



B A S E L I N E G E O T E C H N I C A L I N V E S T I G A T I O N
F O R T H E
S U B S U R F A C E D I S P O S A L O F M I L L W A S T E

FEDERAL-AMERICAN PARTNERS PROJECT
GAS HILLS MINING DISTRICT
FREMONT COUNTY, WYOMING

Prepared For
Federal-American Partners
Job No. 1-1371-3771
1979

FFF EXEMPT
add'l info

9706120293 790312
PDR ADOCK 04004492
B PDR

12224

F. M. FOX & ASSOCIATES, INC.
Consulting Engineers and Geologists

4765 INDEPENDENCE STREET
WHEAT RIDGE (DENVER), COLORADO 80033
(303) 424-5578 — FMFOX

Mr. Floyd D. Jackson
Federal-American Partners
Gas Hills Star Route
Riverton, Wyoming 82501

January 30, 1979

Job No. 1-1371-3771

Dear Mr. Jackson:

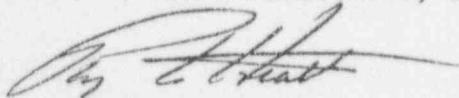
At your request we have completed the Baseline Geotechnical Investigation for the Subsurface Disposal of Millwaste. The report contains geotechnical design criteria to consider in the preparation of the final subsurface disposal pit design and plans. Design criteria are concentrated in the area of the proposed Sagebrush-Tablestakes pit; however, information is also included for the proposed Bullrush area.

In addition to the baseline data, preliminary design alternatives have been prepared based upon our evaluation of the data generated by this report. Design alternatives are presented in Appendix E.

Upon completion of discussion of design alternatives with Federal-American Partners staff we are ready to proceed with the final design phase of the project.

If further consultation regarding the contents of this report is required, or if we can be of further assistance, please do not hesitate to contact us.

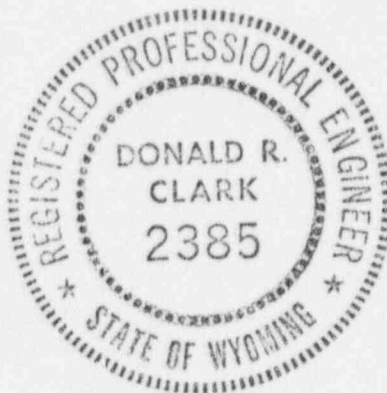
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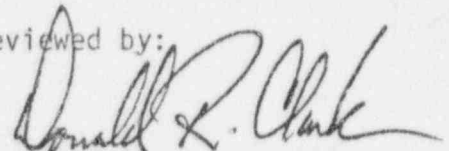
Regan Heath
Project Engineer

RH/tl

Copies: 3



Reviewed by:



Donald R. Clark, P.E.
Division Manager

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SCOPE OF INVESTIGATION

This report presents the results of a baseline geotechnical investigation conducted to delineate subsurface conditions for the proposed subsurface disposal of uranium millwaste at the Federal-American Partners Gas Hills Project, Gas Hills Mining District, Fremont County, Wyoming. This investigation has been conducted to define geologic and hydrologic conditions, and material properties that are pertinent to the geotechnical design of a disposal system that will meet current NRC (Nuclear Regulatory Commission) licensing requirements for below-grade uranium millwaste impoundments. The major geotechnical design criteria that have been gathered during this investigation include the following:

- Foundation and sidewall permeabilities
- Tailing and remolded overburden permeabilities
- Physical Groundwater conditions
- Surface water hydrology
- Overall geologic conditions
- Settlement characteristics of tailing and remolded overburden

This report includes geotechnical data for the proposed Bullrush and Sagebrush-Tablestakes pit areas, however, it is our understanding that the Sagebrush-Tablestakes area is intended for immediate use. Preliminary subsurface disposal design alternatives for the Sagebrush-Tablestakes area are included in the report. This report has been written for use as supporting technical data in the final pit disposal plan.

Factual data gathered during the field and laboratory work are summarized in Appendices A through D. Conceptual pit disposal sections are presented in Appendix E.

PROPOSED PIT REQUIREMENTS, LOCATION & TOPOGRAPHY

Federal-American Partners currently processes approximately 1,000 tons of uranium ore per day and intends to increase its milling capacity to 4,000 tons per day within the next 2 years. In order to dispose of the increased mill-waste volume in an environmentally safe manner, and in accordance with NRC requirements, a subsurface disposal site is required. A pit life of 10 years is desired requiring a volume of approximately 7.4 million cubic yards.

The disposal site under consideration will be located in an abandoned open pit mine. This investigation addresses two potential pit disposal areas, the proposed Bullrush and Sagebrush-Tablestakes pits. The Sagebrush-Tablestakes pit will be used for disposal in the near future as pit excavation is currently in progress. The total Sagebrush-Tablestakes pit volume will be approximately 15 million cubic yards. The Sagebrush-Tablestakes pit limits are presented on Plate 3. The pit is located in the south 1/2 of Section 32, Township 33 North, Range 90 West of the 6th principal meridian, Puddle Springs Quadrangle, Fremont County, Wyoming. More specifically, the proposed site is located approximately 0.8 miles west and south of the Federal-American Partners mill site.

Natural topography of the site consists of rolling hills and small intermittent drainages, however, much of the original topography has been modified by mining activity. Previously mined out pits have been backfilled to the northeast and northwest of the Bullrush area. Open pits and pits being currently mined are located to the south and southwest of the proposed Sagebrush-Tablestakes pit and to the west and northwest of the proposed Bullrush pit. Refer to Plate 1 for the site topography.

AREA GEOLOGY

The Gas Hills area is located in the southern portion of the Wind River Basin adjacent to the northern part of the Sweetwater uplift. Beaver Divide marks the southern most extension of the Wind River Basin and is located approximately three miles south of the Federal-American Partners mill site.

Lithologies encountered during this investigation are part of the Wind River Formation. The geologic materials at the site were derived from two episodes of the Sweetwater uplift. During the first episode, in late Cretaceous time, coarse grained material was deposited north of the Gas Hills area in the deeper portions of the Wind River Basin. As the basin became filled with sediments fine grained sands and silts were deposited in the Gas Hills area. The second episode of Sweetwater uplift, in early Eocene times, resulted in erosion of a portion of the fine grained sands and silts followed by a rapid deposition of new coarse grained material in the Gas Hills area. These newly deposited alluvial fan deposits have become the host rock for the Gas Hills uranium.

The older fine grained sands and silts are known as the lower Wind River Formation and the younger coarser grained material form the upper Wind River Formation. Both the upper and lower Wind River Formations can be found in the Federal-American Partners pit areas.

SEISMIC CONDITIONS

Wyoming is a low seismic activity region with most of the activity occurring in the extreme western portion of the state (S.T. Algermissen, et al.). The seismic risk map of the United States (S.T. Algermissen) indicates

that the Gas Hills area is a Zone 1 seismic area. Zone 1 has been defined as an area that can expect minor earthquake damage from mild earthquake events.

Recorded earthquakes within a 200 mile radius are tabulated on Table 1. The earthquake epicenter location, date of occurrence, Modified Mercalli intensity rating and the approximate distance from the epicenter to the Gas Hills area are included on this table. The information indicates that the highest intensity event recorded, closest to the site, occurred in southeast Fremont County, approximately 21 miles southwest of the Gas Hills on April 21, 1973. The Modified Mercalli intensity at the epicenter was reported as V. Shoshoni, Wyoming reported an intensity of IV for the event. No Modified Mercalli Intensity was recorded for the Gas Hills area, however, it is reasonable to assume that an intensity III or IV was realized.

To our knowledge, no damage to any existing structures (i.e., tailing dams, mill sites, etc.) occurred in the Gas Hills area from this event. A second close event was recorded approximately 31 miles west of the Gas Hills on March 25, 1975 with an intensity III reported at Jeffery City and Riverton, Wyoming.

The Hebgen Lake, Montana earthquake in August of 1959 was the largest recorded, regional earthquake in the Wyoming area. The event was recorded at 7.1 on the Richter Magnitude Scale and has been assigned a Modified Mercalli intensity of X at the epicenter. Refer to Table 2 for recorded intensities reported at various distances away from the Hebgen Lake epicenter. Lander, Wyoming (62 miles from the Gas Hills) and Casper, Wyoming (59 miles from the Gas Hills) reported intensities of IV and III, respectively. A maximum intensity of IV is postulated to have occurred in the Gas Hills area from this event.

REGIONAL EARTHQUAKE HISTORY (200 mile radius)

DATE		APPROX. EPICENTER LOCATION	LAT.	LONG.	MODIFIED MERCALLI INTENSITY	APPROX. DISTANCE TO EPICENTER (miles)
1894	7-25	Casper, Wyoming	42.9N	106.3W	V	61
1897	11-14	Casper, Wyoming	42.9N	106.3W	VII	61
1910	7-26	Rock Springs, Wyo.	41.5N	109.3W	V	128
1917	12-12	Gray, Idaho	43.0N	111.3W	V	193
1923	3-24	Kelly, Wyoming	43.6N	110.6W	V	166
1925	11-18	N. Central Wyo.	44.6N	107.0W	V	127
1928	2-13	Central Wyoming	43.5N	108.2W	V	60
1930	6-12	Grover, Wyoming	42.6N	111.0W	VI	178
1932	1-26	Western Wyoming	43.6N	110.8W	V-VI	176
1933	11-02	Gray, Idaho	43.0N	111.3W	V	193
1934	11-23	Lander, Wyoming	43.0N	109.0W	V	62
1948	2-24	N.W. Wyoming	43.5N	111.0W	VI	183
1951	2-21	W. Central Wyoming	43.0N	110.0W	III	127
1953	6-04	N.W. Wyoming	44.5N	110.5W	VI	191
1954	1-20	S.E. Wyoming	41.5N	105.5W	V	135
1955	2-10	N.W. Wyoming	40.5N	107.0W	V	108
1956	10-03	S.W. Wyoming	41.5N	110.1W	IV	160
1957	11-03	W. Central Wyoming	42.5N	111.0W	IV	179
1958	8-07	Fox Park, Wyoming	41.1N	106.0W	IV	140
1959	12-25	Fox Park, Wyoming	41.1N	106.0W	V	140
1960	8-20	S.E. Idaho	42.3N	111.3W	V	196
1962	10-06	Western Wyoming	43.6N	110.8W	IV	176
1963	2-25	Western Wyoming	42.6N	109.2W	V	87
1963	3-05	S.E. Idaho	42.6N	111.3W	III	194
1963	3-08	Yellowstone Nat'l Park, Wyoming	44.8N	110.2W	VI	193
1963	4-18	Yellowstone Nat'l Park, Wyoming	44.8N	110.3W	V	197
1964	8-22	Eastern Wyoming	42.9N	104.7W	V	142
1967	2-14	Rangely, Colorado	40.1N	109.0W	V	195
1968	1-09	Central Wyoming	42.7N	106.8W	III-IV	36
1969	8-27	W. Central Wyoming	42.9N	110.8W	III	168
1970	4-21	Rangely, Colorado	40.1N	108.9W	V	199
1972	11-24	Idaho	42.5N	111.2W	IV	187
1973	4-22	S.E. Fremont County, Wyoming	42.6N	107.9W	V	21
1974	3-31	Northern Colorado	40.7N	107.1W	II	145
1974	9-19	N. Central Wyoming	44.1N	107.4W	V	91
1975	3-25	Central Wyoming	42.7N	108.1W	III	31
1975	5-16	S.W. So. Dakota	43.2N	103.7W	IV	196
1976	1-27	Rawlins, Wyoming	41.9N	107.2W	FELT	60
1976	9-03	Kaycee, Wyoming	44.0N	106.2W	FELT	109

Data compiled with the help of U.S. Department of Commerce,
National Oceanic and Atmospheric Administration.

HEBGEN LAKE, MONTANA EVENT

AUGUST 17, 1959

EPICENTER - 44.83N, 111.08W

RICHTER MAGNITUDE - 7.1

MERCALLI INTENSITY - X

Earthquake intensity file - selected locations and Mercalli intensity
at that location.

LOCATION	MERCALLI INT.	DISTANCE FROM EPICENTER (miles)	DISTANCE FROM GAS HILLS(miles)
Hebgen Lake, Montana	X	0	216
Yellowstone Nat'l Park, Wyoming	VIII	51	177
Cooke City, Wyoming	VI	57	196
Jackson Lake Dam, Wyoming	VI	112	150
Buffalo, Wyoming	V	220	115
Cody, Wyoming	V	101	143
Jackson, Wyoming	V	95	171
Pinedale, Wyoming	V	150	118
Thermopolis, Wyoming	V	164	69
Lander, Wyoming	IV	181	62
Worland, Wyoming	IV	163	88
Casper, Wyoming	III	275	59

Data obtained from 1959 addition of:

"United States Earthquakes", U.S. Dept. of Commerce,
National Oceanic and Atmospheric Administration

Historical information, such as that discussed above and tabulated in Tables 1 and 2 for the Gas Hills area and the Wyoming region, indicates that the Gas Hills area probably has experienced a disturbance no greater than an intensity of IV. The largest earthquake which is likely to occur, based on the existing seismic data, is not expected to exceed a Modified Mercalli intensity of IV.

SURFACE WATER HYDROLOGY

In order to estimate the volume of surface run-off water that the proposed Sagebrush-Tablestakes pit area will receive a preliminary hydrology study was conducted.

The drainage area that will contribute to the proposed pit is approximately 0.2 square miles. This is a preliminary number because of the continual topographic changes in the mining area. It assumes that the Union Carbide K-1 pit will be backfilled and that drainage from that area will be re-directed to drainages located east of the pit. In addition, it assumes that drainage in the area of a pit under excavation immediately northwest of the Sagebrush-Tablestakes pit will also be re-directed away from the site.

The retention volume for the Sagebrush-Tablestakes pit was determined using volumes that could be expected from the Probable Maximum Flood series. The Probable Maximum Flood series is made up of two floods: the Probable Maximum Flood (PMF) and a flood equivalent to 40 percent of the PMF occurring a few days prior to the main flood.

The water volume generated by the PMF will be approximately 96 acre-feet for the drainage area. The total volume to be retained (above the normal pool elevation) will be $96 + .40 (96) = 134.4$ acre-feet. This assumed negligible evaporation during the time between the two flood events.

The volume of the PMF was determined by adjusting the probable maximum one-hour thunderstorm value of 9.8 inches to a runoff value of 8.83 inches (curve number=92; Antecedent Moisture Condition III). These values were obtained from rainfall maps and charts presented in the Bureau of Reclamation publication "Design of Small Dams" and from charts presented in the Soil Conservation Service Technical Release No. 55 "Urban Hydrology for Small Watersheds". The runoff value of 8.83 inches was used for 90 percent of the drainage area. Since the retention pond in the disposal area will cover approximately 10 percent of the total area, the total 9.8 inch value was used for this water surface. The runoff curve number was obtained by adjusting the normal curve number of 81, which has been found to be satisfactory for the area, to 92 for the saturated antecedent moisture condition (AMC-III). A saturated value is used because it is anticipated that a major portion of the area will be continuously sprayed with water to control fugitive dust.

FIELD INVESTIGATION

The field investigation for the proposed disposal areas consisted of 21 exploration borings drilled around the perimeters of the proposed Bullrush and Sagebrush-Tablestakes pit areas. Refer to Plate 1 (in pocket) for boring locations. Borings were advanced with two CME 55 drill rigs, capable of auger drilling and sampling, in-situ permeability testing and core drilling. The borings were drilled into corable bedrock with four inch diameter solid augers. The soils, fill and/or bedrock above core point were sampled with either a two inch diameter California Sampler or a Split Spoon Standard Sampler. Standard Penetration tests were conducted at each sample location. When corable bedrock was encountered, continuous core was retrieved with an NX wire line core barrel. In-situ packer type permeability tests were conducted

in most of the borings. The tests were conducted at different depths and in different lithological zones, to determine horizontal permeabilities for each lithology. The tests were conducted by using a three or a four inch diameter rubber packer, set in a four inch diameter auger hole or a "NX" size core hole. In most cases the packer tests were conducted at more than one hydraulic head to verify the permeability test results. Upon completion of each boring, the hole was geophysically logged by logging equipment supplied by Federal-American Partners. Resistivity logs are, in most cases, limited to the lower portions of the borings because drilling fluid could not be retained in the holes. Boring ST-F8 was not geophysically logged due to caving problems. Borings ST-F2 and ST-F3 were eliminated from the drilling program due to the availability of Federal-American Partners geophysical logs in that area. Upon completion of drilling and logging, each boring was cased with two inch diameter slotted PVC for water level monitoring. Detailed lithologic boring logs and geophysical logs can be found in Appendicies A and B respectively.

In addition to the drilling program, representative tailing samples were obtained from the mill discharge line. These samples were obtained for use in subsequent laboratory investigations.

LABORATORY INVESTIGATION

Upon completion of the field investigation, all samples obtained during the drilling operations and representative tailing samples were returned to our Denver laboratory and inspected by the project engineer. Field classifications were then verified and the laboratory testing program was formulated.

The laboratory testing program was divided into two sections. The first section was composed of material classification tests, including sieve analysis and Atterberg Limit determinations, on undisturbed samples from each lithology and on samples of mill tailing. The second section consisted of engineering property tests including standard Proctor determinations, one-dimensional time-rate consolidation tests, and falling-head permeability tests. Time-rate consolidation tests were conducted on undisturbed foundation soils and remolded samples of mill tailing and overburden material. Falling-head permeability tests were conducted on undisturbed samples from each lithology and on remolded samples of mill tailing and overburden material.

All of the laboratory tests were conducted in accordance with appropriate ASTM specifications. Laboratory test results are presented in Appendix D.

SUBSOIL CONDITIONS

Borings BUL-F1 through BUL-F8 were drilled in the Bullrush mineralized area. Borings ST-F1 through ST-F13 were drilled in the Sagebrush-Tablestakes mineralized area. Cross sections have been constructed through both areas by combining data obtained from this investigation and previously obtained exploration data supplied by Federal-American Partners. Refer to Plate 1 (in pocket) for boring locations and cross section lines. Refer to Appendix A and B for lithologic and geophysical boring logs respectively. Refer to Appendix C for cross section profiles.

Subsoil conditions are similar across both the Sagebrush-Tablestakes and Bullrush areas but vary with depth. Refer to Appendix C, Figure 2, section B-B' for typical vertical and horizontal lithology changes across the

site. Typically 0 to 90 feet of pit backfill or stockpiled overburden overlies a residual sand (weathered bedrock materials) that varies in thickness from 0 to 50 feet. The bedrock encountered consists of a homogeneous white to yellow brown, fine to coarse grained sandstone over light to dark green, fine to medium grained silty sandstone. This sandstone unit is generally interbedded with mudstone lenses varying from 0 to 40 feet in thickness. A 30 foot thick, continuous mudstone lens was encountered in the Sagebrush-Tablestakes area as is indicated on the cross sections. The bedrock units in the Sagebrush-Tablestakes area are capped with a silty sandstone conglomerate bedrock varying in thickness from 0 to 25 feet. It should be noted that the subsurface conditions are greatly affected by the presence of a high angle normal fault striking approximately east-west and having an average displacement of approximately 110 feet, down to the north. This fault roughly divides the Sagebrush-Tablestakes and Bullrush areas.

Existing fill permeabilities average 5×10^{-4} centimeters per second in both the vertical and horizontal directions. Conglomerate permeabilities could not accurately be determined due to poor sample recovery and hole caving. Conglomerate permeabilities are estimated to be approximately 10^{-3} CM/SEC in both the vertical and horizontal directions. The homogeneous fine to coarse grained sandstone has an average permeability of 2×10^{-4} CM/SEC in both directions. The interbedded fine to medium grained sandstone and mudstone has an average horizontal permeability of 4×10^{-5} CM/SEC and an average vertical permeability controlled by the mudstone lenses, of 3×10^{-7} CM/SEC.

GROUNDWATER CONDITIONS

Refer to Plate 2 (in pocket) for piezometric surface contours within the study area. It can be seen from Plate 2 that the groundwater flow conditions are extremely complicated. Generally, flow is from north to south at gradients corresponding to lithologic dips (refer to north south cross sections). Within the project area, groundwater flow is being controlled by the east-west fault, and by pumping withdrawals from Union Carbide K-1 pit and the Federal-American Partners existing Bullrush pit. The presence of pumping in both pits is indicated very clearly on the piezometric surface contour map, however, the fault effects can be interpreted in two ways:

1. The fault is being recharged to the east and is recharging in the area of investigation to the north and south.
2. The fault has displaced the thick mudstone lens in the Sagebrush-Tablestakes area upward and created a "perched" water surface on top of the mudstone creating two water surfaces.

Using either of these interpretations it is estimated that upon termination of pumping in the Sagebrush-Tablestakes area the groundwater surface will recharge to approximately 30 feet above the top of the continuous mudstone lens. Flow in this area will be generally from north to south with a gradient of approximately 0.015 feet per foot.

Groundwater quality data has not been compiled, however, borings drilled for this investigation have been cased in a manner that will allow for sample collection. It is recommended that water quality data collection be initiated as soon as possible.

DESIGN PERFORMANCE OBJECTIVES

Prior to final design of the subsurface disposal system, performance objectives must be established. The objectives should meet the requirements to satisfy both geotechnical and operational constraints, and to provide an environmentally acceptable disposal plan. Operational objectives are as follows:

1. Design a system to minimize maintenance, and eliminate any continual construction in the system.
2. Design a system that is not generally affected by modifications in the mill circuit.
3. Design a system where pond water can be controlled in the disposal area (i.e., such as sprinkler systems to control fugitive dust), and minimize and amount of water that would be returned to the mill circuit.
4. Design a system that will initially be located in the proposed Sagebrush-Tablestakes area, with the possibility of extending this area to handle future disposal.
5. Design a system to prevent immediate contamination of the Federal-American Partners village well.
6. Design a system that could utilize the existing Tailing Pond No. 1 as an evaporation pond if needed.
7. Design a system where the millwaste can be deposited with or without the use of cyclone separators.
8. Complete final disposal plan for submittal to the NRC and the Wyoming Department of Environmental Quality (DEQ), for final review by March 5, 1979.
9. Initiate subsurface disposal by August 1, 1981.

The geotechnical performance objectives which need to be addressed as a result of this investigation include the following:

1. Reduce to an acceptable level or eliminate groundwater contaminate migration from the proposed storage impoundment.
2. Reduce to an acceptable level or eliminate wind blown contaminate migration from the proposed storage impoundment.
3. Provide for tailing drainage and subsequent drying prior to site reclamation.
4. Control or predict tailing settlement in such a manner to allow for stable impoundment cover placement.
5. Provide sufficient cover upon completion of tailing deposition, drying and settlement to reduce gamma radiation to near background and random radiation to twice background.
6. Eliminate the need for extended monitoring subsequent to reclamation.
7. Perform all of the above in a cost effective manner by maximizing the storage volume and minimizing cost.

SAGEBRUSH-TABLESTAKES AREA PIT

The following is a list of design criteria relative to the proposed Sagebrush-Tablestakes pit to be used in the preparation of a design that will meet performance objectives listed above.

Water Balance Criteria

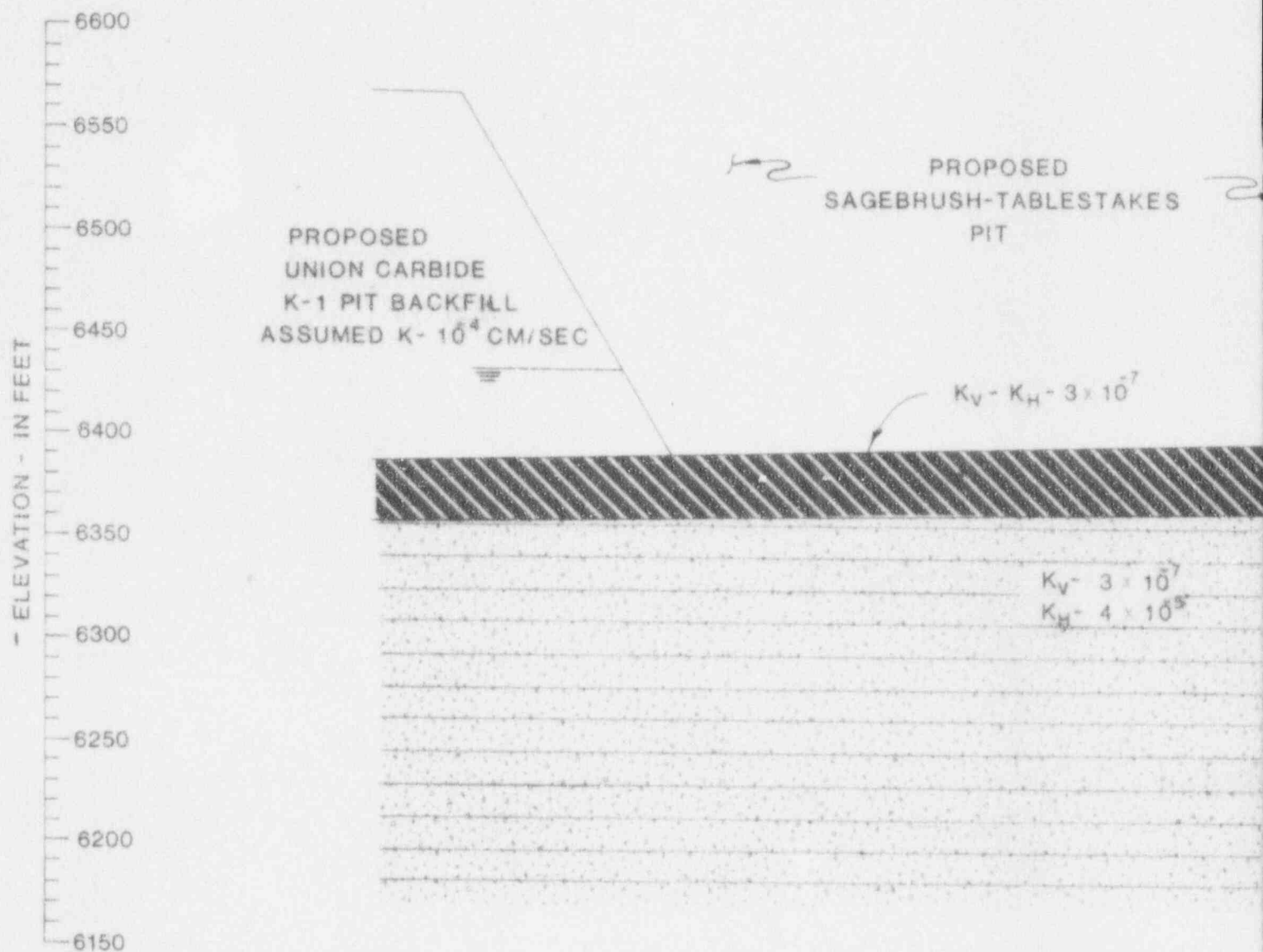
- 1) Tailing will be slurried to the proposed pit. The water portion of the slurry will be approximately 1,000 gallons per minute upon completion of mill expansion.
- 2) An evaporation rate of 42 inches per year.
- 3) Sprinkler irrigation losses for standard rainbird type sprinklers of approximately 25 percent of the total sprinkled volume. (Could be increased by finer spray sprinklers).

4. Zero seepage losses.
5. Possible pit discharge as mill make-up water.
6. A probable maximum flood storage of 96 acre-feet of water and an average rainfall recharge of 9.8 inches per year.

Material Properties Criteria






1. Subsurface conditions as indicated on Figure C-1 through C-5 (Appendix C).
2. Pit sidewall and foundation permeabilities - refer to Figure 1 for average values.
3. Material classifications - refer to Figures D-1 through D-18 (Appendix D)
4. Remolded overburden and tailing permeability as a function of depth of burial - refer to Figure 2.
5. Remolded overburden, tailing and natural foundation material consolidation characteristics - refer to Figure D-21 through D-32 (Appendix D).
6. Natural static water level at 30 feet above the top of the mudstone layer in the bottom of the proposed pit.
7. A maximum seismic event on the order of IV on the Modified Mercalli intensity scale.

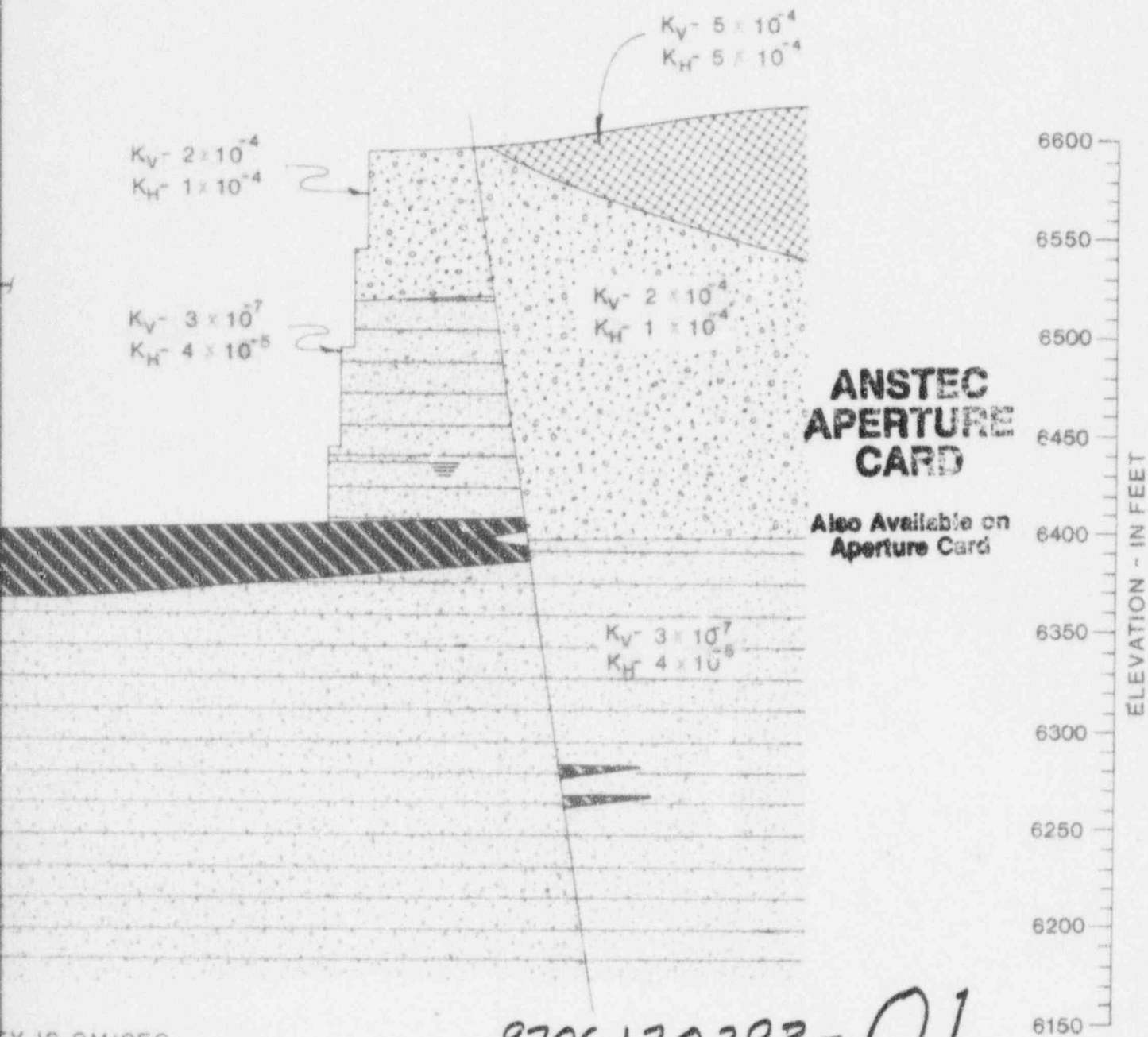
Based upon the results of this investigation, we have formulated six disposal schemes which could be used in the final design to meet both geotechnical and operational performance objectives. The final disposal plan should be based on one of these schemes that will be compatible with the operation of mill circuit. The data generated in this report can be used to design any of the systems and justify the final plan to the reviewing agencies. It is our opinion that the geotechnical data presented provides justification for the use of either scheme presented on Figures E-5 and E-6, and that these schemes can be justified to the NRC and Wyoming DEQ. We emphasize that the NRC has



NOTE: PERMEABIL

LEGEND:

-  FILL, SAND, fine to coarse grained with traces of gravel, silty and loose to medium dense, medium moist, green to brown
-  White to yellow brown, fine to coarse grained, poorly to moderate quartz sandstone, with traces of silt and gravel
-  Sandstone conglomerate with clean lenses
-  Light to dark green, fine to medium grained, silty, poorly to well to moderately cemented (clay), quartz sandstone, with coarse grain mudstone lenses.
-  Green, slightly arenaceous (fine grained), slightly silty, mudstone



TY IS CM/SEC

d clayey in part,

y cemented (clay),

sorted, very weakly
ed sandstone and

9706120293-01

TYPICAL SECTION WITH AVERAGE PERMEABILITIES

FEDERAL-AMERICAN PARTNERS
MILLWASTE SUBSURFACE
DISPOSAL INVESTIGATION

F.M. FOX & ASSOCIATES, INC.
4765 INDEPENDENCE ST.
WHEAT RIDGE, COLO., 80033

DATE: 1/23/79

DRAWN BY: SLM

REVIEWED BY: RHH

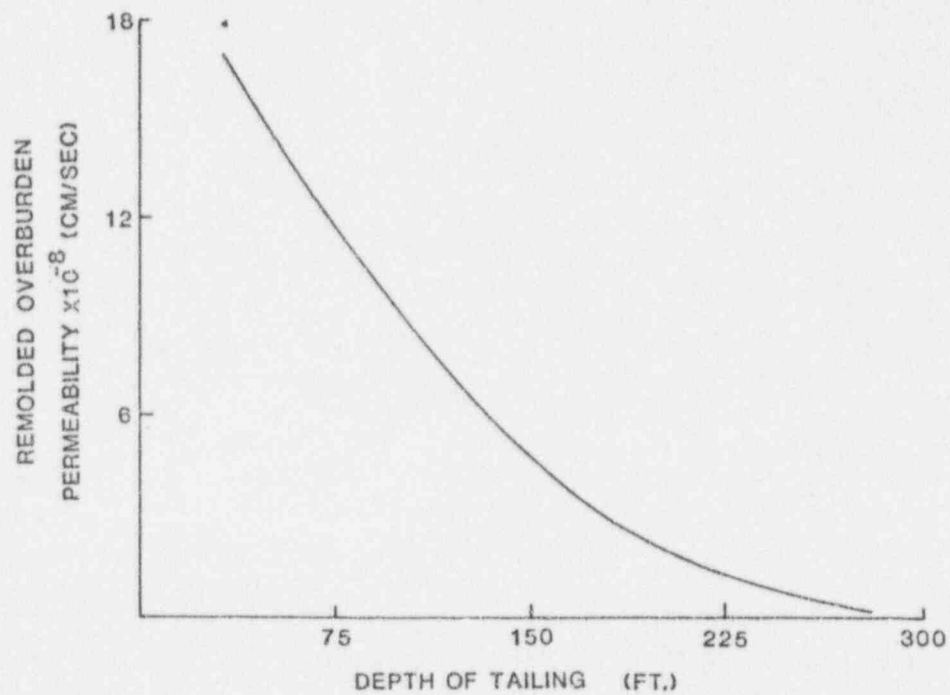
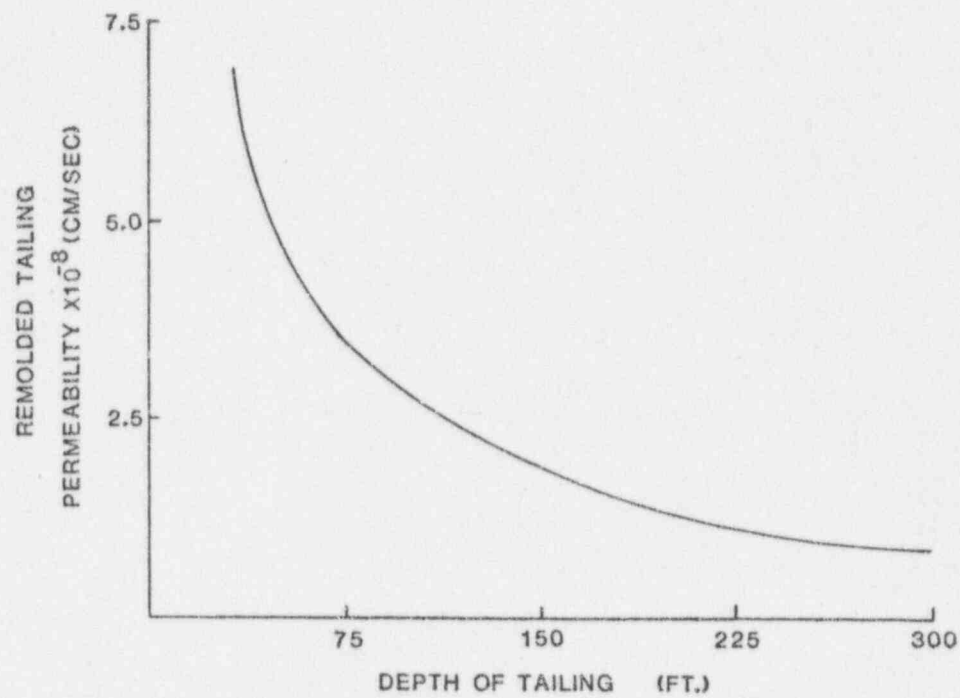
VERTICAL SCALE: 1" = 80'

HORIZONTAL SCALE: 1" = 200'

JOB NO. 1-1371-3771

FIGURE 1

PERMEABILITY AS A FUNCTION OF DEPTH OF TAILING



NOTE. PERMEABILITY DATA AVERAGED FROM
TIME-RATE CONSOLIDATION TEST DATA.

not approved the disposal of millwaste below any "regional" ground water. The use of the scheme presented on Figure E-1 has already been approved but will result in a severe loss of storage capacity. We conclude however, that enough data has been generated, and the technical support can be compiled to justify the use of any of the systems.

The key design features of each scheme are included in Appendix E. The final disposal plan and justification will be initiated by this firm after review of these schemes with you.

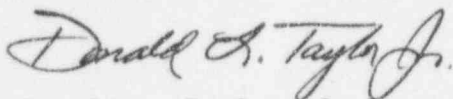
REVIEW

This report presents design objectives and the design data required to prepare a final subsurface disposal system impoundment design.

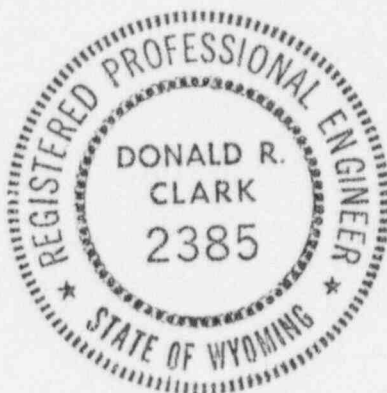
Prior to preparation of the final disposal system design it is very important that operational aspects be discussed with Federal-American Partners. A thorough review and discussion of the preliminary designs is recommended, after which the final design task can be undertaken.

If you have any questions or desire further consultation please do not hesitate to contact us.

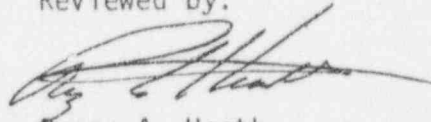
F. M. FOX & ASSOCIATES, INC.



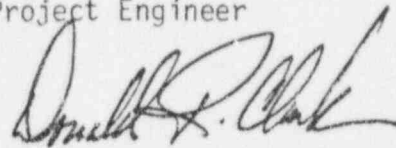
Donald L. Taylor, Jr.
Staff Engineer



Reviewed by:



Regan A. Heath
Project Engineer



Donald R. Clark, P.E.
Division Manager

DLT/RH/t1

APPENDIX A

LITHOLOGIC BORING LOGS

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST F-1

COLLAR ELEVATION: 6583 feet TOTAL DEPTH: 299.5 feet

DATE BEGUN: October 19, 1978 DATE FINISHED: October 26, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA 4"					FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown											
	6573	10				4/12										
	6563	20				8/12										
	6553	30				8/12										
	6543	40			41' Trace of gravel	18/12										
	6533	50			52' Gravel with possible cobbles	24/12										
	6523	60				47/12										
	6513	70				50/10										
	6505	78			76' Mudstone chips											
	6503	80			White to yellow brown, fine to coarse grained, poorly to moderately cemented (clay), quartz sandstone, with traces of silt and gravel	50/4.5										
	6493	90				50/3										
	6483	100			96' - 106' Fine grained, silty lense with some iron staining	50/3										

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES CORE RECOVERY
 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES. REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-37/1

BORING NO. ST F-1

COLLAR ELEVATION: 6583 feet TOTAL DEPTH: 299.5 feet

DATE BEGUN: October 19, 1978 DATE FINISHED: October 25, 1978 LOGGED BY: Ernest Knobel REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION * RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
	6473	110				50/2.5										
	6463	120				50/2.5										
	6453	130														
	6443	140			137' - 143.5' Gravelly with possible cobbles	50/3.6				2.5×10^{-6}	3.8×10^{-4}	20			108.5	
	6438	145														
C	6433	150			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	50/2.5		98								149.5' - started coring with revert, 100% circulation
	6423	160			157' - 163.5' Fine grained, silty, slightly argillaceous, moderately to well cemented lense			100								
	6413	170			170' - 191.5' Coarse grained lense			100								
	6403	180						100								
	6393	190			191.5' - 199.5' Fine grained, silty, slightly argillaceous, moderately to well cemented lense			100		1.3×10^{-4}						192' - 10/22/78 water level 180' down from top of collar, lost all circulation
	6383	200						80								

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
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 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES CORE RECOVERY
 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 3 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-1

COLLAR ELEVATION: 658.5 feet TOTAL DEPTH: 299.5 feet

DATE BEGUN: October 19, 1978 DATE FINISHED: October 25, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: RH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
							100	100								200' - drilling without any revert
							0	0								
	6373	210			215.7' - 220'		94	94								211.5' - 10/24/78 water level 189' down from top of collar
	6363	220					90	90								
							0	0								224.5' - 10% circulation
	6353	230			228.5' - 242'		4.5	4.5								
					Fine grained, silty, slightly argilla- ceous, moderately to well cemented lens		100	100								
	6343	240			242' - 248.5'		100	100								
					Slightly arenaceous (fine grained), mudstone lens with secondary pyrite		100	100								
	6333	250		11/1			100	100								
							100	100								
	6323	260			264.5' - 299.5'		100	100								260' - 10/25/78 water level 189' down from top of collar
					Coarse grained lens		41.5	41.5								
	6313	270		12/18			0	0								270' - 50% circulation
								100								
	6303	280						100								
								0								
	6293	290						0								
							50	50								290' - 10/26/78 water level at 192'
																293' - 295' end of metric log
	6283.5	299.5					0	0								

Bottom of hole

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
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INDICATES
CORE RECOVERY

INDICATES
CORE LOSS

INDICATES WATER
LEVEL AND DATE
RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS: NUMBER
OF BLOWS WITH A 140 POUND HAMMER,
FALLING 30 INCHES, REQUIRED TO DRIVE
A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-4

COLLAR ELEVATION: 6552 feet TOTAL DEPTH: 284.0 feet



DATE BEGUN: September 28, 1978 DATE FINISHED: October 10, 1978 LOGGED BY: Forrest Knobe REVIEWED BY: RAN


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING #200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA	6542	10			FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown 0 - 10' silty 13' Trace of gravel	18/12										
	6532	20				16/12										
	6522	30				25/12										
	6512	40			36' Trace of gravel	23/12					1.5x10 ⁻³	34			125.6	
	6502	50				47/12										
	6492	60				34/12										
	6482	70			68' - 92' Mudstone chips	47/12										
	6472	80				25/12										
	6462	90				36/12										
	6452	100				50/4.5				9.1x10 ⁻⁶						

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
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- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST F-4

COLLAR ELEVATION: 6552 feet TOTAL DEPTH: 284.0 feet

DATE BEGUN: September 28, 1978 DATE FINISHED: October 10, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: RAN

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
R	6442	110			112.5' - 127' Trace of gravel	50/3				3.5×10^{-6}						104.5' - started coring with revert, lost circulation at 112.5' tried tri-cone bit 100% circulation
	6432	120														
	6424	128				50/4.5										
	6422	130			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses 128' - 139.5'											
	6412	140			Fine grained, silty, slightly argillaceous, moderately to well cemented lense	50/5										
	6402	150														
	6392	160			156' - 157' Trace of small gravel	50/2.5										157' wore out tri-cone bit so changed to drag bit
	6382	170			169' - 170' Trace of small gravel 170.5' - 176' Fine grained, silty, slightly argillaceous, moderately to well cemented lense	50/3										
	6372	180		11/1	181.5' - 186.5' Fine grained, silty, slightly argillaceous, moderately to well cemented lense											
	6362	190		12/3	190.5' - 194' Fine grained, silty, slightly argillaceous, moderately to well cemented lense	50/5				4.0×10^{-6}						
	6352	200														

EXPLANATION

HOLE TYPES

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 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

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F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 3 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-4

COLLAR ELEVATION: 6552 feet TOTAL DEPTH: 284.0 feet

DATE BEGUN: September 28, 1978 DATE FINISHED: October 10, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	* PENETRATION RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
	6342	210			212.5' - 217' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lense	50/4										
	6332	220			217' - 223.5' Fine grained, silty, moderately cemented lense	50/3										217' - 50% circulation
	6322	230			223.5' - 227.5' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lense	50/1										232' - 80% circulation
	6312	240			242.5' - 247.5' Traces of gravel	50/1										247' - 90% circulation
	6302	250														
	6292	260			259' - 262' Fine grained, silty, moderately cemented lense	50/5										
	6282	270			262' - 284' Slightly arenaceous (fine grained), mudstone lense	50/2.25										
	6272	280														
	6268	284			Bottom of hole											

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES
CORE RECOVERY

INDICATES
CORE LOSS

INDICATES WATER
LEVEL AND DATE
RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER
 OF BLOWS WITH A 140 POUND HAMMER,
 FALLING 30 INCHES, REQUIRED TO DRIVE
 A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-5

COLLAR ELEVATION: 6589 feet TOTAL DEPTH: 249.25 feet

DATE BEGUN: September 29, 1978 DATE FINISHED: October 8, 1978 LOGGED BY: Don Taylor

REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA																
4"																
	6570	10			FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown	10/12										
	6578	13				48/12					6.0×10^{-4}	20			103.3	
	6569	20			White to yellow brown, fine to coarse grained, poorly to moderately cemented (clay), quartz sandstone, with traces of silt and gravel	37/12										
					18' - 23'	50/8										
					Traces of gravel with some iron staining	50/8										
	6558	30			28' - 42'	50/6.5										
					Trace of pyrite and iron staining	50/5.5					7.4×10^{-4}	18			109.2	
	6549	40				50/5										
C						50/4.75										
2 7/8"																
	6539	50					37	41			1.2×10^{-6}					Started coring at 45' using revert, 100% circulation
							0	3								
	6529	60					0	0								59' - drilled faster
							0	0								pushed casing down 3 more feet
	6519	70			more coarse grained and iron staining towards end of zone		30	30								
	6516	74					48	60			4.9×10^{-5}	16			110.0	72' - drilling firmed up
	6508	80			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	100		100								75.5' drilled faster
					83' - 91'			100								76' - water pressure up
					Coarse grained lense			100								
	6499	90			91' - 119'			100								86' - 95% circulation drilling firmed up and water pressure up
					Fine grained, silty, slightly argilla- ceous, moderately to well cemented lense			100								91.5' - water pressure surge and drilling firmed up
	6489	100						100								

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

- INDICATES CORE RECOVERY
- INDICATES CORE LOSS

- INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-5

COLLAR ELEVATION: 6589 feet TOTAL DEPTH: 249.25 feet



DATE BEGUN: September 29, 1978 DATE FINISHED: October 8, 1978 LOGGED BY: Don Taylor REVIEWED BY: PDH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
C	6479	110					100	100								102' - drilling firmed up 104' - getting water back flow up hole
							82	100								
	6479	110					92	100								114.5' - drilled faster
							100	100								119' - water pressure up and bit trying to plug
	6469	120					100	100								
					127' - 134.5' Traces of gravel		90	90			7.7x10 ⁻⁵	13			115.3	127' - water pressure surge and drilling firmed up
	6459	130					89	100								
							100	100								
	6449	140					100	100								
							100	100								
	6439	150					100	100								150' - drilled faster 10% circulation lost 380 gallons water level 83' down from top of collar
					158' - 162' Slightly arenaceous (fine grained), mudstone lense		60	60			9.5x10 ⁻⁵					155' - lost all circu. lost 140 gallons lost 200 gallons
	6429	160		11/19 11/1			93	100				54	27	30	128.6	162' - drilled faster lost 200 gallons
					169' - 185.5' Coarse grained lense		100	100								168' - barrel started to freeze lost 240 gallons 170' - used some borax lost 190 gallons
	6419	170					10	10								
							60	60								lost 220 gallons
	6409	180					100	100								
					185.5' - 191' Traces of gravel		100	100								
	6399	190					58	58				61	27	35		lost 480 gallons lost 350 gallons
	6398	191			191' - 249.5' Slightly arenaceous (fine grained), mudstone lense		60	100								
	6389	200														

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 3 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-5

COLLAR ELEVATION: 6589 feet

TOTAL DEPTH: 249.25 feet

DATE BEGUN: September 29, 1978

DATE FINISHED: October 8, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
				200' With secondary pyrite and more sand with depth		100	100								204' - water pressure surge and bit trying to plug 209' - running straight water - no revert
	6379	210				100	100								
	6374	215				100	100								
	6369	220		Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses		100	100								
						60	60								
	6359	230				100	100								
						100	100								
	6349	240				100	100								
						100	100								
						100	100								
	6339.75	249.25		Bottom of hole						7.5x10 ⁻⁷	32			118.9	

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
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INDICATES CORE RECOVERY
 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

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BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG






SHEET 1 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-6

COLLAR ELEVATION: 6604 feet TOTAL DEPTH: 217 feet


DATE BEGUN: October 26, 1978 DATE FINISHED: October 30, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA	6594	10			White to yellow brown, fine to coarse grained, poorly to moderately cemented (clay), quartz sandstone, with traces of silt and gravel											
					0' - 10' Sandstone conglomerate with clean lenses	50/5										
	6584	20			18' - 32' Fine grained, silty lens with some iron staining											
R 3"	6574	30			1 inch stained with depth	50/7.5										started rotary at 28' 100% circulation using quick gel
	6564	40				50/7.5										43' - drilling firmed up using standard barrel
	6554	50														
	6544	60			58.5' - 68' Traces of gravel	50/4.75										
	6534					50/4										
	6524	80														
	6514	90				50/3										88' - drilling firmed up
	6508	96														
	6504	100			see next page for sample description											

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES CORE RECOVERY

 INDICATES CORE LOSS

 INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:
 BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-1771

BORING NO. ST F-6

COLLAR ELEVATION: 6604 feet TOTAL DEPTH: 217 feet

DATE BEGUN: October 26, 1978 DATE FINISHED: October 30, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION * RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
C	6494	110			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	50/4	100	100								started coring with revert at 103', 95% circulation
	6484	120			116' - 147' Coarse grained lense		43	43								119.5' - lost circulation
	6474	130					43	43								samples being washed out
	6464	140					40	40								129.5' - drilling firmed up
	6454	150			155' - traces of pyrite		0	3								
	6444	160			161' - 188' Coarse grained lense		0	0								139' - drilled faster
	6434	170					15	15								144.5' - drilling firmed up
	6424	180					0	0								154.5' - drilling firmed up
	6414	190					0	0								164.5' - drilled faster
	6404	200					50	50								174.5' drilling firmed up
							0	0								175' smell of gas noted
							92	100								
							10	20								
							0	0								
							25	30								
							55	55								
							0	0								
							68	68								
							100	100								
							100	100								
																187.5' - 10/29/78 no water in hole
																198' started rotary

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

- INDICATES CORE RECOVERY
- INDICATES CORE LOSS

- INDICATES WATER LEVEL AND DATE RECORDED




*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 3 OF 3



PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST F-6
COLLAR ELEVATION: 6604 feet TOTAL DEPTH: 217 feet
DATE BEGUN: October 26, 1978 DATE FINISHED: October 30, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R O D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
	6394	210				50/1.5										
	6388	215			215' - 217' Slightly arenaceous (fine grained), mudstone lense								17	41	125.6	
	6387	217			Bottom of hole											

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
HA - INDICATES HOLLOW AUGER
C - INDICATES CORE HOLE
R - INDICATES ROTARY HOLE

 INDICATES CORE RECOVERY
 INDICATES CORE LOSS

 INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-7

COLLAR ELEVATION: 6608 feet TOTAL DEPTH: 219 feet

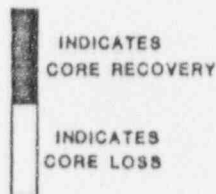
DATE BEGUN: September 12, 1978 DATE FINISHED: November 7, 1978 LOGGED BY: Don Taylor REVIEWED BY: RRH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA 4"					SAND, fine to coarse grained with traces of gravel, silty and clayey in part, some iron staining, loose to medium dense, medium moist to moist, brown to yellow brown	38/12 44/12										
	6598	10														
	6596.5	11.5			White to yellow brown, fine to coarse grained, poorly to moderately cemented (clay), quartz sandstone, with traces of silt and gravel	50/5.5										
	6588	20			14' - 35.5' Sandstone conglomerate with clean lenses	50/3										
	6578	30				50/5.5										
	6578	30				50/8										
	6568	40				50/8.5						10				
	6568	40				50/6.25										
	6558	50				50/5.5										43' - coring with revert sample being washed out
	6548	60					0	0								
	6548	60					0	0								
	6538	70			65' - 69' Traces of gravel with a trace of iron staining		0	0								62' - drilling firmed up
	6538	70				90	90	90			3.6x10 ⁻⁵	19				66' - drilling firmed up
	6528	80				100	100	100								
	6518	90				90	100	100								
	6508	100				100	100	100								

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
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- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE



INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST F-7
 COLLAR ELEVATION: 6608 feet TOTAL DEPTH: 219 feet

DATE BEGUN: September 12, 1978 DATE FINISHED: November 7, 1978 LOGGED BY: Don Taylor REVIEWED BY: RW

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
C	6498	110			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses		100	100					24	27	127.4	
					102' - 104.5'		100	100								116.5' - water pressure up
					Slightly arenaceous (fine grained), mudstone lense		100	100								119.5' - drilled faster
	6488	120			trace of pyrite		100	100								
					125' - 140'		90	100			3.9x10 ⁻⁴				104.2	lost circulation
					Fine grained, silty, slightly argillaceous, moderately to well cemented lense		100	100								135' - lost circulation put borax down hole
	6478	130					100	100								lost 150 gallons
					140' - 187.5'		100	100								lost 360 gallons
					Coarse grained lense		100	100								lost 90 gallons
	6468	140					100	100								lost 180 gallons
							100	100								lost 135 gallons
	6458	150					30	30								lost 135 gallons
							0	0								lost 135 gallons
	6448	160					35	35								lost 135 gallons
							50	50								lost 135 gallons
	6438	170					100	100								lost 225 gallons
							22	22								lost 180 gallons
	6428	180					10	10								lost 230 gallons
							38	38								did not use revert
	6418	190					90	90								lost 135 gallons
							20	20								lost 250 gallons mixed more revert
	6408	200														

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES CORE RECOVERY
 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:
 BLOWS/FOOT: RECORDED AS NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 3 OF 3

PROJECT: E.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-7

COLLAR ELEVATION: 6608 feet TOTAL DEPTH: 219 feet



DATE BEGUN: September 12, 1978 DATE FINISHED: November 7, 1978 LOGGED BY: Dnn Taylor REVIEWED BY: RAH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION * RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
C NX 27 1/8"					202' - 209' Coarse grained lense trace of pyrite		40	40								lost 90 gallons
					197' - 12/3		20	20								lost 320 gallons
	8398	210			210' - 214' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lense		22	22				46	22	27	114.8	207' - drilling firmed up, did not use revert
	8394	214			214' - 219' Slightly arenaceous (fine grained), mudstone lense		100	100			5.8x10 ⁻⁷					lost 190 gallons
	8389	219			Bottom of hole							24	32	103.5		

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
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- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST-FB

COLLAR ELEVATION: 6585 Feet TOTAL DEPTH: 111 Feet

DATE BEGUN: September 15, 1978 DATE FINISHED: September 26, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: BAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA 4"	6478.5	5.5			FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part loose to medium dense, medium moist, green to brown	10/12										
	6477	8			SAND, fine to coarse grained with traces of gravel, silty and clayey in part, some iron staining, loose to medium dense, medium moist to moist, brown to yellow brown.	50/1.7										
	6475	10			white to yellow brown, fine to coarse grained, poorly to moderately cemented (clay) quartz sandstone, with traces of silt and gravel.	50/6										
	6469	16			8'-16' Sandstone conglomerate with clean lenses.	50/6.7										
	6465	20				50/8										
	6455	30					0	0								24' started coring
	6445	40					100	100								29' added revert
	6435	50			48.2'-53.2' Fine grained, silty lens with some iron staining.		100	100								45' lost circulation, pushed casing to 48'
	6425	60					100	100								48' 100% circulation
	6417	68					100	100								60' set packer
	6415	70			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses		100	100								
	6405	80			68'-78' coarse grained lenses.		100	100								
	6395	90			78'-79.5' fine grained, silty, moderately cemented lens.		100	100								
	6385	100			92.5'-103.7' fine grained, silty, moderately cemented lens.		100	100								

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES CORE RECOVERY
 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG


SHEET 2 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST-F8

COLLAR ELEVATION: 6505 Feet TOTAL DEPTH: 111 Feet


DATE BEGUN: September 15, 1978 DATE FINISHED: September 26, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: SKD


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
C 2X 8"	6375 6374	110 111			99'-111' Coarse grained lens		94 0 0	94 0 0								104' 80% circulation 111' lost circulation, caving.


EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

 INDICATES
CORE RECOVERY

 INDICATES
CORE LOSS

 INDICATES WATER
LEVEL AND DATE
RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER
 OF BLOWS WITH A 140 POUND HAMMER,
 FALLING 30 INCHES. REQUIRED TO DRIVE
 A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-9

COLLAR ELEVATION: 6414 feet TOTAL DEPTH: 28.3 feet



DATE BEGUN: August 27, 1978 DATE FINISHED: August 27, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAJ


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA 4"					FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown	11/12										
	6406	8														
	6404	10			Light to dark green, fine to medium grained, silty, poorly to well sorted, 10/23 very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	13/12										
	6401	13				40/12										
	6394	20			8' - 13' Fine grained, silty, moderately cemented lense	50/4				8.8x10 ⁻⁶			22	28	116.8	Drawing water from this level for water trucks
	6386.7	28.3			13' - 23' Slightly arenaceous (fine grained), mudstone lense with traces of pyrite.	50/3										
					Bottom of hole											

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 3

PROJECT: E.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-10

COLLAR ELEVATION: 6616 feet

TOTAL DEPTH: 227 feet

DATE BEGUN: September 6, 1978

DATE FINISHED: September 14, 1978

LOGGED BY: Forrest Knobel



REVIEWED BY: RAH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA	6608	10			FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown	8/12										
	6598	20				15/12					2.7x10 ⁻⁸	79	21	32	122.8	
	6594	22				12/12										
	6586	30			SAND, fine to coarse grained with traces of gravel, silty and clayey in part, some iron staining, loose to medium dense, medium moist to moist, brown to yellow brown	11/12										
	6578	40			White to yellow brown, fine to coarse grained, poorly to moderately cemented (clay), quartz sandstone, with traces of silt and gravel, with some secondary sulfates and iron staining	15/12										
	6570	48			30' - 53' Sandstone conglomerate with clean lenses	36/12										
	6566	50				38/12										
	6556	60				50/5										58.5' - started coring with revert, 100% circulation
C	6546	70				50/4	96	96								
NX	6538	80					100	100								
2 1/8"	6526	90					100	100								
	6516	100					100	100								88.5' - morning of 9-9-78 water level 12' down from top of collar
							100	100			1.2x10 ⁻⁶					

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST F-10

COLLAR ELEVATION: 6616 feet TOTAL DEPTH: 227 feet

DATE BEGUN: September 6, 1978 DATE FINISHED: September 14, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
C NX 2 7/8"	6506	110			115.3' - 118.5' Fine grained, silty lense with some iron staining		100	100		1.2410 ⁻⁶						
	6496	120					100	100								
	6491	125					100	100								
	6488	130			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses 133.5' - 140' Traces of gravel		92	92								118.5' - morning of 9-10-78 water level 11' down from top of collar
	6476	140					100	100								
	6466	150					100	100								
	6458	160			155.5' - 158.5' Fine grained, silty, slightly argillaceous, moderately to well cemented lense with secondary pyrite		94	94								
	6446	170		11/1 10/4			100	100		NO FLOW						166' - 50% circulation 170.5' - 20% circulation
	6438	180			171' - 175' Fine grained, silty, moderately cemented lense		88	88								178.5' - 9/13/78 water level 40' down from top of collar 184.5' - 10% circulation
	6426	190					100	100								
	6416	200			traces of secondary pyrite		90	90								193.5' - 70% circulation 198.5' - 80% circulation

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES CORE RECOVERY
 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 3 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST F-10

COLLAR ELEVATION: 6616 feet TOTAL DEPTH: 227 feet

DATE BEGUN: September 6, 1978 DATE FINISHED: September 14, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: RJA

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION RESISTANCE	R O D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
2 1/2"	6406	210					100	100								
	6398	218					100	100								
	6396	220			218' - 227' Slightly arenaceous (fine grained), mudstone lense		88	88			1.8x10 ⁻⁴	43			120.3	209.5' - 50% circulation 213.5' - 9/14/78 water level at 110' left sample in hole and washed it away
	6389	227			Bottom of hole		10	10								
							100	100			3.9x10 ⁻⁸		26	32	109.3	219' - 20% circulation 219' - end of electric log left sample in hole

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE



- INDICATES CORE RECOVERY
- INDICATES CORE LOSS



- INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: F. A. P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. ST F-11

COLLAR ELEVATION: 6392 feet TOTAL DEPTH: 29.5 feet

DATE BEGUN: August 26, 1978 DATE FINISHED: August 26, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: RAN

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
C	6392.5	2.5			FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown	11/12										
C	6384.5	7.5			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses 2.5' - 7.5'	20/12										
C	6372	20			Fine grained, silty, moderately cemented lens	50/12	50	100								
C	6372	20			7.5' - 29.5' Slightly arenaceous (fine grained), mudstone lens		100	100		1.1x10 ⁻⁶						
C	6362.5	29.5			more sand with depth		100	100				48	27	34		13.5' - started coring with revert drawing water from this area for water trucks
					Bottom of hole											

EXPLANATION

MOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES CORE RECOVERY
 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES. REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1



PROJECT: F. A. P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST F-12
COLLAR ELEVATION: 6387 feet TOTAL DEPTH: 28.6 feet
DATE BEGUN: August 25, 1978 DATE FINISHED: August 25, 1978 LOGGED BY: Don Taylor REVIEWED BY: RDH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA	6379	8		Light to dark green, fine to medium grained, silty, poorly to well sorted, 1/2 very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	40/6										
	6377	10		3' - 8' Fine grained, silty, moderately cemented lense	50/5										
				8' - 28' Slightly arenaceous (fine grained), mudstone lense	35/12										
	6367	20			50/5										
					50/5										
	6368.4	28.6		Bottom of hole	50/7					2.6x10 ⁻⁴	27	19	38	123.5	taking water from this level for water trucks

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-13

COLLAR ELEVATION: 6387 feet

TOTAL DEPTH: 28.4 feet

DATE BEGUN: August 25, 1978

DATE FINISHED: August 25, 1978

LOGGED BY: Forrest Engel



REVIEWED BY: SMH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA 4"					Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented	42/12										
	6377	10			11/23 (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	50/10										
	6373	14			14.0' - 27' Slightly arenaceous (fine grained), mudstone lense	34/12										
	6367	20				42/12										
	6358.6	28.4			27' - 28' Fine grained, silty, slightly argillaceous, moderately to well cemented lense	50/5										
						50/4.5						2.4x10 ⁻⁷	20	19	31	
					Bottom of hole											

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-1

COLLAR ELEVATION: 6473 feet TOTAL DEPTH: 148 feet

DATE BEGUN: August 22, 1978 DATE FINISHED: August 24, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: RKH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA 4"					SA/10, fine to coarse grained with traces of gravel, silty and clayey in part, some iron staining, loose to medium dense, medium moist to moist, brown to yellow brown	6/12										
	6463	10				6/12										
						11/12										
	6453	20			White to yellow brown, fine to coarse grained, poorly to moderately cemented (clay), quartz sandstone, with traces of silt and gravel	18/12										
						50/12										
	6443	30				50/5.5					2.8x10 ⁻⁴	15			114.8	
						50/5.5										
	6433	40			37' - 41.5' Fine grained, silty lense with some iron staining	50/5.5										
						50/3.5										
C 2 7/8"	6423	50						78								
	6418.5	53.5						40								
					Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	92		92								
	6413	60			55' - 62' Fine grained, silty, slightly argillaceous, moderately to well cemented lense	100		100			5.2x10 ⁻⁶	21			109.0	
					62' - 80' Slightly arenaceous (fine grained), mudstone lense	100		100								
	6403	70				100		100								
						98		100								
	6393	80			80' - 103' Fine grained, silty, slightly argillaceous, moderately to well cemented lense	76		76								
						92		92								
	6383	90				80		80								
						63		72								
	6373	100				86		100								

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE



- INDICATES CORE RECOVERY
- INDICATES CORE LOSS

- INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-1

COLLAR ELEVATION: 6473 feet TOTAL DEPTH: 148 feet

DATE BEGUN: August 22, 1978 DATE FINISHED: August 24, 1978 LOGGED BY: Forrest Knobel REVIEWED BY: SAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION RESISTANCE*	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
	6363	110			103' - 125' Coarse grained lens		97	100								
							0	0								
	6353	120					0	0								
							0	0								
							0	0								
	6343	130			125' - 128' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lens		46	66								
							8	44								
					131' - 133' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lens		0	0								
	6333	140					0	0								
							0	0								
	6326	148					0	0								
					Bottom of hole											

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

EXPLANATION

INDICATES
CORE RECOVERY

INDICATES
CORE LOSS

INDICATES WATER
LEVEL AND DATE
RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER
OF BLOWS WITH A 140 POUND HAMMER,
FALLING 30 INCHES, REQUIRED TO DRIVE
A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-2

COLLAR ELEVATION: 6481 feet TOTAL DEPTH: 183 feet

DATE BEGUN: August 31, 1978 DATE FINISHED: September 11, 1978 LOGGED BY: Don Taylor

REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION * RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA	6471	10			SAND, fine to coarse grained with traces of gravel, silty and clayey in part, some iron staining, loose to medium dense, medium moist to moist, brown to yellow brown	10/12										
	6461	20				18/12										
	6460.5	20.5				12/12										
	6451	30			White to yellow brown, fine to coarse grained, poorly to moderately cemented (clay), quartz sandstone, with traces of silt and gravel	50/11										
	6441	40			30' - 37' Fine grained, silty lense with some iron staining	38/12										
	6431	50				50/6										
	6421	60				50/7.5										
	6412.5	65.5				50/1.5										
	6411	70			65' - 68.5' Gravely with possible cobbles	50/4										
	6401	80			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses 68.5' - 79'	50/5										
	6391	90			Fine grained, silty, slightly argillaceous, moderately to well cemented lense 85' - 102'	50/3.5										
	6381	100			Fine grained, silty, slightly argillaceous, moderately to well cemented lense	50/3.5										
						50/3										
						50/8.5										
							82	82								75' - started caving used revert, circulation is 100% 1st 3' drilled slower
							95	95								
							81	81								
							100	100								
							100	100								95' drilling firmed up

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE



- INDICATES CORE RECOVERY
- INDICATES CORE LOSS



- INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: E.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-2

COLLAR ELEVATION: 6481 feet

TOTAL DEPTH: 183 feet

DATE BEGUN: August 31, 1978

DATE FINISHED: September 11, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
	6371	110			102' - 115' Coarse grained lens		82	100								103.5' - drilled faster
							27	27								
	6381	120			115' - 128' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lens		100	100								110' - slowed drilling speed to keep from washing out sample
							100	100								
	6351	130					100	100								
							100	100								
	6341	140		12/2 11/1 10/4	140' - 156.5' Coarse grained lens		100	100								checked water level morning of 9-10-78 found it to be 29.25' down from top of collar
							80	80								
	6331	150					100	100								
							85	85								156' - lost circulation drilled faster lost 425 gallons
	6321	160			156' - 160' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lens		100	100								
							85	85								
	6311	170			160' - 165' Slightly arenaceous (fine grained), mudstone lens		94	100								lost 190 gallons, circulation is 10%
					165' - 174' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lens		90	90								lost all circulation again
	6301	180					N/A	90								177' - drilled faster drill rods trying to freeze up
	6298	183			180' - 183' Coarse grained lens		0	11								
					Bottom of hole							1.6x10 ⁻³	11		125.8	

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

- INDICATES CORE RECOVERY
- INDICATES CORE LOSS

- INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES. REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3271

BORING NO. RUL F-2

COLLAR ELEVATION: 6465 feet

TOTAL DEPTH: 148.5 feet

DATE BEGUN: August 27, 1978

DATE FINISHED: September 7, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RHH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION * RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA	6481.8	3.5			FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown	19/12										
	6455	10			3.5' - 12' SAND, fine to coarse grained with traces of gravel, silty and clayey in part, some iron staining, loose to medium dense, medium moist to moist, brown to yellow brown	10/12										
	6453	12			12' - 23.5' White to yellow brown, fine to coarse grained, poorly to moderately cemented (clay), quartz sandstone, with traces of silt and gravel	50/11										
	6445	20				50/3										sample barrel bouncing
	6435	30				50/2.5										
	6425	40				30/0										
	6415	50			51' - 54.5' Fine grained, silty lense with some iron staining	50/1.5										
	6405	60			58' - 60' Fine grained, silty lense with some iron staining	50/4										53.5' - started coring circulation is 100%
	6395	70				50/4.5										
	6385	80			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	50/4										
	6375	90			74' - 87' Fine grained, silty, moderately cemented lense	50/3.5										87' - lost circulation
	6365	100			94' - 101' Traces of gravel	50/3										90' - added bentonite circulation is 25% 97-99' fractured 100' - lost bit and end of barrel. Moved 15' to the north & started augering

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

- INDICATES CORE RECOVERY
- INDICATES CORE LOSS

- INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES. REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.


F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1271-3771 BORING NO. BUL F-3

COLLAR ELEVATION: 6465 feet TOTAL DEPTH: 148.5 feet



DATE BEGUN: August 27, 1978 DATE FINISHED: September 7, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
C 2 7/8"					101' - 105' Coarse grained lens	50/4		100			6.7x10 ⁻⁴	18			109.2	103.5' - started coring again
	6355	110		12/2 10/4				100								111' - drilling firmed up
	6346	120						100								113.5' - drilled faster
								95								117.5' - drilling firmed up
	6336	130			128.5' - 138' Coarse grained lens			0		6x10 ⁻⁶						tested for water level morning of 9/7/78, found to be 38' down from top of collar.
	6325	140			138' - 141' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lens with traces of pyrite			53		3x10 ⁻⁴					126.4	133.5' - lost circulation lost 75 gallons
					141' - 147' Coarse grained lens			N/A								lost 260 gallons
	6313.5	148.5			147' - 148.5' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lens			45			9.8x10 ⁻⁶	30			114.7	
					Bottom of hole											

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  INDICATES WATER LEVEL AND DATE RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-4

COLLAR ELEVATION: 6447 feet TOTAL DEPTH: 150 feet

DATE BEGUN: October 24, 1978 DATE FINISHED: October 24, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION RESISTANCE*	R O D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
AS	6437	10			FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown	25/12						20			108.4	
	6427	20			19' - 24' Trace of gravel	40/12										
	6417	30			29' - 31' Trace of gravel 33' - 39' Gravel with possible cobbles	33/12										
	6407	40			40' - 44' Trace of gravel	50/5					9.6×10^{-5}	14			111.8	
	6397	50			50.5' - 62' Trace of gravel	35/12										
	6387	60				29/12										
	6377	70				31/12					1.8×10^{-3}	13			100.8	
	6367	80			78' - 82' Mudstone chips with trace of sulfates	36/12										
	6365	82			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses											
	6357	80			82' - 95' Traces of gravel	50/4					2.5×10^{-6}	13			110.8	
	6347	100				50/2.8										

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE



- INDICATES CORE RECOVERY
- INDICATES CORE LOSS

- INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. BUL F-4

COLLAR ELEVATION: 6447 feet TOTAL DEPTH: 150 feet



DATE: October 24, 1978 DATE FINISHED: October 24, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAN


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENE- TRATION RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA 4"				11/29												
	6337	110			108' - 128' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lense	50/1.8										
	6327	120				50/1.5										
	6317	130			128' - 150' Coarse grained lense	50/1.8					6.6x10 ⁻⁵	19			104.5	
	6307	140				50/1										
	6297	150				50/1.5										
					Bottom of hole											

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES
CORE RECOVERY
-  INDICATES
CORE LOSS

-  INDICATES WATER
LEVEL AND DATE
RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER
OF BLOWS WITH A 140 POUND HAMMER,
FALLING 30 INCHES, REQUIRED TO DRIVE
A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 3

PROJECT: Riverton Wyoming PROJECT NO. 1-1371-3771 BORING NO. BUL F-5
 COLLAR ELEVATION: 6579 feet TOTAL DEPTH: 250 feet
 DATE BEGUN: October 10, 1978 DATE FINISHED: October 13, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA 4"																
	6569	10			FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown	8/12										
	6559	20				9/12										
	6549	30				20/12										
	6539	40				19/12										
	6529	50				48/12					9.9x10 ⁻⁶				119.0	
	6519	60				25/12										
	6509	70				27/12										
	6499	80				17/12										
	6482	87			SAND, fine to coarse grained with traces of gravel, silty and clayey in part, some iron staining, loose to medium dense, medium moist to moist, brown to yellow brown	50/9.5										
	6480.5	88.5														
	6469	90			White to yellow brown, fine to coarse grained, poorly to moderately cemented (clay), quartz sandstone, with traces of silt and gravel											
	6479	100				50/11.25										

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES CORE RECOVERY
 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES. REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 3

PROJECT: Riverton, Wyoming

PROJECT NO. 1-1371-3771

BORING NO. BH F-5

COLLAR ELEVATION: 6579 feet

TOTAL DEPTH: 250 feet

DATE BEGUN: October 10, 1978

DATE FINISHED: 10-13-78

LOGGED BY: Don Taylor

REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
3A 4"						50/8										
	6469	110			Fine grained, silty lense with some iron staining	50/4										
	6459	120														
	6449	130			Gravelly with possible cobbles	50/4					3.8x10 ⁻⁴	27			115.4	
	6439	140			Fine grained, silty lense with some iron staining	50/8.5										
C 2 7/8"	6434	145			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	50/3.25	65	70								145' - started coring without revert. Circulation 100%
	6429	150			145' - 148' Coarse grained lense		100	100								
	6419	160			149' - 160' Fine grained, silty, slightly argillaceous, moderately to well cemented lense with secondary pyrite		100	100								161' - drilled faster
	6409	170			168.5' - 175' Slightly arenaceous (fine grained), mudstone lense		30	30								165' - mixed revert 168.5' - water pressure surge 170' - bit trying to plug
	6399	180			175' - 180' Coarse grained lense with secondary pyrite		100	100								
	6389	190			180' - 186.5' Slightly arenaceous (fine grained), mudstone lense		80	80								189' - bit trying to plug again
	6379	200					100	100								190' - drilling firmed up
							100	100								
							100	100								
							100	100								
							85	85								

HOLE TYPES

SA - INDICATES SOLID AUGER
HA - INDICATES HOLLOW AUGER
C - INDICATES CORE HOLE
R - INDICATES ROTARY HOLE

INDICATES
CORE RECOVERY

INDICATES
CORE LOSS

INDICATES WATER
LEVEL AND DATE
RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER
OF BLOWS WITH A 140 POUND HAMMER,
FALLING 30 INCHES, REQUIRED TO DRIVE
A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 3 OF 3

PROJECT: Riverton, Wyoming PROJECT NO. 1-1371-3771 BORING NO. BUL F-5
 COLLAR ELEVATION: 6579 feet TOTAL DEPTH: 250 feet
 DATE BEGUN: October 10, 1978 DATE FINISHED: October 13, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
NO. 8	6388	210			207' - 217' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lense		100	100								
							100	100								
							100	100								
	6359	220			217' - 228' Traces of gravel		100	100								
							0	0								
							40	40								
	6349	230					100	100								225' - drill rods trying to freeze up
							100	100								228' - drilling firmed up
							100	100								
	6339	240			240' - 243' Traces of gravel		100	100								
							100	100								
	6329	250			245' - 250' Fine grained, silty, slightly argilla- ceous, moderately to well cemented lense											
					Bottom of hole											

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES CORE RECOVERY
 INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-6

COLLAR ELEVATION: 6418 feet TOTAL DEPTH: 150 feet

DATE BEGUN: October 25, 1978 DATE FINISHED: October 26, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOC	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	* PENETRATION RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA	6408	10			FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown 8' - 18' Trace of gravel	43/12					4.9x10 ⁻⁴	18			1104	
	6398	20			18' - 33' Mudstone chips											
	6368	30			33.5' - 36.5' Trace of gravel	50/8.3										
	6378	40				50/7.7										
	6368	50														
	6358	60				50/11.5					5.5x10 ⁻⁴	13			107	
	6348	70		12/1		50/10										
	6338	80			80' - 97' Mudstone chips											80' - encountered water
	6328	90				44/12										
	6318	100														

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

INDICATES
CORE RECOVERY

INDICATES
CORE LOSS

INDICATES WATER
LEVEL AND DATE
RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-6

COLLAR ELEVATION: 6418 feet TOTAL DEPTH: 150 feet



DATE BEGUN: October 25, 1978 DATE FINISHED: October 26, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA					103' - 117' Trace of gravel	50/7.9										
	6308	110														
	6301	117														
	6298	120			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses 117' - 145'	50/3										
	6286	130			Fine grained, silty, slightly argillaceous, moderately to well cemented lense	50/1.5					1.6x10 ⁻⁵	48			113.4	
	6278	140														
	6268	150				50/1										
					Bottom of hole											

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  10/26 INDICATES WATER LEVEL AND DATE RECORDED

- * **STANDARD PENETRATION TEST:**
 BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES. REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

SHEET 1 OF 3

BORING NO. BUL F-7

DATE BEGUN: October 27, 1978 DATE FINISHED: November 4, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH

EXPLANATION

INDICATES
CORE RECOVERY

INDICATES
CORE LOSS

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-7

COLLAR ELEVATION: 6496 feet TOTAL DEPTH: 236.5 feet

DATE BEGUN: October 27, 1978 DATE FINISHED: November 4, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAT

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA 4"					85' - 111.5' Traces of gravel											
	6386	110			111.5' - 123.5' Gravelly with possible cobbles											
	6376	120														started coring used revert, circulation 90%
C 2 7/8"	6366	130					0	0								drilling easier after 128.5'
	6364.5	131.5			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses		90	90								
	6356	140			136' - 139' Slightly arenaceous (fine grained), mudstone lense		100	100								
	6346	150			143' - 146.5' Coarse grained lense		90	90								
	6338	160			146.5' - 149.5' Slightly arenaceous (fine grained), mudstone lense		90	90								
	6326	170			155.5' - 167.5' Fine grained, silty, slightly argillaceous, moderately to well cemented lense		100	100								
	6316	180			172' - 180' Coarse grained lense		90	90								165' - drilling easier
	6298	200		11/23			90	90				1.5-10 ⁻⁴	13		111.0	175' - added more revert
					188' - 192' Fine grained, silty, slightly argillaceous, moderately to well cemented lense		0	0								186.5' - slower drilling
					129' - 195' Slightly arenaceous (fine grained), mudstone lense		100	100								
							100	100								
							100	100								
							100	100								

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

- INDICATES CORE RECOVERY
- INDICATES CORE LOSS

INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 3 OF 3

PROJECT: E.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-7

COLLAR ELEVATION: 6496 feet TOTAL DEPTH: 236.5 feet

DATE BEGUN: October 27, 1978 DATE FINISHED: November 4, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION # RESISTANCE	R O D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
	8278							100								
								100								
	8286	210			213.5' - 216.5'			100								
					Fine grained, silty, slightly argilla-			100								
					ceous, moderately to well cemented lense			100								
	6278	220			223.5' - 230.5'			90								
					Fine grained, silty, slightly argilla-			90								
					ceous, moderately to well cemented lense			100								
	6266	230						90								
								100								
	6258.5	236.5						90								
					Bottom of hole						1.8x10 ⁻⁵	25			116.0	232' - circulation at 90%
																236.5' - rods froze up

EXPLANATION

HOLE TYPES

SA - INDICATES SOLID AUGER
 HA - INDICATES HOLLOW AUGER
 C - INDICATES CORE HOLE
 R - INDICATES ROTARY HOLE

INDICATES
 CORE RECOVERY
 INDICATES
 CORE LOSS

INDICATES WATER
 LEVEL AND DATE
 RECORDED

* STANDARD PENETRATION TEST:

BLOWS/FOOT: RECORDED AS, NUMBER
 OF BLOWS WITH A 140 POUND HAMMER,
 FALLING 30 INCHES. REQUIRED TO DRIVE
 A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 3

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-8

COLLAR ELEVATION: 6558 feet

TOTAL DEPTH: 290.5 feet

DATE BEGUN: September 21, 1978

DATE FINISHED: September 28, 1978

LOGGED BY: Don Taylor



REVIEWED BY: RAH


TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION * RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
SA					FILL, SAND, fine to coarse grained with traces of gravel, silty and clayey in part, loose to medium dense, medium moist, green to brown	12/12										
	6548	10			10.5' - 12'	45/12										
					Gravel with possible cobbles	15/12					5.9x10 ⁻⁵	42			111.8	
	6538	20				17/12										
						16/12										
	6528	30			29' - 30'	27/12										
					Mudstone chips	15/12										
	6518	40				17/12										
					41' - 46.5'	17/12										
					Mudstone chips											
	6508	50				24/12										
					53' - 84.5'	14/12										
					Mudstone chips											
	6498	60				37/12					5.1x10 ⁻⁴	31			119.3	
						23/12										
	6488	70				32/12										
	6478	80				33/12										
	6473.5	84.5			Light to dark green, fine to medium grained, silty, poorly to well sorted, very weakly to moderately cemented (clay), quartz sandstone, with coarse grained sandstone and mudstone lenses	50/7.5										
	6468	90			84.5' - 110'											
					Fine grained, silty, slightly argillaceous, moderately to well cemented lense with secondary pyrite	50/8					2.8x10 ⁻⁴		18	22	120.0	
	6458	100														

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE

-  INDICATES CORE RECOVERY
-  INDICATES CORE LOSS

-  INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS. NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 3

PROJECT: E.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-2771

BORING NO. BUL F-8

COLLAR ELEVATION: 6558 feet TOTAL DEPTH: 290.5 feet

DATE BEGUN: September 21, 1978 DATE FINISHED: September 28, 1978 LOGGED BY: Don Taylor REVIEWED BY: DAT

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION* RESISTANCE	R Q D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
	6448	110			110' - 118.5' traces of pyrite	50/5										110.5' - started coring with revert
	6438	120			118.5' - 138.0' Coarse grained lens		100	100								114' - loosening approximately 5 gallons per run
	6428	130					100	100								125' - drilling firmed up
	6418	140			139.5' - 142.5' Coarse grained lens		100	100								
	6408	150			145' - 152' Coarse grained lens		100	100								
	6398	160			153' - 160.5' Coarse grained lens		92	92								154' - changed to carbide bit, 25% circulation, lost 150 gallons
	6388	170			160.5' - 164.5' Fine grained, silty, slightly argillaceous, moderately to well cemented lens with secondary pyrite		100	100								159' - changed to 25k face discharge bit
	6378	180			169.5' - 197.5' Coarse grained lens with secondary pyrite		100	100								166.5' - easier drilling, getting backflow up core barrel
	6368	190					100	100								lost 100 gallons
	6358	200					100	100								lost 150 gallons, 50% circulation sample broke up when blown out of inner barrel lost 80 gallons

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE



- INDICATES CORE RECOVERY
- INDICATES CORE LOSS



- INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES. REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: F.A.P. Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-8

COLLAR ELEVATION: 6558 feet TOTAL DEPTH: 290.5 feet

DATE BEGUN: September 21, 1978 DATE FINISHED: September 28, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH

TYPE AND SIZE OF HOLE	ELEVATION (FEET)	DEPTH (FEET)	GRAPHIC LOG	WATER LEVEL	LITHOLOGY AND PHYSICAL CONDITION	PENETRATION RESISTANCE *	R O D (%)	CORE RECOVERY (%)	TEST SECTIONS	FIELD PERMEABILITY CM./SEC.	LAB PERMEABILITY CM./SEC.	% PASSING 200	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	DRY DENSITY (PCF)	NOTES
C 2 7/8					199.5' - 212' Traces of gravel with vertical fractures and secondary pyrite		58	76								200' - drilling firmed up
							24	67								lost 35 gallons
	6348	210			212' - 224' Coarse grained lense with secondary pyrite		48	100								209.5' - water level 56' down from top of collar
							0	10								lost 195 gallons
	6338	220			224' - 229.5' Coarse grained lense with secondary pyrite		72	100								214.5' - 20% circulation
							100	100								lost 150 gallons
	6328	230			229.5' - 234' Fine grained, silty, slightly arenaceous, moderately to well cemented lense		100	100								lost 110 gallons
					234' - 249' Coarse grained lense with traces of clay and secondary pyrite		100	100								lost 80 gallons
	6318	240		11/1 10/4			0	0								lost 65 gallons
							92	100								230' - 70% circulation
	6308	250			249' - 253' Slightly arenaceous (fine grained), mudstone lense		100	100								235' - 50% circulation
					255.5' - 264.5' Traces of gravel		93	100			6.7x10 ⁻⁸	11			102.4	lost 65 gallons
	6298	260			264.5' - 269.5' Fine grained, silty, slightly arenaceous, moderately to well cemented lense		100	100								lost 45 gallons
							0	0								250' - water pressure surge and drilling firmed up
	6288	270			269.5' - 274.5' Coarse grained lense		100	100								260' - water pressure surge and bit trying to plug
					274.5' - 280' Traces of gravel		100	100								267' - drilling easier
	6278	280			280' - 290.5' Slightly arenaceous (fine grained), mudstone lense with secondary pyrite		50	60								269.5' - change to 20K M crown step bit
							93	100			7.4x10 ⁻⁸					274' - getting very little backflow
	6268	290					50	60								284' - lost all circulation
	6267.5	290.5			Bottom of hole											lost 400 gallons
																lost 300 gallons
																core barrel started to freeze up

EXPLANATION

HOLE TYPES

- SA - INDICATES SOLID AUGER
- HA - INDICATES HOLLOW AUGER
- C - INDICATES CORE HOLE
- R - INDICATES ROTARY HOLE



- INDICATES CORE RECOVERY
- INDICATES CORE LOSS



- INDICATES WATER LEVEL AND DATE RECORDED

*** STANDARD PENETRATION TEST:**

BLOWS/FOOT: RECORDED AS, NUMBER OF BLOWS WITH A 140 POUND HAMMER, FALLING 30 INCHES, REQUIRED TO DRIVE A 2 INCH DIAMETER SAMPLER ONE FOOT.

APPENDIX B

GEOPHYSICAL BORING LOGS

F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-1

GROUND ELEVATION: 6583 feet

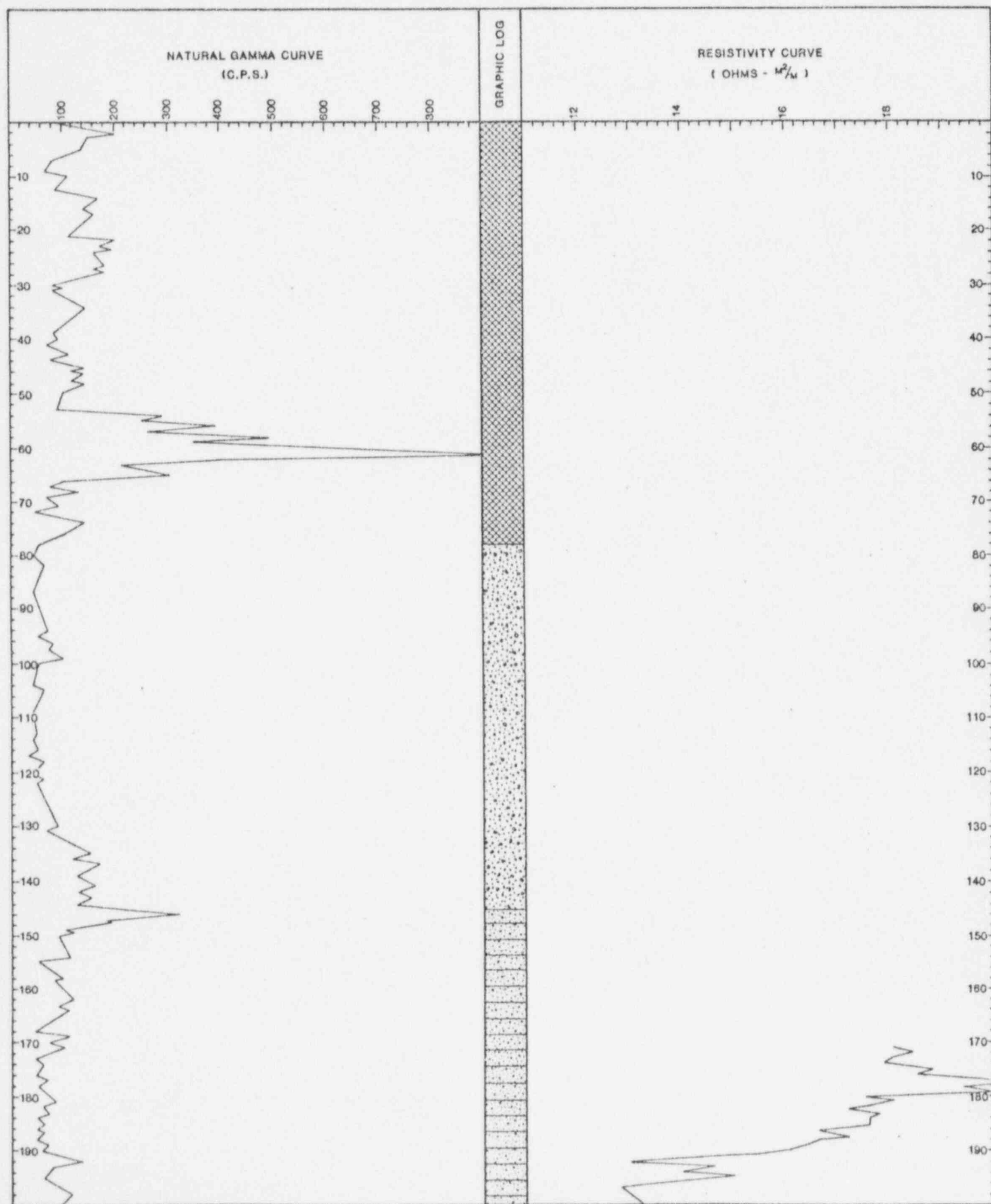
TOTAL DEPTH: 299.5 feet

DATE BEGUN: October 19, 1978

DATE FINISHED: October 25, 1978

LOGGED BY: Don Taylor

REVIEWED BY: Ed



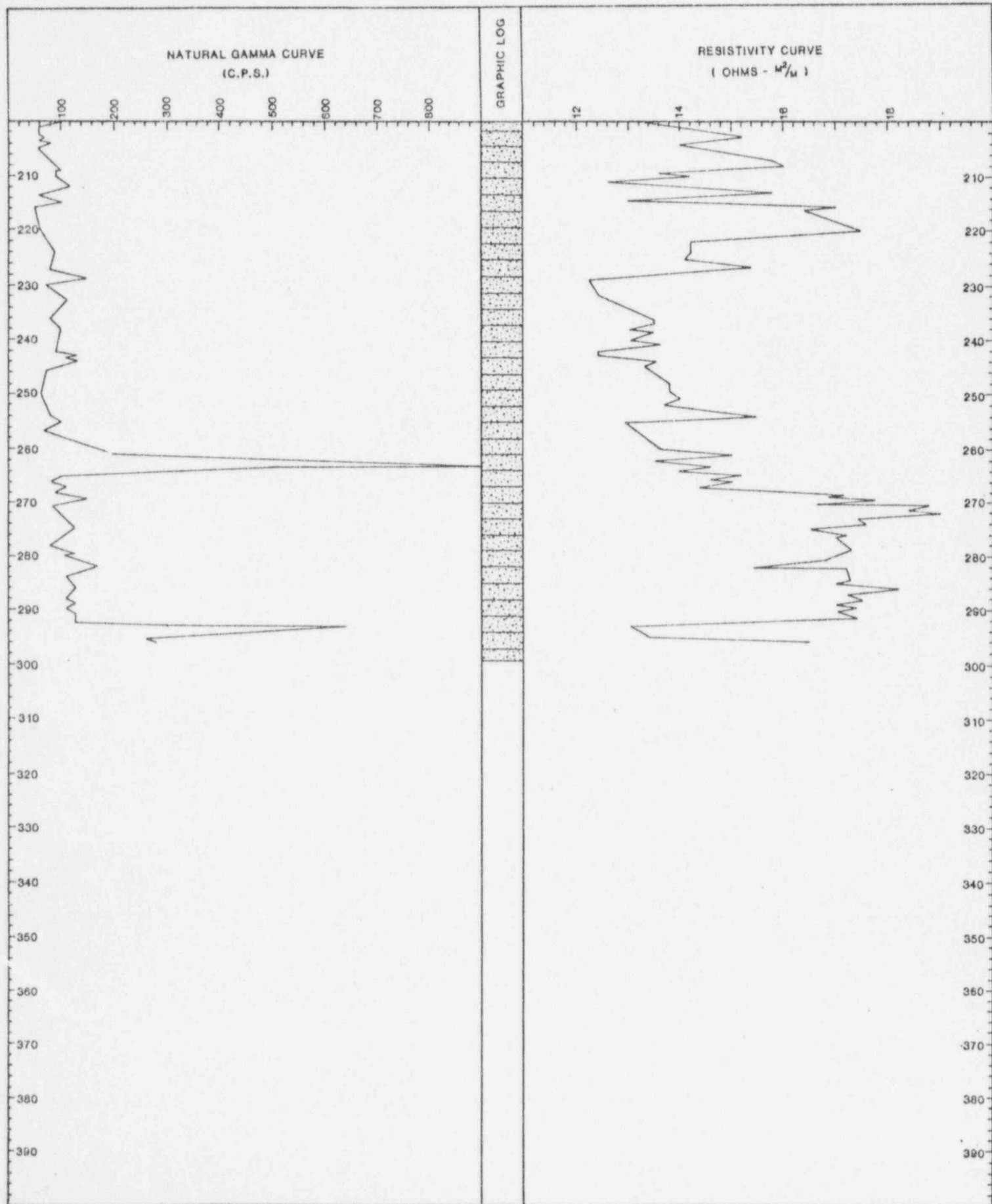
F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST F-1

GROUND ELEVATION: 6583 feet TOTAL DEPTH: 299.5

DATE BEGUN: October 19, 1978 DATE FINISHED: October 25, 1978 LOGGED BY: Don Taylor REVIEWED BY: *DAH*



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-4

GROUND ELEVATION: 6552 feet

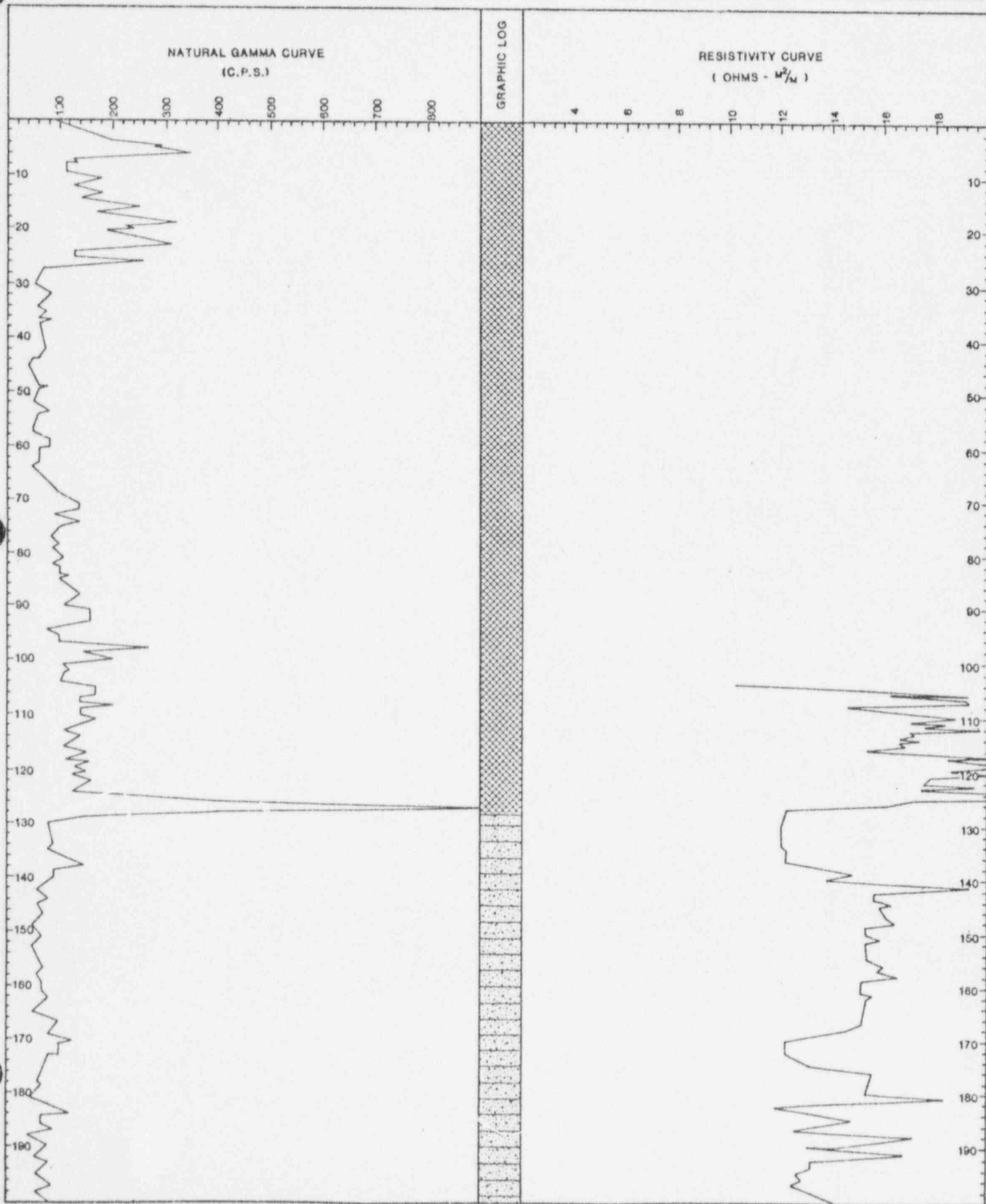
TOTAL DEPTH: 284 feet

DATE BEGUN: September 28, 1978

DATE FINISHED: October 10, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-4

GROUND ELEVATION: 6552 feet

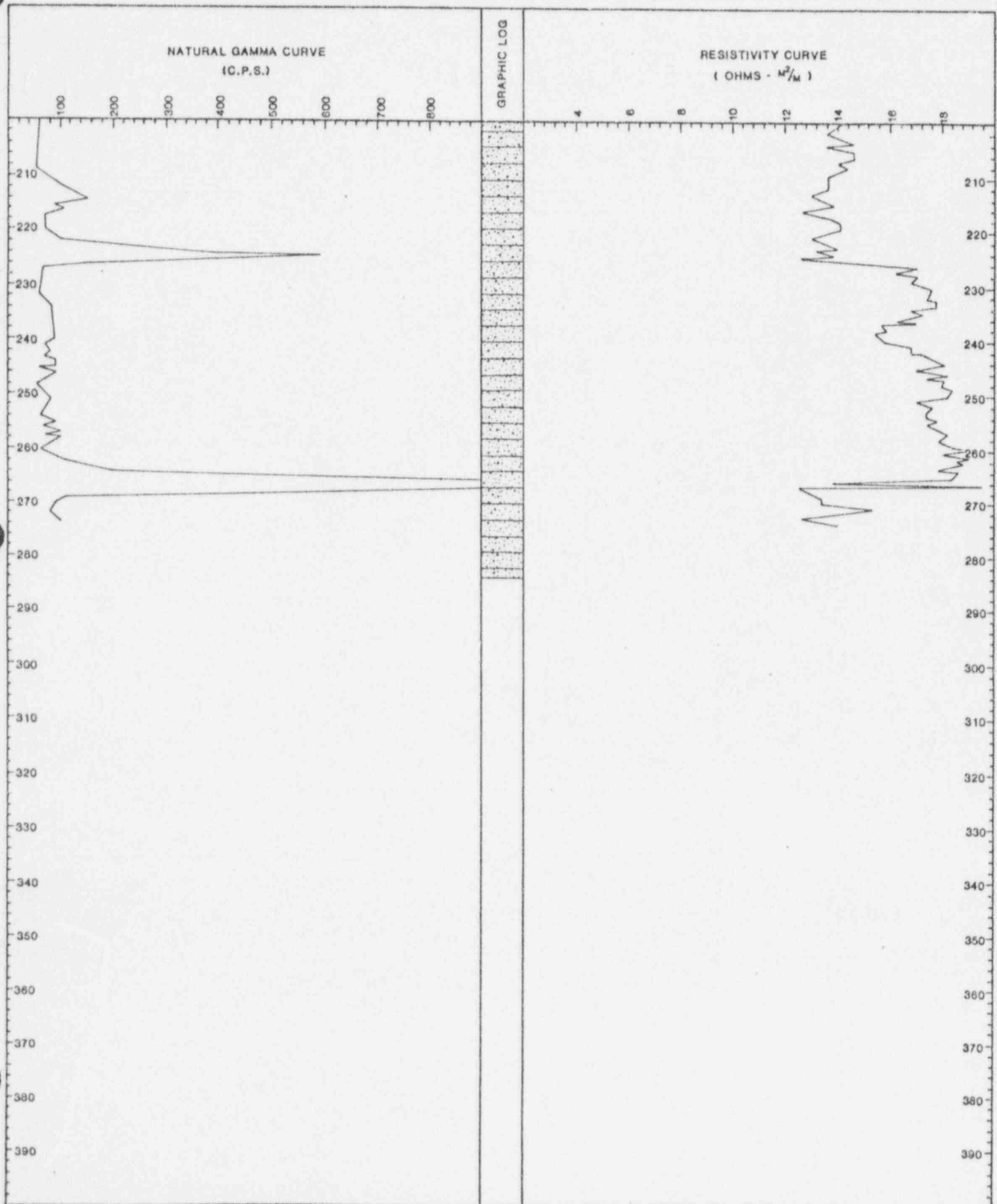
TOTAL DEPTH: 284 feet

DATE BEGUN: September 28, 1978

DATE FINISHED: October 10, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-5

GROUND ELEVATION: 658.9 feet

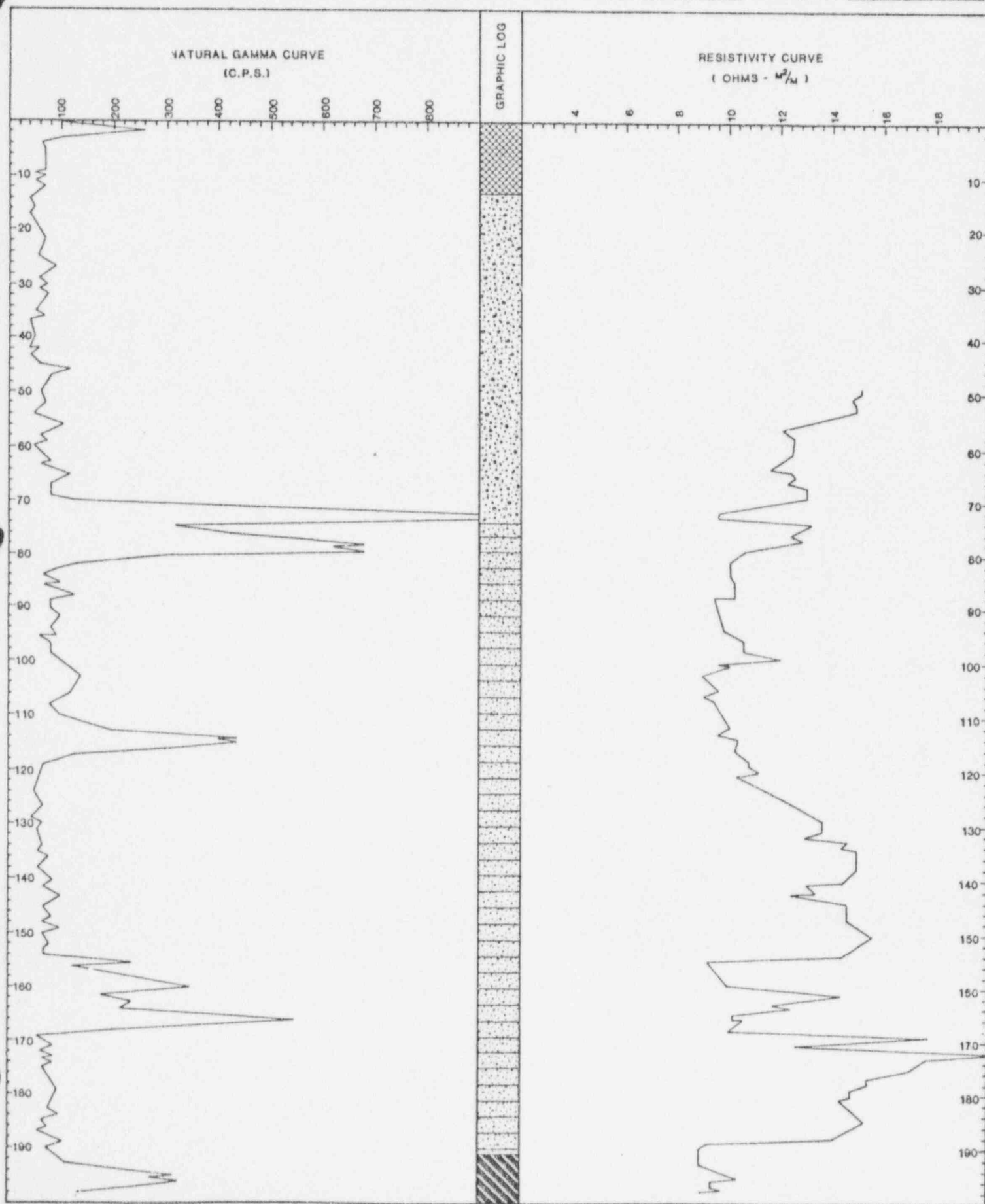
TOTAL DEPTH: 249.25 feet

DATE BEGUN: September 29, 1978

DATE FINISHED: October 8, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAN



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. 5T F-6

GROUND ELEVATION: 6604 feet

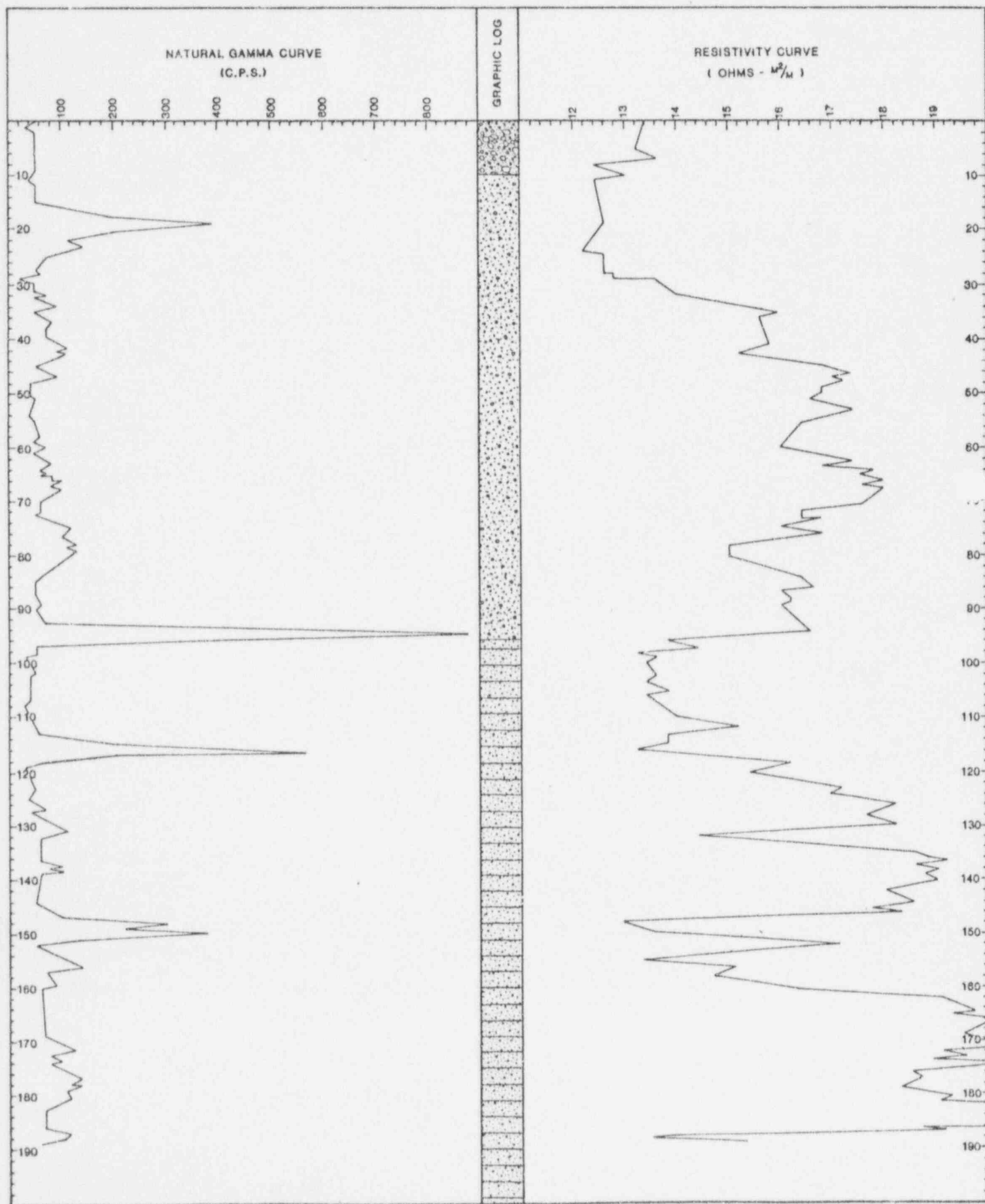
TOTAL DEPTH: 217 feet

DATE BEGUN: October 26, 1978

DATE FINISHED: October 30, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RTH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-7

GROUND ELEVATION: 6608 feet

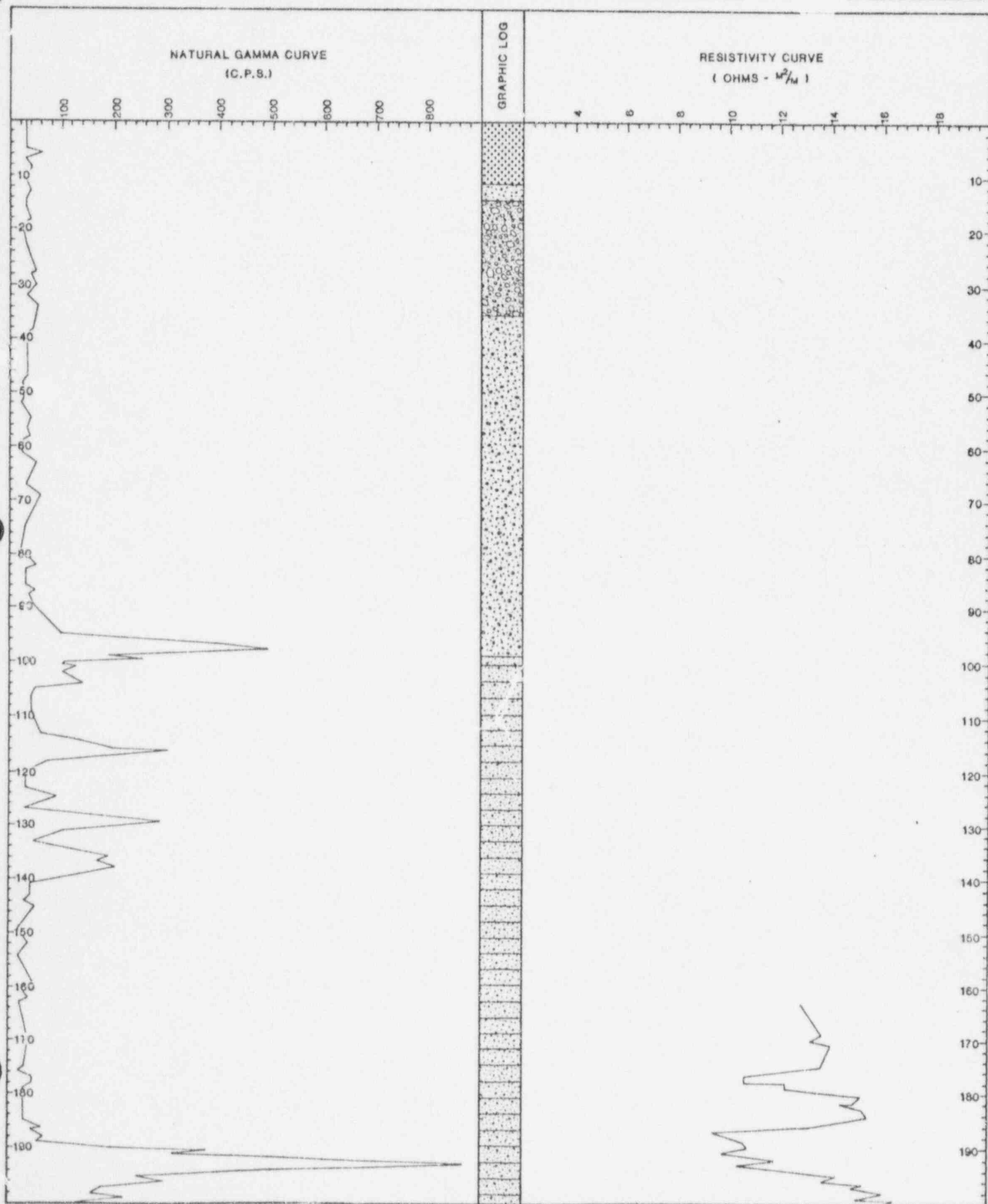
TOTAL DEPTH: 219 feet

DATE BEGUN: September 12, 1978

DATE FINISHED: November 7, 1978

LOGGED BY: Don Taylor

REVIEWED BY: Rad



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-7

GROUND ELEVATION: 6608 feet

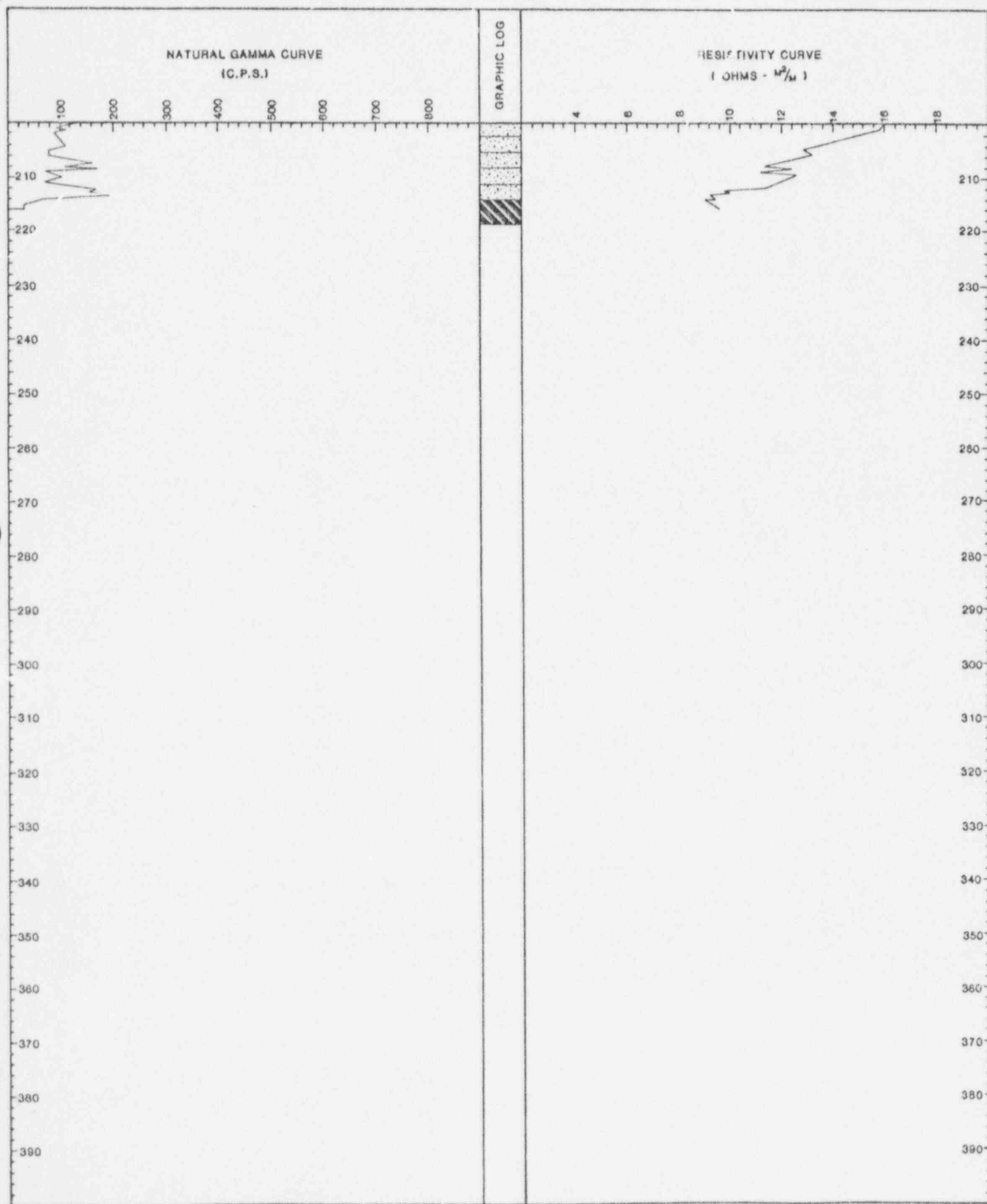
TOTAL DEPTH: 219 feet

DATE BEGUN: September 2, 1978

DATE FINISHED: November 7, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAY



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAA Wiliwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-9

GROUND ELEVATION: 6414 feet

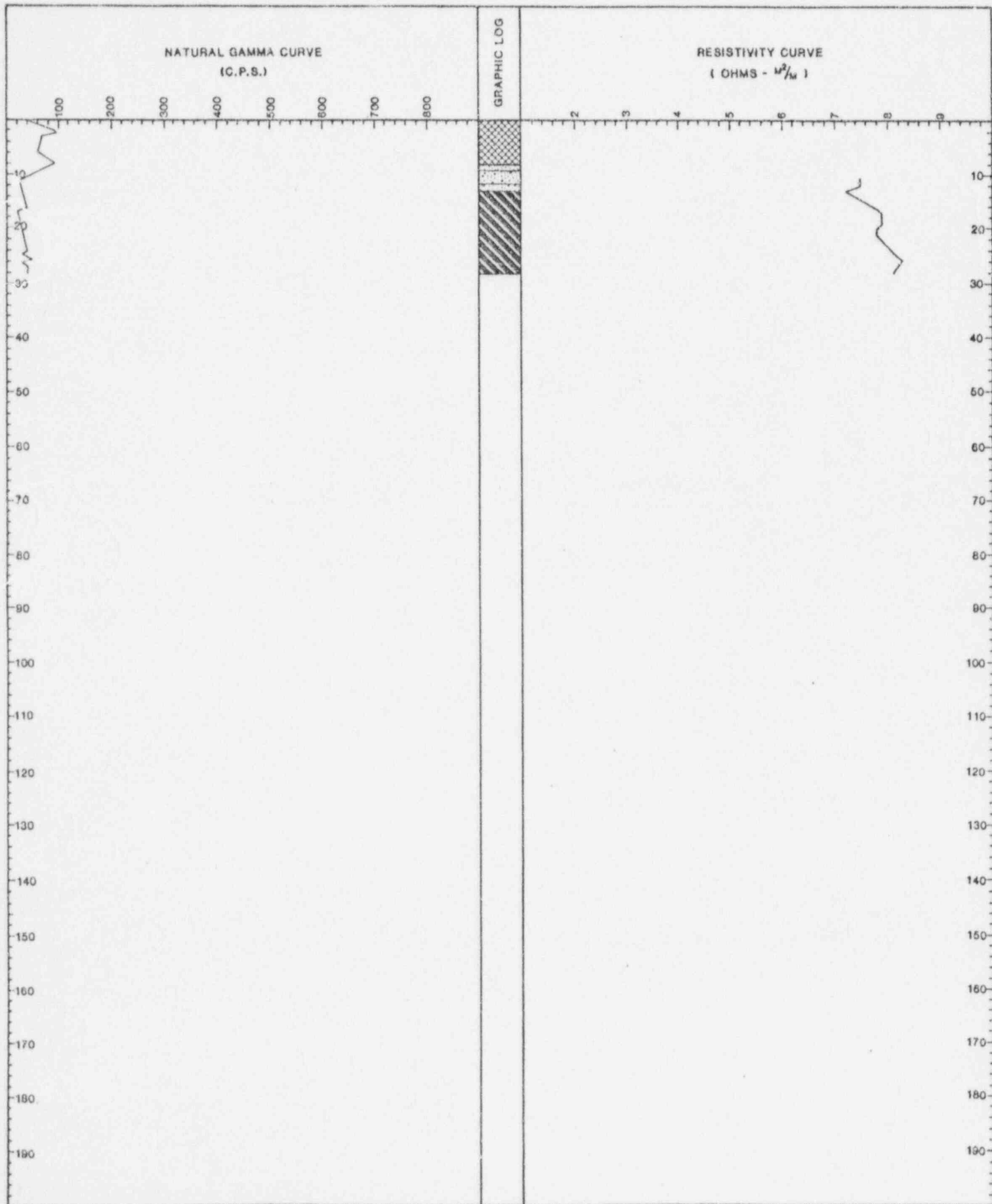
TOTAL DEPTH: 28.3 feet

DATE BEGUN: August 27, 1978

DATE FINISHED: August 27, 1978

LOGGED BY: Don Taylor

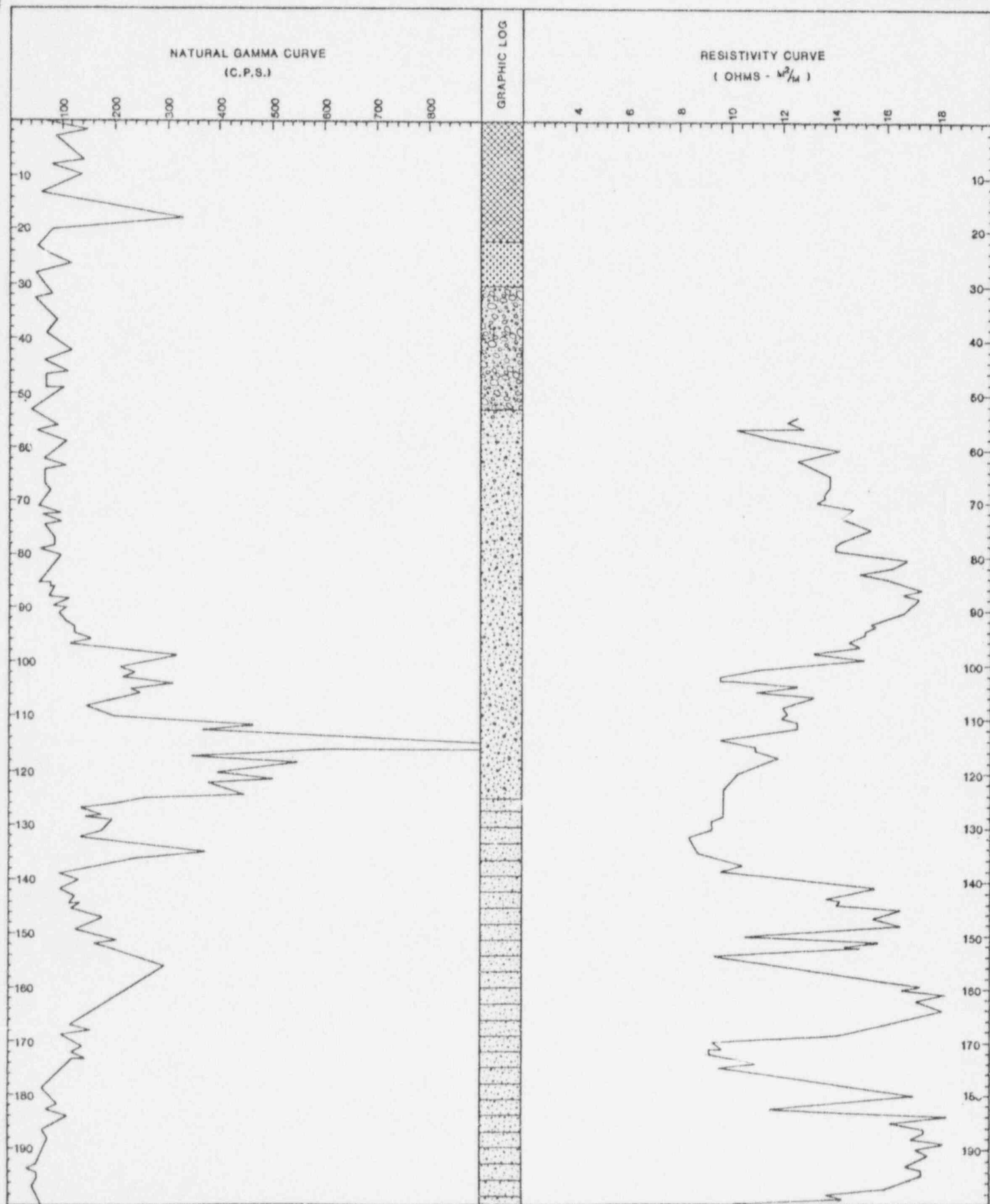
REVIEWED BY: RAH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. ST F-10
GROUND ELEVATION: 6616 feet TOTAL DEPTH: 227 feet
DATE BEGUN: September 6, 1978 DATE FINISHED: September 14, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: FAP Millwork Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-10

GROUND ELEVATION: 6616 feet

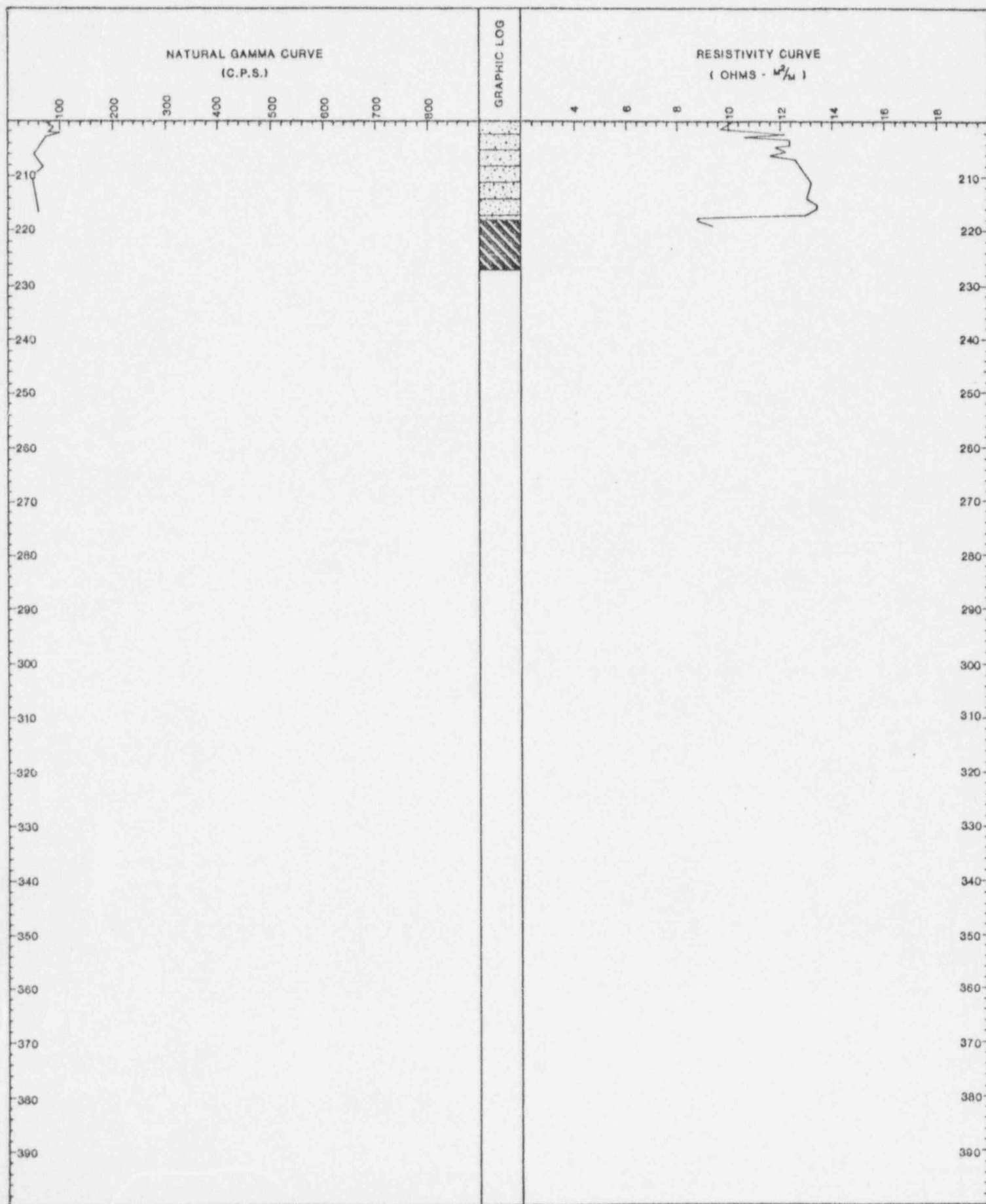
TOTAL DEPTH: 227 feet

DATE BEGUN: September 6, 1978

DATE FINISHED: September 14, 1978

LOGGED BY: Don Taylor

REVIEWED BY: SRH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3

BORING NO. ST F-11

GROUND ELEVATION: 6392 feet

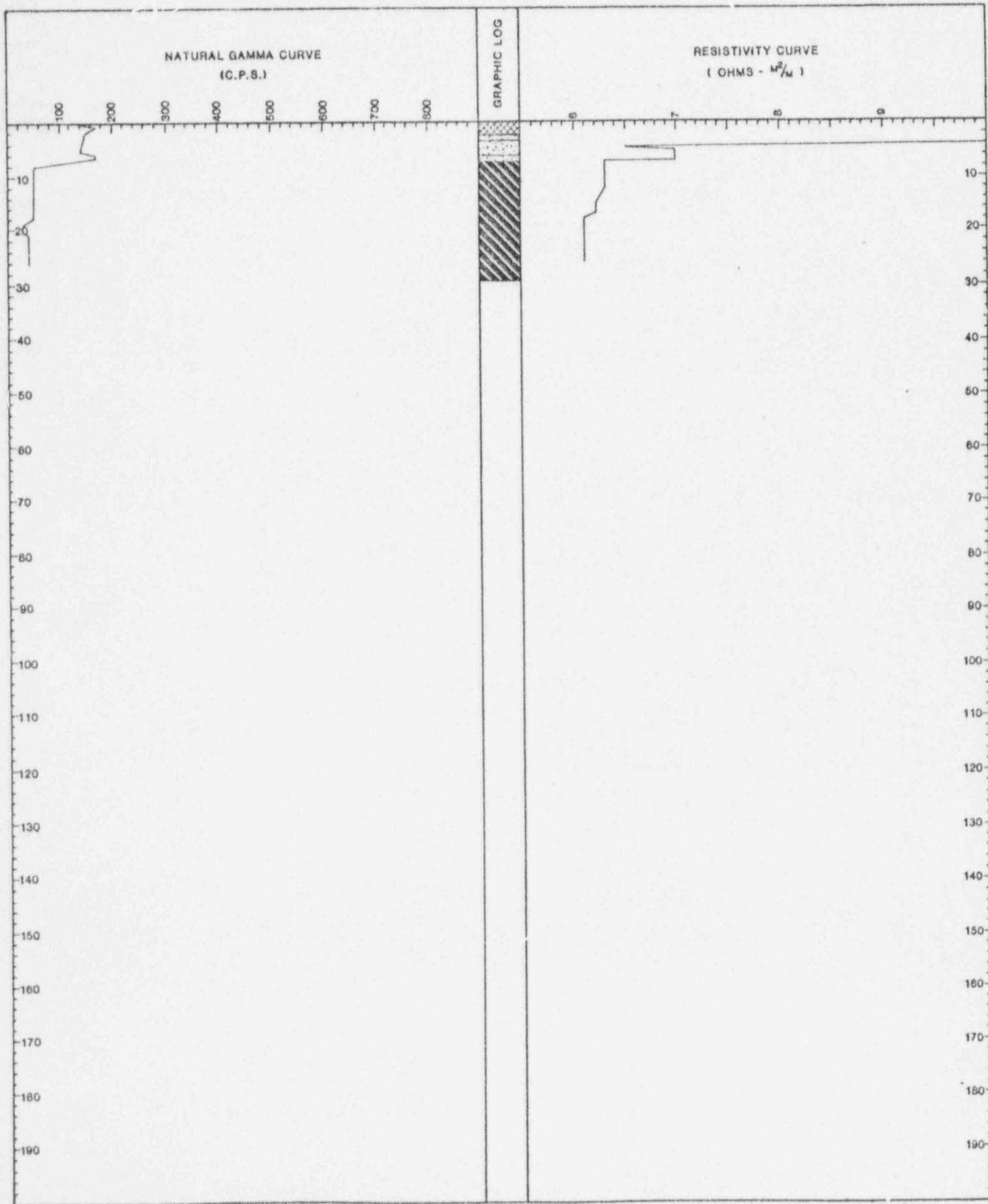
TOTAL DEPTH: 29.5 feet

DATE BEGUN: August 26, 1978

DATE FINISHED: August 26, 1978

LOGGED BY: Don Taylor

REVIEWED BY: *PDH*



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-12

GROUND ELEVATION: 6387 feet

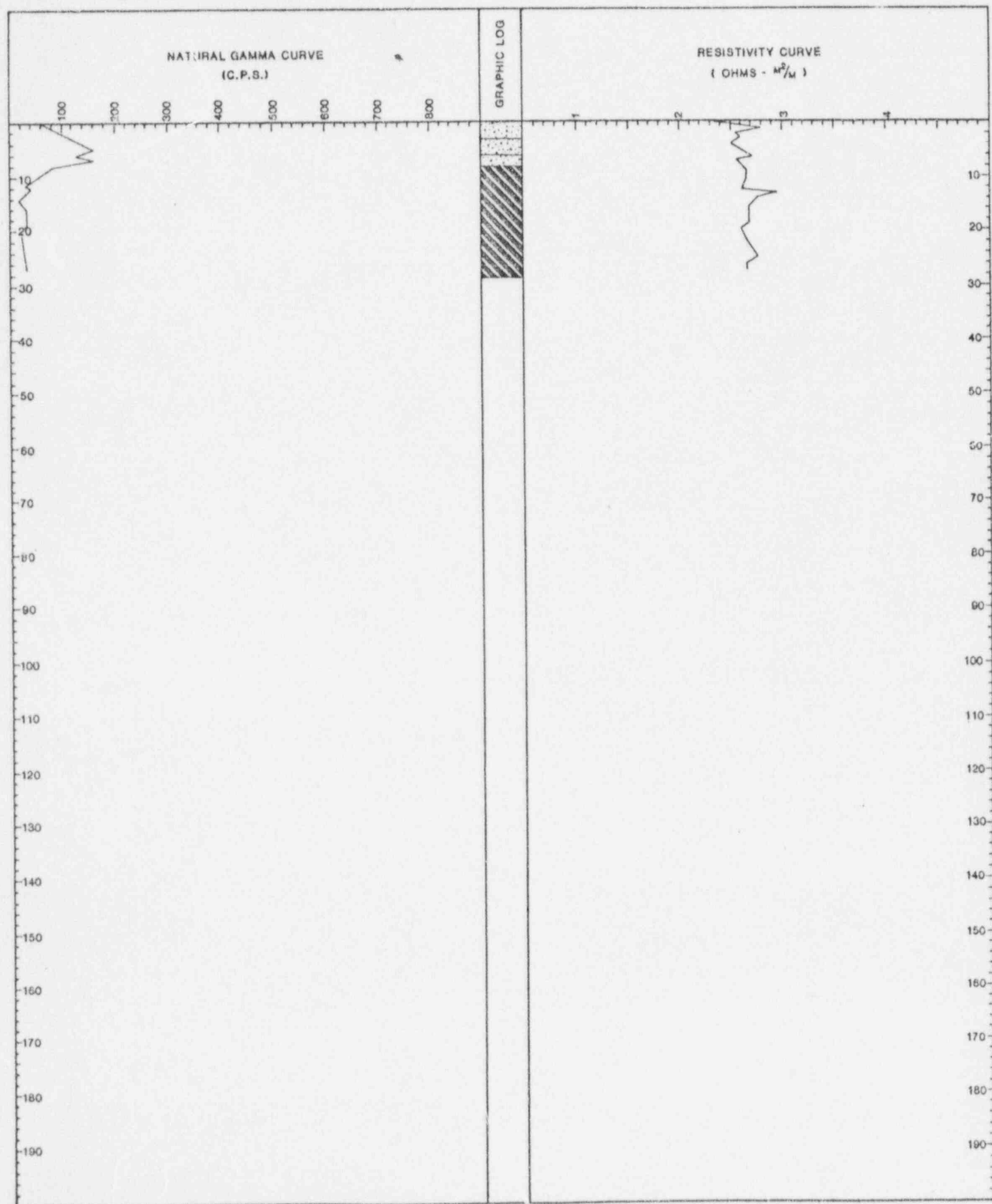
TOTAL DEPTH: 28.6 feet

DATE BEGUN: August 24, 1978

DATE FINISHED: August 25, 1978

LOGGED BY: Don Taylor

REVIEWED BY: *PAH*



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. ST F-13

GROUND ELEVATION: 6387 feet

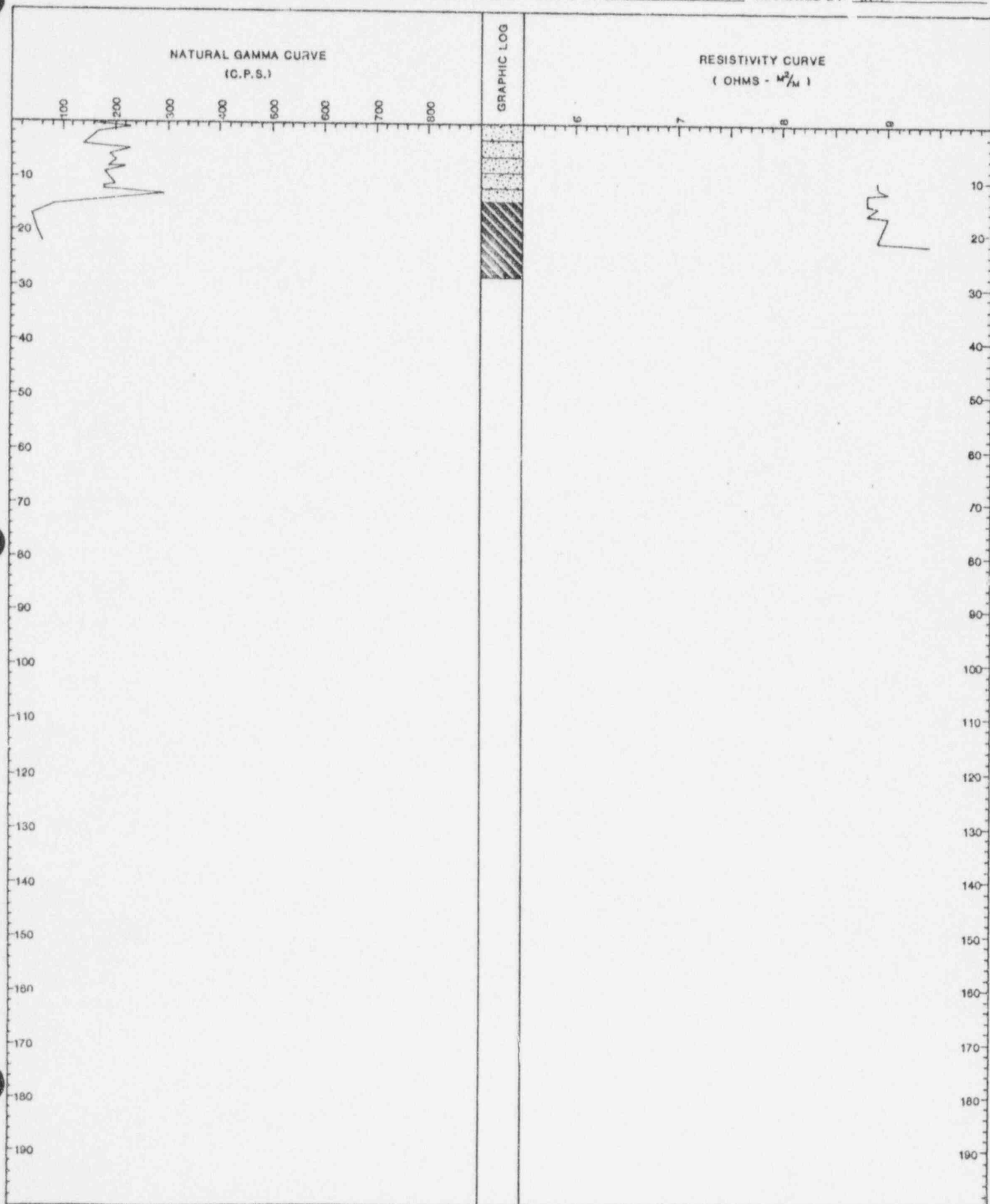
TOTAL DEPTH: 28.4 feet

DATE BEGUN: August 25, 1978

DATE FINISHED: August 25, 1978

LOGGED BY: Don Taylor

REVIEWED BY: DDH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. BUL F-1

GROUND ELEVATION: 6473 feet

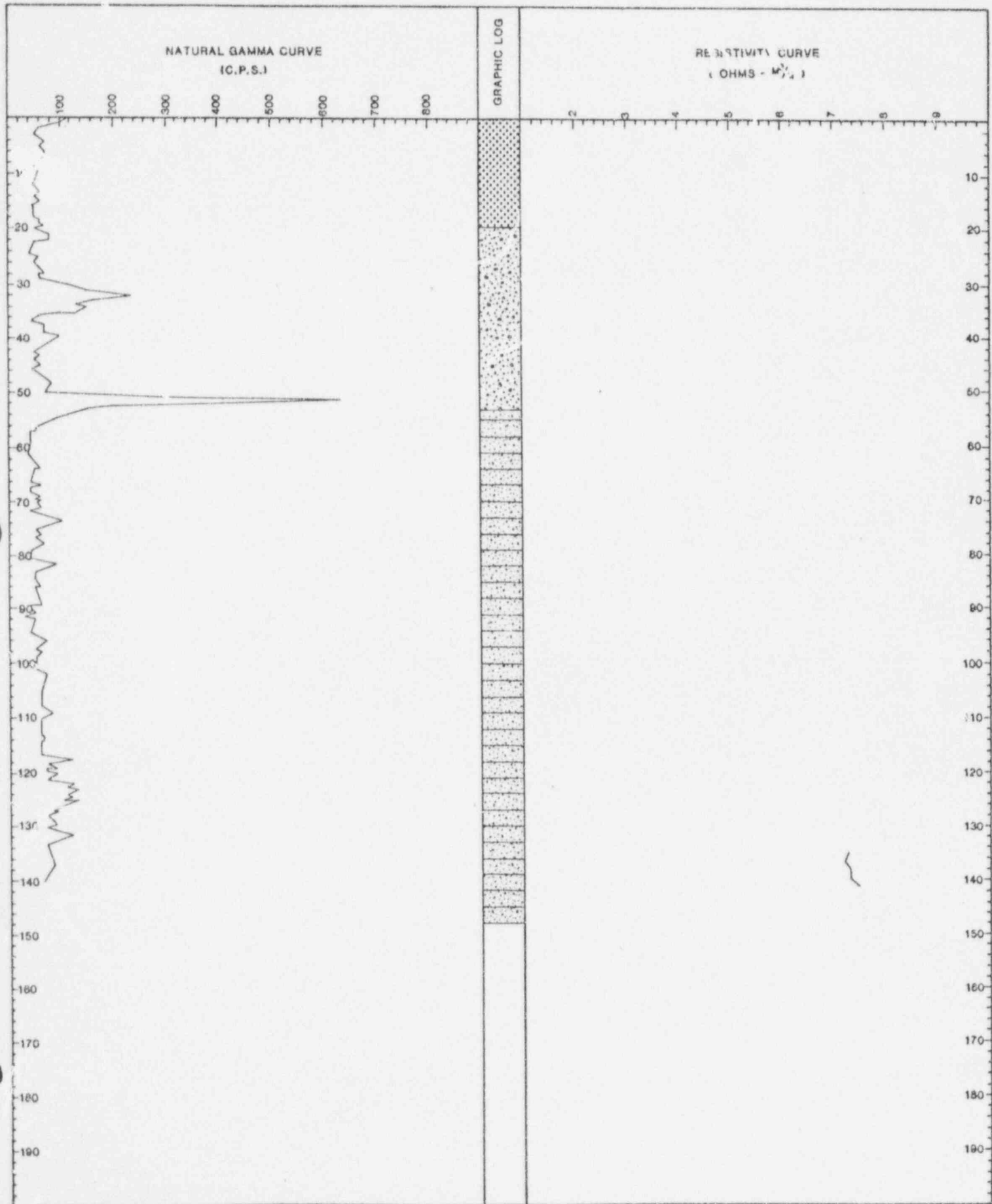
TOTAL DEPTH: 148 feet

DATE BEGUN: August 22, 1978

DATE FINISHED: August 24, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. BUL F-2

GROUND ELEVATION: 6481 feet

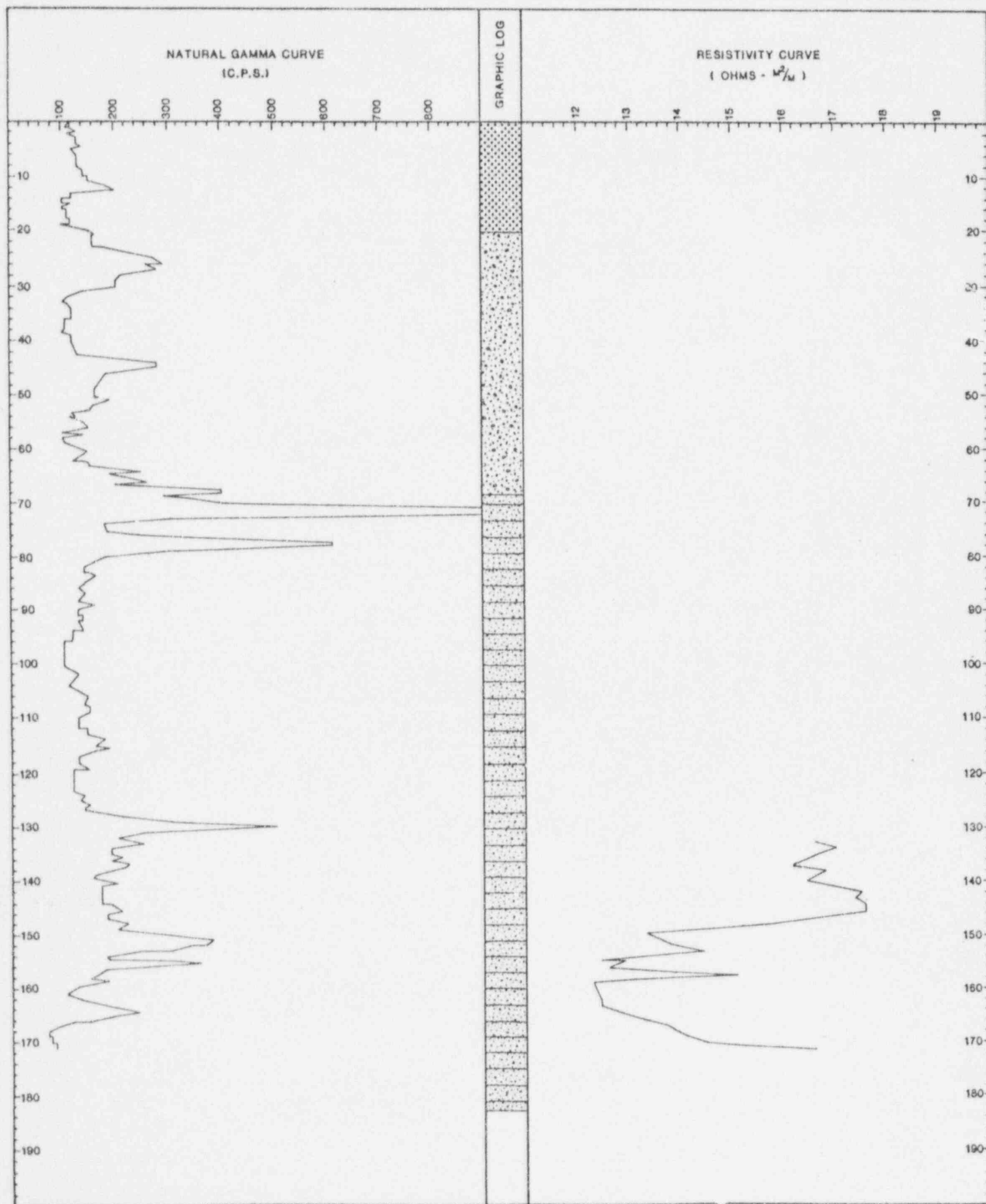
TOTAL DEPTH: 183 feet

DATE BEGUN: August 31, 1978

DATE FINISHED: September 11, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771

BORING NO. BUL F-3

GROUND ELEVATION: 6465 feet

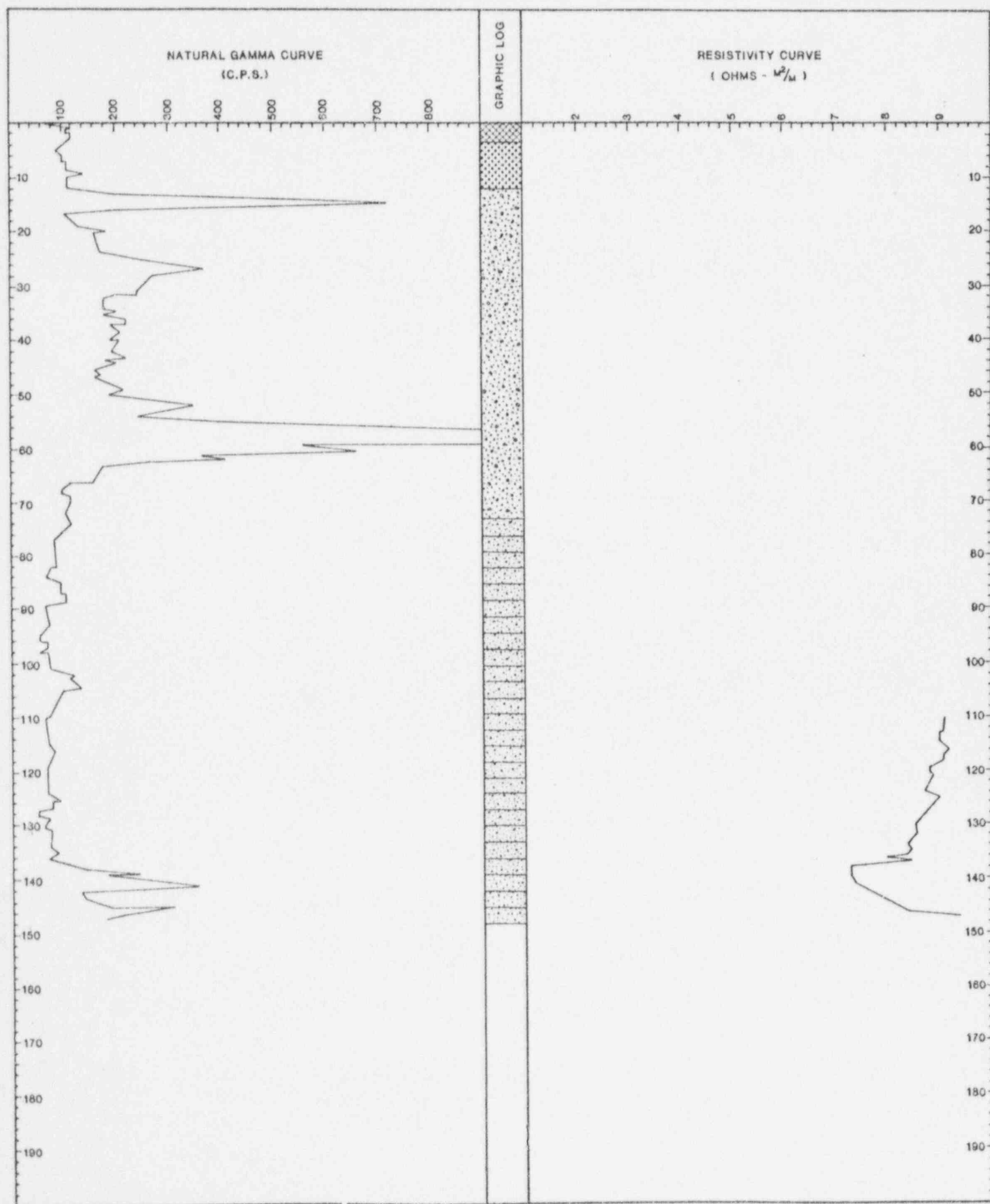
TOTAL DEPTH: 148.5 feet

DATE BEGUN: August 27, 1978

DATE FINISHED: September 7, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAH

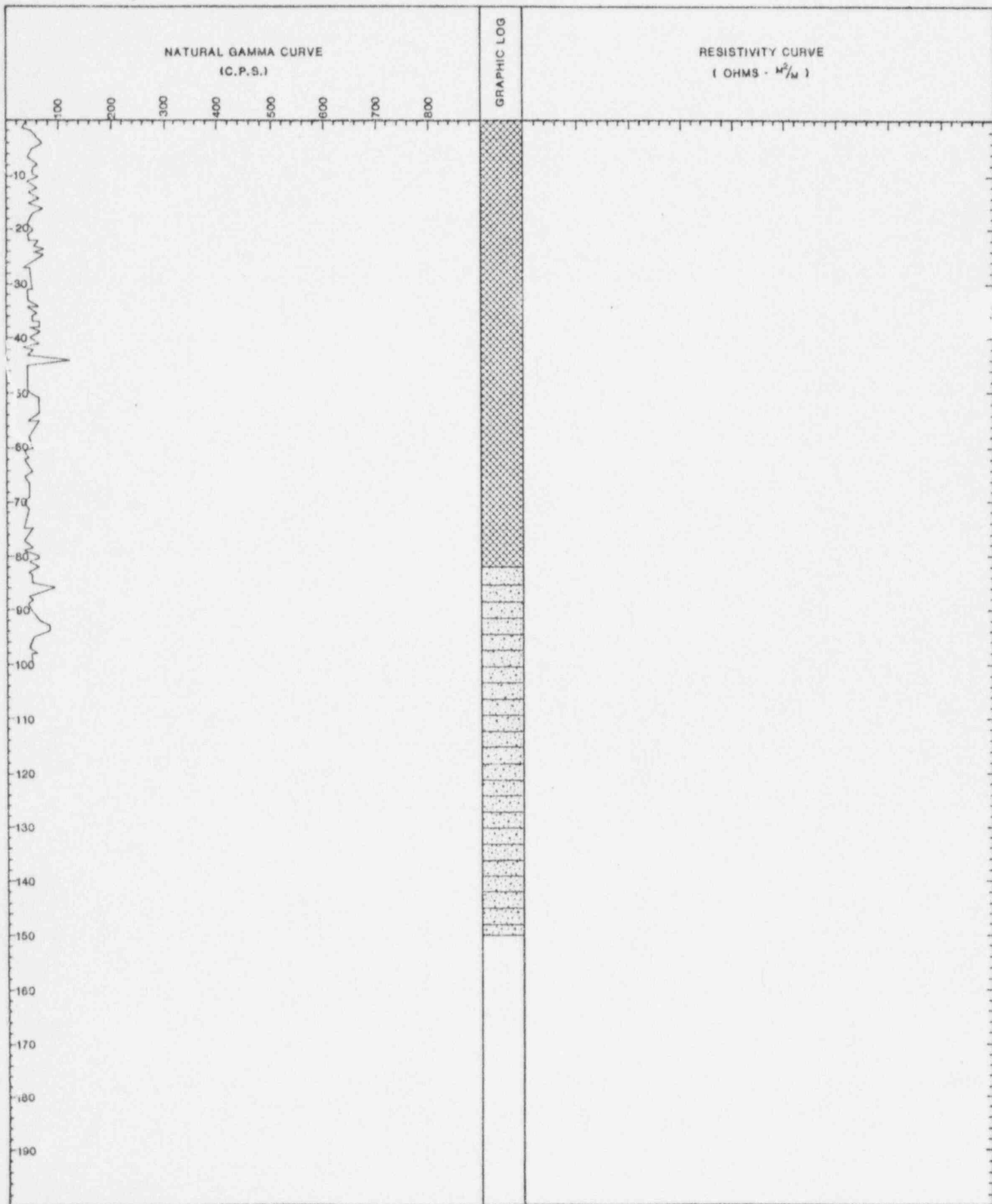


F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. BUL F-4
GROUND ELEVATION: 6447 feet TOTAL DEPTH: 150 feet

DATE BEGUN: October 24, 1978 DATE FINISHED: October 24, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH



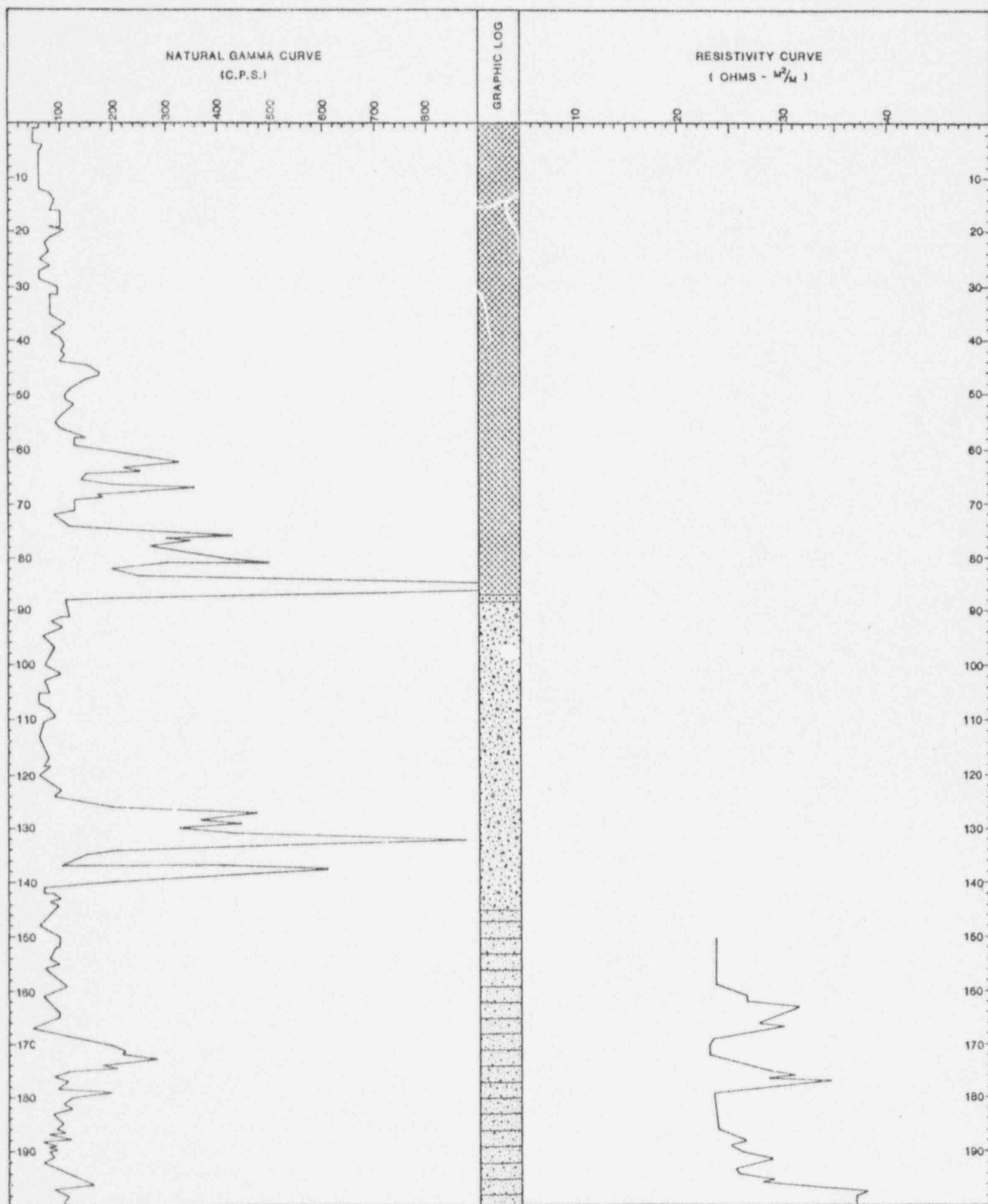
F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: EAP Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. BUL F-5

GROUND ELEVATION: 6579 feet TOTAL DEPTH: 250 feet

DATE BEGUN: October 10, 1978 DATE FINISHED: October 13, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. BUL F-5

GROUND ELEVATION: 65.79 feet

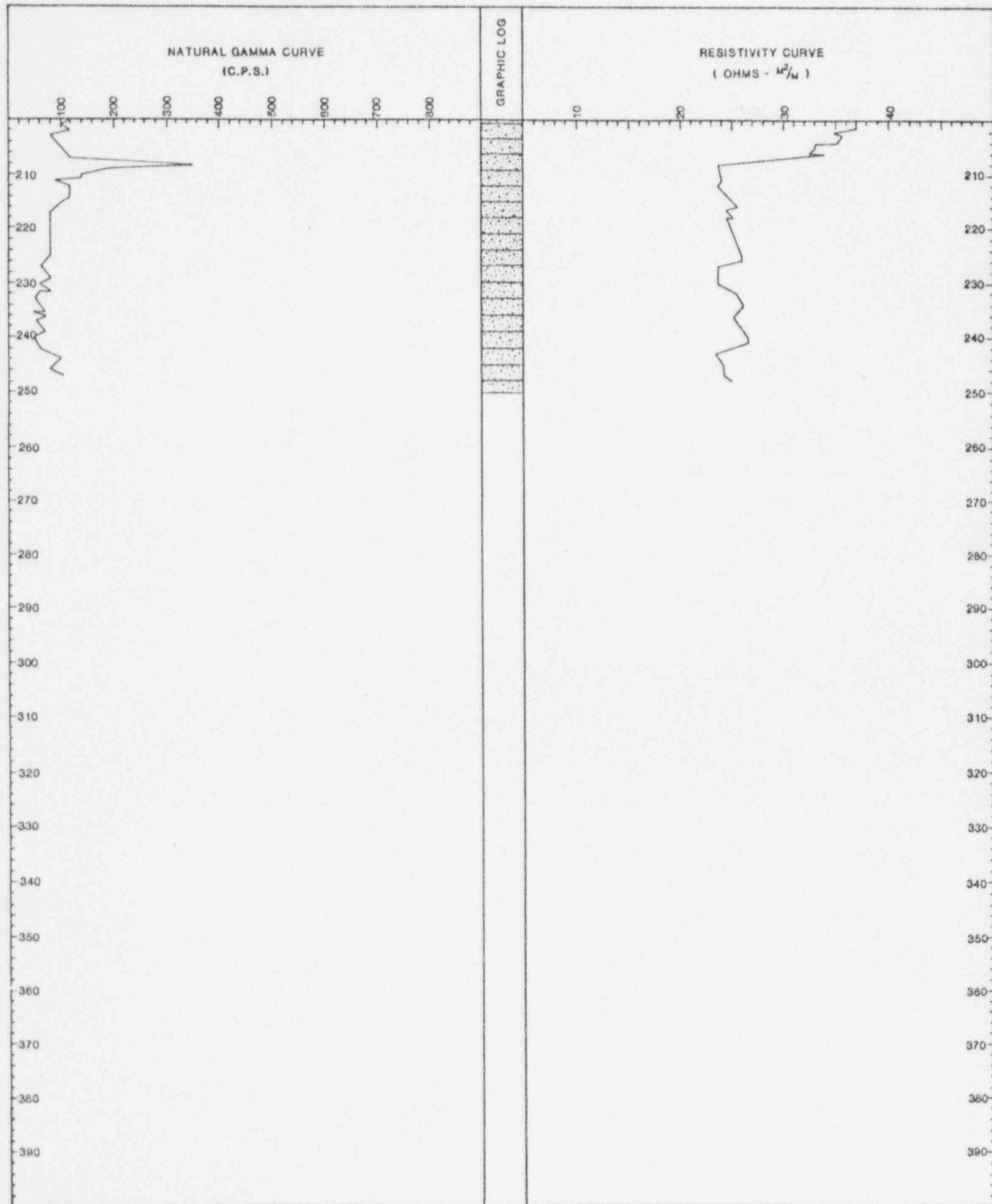
TOTAL DEPTH: 250 feet

DATE BEGUN: October 10, 1978

DATE FINISHED: October 13, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RAH



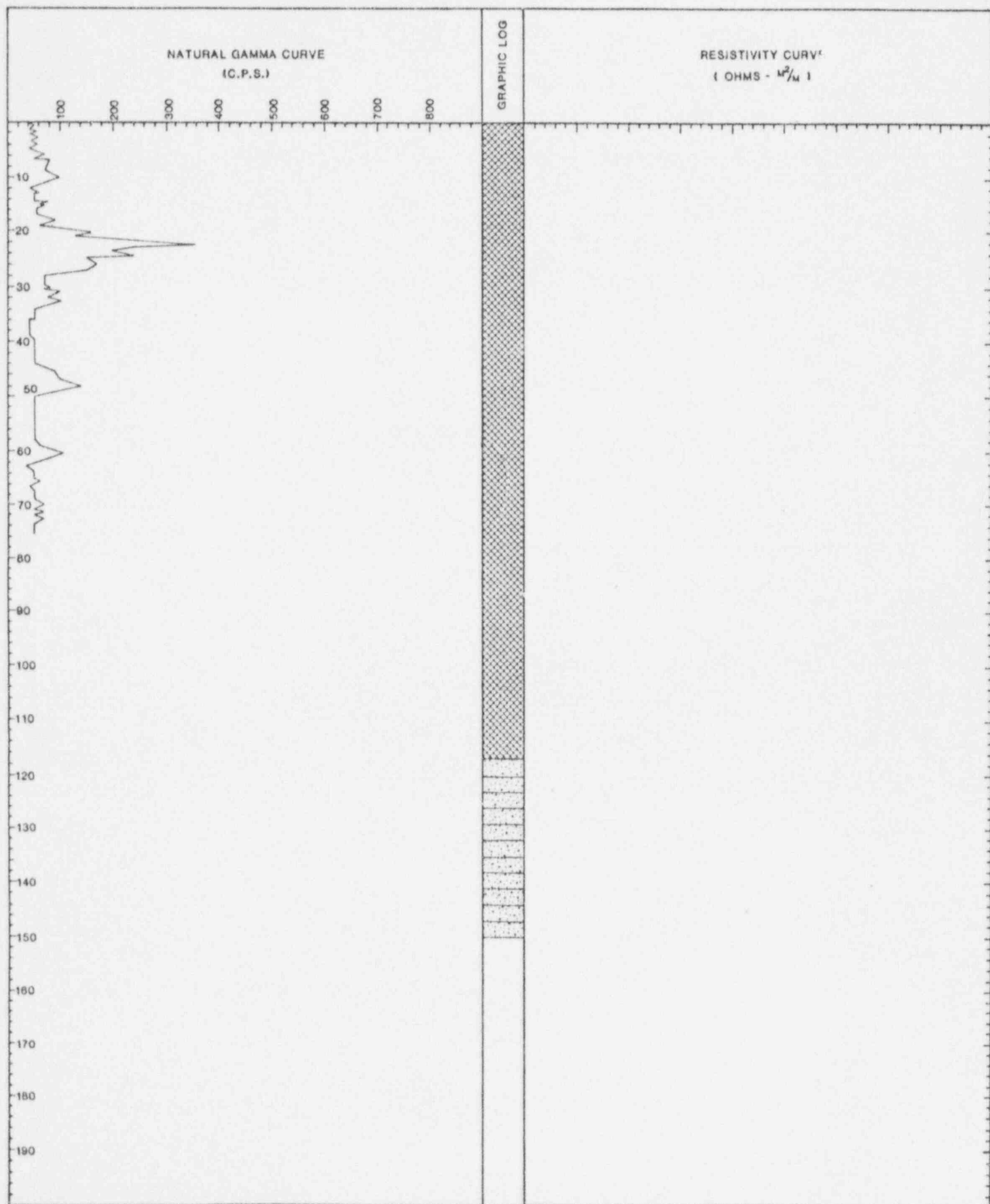
F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 1

PROJECT: FAP Millwaste Subsurface Disposal Investigation PROJECT NO. 1-1371-3771 BORING NO. BUL F-6

GROUND ELEVATION: 6418 feet TOTAL DEPTH: 150 feet

DATE BEGUN: October 25, 1978 DATE FINISHED: October 26, 1978 LOGGED BY: Don Taylor REVIEWED BY: RAH



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. BUL F-7

GROUND ELEVATION: 6496 feet

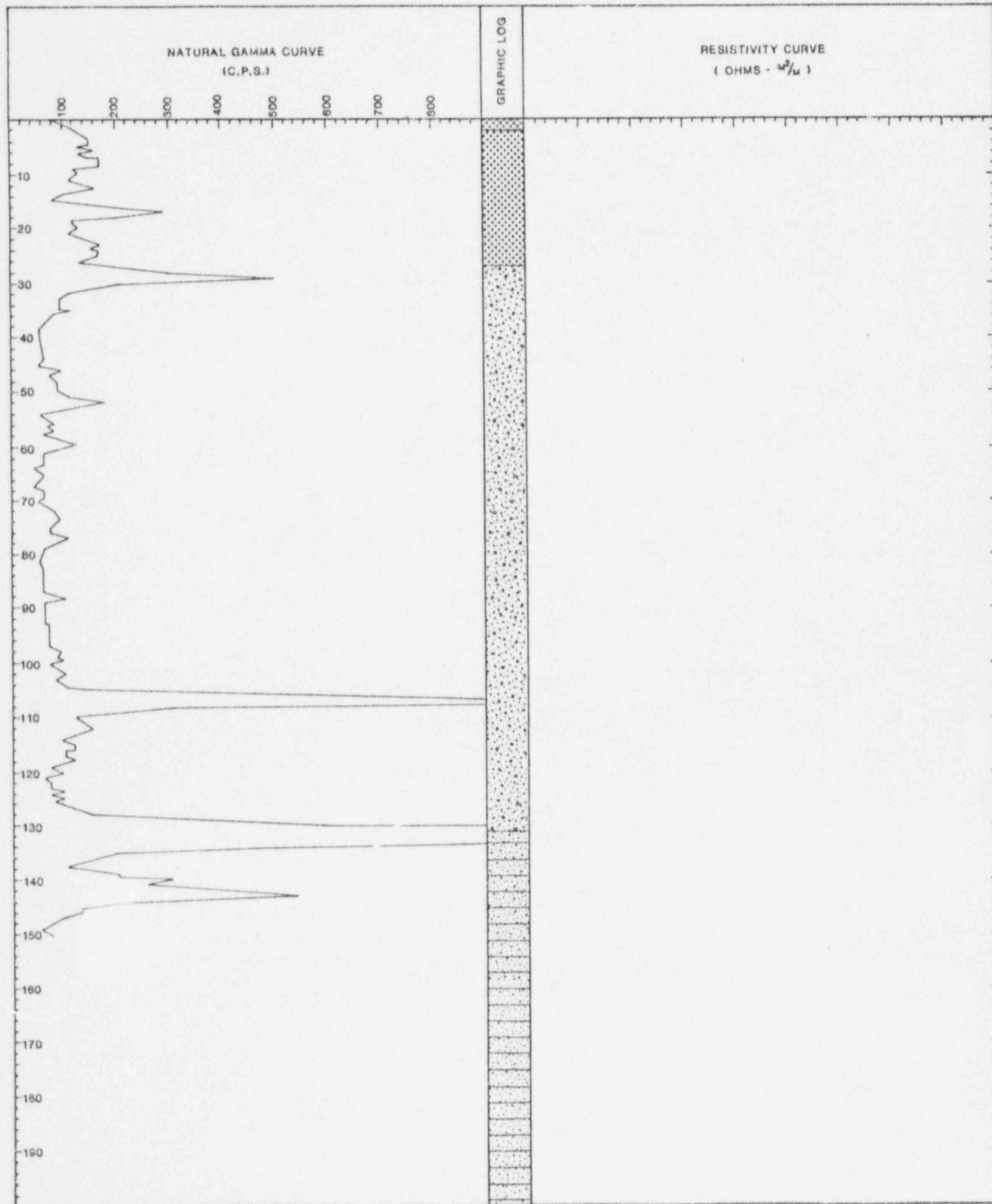
TOTAL DEPTH: 236.5 feet

DATE BEGUN: October 27, 1978

DATE FINISHED: November 4, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RPL



F. M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 1 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. BUL F-8

GROUND ELEVATION: 6558 feet

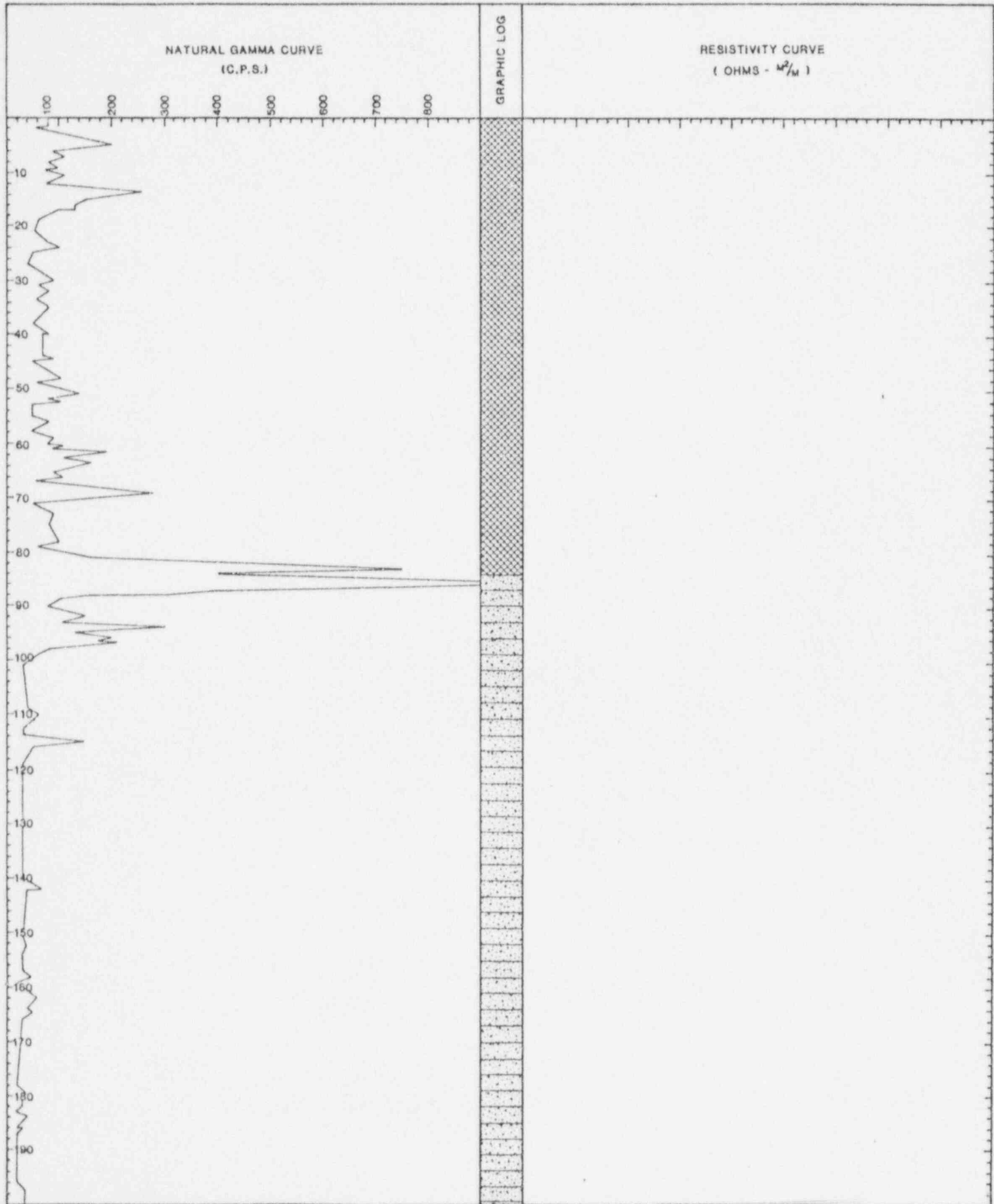
TOTAL DEPTH: 290.5 feet

DATE BEGUN: September 21, 1978

DATE FINISHED: September 28, 1978

LOGGED BY: Don Taylor

REVIEWED BY: SAH



F.M. FOX & ASSOCIATES, INC.
SUBSURFACE EXPLORATION LOG

SHEET 2 OF 2

PROJECT: FAP Millwaste Subsurface Disposal Investigation

PROJECT NO. 1-1371-3771

BORING NO. BUL F-8

GROUND ELEVATION: 6558 feet

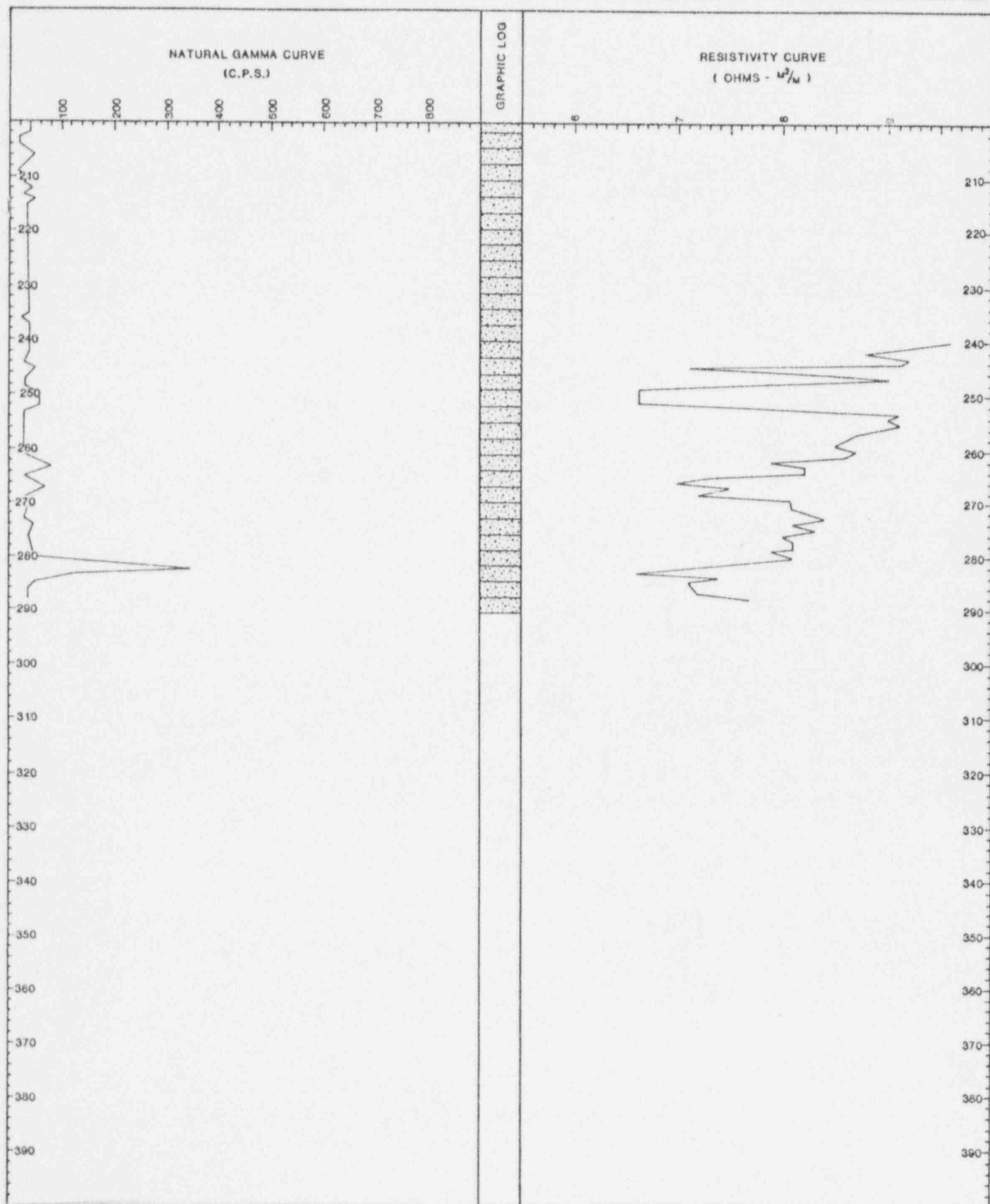
TOTAL DEPTH: 290.5 feet

DATE BEGUN: September 21, 1978

DATE FINISHED: September 28, 1978

LOGGED BY: Don Taylor

REVIEWED BY: RTH



APPENDIX C

CROSS-SECTIONS

APERTURE CARD/PAPER COPY AVAILABLE THROUGH NRC FILE CENTER

NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARD(S) 6

9706120293-02-06

APPENDIX D

LABORATORY TEST RESULTS

APPENDIX D

TABLE OF CONTENTS

Section 1	Figures D-1 through D-18
Classification Tests	
Section 2	Figures D-19 through D-32
Engineering Characteristics	
Summary of Laboratory Results	Figure D-33 through D-36

SECTION 1

CLASSIFICATION TESTS

GRADATION ANALYSIS

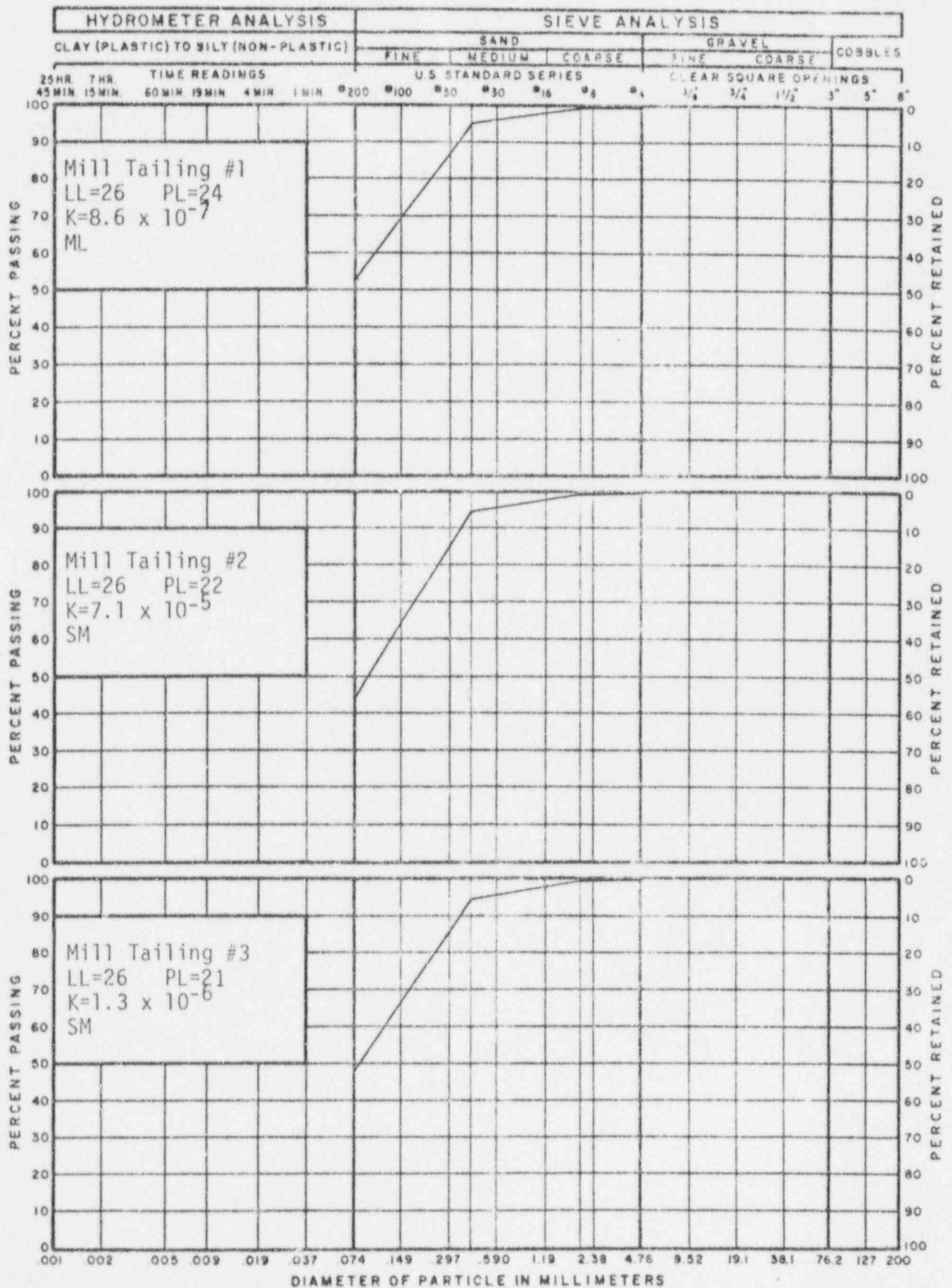


FIG. D-1

GRADATION ANALYSIS

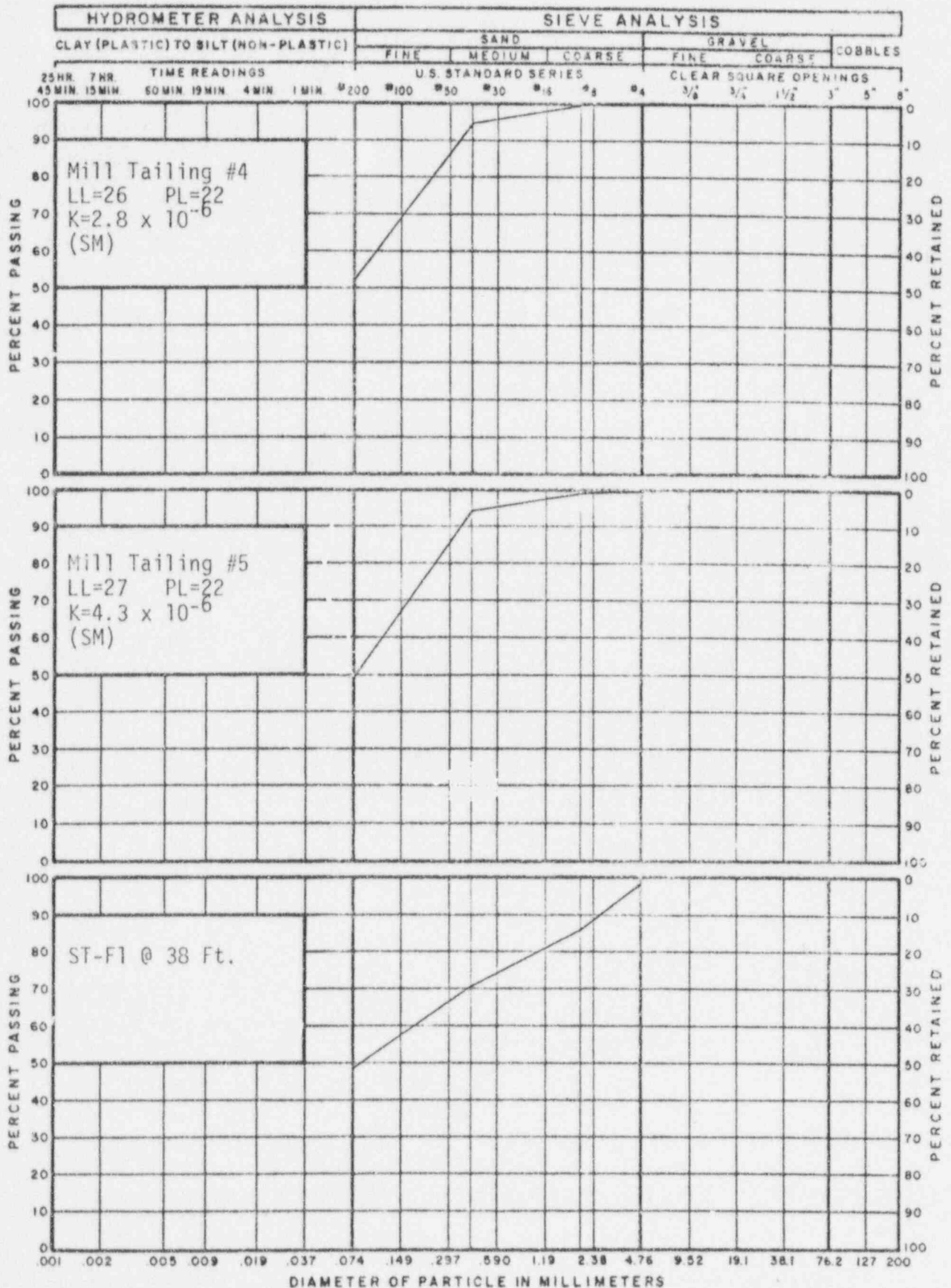


FIG. D-2

GRADATION ANALYSIS

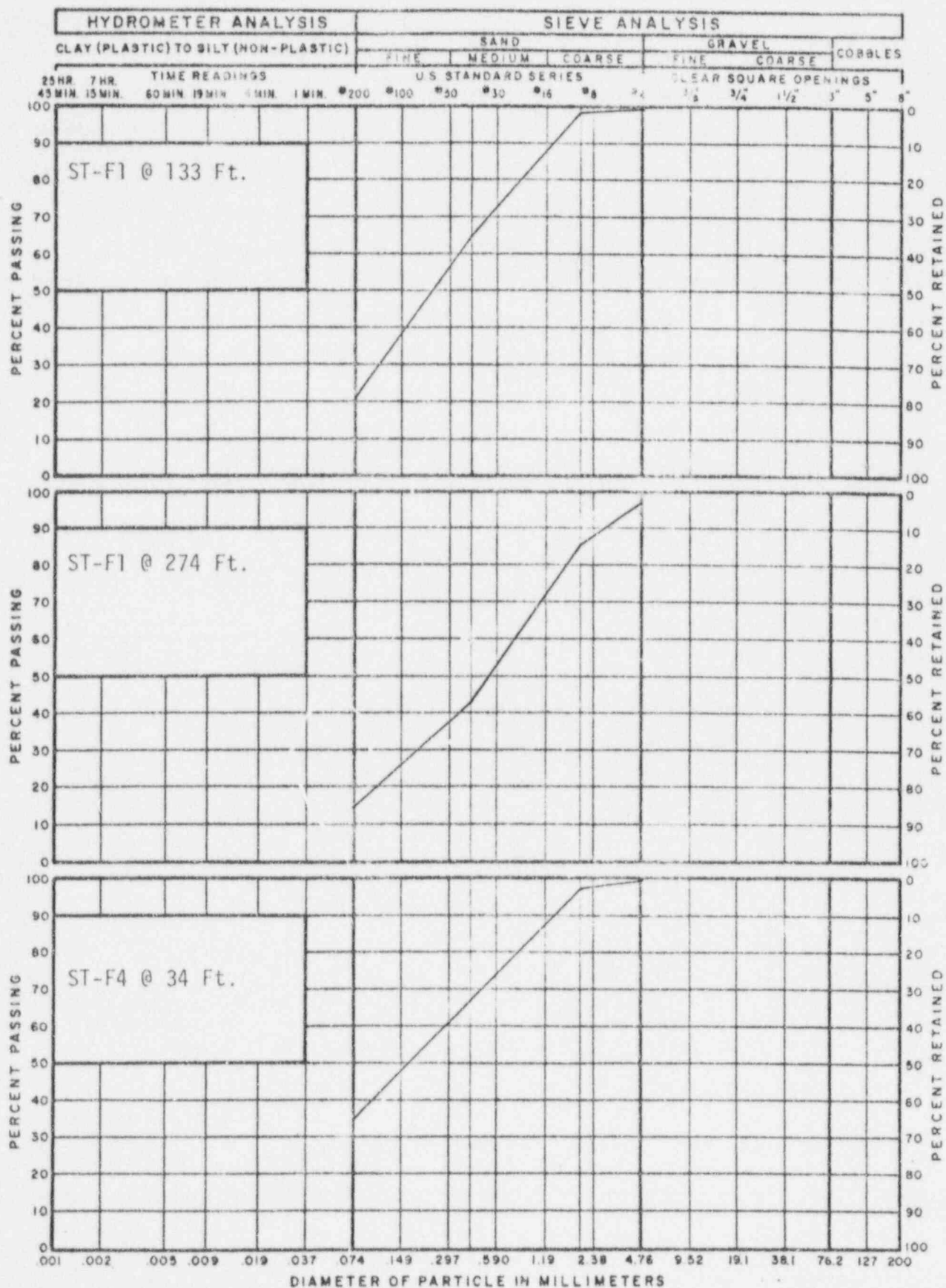


FIG. D-3

GRADATION ANALYSIS

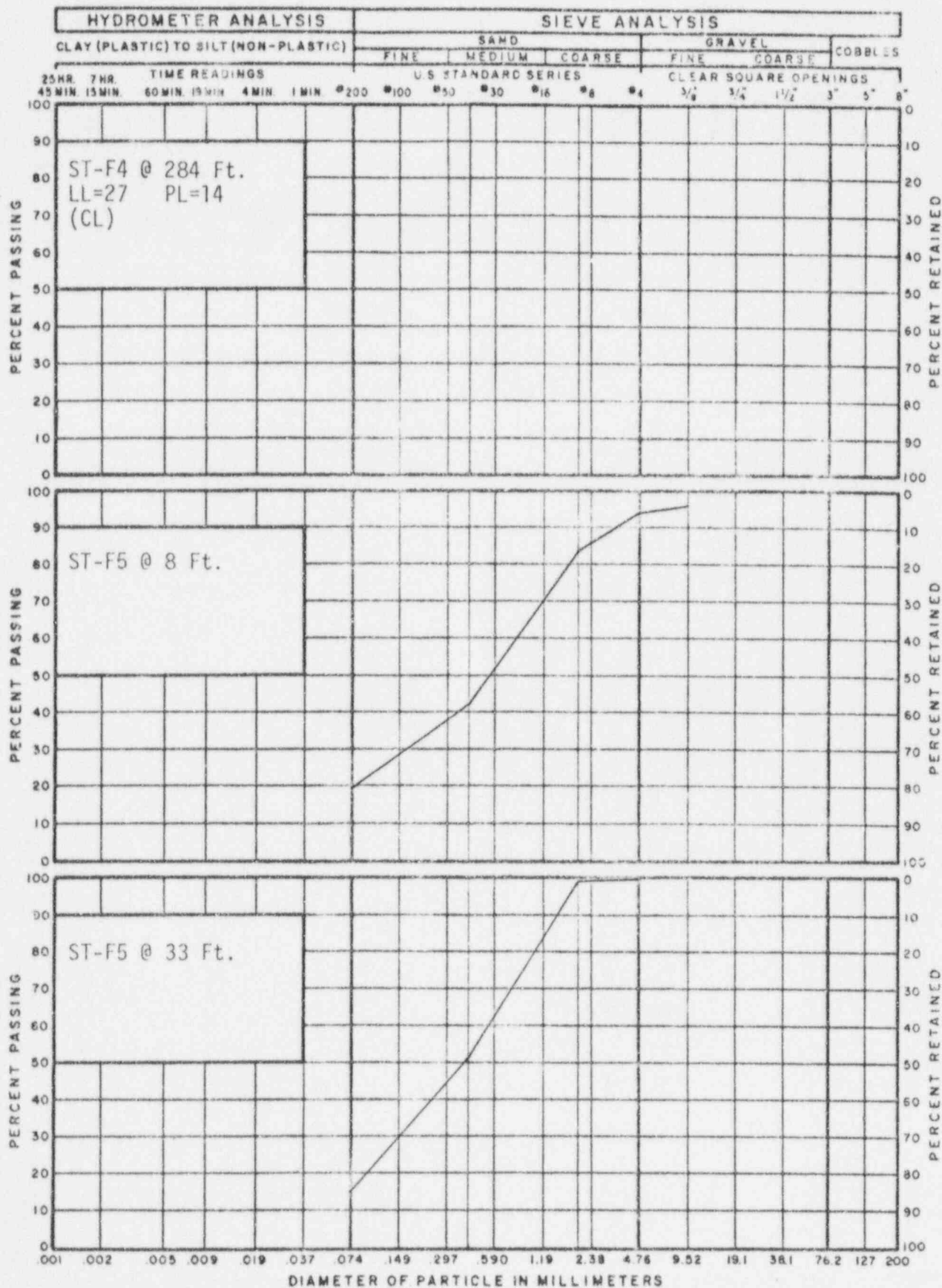


FIG. D-4

GRADATION ANALYSIS

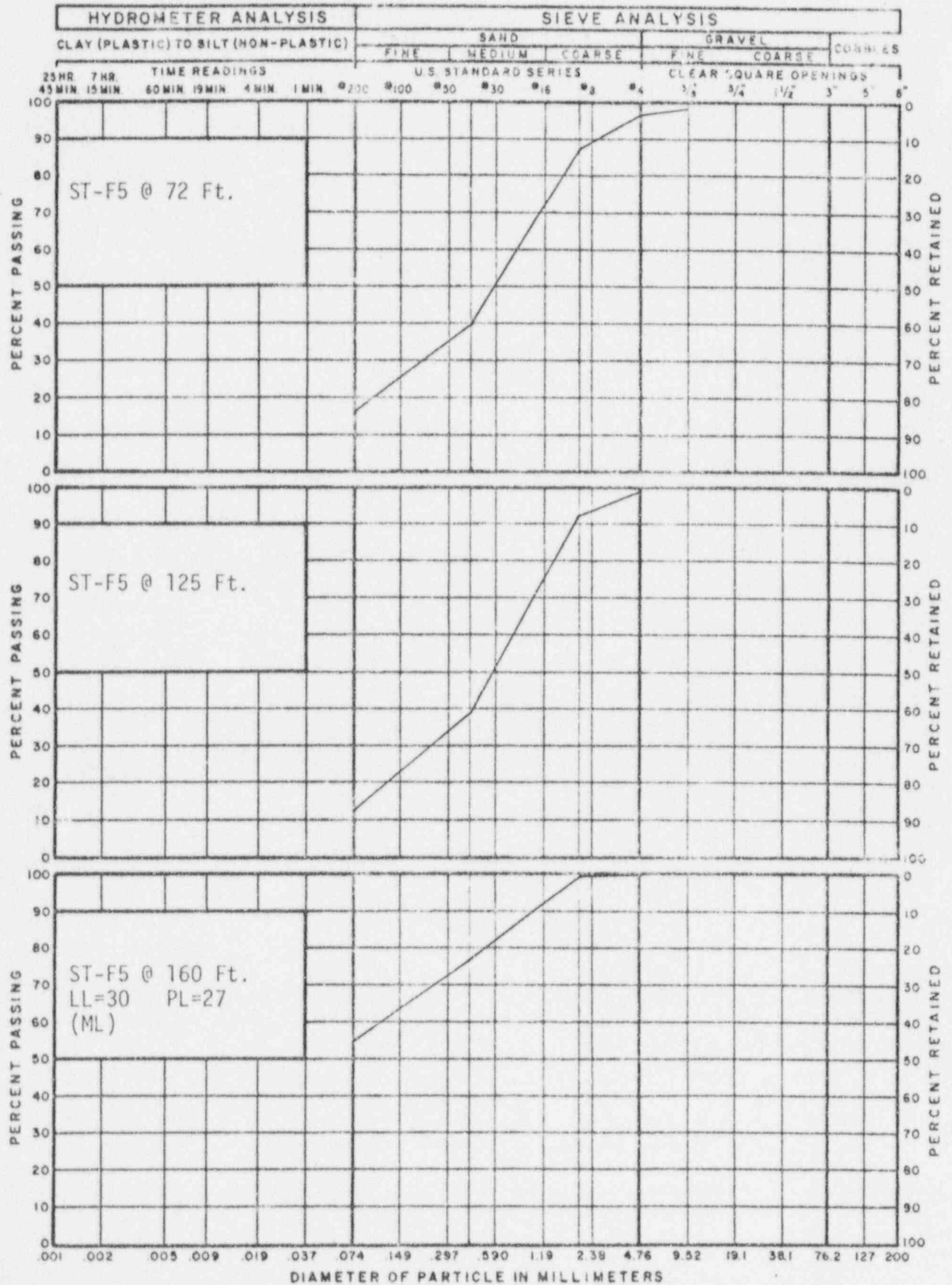


FIG. D-5

GRADATION ANALYSIS

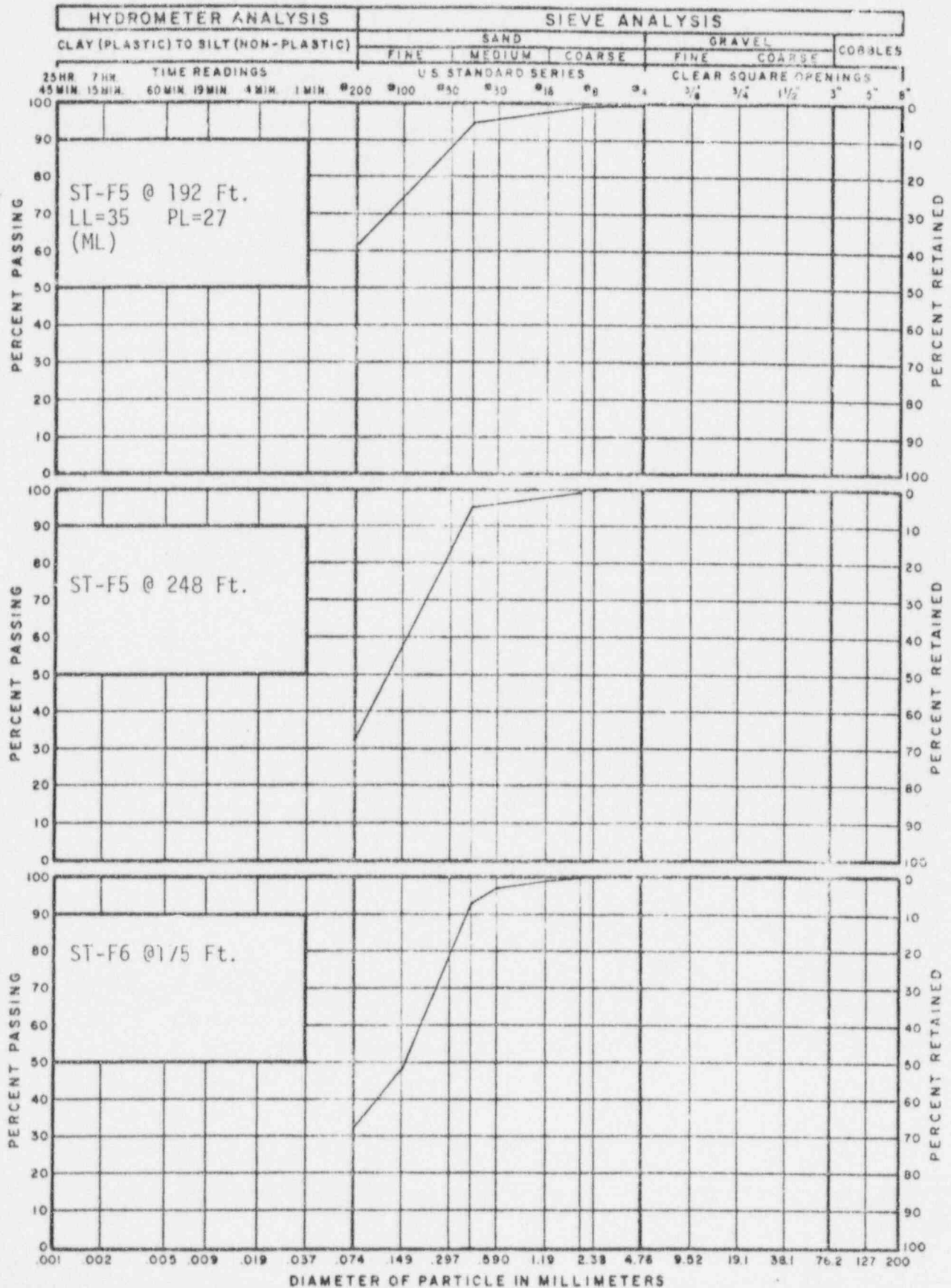
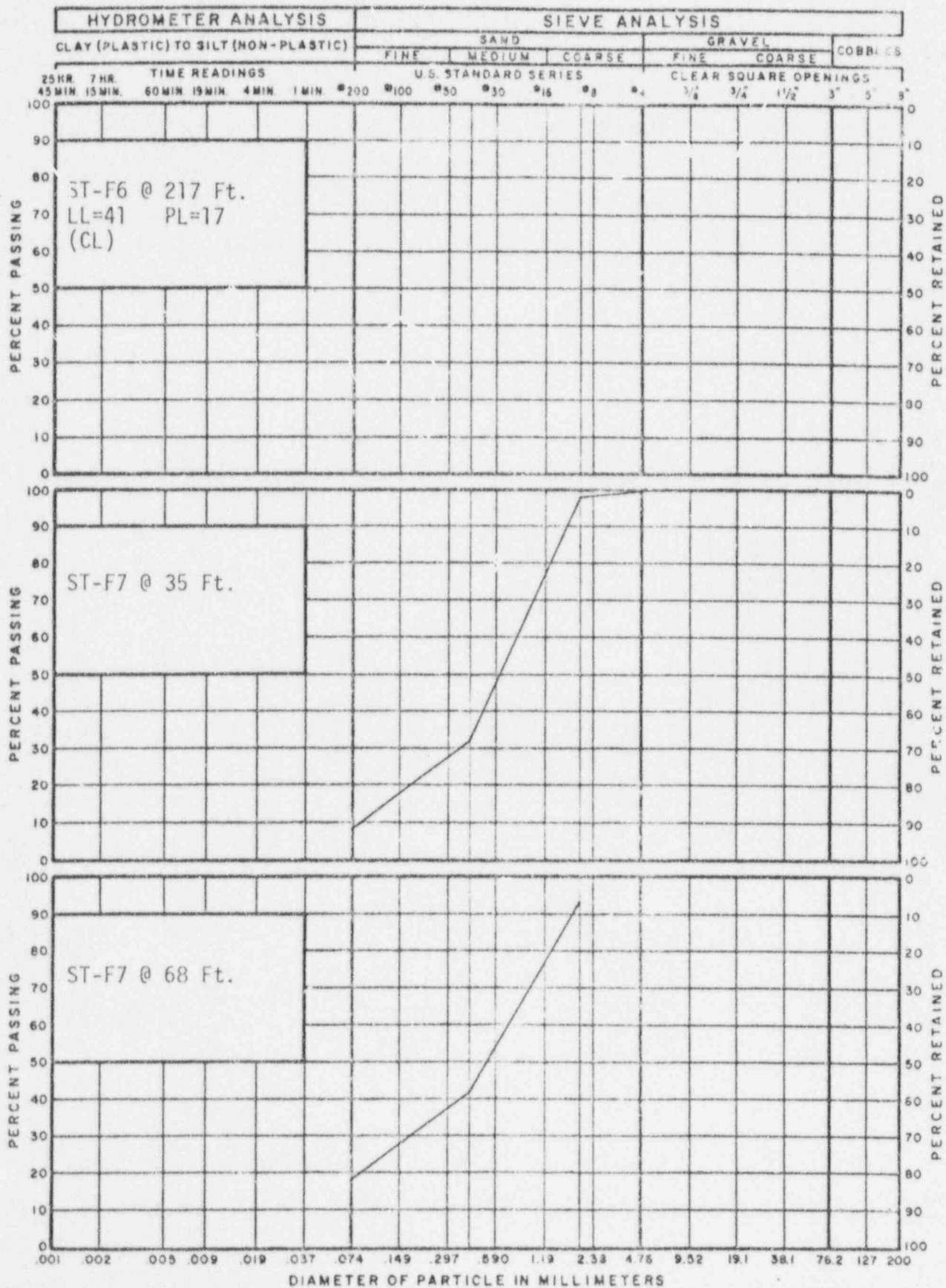


FIG. D-6

GRADATION ANALYSIS



GRADATION ANALYSIS

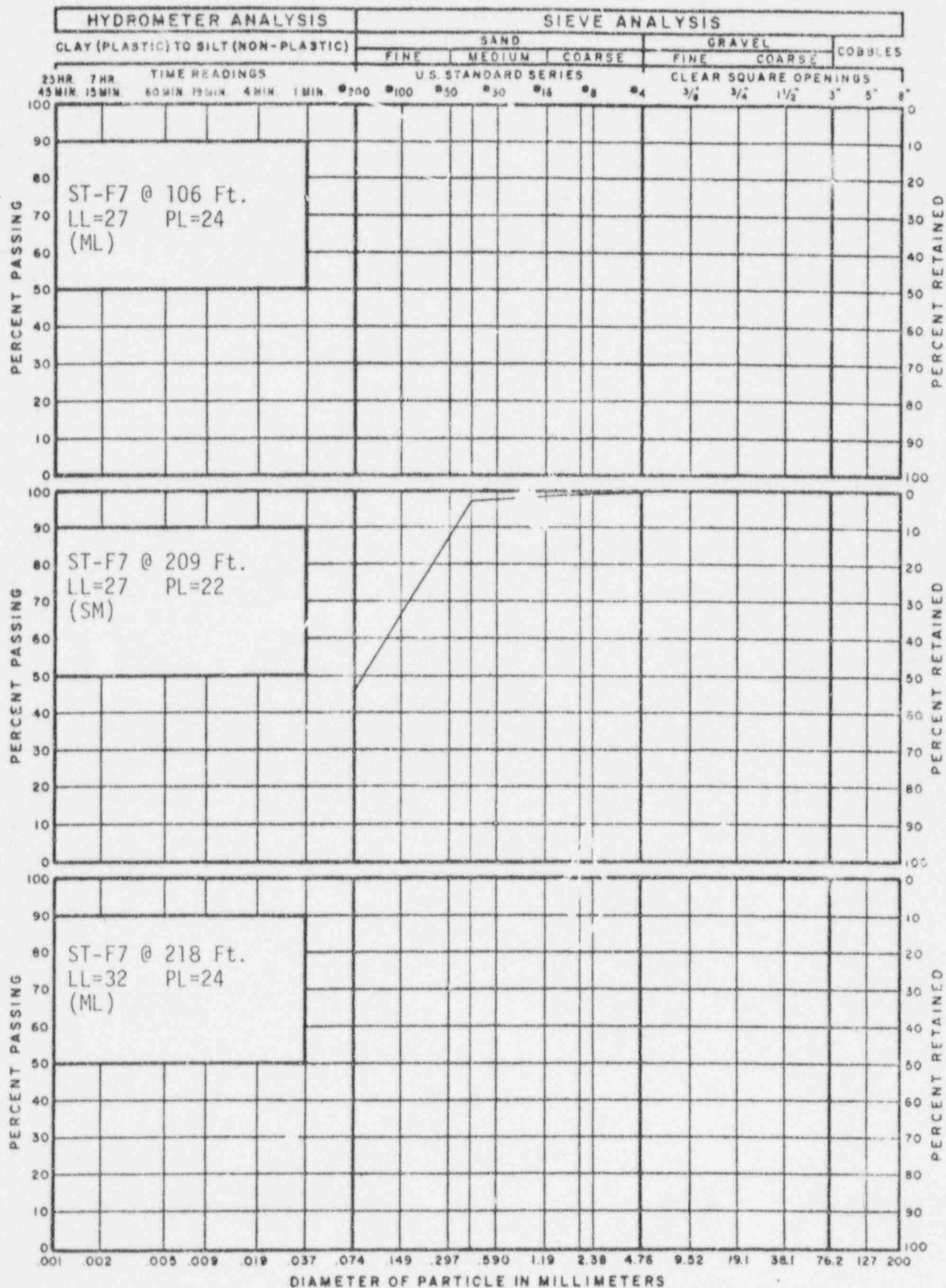
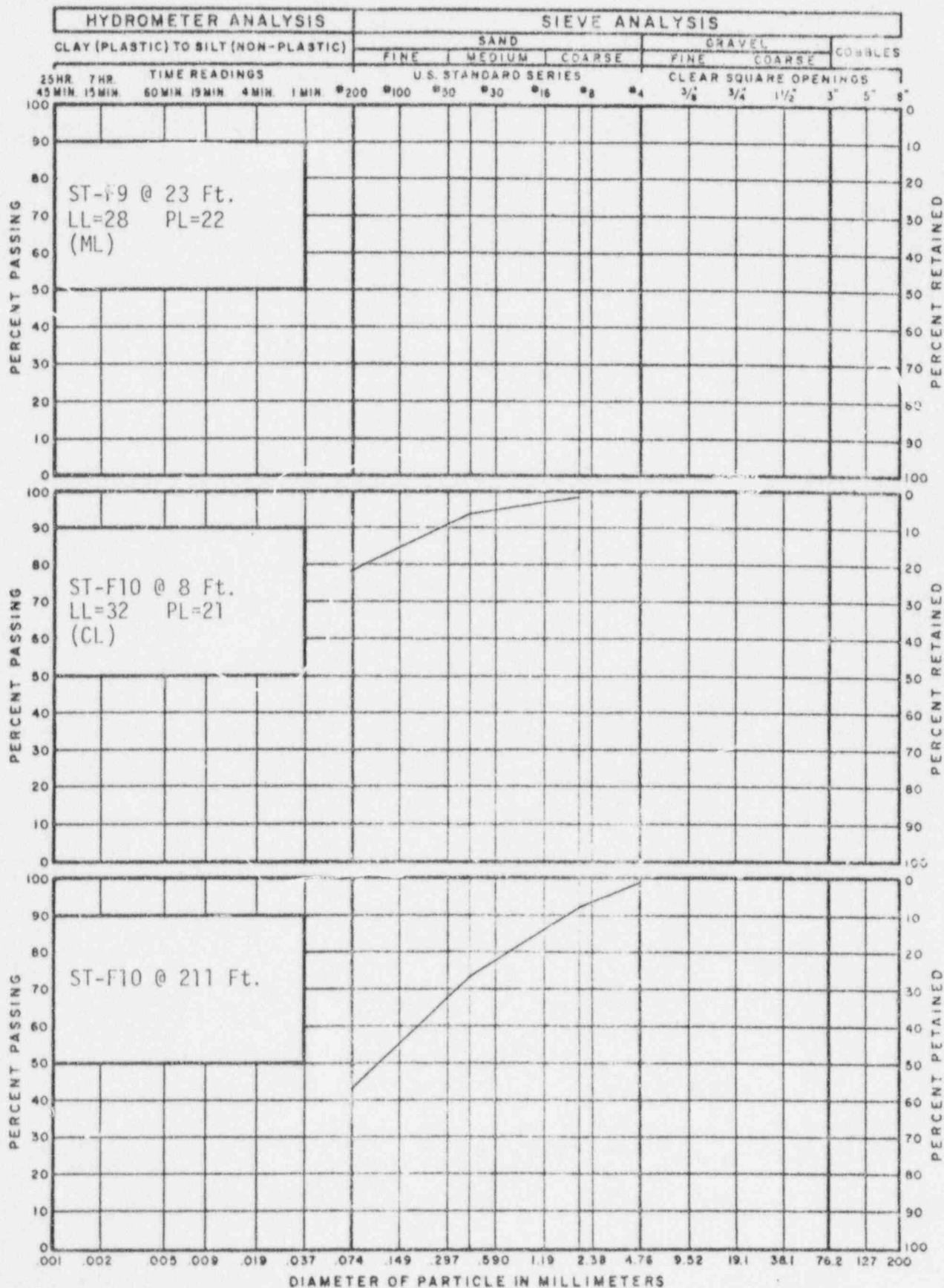


FIG. D-8

GRADATION ANALYSIS



GRADATION ANALYSIS

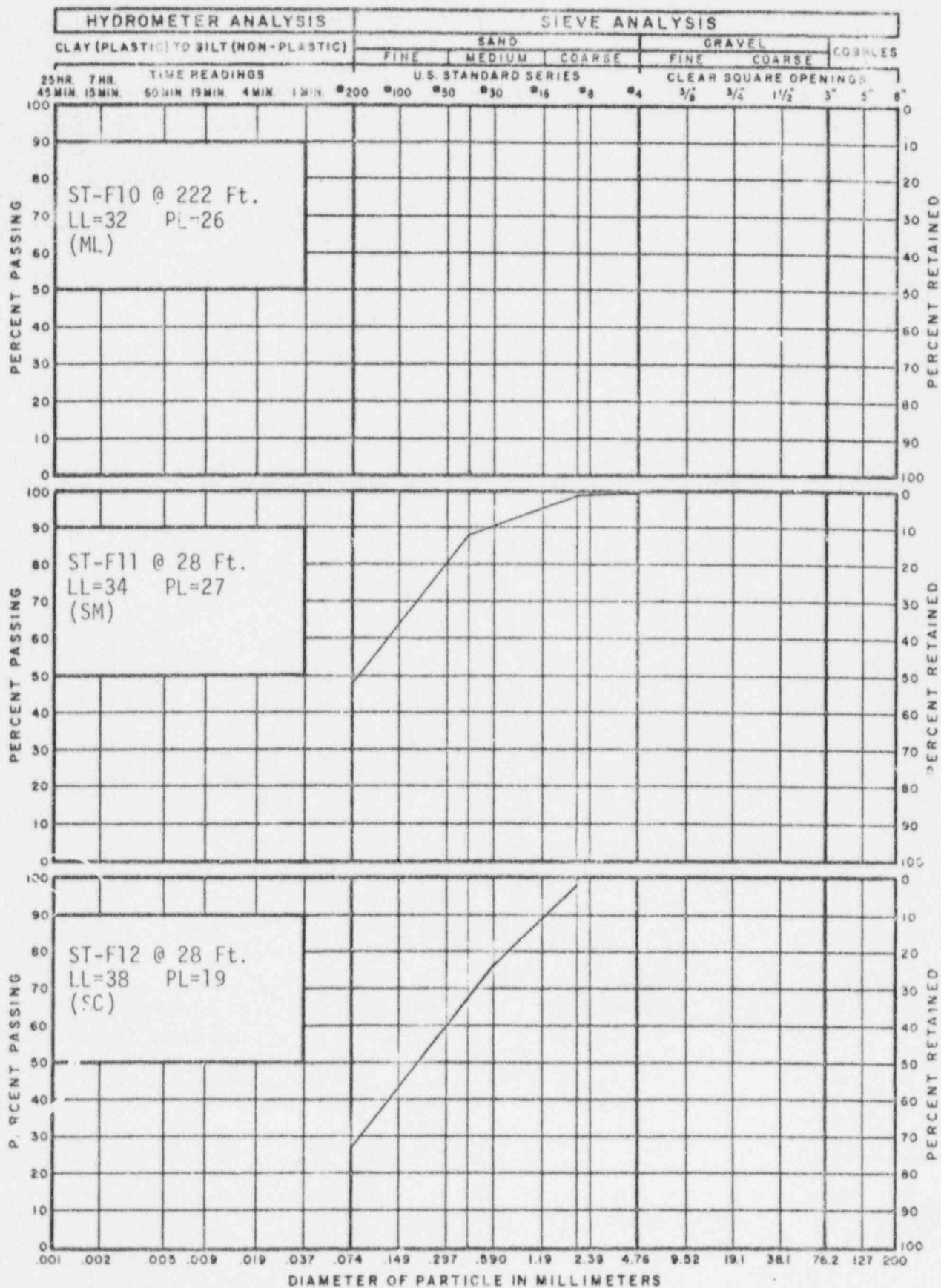
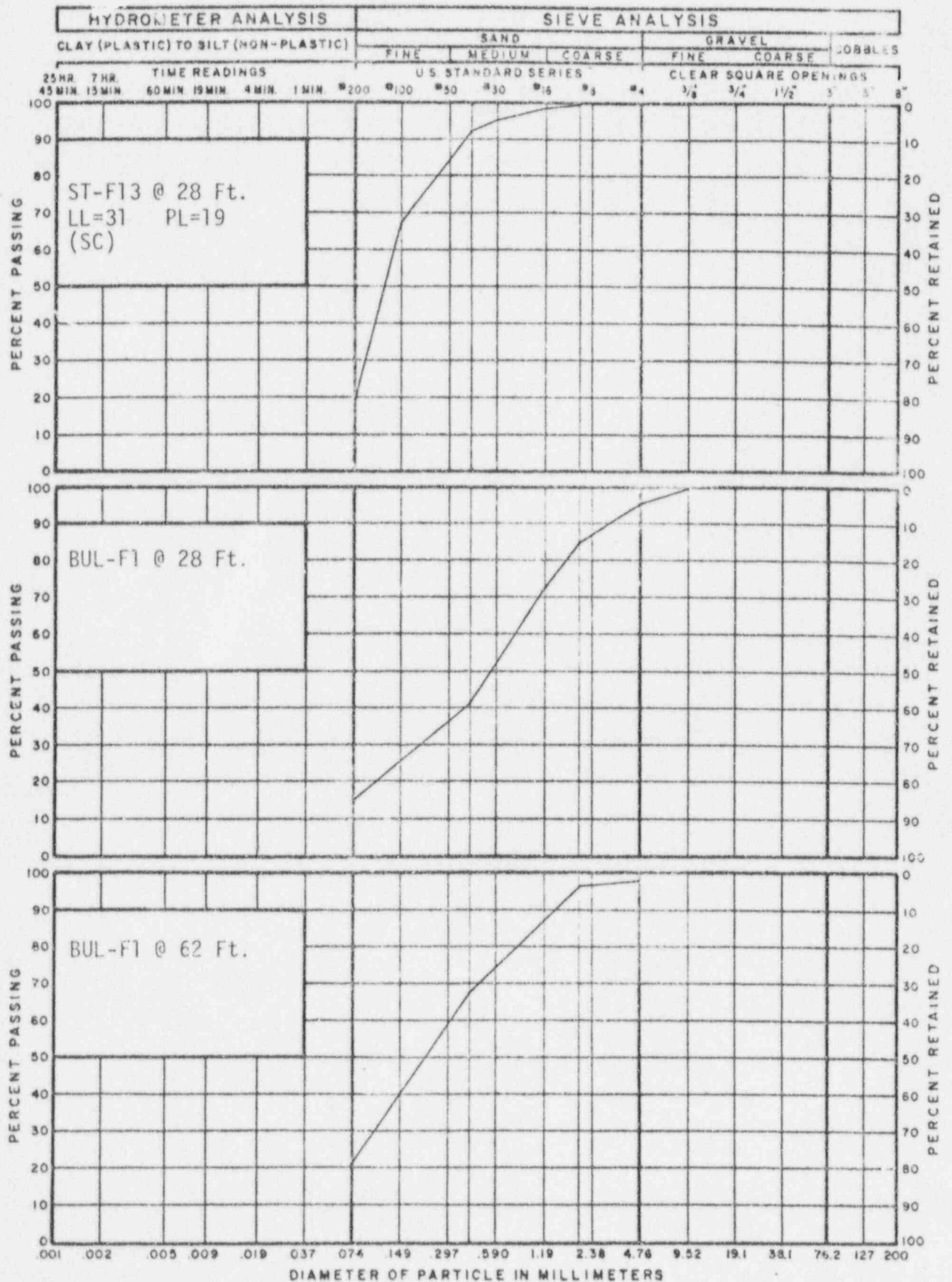
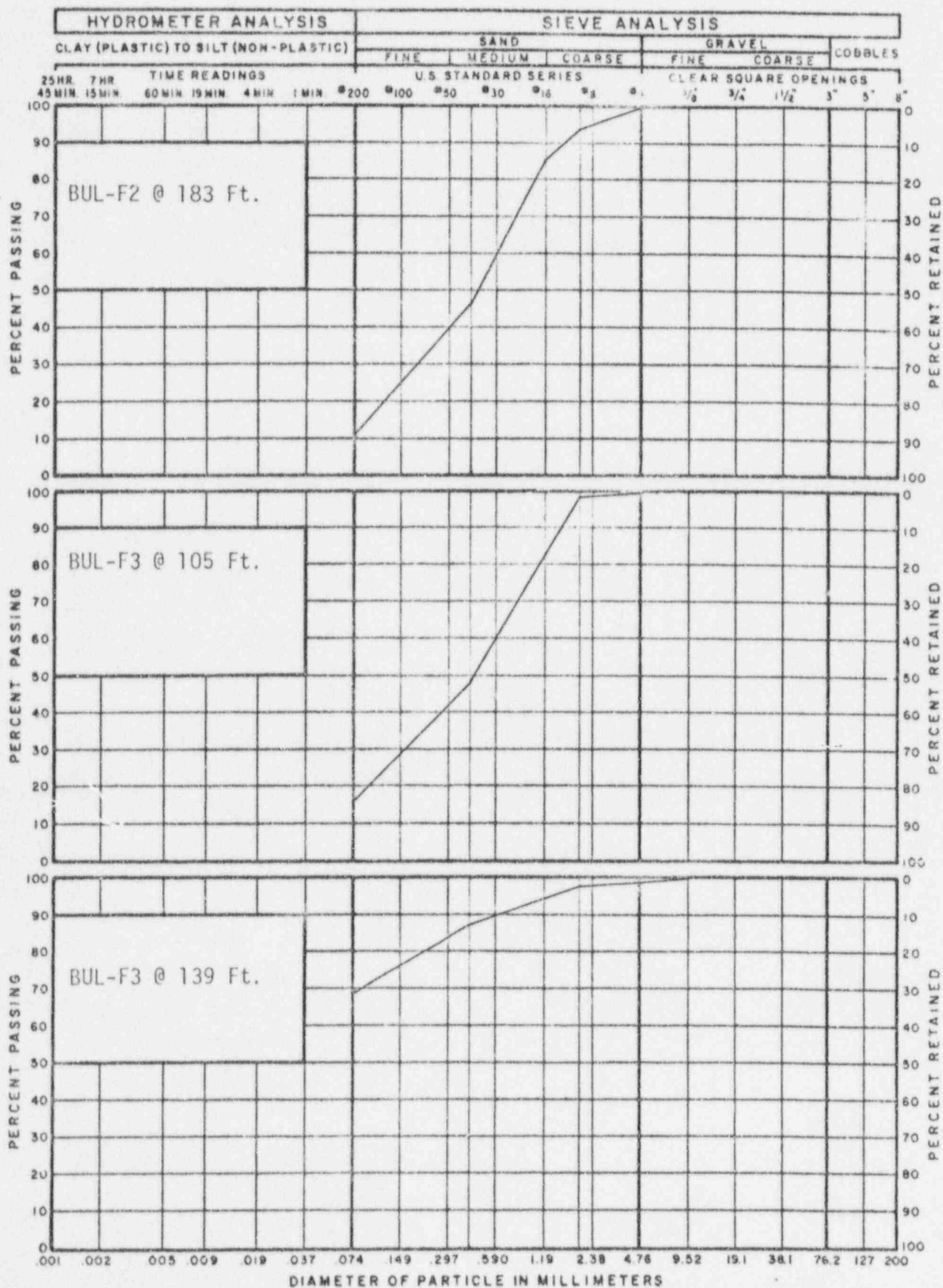


FIG. D-10

GRADATION ANALYSIS



GRADATION ANALYSIS



GRADATION ANALYSIS

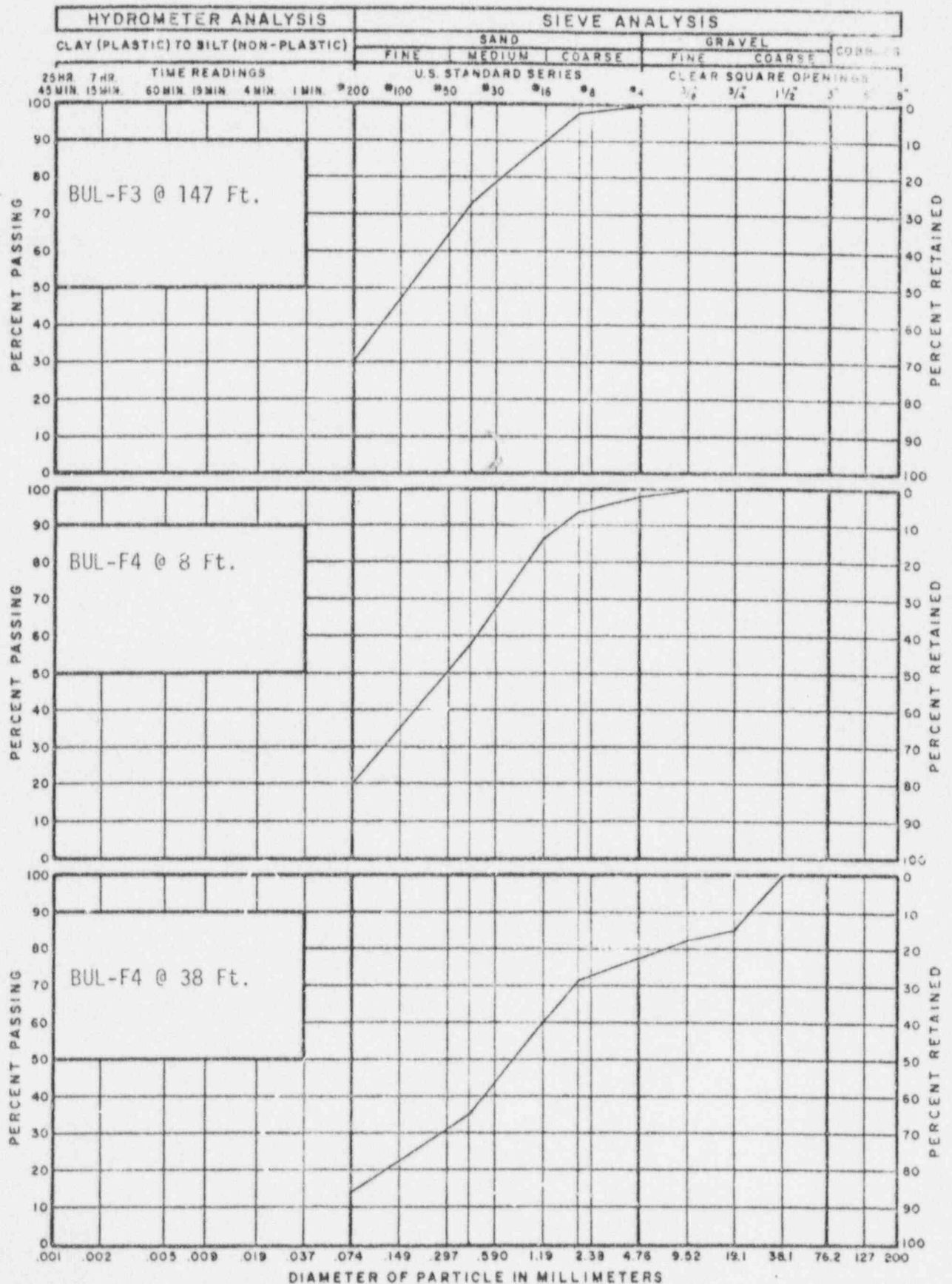
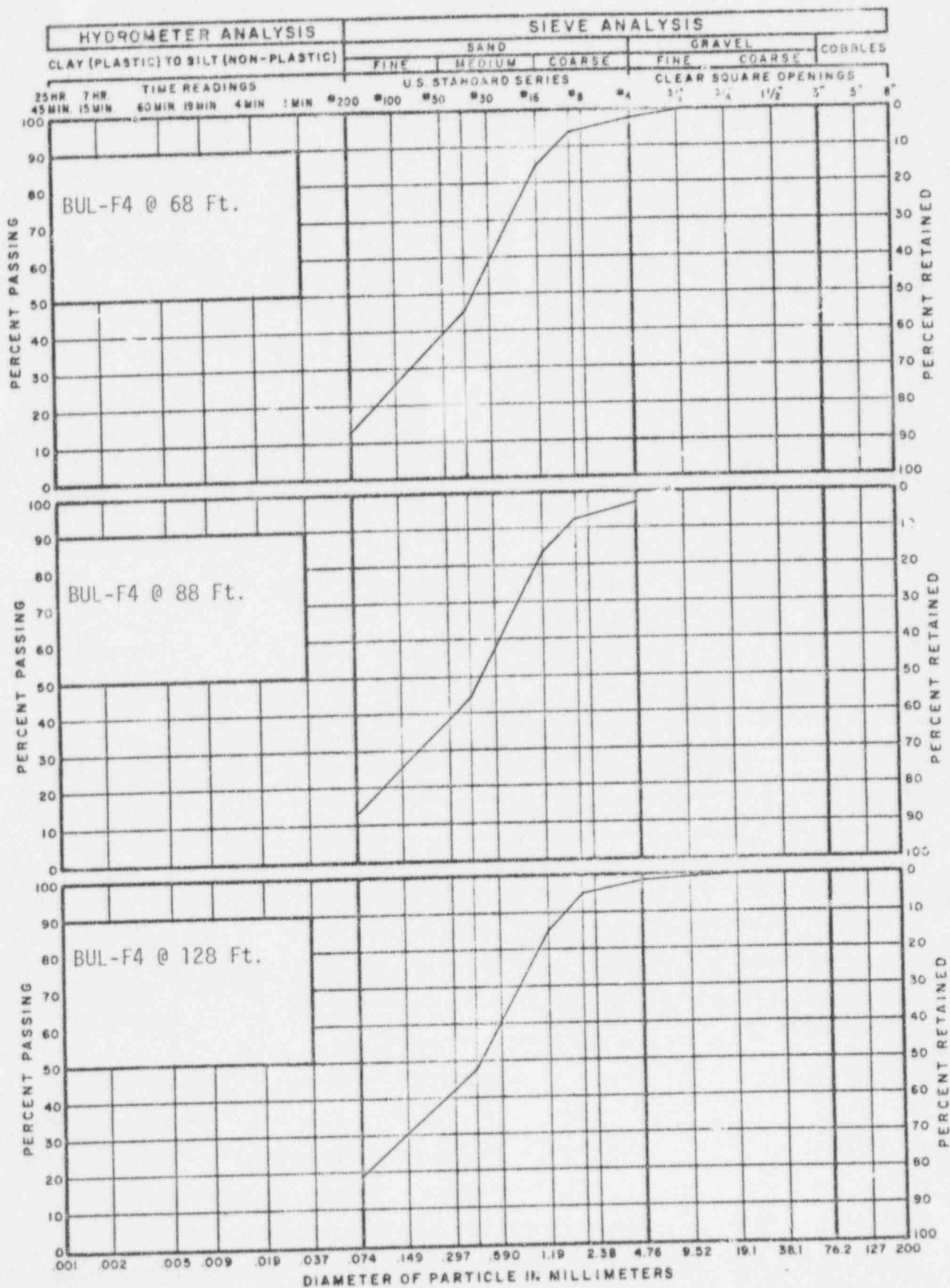


FIG. D-13

GRADATION ANALYSIS



GRADATION ANALYSIS

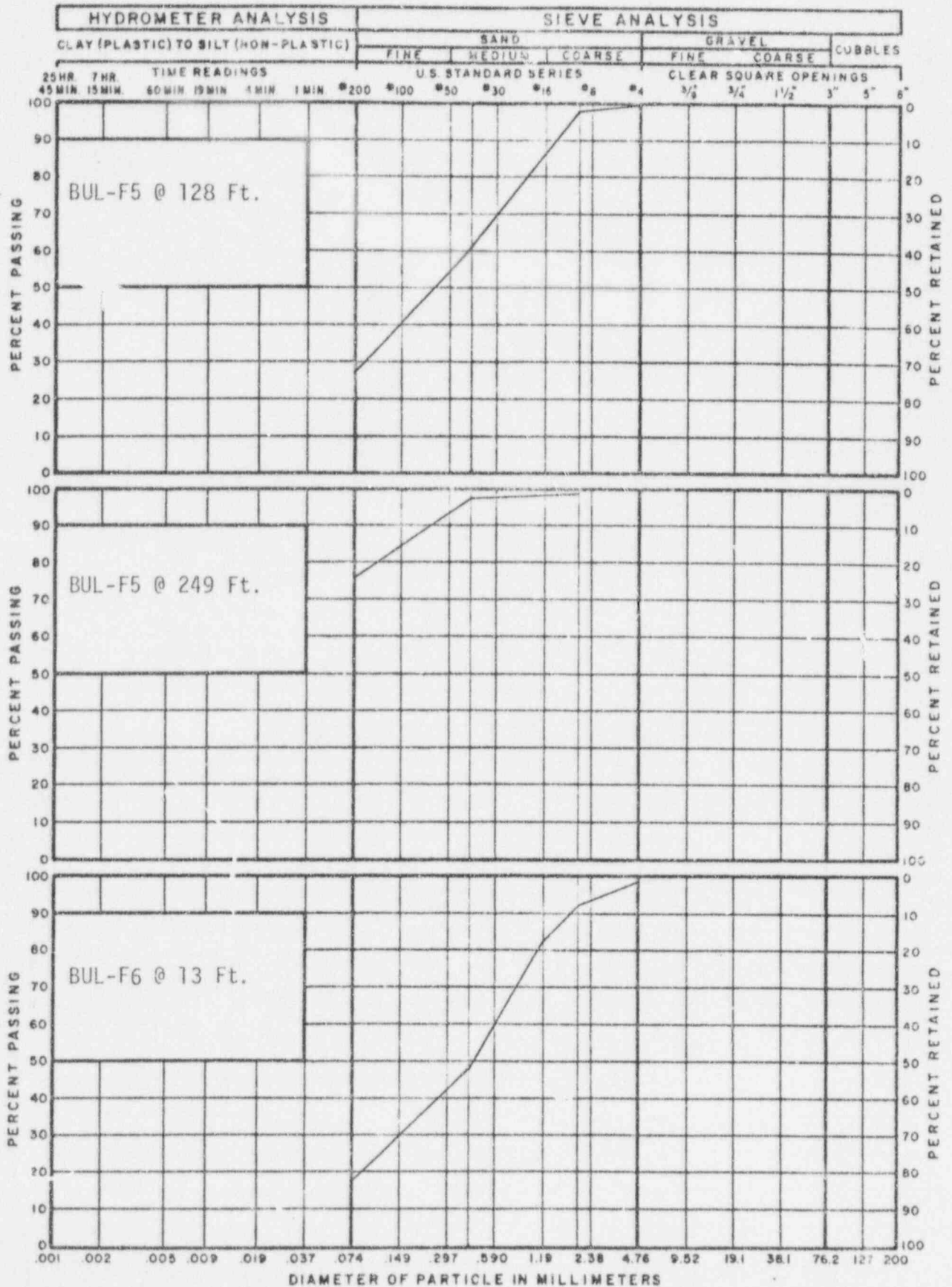


FIG. D-15

GRADATION ANALYSIS

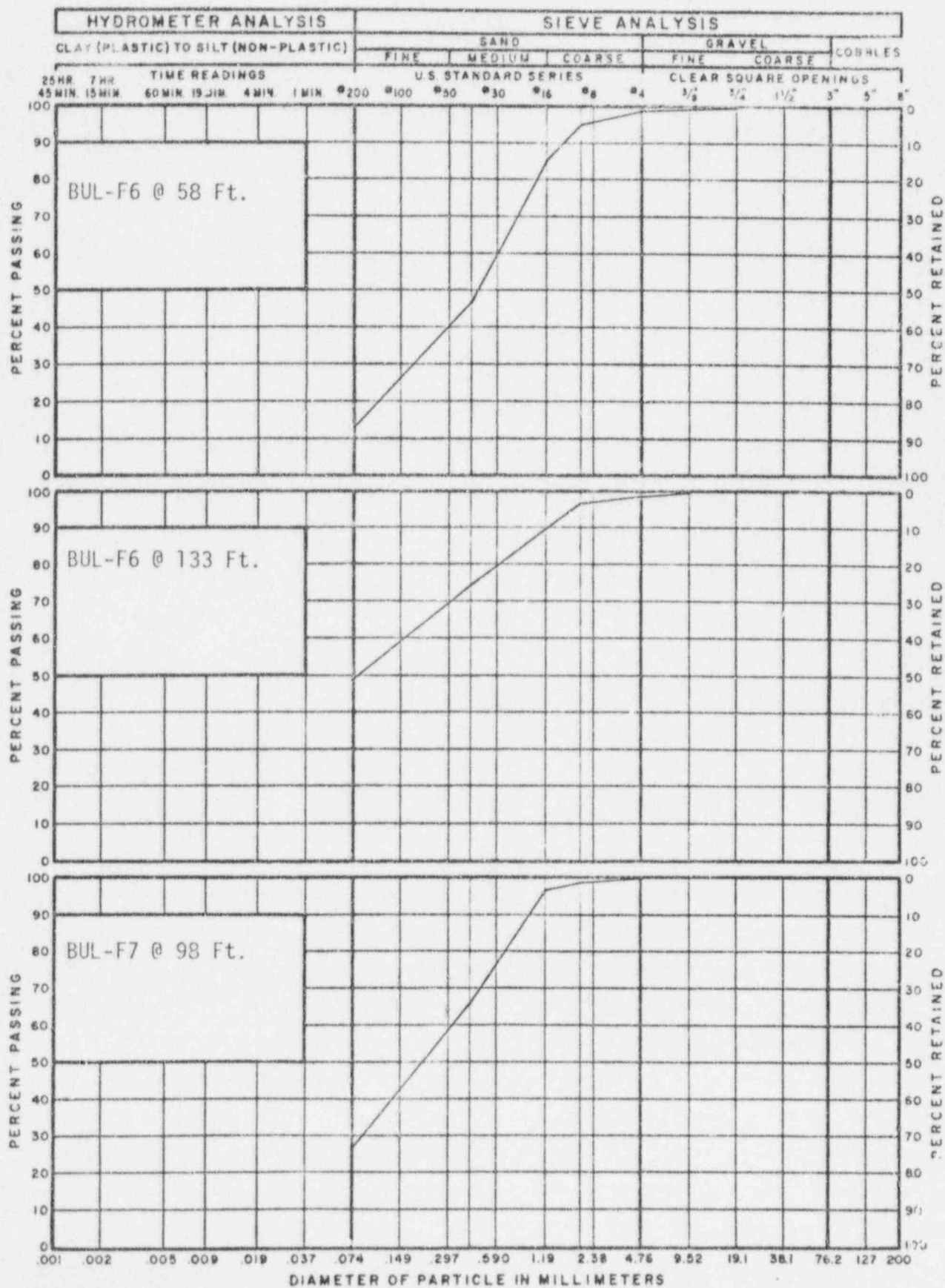


FIG. D-16

GRADATION ANALYSIS

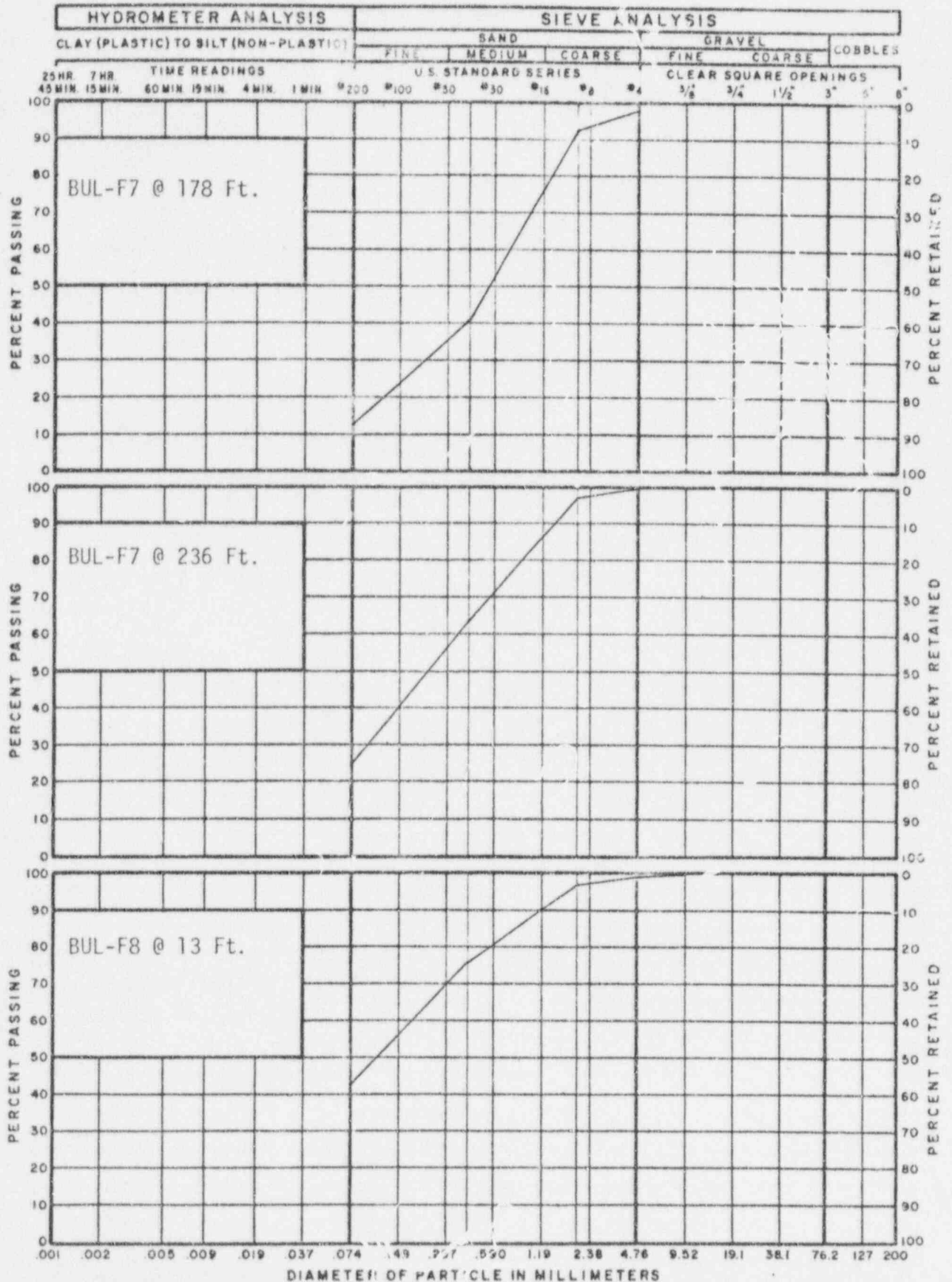


FIG. D-17

GRADATION ANALYSIS

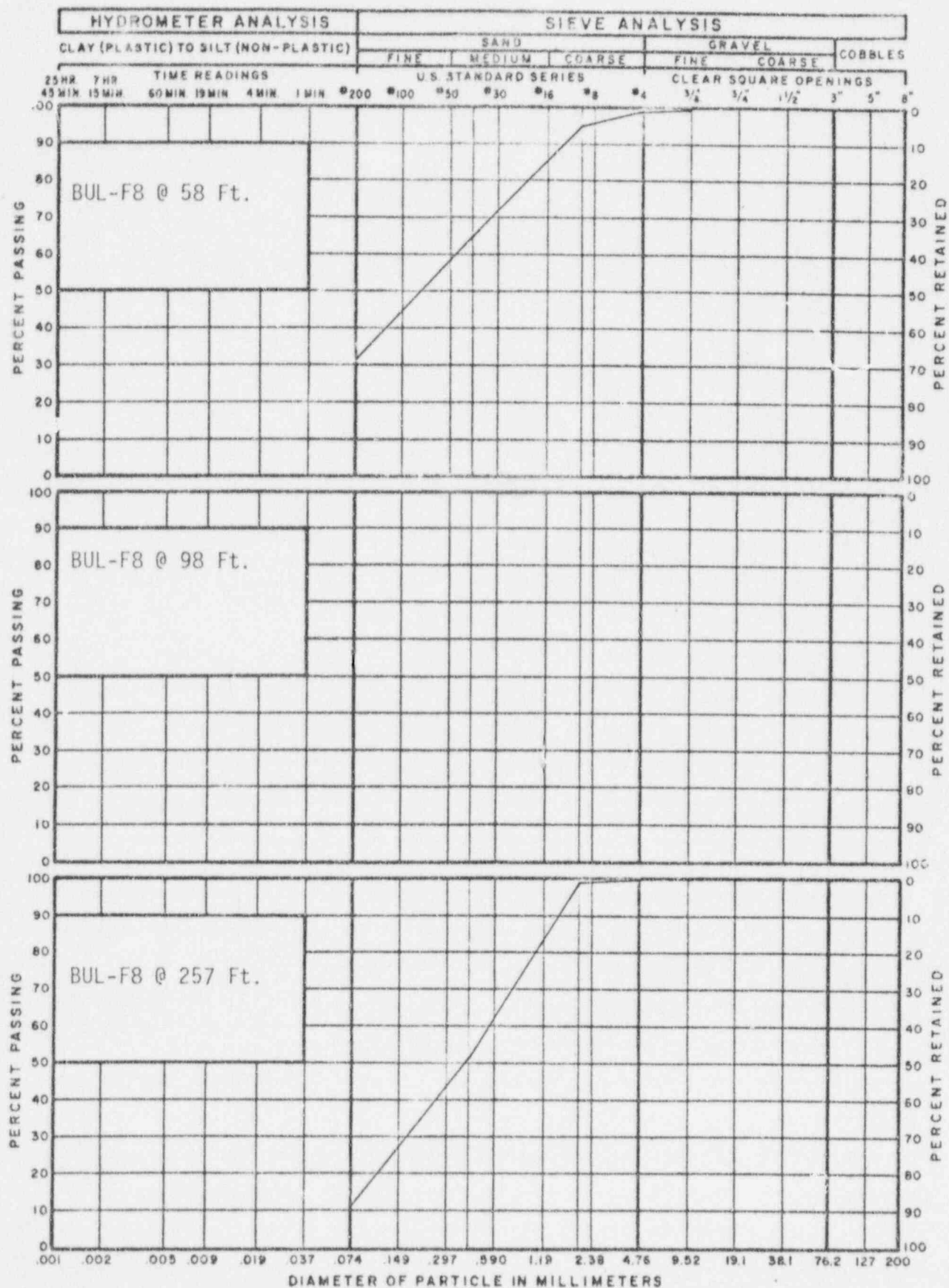
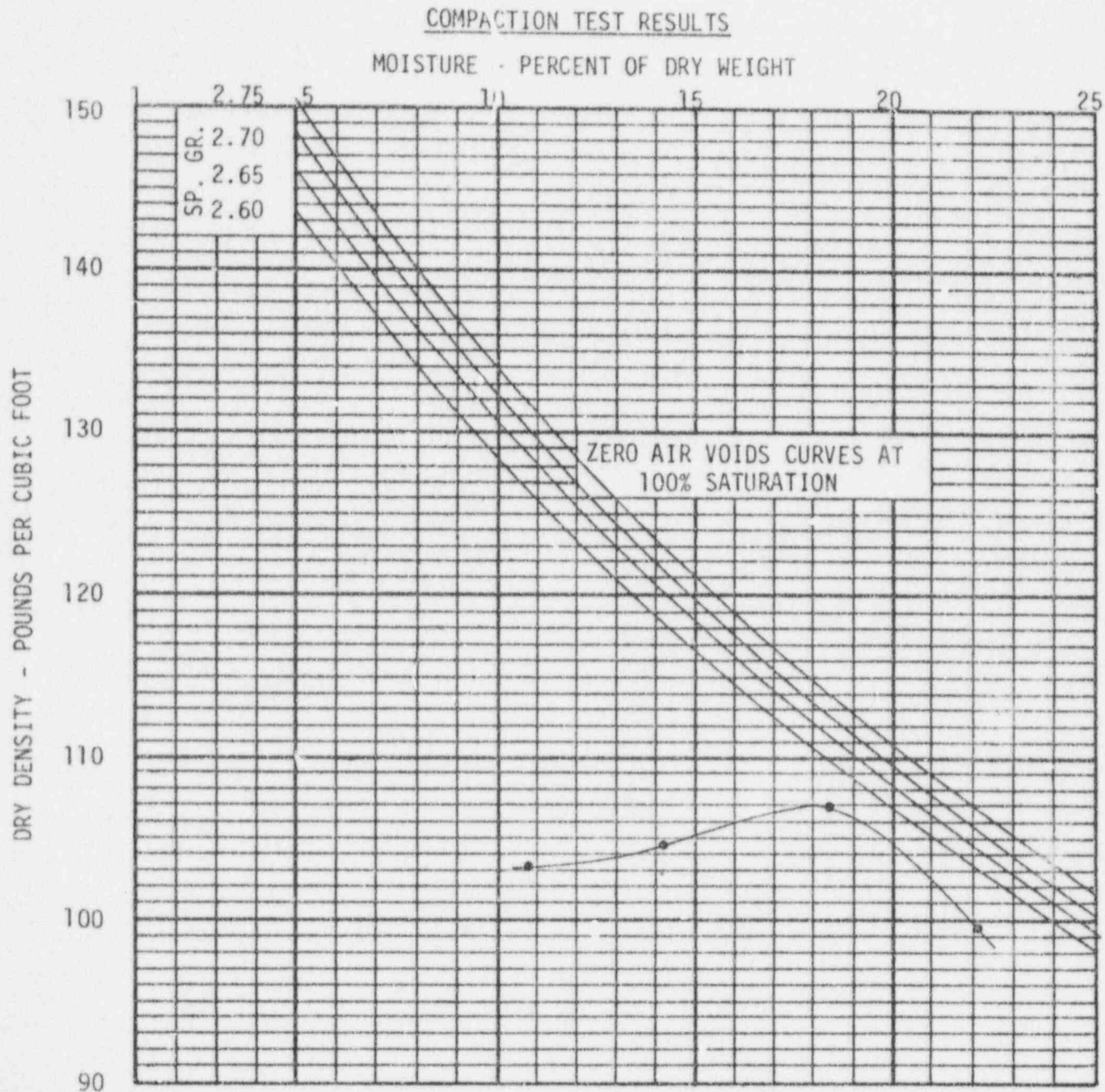


FIG. D-18

SECTION 2

ENGINEERING CHARACTERISTICS



MAXIMUM DRY DENSITY (PCF) 107 PROCTOR NUMBER

OPTIMUM MOISTURE CONTENT (%) 18

AMOUNT OF MATERIAL FINER THAN #200 SIEVE 49.4

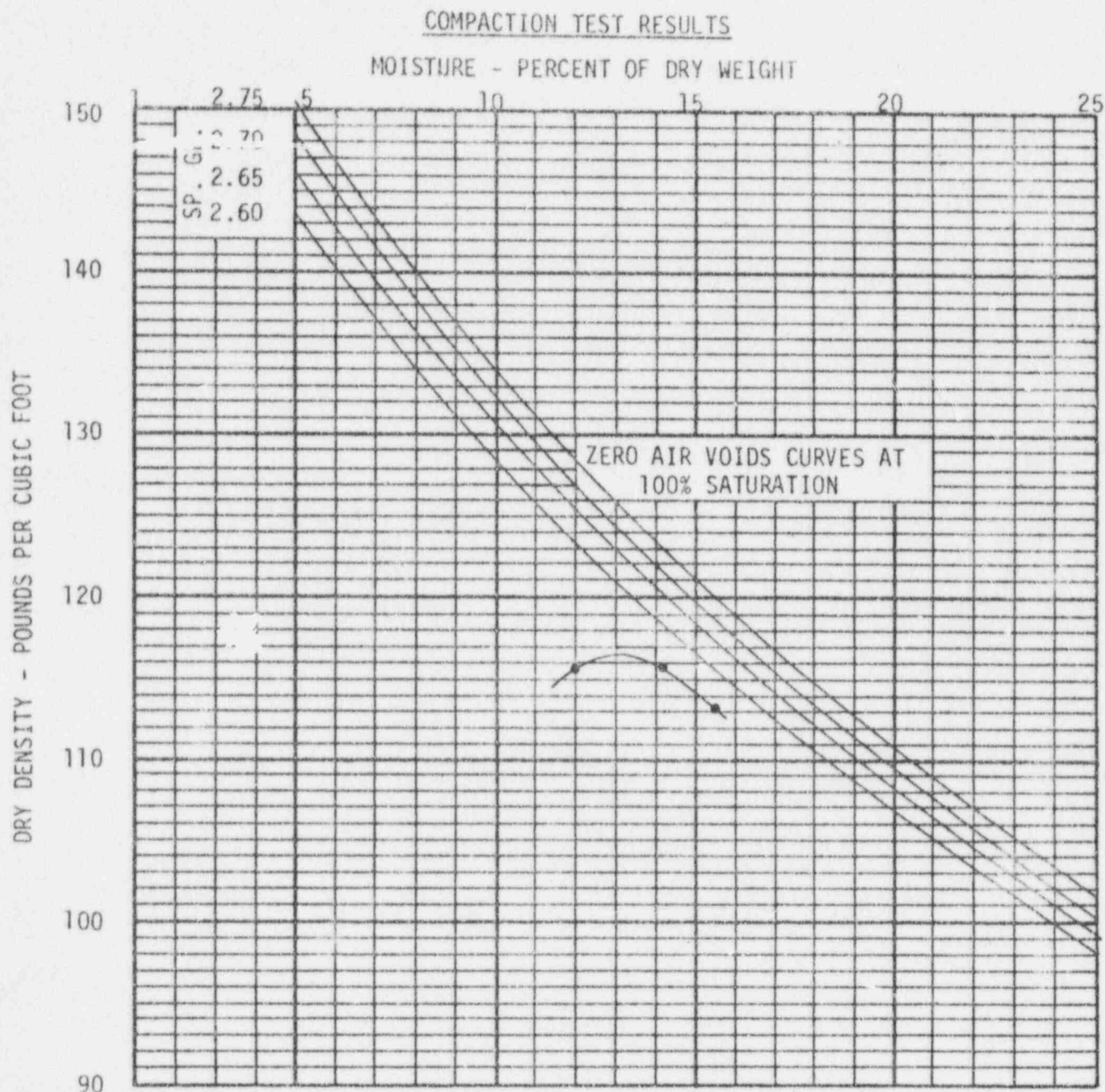
ATTERBERG LIMITS: LL 26 PL 22 PI 4

SWELL/CONSOLIDATION RESULTS: Refer to Figure D-21 through D-25

SAMPLE DESCRIPTION Uranium tailing

FROM Mill discharge COMPACTION TEST PROCEDURE ASTM D-698

CHECK POINTS	<u> </u> PCF @ <u> </u> %	<u> </u> PCF @ <u> </u> %
	<u> </u> PCF @ <u> </u> %	<u> </u> PCF @ <u> </u> %
	<u> </u> PCF @ <u> </u> %	<u> </u> PCF @ <u> </u> %



MAXIMUM DRY DENSITY (PCF) 116.5 PROCTOR NUMBER

OPTIMUM MOISTURE CONTENT (%) 13.1

AMOUNT OF MATERIAL FINER THAN #200 SIEVE

ATTERBERG LIMITS: LL PL PI

SWELL/CONSOLIDATION RESULTS: Refer to Figure D-26 through D-27

SAMPLE DESCRIPTION Overburden

FROM ST-F5 45'-95' COMPACTION TEST PROCEDURE ASTM D-698

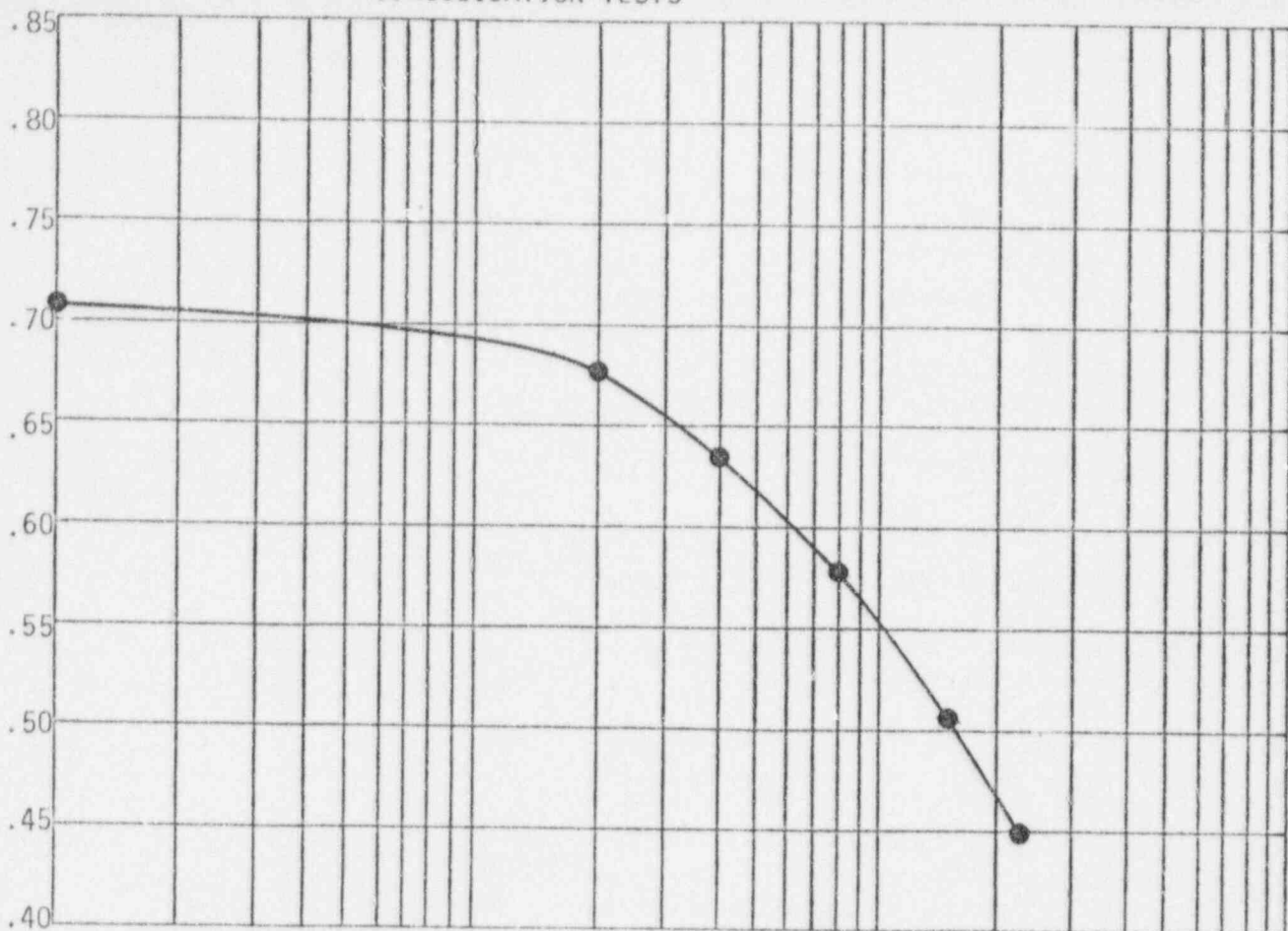
CHECK POINTS PCF @ % PCF @ %

 PCF @ % PCF @ %

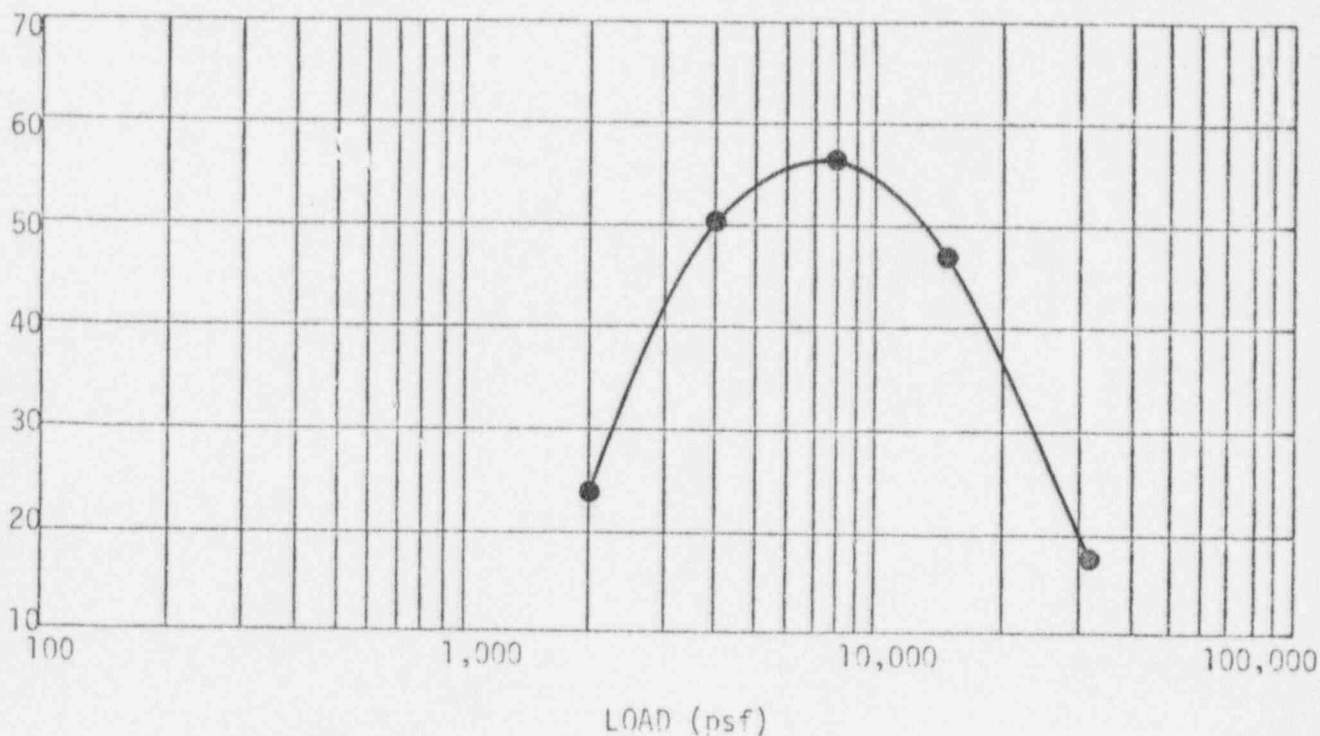
 PCF @ % PCF @ %

CONSOLIDATION TESTS

VOID RATIO
↓



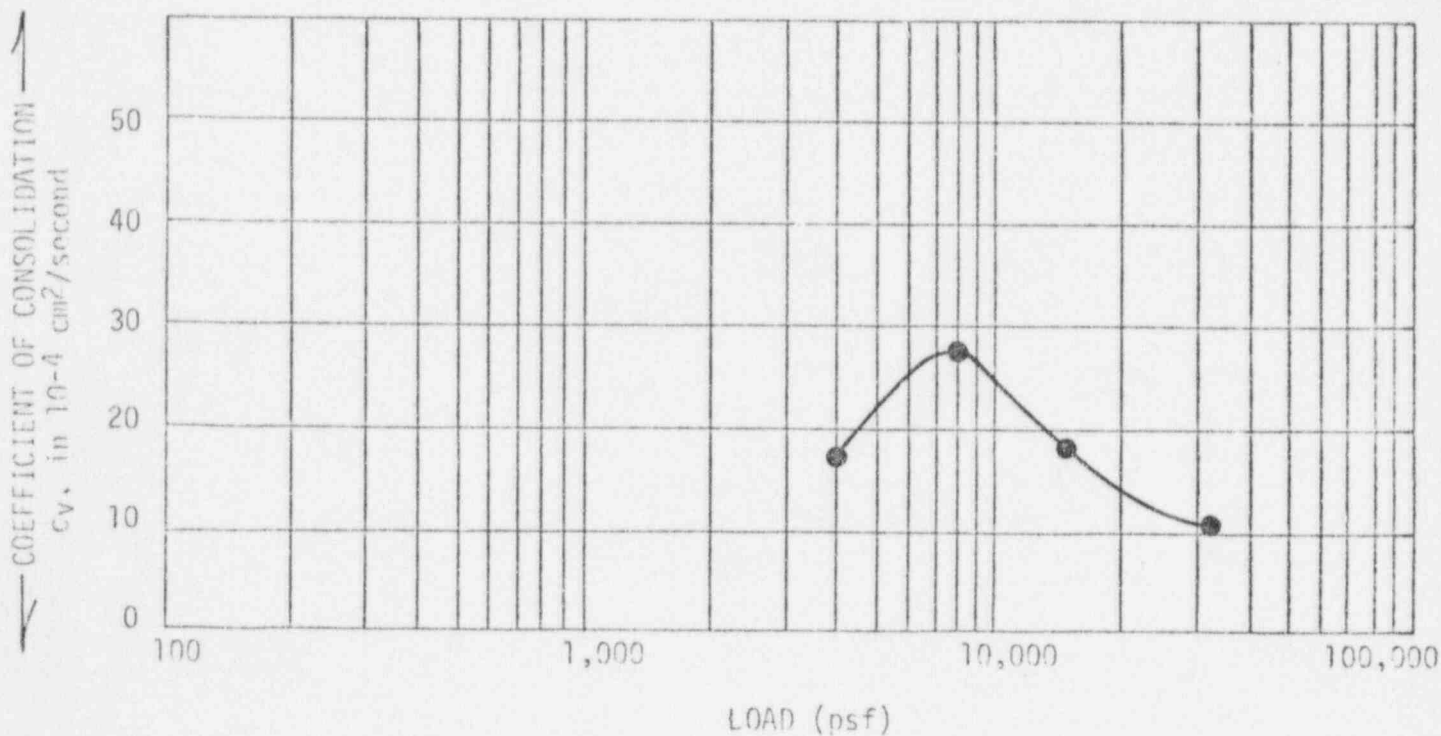
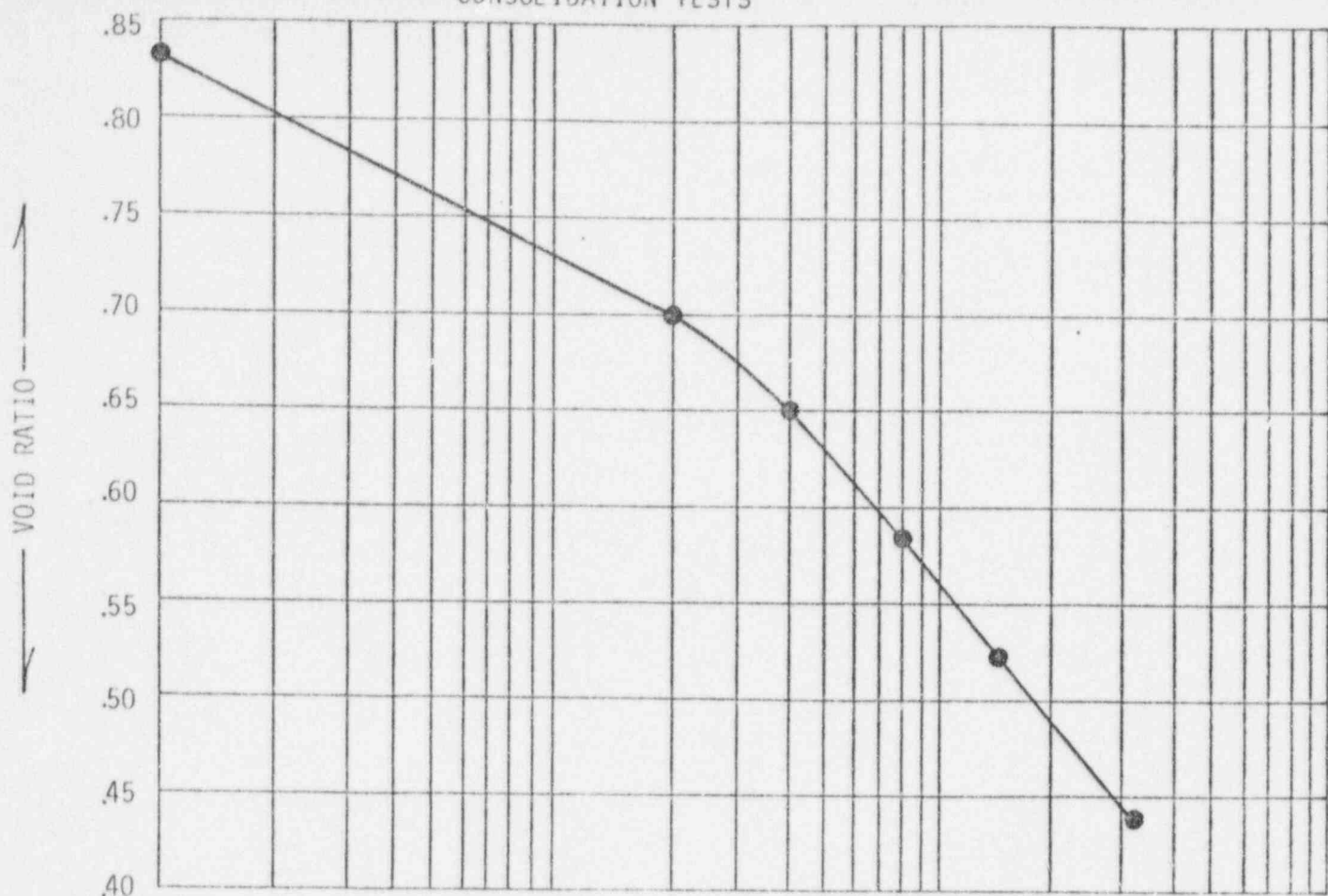
COEFFICIENT OF CONSOLIDATION
cv, in 10⁻⁴ cm²/second
↓



Boring No. Tailing #1 Depth Mill discharge
 Natural Moisture Content Natural Dry Density
 LL = 26 PL = 24 PI = 2
 Specific Gravity = 2.70 Classification ML

FIGURE D-21

CONSOLIDATION TESTS



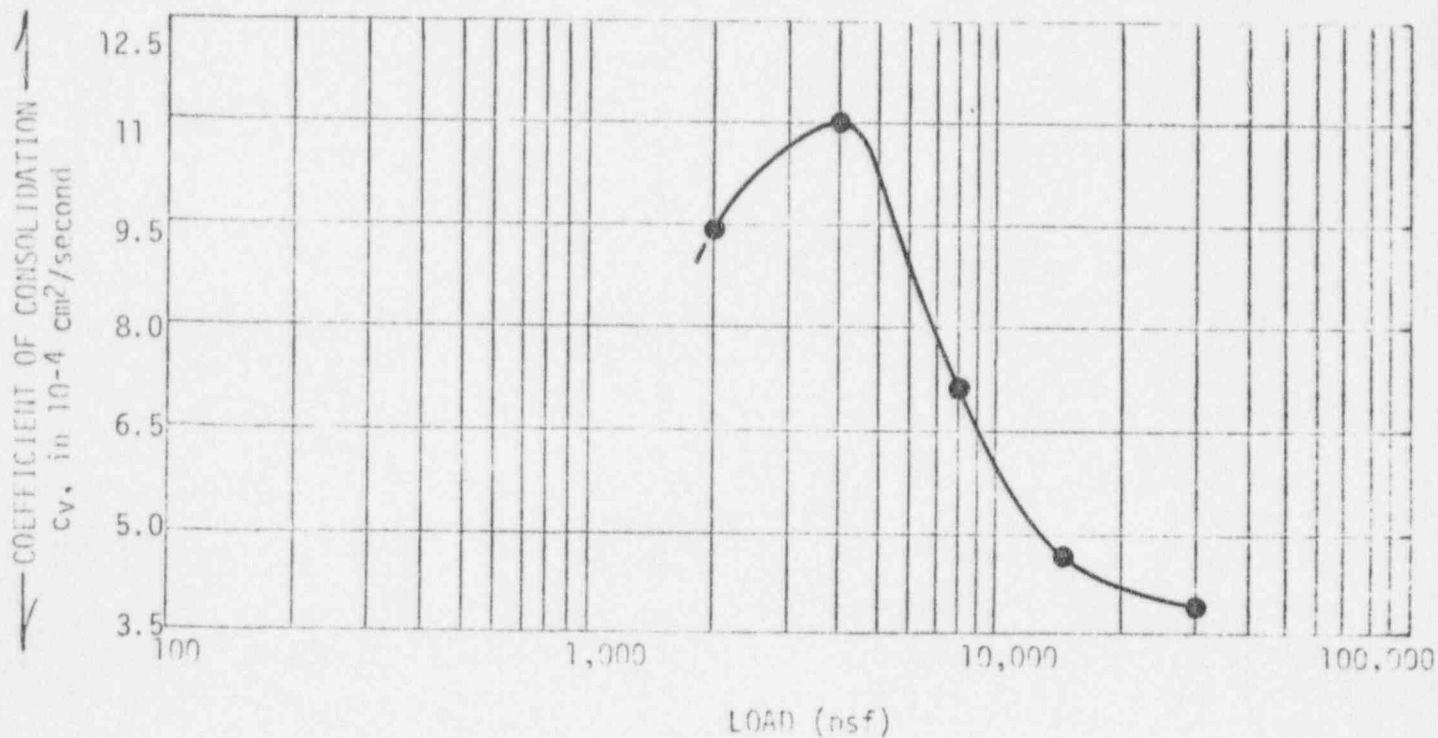
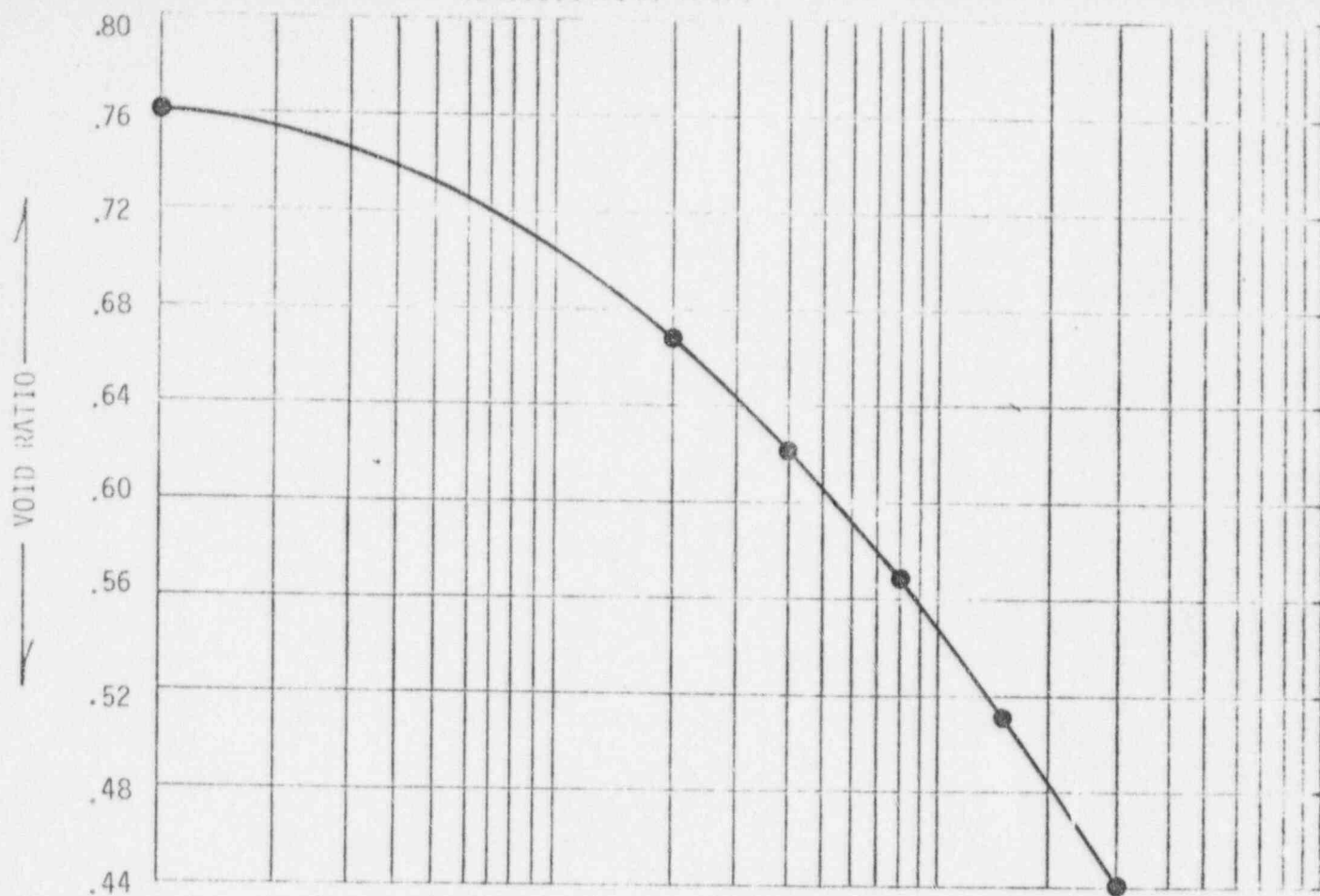
Boring No. Tailings #2 Depth Mill Discharge

Natural Moisture Content Natural Dry Density

LL = 26 PL = 22 PI = 4

Specific Gravity = 2.66 Classification ML

FIGURE D-22

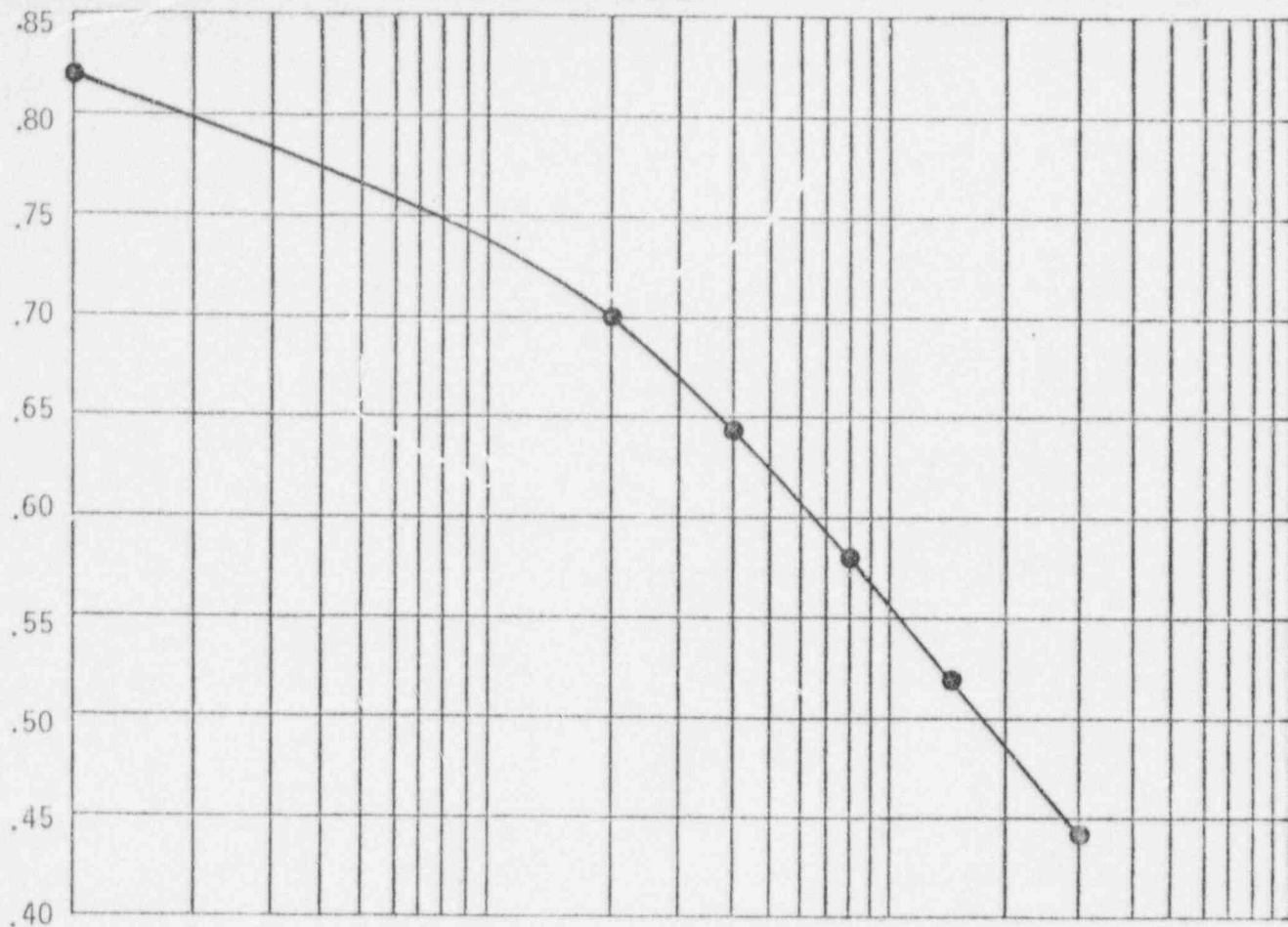


Borings No. Tailings #3 Depth Mill discharge
 Natural Moisture Content _____ Natural Dry Density _____
 LL = 26 PL = 21 PI = 5
 Specific Gravity = 2.71 Classification ML

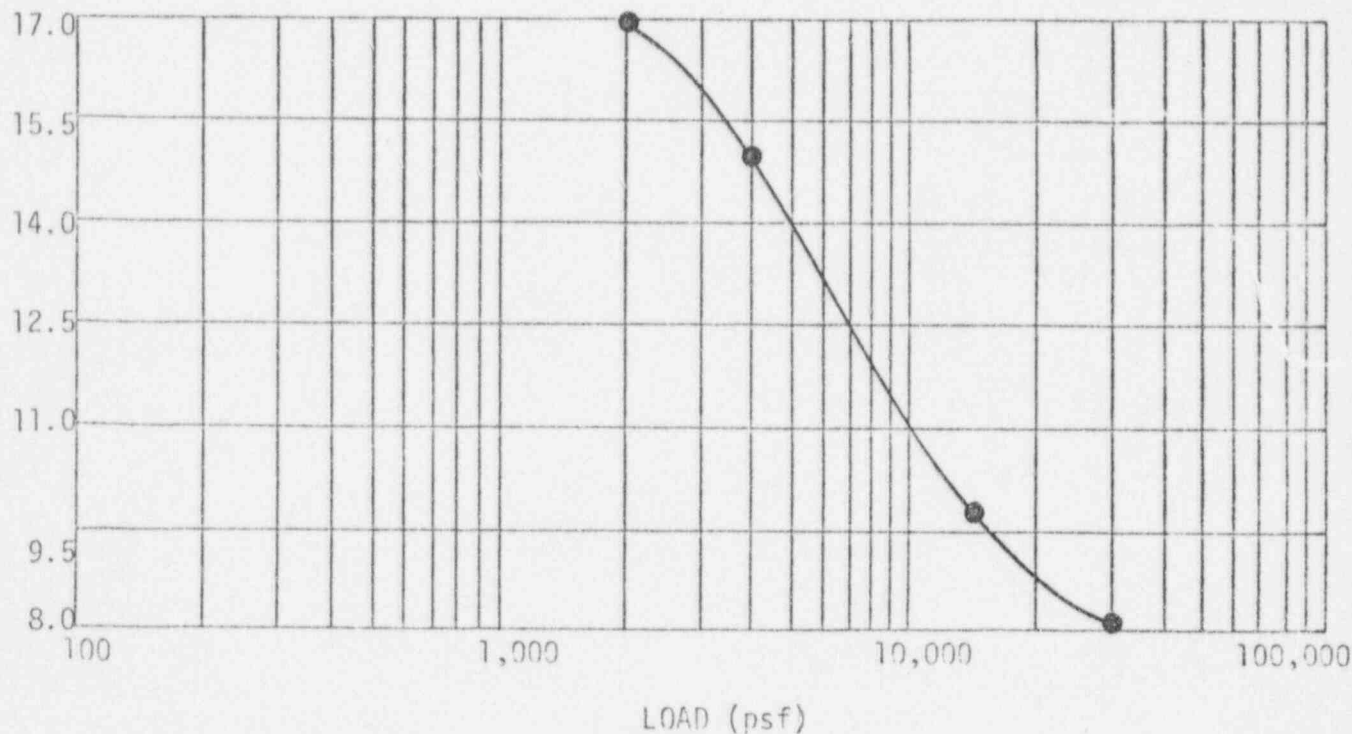
FIGURE D-23

CONSOLIDATION TESTS

VOID RATIO



COEFFICIENT OF CONSOLIDATION
 c_v , in 10^{-4} cm²/second



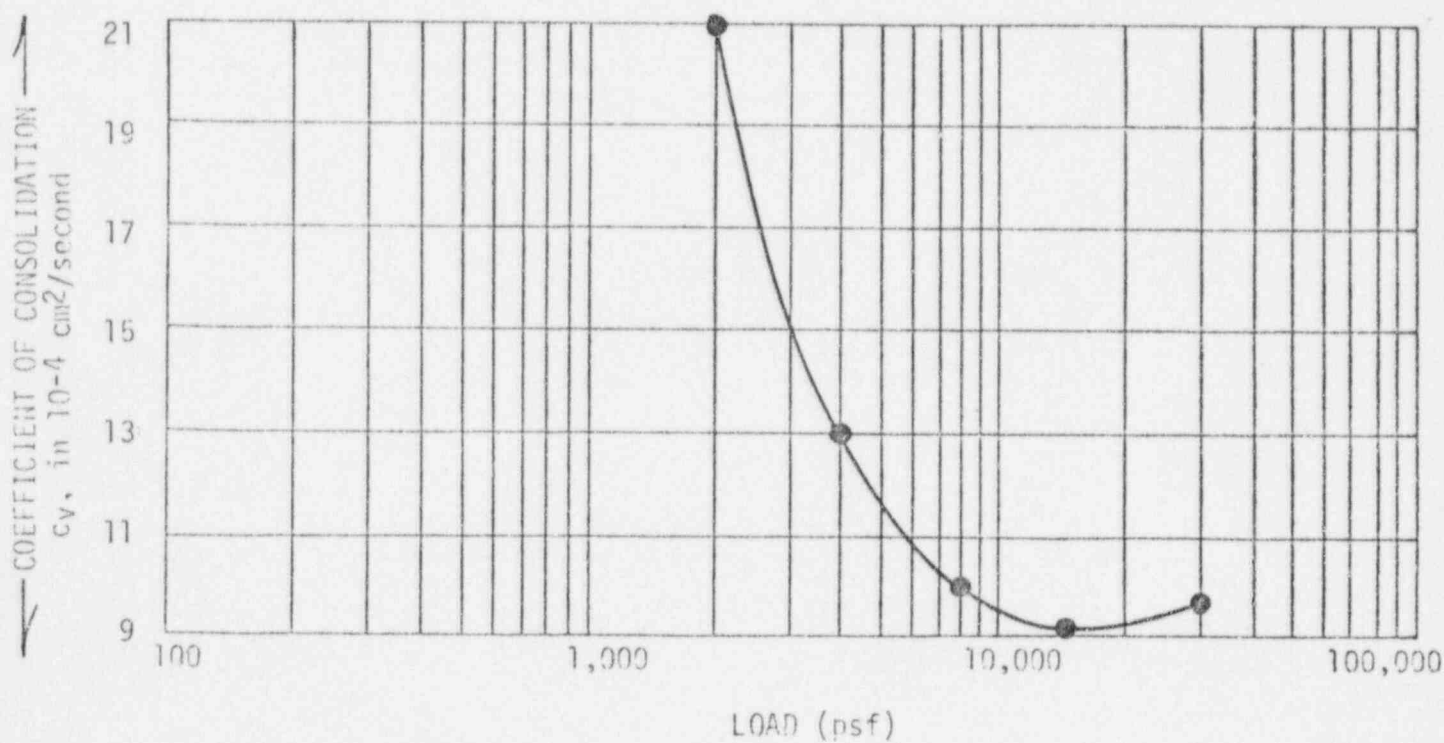
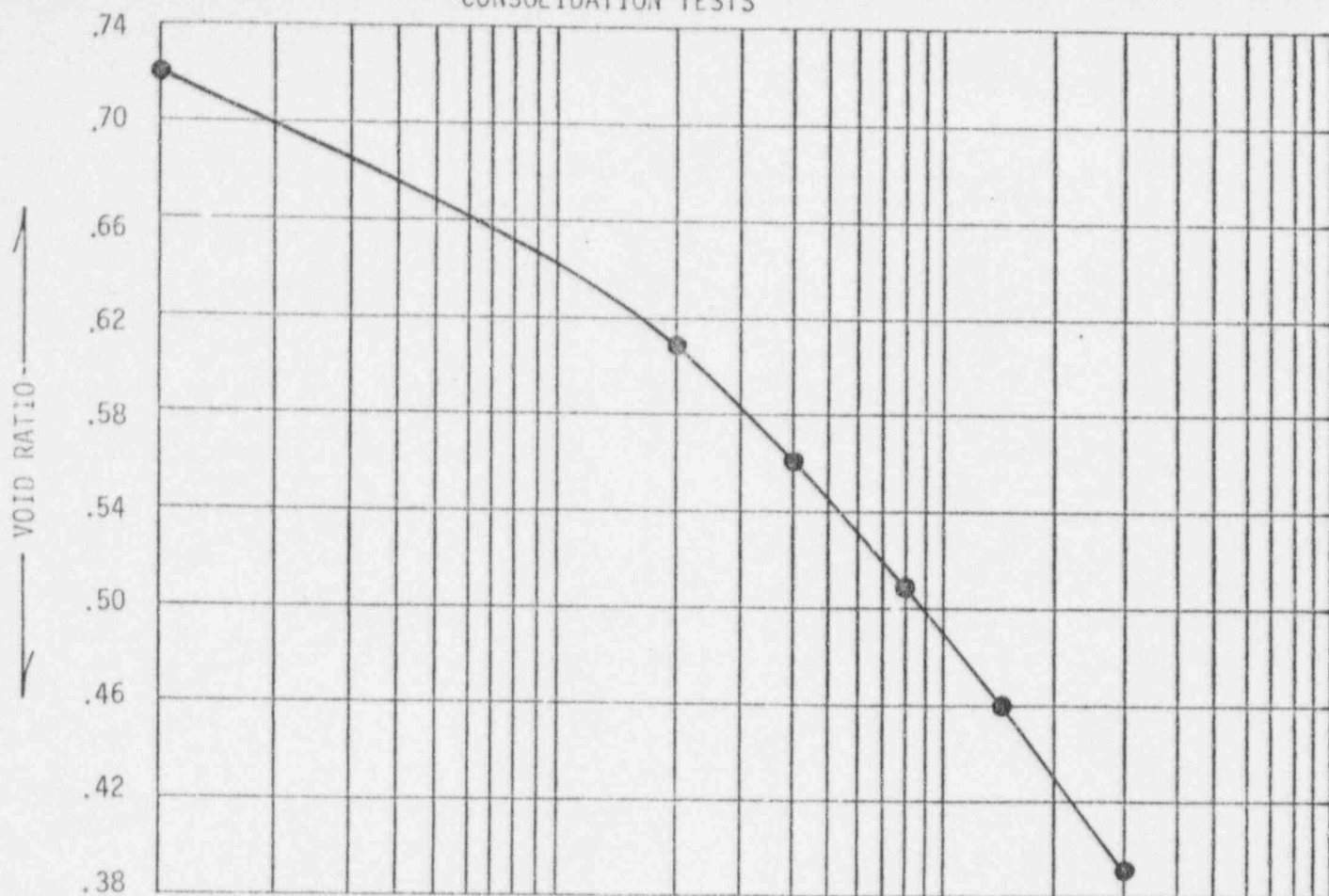
Boring No. Tailings #4 Depth Mill Discharge

Natural Moisture Content Natural Dry Density

LL = 26 PL = 22 PI = 4

Specific Gravity = 2.74 Classification ML

CONSOLIDATION TESTS



Boring No. Tailings #5 Depth Mill Discharge

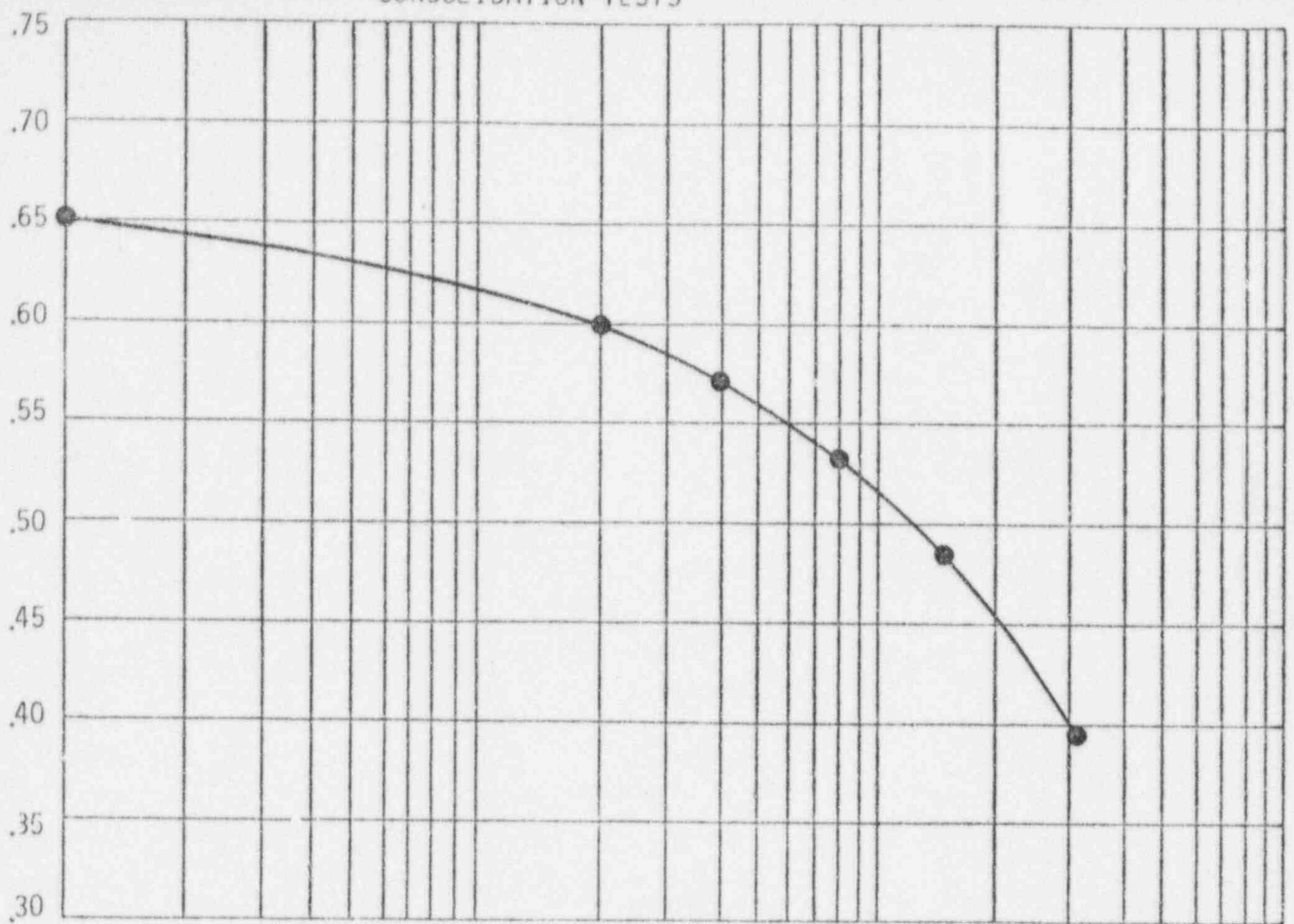
Natural Moisture Content _____ Natural Dry Density _____

LL = 27 PL = 22 PI = 5

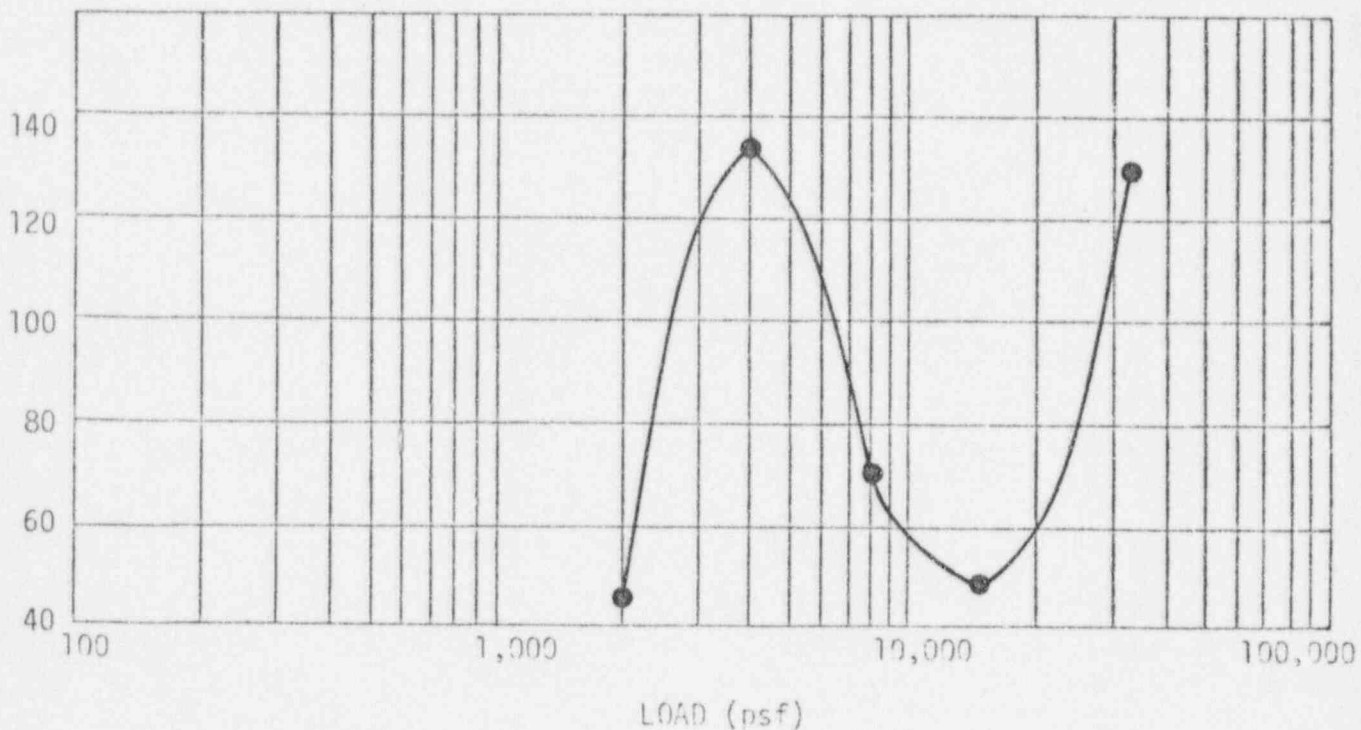
Specific Gravity = 2.64 Classification ML

CONSOLIDATION TESTS

↑
VOID RATIO
↓



↑
COEFFICIENT OF CONSOLIDATION
cv, in 10⁻⁴ cm²/second
↓



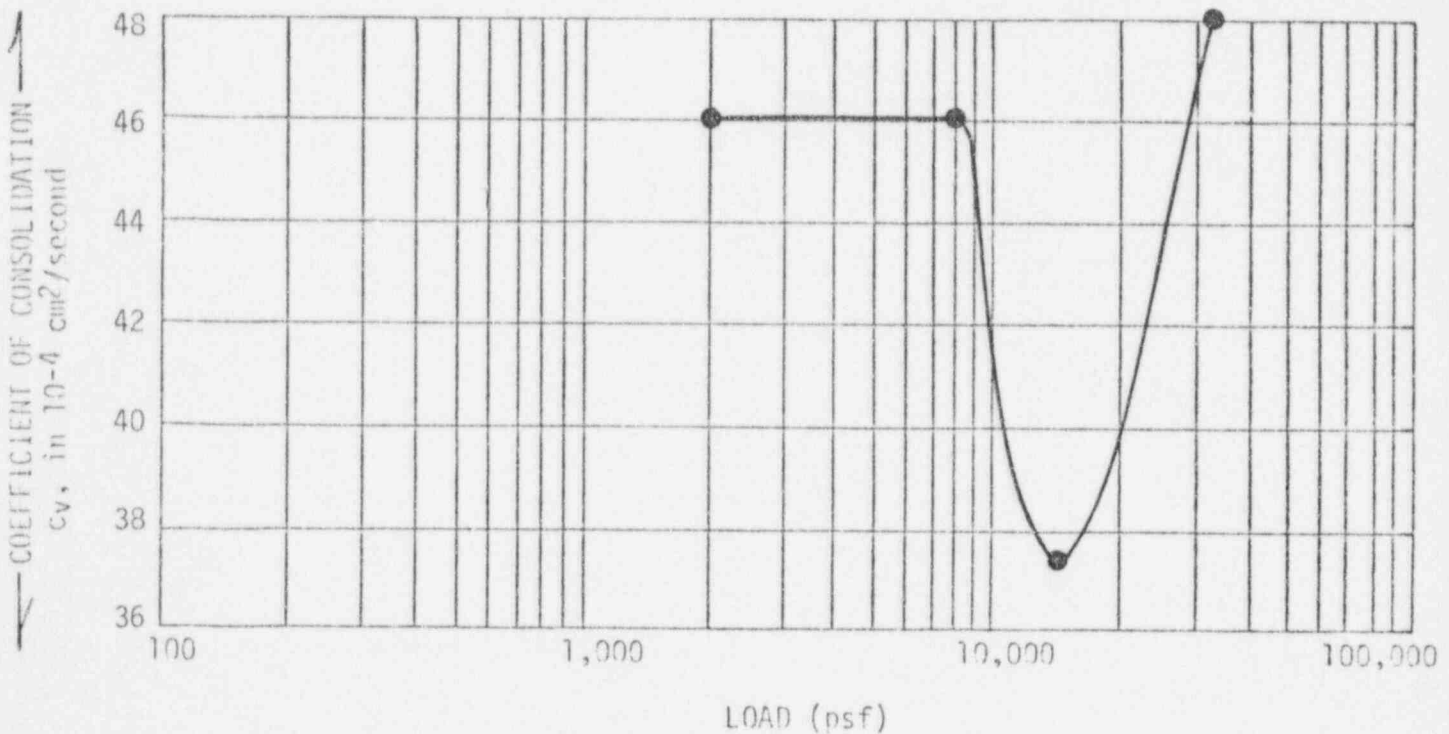
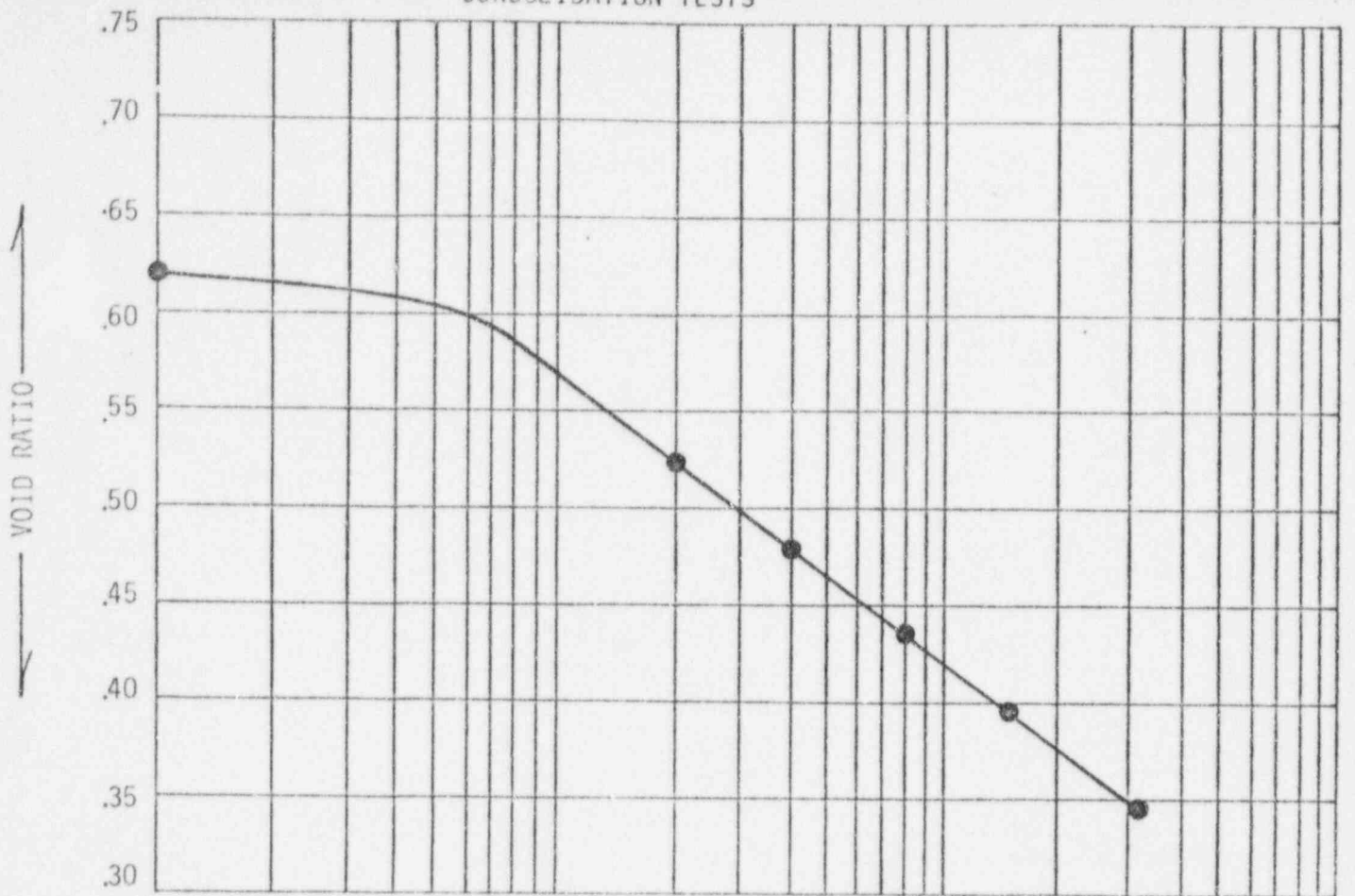
Boring No. _____ Overburden ST-F5 Depth _____ 45'-95'

Natural Moisture Content _____ Natural Dry Density _____

LL = _____ PL = _____ PI = _____

Specific Gravity = _____ 2.65 Classification Refer to boring log

CONSOLIDATION TESTS



Boring No. _____ Overburden ST-F5 Depth 45'-95'

Natural Moisture Content _____ Natural Dry Density _____

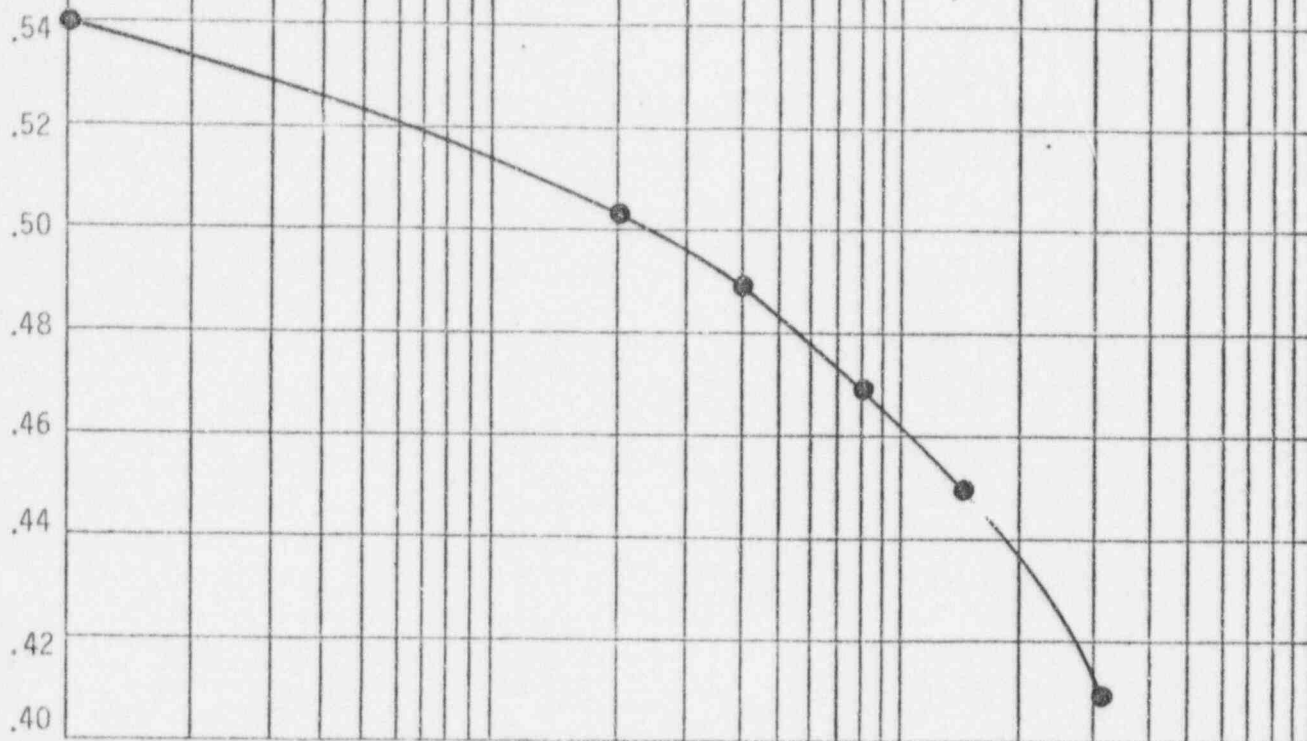
LL = _____ PL = _____ PI = _____

Specific Gravity = 2.67 Classification Refer to boring log

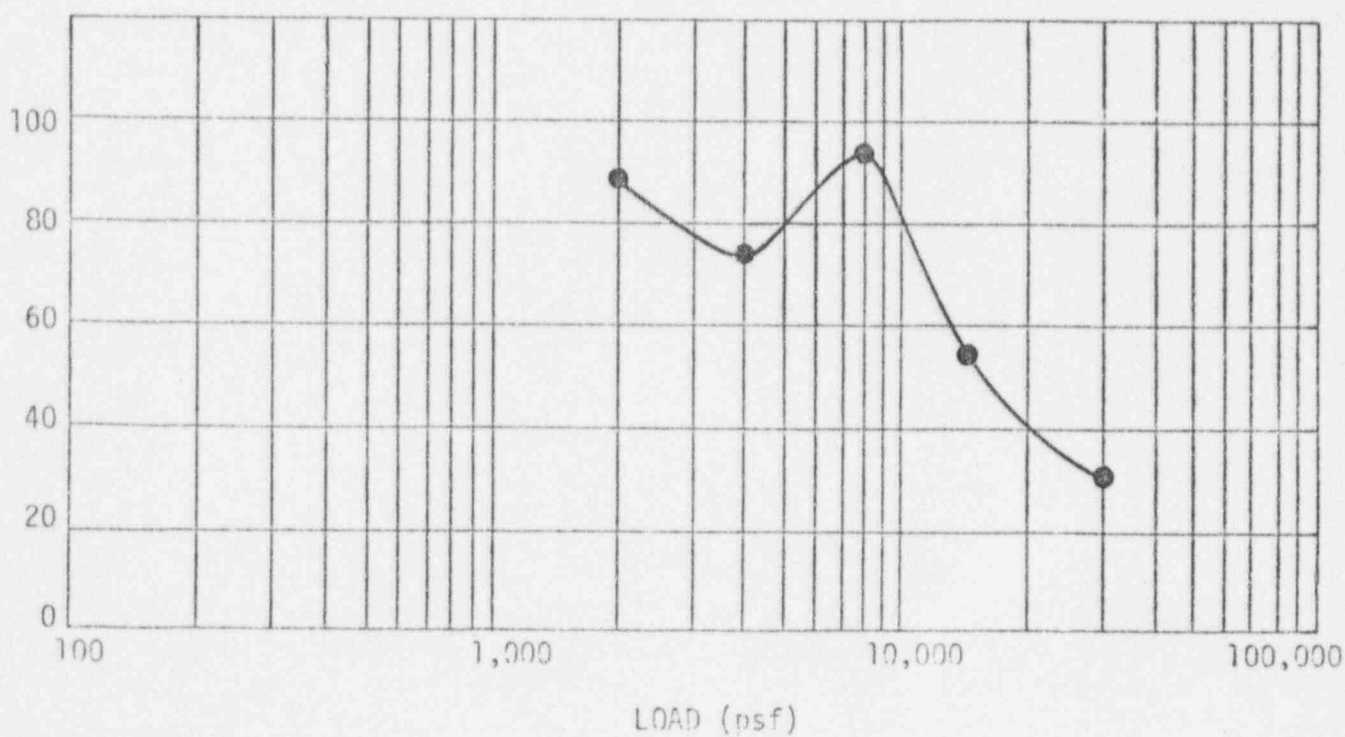
FIGURE D-27

CONSOLIDATION TESTS

VOID RATIO



COEFFICIENT OF CONSOLIDATION
 c_v , in 10^{-4} cm²/second



Boring No. ST-F5 Depth 247.25' - 249.25'

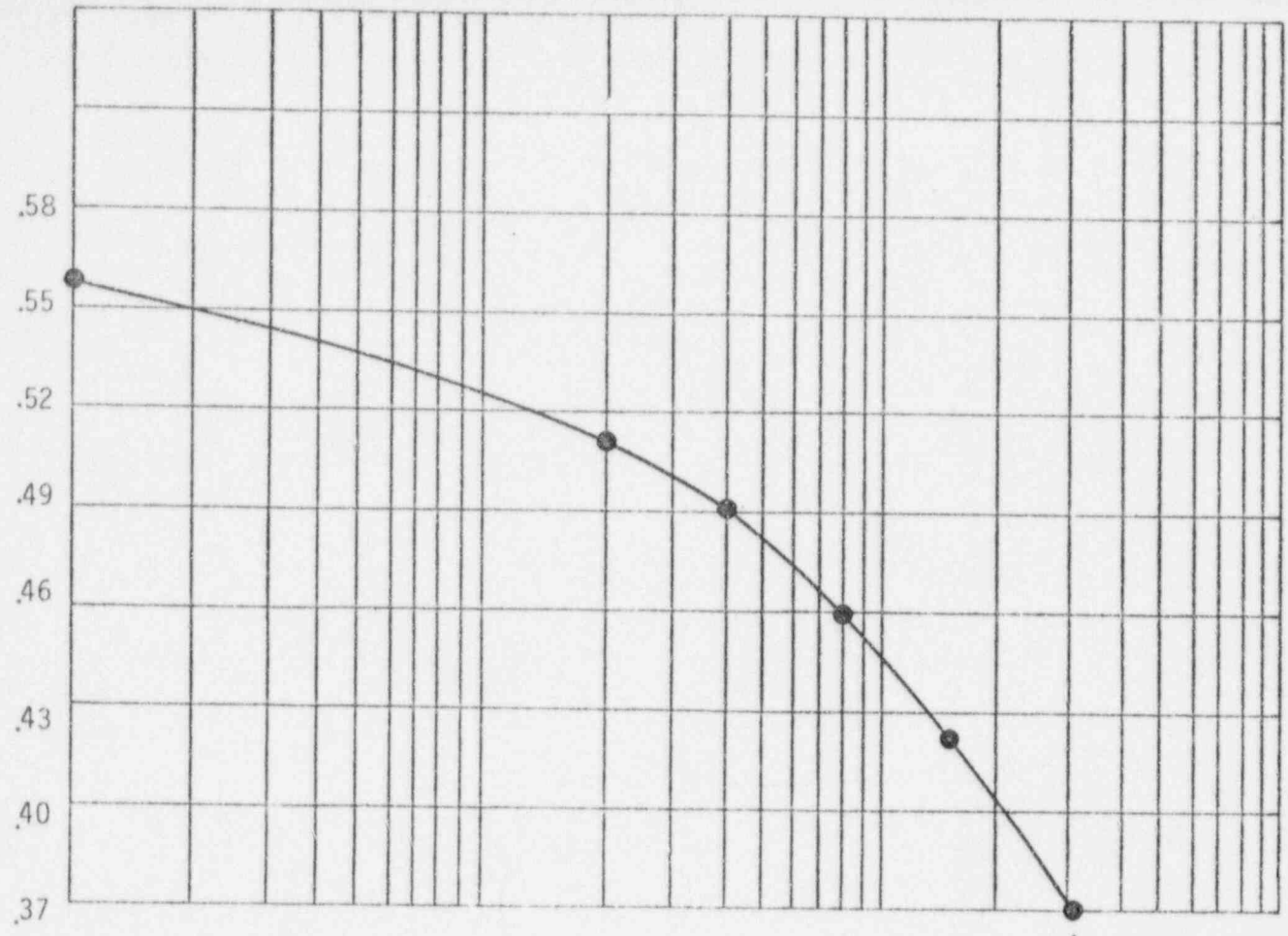
Natural Moisture Content 13.2 Natural Dry Density 116.9 pcf

LL = PL = PI =

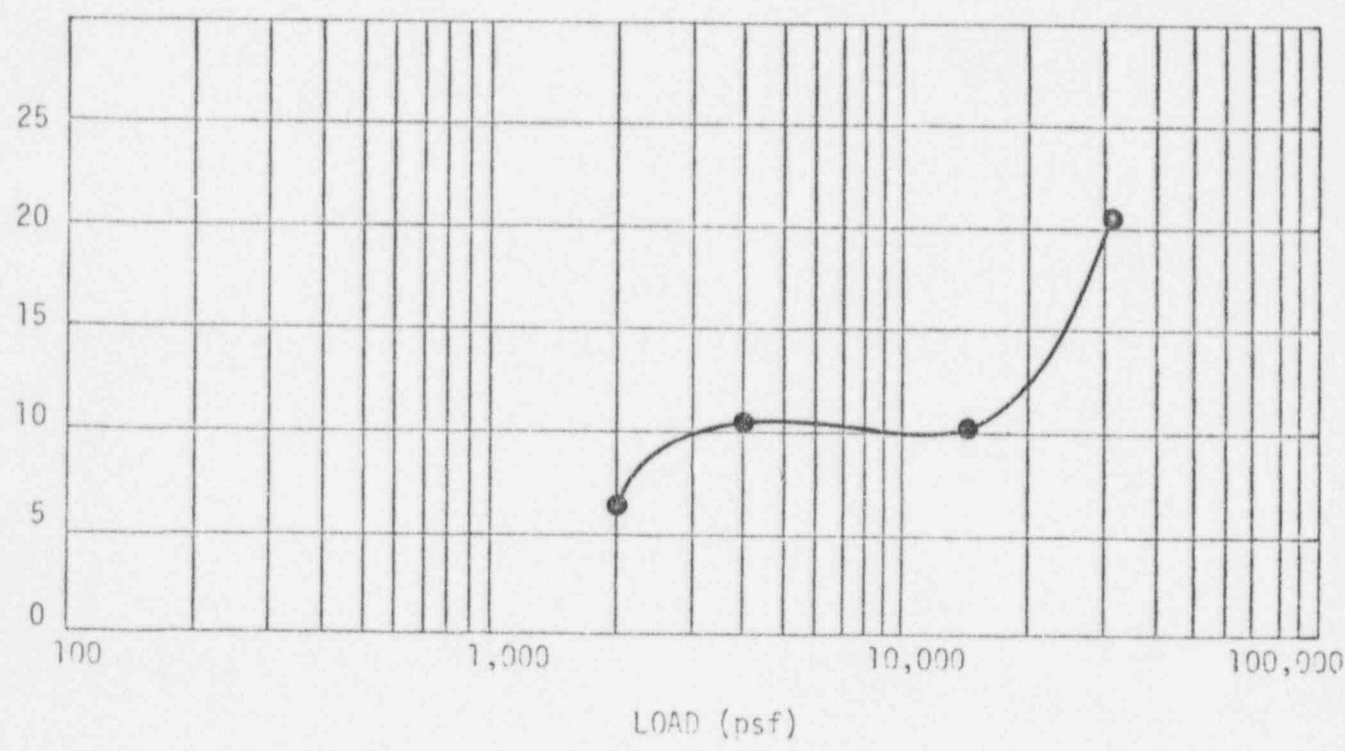
Specific Gravity = 2.77 Classification SM

CONSOLIDATION TESTS

↑
VOID RATIO
↓



↑
COEFFICIENT OF CONSOLIDATION
 c_v , in 10^{-4} cm²/second
↓

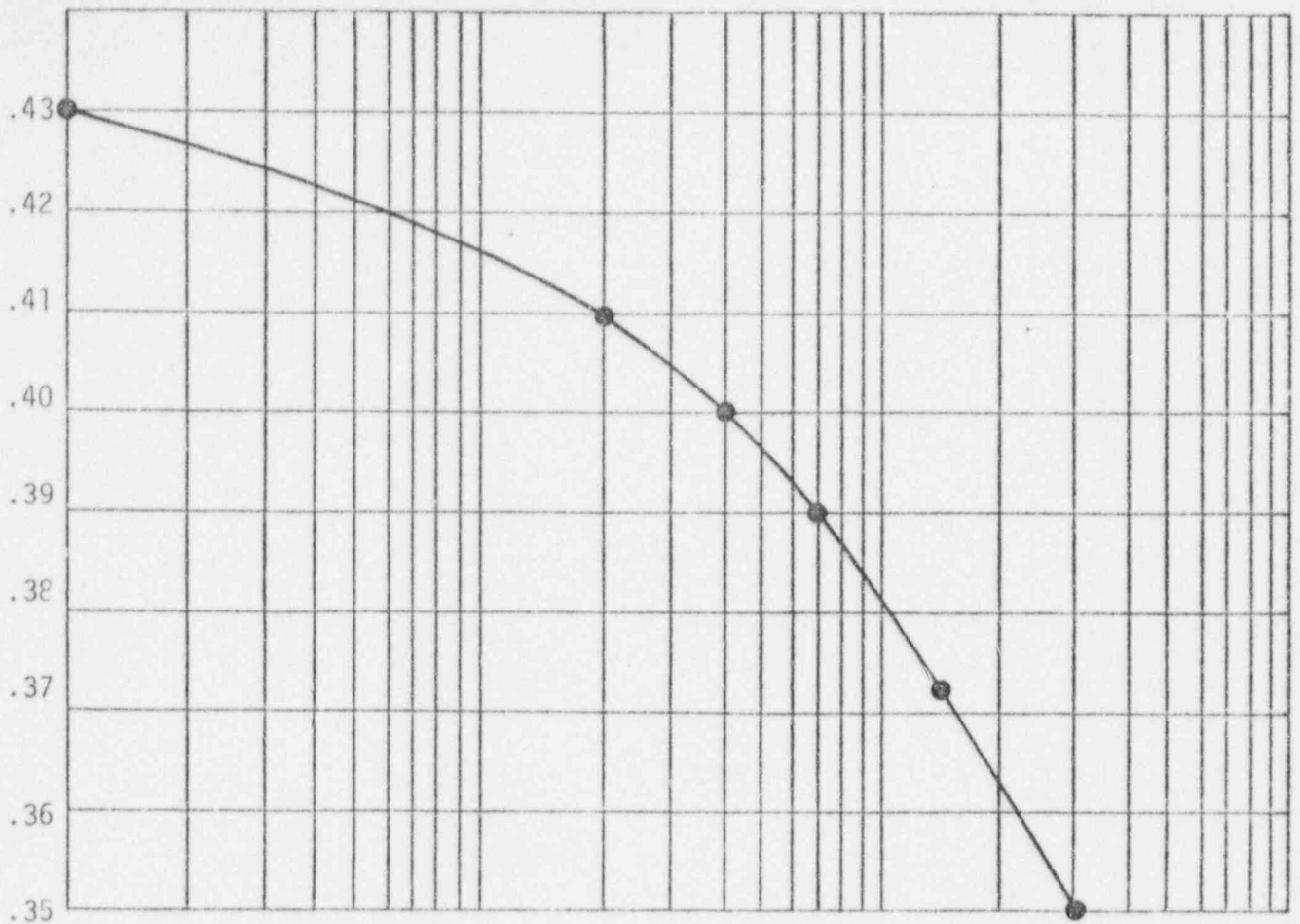


Boring No. SI-F9 Depth 23'
 Natural Moisture Content 13.2% Natural Dry Density 116.8 pcf
 LL = 28 PL = 22 PI = 6
 Specific Gravity = 2.75 Classification ML

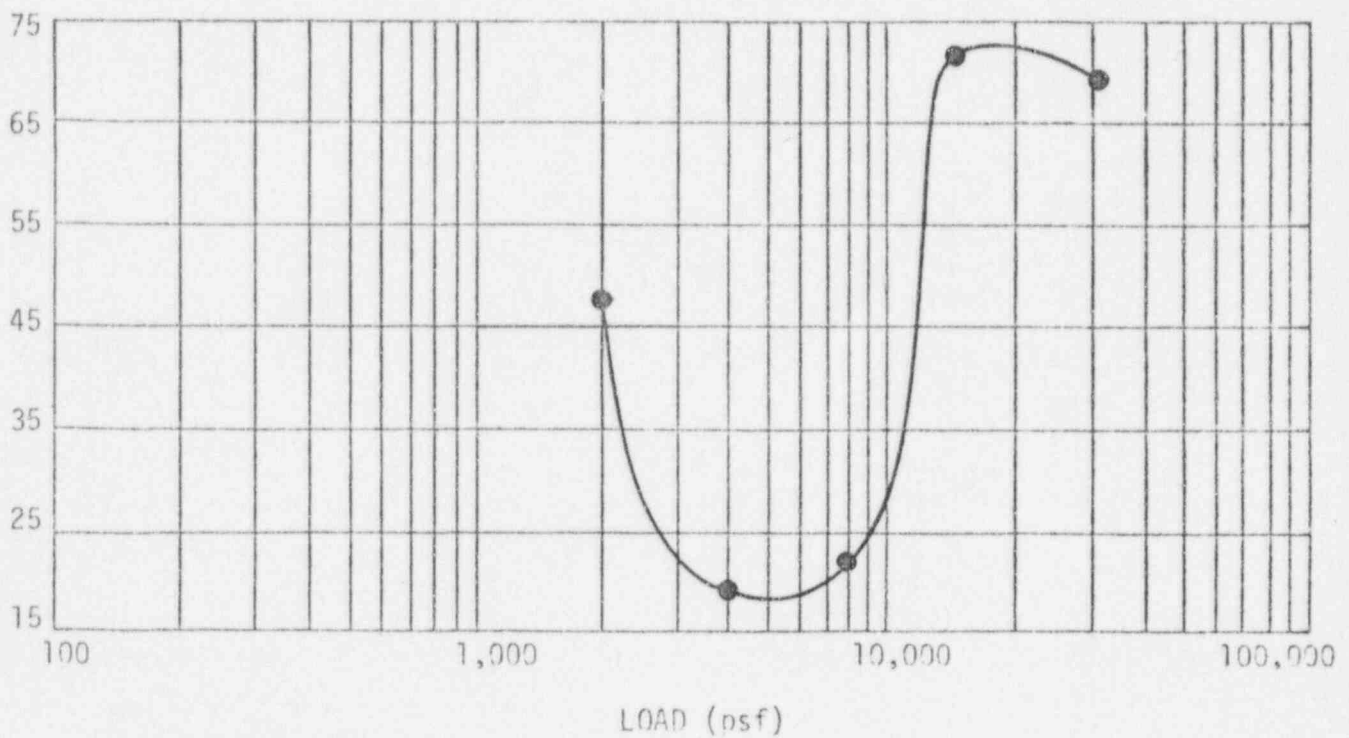
FIGURE D-29

CONSOLIDATION TESTS

VOID RATIO
↓
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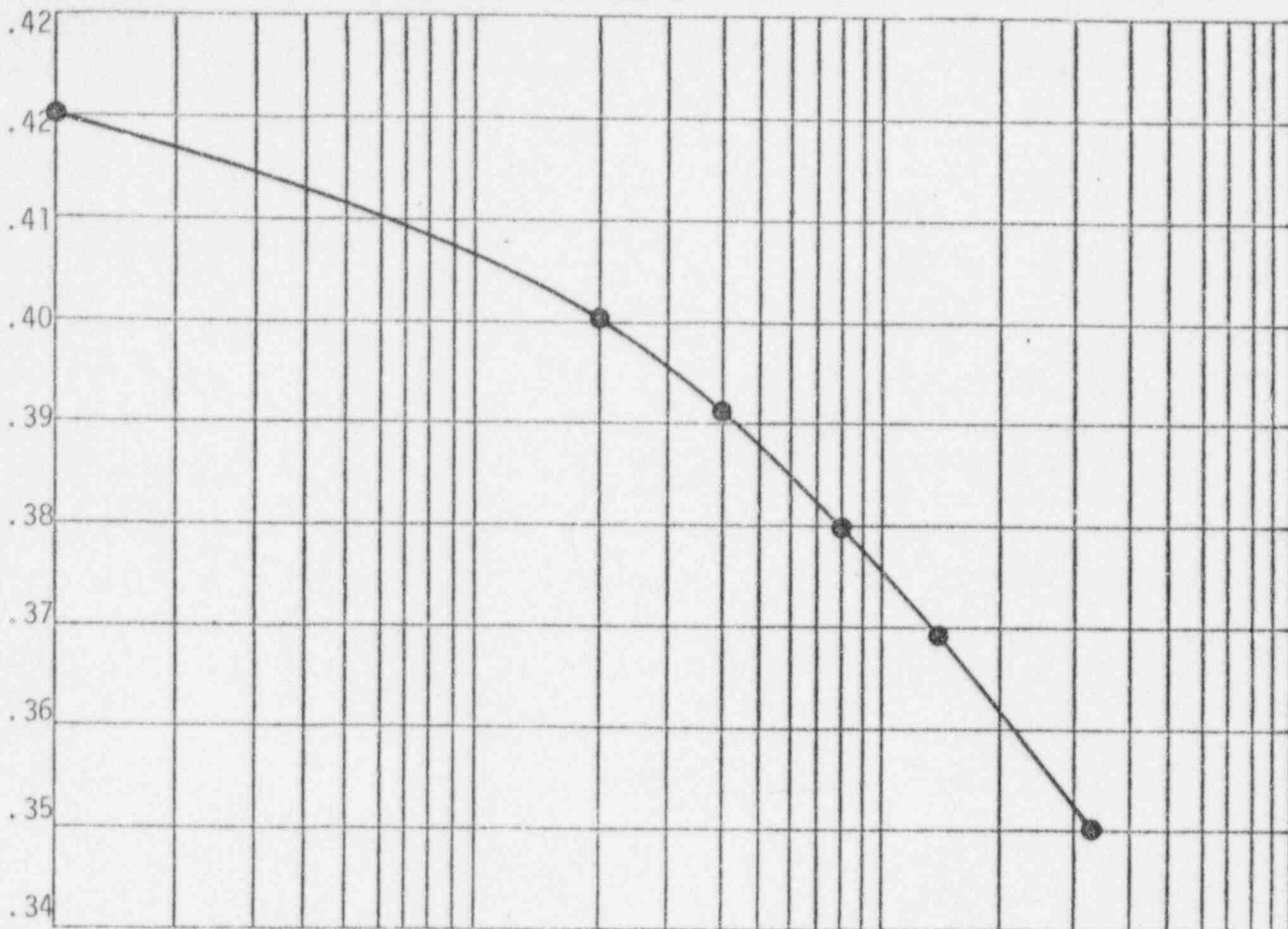
COEFFICIENT OF CONSOLIDATION
cv, in 10⁻⁴ cm²/second
↓
↑



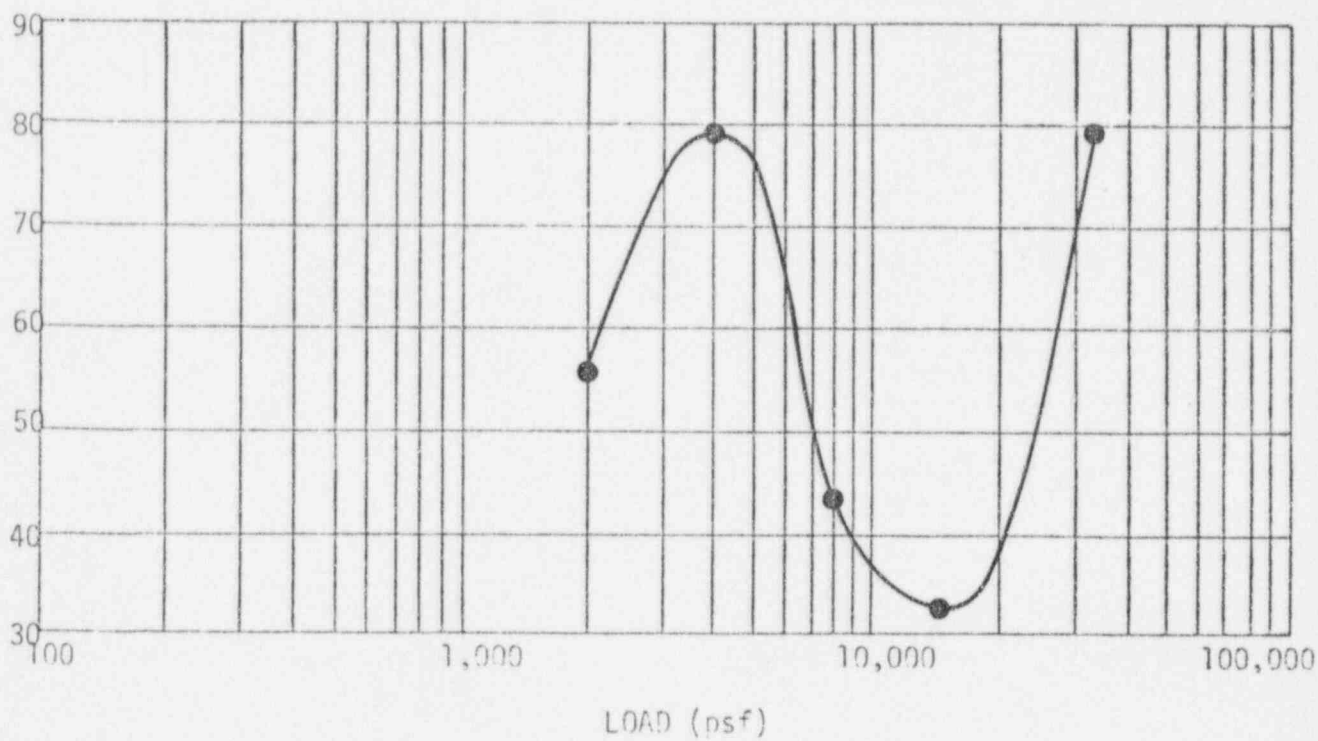
Boring No. BUL-F3 Depth 146.75'-148.5'
 Natural Moisture Content 13.8% Natural Dry Density 114.3 pcf
 LL = PL = PI =
 Specific Gravity = 2.64 Classification SM

CONSOLIDATION TESTS

VOID RATIO



COEFFICIENT OF CONSOLIDATION
 c_v , in 10^{-4} cm²/second

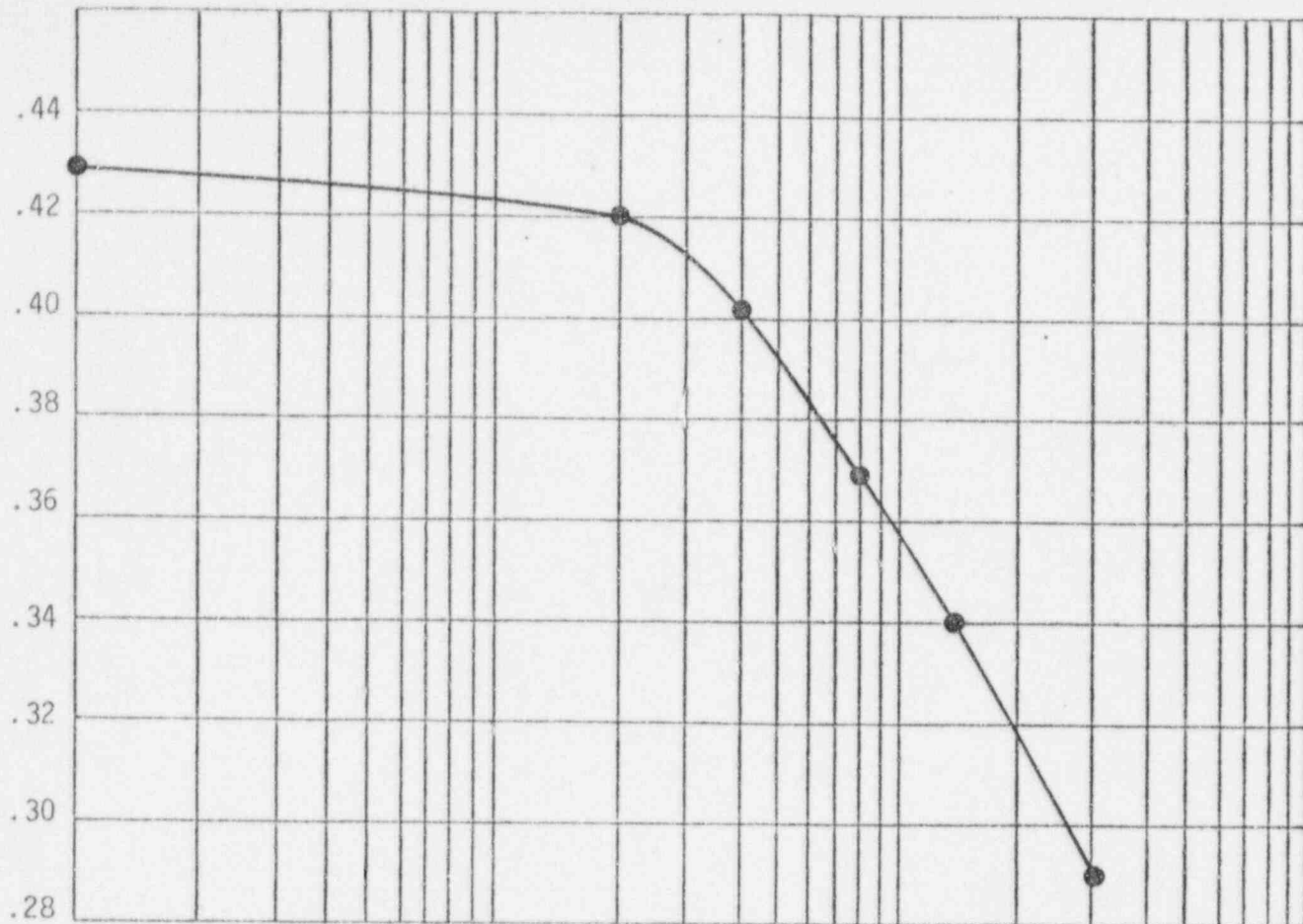


Borino No. BUL-F5 Depth 249'-250'
 Natural Moisture Content 13.1% Natural Dry Density 111.7 pcf
 LL = 30 PL = 24 PI = 6
 Specific Gravity = 2.66 Classification ML

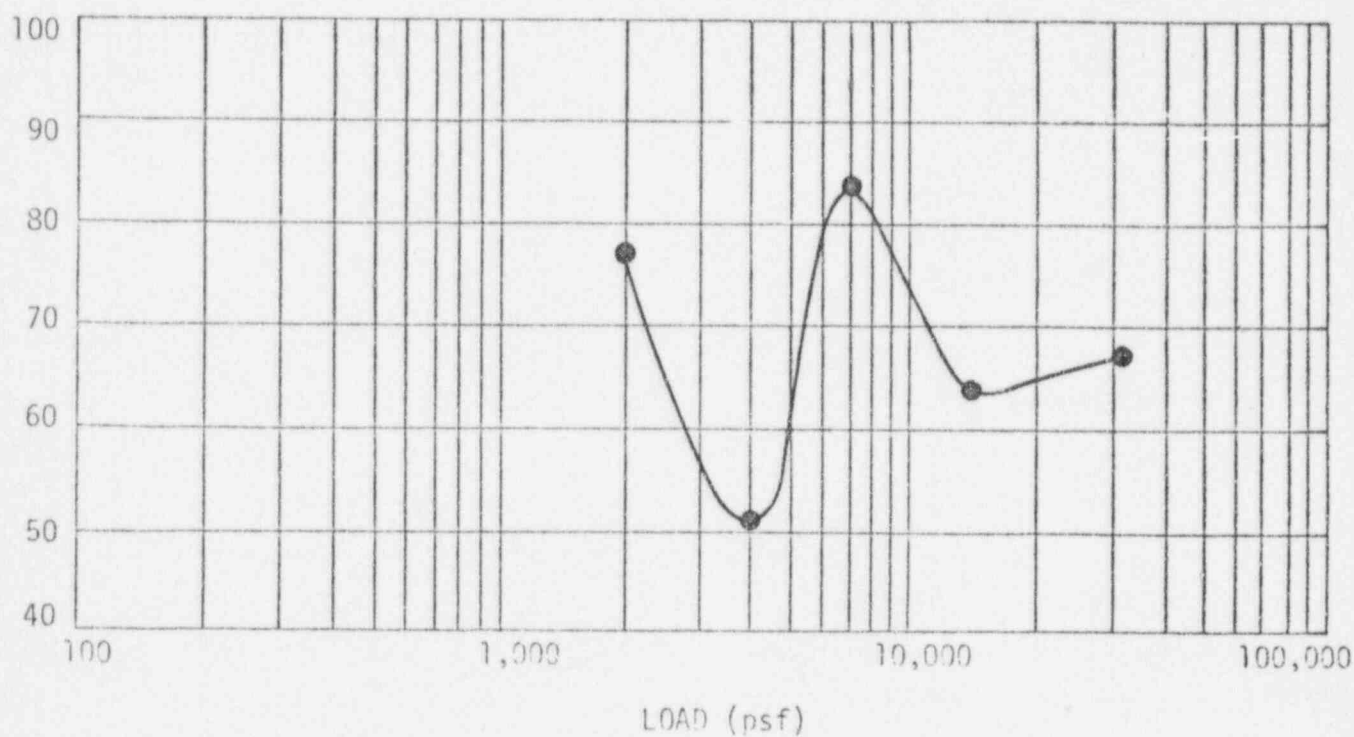
FIGURE D-31

CONSOLIDATION TESTS

VOID RATIO



COEFFICIENT OF CONSOLIDATION
 c_v , in 10^{-4} cm²/second



Boring No. BUL-F8 Depth 288.5'-289.5'
 Natural Moisture Content 13.7% Natural Dry Density 114.5 pcf
 LL = PL = PI =
 Specific Gravity = 2.65 Classification ML

SUMMARY OF LABORATORY TESTING

Hole No.	Depth of Sample (ft)	Natural Dry Density (pcf)	Passing 200 Sieve (%)	Atterberg Limits		Vertical Permeability K_v (CM/SEC)	Figure
				LL (%)	PL (%)		
ST-F1	38	118.7	49	--	--	2.2×10^{-5}	D-2
	133	108.5	20	--	--	3.8×10^{-4}	D-3
	274	105.9	15	--	--	1.6×10^{-4}	D-3
ST-F4	34	125.6	34	--	--	1.5×10^{-3}	D-3
	284	118.4	--	27	14	2.9×10^{-7}	D-4
ST-F5	8	103.3	20	--	--	6.0×10^{-4}	D-4
	33	109.2	16	--	--	7.4×10^{-4}	D-4
	50	--	--	--	--	1.2×10^{-5}	
	72	110.0	16	--	--	4.9×10^{-5}	D-5
	125	115.3	13	--	--	7.7×10^{-5}	D-5
	160	128.6	54	30	27	--	D-5
	192	--	61	35	27	--	D-6
	248	116.9	32	--	--	7.5×10^{-7}	D-6

SUMMARY OF LABORATORY TESTING

Hole No.	Depth of Sample (ft)	Natural Dry Density (pcf)	Passing 200 Sieve (%)	Atterberg Limits LL (%)	PL (%)	Vertical Permeability K_v (CM/SEC)	Figure
ST-F6	175	103.5	32	--	--	3.8×10^{-5}	D-6
	217	125.5	--	41	17	--	D-7
ST-F7	35	--	10	--	--	--	D-7
	68	--	19	--	--	3.6×10^{-5}	D-7
	106	127.4	--	27	24	--	D-8
	123	104.2	--	--	--	3.9×10^{-4}	
	209	114.8	46	27	22	--	D-8
	218	103.5	--	32	24	5.8×10^{-7}	D-8
ST-F9	23	116.8	--	28	22	--	D-9
ST-F10	8	122.6	79	32	21	2.7×10^{-6}	D-9
	211	120.3	43	--	--	1.8×10^{-4}	D-9
	222	109.3	--	32	26	3.9×10^{-8}	D-10
ST-F11	28	--	48	34	27	--	D-10

SUMMARY OF LABORATORY TESTING

Hole No.	Depth of Sample (ft)	Natural Dry Density (pcf)	Passing 200 Sieve (%)	Atterberg Limits LL (%)	PL (%)	Vertical Permeability K_v (CM/SEC)	Figure
ST-F12	28	123.5	27	38	19	2.6×10^{-4}	D-10
ST-F13	28	--	20	19	20	2.4×10^{-7}	D-11
BUL-F1	28	114.8	15	--	--	2.8×10^{-4}	
	62	109.0	21	--	--	5.2×10^{-6}	D-11
BUL-F2	183	125.6	11	--	--	1.6×10^{-3}	D-12
BUL-F3	105	109.2	16	--	--	5.7×10^{-4}	D-12
	139	126.4	69	--	--	--	D-12
	147	114.7	30	--	--	9.8×10^{-6}	D-13
BUL-F4	8	108.4	20	--	--	--	D-13
	38	111.8	14	--	--	9.6×10^{-5}	D-13
	68	100.8	13	--	--	1.8×10^{-3}	D-14
	88	110.6	13	--	--	2.5×10^{-6}	D-14
	128	104.5	19	--	--	6.6×10^{-5}	D-14

SUMMARY OF LABORATORY TESTING

Hole No.	Depth of Sample (ft)	Natural Dry Density (pcf)	Passing 200 Sieve (%)	Atterberg Limits		Vertical Permeability K_v (CM/SEC)	Figure
				LL (%)	PL (%)		
BUL-F5	48	119.0	--	--	--	9.9×10^{-5}	
	128	115.4	27	--	--	3.8×10^{-4}	D-15
	249	111.7	76	30	24	7.2×10^{-7}	D-15
BUL-F6	13	110.4	18	--	--	4.9×10^{-4}	D-15
	58	107.0	13	--	--	5.5×10^{-4}	D-16
	133	113.4	49	--	--	1.6×10^{-5}	D-16
BUL-F7	98	117.6	27	--	--	7.0×10^{-5}	D-16
	178	111.0	13	--	--	1.5×10^{-4}	D-17
	236	115.0	25	--	--	1.9×10^{-5}	D-17
BUL-F8	13	111.8	42	--	--	5.9×10^{-5}	D-17
	58	119.3	31	--	--	5.1×10^{-4}	D-18
	98	120.0	--	22	18	2.8×10^{-4}	D-18
	257	102.4	11	--	--	6.7×10^{-5}	D-18
	290	114.5	--	--	--	7.4×10^{-6}	

SUMMARY OF LABORATORY TESTING

Hole No.	Depth of Sample (ft)	Natural Dry Density (pcf)	Passing 200 Sieve (%)	Atterberg Limits LL (%)	PI (%)	Vertical Permeability K_v (CM/SEC)	Figure
Tailing samples from Mill Discharge							
#1		--	53	26	24	8.6×10^{-7}	D-1
#2		--	43	26	22		D-1
#3		--	48	26	21	1.3×10^{-6}	D-1
#4		--	52	26	22	2.8×10^{-6}	D-2
#5		--	49	27	22	4.3×10^{-6}	D-2
Overburden material - from ST-F5 45'-95'							
#1 (-40 mat'l.)		--	--	--	--	6.5×10^{-7}	
#2 (-40 mat'l.)		--	--	--	--	1.7×10^{-6}	
#3 (-10 mat'l.)		--	--	--	--	1.2×10^{-5}	
#4 (-10 mat'l.)		--	--	--	--	1.3×10^{-5}	
#5 (-4 mat'l.)		--	--	--	--	1.1×10^{-4}	

APPENDIX E

PRELIMINARY DESIGN ALTERNATIVES

APPENDIX E

SAGEBRUSH-TABLESTAKES SUBSURFACE DISPOSAL SYSTEM PRELIMINARY DESIGN ALTERNATIVES

Six preliminary disposal design alternatives have been prepared. Refer to Figures E-1 through E-6. Preliminary design sections are taken in a north-south direction and correspond to Section B-B, Appendix C, Figure 2 in report. Each section assumes that the K-1 pit backfill will be placed prior to or simultaneously with tailing deposition. Each system also assumes that the natural groundwater surface is approximately 30 feet above the mudstone base. Inspection of the boring logs indicates that near the K-1 pit the natural groundwater surface is actually lower than 30 feet above the mudstone; however, it is our opinion that K-1 pit pumping has created this situation.

Key design features, advantages and disadvantages and important design aspects are presented on each design sheet. It should be noted that the final pit and deposition design system may be a combination or modification of any of the six alternatives.

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