUM	11 NOV 86	.010	MGL		ND		ND			
CHROMIUM	12 NOV 86	.010	MGL	ND						
CHROMIUM	14 NOV 86	.010	MGL			ND				
CHROMIUM	17 NOV 86	.010	MGL							ND
CHROMIUM	19 NOV 86	.010	MGL					ND	.012 C	
LEAD	11 NOV 86	.005	MGL		ND		.007 C			
LEAD	12 NOV 86	.005	MGL	ND						
LEAD	14 NOV 86	.005	MGL			ND				
LEAD	17 NOV 86	.005	MGL							ND
LEAD	19 NOV 86	.005	MGL					.008 C	4.030* C	
MERCURY	11 NOV 86	.2	UGL		ND		ND			
MERCURY	12 NOV 86	.2	UGL	ND						
MERCURY	14 NOV 86	.2	UGL			ND				
MERCURY	17 NOV 86	.2	UGL							ND
MERCURY	19 NOV 86	.2	UGL					ND	ND	
SELENIUM	11 NOV 86	.005	MGL		ND		ND			
SELENIUM	12 NOV 86	.005	MGL	ND						
SELENIUM	14 NOV 86	.005	MGL			ND				
SELENIUM	17 NOV 86	.005	MGL							.008 C
SELENIUM	19 NOV 86	.005	MGL					.009 C	ND	
SILVER	11 NOV 86	.025	MGL		ND		ND			
SILVER	12 NOV 86	.025	MGL	ND						
SILVER	14 NOV 86	.025	MGL			ND				
SILVER	17 NOV 86	.025	MGL							ND
SILVER	19 NOV 86	.025	MGL					ND	ND	
CHLORIDE	11 NOV 86	1.0	MGL		10.2		8.3			

Encl 1

RUN DATE. 05 MAR 87

INSTALLATION: SUNFLOWER AAP, KS

SITE. EPA SPLIT SAMPLING

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	MW29	MW31	MW36	MW41	MW42	MW46	MW49
ARSENIC	13 NOV 86	.010	MGL				ND	ND	ND	
ARSENIC	14 NOV 86	.010	MGL							ND
ARSENIC	18 NOV 86	.010	MGL	ND	.011 C	ND				
BARIUM	13 NOV 86	.30	MGL				ND	ND	ND	
BARIUM	14 NOV 86	.30	MGL							ND
BARIUM	18 NOV 86	.30	MGL	ND	ND	ND				
CADMIUM	13 NOV 86	.001	MGL				ND	ND	ND	
CADMIUM	14 NOV 86	.001	MGL							ND
CADMIUM	18 NOV 86	.001	MGL	ND	ND	ND				
CHROMIUM	13 NOV 86	.010	MGL				ND	ND	ND	
CHROMIUM	14 NOV 86	.010	MGL							ND
CHROMIUM	18 NOV 86	.010	MGL	ND	ND	ND				
LEAD	13 NOV 86	.005	MGL				ND	ND	ND	
LEAD	14 NOV 86	.005	MGL							ND
LEAD	18 NOV 86	.005	MGL	ND	ND	ND				
MERCURY	13 NOV 86	.2	UGL				ND	ND	ND	
MERCURY	14 NOV 86	.2	UGL							ND
MERCURY	18 NOV 86	.2	UGL	ND	ND	ND				
SELENIUM	13 NOV 86	.005	MGL				ND	ND	ND	
SELENIUM	14 NOV 86	.005	MGL							ND
SELENIUM	18 NOV 86	.005	MGL	ND	ND	.007 C				
SILVER	13 NOV 86	.025	MGL				ND	ND	ND	
SILVER	14 NOV 86	.025	MGL							ND
SILVER	18 NOV 86	.025	MGL	ND	ND	ND				
CHLORIDE	13 NOV 86	1.0	MGL				32.4	83.0	7.0	
CHLORIDE	14 NOV 86	1.0	MGL							7.0
CHLORIDE	18 NOV 86	1.0	MGL	21.0	21.0	12.0				
IRON	13 NOV 86	.02	MGL				.96# C	.95# C	.55# C	
IRON	14 NOV 86	.02	MGL							.73# C
IRON	18 NOV 86	.02	MGL	1.10# C	7.84# C	.31# C				
MANGANESE	13 NOV 86	.001	MGL				.047 C	.192# C	.031 C	
MANGANESE	14 NOV 86	.001	MGL							.081#. C
MANGANESE	18 NOV 86	.001	MGL	.049 C	5.200# C	.051# C				
PHENOL	13 NOV 86	.01	MGL				ND	ND	ND	
PHENOL	14 NOV 86	.01	MGL							ND
PHENOL	18 NOV 86	.01	MGL	ND	ND	ND				
SODIUM	13 NOV 86	1.	MGL				78. C	89. C	39. C	
SODIUM	14 NOV 86	1.	MGL							46. C
SODIUM	18 NOV 86	1.	MGL	103. C	28. C	57. C				
SULFATE	13 NOV 86	2.0	MGL				.8	375.0#	72.0	
SULFATE	14 NOV 86	2.0	MGL							97.0

RUN DATE: 05 MAR 87

INSTALLATION: SUNFLOWER AAP, KS

SITE: EPA SPLIT SAMPLING

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	MW29	MW31	MW36	MW41	MW42	MW46	MW49
SULFATE	18 NOV 86	2.0	MGL	251.0#	80.0	175.0				
TOX	13 NOV 86	.010	MGL				ND	ND	ND	
TOX	13 NOV 86	.010	MGL				ND	ND	ND	
TOX	13 NOV 86	.010	MGL				ND	ND	ND	
TOX	13 NOV 86	.010	MGL				ND	ND	ND	
TOX	14 NOV 86	.010	MGL							ND
TOX	14 NOV 86	.010	MGL							ND
TOX	14 NOV 86	.010	MGL							ND
TOX	14 NOV 86	.010	MGL							ND
TOX	18 NOV 86	.010	MGL	ND	.066	ND				
TOX	18 NOV 86	.010	MGL	ND	.078	ND				
TOX	18 NOV 86	.010	MGL	ND	.076	ND				
TOX	18 NOV 86	.010	MGL	ND	.074	ND				
TOC(UNFILT)	13 NOV 86	1.0	MGL				1.7	1.6	1.1	
TOC(UNFILT)	13 NOV 86	1.0	MGL				1.7	1.5	1.2	
TOC(UNFILT)	13 NOV 86	1.0	MGL				1.7	1.5	1.2	
TOC(UNFILT)	13 NOV 86	1.0	MGL				1.7	1.6	1.2	
TOC(UNFILT)	14 NOV 86	1.0	MGL							1.6
TOC(UNFILT)	14 NOV 86	1.0	MGL							1.7
TOC(UNFILT)	14 NOV 86	1.0	MGL							1.5
TOC(UNFILT)	14 NOV 86	1.0	MGL							1.6
TOC(UNFILT)	18 NOV 86	1.0	MGL	4.7	3.3	1.1				
TOC(UNFILT)	18 NOV 86	1.0	MGL	4.6	3.4	1.1				
TOC(UNFILT)	18 NOV 86	1.0	MGL	4.6	3.3	1.1				
TOC(UNFILT)	18 NOV 86	1.0	MGL	4.7	3.2	1.0				
TOT SOLIDS	13 NOV 86	1.	MGL				1160.	1184.	580.	
TOT SOLIDS	14 NOV 86	1.	MGL							524.
TOT SOLIDS	18 NOV 86	1.	MGL	952.	624.	660.				
AMMONIA-N	13 NOV 86	.05	MGL				.10	.05	ND	
AMMONIA-N	14 NOV 86	.05	MGL							.05
AMMONIA-N	18 NOV 86	.05	MGL	.13	.27	ND				
CYANIDE	13 NOV 86	.01	MGL				.02	.02	ND	
CYANIDE	14 NOV 86	.01	MGL							ND
CYANIDE	18 NOV 86	.01	MGL	ND	ND	ND				
COPPER	13 NOV 86	.025	MGL				ND	ND	ND	
COPPER	14 NOV 86	.025	MGL							ND
COPPER	18 NOV 86	.025	MGL	.038 C	.031 C	ND				
ZINC	13 NOV 86	.02	MGL				ND	.02 C	.02 C	
ZINC	14 NOV 86	.02	MGL							.03 C
ZINC	18 NOV 86	.02	MGL	.02 C	.04 C	ND				
POTASSIUM	13 NOV 86	.10	MGL				1.08 C	1.26 C	1.60 C	

RUN DATE: 05 MAR 87

INSTALLATION. SUNFLOWER AAP, KS

SITE: EPA SPLIT SAMPLING

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	MW29	MW31	MW36	MW41	MW42	MW46	MW49
POTASSIUM	14 NOV 86	.10	MGL							1.49 C
POTASSIUM	18 NOV 86	.50	MGL	1.53 C	1.29 C	ND				
MAGNESIUM	13 NOV 86	.02	MGL				44.50 C	45.40 C	19.60 C	
MAGNESIUM	14 NOV 86	.02	MGL							28.60 C
MAGNESIUM	18 NOV 86	.02	MGL	38.40 C	23.20 C	28.20 C				
CALCIUM	13 NOV 86	.1	MGL				209.0 C	238.0 C	93.3 C	
CALCIUM	14 NOV 86	.1	MGL							94.9 C
CALCIUM	18 NOV 86	.1	MGL	158.0 C	183.0 C	126.0 C				
NICKEL	13 NOV 86	.10	MGL				ND	ND	ND	
NICKEL	14 NOV 86	.10	MGL							ND
NICKEL	18 NOV 86	.10	MGL	ND	ND	ND				
VANADIUM	13 NOV 86	2.0	MGL				ND	ND	ND	
VANADIUM	14 NOV 86	2.0	MGL							ND
VANADIUM	18 NOV 86	2.0	MGL	ND	ND	ND				
ANTIMONY	13 NOV 86	.500	MGL				ND	ND	ND	
ANTIMONY	14 NOV 86	.500	MGL							ND•
ANTIMONY	18 NOV 86	.500	MGL	ND	ND	ND				
BERYLLIUM	13 NOV 86	.05	MGL				ND	ND	ND	
BERYLLIUM	14 NOV 86	.05	MGL							ND
BERYLLIUM	18 NOV 86	.05	MGL	ND	ND	ND				
THALLIUM	13 NOV 86	1.00	MGL				ND	ND	ND	
THALLIUM	14 NOV 86	1.00	MGL							ND
THALLIUM	18 NOV 86	1.00	MGL	ND	ND	ND				
COBALT	13 NOV 86	.2	MGL				ND	ND	ND	
COBALT	14 NOV 86	.2	MGL							ND
COBALT	18 NOV 86	.2	MGL	ND	ND	ND				
ALUMINUM	13 NOV 86	1.0	MGL				2.5 C	1.4 C	ND	
ALUMINUM	14 NOV 86	.0	MGL							1.6 C
ALUMINUM	18 NOV 86	1.0	MGL	ND	ND	ND				
TIN	13 NOV 86	1.00	MGL				ND	ND	ND	
TIN	14 NOV 86	1.00	MGL							ND
TIN	18 NOV 86	1.00	MGL	ND	ND	ND				
2,4,6-TNT	13 NOV 86	.001	MGL				ND	ND	ND	
2,4,6-TNT	14 NOV 86	.001	MGL							ND
2,4,6-TNT	18 NOV 86	.001	MGL	ND	ND	ND				
2,4-DNT	13 NOV 86	.001	MGL				ND	ND	ND	
2,4-DNT	14 NOV 86	.001	MGL							ND
2,4-DNT	18 NOV 86	.001	MGL	ND	ND	ND				
2,6-DNT	13 NOV 86	.001	MGL				ND	ND	ND	
2,6-DNT	14 NOV 86	.001	MGL							ND
2,6-DNT	18 NOV 86	.001	MGL	ND	ND	ND				

RUN DATE. 05 MAR 87

INSTALLATION: SUNFLOWER AAP, KS

SITE: EPA SPLIT SAMPLING

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	MW29	MW31	MW36	MW41	MW42	MW46	MW49
RDX	13 NOV 86	.030	MGL				ND	ND	ND	
RDX	14 NOV 86	.030	MGL							ND
RDX	18 NOV 86	.030	MGL	ND	ND	ND				
HMX	13 NOV 86	.100	MGL				ND	ND	ND	
HMX	14 NOV 86	.100	MGL							ND
HMX	18 NOV 86	.100	MGL	ND	ND	ND				
TETRYL	13 NOV 86	.010	MGL				ND	ND	ND	
TETRYL	14 NOV 86	.010	MGL							ND
TETRYL	18 NOV 86	.010	MGL	ND	ND	ND				
NQ	13 NOV 86	.1	MGL				ND	ND	ND	
NQ	14 NOV 86	.1	MGL							ND
NITROGLYCERN	13 NOV 86	.001	MGL				ND	ND	ND	
NITROGLYCERN	14 NOV 86	.001	MGL							ND
NITROGLYCERN	18 NOV 86	.001	MGL	ND	ND	ND				
AMMONNITRATE	18 NOV 86	.100	MGL	ND	.540 C.	ND				

RUN DATE. 05 MAR 87

INSTALLATION: SUNFLOWER AAP, KS

SITE: EPA SPLIT SAMPLING

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS MW54	WFLIN	MW60	MW62
ARSENIC	12 NOV 86	.010	MGL			ND	
ARSENIC	18 NOV 86	.010	MGL				ND
ARSENIC	19 NOV 86	.010	MGL	ND	ND		
BARIUM	12 NOV 86	.30	MGL			ND	
BARIUM	18 NOV 86	.30	MGL				ND
BARIUM	19 NOV 86	.30	MGL	ND	ND		
CADMIUM	12 NOV 86	.001	MGL			ND	
CADMIUM	18 NOV 86	.001	MGL				ND
CADMIUM	19 NOV 86	.001	MGL	ND	ND		
CHROMIUM	12 NOV 86	.010	MGL			ND	
CHROMIUM	18 NOV 86	.010	MGL				ND
CHROMIUM	19 NOV 86	.010	MGL	ND	ND		
LEAD	12 NOV 86	.005	MGL			ND	
LEAD	18 NOV 86	.005	MGL				ND
LEAD	19 NOV 86	.005	MGL	ND	ND		
MERCURY	12 NOV 86	.2	UGL			ND	
MERCURY	18 NOV 86	.2	UGL				ND
MERCURY	19 NOV 86	.2	UGL	ND	ND		
SELENIUM	12 NOV 86	.005	MGL			ND	
SELENIUM	18 NOV 86	.005	MGL				.008 C
SELENIUM	19 NOV 86	.005	MGL	ND	ND		
SILVER	12 NOV 86	.025	MGL			ND	
SILVER	18 NOV 86	.025	MGL				ND
SILVER	19 NOV 86	.025	MGL	ND	ND		
CHLORIDE	12 NOV 86	1.0	MGL			8.1	
CHLORIDE	18 NOV 86	1.0	MGL				12.0
CHLORIDE	19 NOV 86	1.0	MGL	8.0	10.0		
IRON	12 NOV 86	.02	MGL			1.01# C	
IRON	18 NOV 86	.02	MGL				.31# C
IRON	19 NOV 86	.02	MGL	.29 C	.23 C		
MANGANESE	12 NOV 86	.001	MGL			.057# C	
MANGANESE	18 NOV 86	.001	MGL				.051# C
MANGANESE	19 NOV 86	.001	MGL	1.050# C	.043 C		
PHENOL	12 NOV 86	.01	MGL			ND	
PHENOL	18 NOV 86	.01	MGL				ND
PHENOL	19 NOV 86	.01	MGL	ND	ND		
SODIUM	12 NOV 86	1.	MGL			28. C	
SODIUM	18 NOV 86	1.	MGL				58. C
SODIUM	19 NOV 86	1.	MGL	13. C	23. C		
SULFATE	12 NOV 86	2.0	MGL			58.0	
SULFATE	18 NOV 86	2.0	MGL				170.0

RUN DATE: 05 MAR 87

INSTALLATION SUNFLOWER AAP, KS

SITE: EPA SPLIT SAMPLING

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS MW54	WFLIN	MW60	MW62
SULFATE	19 NOV 86	2.0	MGL	31.0	59.0		
TOX	12 NOV 86	.010	MGL			ND	
TOX	12 NOV 86	.010	MGL			ND	
TOX	12 NOV 86	.010	MGL			ND	
TOX	12 NOV 86	.010	MGL			ND	
TOX	18 NOV 86	.010	MGL				ND
TOX	18 NOV 86	.010	MGL				ND
TOX	18 NOV 86	.010	MGL				ND
TOX	18 NOV 86	.010	MGL				ND
TOX	19 NOV 86	.010	MGL	ND	ND		
TOX	19 NOV 86	.010	MGL	ND	ND		
TOX	19 NOV 86	.010	MGL	ND	ND		
TOX	19 NOV 86	.010	MGL	ND	ND		
TOC(UNFILT)	12 NOV 86	1.0	MGL			2.7	
TOC(UNFILT)	12 NOV 86	1.0	MGL			2.8	
TOC(UNFILT)	12 NOV 86	1.0	MGL			2.8	
TOC(UNFILT)	12 NOV 86	1.0	MGL			2.8	
TOC(UNFILT)	18 NOV 86	1.0	MGL				1.0
TOC(UNFILT)	18 NOV 86	1.0	MGL				1.0
TOC(UNFILT)	18 NOV 86	1.0	MGL				.9
TOC(UNFILT)	18 NOV 86	1.0	MGL				1.0
TOC(UNFILT)	19 NOV 86	1.0	MGL	1.9	1.5		
TOC(UNFILT)	19 NOV 86	1.0	MGL	2.0	1.6		
TOC(UNFILT)	19 NOV 86	1.0	MGL	2.0	1.6		
TOC(UNFILT)	19 NOV 86	1.0	MGL	2.0	1.5		
TOT SOLIDS	12 NOV 86	1.	MGL			350.	
TOT SOLIDS	18 NOV 86	1.	MGL				676.
TOT SOLIDS	19 NOV 86	1.	MGL	464.	436.		
AMMONIA-N	12 NOV 86	.05	MGL			.12	
AMMONIA-N	18 NOV 86	.05	MGL				ND
AMMONIA-N	19 NOV 86	.05	MGL	1.50	.09		
CYANIDE	12 NOV 86	.01	MGL			.01	
CYANIDE	18 NOV 86	.01	MGL				ND
CYANIDE	19 NOV 86	.01	MGL	ND	ND		
COPPER	12 NOV 86	.025	MGL			ND	
COPPER	18 NOV 86	.025	MGL				ND
COPPER	19 NOV 86	.025	MGL	ND	ND		
ZINC	12 NOV 86	.02	MGL			.02 C	
ZINC	18 NOV 86	.02	MGL				ND
ZINC	19 NOV 86	.02	MGL	ND	ND		
POTASSIUM	12 NOV 86	.10	MGL			1.89 C	

RUN DATE: 05 MAR 87

INSTALLATION: SUNFLOWER AAP, KS

SITE: EPA SPLIT SAMPLING

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	MW54		WFLIN		MW60		MW62	
POTASSIUM	18 NOV 86	.50	MGL							ND	
POTASSIUM	19 NOV 86	.10	MGL	3.63	C	1.70	C				
MAGNESIUM	12 NOV 86	.02	MGL					22.50	C		
MAGNESIUM	18 NOV 86	.02	MGL							28.90	C
MAGNESIUM	19 NOV 86	.02	MGL	21.80	C	14.80	C				
CALCIUM	12 NOV 86	.1	MGL					63.4	C		
CALCIUM	18 NOV 86	.1	MGL							130.0	C
CALCIUM	19 NOV 86	.1	MGL	109.0	C	118.0	C				
NICKEL	12 NOV 86	.10	MGL					ND			
NICKEL	18 NOV 86	.10	MGL							ND	
NICKEL	19 NOV 86	.10	MGL	ND		ND					
VANADIUM	12 NOV 86	2.0	MGL					ND			
VANADIUM	18 NOV 86	2.0	MGL							ND	
VANADIUM	19 NOV 86	2.0	MGL	ND		ND					
ANTIMONY	12 NOV 86	.500	MGL					ND			
ANTIMONY	18 NOV 86	.500	MGL							ND	
ANTIMONY	19 NOV 86	.500	MGL	ND		ND					
BERYLLIUM	12 NOV 86	.05	MGL					ND			
BERYLLIUM	18 NOV 86	.05	MGL							ND	
BERYLLIUM	19 NOV 86	.05	MGL	ND		ND					
THALLIUM	12 NOV 86	1.00	MGL					ND			
THALLIUM	18 NOV 86	1.00	MGL							ND	
THALLIUM	19 NOV 86	1.00	MGL	ND		ND					
COBALT	12 NOV 86	.2	MGL					ND			
COBALT	18 NOV 86	.2	MGL							ND	
COBALT	19 NOV 86	.2	MGL	ND		ND					
ALUMINUM	12 NOV 86	1.0	MGL					ND			
ALUMINUM	18 NOV 86	1.0	MGL							ND	
ALUMINUM	19 NOV 86	1.0	MGL	ND		ND					
TIN	12 NOV 86	1.00	MGL					ND			
TIN	18 NOV 86	1.00	MGL							ND	
TIN	19 NOV 86	1.00	MGL	ND		ND					
2,4,6-TNT	12 NOV 86	.001	MGL					ND			
2,4,6-TNT	18 NOV 86	.001	MGL							ND	
2,4,6-TNT	19 NOV 86	.001	MGL	ND		ND					
2,4-DNT	12 NOV 86	.001	MGL					ND			
2,4-DNT	18 NOV 86	.001	MGL							ND	
2,4-DNT	19 NOV 86	.001	MGL	ND		ND					
2,6-DNT	12 NOV 86	.001	MGL					ND			
2,6-DNT	18 NOV 86	.001	MGL							ND	
2,6-DNT	19 NOV 86	.001	MGL	ND		ND					

RUN DATE. 05 MAR 87

INSTALLATION: SUNFLOWER AAP, KS

SITE: EPA SPLIT SAMPLING

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	MW54	WFLIN	MW60	MW62
RDX	12 NOV 86	.030	MGL			ND	
RDX	18 NOV 86	.030	MGL				ND
RDX	19 NOV 86	.030	MGL	ND	ND		
HMX	12 NOV 86	.100	MGL			ND	
HMX	18 NOV 86	.100	MGL				ND
HMX	19 NOV 86	.100	MGL	ND	ND		
TETRYL	12 NOV 86	.010	MGL			ND	
TETRYL	18 NOV 86	.010	MGL				ND
TETRYL	19 NOV 86	.010	MGL	ND	ND		
NQ	12 NOV 86	.1	MGL			ND	
NITROGLYCERN	12 NOV 86	.001	MGL			ND	
NITROGLYCERN	18 NOV 86	.001	MGL				ND
NITROGLYCERN	19 NOV 86	.001	MGL	ND	ND		
AMMONNITRATE	18 NOV 86	.100	MGL				2.800 C
AMMONNITRATE	19 NOV 86	.100	MGL	1.800 C	3.000 C		

RUN DATE. 05 MAR 87

INSTALLATION SUNFLOWER AAP, KS SITE: EPA SPLIT SAMPLING

LEGEND

NOTES. ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

B UPGRADIENT SITE
& RESULTS ARE FOR UNFILTERED SAMPLE
* VALUE EXCEEDS A NATIONAL INTERIM PRIMARY DRINKING WATER REGULATION STANDARD
// VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

Purgables Method # 624	LIMIT OF DETECTION
Chloromethane	3.
Bromomethane	3.
Vinyl chloride	3.
Chloroethane	3.
Methylene chloride	3.
Fluorotrichloromethane	3.
1,1-Dichloroethene	3.
1,1-Dichloroethane	3.
trans-1,2-Dichloroethene	3.
Chloroform	3.
1,2-Dichloroethane	3.
1,1,1-Trichloroethane	3.
Carbon tetrachloride	3.
Dichlorobromomethane	3.
1,1,2,2-Tetrachloroethane	3.
1,2-Dichloropropane	3.
trans-1,3-Dichloropropene	3.
Trichloroethene	3.
Dibromochloromethane	3.
1,1,2-Trichloroethane	3.
Benzene	3.
cis-1,3-Dichloropropene	3.
2-Chloroethylvinyl ether	3.
Bromoform	3.
Tetrachloroethene	3.
Toluene	3.
Chlorobenzene	3.
Ethylbenzene	3.

Encl 2

Purgables Method # 624	LIMIT OF DETECTION
Chloromethane	3.
Bromomethane	3.
Vinyl chloride	3.
Chloroethane	3.
Methylene chloride	3.
Fluorotrichloromethane	3.
1,1-Dichloroethene	3.
1,1-Dichloroethane	3.
trans-1,2-Dichloroethene	3.
Chloroform	3.
1,2-Dichloroethane	3.
1,1,1-Trichloroethane	3.
Carbon tetrachloride	3.
Dichlorobromomethane	3.
1,1,2,2-Tetrachloroethane	3.
1,2-Dichloropropane	3.
trans-1,3-Dichloropropene	3.
Trichloroethene	3.
Dibromochloromethane	3.
1,1,2-Trichloroethane	3.
Benzene	3.
cis-1,3-Dichloropropene	3.
2-Chloroethylvinyl ether	3.
Bromoform	3.
Tetrachloroethene	3.
Toluene	3.
Chlorobenzene	3.
Ethylbenzene	3.

Encl 2

Base Neutrals	LIMIT OF DETECTION
N-nitrosodimethylamine	10.
bis (2-chloroethyl) ether	10.
1,3-dichlorobenzene	10.
1,4-dichlorobenzene	10.
1,2-dichlorobenzene	10.
bis (2-chloroisopropyl) ether	10.
hexachloroethane	10.
N-nitrosodi-n-propylamine	10.
nitrobenzene	10.
isophorone	10.
bis (2-chloroethoxy) methane	10.
1,2,4-trichlorobenzene	10.
naphthalene	10.
hexachlorobutadiene	10.
hexachlorocyclopentadiene	10.
2-chloronaphthalene	10.
acenaphthylene	10.
dimethyl phthalate	10.
2,6-dinitrotoluene	10.
acenaphthene	10.
2,4-dinitrotoluene	10.
fluorene	10.
4-chlorophenyl phenyl ether	10.
diethyl phthalate	10.
1,2-diphenylhydrazine	10.
N-nitrosodiphenylamine	10.
4-bromophenyl phenyl ether	10.
hexachlorobenzene	10.
phenanthrene	10.
anthracene	10.
di-n-butyl phthalate	10.
fluoranthene	10.
pyrene	10.
benzidine	30.
butyl benzyl phthalate	10.
benzo (a) anthracene	10.
chrysene	10.
3,3'-dichlorobenzidine	30.
bis (2-ethylhexyl) phthalate	10.
di-n-octyl phthalate	10.
benzo (b) fluoranthene	10.
benzo (K) fluoranthene	10.
benzo (a) pyrene	10.
indeno (1,2,3-cd) pyrene	10.
dibenzo (a,h) anthracene	10.
benzo (ghi) perylene	10.

Acid Extractables	LIMIT OF DETECTION
2-chlorophenol	10.
phenol	10.
2-nitrophenol	10.
2,4-dimethylphenol	10.
2,4-dichlorophenol	10.
4-chloro-3-methylphenol	10.
2,4,6-trichlorophenol	10.
2,4-dinitrophenol	30.
4-nitrophenol	30.
2-methyl-4,6-dinitrophenol	30.
pentachlorophenol	30.

Encl 2

Base Neutrals	LIMIT OF DETECTION
N-nitrosodimethylamine	20.
bis (2-chloroethyl) ether	20.
1,3-dichlorobenzene	20.
1,4-dichlorobenzene	20.
1,2-dichlorobenzene	20.
bis (2-chloroisopropyl) ether	20.
hexachloroethane	20.
N-nitrosodi-n-propylamine	20.
nitrobenzene	20.
isophorone	20.
bis (2-chloroethoxy) methane	20.
1,2,4-trichlorobenzene	20.
naphthalene	20.
hexachlorobutadiene	20.
hexachlorocyclopentadiene	20.
2-chloronaphthalene	20.
acenaphthylene	20.
dimethyl phthalate	20.
2,6-dinitrotoluene	20.
acenaphthene	20.
2,4-dinitrotoluene	20.
fluorene	20.
4-chlorophenyl phenyl ether	20.
diethyl phthalate	20.
1,2-diphenylhydrazine	20.
N-nitrosodiphenylamine	20.
4-bromophenyl phenyl ether	20.
hexachlorobenzene	20.
phenanthrene	20.
anthracene	20.
di-n-butyl phthalate	20.
fluoranthene	20.
pyrene	20.
benzidine	60.
butyl benzyl phthalate	20.
benzo (a) anthracene	20.
chrysene	20.
3,3'-dichlorobenzidine	60.
bis (2-ethylhexyl) phthalate	20.
di-n-octyl phthalate	20.
benzo (b) fluoranthene	20.
benzo (K) fluoranthene	20.
benzo (a) pyrene	20.
indeno (1,2,3-cd) pyrene	20.
dibenzo (a,h) anthracene	20.
benzo (ghi) perylene	20.

Acid Extractables	LIMIT OF DETECTION
2-chlorophenol	20.
phenol	20.
2-nitrophenol	20.
2,4-dimethylphenol	20.
2,4-dichlorophenol	20.
4-chloro-3-methylphenol	20.
2,4,6-trichlorophenol	20.
2,4-dinitrophenol	60.
4-nitrophenol	60.
2-methyl-4,6-dinitrophenol	60.
pentachlorophenol	60.

Encl.

PRIMARY PESTICIDE LIST AND LIMITS OF DETECTABILITY FOR PRIMARY PESTICIDES IN POTABLE WATER - WQED WATER QUALITY SURVEYS

PESTICIDE	LIMITS OF DETECTABILITY (ppb)*
HCB	0.80
ALPHA-BHC	0.20
BETA-BHC	0.20
O,P'-DDD	0.40
P,P'-DDD	0.40
O,P'-DDE	0.40
P,P'-DDE	0.40
O,P'-DDT	0.60
P,P'-DDT	0.60
oxychlordane	0.16
mirex	0.04
aldrin	0.16
technical chlordane	1.20
dieldrin	0.24
endrin	0.04
~~heptachlor~~	~~0.06~~
heptachlor epoxide	0.16
lindane	0.08
methoxychlor	1.60
toxaphene	1.60
cis-chlordane	0.16
trans-chlordane	0.16
~~malathion~~	~~1.60~~
~~parathion~~	~~0.40~~
~~chlorpyrifos~~	~~0.24~~
~~diazinon~~	~~1.00~~
~~methyl parathion~~	~~0.60~~
~~ronnel~~	~~0.20~~
2,4-D (acid equiv.)	3.80
silvex (acid equiv.)	0.50
2,4,5-T (acid equiv.)	0.50
PCB (Aroclor 1242)	0.80
PCB (Aroclor 1248)	0.80
PCB (Aroclor 1254)	0.80
PCB (Aroclor 1260)	0.80

*based on electron-capture detection.

also:

delta-BHC	0.20
~~endosulfan I~~	~~0.70~~
~~endosulfan II~~	~~[illegible]~~
~~endosulfan sulfate~~	~~[illegible]~~
endrin aldehyde	1.6
endrin Ketone	0.64
PCB (Aroclor 1016)	1.6
PCB (Aroclor 1221)	1.6
PCB (Aroclor 1232)	1.6

End

APPENDIX V

WP-1154C

INORGANIC DATA USABILITY AUDIT REPORT

Laboratory: CENTEC Total Number of Samples: 22

Case: P-1944 Contract Number: P-1944HQ/6531

Data User: GWMTF Region: 7 Site Number: 36

QC Number: 102 Site: Sunflower, KS

Date Received at EMSL/LV: 1 / 8 / 87 Date Audited: 2 / 9 / 87

Date Submitted by Lab: 1 / 2 / 87 Date Reviewed: 2 / 20 / 87

DATA QUALITY SUMMARY

A. Graphite Furnace AA Analysis: Sb results with exception. As, Cd, Pb, Se, and Tl results are quantitative.
B. ICP Analysis: Ba, Be, Ca, Cr, Co, Cu, Mg, Mn, Ni, K, Ag, Na, V, and Zn are quantiattive. Al and Fe are semi-quantitative.
C. Hg Analysis: Quantitative
D. CN^- Analysis: Quantitative
E. IC Analysis: Br and SO_4 results are quantitative. NO_2 and NO_3 with exception (quantitative) and Cl are semi-quantitative.
F. Ammonia Analysis: Quantitative
G. Phenol Analysis: Quantitative
H. TOC Analysis: Quantitative
I. POC Analysis: Suspect
J. TOX Analysis: Quantitative
K. POX Analysis: Quantitative

DRAFT

FEB 2 1987

NOTE: Usability is determined from guidelines laid out in the "Inorganic Data Validation SOP" written by D.K. White, May 14, 1985.

Initial Audit by:

M.E. Balogh
Senior Scientist

G. Gibson
Data Audit Technician

C.A. Baggett
Data Audit Technician

Reviewed by:

M.E. Balogh
Senior Scientist

Laboratory Performance Monitoring Group
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APPENDIX 2

SUMMARY OF CONCENTRATIONS FOR COMPOUNDS FOUND IN GROUND-WATER AND SAMPLING BLANK SAMPLES AT SITE 36, SUNFLOWER, KS

The following table lists the concentrations for compounds analyzed for and found in samples at the site. Table A2-1 is generated by listing all compounds detected and all tentatively identified compounds reported on the organic Form I, Part B. All tentatively identified compounds with a spectral purity greater than 850 are identified by name and purity in the table. Those with a purity of less than 850 are labeled, unknown.

Sample numbers are designated by the inorganic and corresponding organic sample number. Inorganic sample numbers are preceded by the prefix "MQO" organic sample numbers are preceded by the prefix "QO."

TABLE KEY

A value without a flag indicates a result above the contract required detection limit (CRDL).

J Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed or when the mass spectral data indicated the presence of a compound that meets the identification criteria but the result is less than the specified detection limit but greater than zero. If the limit of detection is 10 µg and a concentration of 3 µg is calculated, then report as 3J.

B This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

GW = ground-water
SW = surface-water
low and medium are indicators of concentration.

CASE NO: 6531/P/1944HO

SAMPLE NO:		01406/M0A696	01422/M0A712	01421/M0A711	01416/M0A704	01417/M0A707	01400/M0A69
SAMPLE LOCATION:		FIELD BLANK	TRIP BLANK	EQUIPT BLANK	WELL-36	WELL-39	WELL-41
SAMPLE TYPE:		GW-LOW	GW-LOW	GW-LOW	GW-LOW DUP	GW-LOW DUP	GW-LOW DUP
VOA	ACETONE		9 JB1	9.2 JB1			
	METHYLENE CHLORIDE		1.9 JB1	2 JB1			1 9
	TETRACHLOROETHENE						3.7
	TOLUENE						
	TRANS-1,2-DICHLOROETHENE						
	TRICHLOROETHENE						
SEMI-VOA	BENZO(A)ANTHRACENE					2.2 J	
	PHENOL						
	2,4,6-TRICHLOROPHENOL						
PEST/PCB	DIELDRIN						
TIC-VOA-PT	FURAN,TETRAHYDRO						
TIC-SEMI-VOA	UNKNOWN						
	UNKNOWN						
	UNKNOWN						
TOTAL METALS	ALUMINUM	140	150	115	1150	974	9700
	ANTIMONY						
	ARSENIC						
	BARIUM	4	7	5	110	112	115
	BERYLLIUM						
	CADMIUM						
	CALCIUM	200	295	193	117000	120000	109000
	CHROMIUM						13
	COBALT		7				
	COPPER						
	IRON				1050	1040	5340
	LEAD						11.5
	MAGNESIUM	94		109	23	[illegible]	37000
	MANGANESE				50	59	50
	MERCURY						
	NICKEL						
	POTASSIUM				454	902	1060
	SELENIUM				4.9	5.5	
	SILVER		10				
	SODIUM	495	446	475	56100	57700	95900
	THALLIUM						
	VANADIUM						
	ZINC						23

ALL CONCENTRATIONS ARE IN ug/L

SITE: SITE 34 SUNFLOWER AMMUNITION PLANT, DESOTO, KS
CASE NO: 6531/P/1944HO

SAMPLE NO:	Q1406/MOA696	Q1422/MOA712	Q1421/MOA711	Q1416/MOA706	Q1417/MOA707	Q1400/MOA690
SAMPLE LOCATION:	FIELD BLANK	TRIP BLANK	EQUIPT BLANK	WELL-34	WELL-36	WELL-41
SAMPLE TYPE:	GW-LOW	GW-LOW	GW-LOW	GW-LOW DUP	GW-LOW DUP	GW-LOW DUP
INORG. AMMONIA NITROGEN						
INDIC BROMIDE						
CHLORIDE				25000	13000	29000
CYANIDE						
NITRATE NITROGEN				800	900	910
NITRITE NITROGEN						
TOC				1900		290
TOX						
SULFATE				130000	230000	440000
TOC					11000	1700
TOTAL PHENOLS						
TOX				9	10	9.9

ALL CONCENTRATIONS ARE IN ug/L.

SITE: SITE 36 SUNFLOWER AMMUNITION PLANT, DESOTO, KS
CASE NO: 6531/P/194400

SAMPLE NO:		01399/MQA689	01396/MQA686	01397/MQA687	01401/MQA691	01402/MQA692	01403/MQA693
SAMPLE LOCATION:		WELL-41	WELL-46	WELL-3	WELL-8	WELL-31	WELL-40
SAMPLE TYPE:		GW-LOW DUP	GW-LOW	GW-LOW	GW-LOW	GW-LOW	GW-LOW
VOA	ACETONE		19		14 B		14
	METHYLENE CHLORIDE		3 JB	1.9 JB	1.7 JB		3.7 J
	TETRACHLOROETHENE	2.9 J					
	TOLUENE						
	TRANS-1,2-DICHLOROETHENE						
	TRICHLOROETHENE						
SEMI-VOA	BENZO(A)ANTHRACENE						
	PHENOL	2.6 J					
	2,4,6-TRICHLOROPHENOL	2 J					
PEST/PCB	DIELDRIN						
TIC-VOA-PT	FURAN,TETRAHYDRO						
TIC-SEMI-VOA	UNKNOWN					24 J	
	UNKNOWN					24 J	
	UNKNOWN					5 J	
TOTAL METALS	ALUMINUM	8050	1970	1590	1320	173	1710
	ANTIMONY						
	ARSENIC						
	BARIUM	170	124	196	289	275	190
	BERYLLIUM						
	CADMIUM		0.4				
	CALCIUM	172000	78700	81900	55400	157000	82600
	CHROMIUM	15		6			6
	COBALT	9			20		
	COPPER						
	IRON	4730	1730	952	9060	4990	1440
	LEAD	9.4	5.1	5.9	19.7		4.6
	MAGNESIUM	34900	15900	19600	14400	19900	23700
	MANGANESE	73	46	53	272	3940	77
	MERCURY						
	NICKEL						
	POTASSIUM	1850	1730	1050	1180	1200	1380
	SELENIUM						
	SILVER	9		5	5		5
	SODIUM	75200	38700	42400	69000	29500	43100
	THALLIUM						
	VANADIUM				8		
	ZINC	42	33		55	26	

ALL CONCENTRATIONS ARE IN ug/L

CASE NO: 6511/P/1944HQ

SAMPLE NO:		01399/HQA689	01396/HQA696	01397/HQA687	01401/HQA691	01402/HQA692	01403/HQA69
SAMPLE LOCATION:		WELL-41	WELL-44	WELL-3	WELL-8	WELL-31	WELL-49
SAMPLE TYPE:		GW-LOW DUP	GW-LOW	GW-LOW	GW-LOW	GW-LOW	GW-LOW
INORG	AMMONIA NITROGEN					100	
INDIC.	BROMIDE					530	
	CHLORIDE	34000	7800	10000	10000	12000	7400
	CYANIDE						
	NITRATE NITROGEN	900	1300	3500	2500		
	NITRITE NITROGEN						
	BOD						
	COD						
	SULFATE	400000	64000	120000	31000	320000	110000
	TOC	1900	1300	2200		3700	1200
	TOTAL PHENOLS						
	TOX	11		15	6.2	14	

ALL CONCENTRATIONS ARE IN UG/L

SAMPLE NO:	Q1399/MQA689	Q1396MQA686	Q1397/MQA687	Q1401/MQA691	Q1402/MQA692	Q1403/MQA6
SAMPLE LOCATION:	WELL-41	WELL-46	WELL-3	WELL-9	WELL-31	WELL-49
SAMPLE TYPE:	GW-LOW DUP	GW-LOW	GW-LOW	GW-LOW	GW-LOW	GW-LOW
INORG: AMMONIA NITROGEN					100	
INORG: BROMIDE					530	
CHLORIDE	34000	7900	10000	10000	12000	7400
CYANIDE						
NITRATE NITROGEN	900	1300	3500	2500		
NITRITE NITROGEN						
POC						
POX						
SULFATE	400000	64000	120000	31000	320000	110000
TOC	1900	1300	2200		3700	1200
TOTAL PHENOLS						
TOX	11		15	4.2	14	

ALL CONCENTRATIONS ARE IN UG/L

CASE NO: 4531/P/1944HO

SAMPLE NO:		Q1404/MOA694	Q1405/MOA695	Q1409/MOA699	Q1410/MOA700	Q1411/MOA701	Q1412/MOA70
SAMPLE LOCATION:		WELL-2	WELL-12	WELL-29	WELL-54	WELL-6	WELL-17
SAMPLE TYPE:		GW-LOW	GW-LOW	GW-LOW	GW-LOW	GW-LOW	GW-LOW
VOA	ACETONE	9.2 JB	13			11	
	METHYLENE CHLORIDE					2.5 JB	
	TETRACHLOROETHENE						
	TOLUENE		2.4 J				
	TRANS-1,2-DICHLOROETHENE						
	TRICHLOROETHENE						
SEMI-VOA	BENZO(A)ANTHRACENE						
	PHENOL						
	2,4,6-TRICHLOROPHENOL						
PEST/PCB	DIELDRIN						
TIC-VOA-PT	FURAN,TETRAHYDRO		IPUR 981 36 J				
TIC-SEMI-VOA	UNKNOWN				15 J		
	UNKNOWN						
	UNKNOWN						
TOTAL METALS	ALUMINUM	4840	2580	1160	1020	1710	7910
	ANTIMONY						
	ARSENIC	4.8	9.9		3.6		5
	BARIUM	343	81	92	190	245	300
	BERYLLIUM						
	CADMIUM			0.4			
	CALCIUM	77300	6130	149000	102000	51200	67000
	CHROMIUM	25				5	16
	COBALT	7					
	COPPER		23				23
	IRON	3830	3740	1200	587	1500	7700
	LEAD	6.9	24.6	4.1	4.7		14.5
	MAGNESIUM	20200	2050	34400	18000	12900	14900
	MANGANESE	171	54	34	981	32	202
	MERCURY						
	NICKEL						
	POTASSIUM	2860	2350	1330	3390	844	2200
	SELENIUM		41.3				11.9
	SILVER	5					
	SODIUM	84700	242000	104000	14700	88400	53500
	THALLIUM						
	VANADIUM	13	47				
	ZINC	95	40	23			70

ALL CONCENTRATIONS ARE IN ug/L.

CASE NO: 6531/P/1944HQ

SAMPLE NO:	Q1404/MQA694	Q1405/MQA695	Q1408/MQA698	Q1410/MQA700	Q1411/MQA701	Q1412/MQA702
SAMPLE LOCATION:	WELL-2	WELL-12	WELL-29	WELL-54	WELL-6	WELL-17
SAMPLE TYPE:	GW-LOW	GW-LOW	GW-LOW	GW-LOW	GW-LOW	GW-LOW
INORG. AMMONIA NITROGEN		NR		600		
INDIC BROMIDE		NR		900		
CHLORIDE	16000	NR	26000	11000	15000	10000
CYANIDE		NR				
NITRATE NITROGEN	6500	NR	250	100	500	8000
NITRITE NITROGEN		NR				
DOC		230				
DOX		NR				
SULFATE	42000	NR	425000	52000	34000	59000
TOC	1300	1600	4900	2000		1300
TOTAL PHENOLS		NR			11	
TOX	15	NR	23	16		9.2

ALL CONCENTRATIONS ARE IN ug/L.

CASE NO: 6531/P/1944HO

SAMPLE NO:		01413/MQA703	01414/MQA704	01415/MQA705	01420/MQA710
SAMPLE LOCATION:		WELL-40	WELL-42	SURFACE	WELL-13
SAMPLE TYPE:		GW-LOW	GW-LOW	GW-LOW	GW-LOW
VOA	ACETONE		14		46
	METHYLENE CHLORIDE	2 JB	3 JB	6 3	14
	TETRACHLOROETHENE				
	TOLUENE				
	TRANS-1,2-DICHLOROETHENE	2.1 J			
	TRICHLOROETHENE				2.8 J
SEMI-VOA	BENZO(A)ANTHRACENE				
	PHENOL				
	2,4,6-TRICHLOROPHENOL				
PEST/PCB	DIELDRIN			12	
TIC-VOA-PT	FURAN,TETRAHYDRO				PUR 975 190 J
TIC-SEMI-VOA	UNKNOWN				
	UNKNOWN				
	UNKNOWN				
TOTAL METALS	ALUMINUM	304	2630	609	7040
	ANTIMONY				10
	ARSENIC				11.4
	BARIUM	97	89	113	342
	BERYLLIUM				
	CADMIUM				1.5
	CALCIUM	57100	191000	107000	57000
	CHROMIUM	6	12		16
	COBALT				
	COPPER				27
	IRON	1210	7530	408	20700
	LEAD		9.1		91.8
	MAGNESIUM	19300	39400	13000	11300
	MANGANESE	69	244	39	991
	MERCURY				
	NICKEL				
	POTASSIUM	1780	1610	1640	4190
	SELENIUM				25
	SILVER	5			
	SODIUM	29300	79400	22600	212000
	THALLIUM				
	VANADIUM				67
	ZINC	43	32		79

ALL CONCENTRATIONS ARE IN UG/L.