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INVESTIGATION OF GROUND WATER POLLUTION AT AIR FORCE PLANT 4 NAS FORT
WORTH TX
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ARMY CORP OF ENGINEERS



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**INVESTIGATION OF GROUND WATER POLLUTION AT -
AIR FORCE PLANT NO. 4
FORT WORTH, TEXAS**

**REPORT TO -
UNITED STATES AIR FORCE**

**PREPARED BY -
U.S. ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT
FORT WORTH DISTRICT**

OCTOBER 1986

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ABSTRACT

Commencing in December 1982, Hargis and Associates, under a contract with General Dynamics Corporation, conducted an extensive investigation to determine the presence and extent of industrial chemical pollution at Air Force Plant No. 4. A major portion of this work was devoted to the testing of ground water flowing within the overburden. In addition, Hargis had 16 wells drilled to monitor for polluted ground water in the upper and middle zones of the Paluxy Formation. Paluxy ground water was monitored because the Formation is a principal water supply for the contiguous city of White Settlement. Hargis, in a letter to General Dynamics dated 12 April 1985, reported discovery of a concentration of 8,900 ug/l of trichloroethylene, 190 ug/l of 1,2-trans-dichloroethylene, and lesser amounts of other chlorinated hydrocarbons, and the existence of abnormally high water levels in the upper zone of the Paluxy Formation in well P-8(U). In this letter, and again in the Phase II report of 1985, Hargis interpreted this information to indicate that chemically polluted ground water from the overburden was recharging the upper zone of the Paluxy aquifer beneath the east parking lot of the plant. In early May 1985, the Fort Worth District, Corps of Engineers, operating for Kansas City District Superfund, was asked to review existing data, investigate the distribution of chemical pollution within the Paluxy, and to locate the

area in which polluted overburden ground water enters the Paluxy aquifer. The Corps proposed to drill six monitor wells into the upper zone of the Paluxy aquifer and five monitor wells into the alluvium mantling the bedrock, both groups of monitor wells to be located in the east parking lot of the plant. Also, the Corps proposed to have geophysical logs run in Paluxy monitor wells P-1 through P-4, and P-5(M) through P-10(M). These proposals were not implemented because of funding curtailment. The following investigative work was performed at the plant:

Three pairs of Paluxy monitoring wells were drilled along the south boundary of the plant to determine if pollutants discovered in well P-8(U) had reached the south plant boundary. One of each pair of these wells was completed in the upper zone of the Paluxy and the other was completed in the middle zone. Ground water was sampled in these wells and tested by Hargis and Associates. To date none of these wells appear to produce chemically polluted ground water. It is recommended that sampling and testing of ground water from all of the well pairs along the south boundary of the plant continue, preferably on a short-cycle basis. In addition to the drilling of 3 pairs of Paluxy monitoring wells, 28 exploratory borings were drilled in the east parking lot to obtain data for mapping topography of the eroded surface of bedrock in the area where the overburden might be in direct contact with the Paluxy aquifer. Exploratory drilling found that an erosion channel there does not penetrate the Paluxy Formation at any of the drill sites. A

sandstone bed, located immediately beneath the Walnut limestone and separated from the upper zone of the Paluxy aquifer below by 8 to 14 feet of shale, was recognized in geophysical logs of the monitor wells along the southern boundary of the plant, the geophysical log of exploratory boring 8A3F-110, and in short-interval cores in the area of predicted contact between the overburden and the Paluxy Formation, which became known as the "window." This sandstone may be the only member of the Paluxy Formation which becomes polluted in the "window" area. Since this has not been proved, it is recommended that two monitor wells be drilled immediately south of the "window" to test separately this uppermost Paluxy sandstone and the upper zone of the Paluxy aquifer proper. If these wells find pollution to be restricted to the uppermost Paluxy sandstone, it is recommended that additional monitor wells be drilled into the upper zone of the Paluxy aquifer in the vicinity of monitor well P-8(U) to determine whether and to what extent pollution has spread in the upper Paluxy zone proper from well P-8(U). It is also recommended that several monitor wells be completed in the overburden in the east parking lot to better define distribution of polluted ground water and to locate sand and gravel deposits in the erosional channel in the bedrock. Additionally, these wells may offer an opportunity to determine the velocity at which ground water moves through the overburden by injecting a nonhazardous dye tracer in selected wells.

**INVESTIGATION OF POLLUTION OF GROUND WATER
IN THE PALUXY AQUIFER AT AIR FORCE PLANT
NO. 4, FORT WORTH, TEXAS**

INTRODUCTION

1. Preceding Studies. Pollution of ground water beneath Air Force Plant No. 4 was studied first by Hargis and Montgomery, Inc., then by Hargis and Associates, Inc. The problem being investigated was chemical pollution of ground water within the overburden. Monitoring and testing of ground water commenced with completion of well HM-1 in December 1982. D'Appolonia Waste Management Service conducted a refraction seismic survey in the east parking lot in 1983 in an effort to delineate topography of the eroded top of the bedrock in that area. The U.S. Environmental Protection Agency contracted four wells which were drilled in May and June 1983 to monitor ground water in the overburden. These wells are located in the city of White Settlement near the south and west boundaries of the plant. A record search to locate additional sites of buried industrial waste was made by CH₂M Hill Company in 1984. The reader is referred to the following reports for details of other investigations of ground-water pollution at the plant:

- a. Hargis and Montgomery Inc. 1983a, dated 3 February 1983.
- b. Hargis and Montgomery, Inc. 1983b, dated 12 July 1983.
- c. Hargis and Associates, Inc. 1984a, dated 12 October 1984.
- d. Hargis and Associates, Inc. 1984b, dated 25 October 1984.
- e. Hargis and Associates, Inc. dated 25 September 1985.

Monitor wells were drilled by Southwestern Laboratories, Inc., of Dallas, Texas for Hargis and Montgomery and Hargis and Associates. Ground water from monitor wells was sampled periodically by Hargis. Ground-water samples were tested for pollutants primarily by Brown and Caldwell Laboratories, Inc., of Bakersfield, California. Some testing was also done by Radian Corporation of Austin, Texas.

Hargis and Associates informed General Dynamics Corporation by a letter dated 12 April 1985, that a concentration of 8,900 ug/l of trichloroethylene, a concentration of 190 ug/l of 1,2-trans-dichloroethylene and lower concentrations of other chlorinated hydrocarbons had been discovered in well P-8(U) monitoring the upper zone of the Paluxy. In this letter and again in the Phase II report of 25 September 1985, Hargis interpreted abnormally high water levels in well P-8(U) and normal water levels in well P-8(M) coupled with finding pollutants in the upper zone of the Paluxy to indicate that ground water from the overburden was probably recharging the upper portion of the Paluxy aquifer in an area east of the Assembly Building where the normally intervening Walnut Formation was believed to be missing. At the beginning of May 1985 the Air Force asked the Corps of Engineers to assist in determining the extent of pollution within the Paluxy Formation beneath the east parking lot in the vicinity of the Paluxy monitor well P-8(U) and to employ contractors to do remedial work if immediate action was required.

2. Scope and Objectives. The Corps of Engineers was to review all accumulated data bearing on pollution of the Paluxy Formation in the southeast part of the plant property. The Corps was then to develop a plan of investigation with the object of defining the limits of pollution within the Paluxy discovered by monitor well P-8(U) and to drill a number of exploratory borings to locate the area in which pollutants enter the Paluxy. The Corps plan included drilling and completing three pairs of Paluxy monitor wells along the southern boundary of the plant to discover if pollutants were present and moving beyond the south plant boundary toward the city of White Settlement. The Corps of Engineers proposed that an additional six monitor wells be drilled and completed in the upper zone of the Paluxy aquifer to aid in defining the pollution plume. The area in which pollutants were believed to enter the Paluxy Formation was to be investigated by the drilling of 20 exploratory borings which would also define bedrock topography. Additionally, five monitor wells were to be completed in the overburden in the east parking lot. Monitor wells P-1 through P-4 and middle Paluxy wells P-5(M) through P-10(M) were to have their pumps pulled and to have geophysical logs run in them to better resolve bedrock stratigraphy. Because of funding curtailment, the Corps drilled only 3 pairs of monitor wells along the south boundary of the plant and 28 exploratory borings in the east parking lot.

3. Local Geology. Air Force Plant No. 4, operated by General Dynamics

Corporation, Fort Worth Division, is situated on overburden immediately beneath which is a sequence of bedrock formations comprised of limestone, shale, and soft sandstone, all of Cretaceous age. The deepest of these formations which are relevant to this investigation is the Glen Rose Formation consisting principally of limestone. Depth of the Glen Rose limestone varies within the plant area from 213 feet in well P-1 to 236 feet in exploratory boring 8A3F-110. Above the Glen Rose, in ascending order, are the Paluxy Formation, the Walnut Formation, and the Goodland Formation.

a. Stratigraphy.

(1) Paluxy Formation. The Paluxy Formation consists primarily of sandstone which varies from nearly uncemented sand to moderately cemented sandstone. The formation also contains a number of shale beds, most of which range from a thickness of less than 1 foot to as much as 5 feet. The top of the Paluxy Formation is defined as the first sandstone encountered beneath shale or limestone of the overlying Walnut Formation. The Paluxy has been divided into three zones. The lower zone, immediately overlying the Glen Rose Formation, is comprised of a number of sandstone beds separated from each other by beds of shale from less than 1 foot thick to as much as 7 feet thick. Two geophysical logs of this zone in the city of White Settlement indicate that much of the sandstone is somewhat shaly or clayey. The zone is quite consistent in total thickness throughout the plant/White settlement area. Because of

the presence of beds of shale and shaly sandstone, the lower zone of the Paluxy probably contributes less ground water to water supply wells within the city of White Settlement than does the middle zone.

The middle zone of the Paluxy has a relatively small shale or clay content. This unit is the uppermost Paluxy unit in which White Settlement city wells are completed. The middle zone of the Paluxy Formation is quite recognizable on geophysical logs of wells in this area. For examples of this see Plate 1 which is a correlation diagram in the plant/White Settlement area utilizing geophysical logs.

Water wells producing from the Paluxy Formation in the city of White Settlement are not completed in the upper zone of the Paluxy because of its low productivity. The upper zone of the Paluxy varies in composition significantly more in the proportion of sandstone and shale which comprise this zone in the area of Plant No. 4 and the city of White Settlement than does either the middle or the lower zone. In White Settlement, well No. 8, 19 feet of Walnut shale separates the Walnut limestone and the Paluxy sandstone. Only 0.5 to 1.5 feet of shale separates these beds in the plant area. The upper Paluxy zone is comprised of individual sandstone beds and of sub-zonal units consisting of a number of sandstone beds. The sub-zonal units are separated from each other by shale beds. These sandstone units vary in thickness from about 13 feet to 20 feet. Individual sandstone beds vary from a thickness of about 1 foot to as much as 8 feet.

(2) Walnut Formation. Regionally the Walnut Formation is comprised principally of shale which has a medial shelly limestone member. This member is the Walnut limestone described in earlier reports of investigation at the plant. The medial limestone member of the Walnut is approximately 30 feet thick in the plant/White Settlement area. Any shale present separating this member from the first Paluxy sandstone below is classified as belonging to the Walnut Formation. The Walnut also has a shale member overlying the Walnut limestone in this area which is approximately 20 feet thick. This shale has, on rare occasions, been classified as belonging to the Goodland limestone Formation above it, but regionally it belongs to the Walnut Formation. This shale contains a few feet of impure limestone in its middle portion. This part of the Walnut Formation can be seen on the geophysical and strip-log of White Settlement well No. 8 on Plate 1.

(3) Goodland Formation. The Goodland Formation overlies the Walnut shale. It is composed of limestone containing a few thin shale beds. Its total thickness is approximately 80 feet near the plant. Only a few feet of the basal part of the formation are present in the bedrock sequence beneath the plant because of erosion of its outcrop. Limestone comprising this formation is present beneath the plant only where the overburden is thin and bedrock is relatively near the surface. These conditions prevail mainly along the southern boundary of the plant property.

(4) Overburden. Alluvium mantling the eroded surface of bedrock beneath the plant has been called the upper zone in reports by Hargis and Montgomery, Inc., and by Hargis and Associates, Inc. This material is referred to here as overburden. Overburden in this immediate area consists primarily of clay, some of which is sandy and gravelly, but it contains channel deposits of sand and gravel as well.

b. Structure. Geologic structure in the shallow Cretaceous bedrock above the top of the Glen Rose Formation consists principally of gentle regional dip slightly south of east at approximately 30 feet per mile. Formational dip places the base of the Walnut limestone at between elevation 582 and elevation 587 along Grants Lane and at elevation 600 to elevation 602 in the vicinity of monitor wells P-10(U) and P-10(M) near the unnamed creek west of Bomber/Meandering Road west of the plant.

c. Aquifer Hydrology.

(1) Overburden. Ground water within the overburden flows in two general directions on top of the eroded bedrock in the plant area. A divide area of relatively high bedrock extends approximately north-south in the general area of the Parts Plant Building (No. 5) northward from about the location of Warehouse No. 1. West of this subsurface divide, overburden ground water flows toward the unnamed creek west of Bomber Road. East of the divide, ground water flows to the east, then to the north, down at least two buried channels eroded into the top of the bedrock.

(2) Paluxy Upper Zone. Many water levels in wells completed in both the upper and middle zones of the Paluxy aquifer are at elevations below the top of the upper zone of the aquifer. In wells P-8(U) and P-10(U) completed in the upper zone, early water levels were 19 and 21 feet higher than water levels in their companion wells P-8(M) and P-10(M) completed in the middle zone of the Paluxy, suggesting recharge of the upper zone of the Paluxy aquifer in the vicinity of the wells. Contours on elevations of water levels in monitor wells completed in the upper zone of the Paluxy aquifer are shown on Plate 2. The contours are drawn on few data. These piezometric data are not well distributed for purposes of hydrologic interpretation. However, it is known that the upper zone of the Paluxy aquifer is recharged through outcrops of this zone in the bottom of Lake Worth, immediately north of the plant where the lake is oriented east-west. Contours in areas of closest well data suggest that ground water in this zone probably flows nearly due south, except for anomalies. Contours around well P-10(U) have been drawn to suggest that recharge may be occurring in the bottom of the unnamed creek west of Bomber/Meandering Road. This was done because of the anomalously high water level in well P-10(U) next to the creek. Anomalously high water levels in the upper zone of the Paluxy in well P-8(U) coupled with the discovery of chemical pollution in water from Paluxy monitor well P-8(U) and water from overburden monitor wells such as HM-82 gave rise to Hargis' interpretation that overburden ground

water containing chemical pollution was in hydraulic contact with the upper zone of the Paluxy Formation and was actively recharging the upper zone of the Paluxy aquifer. That part of the channel eroded into the bedrock in which contact between the overburden and sandstone of the Paluxy aquifer was believed to exist has been called the "window." The "window" was believed to be located under the east parking lot of the plant, southeast of Engineering Building 200.

(3) Paluxy Middle Zone. Plate 3 shows contours on elevations of water levels in the middle zone of the Paluxy aquifer. Water level contours from the relatively few monitor well data in the middle zone of the Paluxy as drawn suggest a flow direction of south 30° east in this zone. The water level elevation data contour smoothly, and 5 foot contours are more widely separated than are those of the upper zone of the Paluxy aquifer. These conditions suggest that the middle zone here may be more remote from its source of recharge than is the upper zone. The flow direction indicated by the contours seems to indicate that the recharge area of the middle zone is farther upstream in Lake Worth than is that of the upper zone. This appears to be in accord with regional structure of the Paluxy Formation. Since the Paluxy Formation dips (inclines) eastwardly, it also rises to the west. The middle zone of the formation is not known to crop out in the bottom of Lake Worth along the north boundary of the plant. It may crop out in the lake bottom north and west of the plant.

PLAN OF INVESTIGATION

1. Paluxy Monitor Well Program. Initial action by the Corps of Engineers was to drill and complete three pairs of monitor wells on an east-west line along the south plant boundary. The well pairs were located 500 feet apart. Wells P-11(U) and P-11(M) were completed in the middle of the south end of the east parking lot. Wells P-12(U) and P-12(M) were located in the alley along the south side of General Warehouse Building No. 188. The well heads were placed in small concrete vaults beneath the alley paving. The vaults were covered by removable steel cover plates to permit vehicle traffic, yet easy access to the well heads and protection from entry of rain runoff into the wells. Wells P-13(U) and P-13(M) were completed 80 to 90 feet south of the line of P-11 and P-12 well pairs. P-13(U) and P-13(M) are located just off the concrete apron approximately 120 feet south of the southwest corner of Run Station No. 1. Zonation of the Paluxy Formation used for completion of these wells was tailored to match that employed by Hargis and Associates. The purpose of the well pairs was to discover if pollution within the Paluxy aquifer had reached the south boundary of the plant in the upper or middle zones of the Paluxy.

a. Well Drilling and Construction. Well drilling and completion procedures employed were similar to those used by Southwestern Laboratories in their work for Hargis and Associates. Of the three wells completed in the upper zone of the Paluxy along the southern

boundary of the plant, only well P-12(U) was completed to include the uppermost sandstone immediately beneath the Walnut limestone. The casing program used for completions in the upper zone of the Paluxy involved steel casing through the Walnut limestone. However, only a 14-inch diameter hole was drilled in this section into which 10-inch steel casing was set, centralized, and cemented from the bottom of the casing to the ground surface. A 9-7/8-inch diameter hole was then drilled from the bottom of the 10-inch casing to total depth of the well into which was set 4-inch centralized, schedule 80 PVC casing, at the bottom of which was 20 feet of 4-inch I.D., 0.010 slot PVC well screen, plugged at the bottom. Filter sand was placed in the annulus around the 4-inch casing, extending upward into the steel casing. A 1/2-HP, 8 gpm, 2-7/8-inch diameter, 20 stage, single phase, Model 2x4 P050 submersible pump, manufactured by the Standard Pump Company of Bartlesville, Oklahoma, was installed in each well for water sampling. A 14-inch hole was drilled through the upper zone of the Paluxy into the uppermost part of the middle zone of the Paluxy and cemented to the surface in wells completed in the middle zone. As in wells completed in the upper zone, a 4-inch PVC casing and 20 feet of 4-inch PVC screen was set and sand packed in the test interval of the middle zone. The same model submersible pump was installed in all wells, regardless of the zone they were completed in.

A black substance was encountered while drilling cement remaining in

the 10-inch casing of well P-13(M) after the casing cement had set. It was found to be gilsonite, a powdered material used to prevent lost circulation while cementing. It was not known if this material had been incorporated in cement behind the casing, but this circumstance was assumed as a "worst case." Samples of this material, recovered during drilling cement in the casing, were analyzed by Southwestern Division Laboratory of the Corps of Engineers in Dallas, Texas, to determine if any toxic substances were present. Additional samples of this material were obtained from the Western Company of North America, the well cementers, and were sent to Hargis and Associates to be exposed to dissolution by a solution of trichloroethylene (TCE) in a concentration similar to that discovered in ground water from well P-8(U). Tests were run to determine first, whether the gilsonite would go into solution; and second, whether any toxic substances would be produced in the process of dissolution. Test results from both laboratories were negative, allowing further operations in the well. Incorporation of gilsonite in the casing cement also raised a question as to the integrity of the casing cement. Western Company of North America pressure tested the well with water under 200 psi and then retreated the well with an additional 75 sacks of neat cement slurry with a surface pressure of 150 psi at their expense. Logging of the Paluxy monitor well pairs was done initially from drill cuttings, as were Paluxy wells P-1 through P-10. In addition, an electric log was run in the open hole

(before setting 4-inch PVC casing) and a gamma ray log was run through the entire hole to produce a log which included the portion of the well where steel casing was set. Though the commercial logs run in the first wells drilled, P-11(U) and P-11(M), were of poor quality, it became obvious very soon that the logs made from drill cuttings from beds below the base of the Walnut limestone did not agree well with the electric and gamma ray logs of the same section of bedrock. A variety of reasons account for this, most of which are related to the soft nature of the bedrock which, when drilled, would break sandstone down to sand grains instead of sandstone chips, and shale into discolored drilling fluid instead of shale chips of sufficient size for recognition. Because of the difficulty in obtaining good logs from drill cuttings, considerable reliance was placed on geophysical logs of the Paluxy monitor wells along the southern property line of the plant. The most desirable features of geophysical logs, compared with drill cutting logs, are the greater degree of resolution of individual beds and small units and the curve character which results in characteristic signatures of each formation, aiding correlation. All of the Paluxy monitor wells were developed by airlift pumping and surging. Each well was pumped by airlift, followed by a brief lowering of the air supply line below the eductor pipe to blow the well with compressed air, followed by an immediate return to airlift pumping. This cyclic activity was repeated every 15 minutes for a total development period of 4 hours.

b. Well Water Sampling and Testing. All sampling and testing of

ground water from Paluxy wells P-11(U) and (M), P-12(U) and (M), and P-13(U and M), was done by Hargis and Associates as part of their continuing program of ground water monitoring. Table 1 lists tests which found pollutants. Other unpolluted tests are included to indicate changes where pollution disappeared. Reproductions of test reports are located in the Appendix at the end of this report. The finding of methylene chloride and toluene in water samples from Paluxy monitor well P-11(U) followed by a 6-month period of unpolluted tests is interpreted to mean that the upper zone is probably unpolluted. Tests of water samples from well P-11(M) have contained no pollutants to date indicating that the middle zone of the Paluxy probably is unpolluted at the site of well P-11(M). Tests of water from well P-12(U) found oil and grease on 12 December 1985 and again on 9 January 1986. This material probably was present only in limited amounts because subsequently it disappeared from tests of water from the well. It may have come from the rig that drilled well P-12(U). On 9 January 1986, 62 ug/l of 1,1,1-trichloroethane was found in P-12(U). This pollutant was found again in concentration of 56 ug/l on 6 April 1986. The same pollutant was found on 9 July 1986, but in a concentration of only 7 ug/l. The trend of diminishing concentrations of 1,1,1-trichloroethane is suggestive that the upper zone of the Paluxy is unpolluted, and that this chemical may have been introduced during drilling. The presence of only one contaminant is considered unusual. Generally two or more

TABLE 1
TEST RESULTS

Well No.	Test Date or Receiving Date	Concentration	Pollutant
P-11(U)	9-05-85	15 ug/l	Methylene Chloride
	9-05-85	64 ug/l	Toluene
	10-10-85	70 ug/l	Toluene
	1-08-86	Purgeable Priority Pollutants - all below detection level.	
	4-05-86	Same	
	7-10-86	Same	
P-11(M)	No pollutants detected between 8-29-85 and 7-22-86.		
P-12(U)	12-12-85	32 mg/l	Oil and Grease
	12-12-85	Purgeable Priority Pollutants - all below detection level.	
	1-09-86	9 mg/l	Oil and Grease
	1-09-86	62 ug/l	1,1,1-Trichloroethane
	4-06-86	56 ug/l	1,1,1-Trichloroethane
	7-09-86	7 ug/l	1,1,1-Trichloroethane
P-12(M)	10-10-85	First Purgeable Priority Pollution test - all below detection level.	
	7-09-86	5 ug/l	1,1,1-Trichloroethane
	7-09-86	2 ug/l	1,1-Dichloroethane
P-13(U)	4-09-86	First Purgeable Priority Pollutant test - all below detection level.	
	5-07-86	0.17 mg/l lead - 0.12 mg/l above maximum permissible concentration.	
	5-07-86	0.06 mg/l - Manganese - 0.01 mg/l above maximum permissible concentration.	
	5-08-86	8 ug/l	Methylene Chloride
	6-05-86	0.06 mg/l lead - 0.01 above maximum permissible concentration	
	6-05-86	Purgeable Priority Pollutants - all below detection level.	
	7-09-86	Purgeable Priority Pollutants - all below detection level.	
	8-06-86	Tests for oil and grease and for total fuel. Hydrocarbons - all below detection level.	
P-13(M)	8-06-86	Purgeable Priority Pollutants - all below detection level.	
	8-06-86	B/NA Priority Pollutants - all below detection level.	
	8-06-86	B/NA Priority Pollutants - all below detection level.	

contaminants are found when an aquifer is polluted. This well should continue to be sampled and tested to build a larger body of test data. Well P-12(M) produced water with only 5 ug/l of 1,1,1-trichloroethane and 2 ug/l of 1,1-dichloroethane on 9 July 1986. Since water from this well has only been sampled and tested once, no conclusion can be reached concerning pollution of the middle zone at the location of the well. This well should continue to be tested to build a body of test data. Only minor concentrations of pollutants have been found in water samples from well P-13(U) to date. Traces of lead and manganese and a low concentration of methylene chloride, found during the initial 3-month period of testing, does not suggest that the upper zone of the Paluxy is polluted at the location of the well. This well should continue to be monitored. Sampling and testing of well P-13(M) so far indicates that no pollutants are present in the middle Paluxy here. Ground water from this well should continue to be sampled and tested.

A test of interzonal communication was conducted in the Paluxy wells P-12(U) and P-12(M). The middle zone was continuously pumped at 8 gpm in well P-12(M) for a period of 3 hours. Water levels were measured in well P-12(U) throughout this period. No drop in water level of P-12(U) was experienced during the test period. Though this test suggests lack of communication between the upper and middle zones of the Paluxy aquifer at this location, the test is not considered to be conclusive. Only unchanging water levels, measured in well P-12(U) during pumping of

well P-12(M) at a much greater rate, sustained over a much longer period, can reasonably demonstrate lack of communication between the upper and middle zones of the Paluxy Formation.

c. Safety Procedures. Hazards to drilling personnel were assessed at the beginning of field operations. It was determined that risk was at EPA Level D (minimal). Optional rubber gloves were used by drilling personnel where needed in addition to other protective clothing specified for Level D risk.

The Failing 1500 drill and all tools used in drilling the Paluxy monitor wells were steam cleaned after completing each well. All drilling fluids and cuttings, including augered materials, were collected and segregated in containers specifically for this purpose. The collected materials were sampled, and the samples were tested for the presence of purgeable priority pollutants. Results of these tests determined whether or not the materials required disposal in a toxic waste dump. The collected materials were turned over to General Dynamics Corporation for disposal based on test documentation supplied at the material transfer. Initially, collected surplus drilling materials were tested for volatile organic compounds as a slurry with a gas chromatograph using EPA Method 601. Subsequently, all materials were tested by gas chromatography/mass spectrometry by EPA Method 624 which tests for a greater range of compounds. Nearly all of the materials removed from the exploratory borings were products of

augering. Since no permanent installation was made in these borings, these materials were used to backfill the holes. Any surplus was collected, tested, and disposed of as were materials derived from drilling wells.

2. "Window" Investigation. The site of the erosion channel in which the "window," as interpreted by Hargis and Associates, was believed to exist, is the east parking lot primarily in an area near Grants Lane, southeast of Engineering Building 200.

a. Drilling Plan and Procedures. A plan of boring and section locations is shown on Plate 4. The drilling program designed to discover the location of the "window" was one of obtaining subsurface topographic data on the top of bedrock in the area of the east parking lot. Data on lithology of the uppermost bedrock were obtained as an integral part of the drilling. Drilling of borings 8A4C-83 through 8A4C-86 early in the investigation, before the drilling of Paluxy wells was well advanced, proved inconclusive in finding the "window" which is the location where overburden alluvium is in contact with sandstone of the Paluxy aquifer. Borings 8A4C-84 through 8A4C-86 found bedrock to be comprised of Walnut limestone, the top of which was at about the same elevation in all three borings. Drilling of exploratory borings was resumed after completion of all Paluxy monitor wells but P-13(M). This effort took the form of laying out four rows of potential exploratory boring locations from which to select those for drilling based on

results obtained. The rows of locations were laid out east-west, parallel to station lines of the plant survey grid. Drilling results from each row were portrayed as geologic sections on plates 6 and 7. Borings at the east end of each row, plus other borings near the eastern boundary of the east parking lot, formed an additional row and were used to construct geologic Section E-E', shown on plate 8. As drilling proceeded on rows D-D' and E-E', additional borings were drilled between the first borings to reduce the risk of failing to encounter any erosional channel in the bedrock which might penetrate the Paluxy Formation and constitute a "window" through which polluted ground water from the overburden might enter the Paluxy aquifer. One boring, 8A3F-110, was drilled and logged geophysically to obtain stratigraphic information on the basal Walnut limestone and the whole of the Paluxy formation beneath the Walnut. See Plate 4 for locations of monitor wells, exploratory borings, and geologic sections in the southeastern portion of the plant..

b. Drilling Results.

(1) Overburden Composition. Alluvium comprising the overburden consists of clay, sand, and gravel with some of these materials of somewhat mixed composition. The materials are shown on Sections A-A' through E-E' on Plates 6 through 8, and on logs of all wells and exploratory borings located in the Appendix at the back of this report.

(2) Bedrock Erosional Topography. Topography of the eroded top

of the bedrock is shown in plan on Plate 5, and in section on Plates 6, 7, and 8. Bedrock topography of direct concern to the site of a "window" is that of an erosional channel in the bedrock commencing near the south end of Warehouse No. 12. The channel extends eastward and "downstream" under Process Building No. 181, Materials Storage Building No. 182 to the northwest corner of General Warehouse Building No. 188 where it turns to the northeast. From Building No. 188 the channel extends across the east parking lot to the site of plugged overburden well HM-67, adjacent to Grants Lane and west of Field Operations support Building No. 189. Data from exploratory borings drilled in this investigation and from foundation borings drilled for plant construction suggest that a relatively flat bedrock exists between boring 8A-105 and Engineering Building No. 200, which includes the area beneath the Field Operations Building and Grants Lane. Elevations of the bedrock here range from 585 to 590. Any deeper erosional channel that may exist, eroded into this relatively flat area, may take a course similar to that suggested by the 595-foot contour on Plate 5.

(3) Bedrock Stratigraphy. The stratigraphic sequence of the lower portion of the Walnut formation and the uppermost portion of the Paluxy Formation is shown on Sections A-A' through E-E' on Plates 6, 7, and 8. Stratigraphy of these formations in the form of five geophysical logs with strip logs showing rock types is also shown on Plate 1, which is a bedrock correlation diagram. Wells numbered H-4 and 8, shown on

Plate 1, are located in the city of White Settlement. Also shown on Plate 1 are monitor wells P-12(M) and P-13(M), which are located along the south boundary of the plant. Stratigraphic boring 8A3F-110, on the right side of Plate 1, is north of monitor wells P-8(U) and P-8(M) in the east parking lot. See Plate 4 for the location of monitor wells and exploratory borings.

Good samples of the uppermost sandstone of the Paluxy Formation, which occurs immediately beneath the Walnut limestone, were obtained by short-interval coring of exploratory borings 8A4C-102 and 8A4C-103. (These borings are shown on Sections D-D', Plate 7, and E-E', Plate 8). Core of the uppermost sandstone was found to be very fine-grained and probably silty. Permeability of this core was not tested, but based on visual appearance, the sandstone has low permeability for a sandstone. Likewise, core of 2.4 feet of the top of the Paluxy aquifer proper from exploratory boring 8A4C-102, and core of the upper part of the upper zone of the Paluxy formation in monitor well P-13(M) was also fine-grained and apparently has low permeability. A gradual downward trend of increasing coarseness of the sandstone of the upper zone of the Paluxy was observed in core from well P-13(M). Boring 8A4C-102 in Section D-D', shows the shallow bedrock sequence logged from 4-inch core. It is to be noted that the log of plugged well HM-67, shown in this section, indicates a unit entirely of shaly clay/claystone. This description is not one normally applied to overburden in this area.

Such a description may indicate either a channel filled with clay, developed during deposition of the Paluxy Formation, or more likely difficult logging of drill cuttings. Section E-E' contains a log of boring 8A4C-103 which shows 3.5 feet of clay shale overlying the basal 1.1 feet of the Walnut limestone. It is unlikely that this material is part of the bedrock and is not shown to be as this portion of the Walnut Formation consists entirely of limestone. It may be that this material is stream-transported, weathered shale which came from bank-sloughing either upslope or upstream. The logging of approximately 9.6 feet of clayey shale in the bottom of well HM-71, shown on Section E-E' on Plate 8, is questioned. Again, this material is in the position normally occupied by the Walnut limestone in this area. - The descriptive name "clay shale" is not one which is normally applied to alluvium in this area.

In almost all of the exploratory borings and monitor wells in and near the east parking lot of the plant, the first bedrock encountered is limestone which belongs to the Walnut or Goodland Formations. The base of the Walnut limestone is shown on the geologic Sections B-B', C-C', D-D', and E-E' (Plates 6 through 8). The sources of data on this stratigraphic horizon are exploratory borings 8A4C-85, 8A4C-102, 8A4C-103, 8A3F-110, and monitor wells P-2, P-9(M), and well pairs P-6, P-7, and P-11.

The logs shown on Plate 1 indicate that at least 50 percent of the

uppermost 14 to 18 feet of the Paluxy Formation is comprised of shale, the remainder of which is comprised of sandstone. The stratigraphic sequence in this portion of the Paluxy, downward from the base of the Walnut limestone, is as follows: 0.5 to 1.5 feet of shale; 2.6 to 8.0 feet of Paluxy sandstone; and 8.0 to 13.8 feet of Paluxy shale. Thicknesses of these units show the major variations to be expected in the area between well H-4 in the city of White Settlement and boring 8A3F-110 in the east parking lot of the plant. The upper zone of the Paluxy aquifer proper commences beneath the last shale listed above. Logs shown on Plate 1 also indicate that individual lithologic members comprising the uppermost 14 to 18 feet of the Paluxy Formation probably persist throughout the area encompassed by the well/boring logs. The most prominent lithologic variation in this part of the Paluxy, shown on Plate 1, is the pinchout of the uppermost sandstone between well H-4 and well number 8 in the city of White Settlement. Core from exploratory borings 8A4C-102 and 8A4C-103, shown on Plate 7, confirm stratigraphic sequence interpreted from the geophysical logs.

Monitor wells P-8(U) and P-8(M) are located in the east parking lot between the line of monitor well pairs P-11, P-12, and P-13, and exploratory borings 8A3F-110 and 8A4C-102. Existence of the consistent stratigraphic section in the uppermost Paluxy in these wells and borings suggests that the shale member separating the uppermost Paluxy sandstone from the upper zone of the Paluxy aquifer proper below probably was not

seen and logged in drill cuttings from P-8(U) and P-8(M).

That portion of Section D-D' on Plate 7 between exploratory boring 8A4C-102 and monitor well HM-67, and the portion of Section E-E' on Plate 8 between exploratory borings 8A-105 and 8A4C-85 show the lowest elevations of the channel. This is the area where the "window" was believed to be located. None of the exploratory borings in the area found the erosion channel to penetrate the Paluxy Formation. In all borings but plugged monitor well HM-67 lithology of the channel bottom is Walnut limestone. However, only 1.1 feet of Walnut limestone was present in boring 8A4C-103. The correlation line depicting the base of the Walnut limestone between well P-9(M) and boring 8A4C-102 on Section D-D' (Plate 7), indicates that the Walnut limestone probably is only 1-foot thick at the location of boring 8A-107. The drill cutting log of monitor well HM-67 (Sections D-D' and E-E') suggests that no Walnut limestone is present above the Paluxy Formation at the location of the well.

(4) **Bedrock Hydrology.** No hydrostatic data were collected from the Paluxy Formation during the drilling of exploratory borings in the east parking lot due to funding curtailment. The six monitor wells, which were to have been completed in the upper zone of the Paluxy, and five monitor wells, which were to have been drilled in the "window" area were expected to define the hydrologic relationship between the overburden and the Paluxy aquifer in this area. Though the desired

100 * 100

hydrologic data were not obtained, possible hydrologic conditions in the "window" area are interpreted from stratigraphic relationships described in the preceding Section 3, Bedrock Stratigraphy. Hydrologic interpretations are made here because: (1) hydrologic conditions in the "window" are pertinent to determining how much thickness of the Paluxy Formation contains polluted ground water and; (2) these interpretations form the basis for a recommendation for future action which appears at the end of this report.

None of the exploratory borings in the east parking lot found the channel located there to have been eroded deeply enough into the bedrock to have penetrated the Paluxy Formation. However, the 1+ foot of Walnut limestone at exploratory boring locations in the relatively flat area comprising the bottom of the channel north of boring 8A-105 (Plates 5 and 8) is missing in monitor well HM-67. It is considered likely that erosion has caused the channel to be incised as much as 5 to 10 feet into the Paluxy sequence of beds in the flat-bottomed area of the "window" near Grants Lane, north of monitor well HM-67, penetrating the uppermost Paluxy sandstone. It is doubted that the channel is eroded as deeply as 15 feet into the Paluxy Formation in the "window" area, which would reach the top of the sandstone of the Paluxy aquifer proper and allow entry of polluted overburden water into the aquifer.

If the channel penetrates the uppermost Paluxy sandstone in the "window" north of the area explored as anticipated, the sandstone will probably be charged with polluted ground water from the overburden. If

the channel does not penetrate the upper zone of the Paluxy aquifer proper, the aquifer should be free of pollution. Since the top of the test interval of monitor well P-8(U) is at the base of the Walnut limestone, the test interval hydraulically connects the uppermost sandstone with the upper zone of the Paluxy aquifer. Connecting these two units renders uncertain the meaning of any water level measured in the well. Given presently available data, it appears possible that only the uppermost Paluxy sandstone in the east parking lot area is recharged with polluted ground water originating in the overburden. This ground water is believed to be entering monitor well P-8(U), causing high water levels. It is also believed that this ground water descends in the well and enters the upper zone of the Paluxy aquifer. The speculations just presented have not yet been proved by the construction and testing of requisite monitor wells. If the conditions suggested prove to be correct, it should be possible to establish that only the uppermost Paluxy sandstone contains polluted ground water and that the upper and middle zones of the Paluxy aquifer are not in danger of being polluted in all of the east parking lot but the area immediately around monitor well P-8(U).

CONCLUSIONS

1. Alluvial overburden was not found to be in contact with the uppermost sandstone of the Paluxy Formation or with sandstone beds comprising the upper zone of the Paluxy aquifer proper in any well or exploratory boring drilled in this investigation. However, only a

minimum of approximately 1 foot of limestone and 0.5 foot of shale separates the overburden and the uppermost Paluxy sandstone in the "window" area.

2. The uppermost sandstone of the Paluxy Formation is separated from the upper zone of the Paluxy aquifer proper, which underlies it by 8 to 14 feet of shale in all wells and exploratory borings which have been logged geophysically or have been cored through this stratigraphic interval in the east parking lot of the plant and in water supply well H-4 in the city of White Settlement.

RECOMMENDATIONS

1. It is recommended that ground water from Paluxy monitor wells P-11(U), P-11(M), P-12(U), P-12(M), P-13(U), and P-13(M), continue to be sampled and tested for the presence of pollutants, preferably on a short-cycle basis.

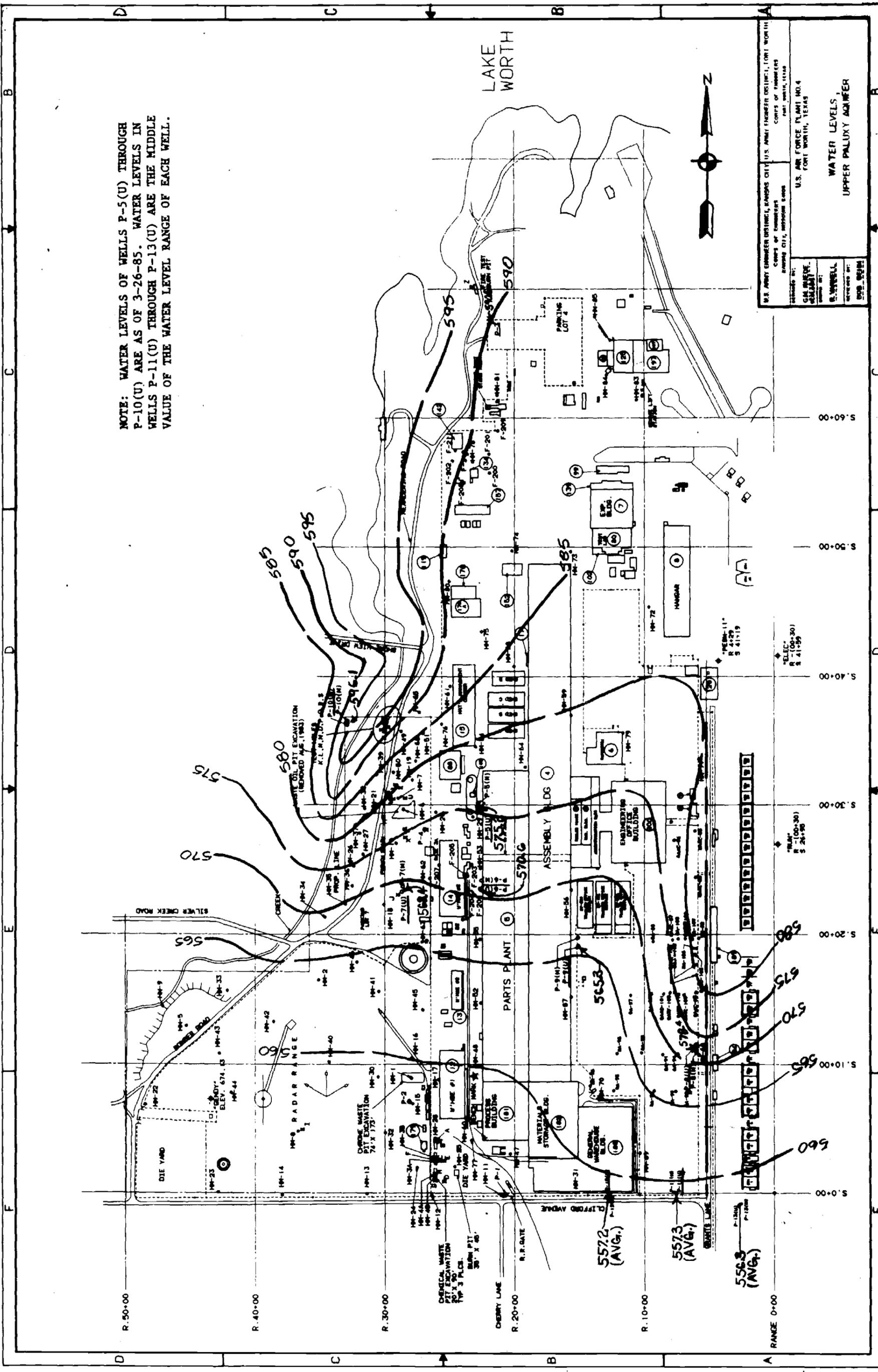
2. It is recommended that two monitor wells be drilled to test separately the uppermost sandstone bed and the upper zone of the Paluxy aquifer proper. These wells should be located just outside the south edge of the "window" area so that at least 5 feet of Walnut limestone will be present in which to set steel casing, better isolating the test interval from the overburden above. The intent of this recommendation is to determine whether pollution is limited to ground water in the uppermost sandstone unit of the Paluxy Formation.

3. If pollution proves to be confined to the uppermost Paluxy sandstone by drilling and testing the recommended wells, it is further recommended

that additional monitor wells be completed in the upper zone of the Paluxy aquifer in the vicinity of existing monitor well P-8(U) to determine whether and to what extent pollution has spread from that well in the upper Paluxy aquifer proper.

4. It is also recommended that several monitor wells, completed in the overburden, be drilled in the east parking lot to better define the distribution of polluted ground water and to locate sand and gravel deposits in the erosional channel in the bedrock. In addition, these wells may offer an opportunity to determine the velocity at which ground water moves through the overburden by injecting a nonhazardous dye tracer in selected wells.

NOTE: WATER LEVELS OF WELLS P-5(U) THROUGH P-10(U) ARE AS OF 3-26-85. WATER LEVELS IN WELLS P-11(U) THROUGH P-13(U) ARE THE MIDDLE VALUE OF THE WATER LEVEL RANGE OF EACH WELL.



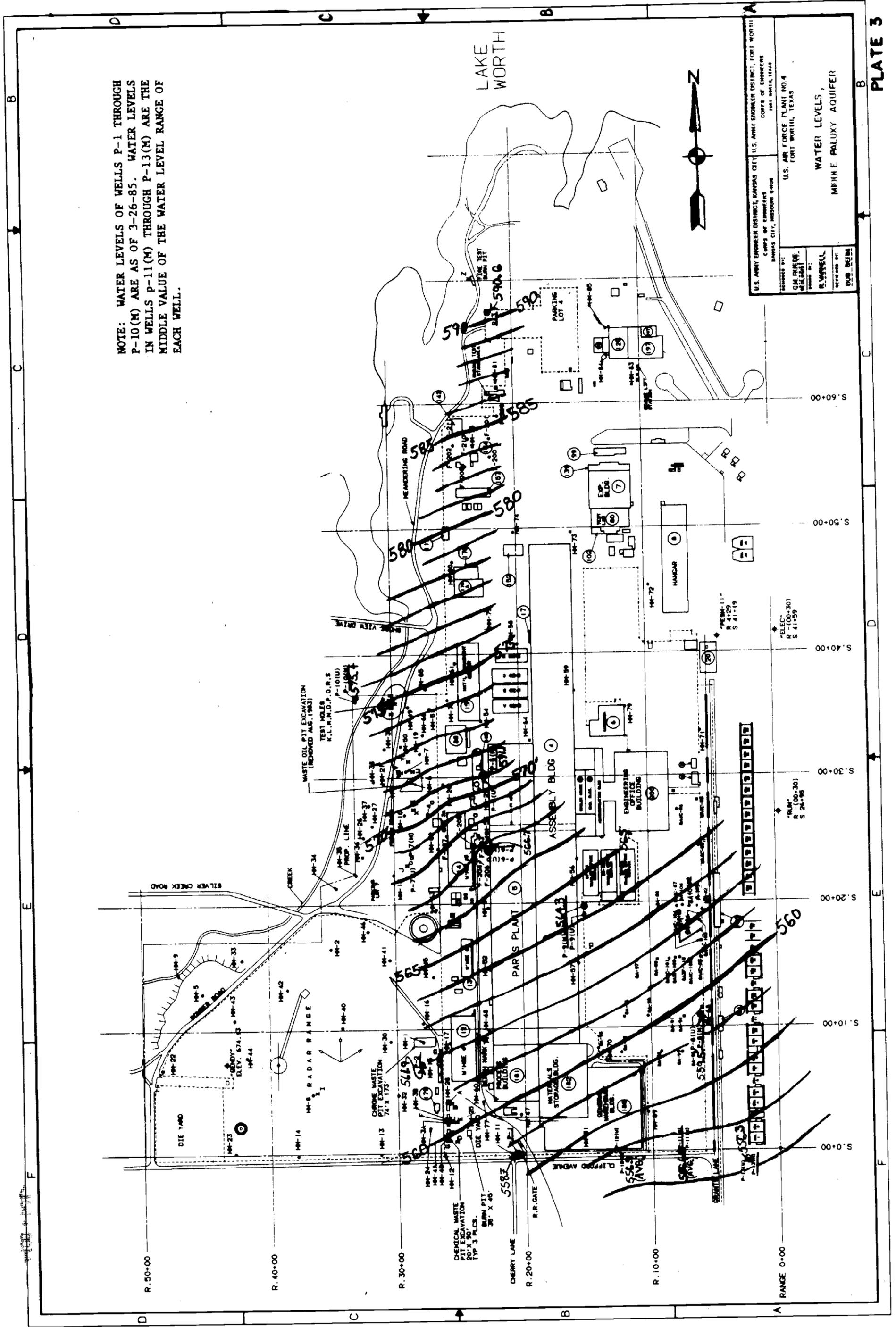
U.S. ARMY ENGINEER DISTRICT, WASHINGTON DISTRICT, FORT WORTH
 CORPS OF ENGINEERS
 WASHINGTON DISTRICT, WASHINGTON DISTRICT

DESIGNED BY: S. J. WISE
 DRAWN BY: S. J. WISE
 CHECKED BY: S. J. WISE
 DATE: 11/85

U.S. AIR FORCE PLANT NO. 4
 WASHINGTON DISTRICT, WASHINGTON DISTRICT

WATER LEVELS,
 UPPER PALUXY AQUIFER

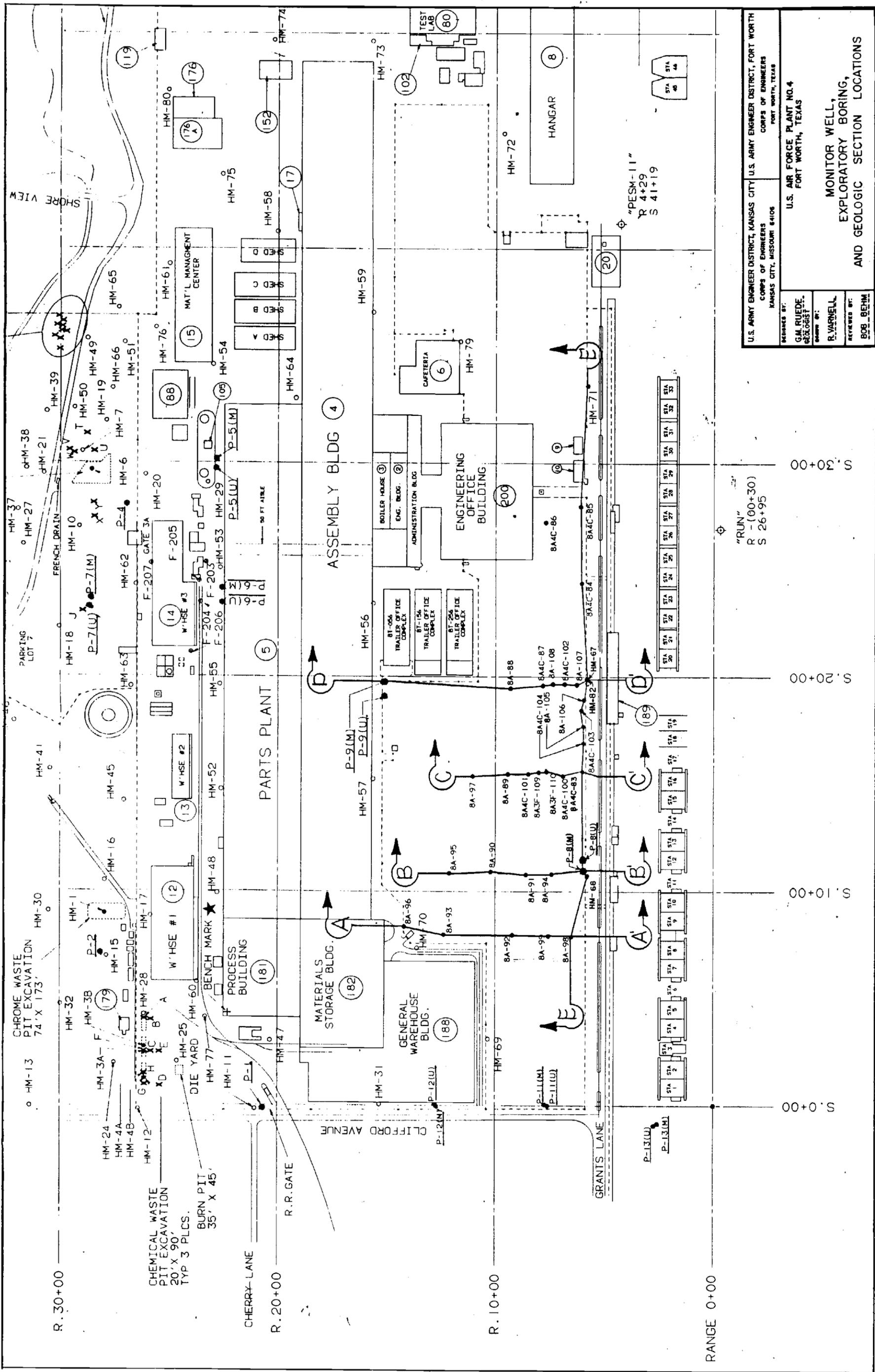
NOTE: WATER LEVELS OF WELLS P-1 THROUGH P-10(M) ARE AS OF 3-26-85. WATER LEVELS IN WELLS P-11(M) THROUGH P-13(M) ARE THE MIDDLE VALUE OF THE WATER LEVEL RANGE OF EACH WELL.



U.S. ARMY ENGINEER DISTRICT, KANSAS CITY, U.S. ARMY ENGINEER DISTRICT, FORT WORTH
 CORPS OF ENGINEERS
 MISSOURI CITY, MISSOURI 63050
 U.S. AIR FORCE PLANT NO. 4
 FORT WORTH, TEXAS
 WATER LEVELS,
 MIDDLE PALUXY AQUIFER

DESIGNED BY: G.M. RUSSELL
 DRAWN BY: R. W. RUSSELL
 CHECKED BY: D. W. RUSSELL
 DATE: 10/1/85

FILE # 100



U.S. ARMY ENGINEER DISTRICT, KANSAS CITY
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI 64108

U.S. AIR FORCE PLANT NO. 4
FORT WORTH, TEXAS

MONITOR WELL,
EXPLORATORY BORING,
AND GEOLOGIC SECTION LOCATIONS

DESIGNED BY:
G.M. RUEDE
GEOLOGIST

DRAWN BY:
R. VARNELL

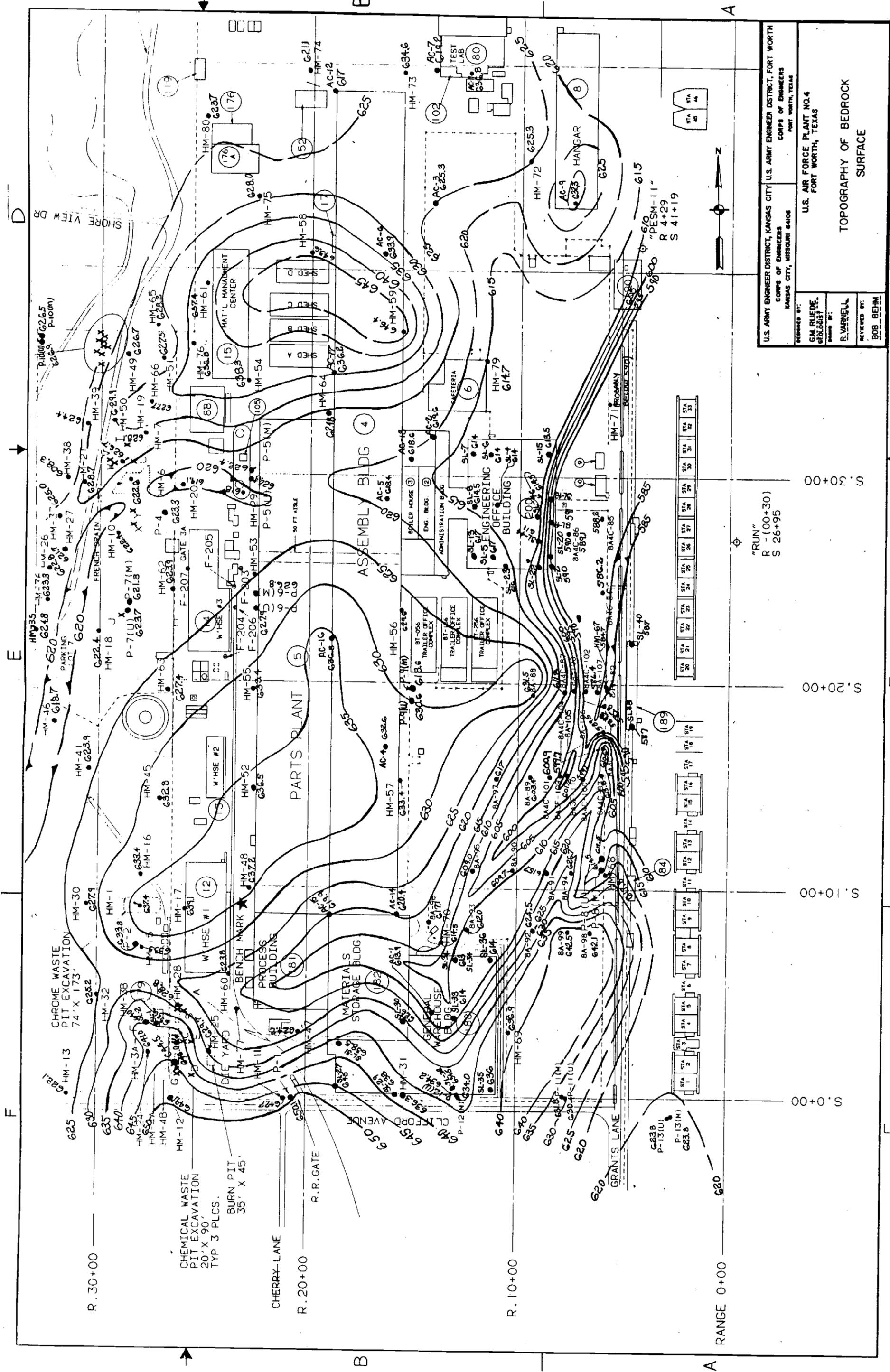
REVIEWED BY:
BOB BEHM

"RUN"
R - (00+30)
S 26+95

STA 20	STA 21	STA 22	STA 23	STA 24	STA 25	STA 26	STA 27	STA 28	STA 29	STA 30	STA 31	STA 32	STA 33	STA 34	STA 35
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S. 20+00

S. 30+00



U.S. ARMY ENGINEER DISTRICT, KANSAS CITY
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI 64108

U.S. AIR FORCE PLANT NO. 4
FORT WORTH, TEXAS

DESIGNED BY:
G.M. RUEDE,
6120337

DRAWN BY:
E. VARNELL

REVIEWED BY:
908. BEHM

TOPOGRAPHY OF BEDROCK SURFACE

"RUN"
R - (00+30)
S 26+95

STA 20	STA 21	STA 22	STA 23	STA 24	STA 25	STA 26	STA 27	STA 28	STA 29	STA 30	STA 31	STA 32	STA 33
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STA 1	STA 2	STA 3	STA 4	STA 5	STA 6	STA 7	STA 8	STA 9	STA 10	STA 11	STA 12	STA 13	STA 14	STA 15	STA 16	STA 17	STA 18	STA 19	STA 20
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STA 21	STA 22	STA 23	STA 24	STA 25	STA 26	STA 27	STA 28	STA 29	STA 30	STA 31	STA 32	STA 33
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**DESIGNATION OF EXPLORATORY
BORINGS AND MONITOR WELLS**

EXPLORATORY BORINGS DRILLED BY THE
CORPS OF ENGINEERS ARE DESIGNATED
BY THEIR MODE OF DRILLING, FOLLOWED BY
THE BORING NUMBER:

- SA = 8" AUGER
- SA+C = 8" AUGER FOLLOWED BY 4" CORE
- SA3F = 8" AUGER FOLLOWED BY 3" FISHTAIL

MONITOR WELLS:

- HM-0 = OVERBURDEN UPPER ZONE
- BY HARGIS & ASSOCIATES
- P-0-0(U) = WELL COMPLETED IN UPPER
ZONE OF PALUXY AQUIFER.
- P-0-0(M) = WELL COMPLETED IN MIDDLE
ZONE OF PALUXY AQUIFER.

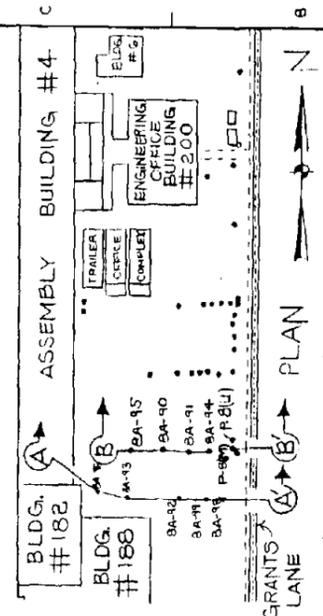
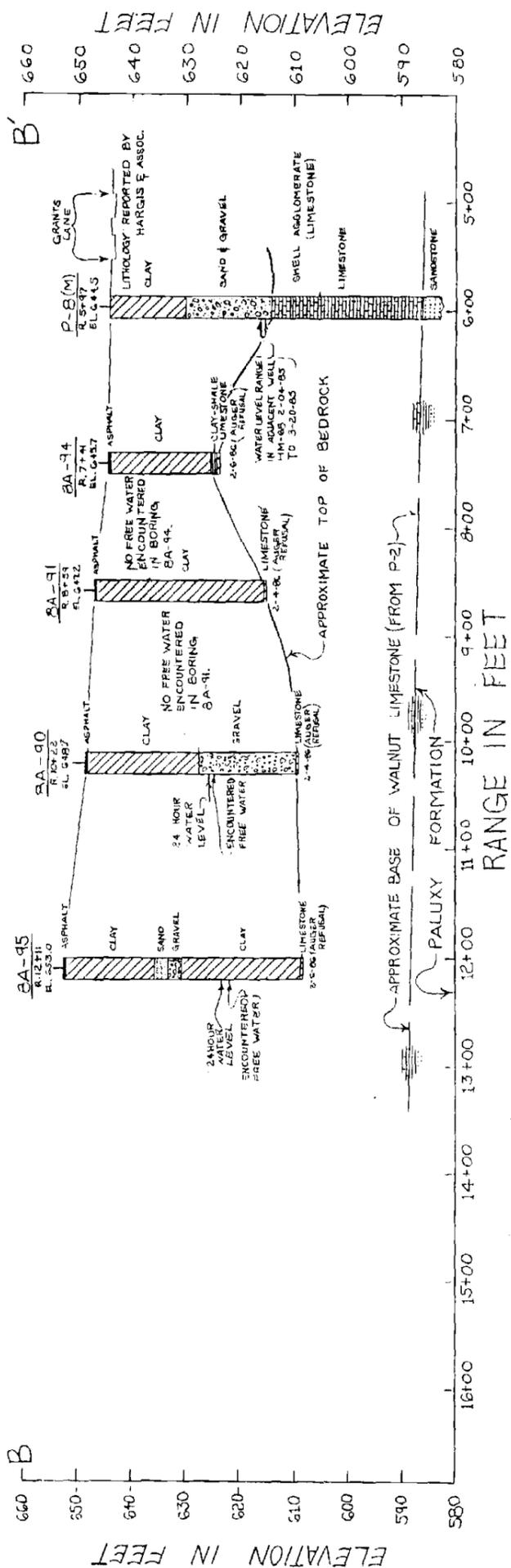
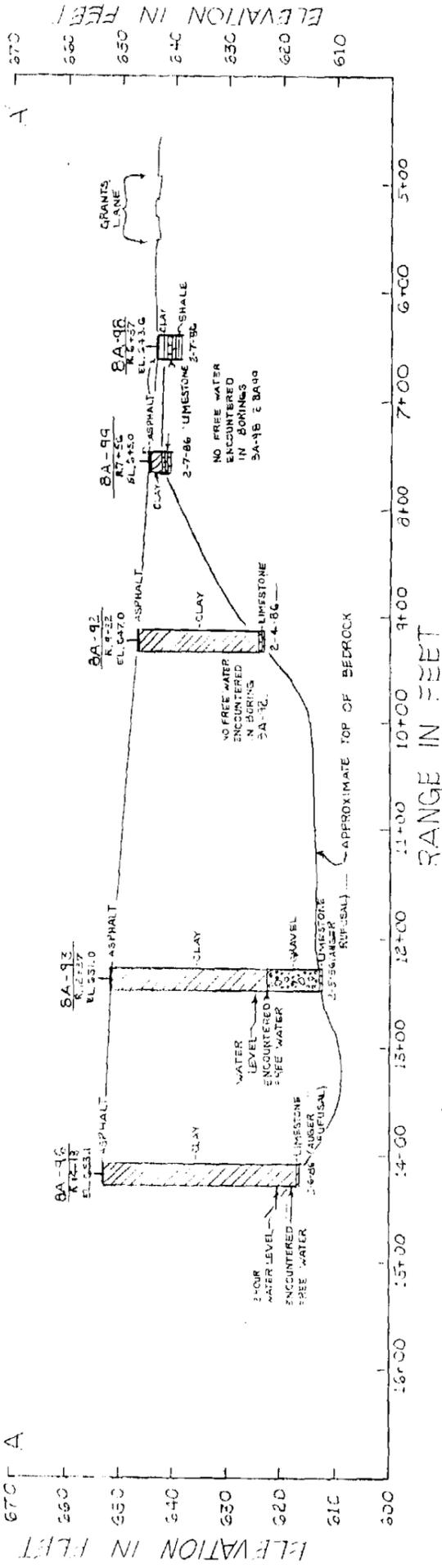
NOTE: COMPLETION DATE OF EXPLORATORY
BORINGS BY CORPS OF ENGINEERS SHOWN
BENEATH EACH BORING

NOTE: SURVEYED LOCATIONS OF EXPLORATORY
BORINGS AND MONITOR WELLS ARE EXPRESSED
IN TERMS OF THE PLANT GRID SYSTEM
COMPRISED OF STATION AND RANGE VALUES.
SECTIONS A-A' THRU D-D' UTILIZE RANGE
VALUES RATHER THAN DISTANCES BETWEEN
BORINGS.

NOTE: WATER LEVEL SHOWN WITHOUT A TIME PERIOD
WAS TAKEN AT COMPLETION OF DRILLING

LEGEND:

- ASPHALT
- CLAY
- SAND
- GRAVEL
- LIMESTONE
- SHALY-CLAY
- CLAYSTONE
- SHALE
- SANDSTONE



U.S. ARMY ENGINEER DISTRICT, KANSAS CITY U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
KANSAS CITY, MISSOURI 64108

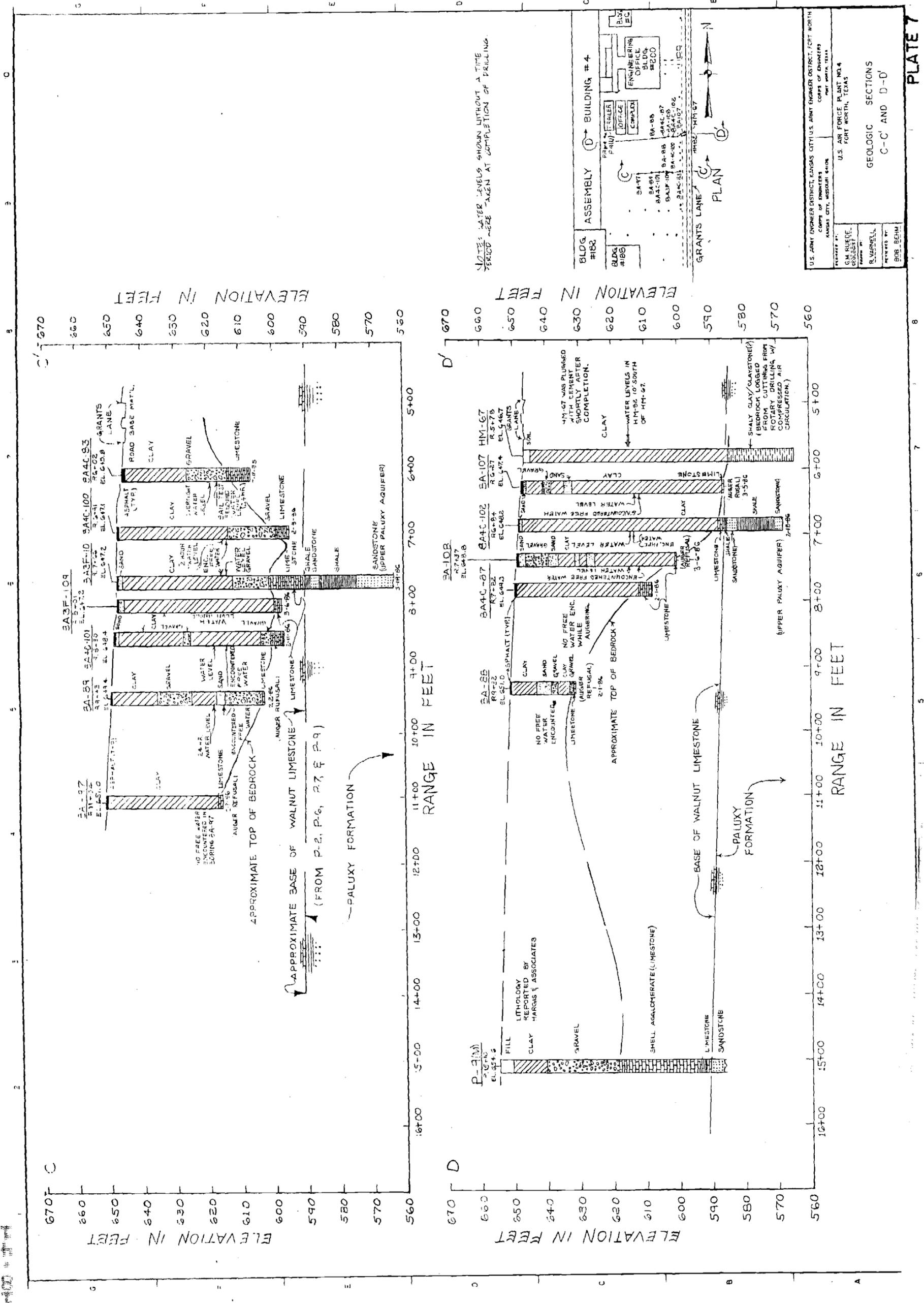
DESIGNED BY:
G.M. RUDE
GEOLOGIST

DRAWN BY:
R. WISEWELL

REVIEWED BY:
D.B. BEHM

U.S. AIR FORCE PLANT NO. 4
FORT WORTH, TEXAS

GEOLOGIC SECTIONS
A-A' AND B-B'



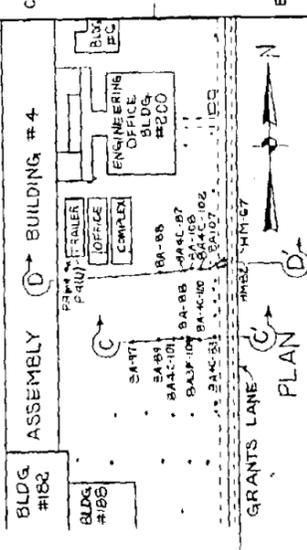
ELEVATION IN FEET

ELEVATION IN FEET

RANGE IN FEET

RANGE IN FEET

NOTE: WATER LEVELS SHOWN WITHOUT A TIME PERIOD WERE TAKEN AT COMPLETION OF DRILLING.



U.S. ARMY ENGINEER DISTRICT, KANSAS CITY U.S. ARMY ENGINEER DISTRICT, FORT WORTH
 COMPANY OF ENGINEERS
 KANSAS CITY, MISSOURI 64108
 FORT WORTH, TEXAS
 PROJECT NO. 608-2811
 DRAWN BY: R. M. BROWN
 CHECKED BY: R. M. BROWN
 U.S. AIR FORCE PLANT NO. 4
 FORT WORTH, TEXAS
 GEOLOGIC SECTIONS
 C-C' AND D-D'

APPENDIX I

BORING AND MONITOR WELL LOGS

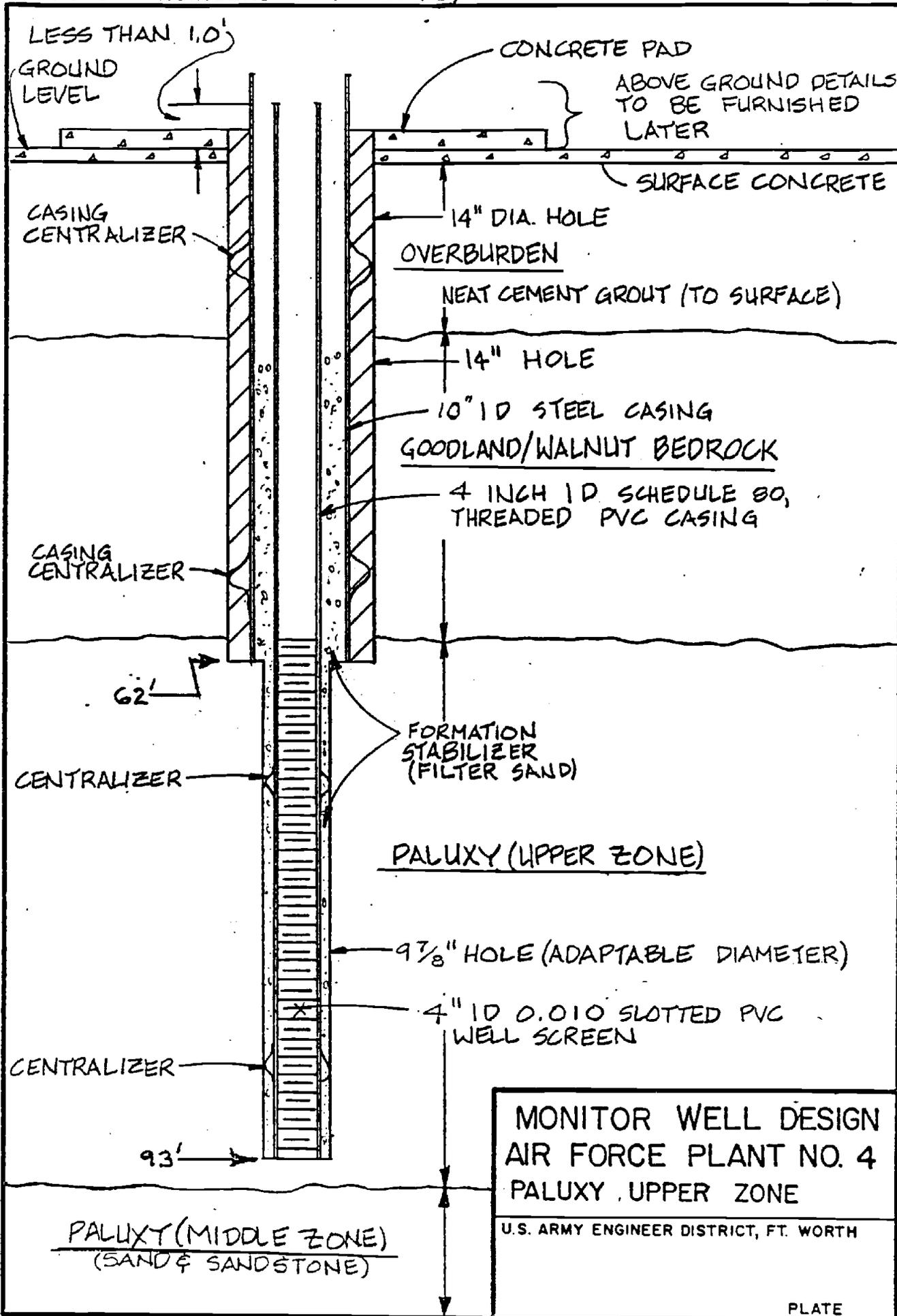
10/1/00

DRILLING LOG		DIVISION SWD	INSTALLATION Ft Worth	SHEET 1 of 2 SHEETS
1. PROJECT A.F. Plant #4(GD), Paluxy Aquifer			10. SIZE AND TYPE OF BIT *	
2. LOCATION (Coordinates or Station)			11. DATUM FOR ELEVATION SHOWN (FSM or MSL)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500	
4. HOLE NO. (As shown on drawing title and its number) P-11(u)			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	
5. NAME OF DRILLER Brewer			14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER 4-4	
7. THICKNESS OF OVERBURDEN 8.3			16. DATE HOLE STARTED 26 July 85 COMPLETED 13 Aug 85	
8. DEPTH DRILLED INTO ROCK 84.7			17. ELEVATION TOP OF HOLE 638.67	
9. TOTAL DEPTH OF HOLE 93.0			18. TOTAL CORE RECOVERY FOR BORING %	
			19. SIGNATURE OF INSPECTOR Robert McVey	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			0.0 to 0.3 - Asphalt.			<p>Note: Hole supervised by Robert McVey from 0.0 to 61.7' and then by James Christie from 61.7 to 93.0' - which also included installation of pipe and pump.</p> <p>Note: The lithology and their contacts were primarily discerned from gamma and electric logs and supported by drill cuttings.</p> <p>* Drilling</p> <p>0 to 9' - 8" auger, 0 to 12.5' - 14" auger, auger refusal at 12.5', 12.5 to 61.7' - 14" rock bit. Hole bailed to 59.2' immediately after 10" metal casing welded and set in hole to 62'. Casing was grouted from bottom of hole(62') up to surface. 61.7 to 92.98' - 9 7/8" rockbit.</p> <p>***</p> <p>Water check on 1 Aug 1985 read at 61.7' with casing in hole. 2 Aug 85 - water at 58.3' no water movement. After TD attained the water check on 12 Aug 85 read at 83.2', 28 Aug 85 reads at 82.3'.</p> <p>Jars</p> <p>A. 0.3 to 2.4 B. 2.4 to 6.5 C. 6.5 to 8.3 D. 8.3 to 12.3</p> <p>Vial samples of fluid and cuttings taken at 93'.</p>
	10'		0.3 to 2.4 <u>CLAY</u> - high plasticity, medium stiff, slightly moist, dark brown, chemical odor.			
			2.4 to 6.5 <u>GRAVEL</u> - coarse to fine, angular, medium dense, slightly moist, brown, very sandy and clayey, calcareous.			
	30'		6.5 to 8.3 <u>CLAY</u> - high plasticity, stiff, slightly moist, red, sandy lime.			
			8.3 to 12.3 <u>SHALE</u> - weathered to a high plastic and very stiff clay consistency, good blocky structure present, moist, yellow brown and light gray, a few scattered lime concentrations and shell fragments - possibly a reworked shale.			
	50'		12.3 to 31.0 <u>ARILLACEOUS LIMESTONE</u> and <u>SHALE</u> interbedded - Walnut Fm. - weather stains noted until 19', then no apparent weathering, white L.S. and yellow brown shale which grades to gray by 19', the beds are generally less than 1' thick, very soft (rock classification) shale to hard L.S.			
	70'		31.0 to 53.5 <u>LIMESTONE</u> - white, moderately hard to hard (rx class).			

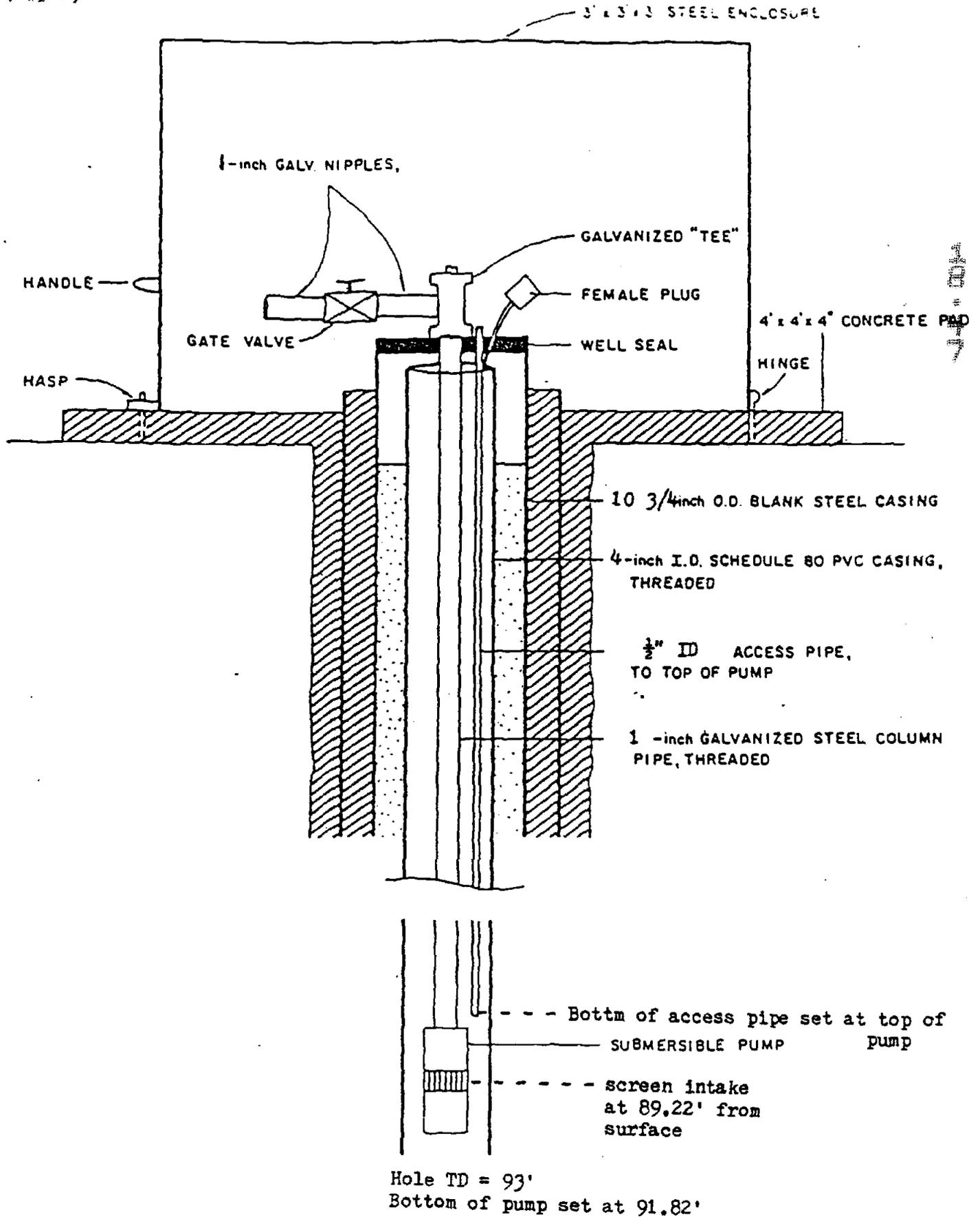
DRILLING LOG	DIVISION SWD	INSTALLATION Ft Worth	SHEET 2 OF 2 SHEETS
1. PROJECT A.F. Plant #4(GD), Paluxy Aquifer		10. SIZE AND TYPE OF BIT	
2. LOCATION (Completions or Station)		11. DATUM FOR ELEVATION SHOWN (FSM or MSL)	
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on existing maps and the number) F-11(u)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: _____ UNDISTURBED: _____	
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED: _____ COMPLETED: _____	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 93'		18. TOTAL CORE RECOVERY FOR BORING 1	
		19. SIGNATURE OF INSPECTOR <i>Robert McVey</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Describe tool, water loss, depth of weathering, etc., if significant) g
			31 to 53.5(continued)			<p align="center"><u>Instrumentation</u></p> <p>For further information see diagram.</p> <p>After completion of drilling: Set 4" pvc from TD to surface and added gravel pack up to 38'. Location of joints of the 4" pipe from the bottom measuring up: 5.43' (bottom blank and plug), 19.82' (screen), 9.79', 9.79', 9.79', 9.79', 9.79', 9.79', 9.79'. & 9.79' totals 93.78' pip with 0.8' stick up.</p> <p>Set subsensible pump at total depth of 91.82' with intake screen at 89.22'.</p> <p>Joints on pump riser listed from bottom of pump and up to surface; pump length = 4.4', then 21.1', 21.08', 21.12', 21.12', 4.0' totals = 92.82' with 1' stick up.</p> <p>ALL DEPTHS FROM GROUND SURFACE</p> <p>Note: Lithology shown between depths 53.5 and 59.8 feet changed based on reinterpretation of geophysical log.</p>
			<u>LIMESTONE</u> - dense oyster shell beds scattered, occasional very hard(rx class) seams, shale seams scattered throughout. <u>Walnut Fm.</u>			
			53.5 to 54.0 <u>SHALE</u> 54.0 to 59.8 <u>SANDSTONE</u>			
			59.8 to 63.8 <u>SHALE</u> - unweathered dark gray, soft(rx class), thin lime stringers throughout, silty, sandy with numerous sand seams. <u>Paluxy, Fm.</u>			
			63.8' to 70.1' <u>SHALE</u> and <u>SAND</u> interbedded - shale is as above shale and sand if fine grained, silty, grey, non cemented. <u>Paluxy Fm.</u> Transition zone.			
			70.1 to 93.0 <u>SAND/SANDSTONE</u> - fine, very silty, numerous silt seams, clayey with scattered clay/shale seams which generally occur in 0.4' thick or less seams, gray and brown, very soft to moderately hard(rock classification), friable, mostly non cemented, but cement noted from drill action.			



MONITOR WELL DESIGN
 AIR FORCE PLANT NO. 4
 PALUXY, UPPER ZONE
 U.S. ARMY ENGINEER DISTRICT, FT. WORTH

P-11 (upper)

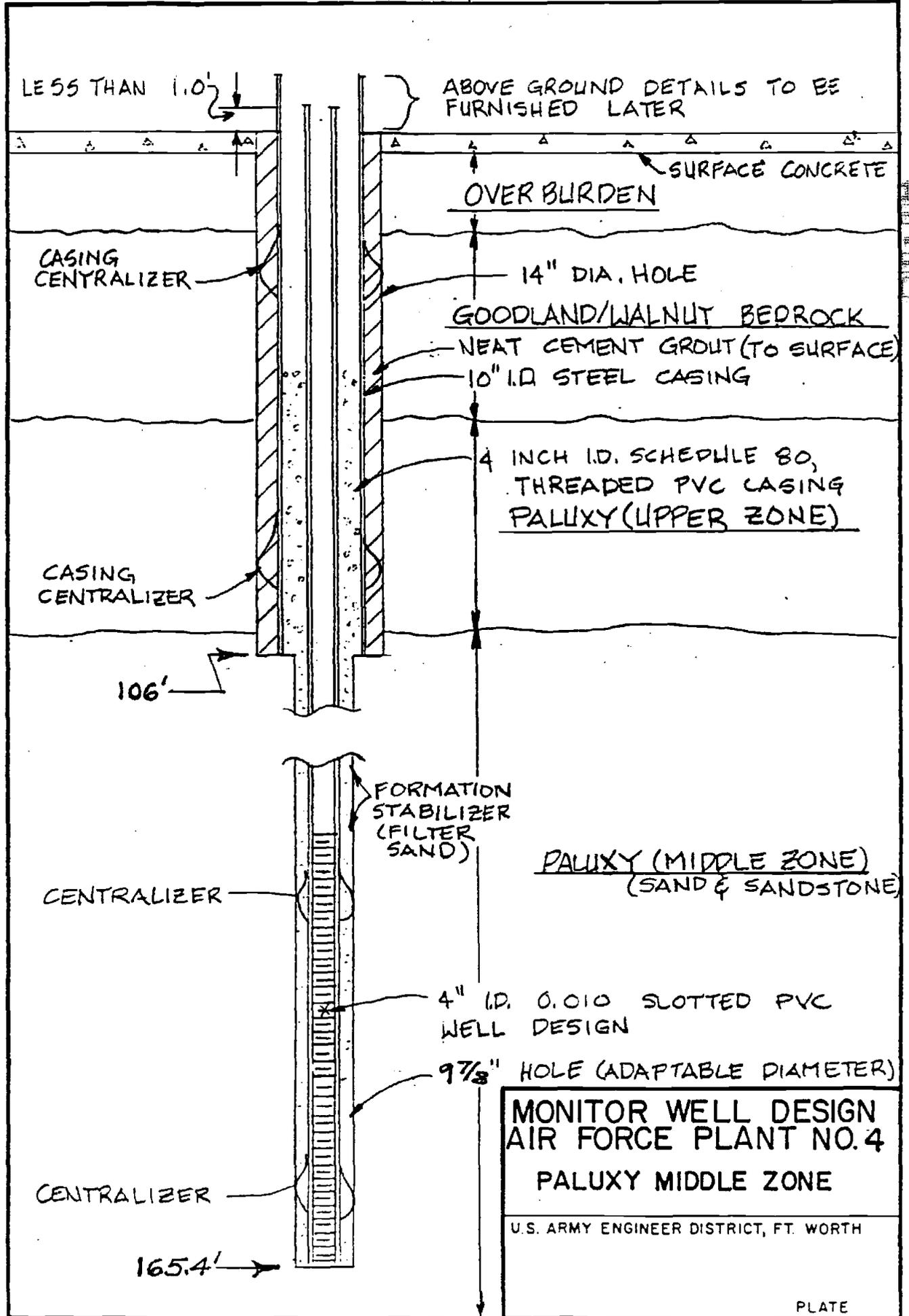


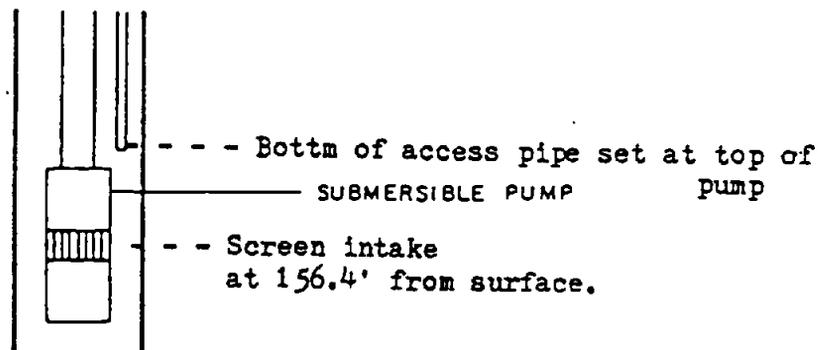
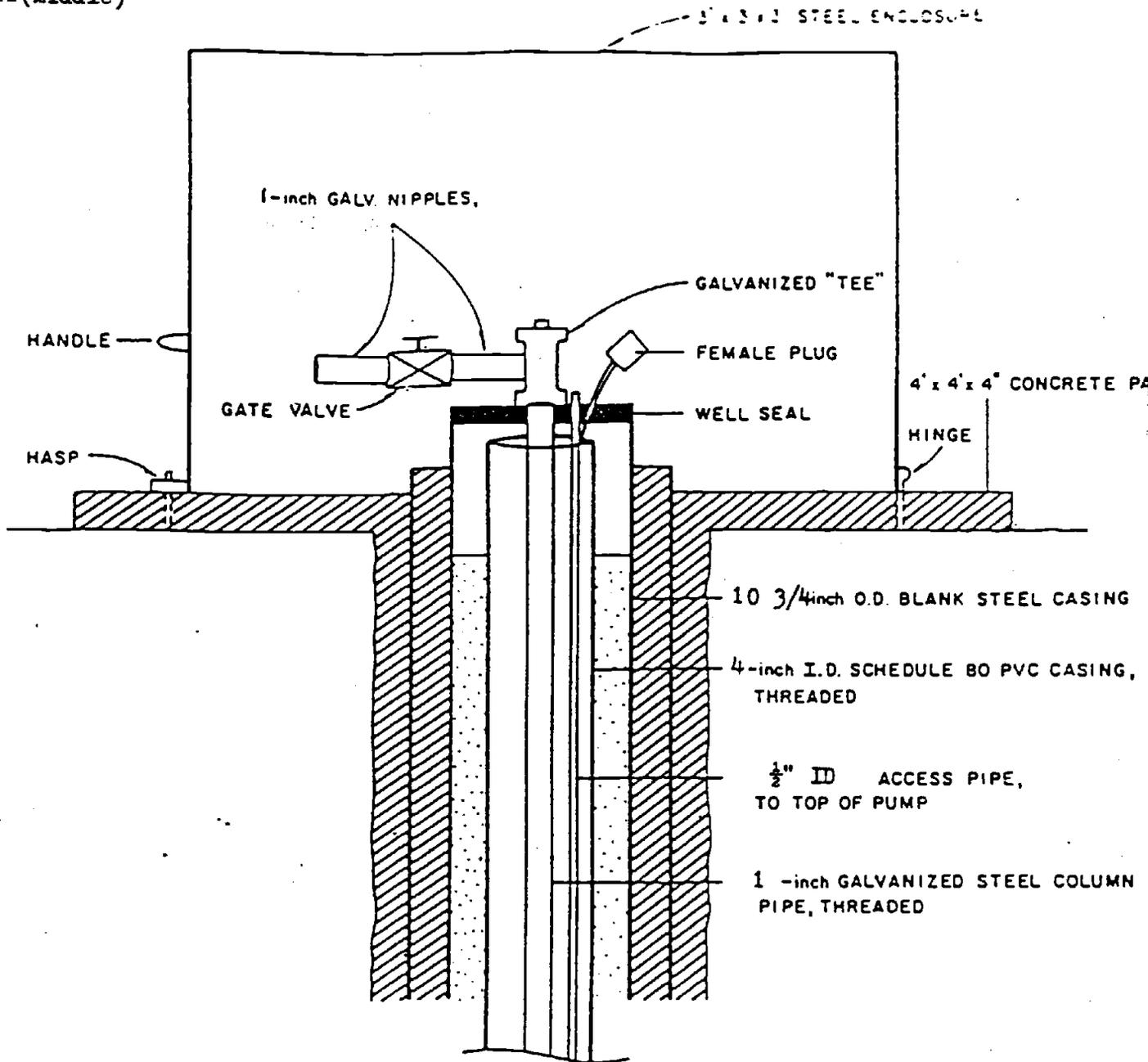
P-11 (upper) - Diagram 2 of 2
AF plant #4 (GD) - Paluxy Aquifer

DRILLING LOG	DIVISION SWD	INSTALLATION Ft Worth	SHEET 1 OF 2 SHEETS
1. PROJECT A.F. Plant #4(GD), Paluxy Aquifer		10. SIZE AND TYPE OF BIT 6	
2. LOCATION (Coordinates or Station)		11. DAY(S) FOR ELEVATION SHOWN (TBM or B.M.)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500	
4. HOLE NO. (As shown on drawing title and file number) P-11 (M)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED ** UNDISTURBED	
5. NAME OF DRILLER Brewer		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER ***	
7. THICKNESS OF OVERBURDEN 7.0		16. DATE HOLE STARTED 13 Aug 85 COMPLETED 26 Aug 85	
8. DEPTH DRILLED INTO ROCK 158.4		17. ELEVATION TOP OF HOLE 638.84	
9. TOTAL DEPTH OF HOLE 165.4		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR Robert McVey	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of casing, etc., if significant) g
			0.0 to 0.3 - Asphalt.			<p>Note: Lithologic units and their contacts were primarily interpreted from gamma and electric logs.</p> <p>* Drilling</p> <p>0 to 12.5' - 14" auger, 12.5 to 106' - 14" rockbit, set 106' of 10" metal csng and csng then grouted from bottom of hole to surface. 106 to 161.0' - 9 7/8" rockbit - the actual bottom of hole measured to be 165.4' - driller claimed wash out of loose sand.</p> <p>**</p> <p>Vial samples of fluid and cuttings together at: 60', 70', 80', 90', 100', and 105.5'. A separate vial for fluid and cuttings taken at 165'.</p> <p>***</p> <p>Water check first thing on morning of 20 Aug 85 with TD of hole at 105.5' = 82'.</p> <p>Hole bailed to 95' on 22 Aug 85 with 10" csng in hole. Water recovered to 82' within 1/2 hour.</p> <p>Note: Lithology shown between depths 54.0 and 61.5 feet changed based on reinterpretation of geophysical log.</p>
			0.3 to 4.8			
10'			CLAY - high plasticity, medium stiff, slightly moist, dark brown, chemical odor at top of unit.			
			4.8 to 7.0			
20'			GRAVEL - coarse to fine, angular, medium dense, slightly moist, brown, very sandy and clayey.			
			7.0 to 12.7			
30'			SHALE - weathered to a plastic and very stiff clay consistency, slightly moist, yellow brown and gray, slightly limey, few scattered shell fragments. Walnut Fm.			
			12.7 to 54.0			
50'			LIMESTONE - weather stained, but mostly white, moderately hard to hard (rock classification), moderately to well cemented, dense oyster shell zones throughout, numerous soft (rx class) shale seams scattered within - they are generally less than 1' thick, but some do thicken up to 2.4', is especially from 24.0 to 31.0', unit is very shaley with sand from 54 to 61.5'. Walnut Fm.			
			54.0 to 54.8 SHALE			
			54.8 to 61.5 SANDSTONE			
			61.5 to 71.0			
80'			SHALE - no apparent weathering, soft (rx class), grey to blue-grey, sand seams throughout, silty.			
90'						

DRILLING LOG		DIVISION	INSTALLATION	SHEET 2 OF 2 SHEETS		
1. PROJECT A.F. Plant #4(GD), Paluxy Aquifer			Ft Worth			
2. LOCATION (Coordinates or Section)			10. SIZE AND TYPE OF BIT			
3. DRILLING AGENCY			11. DATUM FOR ELEVATION SHOWN (TBM or BML)			
4. HOLE NO. (As shown on drawing title and file number)			12. MANUFACTURER'S DESIGNATION OF DRILL			
P-11(m)			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER			14. TOTAL NUMBER CORE SOLES			
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN			16. DATE HOLE		STARTED COMPLETED	
8. DEPTH DRILLED INTO ROCK			17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE 165.4'			18. TOTAL CORE RECOVERY FOR BORING		%	
			19. SIGNATURE OF INSPECTOR <i>Robert McVey</i>			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	110'		71.0 to 153.3 <u>SAND/SANDSTONE</u> - no apparent weathering, friable, weakly to non cemented, soft to moderately hard (rock classification), fine grained, very silty, grey. a few thin lime stringers scattered, clay/shale seams throughout and usually are less than 1' thick, pyrite concretions scattered, lignite noted after 82'. harder zones noted at: 123.5 to 124.7', and 128.3 to 129.0'. thicker shale/clay seams or very shaly zones noted at: 77.3 to 79.5', 83.8 to 86.1', 92.5 to 94', 96.0 to 99', 104 to 109.8', 127.2 to 129', 132.8 to 135', 140.0 to 142.2', 144.3 to 145', <u>Paluxy Fr.</u>			<u>Instrumentation</u> Set 4" pvc pipe to TD and gravel packed up to 83'. The 4" pvc joints were recorded from the bottom up as follows: plug and blank at bottom(165.4') with joints at .65', 4.75', the screens top joint at 19.77', then blank joints at 9.78', 9.73', 9.78', 9.79', 9.75', 9.78', 9.76', 9.76', 9.71', 9.78', 9.79', 9.79', 9.79', 9.79', 9.74', 4.77' which includes 1.3' stick up. Joints with stabilizers on them are indicated by underlining of the above - all stabilizers are 5' below said joint Set submersible pump (Standard, 1/2Hp, 8 gpm at 110') down to 159' with intake screen 2.6' above bottom of pump - this is followed by 7 sections of 1" metal pipe all of which have a 21.2' length with collars, an additional section of pipe of 7' at top included .77' stick up. For further details on installation see diagram. ALL DEPTHS FROM GROUND SURFACE
	150'		153.3 to 165.4 <u>SAND</u> and <u>SHALE</u> interbedded sand is fine, friable, and silty, the shale is dark grey, both are soft(rx class).			
	160'					
	165'					





Hole TD = 165.4'
 Bottom of pump set at 159'.

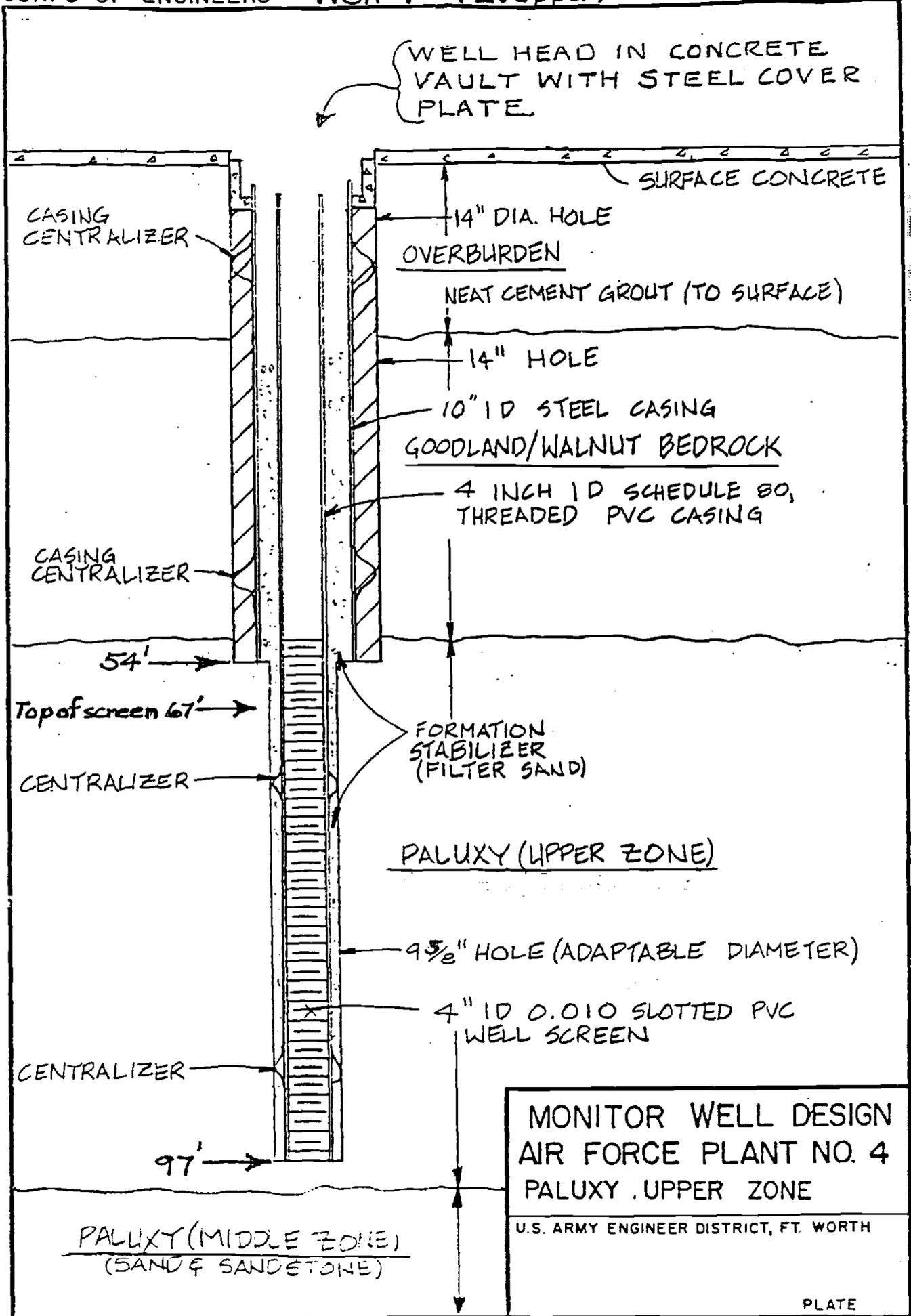
P-11(middle) - Diagram 2 of 2
 AF Plant #4(GD) - Paluxy Aquifer

DRILLING LOG		Division	INSTALLATION	SHEET
		SWD	Ft Worth	1
1. PROJECT		2. SIZE AND TYPE OF BIT		of 2 SHEETS
A.F. Plant #4(GD), Paluxy Aquifer		1. BITUM FOR ELEVATION SHOWN (TBM or BBL)		
3. LOCATION (Coordinates or Station)		12. MANUFACTURER'S DESIGNATION OF DRILL		
2. DRILLING AGENCY		Falling 1500		
USCE		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED **
4. HOLE NO. (As shown on drawing title and file number)		14. TOTAL NUMBER CORE BOXES		UNDISTURBED
P-12(u)		0		
5. NAME OF DRILLER		15. ELEVATION GROUND WATER		***
BROWST		16. DATE HOLE		STARTED 16 Sept 85
6. DIRECTION OF HOLE		COMPLETED 24 Sept 85		
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		17. ELEVATION TOP OF HOLE		643.64
7. THICKNESS OF OVERBURDEN		18. TOTAL CORE RECOVERY FOR BORING		1
9.4		19. SIGNATURE OF INSPECTOR		Robert McVey
8. DEPTH DRILLED INTO ROCK				
87.6				
9. TOTAL DEPTH OF HOLE				
97'				

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of casing, etc., if significant)
a	b	c	d	e	f	g
			0.0 to 0.5 - Concrete. 0.5 to 1.0 - Base GRAVEL.			<p>Note: Lithologic units and their contacts were primarily interpreted by project geologist from gamma and electric logs.</p> <p>* <u>Drilling</u></p> <p>0 to 0.5' - 14" rockbit, 0.5 to 10.5' - 14" auger, 10.5 to 97' - 14" rockbit, set 52' of 10" metal casing after 54' attained. The casing was then grouted in from the bottom and up to surface.</p> <p>**</p> <p>Vial samples were taken at the following depths: at 4' - auger cuttings. at 97' - rockbit cuttings in one vial and drill fluid in another.</p> <p>***</p> <p>Hole bailed after completion of drilling. Water level taken after installation of 4" pipe at 87.9'.</p> <p><u>Installation</u></p> <p>Set 4" pvc pipe to TD of 97' with screen from 97 to 67' (plug in bottom) and blanks to surface with 1' stick up. No pump installed. Pipe to be set inder ground at a later date. Pump for sampling installed later. ALL DEPTHS FROM GROUND SURFACE</p>
			1.0 to 3.3 <u>CLAY</u> - high plasticity, stiff, slightly moist, dark brown, slightly sandy.			
	10'		3.3 to 8.7 <u>GRAVEL</u> and <u>SAND</u> interbedded - both are coarse to fine, medium dense, slightly moist, dark brown to white, clayey and cobbles up to 6", calcareous.			
	20'		8.7 to 9.4 <u>CLAY</u> - high plasticity, stiff to very stiff, slightly moist, yellow brown, lime nodules, oyster shells, sandy and gravelly, possibly a reworked shale.			
	30'		9.4 to 54.6 <u>LIMESTONE</u> - weather stains, white with yellow brown, moderately hard to hard (rock classification), moderately to well cemented, soft(rx class) shale seams scattered throughout, oyster beds within. Very shaley zone from 15.9 to 25.5'. 54.6 to 55.2 <u>SHALE</u> 55.2 to 59.0 <u>SANDSTONE</u> 59.0 to 72.8			
	40'		<u>SHALE</u> and <u>SAND</u> interbedded - sand is fine grained and friable, shale is an unweathered dark gray, both are soft(rx class).			
	50'					

DRILLING LOG		DIVISION SWD	INSTALLATION Ft Worth	SHEET 2 of 2 SHEETS
1. PROJECT A.F. Plant #4(GD), Paluxy Aquifer		10. SIZE AND TYPE OF BIT *		
2. LOCATION (County or Station)		11. DATUM FOR ELEVATION SHOWN (FSM or MSL)		
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL		
4. HOLE NO. (As shown on drawing title and file number) P-12(u)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED	UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES		
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER		
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED COMPLETED		
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE		
9. TOTAL DEPTH OF HOLE 97'		18. TOTAL CORE RECOVERY FOR BORING %		
		19. SIGNATURE OF INSPECTOR Robert McVey		

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY a	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			72.8 to 97.0 SAND/SANDSTONE - fine grained, friable, mostly weak to non cemented, some moderately cemented seams, shale seams scattered, lime stringers within, overall has a grey to light grey color, soft(rx class)			Note: Lithology shown between depths 54.6 and 59.0 feet changed based on reinterpretation of geophysical log.

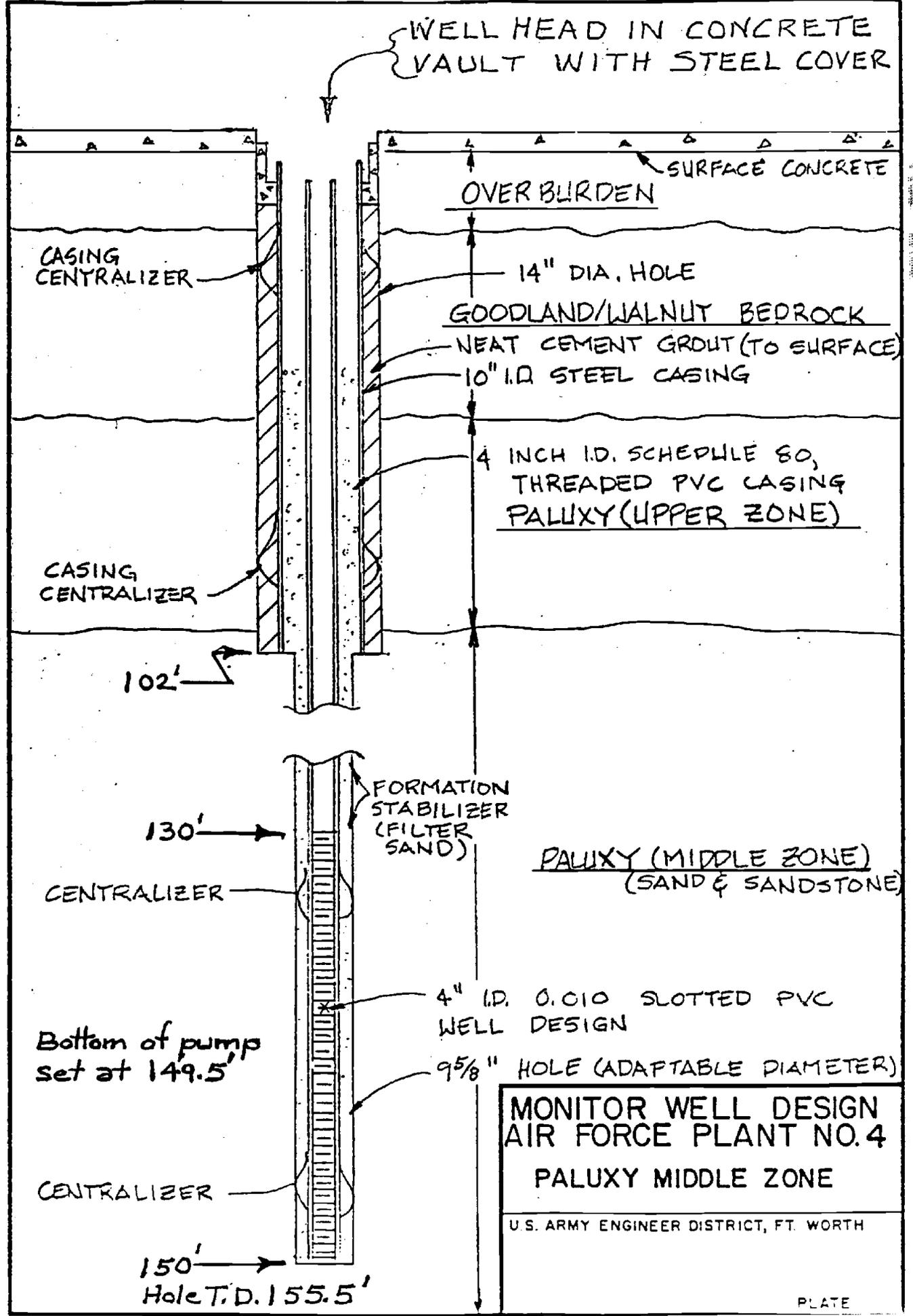


DRILLING LOG		DIVISION SWD	INSTALLATION Ft Worth	SHEET 1 OF 2 SHEETS
1. PROJECT A.F. Plant #4(GD), Paluxy Aquifer			10. SIZE AND TYPE OF BIT *	
2. LOCATION (Coordinates or Station)			11. DATE FOR ELEVATION SHOWN (FSD - HSL)	
3. DRILLING AGENCY USGS			12. MANUFACTURER'S DESIGNATION OF DRILL Falling 1500	
4. HOLE NO. (As shown on drawing title and file number) P-12(M)			13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	
5. NAME OF DRILLER Brown			14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER ***	
7. THICKNESS OF OVERBURDEN 9.4			16. DATE HOLE STARTED 3 Sept 85 COMPLETED 16 Sept 85	
8. DEPTH DRILLED INTO ROCK 146.1			17. ELEVATION TOP OF HOLE 643.54	
9. TOTAL DEPTH OF HOLE 155.5			18. TOTAL CORE RECOVERY FOR BORING 1	
			19. SIGNATURE OF INSPECTOR Robert McVey	

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY f	BOX OR SAMPLE NO. g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) h
			0.0 to 0.5 - Concrete.			<p>Note: Lithologic interpretation and their contacts were determined by the project geologist primarily from gamma and electric logs</p> <p>* Drilling</p> <p>0 to 0.5' - 14" rockbit, 0.5 to 10.5' - 14" auger 10.5 to 155.5' - rockbit, set 103' of 10" metal pipe of which one foot was stuck up. The casing was then grouted up from the bottom to the surface.</p> <p><u>Installations</u></p> <p>Set 4" pvc pipe to TD with intake screen from 150 to 130'. This pipe was then graveled up to 77'. The bottom of pump was then set at 149.5' and 1" riser pipe to surface with 1' stickup.</p> <p>All pump and pipe system to be set under ground at a later date. Diagram to be completed when above system completed.</p> <p>*** Hole bailed after completion of drilling. Water check on 17 Sept 1985 at 87.9'.</p> <p>** Vial samples taken at: one from auger cuttings one from drill fluid at 155.5' and one from rockbit cuttings at 155.5'. ALL DEPTHS FROM GROUND SURFACE</p>
			0.5 to 1.0 - <u>Base GRAVEL</u> .			
			1.0 to 3.5			
			<u>CLAY</u> - high plasticity, stiff, slightly moist, dark gray to dark brown, sandy and gravelly, calcareous.			
			3.5 to 8.7			
			<u>SAND</u> and <u>GRAVEL</u> interbedded - both are coarse to fine grained, medium dense, slightly moist, dark brown, clayey, cobbles, calcareous.			
			8.7 to 9.5			
			<u>CLAY</u> - high plasticity, stiff to very stiff, slightly moist, yellow brown, lime nodules and concentrations, sandy and gravelly, possibly a reworked shale.			
			9.5 to 54.4			
			<u>LIMESTONE</u> - weather stains throughout, white and yellow brown stains, moderately hard to very hard (rock classification), moderately to well cemented, oyster shells throughout with dense oyster beds within, shale seams scattered throughout as are lignite seams, a very shaly zone is encountered from 10.9 to 15.8', the shale is soft (rock classification).			
			54.4 to 55.0 <u>SHALE</u>			
			55.0 to 58.8 <u>SANDSTONE</u>			
			58.8 to 72.6			
			<u>SHALE</u> and <u>SAND</u> interbedded - sand is fine grained and friable, shale is essentially unweathered dark gray, both are soft (rx class) with lignite seams and lime stringers within.			

DRILLING LOG		Division SWD	INSTALLATION Ft Worth	SHEET 2 of 2 SHEETS
1. PROJECT A.F. Plant #4(GD), Paluxy Aquifer			10. SIZE AND TYPE OF BIT 5	
2. LOCATION (Coordinates or Station)			11. DAY(S) FOR ELEVATION SHOWN (726 or 826)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and site number) P-12(M)			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	
5. NAME OF DRILLER			14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN			16. DATE HOLE	
8. DEPTH DRILLED INTO ROCK			17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 155.5'			18. TOTAL CORE RECOVERY FOR BORING	
			19. SIGNATURE OF INSPECTOR <i>Robert McVey</i>	

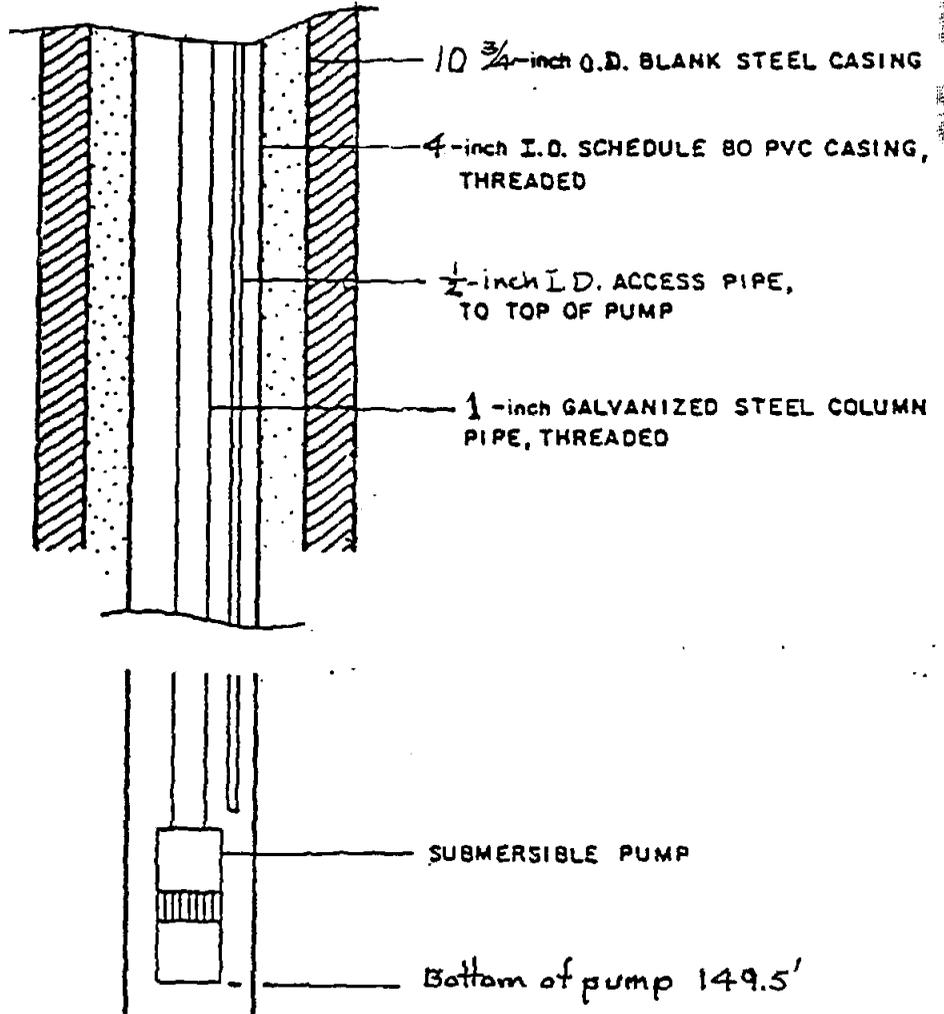
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water level, depth of weathering, etc., if significant) g
	80'		72.6 to 155.5			Note: Lithology shown between depths 54.4 and 65.8 feet changed based on reinterpretation of geophysical log.
	100'		<u>SAND/SANDSTONE</u> - Paluxy Fm. fine grained, no apparent weathering, friable, non cemented to weakly cemented from top of unit to 115.5', then cementation tends to increase in hardness and frequency of appearance, light grey, some white, lime stringers scattered, shale seams and zones scattered throughout, is, 100.5 to 102', 114.2 to 115.5', 145.4 to 148', and 153.1 to 154.3', this unit overall varies from soft to moderately hard (rock classification).			
	120'					
	140'					
	160'					



MONITOR WELL DESIGN
AIR FORCE PLANT NO. 4
PALUXY MIDDLE ZONE

U.S. ARMY ENGINEER DISTRICT, FT. WORTH

WELL P-12(M)



DRILLING LOG	DIVISION SWD	INSTALLATION Ft Worth	SHEET 1 OF 3 SHEETS
1. PROJECT Air Force Plant #4		10. SIZE AND TYPE OF BIT #	
2. LOCATION (Coordinates or Station) Paluxy Aquifer		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL Falling 1500	
4. HOLE NO. (As shown on drawing title and file number) P-13(u)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0
5. NAME OF DRILLER Brewer		14. TOTAL NUMBER CORE BOXES	UNDISTURBED 0
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN 14.4		16. DATE HOLE	STARTED 7 Jan 86
8. DEPTH DRILLED INTO ROCK 76.1		COMPLETED 30 Jan 86	
9. TOTAL DEPTH OF HOLE 90.5		17. ELEVATION TOP OF HOLE 638.18	
		18. TOTAL CORE RECOVERY FOR BORING 5	
		19. SIGNATURE OF INSPECTOR <i>James L. Christie</i>	

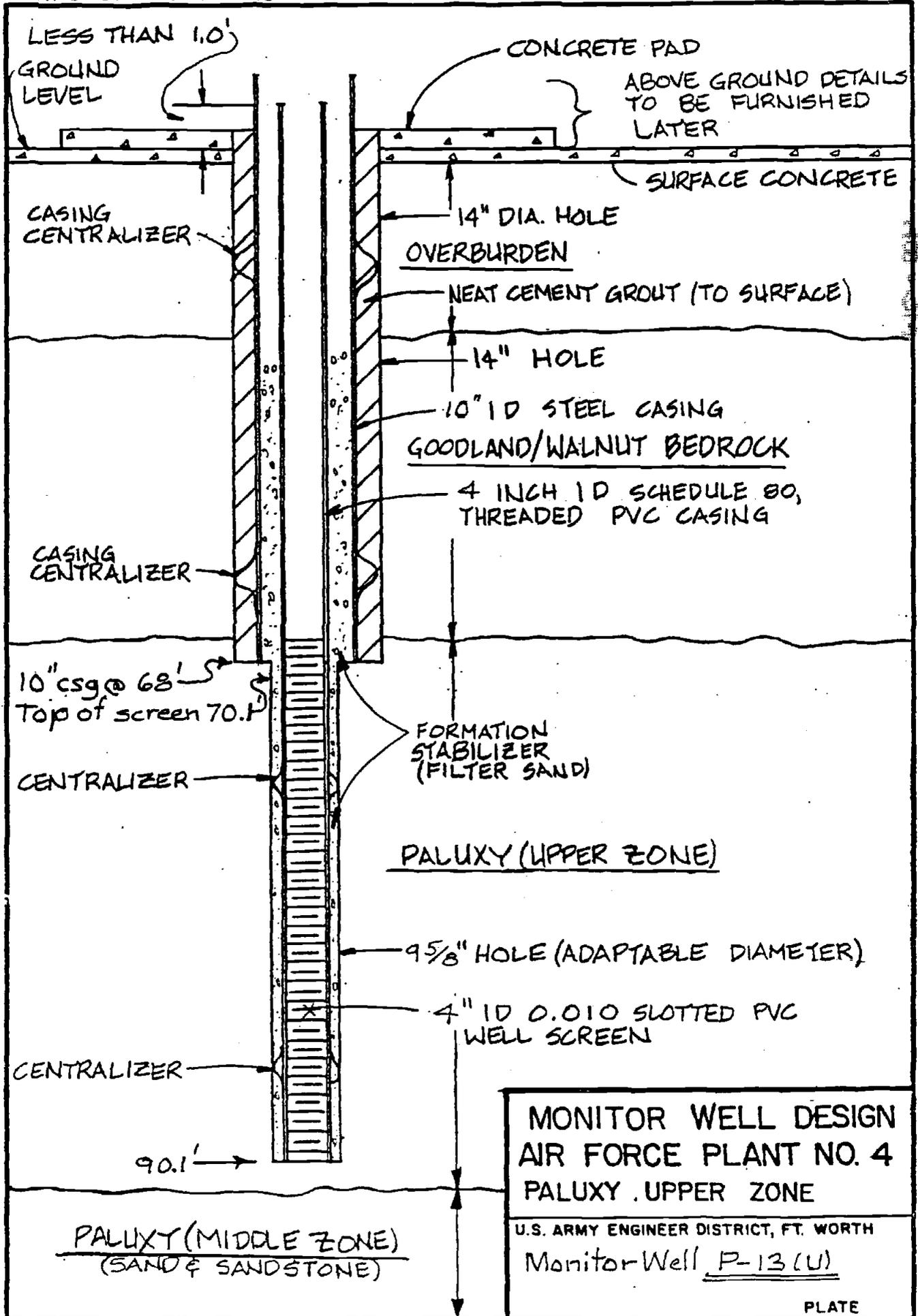
ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			0.0 to 6.9 CLAY - fill, medium plasticity, moderately stiff, slightly moist, black to brown, scattered gravels.			1* Drilling 0.0 to 14.5' - 10" auger, 14.5 to 68.0' - 12" pilot bit & 14" rockbit. 68 to 90.5' - 10" rockbit.
			6.9 to 8.9 CLAY - medium plasticity, moderately stiff, slightly moist, black/brown, scattered gravels.			2. Bedrock lithologies identified from drill cuttings, rate of bit penetration, and from electric log.
			8.9 to 14.4 GRAVEL - slightly cobbly, clayey, slightly moist.			3. Casing: .10" steel casing set to 68' with cement circulated to the ground surface. 4" pvc, 0.010 slot screen set 90.1' to 70.1'. 4" pvc schedule 80 cag set from 70.1 to surface
			14.4 to 26.0 SHALE - calcareous.			
			26.0 to 28.3 LIMESTONE - shaly.			
			28.3 to 55.3 LIMESTONE - few shale seams except from 42.0 to 47.5' where shaly.			4. Pump: 2 7/8" dia, 20 stage, single phase, model 2x4 P050, 8gpm(max) pump, made by Standard Pump Co., Bartlesville, Ok. Pump suction at 88.1' below ground surface.

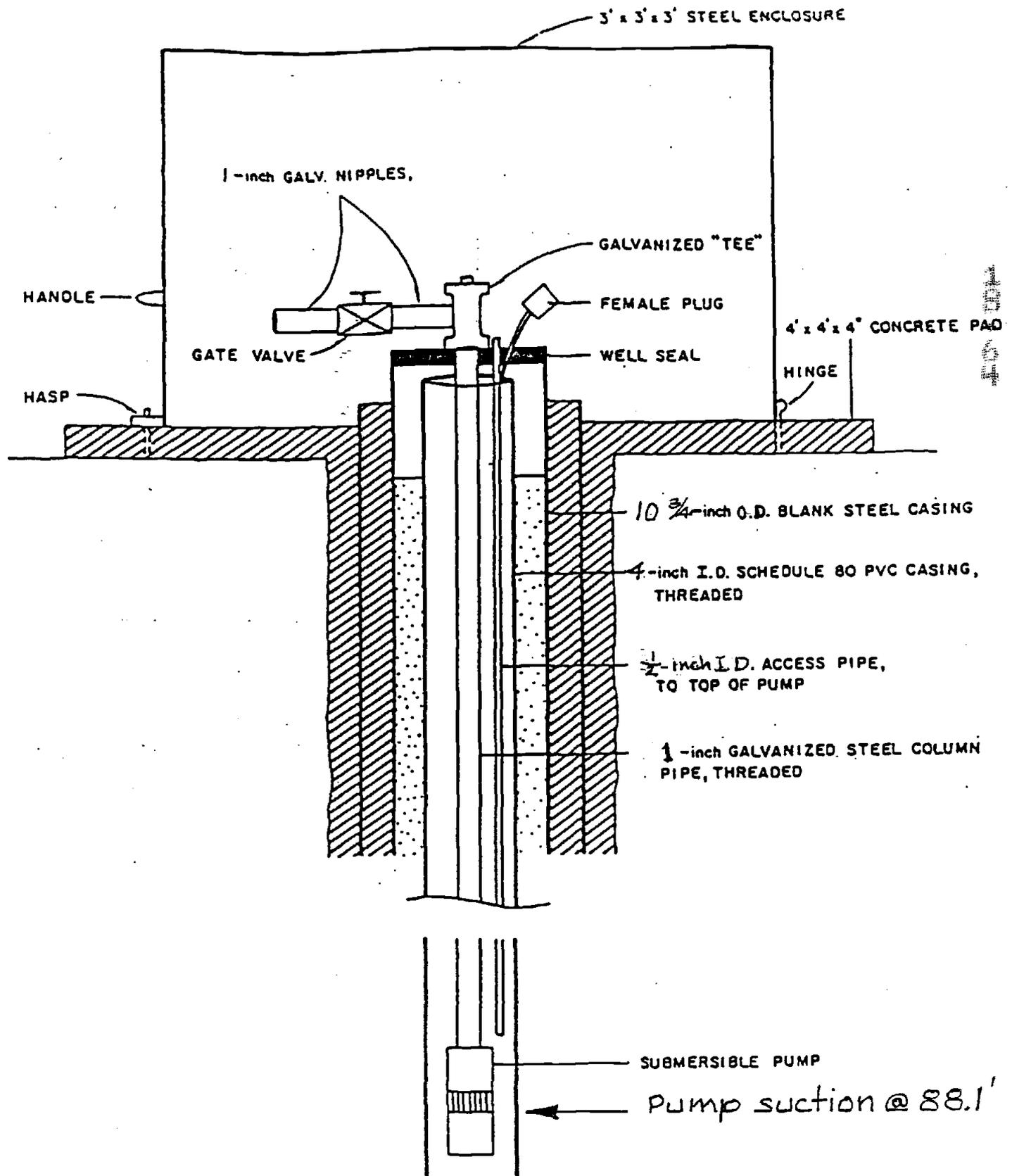
DRILLING LOG	DIVISION SWD	INSTALLATION Ft Worth	SHEET 2
1. PROJECT Air Force Plant #4, Paluxy Aquifer		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or BML)	
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number) P-13(u)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE	STARTED _____ COMPLETED _____
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 90.5'		18. TOTAL CORE RECOVERY FOR BORING	
		19. SIGNATURE OF INSPECTOR <i>James L. Christie</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			55.3 to 56.0 <u>SHALE</u> -			
			56.0 to 63.7 <u>SANDSTONE</u> - silty.			
			63.7 to 72.0 <u>SHALE</u> .			
	50'		72.0 to 76.0 <u>SANDSTONE</u> - very silty decreasing with depth to slightly silty.			
	60'		76.0 to 90.5 <u>SANDSTONE</u> - contains a number of shale streaks and thin seams. - T.D. 90.5' -			
	70'					

DRILLING LOG		DIVISION SWD	INSTALLATION Ft Worth		SHEET 3 of 3 SHEETS	
1. PROJECT Air Force Plant #4, Paluxy Aquifer			10. SIZE AND TYPE OF BIT			
2. LOCATION (Coordinates or Station)			11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY			12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing title and site number) P-13(u)			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED	UNDISTURBED	
5. NAME OF DRILLER			14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN			16. DATE HOLE			
8. DEPTH DRILLED INTO ROCK			17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE 90.5'			18. TOTAL CORE RECOVERY FOR BORING			
			19. SIGNATURE OF INSPECTOR <i>James L. Christie</i>			
ELEVATION <small>a</small>	DEPTH <small>b</small>	LEGEND <small>c</small>	CLASSIFICATION OF MATERIALS (Description) <small>d</small>	CORE RECOVERY <small>e</small>	BOX OR SAMPLE NO. <small>f</small>	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) <small>g</small>
	90'	•••••				

FWS-001





Paluxy Monitor Well P-13 (U)

DRILLING LOG		Division SWD	INSTALLATION Fort Worth	SHEET 1 OF 3 SHEETS
1. PROJECT Air Force Plant Number 4		10. SIZE AND TYPE OF BIT 14" Reamer/6" Core Barrel		
2. LOCATION (Coordinates or Station) Paluxy Aquifer Pollution Investigation		11. DATUM FOR ELEVATION SHOWN (TBM or MLL)		
3. DRILLING AGENCY USCEC		12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500		
4. HOLE NO. (As shown on drawing title and file number) P 13 - M		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		UNOBTAINED 0
5. NAME OF DRILLER Brewer		14. TOTAL NUMBER CORE BOXES 4		15. ELEVATION GROUND WATER See comment 1
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DES. FROM VERT.		16. DATE HOLE 16 Dec. 85		COMPLETED 3 Jan. 86 (110)
7. THICKNESS OF OVERBURDEN 14.0		17. ELEVATION TOP OF HOLE 637.83		
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING 65.0		
9. TOTAL DEPTH OF HOLE		19. SIGNATURE OF INSPECTOR <i>Randy Fickner</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			0.0' to 6.5' CLAY FILL: black-brown; medium plasticity; medium stiff; slightly moist; scattered gravel.			1. Water Level No water level was taken prior to the grouting of the casing.
			6.5' to 8.5' CLAY: black-brown; medium plasticity; medium stiff; slightly moist; scattered gravel.			2. Drilling Methods 0.0 - 14.5 - 14" auger. 14.5 - 56.0 - reamer (11" rockbit with a 14" expander). 56.0 - 77.0 - 10" rockbit. 77.0 - 100.0 - 6" core barrel. Reamed the hole to 100' with the reamer. 100.0 - 110.0 - reamer Electric logged the hole Placed 103' of steel casing. Grouted the casing in place. Drilled the grout out of the casing. From 14.0' to 77.0' - the lithic descriptions are generally based upon electric log interpretations.
	10		8.5' to 14.0' GRAVEL: some cobbles; clayey; slightly moist.			
			14.0' to 26.0' SHALE: calcareous. Identified by cuttings, rate of bit penetration, and electric log only.			
	20		26.0' to 28.0' LIMESTONE: Shaly. Identified by cuttings, rate of bit penetration, and electric log only.			
			28.0' to 55.5' LIMESTONE: occasional shale seams. Identified by cuttings, rate of bit penetration, and electric log only.			

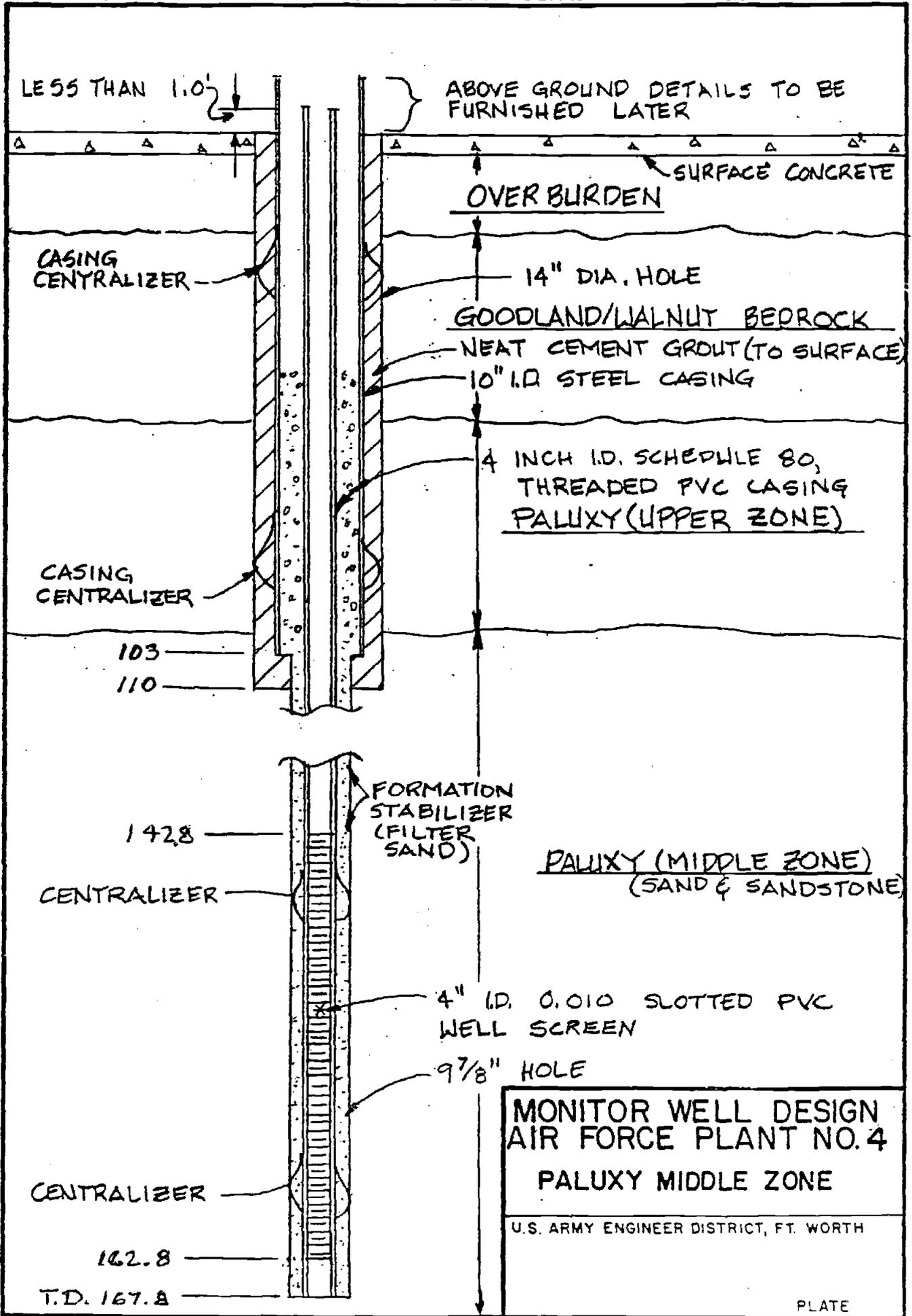
DRILLING LOG	DIVISION SWD	INSTALLATION Fort Worth	SHEET OF 3 SHEETS 2
1. PROJECT Air Force Plant Number 4		10. SIZE AND TYPE OF BIT 14" Reamer/6" Core Barrel	
2. LOCATION (Coordinates or Station) Paluxy Aquifer Pollution Investigation		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCEC		12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500	
4. HOLE NO. (As shown on drawing title and file number) P 13 - M		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER Brewer		14. TOTAL NUMBER CORE BOXES 4	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER See comment 1	
7. THICKNESS OF OVERBURDEN 14.0		16. DATE HOLE STARTED 16 Dec. 85 COMPLETED 3 Jan. 86 (110')	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BORING 65.0 %	
		19. SIGNATURE OF INSPECTOR <i>Randy Fickel</i>	

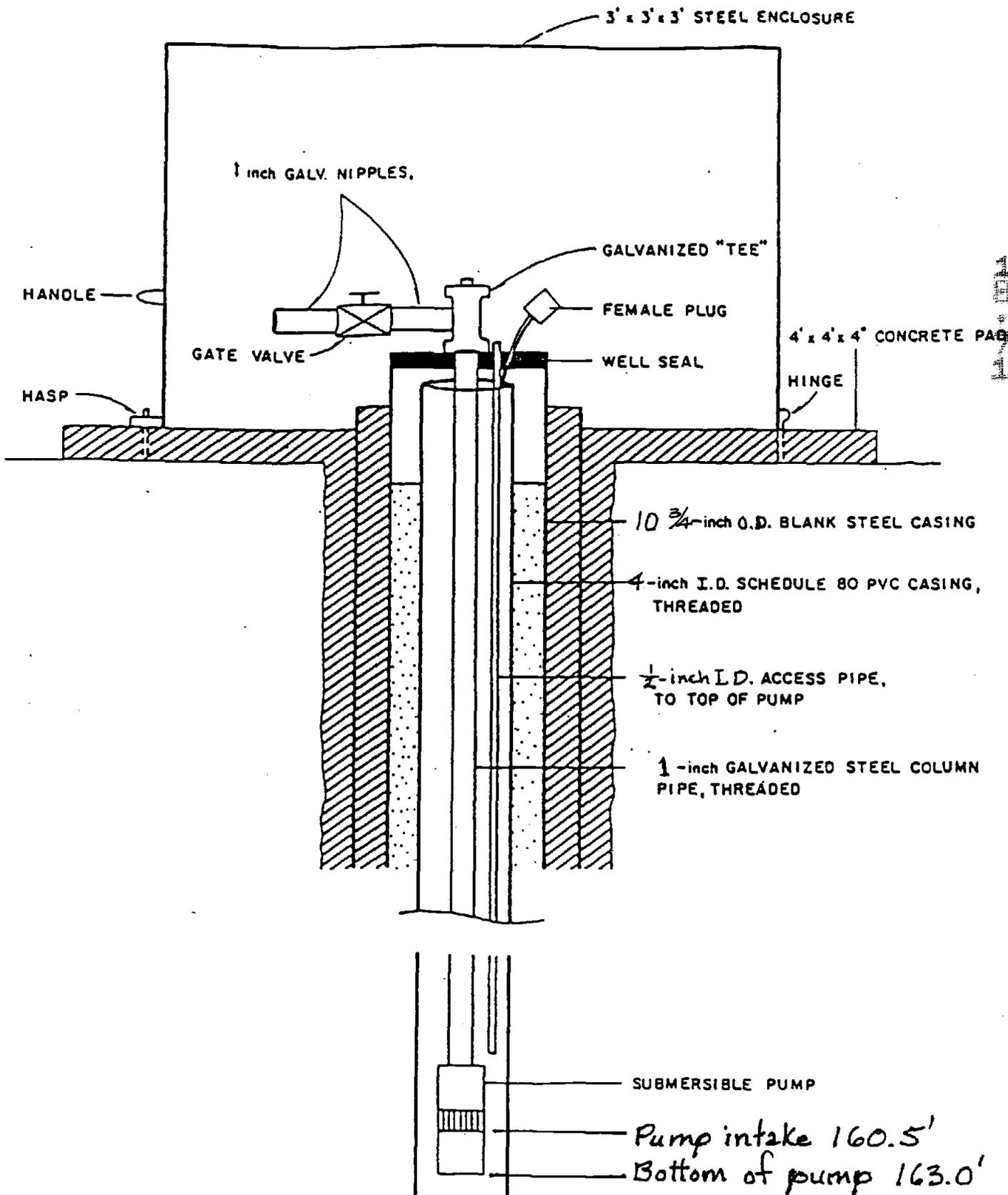
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling fluid, water loss, depth of weathering, etc., if significant) g
			55.5' to 56.0' SHALE: Identified by cuttings, rate of bit penetration, and electric log only.			
	50		56.0' to 64.0' SANDSTONE: Identified by cuttings, rate of bit penetration, and electric log only.			
			64.0' to 72.0' SHALE: Identified by cuttings, rate of bit penetration, and electric log only.			
	60		72.0' to 110.0' SANDSTONE: 72.0' to 77.0': Identified by cuttings, rate of bit penetration; and electric log only. From 75.5 - 78.0 - cemented zone. From 77.0 - 100.0 - 6" core. 77.0' to 96.0': gray; fine grained; calcareous; loosely cemented. Dark gray clay seams - 82.8-82.9, 84.8-85.0, 85.9-86.0, 86.4-86.5. Gray clay pocket at 87.2. 85.4-85.6 - a few lignitic laminations. 88.0-88.3 - interbedded sand and clay. 88.5-89.3 - dark gray clay seam. at 89.7 - hard clay seam with pyrite. at 91.0 - gray clay pocket. 91.4-91.5 - dark gray clay seam. 93.2-93.4 - interbedded clay and sand.			
	70					
				77.0		
				Run 1	B	
				L-23	X	
				80.0	1	

DRILLING LOG		DIVISION SVD	INSTALLATION Ft Worth	SHEET 1 OF 2 SHEETS		
1. PROJECT Paluxy Aquifer Pollution Investigation			10. SIZE AND TYPE OF BIT * Palling 1500			
2. LOCATION (Coordinates or Station) Air Force plant #4.			11. DAY(S) FOR ELEVATION SHOWN (FSM - MSL)			
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL Palling 1500			
4. HOLE NO. (As shown on drawing title and site number) P-13(m) extension			13. TOTAL NO. OF SAMPLES TAKEN DISTURBED: 2 UNDISTURBED: 0			
5. NAME OF DRILLER Brewer/Merva			14. TOTAL NUMBER CORE BOXES 0			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.			15. ELEVATION GROUND WATER To be determined.			
7. THICKNESS OF OVERBURDEN 14'			16. DATE HOLE STARTED: 21 July 86 COMPLETED: 25 July 86			
8. DEPTH DRILLED INTO ROCK 153.8			17. ELEVATION TOP OF HOLE 637.83			
9. TOTAL DEPTH OF HOLE 167.8'			18. TOTAL CORE RECOVERY FOR BORING %			
			19. SIGNATURE OF INSPECTOR <i>Robert McVey</i>			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc.; if significant) g
	110'		110.0 to 167.7 <u>SANDSTONE</u> - Paluxy Fm. - mostly weak to non cemented, some scattered weak to moderate cementation, fine grained, light grey, thin lignite seams scattered throughout, silty and shaley with numerous thin seams throughout.			* <u>Drilling</u> P-13(m) previously drilled 16 dec 85 to 3 Jan 86 to 110' (drill log available). Hole was grouted up to 84.2' within metal casing. Plug from 82.2' to 82.8'. 84.2 to 92.3' - 9 7/8" rockbit - refusal on a metal plug installed with grout. 92.3 to 92.8' - 6" diamond core, 92.3 to 167.8' - 9 7/8" rockbit. Hole was gamma logged (natural) and well monitoring casing installed after drilling. ----- <u>Well Installation</u> TD = 167.8' Bottom of pump = 163.0' Pump intake = 160.5' 4" pvc pipe connects pump to surface and filter material placed around screen. A 5' sump placed below pump and 20' of .010 screen placed immediately above pump. <u>Samples</u> Two samples taken at 167.8'. One vial of drill fluid and one vial of cuttings with distilled water added to fill voids within vial. <u>Note:</u> Robert McVey present only during drilling portion, ie, 84.2 to 167.8'. Gerald Schoonover present for inspection during well installation and logging.
	120'		167.7 to 167.8 <u>SHALE</u> - greenish grey to white,			
	130'					
	140'					
	150'					

DRILLING LOG		DIVISION SWD	INSTALLATION Ft Worth	SHEET 2 OF 2 SHEETS
1. PROJECT Paluxy Aquifer, AF Plant #4			10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinate or Station)			11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and its number) P-13(m)extension			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	
5. NAME OF DRILLER			14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN			16. DATE HOLE	
8. DEPTH DRILLED INTO ROCK			17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 167.8'			18. TOTAL CORE RECOVERY FOR BORING	
			19. SIGNATURE OF INSPECTOR Robert McVey	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
150						
160						
170						





MONITOR WELL P-13(M)

DRILLING LOG	DIVISION SWD	INSTALLATION Fort Worth	SHEET OF 1 SHEETS
1. PROJECT Paluxy Aquifer Pollution Investigation		10. SIZE AND TYPE OF BIT 2" auger, 4" core	
2. LOCATION (Coordinates or Station) C.D. (Air Force Plant #4)		11. DAYUM FOR ELEVATION SHOWN (TBM or BBL)	
3. DRILLING AGENCY USCE-C		12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A4C-83		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 11 UNDISTURBED: 0	
5. NAME OF DRILLER Brewer		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DES. FROM VERT.		15. ELEVATION GROUND WATER ***	
7. THICKNESS OF OVERBURDEN 32.0		16. DATE HOLE STARTED: 9 Jul 85 COMPLETED: 11 Jul 85	
8. DEPTH DRILLED INTO ROCK 7.0		17. ELEVATION TOP OF HOLE 645.83	
9. TOTAL DEPTH OF HOLE 39.0		18. TOTAL CORE RECOVERY FOR BORING 39% 19. SIGNATURE OF INSPECTOR <i>Randy Niekirk</i>	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
a	b	c	d	e	f	g
			0.0 to 0.6' ASPHALT		A	*** 1. Drilled to 32' on 9 Jul. Water level was 26.6' at 0800 10 Jul. After completion of hole, bailed to 38.1. 24 hr check-level was 28.5' 2. JARS: A. 1.1 to 4.0 B. 4.0 to 7.0 C. 7.0 to 10.0 D. 10.0 to 13.0 E. 13.0 to 16.0 F. 16.0 to 19.5 G. 19.5 to 23.0 H. 23.0 to 26.0 I. 26.0 to 29.0 J. 29.0 to 31.0 K. 31.0 to 32.0 3. Drilling methods: 0.0 to 32.0 auger 32.0 to 32.5 - rockbit 32.5 to 39.0 - 4" core 4. After bailing, hole was backfilled to 21.3' with neat cement grout. 5. Water samples:
			0.6' to 1.1' BASE MATERIAL		B	
			1.1' to 19.5' CLAY:		C	
			1.1' to 7.0' - medium plasticity, tan-brown, medium stiff, moist, calcareous with scattered lime nodules.		D	
			7.0' to 19.5' - low to medium plasticity, brown, medium stiff, moist, calcareous, slightly silty.		E	
			19.5' to 32.0' GRAVEL, dense, well graded (fine to medium), tan, moist, sandy, clayey. Borders on a gravelly clay.		F	
			32.0 to 39.0' LIMESTONE (Walnut fm)		G	
			32.0 to 38.1 - moderately hard, dark gray, fossiliferous, dark gray, calcareous clay matrix.		H	
			38.1 to 38.4 - moderately hard, gray, fossiliferous, clayey.		I	
			38.4' to 38.6' - clay seam, soft, tan-gray, sandy, fossiliferous.		J	
			38.6 to 39.0 - moderately hard, gray, fossiliferous, clayey.		K	
			T D 39.0'	cut 4' Lost 4'	X	
				Lo. 1'	Box 1	

DRILLING LOG	DIVISION SWD	INSTALLATION Fort Worth	SHEET OF 2 SHEETS
1. PROJECT Paluxy Aquifer Pollution Investigation		10. SIZE AND TYPE OF BIT 10" Anger/6" Anger	
2. LOCATION (Coordinates or Section) Air Force Plant No. 4 (G. D.) 471 st N. of EM - 83		11. DAYUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCEC		12. MANUFACTURER'S DESIGNATION OF DRILL Falling 1500	
4. HOLE NO. (As shown on drawing title and file number) 84AC - 84		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	14. TOTAL NUMBER CORE BOXES
5. NAME OF DRILLER Brewer		15. ELEVATION GROUND WATER See comment 1	16. DATE HOLE STARTED 12 July 85 COMPLETED 14 July 85
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DES. FROM VERT.		17. ELEVATION TOP OF HOLE 647.65	
7. THICKNESS OF OVERBURDEN 61.5'		18. TOTAL CORE RECOVERY FOR BORING %	
8. DEPTH DRILLED INTO ROCK 00.5'		19. SIGNATURE OF INSPECTOR <i>Landy Prichard</i>	
9. TOTAL DEPTH OF HOLE 62.0'			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			0.0' to 0.6' <u>Asphalt</u>			1. Water Level 24 hr. check - water level had dropped overnight from ground level to 27.0', caved to 57.0'. The hole made to much water to bail dry. 1014 0 34.8" 1015 1 33.2' 1016 2 32.7' 1017 3 32.1' 1018 4 31.8" 2. Jar Samples A. 1.4 - 4.0 B. 4.0 - 7.0 C. 7.0 - 9.0 D. 9.0 - 11.0 E. 11.0 - 14.0 F. 14.0 - 17.0 G. 17.0 - 17.4 H. 17.4 - 20.0 I. 20.0 - 23.0 J. 23.0 - 26.0 K. 26.0 - 29.0 L. 29.0 - 32.0 M. 32.0 - 35.0 N. 35.0 - 38.0 O. 38.0 - 43.0 P. 43.0 - 46.0 Q. 46.0 - 48.0 3. Drilling Methods 0.0' to 41.0' - 10" auger. Set 8" steel casing to 41.0'. 41.0' to 48.0' - 6" auger. 48.0' to 58.0' - 4" core barrel. 58.0' to 62.0' - 7 7/8" rock bit. 9 bags of neat grout was poured into the hole and allowed to set for 20 hrs. Top of grout is at 27.2'. Hole was backfilled with cuttings and left-over cuttings were placed in cloth sample bags. The top 0.6' of the hole was capped off with premixed concrete.
			0.6' to 1.4' <u>Gravel Base</u>		A	
			1.4' to 17.4' <u>CLAY:</u> 1.4' to 7.0': medium to high plasticity; black; stiff; moist; calcareous.		B	
			7.0' to 11.0': high plasticity; tan - brown; very stiff - hard; moist; calcareous; with a few lime nodules from 9.0'; sandy.		C	
			11.0' to 14.0': medium plasticity; reddish brown; very stiff; moist; calcareous; very sandy.		D	
			14.0' to 17.4': low plasticity; tan; stiff; moist; calcareous; silty.		E	
			17.4' to 23.0' <u>GRAVEL:</u> dense; tan; moist; calcareous; well graded (fine to medium gravel sizes), some coarse gravel sizes and cobble sizes from 21.0'; clayey, sandy.		F	
			23.0' to 50.0' <u>CLAY:</u> 23.0' to 26.0': low plasticity; tan; medium stiff - stiff; moist; calcareous; silty.		G	
			26.0' to 29.0': medium plasticity; reddish brown; medium stiff - stiff; moist; calcareous; silty.		H	
					I	
					J	
					K	
					L	
					M	
					N	
					O	

DRILLING LOG		DIVISION		INSTALLATION		SHEET 2	
		SWD		Fort Worth		OF 2 SHEETS	
1. PROJECT Paluxy Aquifer Pollution Investigation				10. SIZE AND TYPE OF BIT 10" Auger/6" Auger			
2. LOCATION (Coordinates or Station) Air Force Plant No. 4 (G. D.)				11. DATUM FOR ELEVATION SHOWN (FSM or MSL)			
3. DRILLING AGENCY USCEC				12. MANUFACTURER'S DESIGNATION OF DRILL Falling 1500			
4. HOLE NO. (As shown on drawing title and site number) 8A4C - 84				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 17	UNDISTURBED 0
5. NAME OF DRILLER Hrewer				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER See comment 1			
7. THICKNESS OF OVERBURDEN 61.5				16. DATE HOLE		STARTED 12 July 85	COMPLETED 14 July 85
8. DEPTH DRILLED INTO ROCK 00.5				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE 62.0				18. TOTAL CORE RECOVERY FOR BORING			
				19. SIGNATURE OF INSPECTOR <i>Randy Fiedler</i>			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
			23.0' to 48.0' <u>50.0'</u> CLAY: 29.0' to 46.0': low plasticity; tan - reddish brown; medium stiff; moist; calcareous; silty. 46.0' to 48.0': medium to high plasticity; reddish brown; very stiff; moist; calcareous.		0		
	50		48.0' to 61.5' GRAVEL: determined from small core sample and drilling action.		P		
			61.5' to 62.0' Walnut Formation (?) Determined from rock bit cuttings.		Q		
	60						
			T.D. 62.0'				
	70						

DRILLING LOG		DIVISION SWD	INSTALLATION Fort Worth	SHEET 1 OF 2 SHEETS
1. PROJECT Paluxy Aquifer Pollution Investigation			10. SIZE AND TYPE OF BIT 10" Anger / 4" Carbobloy	
2. LOCATION (Coordinates or Station) G. D. Air Force Plant No. 4			11. DATUM FOR ELEVATION KNOWN (TBM or B.M.)	
3. DRILLING AGENCY USCEC			12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A4C - 85			13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN DISTURBED 19 UNDISTURBED 0	
5. NAME OF DRILLER Brewer			14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER See comment 1	
7. THICKNESS OF OVERBURDEN 59.0			16. DATE HOLE STARTED 16 July 85 COMPLETED 19 July 85	
8. DEPTH DRILLED INTO ROCK 6.5			17. ELEVATION TOP OF HOLE 647.20	
9. TOTAL DEPTH OF HOLE 65.5			18. TOTAL CORE RECOVERY FOR BORING 92 %	
			19. SIGNATURE OF INSPECTOR <i>Randy Niebuhr</i>	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
a	b	c	d	e	f	g	
			<u>0.0' to 0.4'</u> Asphalt		A	1. <u>Water Level</u> 24 hr. check with a hole depth of 55.0' - water at 24.1' and caved below 37.7'.	
			<u>0.4' to 52.0'</u> CLAY:		B		
			<u>0.4' to 4.3'</u> : high plasticity; red brown - dark red brown; very stiff; damp; calcareous; sandy.		C	2. <u>Jar Samples</u> A. 0.4 - 2.4 B. 2.4 - 4.3 C. 4.3 - 7.0 D. 7.0 - 9.0 E. 9.0 - 14.0 F. 14.0 - 17.0 G. 17.0 - 20.0 H. 20.0 - 23.0 I. 23.0 - 26.0 J. 26.0 - 29.0 K. 29.0 - 32.0 L. 32.0 - 36.0 M. 36.0 - 39.0 N. 39.0 - 42.0 O. 42.0 - 45.0 P. 45.0 - 48.0 Q. 48.0 - 52.0 R. 52.0 - 55.0 S. 55.0 - 59.0	
			<u>4.3" to 9.0'</u> : medium - high plasticity; red brown; stiff - very stiff; damp; calcareous, with lime powder (caliche) and nodules; sandy.		D		
			<u>9.0' to 17.0'</u> : low plasticity; tan - red brown; medium stiff - stiff; moist; calcareous; silty.		E		
			<u>17.0' to 29.0'</u> : medium - high plasticity, with a low plasticity zone from 20.0' to 23.0'; tan; medium stiff - stiff; moist; calcareous; silty from 20.0'.		F		
			<u>29.0' to 32.0'</u> : high plasticity; red brown; stiff - very stiff; moist; calcareous, with abundant lime nodules and limestone clasts; gravelly (fine grained). First sign of water at 30.0'.		G		
			<u>32.0' to 52.0'</u> : high plasticity; tan - red brown; stiff - very stiff; moist; calcareous.		H		
					I		3. <u>Drilling Methods</u> 0.0' to 59.0' - 10" auger. Set 8" steel casing to 59.0'. Had a hard time setting due to caving and sand zone above the Walnut Limestone. 59.0' to 59.5' - 7 7/8" rock bit. 59.5' to 65.5' - 4" core barrel. Bailed the hole to 58.6 and then poured in 12 bags of neat grout. The top of the grout in the hole is at approximately 19.0'. The remainder of the hole was backfilled with cuttings. All cuttings had been bagged directly upon removal from the hole and those cuttings not used to backfill the hole were stored in the area provided by G. D.
					J		
					K		
					L		
					M		
					N		

DRILLING LOG	DIVISION SWD	INSTALLATION Fort Worth	SHEET 2 OF 2 SHEETS
1. PROJECT Paluxy Aquifer Pollution Investigation		10. SIZE AND TYPE OF BIT 10" Auger / 4" Carbology	
2. LOCATION (Coordinates or Station) G. D. Air Force Plant No. 4		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCEC		12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500	
4. HOLE NO. (As shown on drawing title and file number)		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	14. TOTAL NUMBER CORE BOXES
5. NAME OF DRILLER Brever		15. ELEVATION GROUND WATER See comment 1	16. DATE HOLE STARTED 16 July 85 COMPLETED 19 July 85
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		17. ELEVATION TOP OF HOLE	
7. THICKNESS OF OVERBURDEN 59.0		18. TOTAL CORE RECOVERY FOR BORING 92 %	
8. DEPTH DRILLED INTO ROCK 6.5		19. SIGNATURE OF INSPECTOR <i>Randy Niebuhr</i>	
9. TOTAL DEPTH OF HOLE 65.5			

ELEVATION c	DEPTH 40 b	LEGEND e	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY f	BOX OR SAMPLE NO. g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) h
			<u>52.0' to 59.0'</u> SAND: loose; tan; wet; calcareous; poorly graded (fine grained); some clay.		N	4. Note - HM - 83 is located 419.8' south of HM - 82 and 14.8' west of parking lot fence. 8A4C - 84 is located 468.9' north of HM - 82 and 13.9' west of the parking lot fence. 8A4C - 85 is located 357.8' north of 8A4C - 84 and 18.9' west of fence line.
			<u>59.0' to 64.9'</u> LIMESTONE (Walnut Formation) <u>59.0' to 60.5'</u> : moderately hard; tan; highly weathered, iron stained; very fossiliferous, generally the fossils consist of (oyster) shells; calcareous clay matrix. From 60.2' moderately hard; gray; weathered; very fossiliferous; dark gray calcareous clay matrix.		O	
			<u>60.5' to 62.4'</u> : moderately hard; gray; weathered; less fossiliferous, shells generally in small pieces; becoming very argillaceous.		P	
			<u>62.4' to 63.8'</u> : soft; gray; weathered; very argillaceous; fewer fossils. From 63.3' - moderately hard; gray; weathered; broken shell pieces.		Q	
			<u>63.8' to 64.9'</u> : moderately hard; gray; weathered; very fossiliferous (oyster) shells; a few pyrite crystals; some dark gray calcareous clay matrix.		R	
			<u>64.9' to 65.5'</u> SILTSTONE: soft; lime green; calcareous; contains small pockets of a green gray clay (0.05' x 6.1').		S	
			T.D. 65.5'.			

DRILLING LOG		DIVISION SWD	INSTALLATION Fr Worth	SHEET 1 OF 2 SHEETS
1. PROJECT Paluxy Aquifer Pollution Investigation		10. SIZE AND TYPE OF BIT * 11. DATUM FOR ELEVATION SHOWN (TBM or BBL)		
2. LOCATION (Coordinates or Section) Air Force Plant No. 4 (General Dynamics)		12. MANUFACTURER'S DESIGNATION OF DRILL		
3. DRILLING AGENCY USCE		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN 16		
4. HOLE NO. (As shown on drawing title and file number) 8A4C-86		14. TOTAL NUMBER CORE BOXES 1		
5. NAME OF DRILLER Merva		15. ELEVATION GROUND WATER ***		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		16. DATE HOLE STARTED 21 July 85		
7. THICKNESS OF OVERBURDEN 59.9		17. ELEVATION TOP OF HOLE 678.98		
8. DEPTH DRILLED INTO ROCK 5.1		18. TOTAL CORE RECOVERY FOR BORING %		
9. TOTAL DEPTH OF HOLE 65.0		19. SIGNATURE OF INSPECTOR Robert McVey		

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			0.0 to 0.4 - Asphalt.			* Drilling
			0.4 to 59.9 <u>CLAY</u>		A	0 to 60' - 8" auger, set 5' csng,
			0.4 to 2.4 - medium to low plasticity, medium stiff, dry, dark brown, sandy and gravelly.		R	60 to 65' - 4" core. Auger refusal at 60'.
			2.4 to 3.1 - high to medium plasticity, medium stiff, slightly moist, black.		C	***
			3.1 to 4.5 - medium to high plasticity, medium stiff, very dark brown, silty.		D	Water first observed during the 24 to 25' run on 22 July 85.
	10'		4.5 to 6.5 - high plast, stiff, slightly moist, dark red brown, silty to slightly gravelly.		E	On 23 July - water at 22'.
			6.5 to 7.7 - high plast, very stiff, slightly moist, reddish yellow, caliche, silty, slightly sandy, gravelly.		F	
	20'		7.7 to 10.0 - low that grades to medium plasticity, very stiff, slightly moist, yellow, very sandy, silty, calcareous.		G	<u>Jars</u>
			10.0 to 15.0 - high plast, very stiff to stiff, slightly moist, red yellow, silty, scattered sand sized lime nodules.		H	A. 0.4 to 2.4 B. 2.4 to 3.1 C. 3.1 to 4.5 D. 4.5 to 6.5 E. 6.5 to 7.7 F. 7.7 to 10.0 G. 10.0 to 15.0 H. 15.0 to 20.0 I. 20.0 to 25.0 J. 25.0 to 30.0 K. 30.0 to 35.0 L. 35.0 to 40.0 M. 40.0 to 45.0 N. 45.0 to 50.0 O. 50.0 to 55.0 P. 55.0 to 59.9
	30'		15.0 to 50.0 - high/medium plasticity, medium stiff to scattered soft seams, moist, red yellow with yellow brown, silty and sandy, soft sand seam at 28.7 to 29.2', some light gray pockets(silt), some shells from 41 to 45'.		I	
			50.0 to 59.9 - high to medium plasticity, stiff to very stiff, moist, brownish yellow and light gray, few ferruginous clasts scattered within, few sandy lime nodules, sand/silt seams at: 58.9 to 58.9', and 59.8 to 59.9', has shaly appearance w/ slicks.		J	
					K	
					L	

DRILLING LOG		DIVISION SWD	INSTALLATION Fr Worth	SHEET 2 OF 2 SHEETS
1. PROJECT Paluxy Aquifer Pollution Investigation			10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) AREA (GD)			11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY			12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number) 8A4C-86			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	
5. NAME OF DRILLER			14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN			16. DATE MOLE	
8. DEPTH DRILLED INTO ROCK			17. ELEVATION TOP OF MOLE	
9. TOTAL DEPTH OF HOLE 65'			18. TOTAL CORE RECOVERY FOR BORING	
			19. SIGNATURE OF INSPECTOR Robert McVey	

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			59.9 to 62.2			
			<u>ARGILLACEOUS LIMESTONE</u> - weather stained until 60.7' then an unweathered dark gray and white, jointed, massive, soft shale to hard/very hard L.S. (rock classification), moderately to well cemented, oyster shells scattered, shale seams scattered throughout and usually grades to marl		M	
					N	
					O	
					P	
	60'			Lost 1.3'	Box 1	
				Lo-3'		
	64'			Lo-8'		

(TRANSLUCENT)

400-1000

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE		
2. LOCATION (Coordinates or Section) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (TBM or B.M.)		
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500		
4. HOLE NO. (As shown on drawing title and file number) 8A4C-87		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 11 UNDISTURBED 0		
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **		
7. THICKNESS OF OVERBURDEN 37.5		16. DATE HOLE: STARTED 2/1/86 COMPLETED 2/1/86		
8. DEPTH DRILLED INTO ROCK 4.0		17. ELEVATION TOP OF HOLE -- 649.29		
9. TOTAL DEPTH OF HOLE 41.5		18. TOTAL CORE RECOVERY FOR BORING 100%		
		19. SIGNATURE OF INSPECTOR <i>R. R. Andette</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		<u>0.0 to 0.4</u> ASPHALT , good condition		A	1) No free water encountered during augering to top of primary. Boring reamed at primary prior to coring. taped to depth-dry.
			<u>0.4 to 2.5[±]</u> CLAY , medium to high plasticity, stiff, moist, brown.		B	
			<u>2.5 to 6.0[±]</u> CLAY , low to medium plasticity, soft, moist, reddish-brown.		C	
	10.0		<u>6.0 to 37.5[±]</u> CLAY , low plasticity, soft, moist, sandy throughout, small limy nodules and blebs throughout, tan.		D	2) JARS A) 0.0-2.5 B) 2.5-5.0 C) 5.0-6.0 D) 6.0-10.0 E) 10.0-15.0 F) 15.0-20.0 G) 20.0-25.0 H) 25.0-30.0 I) 30.0-35.0 J) 35.0-37.5
			<u>37.5 to 41.5</u> LIMESTONE , tan to brown along basal section, fine to coarse grained, argillaceous, highly fossiliferous, badly weathered to 39.7'; fractured, soft.		E	
	20.0		T.D. - 41.5'		F	
					G	
	30.0				H	3) CARTONS to carton samples
					I	4) DRILLING 0.0 - 37.5, 8" auger refusal at top of limestone. 37.5 - 41.5, 4" core
					J	
	40.0			37.5		Remarks: A) Casing advanced to top of primary and reamed. B) After coring, boring bailed. 4" PVC pipe inserted to depth. Hole grouted through PVC insert with PVC being slowly withdrawn during grouting. C) Boring subsequently backfilled with cuttings.
				4.0	1	

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 2
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE		
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATE FOR ELEVATION SHOWN (YES or NO)		
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500		
4. HOLE NO. (As shown on drawing title and file number) 8A4C-87		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 11	UNDISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **		
7. THICKNESS OF OVERBURDEN 37.5		16. DATE HOLE STARTED 2/1/86 COMPLETED 2/1/86		
8. DEPTH DRILLED INTO ROCK 4.0		17. ELEVATION TOP OF HOLE --		
9. TOTAL DEPTH OF HOLE 41.5		18. TOTAL CORE RECOVERY FOR BORING 100%		
		19. SIGNATURE OF INSPECTOR R.R. Ardella		

ELEVATION e	DEPTH h	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY o	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water level, depth of weathering, etc., if significant) g
40.0	0.0			41.5		
50.0	10.0					
60.0	20.0					
70.0	30.0					
80.0	40.0					

000-101

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DAYUM FOR ELEVATION SHOWN (FEET OR METERS)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-88		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 11 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 19.5		16. DATE HOLE STARTED 2/1/86 COMPLETED 2/1/86	
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE -- 651.0	
9. TOTAL DEPTH OF HOLE 19.5		18. TOTAL CORE RECOVERY FOR BORING --	
		19. SIGNATURE OF INSPECTOR <i>R.R. Audette</i>	

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		<u>0.0 to 0.3</u> , Asphalt			** 1) No free water encountered to top of primary. Boring taped to 17.0' after completion-dry.
			<u>0.3 to 3.5[±]</u> CLAY, medium plasticity, stiff, moist, brown.		A	
			<u>3.5 to 6.5[±]</u> CLAY, medium to high plasticity, stiff, moist, rust to brown.		B	
			<u>6.5 to 8.0[±]</u> CLAY, medium to high plasticity, stiff, moist, calcareous, tan.		C	
	10.0		<u>8.0 to 9.0[±]</u> SAND, fine to coarse grained, loose, moist, clayey, gravelly, calcareous, brown.		D	
			<u>9.0 to 10.5[±]</u> SAND, fine to coarse grained, loose, moist, calcareous, tan.		E	
			<u>10.5 to 12.5[±]</u> SAND, coarse grained, loose, moist, clayey, gravelly, brown.		F	
			<u>12.5 to 14.5[±]</u> GRAVEL, fine grained, rounded to subrounded, loose, moist, clayey, brown.		G	
	20.0		<u>14.5 to 16.0[±]</u> CLAY, low plasticity, soft, moist, gravelly, sandy, brown.		H	
			<u>16.0 to 18.0</u> CLAY, low plasticity, soft, moist, sandy, rust to brown.		I	
			<u>18.0 to 19.5</u> GRAVEL, coarse grained, angular, loose, moist, calcareous, clayey, tan to brown.		J	
	30.0					3) DRILLING 0.0 - 19.5, 8" Auger refusal at top of limestone. -Auger scraping on primary. Fragments of primary materia on stinger.
	40.0					

1400-001

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 2 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (FEET - MSL)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-88		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 11 UNDISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 19.5		16. DATE HOLE STARTED 2/1/86 COMPLETED 2/1/86	
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE --	
9. TOTAL DEPTH OF HOLE 19.5		18. TOTAL CORE RECOVERY FOR BORING --	
		19. SIGNATURE OF INSPECTOR R.R. Audette	

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY g	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) h
40.0	19.5		LIMESTONE, (auger refusal on limestone)			
50.0			T.D.-19.5'			
60.0						
70.0						
80.0						

1000 * 011

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 1 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT		
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (FSL or BSL)		
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500		
4. HOLE NO. (As shown on drawing title and file number) 8A-89		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 11
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES		UNDISTURBED 0
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **		
7. THICKNESS OF OVERBURDEN 46.0		16. DATE HOLE		STARTED 2/2/86
8. DEPTH DRILLED INTO ROCK --		17. ELEVATION TOP OF HOLE		-- 649.35
9. TOTAL DEPTH OF HOLE 46.0		18. TOTAL CORE RECOVERY FOR BORING --		%
		19. SIGNATURE OF INSPECTOR R. R. Audette		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		0.0 to 0.2, Asphalt		A	1) Free water encountered @ 34.0' below grade. 24 hours later free water level stabilized @ 31.0ft. below grade.
			0. to 3.0 [±] CLAY, medium to high plasticity, stiff, moist, brown.		B	
			3.0 to 5.0 [±] CLAY, high plasticity, stiff to hard, moist, reddish-brown.		C	
	10.0		5.0 to 14.0 [±] CLAY, low to medium plasticity, soft, moist, calcareous, tan.		D	2) JARS A) 0.0-3.0 B) 3.0-5.0 C) 5.0-10.0 D) 10.0-14.0 E) 14.0-15.0 F) 15.0-20.0 G) 20.0-24.5 H) 24.5-30.0 I) 30.0-32.0 J) 32.0-34.5 K) 34.5-40.0 L) 40.0-46.0
			14.0 to 24.5 [±] GRAVEL, fine to coarse grained, rounded to subrounded, loose, moist, very clayey, tan to brown.		E	
			24.5 to 32.0 [±] CLAY, low plasticity, soft, moist, gravelly, tan.		F	
	20.0		32.0 to 34.5 [±] SAND, fine to coarse grained, loose, dry, clayey, gravelly, tan to brown.		G	
			34.5 to 46.0 GRAVEL, fine to coarse grained, angular to subangular, dense, wet, clayey, sandy, tan to brown.		H	
	30.0		46.0 LIMESTONE (auger refusal on limestone)		I	
					J	
	40.0				K	Remarks: ground water sample obtained for laboratory analysis.

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 2 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Commissaries or Station) PALUXY AQUIFER INVESTIGATION		11. DAYUM FOR ELEVATION SHOWN (FEET or MET.)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-89		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES	UNDISTURBED 0
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	**
7. THICKNESS OF OVERBURDEN 46.0	16. DATE HOLE	STARTED 2/2/86	COMPLETED 2/2/86
8. DEPTH DRILLED INTO ROCK 0.0	17. ELEVATION TOP OF HOLE --		
9. TOTAL DEPTH OF HOLE 46.0	18. TOTAL CORE RECOVERY FOR BORING --		
19. SIGNATURE OF INSPECTOR <i>R. R. Pucette</i>			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	40.0					
	50.0					
	60.0					
	70.0					
	80.0					
			T.D. -46.0'		2	

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 1 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (TBM or MLL)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A -90		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 12
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES	--
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	--
7. THICKNESS OF OVERBURDEN 39.0		16. DATE HOLE	STARTED 2/3/86 COMPLETED 2/4/86
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE -- 648.74	
9. TOTAL DEPTH OF HOLE 39.0		18. TOTAL CORE RECOVERY FOR BORING --	
19. SIGNATURE OF INSPECTOR R.R. Andette			

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
a	b	c	d	e	f	g
	0.0		0.0 to 0.3, Asphalt 0. to 3.5 ⁺		A	1) During augering free water encountered @ 24.0ft. below grade. 24 hours later static water level taped at 23.0ft. below grade.
			CLAY, medium to high plasticity, stiff, moist, brown to black		B	
			3.5 to 7.0 ⁺		C	
			CLAY, medium to high plasticity, stiff, moist, brown to rust.		D	2) JARS A) 0.0-3.5 B) 3.5-5.0 C) 5.0-7.0 D) 7.0-10.0 E) 10.0-15.0 F) 15.0-18.5 G) 18.5-21.0 H) 21.0-25.0 I) 25.0-27.0 J) 27.0-30.0 K) 30.0-35.0 L) 35.0-39.0
			7.0 to 18.5 ⁺		E	
	10.0		CLAY, low to medium plasticity, soft, moist, sandy, tan.		F	
			18.5 to 21.0 ⁺		G	
			CLAY, high plasticity, stiff, moist, gravelly, calcareous, brown.		H	
			21.0 to 39.0		I	
			GRAVEL		J	3) DRILLING 0.0 - 39.0, 8" auger refusal at top of limestone - Auger scraping on primary. Fragments of limestone on stinger. Remarks: ground water sample obtained for laboratory analysis.
			21.0 - 27.0		K	
	20.0		fine to coarse grained, rounded to subrounded, loose, moist to wet, clayey, brown.		L	
			27.0 - 39.0			
			fine to coarse grained, angular to subangular, with scattered cobbles throughout, dense, wet, tan.			
			39.0			
	30.0		LIMESTONE, (auger refusal on limestone)			
			T.D.-39.0'			
	40.0					

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 1 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (FSM or MSL)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL PAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-91		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 UNDISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES ---	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 31.5		16. DATE HOLE STARTED 2/4/86 COMPLETED 2/4/86	
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE -- 647.21	
9. TOTAL DEPTH OF HOLE 31.5		18. TOTAL CORE RECOVERY FOR BORING -- %	
		19. SIGNATURE OF INSPECTOR R. R. Audette	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		0.0 to 0.3 ASPHALT, good condition			1) No free water encountered to top of primary. Boring taped to depth-dry.
			0.3 to 3.0 [±] CLAY, medium to high plasticity, stiff, moist, brown to black.		visual ident.	
			3.0 to 9.5 [±] CLAY, low to medium plasticity, soft, moist, brown.			
	10.0		9.5 to 26.5 CLAY, low to medium plasticity, soft, moist, sandy with prominent sand seams @14.0-15.5, 18.0-19.0, becoming increasingly calcareous below 24.0' with calcium carbonate blebs and seams in section, tan.			2) JARS visual identification
			26.5 to 31.5 CLAY, high plasticity, stiff, moist, calcareous with numerous calcium carbonate seams and blebs in section, tan to gray to rust.			
	20.0		31.5 LIMESTONE, (auger refusal on limestone)			3) DRILLING 0.0 - 31.5, 8" Auger refusal at top of primary. -Auger scraping on top of limestone. Fragments of primary on stinger.
			T.D.-31.5'		visual ident.	
	30.0					
	40.0					

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 1 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (County, State or Section) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-92		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED --- DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 22.5		16. DATE HOLE STARTED: 2/4/86 COMPLETED: 2/4/86	
8. DEPTH DRILLED INTO ROCK 1.0		17. ELEVATION TOP OF HOLE -- 647.01	
9. TOTAL DEPTH OF HOLE 23.5		18. TOTAL CORE RECOVERY FOR BORING --	
		19. SIGNATURE OF INSPECTOR R.R. Rudette	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
a	b	c	d	e	f	g
	0.0		0.0 to 0.3 ASPHALT, good condition			1) No free water encountered to top of primary. Boring taped to depth-dry.
			0.3 to 2.5 [±] CLAY, medium to high plasticity, stiff, moist, brown to black.			visual ident.
			2.5 to 5.5 [±] CLAY, low plasticity, soft, moist, very gravelly throughout, calcareous, tan.			2) JARS visual identification
	10.0		5.5 to 16.5 [±] CLAY, low to medium plasticity, soft, moist, sandy, calcareous, tan.			3) DRILLING 0.0 - 22.5, 8" Auger refusal at top of limestone primary.
			16.5 to 22.5 CLAY, medium plasticity, stiff, moist, gravelly, calcareous with calcium carbonate nodules and blebs in section, brown to tan.			-Auger advanced into primary @ 1.0 ft. fragments of primary on stinger.
	20.0		22.5 to 23.5 LIMESTONE, light gray, fine grained, soft.			Note: Boring offset approximately 10' east of taped location due to traffic conditions.
			T.D.-23.5'			
	30.0					
	40.0					

DRILLING LOG		DIVISION		INSTALLATION		SHEET	
SOUTHWESTERN		PORT WORTH		SHEET 1		OF 1 SHEETS	
1. PROJECT GENERAL DYNAMICS				10. SIZE AND TYPE OF BITS/AUGER 8" AUGER			
2. LOCATION (Continuation or Station) PALUXY AQUIFER INVESTIGATION				11. DAYTON FOR ELEVATION BORN (1925 or 1983)			
3. DRILLING AGENCY USCE				12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500			
4. HOLE NO. (As shown on drawing and No. on hole)				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
8A-93				0		0	
5. NAME OF DRILLER BREWER				14. TOTAL NUMBER CORE BOXES --			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED <input type="checkbox"/> DEG. FROM VERT.				15. DATE HOLE		STARTED COMPLETED	
				2/5/86		2/5/86	
7. THICKNESS OF OVERBURDEN 39.0				16. ELEVATION GROUND WATER **			
8. DEPTH DRILLED INTO ROCK 0.0				17. ELEVATION TOP OF HOLE -- 650.96			
9. TOTAL DEPTH OF HOLE 39.0				18. TOTAL CORE RECOVERY FOR BORING --			
				19. SIGNATURE OF INSPECTOR R.R. Auletta			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of monitoring, etc., if significant)	
	0.0		0.0 to 0.3 Asphalt, good condition			1) Free water level taped at 29.2ft. below grade. Static water level taped at 27.0ft. below grade.	
			0.3 to 1.5 [±] CLAY, medium to high plasticity, stiff, moist, brown to black.		visual ident.		
			1.5 to 6.0 [±] CLAY, high plasticity, stiff, moist, reddish-brown.			2) JARS visual identification	
	10.0		6.0 to 11.0 [±] CLAY, low plasticity, soft, moist, very sandy throughout, calcareous, tan.		visual ident.		
			11.0 to 29.2 [±] CLAY, medium to high plasticity, stiff, moist, slightly gravelly, calcareous with calcium carbonate blebs and nodules in section, brown to tan to rust.			3) DRILLING 0.0 - 39.0, 8" Auger refusal at top of limestone primary. Auger scraping on top of primary with fragments of primary on stringer	
	20.0		29.2 to 39.0 GRAVEL, fine to coarse grained, angular to subrounded, loose, wet, clayey, sandy, tan to brown.			Note A) Boring offset approximately 20' east of taped location due to traffic conditions.	
			39.0 LIMESTONE, (auger refusal on limestone)		visual ident.	B) ground water sample obtained for laboratory analysis.	
	30.0						
	40.0						
			T.D. - 39.0'				

DRILLING LOG		DIVISION		INSTALLATION		SHEET	
		SOUTHWESTERN		FORT WORTH		1 OF 1 SHEETS	
1. PROJECT				10. SIZE AND TYPE OF BITS "AUGER			
GENERAL DYNAMICS				11. DATUM FOR ELEVATION SHOWN (FSM or MSL)			
2. LOCATION (Coordinates or Station)				12. MANUFACTURER'S DESIGNATION OF DRILL			
PALUXY AQUIFER INVESTIGATION				FAILING 1500			
3. DRILLING AGENCY				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN			
USCE				DISTURBED		UNDISTURBED	
4. HOLE NO. (As shown on drawing title and site number)				0		0	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES			
BREWER				--			
6. DIRECTION OF HOLE				15. ELEVATION GROUND WATER			
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.				**			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE			
19.0				STARTED		COMPLETED	
				2/6/86		2/6/86	
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
1.0				-- 645.72			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
20.0				--			
				19. SIGNATURE OF INSPECTOR			
				R.R. Adatta			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0.0		0.0 to 0.5 ASPHALT, good condition			1) No free water encountered during augering. Boring taped to depth-dry.	
			0.5 to 4.5 [±] CLAY, medium to high plasticity, stiff, moist, brown.			visual ident.	
	10.0		4.5 to 19.0 [±] CLAY, low plasticity, soft, moist, sandy throughout especially along basal section, calcareous with small limy nodules in section, tan.			2) JARS visual identification	
			19.0 to 20.0 CLAY-SHALE, tan to greenish-gray, calcareous, soft.			3) DRILLING 0.0 - 20.0, 8" auger refusal at top of limestone primary. Auger scraping on limestone with fragments of limestone on stinger.	
	20.0		20.0 LIMESTONE, (auger refusal on limestone)			Remarks: Boring offset 12ft. due east of location.	
			T.D.-20.0'				
	30.0						
	40.0						

DRILLING LOG		Division SOUTHWESTERN	INSTALLATION PORT WORTH	SHEET 1
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT "AUGER 8"	
2. LOCATION (Continuation of Section) PALUXY AQUIFER INVESTIGATION			11. DATUM FOR ELEVATION SHOWN (FEET or M) FALLING 1500	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DENOMINATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-95			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER BREWER			14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 44.0			16. DATE HOLE STARTED 2/6/86 COMPLETED 2/6/86	
8. DEPTH DRILLED INTO ROCK 0.0			17. ELEVATION TOP OF HOLE -- 652.95	
9. TOTAL DEPTH OF HOLE 44.0			18. TOTAL CORE RECOVERY FOR BORING --	
			19. SIGNATURE OF INSPECTOR <i>R. R. Audette</i>	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of monitoring, etc., if significant)
0.0	0.0		<u>0.0 to 0.5</u> ASPHALT, good condition			1) During augering free water taped @ 31.0ft. below grade. -24 hours later water level taped at 29.5ft. below grade.
			<u>0.5 to 4.0[±]</u> CLAY, medium to high plasticity, stiff, moist, brown.			visual ident.
			<u>4.0 to 7.5[±]</u> CLAY, medium plasticity, stiff, moist, gravelly, calcareous with limy nodules in section, reddish-brown.			2) JARS visual identification
			<u>7.5 to 17.0[±]</u> CLAY, low plasticity, soft, moist, sandy throughout especially along basal section, small limy nodules scattered in section, tan.			3) DRILLING 0.0 - 44.0, 8" Auger refusal at top of limestone. -Auger scraping on primary with fragments of limestone found on stinger.
			<u>17.0 to 19.5[±]</u> SAND, fine to coarse grained, loose, dry, calcareous, slightly clayey, tan.			Remarks: ground water sample obtained for laboratory analysis.
			<u>19.5 to 22.0[±]</u> GRAVEL, fine to coarse grained, angular to subrounded, loose, dry, sandy, clayey, tan.			
			<u>22.0 to 41.0[±]</u> CLAY, low to medium plasticity, soft to stiff in section, moist to wet, sandy especially along basal section, calcareous with many lime nodules and blebs in section, tan.			visual ident.
			<u>41.0 to 44.0</u> CLAY, medium to high plasticity, stiff, wet, sandy, calcareous, reddish-brown.			

0.0 10.0 20.0 30.0 40.0

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 2 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinate or Station) PALUXY AQUIFER INVESTIGATION		11. DAY ON FOR ELEVATION SHOWN (TRM - MEI)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and site number) 8A-95		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 44.0		16. DATE HOLE STARTED: 2/6/86 COMPLETED: 2/6/86	
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE --	
9. TOTAL DEPTH OF HOLE 44.0		18. TOTAL CORE RECOVERY FOR BORING --	
		19. SIGNATURE OF INSPECTOR R.R. Anlette	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
a	b	c	d	e	f	g
	44.0		44.0 LIMESTONE. (auger refusal on limestone)			
	50.0					
	60.0					
	70.0					
	80.0					
			T.D. -44.0'			

10-50-101

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 1 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DAYTIME FOR ELEVATION SHOWN (FEET OR METERS)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-96		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	UNDISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 36.0		16. DATE HOLE STARTED 2/6/86	COMPLETED 2/6/86
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE -- 653.13	
9. TOTAL DEPTH OF HOLE 36.0		18. TOTAL CORE RECOVERY FOR BORING --	
		19. SIGNATURE OF INSPECTOR R. R. Audette	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		0.0 to 0.3 ASPHALT, good condition			1) During augering free water taped at 35.0ft. below grade. - 12 hours later water level taped at 32.5ft. below grade.
			0.3 to 2.4 [±] CLAY, medium to high plasticity, stiff, moist, brown to black			visual ident.
	10.0		2.4 to 6.5 [±] CLAY, low plasticity, soft, moist, gravelly, calcareous, brown.			2) JARS visual identification
			6.5 to 9.0 [±] CLAY, low plasticity, soft, moist, sandy throughout, tan.			
	20.0		9.0 to 14.5 [±] CLAY, low to medium plasticity, soft to stiff in section, moist, calcareous, gravelly throughout, brown.			3) DRILLING 0.0 - 36.0, 8" Auger refusal at top of limestone Auger scraping on primary with fragments of limestone found on stinger.
			14.5 to 31.5 [±] CLAY, medium plasticity, stiff, moist, sandy throughout, lmy with many calcium carbonate seams in section, tan.			Remarks: ground water sample obtained for laboratory analysis
	30.0		31.5 to 36.0 CLAY, medium to high plasticity, stiff, moist to wet along basal section, sandy especially along basal zone, calcareous with many lime nodules and blebs in section, reddish-brown.			visual ident.
	40.0		36.0 LIMESTONE (auger refusal on limestone)			
			T.D. - 36.0'			

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 1 SHEETS
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Section) PALUXY AQUIFER INVESTIGATION			11. DATUM FOR ELEVATION SHOWN (TBM or BBL)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-97			13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 0 UNDISTURBED 0
5. NAME OF DRILLER BREWER			14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 34.0			16. DATE HOLE STARTED 2/7/86 COMPLETED 2/7/86	
8. DEPTH DRILLED INTO ROCK 1.0			17. ELEVATION TOP OF HOLE -- 650.98	
9. TOTAL DEPTH OF HOLE 35.0			18. TOTAL CORE RECOVERY FOR BORING --	
			19. SIGNATURE OF INSPECTOR R. R. Hudette	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		0.0 to 0.3 ASPHALT, good condition			1) No free water encountered to depth. several hours later boring bridge in @ 27.0ft.-dry.
			0.3 to 4.5 ⁺ CLAY, low plasticity, soft, moist, gravelly, limy with nodules in section, tan to brown.		visual ident.	
	10.0		4.5 to 24.5 ⁺ CLAY, low to medium plasticity, soft, moist, sandy throughout, small limy nodules scattered in section, tan.			2) JARS visual identification
			24.5 to 34.0 CLAY, medium to high plasticity, stiff, moist, sandy, calcareous, reddish-brown.			3) DRILLING 0.0 - 35.0, 8" Auger to depth. Auger advanced into limestone primary with fragments of limestone on stinger.
	20.0		34.0 to 35.0 LIMESTONE, light gray, fine to coarse grained, soft.		visual ident.	
			T.D.-35.0'			
	30.0					
	40.0					

DRILLING LOG		Division SOUTHWESTERN	INSTALLATION PORT WORTH	SHEET 1 OF 1 SHEETS
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION			11. DAYUM FOR ELEVATION SHOWN (FEET - MSL)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL PAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-98			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER			14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.			15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 1.5			16. DATE HOLE STARTED: 2/7/86 COMPLETED: 2/7/86	
8. DEPTH DRILLED INTO ROCK 3.0			17. ELEVATION TOP OF HOLE -- 643.64	
9. TOTAL DEPTH OF HOLE 4.5			18. TOTAL CORE RECOVERY FOR BORING -- %	
			19. SIGNATURE OF INSPECTOR <i>R.R. Hueltke</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		<u>0.0 to 0.3</u> ASPHALT , good condition			1) Boring taped to visual depth-dry. ident. 2) <u>JARS</u> visual identification
			<u>0.3 to 1.5</u> CLAY , low plasticity, soft, moist, gravelly, sandy, brown.			
			<u>1.5 to 3.5</u> LIMESTONE , light gray, fine to coarse grained, arenaceous, soft.			
	10.0		<u>3.5 to 4.5</u> CLAY-SHALE , tan to greenish-gray, calcareous, soft.			3) <u>DRILLING</u> 0.0 - 4.5, 8" Auger to depth. Remarks: Boring offset approximately 35 ft. west on line.
			T.D. - 4.5'			
	20.0					
	30.0					
	40.0					

F.C. 011

DRILLING LOG	Division SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE	
2. LOCATION (Coordinates or Section) PALUXY AQUIFER INVESTIGATION		11. DAYON FOR ELEVATION SHOWN (YES or NO)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and site number) 8A4C-100		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.		15. ELEVATION GROUND WATER --	
7. THICKNESS OF OVERBURDEN 4.80		16. DATE HOLE STARTED: 2/8/86 COMPLETED: 2/9/86	
8. DEPTH DRILLED INTO ROCK 4.0		17. ELEVATION TOP OF HOLE -- 647.10	
9. TOTAL DEPTH OF HOLE 52.0		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR <i>R.R. Audette</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	1 CORE RECOVERY e	2 BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
0.0	0.0		<u>0.0 to 0.4</u> ASPHALT , good condition			1) During augering free water taped @ 33.0ft. below grade. - 2hours later static water level taped @ 32.0ft. below grade.
			<u>0.4 to 4.0[±]</u> CLAY , low plasticity, soft, moist, gravelly, limy with nodules in section, tan to brown.			visual ident.
	10.0		<u>4.0 to 33.5[±]</u> CLAY , low to medium plasticity, soft to stiff in zones, sandy throughout, small limy nodules scattered in section, tan.			2) JARS visual identification
	20.0		<u>33.5 to 48.0</u> GRAVEL , fine to coarse grained, angular to subrounded, loose, wet, clean, tan.			3) DRILLING 0.0 - 48.0, 8" auger refusal at top of limestone primary. 48.0 - 52.0, 4" core to depth.
	30.0		<u>48.0 to 52.0</u> LIMESTONE , gray, fine to coarse grained, argillaceous with shale stringers and thin seams in section, weathered, soft.			Remarks: A) ground water sample obtained for laboratory analysis. B) Casing advanced to top of primary and reamed. C) After coring boring bailed. 4" PVC pipe inserted to depth. Hole grouted through PVC insert with PVC being slowly withdrawn during grouting. D) Boring subsequently backfilled with cuttings. E) Boring offset approximately 7.0ft southwest.
	40.0		T.D.-52.0'			visual ident.

DRILLING LOG		DIVISION SOUTHWESTERN		INSTALLATION FORT WORTH		SHEET 2 OF 2 SHEETS	
1. PROJECT GENERAL DYNAMICS				10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE			
2. LOCATION (Community or Station) PALUXY AQUIFER INVESTIGATION				11. DATUM FOR ELEVATION SHOWN (F.M. or M.L.)			
3. DRILLING AGENCY USCE				12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500			
4. HOLE NO. (As shown on drawing title and file number) 8A4C-100				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER BREWER				14. TOTAL NUMBER CORE BOXES 1			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER **			
7. THICKNESS OF OVERBURDEN 48.0				16. DATE HOLE		STARTED 2/8/86	COMPLETED 2/9/86
8. DEPTH DRILLED INTO ROCK 4.0				17. ELEVATION TOP OF HOLE --			
9. TOTAL DEPTH OF HOLE 52.0				18. TOTAL CORE RECOVERY FOR BORING 1			
				19. SIGNATURE OF INSPECTOR <i>R. B. Audette</i>			

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
40.0						
				48.0	Y	
50.0				100	1	
				52.0		
60.0						
70.0						
80.0						

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION			11. DATUM FOR ELEVATION BROWN (FSM - MSL)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A4C-101			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER			14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT. _____			15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 47.5			16. DATE HOLE STARTED: 2/11/86 COMPLETED: 2/11/86	
8. DEPTH DRILLED INTO ROCK 4.0			17. ELEVATION TOP OF HOLE -- 648.35	
9. TOTAL DEPTH OF HOLE 51.5			18. TOTAL CORE RECOVERY FOR BORING 77.0%	
			19. SIGNATURE OF INSPECTOR <i>R. R. Hudette</i>	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0	0.0		0.0 to 0.5 ASPHALT, good condition			1) During augering free water encountered at 34.0ft. below grade. -Static water level taped at 30.5ft below grade.
			0.2 to 1.2 [±] SAND, fine to coarse grained, loose, dry, gravelly, clayey, brown.			
			1.2 to 4.0 [±] CLAY, medium to high plasticity, stiff, moist, brown to black.		visual ident.	2) JARS visual identification
10.0			4.0 to 21.0 [±] CLAY, low to medium plasticity, soft, to stiff in zones, moist, becoming increasingly sandy below 12.0' to depth, calcareous with limy nodules and blebs noted along basal section, tan.			
			21.0 to 23.0 [±] GRAVEL, fine to coarse grained, subrounded to rounded, loose, dry, clayey, sandy, tan.			3) DRILLING 0.0 - 47.5, 8" auger refusal at top of limestone primary. 47.5 - 51.5, 4" core to depth. Remarks: A) casing advanced to top of primary and reamed. B) After coring, hole bailed repeatedly until nearly dry. One 94 lb. bag of cement used to grout hole. Grout extended to 40.0ft. datum below grade. C) Boring subsequently backfilled with cuttings. D) ground water sample obtained for laboratory analysis.
20.0			23.0 to 35.0 [±] CLAY, low plasticity, soft, moist, calcareous, tan.		visual ident.	
			35.0 to 44.5 [±] CLAY, medium to high plasticity, stiff, wet, calcareous with limy seams and nodules throughout, sandy, reddish-brown.			
30.0			44.5 to 47.5 GRAVEL, coarse grained, rounded to subrounded, loose, wet, clayey, brown.			
40.0						

DRILLING LOG		DIVISION SOUTHWESTERN		INSTALLATION FORT WORTH		SHEET 2 OF 2 SHEETS	
1. PROJECT GENERAL DYNAMICS				10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE			
2. LOCATION (Coordinate or Station) PALUXY AQUIFER INVESTIGATION				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY USCE				12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500			
4. HOLE NO. (As shown on drawing title and file number) 8A4C-101				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER BREWER				14. TOTAL NUMBER CORE BOXES 1			
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER **		16. DATE HOLE	
7. THICKNESS OF OVERBURDEN 47.5				STARTED 2/11/86		COMPLETED 2/11/86	
8. DEPTH DRILLED INTO ROCK 4.0				17. ELEVATION TOP OF HOLE --			
9. TOTAL DEPTH OF HOLE 51.5				18. TOTAL CORE RECOVERY FOR BORING 77.0%			
				19. SIGNATURE OF INSPECTOR <i>R.R. Audette</i>			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
40.0			47.5 to 51.5 LIMESTONE, brown, fine to coarse grained, argillaceous throughout with many stringers and thin seams noted, fossiliferous, in-place fractures noted, soft.			
			T.D.-51.5'	47.5		visual ident.
50.0				2 0.9	1	
				51.5		
60.0						
70.0						
80.0						

500-0014

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION PORT WORTH	SHEET 1 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE		
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (FEET - INCH)		
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500		
4. HOLE NO. (As shown on drawing title and file number) 8A4C-102		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **		
7. THICKNESS OF OVERBURDEN 60.5		16. DATE MOLE STARTED 2/12/86 COMPLETED 2/14/86		
8. DEPTH DRILLED INTO ROCK 19.5		17. ELEVATION TOP OF HOLE -- 648.22		
9. TOTAL DEPTH OF HOLE 80.0		18. TOTAL CORE RECOVERY FOR BORING 86.3%		
		19. SIGNATURE OF INSPECTOR R.R. Andetta		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
	0.0		0.0 to 0.2 <u>ASPHALT</u> , good condition			** 1) During augering free water encountered @ 35.0ft. below grade. Static water level taped at 34.0ft. below grade.
			0.2 to 1.0 ⁺ <u>SAND</u> , fine to coarse grained, loose, dry, gravelly, brown.			
			1.0 to 6.5 ⁺ <u>CLAY</u> , low plasticity, soft, moist, gravelly, calcareous, tan to brown.		visual ident.	2) <u>JARS</u> visual identification
	10.0		6.5 to 44.0 ⁺ <u>CLAY</u> , low to medium plasticity, soft to stiff, moist to wet along basal section, calcareous with limy nodules and blebs especially from 31.0-34.0'; becoming increasingly sandy below 39.0' to depth.			3) <u>DRILLING</u> 0.0 - 60.5, 8" auger refusal at top of limestone primary. 60.5 - 61.0, 77/8" rock bit. 61.0 - 80.0, 4" core to depth.
	20.0		44.0 to 60.5 <u>CLAY</u> , medium to high plasticity, stiff to hard in zones, wet, calcareous, reddish-brown.			Remarks: A) Casing advanced to top of primary and reamed.
			60.5 to 62.4 <u>LIMESTONE</u>		visual ident.	B) Rock bit advanced into primary and hole surged.
	30.0		60.5 - 61.4, brown, fine to coarse grained, strongly argillaceous, highly fossiliferous, soft.			C) After coring, hole bailed repeatedly until nearly dry. Two 94lb. bags of cement used to grout hole. Grout extended to approximately 55.0ft datum below grade. Casing subsequently withdrawn.
			61.4 - 61.8, tan, fine to coarse grained, arenaceous, moderately hard.			D) Boring backfilled with cuttings.
			61.8 - 62.4, gray, fine grained, slightly argillaceous, well cemented, hard.			E) Ground water sample obtained for analysis.
						F) Boring offset seven feet due west.

1004-01

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 2 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DAYUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A4C-102		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES	UNDISTURBED 0
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 60.5		16. DATE HOLE STARTED 2/12/86 COMPLETED 2/14/86	
8. DEPTH DRILLED INTO ROCK 19.5		17. ELEVATION TOP OF HOLE --	
9. TOTAL DEPTH OF HOLE 80.0		18. TOTAL CORE RECOVERY FOR BORING 86.3 %	
		19. SIGNATURE OF INSPECTOR R. B. Burdett	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
a	b	c	d	e	f	g
40.0			62.4 to 63.1 SHALE, dark brown, laminated, arenaceous, soft.			
			63.1 to 66.5 SAND, fine grained, weakly cemented, silty, calcareous throughout, light gray.			visual ident.
50.0			66.5 to 77.6 SHALE, dark brown, very thinly bedded, arenaceous, soft.			
			77.6 to 80.0 SAND, fine grained, with coarse grained sands noted, weakly cemented throughout, coarse grained uncemented zones throughout, silty, very soft.			
60.0			T.D. - 80.0'	61.0	ROCK BIT	
				L 0.0		
				64.8		
				L 0.5	1	
				66.5		
				L 3.1		
70.0				71.5		
				L 1.0		
				73.5		
				L 0.0	2	
				76.0		
				L 0.0		
80.0				80.0	3	

100-100

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION F. FORT WORTH	SHEET 1 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE		
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. STATUS FOR ELEVATION SHOWN (TBM or MSL)		
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL PAILING 1500		
4. HOLE NO. (As shown on drawing title and file number) 8A4C-103		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		UNDISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES 1		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **		
7. THICKNESS OF OVERBURDEN 57.0		16. DATE HOLE STARTED 2/18/86 COMPLETED 2/19/86		
8. DEPTH DRILLED INTO ROCK 8.0		17. ELEVATION TOP OF HOLE -- 646.66		
9. TOTAL DEPTH OF HOLE 65.0		18. TOTAL CORE RECOVERY FOR BORING 70.0%		
		19. SIGNATURE OF INSPECTOR R. R. Archette		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		0.0 to 0.5 <u>ASPHALT</u> , good condition			1) During augering free water measured + 35.0 ft. below grade. Static water level taped at 36.5 ft. below grade.
			0.5 to 1.5 [±] <u>SAND</u> , fine to coarse grained, loose, dry, gravelly, brown.			
			1.5 to 3.0 [±] <u>CLAY</u> , low plasticity, soft, moist, calcareous, sandy, gravelly, tan to brown.		visual ident.	2) <u>JARS</u> visual identification
	10.0		3.0 to 10.6 [±] <u>CLAY</u> , medium to high plasticity, stiff, moist, sandy, gravelly, calcareous with limy nodules and seams in section, reddish-brown.			3) <u>DRILLING</u> 0.0 - 57.0, 8" auger
	20.0		10.6 to 27.0 [±] <u>CLAY</u> , low plasticity, soft, moist, sandy throughout with a strong sand fraction noted @ 21.0-23.0; gravels noted @ 24.0' to 26.0; calcareous, tan.		visual ident.	57.0 - 65.0, 4" core to depth.
	30.0		27.0 to 33.0 [±] <u>CLAY</u> , medium to high plasticity, stiff, moist, calcareous with limy nodules and blebs in section, reddish-brown.			Remarks: A) Casing advanced to top of primary; boring surged. B) After coring, hole bailed repeatedly until nearly dry. One 94 lb bag of cement used to grout hole. Grout extended at least 5 feet above primary contact. Casing subsequently withdrawn. C) Boring subsequently backfilled with cuttings. D) Boring offset approximately 3 ft. west.
	40.0		33.0 to 57.0 <u>CLAY</u> , low plasticity, soft, moist, sandy throughout, calcareous tan.			

NO. 103

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION PORT WORTH	SHEET 2 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, 4" CORE	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DAYON FOR ELEVATION SHOWN (TBM or HML)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A4C-103		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 57.0		16. DATE HOLE STARTED 2/18/86 COMPLETED 2/19/86	
8. DEPTH DRILLED INTO ROCK 8.0		17. ELEVATION TOP OF HOLE --	
9. TOTAL DEPTH OF HOLE 65.0		18. TOTAL CORE RECOVERY FOR BORING 70.0%	
		19. SIGNATURE OF INSPECTOR R. R. Andetta	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
40.0			57.0 to 60.5 CLAY-SHALE, tan to greenish-gray, calcareous, soft.			
			60.5 to 61.6 LIMESTONE, tan to gray, fine to coarse grained, arenaceous, weathered, siliceous zones noted in section, fossiliferous moderately hard.			visual ident.
50.0			61.6 to 62.4 SHALE, dark brown, laminated, arenaceous, soft.			
			62.4 to 65.0 SAND, fine grained, weakly cemented throughout, calcareous, very silty, becoming strongly argillaceous below 63.8' to depth, light gray to brown along basal section.	57.0		
				2.0		
				59.0		
60.0				0.5	1	
				61.0		
			T.D. -65.0'	0.0		
				65.0		
70.0						
80.0						

100-100

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 of 1 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (TBM or MLL)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A4C-104		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES 1	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DES. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 35.7		16. DATE HOLE STARTED: 2/20/86 COMPLETED: 2/20/86	
8. DEPTH DRILLED INTO ROCK 5.0		17. ELEVATION TOP OF HOLE -- 646.27	
9. TOTAL DEPTH OF HOLE 40.7		18. TOTAL CORE RECOVERY FOR BORING 1	
		19. SIGNATURE OF INSPECTOR <i>R. R. Audette</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		<u>0.0 to 0.5</u> ASPHALT , good condition			1) During augering free water encountered @ 31.5ft. below grade. Static water level taped @ 30.4ft below grade.
			<u>0.5 to 2.5[±]</u> SAND , fine to coarse grained, loose, dry, gravelly, brown.			
			<u>2.5 to 35.7</u> CLAY , low plasticity to medium plasticity, soft, moist to wet along basal zone, calcareous with limy nodules and blebs in section, sandy with strong sand fractions @ 12.0±14.5; 16.0±18.0 tan.			2) JARS visual identification
			<u>35.7 to 40.7</u> LIMESTONE , light gray, fine to coarse grained, prominent fracture noted @ 36.7; siliceous, highly fossiliferous in section, moderately hard.			3) DRILLING 0.0 - 35.7, 8" auger refusal at top of limestone. 35.7 - 40.7, 4" core to depth.
			T.D. - 40.7'			Remarks: A) Casing advanced to top of primary; boring surged. B) After coring, hole bailed repeatedly until nearly dry. One 94lb. bag of cement used to grout hole. Grout extended to at least 5 ft. above primary contact. Casing subsequently withdrawn. C) Boring subsequently backfilled with cuttings. D) Boring offset 4 ft west. E) ground water sample obtained for laboratory analysis.
				35.7	Y	
					1	
	40.0			40.7		

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION			11. DAYUM FOR ELEVATION SHOWN (FEET - MMS)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A-105			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER BREWER			14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 57.0			16. DATE HOLE STARTED 2/21/86 COMPLETED 2/21/86	
8. DEPTH DRILLED INTO ROCK 0.0			17. ELEVATION TOP OF HOLE -- 666.49	
9. TOTAL DEPTH OF HOLE 57.0			18. TOTAL CORE RECOVERY FOR BORING -- %	
			19. SIGNATURE OF INSPECTOR R. R. Audette	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc. if significant) g
	0.0		0.0 to 0.6 ASPHALT, good condition			1) During augering free water encountered @ 36.0ft. below grade. Static water level taped @ 34.5ft. below grade.
			0.6 to 2.4 [±] SAND, fine to coarse grained, loose, dry, gravelly, brown.			
			2.4 to 54.0 [±] CLAY, low to medium plasticity, soft to stiff at depth, moist to wet at depth, calcareous with limy nodules and seams in section, sandy throughout especially 11.0'±14.0'; 19.0'-25.0' light gravels noted @ 43.0'±44.0'; tan.		visual ident.	2) JARS visual identification
	10.0					
			54.0 to 57.0 CLAY, medium to high plasticity, stiff, wet, calcareous, slightly gravelly, reddish-brown.			3) DRILLING 0.0 - 57.0, 8" auger refusal at top of limestone primary. Fragments of limestone noted on stinger.
	20.0					
			57.0 LIMESTONE, (auger refusal on top of limestone).		visual ident.	
	30.0					
	40.0		T.D. - 57.0'			

1004-01

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 2 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION			11. DAYON FOR ELEVATION SHOWN (TBM or BBL)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and site number) 8A-105			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER BEWER			14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.			15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 57.0			16. DATE HOLE STARTED 2/21/86 COMPLETED 2/21/86	
8. DEPTH DRILLED INTO ROCK 0.0			17. ELEVATION TOP OF HOLE --	
9. TOTAL DEPTH OF HOLE 57.0			18. TOTAL CORE RECOVERY FOR BORING -- %	
			19. SIGNATURE OF INSPECTOR <i>R.R. Andette</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
40.0						
50.0						
60.0						
70.0						
80.0						

visual ident.

104-01

DRILLING LOG		Division SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 of 2 SHEETS
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Continuation of Station) PALUXY AQUIFER INVESTIGATION			11. DATE FOR ELEVATION BROWN (FEET OR INCH)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and life number) 8A-106			13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER			14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 61.0			16. DATE HOLE STARTED 3/4/86 COMPLETED 3/4/86	
8. DEPTH DRILLED INTO ROCK 0.0			17. ELEVATION TOP OF HOLE -- 646.82	
9. TOTAL DEPTH OF HOLE 61.0			18. TOTAL CORE RECOVERY FOR BORING -- %	
			19. SIGNATURE OF INSPECTOR R.R. Audette	

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY f	BOX OR SAMPLE NO. g	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) h
	0.0		<u>0.0 to 0.7</u> ASPHALT, good condition			1) During augering free water measured at 35.0ft below grade.
			<u>0.7 to 1.8[±]</u> SAND, fine to coarse grained, loose, dry, clayey, brown.			- Static water level taped at 33.5 ft. below grade.
	10.0		<u>1.8 to 8.0[±]</u> CLAY, low to medium plasticity, soft, moist, slightly gravelly, calcareous, tan to brown.		visual ident.	2) JARS visual identification
			<u>8.0 to 10.5[±]</u> SAND, fine to coarse grained, loose, moist, very clayey throughout, calcareous, tan.			
	20.0		<u>10.5 to 14.0[±]</u> CLAY, low plasticity, soft, moist, very sandy throughout, calcareous, tan.			3) DRILLING 0.0 - 61.0, 8" auger refusal at top of limestone. Fragments of limestone noted on stinger.
			<u>14.0 to 16.5[±]</u> SAND, fine to coarse grained, loose, moist, very clayey throughout, calcareous, tan.		visual ident.	
			<u>16.5 to 44.0[±]</u> CLAY, low to medium plasticity, soft to stiff along basal zone, calcareous with limy seams and nodules throughout, sandy, gravel seam noted @ 27.0±28.0; tan.			
			<u>44.0 to 52.0[±]</u> CLAY, medium to high plasticity, stiff, wet, calcareous with limy seams and nodules throughout, reddish-brown.			

100A-106

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH		SHEET 2 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT 8" AUGER		
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION			11. DATUM FOR ELEVATION BROWN (FEET OR MET.)		
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500		
4. HOLE NO. (As shown on drawing title and file number) 8A-106			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		UNDISTURBED
5. NAME OF DRILLER BREWER			14. TOTAL NUMBER CORE BOXES		**
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER		**
7. THICKNESS OF OVERBURDEN 61.0			16. DATE HOLE		STARTED 3/4/86 COMPLETED 3/4/86
8. DEPTH DRILLED INTO ROCK 0.0			17. ELEVATION TOP OF HOLE		--
9. TOTAL DEPTH OF HOLE 61.0			18. TOTAL CORE RECOVERY FOR BORING		--
			19. SIGNATURE OF INSPECTOR R. R. Andette		

ELEVATION e	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
40.0			52.0 to 61.0 CLAY, medium to high plasticity, stiff, wet, calcareous, sandy tan.			visual ident.
50.0			61.0 LIMESTONE, (auger refusal at top of limestone).			visual ident.
60.0			T.D. - 61.0'			
70.0						
80.0						

1004-1004

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DAYUM FOR ELEVATION SHOW (FEET - DEC)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing data and file number) 8A-107		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	14. TOTAL NUMBER CORE BOXES
5. NAME OF DRILLER BREWER		15. ELEVATION GROUND WATER	16. DATE HOLE
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		17. ELEVATION TOP OF HOLE	18. TOTAL CORE RECOVERY FOR BORING
7. THICKNESS OF OVERBURDEN 61.0		19. SIGNATURE OF INSPECTOR R. B. Burdette	
8. DEPTH DRILLED INTO ROCK 0.0			
9. TOTAL DEPTH OF HOLE 61.0			

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0	0.0		0.0 to 0.6 ASPHALT, good condition			1) During augering free water encountered @ 36.0ft. below grade. -Static water level taped at 34.5ft. below grade.
			0.6 to 1.4 [±] SAND, fine to coarse grained, loose, moist, clayey, brown.			2) JARS visual identification
			1.4 to 6.5 [±] CLAY, low plasticity, soft, moist, sandy, calcareous, tan.			visual ident.
			6.5 to 9.0 GRAVEL, fine grained, angular to subangular, loose, moist, clayey, very sandy, calcareous, tan.			3) DRILLING 0.0 - 61.0, 8" auger refusal with auger scraping at top of limestone. Fragments of limestone noted on stinger.
			9.0 to 13.0 [±] CLAY, low plasticity, soft, moist, very sandy throughout, calcareous, tan.			visual ident.
			13.0 to 15.5 [±] SAND, fine grained, loose, moist, very clayey throughout, calcareous, tan.			
			15.5 to 45.0 [±] CLAY, low to medium plasticity, soft to stiff at depth, moist to wet along basal zone, calcareous with limy nodules and blebs in section especially below 30.0; sandy especially along topmost section, tan.			
			45.0 to 61.0 CLAY, medium to high plasticity, stiff, wet, calcareous with limy nodules and blebs throughout, reddish-brown.			

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 2 of 2 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (FEET or MLL)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and site number) 8A-107		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 61.0		16. DATE HOLE STARTED 3/5/86 COMPLETED 3/5/86	
8. DEPTH DRILLED INTO ROCK 0.0		17. ELEVATION TOP OF HOLE --	
9. TOTAL DEPTH OF HOLE 61.0		18. TOTAL CORE RECOVERY FOR BORING --	
		19. SIGNATURE OF INSPECTOR <i>R. R. Audette</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	40.0		61.0 LIMESTONE, (auger refusal at top of limestone). T.D.-61.0'			
	50.0				visual ident.	
	60.0				visual ident.	
	70.0					
	80.0					

011-011

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 2 SHEETS
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT 8" AUGER	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION			11. DATUM FOR ELEVATION SHOWN (NN or MSL)	
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and site number) 8A-108			13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER			14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DES. FROM VERT.			15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 48.0			16. DATE HOLE STARTED 3/6/86 COMPLETED 3/6/86	
8. DEPTH DRILLED INTO ROCK 0.0			17. ELEVATION TOP OF HOLE -- 648.82	
9. TOTAL DEPTH OF HOLE 48.0			18. TOTAL CORE RECOVERY FOR BORING --	
			19. SIGNATURE OF INSPECTOR <i>R. R. Haddock</i>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0.0		<u>0.0 to 0.6</u> <u>ASPHALT</u> , good condition			1) During augering free water measured at 37.0ft. below grade.
			<u>0.6 to 2.5⁺</u> <u>SAND</u> , fine to coarse grained, loose, dry, clayey, brown.			-Static water level taped at 34.0ft below grade.
			<u>2.5 to 9.5⁺</u> <u>GRAVEL</u> , fine to coarse grained, angular to subangular, loose to medium dense, moist, clayey, sandy, tan.			visual ident.
	10.0		<u>9.5 to 12.5⁺</u> <u>SAND</u> , fine grained, loose, moist, clayey, calcareous, tan.			2) <u>JARS</u> visual identification
			<u>12.5 to 17.5⁺</u> <u>CLAY</u> , low to medium plasticity, soft to stiff, moist, sandy, tan.			3) <u>DRILLING</u> 0.0 - 48.0, 8" auger refusal with auger scraping at top of limestone. Fragments of limestone noted on stinger.
	20.0		<u>17.5 to 19.0⁺</u> <u>SAND</u> , fine grained, loose, moist, very clayey, tan.			visual ident.
			<u>19.0 to 21.0⁺</u> <u>CLAY</u> , low to medium plasticity, soft to stiff, sandy, tan.			
			<u>21.0 to 23.5⁺</u> <u>SAND</u> , fine grained, loose, moist, clayey, slightly gravelly, tan.			
	30.0		<u>23.5 to 48.0⁺</u> <u>CLAY</u> , medium to high plasticity, stiff, moist to wet along basal section, calcareous with limy nodules and blebs in section, tan.			

DRILLING LOG		DIVISION SOUTHWESTERN		INSTALLATION PORT WORTH		SHEET 2 OF 2 SHEETS	
1. PROJECT GENERAL DYNAMICS				10. SIZE AND TYPE OF BIT 8" AUGER			
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION				11. DATUM FOR ELEVATION SHOWN (FEET or MLL)			
3. DRILLING AGENCY USCE				12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500			
4. HOLE NO. (As shown on drawing title and file number) 8A-108				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		14. TOTAL NUMBER CORE BOXES	
5. NAME OF DRILLER BREWER				DISTURBED 0		UNDISTURBED 0	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER **		16. DATE HOLE	
7. THICKNESS OF OVERBURDEN 48.0				STARTED 3/6/86		COMPLETED 3/6/86	
8. DEPTH DRILLED INTO ROCK 0.0				17. ELEVATION TOP OF HOLE --		18. TOTAL CORE RECOVERY FOR BORING --	
9. TOTAL DEPTH OF HOLE 48.0				19. SIGNATURE OF INSPECTOR R.A. Audette			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
	40.0		48.0 LIMESTONE, (auger refusal at top of limestone). T.D. -48.0'		↑ visual ident. ↓		
	50.0						
	60.0						
	70.0						
	80.0						

20411-001

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 1 OF 6 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, 3/4" FISHTAIL	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (FEET OR METERS)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL PAILING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A3F-110		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN DISTURBED 0 UNDISTURBED 0	
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 46.0		16. DATE HOLE STARTED 3/13/86 COMPLETED	
8. DEPTH DRILLED INTO ROCK 192.0		17. ELEVATION TOP OF HOLE -- 647.22	
9. TOTAL DEPTH OF HOLE 238.0		18. TOTAL CORE RECOVERY FOR BORING -- %	
		19. SIGNATURE OF INSPECTOR R. B. Audette	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0.0	0.0		0.0 to 0.4 ASPHALT, good condition			1) During augering free water measure @ 31.0' below grade - Static water level taped at 32.8 ft. below grade.
			0.4 to 1.7 [±] SAND, fine to coarse grained, loose, dry, gravelly, clayey, brown.			2) JARS visual identification
10.0			1.7 to 5.3 [±] CLAY, low plasticity, soft, moist, gravelly, sandy, calcareous, tan.			visual ident.
			5.3 to 35.0 CLAY, medium plasticity, soft to stiff in zones, moist to wet along basal section, sandy along topmost section with strongly arenaceous zones noted @ 11.0' 14.0', 16.0' - 18.5' calcareous with limy nodules and blebs in section, tan.			3) DRILLING 0.0 - 35.0, 8" auger refusal at top of coarse basal gravel. 4" i.d. casing set at top of gravels. Annulus filled with bentonite to grade. 35.0 - 238.6, 3/4" fishtail to depth. visual ident.
20.0			35.0 to 46.0 GRAVEL, coarse grained, very dense to hard, wet, sandy, tan to gray. (logged through cuttings and drill action)			Remarks: A) No hydraulics used in drilling through upper and lower Paluxy to top of Glenrose dolomite, exceptions: 98.0-98.5, 104.0-104.5, 109.5-111.0, 126.6-127.4, 173.5-176.5.
			46.0 to 57.0 [±] LIMESTONE, tan to gray, fine to coarse grained, soft. (logged through cuttings and drill action).			B) 240 ft of tremie pipe advanced to depth.
30.0			57.0 to 58.5 SHALE, gray to dark gray, silty, soft in section, (logged through cuttings and E-logging).			C) twenty (20) ninety-four pound bags of portland cement used in grouting hole from depth to grade using a ratio of 7 to 7.5 gallons water to 1 sack of cement. Note: a 1:6 ratio attempted, viscosity too high for mixing apparatus
40.0						

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 2 OF 6 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, FISHTAIL		
2. LOC. JM (Coordinates or Station) PALOXY AQUIFER INVESTIGATION		11. DAYUM FOR ELEVATION SHOWN (FEM or BML)		
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500		
4. HOLE NO. (As shown on drawing title and file number) 8A3F-110		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DES. FROM VERT.		15. ELEVATION GROUND WATER **		
7. THICKNESS OF OVERBURDEN 46.0		16. DATE HOLE STARTED 8/13/86 COMPLETED 3/18/86		
8. DEPTH DRILLED INTO ROCK 192.0		17. ELEVATION TOP OF HOLE --		
9. TOTAL DEPTH OF HOLE 238.0		18. TOTAL CORE RECOVERY FOR BORING --		
		19. SIGNATURE OF INSPECTOR R. R. Audette		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	40.0		58.5 to 61.2 SANDSTONE, very fine grained, siltg, calcareous, soft. (logged through cuttings and E-log).			D) After 19 ⁺ bags used in grouting, an initial grout level of 2.0ft below grade was noted. Tremie pipe was subsequently removed. A final grout level of 10.0ft below grade was noted at plus 20 hours. An additional One-half bag of cement was used to grout to grade using the same 1:7 grout ratio.
	50.0		61.2 to 73.0 ⁺ SHALE, dark gray, arenaceous with abundant sandstone seams and stringers in section, soft. (logged through cuttings and E-log).			E) All auger cuttings were removed and stored in sample bags.
			73.0 to 85.5 ⁺ SANDSTONE, fine to coarse grained, silty, calcareous, shaly with inferred shale stringers and seams, soft. (cuttings and E-log).			F) Two samples of drill water obtained for analysis by SWD lab.
	60.0		85.5 to 106.0 ⁺ SHALE, dark gray, inferred sandstone stringers and seams in section, soft. (logged through E-log and cuttings).			G) Boring offset 7.0ft. due east.
			106.0 to 112.0 ⁺ SANDSTONE, fine grained, silty, calcareous, inferred shale stringers in section, soft. (logged through cuttings and E-log).			visual ident.
	70.0		112.0 to 166.0 ⁺ SANDSTONE, fine to coarse grained, silty, calcareous, soft. (logged through E-log and cuttings).			visual ident.
			166.0 to 167.5 ⁺ SHALE, dark gray, soft. (logged through E-log).			

110-1110

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 3 OF 6 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, FISHTAIL		
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DAYUM FOR ELEVATION SHOWN (FEET or MET)		
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500		
4. HOLE NO. (As shown on drawing title and file number) 8A3F-110		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **		
7. THICKNESS OF OVERBURDEN 46.0		16. DATE HOLE STARTED 3/13/86 COMPLETED 3/18/86		
8. DEPTH DRILLED INTO ROCK 192.0		17. ELEVATION TOP OF HOLE --		
9. TOTAL DEPTH OF HOLE 238.0		18. TOTAL CORE RECOVERY FOR BORING --		
		19. SIGNATURE OF INSPECTOR R.B. Hudetta		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	80.0		167.5 to 230.0 [±] SANDSTONE, fine to coarse grained, silty, calcareous, inferred shale seams and stringers in section, soft. (logged through cuttings and E-log).			
	90.0		230.0 to 236.0 [±] SHALE, dark gray, arenaceous with sand seams and stringers in section, soft. (logged through cuttings and E-Log).		visual ident.	
	100.0		236.0 to 238.0 LIMESTONE, light gray, fine grained, hard (logged through cuttings and E-Log).		visual ident.	
	120.0		T.D.-238.0'			

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 4 OF 6 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, FISHTAIL	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (FEET or METER)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and site number) 8A3F-110		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: 0 UNDISTURBED: 0	
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 46.0		16. DATE HOLE STARTED: 3/13/86 COMPLETED: 3/18/86	
8. DEPTH DRILLED INTO ROCK 192.0		17. ELEVATION TOP OF HOLE --	
9. TOTAL DEPTH OF HOLE 238.0		18. TOTAL CORE RECOVERY FOR BORING --	
		19. SIGNATURE OF INSPECTOR B.R. Hurdette	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
a	b	c	d	e	f	g
120.0	0.0					
130.0	10.0					visual ident.
140.0	20.0					
150.0	30.0					visual ident.
160.0	40.0					

DRILLING LOG	DIVISION SOUTHWESTERN	INSTALLATION PORT WORTH	SHEET 5 OF 6 SHEETS
1. PROJECT GENERAL DYNAMICS		10. SIZE AND TYPE OF BIT 8" AUGER, FISHTAIL	
2. LOCATION (Coordinates or Station) PALUXY AQUIFER INVESTIGATION		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USCE		12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500	
4. HOLE NO. (As shown on drawing title and file number) 8A3F-110		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 UNDISTURBED 0
5. NAME OF DRILLER BREWER		14. TOTAL NUMBER CORE BOXES --	
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER **	
7. THICKNESS OF OVERBURDEN 46.0		16. DATE HOLE STARTED 3/13/86 COMPLETED 3/18/86	
8. DEPTH DRILLED INTO ROCK 192.0		17. ELEVATION TOP OF HOLE --	
9. TOTAL DEPTH OF HOLE 238.0		18. TOTAL CORE RECOVERY FOR BORING -- %	
		19. SIGNATURE OF INSPECTOR R. R. Hudetta	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
160.0						
170.0						
180.0						
190.0						
200.0						

SHEET 5 OF 6

DRILLING LOG		DIVISION SOUTHWESTERN	INSTALLATION FORT WORTH	SHEET 6 OF 6 SHEETS	
1. PROJECT GENERAL DYNAMICS			10. SIZE AND TYPE OF BIT 8" AUGER, 3/4" FISHTAIL		
2. LOCATION (County, State or Section) PALUXY AQUIFER INVESTIGATION			11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		
3. DRILLING AGENCY USCE			12. MANUFACTURER'S DESIGNATION OF DRILL FALLING 1500		
4. HOLE NO. (As shown on drawing title and file number) 8A3F-110			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0	UNDISTURBED 0
5. NAME OF DRILLER BREWER			14. TOTAL NUMBER CORE BOXES --		
6. DIRECTION OF HOLE <input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED DES. FROM VERT.			15. ELEVATION GROUND WATER **		
7. THICKNESS OF OVERBURDEN 46.0			16. DATE HOLE STARTED 3/13/86 COMPLETED 3/18/86		
8. DEPTH DRILLED INTO ROCK 192.0			17. ELEVATION TOP OF HOLE --		
9. TOTAL DEPTH OF HOLE 238.0			18. TOTAL CORE RECOVERY FOR BORING --		
			19. SIGNATURE OF INSPECTOR <i>R.R. Audette</i>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
200.0						
210.0						visual ident.
220.0						visual ident.
230.0						
240.0						

COPY 4 11/86

APPENDIX II

REPORTS OF MONITOR WELL ANALYTICAL RESULTS

10-10-01

RECEIVED

SEP 21 1985

HARGIS & ASSOCIATES, INC.

BROWN AND CALDWELL



ANALYTICAL LABORATORIES

LOG NO: P85-08-419

Received: 29 AUG 85

Reported: 18 SEP 85

David R. Hargis
 Hargis & Associates, Inc.
 1735 East Fort Lowell Road, Suite 5
 Tucson, Arizona 85719

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, GROUND WATER SAMPLES	DATE SAMPLED		
3-419-1	HM-52	27 AUG 85		
08-419-2	HM-53	27 AUG 85		
3-419-3	P-11M	28 AUG 85		
PARAMETER		08-419-1	08-419-2	08-419-3
Base/Neutral Extractables				
Extraction		09/02/85	09/02/85	09/02/85
Date Analyzed		09/14/85	09/15/85	09/15/85
Benzidine, ug/L		<40	<40	<40
Dibutylphthalate, ug/L		<50	<50	<50
Dimethylphthalate, ug/L		<25	<25	<25
N-Nitrosodi-n-propylamine, ug/L		<40	<40	<40
N-Nitrosodimethylamine, ug/L		<80	<80	<80
Naphthalene, ug/L		<10	10	<10
Other Base/Neutral Extractables,		<10	<10	<10
Semi-Quantified Results **				
Total C8-C15 Aromatic Compounds, ug/L		---	400	---

** Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

LOG NO: P85-08-419

Received: 29 AUG 85

Reported: 18 SEP 85

David R. Hargis
Hargis & Associates, Inc.
1735 East Fort Lowell Road, Suite 5
Tucson, Arizona 85719

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, GROUND WATER SAMPLES	DATE SAMPLED		
08-419-1	HM-52	27 AUG 85		
08-419-2	HM-53	27 AUG 85		
08-419-3	P-11M	28 AUG 85		
PARAMETER		08-419-1	08-419-2	08-419-3
Surgeable Priority Pollutants				
Reaction		09/08/85	09/08/85	09/08/85
Acrolein, ug/L		<10	<10	<10
Acrylonitrile, ug/L		<10	<10	<10
Bromodichloromethane, ug/L		2	<1	<1
Chloroform, ug/L		3	<1	<1
Trichloroethylene, ug/L		2	<1	<1
Other Surgeable Priority Pollutants,		<1	<1	<1

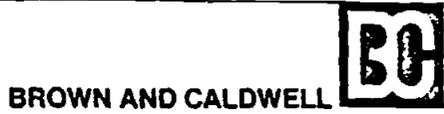
PAGE 2 Analytical Serv REPORT LAB # 85-08-171
RECEIVED: 08/29/85 Results by Sample

SAMPLE ID P-11M		SAMPLE # 01 FRACTIONS: A, B		Date & Time Collected 08/28/85		Category					
AS GA	<.002 ug/ml	CA E	54 ug/ml	CD E	<.002 ug/ml	CL IC	18 mg/L	CO3 A	<1.0 mg/L as CaCO3	CR E	<.005 ug/ml
CU E	<.001 ug/ml	FE E	0.028* ug/ml	HCO3 A	263 mg/L as CaCO3	HG CA	<.0002 ug/ml	K E	5.6 ug/ml	MG E	20 ug/ml
NA E	57 ug/ml	PB GA	<.002 ug/ml	SE GA	<.005 ug/ml	SO4 IC	48 mg/L	SR E	3.5 ug/ml		

RECEIVED

SEP 14 1985

HARGIS & ASSOCIATES, INC.



ANALYTICAL LABORATORIES

LOG NO: P85-09-090

Received: 07 SEP 85

Reported: 12 SEP 85

David R. Hargis
Hargis & Associates, Inc.
1735 East Fort Lowell Road, Suite 5
Tucson, Arizona 85719

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, AQUEOUS SAMPLES	DATE SAMPLED		
09-090-1	P-11(M)	05 SEP 85		
09-090-2	P-11(U)	05 SEP 85		
09-090-3	HM-84	05 SEP 85		
PARAMETER		09-090-1	09-090-2	09-090-3
Purgeable Priority Pollutants				
Extraction		09/11/85	09/11/85	09/11/85
Acrolein, ug/L		<10	<10	<10
Acrylonitrile, ug/L		<10	<10	<10
Methylene Chloride, ug/L		<1	15	3
Toluene, ug/L		<1	64	<1
Other Purgeable Priority Pollutants,		<1	<1	<1

Edward Wilson, Laboratory Director

NOV 04 '85

BROWN AND CALDWELL



ANALYTICAL LABORATORIES

HARGIS & ASSOCIATES, INC.

LOG NO: P85-10-231

Received: 14 OCT 85

Reported: 01 NOV 85

Peter Quinlan
 Hargis & Associates, Inc.
 2223 Avenida de la Playa Suite 300
 La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES					DATE SAMPLED
10-231-1	P-11U					10 OCT 85
10-231-2	P-11M					10 OCT 85
10-231-3	P-12M					10 OCT 85
10-231-4	HM-36					11 OCT 85
10-231-5	HM-37					10 OCT 85
PARAMETER	10-231-1	10-231-2	10-231-3	10-231-4	10-231-5	
Purgeable Priority Pollutants						
Extraction	10/24/85	10/24/85	10/25/85	10/23/85	10/25/85	
Acrolein, ug/L	<10	<10	<10	<10	<100	
Acrylonitrile, ug/L	<10	<10	<10	<10	<100	
Trichloroethylene, ug/L	<1	<1	<1	1	340	
Toluene, ug/L	70	<1	<1	<1	<10	
trans-1,2-Dichloroethylene, ug/L	<1	<1	<1	<1	90	
Other Purgeable Priority Pollutants,	<1	<1	<1	<1	<10	

LOG NO: P85-12-201

Received: 13 DEC 85
Reported: 03 JAN 86

Peter T. Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED		
12-201-2	P-12U	12 DEC 85		
12-201-3	French Drain #1	11 DEC 85		
12-201-4	Drain Pipe	11 DEC 85		
PARAMETER		12-201-2	12-201-3	12-201-4
B/N,A Ext. Priority Pollutants				
Extraction		12/16/85	12/16/85	12/16/85
Date Analyzed		12/19/85	12/20/85	12/20/85
1,2-Dichlorobenzene, ug/L		<10	67	130
1,4-Dichlorobenzene, ug/L		<10	10	18
2,4-Dimethylphenol, ug/L		<10	<10	10
2,4-Dinitrophenol, ug/L		<25	<25	<25
2-Methyl-4,6-dinitrophenol, ug/L		<50	<50	<50
4-Nitrophenol, ug/L		<25	<25	<25
Benzidine, ug/L		<40	<40	<40
Dibutylphthalate, ug/L		<50	<50	<50
Dimethylphthalate, ug/L		<25	<25	<25
N-Nitrosodi-n-propylamine, ug/L		<40	<40	<40
N-Nitrosodimethylamine, ug/L		<80	<80	<80
Naphthalene, ug/L		<10	<10	14
Other B/N,A Ext. Priority Pollutants,		<10	<10	<10
Semi-Quantified Results **				
A Terpenol, ug/L		---	---	20
Total C8-C35 Hydrocarbons, ug/L		---	---	10,000
Total Unidentified Compounds, ug/L		---	60	---
Tetramethyl Butyl Phenol, ug/L		---	10	---

** Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

LOG NO: P85-12-201

Received: 13 DEC 85

Reported: 03 JAN 86

Peter T. Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED		
12-201-2	P-12U	12 DEC 85		
12-201-3	French Drain #1	11 DEC 85		
12-201-4	Drain Pipe	11 DEC 85		
PARAMETER		12-201-2	12-201-3	12-201-4
Purgeable Priority Pollutants				
Extraction		12/21/85	12/20/85	12/21/85
1,1,1-Trichloroethane, ug/L		<1	23	<25
1,1-Dichloroethylene, ug/L		<1	15	48
Acrolein, ug/L		<10	<100	<250
Acrylonitrile, ug/L		<10	<100	<250
Benzene, ug/L		<1	<10	25
Chlorobenzene, ug/L		<1	27	40
Ethylbenzene, ug/L		<1	66	25
Tetrachloroethylene, ug/L		<1	83	180
Trichloroethylene, ug/L		<1	1000	1200
Toluene, ug/L		<1	250	950
Vinyl Chloride, ug/L		<1	2800	11,000
trans-1,2-Dichloroethylene, ug/L		<1	7500	25,000
Other Purgeable Priority Pollutants,		<1	<10	<25
Semi-Quantified Results **				
Xylene Isomers, ug/L		---	---	100

** Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

LOG NO: P85-12-201

Received: 13 DEC 85
Reported: 03 JAN 86

Peter T. Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED		
12-201-2	P-12U	12 DEC 85		
12-201-3	French Drain #1	11 DEC 85		
12-201-4	Drain Pipe	11 DEC 85		
PARAMETER		12-201-2	12-201-3	12-201-4
Total Fuel Hydrocarbons, mg/L		<1	<1	4
Oil and Grease, mg/L		32	14	120

RECEIVED: 12/16/85

Results by Sample

SAMPLE ID HM-85		SAMPLE # 04 FRACTIONS: A		Date & Time Collected 12/12/85		Category					
AG E	<.002 ug/ml	AS GA	0.003* ug/ml	CD E	<.002 ug/ml	CR E	0.48 ug/ml	CU E	<.001 ug/ml	FE E	5.0 ug/ml
HG CA	<.0002 ug/ml	PB GA	0.004* ug/ml	SE GA	0.010* ug/ml	SR E	0.39 ug/ml				

SAMPLE ID P-12U		SAMPLE # 05 FRACTIONS: A,B		Date & Time Collected 12/12/85		Category					
AG E	<.004 ug/ml	AS GA	0.024 ug/ml	CA E	540 ug/ml	CD E	<.002 ug/ml	CL IC	16 mg/L	CO3 A	<1 mg/L as CaCO3
CR E	0.18 ug/ml	CU E	0.093 ug/ml	FE E	77 ug/ml	HCO3 A	174 mg/L as CaCO3	HG CA	<.0002 ug/ml	KE	12 ug/ml
MG E	38 ug/ml	NA E	44 ug/ml	PB GA	0.10 ug/ml	SE GA	0.016* ug/ml	SO4 IC	65 mg/L	SR E	4.3 ug/ml

LOG NO: P86-01-154

Received: 10 JAN 86

Reported: 23 JAN 86

Peter T Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED
01-154-11	P-10 Upper	08 JAN 86
01-154-12	P-10 Middle	08 JAN 86
01-154-13	P-11 Upper	09 JAN 86
01-154-14	P-11 Middle	09 JAN 86
01-154-15	P-12 Middle	09 JAN 86

PARAMETER	01-154-11	01-154-12	01-154-13	01-154-14	01-154-15
Purgeable Priority Pollutants					
Extraction	01/13/86	01/13/86	01/13/86	01/13/86	01/14/86
Acrolein, ug/L	<10	<10	<10	<10	<10
Acrylonitrile, ug/L	<10	<10	<10	<10	<10
trans-1,2-Dichloroethylene, ug/L	4	<1	<1	<1	<1
Other Purgeable Priority Pollutants,	<1	<1	<1	<1	<1

LOG NO: P86-01-154

Received: 10 JAN 86

Reported: 23 JAN 86

Peter T Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED
01-154-24	P-12 Upper	09 JAN 86
PARAMETER	01-154-24	
Oil and Grease, mg/L	9	
Total Fuel Hydrocarbons, mg/L	<1	
Purgeable Priority Pollutants Extraction	01/14/86	
1,1,1-Trichloroethane, ug/L	62	
Acrolein, ug/L	<10	
Acrylonitrile, ug/L	<10	
Other Purgeable Priority Pollutants, B/N,A Ext. Priority Pollutants Extraction	01/13/86	
Date Analyzed	01/16/86	
2,4-Dinitrophenol, ug/L	<25	
2-Methyl-4,6-dinitrophenol, ug/L	<50	
4-Nitrophenol, ug/L	<25	
Benzidine, ug/L	<40	
Dibutylphthalate, ug/L	<50	
Dimethylphthalate, ug/L	<25	
N-Nitrosodi-n-propylamine, ug/L	<40	
N-Nitrosodimethylamine, ug/L	<80	
Other B/N,A Ext. Priority Pollutants,	<10	

SAMPLE ID P-12 upper		SAMPLE # 05 FRACTIONS: A, B		Date & Time Collected 01/09/86		Category							
AG E	0.005* ug/ml	AS GA	<.003 ug/ml	CA E	41 ug/ml	CD E	<.002 ug/ml	CL IC	11 mg/L	CO3 A	<.003 mg/L as CaCO3	CI	<.003 ug/ml
CR E	0.006* ug/ml	CU E	0.012 ug/ml	FE E	1.6 ug/ml	HCO3 A	225 mg/L as CaCO3	HG CA	<.0002 ug/ml	K E	6.5 ug/ml		
MG E	13 ug/ml	MN E	0.076 ug/ml	NA E	44 ug/ml	ND3 IC	<.2 mg/L	PB GA	0.007* ug/ml	SE GA	<.003 ug/ml		
SD4 IC	47 mg/L	SR E	2.6 ug/ml	ZN E	1.5 ug/ml								

LOG NO: P86-04-079

Received: 04 APR 86

Reported: 22 APR 86

David R. Hargis
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES					DATE SAMPLED
04-079-24	P-9 Middle					02 APR 86
04-079-25	P-10 Upper					03 APR 86
04-079-26	P-10 Middle					03 APR 86
04-079-27	P-11 Middle					02 APR 86
04-079-28	French Drain #1					03 APR 86
PARAMETER	04-079-24	04-079-25	04-079-26	04-079-27	04-079-28	
Purgeable Priority Pollutants Extraction	04/14/86	04/14/86	04/14/86	04/14/86	4/15/86	
1,1,1-Trichloroethane, ug/L	<1	<1	<1	<1	89	
Acrolein, ug/L	<10	<10	<10	<10	<500	
Acrylonitrile, ug/L	<10	<10	<10	<10	<500	
Chloroform, ug/L	<1	<1	<1	<1	59	
Tetrachloroethylene, ug/L	<1	<1	<1	<1	210	
Trichloroethylene, ug/L	<1	<1	<1	<1	4200	
Vinyl Chloride, ug/L	<1	<1	<1	<1	1300	
trans-1,2-Dichloroethylene, ug/L	<1	4	<1	<1	24,000	
Other Purgeable Priority Pollutants,	<1	<1	<1	<1	<50	

LOG NO: PB6-04-128

Received: 08 APR 86

Reported: 25 APR 86

Peter T Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES					DATE SAMPLED
04-128-37	HM-92					07 APR 86
04-128-38	P-2					05 APR 86
04-128-39	P-3					06 APR 86
04-128-40	P-11 Upper					05 APR 86
04-128-41	P-12 Upper					06 APR 86
PARAMETER	04-128-37	04-128-38	04-128-39	04-128-40	04-128-41	
Purgeable Priority Pollutants						
Extraction	4/17/86	4/17/86	4/17/86	4/18/86	4/18/86	
1,1,1-Trichloroethane, ug/L	<1	<1	<1	<1	56	
Acrolein, ug/L	<10	<10	<10	<10	<10	
Acrylonitrile, ug/L	<10	<10	<10	<10	<10	
Chloroform, ug/L	2	<1	2	<1	<1	
Toluene, ug/L	2	<1	8	<1	<1	
Other Purgeable Priority Pollutants,	<1	<1	<1	<1	<1	

LOG NO: P86-04-128

Received: 08 APR 86

Reported: 25 APR 86

Peter T Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED		
04-128-42	P-12 Middle	06 APR 86		
04-128-43	Cooling Tower Influent	06 APR 86		
04-128-44	Cooling Tower Effluent	06 APR 86		
PARAMETER		04-128-42	04-128-43	04-128-44
Purgeable Priority Pollutants				
Extraction		4/18/86	4/18/86	4/18/86
1,1,1-Trichloroethane, ug/L		<1	51	3
1,1-Dichloroethylene, ug/L		<1	14	<1
Acrolein, ug/L		<10	<100	<10
Acrylonitrile, ug/L		<10	<100	<10
Chloroform, ug/L		<1	12	<1
Tetrachloroethylene, ug/L		<1	29	2
Trichloroethylene, ug/L		<1	1800	94
Vinyl Chloride, ug/L		<1	150	<1
trans-1,2-Dichloroethylene, ug/L		<1	3000	150
Other Purgeable Priority Pollutants,		<1	<10	<1


Edward Wilson, Laboratory Director

LOG NO: P86-04-220

Received: 10 APR 86
Reported: 15 MAY 86

Sam Williams
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED
04-220-6	P-13 Upper	09 APR 86
PARAMETER	04-220-6	
Oil and Grease, mg/L	<5	
Alkalinity		
Carbonate Alk (as CaCO3), mg/L	40	
Bicarb Alk (as CaCO3), mg/L	210	
Hydroxide Alk (as CaCO3), mg/L	0	
Other Alkalinity,	<10	
Total Fuel Hydrocarbons, mg/L	<1	
Purgeable Priority Pollutants		
Extraction	04/20/86	
Acrolein, ug/L	<10	
Acrylonitrile, ug/L	<10	
Other Purgeable Priority Pollutants,	<1	

LOG NO: P86-04-220

Received: 10 APR 86
Reported: 15 MAY 86

Sam Williams
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED
04-220-6	P-13 Upper	09 APR 86
PARAMETER	04-220-6	
B/N,A Ext. Priority Pollutants		
Extraction	4/14/86	
Date Analyzed	4/17/86	
2,4-Dinitrophenol, ug/L	<25	
2-Methyl-4,6-dinitrophenol, ug/L	<50	
4-Nitrophenol, ug/L	<25	
Benzidine, ug/L	<40	
Dibutylphthalate, ug/L	<50	
Dimethylphthalate, ug/L	<25	
N-Nitrosodi-n-propylamine, ug/L	<40	
N-Nitrosodimethylamine, ug/L	<80	
Other B/N,A Ext. Priority Pollutants,	<10	

LOG NO: P86-04-220

Received: 10 APR 86

Reported: 15 MAY 86

Sam Williams
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED
04-220-6	P-13 Upper	04/29/86
PARAMETER	04-220-6	
Magnesium, mg/L	<0.067	
Copper, mg/L	<0.02	
Iron, mg/L	<0.2	
Manganese, mg/L	<0.01	
Potassium, mg/L	20	
Sodium, mg/L	81	
Zinc, mg/L	0.21	
Arsenic, mg/L	<0.0075	
Cadmium, mg/L	<0.009	
Mercury, mg/L	<0.0005	
Selenium, mg/L	<0.0056	
Strontium, mg/L	2.9	
Chromium, mg/L	<0.03	
Lead, mg/L	0.038	
Dissolved Digestion, Date	04/29/86	
Calcium (EDTA Titration), mg/L	170	
Chloride, mg/L	240	
Surfactants, mg/L	<0.1	
pH, Units	11.5	
Sulfate, mg/L	26	
Specific Conductance, umhos/cm	1600	
Filterable Residue (TDS), mg/L	720	
Nitrate (as NO3), mg/L	<4	

LOG NO: P86-05-179

Received: 09 MAY 86
Reported: 10 JUN 86

Peter Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED
05-179-22	P-13 Upper	08 MAY 86

PARAMETER	05-179-22
Oil and Grease, mg/L	<5
Total Fuel Hydrocarbons, mg/L	<1
Purgeable Priority Pollutants Extraction	05/17/86
Acrolein, ug/L	<10
Acrylonitrile, ug/L	<10
Methylene Chloride, ug/L	8
Other Purgeable Priority Pollutants,	<1
Base/Neutral Extractables Extraction	05/15/86
Date Analyzed	06/06/86
Benzidine, ug/L	<40
Dibutylphthalate, ug/L	<50
Dimethylphthalate, ug/L	<25
N-Nitrosodi-n-propylamine, ug/L	<40
N-Nitrosodimethylamine, ug/L	<80
Other Base/Neutral Extractables,	<10

AGRICULTURE
CHEMICAL ANALYSIS
PETROLEUM



LABORATORIES, INC.

J. J. EGLIN, REG. CHEM. ENGR.

4100 PIERCE RD., BAKERSFIELD, CALIFORNIA 93308 PHONE 327-4911

Hargis & Associates, Inc.
2223 Avenue De La Playa, Suite 300
La Jolla, California 92037

Date Reported: 6/12/86
Date Received: 5/9/86
Laboratory No.: 7140

Attention: Alan Wylie

Job #250

WATER ANALYSIS

Sample Description: 5/7/86 Well P-12 Upper 20:20

<u>Constituents</u>	<u>mg/liter</u>
Iron	0.13
Manganese	0.06
Arsenic	(-) 0.01
Copper	(-) 0.01
Zinc	0.41
Barium	(-) 0.5
Cadmium	(-) 0.005
Total Chromium	(-) 0.01
Lead	(-) 0.01
Mercury	(-) 0.0002
Selenium	(-) 0.005
Silver	(-) 0.01
Antimony	(-) 1.0
Beryllium	(-) 0.01
Nickel	(-) 0.05
Thallium	(-) 0.5
Molybdenum	(-) 0.1
Strontium	1.6

(-) refers to "less than"

B C LABORATORIES, INC.

BY J. J. Eglin
J. J. Eglin

RECEIVED

JUN 13 '86

HARGIS + ASSOCIATES, INC.
LA JOLLA, CA

AGRICULTURE
CHEMICAL ANALYSIS
PETROLEUM



LABORATORIES, INC.

J. J. EGLIN, REG. CHEM. ENGR.

4100 PIERCE RD., BAKERSFIELD, CALIFORNIA 93308 PHONE 327-4911

Hargis & Associates, Inc.
1735 East Fort Lowell Road, Suite 5
Tucson, Arizona 85719

Date Reported: 6/12/86
Date Received: 5/9/86
Laboratory No.: 7141

Attention: Alan Wylie

Job # 250

WATER ANALYSIS

Sample Description: 5/7/86 Well P-13 Upper 18:40

Constituents	epm	mg/liter
Hydroxide	3.28	45.9
Calcium	6.00	120.
Magnesium	0.00	0.03
Sodium	3.39	78.
Potassium	0.54	21.
Carbonate	1.45	43.4
Bicarbonate	0.	0.
Chloride	4.12	146.
Sulfate	1.06	51.
Nitrate	(-) 0.01	0.4
Fluoride		0.55
Iron		0.64
Manganese		0.06
Arsenic		(-) 0.01
Copper		0.14
Zinc		4.4
Total Dissolved Solids @ 180°C		710.
Barium		(-) 0.5
Cadmium		(-) 0.005
Total Chromium		(-) 0.01
Lead		0.17
Mercury		(-) 0.0002
Selenium		(-) 0.005
Silver		(-) 0.01
Boron		(-) 0.10
Silica		18.
Antimony		(-) 1.0
Beryllium		(-) 0.01
Nickel		(-) 0.05
Thallium		(-) 0.5
Molybdenum		(-) 0.1
Strontium		1.1

pH
Electrical Conductivity, Micromhos/cm

11.1
1,550.

(-) refers to "less than"

B C LABORATORIES, INC.

BY

J. J. Eglin
J. J. Eglin

RECEIVED

JUN 13 '86

HARGIS + ASSOCIATES, INC.
LA JOLLA, CA

Results by Sample

Page #
Received: 05/09/86

SAMPLE ID P-12 upper
 SAMPLE # 01 FRACTIONS: A
 Date & Time Collected 05/07/86 Category
 F E 0.17
 ug/ml

SAMPLE ID HM-83
 SAMPLE # 02 FRACTIONS: A
 Date & Time Collected 05/08/86 Category
 F E 9.9
 ug/ml

SAMPLE ID HM-84
 SAMPLE # 03 FRACTIONS: A
 Date & Time Collected 05/07/86 Category
 F E 4.5
 ug/ml

SAMPLE ID HM-85
 SAMPLE # 04 FRACTIONS: A
 Date & Time Collected 05/07/86 Category
 F E 3.6
 ug/ml

LOG NO: P86-06-142

Received: 09 JUN 86
Reported: 07 JUL 86

Peter Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED
06-142-16	HM-21	05 JUN 86
06-142-17	HM-30	04 JUN 86
06-142-18	HM-53	04 JUN 86
06-142-19	P-13 Upper	05 JUN 86

PARAMETER	06-142-16	06-142-17	06-142-18	06-142-19
Oil and Grease, mg/L	---	<5	<5	<5
Total Fuel Hydrocarbons, mg/L	---	<1	2	<1
E/N,A Ext. Priority Pollutants Extraction	---	---	---	06/11/86
Date Analyzed	---	---	---	06/13/86
2,4-Dinitrophenol, ug/L	---	---	---	<25
2-Methyl-4,6-dinitrophenol, ug/L	---	---	---	<50
4-Nitrophenol, ug/L	---	---	---	<25
Benzidine, ug/L	---	---	---	<40
Dibutylphthalate, ug/L	---	---	---	<50
Dimethylphthalate, ug/L	---	---	---	<25
N-Nitrosodi-n-propylamine, ug/L	---	---	---	<40
N-Nitrosodimethylamine, ug/L	---	---	---	<80
Other E/N,A Ext. Priority Pollutants,	---	---	---	<10

LOG NO: P86-06-142

Received: 09 JUN 86
Reported: 07 JUL 86

Peter Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED			
06-142-16	HM-21	05 JUN 86			
06-142-17	HM-30	04 JUN 86			
06-142-18	HM-53	04 JUN 86			
06-142-19	P-13 Upper	05 JUN 86			
PARAMETER	06-142-16	06-142-17	06-142-18	06-142-19	
Purgeable Priority Pollutants					
Extraction	06/14/86	---	---	06/14/86	
Acrolein, ug/L	<500	---	---	<10	
Acrylonitrile, ug/L	<500	---	---	<10	
trans-1,2-Dichloroethylene, ug/L	3850	---	---	<1	
Other Purgeable Priority Pollutants,	<50	---	---	<1	


Edward Wilson, Laboratory Director

AGRICULTURE

CHEMICAL ANALYSIS

PETROLEUM



LABORATORIES, INC.

J. J. EGLIN, REG. CHEM. ENGR.

4100 PIERCE RD., BAKERSFIELD, CALIFORNIA 93308 PHONE 327-4911

Hargis & Associates
 1735 East Fort Lowell Road, Suite 5
 Tucson, Arizona 85719
 Attention: Sam Williams

Date Reported: 7/1/86
 Date Received: 6/9/86
 Laboratory No.: 8934
 Job 250

WATER ANALYSIS

Sample Description: General Dynamics #250 6/5/86 P-13 Upper SW/CR 16:00

<u>Constituents</u>	<u>epm</u>	<u>mg/liter</u>
Hydroxide	3.46	58.8
Calcium	4.40	88.
Magnesium	0.01	0.08
Sodium	3.00	69.
Potassium	0.38	15.
Carbonate	1.02	30.7
Bicarbonate	0.	0.
Chloride	2.01	71.1
Sulfate	1.40	67.
Nitrate	(\leftarrow) 0.01	(\leftarrow) 0.4
Fluoride		0.44
Iron		0.16
Manganese		0.01
Arsenic		(\leftarrow) 0.01
Copper		0.02
Zinc		1.4
Total Dissolved Solids @ 180°C		490.
Barium		(\leftarrow) 0.5
Cadmium		(\leftarrow) 0.005
Total Chromium		(\leftarrow) 0.01
Lead		0.06
Mercury		(\leftarrow) 0.0002
Selenium		(\leftarrow) 0.005
Silver		(\leftarrow) 0.01
Boron		(\leftarrow) 0.10
Silica		22.
Antimony		(\leftarrow) 1.0
Beryllium		(\leftarrow) 0.01
Nickel		(\leftarrow) 0.05
Thallium		(\leftarrow) 0.5
Molybdenum		(\leftarrow) 0.1
Strontium		0.9

Electrical Conductivity,

Micromhos/cm @ 25 °C

730.

pH

10.8

B C LABORATORIES, INC.

BY

J. J. Eglin

6-114-001

LOG NO: P86-07-212

Received: 11 JUL 86

Reported: 29 JUL 86

Peter Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED				
07-212-20	P-9 Upper	10 JUL 86				
07-212-21	P-9 Middle	10 JUL 86				
07-212-22	P-11 Upper	10 JUL 86				
07-212-23	P-11 Middle	10 JUL 86				
07-212-24	P-12 Upper	09 JUL 86				
PARAMETER	07-212-20	07-212-21	07-212-22	07-212-23	07-212-24	
Purgeable Priority Pollutants Extraction	07/21/86	07/22/86	07/22/86	07/22/86	07/22/86	
1,1,1-Trichloroethane, ug/L	<1	<1	<1	<1	7	
Acrolein, ug/L	<10	<10	<10	<10	<10	
Acrylonitrile, ug/L	<10	<10	<10	<10	<10	
Other Purgeable Priority Pollutants,	<1	<1	<1	<1	<1	

LOG NO: P86-07-212

Received: 11 JUL 86

Reported: 29 JUL 86

Peter Quinlan
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES					DATE SAMPLED
07-212-25	P-12 Middle					09 JUL 86
07-212-26	P-13 Upper					09 JUL 86
07-212-27	P-41					09 JUL 86
07-212-28	P-48					09 JUL 86
07-212-29	P-60					09 JUL 86
PARAMETER	07-212-25	07-212-26	07-212-27	07-212-28	07-212-29	
Purgeable Priority Pollutants						
Extraction	07/22/86	07/22/86	07/23/86	07/22/86	07/22/86	
1,1,1-Trichloroethane, ug/L	5	<1	51	30	20	
1,1,2,2-Tetrachloroethane, ug/L	<1	<1	20	<10	<10	
1,1-Dichloroethane, ug/L	2	<1	<10	<10	<10	
1,1-Dichloroethylene, ug/L	<1	<1	17	20	17	
1,2-Dichloroethane, ug/L	<1	<1	17	<10	<10	
1,3-Dichloropropene, ug/L	<1	<1	15	<10	<10	
Acrolein, ug/L	<10	<10	<100	<100	<100	
Acrylonitrile, ug/L	<10	<10	<100	<100	<100	
Bromodichloromethane, ug/L	<1	<1	21	<10	<10	
Benzene, ug/L	<1	<1	33	<10	<10	
Chloroform, ug/L	<1	<1	<10	39	<10	
Ethylbenzene, ug/L	<1	<1	14	<10	<10	
Trichloroethylene, ug/L	<1	<1	930	750	720	
Toluene, ug/L	<1	<1	16	<10	<10	
trans-1,2-Dichloroethylene, ug/L	<1	<1	1400	1100	990	
trans-1,3-Dichloropropene, ug/L	<1	<1	19	<10	<10	
Other Purgeable Priority Pollutants,	<1	<1	<10	<10	<10	

LOG NO: P86-08-106

Received: 07 AUG 86

Reported: 28 AUG 86

Sam Williams
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

REPORT OF ANALYTICAL RESULTS

Page 4

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED				
08-106-16	Radar Range Seep	06 AUG 86				
08-106-17	C-3	06 AUG 86				
08-106-18	C-5	06 AUG 86				
08-106-19	HM-21	06 AUG 86				
08-106-20	P-13M	06 AUG 86				
PARAMETER	08-106-16	08-106-17	08-106-18	08-106-19	08-106-20	
Oil and Grease, mg/L	---	<5	<5	---	<5	
Total Fuel Hydrocarbons, mg/L	---	---	---	---	<1	
B/N,A Ext. Priority Pollutants						
Extraction	---	---	---	---	08/14/86	
Date Analyzed	---	---	---	---	08/25/86	
2,4-Dinitrophenol, ug/L	---	---	---	---	<25	
2-Methyl-4,6-dinitrophenol, ug/L	---	---	---	---	<50	
4-Nitrophenol, ug/L	---	---	---	---	<25	
Benzidine, ug/L	---	---	---	---	<40	
Dibutylphthalate, ug/L	---	---	---	---	<50	
Dimethylphthalate, ug/L	---	---	---	---	<25	
N-Nitrosodi-n-propylamine, ug/L	---	---	---	---	<40	
N-Nitrosodimethylamine, ug/L	---	---	---	---	<80	
Other B/N,A Ext. Priority Pollutants	---	---	---	---	<10	

LOG NO: P86-08-106

Received: 07 AUG 86

Reported: 28 AUG 86

Sam Williams
Hargis & Associates, Inc.
2223 Avenida de la Playa Suite 300
La Jolla, CA 92037

Project: 250

400-1110

REPORT OF ANALYTICAL RESULTS

Page 6

LOG NO	SAMPLE DESCRIPTION , GROUND WATER SAMPLES	DATE SAMPLED				
08-106-16	Radar Range Seep	06 AUG 86				
08-106-17	C-3	06 AUG 86				
08-106-18	C-5	06 AUG 86				
08-106-19	HM-21	06 AUG 86				
08-106-20	P-13M	06 AUG 86				
PARAMETER	08-106-16	08-106-17	08-106-18	08-106-19	08-106-20	
Purgeable Priority Pollutants						
Extraction	08/16/86	08/16/86	08/16/86	08/16/86	08/16/86	
Acrolein, ug/L	<10	<10	<10	<250	<10	
Acrylonitrile, ug/L	<10	<10	<10	<250	<10	
Toluene, ug/L	<1	<1	150	<25	<1	
trans-1,2-Dichloroethylene, ug/L	<1	<1	<1	4400	<1	
Other Purgeable Priority Pollutants	<1	<1	<1	<25	<1	

Edward Wilson, Laboratory Director

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

