

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
WATER RESOURCES BRANCH

LOWER FRASER VALLEY DYKE STUDIES

CONSTRUCTION MATERIALS SURVEY

by

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LOWER FRASER VALLEY DYKE STUDIES

CONSTRUCTION MATERIALS SURVEY

1. INTRODUCTION

During the winter of 1962-63 the Fraser River Board carried out a drilling program to obtain basic data for studies to assess the ability of the dyking systems to withstand high water levels. Results of these studies indicated that improvements would be required to the majority of the dykes and that additional materials would be required for that purpose. The Board, therefore, extended its studies to include a field survey for the necessary construction materials.

2. REQUIREMENTS

The volumes of materials required in each dyking district were specified by the Board design staff. It was assumed that the necessary fine-grained materials would be available, either adjacent to the dyke or within the dyking district. The search for materials, therefore, was restricted to locating sources of gravel and a limited amount of rock for riprap. The volumes of these materials required for each dyking district have been summarized in Table I.

3. FIELD SURVEYS

Since a number of gravel pits were known to be in use throughout the Lower Fraser Valley, the first approach to locate suitable gravels was to inventory gravel pits currently

in use in the vicinity of the various dyking districts. This survey was extended to cover abandoned pits and obvious gravel sources such as creek beds and river bars. For each of the deposits, the ownership was determined and the size was estimated from surface indications as < 10,000 c.y., 10,000 to 100,000 c.y., or > 100,000 c.y. Ownership of rock quarries was also determined.

Samples were taken from most of the larger gravel deposits to indicate the average material available. It should be noted, however, that no matter how carefully single samples are taken, they are not likely to be truly representative of a large deposit and that a number of samples or strip samples would be required to provide this information.

Locations of the gravel deposits and rock quarries have been indicated on plan F-11-4 in Appendix I. Ownership, size and a description of the gravel deposits have been summarized in the Pit and Material Descriptions in Appendix II where photographs of representative deposits are also shown. Similar data have been indicated for the rock quarries.

Data have only been indicated for pits favourably located with respect to the dyking districts.

4. LABORATORY TESTS

The only testing performed on gravel samples was mechanical analysis of the minus three-inch material. Results of this testing and classification symbols for each sample have been tabulated in the Summary of Test Results in

Appendix III. Grain-size curves for twelve typical samples have been included in the same appendix. Test results were used to supplement the field descriptions summarized in Appendix II. Where this has been done, the classification symbol has been shown after the pit description.

Ninety percent of the samples tested were clean (less than 5% fines) and would be free-draining. Two of the remaining samples contained only 6% fines and should be suitable for use. The remaining three samples with 8% to 11% fines may not indicate suitable material and the deposits would require additional investigation to confirm that they were suitable for use.

5. COSTS

In order to determine material costs, a survey was made of municipal, provincial and private contractors' rates to determine the costs for purchase, loading, truck and barge haul, unloading and placing for both gravels and rock. These rates have been summarized and forwarded separately to the Fraser River Board.

6. SUMMARY

In general, adequate supplies of gravels have been located within a reasonable distance of the various dyking districts and it has not been necessary to carry out a more detailed search for gravel deposits. It is recognized, however, that there are additional gravel deposits underlying some of

the developed lands in the valley and that a more rigorous analysis may indicate an economic advantage in buying up existing developments to obtain suitably-located gravel deposits. Such an analysis was considered beyond the scope of this report.

The largest volume of gravel would be required in the Maple Ridge, Pitt Meadows and Pitt Polder dyking districts. This material could be obtained from pits 52 and 53 where an estimated 1,000,000 c.y. should be available by extending the surface area of the pit and from the vicinity of pit 48 where it is estimated that 500,000 c.y. would be available. An alternative which may not be economic would be to obtain gravels from the large deposits available in pits 55 and 56. Gravel for the Coquitlam district could easily be obtained from pit 57. Depending on comparative costs, the Lulu Island and Delta districts could be supplied either by barge from pit 59 or by truck from pits in the Delta area. Nicomen Island is the only other district which requires an appreciable volume and it could easily be obtained from local pits.

APPROVED:


District Engineer

E. M. Clark

TABLE I

MATERIALS REQUIRED

<u>Dyking District</u>	<u>Rock c.y.</u>	<u>Gravel c.y.</u>
Delta) 1,100	129,800
Tilbury Island)	18,900
South Westminster		35,700
Barnston Island	4,400	26,700
West Langley		11,700
Salmon River		7,200
Glen Valley	800	64,000
Matsqui	7,700	42,000
Sumas-West		16,600
Sumas-East		25,800
Vedder Canal		104,400
Chilliwack-West		3,100
Chilliwack-East		8,500
Agassiz		2,400
Harrison Mills	650	25,100
Harrison Hot Springs	7,300	
East Nicomen		9,100
West Nicomen		177,700
North Nicomen		4,800
South Dewdney		74,000
Mission		3,900
Silverdale		17,600
Maple Ridge		237,800
Pitt No. 1		158,700
Pitt No. 2		91,200
Pitt Polder		416,100
Coquitlam	2,800	162,500
Colony Farm		89,000
Trapp Road		3,900
Lulu Island		161,200

APPENDIX I

Plan of Dyke and Pit Locations.

APPENDIX II

Pit and Material Descriptions.

Photographs.

Photo #1 Missing

Photo #1 - Pit #19

Photo #2 Missing

Photo #2 - Area 39-dry channel and
bars of Norrish Creek



Photo #3

Area 41
Surface material.
Typical of Fraser
River bars.



Photo #4

Pit #48
Indicates depth
of excavation.



Photo #5

Pit #48
Exposed materials.



Photo #6

Pit #53 - shows
depth of excavation
and stratification
of deposit.



Photo #7

Pit #59 - shows
depth of excavation.



Photo #8

Pit #59 - exposed materials.

PIT AND MATERIAL DESCRIPTIONS

<u>Pit No.</u>	<u>Volume in c.y.</u>	<u>Ownership</u>	<u>Description</u>
1	> 100,000	Private	Two adjacent operating pits excavated to a depth of 40'. Pit-run material: poorly-graded gravel to 3", sandy, clean. <u>GP</u>
2	10,000 to 100,000	Private	Non-operating pit, excavated to a depth of 30'. Material mainly stratified sand, silty sand, and silt. Usable material is from large isolated deposits of poorly-graded gravel to 3", with 10% cobbles and boulders to 6" and some clay, sandy. <u>GP-GC</u>
3	> 100,000	Private	Operating pit excavated to a depth of 40'. Pit-run material: well-graded gravel to 3", sandy, clean. <u>GW</u>
4	> 100,000	Municipal	Stratified deposit, currently in use and excavated to a depth of 80'. Pit-run material: well-graded gravel to 3", with 5% cobbles and boulders to 6", sandy, clean. Frequent 2'-thick layers of poorly-graded sand, gravelly, 3" maximum size, clean. <u>SP</u>
5	> 100,000	Municipal	Operating pit excavated to a depth of 20'. Stripping of additional area is in progress. Pit-run material: well-graded gravel to 3", with 10% cobbles and boulders to 6", sandy, clean. <u>GW</u>
6	> 100,000	Municipal	Operating pit excavated to near water table at a depth of approximately 7'. Pit-run material: well-graded gravel to 3", sandy, clean. <u>GW</u>
7	> 100,000	Private	Operating pit excavated to near the water table at a depth of approximately 7' and in some locations to below water table. Representative material: well-graded gravel to 3", sandy, clean. <u>GW</u>

<u>Pit No.</u>	<u>Volume in c.y.</u>	<u>Ownership</u>	<u>Description</u>
8	10,000 to 100,000	Municipal	Periodic removal of materials from a pit excavated to a depth of 10'. Pit-run material: poorly-graded sand, gravelly, 3" maximum size, clean. <u>SP</u>
9	10,000 to 100,000	Private	Operating pit excavated to a depth of 20'. Pit-run material: poorly-graded gravel to 3", with 10% cobbles and boulders to 8", sandy, clean. <u>GP</u>
10	> 100,000	Municipal	Periodically-operated pit, excavated to a depth of 15'. Pit-run material: poorly-graded gravel with some silt and 10% cobbles to 5", sandy. <u>GP-GM</u> Material is compact in place.
11	10,000 to 100,000	Private	Operating pit excavated to a depth of 25'. Pit-run material: poorly-graded gravel to 3" with 25% cobbles and boulders to 10", sandy, clean. <u>GP</u>
12	> 100,000	Municipal and Private	Municipal pit currently in operation, excavated to a depth of 10', and immediately adjoining undeveloped private land. Representative material: poorly-graded gravel to 3" with some silt, sandy. <u>GP-GM</u>
13	> 100,000	Private	Non-operating pit excavated to a depth of 30'. Pit-run material: poorly-graded gravel to 3", sandy, clean. <u>GP</u>
14	> 100,000	Private, Municipal & Provincial	Three adjoining operating pits excavated to depths of 50 to 75'. Pit-run material: poorly-graded gravel to 3" with 20% cobbles and boulders to 24", sandy, clean. <u>GP</u>
15		Dyke District	Developed rock quarry.
16	> 100,000	Private	Old excavation 20' in depth, exposing angular rock fragments to 3", with 25% up to 48", sandy, and with some silt.

<u>Pit No.</u>	<u>Volume in c.y.</u>	<u>Ownership</u>	<u>Description</u>	
17	10,000 to 100,000	Municipal	Operating pit excavated to a depth of 30'. Mixture of angular gravel to 3", sand, and boulders to 48", clean.	
18	> 100,000	Private	Operating pit excavated to a depth of 35'. Pit-run material: well-graded angular gravel to 3", with some silt, and 30% angular cobbles and boulders to 36", sandy. <u>GW-GM</u>	
19	> 100,000	Provincial	Material recently removed for highway construction exposed a bank about 250' high containing 60% angular rock fragments 3" to 72" maximum size and 40% well-graded angular gravel to 3", with some silt, sandy. <u>GW-GM</u>	Photo #1
20	> 100,000	Crown	Channel and bar deposits of the Vedder River. Minor river silts cover portions of the bars. Representative material: poorly-graded gravel to 3", sandy, clean.	
21	10,000 to 100,000	Private	Non-operating pit excavated to a depth of 20'. Pit-run material: well-graded gravel to 3", sandy, clean. <u>GW</u>	
22	> 10,000	Private	Gravel from stream channel and from adjacent low lands underlying from 2 to 4' of silt. Representative material: poorly-graded gravel to 3", sandy, clean. <u>GP</u>	
23	> 100,000	Municipal	Operating pit excavated to a depth of 20'. Pit-run material: well-graded gravel to 3", with 10% cobbles and boulders to 12", sandy, clean. <u>GW</u>	
24	10,000 to 100,000	Crown	River bar. Materials are removed by the municipality and a private operator during low water by constructing a small gravel causeway for access. Representative material: poorly-graded gravel to 3", sandy, clean.	

<u>Pit No.</u>	<u>Volume in c.y.</u>	<u>Ownership</u>	<u>Description</u>
25	> 100,000	Crown	River bar with access and removal of materials during low water. Representative material: poorly-graded gravel to 3", with 15% cobbles to 5", sandy, clean.
26	> 100,000	Crown	River bar - accessible. Materials are removed by the municipality during low water. Representative material: poorly-graded gravel to 3", sandy, clean. Surface covered with cobbles and boulders to 8".
27	> 100,000	Crown	River bar - accessible during low water and some material removed at that time. Short haul to dyke. Representative material: well-graded gravel to 3", sandy, clean. <u>GW</u>
28		Municipal	Rock quarry.
28-A		Provincial	Rock quarry - mainly talus.
29	> 100,000	Private	Operating pit excavated to a depth of 50'. Pit-run material: poorly-graded sand, gravelly, clean. <u>SP</u>
30	> 100,000	Municipal	Operating pit excavated to a depth of 60'. Pit-run material: poorly-graded sand with gravel to 3", clean. <u>SP</u>
31	> 100,000	Crown	River bar with low-water access and short haul to dyke. Representative material: poorly-graded gravel to 3", with 10% cobbles to 5", sandy, clean. <u>GP</u> Material removed during low water.
32	10,000 to 100,000	Crown	Highway cut 30' high and 500' long, exposing gravel and periodic small rock outcrops. Representative material: poorly-graded gravel to 3", with 25% cobbles and boulders to 24", sandy, clean. <u>GP</u>
33	> 100,000	Dyke District	Stratified deposit consisting of approximately 60% poorly-graded gravel to 3", sandy, clean, with 40% sub-angular cobbles and boulders to 48". <u>GP</u>

<u>Pit No.</u>	<u>Volume in c.y.</u>	<u>Ownership</u>	<u>Description</u>	
34	10,000 to 100,000	Indian Reserve	Small river bar and low land extending back from river to the existing dyke. Moderate scrub and tree cover - low-water access. Representative material: poorly-graded gravel to 3", sandy, clean. <u>GP</u>	
35	10,000 to 100,000	Private	Abandoned pit, excavated to a depth of 4', grass covered and used for pasture. Representative material: poorly-graded gravel to 3", sandy, clean. <u>GP</u>	
36	10,000 to 100,000	Crown	River bar with direct access to the dyke during low water. Representative material: poorly-graded gravel to 3", sandy, clean.	
37	> 100,000	Indian Reserve	Material from dry channels and outwash near the mouth of Deroche Creek. Representative material: poorly-graded gravel to 3", with 30% cobbles and boulders to 12", sandy, clean. <u>GP</u>	
38	> 100,000	Private	Non-operating pit excavated to a depth of 30'. Pit-run material: poorly-graded gravel to 3", with 30% cobbles and boulders to 36", sandy, clean. <u>GP</u>	
39	> 100,000	Crown	Material from approximately one mile of dry channels and outwash of Norrish Creek. Representative material: poorly-graded gravel to 3", with 35 to 40% cobbles and boulders to 12", sandy, clean. <u>GP</u>	Photo #2
40	> 100,000	Private	Periodic removal of materials from a pit excavated to a depth of 15'. Pit-run material: well-graded angular gravel to 3", with 40% angular cobbles and boulders to 12", sandy, clean. <u>GW</u>	

<u>Pit No.</u>	<u>Volume in c.y.</u>	<u>Ownership</u>	<u>Description</u>	
41	> 100,000	Crown	River bar. Direct access to dyke and some removal of materials during low water. Representative material: poorly-graded gravel-sand mixture, 2" maximum size, clean. <u>GP</u>	Photo #3
42	> 100,000	Private	Abandoned pit, excavated to a depth of 40', now covered by pasture, with mature orchard over the immediately-surrounding area. Pit-run material: poorly-graded sand with gravel to 3", clean. <u>SP</u>	
43	10,000 to 100,000	Private	Undeveloped potential source. Small volume previously removed from a 5' excavation, since overgrown with bush. Representative surface material: poorly-graded gravel to 3", with 25% cobbles and boulders to 8", sandy, clean. <u>GP</u>	
44	> 100,000	Municipal	Operating pit excavated to a depth of 15'. Pit-run material: poorly-graded gravel to 3", with 10% cobbles and boulders to 24", sandy, clean. <u>GP</u>	
45	10,000 to 100,000	Private	Operating pit excavated to a depth of 30'. Pit-run material: well-graded gravel to 3", with 25% cobbles and boulders to 24", sandy, clean. <u>GW</u>	
46	> 100,000	Indian Reserve	Stratified deposit, currently in use and excavated to a depth of 150'. Pit-run material: poorly-graded gravel to 3", with 25% cobbles and boulders to 24", sandy, clean.	
47	> 100,000	Provincial	Operating pit excavated to a depth of 100'. Pit-run material: poorly-graded sand with gravel to 3", 35% cobbles and boulders to 48", clean. <u>SP</u>	

<u>Pit No.</u>	<u>Volume in c.y.</u>	<u>Ownership</u>	<u>Description</u>	
48	> 100,000	Municipal	Stratified deposit, currently in operation and excavated to an average maximum depth of 20', where impervious material is encountered. Pit-run material: poorly-graded gravel-sand mixture, with 25% cobbles and boulders to 12", sandy, clean. <u>GP</u> Estimated 500,000 c.y. available.	Photos #4 & #5
49	10,000 to 100,000	Crown	Material from Alouette River channel and deposits along banks from channel improvements. Representative material: well-graded gravel to 3", with 30% cobbles and boulders to 8", sandy, clean. <u>GW</u>	
50		Provincial	Rock quarry.	
51	10,000 to 100,000	Municipal and Crown	Material from Alouette River channel removed during low-water period. Representative material: well-graded gravel to 3", sandy, clean. <u>GW</u>	
52	> 100,000	Municipal	Stratified deposit, operated periodically and excavated to a 20' depth. Silt and silty-sand overburden prevails to a depth of 5'. Pit-run material: poorly-graded sand with gravel to 1", clean. <u>SP</u>	
53	> 100,000	Private	Stratified deposit, currently in use and excavated to a 30' depth. Pit-run material: poorly-graded sand with gravel to 2", clean. <u>SP</u> Estimated 1,000,000 c.y. available.	Photo #6
54		Private	Operating rock quarry. Barge-loading facilities available.	
55	> 100,000	Private and Crown	Dry creek outwash and channel deposits. Periodic removal of surface materials. Representative material: poorly-graded gravel to 3", with 30% cobbles and boulders to 12", sandy, clean.	

<u>Pit No.</u>	<u>Volume in c.y.</u>	<u>Ownership</u>	<u>Description</u>	
56	> 100,000	Private	Large deposit, currently in use. Has been excavated to a depth of 60'. Pit-run material: poorly-graded sand-gravel mixture, with 20% cobbles and boulders to 16", clean. <u>SP</u>	
57	> 100,000	Private and Crown	Material from approximately one mile of dry channels and bars of the Coquitlam River. Removal and stockpiling of materials in operation. Representative material: well-graded gravel to 3", with 25% cobbles and boulders to 16", sandy, clean. <u>GW</u>	
58	10,000 to 100,000	Crown	Mainly material deposited along banks of Coquitlam River from channel improvements. Representative material: poorly-graded gravel to 3", with 40% cobbles and boulders to 12", sandy, clean. <u>GP</u>	
59	> 100,000	Private	Extremely large deposit, currently in use and excavated to a depth of 100'. Barge and truck-loading facilities available. Pit-run material: poorly-graded gravel to 3", with 25% cobbles and boulders to 36", sandy, clean. <u>GP</u>	Photos #7 & #8
60	> 100,000	Municipal and Provincial	Abandoned pit, excavated to a depth of 80 to 100'. Pit-run material: poorly-graded gravel to 3", with 15% cobbles and boulders to 8", sandy, clean.	

APPENDIX III

Summary of Test Results

Grain Size Curves

SUMMARY OF TEST RESULTS

<u>Pit No.</u>	<u>% Gravel</u>	<u>% Sand</u>	<u>% Fines</u>	<u>Classifi- cation</u>
1	65	34	1	GP
2	84	10	6	GP-GC
3	68	31	1	GW
4	46	54	0	SP
5	69	31	0	GW
6	77	21	2	GW
7	75	24	1	GW
8	45	54	1	SP
9	76	24	0	GP
10	79	13	8	GP-GM
11	62	37	1	GP
12	54	35	11	GP-GM
13	58	41	1	GP
14	57	42	1	GP
18	61	31	8	GW-GM
19	66	28	6	GW-GM
21	68	31	1	GW
22	57	42	1	GP
23	77	21	2	GW
27	67	32	1	GW
29	29	70	1	SP
30	42	57	1	SP
31	70	29	1	GP
32	57	42	1	GP
33	75	24	1	GP

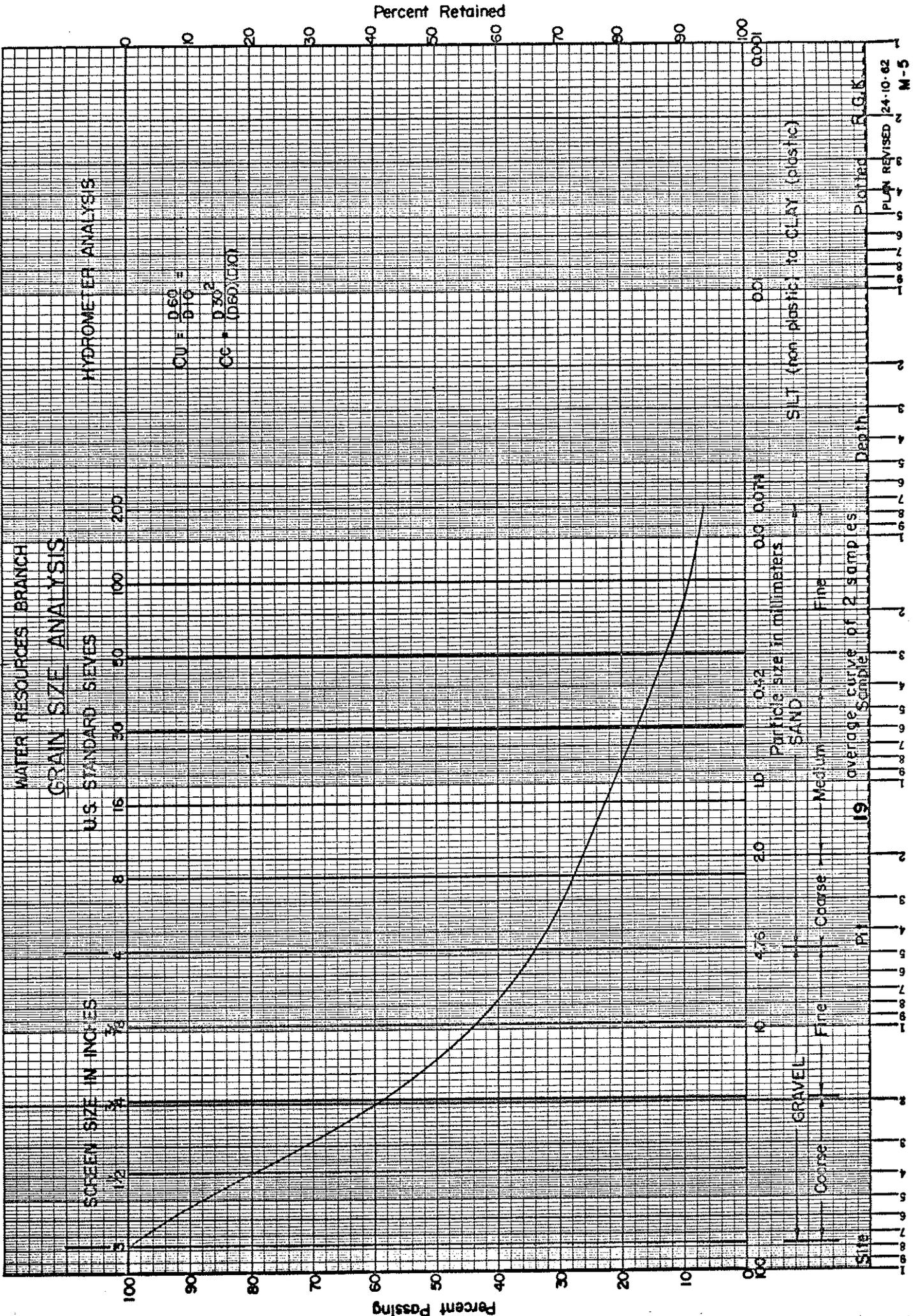
2.

<u>Pit No.</u>	<u>% Gravel</u>	<u>% Sand</u>	<u>% Fines</u>	<u>Classifi- cation</u>
34	56	43	1	GP
35	69	30	1	GP
37	60	39	1	GP
38	62	37	1	GP
39	67	32	1	GP
40	77	22	1	GW
41	50	49	1	GP
42	31	67	2	SP
43	69	30	1	GP
44	52	47	1	GP
45	84	15	1	GP
47	47	52	1	SP
48	49	51	0	SP
49	71	28	1	GW
51	68	32	0	GW
52	32	67	1	SP
53	38	62	0	SP
56	49	50	1	SP
57	69	30	1	GW
58	63	36	1	GP
59	51	48	1	GP

Test results apply only to minus 3" material.

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GRAIN SIZE ANALYSIS



HYDROMETER ANALYSIS

$CU = \frac{D_{60}}{D_{30}} =$
 $CC = \frac{D_{200}}{D_{60}} \times 100$

U.S. STANDARD SIEVES

SCREEN SIZE IN INCHES

SLT (non plastic) to CLAY (plastic)

Particle size in millimeters

GRAVEL
Coarse
Fine

Depth

average curve of 2 samples

Site

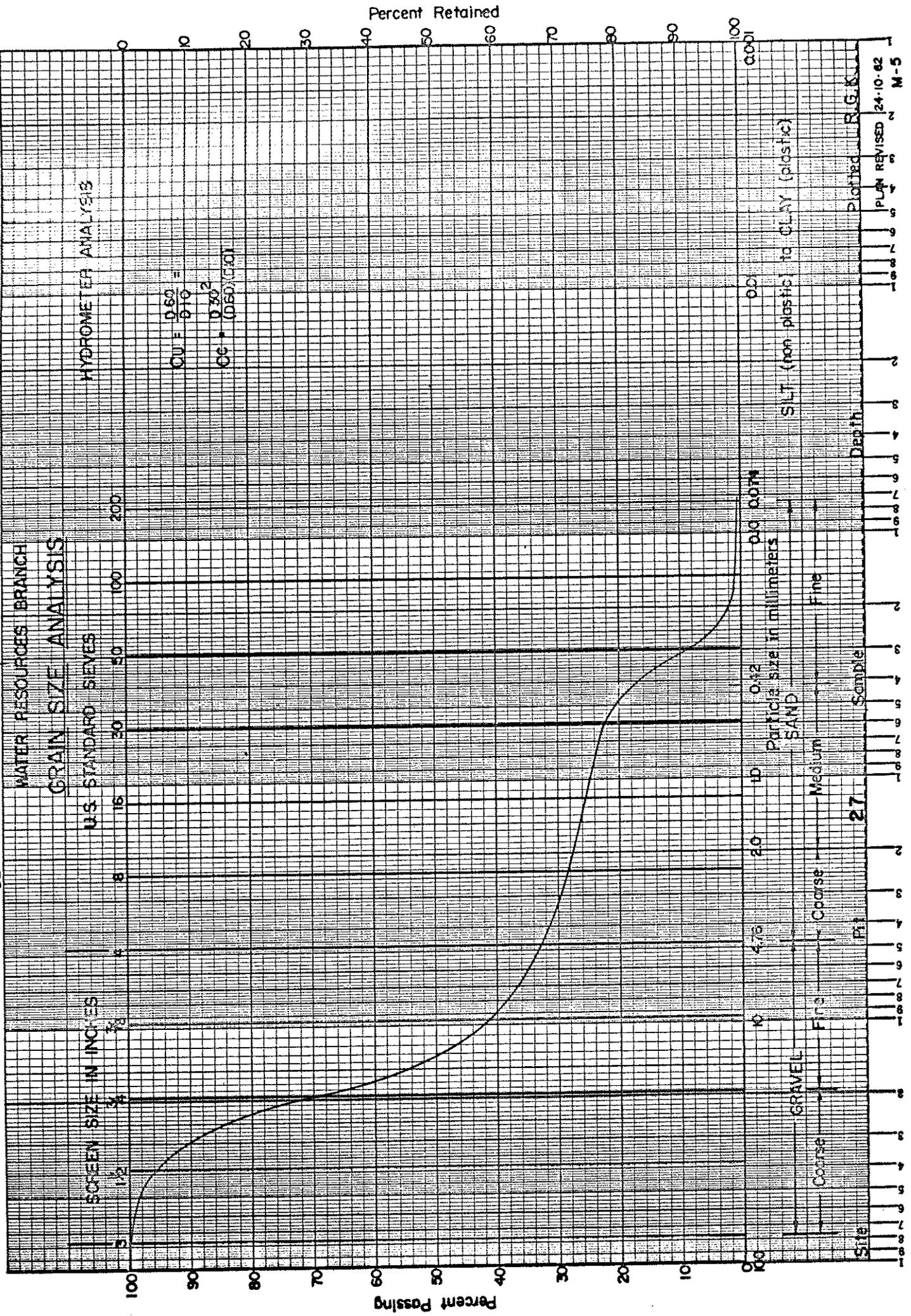
Plotted R.G.K.

PLAN REVISED 24-10-62

M-5

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WATER RESOURCES BRANCH
GRAIN SIZE ANALYSIS



$CU = \frac{0.60}{0.10} = 6$
 $CC = \frac{0.70^2}{(0.60/0.075)}$

PLANNED BY R.G.K.
 PLAN REVISED 24-10-62
 M-5

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS

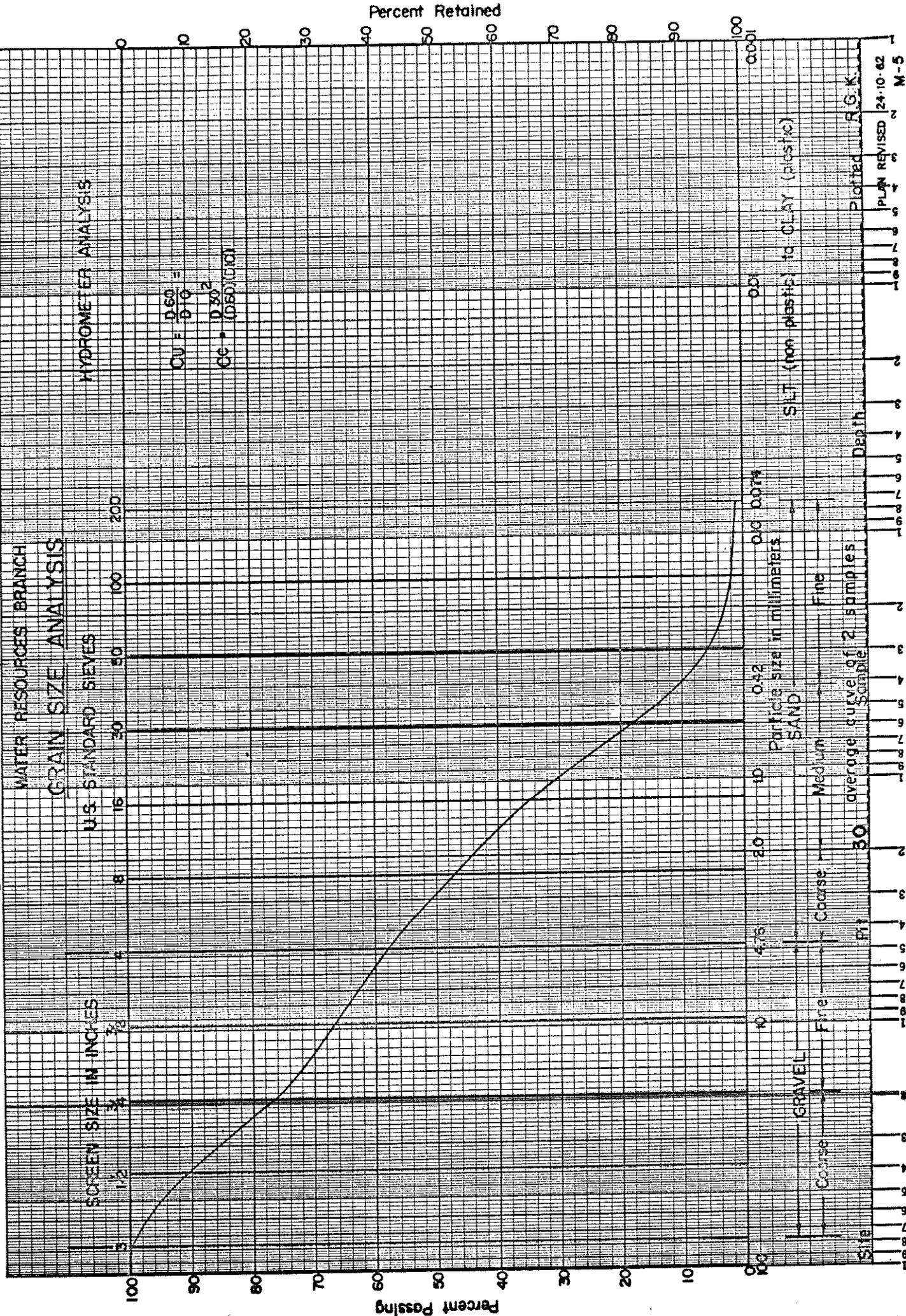
U.S. STANDARD SIEVES

SCREEN SIZE IN INCHES

HYDROMETER ANALYSIS

$$CU = \frac{D_{60}}{D_{10}} =$$

$$CC = D_{20}^2 (DSO)(CI)$$



PLAN REVISED 24-10-62
M-5

Plotted R.G.K.

SILT (non-plastic) to CLAY (plastic)

0.001

0.0075

0.075

0.15

0.3

0.6

1.2

2.5

4.75

7.5

15

30

60

100

200

425

750

1500

3000

6000

12000

25000

50000

100000

200000

425

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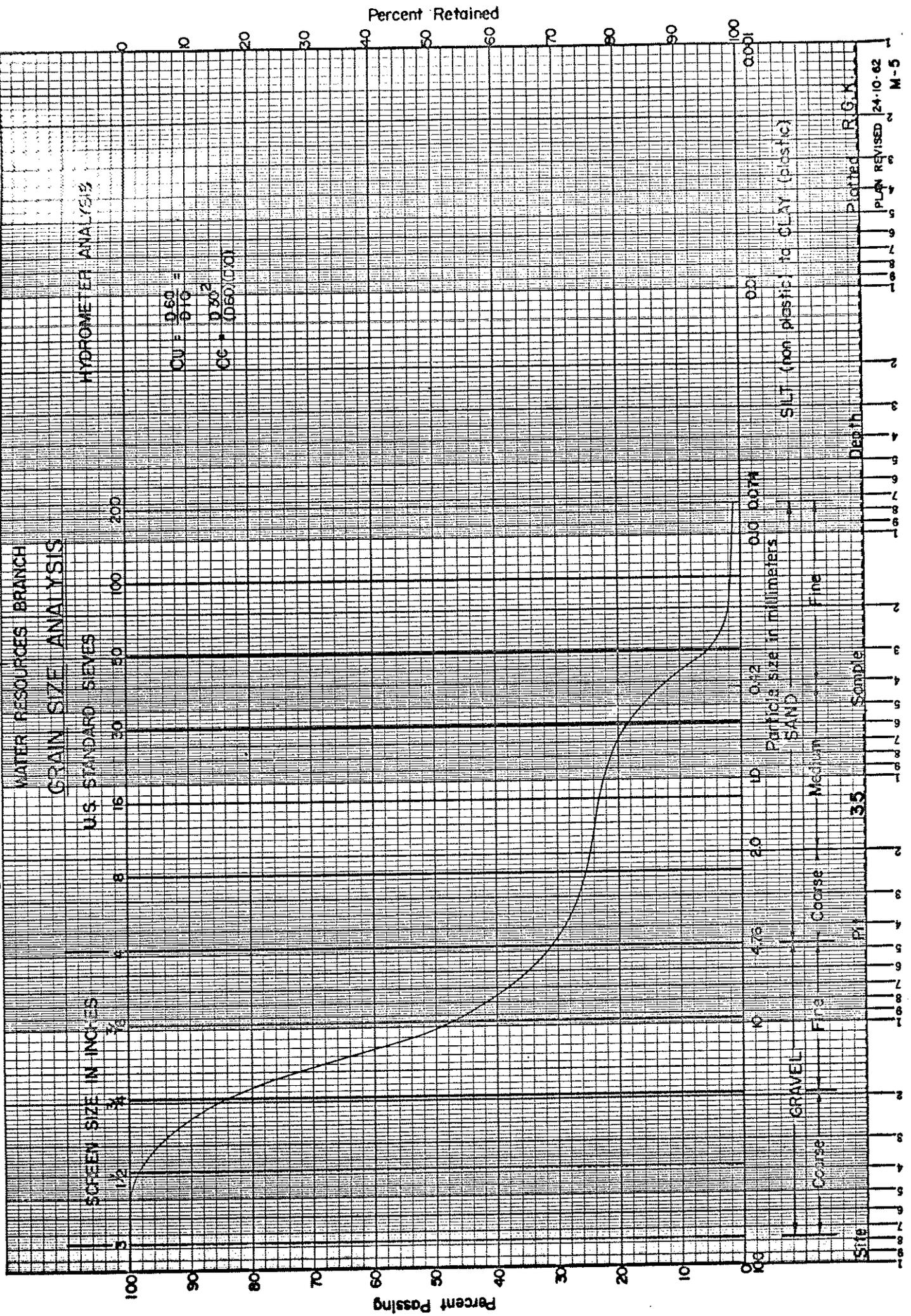
6000

12000

25000

WATER RESOURCES BRANCH

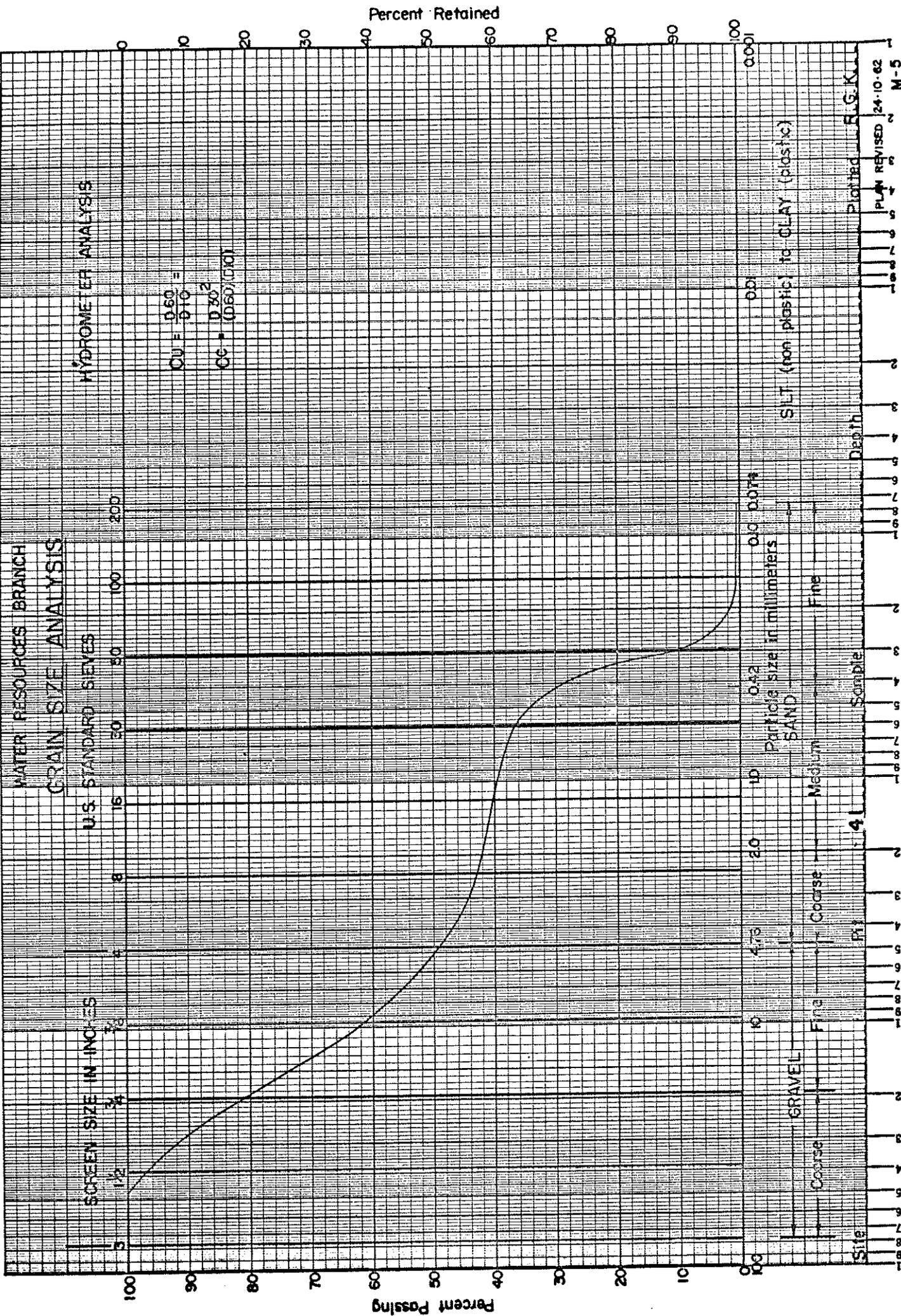
GRAIN SIZE ANALYSIS



DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS



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DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

WATER RESOURCES BRANCH

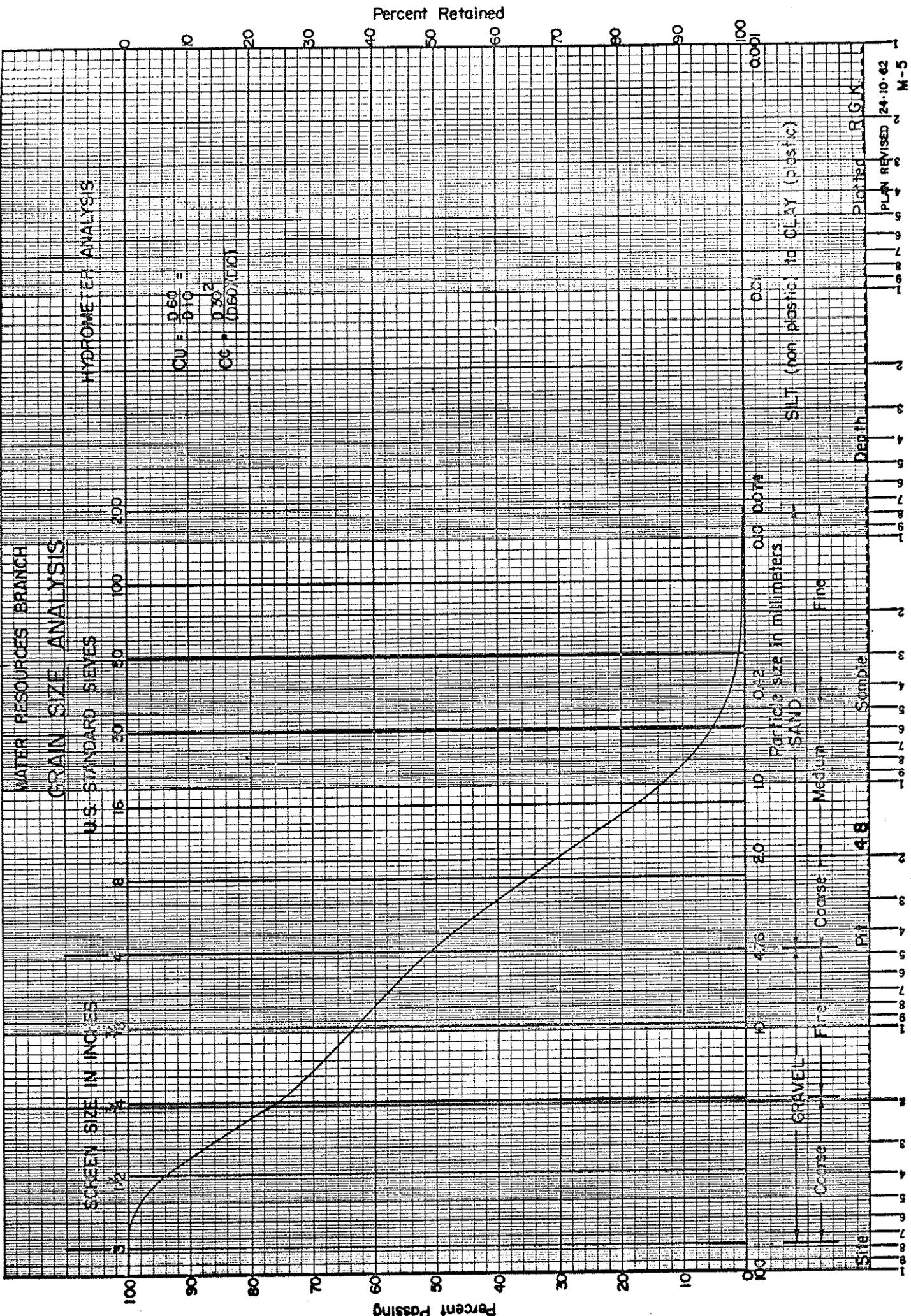
GRAIN SIZE ANALYSIS

U.S. STANDARD SEVES

HYDROMETER ANALYSIS

$$QU = \frac{0.60}{0.10} =$$

$$CC = \frac{0.30^2}{(0.60)(0.001)}$$



PLAN REVISED 24.10.62
M-5

Plotted R.G.X.

Depth

Sample

4.8

Site

WATER RESOURCES BRANCH

GRAIN SIZE ANALYSIS

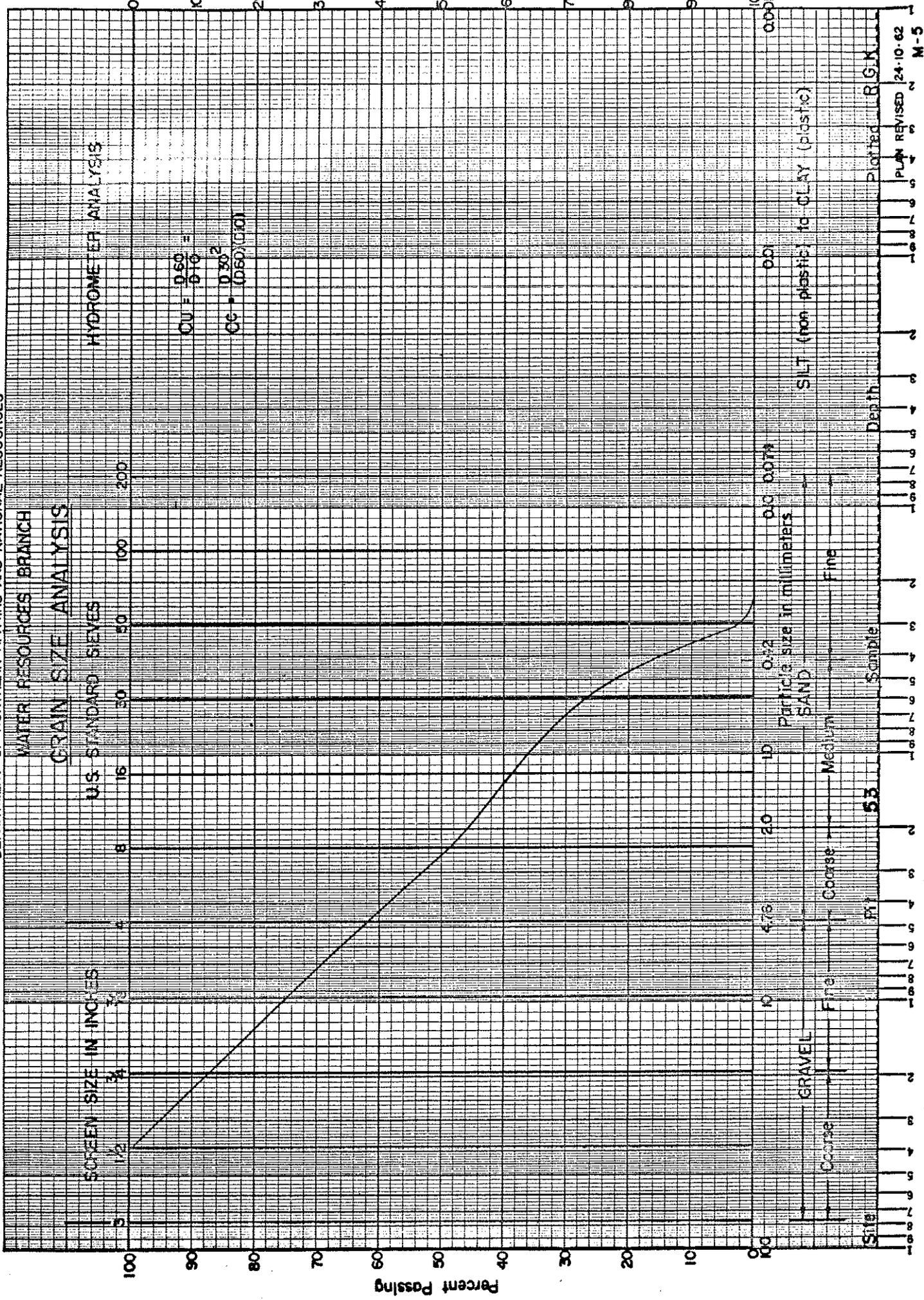
U.S. STANDARD SIEVES

SCREEN SIZE IN INCHES

HYDROMETER ANALYSIS

$$CU = \frac{D_{60}}{D_{10}} = \frac{0.85}{0.075} = 11.33$$

$$Cc = \frac{D_{30}^2}{(D_{10} \times D_{60})} = \frac{0.425^2}{(0.075 \times 0.85)} = 1.02$$



Percent Retained

Particle size in millimeters

SAND (non-plastic) to CLAY (plastic)

GRAVEL

Coarse

Medium

Fine

Site

Sample

Depth

Plotted

R.G.K.

PLAN REVISED 24-10-62

M-5

WATER RESOURCES BRANCH
GRAIN SIZE ANALYSIS

HYDROMETER ANALYSIS

U.S. STANDARD SIEVES

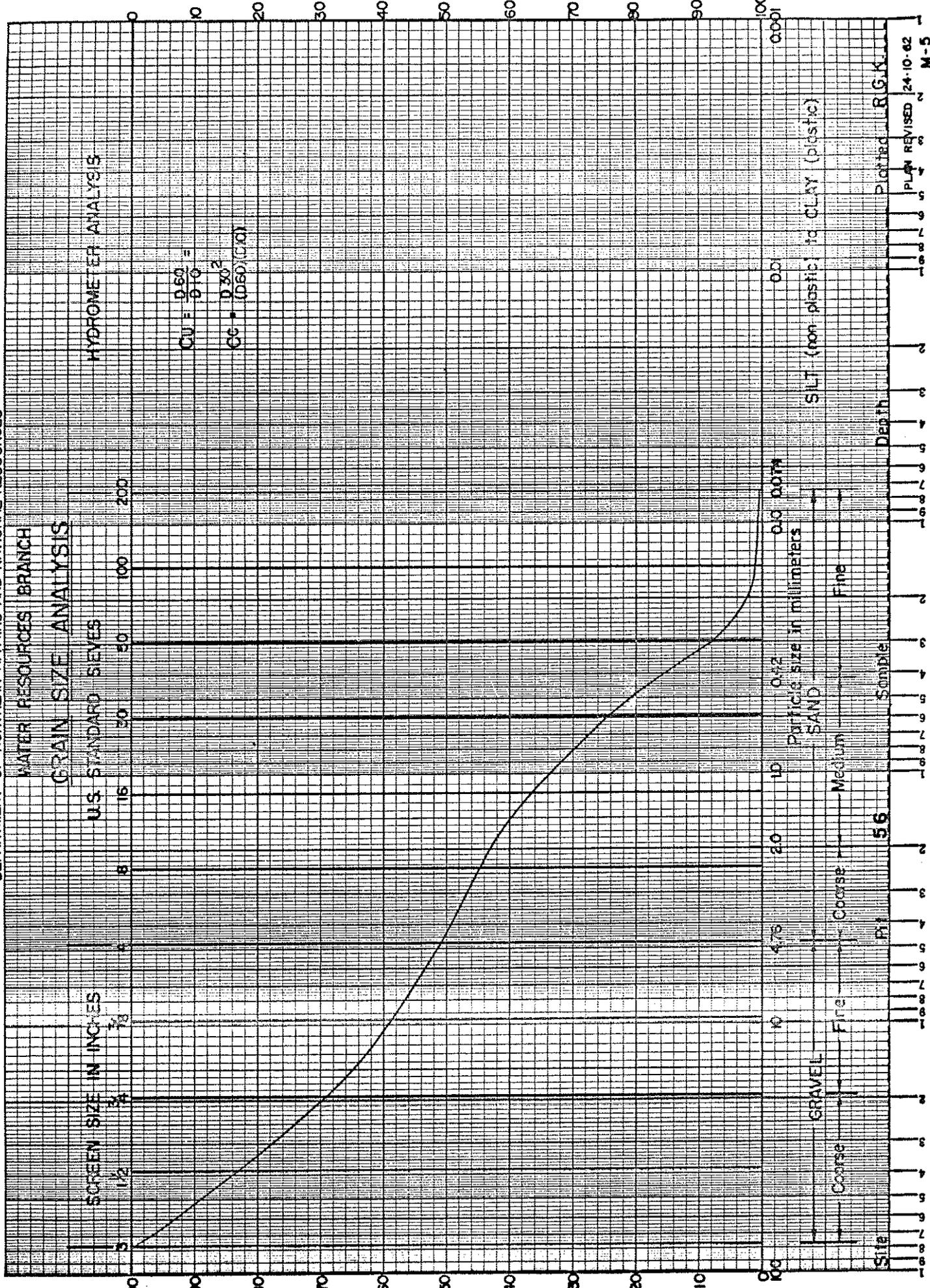
SCREEN SIZE IN INCHES

Percent Retained

Percent Passing

$$CU = \frac{D_{60}}{D_{10}} =$$

$$Cc = \frac{D_{30}^2}{(D_{60})(D_{10})}$$



SILT (non plastic to CLAY (plastic))

GRAVEL
Coarse
Medium
Fine

Site
1
2
3
4
5
6
7
8

Depth
1
2
3
4
5
6
7
8