No. 4

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 114

YUKON RIVER DRAINAGE BASIN

DAM SITE INVESTIGATION

SITE No. 19

GRANITE CANYON DAM SITE

(MAP AND PRELIMINARY REPORT)

BY

E. B. OWEN

OTTAWA

1966

FOR DEPARTMENTAL USE ONLY

NOT TO BE QUOTED AS A PUBLICATION

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 114

YUKON RIVER DRAINAGE BASIN

DAM SITE INVESTIGATION

Site No. 19

GRANITE CANYON DAM SITE

(Map and Preliminary Report)

by

E. B. Owen

OTTAWA

1966

CONTENTS

Illustrations

Granite Canyon Dam Site

Introduction

The examination of Granite Canyon as a potential dam site is part of an investigation by the Water Resources Branch, Department of Mines and Technical Surveys* of the hydroelectric power potential in the Yukon River drainage basin.

Granite Canyon is situated on Pelly River, one of the main tributaries of Yukon River in Canada. Altogether five potential dam sites have been investigated on the Pelly. These are as follows:

Site	Approximate distance from mouth (miles)
Bradens Canyon	19.5
Gerc	20
Granite Canyon	58
Detour	139
Hoole Canyon	269

Three hydroelectric power projects are proposed for Pelly River. One would be located at either Bradens Canyon or Gerc which are alternate sites, a second at Granite Canyon and the third at Hoole Canyon. A fourth dam at Detour would be used to provide storage for the downstream plants. The development of storage for regulation and equalization is extremely

---

* Transfered from the Department of Northern Affairs and National Resources on February 1, 1966.

important because of the variability of flows in Yukon streams.

General Description

Granite Canyon dam site is located on Pelly River about 58 miles from the mouth of the Pelly and 81 miles downstream from Detour dam site described in Topical Report No. 113. The community of Pelly Crossing is located about 25 miles downstream at the point where the Whitehorse-Dawson highway crosses the Pelly. The proposed dam site is included on National Topographic Series sheet No. 115-I (Carmacks), scale 1:250,000, and on Royal Canadian Airforce photograph A 12227-128.

Except in periods of extremely low water the site can be reached by shallow draft boats from the community of Pelly Crossing. Granite Canyon is about 4 miles long and usually can be navigated, although during the high water stage it is advisable to line boats along the right bank or use the portage which follows the left side of the river. Beaver aircraft can be landed on Pelly River within a mile of either end of the canyon.

For many miles upstream from the site Pelly River flows in a general northwest direction along the northeast flank of Pelly Mountains. The valley of Pelly River where it parallels the mountains is a distinct topographic feature which continues as a trench-like depression for several hundred miles across the southern part of Yukon Territory. It is known as Tintina Trench[1].

---

[1] Bostock H.S.: Physiography of the Canadian Cordellera with special reference to the area north of the fifty-fifth parallel; Geol. Surv., Can., Mem. 247, 1948, p. 60.

Granite Canyon dam site is not situated in Tintina Trench. About 30 miles upstream Pelly River makes a wide swing to the left and passing around the northwest end of Pelly Mountains flows in a westerly direction toward Yukon River. However, if the reservoir were to extend upstream to Detour site more than half of it would be located in the Trench.

The U-shaped course of Pelly River at Granite Canyon is similar to that at Detour and Hoole Canyon further upstream. At the latter sites this was the result of glaciation. The original channels were blocked by glacial debris and the rivers diverted into new courses which they followed until they were able to rejoin their former channels some distance downstream. The problem of leakage of reservoir water through the former channels is common to both these sites.

Although the Granite Canyon area has been glaciated, usually by ice moving in a westerly direction, it is believed the most recent ice advance did not reach the dam site area but stopped about 2 miles upstream. The absence of glaciation is indicated by the considerable amount of weathering in the gravel occurring at the site. In places, also, the surface of bedrock where it is exposed in the walls of the canyon above the high water stage of the river is covered with a few inches of soft, clayey, decomposed rock. The bedrock terraces on both side of the canyon vary in height from 130 to 290 feet above the river. They were probably cut by the river before it settled in its present channel. The thick deposits of glacio-lacustrine silt occurring at the junction of Pelly and Macmillan Rivers some 10 miles upstream from the dam site suggests a small, temporary lake existed in this area during the melting of the last ice.

It is unlikely a buried channel exists in or near the dam site area through which reservoir water could escape. The thicknesses of overburden (94 to 117 feet) obtained from seismic line No. 2 located in the right abutment area appear to be too great. Test borings should be put down to confirm these depths.

At one time Tintina Trench was probably a main discharge route for west-flowing, melt water from a wasting Pleistocene ice mass. Depending upon the maximum pool elevation leakage may occur through the Trench by way of Macmillan and Little Kalzas Rivers.

Granite Canyon consists of a narrow valley, some 4 miles in length, with steep sides which in places rise to heights of more than 300 feet above the river. Bedrock is exposed at both ends of the Canyon. At the upstream end the rock consists of massive, coarse-grained, grey granodiorite and in the downstream part of dark andesite lava flows and breccias with minor quantities of dacite. These latter rocks have been described by Bostock as Carmacks volcanics[1]. The volcanic rocks are believed to unconformably overlie the granites. The contact between the two rock types was nowhere seen. It probably occurs in the centre part of the Canyon where it is concealed beneath the overburden.

Unconsolidated Deposits

Four types of unconsolidated deposits occur at Granite Canyon dam site. They are as follows:

---

[1]Bostock, H.S.: Carmacks District, Yukon; Geol. Surv., Can.; Mem. 189, 1956, p. 42.

(1) Recent alluvium: Very little Recent alluvium is exposed at the site. The steep walls of the canyon have confined the river in its channel and thus prevented the formation of flood plain deposits. The Recent alluvium is a coarse-grained material consisting chiefly of rounded to sub-rounded rock fragments ranging from pebble-size to boulders 24 inches in diameter. It is not believed there is sufficient material present to warrant consideration for construction purposes. The thickness of alluvium underlying the river is probably greater than at Detour and Hoole Canyon sites. The presence of large boulders in this material may hinder the driving of steel sheet piling during coffer-dam construction.

(2) Talus: Talus is the result of the mechanical disintegration of adjacent bedrock. At Granite Canyon dam site it consists of large, granitic rock fragments, some several feet in diameter, which have accumulated on the lower parts of the walls of the canyon in areas where bedrock is exposed. Many of the larger fragments have broken off along a prominent joint set which closely parallels the river. The fragments are usually flat-faced and rectangular in shape. The finer material mixed with the bedrock fragments consists of minor quantities of clayey, sandy residual soil and of sand and gravel which originated in the glacio-fluvial deposits which overlie bedrock.

(3) Alluvium: This material consists of fine-grained, silty sand. It occurs only in the upstream part of the site area on a terrace which slopes gently upward from the left side of the river south to the toe of a steep, gravel-covered, bedrock bluff. The alluvium is believed to have been

deposited by the present Pelly River when it flowed at a higher elevation. It is the only material in the dam site area in which frozen soil was encountered. There is not sufficient alluvium present to be useful as a construction material. It is important because of the problems that will be encountered when it is excavated. The large quantities of ice visible in the frozen material indicate its water content is high. Once the insulating layer of moss and organic material is removed and the material starts to thaw it will become fluid and be difficult to handle.

(4) Glacio-fluvial (sand and gravel): This material consists of highly weathered sand and gravel which is exposed in the upper parts of both abutments. The greater part of the material consists of coarse-grained gravel containing boulders up to 24 inches in diameter. Most of the sand occurs as an irregular deposit overlying the gravel along a terrace on the right abutment between elevations 1,820 and 1,850 feet. A grain size analysis of sample No. 7 taken from the bottom of the downstream shot hole of seismic line No. 2 indicates the material consists of about 40 per cent sand; the remainder being almost all silt. The analyses indicates a lower sand content than what was estimated from a field examination of the material in several shallow test pits. Test borings will be necessary to determine the quantity of material available for construction purposes. Some test pits encountered less than 3 feet of sand overlying the gravel. In places, however, the deposits is probably much thicker.

The gravel which is believed to directly overlie bedrock is exposed continuously along the upper parts of both Canyon walls. Its use as a construction material would depend upon the extent of the weathering which is extreme in the upper 2 feet.

Bedrock

General Description

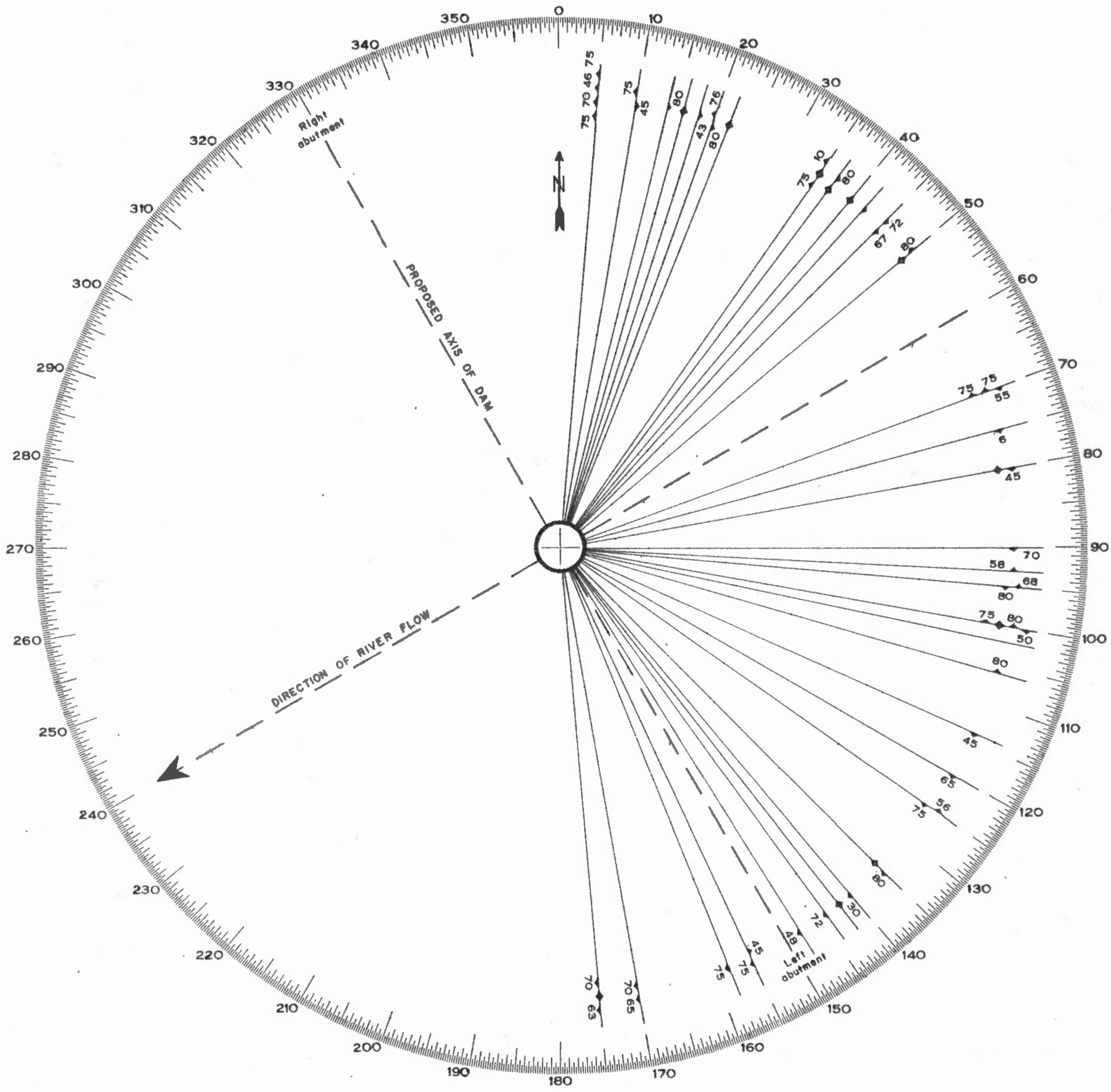
Bedrock exposed at Granite Canyon dam site consists of medium- to coarse-grained, grey granodiorite which in places has a greenish tinge due to the alteration of the feldspars to epidote. The granodiorite is part of an elongated body of similar rock which extends southeast from the west side of Diamain Lake for a distance of more than 16 miles. It intersects Pelly River at Granite Canyon at close to right angles.

The granodiorite is a massive, competent rock. The absence of glaciation during the last ice advance has resulted in the development in some places of up to 2 feet of clayey residual soil on the rock surface. This is most common on the left or south-facing abutment. Beneath the weathered material, however, the rock is sound.

Numerous, irregular veins of white quartz up to 6 inches in width occur in the granodiorite. These would not affect the competency of the rock.

Bedrock Structures

Jointing is common in the granodiorite exposed at Granite Canyon dam site. Although the altitudes are unusually irregular there are 3 sets to which most of the joints can be assigned. One set strikes from 5 to 20 degrees east of north and dips steeply east and west. A second set which closely parallels the river strikes from 35 to 50 degrees east of north and dips steeply into both abutments. The third set intersects the river close to right angles. It strikes from 20 to 33 degrees east of south and dips



JOINT ROSETTE

The above illustration presents diagrammatically the direction and dip of jointing in bedrock exposed at Granite Canyon dam site downstream at angles varying from 48 to 75 degrees. A local set of flat joints evenly spaced at about 12 inches occurs at the foot of the right wall of the canyon near the proposed centre line. The intersection of these joints with a vertical set at 90 degrees to the river gives the face of the rock a distinctive blocky appearance. Sheet jointing which commonly developes parallel to the exposed surfaces of igneous rocks was not observed at Granite Canyon dam site. There is no indication of any movement along or parallel to the jointing. The major movement has been at right angles to the surface of the fracture.

Single joints can frequently be traced on bedrock surface for distances up to 150 feet. Open fractures associated with them range up to 12 inches in width. Many of the larger rock fragments in the talus have broken off along the joint set parallel to the river.

The jointing is the only structure which could affect the competency of bedrock. Test borings will be needed to determine if the joints decrease in number from surface downward and also the depths to which the open fractures extend. The intensity of the jointing present at the dam site will probably result in grouting being necessary to consolidate the rock.

Quality of Bedrock

The granodiorite exposed at Granite Canyon dam site is a competent rock and should provide satisfactory abutment and foundation material. Jointing is the only structure present which could lower the competency of the rock mass. The rock is not of the soluble type and there should be no solution cavities present which could cause excessive leakage.

Engineering Considerations

Depth of Overburden

Most of the overburden in the dam site area consists of glacio-fluvial sand and gravel which directly overlie bedrock. The several terraces on the sides of the canyon are believed to reflect bedrock surface and the overburden on them to be relatively thin. Seismic line No. 1 is located on the second highest terrace in the dam site area (1,915 feet). Here the thickness of the overburden on the terrace which is located in the upstream part of the left abutment area was calculated to be 12 feet. This figure is no doubt correct; it is also believed to be a close approximation of the thickness of the overburden covering the other terraces in the site area. The depths of 94 and 117 feet obtained from seismic line No. 2 located on the right abutment appear to be excessive and should be checked by test borings.

The thickness of the alluvium underlying Pelly River at the site is probably somewhat greater than at Detour and Hoole Canyon sites. There are no bedrock exposures in the river in the site area but some do exist further downstream at the lower end of the canyon. It is estimated the thickness of the alluvium is in the order of 25 to 30 feet.

Abutments and Foundations

With the possible exception of the upper parts of the abutments all the structures for the proposed dam will be founded on bedrock. Test borings will be required to determine how much of each abutment will consist of overburden. The glacio-fluvial sand and gravel exposed on the abutments are permeable and would introduce a seepage problem if used as abutment material. A cut-off trench back-filled with impervious materials may be necessary in these areas.

Bedrock at the dam site is resistant to disintegration and erosion and should provide suitable foundation material. However, there are 2 sets of joints present in the rock which may have some effect upon the design and construction of the project. The dip of the joint set parallel to the river is such as to cause one or both abutments to be unstable when excavated, especially if undercut. The presence of this jointing in the abutments could also decrease the ability of the rock to take the thrust of an arch dam. Another joint set strikes across the river and dips downstream. These joints could decrease the shear resistance of the foundation rock to the horizontal thrust of the dam.

The presence of large quantities of groundwater and the blocky condition of the rock would be the two chief problems involved in driving diversion tunnels through bedrock in the abutments. Both these are due to the jointing. Test borings should be put down along the line of the tunnels to depths at least 35 feet beneath their floor. The purpose of the borings would be to determine if the rock in the vicinity of the tunnels is tight. Permeability tests should be conducted in each boring.

Proposed Location of the Dam

The granitic rocks occurring at the upstream end of Granite Canyon are the most competent rocks exposed in the canyon. Consequently this area was selected for the site of the proposed power project.

Construction Materials

Aggregate

The coarse-grained, glacio-fluvial gravel exposed on the upper parts of the abutment slopes may provide satisfactory aggregate. A sample of the material was not taken. There were no cut banks in the site area where fresh material was exposed and in a preliminary survey of this type where time was limited it would have taken too long to dig test pits sufficiently deep to obtain a representative sample of the fresh material. The material down to about 3 feet beneath ground surface was highly weathered, dirty and contained numerous boulders, chiefly of quartzite and granite, up to 24 inches in diameter. The surfaces of many of the granitic boulders were soft and weathered. The quality of the gravel and the quantity available should be thoroughly investigated before any decision is made regarding its use. Especially when it is probable that in some places the deposit forms only a thin veneer over bedrock.

A sample (No. 7) was taken of the fine-grained sand which overlies the gravel on a terrace on the right abutment. It was thought the sand might be useful as blending material in aggregate. A grain size analyses of the material indicates only about 40 per cent consists of sand-size particles. This is considerably lower than that estimated in the field.

A sample (No. 6) was taken of a tightly cemented, sandy gravel exposed in a 75-foot bluff located on the right side of Pelly River about a mile upstream from the site. It was not possible to obtain a grain size curve of this material. To attempt to do so would have required crushing and consequent destruction of the natural particle size.

Considerable gravel is exposed in cut banks along both sides of Pelly River between the dam site and the community of Pelly Crossing some 25 miles downstream. Sample No. 10 taken from a 30-foot bluff situated on the right side of the river some 17 miles downstream is representative of this material. It could probably be processed to produce suitable aggregate. The deposit is readily accessible and the quantity of material available is unlimited. Suitable aggregate could be obtained by crushing bedrock exposed at the site. This, however, would be a relatively expensive process as the rock, especially the finer-grained type at the upstream end of the site area, is hard and dense.

Pervious Material

Pervious materials required for construction of an earth dam could be obtained by processing the better quality gravel described in the section under aggregate. There are unlimited quantities available.

Impervious Material

Most visible deposits of potential impervious material are located upstream from the dam site in the reservoir area. Three (Nos. 5, 8 and 9) of these deposits were sampled and as well a sample (No. 11) was taken from a deposit located some 22 miles downstream from the site. Descriptions of these materials as well as grain size analyses curves and some index properties are included at the end of this report. The most satisfactory material consists of a dense, silty, sandy till (sample (No. 5) exposed in a 200-foot bluff about one mile upstream from the site. The deposit is readily accessible from the site and there is an unlimited quantity available.

Riprap and Rock Fill

Riprap and rock fill that should satisfy the requirements of the project can be obtained from bedrock exposed at the site. The rock is tough and durable with a specific gravity in the order of 2.70. The size and shape of the rock fragments will depend upon the spacing of the jointing in the rock outcrops as the rock will probably break along these fractures when excavated. The joint spacing varies from a few inches to several feet. In general the spacing is closer in the upstream part of the site area and further apart in the downstream section.

Groundwater

Two springs exist in the dam site area; both are located in the downstream part of the right abutment. One spring occurs on the floor of the deeply incised valley of Diamain Creek about 200 feet north of and 70 feet above Pelly River. The other is about 600 feet upstream from the creek and 550 feet north of the river. This spring is about 125 feet above the river. At the time of the investigation Diamain Creek which drains Diamain Lake 2 miles north was completely dry.

Samples of the spring water taken on July 19, 1965 were analysed by the Industrial Waters Section, Mines Branch, Department of Mines and Technical Surveys, Ottawa.

The mineral content of the water from the two springs is similar. The chief mineralization consists of bicarbonate salts of calcium and magnesium; the sulphate content in both is low. The low mineral content of the groundwater indicates the recharge area is close, probably on the extensive gravel-covered terrace which extends north from the top of the abutment. It is improbable the spring in the valley of Diamain Creek is the result of subsurface drainage from Diamain Lake.

Frozen Soil

Frozen soil was encountered only on the low, alluvium-covered terrace on the upstream part of the left abutment. On July 25, 1965 the frost line existed at depths of 12 to 18 inches beneath ground surface. The depths to the frozen material depended upon the thickness of the overlying layer of moss and decayed organic material. In places where the thickness of the organic material exceeded 24 inches the frost line was at about 12 inches whereas in other localities where there was little or no organic material the frozen soil was deeper or was not encountered in test pits dug to 36 inches. Samples of the frozen soil were not taken at Granite Canyon dam site. However similar materials were sampled further downstream in the vicinity of Pelly Crossing. These were all taken from places that lie within the reservoirs of the proposed dams at Bradens Canyon and Gerc. The samples were taken by driving BX casing or a 2-inch, O.D. split tube with a 10-pound sledge hammer. Descriptions of the frozen material and grain size analyses curves are included on the following pages.

Frozen Soil Classification Chart

Sample No.	% passing #4	% passing #200	%Co	%F	%G	%S	D10	D30	D60	Cu	Cd	L.L.	P.L.	P.I.	Group* Symbol
1	100	69.0	31.0	69.0	0.0	31.0	.0056	.029	.063		Non-	plastic			ML
2	100	75.0	25.0	75.0	0.0	25.0	.0090	.030	.056		"	"			ML
3	100	85.0	15.0	85.0	0.0	15.0	.0080	.023	.042		"	"			ML
4	100	90.0	10.0	90.0	0.0	10.0	-	.0070	.019		"	"			ML
5	98.5	78.0	22.0	78.0	1.5	20.5	-	.0045	.017		"	"			ML
6	100	94.0	6.0	94.0	0.0	6.0	-	-	-		"	32.1	24.0	8.1	ML
7	100	99.0	1.0	99.0	0.0	1.0	-	.0078	.022		Non-	plastic			ML
8		Not	sufficient		sample	for Analysis									
9	71.0	24.0	76.0	24.0	29.0	47.0	-	.025	2.7		"	"			ML
10	100	97.0	3.0	97.0	0.0	3.0	-	.0095	.028		"	"			ML
11	100	94.0	6.0	94.0	0.0	6.0	-	.010	.021		"	"			ML

*Unified Soil Classification System

Description of Frozen Soil

Pit No.	Location	Sample No.	Depth (in inches)	Description	Group Symbol	Moisture Content*	Visible Ice	Log of test pit (in inches)
1	On level terrace along left side of Pelly River, 6 miles upstream from Pelly Crossing, 100 feet from river, 20 feet above river	1	30 - 37	Silt: fine-grained, sandy, alluvial, non-plastic, not weathered, no pebbles	ML	45.8%	None	0- 8 = moss 8-24 = silt as in samples at 24= frost line 24-44 = silt as in samples
		2	38 - 44	" "	ML	46.6%	None	
2	On level terrace along left side of Pelly River, 6 miles upstream from Pelly Crossing, 25 feet from river, 15 feet above river	3	39 - 47	Silt: minor fine-grained sand, alluvial, non-plastic, not weathered, no pebbles	ML	25.1%	None	0- 4 = moss and decayed organic material 4-30 = silt as in sample at 30= frost line 30-47 = silt as in sample N.B. Temperature at 46 inches = 31°F. Temperature of air = 67°F. (August 12, 1965)

*Unified Soil Classification System

Description of Frozen Soil

Pit No.	Location	Sample No.	Depth (in inches)	Description	Group* Symbol	Moisture Content	Visible Ice	Log of test pit (in inches)
3	On level terrace along left side of Pelly River, 1 mile downstream from Pelly Crossing, 100 feet from river, 30 feet above river	4	22 - 26	Till: silty, minor sand, dense, grey, subrounded boulders to 12 inches. Samples are of the fine material in the till	ML	107.1%	About 25%, lenses to 1 inch	0- 8 = moss 8-16 = organic material at 16= frost line 16-22 = organic material 22-39 = Till
		5	26 - 33		ML	52.7%	"	
		6	33 - 39		ML	48.6%	"	
4	On level terrace along left side of Pelly River, 3 miles downstream from Pelly Crossing, 75 feet from river, 25 feet above river	7	32 - 38	Silt: alluvial, non-plastic, no pebbles, not weathered	ML	14.8%	None	0-10 = moss and organic material 10-18 = silt as in sample No. 7 at 18= frost line 18-38 = silt as in sample No. 7 38-43 = sand as in sample No. 8 N.B. 10 miles upstream from Bradens Canyon
		8	38 - 43	Sand: gravelly, silty, alluvial	SM	32.2%	10%, clear ice to ¼ inch	

*Unified Soil Classification System

Description of Frozen Soil

Pit No.	Location	Sample No.	Depth (in inches)	Description	Group Symbol*	Moisture Content	Visible Ice	Log of test pit (in inches)
5	On level terrace along left side of Pelly River, 8 miles downstream from Pelly Crossing, 100 feet from river, 40 feet above river	9	30 - 36	Sand: gravelly, silty, alluvial	SM	32.2%	10% as clear ice to ¼ inch	0- 6 = moss 6-19 = organic material at 19= frost line 19-30 = organic material 30-36 = sand as in sample No. 9 N.B. 6 miles upstream from Bradens Canyon
6	On level terrace along right side of Pelly River, 13 miles downstream from Pelly Crossing, 300 feet from river, 20 feet above river	10	32 - 42	Silt: minor fine-grained sand, non-plastic, no pebbles, not weathered	ML	40.2%	None	0- 5 = moss 5-31 = silt as in sample No. 10 at 31= frost line 31-42 = silt as in sample No. 10 N.B. at upstream end of Gerc dam site

*Unified Soil Classification System

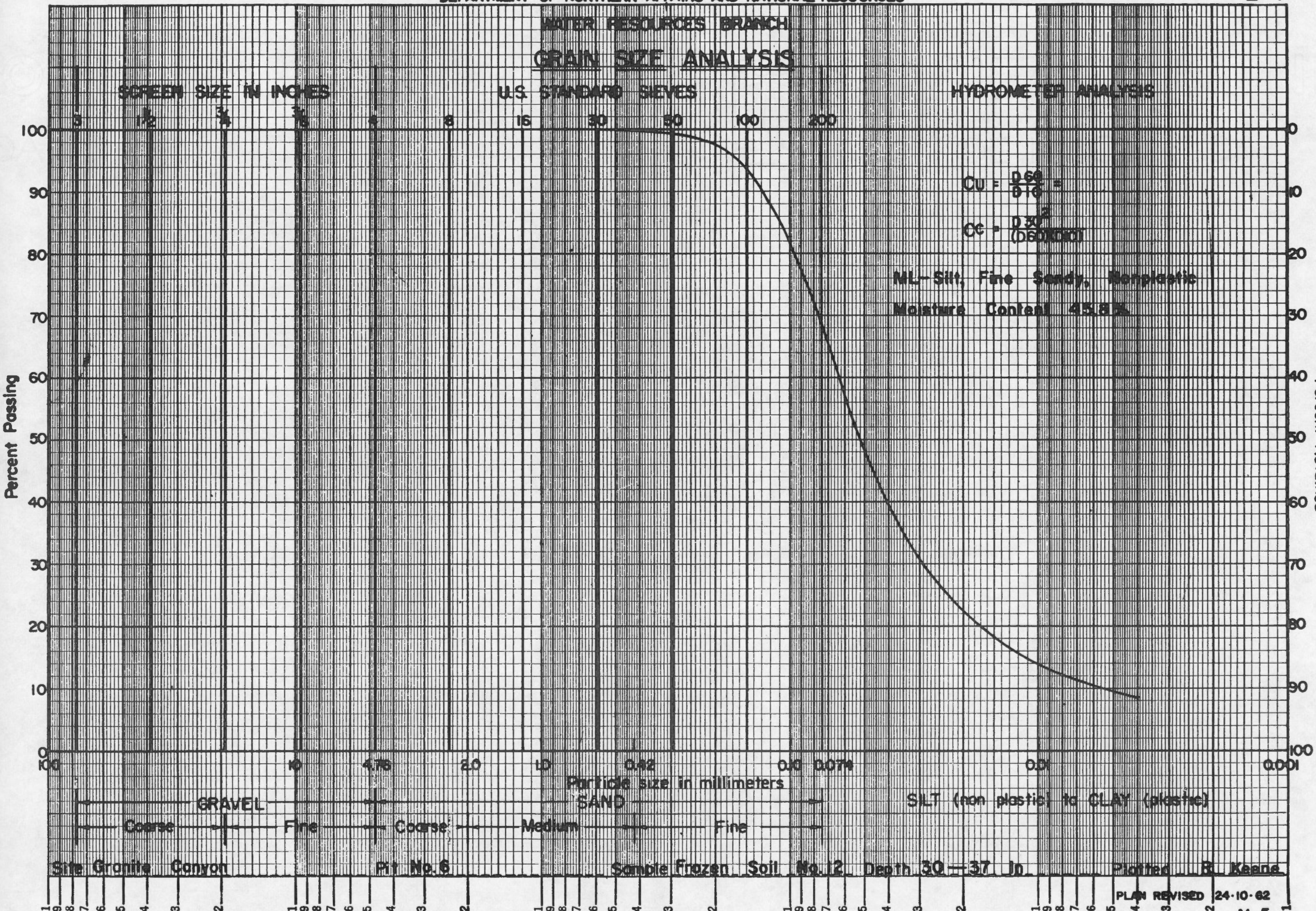
Description of Frozen Soil

Pit No.	Location	Sample No.	Depth (in inches)	Description	Group* Symbol	Moisture Content	Visible Ice	Log of test pit (in inches)
7	On level terrace along left side of Pelly River, 10 miles down-stream from Pelly Crossing, 150 feet from river, 20 feet above river	11	23 - 32	Silt: minor fine-grained sand, non-plastic, no pebbles, not weathered	ML	100.0%	10% as clear ice to $\frac{1}{4}$ inch	0-10 = moss 10-16 = silt as in sample No. 11 at 16= frost line 16-32 = silt as in sample No. 11

*Unified Soil Classification System

L-7

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES



M-5

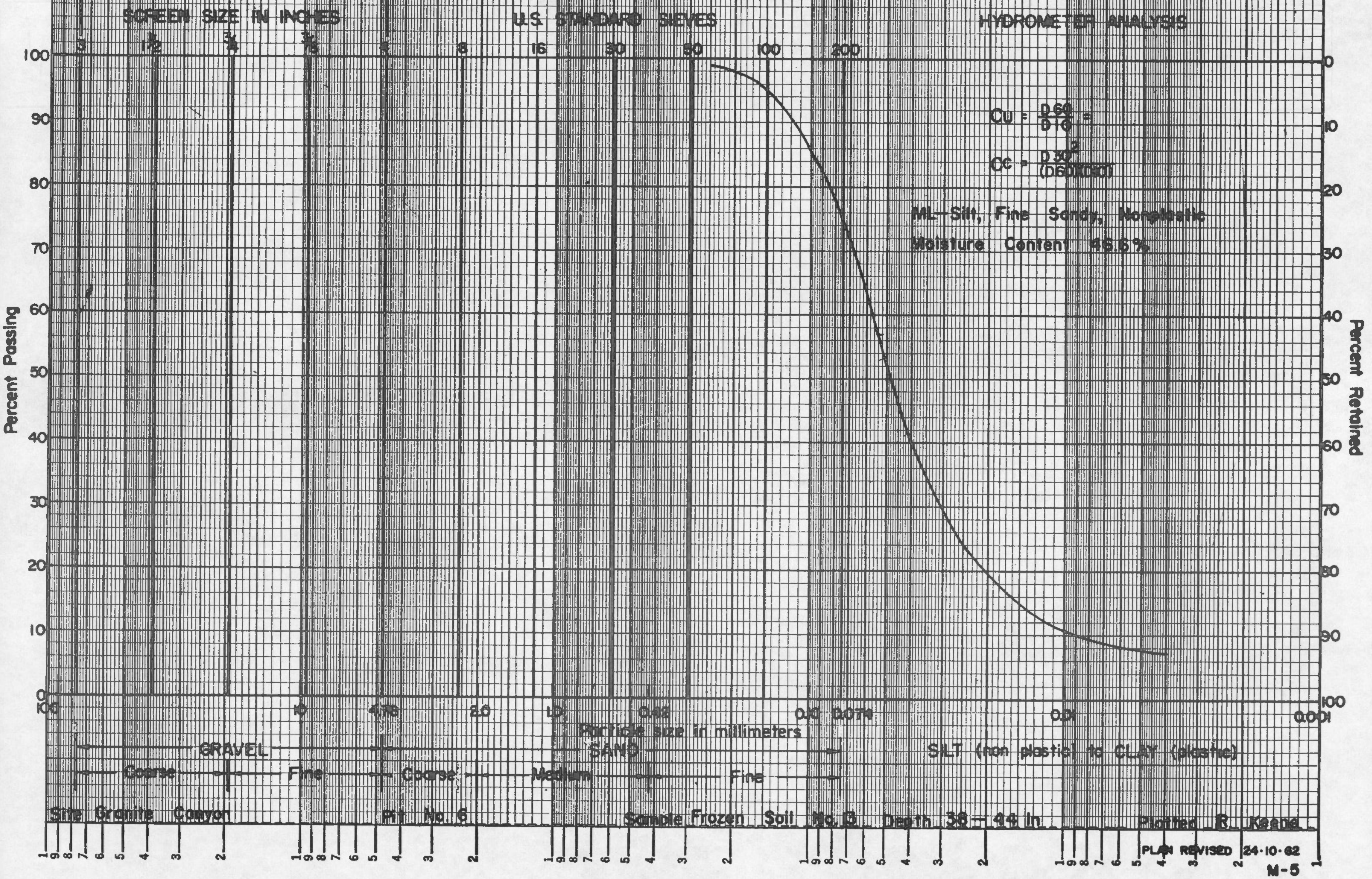
K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

L-7

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



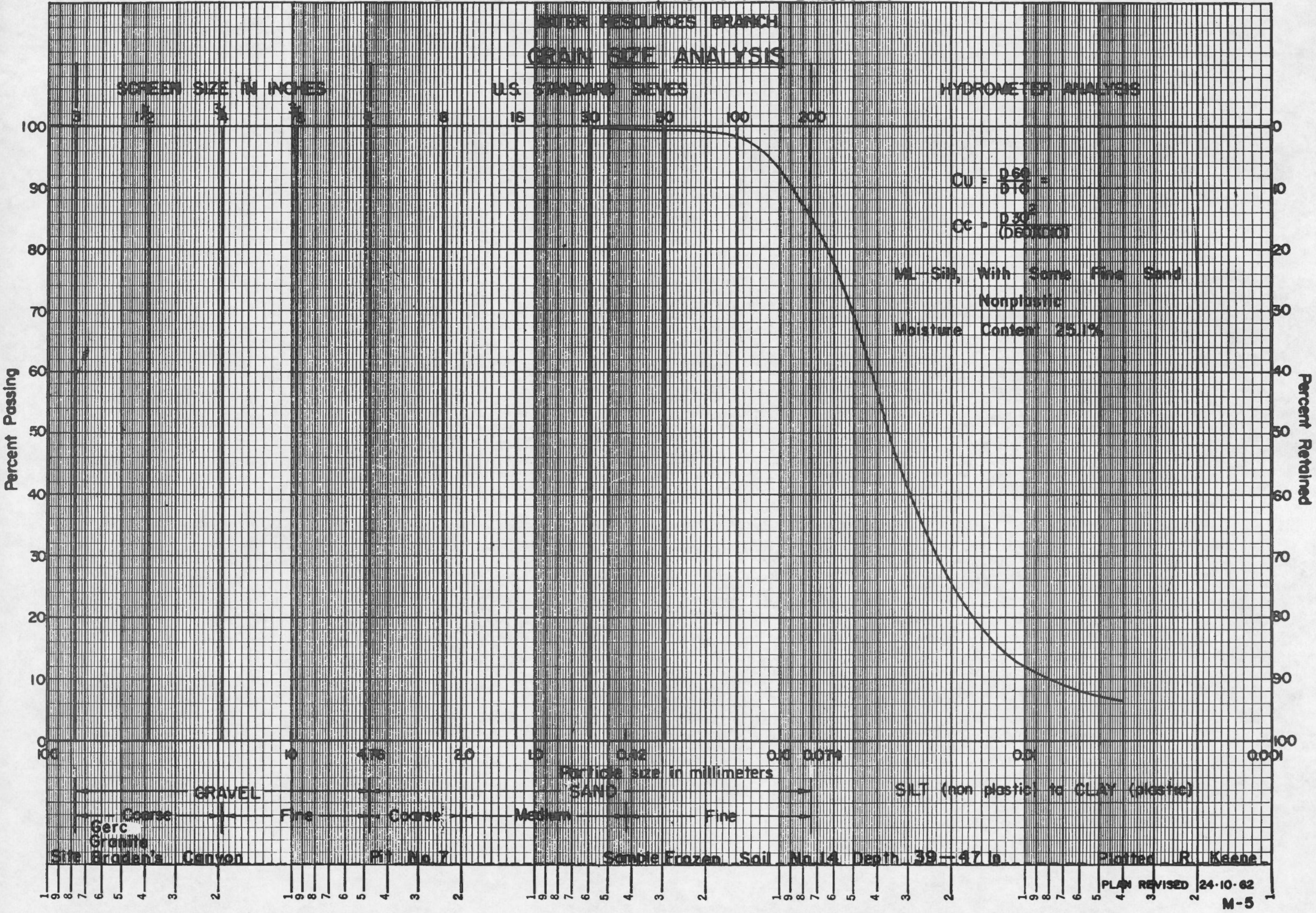
K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

L-7

WATER RESOURCES BRANCH

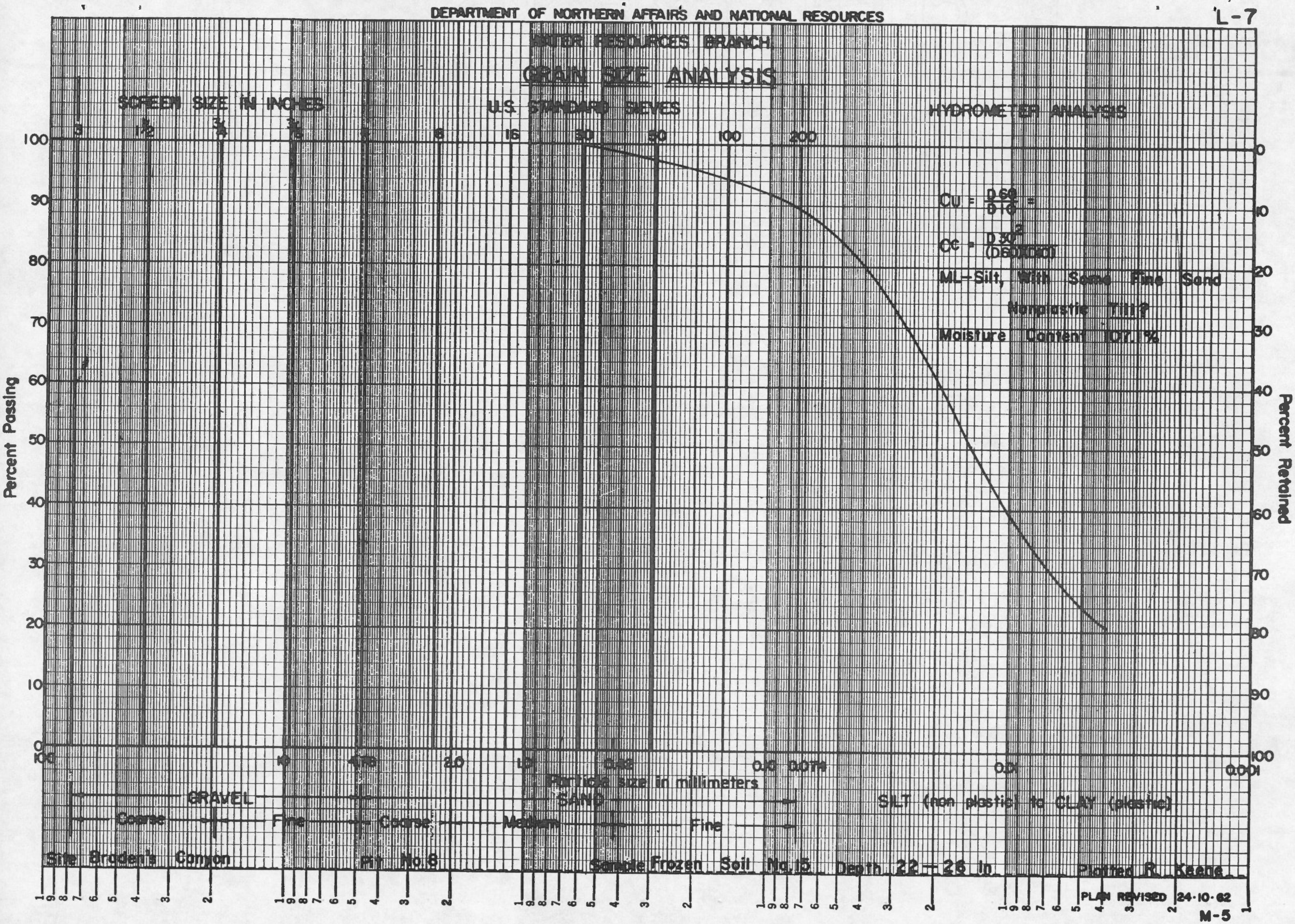
GRAIN SIZE ANALYSIS



PLAN REVISED 24·10·62

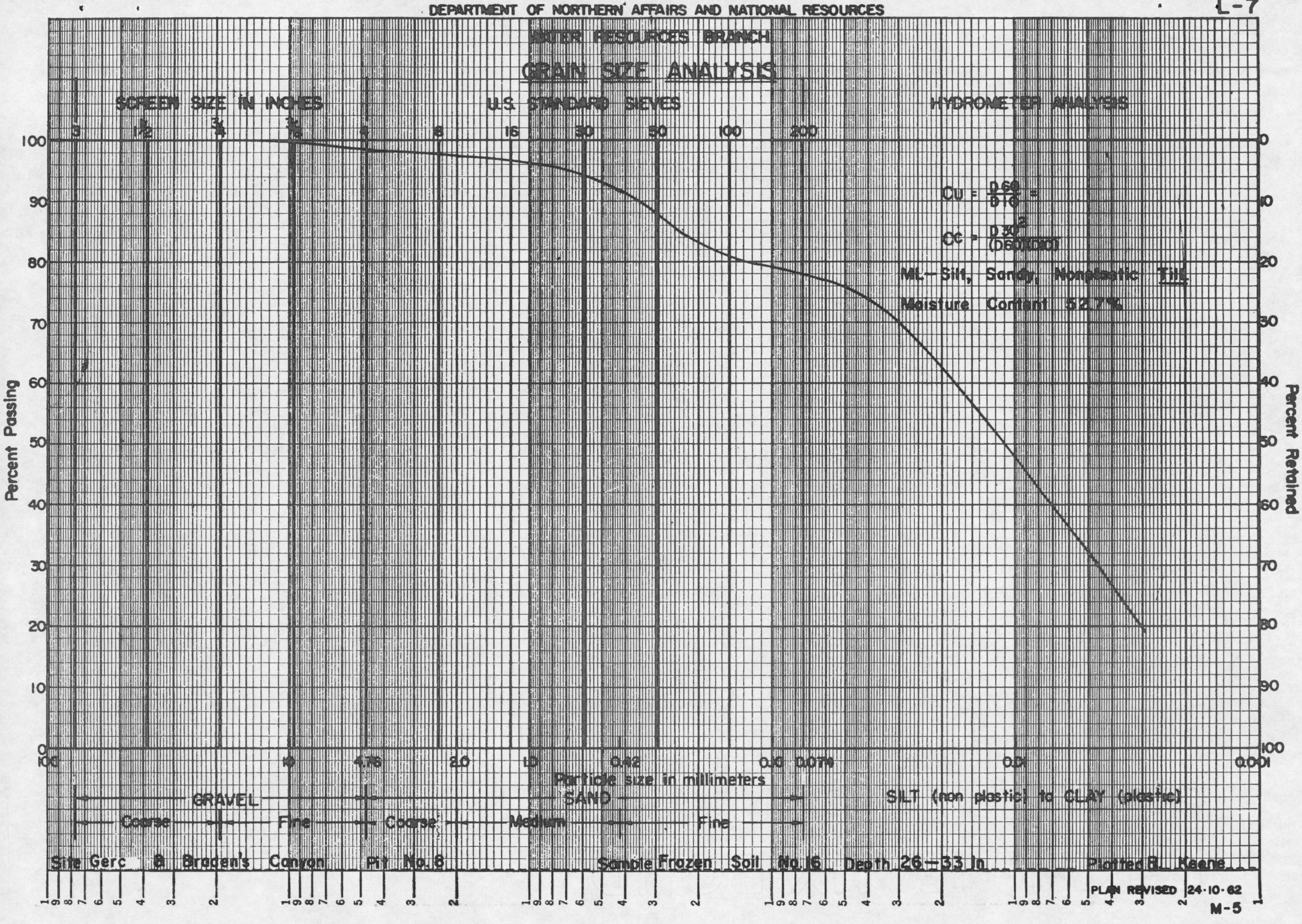
M-5

K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

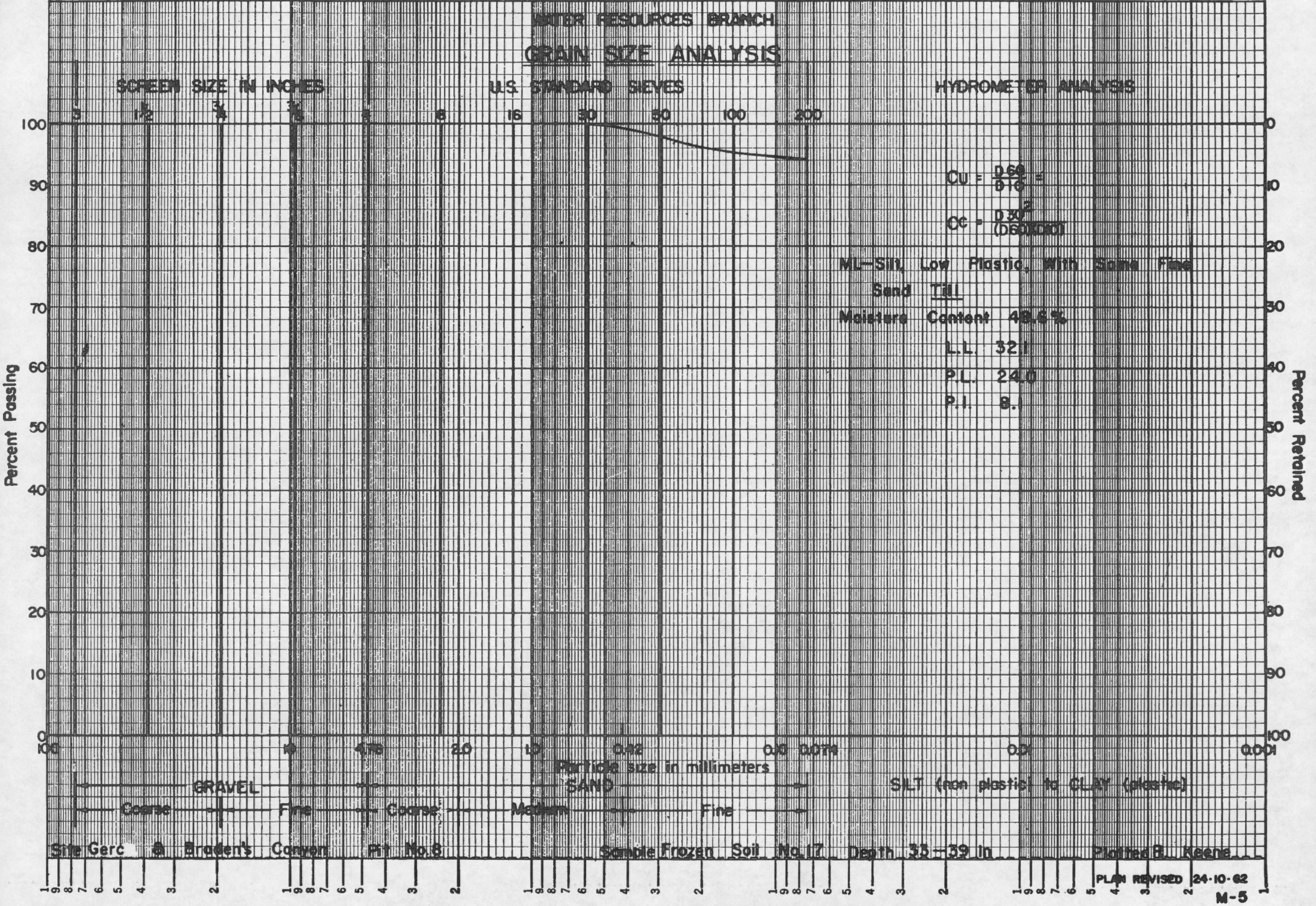


K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

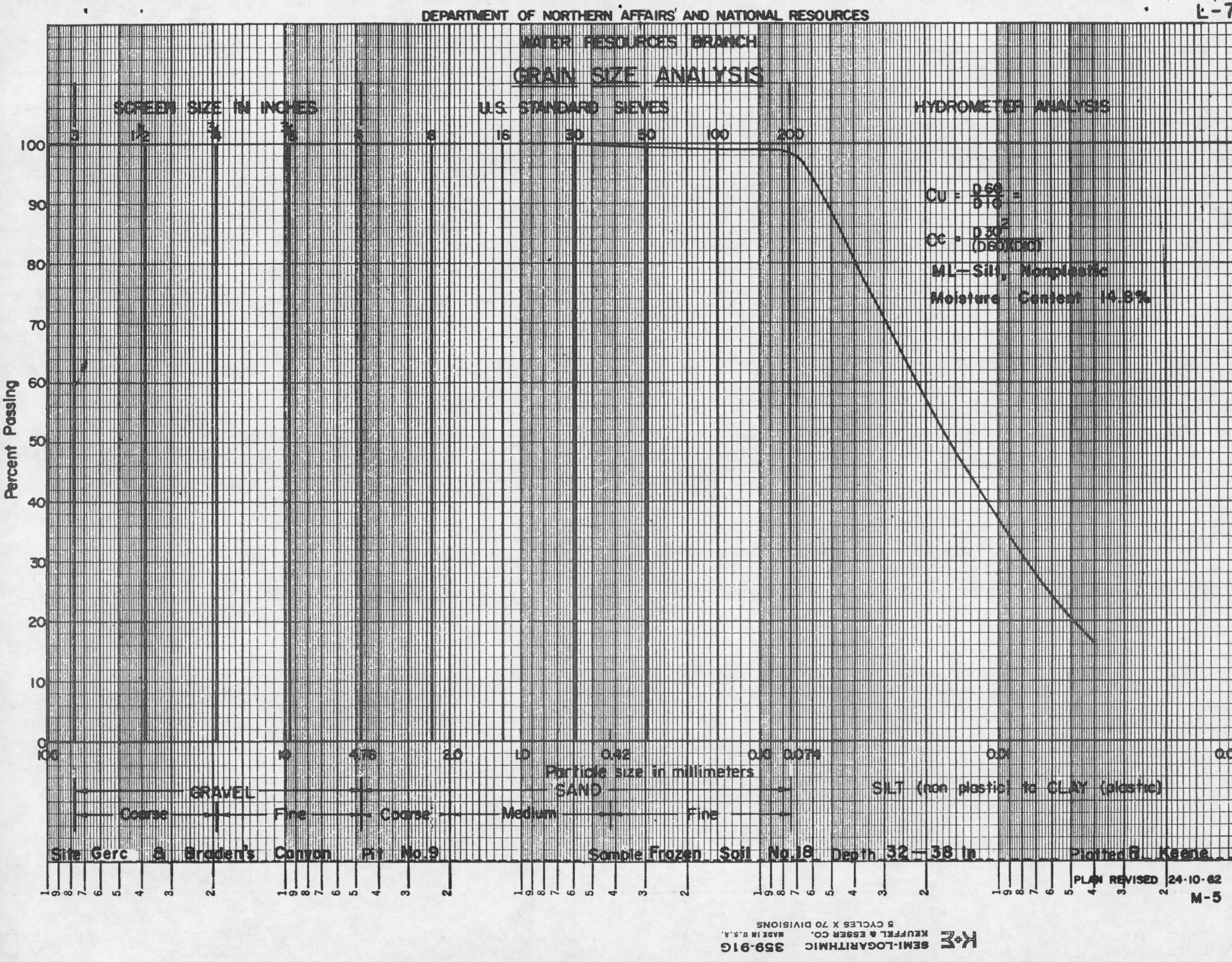
L-7


DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
WATER RESOURCES BRANCH
GRAIN SIZE ANALYSIS
SCREEN SIZE IN INCHES
U.S. STANDARD SIEVES
HYDROMETER ANALYSIS
3
1½
¾
⅜
4
8
16
30
50
100
200
Percent Passing
Percent Retained
$Cu = \frac{D60}{D10} =$
$Cc = \frac{D30^2}{(D60)(D10)}$
ML – Silt, Sandy, Nonplastic Till
Moisture Content 52.7%
100
10
4.76
2.0
1.0
0.42
0.10
0.074
0.01
0.001
Particle size in millimeters
GRAVEL
SAND
SILT (non plastic) to CLAY (plastic)
Coarse
Fine
Coarse
Medium
Fine
Site Gerc & Braden's Canyon
Pit No. 8
Sample Frozen
Soil No. 16
Depth 26 – 33 In.
Plotted B. Keene
PLAN REVISED 24·10·62
M-5
K&E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES



K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

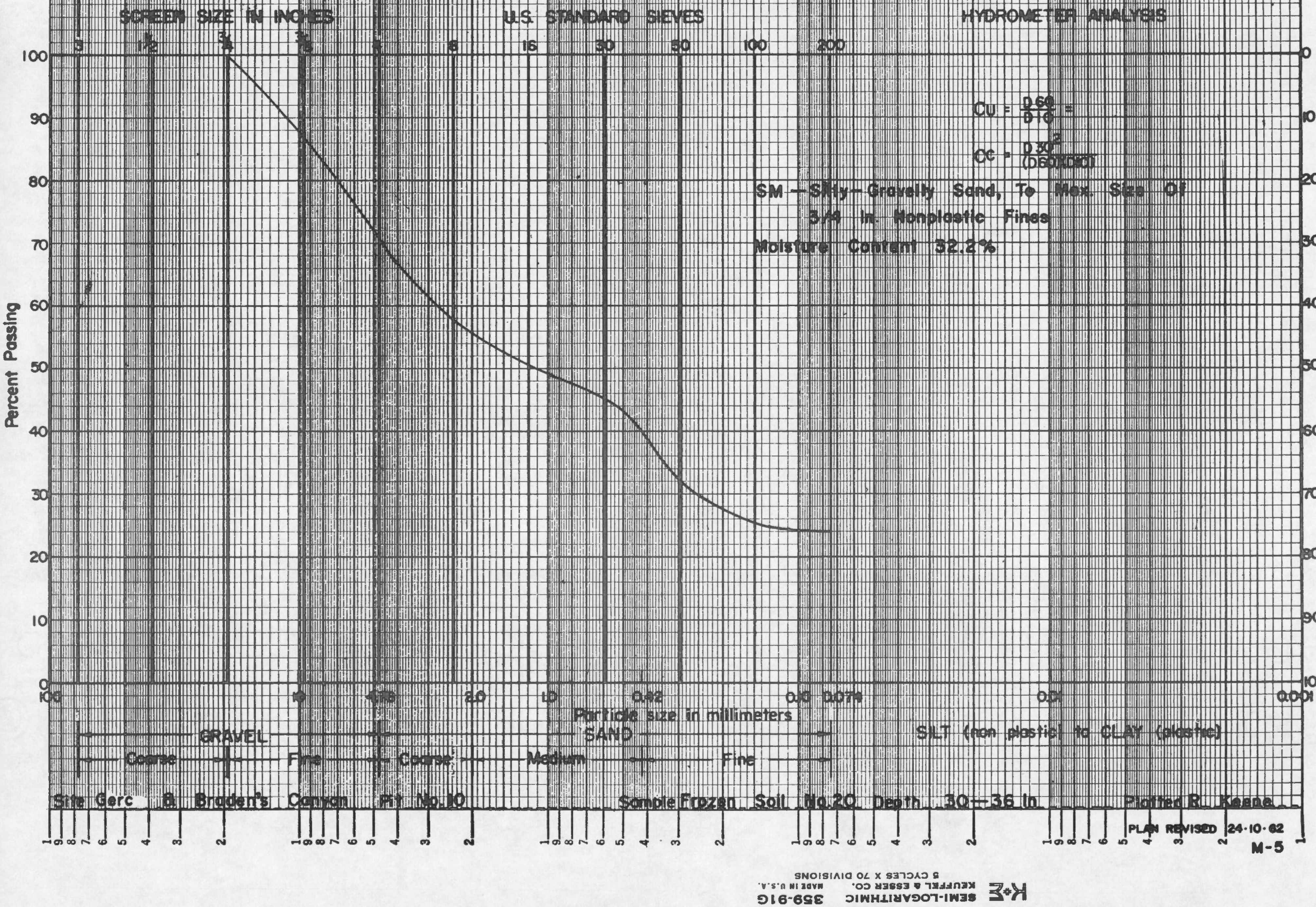

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
WATER RESOURCES BRANCH
GRAIN SIZE ANALYSIS
SCREEN SIZE IN INCHES
U.S. STANDARD SIEVES
HYDROMETER ANALYSIS
Cu = D60/D10 =
Cc = D30²/(D60)(D10)
ML—Silt, Nonplastic
Moisture Content 14.8%
Percent Passing
Percent Retained
Particle size in millimeters
GRAVEL
SAND
SILT (non plastic) to CLAY (plastic)
Coarse
Fine
Coarse
Medium
Fine
Site Gerc & Braden's Canyon Pit No.9 Sample Frozen Soil No.18 Depth 32—38 in Plotted R. Keene
PLAN REVISED 24·10·62
M-5
K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

L-7

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

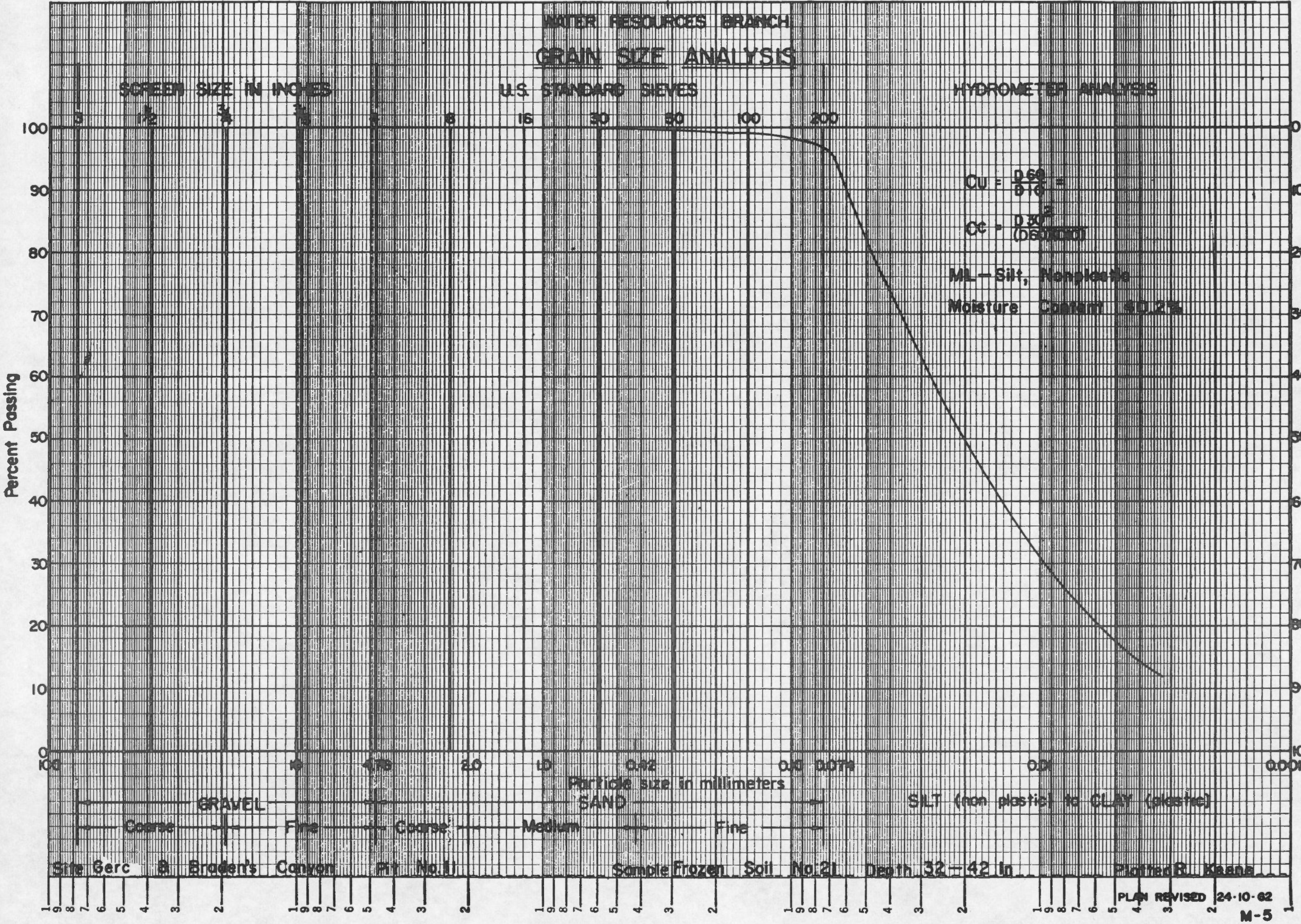
WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



L-7

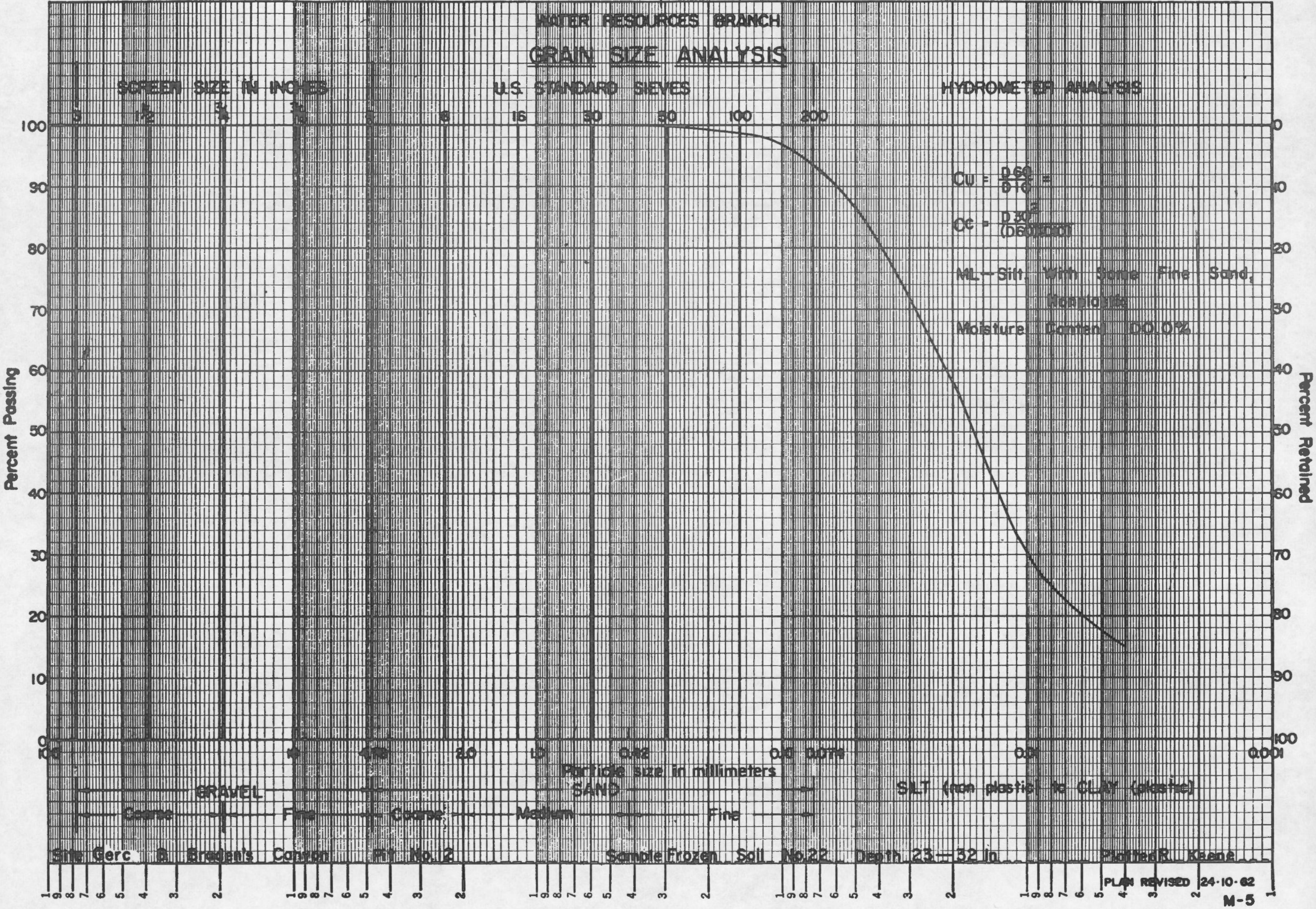
DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES



K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

L-7

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES



K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

Chemical Analysis of Pelly River Water

On July 18, 1965 a sample was taken of Pelly River water from the centre of the river at Granite Canyon and send to the Industrial Waters Section, Mines Branch, Department of Mines and Technical Surveys, Ottawa for chemical analysis. The results of the analysis indicate there is little difference between the mineral content of the water at Granite Canyon and Detour some 81 miles upstream. Bicarbonate salts of calcium and magnesium constitute the chief mineralization. The concrete and other exposed parts of the dam structures would not be harmed by any of the salts present in the water. The results of the analysis as well as the analyses of the water from 2 springs in the right abutment are included on the following page.

Chemical Analyses of Pelly River water and Groundwater at Granite Canyon dam site
(parts per million)

Location	Date	Discharge	pH	SiO_2	Ca	Mg	Na	K	Fe	CO_3	HCO_3	SO_4	Cl	F	NO_3	Turbidity	Hardness as $CaCO_3$
Pelly River, centre of river, 12 inches below surface of water	July 18, 1965	Low Temp. 61°F.	7.7	5.6	31.1	9.1	1.6	0.7	0.51	0	99.0	32.4	0.3	0.19	0	2.5	115
Spring, right abutment, in valley of Diamain Creek, 200 feet from river, 70 feet above river	July 19, 1965	Temp. 44.5°F.	7.5	6.4	28.8	8.3	3.2	1.7	0.01	0	123.0	9.5	0.6	0.30	2.4	0	106
Spring, right abutment, 600 feet upstream from Diamain Creek, 550 feet from river, 125 feet above river	July 19, 1965	Temp. 45°F.	7.4	7.0	21.4	6.9	2.6	1.5	0.01	0	93.5	10.2	0.5	0.23	0.4	0	81.8

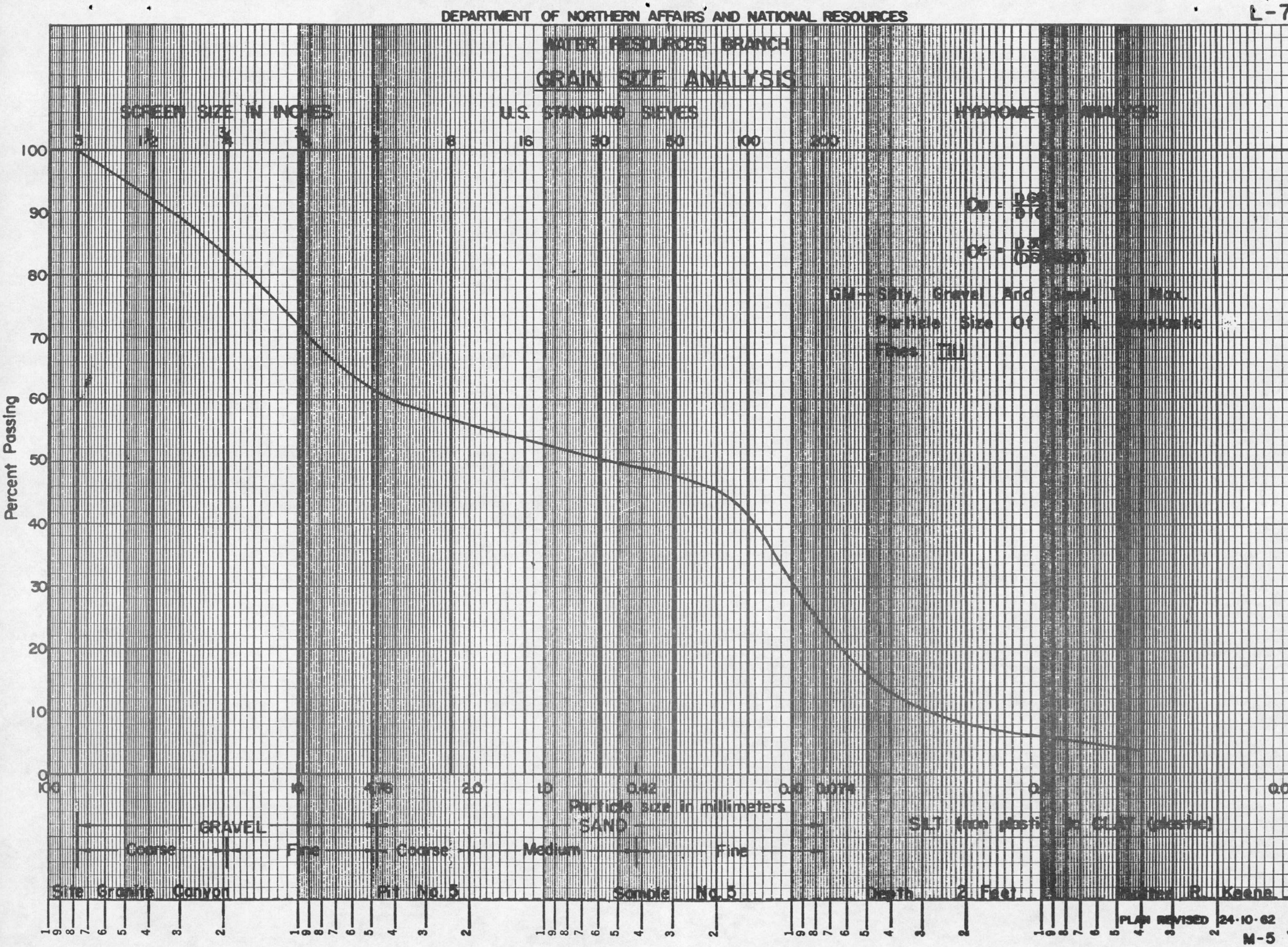
Grain Size Analyses Curves

Six soil samples, each weighing about 35 pounds, of potential construction materials were taken at different localities along Pelly River and sent to the Soils Laboratory of the Water Resources Branch in Vancouver for testing. The grain size analyses curves included in this report were prepared in Vancouver. Five of the soils were sampled as potential impervious material and the other as potential aggregate. Descriptions of the materials are included on the following pages.

Description of Potential Impervious Material for the following Grain Size Analyses Curves

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
5	200-foot bluff along right side of Pelly River, 1 mile upstream from site, 50 feet above river	Till: silty, sandy, grey, dense; many pebbles and cobbles of soft, sericite schist, white quartz and medium-grained, grey granite; a few scattered silt and sand lenses	None	200 feet	Unlimited	Easily accessible from site
7	Right abutment of dam site; downstream shot hole of seismic line No. 2; 6 feet beneath ground surface	Silt: sandy, grey, loose; poorly stratified, non-plastic	None	2-10 feet	Not great, test pitting required	Overlies coarse-grained, glacio-fluvial gravel; upper 18-24 inches badly weathered
8	90-foot bluff along right side of Pelly River, 13 miles upstream from site, 30 feet above river	Till (?): silty, sandy, dense, pebbles and cobbles as in sample No. 5	5 feet of gravel	55 feet	length-2,000 feet width-500 plus feet	Log of bluff where sample taken (in feet) 0- 3 = gravel: coarse-grained, weathered 3- 5 = gravel: as above, not weathered 5-60 = till-like material as in sample 60-75 = interstratified sand and gravel 75-90 = till at 90 = bedrock surface N.B. average height of bluff is 75 feet

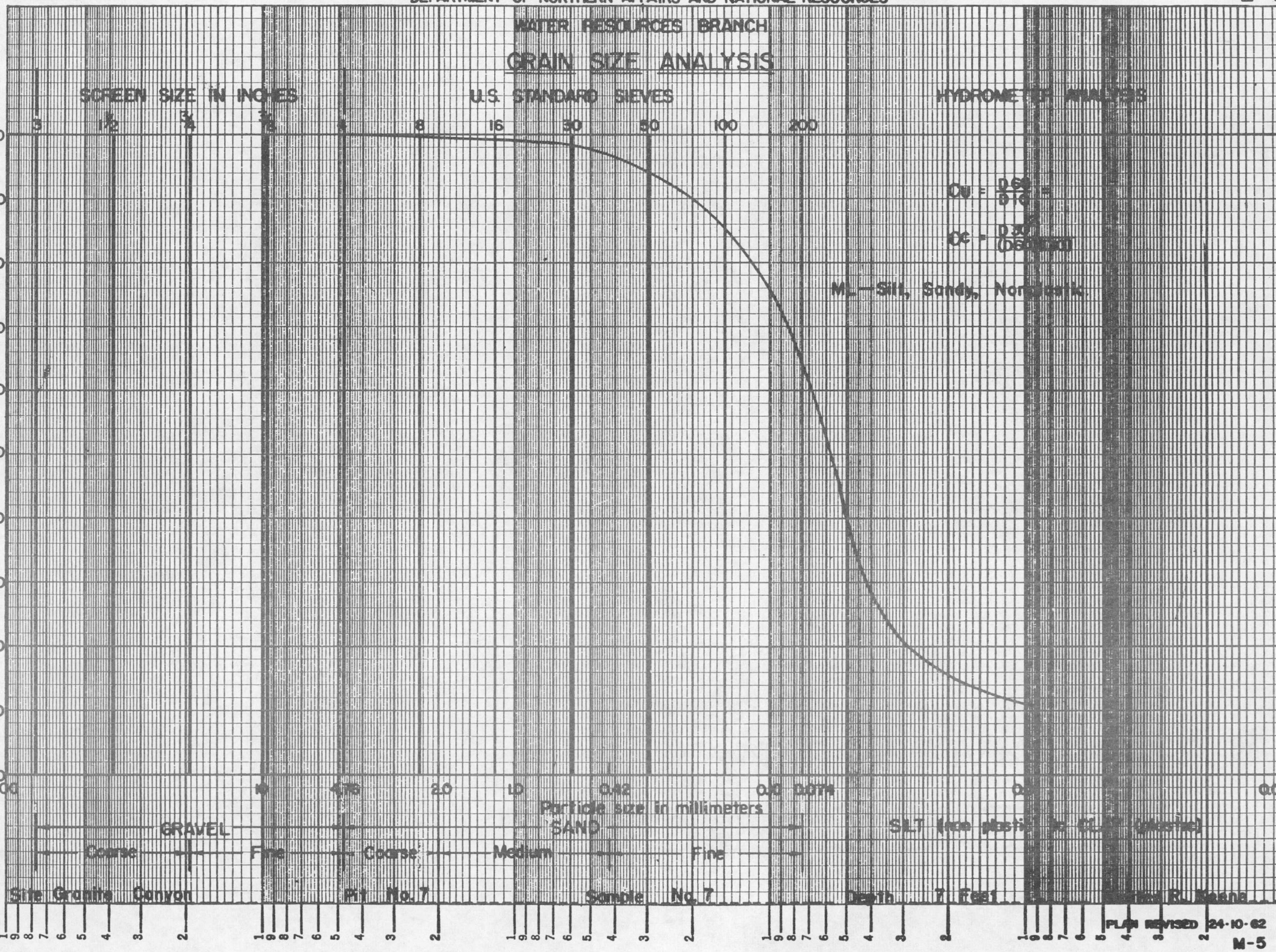
L-7



K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

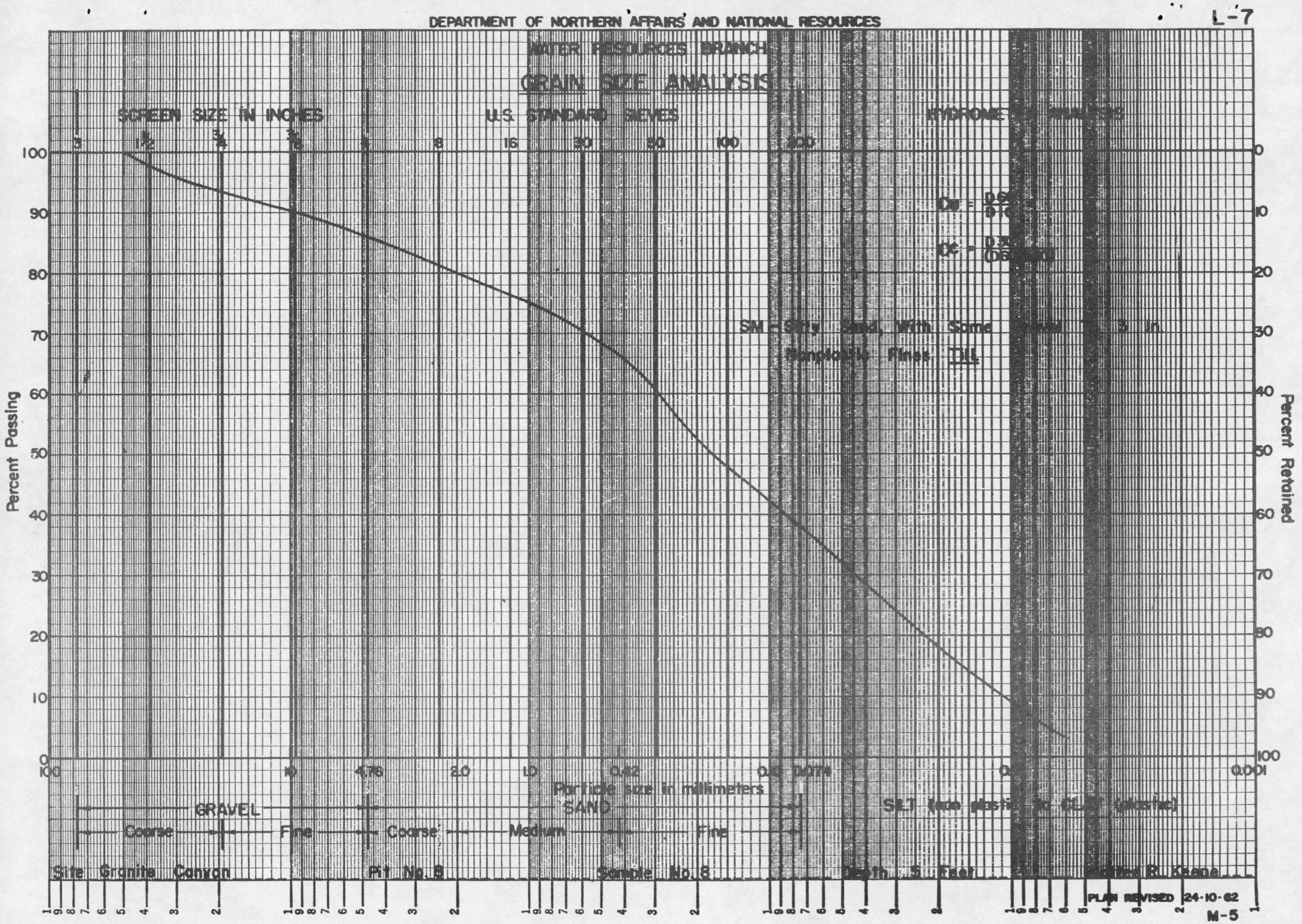
DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

L-7



K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

L-7



K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

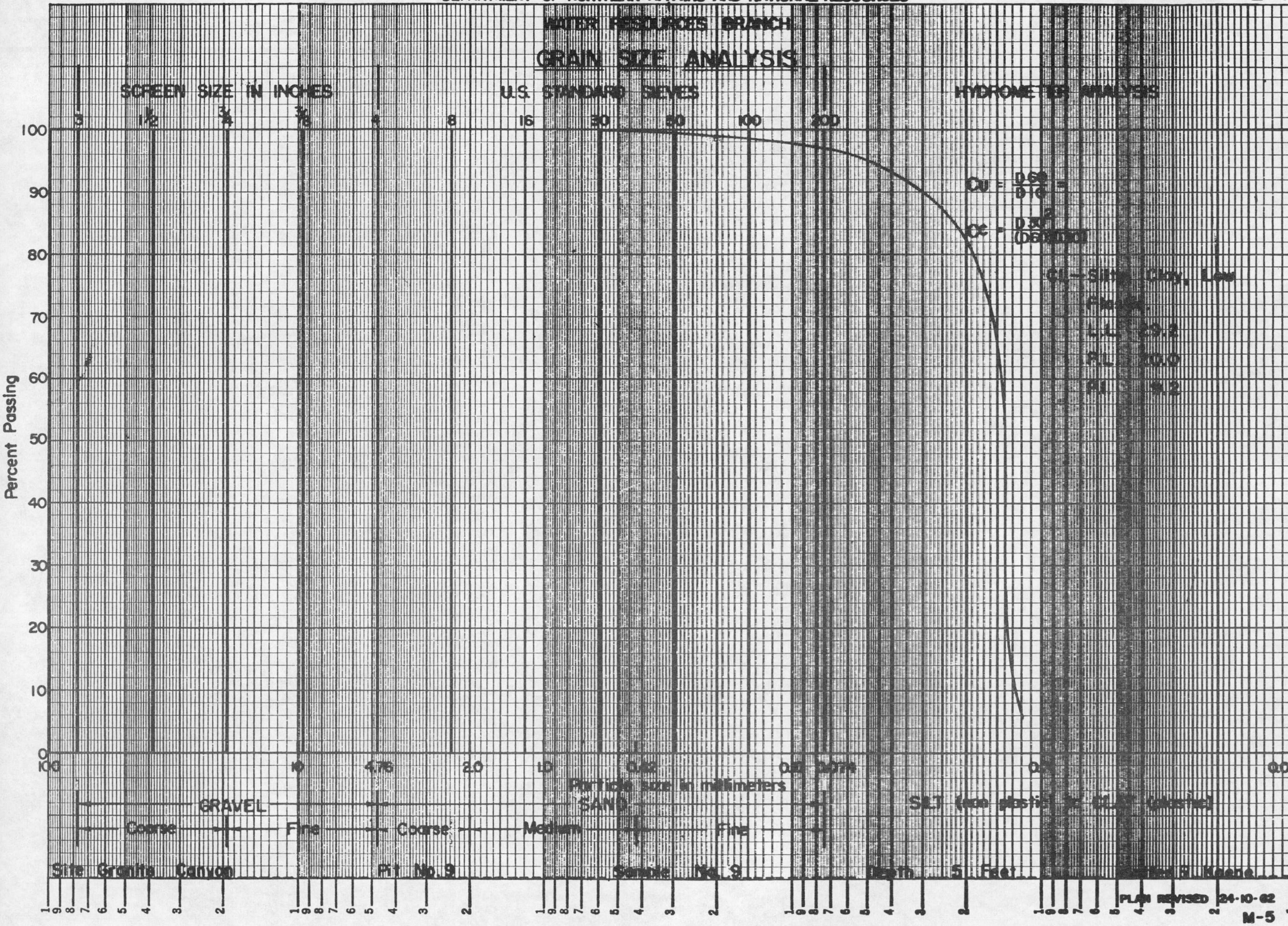
Description of Potential Impervious Material for the following Grain Size Analyses Curves

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
9	100-foot bluff along right side of Pelly River, 10 miles up-stream from site, 60 feet above river, bluff is immediately downstream from mouth of Macmillan River	Silt: clayey, minor sand, stratified, buff-coloured	None	100 feet	Exposed for several miles upstream along MacMillan River; an extensive deposit	A glacio-lacustrine deposit similar to those in places along Yukon River
11	35-foot bluff along right side of Pelly River, 22 miles down-stream from site, 20 feet above river	Till: silty, sandy, grey; subrounded boulders to 12 inches chiefly grey granite; numerous black chert pebbles	8-10 feet of silt	25 feet (average)	Exposed along river for 1,000 feet	Gravel as in potential aggregate sample No. 10 in bluff at both ends of till exposure

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

WATER RESOURCES BRANCH

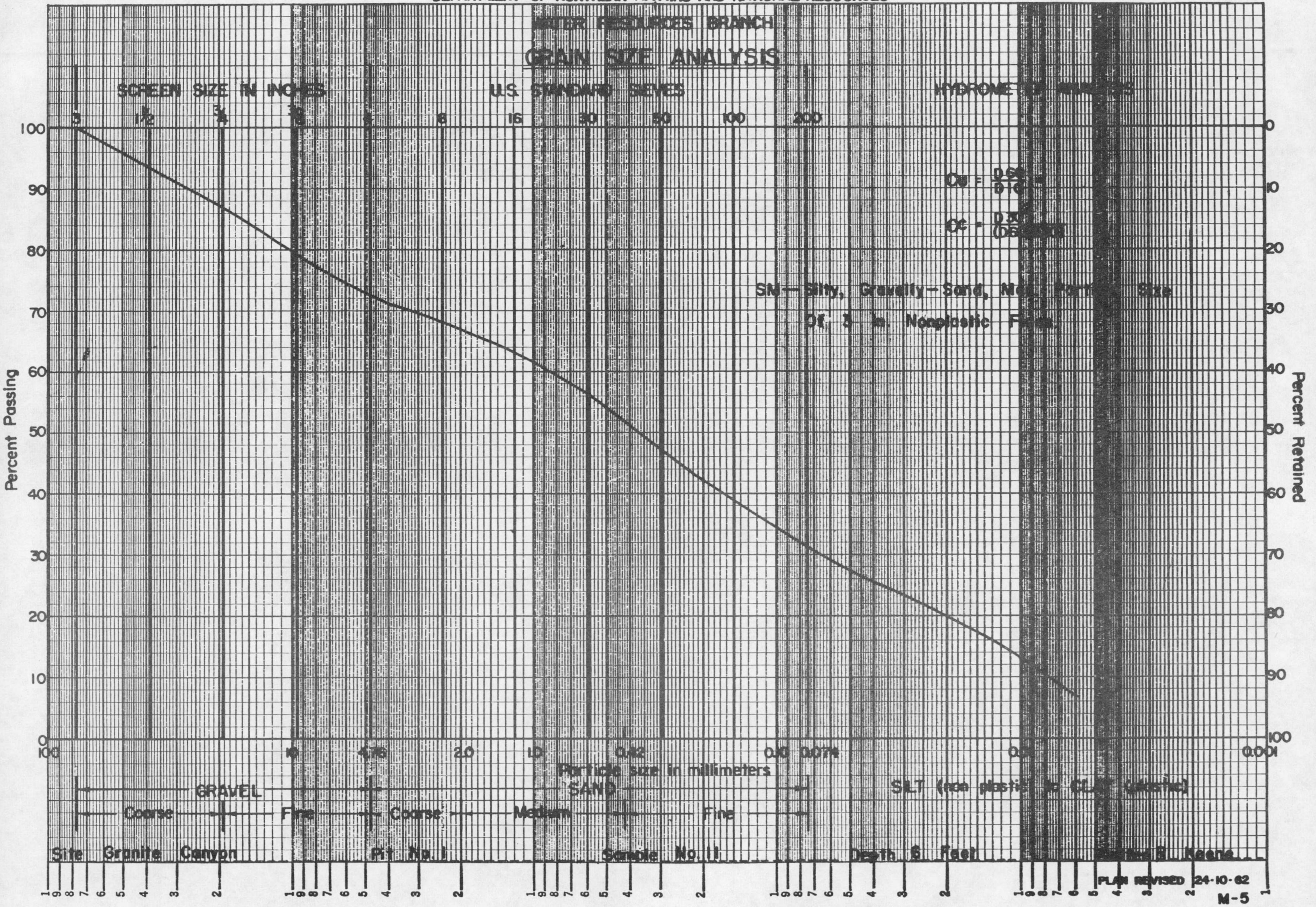
GRAIN SIZE ANALYSIS



K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

L-7

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES



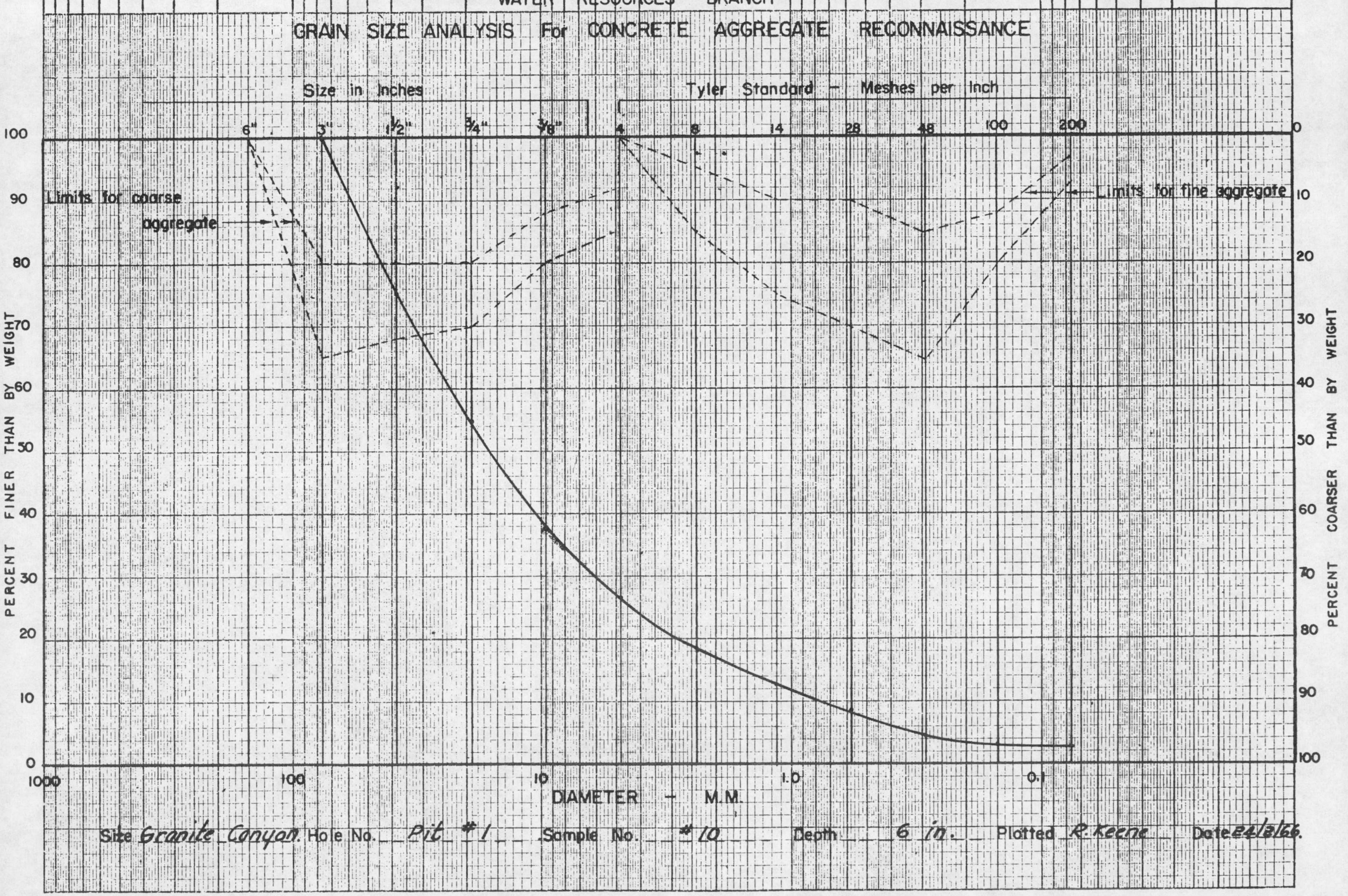
K+E SEMI-LOGARITHMIC 359-91G
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS

Description of Potential Aggregate for the following Grain Size Analysis Curve

Sample Number	Location	Field Description of Material	Field Description of Overburden	Thickness of Deposit	Areal Extent (Estimated)	Remarks
10	30-foot bluff along right side of Pelly River, 17 miles downstream from site, 20 feet above river	Gravel: coarse-grained, sandy, clean, loose, well sorted, minor weathering, gravel-size material chiefly granite and quartzite	12 inches to 4 feet of buff-coloured silt	25 feet (average)	Unlimited, exposed intermittently along river for about 7 miles	An extensive glacio-fluvial deposit, probably overlies till

DEPARTMENT OF NORTHERN AFFAIRS & NATIONAL RESOURCES

WATER RESOURCES BRANCH



Further Investigations - Conclusions

It should be remembered this report is based upon a preliminary geological investigation designed to furnish the engineer with general geological information regarding the proposed dam site. The data compiled are only sufficiently precise to permit office studies and obtain general cost estimates.

As a result of the investigation the following conclusions were reached:

1. The dam site should be located in the upstream end of Granite Canyon as the granodiorite occurring in this area is the most competent rock exposed in the canyon.

2. The granodiorite should provide satisfactory foundation and abutment material. It could be quarried to produce riprap and rock fill and, if necessary, aggregate.

3. Joints are plentiful in bedrock and consequently grouting may be necessary to consolidate the rock and prevent seepage.

4. Granite Canyon has been glaciated in the past but the last ice advance moving in a westerly direction did not reach the site area. Consequently, unlike Hoole Canyon and Detour sites, it is unlikely a buried channel exists in the site or reservoir areas. It is probable, however, there is more fill beneath the river at Granite Canyon than the other two sites.

5. The last ice advance terminated a short distance upstream from the canyon. The till (sample No. 5) in the terminal moraine left by the ice and silt (sample No. 9) deposited in a temporary lake dammed by the moraine are potential impervious materials for an earth dam.

6. The glacio-fluvial deposits of gravel on the abutments are thin and highly weathered. It is doubtful if satisfactory aggregate can be obtained from them. Better material is exposed along the sides of Pelly River downstream from the site (sample No. 10).

Test borings will be required to determine the thickness of the overburden on the abutments and beneath Pelly River. Continuous soil samples should be taken, permeability tests conducted and bedrock penetrated to depths of at least 35 feet into solid rock. The depths to the frost line should be noted in the abutments and also the presence of large boulders in the material underlying the river. Borings should also be put down along seismic line No. 2 on the right abutment. The thicknesses of overburden calculated for this area seem excessive. The depths to which the jointing extends down into bedrock should be investigated by borings. It may be necessary to seal these fractures by grouting.

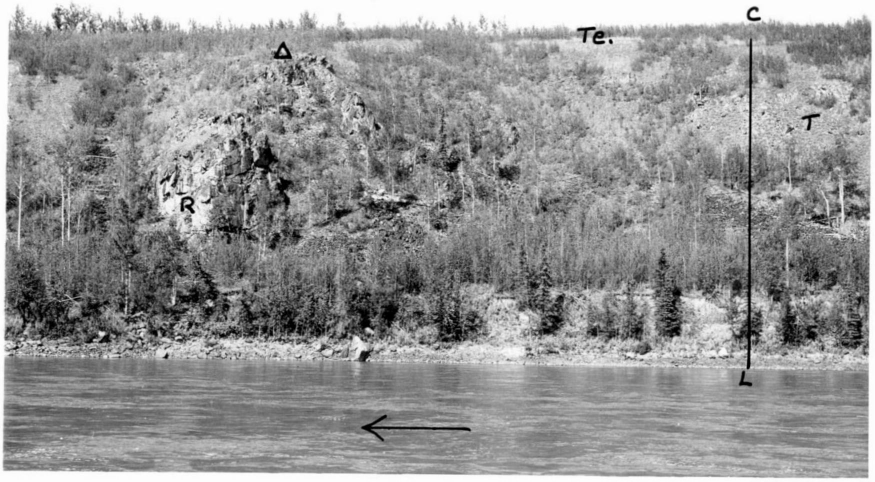


Plate 1

Right abutment, Granite Canyon
dam site, CL - approximate
centre line, Δ - survey station E-4,
Te - gravel-covered terrace, R - steep bedrock
bluff, T - talus.

G.S.C. 5-3-65

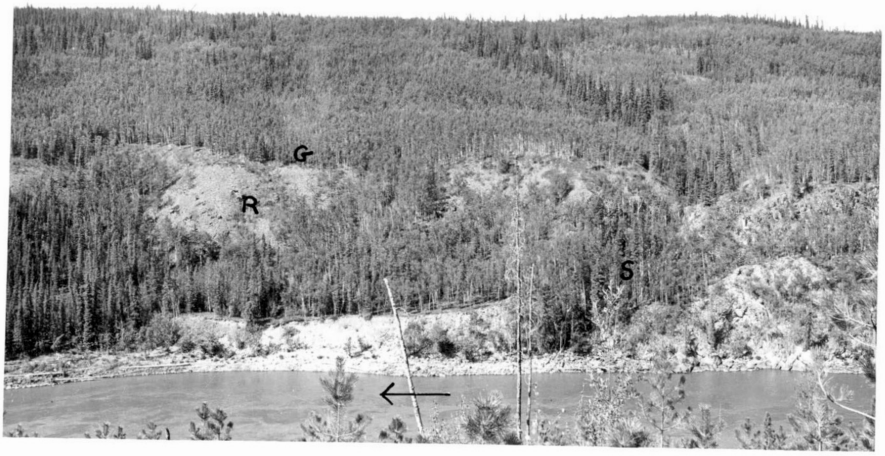


Plate 2

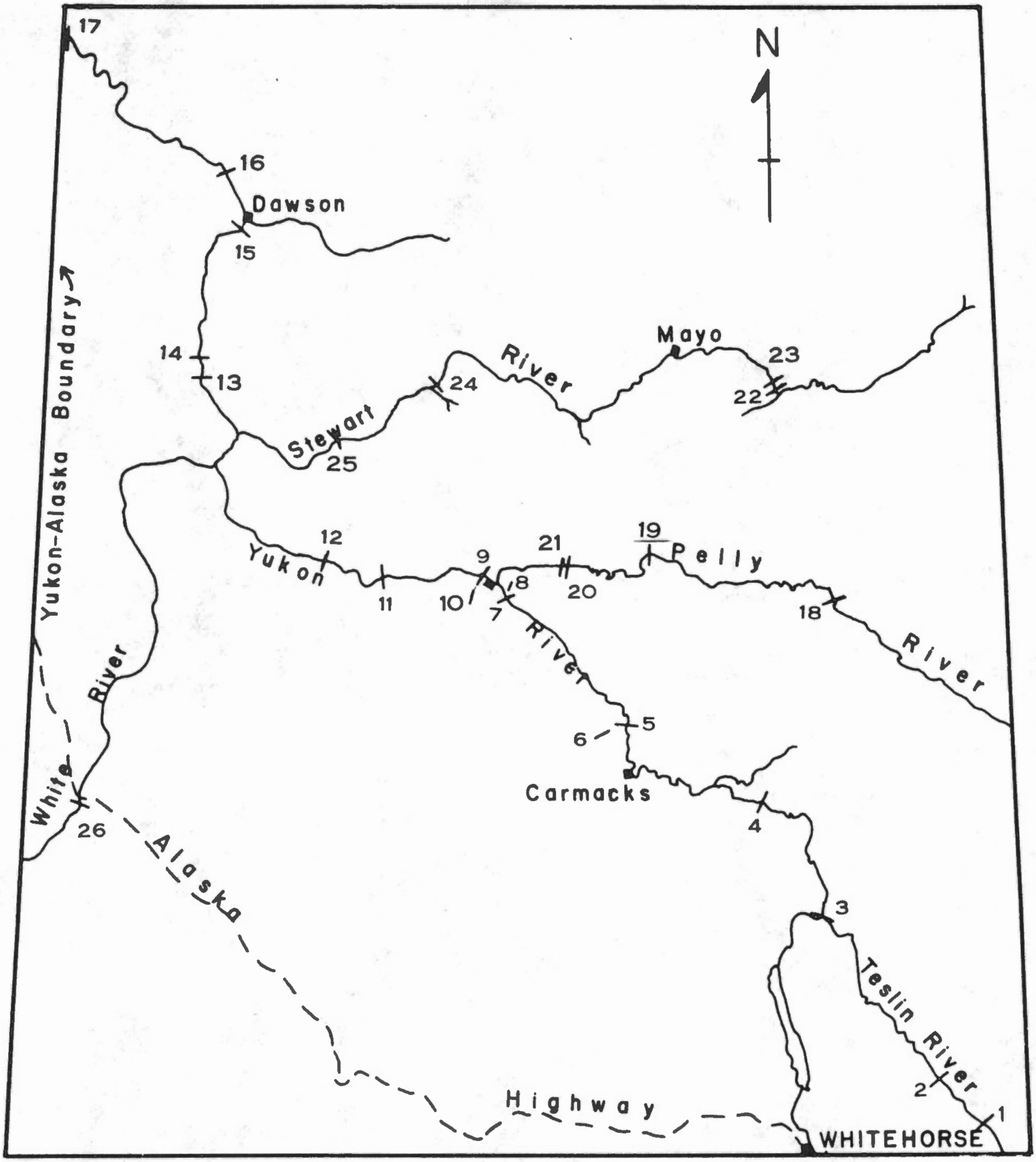
Downstream end of right abutment; S - spring in valley of Diamain Creek, elevation 1,695 (approx.), G - gravel-covered terrace, elevation 1,905 (approx.), R - bedrock bluff partly covered with talus.

G.S.C. 5-2-65

Plate 3

View looking upstream from left abutment of Granite Canyon dam site. A - alluvium-covered terrace with frozen soil at 12-18 inches, T - 200-foot bluff of potential impervious material (till), sample No. 5.

G.S.C. 5-1-65



LOCATION OF PROPOSED DAM SITES
YUKON RIVER DRAINAGE BASIN
Scale: 1 inch = 40 miles

Site No.	Name	Site No.	Name	Site No.	Name
1 —	Swift River	10 —	Fort Selkirk Draw	19 —	Granite Canyon
2 —	Northwest Power	11 —	Selwyn	20 —	Gerc
3 —	Hootalinqua	12 —	Britannia	21 —	Bradens Canyon
4 —	Big Salmon	13 —	Ogilvie no. 1	22 —	Five Mile Rapids
5 —	Five Finger Rapids	14 —	Ogilvie no. 2	23 —	Fraser Falls
6 —	Five Finger Draw	15 —	Upper Dawson	24 —	Independence
7 —	Wolverine	16 —	Lower Dawson	25 —	Porcupine
8 —	Wolverine Draw	17 —	Boundary	26 —	Lower Canyon
9 —	Fort Selkirk	18 —	Detour		