

THESIS

TEST OF GRAVELS OF INGHAM COUNTY

JOHN H. BARR

1921

1965

1965

LIBRARY
Michigan State
University

PLACE IN RETURN BOX to remove this checkout from your record.
TO AVOID FINES return on or before date due.

DATE DUE	DATE DUE	DATE DUE
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

MSU Is An Affirmative Action/Equal Opportunity Institution

c:\pic\dlabel pm3-p 1

THESIS

TEST OF GRAVELLS OF THE COUNTY
OF INGHAM,
STATE OF MICHIGAN.

PRESENTED TO THE FACULTY OF

THE

MICHIGAN AGRICULTURAL COLLEGE

BY

JOHN H. BARR -----JUNE, 1921.

A Candidate for the Degree in Bachelor of Science.

THES-

cop. 2

OBJECT

The object of this thesis is to determine to what uses the gravels of the County of Ingham, State of Michigan, can be put. More especially to their use in construction and maintenance of gravel roads, concrete roads, asphalt roads and sewage disposal beds. There are certain specified requirements that the gravel must meet. It is to determine how nearly the gravels of this County meet with those requirements, that this thesis was worked and written.

INTRODUCTION

Samples of gravel were taken from nearly every pit in Ingham County, the total number of pits reached being thirty-six (36). This constituted in large the entire County. The samples taken from this pit were as nearly as possible the average run of the gravel in the pit and in places where the gravel changed grades, more than one sample was taken.

The pits from which the samples were taken, were located from data and maps furnished by Michigan State Highway Department and by the County Road Commissioners at Mason, Michigan. The pits were reached by means of a Ford furnished through the courtesy of the Michigan State Highway Department and Fred Rogers, and by means of said machine, the gravel was conveyed to the laboratory.

No attempt was made to estimate the quantity of gravel in each pit and nothing noted except that having direct bearing on the tests to be made or information obtained from conversation with the men or the owners at the pit.

Samples were carried to the laboratory and each numbered according to the number given the pit on the map so that the numbering on the pit and on the samples are identical. The weight of each sample varied but as an average thirty-five pounds was about the weight throughout. The samples were tested and their results compared with the required specifications in order to find out to what uses the gravel could be put.

TESTS MADE

Three tests were made on the samples, namely: Mechanical Analysis or Sieve Test, the Organic or Colorimetric Test and approximate Silt Test.

The first of these, mechanical analysis of aggregate is for the determination for the sizes of gravel and sand and consists of the sifting of the material thru several different sized sieves, (In this case thirteen in number) and then plotting upon the diagram the percentages by weight retained on each sieve. This test is necessary because experiment has developed definite laws establishing the relation of percentages and sizes of particles to maximum density and strength of concrete.

The organic test was as follows:

A twelve oz. graduated bottle was filled to the Four and one half Oz. mark with sand. A three per cent solution of Sodium hy-droxide was added until the volume of sand and hy-droxied after shaking, amounted to seven oz. After shaking thoroughly the solution was allowed to stand for twenty-four hours and the color observed. If the clear supernatant liquid was colorless or of a light yellow color the sand was considered satisfactorily in so far as organic impurities were concerned. If on the other hand, a dark colored solution, ranging from dark red to black was evident the gravel was rejected and this should not be used for concrete work unless those sands are subjected to the usual mortar strength tests.

The necessity for such a test is that organic matter on sand grains appear not only to prevent the cement from adhering but also to affect it chemically.

The third test that of determination of amount of silt in the gravel was but an approximate test. The approximate volumetric determination was made by measuring the thickness of the layer of fine material which settled on top of the sand in the organic test.

The necessity for the silt test is that this impurity causes injury to the mortar or concrete not only when it exists as a coating but is equally undesirable when it occurs in such amounts, or unequally distributed, that it's extremely fine grains "ball up" and stick together when wetted, so as to remain in lumps in the finished mortar or concrete. The allowable percentage of silt in gravel is ten to fifteen percent of the sand.

SPECIFICATIONS OF GRAVEL FOR GRAVEL ROADS, CONCRETE ROADS, ASPHALT ROADS, AND STORAGE DISPOSAL BEDS.

GRAVEL ROADS

The requirements of the Michigan Highway Department for gravel roads are the specifications used in this thesis. These state that all gravel used for surface work must pass a Two Inch screen and 75% of that must be retained on an #8 screen. Also that base gravel must pass a #2 screen and 60% of that be retained on an #8 screen. For second class road or resurfacing 60% gravel may be used.

CONCRETE PAVEMENT

In standard specifications for concrete pavement adopted by the American Concrete Institution, the fine aggregate is required to pass, when dry, a screen having $\frac{1}{4}$ inch openings. Not more than 20% is allowed to pass a sieve having fifty meshes per lineal inch. The coarse aggregate is specified as such as will pass a $1\frac{1}{2}$ inch round opening and will be retained on a screen having $\frac{1}{2}$ inch openings.

The joint committee recommends that not more than 30% of sand by weight shall pass a sieve having fifty meshes per lineal inch. The American Concrete Institute will be used for determination of values used in this thesis.

ASPHALTIC CONCRETE BASE

Material 95% of which passes a $2\frac{1}{2}$ inch screen and which is retained on a $\frac{1}{2}$ inch screen may be used as coarse aggregate. Fine aggregate should consist of sand and such portions of the coarse aggregate which passes a $\frac{1}{2}$ inch screen, so graded as to meet the following limitations:

<u>PASSING</u>	<u>RETAINED ON</u>	<u>PER CENT</u>
$\frac{1}{2}$ inch screen	10 mesh sieve	0 to 20
10 mesh sieve	40 mesh sieve	15 to 15
40 mesh sieve	80 mesh sieve	25 to 65
80 mesh sieve	200 mesh sieve	7 to 40
100 mesh sieve		0 to 6

ASPHALT CONCRETE

Fine aggregate shall pass $\frac{1}{2}$ inch screen and 30 to 70% of the gravel shall pass a 40 mesh sieve and not more than 10% shall pass a 200 mesh sieve. This is given by the U. S. Bureau of Public Roads for a class 2 concrete asphalted road. Coarse aggregate shall consist of broken stone and slag which will pass a $\frac{1}{2}$ inch screen. Gravel is not usually used for this. Sometimes it is required that 20% of the coarse aggregate be retained on a $\frac{1}{2}$ inch screen. Fine aggregate should pass a $\frac{1}{2}$ inch screen and 90% passing should be retained on a 200 mesh sieve. This is for class 3 asphaltic road and with the following grading is recommended by the U.S. Bureau of Public Roads.

<u>PASSING</u>	<u>RETAINED ON</u>	<u>PER CENT</u>
$\frac{1}{2}$ inch screen	$\frac{1}{2}$ inch screen	5 to 10
$\frac{1}{4}$ inch screen	10 mesh sieve	11 to 25
10 mesh screen	40 mesh screen	7 to 25
40 mesh screen	80 mesh screen	11 to 36
80 mesh screen		10 to 25
200 mesh screen		5 to 11

SHEET ASPHALT

Aggregate for sheet asphalt is required to pass a 10 mesh sieve. None of the gravels or sands considered here could be economically used for this purpose without extra screen. So it does not seem necessary to consider the sands for use in asphalt sheeting except that those sands which are considered good for asphaltic concrete could be used after screening for asphalt sheeting.

REMARKS ON RESULTS

The results in this thesis will be judged as nearly as possible from an economical standpoint. That is, if a pit contains gravel best fitted, as it stands, for gravel road construction, that gravel will not be considered as fitted for any other use, except to mention the qualifications it may have for other uses. The reason for this is that altho it could be made to fit other uses, to do that would involve more expense and from an economical stand-point would not be good engineering policy.

with the 1/2 inch of which passes a 25 inch screen and which is
 used as a 1/2 inch screen may be used as a coarse aggregate.
 The 1/2 inch material is used as a coarse aggregate and which is
 used as a 1/2 inch screen, as graded as to
 the following table:

PERCENT	GRADE	PERCENT
0 to 10	1/2 inch screen	100
10 to 15	3/4 inch screen	100
15 to 20	1 inch screen	100
20 to 25	1 1/2 inch screen	100
25 to 30	2 inch screen	100
30 to 35	2 1/2 inch screen	100
35 to 40	3 inch screen	100
40 to 45	3 1/2 inch screen	100
45 to 50	4 inch screen	100
50 to 55	4 1/2 inch screen	100
55 to 60	5 inch screen	100
60 to 65	5 1/2 inch screen	100
65 to 70	6 inch screen	100
70 to 75	6 1/2 inch screen	100
75 to 80	7 inch screen	100
80 to 85	7 1/2 inch screen	100
85 to 90	8 inch screen	100
90 to 95	8 1/2 inch screen	100
95 to 100	9 inch screen	100

TABLE

The material is used as a coarse aggregate and which is
 used as a 1/2 inch screen, as graded as to
 the following table:

PERCENT	GRADE	PERCENT
0 to 10	1/2 inch screen	100
10 to 15	3/4 inch screen	100
15 to 20	1 inch screen	100
20 to 25	1 1/2 inch screen	100
25 to 30	2 inch screen	100
30 to 35	2 1/2 inch screen	100
35 to 40	3 inch screen	100
40 to 45	3 1/2 inch screen	100
45 to 50	4 inch screen	100
50 to 55	4 1/2 inch screen	100
55 to 60	5 inch screen	100
60 to 65	5 1/2 inch screen	100
65 to 70	6 inch screen	100
70 to 75	6 1/2 inch screen	100
75 to 80	7 inch screen	100
80 to 85	7 1/2 inch screen	100
85 to 90	8 inch screen	100
90 to 95	8 1/2 inch screen	100
95 to 100	9 inch screen	100

TABLE

The material is used as a coarse aggregate and which is
 used as a 1/2 inch screen, as graded as to
 the following table:

The material is used as a coarse aggregate and which is
 used as a 1/2 inch screen, as graded as to
 the following table:

REMARKS ON TESTS

The results of this thesis will be based wholly on the tests made. It may be that other tests than those which have been made on the gravels considered, would tend to give negative results. But if the gravel meets the requirements of the Mechanical Analysis, the organic and the silt tests, it will be considered as fit for a gravel road, concrete road or asphalt road.

Weights and percentages retained on the
Number 4 screen and the number 8 screen.

<u>No. of Pit</u>	<u>Weight of Sample</u>	<u>Weight retained #4 screen</u>	<u>Weight retained #8 screen</u>	<u>Percent retained #4 screen</u>	<u>Percent retained #8 screen</u>	<u>Cumulative Percentages by weight</u>
1-1	6.0	2.0	0.5	33.3	8.3	41.6
1-2	6.5	4.5	0.5	68.2	7.7	75.9
2-1	9.5	2.5	1.5	26.7	15.8	42.5
2-2	9.5	1.5	1.5	15.8	15.8	31.6
3-1	14.0	6.3	1.0	44.6	7.2	51.8
4-1	7.0	1.5	1.3	21.4	18.9	40.3
4-2	9.0	1.0	0.75	11.1	8.3	19.4
5-1	12.5	7.0	2.5	56.0	20.0	76.0
5-2	8.0	2.5	1.0	31.2	12.5	43.7
6-1	7.0	4.5	1.0	64.2	14.3	78.5
6-2	12.0	6.5	1.5	54.1	12.5	66.6
6-3	7.5	3.5	1.0	50.0	13.2	63.2
7-1	10.0	4.5	1.0	45.0	1.0	46.0
8-1	11.5	7.0	1.5	56.2	13.0	69.2
9-1	7.0	2.5	1.5	35.6	21.4	57.0
10-1	9.0	3.0	2.0	33.3	17.5	50.5
11-1	10.0	6.0	1.5	60.0	15.0	75.0
12-1	6.0	2.0	1.0	33.3	16.6	49.9
13-1	9.0	3.5	1.0	38.8	11.5	50.3
14-1	8.0	1.5	0.5	16.8	6.3	23.1
15-1	9.0	4.5	1.5	50.0	16.6	66.6
16-1	9.0	3.5	1.2	37.8	13.3	51.1
16-2	8.0	4.0	1.0	50.0	12.5	62.5
17-1	7.0	3.0	1.0	42.8	14.3	57.1
17-2	10.0	4.0	1.0	40.0	10.0	50.0
17-3	6.5	3.0	0.75	46.0	11.0	57.0
18-1	7.0	3.5	1.0	46.7	13.3	60.0
19-1	7.0	4.0	1.0	57.2	14.3	71.5
20-1	8.0	0.5	0.5	6.3	6.2	12.5
20-2	7.0	1.5	1.0	23.6	14.3	37.9
21-1	10.0	5.0	1.5	50.0	15.0	65.0
21-2	9.0	4.0	1.5	44.6	16.7	61.3
21-3	8.5	4.0	1.5	47.1	17.6	64.7
22-1	8.5	3.0	2.0	35.3	23.6	58.9
23-1	9.0	5.0	2.0	55.0	22.2	77.2
23-2	9.0	2.0	1.5	22.2	16.6	38.8
23-3	7.5	2.5	1.5	33.4	20.0	53.4
25-1	8.0	3.0	1.5	37.5	18.8	56.3
26-1	7.5	4.5	1.0	60.0	13.3	73.3
27-1	9.5	4.0	1.5	42.1	14.8	56.9
27-2	7.5	3.0	1.5	40.0	20.0	60.0
28-1	8.0	2.0	1.0	25.0	12.0	37.5
29-1	8.0	3.5	1.0	43.8	12.5	56.3
29-2	8.0	3.5	1.3	43.8	15.6	59.4
30-1	7.5	5.0	1.0	66.7	13.3	80.0
31-1	8.0	5.0	1.0	62.5	12.5	75.1
31-2	10.0	5.5	1.5	55.0	15.0	70.0
32-1	9.0	4.5	1.0	50.0	11.1	61.1
33-1	6.0	1.0	0.5	15.0	8.3	23.3
34-1	6.0	5.0	0.5	83.4	8.3	91.7
34-2	8.5	3.5	2.0	41.2	23.5	64.7
34-3	8.0	0.25	0.5	3.2	6.3	9.5
35-1	6.0	2.0	1.0	33.3	16.6	49.9
35-2	7.5	2.0	1.5	26.6	20.0	50.0
35-3	13.5	8.0	1.5	59.2	11.1	70.3
36-1	9.0	4.0	1.5	44.4	16.6	61.0

PIT NUMBER-I-

Sample-1-

From pit number one two samples were taken there seemingly being two distinct grades of gravel. Sample one as indicated on the diagram is entirely useless as a gravel for gravel road construction, there being only thirty-three (33%) retained on a #8 screen. Since the sample showed that it contained very much organic matter it would not be advisable for use in concrete construction. Sample one showed about 8% silt which is less than allowable for use in concrete construction.

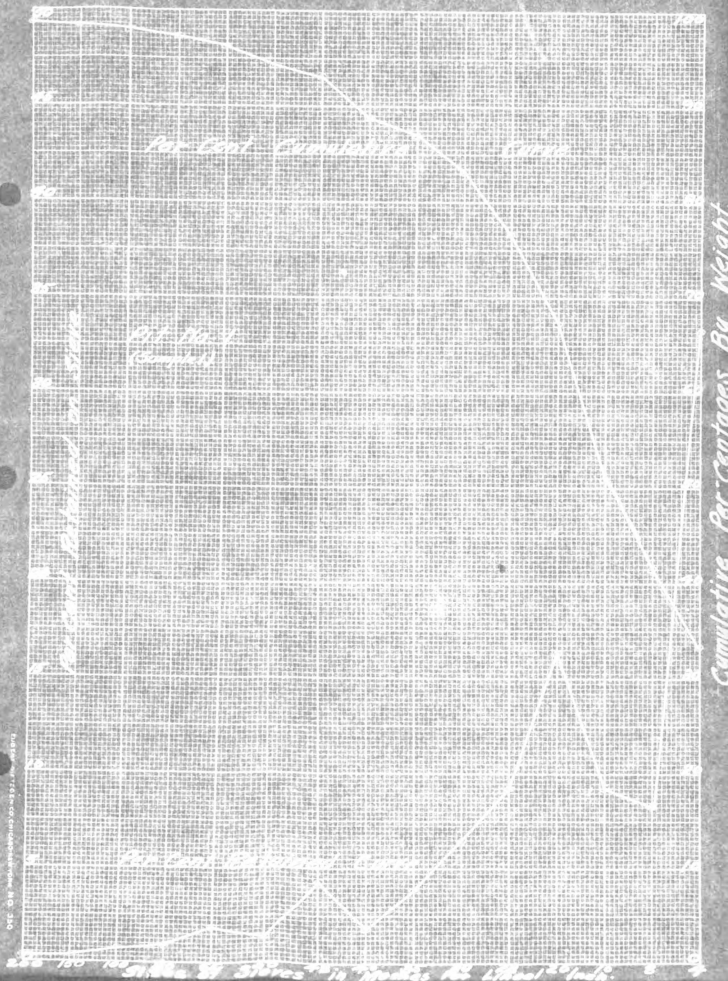
The following is a data obtained from the Mechanical Analysis of the gravel and sand:

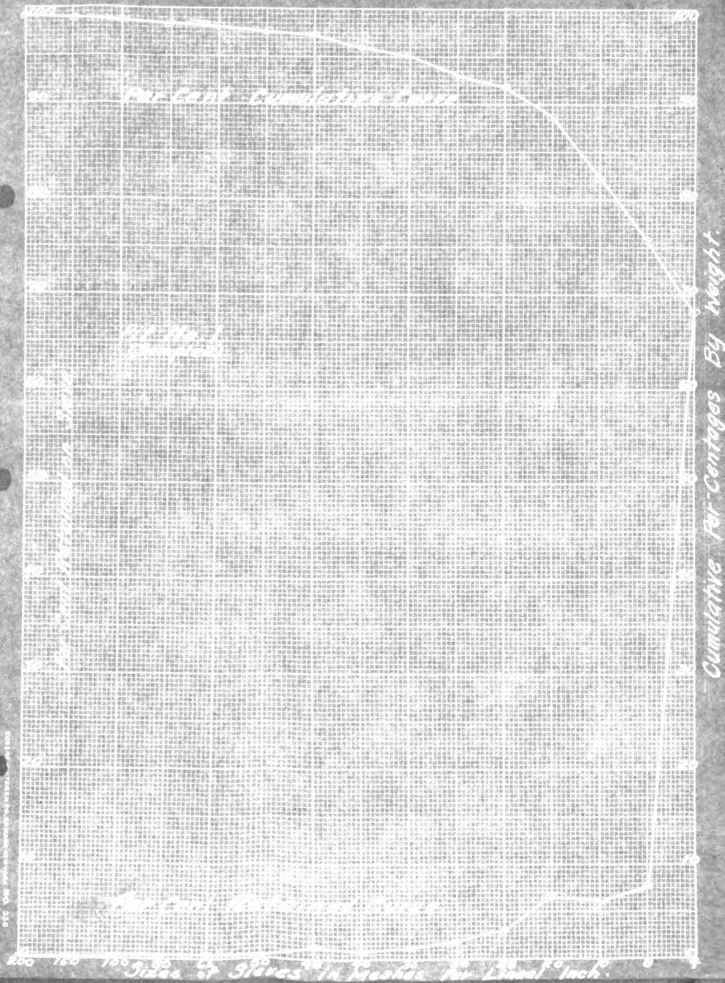
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			33.3	33.3
8			8.3	41.6
10	62.9	15.6	9.3	50.9
20	112.9	27.8	16.4	67.3
28	63.6	15.7	9.3	76.6
30	44.3	10.9	6.6	83.1
35	27.2	6.7	3.9	87.0
40	18.8	2.9	1.8	88.8
48	29.0	7.2	4.3	93.1
50	8.5	2.1	1.3	94.4
65	12.9	3.2	1.9	96.3
80	6.4	1.6	0.9	97.2
100	5.2	1.3	0.8	98.0
150	2.4	0.6	0.4	98.4
200	2.1	0.5	0.3	98.7
Passing 200	7.5	1.8	1.3	100.0
	403.7			

Sample -2-

This sample was a better quality than sample one. It tested very good for gravel road construction, 75% being retained on a #8 screen. The sample showed much organic matter so that it would be useless to consider it for concrete work. It contained about 2% silt. The following is the Mechanical Analysis data:

4			68.2	68.2
8			7.7	75.9
10	99.1	26.6	6.3	82.2
20	103.5	27.6	6.6	88.8
28	49.3	13.2	3.1	91.9
30	31.5	8.8	2.0	93.0
35	18.5	4.9	1.2	95.1
40	13.5	3.6	0.8	95.9
48	21.5	5.7	1.4	97.3
50	5.7	1.5	0.3	97.6
65	10.2	2.7	0.6	98.1
80	5.5	1.5	0.4	98.5
100	5.1	1.4	0.3	98.8
150	4.0	1.0	0.2	99.0
200	4.0	1.0	0.2	99.2
Passed 200	12.9	3.4	0.8	100.0
	374.2			





Sample 1

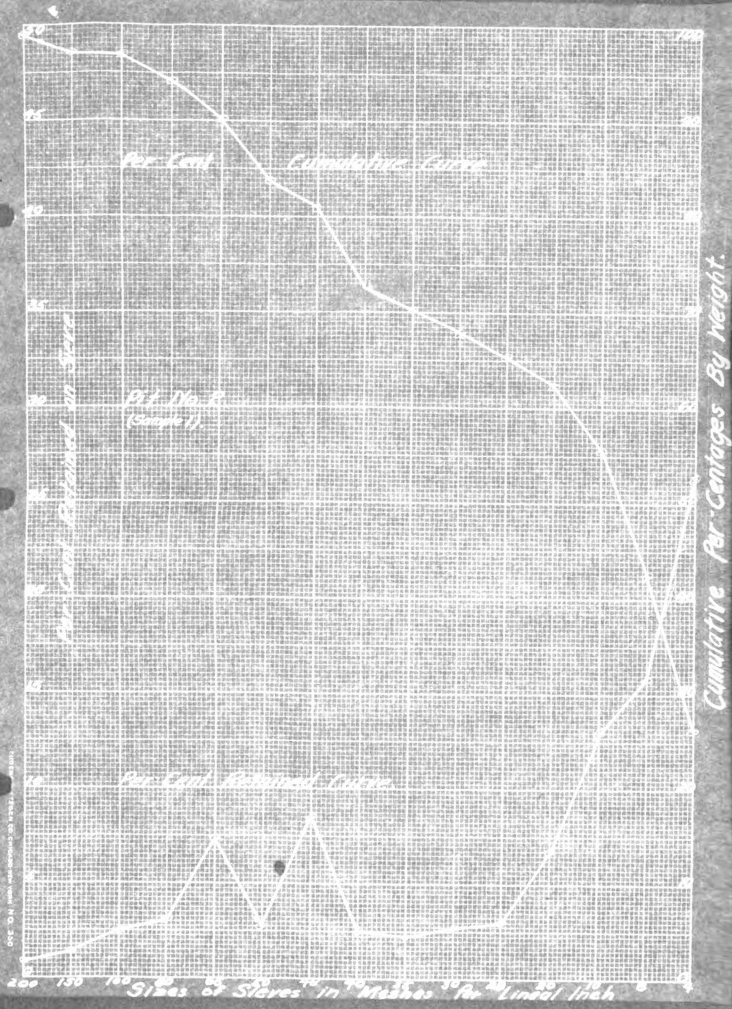
This sample showed a great deal of organic matter and a very high percentage of silt. So as far as concrete construction is concerned this gravel could not be used for the same. The percentage retained on a #8 inch screen being only 42%, the requirements for road gravel are not met this might be used however as maintenance gravel on light traffic roads such as campus or park drives. The following is a Mechanical Analysis data:

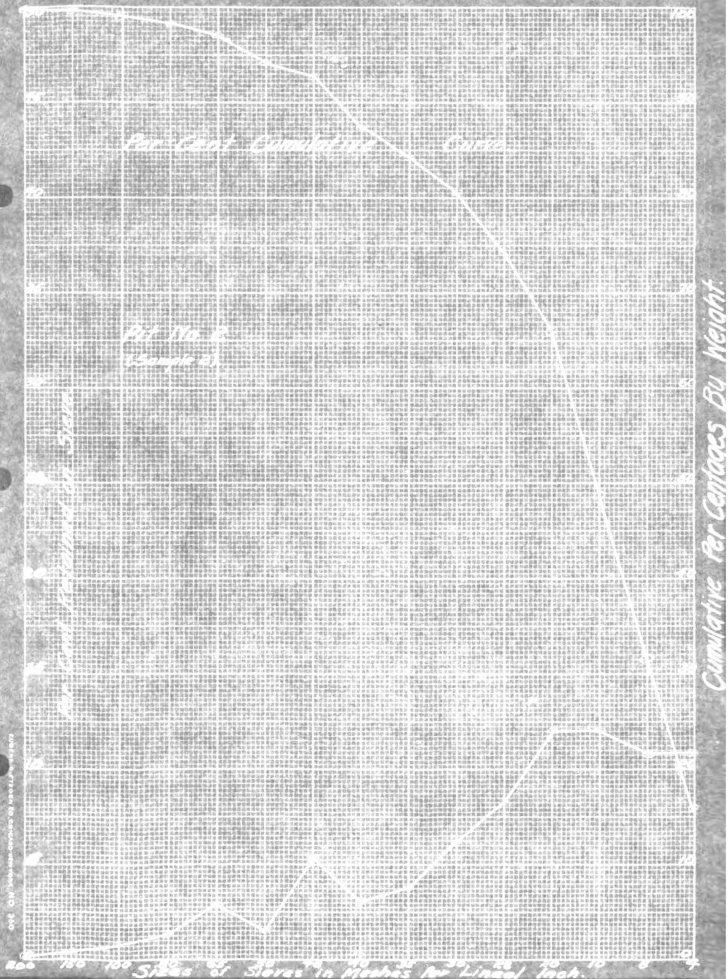
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>% Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			26.7	26.7
8			15.8	42.5
10	85.9	22.6	13.0	55.5
20	44.5	11.9	6.3	62.3
28	19.5	5.2	3.0	65.3
30	17.2	4.7	2.7	68.0
38	14.7	3.9	2.2	70.2
40	16.5	4.4	2.5	72.5
48	54.6	14.7	8.5	81.0
50	18.4	4.9	2.8	83.8
65	47.5	12.7	7.3	91.1
80	20.1	5.4	3.1	94.2
100	16.3	4.4	2.5	96.7
150	8.5	2.3	1.4	98.1
200	5.8	1.5	0.9	99.0
Passed 200	5.0	2.0	0.9	100.0
	<u>372.5</u>			

Sample 2

This sample tested free of organic material and but one percent silt so that since all but 16 % passed a #4 screen the gravel can be used as fine aggregate in concrete construction as well as in asphalt concrete. The following is a Mechanical Analysis data:

4			15.8	15.8
8			15.8	31.6
10	142.5	24.8	17.1	48.7
20	144.6	25.2	17.3	66.0
28	70.3	12.2	8.3	74.3
30	51.4	8.9	6.2	80.5
38	32.9	5.7	3.8	84.3
40	24.9	4.4	3.1	87.4
48	49.2	7.8	5.3	92.7
50	11.7	2.0	1.5	94.2
65	24.6	4.3	2.9	97.1
80	10.1	1.8	1.3	98.4
100	6.6	1.2	0.8	99.2
150	2.9	0.5	0.4	99.6
200	1.5	0.3	0.2	99.8
Passed 200	1.3	0.2	0.2	100.0
	<u>874.5</u>			



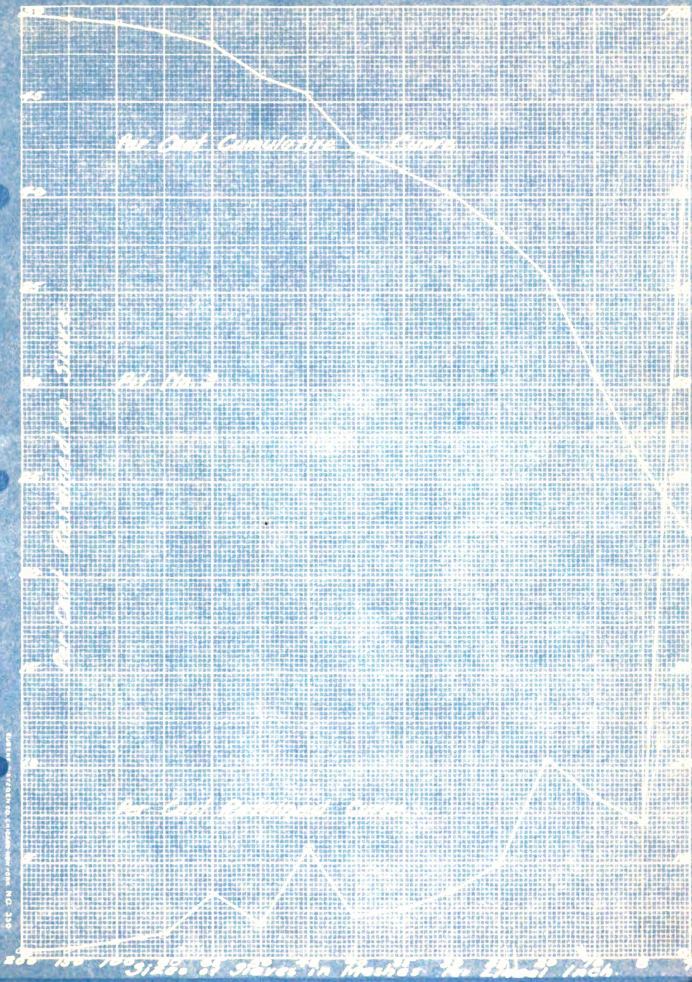


PIT NUMBER 3

Sample 1

The gravel from this pit showed a slight percentage of organic material but not enough to make it useless for concrete and it also contained only about 2% silt. About 52% was retained on a number 8 screen which would make it not only useful for concrete, Asphalt concrete, asphalt sheeting but also for use in maintenance of gravel roads. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			44.6	52.8
8			7.2	51.8
10	128.7	19.4	9.4	61.2
20	143.9	21.6	10.4	71.6
28	69.2	10.4	5.0	76.6
30	50.1	7.6	3.6	80.2
35	36.2	5.4	2.6	82.8
40	32.9	4.7	2.3	85.1
48	80.5	12.1	5.8	90.9
60	20.2	3.5	1.8	92.7
65	45.1	6.8	3.4	96.1
80	17.6	2.6	1.3	97.4
100	12.9	1.9	0.9	98.3
150	7.2	1.0	0.5	98.8
200	5.5	0.8	0.4	99.2
Passed 200	12.5	1.7	0.8	100.0
	<u>662.5</u>			



Cumulative Per-Centages By Weight

PIT BULDER 4

Sample 1

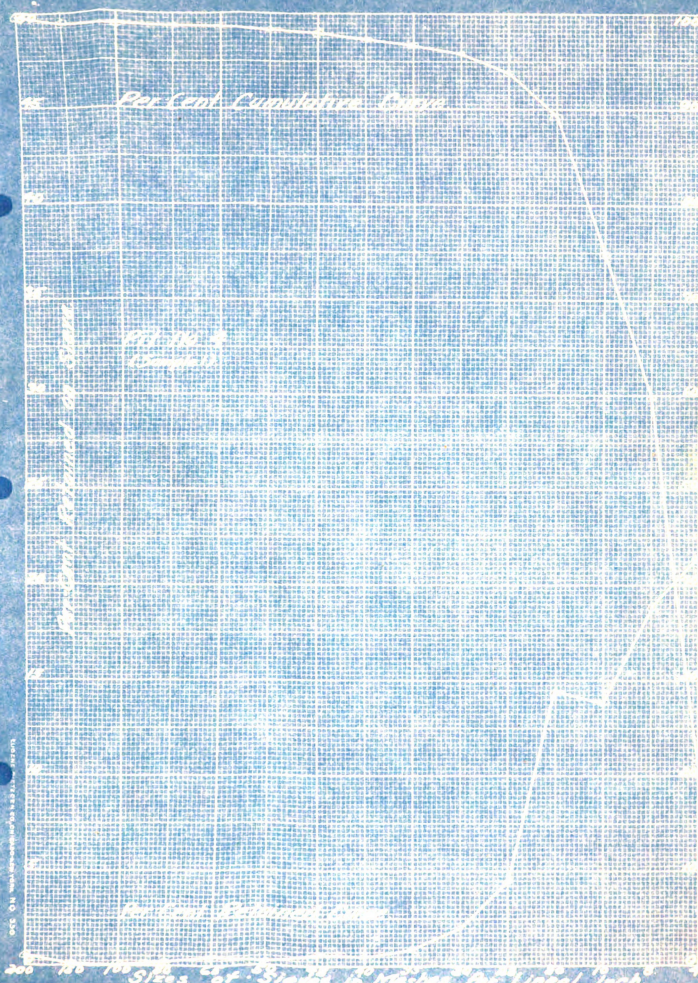
This sample passed a good organic test being almost free from that material and contained only about 1% silt about 20% was retained on a #4 screen and about 60% retained on a #8 screen. So the gravel of this pit can be used as fine aggregate for concrete or in construction of base of gravel roads or in maintenance work on gravel roads. The following is the Mechanical Analysis data:

<u>No. of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>% Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			21.4	21.4
8			18.9	40.3
10	162.8	33.8	19.9	60.2
20	174.0	35.6	21.2	81.4
28	32.2	11.2	6.9	88.3
30	23.8	5.1	3.1	91.4
35	9.6	2.0	1.2	92.6
40	6.3	2.1	1.3	93.9
48	8.0	1.9	1.2	95.1
50	1.8	0.7	0.4	95.5
65	5.4	0.9	0.5	96.0
80	3.4	0.6	0.5	96.5
100	2.8	0.6	0.4	96.9
200	2.6	0.4	0.4	97.3
200	2.6	0.4	0.4	97.7
Passed 200	5.5	1.1	0.8	98.5

Sample 2

About 70% passed $\frac{1}{2}$ inch screen which might indicate a gravel for concrete construction. But due to the amount of organic matter in it, it would not be best to use it for such work. The silt in this gravel was low containing only about 2%. So the best use to which this could be put would be for maintenance work on gravel roads provided it could be used with sample 1. The following is the Mechanical Analysis data:

4			11.1	11.1
8			8.3	19.4
10	55.5	11.1	8.4	27.8
20	141.6	28.7	23.2	51.0
28	114.9	23.2	18.6	69.6
30	74.3	15.0	12.1	81.7
35	35.6	7.2	5.8	87.5
40	21.9	4.4	3.8	91.3
48	28.0	5.6	4.5	95.8
50	6.7	1.3	1.1	96.9
65	8.8	1.7	1.4	98.3
80	3.6	0.6	0.6	98.9
100	2.1	0.3	0.2	99.1
150	1.1	0.2	0.2	99.3
200	1.1	0.2	0.2	99.5
Passed 200	3.3	0.6	0.5	100.0
	<u>498.5</u>			



United States Geological Survey, N.O. 350

200 100 100 Sieves of Sizes in Meshes Per Linear Inch

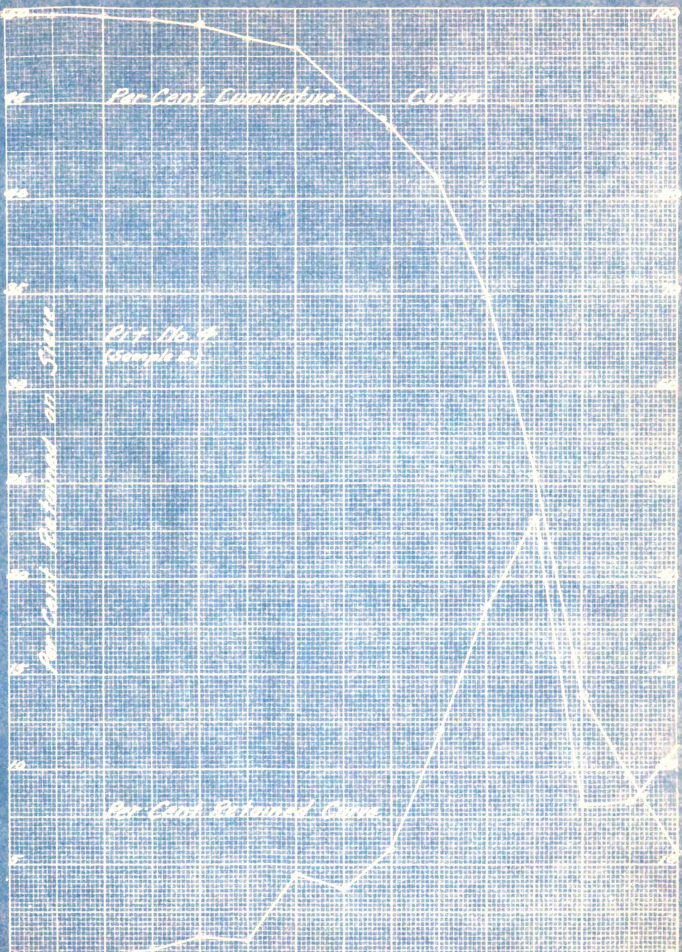
Per Cent Cumulative

Curve

Per Cent Retained
Curve

Per Cent Retained on Sieve

Cumulative Per Centages By Weight



PIT NUMBER 5

Sample 1

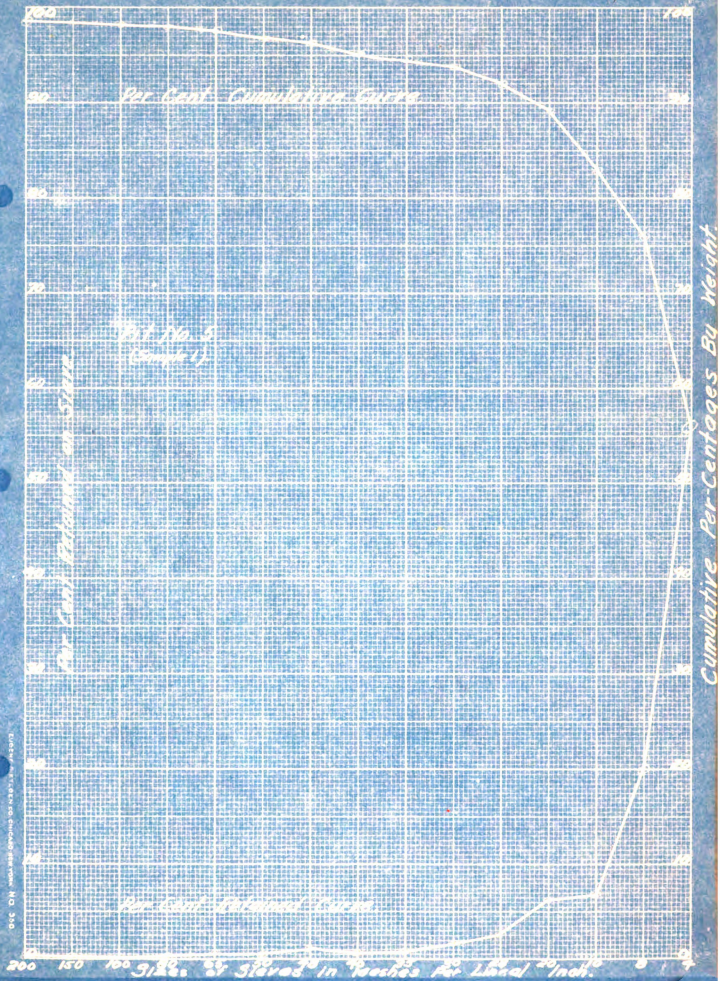
This sample tested high in organic matter as well as being high in silt. Silt amounted to about 15%. This data would indicate the uselessness of considering the use of this gravel for concrete or asphalt construction. The sample tested high as a road gravel 76% being retained on the #8 screen. The following is the Mechanical Analysis data:

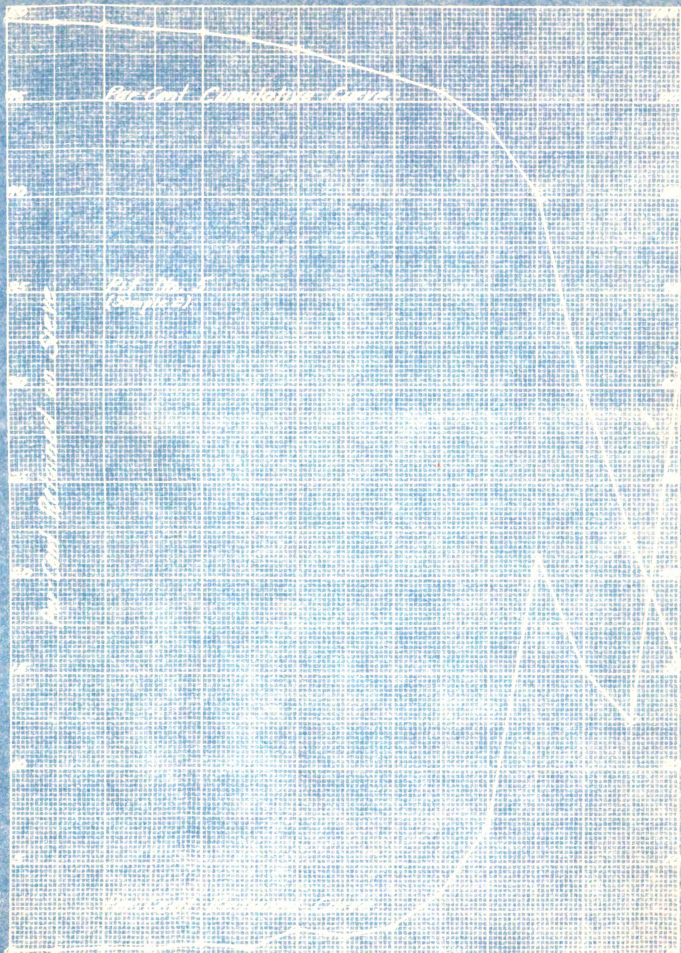
<u>No of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			56.0	56.0
8			20.0	76.0
10	68.5	28.6	6.9	82.9
20	63.3	26.4	6.3	89.2
28	30.2	11.6	2.8	92.0
30	16.9	7.1	1.7	93.7
35	6.3	3.4	0.8	94.5
40	6.3	2.6	0.6	95.1
48	13.5	5.6	1.3	96.4
50	5.0	2.1	0.5	96.9
65	7.0	2.9	0.7	97.6
80	3.8	1.6	0.4	98.0
100	3.0	1.2	0.3	98.3
150	1.7	0.7	0.2	98.5
200	2.2	0.9	0.3	98.8
Passed 200	10.2	4.2	1.2	100.0
	<u>239.9</u>			

Sample 2

About 70% passed #4 screen which might indicate a gravel for concrete work. But due to organic matter in this gravel it would not be best to use it for such. The silt in this gravel is low containing only about 2%. So the best use to which this gravel could be put would be for maintenance work on gravel roads provided it could be used with sample 1. The following is the Mechanical Analysis:

4			31.2	31.2
8			12.5	43.7
10	114.7	28.6	15.2	59.3
20	150.9	37.7	21.2	80.3
28	50.3	12.5	6.9	87.2
30	25.5	6.5	3.8	91.0
35	11.9	2.9	1.7	92.7
40	7.5	1.9	1.2	93.9
48	11.4	2.8	1.6	95.5
50	3.9	0.9	0.6	96.1
65	5.4	1.3	0.8	96.9
80	3.5	0.9	0.6	97.5
100	3.0	0.7	0.5	98.0
150	1.8	0.5	0.4	98.4
200	1.9	0.5	0.4	98.8
Passed 200	7.7	1.9	1.2	100.0
	<u>399.4</u>			





200 1. 11 Sides of Sides in "Washes" for Linkel Truck

Sample 1

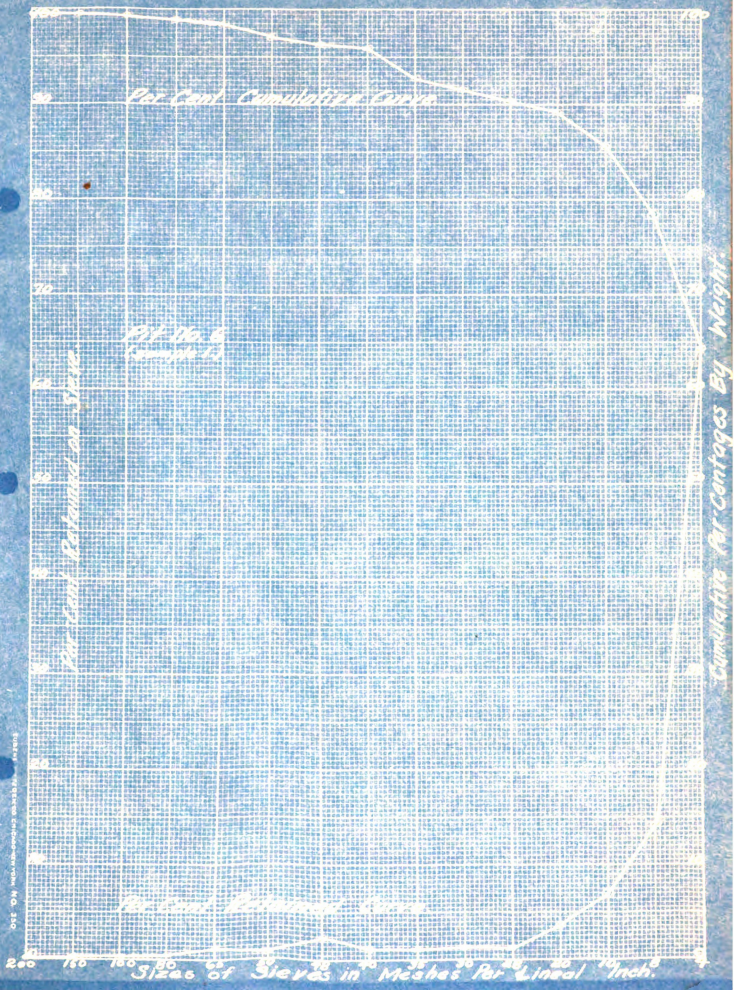
This gravel tested free of organic matter and contained only about 2% silt. Mechanical Analysis showed a #4 screen to retain 65% and a #8 screen to retain 78% , so that the best use to which this gravel could be put would be in the construction of gravel roads. The following is the Mechanical Analysis data:

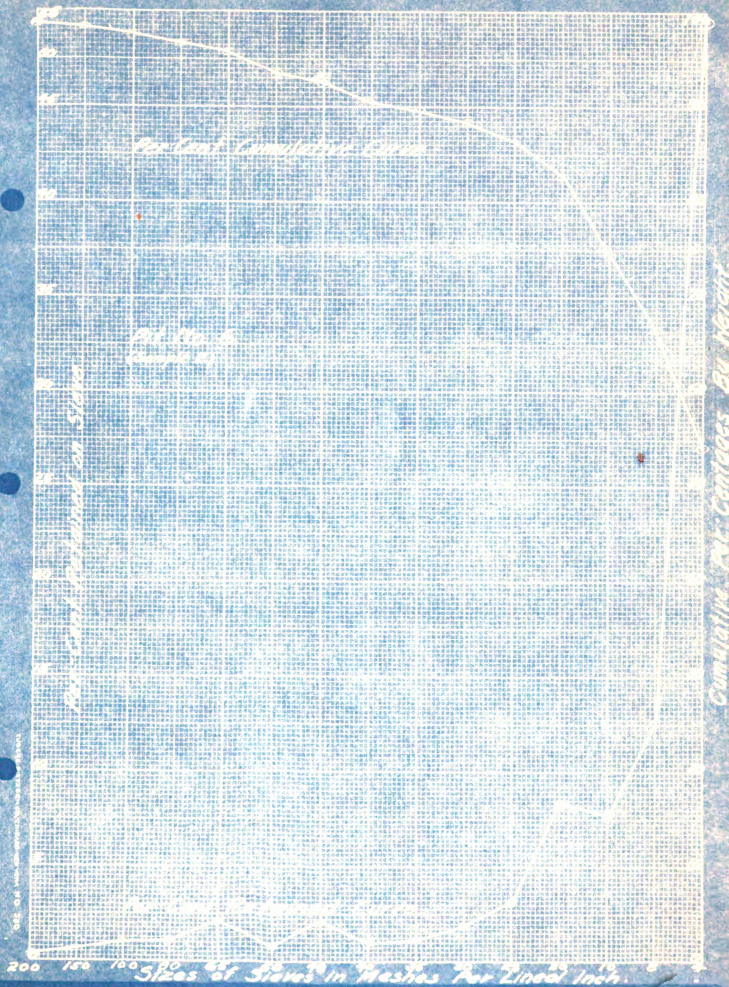
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			64.2	64.2
8			14.3	78.5
10	129.7	32.6	7.0	85.5
20	65.7	16.6	3.6	89.1
28	23.1	5.8	1.2	90.3
30	24.1	6.1	1.3	91.6
35	21.9	5.6	1.2	92.8
40	22.0	5.6	1.2	94.0
48	43.7	11.1	2.4	96.4
50	14.2	3.6	0.8	97.2
65	23.6	5.9	1.3	98.5
80	9.8	2.4	0.5	99.0
100	6.6	1.6	0.3	99.3
150	3.7	0.9	0.2	99.5
200	2.7	0.7	0.1	99.6
Passed 200	6.7	1.7	0.4	100.0
	<u>397.5</u>			

Sample 2

This sample also was free from organic material and contained about 4% silt. The #4 screen retained 55% and the #8 screen contained 66%. This gravel could be used for gravel road construction, for resurfacing as well as being good gravel for construction of base of gravel road. The following is the Mechanical Analysis data:

4			54.1	54.1
8			12.5	66.6
10	89.5	23.3	7.8	74.5
20	97.0	25.2	8.4	82.9
28	38.7	10.5	3.5	86.3
30	22.3	5.8	1.9	88.3
35	14.0	3.6	1.2	89.5
40	11.5	2.9	0.9	90.5
48	25.3	6.5	2.2	92.7
50	9.8	2.6	0.8	93.5
65	24.4	6.3	2.1	95.6
80	13.3	3.3	1.1	96.7
100	11.3	2.9	0.9	97.7
150	6.9	2.0	0.7	98.4
200	5.5	1.4	0.4	98.8
Passed 200	15.6	4.0	1.2	100.0
	<u>385.1</u>			



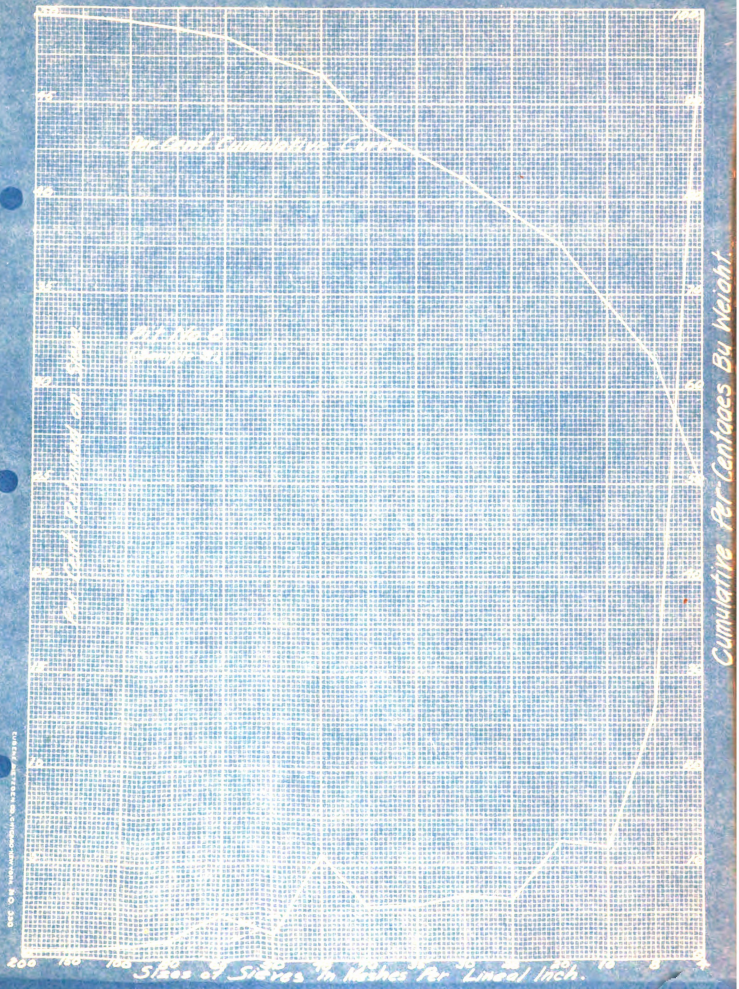


PIT #6 CONTINUED.

Sample 3

This sample showed both a high percentage of organic material and also silt material. The percentage of silt amounted to about 20%. Due to this and to the screen analysis, which showed 50% on a #4 screen and 62% on a #8 screen, the gravel is best suited for gravel road construction either base or surface and can also be used for maintenance of gravel roads. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Summative Percentages by Weight</u>
4			50.0	50.0
8			13.2	63.2
10	49.5	16.3	6.0	69.2
20	50.3	16.5	6.2	75.4
28	26.6	8.7	3.2	78.6
30	27.7	9.1	3.4	82.0
35	24.3	7.9	2.9	84.9
40	22.8	7.5	2.8	87.7
48	45.3	14.8	5.5	93.2
50	12.1	3.9	1.4	94.6
65	19.3	6.3	2.3	96.9
80	8.7	2.6	1.0	97.9
100	5.8	1.9	0.7	98.6
150	3.2	1.1	0.4	99.0
200	2.5	0.8	0.3	99.3
Passed 200	6.0	1.9	0.7	100.0
	<u>304.1</u>			



PIT NUMBER 7

Sample 1

The gravel from this pit tested free from organic matter and contained silt to the amount about 10%. Since only about 46% was retained on the #8 screen it would seem that this gravel would be rather poor for road gravel and would have to be screened for fine aggregate in concrete and asphalt concrete construction. It might be used for gravel road maintenance although it is below specifications. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			45.0	45.0
8			1.0	46.0
10	90.6	25.6	13.8	59.8
20	105.0	29.8	16.1	75.9
28	40.1	11.3	6.1	82.0
30	23.8	6.8	3.6	85.6
35	13.6	3.9	2.0	87.7
40	10.0	2.8	1.5	89.2
48	17.9	5.1	2.7	91.9
50	5.8	1.7	0.9	92.8
65	7.7	2.2	1.2	94.00
80	4.2	1.2	0.6	94.7
100	4.1	1.2	0.6	95.4
150	2.5	0.7	0.4	95.7
200	4.2	1.2	6.4	96.5
Passed 200	22.5	6.4	3.5	100.0
	<u>352.3</u>			

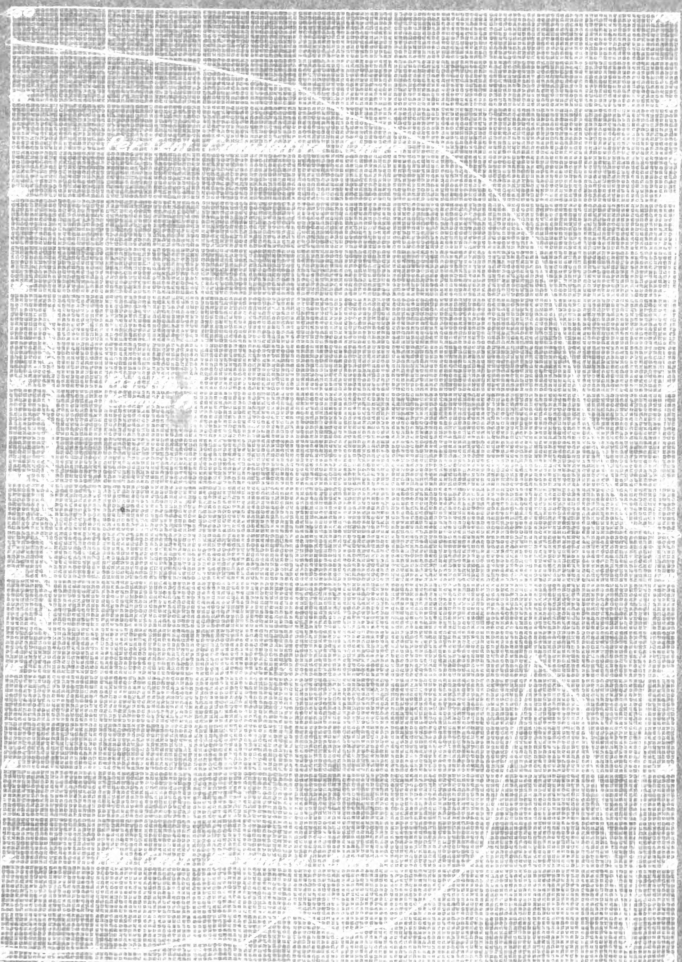
500 100 1000 Slices of 1/2 inch thick for 1 inch thick

Per Unit Cumulative Error

0.000000

Per Unit Cumulative Error

Cumulative Per Centiles For Weight



PIT NUMBER 8

Sample 1

This gravel showed very little organic material and was passed as fit to use in concrete it tested about 7 % silt. The Mechanical Analysis gave 56 % retained on a #4 screen and 69% on the #3 screen which would indicate that the gravel might be best used for gravel road construction. The gravel from this pit at present is being used for that purpose. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			56.2	56.2
8			13.0	69.2
10	99.2	28.7	8.9	78.1
20	94.1	27.4	8.5	86.6
28	40.5	11.7	3.6	90.2
30	26.7	7.8	2.3	92.5
35	17.4	5.0	1.5	94.0
40	13.0	3.7	1.1	95.1
48	21.5	6.2	1.9	97.0
50	6.2	1.8	0.6	97.6
65	8.9	2.5	0.8	98.4
80	4.1	1.2	0.5	98.9
100	3.3	0.9	0.3	99.2
150	2.0	0.5	0.1	99.3
200	2.1	0.5	0.1	99.4
Passed 200	7.0	2.1	0.6	100.0
	<u>346.0</u>			

Percent Retained on Sieve

Percent Cumulative Percent

Percent Retained on Sieve

Percent Retained on Sieve

Sizes of Sands in Inches for Liquid Inch

Percent Retained on Sieve

PIT NUMBER 9

Sample 1

This gravel tested as containing organic material and also showed about 9% silt. Mechanical Analysis showed about 36% retained on a #4 screen and about 57% retained on a #8 screen. The organic matter in the gravel makes it useless for concrete construction so that it would seem that this sample would be best fitted for gravel road base construction or for maintenance of gravel roads. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			35.6	35.6
8			21.4	57.0
10	111.1	32.7	14.1	71.1
20	96.6	28.4	12.3	83.4
28	31.1	9.1	3.9	87.3
30	16.3	4.5	1.9	89.2
35	11.4	3.6	1.5	90.7
40	7.9	2.3	1.0	91.7
48	13.0	3.8	1.6	93.3
50	2.5	0.7	0.3	93.6
65	7.2	2.1	0.9	94.5
80	4.7	1.4	0.6	95.1
100	5.1	1.5	0.6	95.7
150	4.3	1.2	0.5	96.2
200	5.8	1.7	0.7	96.9
Passed 200	24.3	7.1	3.1	100.0
	<u>340.3</u>			

PIT NUMBER 10

Sample 1

This gravel tested free of organic matter which showed a very high percentage of silt, the amount being about 20% to 25%. This latter would make the gravel useless for concrete construction. The Mechanical Analysis showed about 32% retained on a #4 screen and 51% on the #8 screen. Thus it would seem that the gravel from this pit could be best used for maintenance of gravel roads. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>% Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			33.3	33.3
8			17.5	50.5
10	113.8	39.6	19.2	69.7
20	57.0	19.4	9.6	79.3
28	12.0	4.1	2.0	81.3
30	8.6	2.9	1.4	82.7
35	7.7	2.6	1.3	84.0
40	5.2	2.1	1.0	85.0
48	11.8	4.0	2.0	87.0
50	4.7	1.6	0.8	87.8
65	8.6	2.9	1.4	89.2
80	4.8	1.6	0.8	90.0
100	4.6	1.6	0.7	90.7
150	3.5	1.2	0.6	91.3
200	4.9	1.7	0.7	92.0
Passed 200	45.5	16.2	8.0	100.0
	<u>293.7</u>			

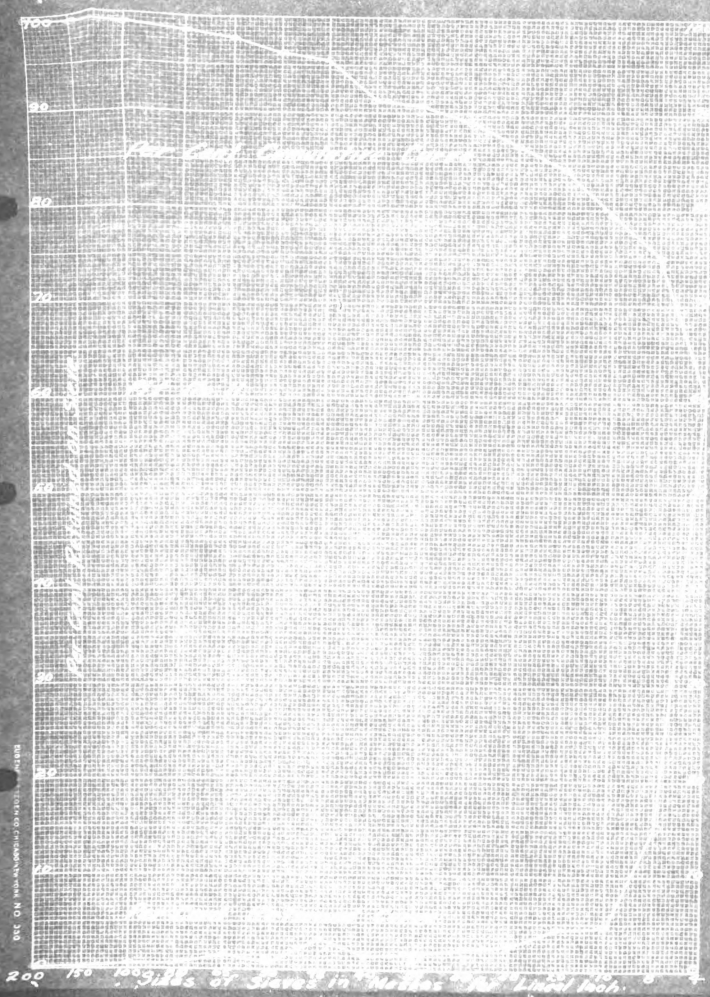


Sample 1

This gravel tested free of organic matter and showed silt present to the amount of about 10%. The Mechanical Analysis showed the #4 screen to retain 60% and the #8 to retain about 75%. This would indicate that the gravel could be best used for road gravel construction.

This pit had a great deal of over size so that our sample was not as representative as sample as it ought to have been and in order to get the gravel suited for gravel road construction much of the over size would have to be thrown out. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			60.0	60.0
8			15.0	75.0
10	94.8	18.6	4.6	79.6
20	93.5	18.3	4.5	84.1
28	52.4	10.3	2.6	86.7
30	45.9	9.0	2.3	89.0
35	34.2	6.7	1.7	90.7
40	30.5	5.9	1.5	92.2
48	62.7	13.2	3.3	95.5
50	15.5	3.0	0.7	96.2
65	34.7	6.3	1.6	97.8
80	14.5	2.8	0.7	98.5
100	11.0	2.2	0.6	99.1
150	7.3	1.4	0.3	99.4
200	5.0	0.9	0.2	99.6
Passed 200	8.5	1.7	0.4	100.0
	<u>510.4</u>			



PIT NUMBER 12

Sample 1

The gravel from this pit contained a very high percentage of organic matter and showed about 5% silt. The Mechanical Analysis showed the #4 screen to retain about 33% and the #8 screen to retain about 50%. This showed the gravel to be of poor quality throughout and could be used for nothing except maintenance of gravel roads. But even this could not be done for the pit was practically worked out. However, the land or hill adjacent to the pit seemed to contain a gravel of about the same nature as that of the pit. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			33.3	33.3
8			16.6	49.9
10	165.0	38.4	19.2	69.1
20	133.1	31.0	15.5	84.6
28	44.1	10.2	5.1	89.7
30	26.5	6.2	3.5	93.2
35	16.3	3.8	1.9	95.1
40	10.3	2.4	1.1	96.2
48	15.4	3.6	1.7	97.9
50	2.9	0.7	0.4	98.3
65	5.0	1.2	0.6	98.9
80	1.9	0.4	0.2	99.1
100	1.8	0.4	0.2	99.3
150	1.1	0.3	0.1	99.4
200	1.3	0.2	0.1	99.5
Passed 200	4.4	1.0	0.5	100.0
	<u>429.1</u>			

Sample 1

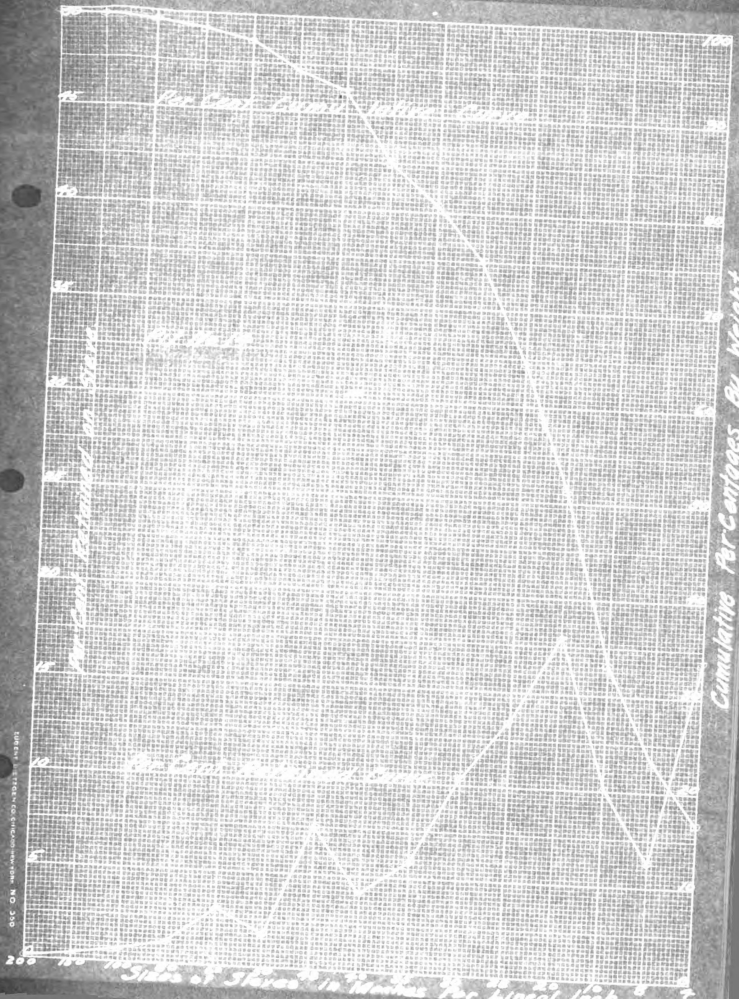
The gravel from this pit contained a high percentage of organic matter and showed silt present to the amount of about 6%. The Mechanical Analysis showed the number 4 screen to retain 39% and the #8 screen to retain 51%. Due to the presence of organic matter the gravel cannot be used for concrete and the sieve test would indicate the gravel best suited for maintenance of gravel roads. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			38.8	38.8
8			11.5	50.3
10	115.2	24.4	12.1	62.4
20	137.0	29.1	14.5	76.9
28	77.0	16.4	8.2	85.1
30	53.3	11.8	5.9	91.0
35	26.4	5.5	2.7	93.7
40	16.1	3.2	1.6	95.3
48	20.3	4.5	2.2	97.5
50	4.0	0.8	0.4	97.9
65	6.2	1.3	0.6	98.5
80	2.6	0.5	0.2	98.7
100	2.6	0.5	0.3	99.0
250	1.6	0.3	0.2	99.2
200	1.7	0.3	0.2	99.4
Passed 200	6.4	1.3	0.6	100.0
	<u>469.4</u>			

Sample 1

The gravel from this pit showed a very high percentage of organic material which indicated the gravel useless for concrete construction. Silt was present to the amount of about 2%. Mechanical Analysis showed the #4 screen to retain about 17 % and the #8 screen to retain about 23%. This screen test would indicate the sample as concrete gravel but due to the organic matter present it could not be used for such. So from the above data it would seem that the gravel in this pit is practically useless. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			16.8	16.8
8			6.3	23.1
10	83.5	13.2	10.1	33.2
20	146.9	23.2	17.9	51.1
28	111.5	17.5	13.5	64.6
30	86.7	13.6	10.4	75.0
35	47.4	7.5	5.8	80.8
40	34.2	5.4	4.2	85.0
48	62.6	9.8	7.5	92.5
50	13.9	2.2	1.7	94.2
65	26.2	4.0	3.1	97.3
80	10.2	1.6	1.2	98.5
100	5.6	0.9	0.7	99.2
150	2.6	0.4	0.3	99.5
200	1.9	0.3	0.2	99.7
Passed 200	2.7	0.4	0.3	100.0
	<u>635.9</u>			

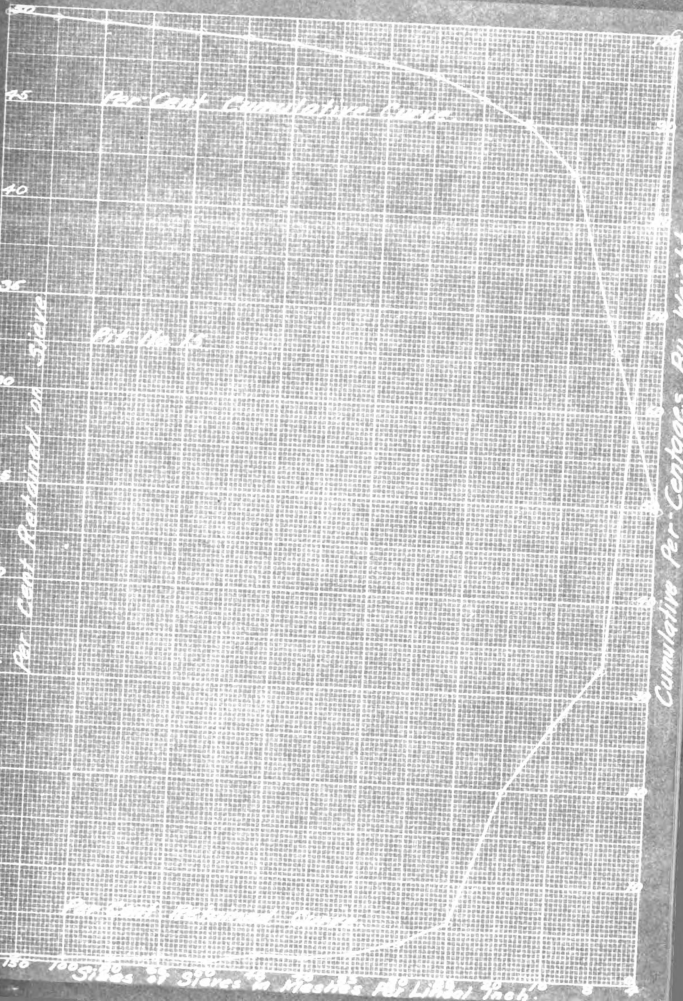


PIT NUMBER 15

Sample 1

The gravel from this pit tested free from organic matter and showed silt present to the amount of about 6% Mechanical Analysis showed the #4 screen to retain 50% and the #8 screen to retain 67%. This would indicate that altho the gravel could be used for concrete construction it could be best used for gravel road construction. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			50.0	50.0
8			16.6	66.6
10	233.1	40.4	13.4	80.0
20	171.4	29.6	9.9	89.9
28	51.9	8.9	2.8	92.3
30	30.5	5.3	1.8	94.6
35	19.2	3.3	1.1	95.7
40	13.0	2.3	0.8	96.5
48	14.0	2.4	0.8	97.3
50	7.2	1.2	0.4	97.7
65	11.6	2.0	0.6	98.3
80	5.9	1.0	0.3	98.6
100	4.8	0.8	0.3	98.9
150	3.4	0.6	0.3	99.2
200	3.1	0.5	0.2	99.4
Passed 200	9.6	1.7	0.5	99.9
	<u>578.7</u>			



Sample 1

This sample of gravel tested high in organic matter it also tested very high in silt. The silt contained in this gravel amounted to nearly 40% of the sand. The Mechanical Analysis showed the #8 screen to retain 50%. The above data would indicate the gravel as best fitted for gravel road maintenance. The following is the Mechanical Analysis data:

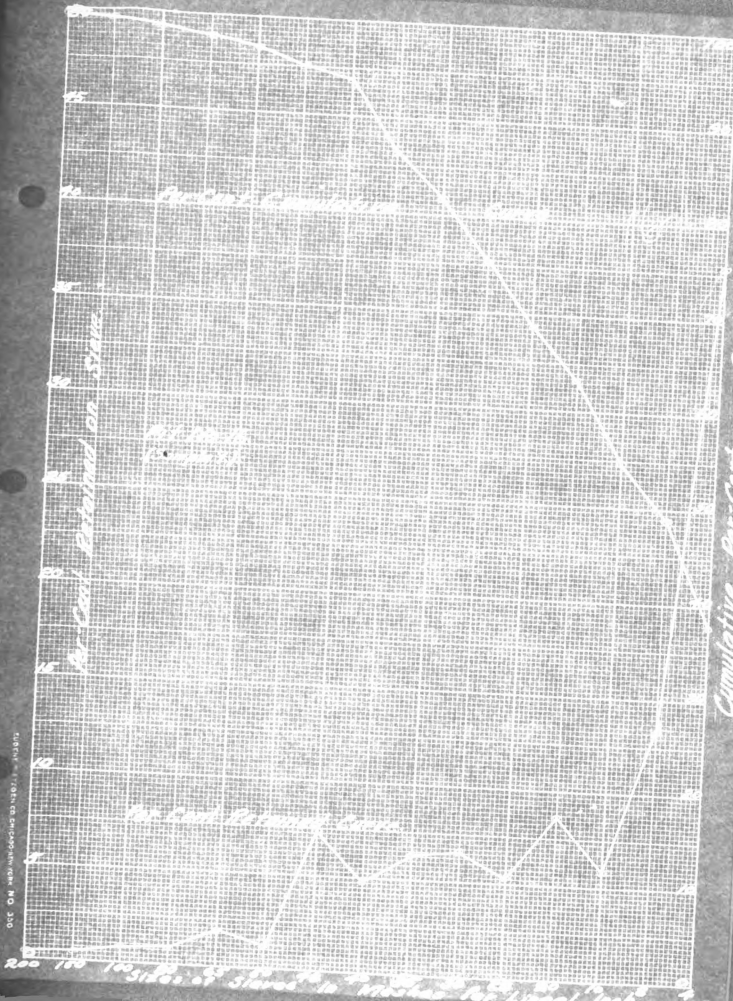
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			37.8	37.8
8			13.3	51.1
10	69.0	11.3	5.8	54.7
20	95.2	16.9	8.7	63.4
28	57.5	10.3	5.3	68.7
30	71.5	12.7	6.6	75.3
35	67.4	12.1	6.3	81.6
40	53.7	9.4	4.8	86.4
48	79.6	14.3	7.4	93.8
50	13.6	2.2	1.2	95.0
65	21.6	3.8	1.9	96.9
80	9.7	1.8	0.9	97.8
100	8.1	1.4	0.8	98.6
150	4.1	0.8	0.5	99.1
200	3.3	0.6	0.4	99.5
Passed 200	7.9	0.8	0.5	100.0
	<u>632.2</u>			

Sample 2

This sample was practically free from organic material and tested silt to the amount of about 2%. Mechanical Analysis shows a #4 screen to retain 50%, a #8 screen to retain 65%. This would indicate a good gravel for either gravel construction or concrete and asphalt concrete construction. The color of the gravel would indicate the presence of iron-oxide. The following is the Mechanical Analysis data:

4			50.0	50.0
8			12.5	62.5
10	114.4	33.7	12.7	75.2
20	90.6	26.8	10.1	85.3
28	25.5	7.5	2.8	88.1
30	16.0	4.7	1.8	89.9
35	12.0	3.5	1.3	91.2
40	11.5	3.4	1.3	92.5
48	23.8	7.1	2.6	95.1
50	5.8	1.7	0.6	95.7
65	8.1	2.4	0.9	96.6
80	3.4	1.0	0.4	97.0
100	3.6	1.1	0.4	97.4
150	3.0	0.9	0.4	97.8
200	4.4	1.3	0.5	98.3
Passed 200	18.1	4.5	1.7	100.0
	<u>337.2</u>			

20



PIT NUMBER 17

Sample 1

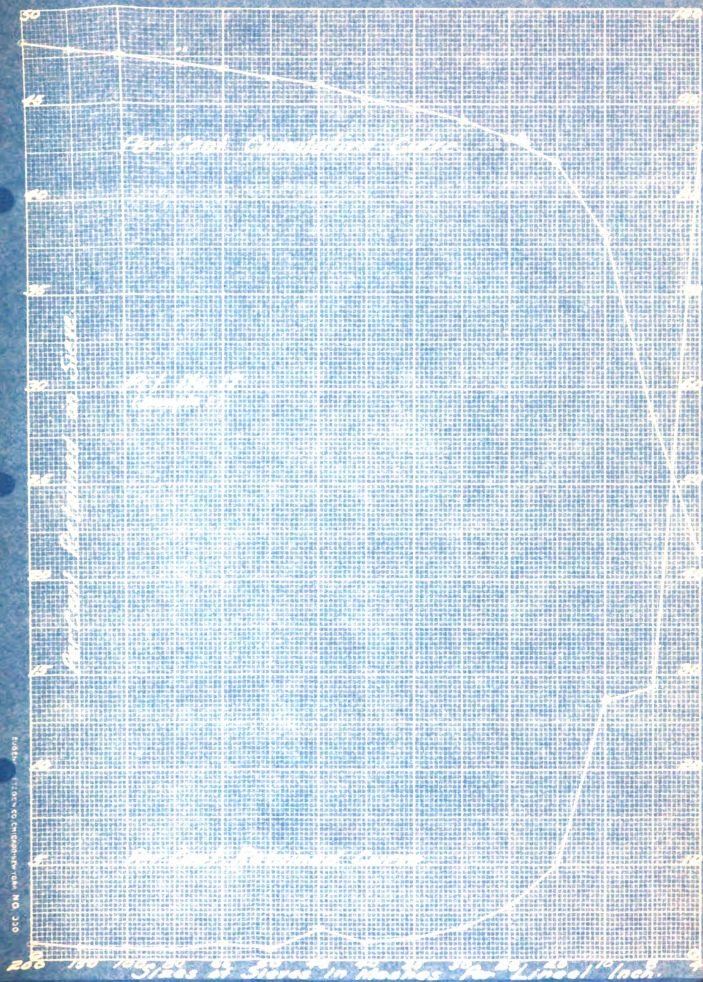
This gravel tested free of organic matter and showed silt present to the amount of about 6%. The Mechanical Analysis showed the #4 screen to contain about 43% and a #8 screen to contain 57%. These facts would indicate that the gravel could be used for maintenance work, base construction of gravel roads, or could be used for concrete construction. This sample was taken from deep in the pit. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			42.8	42.8
8			14.3	57.1
10	241.1	38.4	16.5	73.6
20	147.9	23.6	10.1	83.7
28	41.1	6.6	2.8	86.5
30	26.6	4.2	1.8	88.3
35	18.5	2.9	1.2	89.5
40	14.8	2.4	1.0	90.5
48	24.3	3.9	1.7	92.2
50	8.4	1.3	0.6	92.8
65	13.7	2.2	0.9	93.7
80	9.8	1.5	0.6	94.3
100	10.3	1.6	0.7	95.0
150	9.5	1.5	0.7	95.7
200	12.0	1.9	0.9	96.9
Passed 200	48.9	7.8	3.4	100.0
	<u>625.9</u>			

Sample 2

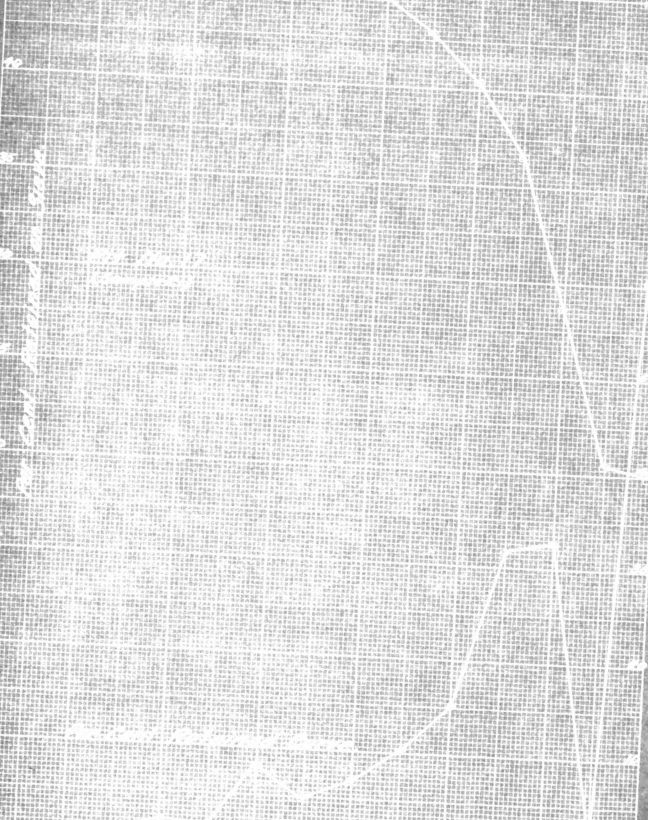
This sample was also free from organic matter and contained about 4% silt. The Mechanical Analysis showed a #4 screen to contain 40% and #8 to contain 50%. These facts indicate good concrete construction gravel as well as fairly good maintenance gravel for gravel road construction and asphalt concrete construction. The following is the Mechanical Analysis data:

4			40.0	40.0
8			10.0	50.0
10	129.2	27.6	13.8	63.8
20	126.1	26.8	13.4	77.2
28	58.9	12.8	6.4	83.6
30	41.6	8.8	4.4	88.0
35	28.2	6.0	3.0	91.0
40	19.8	4.2	2.1	93.1
48	32.9	7.0	3.5	96.6
50	7.2	1.6	0.8	97.4
65	9.1	1.9	0.9	98.3
80	3.8	0.8	0.4	98.7
100	2.8	0.6	0.3	99.0
150	1.6	0.3	0.2	99.2
200	1.8	0.4	0.2	99.4
Passed 200	5.9	1.3	0.6	100.0
	<u>468.9</u>			



DATE: 11-18-64 BY: CHAS. W. HALL, JR. 350

Per Cent Cumulative Error



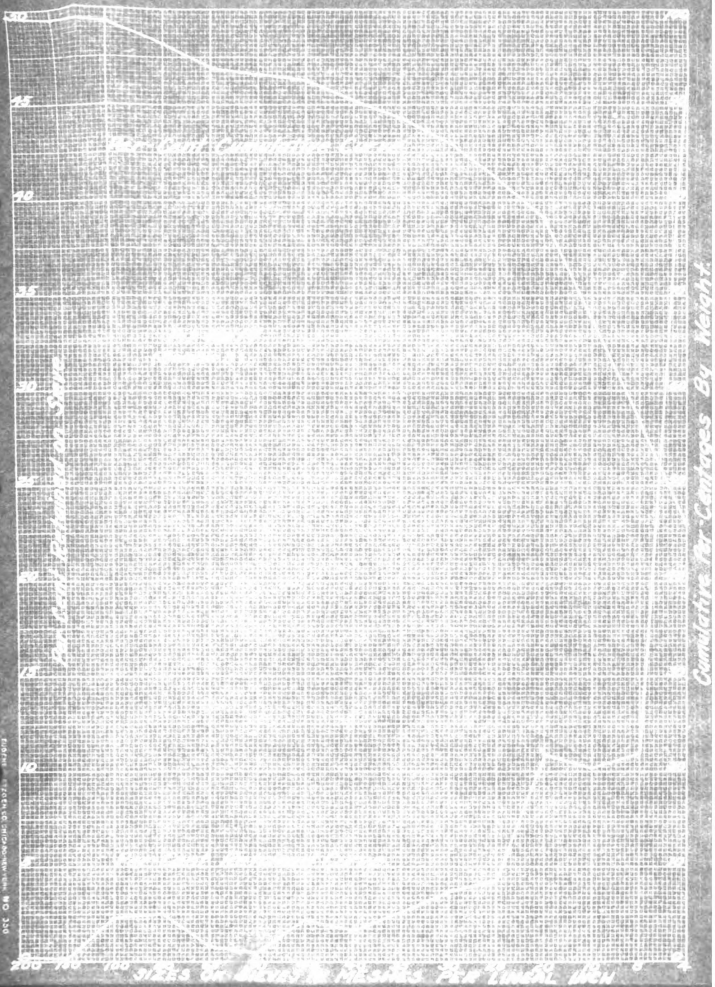
Cumulative Per Cent Error

PIT NUMBER 17 CONTINUED

Sample 3

This sample was also free from organic matter and contained about 9% silt. The Mechanical Analysis showed the #4 screen to contain 46% and the #8 screen to contain 57%. Altho this gravel could be used in concrete it would seem best fitted for maintenance of gravel road and concrete base construction. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			46.00	46.0
8			11.0	57.0
10	140.6	26.6	10.2	67.2
20	149.2	28.2	10.9	78.1
28	58.5	11.1	4.3	82.4
30	51.0	9.7	3.7	86.1
35	35.8	6.8	2.6	88.7
40	23.4	4.5	1.7	90.4
48	30.6	5.8	2.2	92.6
50	6.6	1.2	0.5	93.1
65	8.9	1.7	0.8	93.9
80	3.5	6.6	2.5	96.4
100	3.1	5.9	2.3	98.7
150	2.2	0.4	0.2	98.9
200	2.5	0.4	0.2	99.1
Passed 200	11.1	2.1	0.9	100.0
	<u>527.6</u>			

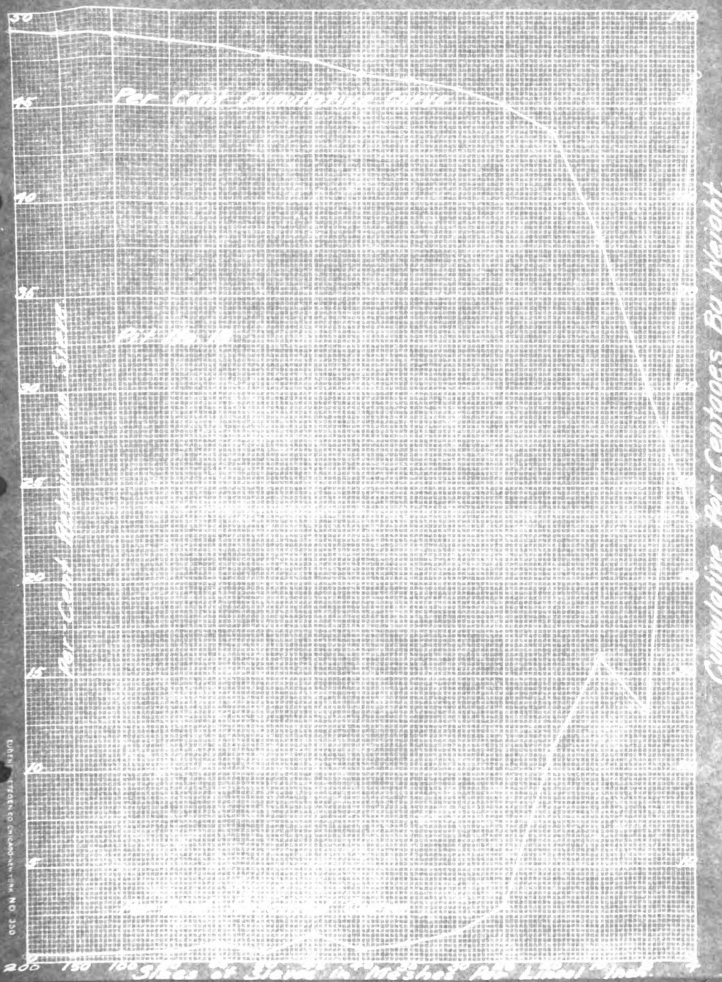


PIT NUMBER 18

Sample 1

The gravel of this pit showed a slight trace of organic matter and about 5% silt. The Mechanical Analysis showed the #4 screen to retain about 47% and #8 screen to retain 60%. The data would seem to indicate that this gravel could be best used on construction and maintenance of gravel roads, altho it might also be used for concrete construction since the amount of organic matter was very little. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			46.7	46.7
8			13.3	60.0
10	161.8	40.0	16.0	76.0
20	102.4	25.3	11.2	87.2
28	29.4	7.3	2.9	90.1
30	16.1	3.9	1.6	91.7
35	10.1	2.5	1.0	92.7
40	7.2	1.7	0.7	93.4
48	15.8	3.9	1.5	94.9
50	5.2	1.3	0.5	95.4
65	9.1	2.2	0.9	96.3
80	5.8	1.4	0.6	96.9
100	5.1	1.4	0.5	97.4
150	3.8	0.9	0.4	97.8
200	4.2	1.0	0.4	98.2
Passed 200	19.3	4.8	1.8	100.0
	<u>405.3</u>			

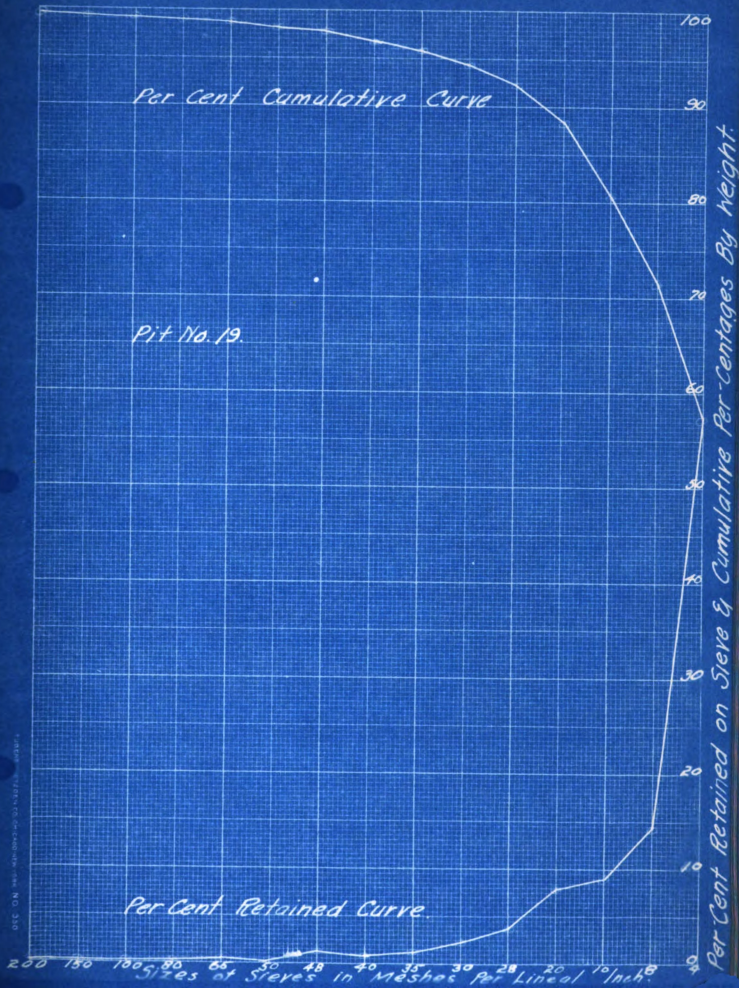


PIT NUMBER 19

Sample 1

The gravel from this pit tested free from organic matter and contained about 12% silt. The Mechanical Analysis showed the #4 screen to retain 47% and #8 screen to contain 72%. This would indicate a very good grade of road gravel and could be best used in gravel road construction especially for surface work. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			57.2	57.2
8			14.3	71.5
10	116.7	31.5	9.0	80.5
20	102.8	27.8	7.9	88.4
28	47.9	12.9	3.7	92.1
30	29.1	7.9	2.3	94.4
35	17.5	4.7	1.3	95.7
40	11.2	3.0	0.9	96.6
48	17.5	4.7	1.3	97.9
50	4.1	1.1	0.3	98.2
65	6.2	1.7	0.5	98.7
80	3.3	0.9	0.3	99.0
100	3.1	0.8	0.2	99.2
150	2.4	0.6	0.2	99.4
200	2.2	0.6	0.1	99.5
Passed 200	6.8	1.8	0.5	100.0
	<u>370.8</u>			



Sample 1

The gravel in this pit was tested and found free of organic matter and contained about 4% silt. The Mechanical Analysis showed the #4 screen to contain 6% and the #4 screen to contain 6%. This data would indicate that the gravel could be best used in concrete or asphalt concrete construction. The following is the Mechanical Analysis data:

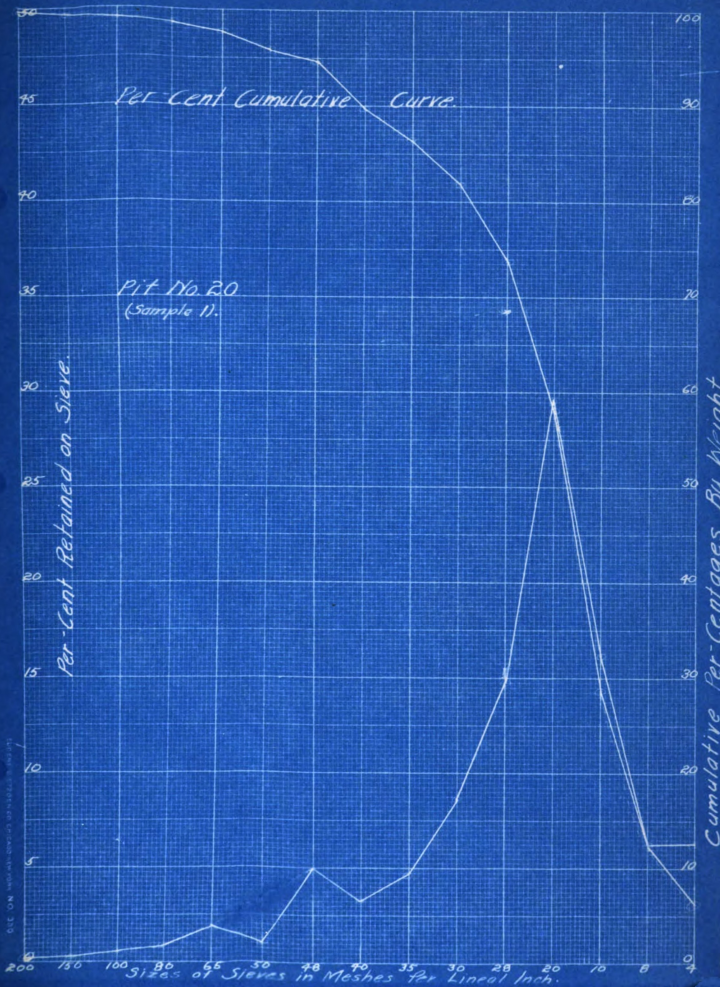
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			6.3	6.3
8			6.2	12.5
10	130.8	19.4	16.2	28.7
20	226.4	33.4	29.5	58.2
28	113.6	16.8	14.8	73.8
30	66.3	9.8	8.7	81.7
35	36.1	5.3	4.7	86.4
40	24.4	3.7	3.3	89.7
48	38.7	5.7	5.0	94.7
50	8.4	1.2	1.2	95.9
65	14.2	2.1	1.9	97.8
80	5.2	0.7	0.7	98.5
100	4.9	0.6	0.6	99.1
150	1.6	0.3	0.3	99.4
200	1.2	0.2	0.2	99.6
Passed 200	3.1	0.5	0.4	100.0
	<u>673.5</u>			

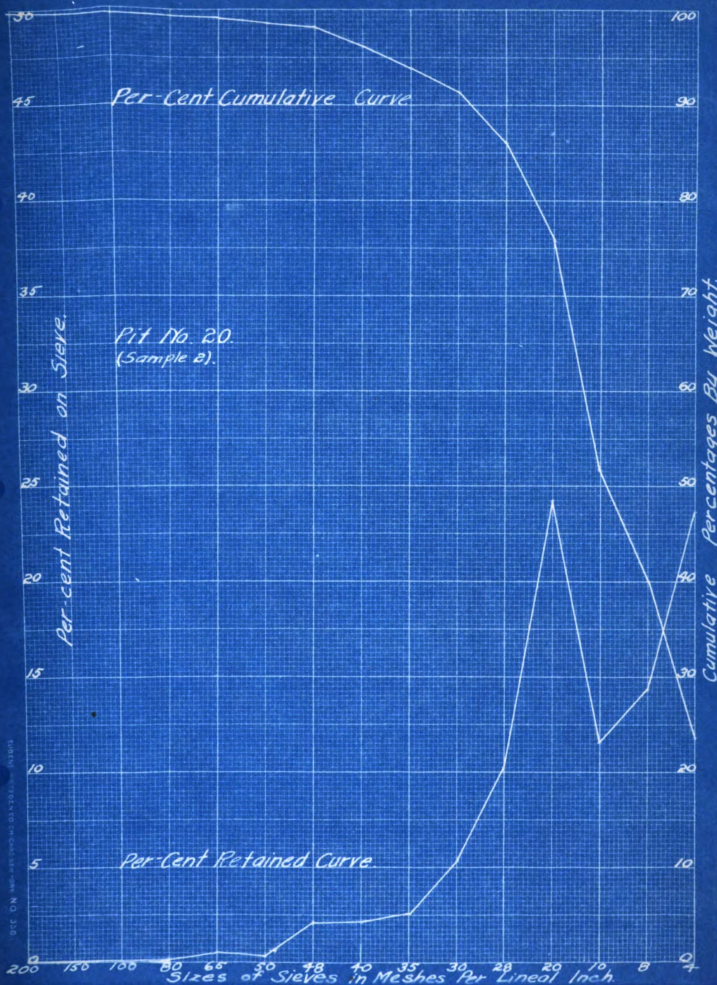
Sample 2

This sample also tested free of organic matter and contained about 9% silt. The Mechanical Analysis showed the #4 screen to retain 24% and the #8 to retain 40%. This would indicate good gravel for use in concrete and concrete asphalt construction.

It is from this pit that Michigan Agricultural College gets its gravel for concrete construction. It is estimated that the pit contains 50,000 cubic yards of this gravel. The following is the Mechanical Analysis data:

4			23.6	23.6
8			14.3	37.9
10	11.5	19.4	11.6	51.6
20	148.1	40.2	24.2	75.8
28	63.6	17.2	10.2	86.0
30	33.2	9.0	5.3	91.3
35	16.7	4.5	2.6	93.9
40	10.9	3.9	2.2	96.1
48	13.9	3.7	2.2	98.3
50	2.1	0.6	0.3	98.6
65	3.6	0.9	0.6	99.2
80	1.0	0.3	0.2	99.4
100	0.8	0.2	0.1	99.5
150	1.5	0.1	0.1	99.6
200	0.5	0.1	0.1	99.7
Passed 200	2.4	0.6	0.3	100.0
	<u>368.8</u>			





PIT NUMBER 21

Sample 1

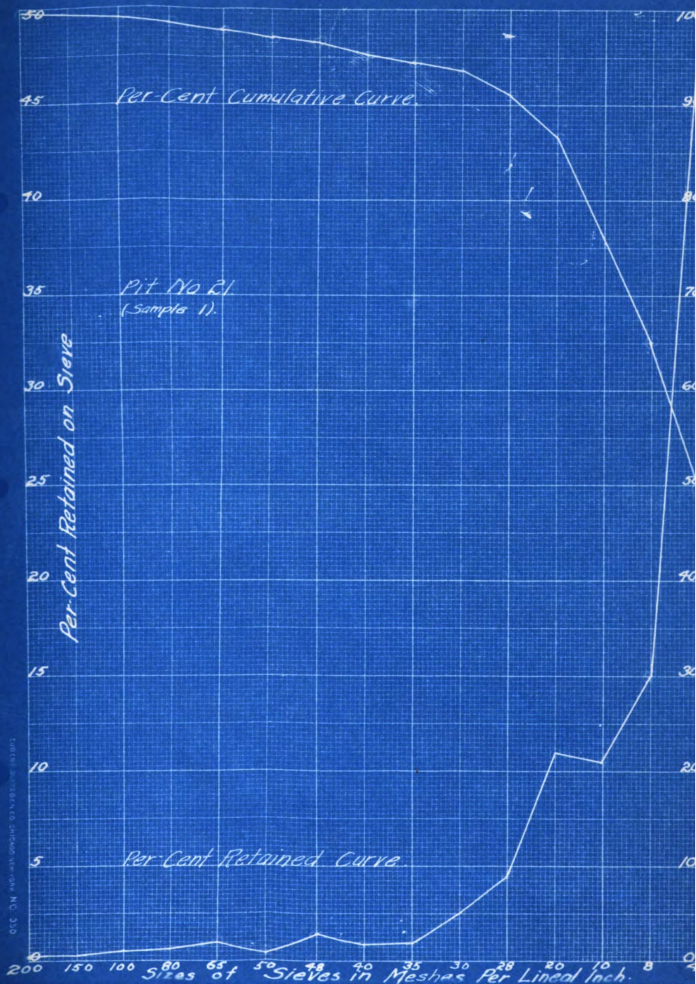
This sample showed a slight trace of organic material but not enough to make it useless for concrete. It showed a silt test of about 4%. The Mechanical Analysis showed a #4 screen to contain 50% and #8 screen to retain 65%. This gravel could be used for concrete construction but as it stands is best suited for gravel road construction and maintenance. The following is the Mechanical Analysis data:

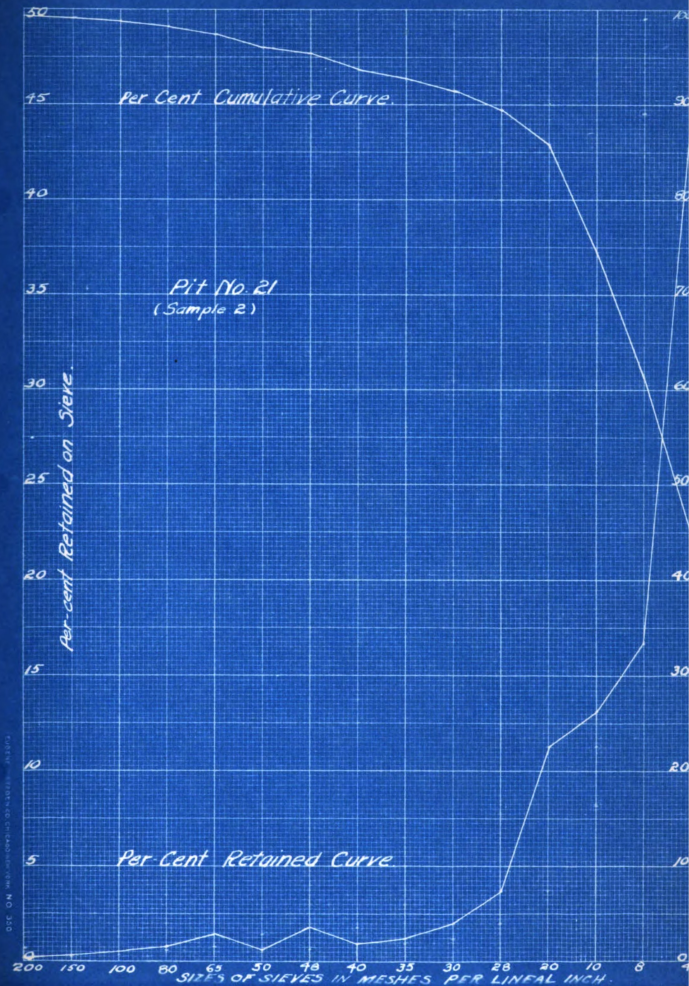
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			50.0	50.0
8			15.0	65.0
10	117.9	29.9	10.5	75.5
20	123.8	31.4	11.0	86.5
28	50.3	12.8	12.5	91.0
30	28.8	7.3	2.5	93.5
35	10.4	2.7	0.9	94.4
40	9.2	2.3	0.8	95.2
48	15.9	4.0	1.4	96.6
50	4.8	1.2	0.4	97.0
65	11.2	2.8	1.0	98.0
80	6.3	1.6	0.6	98.6
100	5.2	1.3	0.5	99.1
150	2.6	0.6	0.3	99.4
200	1.9	0.5	0.3	99.7
Passed 200	3.3	0.8	0.3	100.0
	<u>391.8</u>			

Sample 2

This sample also tested free of organic matter and about 7% silt. The Mechanical Analysis showed #4 screen to retain 45 % and #8 screen to retain 62%. It can be put to the same uses as sample 1. The following is the Mechanical Analysis data:

4			44.6	44.6
8			16.7	61.3
10	116.8	34.4	13.2	74.5
20	101.8	29.5	11.3	85.8
28	33.4	10.0	3.7	89.5
30	18.1	5.2	2.0	91.5
35	10.5	3.1	1.2	92.7
40	7.5	2.2	0.9	93.6
48	16.3	4.7	1.8	95.4
50	5.6	1.6	0.6	96.0
65	12.4	3.6	1.4	97.4
80	7.3	2.1	0.8	98.2
100	5.2	1.5	0.6	98.8
150	2.8	0.8	0.3	99.1
200	1.7	0.5	0.2	99.3
Passed 200	5.8	1.7	0.7	100.0
	<u>345.2</u>			



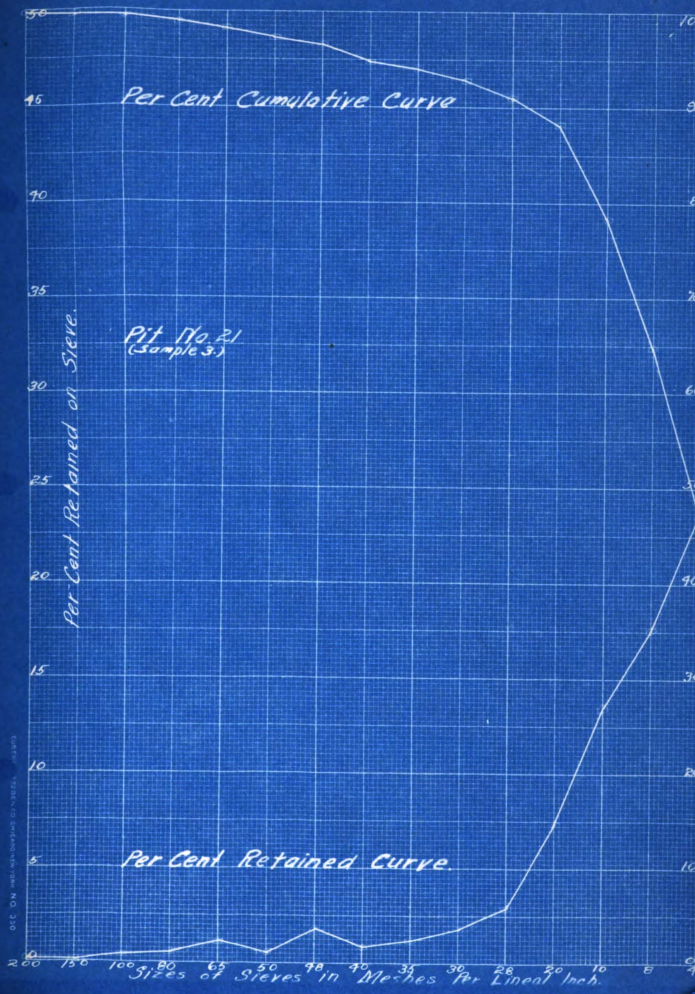


PIT NUMBER 21 CONTINUED.

Sample 3

This sample tested practically the same as the other two which shows a uniformity thru-out the pit. The following is the Mechanical Analysis data:

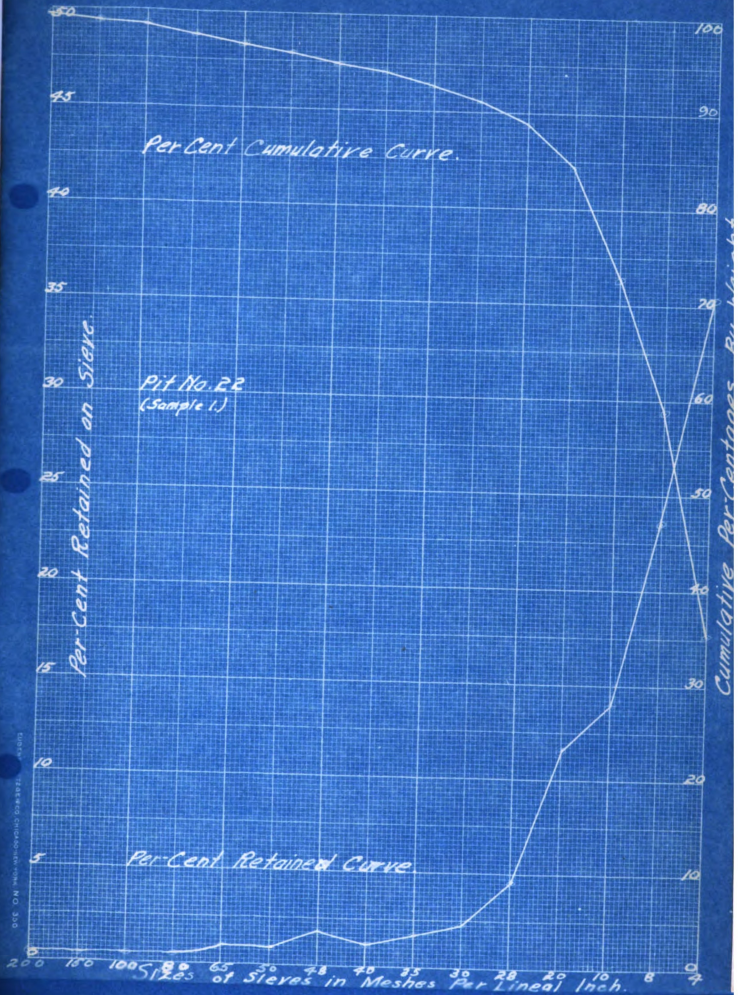
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			47.1	47.1
8			17.6	64.7
10	154.5	38.2	13.5	78.3
20	112.2	27.7	9.8	88.1
30	34.2	8.4	2.9	91.0
35	20.6	5.0	1.8	92.8
40	13.5	3.3	1.2	94.0
48	9.4	2.3	0.8	94.8
50	20.9	5.2	1.8	96.6
60	6.6	1.6	0.6	97.2
65	11.7	2.9	1.2	98.4
80	7.0	1.7	0.6	99.0
100	4.9	1.2	0.4	99.4
150	2.5	0.6	0.1	99.5
200	2.0	0.5	0.2	99.7
Passed 200	3.7	0.9	0.3	100.0
	<u>403.8</u>			



Sample 1

The gravel in this pit tested free of organic matter and showed silt to the amount of about 3%. The Mechanical Analysis showed #4 screen to retain 35% and #8 screen to retain 59%. From this data it appears that the gravel from this pit can be used for gravel road maintenance and base construction as well as concrete and asphalt concrete pavements. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			35.3	35.3
8			23.6	58.9
10	148.7	33.3	13.9	72.7
20	222.7	27.6	11.6	84.3
28	46.4	10.6	4.6	88.9
30	24.2	5.2	2.3	91.2
35	15.9	3.7	1.7	92.9
40	10.2	2.4	1.2	94.1
48	17.8	4.1	1.8	95.9
50	5.4	1.3	0.7	96.6
65	9.7	2.3	1.0	97.6
80	4.2	0.9	0.5	98.1
100	4.3	1.0	0.5	98.6
150	3.2	0.8	0.4	99.0
200	4.4	1.0	0.5	99.5
Passed 200	5.1	1.2	0.5	100.0
	<u>443.2</u>			



Sample 1

The gravel from this ample is free from organic matter but contains a very high percentage of silt, the amount being about 20%. The Mechanical Analysis showed the #4 screen to retain 55% and #8 to retain 77%. Therefore this gravel is best suited for gravel road construction. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight.</u>
4			55.0	55.0
8			22.2	77.2
10	123.6	28.1	6.4	83.6
20	138.2	31.7	7.2	90.8
28	25.0	5.7	1.3	92.1
30	7.9	1.8	0.4	92.5
35	5.1	1.2	0.3	92.8
40	6.2	1.4	0.3	93.1
48	27.2	6.2	1.4	94.5
50	14.8	3.4	0.8	95.3
65	33.6	7.9	1.8	97.1
80	16.9	3.8	0.8	97.9
100	12.1	2.8	0.6	98.5
150	7.0	1.6	0.4	98.9
200	5.8	1.3	0.3	99.2
Passed 200	13.5	3.1	0.8	100.0
	<u>436.9</u>			

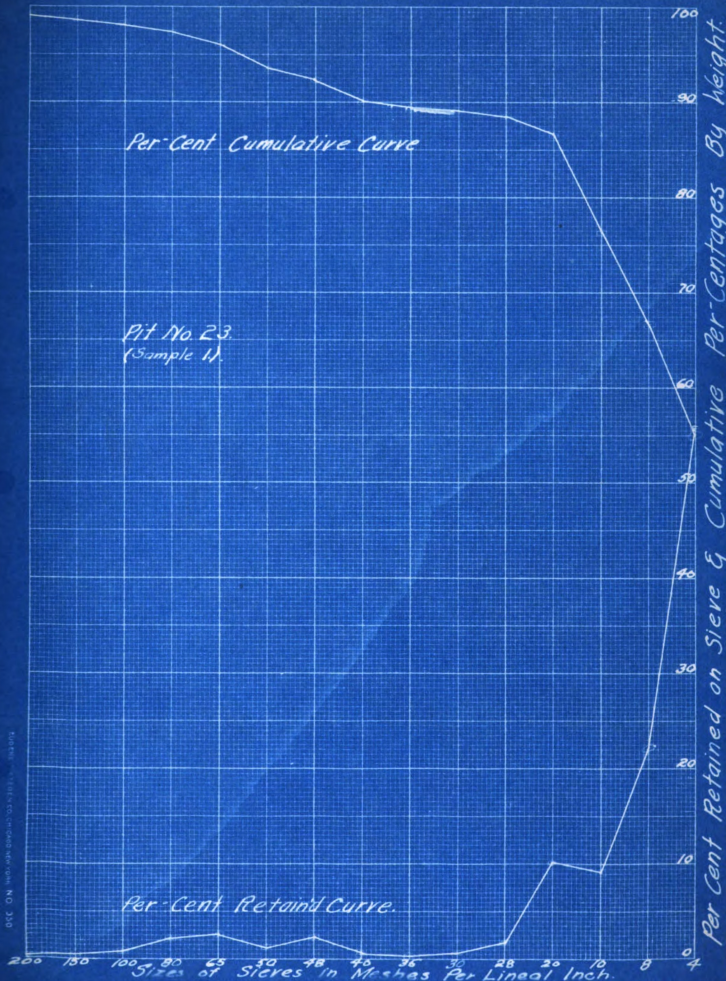
Sample 2

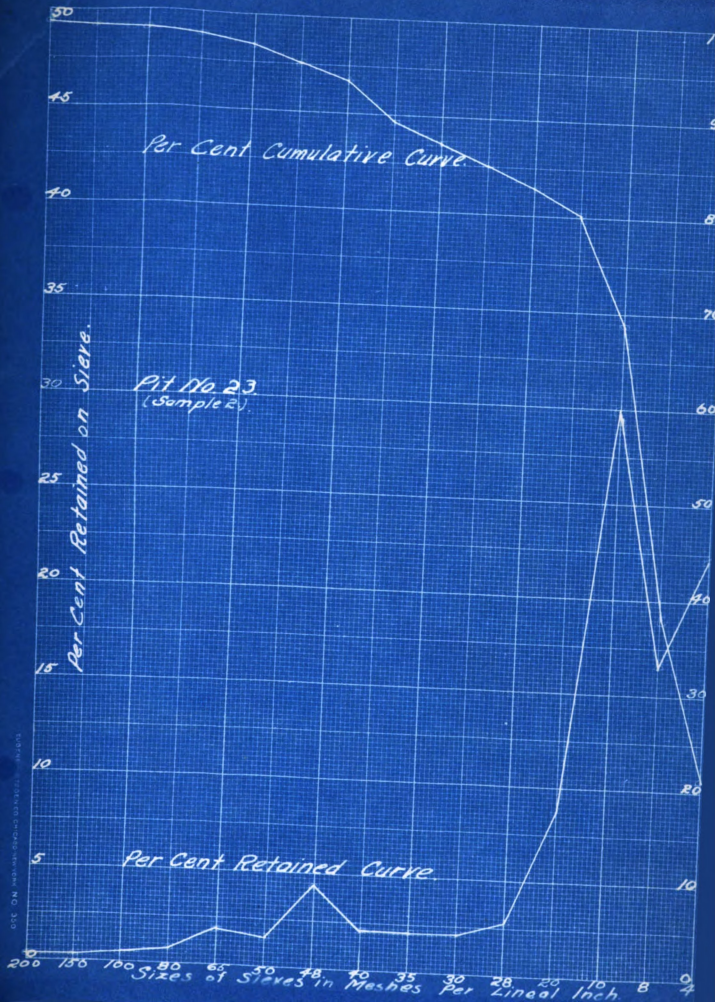
This sample was tested and found to contain organic matter and also a high percentage of silt. Mechanical Analysis showed #4 screen to retain 21% and #8 to retain 37%. So from the data above it would seem that this gravel was almost useless as it meets the requirements for neither gravel nor concrete constructions. The following is the Mechanical Analysis data:

4			22.02	22.2
8			16.6	38.8
10	161.7	49.2	30.0	68.8
20	60.3	18.4	11.3	80.1
28	15.2	4.6	2.8	82.9
30	11.2	3.4	2.1	85.0
35	11.4	3.5	2.1	87.1
40	10.8	3.3	2.1	89.2
48	23.4	7.1	4.3	93.5
50	7.2	2.2	1.5	95.0
65	10.4	3.1	1.9	96.9
80	4.5	1.4	0.8	97.7
100	2.9	0.8	0.5	98.2
150	1.6	0.5	0.3	98.5
200	1.8	0.6	0.3	98.8
Passed 200	6.4	1.9	1.2	100.0
	<u>328.8</u>			

Sample 3

This sample due to the very high percentage of silt and a low percentage retained on a #8 screen, could be used for maintenance of gravel roads only. It gave a fairly good organic test.

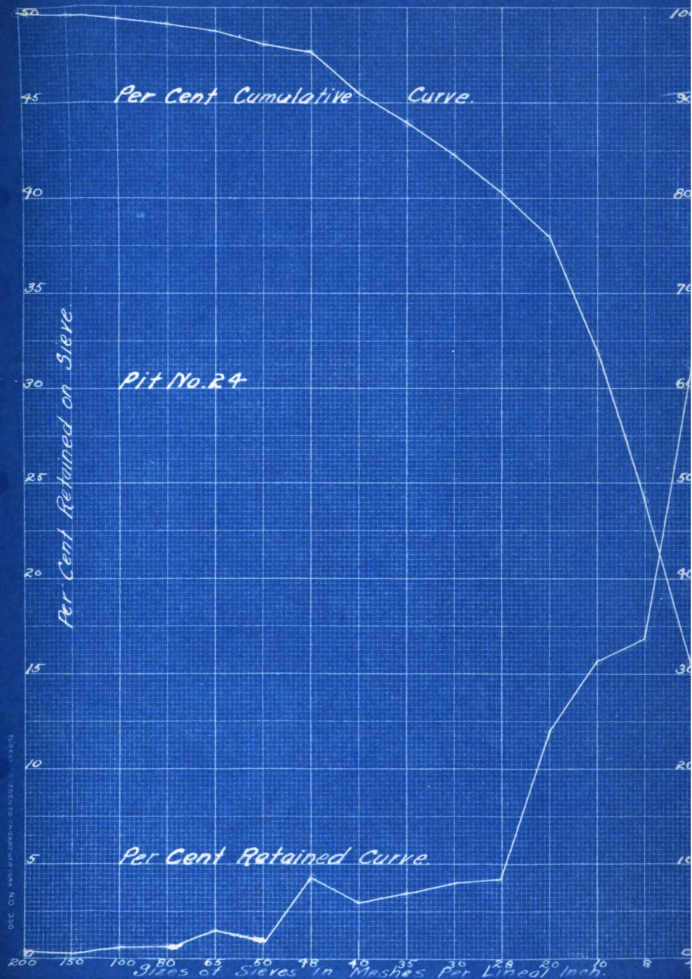




Sample 1

This sample contains a high percentage of organic matter and showed about 5% silt. Mechanical Analysis showed the #4 screen to retain about 31% and #8 screen to retain 48%. Due to the amount of stripping necessary at the pit it would be hard to get a good grade of gravel out. So the only thing for which this could be used would be maintenance of gravel roads, altho the gravel does not meet the necessary requirements. The following is the Mechanical Analysis data:

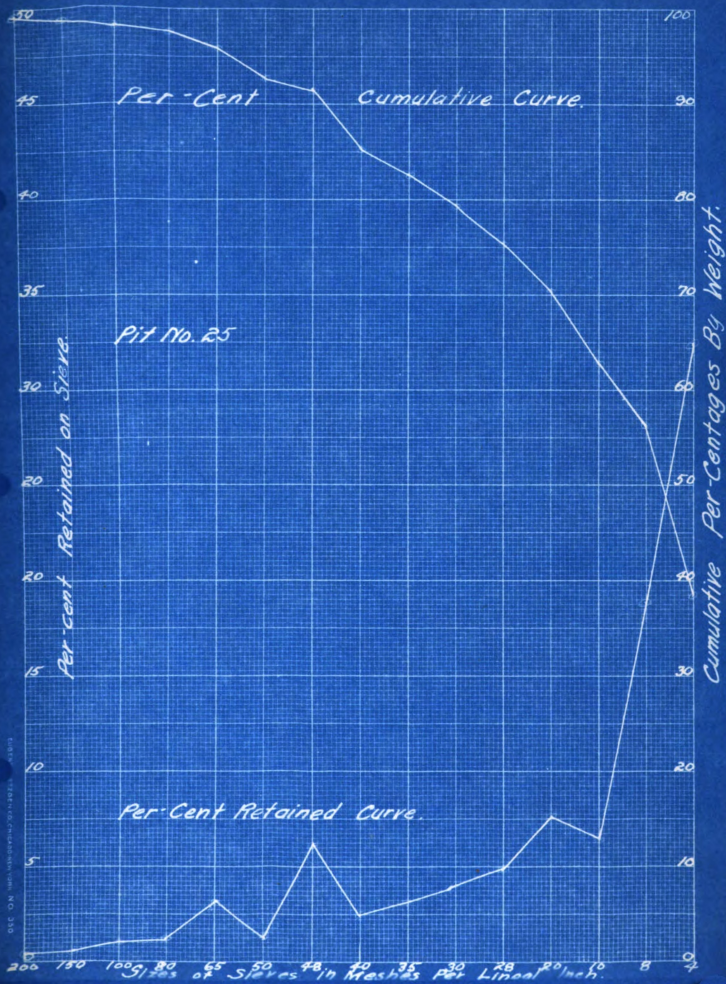
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			31.3	31.3
8			16.8	48.1
10	128.1	30.3	15.7	63.8
20	97.9	23.2	12.1	75.9
28	37.6	8.9	4.6	80.5
30	32.6	7.9	4.1	84.6
35	27.6	6.5	3.4	88.0
40	24.6	5.8	3.0	91.0
48	35.4	8.4	4.3	95.3
50	7.8	1.8	0.9	96.2
65	11.3	2.6	1.4	97.6
80	5.4	1.3	0.7	98.3
100	4.7	1.1	0.6	98.9
150	2.5	0.6	0.3	99.2
200	2.1	0.5	0.3	99.5
passed 200	4.5	1.1	0.5	100.0
	<u>422.1</u>			



Sample 1

The gravel from this pit tested free of organic matter and gave a low silt test. Mechanical Analysis shows the #4 screen retaining a 38% and #8 screen retaining 57%. This gravel might be used either for concrete and asphalt concrete or gravel road maintenance. The trouble with this pit is that a great deal of stripping is necessary. The following is the Mechanical Analysis data:

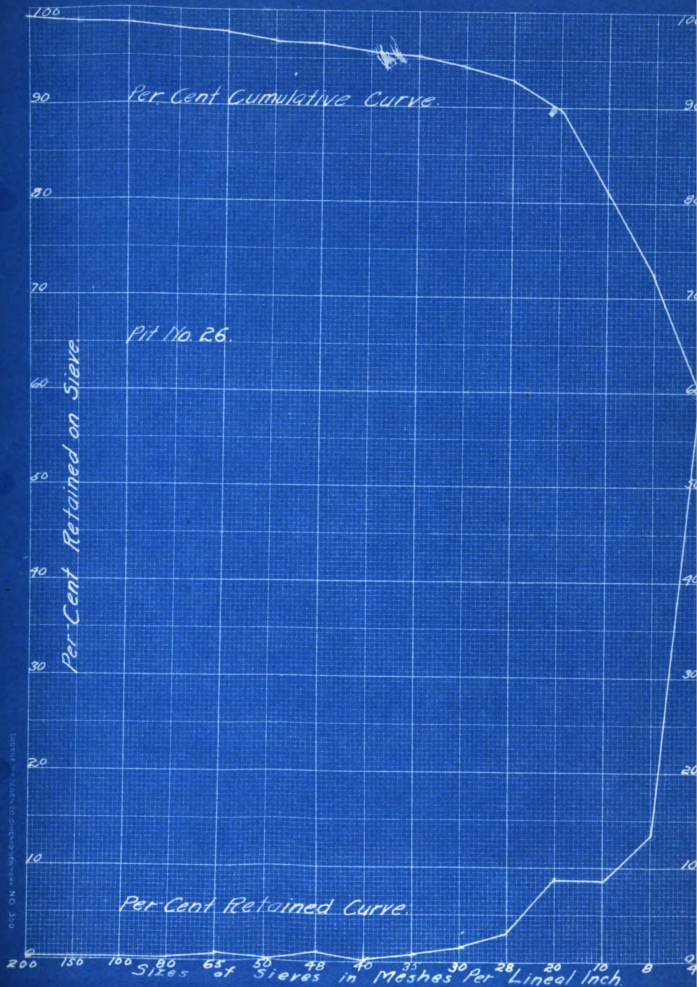
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			37.5	37.5
8			18.8	56.3
10	63.4	14.7	6.4	62.7
20	76.5	17.7	7.7	70.4
28	48.1	11.2	4.9	75.3
30	41.2	9.5	4.1	79.4
35	30.5	7.2	3.2	82.6
40	25.1	5.8	2.5	85.1
48	59.8	13.8	6.2	91.3
50	12.5	2.9	1.3	92.6
65	31.5	7.4	3.2	95.8
80	13.5	3.1	1.3	97.1
100	10.6	2.5	1.1	98.2
150	6.1	1.4	0.6	98.8
200	4.5	1.0	0.4	99.2
Passed 200	8.2	1.8	0.8	100.0
	<u>431.8</u>			



Sample 1

The gravel of this pit tested high in organic material and tested silt to the amount of about 25%. Mechanical Analysis shows this gravel as best suited for gravel road construction about 74% being retained on #8 screen. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			60.0	60.0
8			13.3	73.3
10	112.0	31.4	8.7	81.0
20	113.7	31.5	8.7	89.7
28	40.4	11.3	3.1	92.8
30	20.5	5.7	2.6	94.4
35	11.9	3.3	0.9	95.3
40	5.4	1.5	0.4	95.7
48	13.3	3.7	1.0	96.7
50	2.3	0.6	0.2	96.9
65	8.5	2.4	0.8	97.7
80	4.6	1.3	0.4	98.1
100	5.7	1.6	0.4	98.5
150	3.8	1.1	0.3	98.8
200	3.8	1.1	0.3	99.1
Passed 200	12.0	3.4	0.9	100.0
	<u>357.9</u>			



Sample 1

The gravel of this pit was tested and found free of organic matter showed about 7% silt. Mechanical Analysis showed #4 screen to retain 42% and #8 to retain 57%. This gravel may be used for base construction of gravel road or for concrete and asphalt concrete construction.

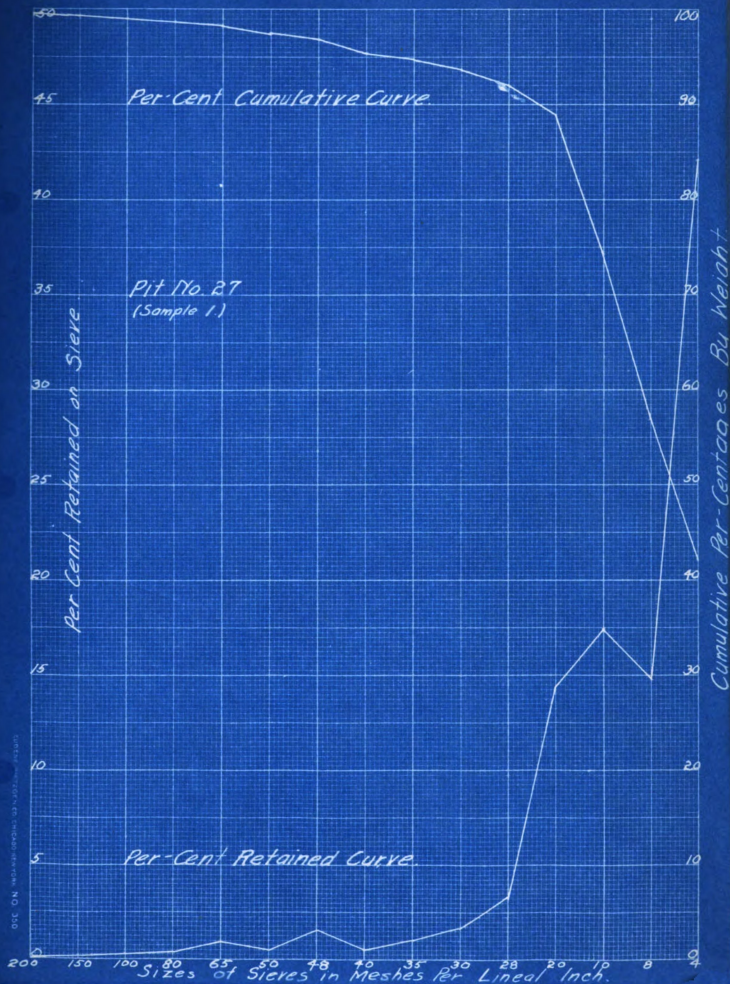
(The gravel was being shipped to Bay City for Concrete use)
(Freight charges on the gravel being \$150 per yard) The following is the Mechanical Analysis data:

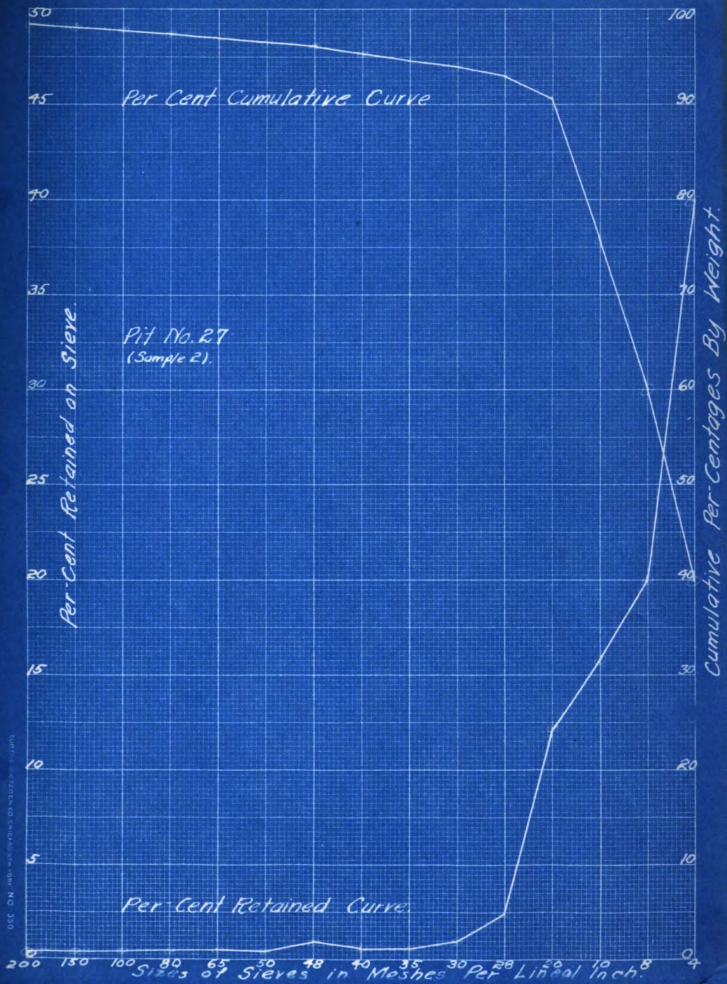
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			42.1	42.1
8			14.8	56.9
10	172.1	40.5	17.4	74.3
20	142.8	33.5	14.4	88.7
28	33.0	7.7	3.3	92.0
30	17.1	4.0	1.7	93.7
35	11.1	2.6	1.1	94.8
40	4.9	1.1	0.5	95.3
48	15.7	3.7	1.6	96.9
50	4.9	1.1	0.5	97.4
65	7.9	1.9	0.9	98.3
80	4.2	0.9	0.4	98.7
100	3.2	0.7	0.3	99.0
150	2.1	0.5	0.2	99.2
200	1.9	0.4	0.2	99.4
Passed 200	5.4	1.3	0.6	100.0
	<u>426.3</u>			

Sample 2

This sample was also found free of organic matter and tested about 8% silt. The Mechanical Analysis test showed #4 screen to retain 40% and #8 screen to retain 60%. This gravel can be used as above. The following is the Mechanical Analysis data:

4			40.0	40.0
8			20.0	60.0
10	121.5	39.7	15.8	75.8
20	108.5	35.6	14.7	90.5
28	18.3	6.2	2.5	93.0
30	7.4	2.4	1.0	94.0
35	4.9	1.6	0.6	94.6
40	3.6	1.2	0.5	95.1
48	7.6	2.5	1.0	96.1
50	3.3	1.1	0.4	96.5
65	4.5	1.5	0.5	97.0
80	3.0	1.0	0.4	97.4
100	3.0	1.0	0.4	97.8
150	2.0	0.7	0.3	98.1
200	3.2	1.1	0.4	98.4
Passed 200	13.2	4.3	1.6	100.0
	<u>304.0</u>			



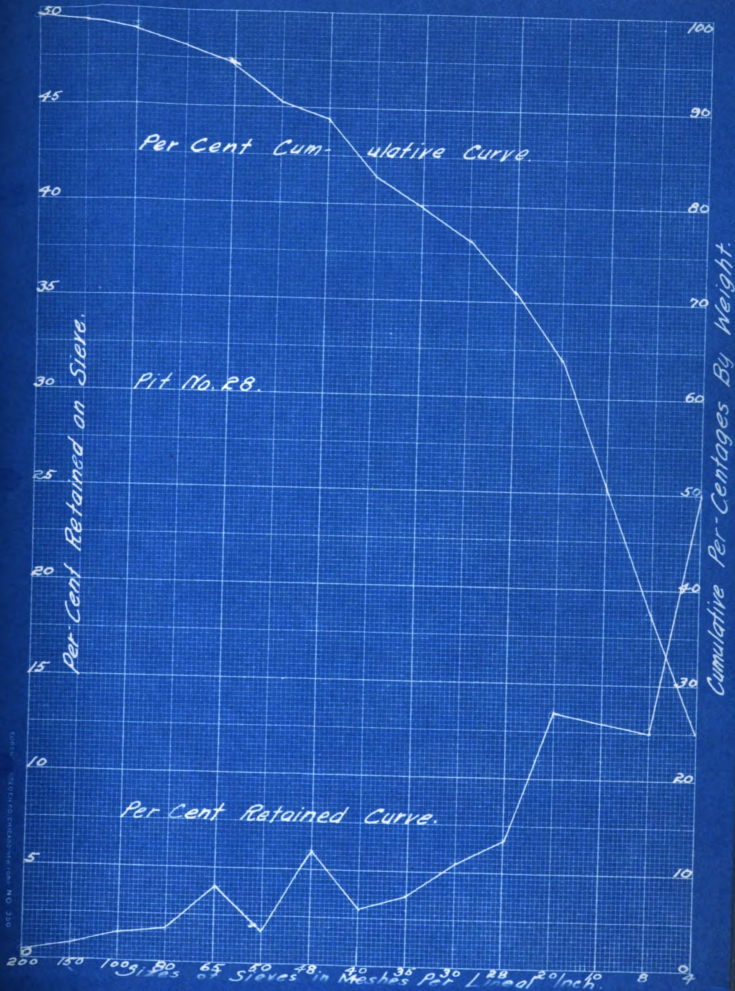


Sample 1

The gravel from this pit tested free of organic material and contained about 8% silt. Mechanical Analysis gave a #4 screen as retaining 25% and #8 screen as retaining 37%. This data seems to indicate that the gravel could best be used for a concrete and asphalt concrete construction.

The gravel at this pit is used in concrete construction and manufacture of cement blocks. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retaining in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			25.0	25.0
8			12.0	37.5
10	117.6	20.7	13.0	50.5
20	122.0	21.6	13.5	64.0
28	61.0	10.8	6.7	70.7
30	49.1	8.8	5.5	76.2
35	33.4	5.9	3.7	79.9
40	27.1	4.8	3.0	82.9
48	52.5	9.4	5.9	88.8
50	15.2	2.7	1.7	90.5
65	35.7	6.4	4.0	94.5
80	16.2	2.9	1.8	96.3
100	14.1	2.5	1.6	97.9
150	7.9	1.4	0.9	98.8
200	4.9	0.8	0.5	99.3
Passed 200	6.6	1.2	0.7	100.0
	<u>563.3</u>			



PIT NUMBER 29

Sample 1

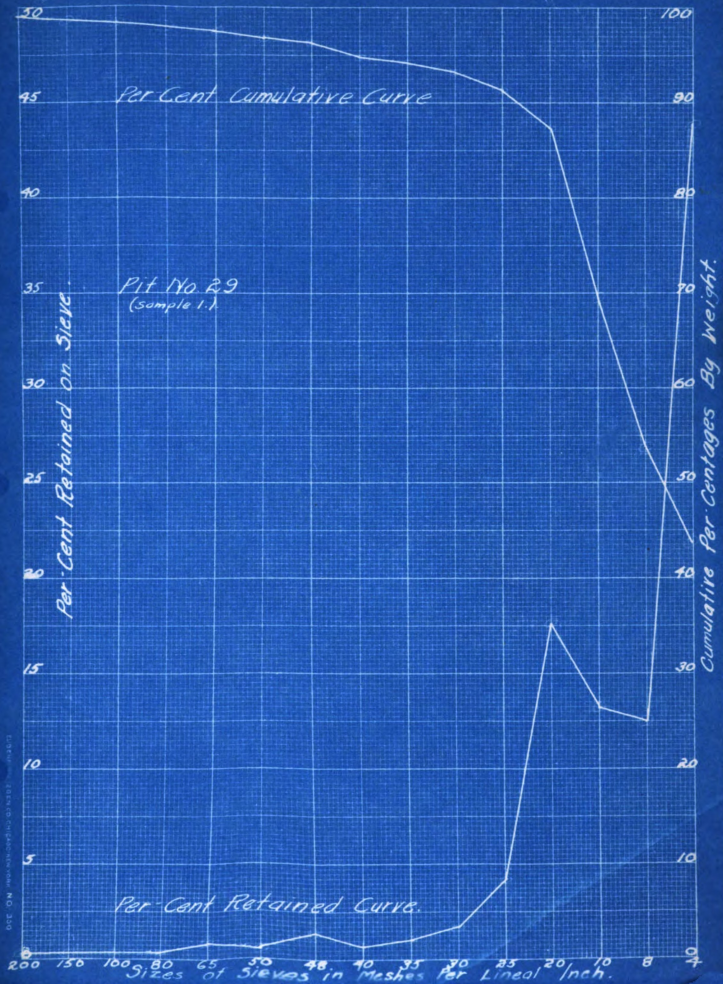
The gravel from this pit tested free from organic matter and contained about 15% silt. The Mechanical Analysis showed a #4 screen to retain 44% and the #8 to retain 54%. This gravel could be used for maintenance work of gravel roads as well as for concrete and asphalt concrete construction. Cement blocks were manufactured at this pit. The following is the Mechanical Analysis data:

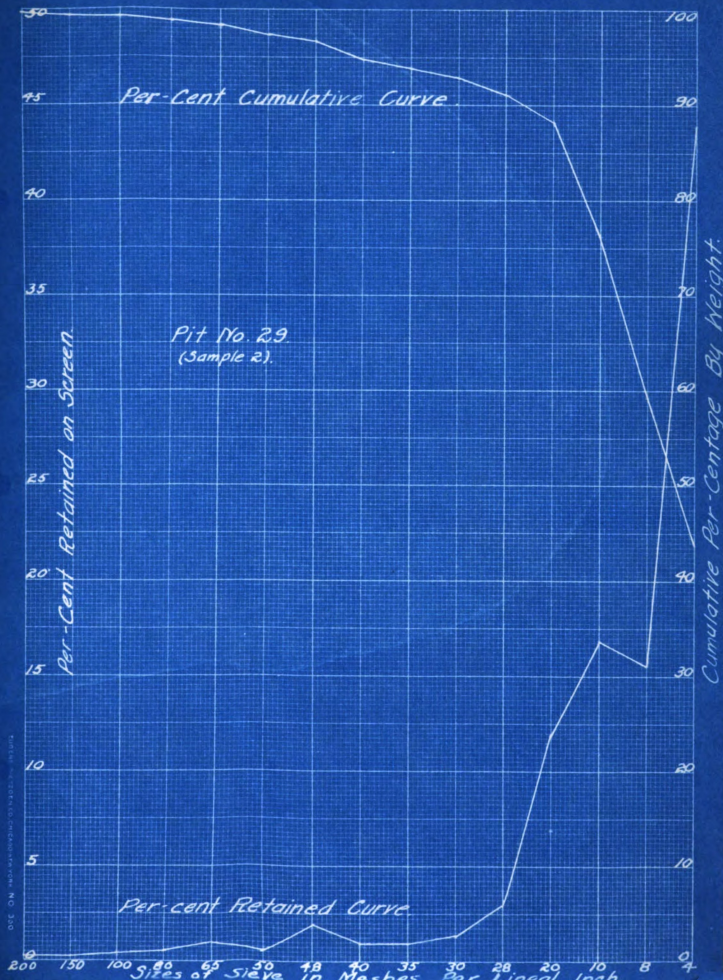
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			43.8	43.8
8			12.5	56.3
10	116.8	29.9	13.2	69.5
20	157.8	40.4	17.7	87.2
28	37.8	9.6	4.2	91.4
30	15.6	4.0	1.7	93.1
35	8.8	2.3	1.1	94.2
40	6.2	1.7	0.7	94.9
48	12.1	3.1	1.4	96.3
50	4.3	1.1	0.5	96.8
65	7.5	1.9	0.8	97.6
80	4.2	1.1	0.4	98.0
100	3.8	0.9	0.4	98.4
150	2.6	0.7	0.3	98.7
200	2.8	0.7	0.3	99.0
Passed 200	9.3	2.4	1.0	100.0
	<u>388.8</u>			

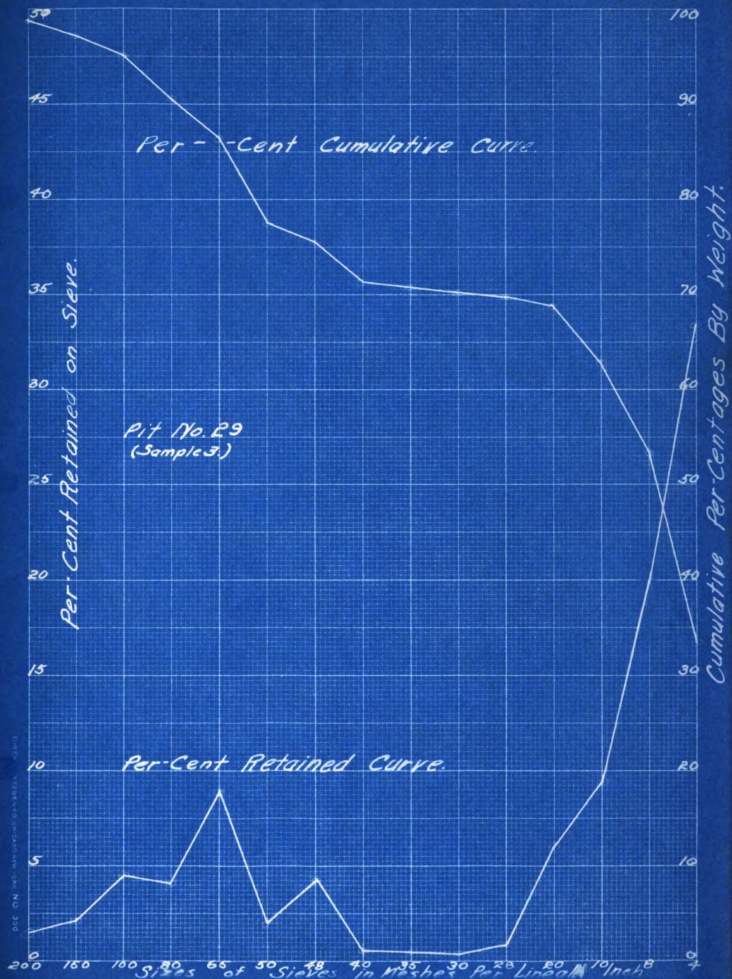
Sample 2

This sample contained organic matter and tested still to the amount of 8%. The Mechanical Analysis and organic test showed the gravel best fitted for maintenance work and construction of base for gravel roads. The following is the Mechanical Analysis data:

4			43.8	43.8
8			15.6	59.4
10	128.6	41.5	16.8	76.2
20	90.8	29.2	11.9	88.1
28	22.8	7.3	2.9	91.0
30	13.1	4.2	1.7	92.7
35	9.1	2.9	1.2	93.9
40	6.9	2.2	0.9	94.8
48	15.3	4.9	2.0	96.8
50	4.7	1.5	0.6	97.4
65	7.4	2.4	1.0	98.4
80	3.7	1.2	0.5	98.9
100	2.8	0.9	0.4	99.3
150	1.3	0.4	0.2	99.5
200	1.2	0.4	0.2	99.7
Passed 200	2.5	0.8	0.3	100.0
	<u>309.8</u>			



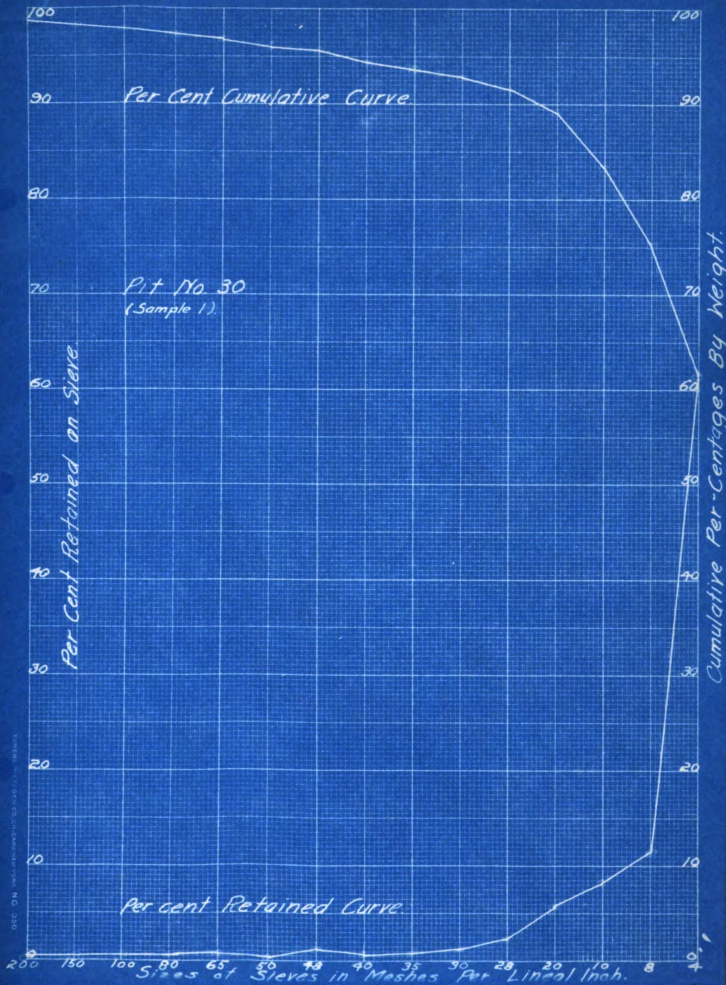




Sample 1

This sample was tested free of organic matter and showed silt present to the amount of about 20% the #4 screen contained 67% and #8 screen 80%. This is very good road gravel and could be used in gravel road construction. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			66.7	66.7
8			13.3	80.0
10	110.9	45.2	9.0	89.0
20	67.0	27.8	5.5	94.5
28	16.6	6.7	1.3	95.8
30	7.7	3.4	0.7	96.5
35	5.0	2.0	0.4	96.9
40	3.1	1.3	0.3	97.2
48	8.1	3.3	0.7	97.9
50	2.2	0.9	0.2	98.1
65	5.1	2.1	0.4	98.5
80	3.4	1.4	0.3	98.8
100	4.5	1.8	0.4	99.2
150	3.8	1.6	0.3	99.5
200	4.2	1.7	0.3	99.8
Passed 200	3.2	1.3	0.2	100.0
	<u>244.8</u>			



Sample 1

The gravel from this pit was practically free from organic matter and tested silt to the amount of nearly 20%. The Mechanical Analysis shows #4 screen to retain 63% the #8 screen to retain 75%. This would indicate a very good grade of road gravel and would be used in the construction of gravel roads. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percent ges by Weight</u>
4			66.7	66.7
8			13.3	80.0
10	93.3	33.4	8.3	83.4
20	64.5	23.0	5.8	89.2
28	25.7	9.2	2.3	91.3
30	14.3	5.1	1.3	92.8
35	10.5	3.7	0.9	93.7
40	6.6	2.3	0.6	94.3
48	14.9	5.3	1.3	95.6
50	4.1	1.5	0.4	96.0
65	9.3	3.3	0.8	96.8
80	5.5	1.9	0.5	97.3
100	6.2	2.2	0.5	97.8
150	5.5	1.9	0.5	98.3
200	5.2	1.8	0.4	98.7
Passed 200	15.5	5.5	1.3	100.0
	<u>281.1</u>			

Per-Cent Cumulative Curve

Pit No. 31
(Sample 1)

Per-Cent Retained Curve

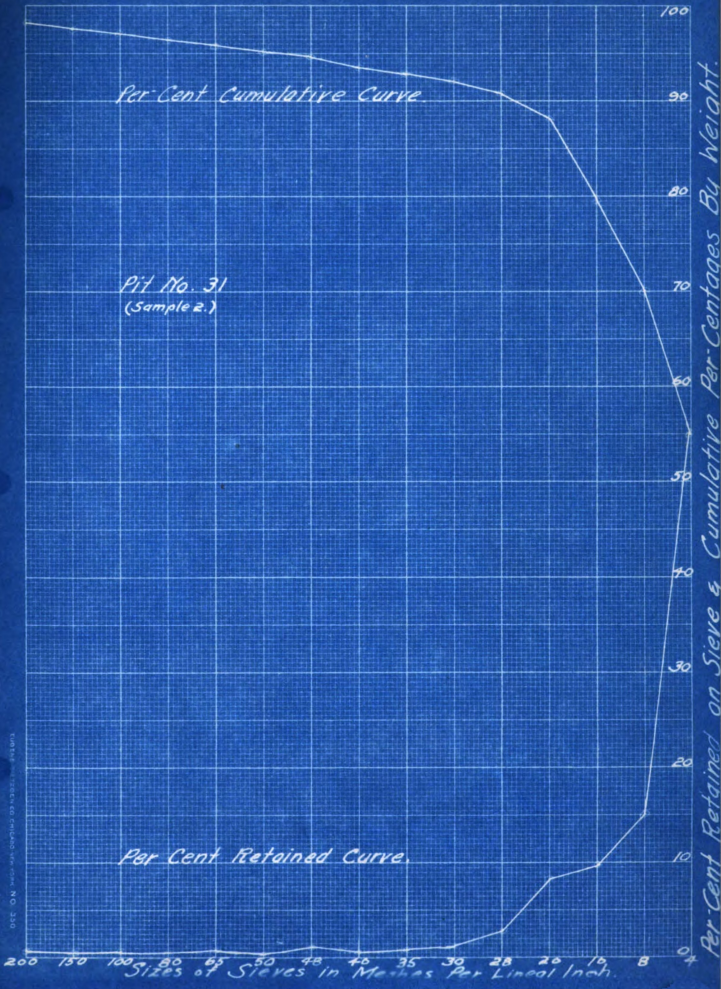
Sizes of Sieves in Meshes Per Linear Inch

PIT NUMBER 31

Sample 2

This sample tested as containing organic matter and tested silt to the amount of about 15%. The Mechanical Analysis showed #8 screen to retain 70%. This gravel could be best used for construction of gravel roads. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained,</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			55.0	55.0
8			15.0	70.0
10	38.6	32.9	9.7	79.7
20	112.8	28.9	8.4	88.1
28	37.7	9.0	2.7	90.8
30	19.0	4.5	1.3	92.1
35	11.4	2.7	0.8	92.9
40	8.8	2.1	0.6	93.5
48	17.7	4.2	1.2	94.7
50-	6.1	1.4	0.4	95.1
65	10.9	2.6	0.8	95.9
80	7.4	1.7	0.5	96.4
100	8.1	1.9	0.6	97.0
150	7.1	1.7	0.5	97.5
200	9.4	2.2	0.7	98.2
Passed 200	26.5	6.3	1.8	100.0
	<u>421.5</u>			

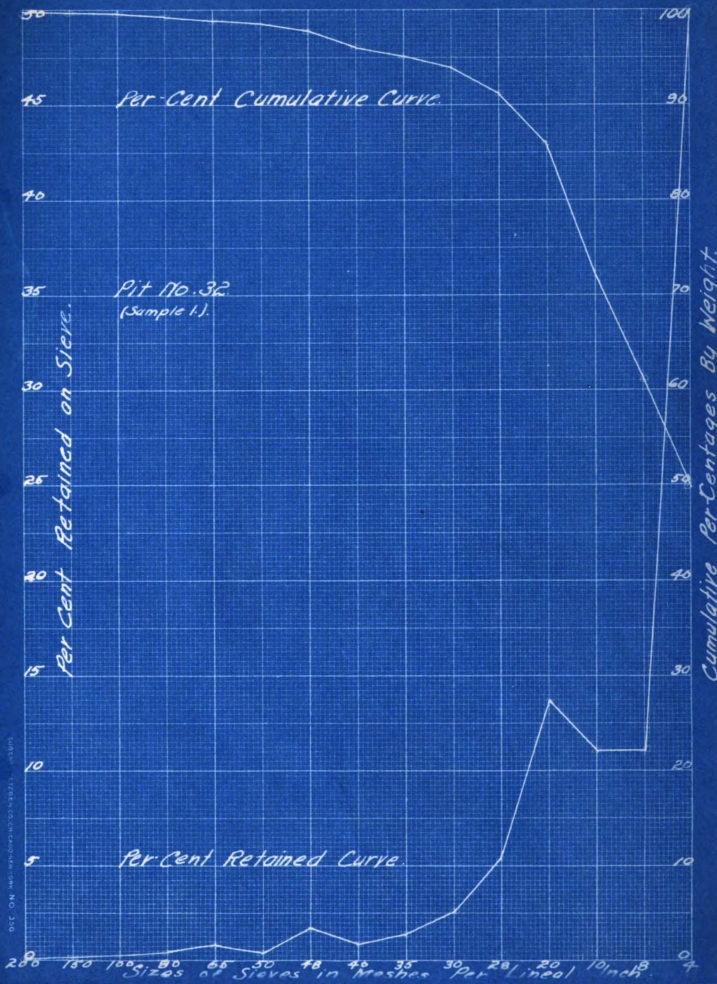


PIT NUMBER 32

Sample 1

The gravel from this pit tested free from organic matter and contained only about 1% silt..The Mechanical Analysis showed #4 screen to retain 50% and the #8 screen to retain 61%. This showed a gravel that could be used for gravel road base and maintenance in gravel road or for concrete and concrete asphalt construction. The following is the Mechanical Analysis data:

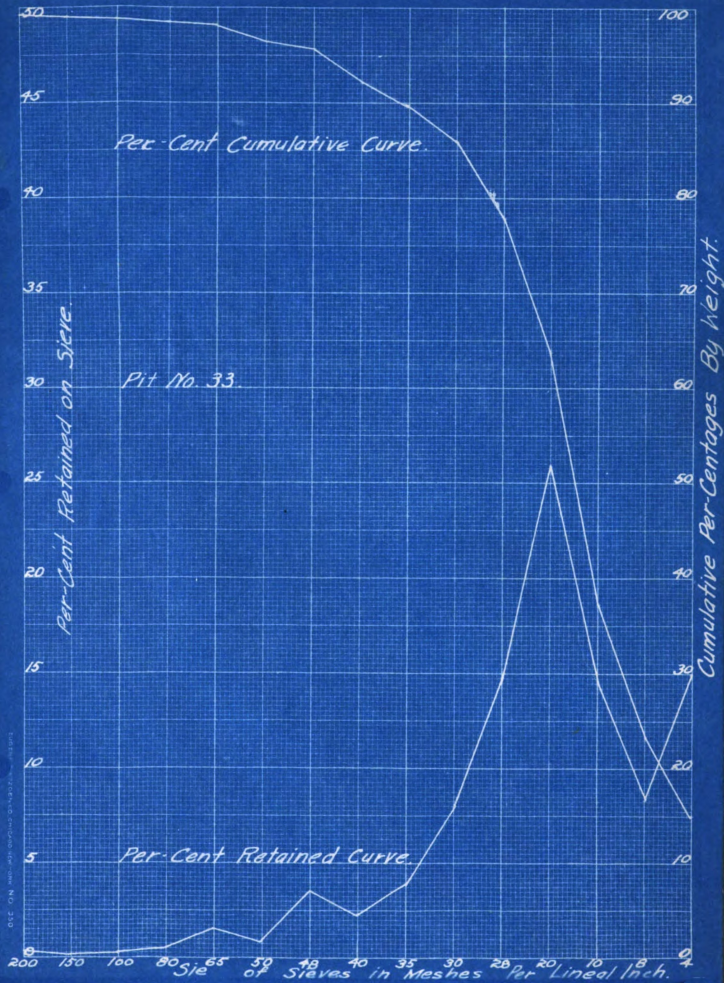
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			50.0	50.0
8			11.1	61.1
10	99.7	28.5	11.1	72.2
20	122.5	35.1	13.7	85.9
28	47.3	13.5	5.3	91.2
30	23.0	6.7	2.6	93.8
35	12.1	3.4	1.3	95.1
40	8.3	2.3	0.9	96.0
48	14.3	4.1	1.7	97.7
50	4.4	1.7	0.4	98.1
65	7.4	2.0	0.8	98.9
80	3.6	1.0	0.4	99.3
100	2.6	0.7	0.3	99.6
150	1.2	0.3	0.1	99.7
200	1.1	0.3	0.1	99.8
Passed 200	1.9	0.5	0.2	100.0
	<u>349.3</u>			



Sample 1

This sample contained organic matter and tested silt to the amount of about 8%. The Mechanical Analysis shows a #4 screen to retain 15% and the #8 screen to retain 24%. This data would indicate useless gravel but it was being used for maintenance work. The following is the Mechanical Analysis data.

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			15.0	15.0
8			8.3	23.3
10	106.3	18.2	14.0	37.3
20	202.5	34.6	26.4	63.7
28	110.4	18.8	14.3	77.8
30	62.7	10.7	8.1	85.9
35	30.9	5.3	3.9	89.8
40	18.3	3.1	2.3	92.1
48	28.4	4.8	3.6	95.7
50	7.2	1.2	0.8	96.5
65	12.7	2.2	1.6	98.1
80	4.9	0.8	0.5	98.6
100	3.3	0.6	0.3	98.9
150	1.8	0.3	0.1	99.0
200	1.6	0.3	0.3	99.3
Passed 200	5.4	0.9	0.7	100.0
	<u>587.6</u>			



Sample 1

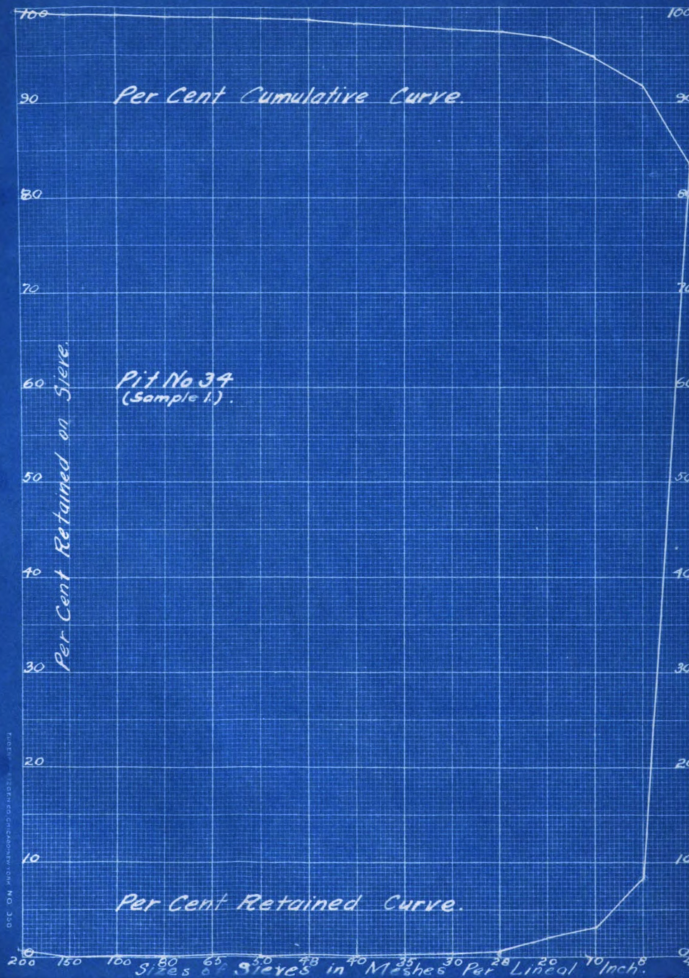
This sample was found to contain organic and a small percentage of silt. The Mechanical Analysis shows a #4 screen to retain 83% and the #8 screen to retain 92%. This gravel can best be used for gravel road construction. The following is the Mechanical Analysis data:

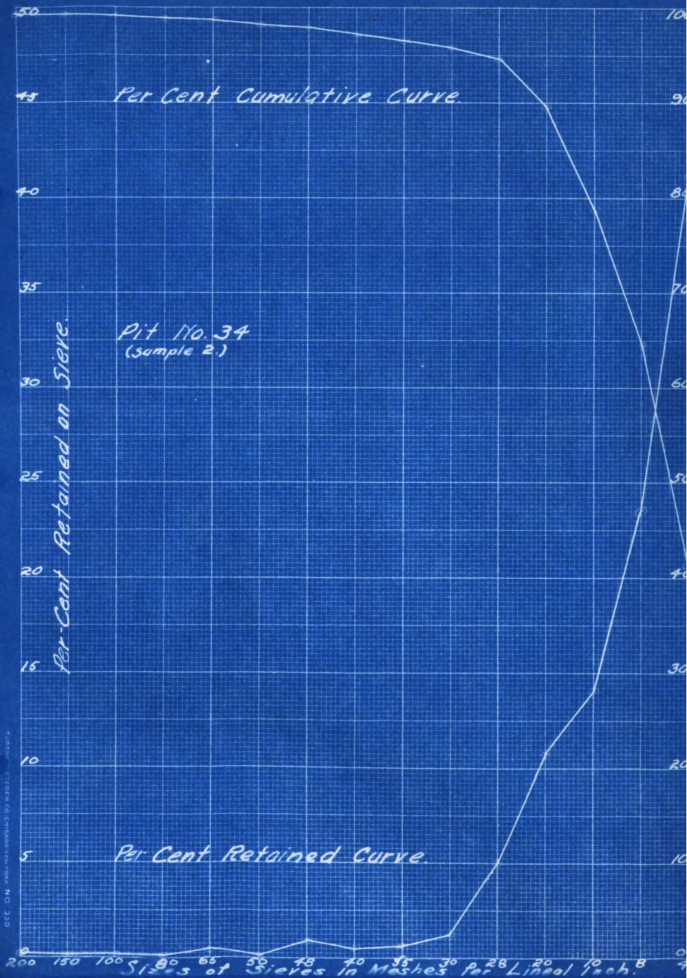
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			83.4	83.4
8			8.3	91.7
10	198.4	38.9	31.1	94.8
20	136.1	26.6	2.1	96.9
28	38.6	7.6	0.6	97.5
30	25.0	4.9	0.4	97.9
35	15.9	3.1	0.3	98.2
40	12.1	2.4	0.2	98.4
48	22.8	4.5	0.4	98.8
50	6.9	1.4	0.1	98.9
65	10.8	2.1	0.2	99.1
80	6.6	1.3	0.1	99.2
100	15.1	2.9	0.1	99.3
150	0.8	0.2	0.0	99.3
200	3.8	0.7	0.5	99.8
Passed 200	16.4	3.2	0.2	100.0
	<u>509.3</u>			

Sample 2

This sample was tested free of organic matter and contained about 8% silt. The Mechanical Analysis shows #4 screen to retain 41% and #8 screen to retain 65%. So the results indicate that the sample can be best used for gravel construction as well as concrete and asphalt concrete. The following is the Mechanical Analysis data:

4			41.2	41.2
8			23.5	64.7
10	146.0	40.0	14.1	78.8
20	111.2	30.4	10.8	89.6
28	51.8	14.2	5.0	94.6
30	13.8	3.8	1.3	95.9
35	5.5	2.1	0.7	96.6
40	4.9	1.3	0.5	97.1
48	9.2	2.5	0.9	98.0
50	2.4	0.7	0.2	98.2
65	5.0	1.4	0.5	98.7
80	2.5	0.7	0.2	98.9
100	2.3	0.6	0.2	99.1
150	1.5	0.4	0.1	99.2
200	1.8	0.4	0.2	99.4
Passed 200	5.8	1.6	0.6	100.0
	<u>365.6</u>			

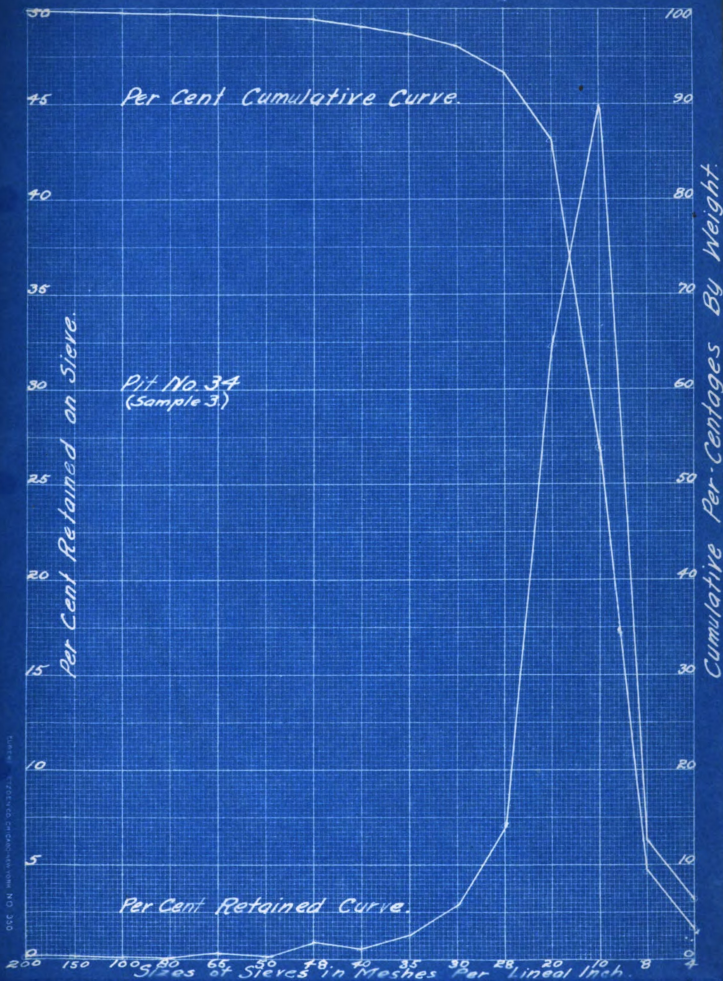




Sample 3

This sample also tested free of organic matter and tested about 3% silt. The Mechanical Analysis shows #4 screen to retain 4% and #8 screen to retain 9%. This data would indicate the sample best suited for concrete and asphalt concrete construction. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>% Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			3.2	3.2
8			6.3	9.5
10	323.5	49.2	44.4	53.9
20	243.2	35.7	32.3	86.2
28	58.2	7.8	7.1	93.3
30	21.4	3.2	2.9	96.2
35	8.7	1.3	1.3	97.5
40	4.6	0.7	0.6	98.1
48	6.9	1.0	0.9	99.0
50	1.1	0.2	0.1	99.1
65	2.4	0.4	0.3	99.4
80	0.7	0.1	0.1	99.5
100	0.9	0.1	0.1	99.6
150	0.5	0.1	0.1	99.7
200	0.5	0.1	0.1	99.8
passed 200	1.4	0.2	0.2	100.0
	<u>678.0</u>			



PIT NUMBER 35
South Lansing

Sample 1

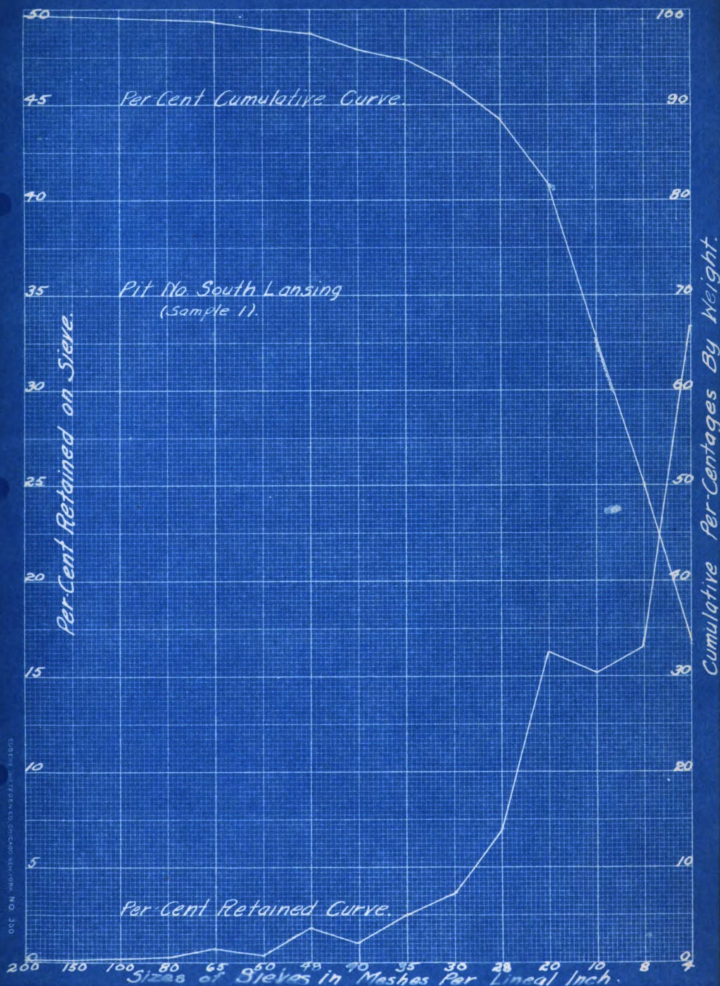
This gravel tested of organic matter it also tested about 8% silt. The #4 screen retained 33% and #8 screen 50%. The gravel was of red color indicating the presence of iron-oxide. It was being used for gravel road construction which is certainly below the requirements of the Michigan State Highway Department. The following is the Mechanical Analysis data:

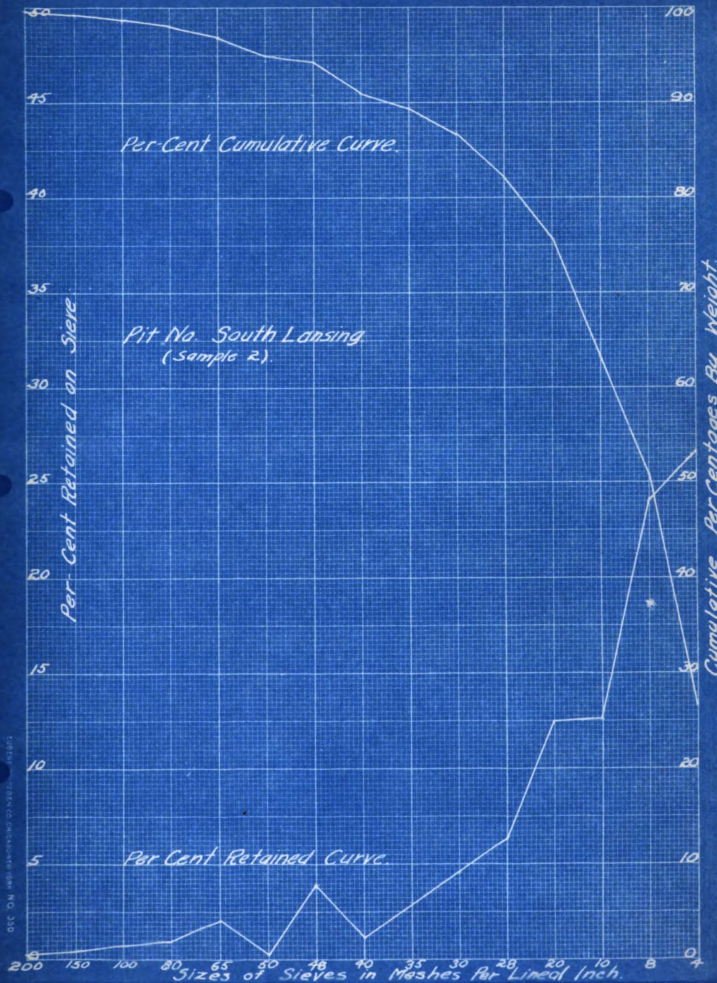
<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			33.3	33.3
8			16.6	49.9
10	114.9	30.7	15.2	65.3
20	121.5	32.6	16.2	81.5
28	52.4	14.1	7.0	88.5
30	29.3	7.9	3.7	92.2
35	14.5	3.8	2.5	94.7
40	8.3	2.2	1.1	95.8
48	13.0	3.5	1.8	97.6
50	3.0	0.8	0.4	98.0
65	5.6	1.5	0.7	98.7
80	2.2	0.6	0.3	99.0
100	1.7	0.4	0.2	99.2
150	1.0	0.2	0.1	99.3
200	1.0	0.2	0.1	99.4
Passed 200	3.9	1.0	0.6	100.0
	<u>372.3</u>			

Sample 2

This sample showed very little organic material and tested 1% silt. The mechanical Analysis shows 27% retained on #4 screen and 51 % on #8 screen, This gravel is used for a concrete and asphalt concrete construction. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			26.6	26.6
8			24.0	50.6
10	107.6	23.7	12.6	63.2
20	103.1	23.6	12.5	75.7
28	51.6	12.1	6.4	82.1
30	37.4	8.8	4.6	86.7
35	23.2	5.4	2.8	89.5
40	16.6	2.5	1.2	90.7
48	30.4	7.1	3.9	94.6
50	7.8	1.8	0.3	94.9
65	17.4	4.1	2.1	97.0
80	7.8	1.8	1.0	98.0
100	6.3	1.5	0.8	98.8
150	3.3	0.7	0.5	99.3
200	2.4	0.6	0.3	99.6
Passed 200	2.9	0.7	0.4	100.0
	<u>423.9</u>			

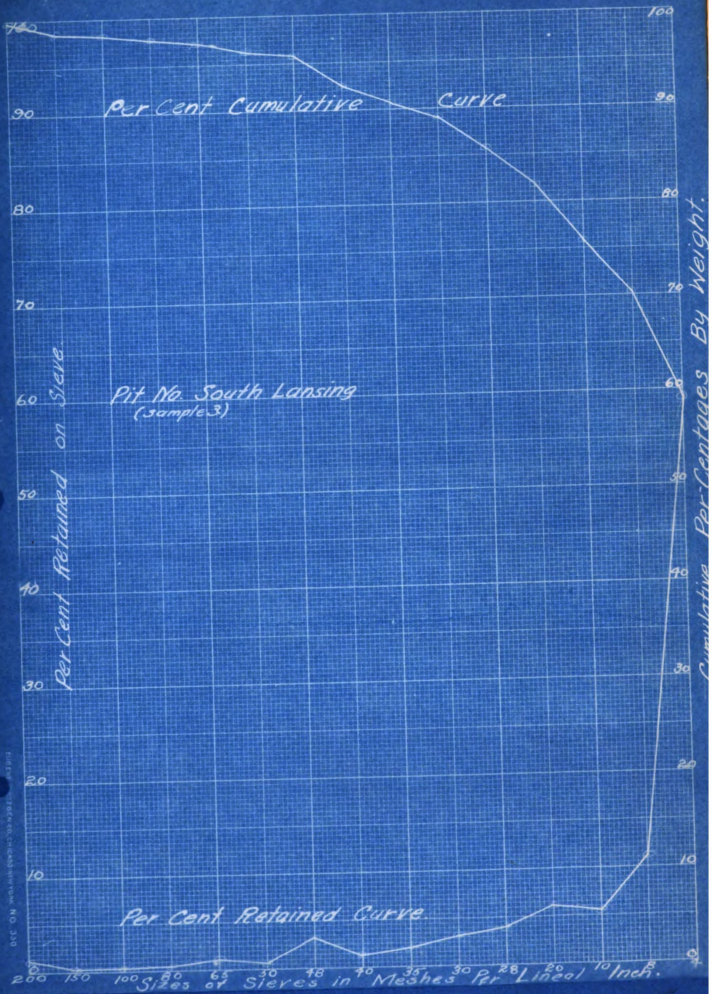




Sample 3

This sample tested free of organic matter and contained very little silt. Mechanical Analysis showed #4 screen to retain 59% and #8 screen to retain 70%. This would indicate that the gravel could be best used for gravel road construction and this is the use to which it is being put. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			59.0	59.0
8			11.1	70.3
10	86.6	19.0	5.5	75.8
20	95.4	21.1	6.1	81.9
28	61.8	13.6	4.0	85.9
30	50.2	11.1	3.2	89.1
35	31.6	6.9	2.0	91.1
40	23.4	5.2	1.4	92.5
48	50.9	11.2	3.2	95.7
50	10.7	2.3	0.6	96.3
65	18.4	4.0	1.1	97.4
80	8.0	1.8	0.5	97.9
100	5.9	1.3	0.4	98.3
150	3.2	0.7	0.2	98.5
200	2.0	0.4	1.2	99.7
Passed 200	4.8	1.0	0.25	100.0
	<u>452.9</u>			

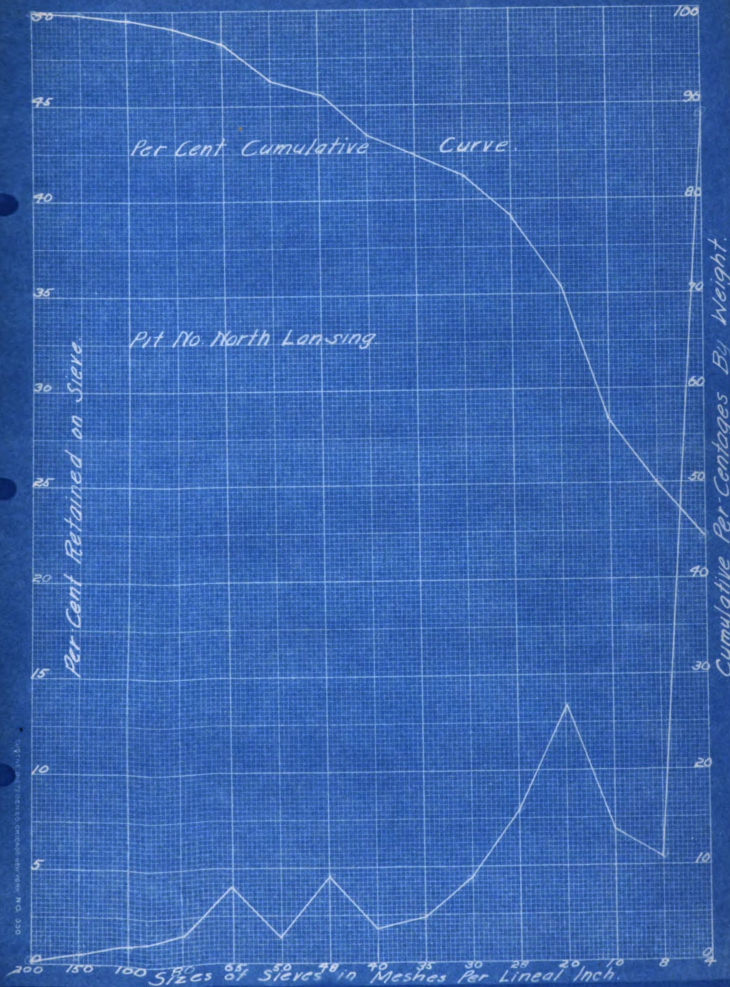


PIT NUMBER 36
North Lansing

Sample 1

The gravel from this pit tested of organic matter. The reason for this is that the pit contains a streak of gravel about three feet thick with stripping six to 10 feet deep on top of it and likewise on the bottom of it, so that it is impossible to get out the gravel without a great deal of dirt. This sample showed a silt test of about 5%. The Mechanical Analysis shows #4 screen to retain 44% and #8 to retain 50%. If the gravel itself could be taken out free from stripping it would probably test about 70% on the #8 screen. This gravel as it stands under the deep stripping should not be used for road-ways unless it could be removed without getting so much dirt. The following is the Mechanical Analysis data:

<u>Number of Sieve</u>	<u>Amount Retained in Grams</u>	<u>Percent Sample Retained</u>	<u>%Original Sample Retained</u>	<u>Cumulative Percentages by Weight</u>
4			44.5	44.5
8			5.5	50.0
10	73.7	13.8	6.9	56.9
20	142.5	26.6	13.3	70.2
28	84.2	15.7	7.9	78.1
30	47.1	8.8	4.4	82.5
35	26.1	4.8	2.4	84.9
40	19.1	3.6	1.8	86.7
48	48.8	9.0	4.5	91.2
50	15.7	2.9	1.4	92.6
65	41.6	7.7	3.9	96.5
80	16.1	3.0	1.6	98.1
100	11.3	2.1	1.0	99.1
150	4.9	0.9	0.5	99.6
200	2.2	0.4	0.2	99.8
Passed 200	2.5	0.5	0.2	100.0
	<u>535.9</u>			



CONCLUSION

No account has been taken as to the value of the gravel for sewage disposal beds. It was not possible to make such tests because of the lack of time for laboratory work. As a whole though, the gravels of this County would be considered too dirty for such work.

The gravel as a whole seems to be ~~more~~ suited for gravel road maintenance than anything else although, it can also be used for gravel road base construction. This is probably due to the fact that the pits of this County have been worked a great deal. When one considers the amount of road construction that has taken place in this County, one must realize that many thousands of cubic yards have been removed and used in this construction. So it is little wonder that some of the pits are worn out and poor grade of gravel contained in them. Most of the gravels can be screened and used as fine aggregate in concrete, provided of course that no organic matter is evident in the gravel. About half of the pits due to organic matter could not furnish gravel for concrete or asphalt concrete.

In concluding it would appear to the writer that Ingham County would do well to invest in location of new gravel fields.

Suggestions for future tests

The writer would suggest that for future tests of gravels of any county, that the county be divided into divisions. This would make, of course, lesser territory to cover and less samples of gravel to test. To lessen the amount of territory would perhaps seem like cutting down on the work to be done, but such would not be true. More tests could be made in the laboratory and more data and results obtained, so that a better idea of the gravel could be had than this report shows. For this county too few tests were made on the gravel due to the lack of laboratory time and too much time had to be spent on the graphs and writing. This report may be of some value in finding certain gravels necessary for certain work, but it would be much more valuable where the gravel pits were practically new and not as well known and worn out as a great many of Ingham County's pits are.

The writer wishes to thank Professor Ren Saxton and Professor Allen for their suggestions and helps on this thesis also Fred Rogers for his assistance in collecting the samples and the American Association of Asphalt for their specifications for concrete and asphalt.

MICHIGAN STATE UNIVERSITY LIBRARIES



3 1293 03062 7368