Slope Stability Report
For
Broadstreet Hollow Stream Realignment

Prepared For:

Kaaterskill Engineering

Prepared By:

Daniel G Loucks, PE
NYSPE 068389

8 May, 2000

INTRODUCTION:

The slope stability investigation for the proposed Realignment of the Broadstreet Hollow Stream has been completed.

The scope of my work consists of an analysis of the slope instability adjacent to the stream and recommendations for improving the stability of the failed slope. I have also provided foundation recommendations for the proposed retaining wall.

I have completed four site specific slope stability analyses where the existing slopes have failed. Detailed results for analysis of these areas can be found in the appendix of this report.

If desired by the client, I will complete any necessary additional work including a more detailed groundwater investigation to estimate groundwater drawdown from the wells and if additional wells are required.

The purpose of this report is to describe the investigation conducted and results obtained; to analyze and interpret the data obtained; and to make recommendations for improving the slope stability and for the design of foundations for the proposed retaining wall.

The slope stability recommendations contained in this report can be considered final unless additional work is performed to alter these recommendations. This report does not address any other aspects of the project such as general grading and erosion control.

FIELD INVESTIGATION PROCEDURES:

The borings were performed with an ATV-mounted, hollow-stem auger-drilling rig.

The borings were extended by means of six-inch O.D., hollow-stem, augers.

Representative samples were obtained from the boring holes by means of the split-spoon sampling procedure performed in accordance with ASTM D 1586. Crossed circles on the soil boring logs have indicated the standard penetration values obtained from this procedure, graphically.

Representative samples of the clay and silt soils were obtained by means of thin-wall, tube, sampling performed in accordance with ASTM D 1587-67.

Soil samples obtained from these procedures were examined in the field, sealed in containers, and shipped to the laboratory for further examination, classification and testing, as applicable.

A soils engineer visited the site to observe the surface conditions on the slopes and adjacent areas.

The surface soils and condition of the trees along the slope were noted.

LABORATORY INVESTIGATION:

All samples were examined in the laboratory by a soils engineer and classified according to the Unified Soil Classification System. In this system, the soils are visually classified according to texture and plasticity. The appropriate group symbol is indicated on the soil boring logs.

Samples exhibiting significant percentages of fine-grained soils or organic materials were subjected to moisture content testing. This testing was performed in accordance with ASTM D 2216-71. Solid black circles on the soil boring logs indicate the results of these tests, graphically.

Samples exhibiting significant cohesion were tested with a calibrated, spring-loaded, penetrometer. This test is used to estimate the unconfined compressive strength of the soil sample by measuring the soil's resistance to the penetration of the penetrometer needle. The results of these tests are indicated, graphically, on the boring logs by open circles with dashed lines on each side of the circle.

A Triaxial Permeability Test was performed on a representative sample obtained by the thin walled tube sampling procedure. Results of the test can be found in the appendix of the report.

Sieve Analyses were performed on representative samples in accordance with ASTM Specification D 422. These tests were performed to verify the visual soil classifications and to design the filter sand that is required around the well screen.

The site soil parameters have been conservatively estimated based on past experience with similar soils. The angle of friction of the soils, total unit weight of the soils and cohesion has been shown on the cross sections of geometry in the appendix.

Rock or a hard strata have been assumed to be deep.

SITE CONDITIONS:

The failed slope area is wooded and is on the north side of the existing stream just upstream of the Timberlake Road bridge.

The slope of the ground surface in the area that failed varies from between 4.0:1.0 (H:V) and 7.0:1.0 (H:V). The slopes to the north and east are at similar slopes. The slope to the west is as steep as 2.5:1.0 (H:V). These other areas show no significant signs of slope instability.

It is my understanding that the stream bottom appears to rise up and islands are formed after the failed slope moves.

SUBSURFACE CONDITIONS:

The specific subsurface conditions encountered at each boring location are indicated on the individual soil boring logs. However, to aid in the evaluation of this data, I have prepared a generalized description of the soil conditions based on the boring data.

The borings show an upper layer of sand, gravel and silt that extends to between 7.0 and 9.0 feet. This layer is loose to very dense. In borings 1 and 3 this upper layer is old fill that was placed after the last major stream erosion.

Below the sand, gravel and silt is a layered silt and clay. This layered soil extends to between 13.0 and 30.0 feet and is loose/soft.

In boring 1 a layer of fine sand and silt that changed into glacial till was encountered under the clay layer to a depth of 30 feet.

In borings 2 and 3 layers of clean sand were encountered at between 26 and 30 feet.

GROUNDWATER CONDITIONS:

The water levels have been indicated on the individual boring logs. Boring 2 encountered a layer of clean sand under the upper clay layer. An observation well was placed in this sand layer and the groundwater level in the well was at approximately 2.1 feet below the existing ground surface. This condition would cause artesian conditions in the stream.

Perched groundwater tables may occur at higher elevations in the soil profile due to groundwater being retained by layers or lenses of silt or clay soils.

Some fluctuation in hydrostatic groundwater levels and perched water conditions should be anticipated with variations in the seasonal rainfall and surface runoff.

ANALYSIS AND RECOMMENDATIONS:

Slope Stability:

The failed slope area was visually investigated and analyzed using a computer-aided stability analysis and my own experience. The procedure used to determine possible ways of improving the stability of the failed slope area is as follows:

1. The existing slopes were considered to have a factor of safety against sliding of less then 1.0. This is indicated by evidence of creep movement and past failures. Soil strength parameters were assumed based on my experience in similar soils. Groundwater levels were established to represent the historical high groundwater conditions resulting in the slopes having this factor of safety of less then 1.0.

2. Using the same soil parameters and groundwater levels as obtained above, the representative cross sections of the slopes were investigated by computer analysis. In each case, changes in the grading and/or groundwater levels were made until the area had a factor of safety of at least 1.3 against shear failure.

The computer analysis and observation well data indicate that the slope failure was likely caused by excess water pressure that exists in the sand layer below the bottom of the stream. This water pressure causes the sloping area to move toward the stream when the pressure becomes too large and/or when the stream bottom has eroded away enough soil to cause instability of the slope.

I recommend that erosion control/fill be placed in the bottom of the stream and relief wells be installed to improve the stability of the failed sloping area.

I understand that a minimum of 2.0 feet of erosion control/fill is proposed in the bottom of the stream. This erosion control is required in the bottom of the stream to reduce the amount of erosion. I also recommend that a layer of geotextile (Amoco 4512 or equal) be placed under the rip-rap in this portion of the stream.

If no erosion control is taken, the existing stream will continue to cut and increase the potential of slope instability. The slopes will tend to maintain their present degree of slope. If the toe elevation is lowered, the top of the slope will eventually be eroded or sheared back until the same slope is recovered as prevailed prior to the toe erosion.

Along with the 2.0 feet of erosion control/fill, I recommend that a minimum of three (3) relief wells be installed to reduce the groundwater pressure in the sand layer below the stream. My añalysis shows that if the water pressure is reduced by approximately 250 psf or approximately 4.0 feet of head that the factor of safety against sliding will be approximately 1.5.

The relief wells should be placed approximately as indicated on the diagram located in the appendix of the report. Additional relief wells may be required if the initial wells do not lower the pressure in the sand layer and further instability occurs. The existing wells could then be used to calculate approximately how many additional wells would be required.

I have included a typical cross section sketch of the recommended relief well design. As the sketch shows the well screen should be installed at approximately between 24 and 34 feet below the ground surface. The actual distance will vary depending on the depth of the existing sand layer. The well screen should have a maximum slot size of 10-slot and the gravel/sand pack should be composed of sand having a grain size of 1.0 mm. The remaining portion of the well design is shown on the sketch.

The well should be installed by advancing a minimum of a 14 inch diameter straight sided steel casing to a depth of approximately 2.0 feet below the bottom of the well screen. The inside of the casing should be cleaned out while advancing to identify the location of the sand layer. Augered flighted casing should not be used. After the proper depth is reached the well screen, riser, tee, gravel pack, bentonite seal and drain pipe should be installed. The drain pipe should be designed to drain to the existing stream.

All wells should be developed to provide proper performance.

Differences in the slopes from those described by the map provided may affect the recommendations contained in this report.

Retaining Wall Recommendations:

I recommend that the proposed retaining wall be supported by spread footing foundations resting on virgin, inorganic, soils or on controlled fill which, in turn, rests on these virgin materials. Footings can be designed for a maximum, net, allowable soil bearing pressure of 1500 psf.

A minimum footing width of 2.5 feet is recommended for load bearing strip footings. Footings should have a minimum embedment of 2.0 feet below the bottom of the stream to develop the bearing value of the soils. Additional depth may be required to prevent scour.

The retaining wall should have a drain tile placed around the interior base of the wall. The drain tile should be a minimum of 4 inches in diameter, surrounded by a minimum of 6 inches of washed sand or crushed stone wrapped with a filter fabric (Amoco 4545 or equal). The drain tile should drain to daylight. If crushed stone is used as backfill no drain is required.

The wall should then be backfilled with a controlled, well graded, free-draining granular material or crushed stone. The material should extend away from the wall a horizontal distance of two-thirds the height of the fill being placed. The upper 1 foot of material should be a fairly impermeable material to shed surface water. If crushed stone is used a layer of geotextile (Amoco 4508 or equal) should be placed between the crushed stone and any soil.

If these procedures are used, a lateral soil pressure of 40 psf per foot of retained soil can be used for design of the wall. This active lateral soil pressure is based on a moist unit weight of 125 pcf and an angle of internal friction of 32 degrees. A coefficient of base sliding of 0.3 can also be used for design. If crushed stone is used a lateral soil pressure of 20 psf per foot of stone can be used for the design.

Broadstreet Hollow Stream Alignment
File No.601

CONTENTS OF APPENDIX:

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS

SS	:	Split-Spoon— 1 3/4" I.D., 2" O.D., except where noted
S	:	Shelby Tube — 2" O.D., except where noted
PA	:	Power Auger Sample
DB	:	Diamond Bit — NX: BX: AX:
CB	:	Carboloy Bit — NX: BX: AX:
OS	:	Osterberg Sampler — 3" Shelby Tube
HS	:	Housel Sampler
WS	:	Wash Sample
FT	:	Fish Tail
RB	:	Rock Bit
WO	:	Wash Out

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon, except where noted

WATER LEVEL MEASUREMENT SYMBOLS

WL	:	Water Level
WCI	:	Wet Cave In
DCI	:	Dry Cave In
WS	:	While Sampling
WD	:	While Drilling
BCR	:	Before Casing Removal
ACR	:	After Casing Removal
AB	:	After Boring

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable ground water levels. In impervious soils the accurate determination of ground water elevations is not possible in even several day's observation, and additional evidence on ground water elevations must be sought.

CLASSIFICATION

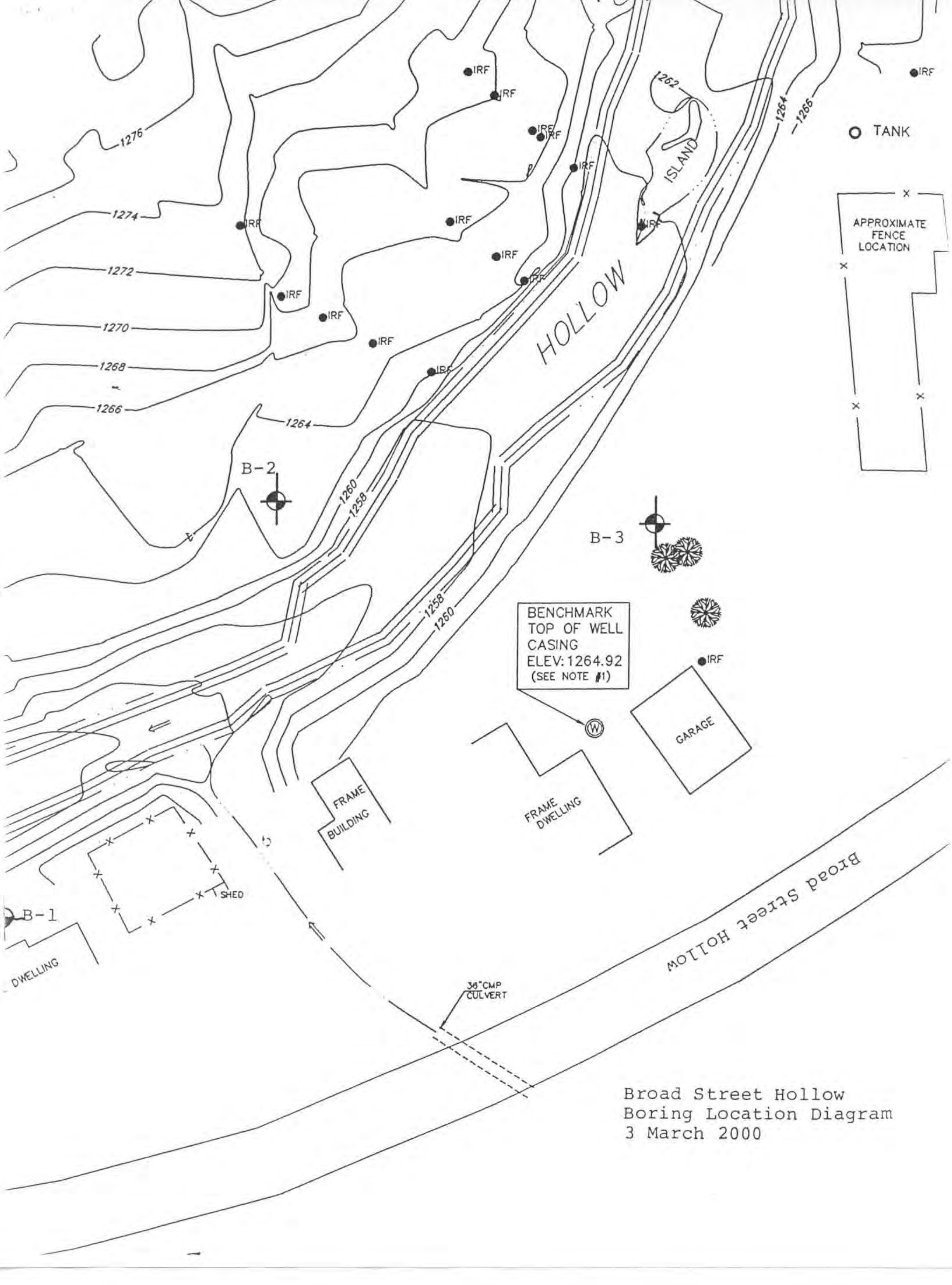
COHESIONLESS SOILS

"Trace"	:	1% to 10%	
"Trace to some"	:	10% to 20%	
"Some"	:	20% to 35%	
"And"	:	35% to 50%	
Loose	:	0 to 9 Blows	or equivalent
Medium Dense	:	10 to 29 Blows	or equivalent
Dense	:	30 to 59 Blows	or equivalent
Very Dense	:	$\geq$ 60 Blows	or equivalent

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, then clay becomes the principle noun with the other major soil constituent as modifiers: i.e., silty clay. Other minor soil constituents may be added according to classification breakdown for cohesionless soils; i.e., silty clay, trace to some sand, trace gravel.

Soft	:	0.00 — 0.59 tons/ft^2
Medium	:	0.60 — 0.99 tons/ft^2
Stiff	:	1.00 — 1.99 tons/ft^2
Very Stiff	:	2.00 — 3.99 tons/ft^2
Hard	:	$\geq$ 4.00 tons/ft^2



Broad Street Hollow
Boring Location Diagram
3 March 2000

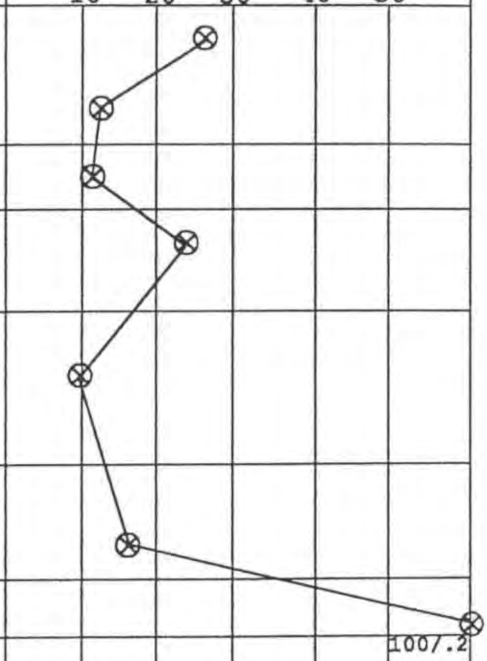
PROJECT NAME: BROAD STREET HOLLOW SLOPE	LOG OF BORING NO. 1
PROJECT LOCATION: Lexington, New York	OFFSET - ON
CLIENT: Kaaterskill Engineering Associates, P.C.	

UNCONFINED COMPRESSIVE STRENGTH (TSF): 1 2 3 4 5

PLASTIC LIMIT x — WATER CONTENT % ● — LIQUID LIMIT △: 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FOOT): 10 20 30 40 50

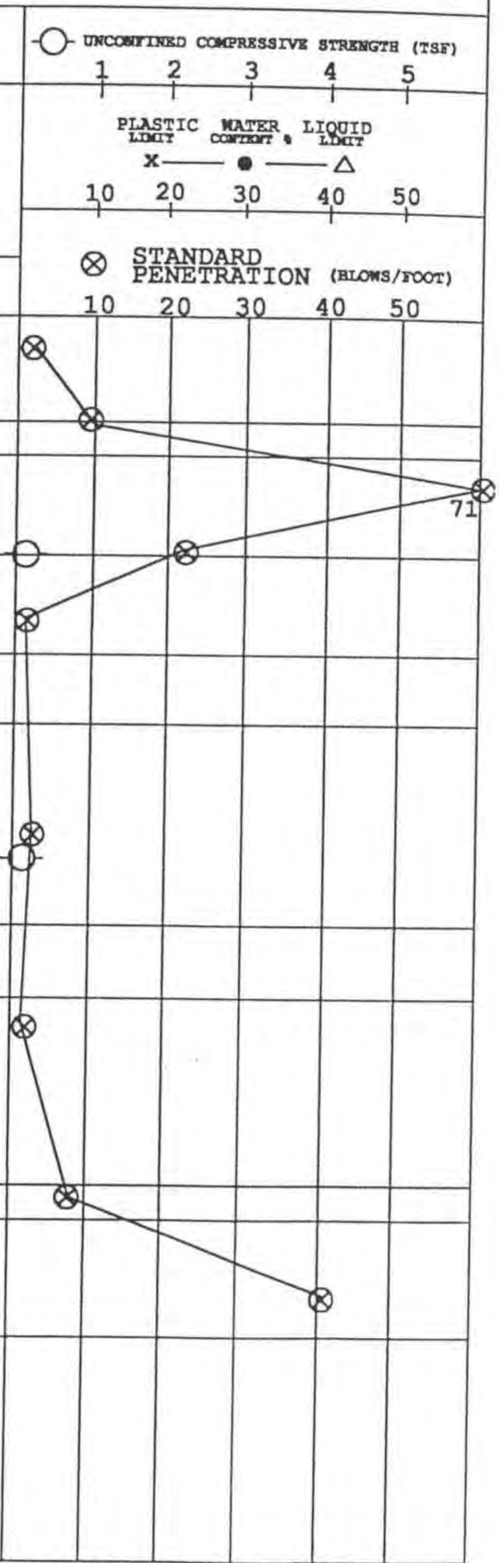
ELEVATION DEPTH	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION
0	1	SS			Sand and gravel, trace to some silt, red and brown, moist, medium dense (SM)(GM) fill
	2	SS			
5	3	SS			Medium gravel and sand, trace to some clayey silt, red and brown, moist to wet, medium dense (GM)(SM) fill
	4	SS			Medium gravel, some sand, trace to some silt, red and brown, moist to wet, medium dense (GM) fill
		PA			
10	5	SS			Silt, some sand, trace to some clay, red and brown, wet, medium dense, soft (ML)(SM) layered
		PA			
15	6	SS			Fine sand, some silt, trace to some gravel, red and brown, wet, medium dense (SM)
		PA			Clayey silt, trace to some gravel, trace sand, red & brown, moist, very dense (ML) till
	7	SS			
20					END OF BORING AT 18.7 FEET WITH SPLIT SPOON REFUSAL
25					
30					



WATER LEVEL at 9.8' while sampling; at 14.2' before casing removal	DGL FILE NO. 601	DANIEL G. LOUCKS, P.E. GEOTECHNICAL ENGINEERING P. O. BOX 163 BALLSTON SPA, NEW YORK 12020 (518) 347-2817 [FAX 347-2817]
DATE 03/30/00	STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, TRANSITION MAY BE GRADUAL.	

PROJECT NAME: BROAD STREET HOLLOW SLOPE	LOG OF BORING NO. 2
PROJECT LOCATION: Lexington, New York	BORING LOCATION: Other side of creek from houses, downhill
CLIENT: Kaaterskill Engineering Associates, P.C.	

ELEVATION DEPTH	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL / SURFACE ELEVATION
0	1	SS			Fine to medium sand, trace to some silt, trace gravel, red and brown, moist, loose (SM)
	2	SS			Note A: (below)
5	3	SS			Medium to coarse gravel, some sand, trace to some silt, red and brown, moist, very dense (GM)
	4	SS			Clay, red and brown, moist to wet, soft (CL)
	5	SS			
10		PA			Shelby tube
					Silty clay, some silt, red and brown, moist to wet, loose, soft (CL) (ML) thin silt layers
15	6	SS			
		PA			Shelby tube
20	7	SS			Set 10' PVC 19.5' - 29.5'
		PA			Clay, some silt, trace sand, red and brown, moist to wet, loose, soft (CL) (ML) (SM) thin silt layers with occasional thin sand layers
25	8	SS			Fine sand, trace silt, brown, wet, loose (SP)
		PA			Medium to coarse gravel, some clayey silt, trace sand, red and brown, wet, dense (GM)
	9	SS			
30					END OF BORING AT 30.0 FEET
					Note A: Fine to medium sand, some gravel, trace to some silt, red and brown, moist, loose (SM)



WATER LEVEL
at 5.0' before casing removal
at 2.1' on April 20, 2000

DATE Started: 03/30/00
Completed: 03/31/00

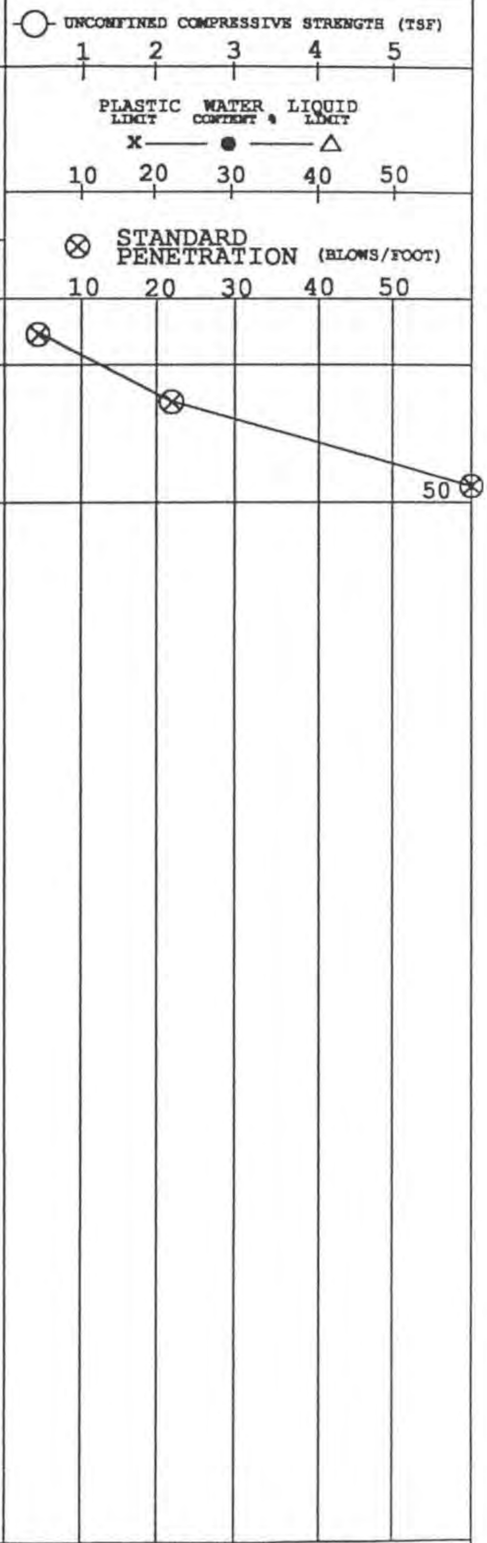
DGL FILE NO. 601

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, TRANSITION MAY BE GRADUAL.

DANIEL G. LOUCKS, P.E.
GEOTECHNICAL ENGINEERING
P. O. BOX 163
BALLSTON SPA, NEW YORK 12020
(518) 347-2817
[FAX 347-2817]

PROJECT NAME: BROAD STREET HOLLOW SLOPE	LOG OF BORING NO. 3
PROJECT LOCATION: Lexington, New York	BORING LOCATION: 21.7' off maple tree towards creek
CLIENT: Kaaterskill Engineering Associates, P.C.	

ELEVATION DEPTH	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL / SURFACE ELEVATION
0	1	SS			Fine to medium sand, some gravel, trace to some silt, trace roots, red and brown, moist, loose (SM) fill
	2	SS			Silty clay, trace to some gravel, brown, moist to wet, medium stiff (CL) fill
		PA			Driller notes cobbles
5	3	SS			Driller moved hole 6' closer to tree
					END OF BORING AT 6.0 FEET WITH SPLIT SPOON AND POWER AUGER REFUSALS - CONTINUE 3A
10					
15					
20					
25					
30					



WATER LEVEL
at 3.8' before casing removal;
Cave-in at 10.0' after casing removal

DATE
03/31/00

DGL FILE NO. 601

STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, TRANSITION MAY BE GRADUAL.

DANIEL G. LOUCKS, P.E.
GEOTECHNICAL ENGINEERING
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(518) 347-2817
[FAX 347-2817]

PROJECT NAME: BROAD STREET HOLLOW SLOPE	LOG OF BORING NO. 3A
PROJECT LOCATION: Lexington, New York	BORING LOCATION: 6' closer to tree from B-3
CLIENT: Kaaterskill Engineering Associates, P.C.	

UNCONFINED COMPRESSIVE STRENGTH (TSF): 1 2 3 4 5

PLASTIC LIMIT x — WATER CONTENT % ● — LIQUID LIMIT △: 10 20 30 40 50

⊗ STANDARD PENETRATION (BLOWS/FOOT): 10 20 30 40 50

ELEVATION DEPTH	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL
					SURFACE ELEVATION
0	-	PA			Power auger down to 5.0'
5	4	SS			Silty clay, trace to some gravel, brown, moist to wet, med. stiff (CL) fill. Driller notes cobbles
	5	SS			Clay, trace to some silt, red and brown, moist to wet, loose, soft (CL) (ML) thin silt layers
		PA			
10	6	SS			Clay, some silt, red and brown, moist to wet, loose, soft (CL) (ML)
		PA			Clay, trace silt, brown, moist to wet, loose, soft (CL) (ML) thin silt layers
15	6	SS			
		PA			
20	7	SS			Clay, trace to some silt, trace sand, brown, moist to wet, loose, soft (CL) (ML) (SM) thin silt and sand layers
		PA			Clayey silt, trace to some sand, red and brown, wet, loose (ML) (SM) fine sand layers
25	8	SS			
		PA			
	9	SS			
30					END OF BORING AT 30.0 FEET

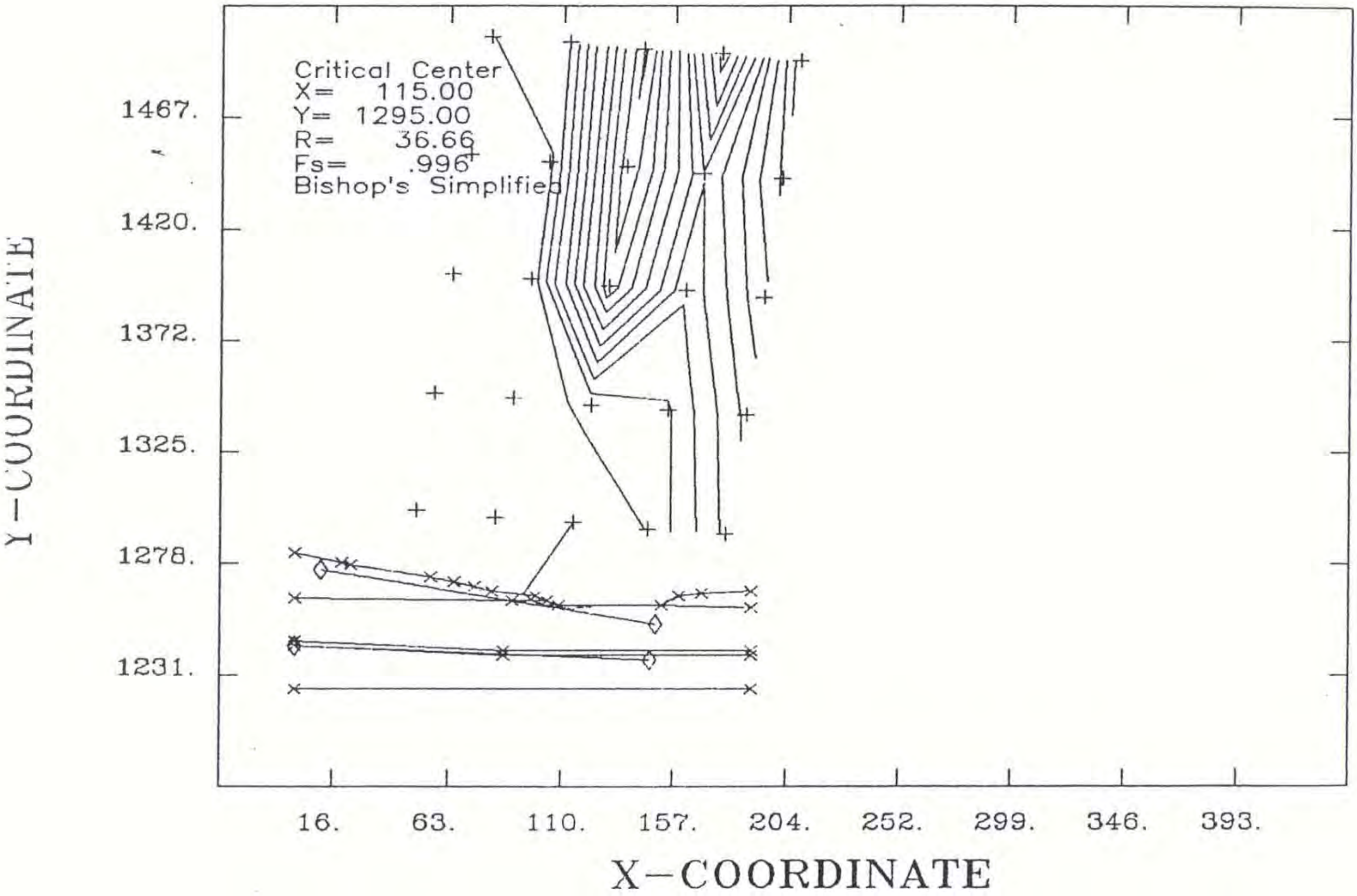
WATER LEVEL at 3.8' before casing removal; Cave-in at 10.0' after casing removal	DGL FILE NO. 601	DANIEL G. LOUCKS, P.E. GEOTECHNICAL ENGINEERING P. O. BOX 163 BALLSTON SPA, NEW YORK 12020 (518) 347-2817 [FAX 347-2817]
DATE 03/31/00	STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, TRANSITION MAY BE GRADUAL.	

CROSS-SECTION OF GEOMETRY

BROADSTREET HOLLOW STREAM RELOCATION

1 3 MAY 00

FINDING SOIL GW PARAMETERS



UNIT WEIGHT	COHESION	PHI	DESCRIPTION
125.00	.00	32.00	CLAYEY SILT,SAND AND GRAVEL
115.00	.00	22.00	SILT AND CLAY
115.00	.00	34.00	FINE SAND
125.00	.00	34.00	TILL
−1.00	.00	.00	BOUNDRY

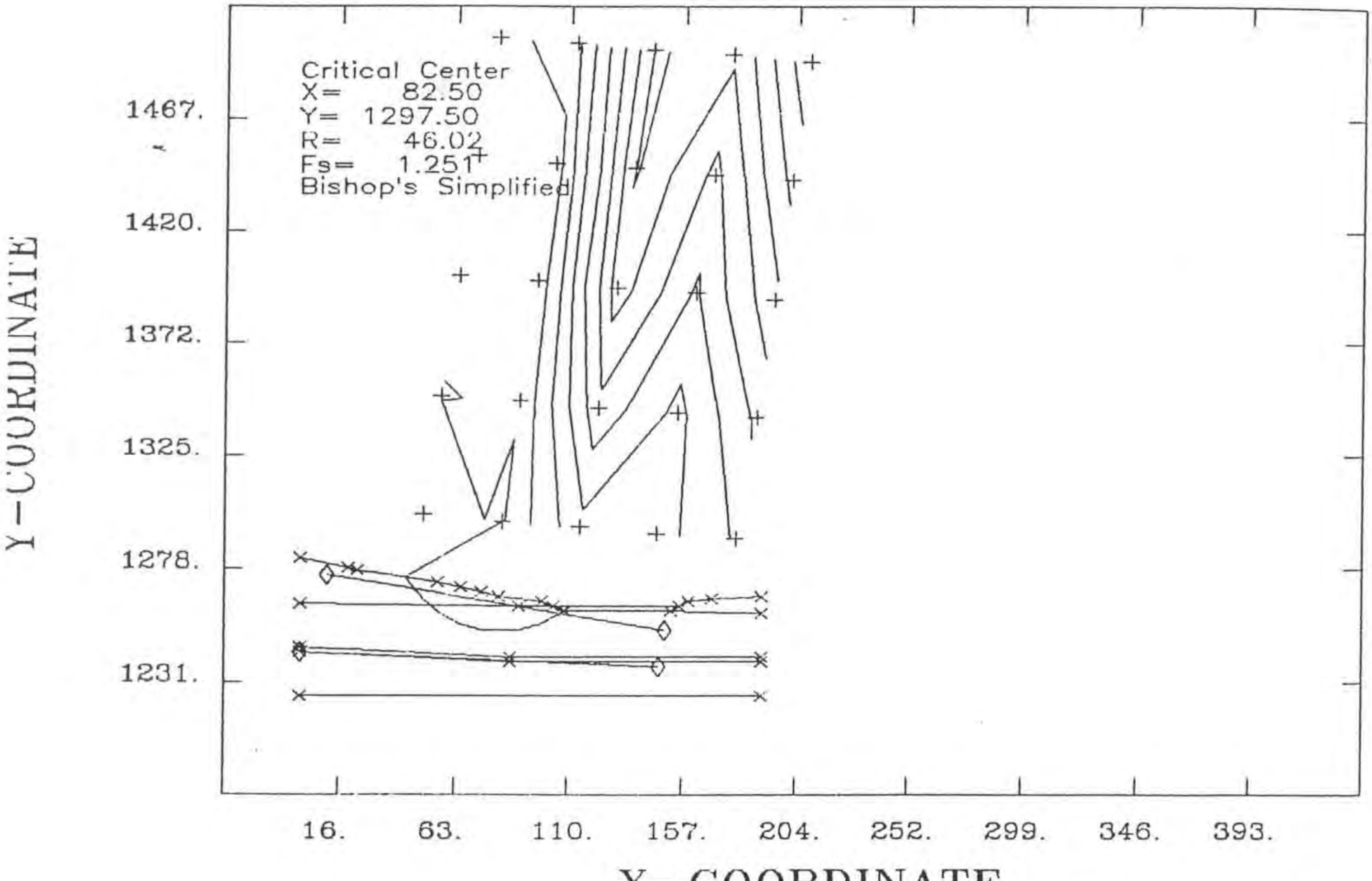
File name : 601−A.SET

CROSS-SECTION OF GEOMETRY

BROADSTREET HOLLOW STREAM RELOCATION

1 3 MAY 00

ADD 2' RIP-RAP ON STREAM BOTTOM



UNIT WEIGHT	COHESION	PHI	DESCRIPTION
110.00	.00	45.00	RIP-RAP
125.00	.00	32.00	CLAYEY SILT , SAND AND GRAVEL
115.00	.00	22.00	SILT AND CLAY
115.00	.00	34.00	FINE SAND
125.00	.00	34.00	TILL
-1.00	.00	.00	BOUNDRY

File name : 601-AA.SET

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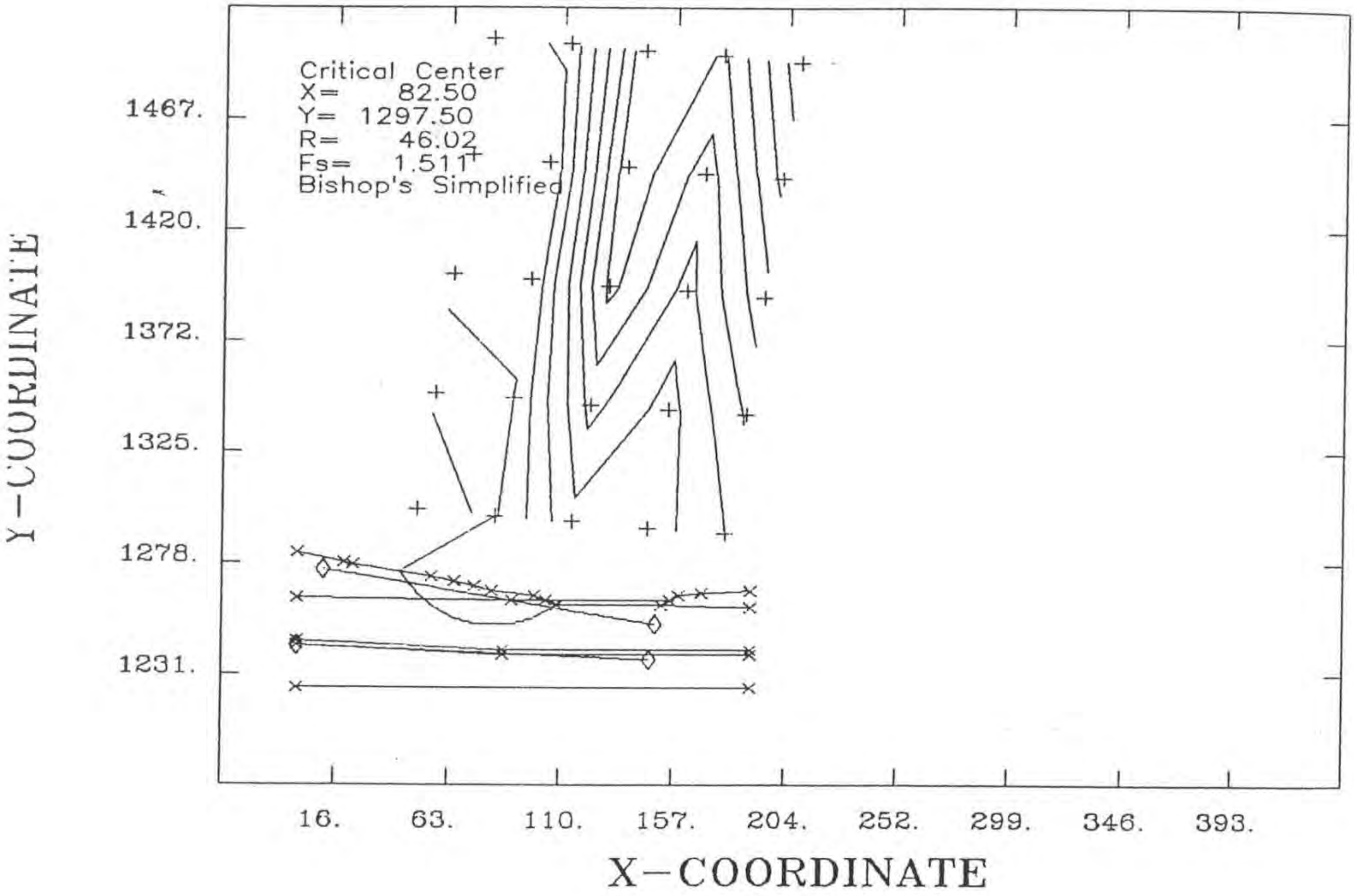
CROSS-SECTION OF GEOMETRY

BROADSTREET HOLLOW STREAM RELOCATION

1 3 MAY 00

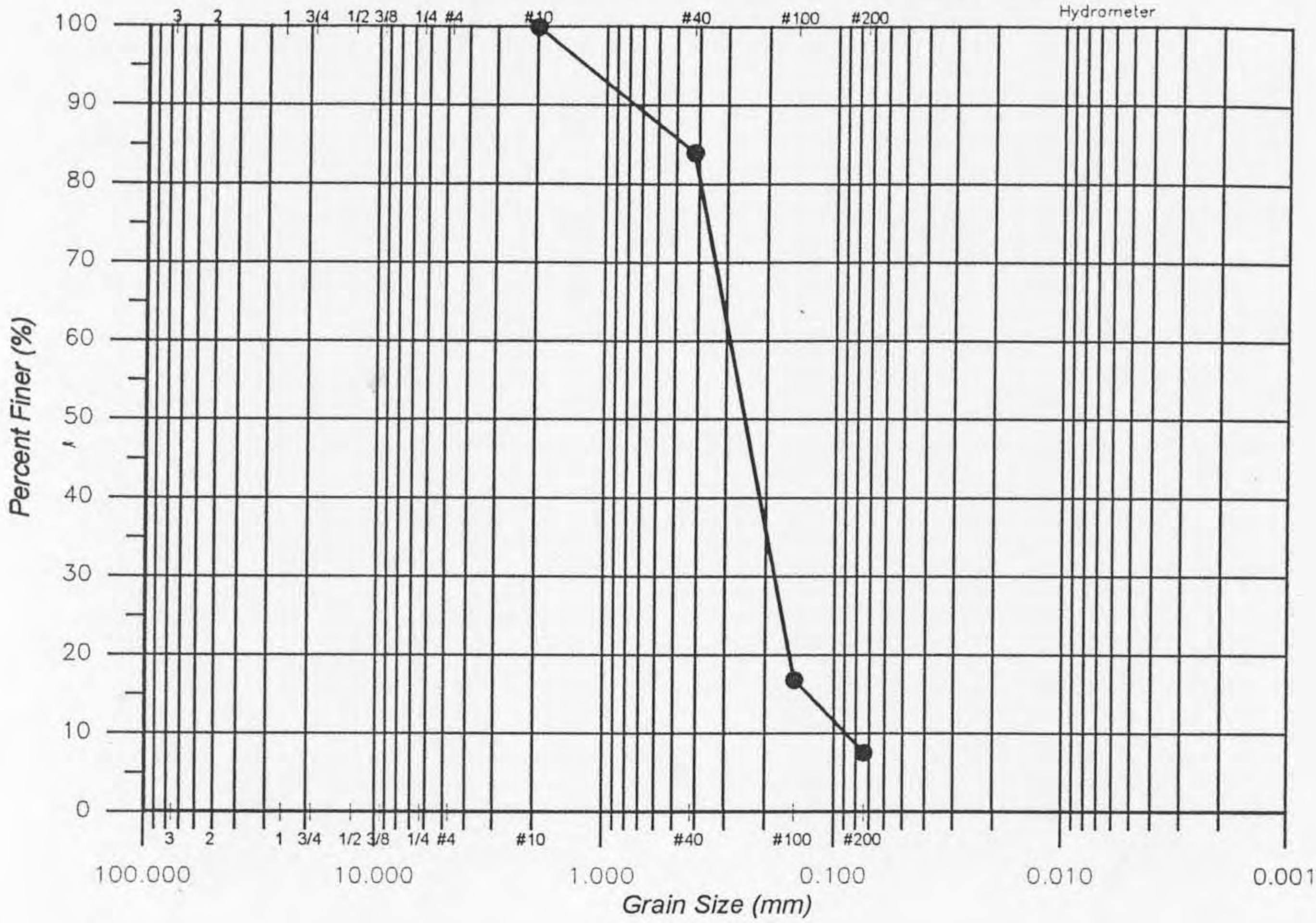
2' RIP-RAP, DROP WATER 4'



UNIT WEIGHT	COHESION	PHI	DESCRIPTION
110.00	.00	45.00	RIP-RAP
125.00	.00	32.00	CLAYEY SILT , SAND AND GRAVEL
115.00	.00	22.00	SILT AND CLAY
115.00	.00	34.00	FINE SAND
125.00	.00	34.00	TILL
-1.00	.00	.00	BOUNDRY

File name : 601-AAA.SET

ASTM D 422 - Grain Size Analysis (washed)



Boring No.: B-2	Sample No.: S-8	Depth: 25' - 27'

SIEVE SIZE		% PASSING	SIEVE SIZE		% PASSING
1"	=		No. 4	=	
3/4"	=		No. 10	=	100.0%
1/2"	=		No. 40	=	84.0%
3/8"	=		No. 100	=	16.9%
1/4"	=		No. 200	=	7.6%

Material Description: Fine SAND, trace silt | Natural Percent Moisture: 23.7%

PROJECT: Broadstreet Hollow Stream
Lexington, Greene County, New York
CLIENT: Daniel G. Loucks, PE, Ballston Spa, New York
PROJECT No.: DGL 601
DATE SAMPLED: 03/30/00
DATE TESTED: 05/03/00

VERNON HOFFMAN PE
118 South Ferry Street
Schenectady, New York
(518) 382-0207
E-mail: VHoffmanPE@aol.com

CONSTRUCTION TECHNOLOGY

INSPECTION & TESTING DIVISION, P.D. & T.S., INC.
4 Williams Street, Ballston Lake, New York 12019, (518) 399-1848

CLIENT: DANIEL LOUCKS, P.E.
POST OFFICE BOX 163
BALLSTON SPA, NEW YORK 12020
ATT'N: MR. DANIEL LOUCKS, P.E.
PROJECT: BROAD HOLLOW ROAD

REPORT NUMBER: 1 PAGE: 1
REPORT DATE: 4/17/00
FILE NUMBER: 750.001
FILE LOCATION: LOUCKS, 1175

SUMMARY OF TRIAXIAL PERMEABILITY TEST RESULTS

SAMPLE # 1175: DESCRIPTION: UNDISTURBED TUBE SAMPLE: SAMPLE #1 @ 10-12'
SAMPLE # : DESCRIPTION:
SAMPLE # : DESCRIPTION:
SAMPLE # : DESCRIPTION:

PHYSICAL PROPERTY DATA

SAMPLE: LAB ID:		1175
MAX. DRY DENSITY	(pcf)	
OPTIMUM MOISTURE	(%)	
SAMPLE HEIGHT	(in.)	4.00
SAMPLE DIAMETER	(in.)	2.80
SAMPLE WET WEIGHT	(gm.)	761.30
SAMPLE WET DENSITY	(pcf)	117.64
MOISTURE CONTENT	(%)	43.10
SAMPLE DRY DENSITY	(pcf)	82.21
FINAL HEIGHT	(in.)	
FINAL DIAMETER	(in.)	
FINAL WET WEIGHT	(gm.)	
WET DENSITY	(pcf)	
MOISTURE CONTENT	(%)	
DRY DENSITY	(pcf)	

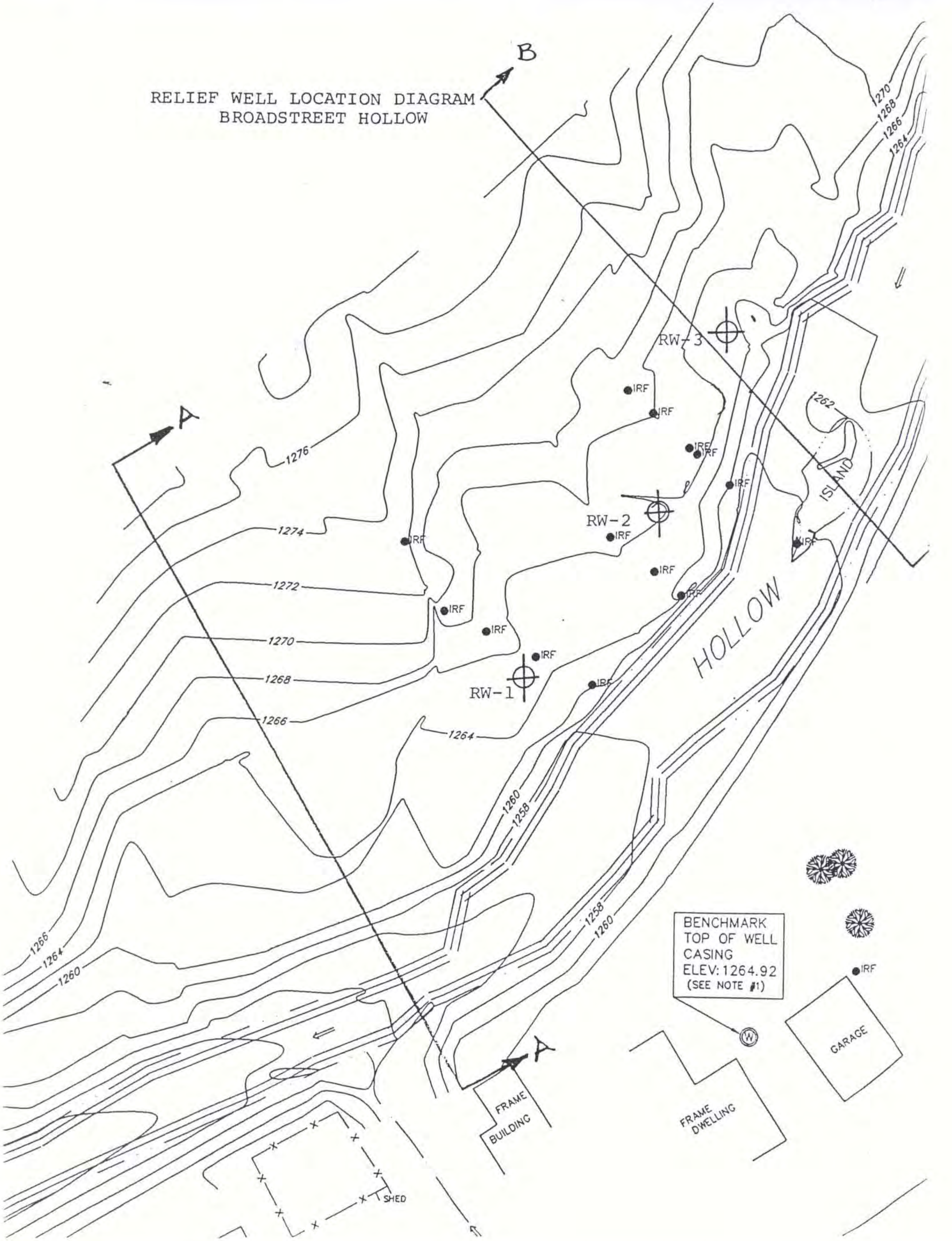
TEST PARAMETERS

CELL PRESSURE	(psi)	55.00
HEAD PREASURE	(psi)	50.00
BACK PRESSURE	(psi)	45.00

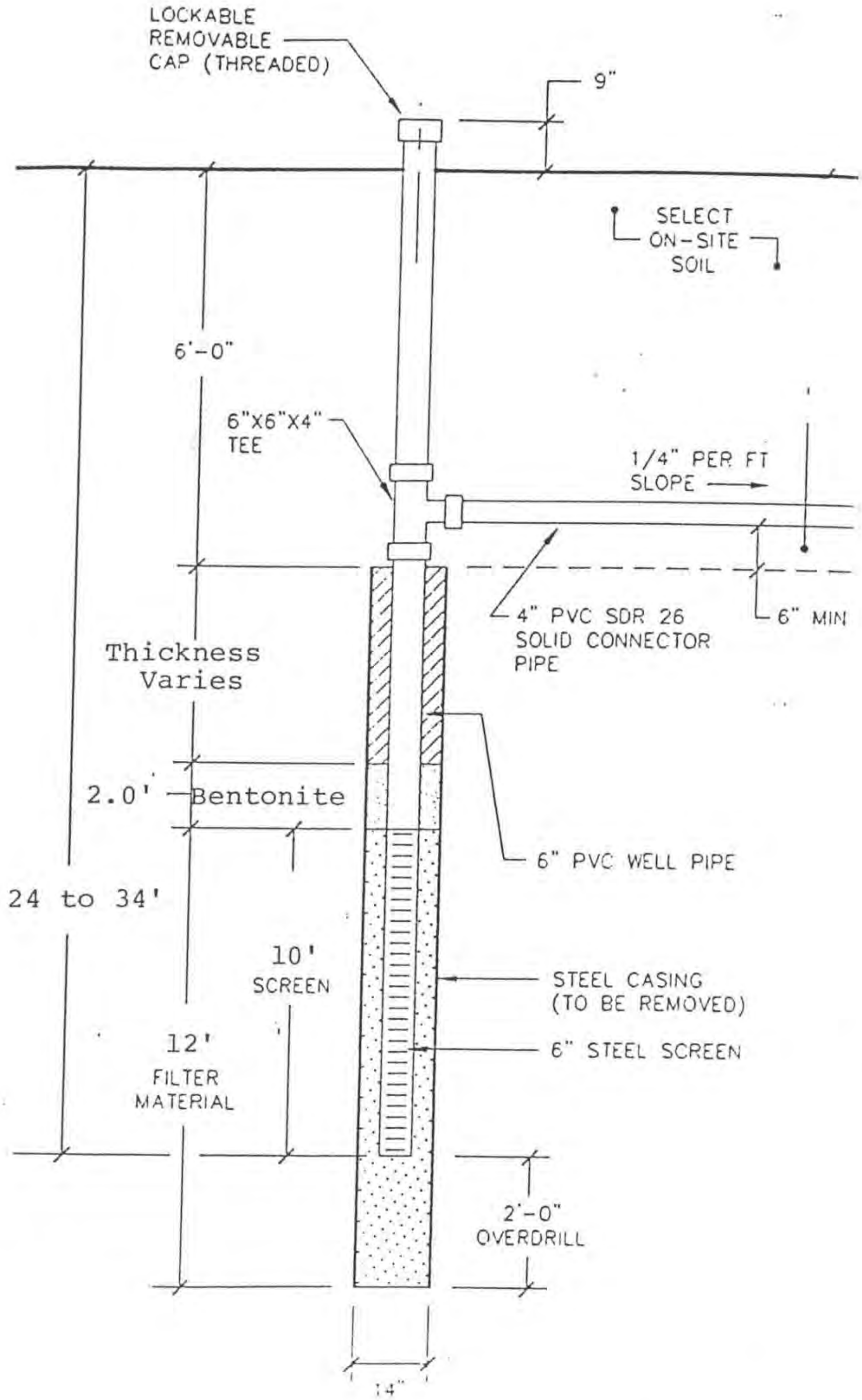
PERMEABILITY INPUT DATA

FLOW, Q	(cc.)	1.90
LENGTH, L	(in.)	4.00
AREA, A	(in2)	6.16
HEAD, h	(psi)	5.00
TIME, t	(min)	240.00
TEMP, T	(C)	23.00
TEMPERATURE CORRECTION		.931
INITIAL COMPACTION (%)		
MOISTURE RELATION TO OPTIMUM		
PERMEABILITY, K = (cm/sec)		8.94e-8

REPORT DISTRIBUTION:	GENERAL NOTES:	RESPECTFULLY,
1: FILE		CONSTRUCTION TECHNOLOGY
2:		[signature]
3:		TOM JOSLIN, S.E.T. (NICET)
4:		MANAGER TECHNICAL SERVICES



RELIEF WELL LOCATION DIAGRAM
BROADSTREET HOLLOW
B
A
RW-1
RW-2
RW-3
IRF
1276
1274
1272
1270
1268
1266
1264
1262
1260
1258
HOLLOW
ISLAND
BENCHMARK
TOP OF WELL
CASING
ELEV: 1264.92
(SEE NOTE #1)
GARAGE
FRAME BUILDING
FRAME DWELLING
SHED



LOCKABLE
REMOVABLE
CAP (THREADED)
9"
SELECT
ON-SITE
SOIL
6'-0"
6"X6"X4"
TEE
1/4" PER FT
SLOPE
4" PVC SDR 26
SOLID CONNECTOR
PIPE
6" MIN
Thickness
Varies
2.0'
Bentonite
6" PVC WELL PIPE
24 to 34'
10'
SCREEN
STEEL CASING
(TO BE REMOVED)
6" STEEL SCREEN
12'
FILTER
MATERIAL
2'-0"
OVERDRILL
14"

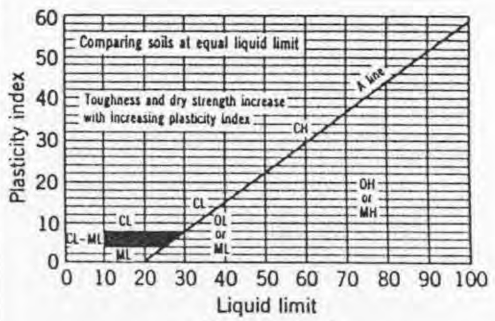
RELIEF WELL

Table 3.5 Unified Soil Classification

Major Divisions			Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights)	Group Symbols [a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria	
Coarse-grained soils: More than half of material is *larger* than No. 200 sieve size[b] (The No. 200 sieve size is about the smallest particle visible to naked eye)	Gravels: More than half of coarse fraction is larger than No. 4 sieve size (For visual classification, the ¼ in. 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; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for *GW*	
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	Atterberg limits below "A" line, or *PI* less than 4	Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		Atterberg limits above "A" line, with *PI* greater than 7	
	Sands: More than half of coarse fraction is smaller than 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 ½-in. maximum size; rounded and subangular sand grains coarse to fine, about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for *SW*	
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or *PI* less than 5	Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits below "A" line with *PI* greater than 7	

Laboratory classification criteria (coarse-grained soils): Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols

Major Divisions		Identification Procedures on Fraction Smaller than No. 40 Sieve Size: Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols [a]	Typical Names	Information Required for Describing Soils
Fine-grained soils: More than half of material is *smaller* than No. 200 sieve size (The No. 200 sieve size is about the smallest particle visible to naked eye)	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart for laboratory classification of fine grained soils

From Wagner, 1957.

[a] *Boundary classifications.* Soils possessing characteristics of two groups are designated by combinations of group symbols. For example *GW–GC*, well graded gravel-sand mixture with clay binder.

[b] All sieve sizes on this chart are U.S. standard.

Field Identification Procedure for Fine Grained Soils or Fractions

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

Dilatancy (Reaction to shaking):

After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky.

Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

Dry Strength (Crushing characteristics):

After removing particles larger than No. 40 sieve size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

Toughness (Consistency near plastic limit):

After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size, is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eight inch in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

Soil Characteristics Pertinent to Roads and Airfields

Major Divisions		Letter (1)		Name	Value as Subgrade When Not Subject to Frost Action	Value as Subbase When Not Subject to Frost Action	Value as Base When Not Subject to Frost Action	Potential Frost Action	Compressibility and Expansion	Drainage Characteristics	Compaction Equipment	Unit Dry Weight lb. per cu. ft.	Typical Design Values CBR (2)	Typical Design Values Subgrade Modulus k lb. per cu. in.
Coarse-Grained Soils	Gravel and Gravelly Soils	GW		Well-graded gravels or gravel-sand mixtures, little or no fines	Excellent	Excellent	Good	None to very slight	Almost none	Excellent	Crawler-type tractor, rubber-tired roller, steel-wheeled roller	125-140	40-80	300-500
		GP		Poorly graded gravels or gravel-sand mixtures, little or no fines	Good to excellent	Good	Fair to good	None to very slight	Almost none	Excellent	Crawler-type tractor, rubber-tired roller, steel-wheeled roller	110-140	30-60	300-500
		GM	d	Silty gravels, gravel-sand-silt mixtures	Good to excellent	Good	Fair to good	Slight to medium	Very slight	Fair to poor	Rubber-tired roller, sheepsfoot roller; close control of moisture	125-145	40-60	300-500
			u		Good	Fair	Poor to not suitable	Slight to medium	Slight	Poor to practically impervious	Rubber-tired roller, sheepsfoot roller	115-135	20-30	200-500
		GC		Clayey gravels, gravel-sand-clay mixtures	Good	Fair	Poor to not suitable	Slight to medium	Slight	Poor to practically impervious	Rubber-tired roller, sheepsfoot roller	130-145	20-40	200-500
	Sand and Sandy Soils	SW		Well-graded sands or gravelly sands, little or no fines	Good	Fair to good	Poor	None to very slight	Almost none	Excellent	Crawler-type tractor, rubber-tired roller	110-130	20-40	200-400
		SP		Poorly graded sands or gravelly sands, little or no fines	Fair to good	Fair	Poor to not suitable	None to very slight	Almost none	Excellent	Crawler-type tractor, rubber-tired roller	105-135	10-40	150-400
		SM	d	Silty sands, sand-silt mixtures	Fair to good	Fair to good	Poor	Slight to high	Very slight	Fair to poor	Rubber-tired roller, sheepsfoot roller; close control of moisture	120-135	15-40	150-400
			u		Fair	Poor to fair	Not suitable	Slight to high	Slight to medium	Poor to practically impervious	Rubber-tired roller, sheepsfoot roller	100-130	10-20	100-300
		SC		Clayey sands, sand-clay mixtures	Poor to fair	Poor	Not suitable	Slight to high	Slight to medium	Poor to practically impervious	Rubber-tired roller, sheepsfoot roller	100-135	5-20	100-300
Fine-Grained Soils	Silts and Clays LL is less than 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Poor to fair	Not suitable	Not suitable	Medium to very high	Slight to medium	Fair to poor	Rubber-tired roller, sheepsfoot roller; close control of moisture	90-130	15 or less	100-200
		CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Poor to fair	Not suitable	Not suitable	Medium to high	Medium	Practically impervious	Rubber-tired roller, sheepsfoot roller	90-130	15 or less	50-150
		OL		Organic silts and organic silt-clays of low plasticity	Poor	Not suitable	Not suitable	Medium to high	Medium to high	Poor	Rubber-tired roller, sheepsfoot roller	90-105	5 or less	50-100
	Silts and Clays LL is greater than 50	MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	Not suitable	Not suitable	Medium to very high	High	Fair to poor	Sheepsfoot roller, rubber-tired roller	80-105	10 or less	50-100
		CH		Inorganic clays of medium to high plasticity, organic silts	Poor to fair	Not suitable	Not suitable	Medium	High	Practically impervious	Sheepsfoot roller, rubber-tired roller	90-115	15 or less	50-150
		OH		Organic clays of high plasticity, fat clays	Poor to very poor	Not suitable	Not suitable	Medium	High	Practically impervious	Sheepsfoot roller, rubber-tired roller	80-110	5 or less	25-100
Highly Organic Soils		Pt		Peat and other highly organic soils	Not suitable	Not suitable	Not suitable	Slight	Very high	Fair to poor	Compaction not practical	—	—	—

Note:
(1) Unit Dry Weights are for compacted soil at optimum moisture content for modified AASHO compaction effort. Division of GM and SM groups into subdivision of d and u are for roads and airfields only. Subdivision is basis of Atterberg limits; suffix d (e.g., GMd) will be used when the liquid limit (LL) is 25 or less and the plasticity index is 6 or less; the suffix u will be used otherwise.

(2) The maximum value that can be used in design of airfields is, in some cases, limited by gradation and plasticity requirements.

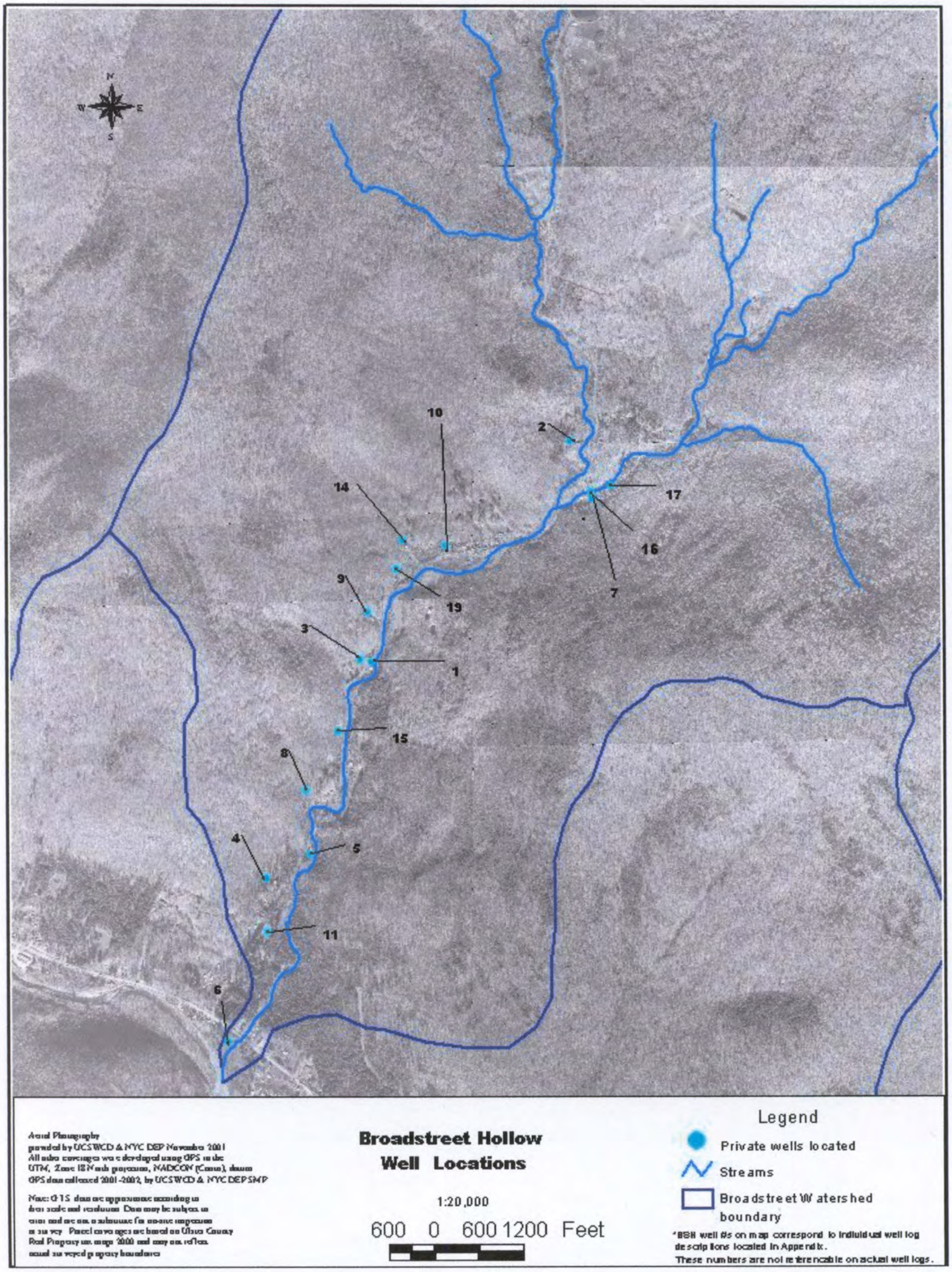
GENERAL QUALIFICATIONS

This report has been prepared in order to aid in the evaluation of this property and to assist the architect and/or engineer in the design of this project. The scope of the project and location described herein, and our description of the project represents our understanding of the significant aspects relevant to soil and foundation characteristics. In the event that any changes in the design or location of the proposed facilities, as outlined in this report, are planned, we should be informed so the changes can be reviewed and the conclusions of this report modified or approved in writing by ourselves.

It is recommended that all construction operations dealing with earthwork and foundations be inspected by an experienced soils engineer to assure that the design requirements are fulfilled in the actual construction. If you wish, we would welcome the opportunity to review the plans and specifications when they have been prepared so that we may have the opportunity of commenting on the effect of soil conditions on the design and specifications.

The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings and/or test pits performed at the locations indicated on the location diagram and from any other information discussed in the report. This report does not reflect any variations which may occur between these borings and/or test pits. In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in soil and rock conditions exist on most sites between boring locations and also such situations as groundwater conditions vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, it will be necessary for a reevaluation of the recommendations of this report after performing on-site observations during the construction period and noting the characteristics of any variations.

4.1.3 Domestic Well Logs and Geotechnical Boring Logs



Summary of Domestic Well Log Data										
Well	Parcel #	**Name registered on log**	Mgt Unit	Easting	Northing	Surface Elevation	Depth to Bedrock	Depth to Clay	Thickness of Clay	
BSH-1	5.4-1-47.100	Marshall	8	553521	4663794	1150	163	85	45	
BSH-2	204.00-2-5	Monsees	3			1340	47	0	47	wlu
BSH-3	5.4-1-48	Simmons	8	553452	4663807	1161	100	nr	nr	
BSH-4	5.4-1-41	Weber	13	553117	4662919	1065	198	20	20	
BSH-5	5.4-1-11	Lennon	12,13	553279	4663030	1134	119	85	10?	
BSH-6	5.18-2-22	Paultre	19	552907	4662317	1020	>142	14	106	
BSH-7	204.00-2-31	Rotella	3	554484	4664478	1263	>200	100	18	wlu
BSH-8	5.4-1-43	Ruane	10,11,12			1150	91	nr	nr	wlu
BSH-9	5.4-1-49.200	Sharon	8	553507	4663976	1190	172	?	?	wlu
BSH-10	204.00-3-9	Collins	6 or 7	553825	4664269	1222	>160	65	36	
BSH-11	5.4-1-14	Cohn	14,15	553097	4662714	1068	160	?	?	
BSH-12	?	Pavisi	?				190	?	?	wlu
BSH-13	?	Krentz	?				103	nr	nr	wlu
BSH-14	5.4-1-2	Kelly	7	553648	4664285	1284	220	?	?	
BSH 15	5.4-145	Tuozzo nl	12	553381	4663515	1204	nl	nl	nl	
BSH 16	204.00-2-36	Torregrossa Jr	3	554462	4664505	1260	nl	nl	nl	
BSH 17	204.00-2-38	Torregrossa Sr	3	554523	4664537	1257	nl	nl	nl	
BSH 18	204.00-2-7	Rapp	3	554344	4664683	1326	nl	nl	nl	
BSH 19	5.4-1-50	Channon/Charon	7,8	553613	4664175	1234	spring box	nl	nl	

nr	no clay reported
?	not clear from log
nl	no log obtained
wlu	well location uncertain/general elelvation, NE of property obtained if possible

Domestic Water Supply Well Log for the Broadstreet Hollow Basin

Well Id	BSH-1	**Parcel #**	5.4-1-47.100	Coordinates	
Datum (ft amsl)		**Mgt Unit**	8	E:553521	N:4663794
Date Drilled	7/7/1987	**Yield (gpm)**	12		
Depth (ft)	197	**Drilling Method:**			
Depth Casing (ft)	163	**Driller**	Titan		

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**
0		Hardpan, gravel, boulders	glacial till
70		Fine gravel	glaciofluvial deposit
85		Clay	glaciolacustrune clay
130		Hardpan, gravel	glacial till
163		Green Shale	Oneonta Formation
170		Blue Sandstone	Oneonta Formation
183		Green Sandstone	Oneonta Formation
187		Blue Sandstone	Oneonta Formation
197		End of boring	

Depth to Bedrock: 163

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Domestic Water Supply Well Logs for the Broadstreet Hollow Basin

Well Id	BSH-2	**Owner**	204.00-2-5	Coordinates
Datum (ft amsl)		**Mgt Unit**	3	
Date Drilled	1986	**Yield (gpm)**	8	
Depth (ft)	248	**Drilling Method**		
Depth Casing (ft)	163	**Driller**	Titan	

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**
0		Clay, fine gravel	glaciolacustrine/fluvial
47		Red Shale	Oneonta Formation
62		Blue Sandstone	Oneonta Formation
125		Green Sandstone	Oneonta Formation
146		Blue Sandstone	Oneonta Formation
197		Red Shale	Oneonta Formation
248		End of boring	

Depth to Bedrock: 47

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Domestic Water Supply Well Logs for the Broadstreet Hollow Basin

Well Id	BSH-3	**Owner**	5.4-1-48	Coordinates	
Datum (ft amsl)		**Mgt Unit**	8	E:553452	N:4663807
Date Drilled	9/25/1986	**Yield (gpm)**	45		
Depth (ft)	248	**Drilling Method**	air hammer		
Depth Casing (ft)	105	**Driller**	Titan		

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**
0		hardpan	glacial till
8		boulder	glacial till
12		hardpan, water	glacial till
24		boulder	glacial till
30		coarse gravel	glaciofluvial deposit
50		boulder	glaciofluvial deposit
53		sand, water	glaciofluvial deposit
70		boulder	glaciofluvial deposit
77		sand, gravel, water	glaciofluvial deposit
89		boulder	glaciofluvial deposit
92		gravel	glaciofluvial deposit
100		red/gray shale	Oneonta Formation
168		blue sandstone	Oneonta Formation
206		red/gray shale	Oneonta Formation
248		end of boring	

Depth to Bedrock: 100

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Well Id	BSH-4	**Owner**		Coordinates	
Datum (ft amsl)		**Mgt Unit**	13	E:553117	N:4662919
Date Drilled	5/30/1984	**Yield (gpm)**	?		
Depth (ft)	212	**Drilling Method**			
Depth Casing (ft)	180?	**Driller**	Titan		

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**
0		clay and gravel	glacial till
20		clay	glaciolacustrine deposit
40		clay and a lot of boulders	glacial till
80		clay	glaciolacustrine deposit
123		rock	
130		clay	glaciolacustrine deposit
147		rock	
149		clay and rocks	glacial till
194		gravel and water	glaciofluvial deposit
198		red shale	Oneonta Formation
212		end of boring	

Depth to Bedrock: 198

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Domestic Water Supply Well Logs for the Broadstreet Hollow Basin

Well Id	BSH-5	**Owner**		Coordinates	
Datum (ft amsl)		**Mgt Unit**	12, 13	E:553279	N:4663030
Date Drilled		**Yield (gpm)**	20/5		
Depth (ft)	130	**Drilling Method**			
Depth Casing (ft)	100	**Driller**	Titan		

Depth	Elevation	Driller's Description	Geologic Interpretation
0		boulders and gravel	glacial till ?
50		gravel and hardpan	glacial till ?
85		clay and sand	glaciolacustrine/fluvial?
95		gravel and water	glaciofluvial deposit
110		hardpan	glacial till
119		green sandstone	Oneonta Formation
130		end of boring	

Depth to Bedrock: 119

Note: groundwater flow from gravel.

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Well Id	BSH-6	**Owner**		Coordinates	
Datum (ft amsl)		**Mgt Unit**	19	E:552907	N:4662317
Date Drilled	7/5/1997	**Yield (gpm)**	20		
Depth (ft)	142	**Drilling Method**			
Depth Casing (ft)	140	**Driller**	Titan		

Depth	Elevation	Driller's Description	Geologic Interpretation
0		sand and gravel	fluvial deposit
14		clay	glaciolacustrine deposit
120		sand	glaciofluvial deposit
135		sand and gravel	glaciofluvial deposit
142		end of boring	

Depth to Bedrock: >142

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Domestic Water Supply Well Logs for the Broadstreet Hollow Basin

Well Id	BSH-7	**Owner**		Coordinates	
Datum (ft amsl)		**Mgt Unit**	3	E:554484	N:4664478
Date Drilled	?	**Yield (gpm)**	20		
Depth (ft)	200	**Drilling Method**			
Depth Casing (ft)	180	**Driller**	Titan		

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**	
0		sand and gravel	fluvial deposit	
16		hardpan	glacial till	
38		sand and gravel	glaciofluvial deposit	
100		clay	glaciolacustrine deposit	
118		gravel and water	glaciofluvial deposit	
200		end of boring		

Depth to Bedrock: >200

Domestic Water Supply Well Logs for the Broadstreet Hollow Basin

Well Id	BSH-8	**Owner**		Coordinates
Datum (ft amsl)		**Mgt Unit**	10, 11, 12	
Date Drilled	7/27/1999	**Yield (gpm)**	20+	
Depth (ft)	235	**Drilling Method**	air hammer	
Depth Casing (ft)	97	**Driller**	Titan	

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**
0		hardpan/gravel	"lumped" glacial deposits
91		red shale	Oneonta Formation
106		green sandstone	Oneonta Formation
108		red shale	Oneonta Formation
138		red sandstone	Oneonta Formation
141		bluestone	Oneonta Formation
148		red sandstone	Oneonta Formation
151		bluestone	Oneonta Formation
164		green sandstone	Oneonta Formation
166		bluestone	Oneonta Formation
193		redshale	Oneonta Formation
235		end of boring	

Depth to Bedrock: 91

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Domestic Water Supply Well Logs for the Broadstreet Hollow Basin

Well Id	BSH-9	**Owner**		Coordinates
Datum (ft amsl)		**Mgt Unit**	8	E:553507 N:4663976
Date Drilled	?/26/93	**Yield (gpm)**	8	
Depth (ft)	273	**Drilling Method**		
Depth Casing (ft)	180	**Driller**	Titan	

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**
0		clay sand gravel water	"lumped" glacial deposits
172		red sandstone	Oneonta Formation
186		red shale	Oneonta Formation
193		blue sandstone	Oneonta Formation
210		red sandstone	Oneonta Formation
226		blue sandstone	Oneonta Formation
240		red shale	Oneonta Formation
273		end of boring	
Depth to Bedrock:	172		

Note: tried to develop 170' gravel well a lot of water and a lot of sand.
probably fluvial deposits above bdrk

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Domestic Water Supply Well Logs for the Broadstreet Hollow Basin

Well Id	BSH-10	**Owner**		Coordinates	
Datum (ft amsl)		**Mgt Unit**	6 or 7	E:553825	N:4664269
Date Drilled	6/26/1986	**Yield (gpm)**	50		
Depth (ft)	173	**Drilling Method**			
Depth Casing (ft)	160	**Driller**	Titan		

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**
0		top soil	
5		hardpan	glacial till
18		boulder	glacial till
21		hardpan	glacial till
49		boulder	glacial till
51		sand, water	glaciofluvial deposit
65		clay, water	glaciolacustrine deposit
101		sand, water	glaciofluvial deposit
145		gravel, water	glaciofluvial deposit
160		end of boring	

Depth to Bedrock: >160

log ends description at 160, but form states total depth drilled at 173.

Well Id	BSH-11	**Owner**		Coordinates	
Datum (ft amsl)		**Mgt Unit**	14, 15	E:553097	N:4662714
Date Drilled	1/28/1984	**Yield (gpm)**	30		
Depth (ft)	273	**Drilling Method**			
Depth Casing (ft)	170	**Driller**	Titan		

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**
0		hardpan and boulders	glacial till
60		sand	glaciofluvial deposit
70		clay with sand and boulders	glacial till, g'lacustrine?
160		bluestone	Oneonta Formation
172		red shale	Oneonta Formation
216		blue shale	Oneonta Formation
225		red shale	Oneonta Formation
240		bluestone	Oneonta Formation
273		end of boring	

Depth to Bedrock: 160

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Well Id	BSH-12	Owner		Coordinates
Datum (ft amsl)		Mgt Unit	19?	
Date Drilled	?	Yield (gpm)	100	
Depth (ft)	198	Drilling Method		
Depth Casing (ft)	190	Driller	Titan	

Depth	Elevation	Driller's Description	Geologic Interpretation
0		no description	glacial till
120		gravel and sand (no water)	glaciofluvial deposit
190		bluestone	Oneonta Formation
192		green sandstone	Oneonta Formation
195		bluestone	Oneonta Formation
198		end of boring	Oneonta Formation

Depth to Bedrock: 190

Setup on existing well 105 ft deep.

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Well Id	BSH-13	Owner		Coordinates
Datum (ft amsl)		Mgt Unit	?	
Date Drilled	9/25/1989	Yield (gpm)	6	
Depth (ft)	248	Drilling Method	air	
Depth Casing (ft)	112	Driller	Titan	

Depth	Elevation	Driller's Description	Geologic Interpretation
0		hardpan boulders	glacial till
3		sand/gravel/boulders/water	mixed till/g'fluvial deposit
103		blue sandstone	Oneonta Formation
186		red shale	Oneonta Formation
218		red/blue sandstone	Oneonta Formation
229		red shale	Oneonta Formation
248		end of boring	

Depth to Bedrock: 103

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain

Domestic Water Supply Well Logs for the Broadstreet Hollow Basin

Well Id	BSH-14	**Owner**		Coordinates	
Datum (ft amsl)		**Mgt Unit**	7	E:553648	N:4664285
Date Drilled	7/6/1973	**Yield (gpm)**	?		
Depth (ft)	300?	**Drilling Method**			
Depth Casing (ft)	240?	**Driller**	Titan		

Depth	**Elevation**	**Driller's Description**	**Geologic Interpretation**
125		dirty gravel	glaciofluvial deposit ?
160		boulder	glaciofluvial deposit ?
163		dirty gravel	glaciofluvial deposit ?
170		quicksand, dirty gravel	glaciofluvial deposit ?
190		dirty gravel and boulders	glaciofluvial deposit ?
220		red shale	Oneonta Formation
275		blue sandstone?	Oneonta Formation
300		end of boring	

Depth to Bedrock: 220

Setup on existing well 120? ft deep. description starts at 125 ft

The Upper Devonian Oneonta Formation is comprised of river deltaic deposits (fluvial sands, and overbank (flood plain) fine-grained deposits that were lithified into alternating layers of sandstone and siltstone/shales. The Onenota Formation is overlain