

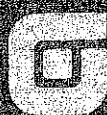
NOT A PART OF THE CONTRACT

Subsurface Investigation

CLAY SANITARY DISTRICT

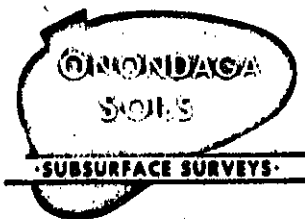
Contract No. 1A
Oak Orchard Force Main &
Effluent Sewer

County of Onondaga, New York
Department of Public Works
Division of Drainage & Sanitation



O'BRIEN & GERE
ENGINEERS, INC.

1972



Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD

EAST SYRACUSE, N. Y. 13057

656-7211

SUBSURFACE INVESTIGATION REPORT

ON

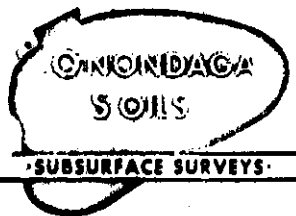
CLAY FORCE MAIN & EFFLUENT SEWERS
CLAY SANITARY DISTRICT
CLAY, NEW YORK

FOR

O'BRIEN & GERE, ENGINEERS, INC.
1050 WEST GENESEE STREET
SYRACUSE, NEW YORK

BY

ONONDAGA SOIL TESTING, INC.
6309 GIRDEN ROAD
EAST SYRACUSE, NEW YORK



Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD EAST SYRACUSE, N. Y. 13057

656-7211

O'BRIEN & GERE
SYRACUSE, N. Y.

DEC 7 1972

RECEIVED

To: O'Brien & Gere Engineers, Inc. Date: December 6, 1972

1050 West Genesee Street

Syracuse, New York

Attention: Mr. Lyall Squairs

Re: Proposed Clay Sanitary District

Clay, New York

Job No. P-5509

Gentlemen:

We are sending you: Herewith ☒ Under separate cover ☐

Prints ☐ Specifications ☐ Preliminary Copies ☐ ☐

No. of copies	Job No.	Job Name	Latest Date	Description or Remarks
1	same	same		

General Remarks:

COMPLETED REPORT

Sent by:

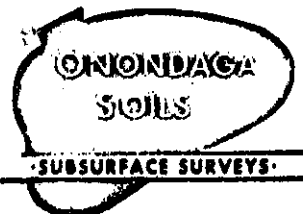
- ☐ Messenger
☐ Express
☐ First Class Mail
☐ Parcel Post
☐ _____

If enclosures are not as listed, kindly notify at once.

Very truly yours,

A. Duncan

By _____



Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD

EAST SYRACUSE, N. Y. 13057

656-7211

December 4, 1972

O'Brien & Gere Engineers, Inc.
1050 West Genesee Street
Syracuse, New York

Re: Clay Force Main & Effluent Sewer, Clay Sanitary District

Gentlemen:

In accordance with your request, we have investigated the above site by means of eight (8) test borings. Locations were determined in the field by your office.

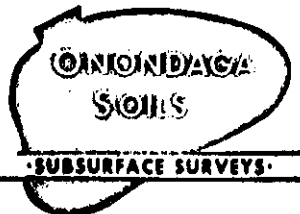
The purpose of these investigations was to determine the various soils throughout the path of the proposed main.

MATERIALS ENCOUNTERED

In general, four (4) main types of materials were encountered at these locations. All materials are generally quite soft lacustrine soils deposited during the recession of the recent Wisconsin glacier. The soil sequence can be broken down as follows:

1. **PLASTIC SILTS:** These fine grained soils were encountered near the surface at this site. They are highly saturated in nature and have high plasticity. In general, small amounts of clays were found in these soils and they are quite uniform. Soils of this type are classified by the Unified Soil System as MH.

2. **SLIGHTLY PLASTIC SILTS:** These soils are found underlying the thin plastic surface soils and in general contain twenty per-



Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD

EAST SYRACUSE, N. Y. 13057

656-7211

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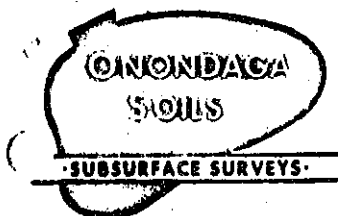
December 4, 1972

O'Brien & Gere Engineers, Inc.

cent (20%) or less of fine sands. They are slightly plastic in nature and are in a saturated condition. They are classified by the Unified Soils System as ML.

3. GLACIAL TILLS AND GRAVELS: These materials were found to underlie the relatively thicker lacustrine silts. These soils are generally quite dense in nature and have good load bearing characteristics. They are classified by the Unified Soils System as GM. These soils are found to contain varying amounts of the underlying bedrock, which appears to have been "re-worked" into the soils by glacial action. Test hole one (TH-1) encountered materials similar to this at a depth of twenty-one (21) feet. However, a soft zone is present in this strata, as can be seen from the blow counts on the sampler. This appears to be caused by a loose sand and gravel seam and the presence of this soft zone should be noted accordingly.

4. PARENT BEDROCK: The parent bedrock at this location is derived from the Clinton Group. In general, this bedrock is somewhat variable and consists primarily of interbedded shale and sand stones, which varies from a soft to a medium hard rock is a quite competent bedrock. Bedrock was cored in test hole six (TH-6), test hole seven (TH-7), and test hole eight (TH-8) and the types of rock encountered are indicated on the boring logs. Bedrock was encountered in several of the remaining test holes. however, it was not cored



Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD

EAST SYRACUSE, N. Y. 13057

656.7211

O'Brien & Gere Engineers, Inc.

-3-

December 4, 1972

in any of these cases.

WATER LEVELS

Water levels were observed at the completion of each test hole and are noted on the logs. In general, the water table is somewhat variable at this site. However, it can be expected to be relatively high based on observations of the soil samples. Therefore, the presence of this table should be noted accordingly, particularly for excavation purposes.

CLASSIFICATIONS

The material was first classified in the field by the foreman in charge, it was then forwarded to this office where each sample was individually examined and classified in accordance with the Unified Soils System, a copy and brief description of which is enclosed for your reference.

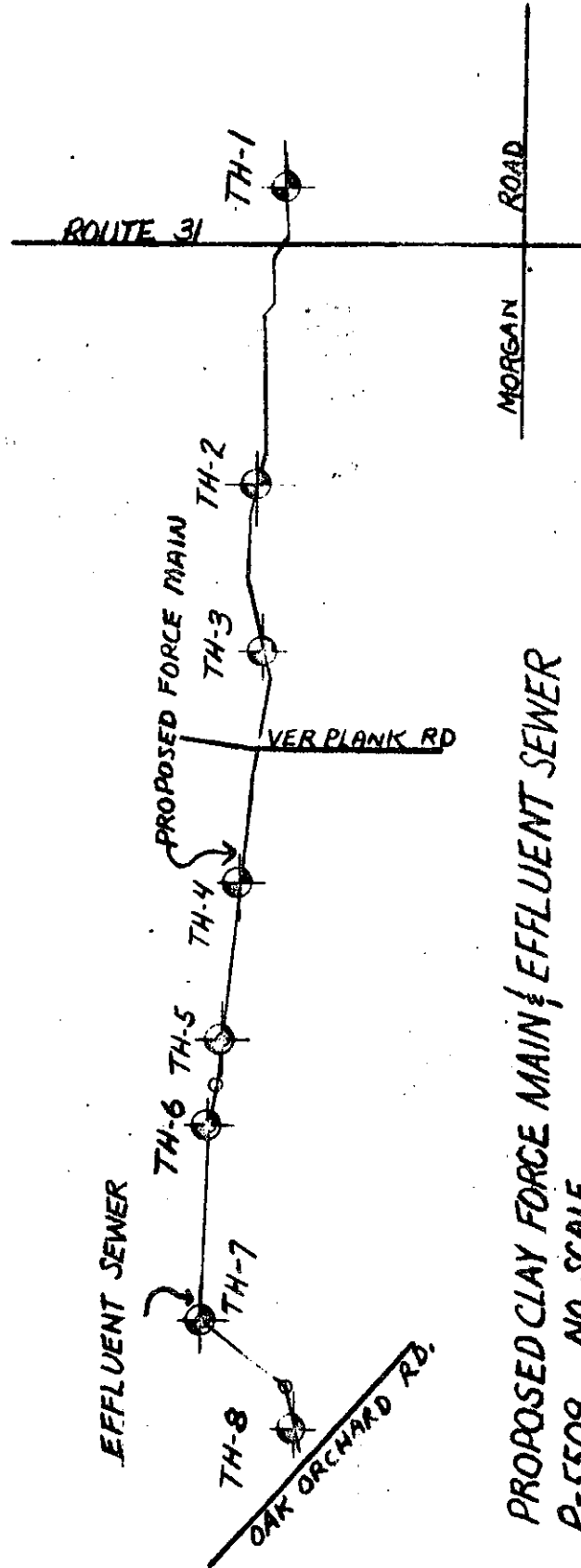
If you have any questions on the above, or if we may be of further service, please feel free to contact us.

Very truly yours,

ONONDAGA SOIL TESTING, INC.

Fred W. Zercher
FRED W. ZERCHER,

FWZ/jc

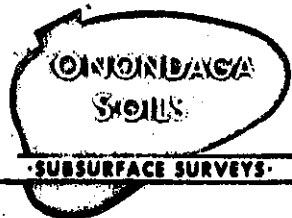


PROPOSED CLAY FORCE MAIN & EFFLUENT SEWER

P-5509 NO SCALE

11-27-72

NOTE: TEST HOLE LOCATIONS STAKED IN FIELD BY O'BRIEN & GERE



Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD

EAST SYRACUSE, N. Y. 13057

636-7211

JOB NO. P-5509

HOLE NO. TH-1
72-267

TITLE CLAY FORCE MAIN & EFFLUENT SEWER, CLAY SANITARY DISTRICT

CLIENT O'BRIEN & GERE ENGINEERS, INC., 1050 WEST GENESEE ST., SYRACUSE

ELEV. AT GROUND SURFACE TECHNICIAN C. SMITH

DATE STARTED NOVEMBER 13, 1972 COMPLETED NOVEMBER 13, 1972

GROUND WATER 10'4" BELOW SURFACE AT COMPLETION

DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER		SAMPLE NO.	DEPTH OF SAMPLE	CLASSIFICATION & REMARKS
		0-6"	6"-18" N			
5'		5	4-4	1	1'0"-2'6"	SOFT SILT, LITTLE CLAY (BROWN, MOIST, PLASTIC) MH
						4'6"
		3	3-3	2	5'0"-6'6"	SOFT SILT, LITTLE FINE SAND, TRACE CLAY (BROWN, WET, SLIGHTLY PLASTIC) ML
10'						
		4	5-7	3	10'-11'6"	(BROWN, WET, SLIGHTLY PLASTIC) ML
15'						
		2	3-4	4	15'-16'6"	(BROWN, WET, SLIGHTLY PLASTIC) ML
20'						
		3	105=11	5	20'-21'5"	(BROWN, WET, SLIGHTLY PLASTIC) ML 21'0"
25'						DENSE TO VERY DENSE SILT, MEDIUM TO FIN GRAVEL, LITTLE FINE SAND, ROCK FRAG- MENTS (GREY, MOIST, NON PLASTIC) GM
		6	6-20	5	25'-26'6"	(GREY, MOIST, NON PLASTIC) GM 26'6"
						BORING TERMINATED AT 26'6"

NOTE: N = NO. BLOWS TO DRIVE 2" SPOON 12" WITH 140 LB. WT. 30" PER BLOW

C = NO. BLOWS TO DRIVE 2 1/2" CASING 12" WITH 200 LB. WT. 24" PER BLOW

JOB NO. P-5509 HOLE NO. TH-2
 TITLE CLAY FORCE MAIN & EFFLUENT SEWER, CLAY SANITARY DISTRICT
 CLIENT O'BRIEN & GERE ENGINEERS, INC., SYRACUSE, NEW YORK
 ELEV. AT GROUND SURFACE TECHNICIAN C. SMITH
 DATE STARTED NOVEMBER 13, 1972 COMPLETED NOVEMBER 13, 1972
 GROUND WATER 6'3" BELOW SURFACE AT COMPLETION

DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER		SAMPLE NO.	DEPTH OF SAMPLE	CLASSIFICATION & REMARKS
		0-6"	6"-18" N			
		2	3-5	1	1'0"-2'6"	SOFT TO FIRM SILT, LITTLE CLAY (BROWN, WET, SLIGHTLY PLASTIC) ML
5'		5	6-6	2	5'0"-6'6"	(BROWN, WET, SLIGHTLY PLASTIC) ML
10'		6	5-5	3	10'-11'6"	(BROWN, WET, SLIGHTLY PLASTIC) ML
15'		2	2-2	4	15'-16'6"	VERY SOFT SILTY CLAY (GREY, WET, PLASTIC) CL
20'		17	16-12	5	20'-21'6"	DENSE TO VERY DENSE GLACIAL TILL CON- SISTING OF: SILT, FINE SAND, MEDIUM TO FINE GRAVEL, LITTLE CLAY (BROWN, BLACK, WET, NON PLASTIC) GM
25'		22	25-20	6	25'-26'6"	DECOMPOSED SHALE NOTED IN S-6 (BROWN, BLACK, WET, NON PLASTIC) GM
						BORING TERMINATED AT 26'6"

NOTE: N = NO. BLOWS TO DRIVE 2" SPOON 12" WITH 140 LB. WT. 30" PER BLOW

C = NO. BLOWS TO DRIVE 2 1/2" CASING 12" WITH 250 LB. WT. 24" PER BLOW

ONONDAGA
SOILS

SUBSURFACE SURVEYS

Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD

EAST SYRACUSE, N. Y. 13057

656-7211

P-5509

JOB NO.

TH-4

HOLE NO. 72-204

TITLE CLAY FORCE MAIN & EFFLUENT SEWER, CLAY SANITARY DISTRICT

CLIENT O'BRIEN & GERE ENGINEERS, INC. SYRACUSE, NEW YORK

ELEV. AT GROUND SURFACE TECHNICIAN C. SMITH

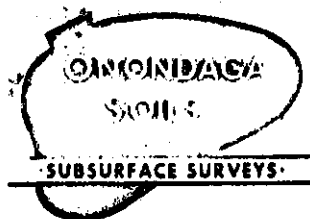
DATE STARTED NOVEMBER 14, 1972 COMPLETED NOVEMBER 14, 1972

GROUND WATER 10'3" BELOW SURFACE AT COMPLETION

DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER		SAMPLE NO.	DEPTH OF SAMPLE	CLASSIFICATION & REMARKS
		0-6"	6"-18" N			
5'		4	3-4	1	1'0"-2'6"	SOFT SILT, LITTLE CLAY, TRACE FINE SAND (BROWN, WET, PLASTIC) MH
10'		4	5-5	2	5'0"-6'6"	(BROWN, WET, PLASTIC) MH
						8'0"
15'						SOFT TO FIRM SILTY CLAY
		7	4-3	3	10'-11'6"	(GRAY, WET, PLASTIC) MH
20'						
		8	5-5	4	15'-16'6"	(GRAY, WET, PLASTIC) MH
25'						
		10	12-12	5	20'-21'6"	(GRAY, WET, PLASTIC) MH
						22'0"
						DENSE WEATHERED SHALE, SILT, FINE SAND, ANGULAR SHALE FRAGMENTS
		10	20-18	6	25'-26'6"	(BLACK, DARK GRAY, WET, NON PLASTIC)
						26'6"
						BORING TERMINATED AT 26'6"

NOTE: N = NO. BLOWS TO DRIVE 2" SPOON 18" WITH 140 LB. WT. 30" PER BLOW

C = NO. BLOWS TO DRIVE 2 1/2" CASING 18" WITH 300 LB. WT. 24" PER BLOW



Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD

EAST SYRACUSE, N. Y. 13057

656-7211

JOB NO. P-5509

HOLE NO. TH-5

TITLE CLAY FORCE MAIN & EFFLUENT SEWER, CLAY SANITARY DISTRICT

CLIENT O'BRIEN & GERE ENGINEERS, INC., SYRACUSE, NEW YORK

ELEV. AT GROUND SURFACE TECHNICIAN C. SMITH

DATE STARTED NOVEMBER 16, 1972 COMPLETED NOVEMBER 16, 1972

GROUND WATER 13'2" BELOW SURFACE AT COMPLETION

DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER		SAMPLE NO.	DEPTH OF SAMPLE	CLASSIFICATION & REMARKS
		0-6"	6"-18" N			
5'						TOPSOIL 0'8"
		8	5-4	1	1'0"-2'6"	FIRM SILT, LITTLE CLAY, FINE SAND (BROWN, WET, PLASTIC) MH 4'0"
		9	10-8	2	5'0"-6'6"	FIRM SILT SOME FINE SAND, LITTLE MEDIUM TO FINE GRAVEL, CLAY (BROWN, WET, SLIGHTLY PLASTIC) ML 7'0"
10'		34	34-32	3	10'-11'6"	VERY DENSE GLACIAL TILL CONSISTING OF: SILT, FINE GRAVEL, ANGULAR SHALE FRAG- MENTS, LITTLE FINE SAND, DECOMPOSED SHALE (BLACK, DARK BROWN, DAMP, NON PLASTIC) GM
15'		11	34-50	4	15'-16'6"	(BLACK, DARK BROWN, DAMP, NON PLASTIC) GM 16'0"
20'		76	84=17"	5	20'-21'0"	VERY DENSE WEATHERED SHALE, SILT, ANGULAR SHALE FRAGMENTS & SHALE LAYERS (DARK BROWN, BLACK, MOIST, NON PLASTIC) (DARK BROWN, BLACK, MOIST, NON PLASTIC)
25'		96	195=6"	6	23'-23'6"	(DARK BROWN, BLACK, MOIST, NON PLASTIC) 23'6"
						BORING TERMINATED AT 23'6"

NOTE: N = NO. BLOWS TO DRIVE 2" SPOON 12" WITH 140 LB. WT. 30" PER BLOW

C = NO. BLOWS TO DRIVE 2 1/2" CASING 12" WITH 250 LB. WT. 24" PER BLOW

JOB NO. P-5509

HOLE NO. TH-6

TITLE CLAY FORCE MAIN & EFFLUENT SEWER, CLAY SANITARY DISTRICT

CLIENT O'BRIEN & GERE ENGINEERS, INC., SYRACUSE, NEW YORK

ELEV. AT GROUND SURFACE TECHNICIAN C. SMITH

DATE STARTED NOVEMBER 15, 1972 COMPLETED NOVEMBER 16, 1972

GROUND WATER 3' BELOW SURFACE 1 HOUR AFTER COMPLETION

PAGE 1 OF 2

DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER		SAMPLE NO.	DEPTH OF SAMPLE	CLASSIFICATION & REMARKS
		0-6"	6"-18" N			
5'		9	3-7	1	1'0"-2'6"	SOFT SILT, LITTLE CLAY, TRACE FINE SAND (BROWN, MOIST, PLASTIC) MH 3'0"
		9	7-6	2	5'0"-6'6"	FIRM SILT, MEDIUM TO FINE GRAVEL & ANGULAR SHALE FRAGMENTS, LITTLE FINE SAND (GRAY, WET, NON PLASTIC) GM 8'0"
10'		4	3-3	3	10'-11'6"	SOFT SILT, TRACE FINE SAND & CLAY (GRAY, WET, SLIGHTLY PLASTIC) ML 13'6"
15'		9	10-11	4	15'-16'6"	COMPACT FINE SAND, SOME SILT (GRAY, WET, NON PLASTIC) SM 18'0"
20'		22	42-44	5	20'-21'6"	SEE NOTE "A" 20'6"
25'		100=7'		6	24'-24'7"	MEDIUM TO FINE SAND, SILT, ROCK FRAG- MENTS (BLACK, DARK GRAY, WET, NON PLASTIC) 24'7"
						THIN BEDDED GRAY TO BLACK, SHALE, SOFT, HIGHLY FRACTURED (CLINTON GROUP) 29'7"
						BORING TERMINATED AT 29'7"

NOTE: N = NO. BLOWS TO DRIVE 2" SPOON 12" WITH 140 LB. WT. 30" PER BLOW

C = NO. BLOWS TO DRIVE 1 1/2" CASING 12" WITH 200 LB. WT. 24" PER BLOW

JOB NO. P-5509

HOLE NO. TH-7

TITLE CLAY FORCE MAIN & EFFLUENT SEWER, CLAY SANITARY DISTRICT

CLIENT O'BRIEN & GERE ENGINEERS, INC., SYRACUSE, NEW YORK

ELEV. AT GROUND SURFACE TECHNICIAN C. SMITH

DATE STARTED NOVEMBER 14, 1972 COMPLETED NOVEMBER 15, 1972

GROUND WATER 21'3" BELOW SURFACE AT COMPLETION

PAGE 1 OF 2

DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER		SAMPLE NO.	DEPTH OF SAMPLE	CLASSIFICATION & REMARKS
		0-6"	6"-18" N			
5'		6	4-5	1	1'0"-2'6"	SOFT TO FIRM SILT, LITTLE CLAY, TRACE FINE SAND (BROWN, WET, PLASTIC) MH
10'		5	5-5	2	5'0"-6'6"	(BROWN, WET, PLASTIC) MH
15'		3	6-5	3	10'-11'6"	(BROWN, WET, PLASTIC) MH
20'		5	5-5	4	15'-16'6"	(BROWN, WET, PLASTIC) MH
25'		6	8-7	5	20'-21'6"	(BROWN, WET, PLASTIC) MH
30'		1	1-1	6	25'-26'6"	SOFT TO FIRM SILT, TRACE CLAY, FINE SAND (GRAY, WET, SLIGHTLY PLASTIC) ML
35'		9	8-10	7	30'-31'6"	(GRAY, WET, SLIGHTLY PLASTIC) ML

NOTE: N = NO. BLOWS TO DRIVE 2" SPOON 12" WITH 140 LB. WT. 30" PER BLOW

ONONDAGA
SOILS

SUBSURFACE SURVEYS

Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD

EAST SYRACUSE, N. Y. 13057

656-7211

JOB NO. P-5509

HOLE NO. TH-7

TITLE CLAY FORCE MAIN & EFFLUENT SEWER, CLAY SANITARY DISTRICT

CLIENT O'BRIEN & GERE ENGINEERS, INC. SYRACUSE, NEW YORK

ELEV. AT GROUND SURFACE TECHNICIAN C. SMITH

DATE STARTED NOVEMBER 14, 1972 COMPLETED NOVEMBER 15, 1972

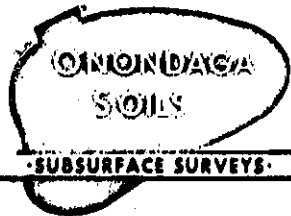
GROUND WATER 21'3" BELOW SURFACE AT COMPLETION

PAGE 2 OF 2

DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER		SAMPLE NO.	DEPTH OF SAMPLE	CLASSIFICATION & REMARKS
		0-6"	6"-18" N			
40'		10	10-10	8	35'-36'6"	(GREY, WET, SLIGHTLY PLASTIC) ML 37'0"
						VERY DENSE WEATHERED SHALE & SILT, ANGULAR SHALE FRAGMENTS
		53	70=12"	9	40'-41'0"	(BLACK, GRAY, WET, NON PLASTIC) 41'0"
						BORING TERMINATED AT 41'0"
						NOTE: POSSIBLE BEDROCK OR BOULDER AT 41'0".
						NOTE: BLOWING CONDITION FROM 20' TO 35'

NOTE: N = NO. BLOWS TO DRIVE 2" SPOON 12" WITH 140 LB. WT. 30" PER BLOW

C = NO. BLOWS TO DRIVE 2" CASING 12" WITH 200 LB. WT. 30" PER BLOW



Onondaga Soil Testing, Inc. *Subsurface Investigation*

6309 GIRDEN ROAD

EAST SYRACUSE, N. Y. 13057

656-7211

JOB NO. P-5509

HOLE NO. TH-8

TITLE CLAY FORCE MAIN & EFFLUENT SEWER, CLAY SANITARY DISTRICT

CLIENT O'BRIEN & GERE ENGINEERS, INC., SYRACUSE, NEW YORK

ELEV. AT GROUND SURFACE TECHNICIAN C. SMITH

DATE STARTED NOVEMBER 17, 1972 COMPLETED NOVEMBER 17, 1972

GROUND WATER AT GROUND SURFACE AT COMPLETION

DEPTH BELOW SURFACE	C	BLOWS ON SAMPLER		SAMPLE NO.	DEPTH OF SAMPLE	CLASSIFICATION & REMARKS
		0-6"	6"-18" N			
5'		3	4-4	1	1'0"-2'6"	SOFT SILT, LITTLE FINE SAND, CLAY, TRACE ORGANIC MATTER, ROOTS (BROWN, WET, PLASTIC) MH
						4'0"
		1	2-1	2	5'0"-6'6"	LOOSE MEDIUM TO FINE SAND & SILT (BROWN, WET, NON PLASTIC) SM/ML
						8'0"
10'		4	17-11	3	10'-11'6"	COMPACT SILT, LITTLE FINE SAND, TRACE CLAY (GRAY, WET, SLIGHTLY PLASTIC) ML
						13'0"
15'		12	15-40	4	15'-16'6"	DENSE GLACIAL TILL CONSISTING OF: SILT MEDIUM TO FINE GRAVEL, ANGULAR SHALE FRAGMENTS, LITTLE FINE SAND, CLAY (DARK GRAY, BLACK, WET, SLIGHTLY PLASTIC) GM
20'		100=1"			20'-20'1"	NO RECOVERY
						20'1"
25'						THIN BEDDED, GRAY, HARD SANDSTONE INTERBEDDED WITH THIN SHALE SEAMS (CLINTON GROUP)
						25'1"
						BORING TERMINATED AT 25'1"
						NOTE: CORE DRILLED WITH AX DIAMOND BIT & BARREL FROM 20'1" TO 25'1" RECOVERY 42" (70%)

NOTE: N = NO. BLOWS TO DRIVE 2" SPOON 12" WITH 140 LB. WT. 30" PER BLOW

C = NO. BLOWS TO DRIVE 2 1/2" CASING 12" WITH 250 LB. WT. 24" PER BLOW

A BRIEF DESCRIPTION OF THE UNIFIED SOIL SYSTEM

The Unified Classification System is an engineering soil classification that is an outgrowth of the Air-Field classification developed by Casagrande.

The system incorporates the textural characteristics of a soil into the engineering classification. All soils are classified into fifteen groups, each group being designated by two letters. These letters are as follows: G—gravel, S—sand, M—Non plastic or low plasticity fines, C—plastic fines, Pt—peat, humus and swamp soils, O—organic, W—well graded, P—poorly graded, L—low liquid limit, H—high liquid limit.

GW and SW Groups

These groups comprise well graded gravelly and sandy soils which contain less than 5% of non plastic fines passing a #200 sieve. Fines which are present must not noticeably change the strength characteristics of the coarse grain fraction and must not interfere with its free draining characteristics. In areas subject to frost action the material should not contain more than about 3% of soil grains smaller than .02 millimeters in size.

GP and SP Groups

These groups are poorly graded gravels and sands containing less than 5% non plastic fines. They may consist of uniform gravels, uniform sands, or non uniform mixtures of very coarse material and very fine sand with intermediate sizes lacking. Materials of this latter type are sometimes referred to as skip graded, cap graded, or step graded.

GM and SM Groups

In general, these groups include gravels or sands which contain more than 12% of fines having little or no plasticity. The plasticity index and liquid limit of a soil in either of these groups plot below the "A" line on a plasticity chart. Gradation is not important and both low grade and poorly graded materials are included. Some sands and gravels in these groups may have a binder composed of natural cementing agents so proportioned that the mixture shows negligible swelling or shrinkage. Thus, the dry strength is provided by a small amount of soil binder or by cementation of calcareous materials or iron oxide. A fine fraction of non cemented materials may be composed of silts or rock flour types having little or no plasticity, and the mixture will exhibit no dry strength.

GC and SC Groups

These groups comprise gravelly or sandy soils with more than 12% of fines which exhibit either low or high plasticity. The plasticity index and liquid limit of a soil in either of these groups plot above the "A" line on the plasticity chart. Gradation of these materials is not important. Plasticity of the binder fraction has more influence on the behavior of the soils than does the variation in gradation. A fine fraction is generally composed of clays.

ML and MH Groups

These groups include predominantly silty materials and micaceous or diatomaceous soils. An arbitrary division between the two groups has been established with a liquid limit of 50. Soils in these groups are sandy silts, clayey silts or organic silts with relatively low plasticity. Also included are loessial soils and rock flours. Micaceous and diatomaceous soils generally fall within the MH group, but may extend into the ML group when their liquid limit is less than 50. The same is true for certain types of kaolin clays and some illite clays having relatively low plasticity.

CL and CH Groups

The CL and CH groups embrace clays with low and high liquid limits respectively. They are primarily inorganic clays. Low plasticity clays are classified as CL and are usually lean clays, sandy clays, and silty clays. The medium plasticity and high plasticity clays are classified as CH. These include fat clays, gumbo clays, certain volcanic clays and bentonite.

OL and OH Groups

The soils in these groups are characterized by the presence of organic matter including organic silts and clays. They have a plasticity range that corresponds with the ML and MH groups.

Pt Group

Highly organic soils which are very compressible have undesirable construction characteristics are classified in one group with the symbol Pt. Peat, humus and swamp soils with a highly organic texture are typical of the group. Particles of leaves, grass, branches of bushes and other fibrous vegetable matter are common components of these soils.

Borderline Classification

Soils in the GW, SW, GP and SP groups are non plastic materials having less than 5% passing the #200 sieve, while GM, SM, GC, and SC soils have more than 12% passing the #200 sieve. When these coarse grain materials contain between 5% and 12% of fines they are classified as borderline, and are designated by the dual symbol such as GW-GM. Similarly coarse grain soils which have less than 5% passing the #200 sieve, but which are not free draining or in which the fine fraction exhibits plasticity are also classed as borderline and are given a dual symbol. Still another type of borderline classification occurs when a liquid limit of a fine grain soil is less than 29 and the plasticity index lies in the range of four to seven. These limits are indicated by the shaded area on the plasticity chart.

Silty and Clayey

In the Unified System, these terms are used to describe soils whose Atterberg limits plot below and above the "A" line on the plasticity chart. The adjectives silty and clayey are used to describe soils whose limits plot close to the "A" line.

Typical Names of Soil Groups	Group Symbols	Important Properties			Relative Desirability for Various Uses										
		Permeability When Compacted	Shearing Strength When Compacted and Saturated	Compressibility When Compacted and Saturated	Workability as a Construction Material	Rolled Earth Dams			Canal Sections		Foundations		Roadways		
						Homogeneous Embankment	Core	Shell	Erosion Resistance	Compacted Earth Lining	Seepage Important	Seepage Not Important	Frost Heave Not Possible	Frost Heave Possible	Surfacing
Well-graded gravels, gravel sand mixtures, little or no fines	GW	Pervious	Excellent	Negligible	Excellent			1	1			1	1	1	3
Poorly graded gravels, gravel sand mixtures little or no fines	GP	Very Pervious	Good	Negligible	Good			2	2			3	3	3	
Silty gravels, poorly graded, gravel-sand mixtures	GM	Semipervious To Impervious	Good	Negligible	Good	2	4		4	4	1			9	5
Clayey Gravels, poorly graded gravel-sand clay mixtures	GC	Impervious	Good To Fair	Very Low	Fair	1	1		3	1	2	6	5	5	1
Well graded sands, gravelly sands, little or no fines	SW	Pervious	Excellent	Negligible	Excellent			3 if gravelly	6			2	2	2	4
Poorly graded sands, gravelly sands, little or no fines	SP	Pervious	Good	Very Low	Fair			4 if gravelly	7 if gravelly			5	6	4	
Silty sands, poorly graded sand & silt mixtures	SM	Semipervious To Impervious	Good	Low	Fair	4	5		8 if gravelly	5 erosion critical	3	7	8	10	6
Clayey sand-s, poorly graded sand-clay mixtures	SC	Impervious	Good to Fair	Low	Good	3	2		5	2	4	8	7	6	2
Inorganic silts & very fine sand - rock floor, silty or clayey sand with slight plasticity	ML	Semipervious To Impervious	Fair	Medium	Fair	6	6			6 erosion critical	6	9	10	11	
Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	CL	Impervious	Fair	Medium	Good to Fair	5	3		9	3	5	10	9	7	7
Organic silts and organic silt clays of low plasticity	OL	Semipervious To Impervious	Poor	Medium	Fair	8	8			7 erosion critical	7	11	11	12	
Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	MH	Semipervious To Impervious	Fair to Good	High	Poor	9	9				8	12	12	13	
Inorganic clays of Medium to High Plasticity	OH	Impervious	Poor	High	Poor	7	7		10		9	13	13	8	
Organic clays of Medium to High Plasticity	OH	Impervious	Poor	High	Poor	10	10				10	14	14	14	
Peat and Other Highly Organic Soils	PT														

Note: No. 1 is best.

UNIFIED SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION									
FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 5 inches and basing fractions on estimated weights)				GROUP SYMBOLS	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS			
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size is	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size (For visual classifications, the 3" size may be used as equivalent to the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes		GW	Well graded gravels, gravel-sand mixtures, little or no fines.	Give typical name, indicate approximate percentages of sand and gravel, max. size, angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information, and symbol in parentheses. For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics. EXAMPLE:- Silty sand, gravelly; about 20% hard, angular gravel particles 1/2" in maximum size; rounded and subangular sand grains coarse to fine; about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM)		
			Predominantly one size or a range of sizes with some intermediate sizes missing.		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.			
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)		GM	Silty gravels, poorly graded gravel-sand-silt mixtures.			
			Plastic fines (for identification procedures see CL below)		GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.			
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size (For visual classifications, the 3" size may be used as equivalent to the No. 4 sieve size)	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.		SW	Well graded sands, gravelly sands; little or no fines.	EXAMPLE:- Silty sand, gravelly; about 20% hard, angular gravel particles 1/2" in maximum size; rounded and subangular sand grains coarse to fine; about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM)		
			Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	Poorly graded sands, gravelly sands; little or no fines.			
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)		SM	Silty sands, poorly graded sand-silt mixtures.			
			Plastic fines (for identification procedures see CL below)		SC	Clayey sands, poorly graded sand-clay mixtures.			
	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE						Give typical name, indicate degree and character of plasticity, amount and maximum size of coarse grains; color in wet condition, odor if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses. For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions. EXAMPLE:- Clayey silt, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML)		
	SILTS AND CLAYS Liquid limit less than 50	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.			
		None to slight	Quick to slow	None	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.			
		Medium to high	None to very slow	Medium	OL	Organic silts and organic silt-clays of low plasticity.			
SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow	Slight	MM	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.				
	Slight to medium	Slow to none	Slight to medium	GM	Inorganic clays of high plasticity, fat clays.				
	High to very high	None	High	OM	Organic clays of medium to high plasticity.				
SILTS AND CLAYS Liquid limit greater than 50	Medium to high	None to very slow	Slight to medium	OM	Organic clays of medium to high plasticity.				
	High to very high	None	High	OM	Organic clays of medium to high plasticity.				
	Medium to high	None to very slow	Slight to medium	OM	Organic clays of medium to high plasticity.				
HIGHLY ORGANIC SOILS Readily identified by color, odor, spongy feel and frequently by fibrous texture.				PT	Peat and other highly organic soils.				

Use grain size curve in identifying the fractions as given under field identification

Use grain size curve in identifying the fractions as given under field identification

