SOILS INVESTIGATION
PROPOSED TWO BUILDINGS
CHERRY HILL AND NEWBURG ROADS
WESTLAND, MICHIGAN

MR. CURT MOLINO
22174 HARLEN DRIVE
GROSSE ILE, MICHIGAN 48138

JANUARY 11, 2021
BY
McDOWELL & ASSOCIATES

McDowell & Associates

Geotechnical, Environmental & Hydrogeological Services • Materials Testing & Inspection

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January 11, 2021

Mr. Curt Molino
22174 Harlen Drive
Grosse Ile, Michigan 48138

Job No. 20-349

Subject: Soils Investigation
Proposed Two Buildings
Cherry Hill and Newburg Roads
Westland, Michigan

Dear Mr. Molino:

In accordance with your request, we have performed a Soils Investigation at the subject project.

Seven (7) Soil Test Borings, designated as 1 through 7, were performed at or near the locations you required. Borings 4 and 5 were moved due to debris piles, soft ground and standing water. Offset information is noted on the logs of these borings. The approximate locations of the borings are shown on the Soil Boring Location Plan which accompanies this report. The borings were advanced to depths of about fifteen feet (15') and twenty feet (20') below the ground surface at the boring locations. It should be noted that a buried concrete obstruction was encountered at Boring 4 requiring our drillers to move the boring twice to successfully drill this boring.

Soil descriptions, groundwater observations and the results of field and laboratory tests are to be found on the accompanying Logs of Soil Test Borings and summary sheet of Sieve Analysis results.

Borings 1, 2, 3, 5 and 7 encountered five feet (5') to six feet six inches (6'6") of fill soils, two feet six inches (2'6") to six feet six inches (6'6") of compact to extremely compact brown to gray silt and fine sand to silty sand, followed by stiff to extremely stiff blue silty clay which were found throughout the remainder of these borings. Borings 4 and 6 encountered five feet (5') and six feet six inches (6'6") of fill soils, one foot six inches (1'6") and two feet (2') of dark brown organic clayey peat and slightly compact gray silt and fine sand with peat seams, three feet (3') and five feet six inches (5'6") of compact to very compact brown to gray silt and fine sand to sand, followed by extremely stiff blue silty clay. The fill soils found in the borings consisted of topsoil, broken concrete and stiff to very stiff brown, discolored brown and dark brown silty clay to sandy clay. The fill soils were described by our drillers as containing varying amounts of vegetation, topsoil, concrete, asphalt, crushed stone and Styrofoam. Possible methane bubbles were noted in Boring 5 in water that collected in the borehole. Also, a buried concrete obstruction was encountered at a three-foot (3') depth in Boring 4, requiring our drillers to move the boring twice to successfully drill this boring.

Soil descriptions and depths shown on the boring logs are approximate indications of change from one soil type to another and are not intended to represent an area of exact geological change or stratification. Also, the site shows signs of significant modification which could indicate fill and soil conditions different from those encountered at the boring locations.

Water was encountered in the borings at depths ranging from five feet (5') to seven feet six inches (7'6") below the existing ground surface. Water was measured upon completion of the drilling operation in Borings 1, 2, 4 and 6 at depths ranging from four feet eight inches (4'8") to seven feet ten inches (7'10"). Borings 3, 5 and 7 were found to cave in upon completion at depths of five feet (5'), five feet six inches (5'6") and seven feet (7'). It should be noted that short-term groundwater observations may not provide a reliable indication of the depth of the water table. In clay and organic silt soils, this is due to the potential for water to become trapped in overlying layers of granular soils during periods of heavy rainfall. Water levels in granular soils fluctuate with seasonal and climatic changes as well as with the amount of rainfall in the area immediately prior to the measurements. It should be expected that groundwater level fluctuations could occur on a seasonal basis and that seams of water-bearing sands or silts could be found within the various clay soils at the site.

Standard Penetration Tests made during sampling indicate that the fill soils and buried organic peat soils have variable strengths and densities while the underlying native soils have very good strengths and densities. Tests taken in the fill soils and buried organic peat soils gave results ranging from 4 blows per foot to 30 blows per six inches (6"). Tests taken in the native organic soils gave results ranging from 10 blows per foot to 32 blows per nine inches (9").

It is understood that two (2) one-story slab-on-grade buildings are planned to be constructed at the site. It is assumed that the new structures will transmit relatively light loads to the supporting soils.

Based on project information provided and the results of field and laboratory tests, it is believed that the new structures could be supported by conventional spread or strip footings founded on native soils or engineered fill. However, due to the depth of the fill and buried peat soils and groundwater conditions, it appears that excavating through these soils may be difficult and some dewatering may be required. If groundwater cannot be controlled by dewatering, or excavations encroach upon the nearby underground utilities or upon the nearby existing structures, then the new buildings could be supported on a system of deep foundations consisting of drilled piers (caissons), timber piles, mini piles, helical piles or possibly "stone" geopiers. Additional deeper borings should be performed if deep foundations are planned to support the buildings.

If conventional footings for the new buildings are installed to rest on native, non-organic soils at the site, then all exterior footings should be constructed at, or below, a minimum frost penetration depth of three feet six inches (3'6") below finished grade. All interior and exterior load-bearing footings should extend through non-engineered fill soils, soils containing a significant amount of organic substances or excessively weak soils. All strip footings should be continuously reinforced in order to minimize the noticeable effects of differential settlement.

The building footings could be proportioned for the design soil pressures shown in the chart below provided this results in the footings bearing on native, non-organic soils.

Boring	Depth	Soil Pressure (psf)
1	6'0" to 12'0"	4,000
2	6'0" to 12'0"	4,000
3	6'6" to 12'0"	4,000
4	8'6" to 12'0"	3,000
5	6'6" to 12'0"	4,000
6	6'6" to 12'0"	4,000
7	5'0" to 8'6" 9'0" to 12'0"	3,500 4,000

As noted in the above chart, minimum footing depths vary from five feet (5') to eight feet six inches (8'6") below the existing ground surface at the boring locations.

It should be noted that footing excavations may be near, or below, the level at which water was encountered in the borings. Depending upon the depth of the footings relative to the existing ground surface and the actual conditions at the time of construction, it may be necessary to depress the water table in these locations to allow for footings to be constructed. It is sometimes possible to construct strip footings a foot or so below the water table in coarse granular soils using a rapid sequence of excavation and placement of concrete. If this is not possible, it may be necessary to use special dewatering techniques to depress the water table. A potential exists during any dewatering operation that nearby existing structures or utilities could be affected by the dewatering and could settle, especially if the nearby buildings are supported on shallow frost depth footings. Therefore, extreme caution should be practiced during any dewatering operation if the existing buildings or nearby utilities are sensitive to settlement. Extreme care must be taken to minimize any removal of soil fines during any dewatering operation to not cause ground loss. It is difficult to dewater silt soils.

As an alternative to deep footings, spread or strip footings for the new buildings could be supported on engineered fill. Any existing fill, highly organic soils, soft soils or loose granular soils should be excavated and removed from the proposed building areas. Dewatering will probably be required to facilitate the removal of the unacceptable materials from the excavation areas. Extreme care must be taken during any dewatering operation as noted above. The excavations should extend beyond the edge of the structures' footings one foot (1') for every foot below the footing. The removal of the unsuitable soils should be done in the presence of a qualified soils engineer to ensure that no uncontrolled fill or highly organic soils are left behind before the placement of the engineered fill. After the unsuitable soils have been removed, the excavation should be backfilled with compacted bank run sand consisting of MDOT Type I or II granular soils. If the bottom of the excavation is not sufficiently stable to install a bank run sand, then a layer of coarse stone fill such as MDOT 6AA could be installed. Geotextile fabric should be placed between the coarse stone engineered fill material and lower native granular soils and upper granular engineered fill materials to minimize the amount of fines infiltrating into the aggregate material. The granular MDOT Type I or II soils should be deposited in horizontal lifts not to exceed nine inches (9") in thickness with each lift being compacted uniformly to a minimum density of 95% of its maximum value as determined by the

Modified Proctor Test (AASHTO T-180 or ASTM D-1557). Engineered fill should be placed and compacted up to footing and floor invert elevations.

One-inch by three-inch (1" x 3") size crushed stone or crushed concrete could be used in lieu of the MDOT Type 6AA aggregate and bank run sand that we recommended above. The crushed material would need to be placed and compacted in lifts not exceeding nine inches (9") up to about one foot (1') below the planned buildings' footings and floor slabs. About a one-foot (1') thick layer of MDOT 21AA dense aggregate could then be placed above the crushed material in an effort to choke off the stone. The crushed stone or crushed concrete material should not contain a significant amount of brick and should be relatively clean of lime or cement dust which could potentially foul up or clog drain tiles. We suggest that the brick content should be less than 5% and cement/lime dust should be less than 3%. The large crushed material will need to be separated from the existing site granular soils by a geotextile fabric. We suggest that a Mirafi 500 type fabric or equivalent be placed along the bottom and sides of the engineered fill excavation in an effort to minimize fines from migrating into the voids within the crushed material. It should be noted that the use of crushed concrete could cause problems for nearby basements, truck docks or below-grade area drains and sump pumps.

When water percolates through crushed concrete, the pH of the water can increase and minerals can precipitate out of the solution (mostly calcium salts and in some cases calcium hydroxide). Mineral deposits precipitating from the solution can shorten the life of sump pumps and plug drain tiles. High pH water can also corrode metal pipes. See AASHTO M319-02 for discussion of these problems. Concerns about clogging or corrosion would be minimized if the buildings are planned to be slab-on-grade structures without any below-grade areas and there are no nearby houses.

Foundations placed on the engineered fill material can be proportioned for a design soil pressure of three thousand pounds per square foot (3000 psf) provided the design soil pressure is not limited by the strength of the underlying soils. All exterior footings should be constructed at or below a minimum frost penetration depth of three feet six inches (3'6") below finished grade.

If excavations do not remain stable to allow the installation of footings or engineered fill, or if excavation limits are limited by site constraints, then an alternative foundation support system consisting of drilled piers, commonly known as caissons, could be installed to support the planned buildings. The caissons could be drilled below the existing fill, peat and wet granular soils and be proportioned for the following design soil pressures:

Boring	Depth	Soil Pressure (psf)
1	10'0" to 15'0"	6,000
2	10'0" to 15'0"	6,000
3	14'0" to 18'0"	6,000
5	10'0" to 15'0"	5,000
6	10'0" to 15'0"	6,000
7	9'6" to 15'0"	6,000

Caissons should consist of straight shafts with diameters not less than twenty-four inches (24"). Belling of the shafts may be difficult considering the wet silt and fine sand soils at the site. Caissons should be spaced at least three times the larger shaft or bell diameter. Due to the upper wet granular soils and peat sediments, the caissons will need casings. If significant inflow is encountered, then concrete will need to be tremied into the excavation. The presence of possible concrete rubble and methane gas may hamper the drilling operation. Proper precautions should be taken during caisson construction to reduce the possibility of accidents resulting from the presence of gas in the site soils. Drilled caisson foundations should be monitored to ensure proper installation and soil strengths have been achieved.

As a second deep foundation support system, it appears that driven timber piles could be used to support the planned buildings. It is anticipated that a Class B type wood pile would realize the following allowable carrying capacities per foot of penetration:

Boring	Depth			Allowable Supporting Capacity per Foot of Penetration
1	6'0"	to	9'0"	1½ Tons/Foot
	9'6"	to	18'0"	1¾ Tons/Foot
	18'6"	to	20'0"	2 Tons/Foot
2	6'0"	to	14'0"	1½ Tons/Foot
	14'6"	to	15'0"	2½ Tons/Foot
3	6'6"	to	9'0"	2 Tons/Foot
	9'6"	to	13'0"	1¼ Tons/Foot
	13'6"	and	Below	3 Tons/Foot + Point Resistance
4	8'6"	to	14'0"	¾ Ton/Foot
	14'6"	to	15'0"	3 Tons/Foot + Point Resistance
5	6'6"	to	9'0"	1¾ Tons/Foot
	9'6"	to	13'0"	1¼ Tons/Foot
	13'6"	and	Below	3 Tons/Foot + Point Resistance
6	6'6"	to	9'6"	2 Tons/Foot
	10'0"	to	12'0"	2½ Tons/Foot
	12'6"	and	Below	3 Tons/Foot + Point Resistance
7	5'0"	to	8'6"	1 Ton/Foot
	9'0"	to	13'0"	2½ Tons/Foot
	13'6"	and	Below	3 Tons/Foot + Point Resistance

Based on the above chart, we would anticipate that timber piles could develop about 10 tons allowable carrying capacity when driven to depths of about twelve feet (12') to sixteen feet (16') at the boring locations. Actual pile capacities must be evaluated in the field either through the use of a dynamic pile driving formula or static load test. Any resistance in the upper fill soils should be subtracted when evaluating pile capacities as the soils should not be counted on to provide long-term support. If the existing fill is younger than 15 to 20 years or if additional fill is to be placed over the present grade, then the estimated pile capacities should be reduced by an appropriate negative friction allowance. This negative friction could be quite large, on the order of 2 to 6 tons. If should be understood that vibrations during pile driving could damage nearby structures if they are supported on shallow foundations or shallow utilities. Pilot holes may be required to facilitate the driving of piles through the fill soils. It is suggested that you discuss these issues with a pile driving contractor.

As noted earlier, additional deep foundation systems could consist of mini piles, helical-type piles, or rammed aggregate "stone" piers. We understand that manufacturers and contractors who install these piles and piers have qualified engineering staffs who estimate lengths and capacities. If you wish, we could review their work. We understand that specialty contractors such as AA Spartan Specialties have experience in installing mini piles. Hardman Construction out of Ludington, Michigan installs auger cast piles. Kent Companies and Calculus Foundations install helical piles. Finally, GeoPier Foundation Company installs rammed aggregate "stone" geopiers. Due to the smaller shaft diameters of the helical and mini piles, we would expect potential negative friction values to be smaller than the driven timber piles. Pilot holes may be needed to facilitate the installation of the mini piles or helical piles through the site fill soils.

For the northern building (Borings 1 and 2), if deep conventional footings or pile foundations are installed with the existing fill soils kept in place and the existing fill has been in place for at least 15 to 20 years, and if the possibility of more than normal differential movement can be tolerated, then slab-on-grade floors or floor supporting backfill could be placed at or near the present grade. Any existing pavements, surface topsoil or buried topsoil within eighteen inches (18") of the new buildings' slab surfaces should be removed from the building areas. Any loose, soft, organic or obviously objectionable material should be removed and the subgrade thoroughly proof-compacted with heavy, rubber-tired equipment. If during the proof-compaction operation areas are found where the soils yield excessively, the yielding materials should be scarified, dried and recompacted or removed and replaced with engineered fill as outlined above.

If the existing fill has been in place less than 15 to 20 years or if the possibility of more than normal differential movement cannot be tolerated, then all existing fill material should be removed and replaced with engineered fill meeting the requirements outlined above or floor slabs should be structurally supported.

For the southern building (Borings 3 through 7), buried peat and sand with peat seams were found at Borings 4 and 6. Floor slabs for this building should be structurally supported or floor slabs should be supported on engineered fill as outlined above.

Possible methane gas ~~was noted in Boring 5.~~ This report did not include an environmental assessment of the site.

Experience indicates that the actual subsoil conditions at the site could vary from those found at the test borings made at specific locations. It is, therefore, essential that McDowell & Associates be notified of any variation of soil conditions to determine their effects on the recommendations presented in this report. The evaluations and recommendations presented in this report have been formulated on the basis of reported or assumed data relating to the proposed project. Any significant change in this data in the final design plans should be brought to our attention for review and evaluation with respect to the prevailing subsoil conditions. Additional deeper borings should be performed if the new buildings are planned to be supported on deep foundations.

It is recommended that the services of McDowell & Associates be engaged to monitor the pile driving operation to estimate the field load capacity of the piles using a dynamic pile driving formula. If footings or caissons are to be constructed, then a geotechnical engineer should be retained to observe the base of the footing excavations prior to placement of concrete. Inspection and testing should also be performed to check that suitable materials are being used for controlled fills and that they are properly placed and compacted.

If we can be of any further service, please feel free to call.

Very truly yours,

McDOWELL & ASSOCIATES

Daniel A. Kaniarz, M.S., P.E.

DAK/ks/nm

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LOG OF SOIL BORING NO. 1

PROJECT Soils Investigation

JOB NO. 20-349

LOCATION Proposed Buildings
Cherry Hill and Newburg Roads
Westland, Michigan

SURFACE ELEV. ______ **DATE** 1-4-21

Sample & Type	Depth	Legend	Soil Description	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	0'–1'6"		Moist dark brown clayey TOPSOIL with sand and pebbles, vegetation and some occasional stone and concrete						
A SS	1'6"–4'0"		Very stiff moist brown and dark brown silty CLAY with topsoil, sand and pebbles and broken concrete, fill	30/6" --- ---	8.9				
B SS	4'0"–6'0"		Stiff moist brown and dark brown silty CLAY with moist to wet greenish gray silty sand seams and topsoil streaks, fill	4 6 8	25.3				
C SS	6'0"–9'0"		Very compact wet gray silty fine SAND with moist variegated silty clay seams	5 10 10	19.0				
D SS	9'0"–20'6"		Very stiff moist blue silty CLAY with moist to wet gray silt seams	6 8 13	19.8		*	(5000)	
E SS				8 10 13					
F SS				10 12 13					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	5 FT.	0 INS.		
G.W. ENCOUNTERED AT	6 FT.	0 INS.		
G.W. AFTER COMPLETION	4 FT.	8 INS.		
G.W. AFTER	HRS.	FT.	INS.	
G.W. VOLUMES	Heavy			

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LOG OF SOIL BORING NO. 2

PROJECT Soils Investigation

JOB NO. 20-349

LOCATION Proposed Buildings
Cherry Hill and Newburg Roads
Westland, Michigan

SURFACE ELEV. ____________ **DATE** 1-5-21

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		Moist dark brown sandy TOPSOIL with concrete and asphalt rubble and vegetation, fill						
A	2								
D			2'0"		12.4				
	3		Moist discolored brown silty CLAY with topsoil, vegetation, broken concrete, sand and pebbles, fill						
	4								
B			4'0"	6					
SS	5		Stiff moist dark brown and discolored brown silty CLAY with moist to wet gray silt seams and topsoil streaks, fill	6	19.5				
				8			*	(4000)	
	6		6'0"						
C	7			8					
SS				11	22.4				
	8		Very compact wet gray SILT & fine SAND with trace of clay	11					
	9		9'0"						
D				10					
SS	10			8					
				13					
	11								
	12		Very stiff moist blue silty CLAY with traces of sand and pebbles						
	13								
	14		14'0"						
E				10					
SS	15		Extremely stiff moist blue silty CLAY with traces of sand and pebbles	14					
			15'6"	18					
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	5	FT.	0	INS.	
G.W. ENCOUNTERED AT	6	FT.	0	INS.	
G.W. AFTER COMPLETION	5	FT.	7	INS.	
G.W. AFTER HRS.		FT.		INS.	
G.W. VOLUMES	Heavy				

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LOG OF SOIL BORING NO. 3

PROJECT Soils Investigation

JOB NO. 20-349

LOCATION Proposed Buildings, Cherry Hill and Newburg Roads, Westland, Michigan

SURFACE ELEV. ______ **DATE** 1-6-21

Sample & Type	Depth	Legend	Soil Description	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		Moist dark brown sandy TOPSOIL with clay and pebbles, fill						
		1'6"							
A	2			7					
SS				8	13.0				
	3		Very stiff moist dark brown and discolored brown silty CLAY with topsoil, sand and pebbles, fill	12			*	(6000)	
	4								
		4'6"							
B				13					
SS	5			10	19.3				
			Very stiff moist discolored brown silty CLAY with moist black clayey topsoil seams, fill	10			*	(4000)	
	6								
		6'6"							
C	7			10					
SS				12	24.3				
	8		Extremely compact wet brown SILT & fine SAND	15					
	9								
		9'0"							
D				10					
SS	10			10					
				6					
	11								
	12		Very compact wet brown silty fine to medium SAND with moist blue silty clay seams						
	13								
		13'0"							
	14								
E				10					
SS	15			14					
				12/3"					
	16								
	17		Extremely stiff moist blue silty CLAY with sand and pebbles and occasional stones						
	18								
	19								
F				8					
SS	20			13					
				15/3"					
		20'6"							
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
- D. - DISTURBED
- U.L. - UNDIST. LINER
- S.T. - SHELBY TUBE
- S.S. - SPLIT SPOON
- R.C. - ROCK CORE
- ( ) - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	6 FT.	6 INS.		
G.W. ENCOUNTERED AT	9 FT.	0 INS.		
G.W. AFTER COMPLETION	7 FT.	0 INS.		
G.W. AFTER HRS.	FT.	INS.		
G.W. VOLUMES	Heavy	Cave-In at 7'0"		

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LOG OF SOIL BORING NO. 4

JOB NO. 20-349

SURFACE ELEV.

DATE 1-5-21

PROJECT: Soils Investigation

LOCATION: Proposed Buildings
Cherry Hill and Newburg Roads
Westland, Michigan

Sample & Type	Depth	Soil Description	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
A D	0 – 2'0"	Moist dark brown sandy TOPSOIL with sand, pebbles, stones, asphalt and concrete rubble and styrofoam		11.8				
	2'0" – 4'0"	Broken CONCRETE						
B SS	4'0" – 6'6"	Very stiff moist dark brown and discolored brown silty CLAY with sand and pebbles, topsoil streaks and moist brown silty fine sand seams, fill	6 10 14	16.3		*	(6000)	
C SS	6'6" – 8'6"	Slightly compact moist to wet gray SILT & fine SAND with moist black clayey peat seams	3 2 2	29.4				
D SS	8'6" – 14'0"	Compact wet gray silty fine SAND with moist blue silty clay seams	7 6 4	17.6		*	(3000)	
E SS	14'0" – 15'6"	Extremely stiff moist blue silty CLAY with sand and pebbles and rouge streaks	10 16 10/3"					

Notes:

1) Offset boring 15' west of planned location due to standing water and debris piles.

2) Hit concrete obstruction at 3' and moved boring twice to drill for 5' sample.

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	7	FT.	6	INS.
G.W. ENCOUNTERED AT	9	FT.	0	INS.
G.W. AFTER COMPLETION	7	FT.	10	INS.
G.W. AFTER HRS.		FT.		INS.
G.W. VOLUMES	Heavy			

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LOG OF SOIL BORING NO. 5

PROJECT Soils Investigation

JOB NO. 20-349

LOCATION Proposed Buildings
Cherry Hill and Newburg Roads
Westland, Michigan

SURFACE ELEV. ____________ **DATE** 1-6-21

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1		Moist brown silty CLAY with crushed stone, fill						
		1'6"							
A SS	2		Stiff moist discolored brown silty CLAY with moist gray silt seams, crushed stone and concrete washout material, fill	4					
				8					
	3			8					
	4	4'0"							
B SS	5		Stiff moist dark brown clayey TOPSOIL with moist to wet brown silty fine sand streaks with trace of peat seams (possible methane bubbles in water), fill	4					
				3					
				4					
	6	6'6"							
C SS	7		Very compact wet brown to gray SILT & fine SAND with trace of clay	6					
				10					
	8			12					
	9	9'0"							
D SS	10		Stiff moist blue silty CLAY with sand and pebbles and wet gray silt seams	5					
				6					
				10					
	11								
	12								
	13	13'0"							
	14		Extremely stiff moist blue silty CLAY with sand and pebbles						
E SS	15			11					
				17					
		15'2"		10/2"					
	16								
	17								
	18		Note: Offset boring 30' east of planned location due to soft ground and standing water						
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	5	FT.	3	INS.
G.W. ENCOUNTERED AT	6	FT.	6	INS.
G.W. AFTER COMPLETION	5	FT.	6	INS.
G.W. AFTER HRS.		FT.		INS.
G.W. VOLUMES	Heavy	Cave-In at 5'6"		

McDOWELL & ASSOCIATES
Geotechnical, Environmental, & Hydrogeologic Services
21355 Hatcher Avenue • Ferndale, MI 48220
Phone: (248) 399-2066 • Fax: (248) 399-2157

LOG OF SOIL BORING NO. 6

PROJECT Soils Investigation

JOB NO. 20-349

LOCATION Proposed Buildings, Cherry Hill and Newburg Roads, Westland, Michigan

SURFACE ELEV. ______ **DATE** 1-5-21

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
	1								
A SS	2		Very stiff moist brown and dark brown silty CLAY with topsoil, sand, pebbles and occasional stones, fill	8					
				10	11.0				
	3			12			*	(9000+)	
	4	4'0"							
B SS	5		Stiff moist brown sandy CLAY with moist dark brown clayey peat seams and wet gray and dark brown silt lenses, fill	6					
		5'0"		6	62.1				
				7					
	6		Stiff moist dark brown clayey PEAT with moist dark brown fine sand seams						
C SS	7	6'6"		10					
			Very compact wet gray SILT & fine SAND with trace of clay	10	17.1				
	8			14					
	9	8'6"	Very compact wet brown fine to medium SAND						
D SS		9'6"		8					
	10			12	13.2				
				18			*	(7000)	
	11								
	12		Extremely stiff moist blue silty CLAY with sand and pebbles						
	13								
	14								
E SS				13					
	15			16					
		15'6"		10/3"					
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	5 FT.	0 INS.		
G.W. ENCOUNTERED AT	6 FT.	6 INS.		
G.W. AFTER COMPLETION	7 FT.	9 INS.		
G.W. AFTER HRS.	FT.	INS.		
G.W. VOLUMES	Heavy			

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LOG OF SOIL BORING NO. 7

PROJECT Soils Investigation

JOB NO. 20-349

LOCATION Proposed Buildings
Cherry Hill and Newburg Roads
Westland, Michigan

SURFACE ELEV. ______ **DATE** 1-6-21

Sample & Type	Depth	Legend	Strata Depth	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF.	Str. %
				Moist brown and dark brown silty CLAY with topsoil, sand and pebbles and traces of concrete and asphalt, fill						
	1									
			1'6"							
A	2				7					
SS					6	16.4				
	3			Stiff moist brown and dark brown silty CLAY with topsoil, sand and pebbles and occasional stones, fill	5			*	(3000)	
	4									
B			4'6"	Very stiff moist dark brown clayey TOPSOIL with moist brown silty fine sand seams and broken concrete, fill	11					
SS	5		5'0" ←		22	16.0				
					15/3"					
	6									
C	7			Compact moist to wet brown SILT & fine SAND	6					
SS					7	17.9				
	8				5					
			8'6"							
	9									
D					6					
SS	10				15					
					20					
	11									
	12									
	13			Extremely stiff moist blue silty CLAY with sand and pebbles and occasional rouge streaks						
	14									
E					11					
SS	15				16					
					10/3"					
	16									
	17									
	18									
	19									
F					11					
SS	20				16					
			20'3"		16/3"					
	21									
	22									
	23									
	24									
	25									

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
( ) - PENETROMETER

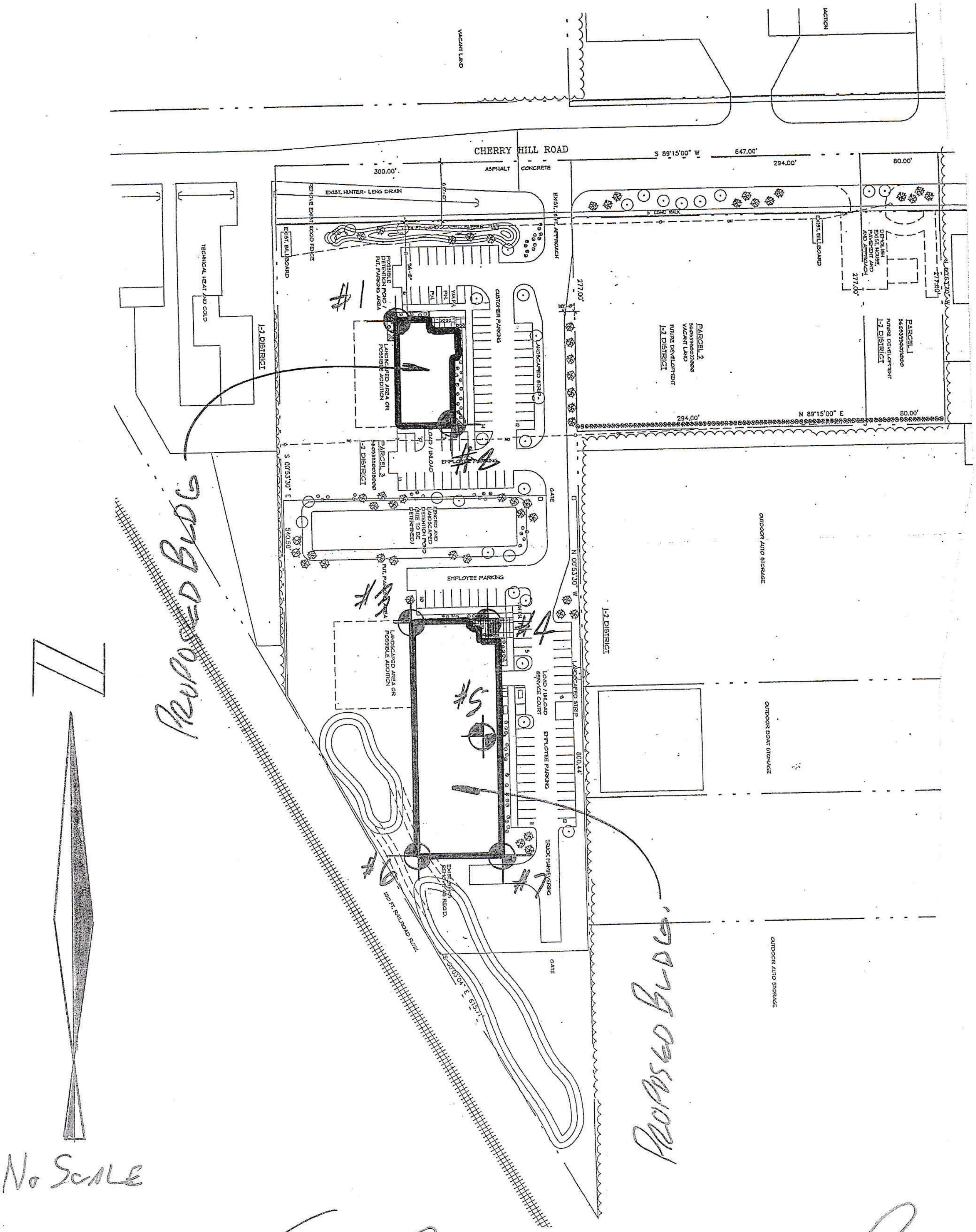
REMARKS: *Calibrated Penetrometer

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 5 FT. 0 INS.
G.W. ENCOUNTERED AT ___ FT. ___ INS.
G.W. AFTER COMPLETION ___ FT. ___ INS.
G.W. AFTER ___ HRS. ___ FT. ___ INS.
G.W. VOLUMES

Heavy Cave-In at 5'0"



Soil Boring Location Plan

#20-349