Soils & Structures Inc.

Structural Engineering

Geotechnical Engineering

Construction Material Testing

Geotechnical Drilling

Structural Steel Inspection

February 6, 2012

C2AE
123 West Main Street, Suite 200
Gaylord, Michigan 49735

Attention: Mr. Larry Fox

Regarding: Boyne City DPW & City Hall Addition
Boyne City, Michigan

Dear Mr. Fox:

Soils & Structures is pleased to present the report of the geotechnical investigation for the above referenced project.

The investigation included ten (10) test borings drilled to a depth of 11.0 and 26.0 feet in accordance with ASTM D 1586 procedures.

The report, test boring location plan and test boring logs are enclosed. The report provides recommendations for site preparation, spread foundations, fill, floors and pavement.

We appreciate the opportunity to be of service to you. If you have a question concerning the report please contact our office.

Sincerely,
Soils & Structures, Inc.

David W. Hohmeyer, P.E.
DWH/dh

File No. TC2012.0001

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Muskegon, MI 49441

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Soils & Structures Inc.

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Location of Soil Investigation

The soil investigation was located at the existing Boyne City Department of Public Works and City Hall Complex at 319 North Lake Street in Boyne City, Michigan.

Purpose of Investigation

The purpose of the investigation is to provide soil related recommendations for building additions and pavement.

Design Information

The proposed building additions are anticipated to be one story masonry and steel structures with a slab on grade floor. The plan area of the main addition will be approximately 15,000 square feet and will connect the City Hall and Department of Public Works Building. A smaller addition of approximately 500 square feet will be located on the west side of the Department of Public Works Building.

The maximum column load is anticipated to be less than 200,000 pounds. The maximum of wall load is anticipated to be less than 8000 pounds per linear foot. Average floor loads are anticipated to be less than approximately 250 pounds per square foot. Allowable settlements of 0.5 inches for total settlement and 0.3 inches for differential settlement are assumed.

The floor levels of the additions are anticipated to match the floor of the existing buildings. At this level the depth of new fill under the buildings will be 4.0 feet or less. The greatest depth of fill will occur in the northwest portion of the west addition where buried peat will be removed and replaced with sand. Fill required for this project is anticipated to be obtained off site from a source still to be determined.

The maximum excavation depth is anticipated to be approximately 10.0 feet.

The pavement recommendations are based on combined automobile and truck traffic. An Equivalent Axle Load (EAL) of 5000 and service life of twenty years were used for the design. The recommendations are also based on a subgrade that has been prepared in accordance with the recommendations in this report.

Tests Performed

Ten test borings were drilled to depths of 11.0 and 26.0 feet in accordance with ASTM D 1586 procedures at the locations specified by C2AE. A few of the test borings were offset short distance to avoid utilizes and structures. The ASTM D 1586 standard describes the procedure for testing the soil and is included in the appendix. An automatic hammer was used to obtain the soil samples.

Soil samples were classified according to the Unified Soil Classification System. This method is a standardized system for classifying soil according to its engineering properties. Please refer to the appendix of this report for the Unified Classification System Chart. The classification is shown in the right hand column of the test boring logs.

The soil strength and the allowable soil bearing value were evaluated using the "N" value. The "N" value is the number of blows required to drive a soil sampler one foot with a standard 140 pound drop hammer. The sampler is driven a distance of 18.0 inches. The number of blows for each 6.0 inch increment is recorded. The sum of the second and third intervals is the "N" value. The number of blows for each 6.0 inch interval is shown on the test boring logs under the column labeled "Penetration." The "N" value for each sample is shown in the adjacent column.

In the laboratory water content and sieve tests were performed on representative samples of the soil. The tests were performed in accordance with applicable ASTM standards. The sieve test measures the grain size distribution and is used to estimate the properties of the soil.

In addition to the field and laboratory tests the U.S. Geological Survey map and the Quaternary Geology map of Southern Michigan were reviewed. These maps provide general information about the geology in the region.

Surface elevations were referenced to the floor of the existing buildings. An elevation of 100.0 feet was assumed for the floors.

Description of Soil

The general soil profile consists of sand to a depth of at least 20.0 feet over clay and silt. The clay and silt are underlain by a second sand layer. In the northwest portion of the site the upper few feet of the sand is fill. The fill is underlain by 1.0 to 2.0 feet of peat. Pavement and topsoil are present at the surface.

The topsoil, where present, consists of dark brown sandy topsoil with a low to moderate organic content. The thickness ranges from 3.0 to 18.0 inches.

The upper sand layer consists of a light brown to brown fine sand with pockets of fine to medium and fine to coarse sand. A pocket of clay is also present in the area of Test Boring Three at a depth of 7.5 feet. The sand layer is a glacial lake deposit. The sand is relatively free of fine and is well draining. The "N" Value ranges from 1 to 9 which indicates that the sand is in a loose to compact state. Most of the upper sand layer is in a loose state which is indicated where the "N" value is 5 or less. The thickness of the loose zone has significant variation. The greatest thickness is approximately 13.0 feet. In the compact state the internal angle of friction will be in the range of 34 to 36 degrees. The sand will support foundations after extensive compaction is performed.

The clay and silt layer consists of a brown and gray silty clay with occasional pockets of clayey silt. The clay appears to be a glacial lake deposit. The shear strength of the clay ranges from 500 to 2000 pounds per square foot which classifies the clay as soft to stiff. The clay will support foundation in the overlying sand layer after it has been compacted.

A second sand layer underlies the clay and silt layer. The sand is a glacial outwash deposit. The "N" Value of 23 is high and indicates that the sand is in a compact state. The sand lower sand layer will support foundations in the overlying soil layers and piles bearing directly in the sand.

Description of Groundwater Conditions

The water table is present at a depth of 2.0 to 7.0 feet. The water table is anticipated to be within the depth of foundation and utility excavations. The fluctuation of the water table will match the variation of the nearby Lake Charlevoix.

Description of Site

The Department of Public Works and City Hall Complex consists of two main buildings and a smaller out building. The buildings are one story with exterior masonry wall. Cracking and shifting of the masonry walls indicates that these buildings have settled significantly. The area surrounding the buildings is primarily asphalt pavement with a few grass and landscaped areas. The topography is relatively flat and level. The surface elevation ranges from 99.0 to 100.0 feet over most of the site.

Settlement

The maximum building settlement will be approximately 0.1 to 0.3 inches with spread foundations provided the recommendations in this report are observed. The Vibrocompaction method is recommended to limit settlement to acceptable levels. Differential settlement will be approximately one half to three quarters of the maximum value. These levels of settlement should be acceptable for the additions.

If the Vibrocompaction process is not performed the settlement of the additions will be similar to the existing building with the associated wall cracking. In this case the settlement is estimated to be in the range of 0.5 to 3.0 inches. This level of settlement is not typically considered acceptable for new construction.

Recommendations

Building Pad & Site Preparation

The topsoil and buried peat should be removed from the building, pavement and fill areas. Topsoil, peat and soil with organic material should be removed to the extent that all soil with an organic content of 3.0 percent or greater is removed. Soil containing roots should be removed to the extent that all roots over 0.5 inches are removed. Soil containing roots should be removed to the extent that the root content by volume is 5.0 percent or less. Excavation to a depth of at least 4.0 feet will be required to remove the buried peat. The quantity of buried peat that will require removed is anticipated to be in the range of 400 to 800 cubic yards.

The Vibrocompaction process should be performed to compact the soil under the building foundations to a depth of 15.0 feet below the foundation and to a depth of 10.0 feet below the floor. The method consists of using large rotating weights in a metal probe to compact the soil. The probe is inserted into the ground at specified intervals. The recommended intervals are 4.0 to 8.0 feet under column foundations, 8.0 to 10.0 feet along wall foundations and on a 8.0 to 12.0 foot grid under the floor. The actual spacing should be proposed by the Vibrocompaction contractor based on the size of their equipment and reviewed by the geotechnical engineer of record. This method is very effective method to limit settlement and obtain relatively high allowable soil bearing values. This method of compaction is a proprietary method and requires specialty contractors. The contact information for reputable Vibrocompaction contractor(s) will be provided upon request. The Vibracompaction process is performed by several proprietary methods and each method has specific labels which include rammed aggregate piers, geo-piers and stone columns.

Typically the onsite sand is used for backfill with the Vibrocompaction process. The backfill is placed along the side of the vibrating probe. In some cases coarse aggregate is used for backfill. At this site coarse aggregate will be required in the area of Test Boring Three where the clay pocket is present. Due to the extensive amount of loose sand that is present at this site sand and aggregate will probably have to be obtained off site to account for the volume of soil that will be lost from compaction.

After the Vibrocompaction process is completed, the building, pavement and fill areas outside of the building area should be proof compacted with a vibratory roller before fill is placed. The vibratory roller should have a weight of ten tons. A minimum of five passes is recommended.

Fill should be placed in accordance with the "Fill" section of this report. The fill should be compacted to 95.0 percent of its maximum density. The soil which will be used for fill should be kept free of topsoil and other organic materials. Compaction tests are recommended to check the compaction of the fill.

Foundations

Spread foundations are recommended for the proposed building. The foundations should bear on the existing natural soil after it has been compacted using the Vibrocompaction method. Dewatering may be required to construct foundations which will be as much as 1.5 feet below the water table.

The foundation subgrade should be compacted with a hand compactor prior to placing concrete. The subgrade should be compacted to a density of 95.0 percent of the soil's maximum density. The compaction with the hand compactor should be performed in addition to the compaction using the Vibrocompaction process. Fill under foundations should possess a density of 95.0 percent of its maximum density to its full depth. Compaction tests should be performed in the foundation subgrade to verify this level of compaction. Soil that possesses lower densities should be recompacted.

The recommended cover over exterior foundations is 42 inches for protection against frost heave.

Foundations should not be constructed on frozen soil. During cold weather construction the foundation subgrade and foundations should be protected from freezing with insulated blankets until backfill is placed over both sides of the foundation. Foundations that are damaged by frost heave should be replaced.

The site classification for seismic design is "E" based on the Michigan Building Code. The long period acceleration for the site is 2.9 percent and the short period acceleration is 5.8 percent. The design spectral response acceleration parameters (S_D) are 0.068g for the one second response and 0.097g for the short term response.

Foundations may be designed using an allowable soil bearing value of 4000 for isolated column foundations and 3000 pounds per square foot for wall foundations provided the recommendations in this report are observed. A minimum foundation width of 16.0 inches is recommended.

Floors

A base of 12.0 inches of clean sand is recommended under the floors. The sand should meet MDOT Class II specifications. The existing sand may be left in place where it is not underlain by peat and used for the sand base. Where peat is present, it should be removed and replaced with clean sand. Fill under floors should be compacted to a density of 95.0 percent of its maximum density for its full depth.

A modulus of subgrade reaction of 150 pounds per inches cubed is recommended for the design of slabs on grade.

Lateral Earth Pressure

Sand should be used as backfill behind retaining and foundation walls. The sand should meet MDOT Class II specifications. The walls should be designed using a soil density of 130 pounds per cubic foot and a coefficient of active earth pressure of 0.35 for level sand backfill. The equivalent fluid pressure is 46 pounds per cubic foot for level backfill. The effects of any surcharge or sloping backfill should also be included in the design. The passive resistance of the existing sand should be calculated using an earth pressure coefficient of 4.0.

Excavations

The sand is an OSHA type "C" soil. Excavations should be based on OSHA requirements for a type "C" soil. Based on OSHA requirements a maximum allowable side slope of 34 degrees (1.5H:1V) is recommended for excavation 4.0 to 10.0 feet deep. For excavations adjacent to existing foundations and retaining walls or over 10.0 feet deep retaining systems are recommended. Excavations less than 4.0 feet deep may have vertical side slopes..

Fill

Fill including the aggregate layers under pavement should be compacted to a density of 95.0 percent of its maximum density. The maximum density should be determined in accordance with the ASTM D 1557 standard. A maximum thickness per layer of 6.0 inches is recommended. The lift thickness may be increased to 12.0 inches if a vibratory roller or loader is used for compaction. Compaction tests are recommended to confirm that the fill is compacted to the required density.

General structural fill should be sand meeting MDOT Class II requirements or ASTM requirements for a SP or SW which are the designations for clean sand. The natural sand meets these requirements and may be used for fill. Most of the sand required for this project will have to be obtained on site from the excavation of the storm water basin.

Groundwater Management & Drainage

Dewatering will be necessary to construct foundations and possibly utilities depending on their depth. Dewatering will be necessary in excavations that extend below an elevation of 97.5 feet. A system of well points is recommended for dewatering excavations.

Drains are recommended around the perimeter foundations and should be considered under the floor. The drains should consist of a 4.0 or 6.0 inch diameter slotted plastic drain wrapped in filter fabric. The drains along the foundation should be located at the top of the foundation. A spacing of 25.0 feet on center is recommended for the drains under the floor. The drains should be connected to a sump. The perimeter drains are anticipated to intercept the water table when it rises to the foundation level and limit its additional upward movement.

A vapor barrier is recommended under the floor of portions of the building that will be enclosed and heated. The vapor barrier should consist of a 7 mil plastic sheet located directly under the slab.

An infiltration rate of 15 inches per hour is recommended for the drainage structure design.

Asphalt Pavement

A bituminous thickness of 3.0 inches with an MDOT 22A aggregate base of 6.0 inches and an MDOT Class II sand subbase of 12.0 inches is recommended for automobile parking areas. A bituminous thickness of 3.5 inches with an MDOT 22A aggregate base of 8.0 inches and an MDOT Class II sand subbase of 12.0 inches is recommended for truck traffic, drives and entries. The bituminous mixture should be placed in two lifts.

The existing soil will provide an adequate subgrade for the pavement provided it is prepared in accordance with the "Site Preparation" and "Fill" section of this report.

The paving contractor should submit the proposed mix designs for review. The bituminous paving mixture should meet and be installed to the following criteria:

Table One: Bituminous Mixture Requirements

Criteria	Base Course		Wearing Course	
	minimum	maximum	minimum	maximum
MDOT Mix Type	3B		36A	
Marshall Stability	1100		1100	
Flow (0.01 inches)	8.0	16.0	8.0	16.0
Asphalt Content (%)	4.5	6.0	5.0	7.0
Void Content (%)	3.0	5.0	3.0	7.0
VMA (%)	15.0		15.0	
Max. Aggregate Size (inches)	0.50	0.75	0.50	0.50
Crushed Aggregate (%)	50		50	
Lift Thickness (inches) Automobile Parking Areas Drives and Entries	 1.5 2.0		 1.5 1.5	

The base course should have an asphalt content of 0.4 to 0.8 percent less than the wearing course. The asphalt grade should be AC-10 or PG 58-28. The base course should be compacted to 93.0 percent of the 50 blow Marshall Densities and the wearing course should be compacted to 94.0 percent.

Concrete Pavement

The subgrade should be prepared in accordance with the "Site Preparation" and "Fill" sections of this report.

A base of 12.0 inches of clean sand is recommended under the pavement. The sand should meet MDOT Class II specifications.

A modulus of subgrade reaction of 150 pounds per inches cubed is recommended for the design of concrete pavement. A minimum slab thickness 6.0 inches is recommended. The reinforcing should be designed by a structural engineer.

Inspection & Quality Control Testing

Full time inspection of the Vibrocompaction is recommended. For each compaction location the following information should be recorded. Amperage achieved, probed depth, approximate backfill quantities, obstructions and offsets. After the Vibrocompaction is completed test borings performed with a drill rig should be performed to verify the level of compaction. The recommended number of test borings is one for each half day of production.

Compaction tests (ASTM D 2922) are recommended to confirm that fill and natural soil in the building area are compacted to the specified density. While fill is being placed compaction tests should be performed at the rate of one test per 400 cubic yard of fill and throughout the depth of the fill with a minimum of five tests at each 1.0 foot elevation interval. Compaction tests should be performed under foundations at the rate of one test per 50 linear feet for wall foundations and one test per column foundation. The recommended testing frequency in the floor and pavement subgrade is one test per 2500 square feet. Tests should also be performed in the backfill over foundations and utilities.

A smooth 0.5 to 0.75 inch diameter rod should be used in conjunction with compaction tests to probe for loose areas under foundations, in fill and under floors.

The maximum density should be determined in accordance with ASTM D 1557 or ASTM D 4253 procedures.

A dynamic cone should not be substituted for compaction tests for evaluating fill.

Testing should be performed by technicians supervised by a registered geotechnical engineer.

General Conditions & Reliance

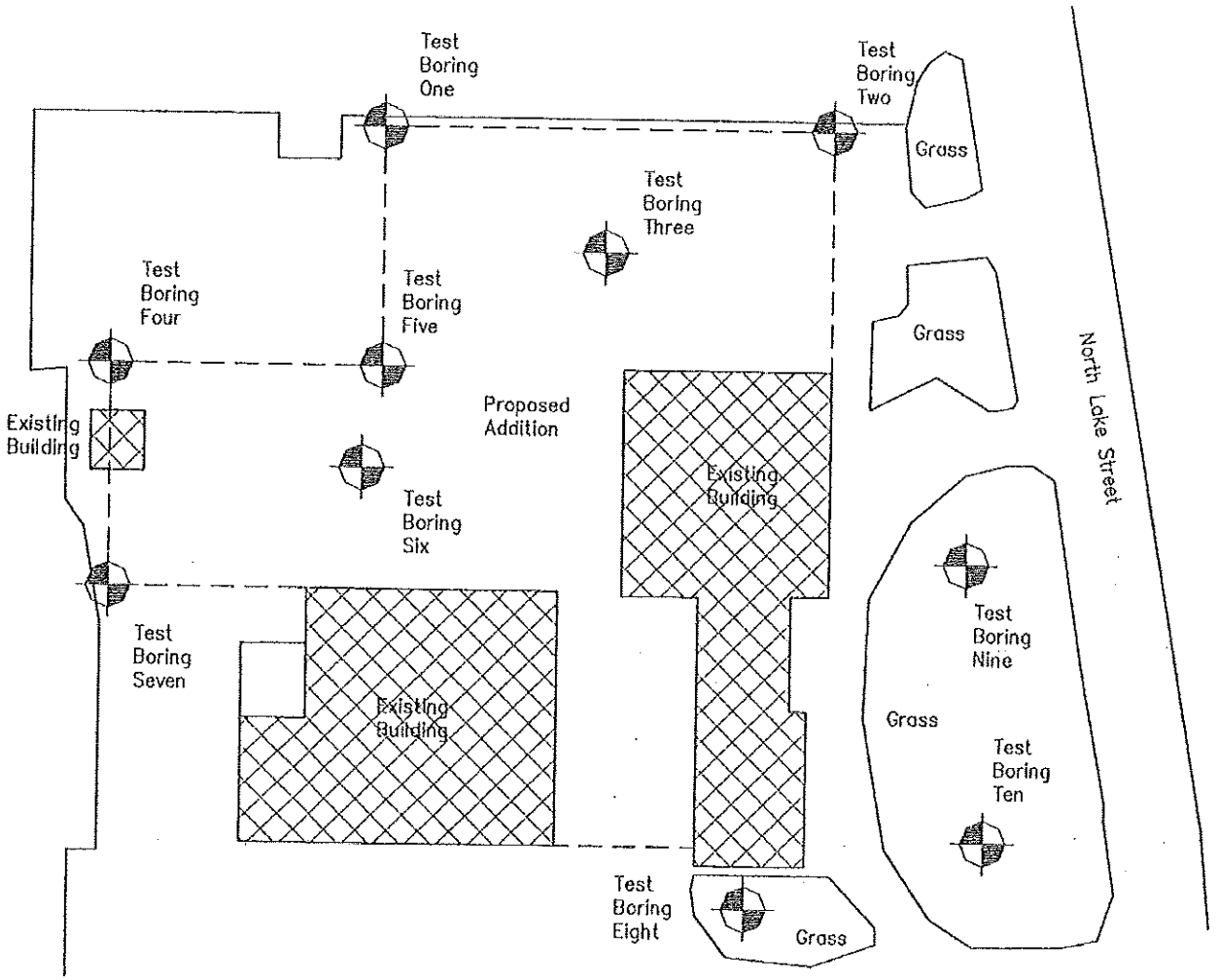
The report was prepared in accordance with generally accepted practices of the geotechnical engineering profession. The scope of work consisted of performing ten test borings and providing soil related recommendations for the design and construction of two building additions. The scope of work did not include an environmental study or wetland determination.

The report and the associated test boring were prepared specifically for the previously described project and site. Soils & Structures should be consulted if a significant change in the scope of the project is made.

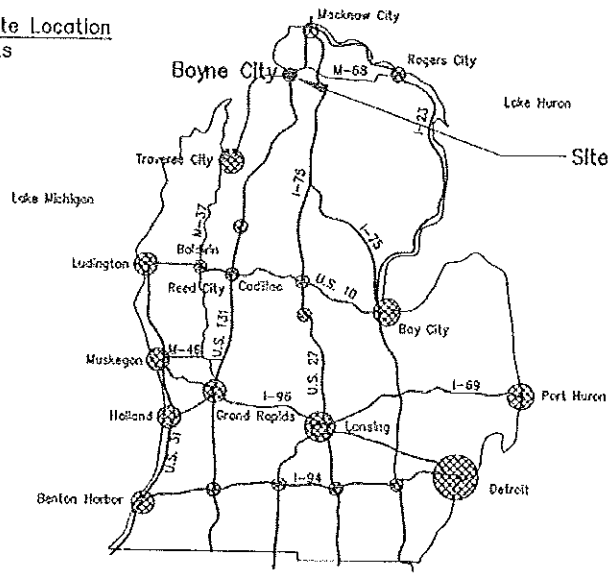
The test borings represent point information and may not have encountered all of the soil types and materials present on this site. This report does not constitute a guarantee of the soil or groundwater conditions or that the test boring is an exact representation of the soil or groundwater conditions at all points on this site.

The descriptions and recommendations contained in this report are based on an interpretation of the test borings and laboratory tests. The test borings should not be used independently of the report. If soil conditions are encountered which are significantly different from the test borings Soils & Structures should be consulted for additional recommendations.

The report and test borings may be relied upon by C2AE for the design, construction, permitting and financing associated with the construction of an additions to the buildings at 319 North Lake Street in Boyne City, Michigan. The use of the report and test borings by third parties not associated with this project or for other sites has not been agreed upon by Soils & Structures. Soils & Structures does not recommend or consent to third party use or reliance of the report or test borings unless allowed to review the proposed use of these materials. Unless obtained in writing no consent to third party use should be assumed. Third parties using the report or test boring logs do so at their own risk and are offered no guarantee or promise of indemnity.



Site Location
nts



TEST BORING LOCATION PLAN
NTS

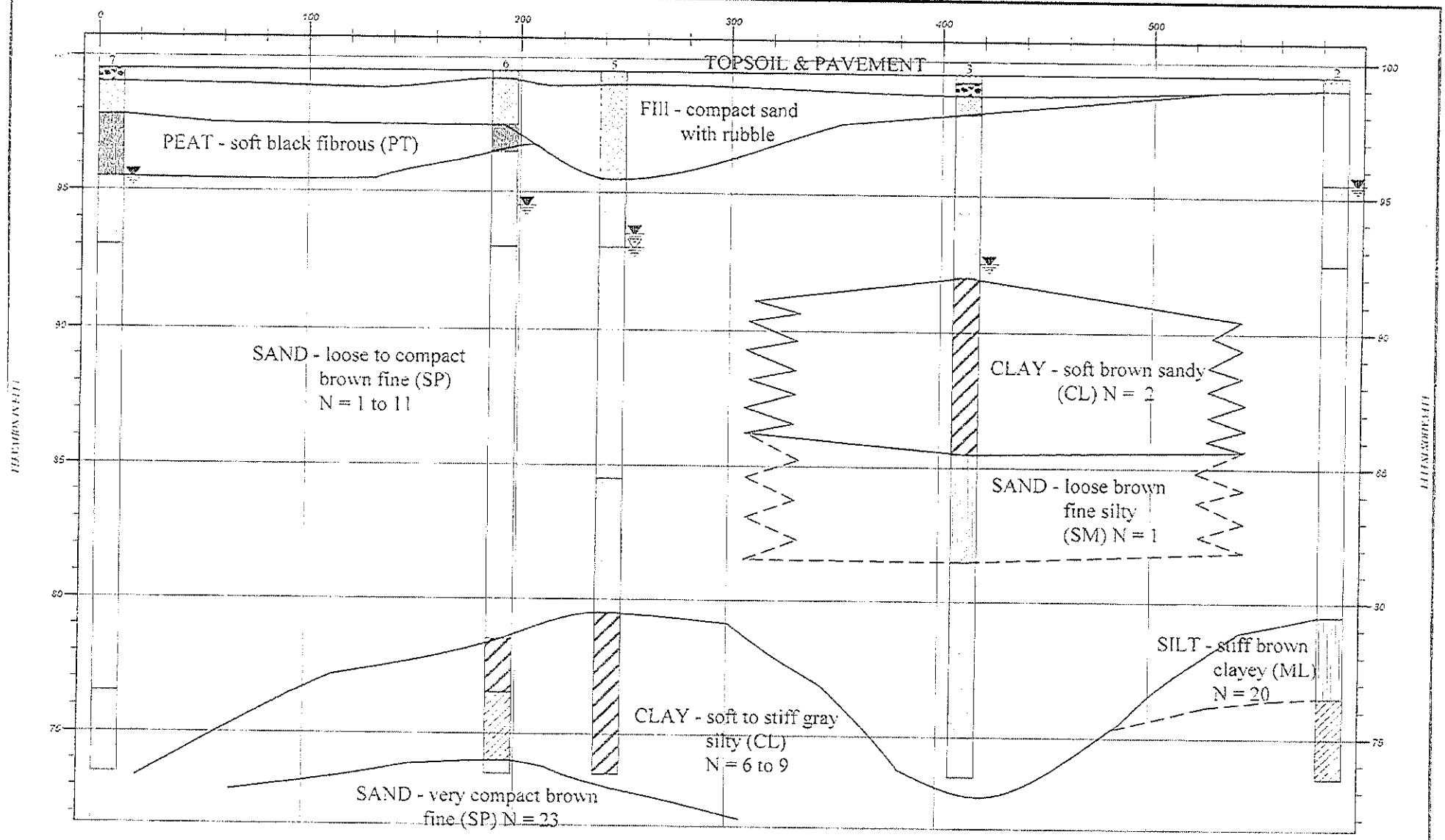
N

Note: The background of the test boring location plan plan is a portion of an aerial photograph by C2AE.

Boyne City – City Hall Expansion
North Lake Street
Boyne City, Michigan

Soils & Structures, Inc.
6480 Grand Haven Road
Muskegon, Michigan 49441

JOB NO. TC2012.0012 DATE 2-3-2012



Plan View

Strata symbols

- Gravel
- Fill
- Peat
- Compact poorly graded sand
- Loose poorly graded sand
- Topsoil
- Soft low plasticity clay
- Stiff low plasticity clay
- Silty sand
- Silt

Note: The water table is at a depth of 2.0 to 7.0 feet.

SOILS & STRUCTURES, INC.

GENERALIZED SOIL PROFILE

HORIZONTAL SCALE: 1"=100' (proportional) VERTICAL SCALE: 1"=5'	DRAWN BY/APPROVED BY	DATE DRAWN
	D. Hohmeyer, P.E.	2/7/2012

Boyne City DPW & City Hall Renovations

PROJECT NO. TC12.0001

FIGURE NUMBER

Log of Test Boring

Soils &
Structures
Inc.
Offices:
Muskegon, Michigan
Traverse City, Michigan

231 798 4127
800 933 3959
fax 798 1383

project: Boyne City DPW &
City Hall Expansion

location: Boyne City, Michigan

job number: TC12.0001

Boring Number 1	Crew Chief S. Hohmeyer	Ground Water Encountered 5.0 ft.	Plugging Record		
Depth Drilled 26 ft.	Helper N. Kroll	After Completion 5.0 ft.	Boring Sealed with: excavated		
Surface Elev. 99.5 ft.	Drill Rig D-50 truck	After 1.4 hrs. 5.0 ft.	soil between 0.0 ft. & 26.0 ft.		
Date Started 1-18-12	Boring Method 3 1/4" ID	Volume heavy	____ between ____ ft. & ____ ft.		
Date Completed 1-18-	hollow stem auger	Seepage at 5.0 ft.	Reviewed by:		

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Laboratory Data: Wet Density (pcf)	Laboratory Data: Shear Strength (psf)	Laboratory Data: Unified Soil Classif.
0.4'		TOPSOIL - dark brown sand						
1.5'		SAND - brown fine with gravel						
		SAND - brown fine with gravel seams and peat lenses	5-3-3	6				SP
4.0'								
5.0'		SAND - loose brown fine	1-2-2	4				SP
6.5'		SILT - loose brown sandy						
			1-1/2-1/2	1				SP
		SAND - loose brown fine	1/2-1/2-1	1				SP
13.0'								
			2-3-4	7				SP
		SAND - compact brown fine	4-5-6	11				SP
25.8'			3-2-3	5				SP&CL
26.0'		CLAY - soft to firm brown silty End of Boring						

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location Boyne City, Michigan
job number TC12.0001

Boring Number 2	Crew Chief S. Hohmeyer	Ground Water Encountered 4.0 ft.	Plugging Record Boring Sealed with: excavated
Depth Drilled 26 ft.	Helper N. Kroll	After Completion 4.0 ft.	soil between 0.0 ft. & 26.0ft.
Surface Elev. 99.5 ft.	Drill Rig D-50 truck	After 1.4 hrs. 4.0 ft.	____ between ____ ft. & ____ ft.
Date Started 1-18-12	Boring Method 3 1/4" ID	Volume heavy	
Date Completed 1-18-	hollow stem auger	Seepage at 4.0 ft.	Reviewed by:

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Wet Density (pcf)	Shear Strength (psf)	Unified Soil Classif.
0.5'		TOPSOIL - dark brown sand						
1.4'		SAND - loose fine with gravel						
2.5'		SAND - loose fine with gravel and peat						
4.0'		SAND - slightly compact light brown fine	2-2-3	5				SP
		SAND - compact brown fine to coarse with an occasional clay lense	3-3-4	7				SP
7.0'			2-2-1	3				SP
			1-1-1	2				SP
		SAND - loose brown fine	2-4-4	8				SP
20.0'		SILT - stiff brown with a trace of sand and clay	4-10-10	20				SP&ML
23.0'		CLAY - stiff brown with lenses of sand and silt	3-4-5	9				CL
26.0'		End of Boring						

Log of Test Boring

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Boring Number 3	Crew Chief S. Hohmeyer	Ground Water Encountered 7.0 ft.	Plugging Record		
Depth Drilled 26 ft.	Helper N. Kroll	After Completion 7.0 ft.	Boring Sealed with: excavated		
Surface Elev. 99.5 ft.	Drill Rig D-50 truck	After 1.4 hrs. 7.0 ft.	soil between 0.0 ft. & 26.0 ft.		
Date Started 1-18-12	Boring Method 3 1/4" ID	Volume heavy	____ between ____ ft. & ____ ft.		
Date Completed 1-18-	hollow stem auger	Seepage at 7.0 ft.	Reviewed by:		

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Wet Density (pcf)	Shear Strength (psf)	Unified Soil Classif.
0.3'		TOPSOIL - dark brown sand						
0.8'		GRAVEL - brown sandy						
1.5'		SAND - brown fine with gravel and topsoil (fill)	4-5-6	11				SP
		SAND - compact light brown fine	2-2-3	5				SP
7.5'			3-1-1	2				SP
		CLAY - soft brown with seams of fine sand	1-1-1	2				CL
14.0'								
		SAND - loose brown fine silty	0-0-1	1				SM
18.0'								
		SAND - slightly compact to compact brown fine	3-4-5	9				SP
26.0'		End of Boring	2-2-3	5				SP

Log of Test Boring

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job number TC12.0001

Boring Number	4	Crew Chief	S. Hohmeyer	Ground Water Encountered	5.0 ft.	Plugging Record Boring Sealed with:	excavated
Depth Drilled	26 ft.	Helper	N. Kroll	After Completion	5.0 ft.	soil between	0.0 ft. & 26.0ft.
Surface Elev.	99.5 ft.	Drill Rig	D-50 truck	After 1.4 hrs.	5.0 ft.	____ between	____ ft. & ____ ft.
Date Started	1-18-12	Boring Method	3 1/4" ID	Volume	heavy		
Date Completed	1-18-		hollow stem auger	Seepage at	5.0 ft.	Reviewed by:	

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Wet Density (pcf)	Shear Strength (psf)	Unified Soil Classif.
0.3'		TOPSOIL - dark brown sand						
2.0'		SAND - slightly compact brown fine with some gravel and a trace of clay (fill)						
		PEAT - soft black fibrous	1-3-2	5				PT
4.5'			2-4-6	10				SP
		SAND - compact brown fine to medium	3-3-2	5				SP
9.0'			1/2-1/2-1	1				SP
		SAND - loose brown fine to medium with peat lenses	0-1-1	2				SP
20.0'			2-3-4	7				SP
		SAND - compact brown fine to medium with a trace of gravel	1-3-7	10				SP
26.0'		End of Boring						

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job number TC12.0001

Boring Number 5	Crew Chief S. Hohmeyer	Ground Water Encountered 6.5 ft.	Plugging Record
Depth Drilled 26 ft.	Helper N. Kroll	After Completion 6.0 ft.	Boring Sealed with: excavated
Surface Elev. 99.5 ft.	Drill Rig D-50 truck	After 1.4 hrs. 6.0 ft.	soil between 0.0 ft. & 26.0 ft.
Date Started 1-18-12	Boring Method 3 1/4" ID	Volume heavy	_____ between _____ ft. & _____ ft.
Date Completed 1-18-	hollow stem auger	Seepage at 6.0 ft.	Reviewed by:

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Wet Density (pcf)	Shear Strength (psf)	Unified Soil Classif.
		SAND - slightly compact brown fine with gravel and rubble (fill)						
4.0'								
		SAND - slightly compact to compact brown fine	2-3-3	6				SP
6.5'								
			1-1-1	2				SP
		SAND - loose brown fine to coarse	1-1-1	2				SP
15.0'								
			1-2-2	4				SP
		SAND - slightly compact brown fine						
20.0'								
			2-3-3	6				SP&CL
		CLAY - firm to stiff brown with lenses of sand						
			2-2-6	8				CL
26.0'		End of Boring						

Log of Test Boring

Soils &
Structures
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project Boyne City DPW &
City Hall Expansion
location Boyne City, Michigan
job number TC12.0001

Boring Number 6
Depth Drilled 26 ft.
Surface Elev. 99.5 ft.
Date Started 1-18-12
Date Completed 1-18-

Crew Chief S. Hohmeyer
Helper N. Kroll
Drill Rig D-50 truck
Boring Method 3 1/4" ID hollow stem auger

Ground Water
Encountered 5.0 ft.
After Completion 5.0 ft.
After 1.4 hrs. 5.0 ft.
Volume heavy
Seepage at 5.0 ft.

Plugging Record
Boring Sealed with: excavated
soil between 0.0 ft. & 26.0 ft.
____ between ____ ft. & ____ ft.

Reviewed by:

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Laboratory Data: Wet Density (pcf)	Laboratory Data: Shear Strength (psf)	Laboratory Data: Unified Soil Classif.
0.3'		TOPSOIL - dark brown sand						
		SAND - brown fine with gravel						
2.0'								
3.0'		PEAT - soft black fibrous	4-2-4	6				SP T
		SAND - compact light brown fine	4-4-4	8				PT
6.5'			1-1-1	2				SP
			1-1-2	3				SP
		SAND - loose brown fine	1-1-1	2				SP
21.0'			2-2-3	5				SP
		CLAY - soft to firm gray silty						
23.0'		CLAY - stiff gray silty						
25.5'		SAND - very compact brown fine	5-10-13	23				CL&SP
26.0'		End of Boring						

Log of Test Boring

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job number: TC12.0001

Boring Number 7	Crew Chief S. Hohmeyer	Ground Water Encountered 4.0 ft.	Plugging Record: Boring Sealed with: excavated
Depth Drilled 26 ft.	Helper N. Kroll	After Completion 4.0 ft.	soil between 0.0 ft. & 26.0ft.
Surface Elev. 99.5 ft.	Drill Rig D-50 truck	After 1.4 hrs. 4.0 ft.	_____ between _____ ft. & _____ ft.
Date Started 1-18-12	Boring Method 3 1/4" ID	Volume heavy	
Date Completed 1-18-	hollow stem auger	Seepage at 4.0 ft.	Reviewed by:

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Wet Density (pcf)	Shear Strength (psf)	Unified Soil Classif.
0.5'		GRAVEL - (6")						
		SAND - dark brown fine with gravel						
1.7'		PEAT - firm black with wood	1-3-8	11				PT
4.0'		SAND - compact brown fine	3-4-7	11				SP
6.5'		SAND - loose brown fine with some peat	1-1-2	3				SP
8.0'			1-2-1	3				SP
		SAND - loose to slightly compact brown fine	1-2-2	4				SP
			2-2-2	4				SP
23.0'		SAND - compact brown fine	3-4-4	8				SP
26.0'		End of Boring						

Log of Test Boring

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Boring Number 8
Depth Drilled 26 ft.
Surface Elev. 99.5 ft.
Date Started 1-18-12
Date Completed 1-18-

Crew Chief S. Hohmeyer
Helper N. Kroll
Drill Rig D-50 truck
Boring Method 3 1/4" ID hollow stem auger

Ground Water
Encountered 3.5 ft.
After Completion 3.5 ft.
After 1.4 hrs. 3.5 ft.
Volume heavy
Seepage at 3.5 ft.

Plugging Record
Boring Sealed with: excavated soil between 0.0 ft. & 26.0ft.
_____ between _____ ft. & _____ ft.

Reviewed by:

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Wet Density (pcf)	Shear Strength (psf)	Unified Soil Classif.
		TOPSOIL - peat mixed with sand and gravel						
1.5'		SAND - compact brown fine with lenses of clayey sand	3-4-4	8				SP
4.0'		SAND - compact brown fine with occasional lenses of sandy peat	3-4-4	8				SP
6.9'			2-2-2	4				SP
		SAND - slightly compact brown fine	2-2-3	5				SP
15.0'			1-4-6	10				SP
		SAND - compact brown fine	4-4-6	10				SP
23.0'		SAND - very compact brown fine	9-13-14	27				SP
26.0'		End of Boring						

Log of Test Boring

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Boring Number	9	Crew Chief	S. Hohmeyer	Ground Water Encountered	2.0 ft.	Plugging Record Boring Sealed with:	excavated
Depth Drilled	11 ft.	Helper	N. Kroll	After Completion	2.0 ft.	soil between	0.0 ft. & 11.0 ft.
Surface Elev.	99.5 ft.	Drill Rig	D-50 truck	After 1.4 hrs.	2.0 ft.	_____ between	_____ ft. & _____ ft.
Date Started	1-24-12	Boring Method	3 1/4" ID	Volume	heavy		
Date Completed	1-24-		hollow stem auger	Seepage at	2.0 ft.	Reviewed by:	

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Wet Density (pcf)	Shear Strength (psf)	Unified Soil Classif.
0.5'		TOPSOIL - dark brown sand with peat and roots						
0.9'								
1.8'		CLAY - brown with topsoil and sand (4")						
2.3'		PEAT - soft black fibrous						
		MARL - soft gray with sand and roots						
4.5'		SAND - compact brown fine with a trace of clay and silt	3-3-3	6				SP-SC
		SAND - compact brown fine	2-3-5	8				SP
			4-4-5	9				SP
11.0'		End of Boring						

Log of Test Boring

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Boring Number	10	Crew Chief	S. Hohmeyer	Ground Water Encountered	2.0 ft.	Plugging Record Boring Sealed with:	excavated
Depth Drilled	11 ft.	Helper	N. Kroll	After Completion	2.0 ft.	soil between	0.0 ft. & 11.0 ft.
Surface Elev.	99.5 ft.	Drill Rig	D-50 truck	After 1.4 hrs.	2.0 ft.	_____ between	_____ ft. & _____ ft.
Date Started	1-24-12	Boring Method	3 1/4" ID	Volume	heavy		
Date Completed	1-24-		hollow stem auger	Seepage at	2.0 ft.	Reviewed by:	

Depth in Feet	Soil Sym.	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Wet Density (pcf)	Shear Strength (psf)	Unified Soil Classif.
0.5'		TOPSOIL - dark brown sand with peat						
1.2'		PEAT - soft black fibrous						
		SAND - slightly compact to compact brown fine with lenses of sandy silt	2-2-3	5				SP
			2-3-4	7				SP
			3-4-5	9				SP
11.0'		End of Boring						