FEASIBILITY STUDY

GROUNDWATER SUPPLY AND GROUND DISPOSAL OF SEWAGE EFFLUENT

at

Dr. H. R. McDiarmind Property

Chesterman Beach

Tofino, British Columbia

for

Mitchell and Associates

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75-163

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1.0 INTRODUCTION

This report describes the work done at the proposed develepement site to test the feasibility of:

1. Supplying the subject site with potable water from wells;
2. Disposing of sewage effluent into the ground at the subject site.

The proposed development site is located at the north end of Chesterman Beach, which is approximately 2 miles south of the village of Tofino on the west coast of Vancouver Island, British Columbia (see Location Map on Figure 1A).

The information given in this report and shown on the attached Figure 1A is based on the following:

1. An airphoto study;
2. Geological observations made in the field;
3. Records of the sediments encountered in seven test holes dug to depths of up to 6 feet;
4. Drill logs of holes drilled for water in the general area;
5. Percolation tests which were carried out using standard Health Branch procedures;
6. Sieve and soil analyses of selected soil samples.

The calculations for the drainfield areas are based upon regulations for the sizing of drainfields which are presently being used by the Pollution Control Branch. These regulations may change in the near future, but we believe that they give sizes that are close enough for present purposes.

2.0 PROPOSED PROPERTY DEVELOPMENT

The present plans are to construct a restaurant, a bar and 100 motel units, each pair of which will have access to a common kitchen. Using this information and standard figures for estimating minimum daily sewage flows, the estimated design discharge of sewage effluent is calculated as follows:

		Imp.gpd.
1.	50 motel units (no kitchens) @ 70 gpd/unit	= 3,500
2.	50 motel units (with kitchens) @ 100 gpd/unit	= 5,000
3.	Restaurant, 150 seats, which occupy an estimated area of 1500 sq.ft. using 1,500 sq. ft. @ 2 gpd/sq.ft.	= 3,000
4.	Bar - 50 seats, assume 500 sq. ft. @ 3 gpd/sq.ft.	= 1,500
	TOTAL	13,000 gpd
		= 9 gpm

We estimate that the proposed development would require a fresh water supply with a maximum pumping capacity of between 12 - 20 I gpm, depending on the storage to be provided.

These figures assume that any irrigation requirements will be minimal. For the purpose of this study we will assume a maximum requirement of 20 I gpm.

3.0 SURFICIAL AND BEDROCK GEOLOGY

The ground on and around the property has a dense forest cover, and where the drainage is poor, is a spongy swamp. Recent beach sands, exposed along Chesterman beach, do not appear to extend more than a few tens of feet inland beyond the present tree line. The most predominant sediments covering the area were laid down in a glacial-marine environment in which glacial sediments were fed into a shallow sea. These glacial-marine sediments are seen in an exposed road cut along the south side of the property. The sediments include stratified clean fine sands, silty fine sands and silty clay. These sediments were also encountered in test holes dug on the property.

The thickness of these sediments is not known but based on wells drilled in the area could be in the order of 80 feet thick.

The bedrock is exposed at two points along the shore line of the property. This rock is a mildly metamorphosed sedimentary rock called argillite. The rock is fractured and air photo studies indicate that major faults and fractures extend through the bedrock beneath the surficial deposits.

4.0 GROUNDWATER POTENTIAL

The near surface sands and silts have only a limited potential for a water supply. Shallow dug wells could have water of adequate quality (for example the groundwater sample analyses at the back of this report) but such wells would be insufficient to supply water during the drier months. In addition, shallow wells would be prone to contamination either from the proposed drainfields or from people using the area. With these considerations in mind we recommend that a deep drilled well be constructed and pump tested.

Our company has been involved in the exploration and construction of a number of successful wells in the Ucluet-Tofino area. These wells were generally completed in water bearing sands and gravels at depths ranging from 25-60 feet deep. The notable exception is a well drilled for the Christie Student Hostel (located approximately 1 mile north of the subject property). This well encountered 62 feet of unconsolidated clays and silts. These sediments contained marine sea shells just above the bedrock. Below 62 feet the well drilled through argillite bedrock to its total depth of 110 feet. Two fracture zones containing water were encountered at depths of 89 and 97 feet. The water from these fractures rose up to a depth of only 6.5 feet below ground surface. Such a non-flowing artesian system indicates that the water is entering the fracture system from a high area that might possibly be Meares Island. The specific capacity of this well was one U.S. gpm per foot of drawdown.

Our company has had considerable experience with the location and development of water wells in fractured bedrock on Vancouver Island. Based upon available data, we believe that there is a 95% chance of constructing and developing water wells in the subject area capable of safety delivering at least 12 Igpm. of potable water. Based on our preliminary estimate for the water requirements we believe that one or possibly two wells will be necessary.

The locations of four potential well sites are shown in Figure 1A. Any well drilled in this area would require a properly constructed surface seal to prevent contamination of the well water be polluted surface or near surface waters. Sites 2 and 3 are sufficiently remote from the proposed drainfield to ensure that a properly constructed well will not be contaminated. As an additional safety factor it would be desirable to encounter a good thickness (greater than 30 feet) of tight clay or silty clay before encountering a water bearing zone. The presence of the clay zone would not be so essential at sites 1 and 4. For this reason we recommend that the first test-production well be drilled at either sites 1 or 4.

5.0 GROUND DISPOSAL OF TREATED SEWAGE EFFLUENT

A test hole digging program was carried out in the potential drainfield area in order to collect and analyse samples of the near surface sediments. Seven holes were dug and the location of these holes are shown in Figure 1A. Holes

1 to 6 were dug to a depth of six feet using a 6-inch power auger and hole 7 was hand dug. The sediments encountered in each hole were carefully logged and sampled. Some selected sediments were analysed for grain size, cation exchange capacity (CEC), organic content and leachable salts. The logs of the seven holes are summarised in Table I and grain size analyses are plotted in Figures 2 - 7.

The property can be divided into four general zones according to the type of soil and water table conditions prevailing at the surface. These four areas, as shown in Figure 1A, are as follows:

1. Areas where solid bedrock is at or close to (less than four feet) the ground surface. These areas would not be suitable for ground disposal of sewage effluent due to the lack of sufficient soil cover over the bedrock.

2. Areas which are generally swampy and where the natural groundwater table is at or near the ground surface (i.e. less than four feet). These areas generally have a thick organic (peaty) soil cover with water saturated sands beneath and are not suited for sewage effluent disposal.

3. Areas which are marginal and could be used for specially designed drainfields. This area generally has a heavy black soil cover which overlies unsaturated sands. The depth to the water table in these

areas is variable but in some places may be greater than three feet. In such cases it may be possible to construct small drainfields up to about 3,000 gpd capacity. These drainfields would probably need to have 1 to 2 feet of fill added to the ground surface in order to ensure that the drain-pipes are not water logged.

4. The area most suitable for the construction of a drainfield capable of discharging up to 13,000 I gpd. This area is located on a low ridge which transects the property. The top soil varies from 6 to 24 inches thick and is underlain by glacio-marine sediments. These sediments are very variable as can be seen from the logs in Table I. Medium sands are the most predominant sediment and lenses of silts and clays are found interbedded with these sands. These sands are uniform with mean grain sizes ranging from 0.15 to 0.42 mm.

Construction permits for the project will require a permit from the Pollution Control Branch of the Department of Lands, Forests and Water Resources. Their present regulations require the construction of two drainfields and to set aside an equivalent area as a reserve. We have drawn in an approximate outline of these three areas that would be suitable for the discharge of effluent at 13,000 I gpd. This assumes an average percolation time of 10 minutes. Further testing will be necessary to prove out this area and to determine a more representative percolation time.

6.0 SOIL AND WATER CHEMISTRY

A sample of the groundwater taken from a dug well east of the property was collected and submitted for inorganic chemical analysis (A copy of the chemists report is included in this report). The water has a high pH, low dissolved iron and moderate hardness.

Three soils were analysed to determine the cation exchange capacity (CEC), and organic contents of these soils. The results of these tests are given in the chemical report in the back of this report. In addition two samples were analysed for leachable iron and calcium. The results are summarised in the following table.

Sample No.	Hole No.	Sample Depth (feet)	Sediment Type	CEC (mg Eq/100 gm)	Organic Matter (%)	Leachable (ppm)	
						Iron	Calcium
1	1	2	SAND: medium, with silt and minor clay	12.31	6.6	-	-
5	1	5	SAND: medium, with clay stringers, water bearing	4.97	3.64	nil	3.46
17	3	5.5	SAND: medium, with dense silt stringers	10.03	9.23	1.36	1.27

The CEC values were found to be moderately low and is probably related to the organic content. The high leachable iron content in sample No. 17 is probably derived from the dense silt stringers encountered in the sand layer. The leachable iron will not normally be accessible to the percolating sewage effluent due to the density of these layers. The pH of the discharge sewage effluent would have to be kept high (greater than 7.5) in order to minimise remobilization of iron. These preliminary data indicate that the soil will be adequate for the attenuation and degradation of pollutants in the infiltrating sewage effluent.

7.0 CONCLUSIONS AND RECOMMENDATIONS

1. The proposed development would need a water source capable of a flow of 20 I gpm.

2. Groundwater can be developed from either sands and gravels beneath a clay layer or more probably from fractured bedrock beneath the site. Four potential well sites have been selected.

3. Test-production wells should be drilled at sites 1 and/or 4 first, before considering the other two sites.

4. The estimated design maximum flow of sewage effluent is 13,000 I gpd.

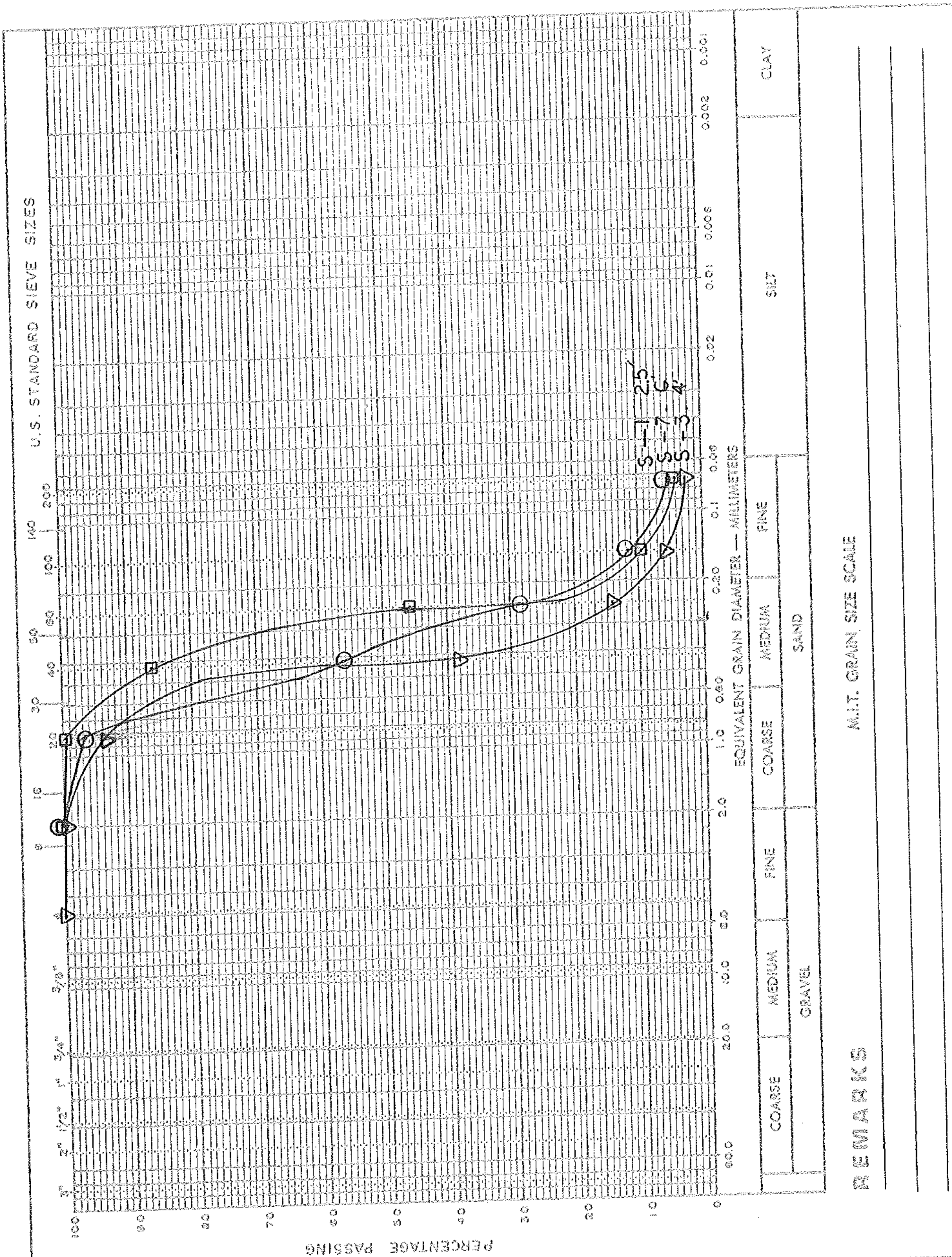
5. The most suitable area for ground disposal of sewage effluent is a low lying sandy ridge that transects the middle of the property.

6. A more extensive investigation will be necessary to obtain more data on the suitability of the sands for effluent disposal. The next phase of investigation would require:

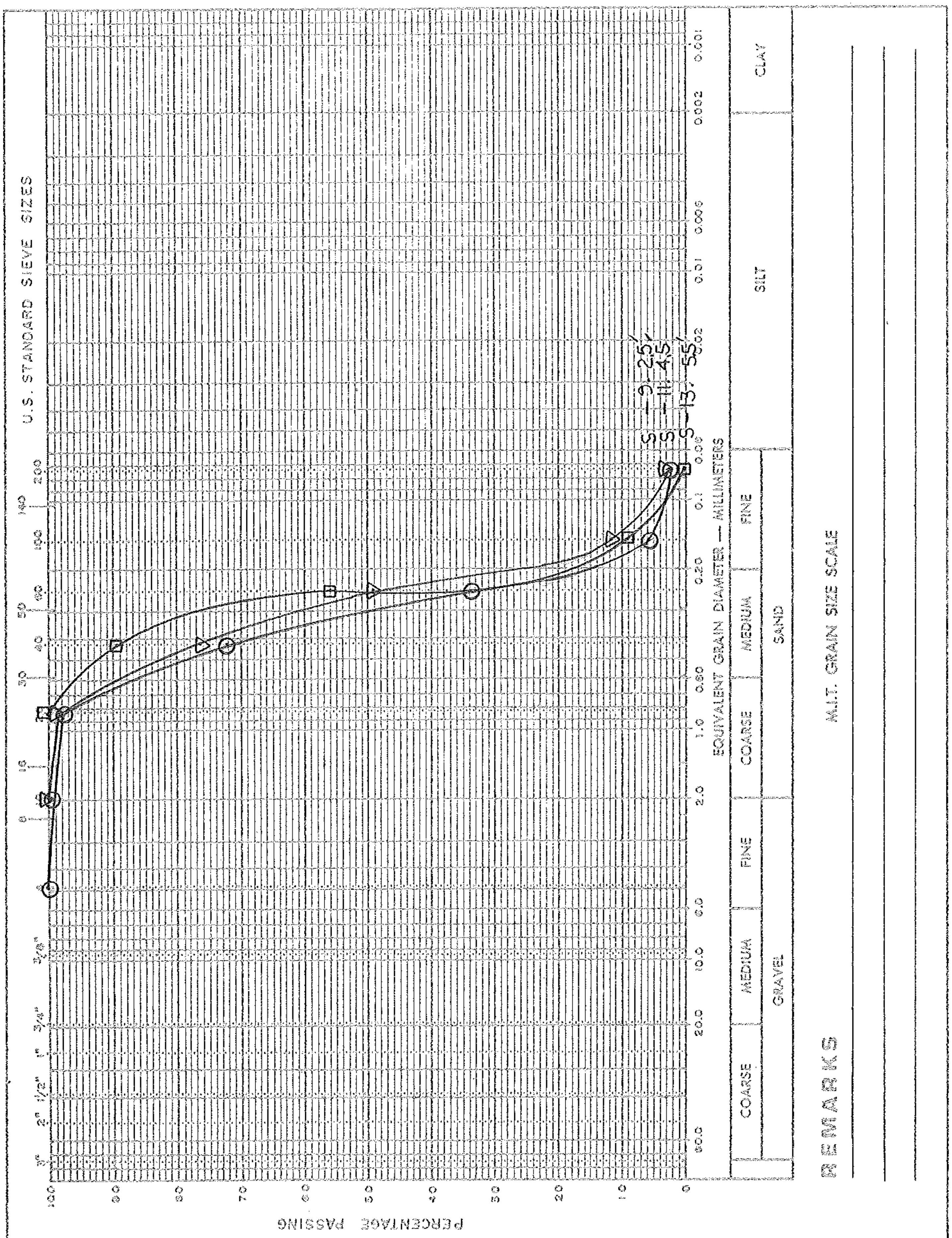
a) additional test pits
b) drilling of two bore holes
c) additional sampling of sediments
d) additional percolation tests and pump testing of bore holes.

7. A monitoring program should immediately be set up to monitor the water table level in the three test holes (holes 3, 5 and 6) fitted with stand pipes. These holes should be monitored once a month and continued at least until April 1976.

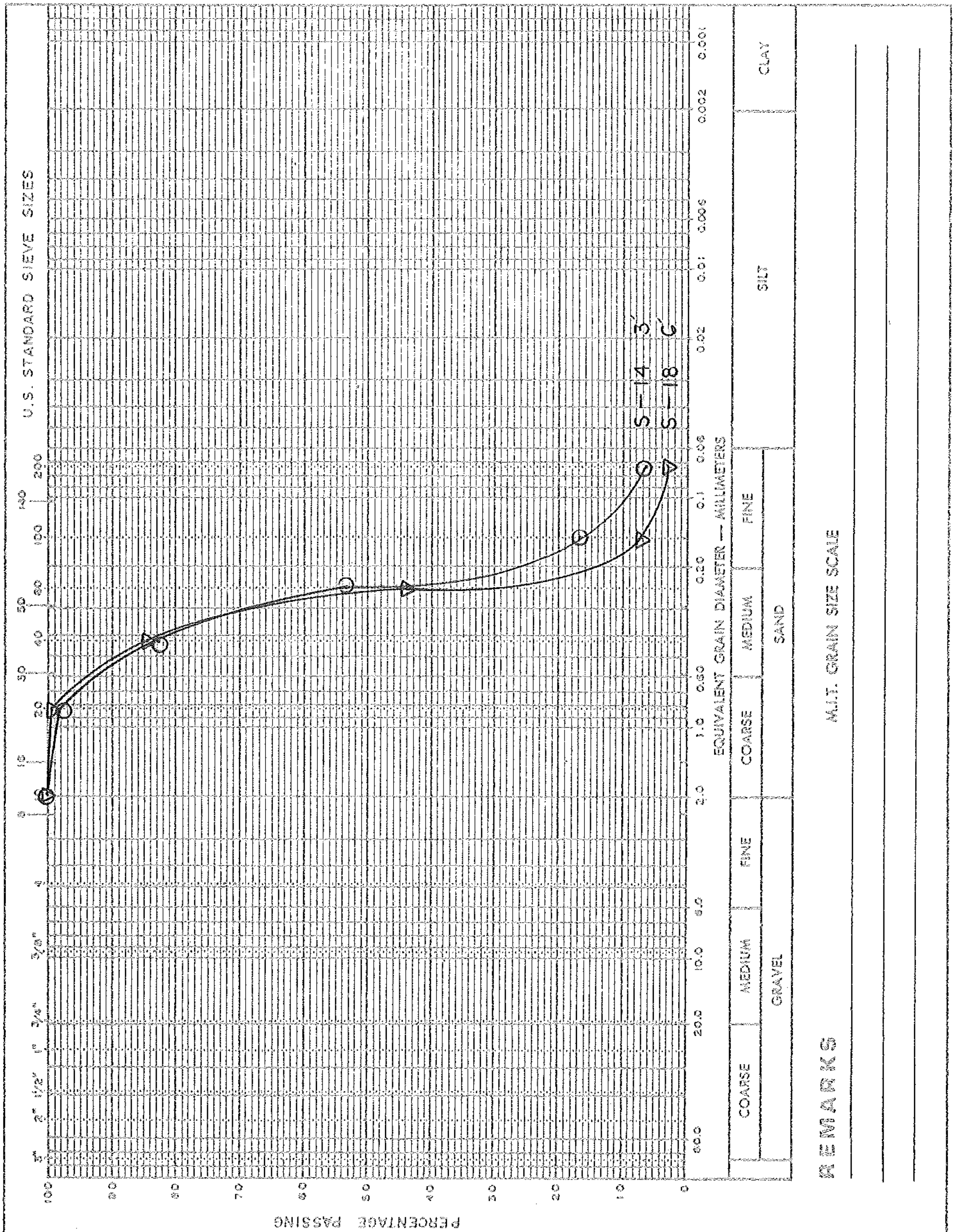
8. The drilling and testing of the water wells and bore holes be carried out at the same time, after access roads have been constructed.



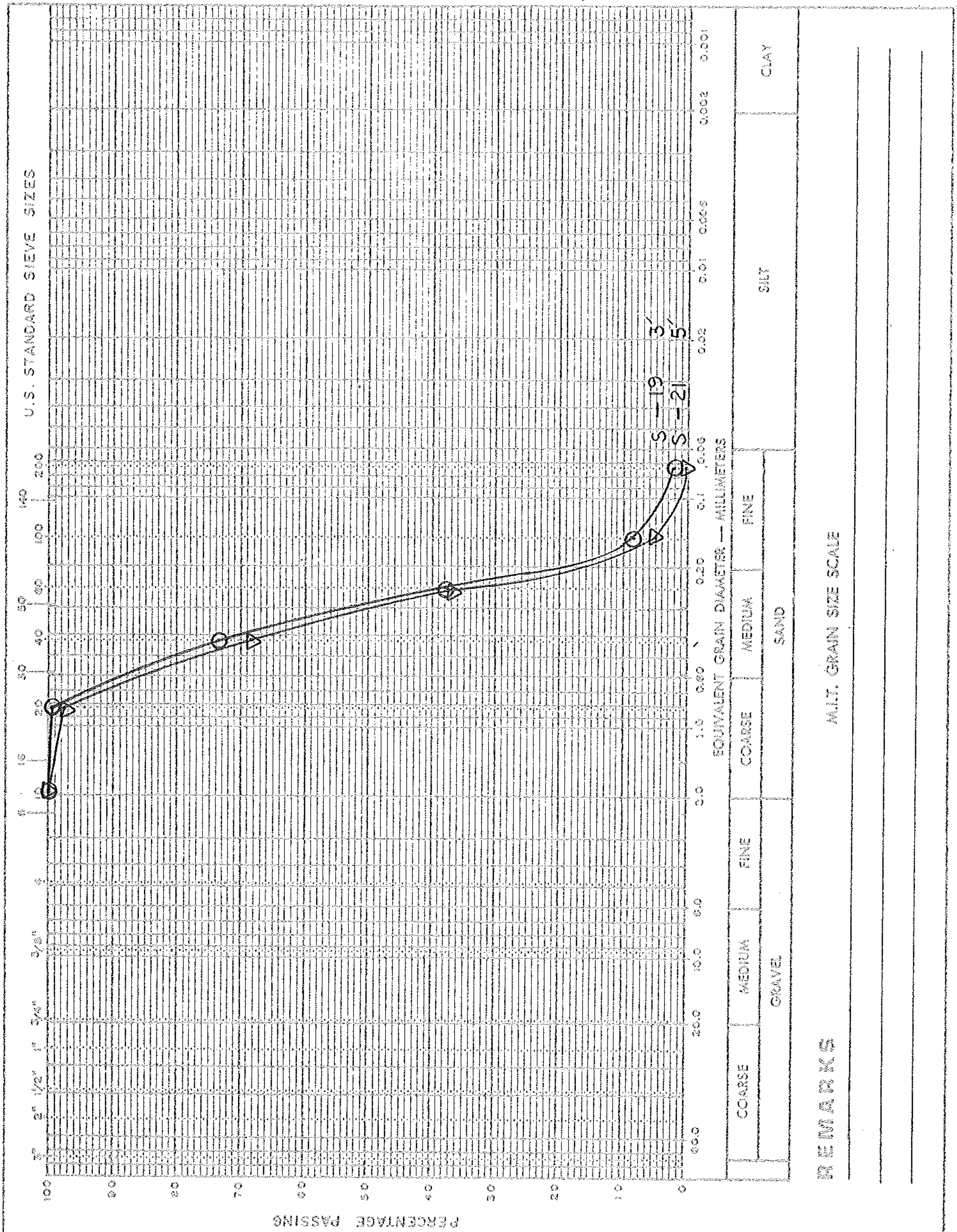
MITCHELL	PITEAU GADSBY MACLEOD LIMITED		
	GRAIN SIZE ANALYSIS	By: A N	Date: 30-10-75
	HOLE - 1	Job: 75163	Dwg: Fig: 2



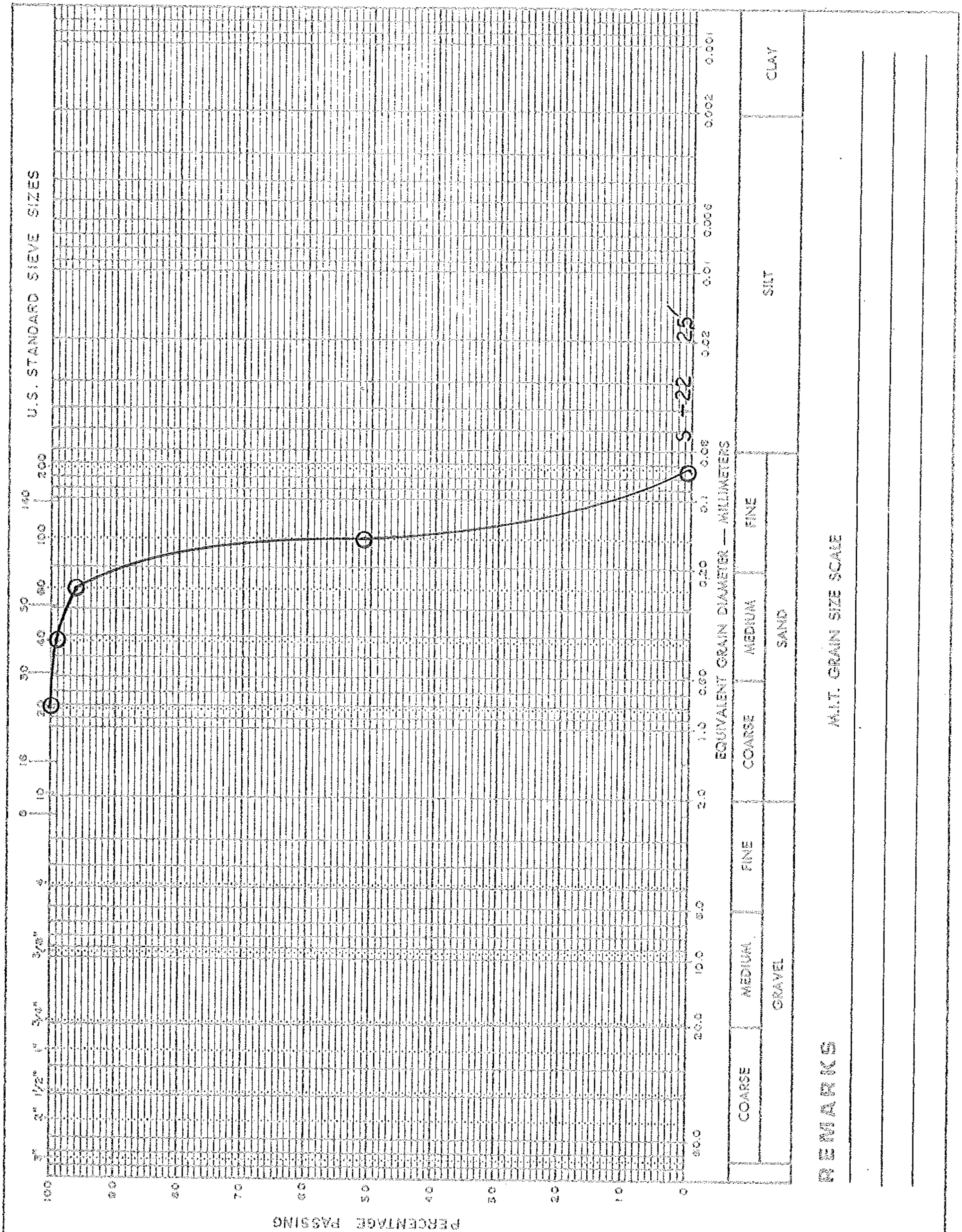
MITCHELL	PITEAU GADSBY MACLEOD LIMITED		
	GRAIN SIZE ANALYSIS	By: A. N.	Date: 30-10-75
	HOLE — 2	Job: 75163	Dwg: Fig : 3



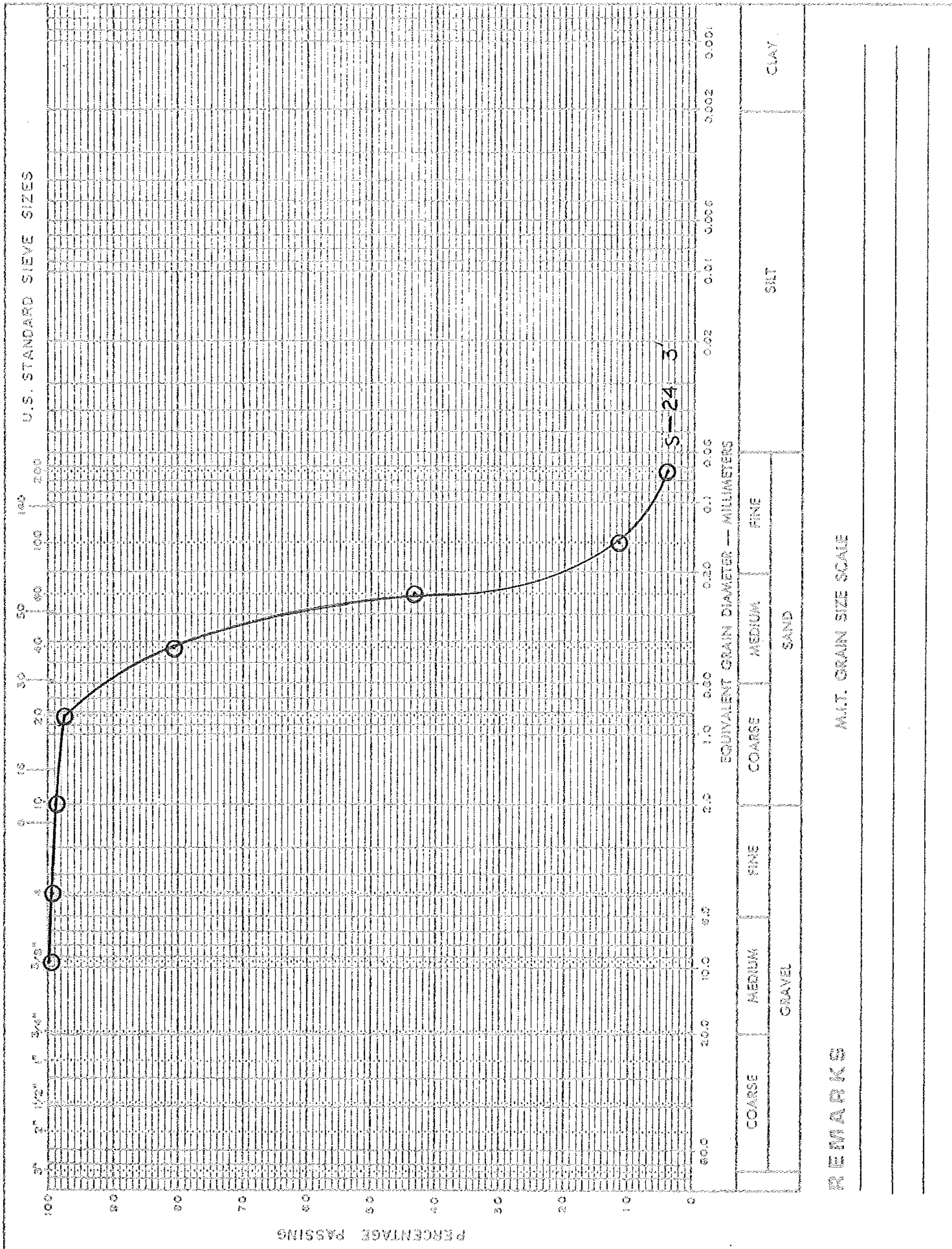
MITCHELL	PITEAU GADSBY MACLEOD LIMITED		
	GRAIN SIZE ANALYSIS HOLE — 3	By: A.N. Job: 75163	Date: 30-10-75 Dwg: Fig: 4



MITCHELL	PITEAU GADSBY MACLEOD LIMITED		
	GRAIN SIZE ANALYSIS HOLE — 4	By: A . N . Job: 75163	Date: 30-10-75 Dwg: Fig : 5



MITCHELL	PITEAU GADSBY MACLEOD LIMITED		
	GRAIN SIZE ANALYSIS HOLE — 5	By: A. N. Job: 75163	Date: 30-10-75 Dwg: Fig: 6



MITCHELL	PITEAU GADSBY MACLEOD LIMITED		
	GRAIN SIZE ANALYSIS HOLE — 6	By: A. N. Job: 75163	Date: 30-10-75 Dwg: Fig: 7