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PRELIMINARY REPORT OF GEOTECHNICAL EXPLORATION AND REVIEW

New Walser Toyota Dealership

4401 West American Boulevard
Bloomington, Minnesota

Report No. 01-06521

Date:

July 17, 2015

Prepared for:

Phillips Architects & Contractors
227 Colfax Avenue North
Suite 100
Minneapolis, MN 55405

www.amengtest.com

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July 17, 2015

Phillips Architects & Contractors
227 Colfax Avenue North
Suite 100
Minneapolis, MN 55405

Attn: David Phillips (dphillips@phillipsarchitects.com)

RE: Preliminary Geotechnical Exploration and Review
New Walser Toyota Dealership
4401 West American Boulevard
Bloomington, Minnesota
Report No. 01-06521

Dear Mr. Phillips:

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for the proposed Walser Toyota Dealership in Bloomington, Minnesota. This report is designated as preliminary, pending final building design information which is expected at a later date in 2015.

We are submitting one (1) hard copy of the report to you and one (1) electronic PDF copy to you. Additional electronic copies are being sent on your behalf, as noted below.

Please contact me if you have questions about the report.

Sincerely,
American Engineering Testing, Inc.

Michael P. McCarthy, PE
Principal Engineer
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mmccarthy@amengtest.com

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Principal Engineer

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under Minnesota Statute Section 326.02 to 326.15

Name: Michael P. McCarthy

Date: 7/17/2015 **License #: 16688**

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1.0 INTRODUCTION

Construction of a new Walser Toyota dealership building is being proposed near the existing Walser Toyota dealership in Bloomington, Minnesota. To assist in planning and design, American Engineering Testing, Inc. (AET) was authorized to conduct a subsurface exploration program at the site and perform a preliminary geotechnical engineering review for the project. This report presents the results of the above services and provides our preliminary engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

The approved scope of services was presented in our May 6, 2015 proposal. Authorization to proceed with these services was received from Phillips Architects and Contractors on May 8, 2015. The approved scope of services consisted of the following:

- Drilling five (5) standard penetration test (SPT) borings within the proposed building location, to depths of about 130 feet or obstruction on bedrock, whichever occurred first.
- Drilling two (2) standard penetration test (SPT) borings within the proposed building location, to depths of about 60 to 80 feet.
- Performing geotechnical laboratory index tests on selected soil samples.
- Conducting an engineering analysis based on the obtained data, and preparing this geotechnical engineering report.

These services are intended for geotechnical purposes. The scope is not intended to explore for the presence or extent of environmental contamination.

3.0 PROJECT INFORMATION

A new Walser Toyota dealership building is planned to replace the existing Toyota dealership building. The new building will be located in the eastern half of the site at 4401 West American Boulevard. The locations and configurations of the new and existing buildings are shown on Figure 1 in Appendix.

The new dealership building will be a four to five-level structure which will include a showroom, a service area, and an attached parking ramp. The showroom and service areas will be at the front (north side) of the building. The parking ramp will be at the rear (south) side of the building. The new building will have overall dimensions of approximately 255 feet by 295 feet. The finished floor elevation of the new building has not been established at this time; however, we anticipate it will be very close to that of the existing Toyota dealership building to the west. The floor of the existing building has an elevation of 829.0 feet.

The new Toyota dealership building and parking ramp will be constructed using primarily cast-in-place concrete, including post-tensioned concrete elevated slabs and beams. Other portions may utilize some structural steel and reinforced masonry. Based on the information provided, we estimate the column loads will range from about 1,600 to 2,000 kips. Bearing wall loads are expected to be about 10 to 12 kips per linear foot.

Our foundation design assumptions include a minimum factor of safety of three with respect to localized shear or base failure of the foundations. We assume the structures can tolerate total settlements of up to 1-inch, and differential settlements of up to ½-inch over 30 feet.

Existing bituminous pavements will remain around the new building. After opening the new building, the existing structure will be demolished and that area will become a parking lot. The majority of the pavements will be used by automobiles and light trucks with axle loads less than 4 tons. Some areas will be designated for heavier truck traffic, primarily for car carriers delivering new vehicles to the dealership. The heavy-duty pavement areas will experience axle loads up to 10 tons.

The information stated represents our current understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

The subsurface exploration program consisted of seven (7) SPT's, performed from May 11 to 28, 2015. The logs of these borings and details of the methods used appear in Appendix A. The SPT logs contain information concerning soil layering, soil classification, geologic description, and moisture condition. Relative density or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

The approximate locations of the SPT borings are shown on Figure 1. The locations were selected by Phillips Architects & Contractors, and were located in the field by AET personnel by measuring from the existing Toyota dealership building. The surface elevations at the boring locations were measured by the AET drill crew using an engineer's level and rod. The elevations were referenced to the floor slab of the existing building at a doorway near the southeast corner of the building. The elevation of the building floor slab is 829.0 feet.

4.2 Laboratory Testing of Soils

During laboratory classification logging, numerous water content tests were conducted on cohesive soil samples. The test results appear in the WC column on the individual boring logs, opposite the samples on which they were performed.

5.0 SITE CONDITIONS

5.1 Surface Conditions

The proposed Toyota dealership building will be located east of the existing Walser Toyota building, which occupies the western portion of the site. The existing building is a one-story brick structure which also has large glass windows in the northern part of the structure. This existing building is supported by driven piles, consisting of 12¾-inch diameter pipes with 0.250-inch wall thickness. The piles supporting the building were driven to working load capacities of 45 tons for support of the floor slabs and 70 tons for support of the foundations. The 70-ton piles were driven to tip elevations of about 740 to 750 feet, and the 45-ton piles were driven to tip elevations of about 760 to 770 feet.

The remaining portions of the site, outside of the existing building, are covered by bituminous pavements. The site terrain generally slopes downward from the north to the south and southeast. The surface elevations at our recent boring locations range from 825.0 feet at Boring SB-5 up to 827.4 feet at Boring SB-7. From this, it appears that approximately 1½ to 4 feet of grade increase will be needed to establish the anticipated new building floor elevation of 829.0 feet.

5.2 Subsurface Soils/Geology

The site geology consists of surficial fill overlying organic swamp deposits, water-deposited alluvial soils, and glacially-deposited till soils. None of the borings encountered bedrock; but terminated in very dense sands and gravel.

5.2.1 Fill

Bituminous exists at the surface of each boring. The bituminous is typically about 4 to 4¼ inches thick, except at Boring SB-1, where it is 6 inches thick. Below the bituminous, fill exists at each boring location, ranging in depth from about 6½ to 31½ feet at the boring locations. The fill soils are deepest in the northern part of the future building and shallowest at the southeast corner of the proposed building.

The fill consists of a mixture of soil types, including silty sands, clayey sands, sands, sandy lean clays, and gravel. At some boring locations, the fill also contains miscellaneous debris and rubble which includes pieces of brick, bituminous, concrete, and wood. The N-values recorded in the fill are highly variable, often depending on the presence of debris and rubble. We judge the fill to have variable strength and compressibility. Generally, the fill soils are judged to have variable drainage and frost heave potential.

5.2.2 Swamp Deposits

The swamp deposits consist of organic clays, sapric peat, hemic peat, and silty sands or clayey sands with organic fines. The N-values recorded in the swamp deposits are slightly higher than normally found in soils like these, which indicates they have undergone some compression and settlement over the years due to the weight of the overlying fill. Even with this "precompression" we judge the organic soils and peat to have low strength and high compressibility, especially if site grades are raised. The swamp deposits are slow draining and are judged to be susceptible to freeze-thaw movements.

5.2.3 Alluvial Soils

The alluvial soils include coarse alluvial sands, silty sands, and gravels; mixed alluvial clayey sands; and fine alluvial lean clays and fat clays. These soils exist below the swamp deposits at some of the boring locations, and below glacial till soils at the other boring locations. The coarse alluvial sands and silty sands contain variable amounts of gravel, but can also contain cobbles and boulders. Based on the N-values the coarse alluvial sands and silty sands are judged to have moderately low to very high strength and moderate to low compressibility. The higher strength alluvial sands are most often present below about 50 feet. The sands and gravels are judged to be fast draining and have low susceptibility to freeze-thaw movements. The silty sands are judged to be moderately fast draining and have moderately low susceptibility to freeze-thaw movements.

The fine alluvial clays range in consistency from firm to very stiff. These clays are judged to have low to moderate strength and moderately low to moderately high compressibility. These soils are generally slow draining and susceptible to freeze-thaw movements when exposed to freezing temperatures.

The mixed alluvial clayey sands are interbedded between swamp deposit layers at Boring SB-2. These soils range in consistency from stiff to firm and are judged to have moderate strength and moderate compressibility. The clayey sands are slow draining, but are at a depth where they should not be affected by freezing temperatures.

5.2.4 Glacial Till

The glacial till deposit consists of clayey sands and silty sands. The till soils also contain variable amounts of gravel and may contain cobbles and boulders. The N-values indicate the clayey sands range in consistency from firm to hard, and the silty sands are medium dense to very dense. We judge the clayey sand till soils to have moderate to high strength and moderate to low compressibility. The silty sand till soils are judged to have high strength and low compressibility.

5.3 Ground Water

Water levels were measured in all of the boreholes during our drilling activities. The water levels were taken prior to the introduction of drilling mud, after which we cannot obtain water level readings. The results of our water level readings are presented in Table 5.3 below:

TABLE 5.3 – ESTIMATED WATER LEVEL DEPTHS AND ELEVATIONS

Boring No.	Ground Surface Elevation	Estimated Ground Water Level (ft.)	Estimated Ground Water Elevation
SB-1	825.8	12	814
SB-2	826.7	7	819½
SB-3	825.6	26½*	799*
SB-4	826.5	9	817½
SB-5	825.0	11½	813½
SB-6	826.2	9½	816½
SB-7	827.4	29*	798½*

* – *Water level expected to be higher, based on appearance of samples.*

As shown in Table 5.3, the ground water levels appear to vary significantly, between elevations 798½ feet up to 819½ feet. Most of the water level readings were obtained in slow draining clayey and silty soils; therefore, it may take several hours or even days for water levels to stabilize in an open borehole. Long-term monitoring of water levels using piezometers is needed to obtain accurate ground water readings in clayey and silty soils. This long-term monitoring was beyond our scope of services.

At Boring SB-5, the ground water level was measured in free-draining sands at a depth of about 11½ feet or at elevation 813½ feet. Water levels recorded in free-draining soils typically provide a more reliable indication of the actual steady-state ground water level.

Fluctuations of water levels can also be expected on a seasonal basis associated with precipitation patterns and amounts.

6.0 GEOTECHNICAL ANALYSIS

6.1 Soil Compressibility/Future Settlements

The borings encountered significant depths of fill, organic swamp deposits, and softer clays. These soils should not be used to support the propose building foundations and floor slabs. The loads exerted by the building foundations will cause significant amounts of settlement and possible shear failure if normal spread footings are used. Rather, deeper foundations should be considered for support of the building and parking ramp to provide the high capacity needed for the building loads and to limit structural settlements to tolerable levels.

It appears that final grades around the new building will likely be higher than the existing grades, on the order of about 1½ to 4 feet. The additional weight of the new fill needed to raise grades will initiate consolidation of the compressible swamp deposits and soft alluvial clays. This consolidation will cause long-term settlements which could affect the performance of building stoops, sidewalks, pavements, and underground utilities. Where grade increases will be 2 feet or less, the potential long-term settlements should not be significant. Post-construction settlements can be reduced if final grades are established as soon as possible during the construction process – although this may not keep settlements at tolerable levels where significant grade increases are needed.

6.2 Pile Foundation Analysis

Because of the compressible nature of the variable strength fill, swamp deposits, topsoil, and alluvial clays, it is our opinion that the proposed Toyota dealership building and parking ramp should be supported on a deep foundation system. These compressible soils are not recommended for support of the building foundations or floor slab. Although the existing building foundations are supported by piles driven to a working load capacity of 70 tons per pile, higher capacity piles will be needed to support the significantly higher structural loads from the new building.

We have considered the use of 9⅝-inch outside diameter (O.D.) steel pipe piles and 12¾-inch outside diameter steel pipe piles for building support. These piles, depending on the wall thickness of the pipes, can be driven to a working load capacity of 120 tons per pile. Smaller diameter piles (7 or 7⅝ inches) were also considered; however, these piles will be driven to greater depths and are limited to a capacity of about 100 tons per pile. To achieve the aforementioned capacities, the piles should be driven through the fill, swamp deposits, and weaker alluvial or till soils to denser sands and silty sands or hard clayey sands.

7.0 PRELIMINARY RECOMMENDATIONS

7.1 Pile Foundation Support

The new Walser Toyota dealership building and parking ramp foundations and floor slabs should be supported on driven piles. To achieve the highest capacity, the piles should be driven into the dense or very dense alluvial sands and silty sands, the dense or very dense glacial till silty sands, or the hard glacial till clayey sands. To obtain the higher capacities needed for supporting the heavy structural loads, we recommend using 9⅝-inch or 12¾-inch O.D. steel pipe piles. These piles which can be driven to total working load capacities of up to 120 tons per pile if they have wall thicknesses of at least 0.395 inches for the 9⅝-inch pipes or 0.250 inches for the 12¾-inch diameter pipes. Smaller 7-inch diameter or 7⅝-inch diameter pipe piles are not being considered. Table 7.1.1 below presents our estimates of pile tip elevations at the boring locations using these pile types:

TABLE 7.1 – ESTIMATED PILE CAPACITIES AND TIP ELEVATIONS

Boring No.	Ground Surface Elevation	Estimated Pile Tip Elevations	
		9⅝-inch Dia. Pipe Piles (120 ton Capacity)*	**12¾-inch Dia. Pipe Piles (120 ton Capacity)***
SB-3	825.6	710 - 720	715 – 725
SB-4	826.5	725 - 730	745 – 755
SB-5	825.0	725 - 730	740 – 750
SB-6	826.2	720 - 725	730 – 735
SB-7	827.4	700 - 710	715 – 725

**Assumes a factor of safety of 2.0 with respect to the ultimate geotechnical capacity*

Because these piles will rely on a combination of side friction and end bearing, the full capacities may not be demonstrated during the initial drive. A delay after the initial drive may be needed to allow "pile set-up" to occur in the coarse alluvium or glacial till soils in order to demonstrate the full capacity. This is usually done following a wait ("set-up") period of at least a day and is verified with PDA monitoring during a restrike.

It is anticipated that some grade increases, estimated to be about 1½ to 4 feet, will be needed to establish final building grades. This additional weight of new fill will cause compression of the underlying organic soils and cause down-drag or negative loads to act on the piles. This negative load must be accounted for, and will reduce the capacity of the piles available for structural support. In the northern half of the proposed building, we recommend reserving at least 25 tons per pile to counteract down-drag loads on the 9⅝-inch O.D. piles and reserving at least 35 tons per pile to counteract down-drag loads on the 12¾-inch O.D. steel pipe piles. In the southern half of the proposed building, we recommend reserving at least 15 tons per pile to counteract down-drag loads on the 9⅝-inch O.D. piles and reserving at least 25 tons per pile to counteract down-drag loads on the 12¾-inch O.D. steel pipe piles. These negative loads must be subtracted from the working load capacities provided in Table 7.1 above, to obtain the actual capacity available for support of the structural loads.

To achieve the capacities shown in Table 7.1, the steel pipe piles should have minimum yield strength (f_y) of at least 45 ksi. The 9⅝-inch O.D. piles should have a minimum wall thickness of at least 0.395 inches. The 12¾-inch O.D. piles should have minimum wall thicknesses of at least 0.250. The piles should be driven with a minimum center-to-center spacing of three (3) times the pile diameter.

All pipe piles should be driven with a flat steel plate welded to the pile tip (closed end). The plate should have a minimum thickness of 0.75 inches and a diameter no greater than the outside diameter of the pipe.

After driving, the pipe piles should be inspected for damage to verify their structural integrity before being filled with concrete. The pipe piles should be filled with concrete after driving to provide additional capacity and lateral strength. We recommend the concrete pile fill have a minimum 28-day compressive strength of 3,000 psi.

If the contractor proposes to use piles types other than those recommended, they should provide you with the capacities and estimated depths for the proposed pile types for review by an AET Geotechnical Engineer.

We recommend at least four (4) test piles be driven and evaluated in the field using high strain dynamic (PDA) testing according to ASTM: D4945 at the start of pile driving. This data will be used to establish a depth and driving criteria to provide proper capacity for remaining piles.

We understand no portions of the building will be constructed below-grade, other than service pits in the garage area. If the unbalanced load conditions on the service pits are substantial, it may be necessary to use battered piles to resist the lateral loads from the wall backfill.

We estimate that total and differential settlements of the piles when using the recommended capacities should not exceed ½ inch. The pile cap foundations within heated building spaces can be placed at shallow depths below the lowest level floor slab. If the parking ramp will not be heated, we recommend the bottoms of the pile caps be placed at least 5 feet below the floor slab. Similarly, exterior pile caps that will be in unheated conditions should be placed at least 5 feet below final ground surfaces for frost protection.

Boulders and cobbles may exist within the driven depths of the piles. Although the amount of oversized particles does not appear to be significant enough to justify the need for pre-boring, the possibility does exist that pile penetration may occasionally be obstructed. In this case, additional pile and foundation review may be needed.

Even with precautions taken during driving, it is normal to have a certain percentage of the piles become damaged or driven out-of-plumb. The percentages of piles that need to be replaced on a project typically varies between 2% to 4%. At sites where there is a higher likelihood of obstructions, this percentage could be higher. The percentage of replacement piles may be reduced if thicker-walled pipe sections are used; however, the cost of the thicker-wall piles may not outweigh the cost of the occasional replacement pile.

To achieve the pile capacities presented in Table 7.1, we estimate that the piles would need to be driven with a hammer which has a manufacturer's rated energy of 30,000 to 60,000 foot-pounds. The actual hammer and pile combination should be carefully selected by the piling contractor to avoid over-stressing the piles and causing damage. The contractor should perform a pre-construction wave equation analysis to assess the suitability of their proposed hammer and pile combination to achieve the required capacities without damage.

7.2 Construction Impacts on Existing Building and Surrounding Property

Protection of the existing building (if it will remain open during construction) and nearby surrounding properties must be considered. Pile driving will generate vibrations; therefore, we recommend conducting pre-construction condition surveys of the nearby structures. Vibration monitoring is also recommended to evaluate the potential for structural distress. The structures to be monitored will depend on the proximity to the site and the sensitivity of the occupants.

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7.3 Floor Slab Design

7.3.1 Driven Pile Option

To eliminate the potential for on-grade floor slab settlement, we recommend the floor slabs be structurally supported by driven piles, pile caps, and grade beams.

7.3.2 Moisture/Vapor Protection

For recommendations pertaining to moisture and vapor protection of interior floor slabs, we refer you to the standard sheet entitled "Floor Slab Moisture/Vapor Protection" at the end of this report. Typically, the use of moisture and vapor protection of interior slabs is recommended if moisture sensitive floor coverings will be placed over the on-grade slab. The lowest floor slab of the parking ramp should not require a moisture-vapor membrane.

7.4 Exterior Building Backfilling

Most of the near-surface on-site soils that will not be excavated from the exterior perimeter of the building are considered to be at least moderately susceptible to freeze-thaw movements, especially if they are wet. Because of this, certain design considerations are needed to mitigate their frost effects. For details, we refer you to the sheet entitled "Freezing Weather Effects on Building Construction" at the end of this report.

Fill that is placed below sidewalks, stoops, and exterior slabs should be compacted to a minimum of 95% of the Standard Proctor maximum dry density. Fill placed in landscaped areas should be compacted to a minimum of 90% of the Standard Proctor maximum dry density.

Site grade increases of about 2 feet or more may cause compression of the swamp deposits, causing post-construction settlements. The amounts of settlement will vary depending on the thickness of the compressible soil layers and the thickness of the new fill needed. In addition to general ground subsidence around the perimeter of the building, settlement of the exterior slabs and stoops will occur if they are not structurally supported. Abrupt settlements at stoops and sidewalks will cause potential trip hazards. Slabs that extend outward from the building should be structurally supported to avoid binding issues at doorways and trip hazards at other pedestrian areas. These slabs could be "hinged" to allow for some settlement at the outer edges of the slab. We are available to discuss possible "hinged" slabs and transitioning of the slabs from the building to the on-grade slabs.

To reduce long-term settlements around the new building, we recommend that final site grades be established as quickly as the construction schedule will allow – thus providing as much time as possible for the settlements to dissipate. A normal construction schedule; however, probably will not allow enough time for all settlements to occur and post-construction settlements should be anticipated.

7.5 Underground Utilities

We anticipate the new utilities will enter the site and the new building from the north where the fill and swamp deposits are thickest. In these areas, the potential for long-term utility settlement is greatest because of the thickness of the compressible soils and the increases in final site grades. Depending on their tolerance to settlement, it may be necessary to support the utilities on piles to avoid significant amounts of settlement. Below the proposed building, we recommend the utilities be structurally supported, which is typically done by "hanging" them from the bottom of the structural slab. Where the utilities enter the building, flexible connections are recommended to avoid abrupt movements which will cause differential movement at the building wall and could fracture the pipes.

The compacted inorganic fill soils present in existing and future pavement areas should support the underground utilities. If unstable, weak, or organic soils exist at pipe invert elevations, we recommend that they be subcut 6 to 12 inches to allow the placement of a bedding layer that is compacted below and around the pipes. The bedding layer soils should be compacted to at least 95% of the Standard Proctor maximum dry density. If organic soils are present in the bottoms of the excavations, this bedding layer should be enveloped by geotextile fabric.

7.6 Pavements

7.6.1 Existing Pavements

We expect the existing pavements will be saved in as much of the site as possible. Areas of severe distress or cracking may require localized patching or repair.

7.6.2 Grading for New Pavements

We understand the existing structure will be demolished and removed after the new building is operational. The area occupied by the existing building will then be converted to on-grade parking. To prepare pavement subgrades in this area, we recommend removal of all building elements (slabs, walls, pile caps, and grade beams) to a depth of at least 3 feet below subgrade elevation. Where underground utilities will be installed, the existing building elements may have to be removed to greater depth to accommodate utility installation.

The exposed subgrade should then be test rolled with a loaded tandem-axle dump truck to evaluate its stability prior to placing any additional fill or aggregate base materials. Subgrade areas which are judged to be too unstable or weak should be reworked; consisting of removing weak and unstable soils and replacing them, or scarifying the weak and unstable soils to dry them prior to compacting them back into place.

Subgrade elevations can be established by placing fill where needed. We recommend the fill consist of inorganic sands or silty sands having no more than 20% of the material finer than the #200 sieve. The fill should be free of debris and rubble. Frozen soils should not be used as fill.

Fill that is needed to establish subgrade elevations should be placed and compacted in general accordance with the requirements of MnDOT Specification 2105.3F1 (Specified Density Method). This specification states that soils placed in the upper 3 feet of the subgrade be compacted to a minimum of 100% of the Standard Proctor maximum dry density (ASTM: D698), at water contents between 65% and 102% of their respective optimum water contents. A reduced minimum compaction level of 95% can be used for fill placed below the upper 3 feet.

Read the standard data sheet "Bituminous Pavement Subgrade Preparation and Design" for general information on pavement stability and design.

7.6.3 Subgrade Stability and Test Roll

Pavement subgrade stability should be evaluated prior to placement of the aggregate base material. The test roll procedure should be conducted by having a loaded, tandem-axle dump truck make repeated passes over all pavement subgrade soils. The test roll will help to delineate any unstable soils that will not be acceptable in the upper pavement subgrade. These unstable soils should be removed and replaced; or aerated, dried and recompacted back into place as recommended by AET geotechnical personnel. After the subgrade soils pass a test roll procedure, the aggregate base can be placed and compacted.

7.6.4 Section Thicknesses

We are presenting pavement designs based on two potential traffic situations (light and heavy duty) in Table 6.8.3 below. The light duty design refers to parking areas which are intended only for automobiles and passenger trucks/vans. The heavy duty design is intended for drive lanes and pavements which will experience the heavier truck traffic (up to 10-ton design load). Assuming the pavement subgrade governing condition will be stable silty sands and clayey sands, we recommend using an R-value of 30 for pavement design.

Table 6.8.3 - Pavement Thickness Designs

	Section Thickness – Assumes R-value = 30	
Material	**Light Duty**	**Heavy Duty**
Bituminous (2 layers)	4 inches (2 lifts)	4½ inches (2 lifts)
Class 5, 6, or 7 Aggregate Base	6 inches	8 inches

7.6.5 Pavement Maintenance

Even if placed and compacted properly on stable subgrade conditions, bituminous pavements will still experience cracking in 1 to 3 years, primarily due to temperature-related expansion and shrinkage. We recommend that a regularly scheduled maintenance program consisting of patching of cracks and local distressed areas be implemented. Seal coating of the pavement surface after 3 to 5 years often helps prolong the pavement life.

8.0 CONSTRUCTION CONSIDERATIONS

8.1 Excavation Backsloping

Where excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce side-slope erosion or running which could require slope maintenance. The responsibility for excavation face maintenance in accordance with OSHA requirements should lie with the contractor, and we recommend the construction documents be prepared as such.

8.2 Observations and Testing

The recommendations in this report are based on the subsurface conditions found at the boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observations by AET geotechnical personnel during construction to evaluate these potential changes.

At the start of the pile driving, we recommend driving at least four (4) test piles which are monitored using a Pile Driving Analyzer (PDA). These test piles can then be used to assist in establishing the driving criteria for the production pile.

During pile installation, AET geotechnical personnel should perform observations on a continuous, full-time basis during driving of all foundation piles. These observations should include keeping records of pile lengths and final driving resistance, verifying that the piles have been driven to the established driving criteria, and evaluating for pile damage by "shining" the insides of the pipe piles before concrete fill is placed.

Sieve analysis tests should be performed on engineered fill in order to document that materials used meet the intended gradation specifications. Soil density and Proctor testing should be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

9.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, either express or implied, is intended.

Important information regarding risk management and proper use of this report is given in Appendix B entitled "Geotechnical Report Limitations and Guidelines for Use."

FLOOR SLAB MOISTURE/VAPOR PROTECTION

Floor slab design relative to moisture/vapor protection should consider the type and location of two elements, a granular layer and a vapor membrane (vapor retarder, water resistant barrier or vapor barrier). In the following sections, the pros and cons of the possible options regarding these elements will be presented, such that you and your specifier can make an engineering decision based on the benefits and costs of the choices.

GRANULAR LAYER

In American Concrete Institute (ACI) 302.1R-04, a "base material" is recommended over the vapor membrane, rather than the conventional clean "sand cushion" material. The base layer should be a minimum of 4 inches (100 mm) thick, trimmable, compactable, granular fill (not sand), a so-called crusher-run material. Usually graded from 1½ inches to 2 inches (38 to 50 mm) down to rock dust is suitable. Following compaction, the surface can be choked off with a fine-grade material. We refer you to ACI 302.1R-04 for additional details regarding the requirements for the base material.

In cases where potential static water levels or significant perched water sources appear near or above the floor slab, an under floor drainage system may be needed wherein a draintile system is placed within a thicker clean sand or gravel layer. Such a system should be properly engineered depending on subgrade soil types and rate/head of water inflow.

VAPOR MEMBRANE

The need for a vapor membrane depends on whether the floor slab will have a vapor sensitive covering, will have vapor sensitive items stored on the slab, or if the space above the slab will be a humidity controlled area. If the project does not have this vapor sensitivity or moisture control need, placement of a vapor membrane may not be necessary. Your decision will then relate to whether to use the ACI base material or a conventional sand cushion layer. However, if any of the above sensitivity issues apply, placement of a vapor membrane is recommended. Some floor covering systems (adhesives and flooring materials) require installation of a vapor membrane to limit the slab moisture content as a condition of their warranty.

VAPOR MEMBRANE/GRANULAR LAYER PLACEMENT

A number of issues should be considered when deciding whether to place the vapor membrane above or below the granular layer. The benefits of placing the slab on a granular layer, with the vapor membrane placed **below** the granular layer, include **reduction** of the following:

- Slab curling during the curing and drying process.
- Time of bleeding, which allows for quicker finishing.
- Vapor membrane puncturing.
- Surface blistering or delamination caused by an extended bleeding period.
- Cracking caused by plastic or drying shrinkage.

The benefits of placing the vapor membrane over the granular layer include the following:

- A lower moisture emission rate is achieved faster.
- Eliminates a potential water reservoir within the granular layer above the membrane.
- Provides a "slip surface", thereby reducing slab restraint and the associated random cracking.

If a membrane is to be used in conjunction with a granular layer, the approach recommended depends on slab usage and the construction schedule. The vapor membrane should be placed above the granular layer when:

- Vapor sensitive floor covering systems are used or vapor sensitive items will be directly placed on the slab.
- The area will be humidity controlled, but the slab will be placed before the building is enclosed and sealed from rain.
- Required by a floor covering manufacturer's system warranty.

The vapor membrane should be placed below the granular layer when:

- Used in humidity controlled areas (without vapor sensitive coverings/stored items), with the roof membrane in place, and the building enclosed to the point where precipitation will not intrude into the slab area. Consideration should be given to slight sloping of the membrane to edges where draintile or other disposal methods can alleviate potential water sources, such as pipe or roof leaks, foundation wall damp proofing failure, fire sprinkler system activation, etc.

There may be cases where membrane placement may have a detrimental effect on the subgrade support system (e.g., expansive soils). In these cases, your decision will need to weigh the cost of subgrade options and the performance risks.

FREEZING WEATHER EFFECTS ON BUILDING CONSTRUCTION

GENERAL

Because water expands upon freezing and soils contain water, soils which are allowed to freeze will heave and lose density. Upon thawing, these soils will not regain their original strength and density. The extent of heave and density/strength loss depends on the soil type and moisture condition. Heave is greater in soils with higher percentages of fines (silts/clays). High silt content soils are most susceptible, due to their high capillary rise potential which can create ice lenses. Fine grained soils generally heave about 1/4" to 3/8" for each foot of frost penetration. This can translate to 1" to 2" of total frost heave. This total amount can be significantly greater if ice lensing occurs.

DESIGN CONSIDERATIONS

Clayey and silty soils can be used as perimeter backfill, although the effect of their poor drainage and frost properties should be considered. Basement areas will have special drainage and lateral load requirements which are not discussed here. Frost heave may be critical in doorway areas. Stoops or sidewalks adjacent to doorways could be designed as structural slabs supported on frost footings with void spaces below. With this design, movements may then occur between the structural slab and the adjacent on-grade slabs. Non-frost susceptible sands (with less than 5% passing a #200 sieve) can be used below such areas. Depending on the function of surrounding areas, the sand layer may need a thickness transition away from the area where movement is critical. With sand placement over slower draining soils, subsurface drainage would be needed for the sand layer. High density extruded insulation could be used within the sand to reduce frost penetration, thereby reducing the sand thickness needed. We caution that insulation placed near the surface can increase the potential for ice glazing of the surface.

The possible effects of adfreezing should be considered if clayey or silty soils are used as backfill. Adfreezing occurs when backfill adheres to rough surfaced foundation walls and lifts the wall as it freezes and heaves. This occurrence is most common with masonry block walls, unheated or poorly heated building situations and clay backfill. The potential is also increased where backfill soils are poorly compacted and become saturated. The risk of adfreezing can be decreased by placing a low friction separating layer between the wall and backfill.

Adfreezing can occur on exterior piers (such as deck, fence, or other similar pier footings), even if a smooth surface is provided. This is more likely in poor drainage situations where soils become saturated. Additional footing embedment and/or widened footings below the frost zones (which include tensile reinforcement) can be used to resist uplift forces. Specific designs would require individual analysis.

CONSTRUCTION CONSIDERATIONS

Foundations, slabs and other improvements which may be affected by frost movements should be insulated from frost penetration during freezing weather. If filling takes place during freezing weather, all frozen soils, snow and ice should be stripped from areas to be filled prior to new fill placement. The new fill should not be allowed to freeze during transit, placement or compaction. This should be considered in the project scheduling, budgeting and quantity estimating. It is usually beneficial to perform cold weather earthwork operations in small areas where grade can be attained quickly rather than working larger areas where a greater amount of frost stripping may be needed. If slab subgrade areas freeze, we recommend the subgrade be thawed prior to floor slab placement. The frost action may also require reworking and recompaction of the thawed subgrade.

BITUMINOUS PAVEMENT SUBGRADE PREPARATION AND DESIGN

GENERAL

Bituminous pavements are considered layered "flexible" systems. Dynamic wheel loads transmit high local stresses through the bituminous/base onto the subgrade. Because of this, the upper portion of the subgrade requires high strength/stability to reduce deflection and fatigue of the bituminous/base system. The wheel load intensity dissipates through the subgrade such that the high level of soil stability is usually not needed below about 2 feet to 4 feet (depending on the anticipated traffic and underlying soil conditions). This is the primary reason for specifying a higher level of compaction within the upper subgrade zone versus the lower portion. Moderate compaction is usually desired below the upper critical zone, primarily to avoid settlements/sags of the roadway. However, if the soils present below the upper 3 feet subgrade zone are unstable, attempts to properly compact the upper 3 feet zone to the 100% level may be difficult or not possible. Therefore, control of moisture just below the 3 feet level may be needed to provide a non-yielding base upon which to compact the upper subgrade soils.

Long-term pavement performance is dependent on the soil subgrade drainage and frost characteristics. Poor to moderate draining soils tend to be susceptible to frost heave and subsequent weakening upon thaw. This condition can result in irregular frost movements and "pop-outs," as well as an accelerated softening of the subgrade. Frost problems become more pronounced when the subgrade is layered with soils of varying permeability. In this situation, the free-draining soils provide a pathway and reservoir for water infiltration which exaggerates the movements. The placement of a well-drained sand subbase layer as the top of subgrade can minimize trapped water, smooth frost movements and significantly reduce subgrade softening. In wet, layered and/or poor drainage situations, the long-term performance gain should be significant. If a sand subbase is placed, we recommend it be a "Select Granular Borrow" which meets Mn/DOT Specification 3149.2B2.

PREPARATION

Subgrade preparation should include stripping surficial vegetation and organic soils; where the exposed soils are within the upper "critical" subgrade zone (generally 2 feet deep for "auto only" areas and 3 feet deep for "heavy duty" areas), they should be evaluated for stability. Excavation equipment may make such areas obvious due to deflection and rutting patterns. Final evaluation of soils within the critical subgrade zone should be done by test rolling with heavy rubber-tired construction equipment, such as a loaded dump truck. Soils which rut or deflect 1" or more under the test roll should be corrected by either subcutting or replacement; or by scarification, drying, and recompaction. Reworked soils and new fill should be compacted per the "Specified Density Method" outlined in Mn/DOT Specification 2105.3F1 (a minimum of 100% of Standard Proctor density in the upper 3 feet subgrade zone, and a minimum of 95% below this).

Subgrade preparation scheduling can be an important consideration. Fall and Spring seasons usually have unfavorable weather for soil drying. Stabilizing non-sand subgrades during these seasons may be difficult, and attempts often result in compromising the pavement quality. Where construction scheduling requires subgrade preparation during these times, the use of a sand subbase becomes even more beneficial for constructability reasons.

SUBGRADE DRAINAGE

If a sand subbase layer is used, it should be provided with a means of subsurface drainage to prevent water build-up. This can be in the form of draintile lines which dispose into storm sewer systems, or outlets into ditches. Where sand subbase layers include sufficient sloping and water can migrate to lower areas, draintile lines can be limited to finger drains at the catch basins. Even if a sand layer is not placed, strategically placed draintile lines can aid in improving pavement performance. This would be most important in areas where adjacent non-paved areas slope towards the pavement. Perimeter edge drains can aid in intercepting water which may infiltrate below the pavement.

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Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations
Subsurface Boring Logs

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Appendix A
Geotechnical Field Exploration and Testing
Report No. 01-06521

A.1 FIELD EXPLORATION

The subsurface conditions at the Interchange site were explored by drilling seven (7) standard penetration test borings. The test locations appear on Figure 1, preceding the Subsurface Boring Logs in this appendix.

A.2 SOIL BORING SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM:D1586 with one primary modification. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

Most newer drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30 inches. The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method is significantly better than the standard ASTM Method.

A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

A.3 SOIL BORING CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification System (USCS). The USCS is described in ASTM:D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM:D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USCS, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

A.4 SOIL BORING WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests

Conducted in general accordance with ASTM:D2216.

A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.7 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
AR:	Sample of material obtained from cuttings blown out the top of the borehole during air rotary procedure.
B, H, N:	Size of flush-joint casing
CAS:	Pipe casing, number indicates nominal diameter in inches
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
DP:	Direct push drilling; a 2.125 inch OD outer casing with an inner 1½ inch ID plastic tube is driven continuously into the ground.
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RDA:	Rotary drilling with compressed air and roller or drag bit.
RDF:	Rotary drilling with drilling fluid and roller or drag bit
REC:	In split-spoon (see notes), direct push and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
SS:	Standard split-spoon sampler (steel; 1.5" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
▼:	Water level directly measured in boring
▽:	Estimated water level based solely on sample appearance

TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field; L - Laboratory
PL:	Plastic Limit, %
q_p:	Pocket Penetrometer strength, tsf (approximate)
q_c:	Static cone bearing pressure, tsf
q_u:	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent (aggregate length of core pieces 4" or more in length as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remolded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

STANDARD PENETRATION TEST NOTES
(Calibrated Hammer Weight)

The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide N_{60} values) and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	Cu≥4 and 1≤Cc≤3[E]	GW	Well graded gravel[F]
			Cu<4 and/or 1>Cc>3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	Cu≥6 and 1≤Cc≤3[E]	SW	Well-graded sand[I]
			Cu<6 and 1>Cc>3[E]	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	PI>7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI<4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OL	Organic clay[K,L,M,N] Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OH	Organic clay[K,L,M,P] Organic silt[K,L,M,Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]

Notes

[A] Based on the material passing the 3-in (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[E] $Cu = D_{60} / D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot is hatched area, soils is a CL-ML silty clay.

[K] If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.

[L] If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.

[M] If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

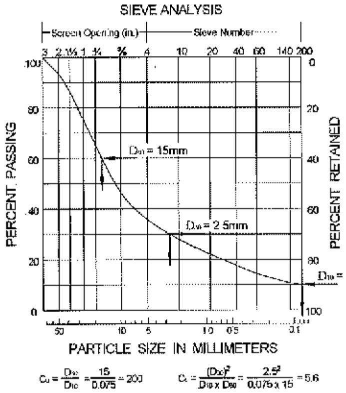
[N] PI≥4 and plots on or above "A" line.

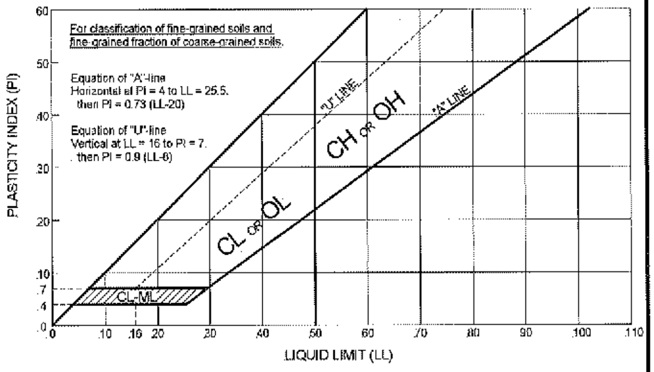
[O] PI<4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.

[R] Fiber Content description shown below.





Plasticity Chart

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition
(MC Column)

D (Dry):	Absense of moisture, dusty, dry to touch.
M (Moist):	Damp, although free water not visible. Soil may still have a high water content (over "optimum").
W (Wet/ Waterbearing):	Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.
F (Frozen):	Soil frozen

Layering Notes

Laminations:	Layers less than ½" thick of differing material or color.
Lenses:	Pockets or layers greater than ½" thick of differing material or color.

Fiber Content of Peat

Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic/Roots Description (if no lab tests)

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the soil properties. *Slightly organic* used for borderline cases.

With roots:	Judged to have sufficient quantity of roots to influence the soil properties.
Trace roots:	Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.

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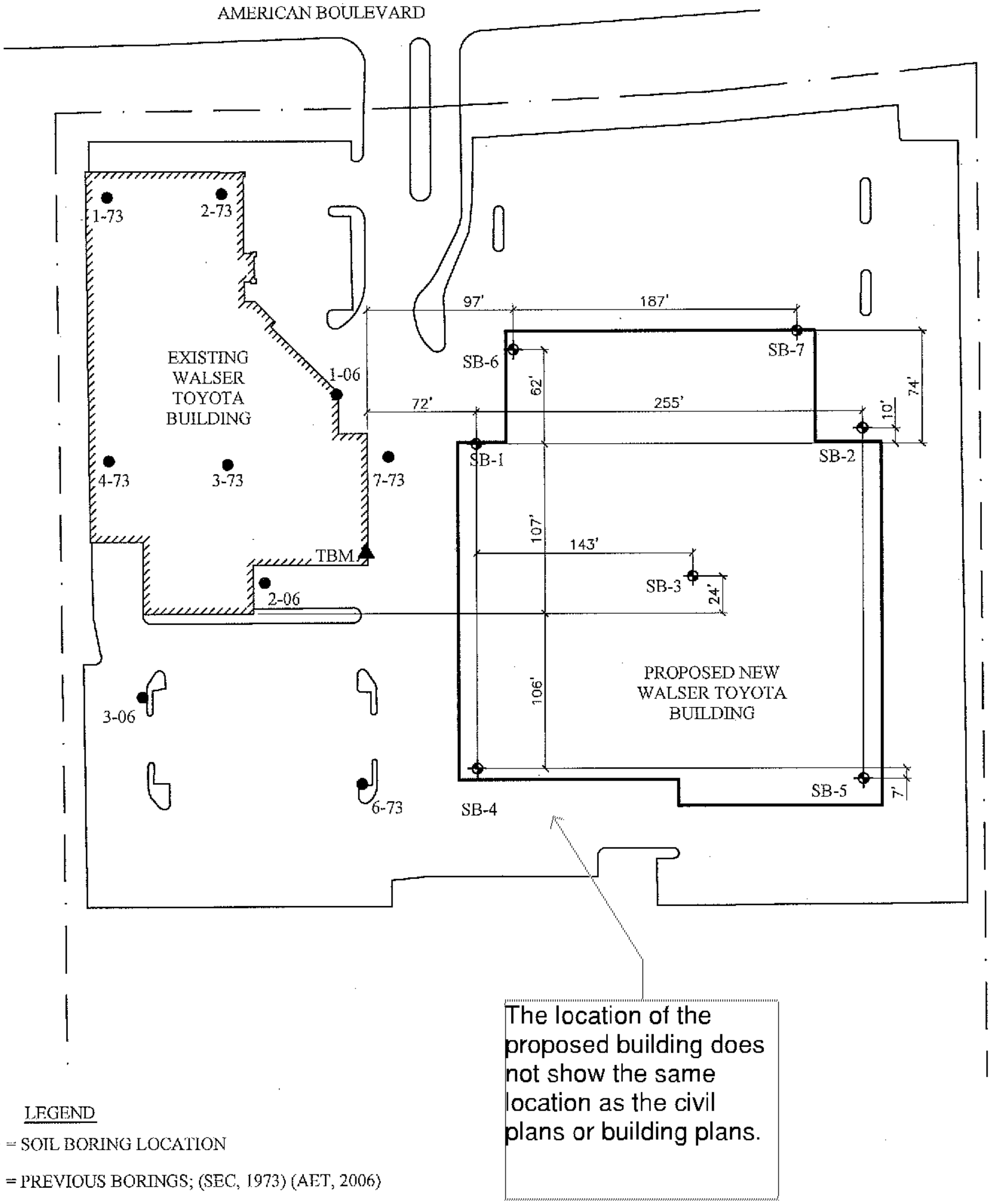

The location of the proposed building does not show the same location as the civil plans or building plans.

LEGEND

⌖ = SOIL BORING LOCATION

● = PREVIOUS BORINGS; (SEC, 1973) (AET, 2006)

▲ = TBM; FINISHED FLOOR OF EXISTING BUILDING; ELEVATION = 829.0'

AMERICAN ENGINEERING TESTING, INC.

N

APPROXIMATE SCALE

0 FEET 100'

PROJECT New Walser Bloomington Toyota
4401 American Boulevard West
Bloomington, Minnesota

AET NO. 01-06521

SUBJECT Boring Locations

DATE June 2015

DRAWN BY VJL

CHECKED BY MPM

FIGURE 1

SUBSURFACE BORING LOG

AET No: **01-06521**

Log of Boring No. **SB-1 (p. 1 of 2)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

Surface Elevation **825.8**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
	6" Bituminous pavement	FILL			SU						
1 2	FILL, mostly sand with silt, a little gravel, pieces of bituminous and concrete, grayish brown (aggregate base)		55	M	SS	12					
3 4	FILL, mostly sand with silt, a little gravel, silty sand and clayey sand, pieces of brick, grayish brown, a little dark brown		24	M	SS	14					
5 6	FILL, mostly silty sand, a little gravel and sand with silt, grayish brown, a little gray		35	M	SS	14					
7 8 9	FILL, mostly silty sand, a little gravel and clayey sand, brown		30	M	SS	18					
10 11	FILL, mostly clayey sand, a little gravel, pieces of wood and bituminous, trace roots, grayish brown		19	M	SS	12	11				
12 13 14	FILL, mostly silty sand, a little gravel, sand and clayey sand, trace roots, brownish gray, dark brown and black		18	▼ W	SS	16					
15 16			8	W	SS	8	16				
17 18	FILL, mostly pieces of concrete *N-value = 60/.5 + 8/.5 + 5/.5		*	W	SS	4					
19 20 21	FILL, mostly silty sand, a little gravel, pieces of bituminous, trace roots, gray, a little brownish gray		60/.5	W	SS	3					
22 23	FILL, mostly clayey sand, a little gravel and silty sand, pieces of bituminous, trace roots, dark brown and black **N-value = 10/.5 + 50/.5		**	W	SS	12					
24	FILL, mostly pieces of concrete										
25 26	FILL, mostly silty sand, pieces of wood, a little concrete, light brown and gray		11	W	SS	2					
27 28	FILL, mostly clayey sand, a little gravel, dark brown		6	W	SS	12	19				
29 30	HEMIC PEAT, dark brown (PT)	SWAMP DEPOSIT	8	W	SS	16	228				
31	SAPRIC PEAT, trace shells, dark brown (PT)										

DEPTH:	DRILLING METHOD
0-44½'	**3.25" HSA**
44½-59½'	**RD w/DM**

BORING COMPLETED: **5/13/15**

DR: **GH** LG: **JMM** Rig: **85C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
5/13/15	**12:00**	**18.5**	**17.0**	**18.0**		**12.1**
5/13/15	**1:05**	**41.0**	**39.5**	**35.4**		**17.7**
5/13/15	**1:20**	**41.0**	**39.5**	**34.5**		**13.1**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

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SUBSURFACE BORING LOG

AET No: **01-06521**
Log of Boring No. **SB-1 (p. 2 of 2)**
Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
33	SAPRIC PEAT, trace shells, dark brown (PT) *(continued)*	SWAMP DEPOSIT *(continued)*	8	W	SS	18	190				
34	ORGANIC CLAY, trace shells, trace roots, dark grayish brown, stiff, lenses and laminations of sapric peat (OH)										
35			11	M/W	SS	18	143				
36											
37	SAND, a little gravel, fine to medium grained, gray, waterbearing, medium dense (SP)	COARSE ALLUVIUM									
38	SAND WITH GRAVEL, medium grained, gray, waterbearing, medium dense (SP)		18	W	SS	16					
39											
40			18	W	SS	18					
41											
42											
43	SAND WITH GRAVEL, coarse to medium grained, gray, waterbearing, medium dense (SP)										
44											
45			25	W	SS	18					
46											
47											
48	SAND, a little gravel, fine to medium grained, gray, waterbearing, medium dense to dense to medium dense (SP)										
49											
50			20	W	SS	12					
51											
52											
53											
54											
55			31	W	SS	12					
56											
57											
58											
59											
60			20	W	SS	1					
61	**END OF BORING**										

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SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-2 (p. 1 of 2)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

Surface Elevation **826.7**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
	4" Bituminous pavement	FILL			SU						
1	FILL, mostly silty sand, a little gravel and clayey sand, brown		20	M	SS	16					
2											
3			19		SS	0					
4	FILL, mostly sand, a little gravel, brown										
5			12	M/W	SS	12					
6				▼							
7	FILL, mostly silty sand, a little gravel and clayey sand, brown										
8			9	W	SS	12					
9											
10			33	W	SS	16					
11											
12											
13			12	W	SS	12					
14	FILL, mostly clayey sand, a little gravel, silty sand and lean clay, trace roots, dark brown, a little gray and brown										
15			6	M/W	SS	12	15				
16											
17											
18	ORGANIC CLAY, pieces of wood, trace shells, trace roots, dark brown, a little gray and brown, firm to soft, lenses and laminations of clayey sand (OH)	SWAMP DEPOSIT	6	M/W	SS	12	38				
19											
20			6	W	SS	12	72				
21											
22											
23			4	W	SS	18	99				
24	CLAYEY SAND, a little gravel, brown and gray mottled to brown, stiff to firm, lenses and laminations of wet silty sand and silt (SC)	MIXED ALLUVIUM									
25			13	M/W	SS	18	16				
26											
27											
28			8	M/W	SS	16	16				
29	ORGANIC CLAY, pieces of wood, trace roots, dark brown, a little gray, soft, lenses and laminations of sapric peat (OH)	SWAMP DEPOSIT									
30			4	W	SS	18	86				
31											

DEPTH:	DRILLING METHOD
0-39½'	**3.25" HSA**
39½-59½'	**RD w/DM**

BORING COMPLETED: **5/11/15**

DR: **GH** LG: **JMM** Rig: **85C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
5/11/15	**9:05**	**8.5**	**7.0**	**8.1**		**7.7**
5/11/15	**9:15**	**8.5**	**7.0**	**8.1**		**6.9**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 01-06521.GPJ AET+CPT+WELL.GDT 7/1/15

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SUBSURFACE BORING LOG

AET No: **01-06521**   Log of Boring No. **SB-2 (p. 2 of 2)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
33	ORGANIC CLAY, trace shells, trace roots, grayish brown, soft (OH)	SWAMP DEPOSIT *(continued)*	4	W	SS	16	111				
34	ORGANIC CLAY, trace shells, dark gray, soft (OH)		9	W	SS	18	51				
35	SILTY SAND WITH ORGANIC FINES, a little gravel, trace roots, fine to medium grained, black, wet, loose (SM)										
37	CLAYEY SAND, a little gravel, grayish brown, stiff (SC)	TILL	10	M	SS	12	12				
40			11	M	SS	18	12				
43	SILTY SAND, a little gravel, grayish brown, medium dense to dense (SM)										
45			22	M	SS	18					
50			30	M	SS	16					
55			32	M	SS	8					
60			50	M	SS	12					
61	**END OF BORING**										

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PL2020-55 **SUBSURFACE BORING LOG**

AET No: **01-06521**   Log of Boring No. **SB-3 (p. 1 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

Surface Elevation **825.6**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
	4.25" Bituminous pavement	FILL			SU						
1	FILL, mostly silty sand, a little gravel, pieces of bituminous and brick, trace roots, dark brown (aggregate base)		24	M	SS	18					
2											
3	FILL, mostly silty sand, a little gravel and clayey sand, brown		18	M	SS	12					
4	FILL, mostly clayey sand, a little gravel, silty sand and sand, trace roots, brownish gray, gray and brown										
5			18	M	SS	12	28				
6											
7											
8			20	M	SS	12	14				
9											
10			12	M	SS	12	15				
11											
12											
13			5	M	SS	18	17				
14	HEMIC PEAT, dark brown (PT)	SWAMP DEPOSIT									
15			3	W	SS	18	271				
16	SAPRIC PEAT, trace shells, dark brown (PT)										
17											
18			3	W	SS	18	239				
19											
20			3	W	SS	18	204				
21											
22	ORGANIC CLAY, trace roots and shells, dark brown, soft, lenses and laminations of sapric peat (OH)										
23			3	W	SS	16	117				
24	CLAYEY SAND, a little gravel, gray, firm, lenses of waterbearing sand and silty sand (SC)	TILL									
25			5	M/W	SS	12	14				
26				▼							
27											
28			6	M/W	SS	18	14				
29											
30			7	M/W	SS	18	10				
31											

DEPTH:	DRILLING METHOD
0-29½'	**3.25" HSA**
29½-129½'	**RD w/DM**

BORING COMPLETED: **5/21/15**

DR: **GH** LG: **JMM** Rig: **85C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
5/18/15	**10:55**	**28.5**	**27.0**	**27.7**		**27.4**
5/18/15	**11:15**	**28.5**	**27.0**	**27.7**		**26.4**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 01-06521.GPJ AET+CPT+WELL.GDT 7/1/15

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SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-3 (p. 2 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
33	CLAYEY SAND, a little gravel, gray, firm, lenses of waterbearing sand and silty sand (SC) *(continued)*	TILL *(continued)*									
34	CLAYEY SAND, a little gravel, brown, stiff to very stiff (SC)										
35			14	M/W	SS	16	13				
36											
37											
38											
39											
40			16	M/W	SS	12	12				
41											
42											
43											
44	CLAYEY SAND, a little gravel, brownish gray, hard, lenses and laminations of waterbearing sand (SC)										
45			42	M/W	SS	12	11				
46											
47											
48											
49											
50			50	M/W	SS	12	9				
51											
52											
53	CLAYEY SAND, a little gravel, brown to grayish brown, very stiff (SC)										
54											
55			30	M	SS	10	12				
56											
57											
58											
59											
60			30	M	SS	12	11				
61											
62											
63											
64											
65			30	M	SS	12	10				
66											
67											
68											
69											

AET_CORP 01-06521.GPJ AET+CPT+WELL.GDT 7/1/15

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SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-3 (p. 3 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
	CLAYEY SAND, a little gravel, brown to grayish brown, very stiff (SC) *(continued)*	TILL *(continued)*	22	M	SS	12	12				
71											
72											
73											
74											
75			28	M	SS	8	12				
76											
77											
78	CLAYEY SAND, a little gravel, possible cobbles from about 82' to 87', grayish brown, hard to very stiff, laminations of waterbearing sand (SC)										
79											
80			37	M/W	SS	12	11				
81											
82											
83											
84											
85			60	M/W	SS	6	13				
86											
87											
88											
89											
90			22	M/W	SS	14	13				
91											
92											
93											
94											
95			29	M/W	SS	16	13				
96											
97											
98	SAND, a little gravel, fine to medium grained, gray, waterbearing, dense (SP)	COARSE ALLUVIUM									
99											
100			38	W	SS	3					
101											
102											
103											
104											
105			34	W	SS	6					
106											
107											

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SUBSURFACE BORING LOG

AET No: **01-06521**

Log of Boring No. **SB-3 (p. 4 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
108	SILTY SAND, fine grained, gray, waterbearing, very dense, lenses and laminations of sand (SM)	COARSE ALLUVIUM *(continued)*									
109											
110			73	W	SS	12					
111											
112											
113											
114											
115			81	W	SS	0					
116											
117											
118	SAND, a little gravel, fine to medium grained, gray, waterbearing, very dense (SP)										
119											
120			65	W	SS	12					
121											
122											
123											
124											
125			67	W	SS	14					
126	SAND WITH GRAVEL, medium to fine grained, gray, waterbearing, very dense (SP)										
127											
128											
129											
	END OF BORING - OBSTRUCTED ON COBBLES OR BOULDER										

AMERICAN ENGINEERING TESTING, INC.

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SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-4 (p. 1 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	Surface Elevation 826.5 MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	4.25" Bituminous pavement	FILL			SU						
1	FILL, mostly silty sand, a little gravel, pieces of concrete and bituminous, dark brown (aggregate base)		10	M	SS	16					
2											
3	FILL, mixture of silty sand and clayey sand, a little gravel, gray and grayish brown, a little brown		16	M	SS	18	13				
4											
5	FILL, mostly silty sand, a little gravel, pieces of bituminous, grayish brown		14	M	SS	18					
6											
7	FILL, mixture of clayey sand and silty sand, a little gravel, dark brown and brown										
8			20	M	SS	18	15				
9				▼							
10			15	M/W	SS	18					
11											
12	FILL, mostly silty sand with organic fines, a little gravel, pieces of concrete and wood, black and dark brown										
13			8	W	SS	18					
14	SAPRIC PEAT, dark brown (PT)	SWAMP DEPOSIT									
15			6	M/W	SS	6	233				
16											
17	CLAYEY SAND, with organic fines, a little gravel, pieces of wood, trace roots, dark brown, firm (SC)										
18			5	M/W	SS	16	35				
19	LEAN CLAY, trace roots, brownish gray, firm (CL)	FINE ALLUVIUM									
20			5	M/W	SS	14	33				
21											
22	SILTY SAND, a little gravel, fine to medium grained, brown, waterbearing, medium dense, a lens of clayey sand (SM)	COARSE ALLUVIUM									
23			16	W	SS	10					
24	SAND WITH SILT, a little gravel, fine to medium grained, gray, waterbearing, medium dense, lenses and laminations of clayey sand (SP-SM)										
25			11	W	SS	12					
26											
27											
28	GRAVELLY SAND, fine to medium grained, gray, waterbearing, loose to medium dense (SP)										
29											
30			9	W	SS	0					
31											

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-34½'	3.25" HSA							
34½-124½'	RD w/DM	5/14/15	11:00	13.5	12.0	12.2		9.2
		5/14/15	11:10	13.5	12.0	12.2		9.2
BORING COMPLETED:	5/16/15	5/14/15	11:50	31.0	29.5	26.9		18.3
DR: DS LG: GH	Rig: 85C							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

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SUBSURFACE BORING LOG

AET No: **01-06521**   Log of Boring No. **SB-4 (p. 2 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
33	GRAVELLY SAND, fine to medium grained, gray, waterbearing, loose to medium dense (SP) *(continued)*	COARSE ALLUVIUM *(continued)*									
34											
35			11	W	SS	6					
36											
37											
38	SAND, a little gravel, fine to medium grained, brownish gray, waterbearing, medium dense to dense to medium dense (SP)										
39											
40			18	W	SS	0					
41											
42											
43											
44											
45			21	W	SS	16					
46											
47											
48											
49											
50			24	W	SS	12					
51											
52											
53											
54											
55			32	W	SS	14					
56											
57											
58											
59											
60			30	W	SS	18					
61											
62											
63	CLAYEY SAND, a little gravel, gray, hard (SC)	TILL									
64											
65			50	M	SS	18	15				
66											
67											
68	SILTY SAND, a little gravel, grayish brown, very dense, lenses of clayey sand (SM)										
69											

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SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-4 (p. 3 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#20
	SILTY SAND, a little gravel, grayish brown, very dense, lenses of clayey sand (SM) *(continued)*	TILL *(continued)*	70	M	SS	18					
71											
72											
73	CLAYEY SAND, a little gravel, brownish gray, hard (SC)										
74											
75			67	M	SS	18	16				
76											
77											
78	SILTY SAND, a little gravel, apparent cobbles from about 83.5' to 84.5' and from about 85' to 100', brown, very dense (SM)										
79											
80			60	M	SS	12					
81											
82											
83											
84											
85			51	M	SS	14					
86											
87											
88											
89											
90			60	M	SS	18					
91											
92											
93											
94											
95			80	M	SS	12					
96											
97											
98											
99											
100			85	M	SS	16					
101											
102											
103	CLAYEY SAND, a little gravel, brown, hard (SC)										
104											
105			45	M	SS	18	11				
106											
107											

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SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-4 (p. 4 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#20
108	CLAYEY SAND, a little gravel, brown, hard (SC) *(continued)*	TILL *(continued)*									
109											
110			55	M	SS	18	12				
111											
112											
113											
114											
115			65	M	SS	18	12				
116											
117											
118	SAND, a little gravel, fine to medium grained, gray, waterbearing, very dense (SP)	COARSE ALLUVIUM									
119											
120			110	W	SS	16					
121											
122											
123	SAND WITH GRAVEL, fine to medium grained, gray, waterbearing, very dense (SP)										
124											
125			100	W	SS	12					
126	**END OF BORING**										

AMERICAN ENGINEERING TESTING, INC.

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PL2020-55 **SUBSURFACE BORING LOG**

AET No: **01-06521** Log of Boring No. **SB-5 (p. 1 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

Surface Elevation **825.0**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	4" Bituminous pavement	FILL			SU						
1	FILL, mixture of clayey sand and silty sand, a little gravel, brown		24	M	SS	16	9				
2											
3	FILL, mostly silty sand, a little gravel, pieces of bituminous, dark brown and black		36	M	SS	12					
4											
5	FILL, mostly clayey sand, a little gravel and silty sand, trace roots, dark brown, a little dark gray		11	M	SS	12	27				
6											
7	HEMIC PEAT, dark brown (PT)	SWAMP DEPOSIT									
8			9	W	SS	16	287				
9	SAND WITH SILT, a little gravel, fine to medium grained, brown, moist to about 11½' then waterbearing, loose, lenses and laminations of clayey sand (SP-SM)	COARSE ALLUVIUM									
10			8	M/W	SS	8					
11				▼							
12	SAND WITH SILT AND GRAVEL, fine to medium grained, brown, waterbearing, loose to medium dense, laminations of clayey sand (SP-SM)										
13			8	W	SS	10					
14											
15			17	W	SS	8					
16											
17	SAND WITH SILT, a little gravel, fine to medium grained, dark brown, waterbearing, very loose (SP-SM)										
18			3	W	SS	2					
19											
20			4	W	SS	3					
21											
22	SAND WITH SILT AND GRAVEL, fine to medium grained, grayish brown, waterbearing, medium dense (SP-SM)										
23			20	W	SS	10					
24	SAND, a little gravel, fine to medium grained, brownish gray, waterbearing, loose to medium dense (SP)										
25			10	W	SS	6					
26											
27											
28			5	W	SS	12					
29											
30			6	W	SS	12					
31											

DEPTH:	DRILLING METHOD
0-59½'	**3.25" HSA**
59½-129½'	**RD w/DM**

BORING COMPLETED: **5/13/15**

DR: **GH** LG: **JMM** Rig: **85C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
5/11/15	**2:00**	**13.5**	**12.5**	**13.0**		**12.5**
5/11/15	**2:10**	**13.5**	**12.5**	**13.0**		**11.3**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 01-06521.GPJ AET+CPT+WELL.GDT 7/1/15

SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-5 (p. 2 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
33	SAND, a little gravel, fine to medium grained, brownish gray, waterbearing, loose to medium dense (SP) *(continued)*	COARSE ALLUVIUM *(continued)*	12	W	SS	16					
34											
35			16	W	SS	16					
36											
37											
38											
39											
40			20	W	SS	12					
41											
42											
43											
44											
45			12	W	SS	18					
46											
47											
48											
49											
50			12	W	SS	18					
51											
52											
53	SAND WITH SILT, fine grained, gray, waterbearing, dense, lenses and laminations of silt (SP-SM)										
54											
55			40	W	SS	18					
56											
57											
58	SILTY SAND, a little gravel, fine to medium grained, gray, a little dark brown, waterbearing, dense, lenses and laminations of silt (SM)										
59											
60			42	W	SS	18					
61											
62											
63	SAND, a little gravel, fine to medium grained, brownish gray, waterbearing, medium dense to dense (SP)										
64											
65			22	W	SS	12					
66											
67											
68											
69											

SUBSURFACE BORING LOG

AET No: **01-06521**

Log of Boring No. **SB-5 (p. 3 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#20
70–71	SAND, a little gravel, fine to medium grained, brownish gray, waterbearing, medium dense to dense (SP) *(continued)*	COARSE ALLUVIUM *(continued)*	20	W	SS	12					
75			27	W	SS	4					
80			40	W	SS	1					
81	CLAYEY SAND, a little gravel, grayish brown, hard (SC)	TILL									
85			45	M	SS	6	11				
90			40	M	SS	18	10				
95			52	M	SS	16	10				
100			60	M	SS	18	13				
103	SAND WITH SILT, fine grained, brown, waterbearing, very dense (SP-SM)	COARSE ALLUVIUM									
105			55	W	SS	16					

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SUBSURFACE BORING LOG

AET No: **01-06521**　　Log of Boring No. **SB-5 (p. 4 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
108	SAND, a little gravel, fine to medium grained, gray, waterbearing, very dense (SP) *(continued)*	COARSE ALLUVIUM *(continued)*									
109											
110			100	W	SS	18					
111											
112											
113											
114											
115			120	W	SS	18					
116											
117											
118											
119											
120			100	W	SS	12					
121											
122											
123											
124											
125			150	W	SS	18					
126											
127											
128											
129											
130			80	W	SS	8					
131	**END OF BORING**										

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SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-6 (p. 1 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	Surface Elevation **826.2** MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
	4" Bituminous	FILL			SU						
1	FILL, mostly silty sand, a little gravel, pieces of bituminous, dark grayish brown		50	M	SS	16					
2	FILL, mostly silty sand with gravel, a little clayey sand, grayish brown										
3			37	M	SS	12					
4											
5	FILL, mostly silty sand, a little gravel, grayish brown, brown and dark brown, a little gray		24	M	SS	16					
6											
7	FILL, mostly clayey sand, a little gravel and silty sand, pieces of concrete, trace roots, dark brown, a little brown										
8			80	M	SS	18					
9				▼							
10			WH	M	SS	3	14				
11											
12	FILL, mostly clayey sand with organic fines, a little gravel, trace shells, trace roots, pieces of concrete and wood, black, a little dark brown										
13			5	W	SS	12	35				
14											
15			17	W	SS	3	29				
16											
17	*N-value = 2/.5 + 5/.5 + 60/.5										
18	FILL, mostly pieces of concrete and wood, gray and brown		*	W	SS	10	24				
19											
20			18	W	SS	10					
21											
22	FILL, mostly silty sand, a little gravel, pieces of wood and concrete, brownish gray, a little brown										
23			60	W	SS	10					
24	SAPRIC PEAT, trace shells and roots, dark brown (PT)	SWAMP DEPOSIT									
25			6	W	SS	12	211				
26											
27											
28			7	W	SS	0					
29											
30			7	W	SS	12	177				
31											

DEPTH:	DRILLING METHOD
0-79½'	**3.25" HSA**
79½-129½'	**RD w/DM**

BORING COMPLETED: **5/28/15**

DR: **GH** LG: **JMM** Rig: **85C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
5/26/15	**12:35**	**11.0**	**9.5**	**11.0**		**9.7**
5/26/15	**12:45**	**11.0**	**9.5**	**11.0**		**9.7**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

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SUBSURFACE BORING LOG

AET No: **01-06521**

Log of Boring No. **SB-6 (p. 2 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#20
33	SAPRIC PEAT, trace shells and roots, dark brown (PT) *(continued)*	SWAMP DEPOSIT *(continued)*	7	W	SS	18	200				
34	FAT CLAY, pieces of wood, gray, a little dark brown, firm, lenses and laminations of sapric peat and organic clay (CH)	FINE ALLUVIUM	7	M/W	SS	16	41				
			5	M/W	SS	12	58				
39	SILTY SAND, a little gravel, fine to medium grained, gray, waterbearing, loose (SM)	COARSE ALLUVIUM	7	W	SS	16					
			9	W	SS	12					
48	SAND WITH GRAVEL, fine to medium grained, gray, waterbearing, medium dense (SP)		11	W	SS	10					
			13	W	SS	4					
58	SAND WITH GRAVEL, medium to fine grained, gray, waterbearing, dense (SP)		33	W	SS	12					
62	SAND, a little gravel, fine to medium grained, brownish gray, waterbearing, medium dense (SP)		20	W	SS	12					
68	SAND WITH GRAVEL, fine to medium grained, gray, waterbearing, medium dense (SP)										

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SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-6 (p. 3 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	SAND WITH GRAVEL, fine to medium grained, gray, waterbearing, medium dense (SP) *(continued)*	COARSE ALLUVIUM *(continued)*	23	W	SS	6					
71											
72											
73	SAND, a little gravel, fine to medium grained, gray, waterbearing, dense (SP)										
74											
75			45	W	SS	12					
76											
77											
78											
79											
80			37	W	SS	18					
81											
82											
83											
84											
85			42	W	SS	16					
86											
87											
88	CLAYEY SAND, a little gravel, gray to grayish brown, hard (SC)	TILL									
89											
90			40	M	SS	18	13				
91											
92											
93											
94											
95			42	M	SS	18	12				
96											
97											
98											
99											
100			50	M	SS	3	14				
101											
102											
103											
104											
105			95	M	SS	2	15				
106											
107											

SUBSURFACE BORING LOG

AET No: **01-06521**

Log of Boring No. **SB-6 (p. 4 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
108	SILTY SAND, a little gravel, grayish brown, very dense (SM)	TILL *(continued)*									
109											
110			55	M	SS	16					
111											
112											
113	CLAYEY SAND, a little gravel, grayish brown, a little gray, hard, lenses and laminations of silty sand (SC)										
114											
115			38	M	SS	18	12				
116	SILTY SAND, a little gravel, grayish brown, dense to very dense (SM)										
117											
118											
119											
120			50	M	SS	12					
121											
122											
123											
124											
125			80	M	SS	12					
126											
127											
128	SAND, a little gravel, fine to medium grained, gray, waterbearing, medium dense (SP)	COARSE ALLUVIUM									
129											
130			28	W	SS	18					
131	**END OF BORING**										

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SUBSURFACE BORING LOG

AET No: **01-06521**

Log of Boring No. **SB-7 (p. 1 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	Surface Elevation 827.4 MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	4" Bituminous pavement	FILL			SU						
1	FILL, mostly silty sand, a little gravel, pieces of concrete and bituminous, a little clayey sand, trace roots, dark brown		35	M	SS	16					
2											
3	FILL, mostly sand with silt, a little gravel and clayey sand, brown		13	M	SS	12	12				
4											
5	FILL, mostly clayey sand, a little gravel, sand and silty sand, trace roots, brown, a little dark brown		9	M	SS	14	15				
6											
7	FILL, mostly silty sand, a little gravel and sand, grayish brown										
8			28	M	SS	16					
9											
10	FILL, mostly sandy lean clay, a little gravel, clayey sand and sand, dark brown, a little brown		11	M	SS	12	18				
11											
12	FILL, mostly sandy lean clay, a little gravel, silty sand and silt, gray, a little light gray										
13			12	M	SS	8	20				
14											
15	FILL, mostly clayey sand, a little gravel, silty sand and sand, dark gray and brown		9	M	SS	2	15				
16											
17	FILL, mostly clayey sand, a little gravel, trace roots, dark gray										
18			5	M	SS	16	21				
19											
20	FILL, mostly clayey sand, a little gravel, lean clay and silt, dark gray, a little brown		5	M	SS	18	19				
21											
22	FILL, mostly clayey sand, a little gravel, dark brownish gray										
23			5	M	SS	18	14				
24											
25			4	M	SS	16	14				
26											
27											
28			10	M/W	SS	18	14				
29				▼							
30			7	M/W	SS	18	16				
31	FILL, mostly silty sand, a little gravel and clayey sand, dark gray										

DEPTH:	DRILLING METHOD
0-44½'	3.25" HSA
44½-119½'	RD w/DM
BORING COMPLETED:	5/21/15
DR: GH	LG: CD/TM Rig: 85C

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
5/21/15	2:28	31.0	29.5	31.0		29.8
5/21/15	2:37	31.0	29.5	30.4		29.1
5/21/15	3:25	46.0	44.5	45.1		43.2
5/21/15	3:39	46.0	44.5	45.1		42.0

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

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SUBSURFACE BORING LOG

AET No: **01-06521** Log of Boring No. **SB-7 (p. 2 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	SAPRIC PEAT, dark brown (PT) *(continued)*	SWAMP DEPOSIT *(continued)*	13	M/W	SS	18	170 31				
33 34	CLAYEY SAND WITH ORGANIC FINES, a little gravel, trace shells, trace roots, dark gray, a little dark brown, stiff, lenses and laminations of silty sand and sapric peat (SC)		7	M	SS	14	14				
35 36 37 38 39 40 41	CLAYEY SAND, a little gravel, dark brownish gray, firm to stiff, lenses and laminations of silty sand (SC)		11	M	SS	14	21				
			9	M/W	SS	18	14				
42 43	LEAN CLAY, pieces of wood, trace roots, dark gray, a little light gray, stiff, lenses and laminations of silt (CL)	FINE ALLUVIUM	14	M/W	SS	18	82 36				
44	LEAN CLAY, trace roots, gray, very stiff, lenses and laminations of silty clay and silt (CL)		16	M/W	SS	18	30				
45 46 47	SILTY SAND, a little gravel, fine to medium grained, gray, waterbearing, medium dense, lenses and laminations of clayey sand (SM)	COARSE ALLUVIUM									
48 49 50 51 52	SAND WITH SILT, a little gravel, fine to medium grained, gray, waterbearing, medium dense, lenses and laminations of clayey sand (SP-SM)		11	W	SS	6					
53 54 55 56 57	GRAVELLY SAND, medium to fine grained, light gray, waterbearing, medium dense (SP)		15	W	SS	4					
58 59 60 61 62 63 64	SAND WITH GRAVEL, fine grained, light brownish gray, waterbearing, medium dense (SP)		26	W	SS	6					
65 66 67	CLAYEY SAND, a little gravel, gray, hard (SC)	TILL	48	M	SS	12	14				
68 69	SILTY SAND, a little gravel, grayish brown, dense to medium dense to dense (SM)										

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SUBSURFACE BORING LOG

AET No: **01-06521**　　Log of Boring No. **SB-7 (p. 3 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#200
	SILTY SAND, a little gravel, grayish brown, dense to medium dense to dense (SM) *(continued)*	TILL *(continued)*	31	W	SS	14					
71											
72											
73											
74											
75			30	W	SS	16					
76											
77											
78											
79											
80			31	W	SS	16					
81											
82											
83											
84	CLAYEY SAND, a little gravel, grayish brown, very stiff to hard (SC)										
85			23	M/W	SS	16	13				
86											
87											
88											
89											
90			48	M/W	SS	14	11				
91											
92											
93											
94											
95			19	M/W	SS	16	12				
96											
97											
98											
99											
100			33	M/W	SS	14	11				
101											
102											
103	SILTY SAND, a little gravel, grayish brown, dense, lenses of clayey sand, laminations of waterbearing sand and silt (SM)										
104											
105			39	W	SS	14					
106											
107											

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SUBSURFACE BORING LOG

AET No: **01-06521**   Log of Boring No. **SB-7 (p. 4 of 4)**

Project: **New Walser Bloomington Toyota Dealership Building; 4401 American Blvd. W.; Bloomington, MN**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS				
							WC	DEN	LL	PL	%-#20
108	SILTY SAND, a little gravel, grayish brown, dense, lenses of clayey sand, laminations of waterbearing sand and silt (SM) *(continued)*	TILL *(continued)*									
109											
110			51	W	SS	14					
111											
112											
113											
114											
115			53	W	SS	14					
116											
117											
118											
119			73	W	SS	14					
120	**END OF BORING**										

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Appendix B

Geotechnical Report Limitations and Guidelines for Use

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by ASFE[1], of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. And no one, not even you, should apply the report for any purpose or project except the one originally contemplated.

B.2.2 Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

B.2.3 A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typically factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, always inform your geotechnical engineer of project changes, even minor ones, and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

B.2.4 Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

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[1] ASFE, 8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 : www.asfe.org

B.2.5 Most Geotechnical Findings Are Professional Opinions

Site exploration identified subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

B.2.6 A Report's Recommendations Are Not Final

Do not overrely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

B.2.7 A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

B.2.8 Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

B.2.9 Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In the letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need to prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

B.2.10 Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their report. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

B.2.11 Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.