June 11th, 2012

The City of Winnipeg Planning, Property and Development Department
4th Floor - 185 King Street
Winnipeg, Manitoba
R3B 1J1
Attention: Ms. Tracy L. Stople, Project Officer, Municipal Accommodations Division

Dear Madam:

RE: GEOTECHNICAL INVESTIGATION FOR THE PROPOSED 3,500 FT^2, ONE-STOREY NEW COMMUNITY CENTRE WITH PRE-CAST CONCRETE STRUCTURAL ELEMENTS TO BE LOCATED AT 40 MAYFAIR PLACE IN WINNIPEG, MANITOBA

1.0 TERMS OF REFERENCE

On May 28th, 2012, M. Block & Associates Ltd. (MBA) received e-mailed authorization from Ms. Tracy L. Stople, representing The City of Winnipeg, the land owner and project's developer, to proceed with the geotechnical investigation for the proposed 3,500 ft^2, one-storey, new community centre, with pre-cast concrete structural elements, to be located at 40 Mayfair Place in Winnipeg, Manitoba. Therefore, on June 8th, 2012, six test holes in total were bored implementing a truck-mounted Acker MP-8 drill rig, using interconnected 5' long x 5" diameter continuous flight solid stem augers, supplied by Paddock Drilling Ltd. of Winnipeg, Manitoba. Representative "undisturbed" and "disturbed" soil samples were retrieved from the test holes and brought back to MBA's CSA certified materials testing laboratory in Winnipeg for unconfined compression and moisture content testing, respectively, and verification of the field soil classifications. Alternatively, during the field investigation, the fine grained soils' respective 'disturbed' undrained shear strengths were measured implementing a hand-held calibrated Pocket Geotester. Upon the completion of this investigation, the test holes' elevations and the groundwater elevations in them, if any, were measured and referenced to their respective surfaces and also the top of the fire hydrant located near the southwest corner of the subject site, as illustrated on pages 17 - 25 of this report. In addition, the test holes were backfilled with bentonite and the soil cuttings.

2.0 SOIL LITHOLOGY AND GROUNDWATER CONDITIONS

Test holes #1, #2, #3, #5 and #6 were overlain with, approximately, 1', 2'6", 1', 2' and 2'6", respectively, of black/grey, stiff, moist, silty clay fill with and without granular. Black, becoming brown in colour with increasing depth, alluvially deposited, stiff, moist, silty clay was then traversed in test holes #1, #2, #3, #4, #5 and #6 down to the 3'6", 5'6", 2'9", 3'9", 5'6" and 5'6" depths, respectively. Next, brown, alluvially deposited, soft, saturated, sandy silt was observed in, only, test holes #1, #3 and #4 down to the 4'6", 3'9" and 5' depths, respectively. Brown, becoming grey in colour below the 22' depth, glaciolacustrine, stiff to firm, moist, silty clay with silt and gypsum inclusions was then noted in test holes #1, #2 and the shallow probe holes down to the 45', 48' and 10' depths, respectively. Grey, saturated, dense, silty gravelly sand with cobbles and boulders (glacial till) was next recorded in, only, test hole #1 down to the 47' depth. Finally, brown, hard, dry, very dense, practically non-plastic, gravelly sandy silt with cobbles and boulders (glacial till) was encountered in, only, test hole #2, down to the 50'4" depth. As such, upon obtaining auger refusal on suspected fractured limestone bedrock, the deep test holes were discontinued at the aforementioned depths. Alternatively, the shallow probe holes were terminated at the 10' depth. Upon penetrating the possible fractured limestone bedrock's aquifer, groundwater flowed into test holes #1 and #2 at very high inflow rates. In addition, within ten minutes of obtaining auger refusal, the groundwater elevations in test holes #1 and #2 were measured 33' and 23' below their current ground elevations, respectively. Furthermore, it is anticipated that this phreatic surface could rise by an additional 10' during wet spring runoffs and/or heavy rainfall runoff events. As such, that contingency will be incorporated into the project's geotechnical designs presented in this report. During this investigation, groundwater seepage and soil sloughing, emanating from the alluvially deposited, soft, saturated, sandy silt, flowed and sloughed into, only, test holes #1, #3 and #4 at nil to minimal inflow rates. Alternatively, groundwater seepage and soil sloughing, emanating from the saturated, predominantly coarse-grained glacial till matrix, flowed and sloughed into, only, test hole #1 at severe and significant inflow rates, respectively. The soil lithology in the test holes and their specific locations were appended to this report on pages 17 – 25.

3.0 SUMMARY OF FIELD AND LABORATORY TESTS

TH #	DEPTH	UNCONFINED COMPRESSION	BULK UNIT WEIGHT	MOISTURE CONTENT
1	16'	3085 psf	107.96 pcf	53.77 %
1	26'	2227 psf	111.87 pcf	45.54 %
1	36'	1609 psf	107.27 pcf	53.24 %

The unconfined compressive strengths are also located on test hole #1's log sheets.
The soils' measured Pocket Geotester strengths are located on test hole #2's log sheets.
Moisture content vs. Depth graphs are located on the test holes' log sheets.
A summary of the laboratory data is appended to this report on pages 29 - 30.

4.0 FOUNDATION DESIGN ALTERNATIVES

4.1 SHALLOW CONCRETE STRIP FOOTINGS

Based upon the depth of the alluvially deposited, soft, saturated, sandy silt encountered in the test holes, it is the writer's professional opinion that a shallow concrete footing foundation design, potentially constructed on or over the aforementioned potentially deleterious deposition underlying this site, is susceptible to significant and/or differential foundation settlement, and, as such, strongly not recommended as a feasible superstructure support system for the proposed 3,500 ft^2, one-storey, new community centre, with pre-cast concrete structural elements, to be located at 40 Mayfair Place in Winnipeg, Manitoba.

4.2 DEEP CONCRETE FOOTINGS

Predicated upon the well-documented, volumetrically sensitive, glaciolacustrine silty clay deposition in the former Lake Agassiz that has caused significant structural distresses in typical deep below grade footings in similarly constructed structures in the Red River Basin and the upper glaciolacustrine deposition's stiff unconfined compressive strength, its estimated extremely high liquid limit and plasticity index, and "normal" moisture content on this site above the 15' depth, it is the writer's professional opinion that a reinforced concrete deep footing foundation system, constructed on the glaciolacustrine soil above the 15' depth on this site, is still susceptible to significant soil swelling, shrinkage and/or rebound, and, as such, strongly not recommended as a feasible foundation support system for this project.

4.3 DRILLED CAST IN PLACE CONCRETE FRICTION PILES

Alternatively, drilled cast in place concrete friction piles could be implemented as the foundation design for the proposed 3,500 ft^2, one-storey, new community centre, with pre-cast concrete structural elements, to be located at 40 Mayfair Place in Winnipeg, Manitoba. Predicated upon the neutral plane of this pile type modeled near the 6' depth and the risk of basal instability occurring in this foundation type below the 40' depth, the allowable effective functional friction length of glaciolacustrine silty clay at this site, from the present grade of test hole #1, is **40' – 6' = 34'.** The laboratory data indicates that the factored geotechnical resistance, using ultimate limit states where $\Phi = 0.4$, of the soil/concrete interface from the 6' to 40' depths, only, is 381 psf. The concrete, relative to the soil, has an additional net weight of, approximately, 35 pcf in the upper 40' of overburden. Therefore, the additional net weight of the concrete is included in the above analysis. In addition, in order to avoid reducing the piles' net efficiency, they must be spaced at least three pile diameters, on center. Furthermore, in order to resist potential soil swelling and frost jacking uplift stresses, these piles shall have minimum embedment lengths of 26' and 35' in heated and unheated areas of the site, respectively. Finally, full-length reinforcing steel shall also be installed in all the piles implemented in an unheated service condition.

It is recommended that the geotechnical engineer's personnel inspect the installation of this foundation type in order to verify that it conforms to the contents of this report, the structural drawings and project's specifications.

The foundation contractor shall be fully cognizant that the soft, saturated, sandy silt stratum will slough and seep severely into some or many of the piles' excavations only during wet seasons and/or years. Therefore, should that situation likely transpire, steel casing through that entire deposition would then be required. Since soil sloughing during concreting may cause improper foundation performance, special care must be given when removing the steel sleeve not to cause sloughing soil from entering a pile's excavation from in behind it. As such, the foundation contractor should be diligent when removing the steel sleeve not to cause sloughing soil from entering the pile’s excavation from in behind it. In addition, all the piles’ upper 8' of embedment length shall be mechanically vibrated.

The advantages of this piling system are its relatively fast rate of pile installation, frequency of being more economical than other piled foundation designs in this area, efficiency of installation in comparison with spread bore concrete end-bearing piles, the many piling businesses located in the vicinity and minimal magnitude of modeled long-term foundation settlement. The disadvantages of this piling system are the limited functional depth of serviceable silty clay and, as such, frictional pile capacity on this site, the extra cost associated with temporary steel sleeving and pile settlement, if constructed improperly.

4.4 DRILLED SPREAD BORE CONCRETE END-BEARING PILES

Similarly, drilled, cast in place, spread bore concrete end-bearing piles could also be implemented as the foundation design for the proposed 3,500 ft^2, one-storey, new community centre, with pre-cast concrete structural elements, to be located at 40 Mayfair Place in Winnipeg, Manitoba. These piles shall only be mechanically constructed on the stiff glaciolacustrine silty clay 6.10 m below test hole #1’s current elevation, where the factored geotechnical resistance, using ultimate limit states where $\Phi = 0.4$, and the piling installation supervised by qualified geotechnical personnel, would be 110 kPa. In addition, in order to avoid reducing the piles’ net efficiency, they must be spaced at least two-and-a-half bell and three shaft diameters, on center, from each other.

In order to protect these short piles from frost jacking stresses in unheated applications, only, they shall have sono-tube casings installed along their upper 3.0 m of embedment length. Furthermore, the sono-tube shall be wrapped in 6 mil poly and completely greased on its inside. In addition, full-length reinforcing steel shall also be installed in all the piles implemented in an unheated service condition.

The foundation contractor shall be fully cognizant that the soft, saturated, sandy silt stratum will slough and seep severely into some or many of the piles' excavations only during wet seasons and/or years. Therefore, should that situation likely transpire, steel casing through that entire deposition would then be required. Since soil sloughing during concreting may cause improper foundation performance, special care must be given when removing the steel sleeve not to cause sloughing soil from entering a pile's excavation from in behind it. As such, the foundation contractor should be diligent when removing the steel sleeve not to cause sloughing soil from entering the pile's excavation from in behind it. In addition, all the piles' upper 2.4 m of embedment length shall be mechanically vibrated.

The advantages of this piling system are its anticipated relatively short pile embedment length, moderate allowable axial compressive, tensile and frost jacking resistances and minimal magnitude of modeled long-term foundation settlement. The disadvantages of this piling system are its higher cost and longer foundation installation time per pile associated with mechanically constructing the bell and temporary steel sleeving, if any, and the potential for pile settlement, if incorrectly constructed.

4.5 DRIVEN PRE-CAST CONCRETE END BEARING PILES

Finally, driven pre-cast concrete end-bearing piles could also be implemented as the foundation design for the proposed 3,500 ft^2, one-storey, new community centre, with pre-cast concrete structural elements, to be located at 40 Mayfair Place in Winnipeg, Manitoba. All driven pre-cast concrete piles should be pre-drilled at least 2.0 m in depth and also through the depth of frost penetration, if any, prior to being driven down to refusal onto a dense stratum, such as, a hard glacial till matrix, a dense granular stratum or bedrock. The estimated length of properly driven pre-cast concrete piles required at this location would be **in the order of 13.72 m – 15.24 m from the present ground elevation of test hole #1.**

However, the foundation contractor should still verify the estimated length of pre-cast concrete piles required at this site and become fully cognizant with the contents of this report. Following their successful installation, in order to maximize their lateral support and minimize their adhesion and frictional capacity with the underlying volumetrically sensitive glaciolacustrine silty clay, all the piles' oversized pre-bores should then be backfilled with clean sand or another pre-approved equivalent substitute alternative. Furthermore, the geotechnical engineer's personnel should inspect the foundation installation in order to verify the factored geotechnical resistance (FGR), using ultimate limit states (ULS) where Φ = 0.6, based upon the following pile driving criteria:

PILE DIAMETER	DRIVING ENERGY	REFUSAL CRITERIA	ULS FGR
305 mm	30 foot * kips	5 blows / 1" (25 mm)	75 tons
350 mm	30 foot * kips	10 blows / 1" (25 mm)	105 tons
400 mm	30 foot * kips	15 blows / 1" (25 mm)	135 tons

Note: Max 1" (25.4 mm) penetration per set, for 3 consecutive sets

In addition to the aforementioned specifications for driven pre-cast concrete piles, MBA offers the following recommendations:

- Pre-drilling through the zone of frost may be required for winter or early spring construction.
- If a drop hammer is to be used to install these piles, the mass of the hammer shall be 3 times greater than the mass of the pile.
- Pile spacing shall not be less than three pile diameters, on center.
- Piles driven within five pile diameters, on center, shall be monitored for heave and where it is observed; the piles shall be re-driven to the aforementioned refusal criteria.
- Once pile driving is initiated, all piles shall be driven continuously to their respective refusal depth.

The advantages of this piling system are its very heavy allowable axial compressive capacities and minimal magnitude of modeled long-term foundation settlement. The disadvantages of this piling system are its frequently greater cost per foot of pile and the potentially variable depths to practical refusal across this site.

5.0 CONCRETE DESIGN

Due to the visibly high concentration of sulphate in the glaciolacustrine deposition at this site, Sulphate Resisting Cement shall be used in all the concrete implemented for the aforementioned concrete foundation systems. Its concrete shall have a minimum 28-Day laboratory compressive strength of 32 mPa. Furthermore, the concrete shall contain at least 550 pounds of cement per cubic yard, have a maximum water cement ratio, a plastic concrete air content and slump of 0.45, 4 to 6 percent and 60 mm to 100 mm, respectively.

Alternatively, due to the higher elevation of the proposed structure in relation to the elevations of these test holes and the likely low concentration of sulphate in the filled and alluvial depositions traversed across this site, Normal Portland Cement could be used in all the concrete implemented for the structure’s grade beams and floor slabs.

All other concrete exposed to freezing and thawing cycles shall contain an air entraining admixture that corresponds to the applicable class of exposure listed in tables 2-4 of the recent addition of CSA. Concrete poured in cold weather shall be heated and protected in accordance with CSA A23.1-04 clause 21.2.3.

In addition, all concrete poured shall be tested in accordance with CSA A23.1-04 every day and at least once every 50 m^3 per day by a CSA certified concrete testing laboratory.

6.0 PAVEMENT DESIGNS

All the soil depositions located above the pavements' designated working sub-grade elevation, as designated by the project's forthcoming civil engineering consultant, shall be stripped and then transported off of the site. In addition, all the deleterious soil encountered at or below the project's recommended working sub-grade elevation, if any, shall also be excavated and then transported off of the site. Next, prior to placing the proposed pavement structures' granular sub-base and base courses, the in-situ, primarily fine-grained silty clay fill, with a high plasticity index, located at or below the working sub-grade elevation, shall then be proof-rolled using a sheepsfoot roller until it has at least 95 % of its standard proctor density (SPD). Areas failing the aforementioned proof-roll test and any other deleterious material encountered at or below the working sub-grade elevation shall be verified and documented by the geotechnical engineer's personnel. Predicated upon this consultant's recommendations, the project's pavement sub-contractor shall then excavate and replace the documented failed proof-rolled soil and any other deleterious material encountered at or below the working sub-grade elevation with 100 mm or 50 mm down crushed limestone fill or another pre-approved equivalent bridging material placed in sufficient 200 mm deep lifts and compacted until each layer has at least 95 % of its SPD.

Next, any segments of the proposed pavement areas naturally lower than the proposed sub-grade elevation, if any, shall then be brought up to the working sub-grade elevation implementing either a highly plastic silty clay; 100 mm or 50 mm down crushed limestone fill; granular C-Base fill or another pre-approved equivalent bridging material, placed in sufficient 200 mm deep lifts and compacted until each layer has at least 95 % of its SPD.

In order to provide adequate structural support in areas designated for heavy truck traffic and the sidewalk's concrete slab, their sub-bases shall consist of at least two layers of 50 mm down crushed limestone fill, C-Base fill or another pre-approved equivalent material placed in 150 mm deep lifts and compacted until each layer has at least 98 % of its SPD. However, only one lift of granular sub-base is structurally required for the light car traffic's pavement construction. Alternatively, in all traffic areas, the granular base course shall be composed of a 150 mm deep layer of A-Base, compacted until it has at least 100 % of its SPD. Finally, the light car traffic's asphalt pavement shall be laid in two layers with each lift having a minimum thickness of 38 mm. Similarly, areas with heavier truck traffic shall have 2-57 mm lifts of asphalt pavement. Each asphalt pavement area shall be consolidated until it has at least 98 % of its respective laboratory Marshall Density. An elevation drawing of the car and heavy truck traffic's pavement structures is illustrated on page 26 of this report.

The sidewalk's concrete slab shall have a design thickness of 150 mm, overlying its aforementioned granular base's structural support, and an air-entrainment, slump and water cement ratio in accordance with all the relevant CSA standards in A23.1-04.

The asphalt aggregate shall have a crushed count of >60%. The asphalt shall be placed at a temperature of 125°C to 155°C. The ambient temperature may be no less than 6°C when the asphalt is to be laid. The geotechnical engineer's personnel shall test the asphalt of the following aggregate gradation specifications and physical properties.

METRIC SIEVE SIZE (microns)	(% Passing)
16,000	100
10,000	70 – 85
5,000	55 – 70
2,500	40 – 60
1,250	25 – 50
630	15 – 40
315	5 – 20
160	4 – 11
80	3 – 7

Asphalt Cement, % total sample weight	5.0 % - 6.0 %
Voids in Mineral Aggregate	14% minimum
Air Voids	3.0% - 5.0%
Marshall Stability, N at 60° C	7 kN minimum
Flow Index, units of 250 μm	6.0 – 16.0

The pavement's slope and catch basin placement shall be designed by the project's municipal engineering consultant. Currently, the writer has not been provided the proposed municipal site plan indicating proposed cut and fill depths and, as such, it is unknown if the aforementioned soft silt deposition will be near the project's designated sub-grade elevations. However, if the sub-grade elevations are lowered substantially from the test holes' respective current elevations, then additional excavation and granular fill replacement of any soft silt should be included as a cost per unit of volume in the pavement contractors' respective base bids. Finally, the pavement shall be sufficiently sloped at a minimum grading of 2 % for expedient drainage into catch basins or towards the perimeter of the property.

7.0 LATERAL EARTH PRESSURE

Typically, new structures, such as, the one proposed for this site, have all of their below grade walls rigidly designed and constructed. Therefore, the "at-rest" earth pressures (K_o) will apply for all cases on this project. The distribution of the lateral earth pressures are dependent upon the following key factors; backfill type, compaction effort and drainage conditions. As such, the following two equations should be used for the calculation of the lateral earth pressures where sub-drainage is provided and not provided, respectively.

Sub-drainage Provided

$$P_h = K_o \gamma H$$

where:
- P_h = lateral earth pressure at any depth (psf)
- K_o = earth pressure coefficient
- γ = unit weight of the soil (pcf)
- H = height of the wall in (ft.)

Sub-drainage not Provided

$$P_h = K_o \gamma' H + \gamma_w H$$

where:
- P_h = lateral earth pressure at any depth (psf)
- K_o = earth pressure coefficient
- γ' = buoyant unit weight of the soil (pcf)
- γ_w = unit weight of water (pcf)
- H = height of the wall in (ft.)

If the sub-grade located adjacent to the pits is utilized to support a surface concrete slab on grade or any pavement structures, 98% - 100% of its SPD (well compacted) will be required and therefore the following K_o values listed in the table below should be used.

COMPACTION SPEC. & SOIL TYPE	**K_o**	**TOTAL UNIT WEIGHT (pcf)**
98% - 100% of its SPD (Sands & Gravels)	0.43	145
98% - 100% of its SPD (Silty Clays)	0.58	110

When the sub-grade soils compaction is required to be in the range of 90% - 95% of its SPD (moderate compaction) then the following table of K_o values should be implemented.

COMPACTION SPEC. & SOIL TYPE	**K_o**	**TOTAL UNIT WEIGHT (pcf)**
90% - 95% of its SPD (Sands & Gravels)	0.55	135
90% - 95% of its SPD (Silty Clays)	0.71	100

If surcharge loadings (i.e. line loads and point loads) are to be incorporated into this projects design then the figure located on page 27, obtained from the Canadian Engineering Foundation Manual, should be used to determine their associated respective lateral pressures on the rigidly structurally designed member. For a uniformly distributed surcharge load, the lateral earth pressure is simply determined by multiplying the load by the aforementioned applicable K_o factor. In addition, for the soils that require 98% - 100% of their SPD (well compacted), the size and type of compaction equipment used to compact the backfill induces additional lateral earth pressures. Therefore, in order to calculate the lateral earth pressures caused by the compaction equipment, a design chart has been provided on page 28 of this report. In addition, it still may also be necessary to provide temporary bracing of the wall during construction in order to resist those lateral earth pressures associated with the compaction equipment.

Alternatively, if the sub-grades located adjacent to the pits and walls are not required to support surface concrete slab on grade or pavement structures, then the standard triangular earth pressure distribution should be used for design purposes.

8.0 RECOMMENDATIONS

Predicated upon the soils' aforementioned respective strength parameters, lithology and physical properties, the current and modeled groundwater elevations, the field and laboratory test data, and the proposed 3,500 ft^2, one-storey, structure with pre-cast concrete structural elements' anticipated moderate applied foundation stresses, drilled cast in place concrete friction piles, drilled spread bore concrete end-bearing piles or driven pre-cast concrete end-bearing piles could be implemented as the foundation design for the proposed new community centre to be located at 40 Mayfair Place in Winnipeg, Manitoba. Based upon the aforementioned advantages and disadvantages of these foundation systems, a drilled cast in place concrete friction piled foundation design would likely be a well performing, more economical and efficient one for the proposed one-storey, moderately-loaded, community centre project placed on a site with the aforementioned geotechnical design parameters and implemented in a heated service condition. However, the choice of foundation type implemented for this project will ultimately depend upon their respective, previously described, advantages and disadvantages, estimated installation costs and the applied foundation loads that will be calculated by the project's structural engineering consultant.

It is recommended in the strongest of terms that the geotechnical engineer's personnel inspect the installation of all the foundation elements in order to verify that they all conform with the contents of this report, the structural drawings and the project's specifications.

Any areas of the yard naturally lower in elevation, if any, shall be brought up to its future grade implementing a highly plastic silty clay fill, 50 mm down limestone fill, granular C-Base fill or another pre-approved equivalent material, placed in sufficient 200 mm deep lifts and compacted until each layer has at least 95 % of its SPD.

The backfill material around the perimeter of the proposed structure shall be brought up to its future grade implementing either a 20 mm down limestone fill; granular C-Base fill; or another pre-approved equivalent material, placed in sufficient 150 mm deep lifts and compacted until each layer has densities in the range of 92 % to 97 % of its SPD.

The selected 50 mm down and 20 mm down crushed limestone, A-Base and C-Base gravels implemented for this project shall all meet the following gradation specifications:

METRIC SIEVE SIZE (μm)	20 mm Limestone (% Passing)	50 mm Limestone (% Passing)	A-BASE (% Passing)	C-BASE (% Passing)
50,000		100		
25,000			100	100
20,000	100		80 – 100	
5,000	40 – 70	25 – 80	40 – 70	25 – 80
2,500	25 – 60		25 – 55	
315	8 - 25		13 – 30	
80	6 - 17	5 – 18	5 – 15	5 – 18

In order to minimize frost penetration under the building, 50 mm thick rigid horizontal insulation, or another pre-approved equivalent frost protection, shall be placed around the exterior of the entire structure. This insulation shall be placed along the face of the proposed building out to a distance 1200 mm away from it at a depth of 300 mm below future ground elevation and also along the outside faces of the structure's exterior concrete grade beams.

All the various proposed asphalt pavement surfaces shall be constructed as per the recommendations outlined in section 6.0 of this report. Furthermore, the pavement contractor shall also take precautions to prevent the fine-grained sub-grade soil from the following conditions; freezing, excessive soil moisture loss or gain, water ponding and heavily loaded axle traffic. In addition, the granular fill placed for this project shall be free of frost, frozen material and placed at an ambient air temperature of at least 6° Celsius. In order to verify compliance with the aforementioned standard proctor and Marshall Density specifications, field compaction tests shall be taken on every lift of granular material and asphalt placed for this project, respectively. All concrete poured shall be tested in accordance with CSA A23.1-04 every day and at least once every 50 m^3 per day by a CSA Certified concrete testing laboratory.

The proposed structure shall have properly designed and installed weeping tile drainage system connected to sump pit(s) with operational sump pump(s), in accordance with the National Building Code of Canada (NBCC) and the City of Winnipeg Building Code. The building's superstructure and suspended main floor shall be entirely structurally supported by only one of the aforementioned approved foundation systems. In addition, in all the aforementioned feasible piled foundation designs, a void space, of at least 150 mm in thickness, shall be constructed under all pile caps, grade beams and/or walls to allow for the potential expansive capability of the stiff, moist, filled, alluvial and glaciolacustrine silty clay depositions underlying this site. The structurally supported concrete main floor shall overlay either a minimum 300 mm deep vented crawlspace or a minimum 150 mm thick biodegradable void form. The surface of any crawlspace shall be covered by a minimum 100 mm deep layer of clean sand fill overlying a 6 mm thick impervious poly vapour barrier. Lastly, the writer understands that a crawlspace is intended for the proposed structure.

Since underground pits and walls are intended underlying the parts of the proposed structure, their associated lateral earth pressures should be calculated as per section 7.0 of this report. Furthermore, the proposed pits' and walls' excavations and shoring should, at a minimum, comply with all the Manitoba Department's Workplace Health and Safety guidelines for confined underground work and be designed by the project's structural engineering consultant, respectively. Their construction should then proceed as per those standards and the project's sealed drawings and specifications.

If any of the aforementioned design elements are modified or deleted, please contact the undersigned to determine if that course of action will be acceptable.

In addition, MBA respectfully requests an opportunity to review all the relevant finalized structural drawings and the project's foundation and materials testing specifications for this project in order to verify their conformance with the contents of this report.

The test holes drilled during the investigation represent only those specific areas tested. The soil conditions on this site may vary from that described in this report. Should that situation occur, please contact this office for further instructions.

All the geotechnical engineering design recommendations presented in this report are predicated upon the assumption that a sufficient degree of inspection will be provided during the project's construction and that a qualified and experienced foundation contractor properly installs an aforementioned pre-approved, engineered and sealed foundation type.

Any uses which a third party makes of this report, or any reliance on decisions to be made based on it, are the sole responsibility of such third parties. MBA accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based upon this report.

Yours Truly,
M. Block & Associates Ltd.

PROVINCE OF MANITOBA
6/11/12
S. J.
BLOCK
REGISTERED PROFESSIONAL ENGINEER

APEGM
Certificate of Authorization
M. Block & Associates Ltd.
No. 1527 Expiry: April 30, 2013

Jeffrey Block, P. Eng., Senior Geotechnical Engineer

M. Block & Associates Ltd.

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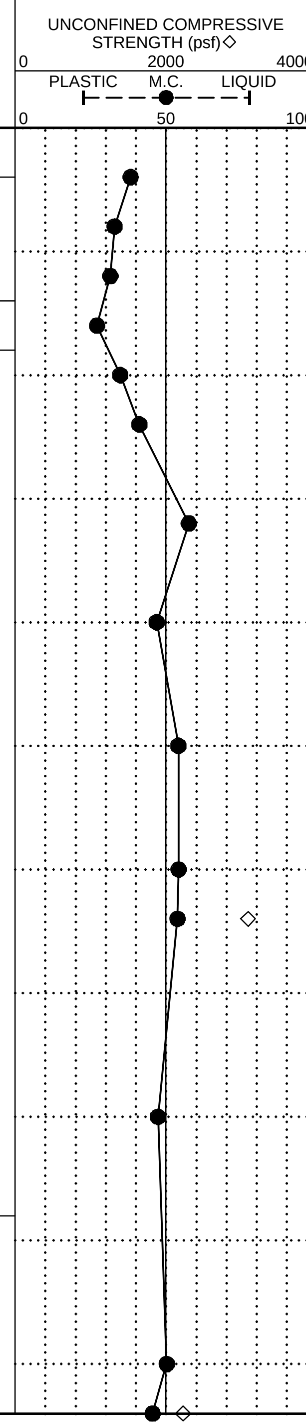
.

TEST HOLE NO.: 1

Sheet 1 of 2

Client:	City of Winnipeg Project Services Branch	Job No.: 2012-1218	Logged By:	Matthew Appleyard	Date: 8/6/12
Project:	New 3,500 sq. ft., one-storey, community centre		Reviewed By:	J. Block, P. Eng.	Time: 12:06 PM
Location:	40 Mayfair Place in Winnipeg, Manitoba	Elevation: 99.24m	Drawing Number:	5588	

Depth, ft	Sample Type	Sample Number	U S C S	Graphic Log	MATERIAL DESCRIPTION
0.0			CH		Black/grey, stiff, moist, silty CLAY FILL
		25			
			CH		Brown, alluvially deposited, stiff, moist, silty CLAY
		26			
2.5		27			
▽		28	ML		Brown, alluvially deposited, soft, saturated, sandy SILT
5.0		29	CH		Brown, glaciolacustrine, stiff, moist, silty CLAY with silt and gypsum inclusions
		30			
7.5		31			
10.0		32			
12.5		33			
15.0		34			
		35			
17.5					
20.0		36			
22.5			CH		Grey, glaciolacustrine, stiff to firm, moist, silty CLAY with silt inclusions
25.0		37			



Continued Next Page

SAMPLE TYPE SYMBOLS

Split Spoon
Shelby Tube
Vane Shear
Auger Cuttings
Grab Sample
Rock Core

Drill Rig:	Acker truck mounted drill rig
Auger:	5" dia. continuous flight augers
Contractor:	Paddock Drilling Ltd.

WATER LEVELS

▽ Phreatic Surface #1:	3.5 ft
▼ Phreatic Surface #2:	33.0 ft

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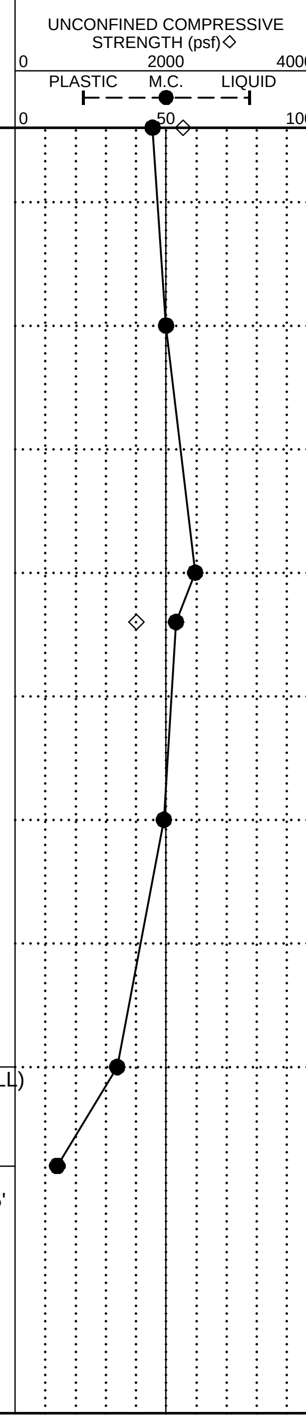
Location:	40 Mayfair Place in Winnipeg, Manitoba	Elevation: 99.24m	Drawing Number:	5588	

Depth, ft	Sample Type	Sample Number	U S C S	Graphic Log	MATERIAL DESCRIPTION
	Shelby Tube	38	CH		Grey, glaciolacustrine, stiff to firm, moist, silty CLAY with silt inclusions *(continued)*
27.5					
30.0		39			
32.5 ▼					
35.0		40			
	Shelby Tube	41			
37.5					
40.0		42			
42.5					
45.0		43	SM		Grey, saturated, dense, silty gravelly SAND with cobbles and boulders (GLACIAL TILL) - Severe soil sloughing and groundwater seepage
		44			47' - Auger refusal on suspected LIMESTONE BEDROCK; - Upon completion, the groundwater & sloughed soil was measured at the 33' and 45' depths, respectively
47.5					
50.0					



SAMPLE TYPE SYMBOLS

- Split Spoon
- Shelby Tube
- Vane Shear
- Auger Cuttings
- Grab Sample
- Rock Core

Drill Rig:	Acker truck mounted drill rig
Auger:	5" dia. continuous flight augers
Contractor:	Paddock Drilling Ltd.

WATER LEVELS

▽ Phreatic Surface #1:	3.5 ft
▼ Phreatic Surface #2:	33.0 ft

M. Block & Associates Ltd.

2484 Ferrier Street
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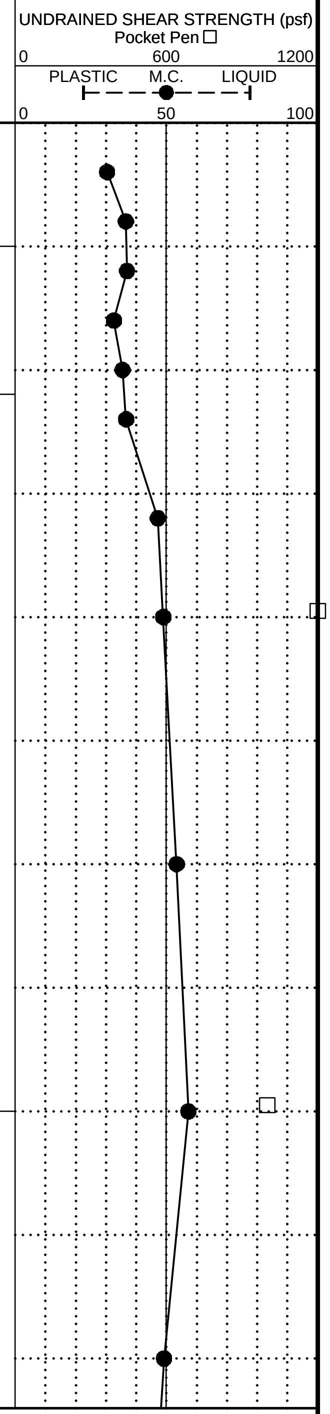
Telephone: 204-334-5356
Fax: 204-339-7976

.

TEST HOLE NO.: 2

Client: City of Winnipeg Project Services Branch	Job No.: 2012-1218	Logged By: Matthew Appleyard	Date: 8/6/12
Project: New 3,500 sq. ft., one-storey, community centre		Reviewed By: J. Block, P. Eng.	Time: 1:53 PM
Location: 40 Mayfair Place in Winnipeg, Manitoba	Elevation: 100.06m	Drawing Number: 5588	

Depth, ft	Sample Type	Sample Number	U S C S	Graphic Log	MATERIAL DESCRIPTION
0.0			CH		Black/grey, stiff, moist, silty CLAY FILL with granular
		45			
		46			
2.5		47	CH		Brown, alluvially deposited, stiff, moist, silty CLAY
		48			
5.0		49			
		50	CH		Brown, glaciolacustrine, stiff, moist, silty CLAY with silt and gypsum inclusions
7.5		51			
10.0		52			
12.5					
15.0		53			
17.5					
20.0		54	CH		Grey, glaciolacustrine, stiff to firm, moist, silty CLAY with silt inclusions
22.5					
25.0		55			



Continued Next Page

SAMPLE TYPE SYMBOLS

Split Spoon
Shelby Tube
Vane Shear
Auger Cuttings
Grab Sample
Rock Core

Drill Rig:	Acker truck mounted drill rig
Auger:	5" dia. continuous flight augers
Contractor:	Paddock Drilling Ltd.

WATER LEVELS

Phreatic Surface #1: 23.0 ft

M. Block & Associates Ltd.

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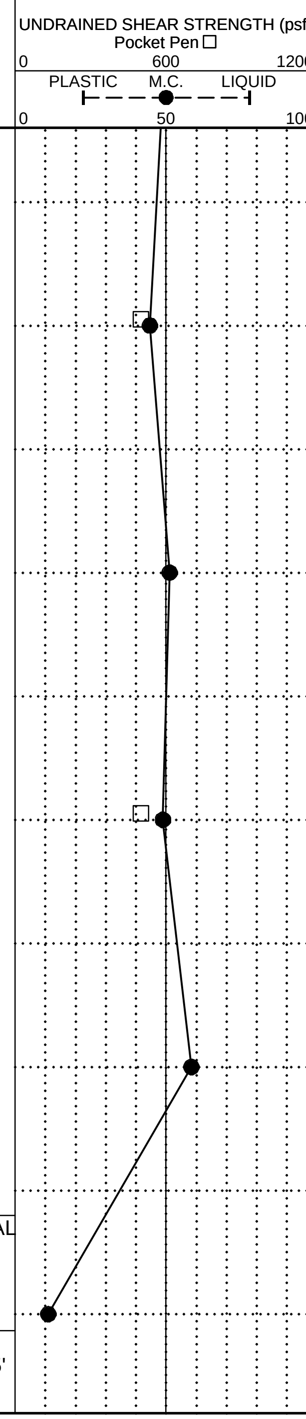
.

TEST HOLE NO.: 2

Client: City of Winnipeg Project Services Branch	Job No.: 2012-1218	Logged By: Matthew Appleyard	Date: 8/6/12
Project: New 3,500 sq. ft., one-storey, community centre		Reviewed By: J. Block, P. Eng.	Time: 1:53 PM
Location: 40 Mayfair Place in Winnipeg, Manitoba	Elevation: 100.06m	Drawing Number: 5588	

Depth, ft	Sample Type	Sample Number	U S C S	Graphic Log	MATERIAL DESCRIPTION
			CH		Grey, glaciolacustrine, stiff to firm, moist, silty CLAY with silt inclusions *(continued)*
27.5					
30.0		56			
32.5					
35.0		57			
37.5					
40.0		58			
42.5					
45.0		59			
47.5					
			CL-ML		Grey, hard, dry, very dense, gravelly sandy SILT with cobbles and boulders (GLACIAL TILL)
50.0		60			
					50'4" - Auger refusal on suspected LIMESTONE BEDROCK; - Upon completion, the groundwater & sloughed soil was measured at the 23' and 45' depths, respectively



SAMPLE TYPE SYMBOLS

Split Spoon	Shelby Tube
Vane Shear	Auger Cuttings
Grab Sample	Rock Core

Drill Rig:	Acker truck mounted drill rig
Auger:	5" dia. continuous flight augers
Contractor:	Paddock Drilling Ltd.

WATER LEVELS

Phreatic Surface #1: 23.0 ft

M. Block & Associates Ltd.

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Winnipeg, Manitoba, R2V 4P6
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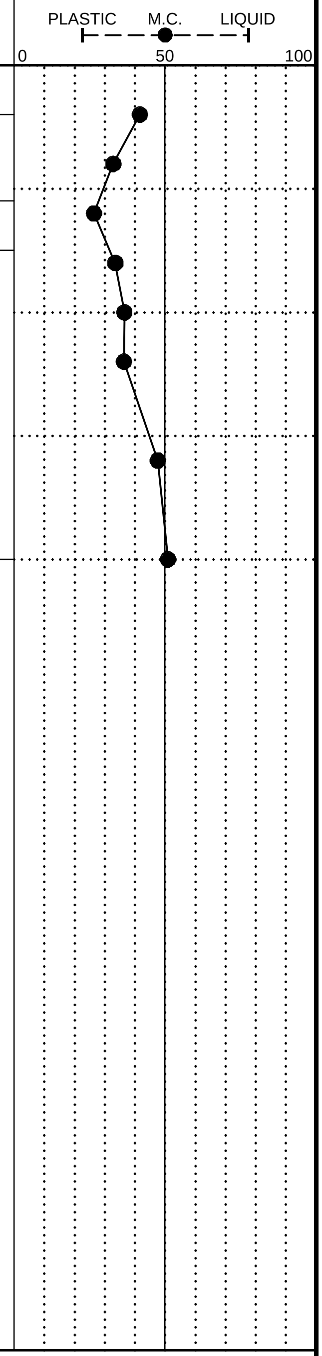
.

TEST HOLE NO.: 3

Sheet 1 of 1

Client: City of Winnipeg Project Services Branch	Job No.: 2012-1218	Logged By: Matthew Appleyard	Date: 8/6/12
Project: New 3,500 sq. ft., one-storey, community centre		Reviewed By: J. Block, P. Eng.	Time: 11:40 AM
Location: 40 Mayfair Place in Winnipeg, Manitoba	Elevation: 99.32m	Drawing Number: 5588	

Depth, ft	Sample Type	Sample Number	U S C S	Graphic Log	MATERIAL DESCRIPTION
0.0			CH		Black/grey, stiff, moist, silty CLAY FILL
	Shelby Tube	1			
			CH		Brown, alluvially deposited, stiff, moist, silty CLAY
	Shelby Tube	2			
2.5					
	Shelby Tube	3	ML		Brown, alluvially deposited, soft, saturated, sandy SILT
	Shelby Tube	4	CH		Brown, glaciolacustrine, stiff, moist, silty CLAY with silt and gypsum inclusions
5.0	Shelby Tube	5			
	Shelby Tube	6			
7.5					
	Shelby Tube	7			
10.0	Shelby Tube	8			10' - End of test hole; - Groundwater and/or sloughed soil was not encountered in test hole
12.5					
15.0					
17.5					
20.0					
22.5					
25.0					



SAMPLE TYPE SYMBOLS

Split Spoon	Shelby Tube
Vane Shear	Auger Cuttings
Grab Sample	Rock Core

Drill Rig:	Acker truck mounted drill rig
Auger:	5" dia. continuous flight augers
Contractor:	Paddock Drilling Ltd.

WATER LEVELS

Phreatic Surface #1: 2.8 ft

TEST HOLE LOG 2012-1218-CITY OF WINNIPEG-40 MAYFAIR.GPJ M BLOCK ASSOC.GDT 11/6/12

M. Block & Associates Ltd.
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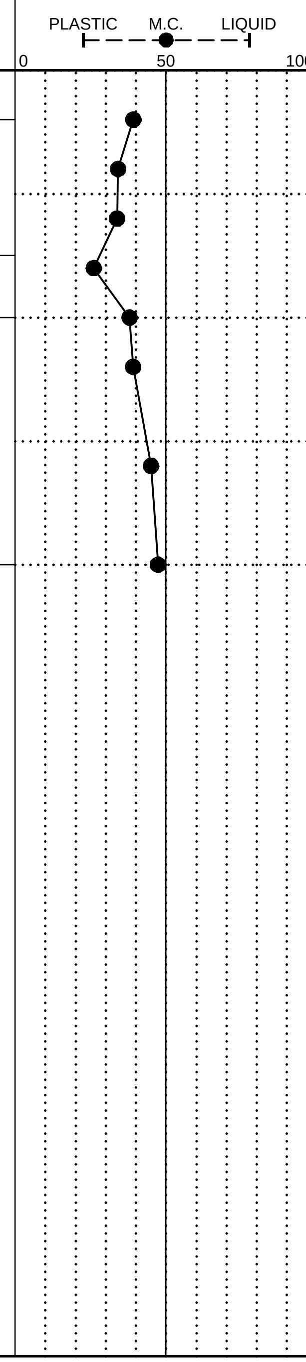
Fax: 204-339-7976

TEST HOLE NO.: 4

Sheet 1 of 1

Client: City of Winnipeg Project Services Branch	Job No.: 2012-1218	Logged By: Matthew Appleyard	Date: 8/6/12
Project: New 3,500 sq. ft., one-storey, community centre		Reviewed By: J. Block, P. Eng.	Time: 11:56 AM
Location: 40 Mayfair Place in Winnipeg, Manitoba	Elevation: 99.13m	Drawing Number: 5588	

Depth, ft	Sample Type	Sample Number	U S C S	Graphic Log	MATERIAL DESCRIPTION
0.0			CH		Black, alluvially deposited, stiff, moist, silty CLAY
		9			
		10	CH		Brown, alluvially deposited, stiff, moist, silty CLAY
2.5		11			
		12	ML		Brown, alluvially deposited, soft, saturated, sandy SILT
5.0		13	CH		Brown, glaciolacustrine, stiff, moist, silty CLAY with silt and gypsum inclusions
		14			
7.5		15			
10.0		16			10' - End of test hole; - Groundwater and/or sloughed soil was not encountered in test hole
12.5					
15.0					
17.5					
20.0					
22.5					
25.0					



SAMPLE TYPE SYMBOLS

Split Spoon
Shelby Tube
Vane Shear
Auger Cuttings
Grab Sample
Rock Core

Drill Rig:	Acker truck mounted drill rig
Auger:	5" dia. continuous flight augers
Contractor:	Paddock Drilling Ltd.

WATER LEVELS

Phreatic Surface #1: 3.8 ft

M. Block & Associates Ltd.

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Winnipeg, Manitoba, R2V 4P6
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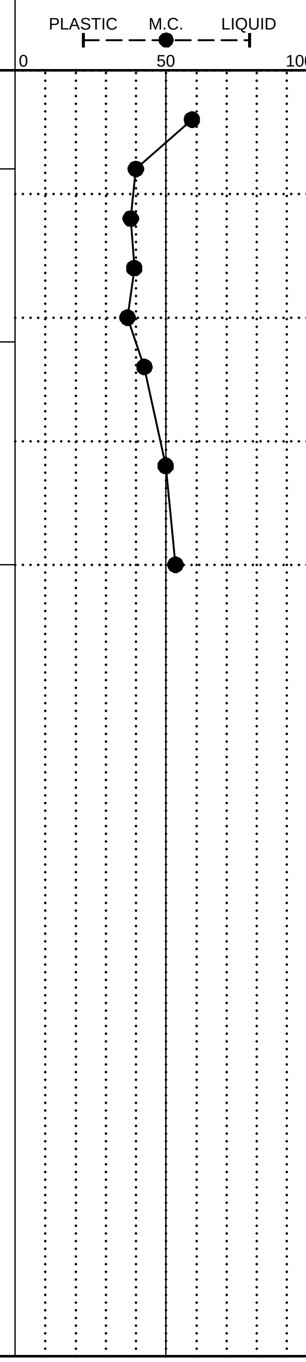
Fax: 204-339-7976

.

TEST HOLE NO.: 5

Client: City of Winnipeg Project Services Branch	Job No.: 2012-1218	Logged By: Matthew Appleyard	Date: 8/6/12
Project: New 3,500 sq. ft., one-storey, community centre		Reviewed By: J. Block, P. Eng.	Time: 12:03 PM
Location: 40 Mayfair Place in Winnipeg, Manitoba	Elevation: 99.29m	Drawing Number: 5588	

Depth, ft	Sample Type	Sample Number	U S C S	Graphic Log	MATERIAL DESCRIPTION
0.0		17, 18	CH		Black/grey, stiff, moist, silty CLAY FILL
2.5		19, 20, 21	CH		Brown, alluvially deposited, stiff, moist, silty CLAY
5.0 / 7.5		22, 23, 24	CH		Brown, glaciolacustrine, stiff, moist, silty CLAY with silt and gypsum inclusions
10.0					10' - End of test hole; - Groundwater and/or sloughed soil was not encountered in test hole
12.5					
15.0					
17.5					
20.0					
22.5					
25.0					



SAMPLE TYPE SYMBOLS

- Split Spoon
- Shelby Tube
- Vane Shear
- Auger Cuttings
- Grab Sample
- Rock Core

Drill Rig:	Acker truck mounted drill rig
Auger:	5" dia. continuous flight augers
Contractor:	Paddock Drilling Ltd.

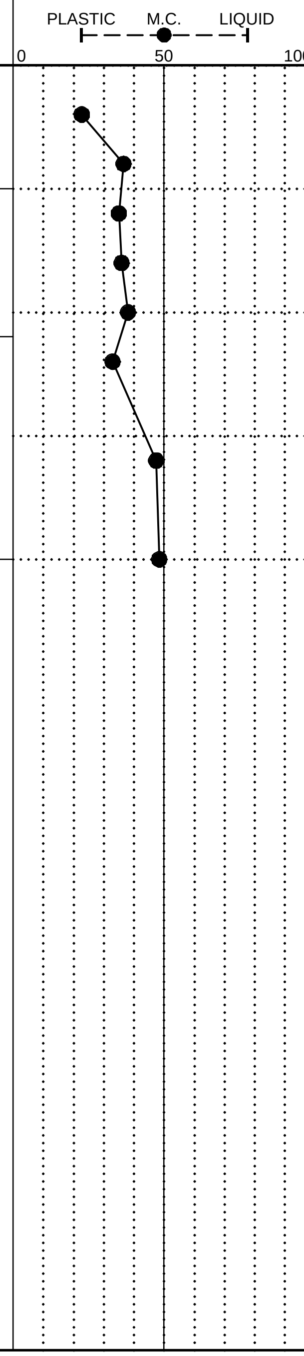
WATER LEVELS

No Ground Water Encountered

M. Block & Associates Ltd.		TEST HOLE NO.: 6
2484 Ferrier Street Winnipeg, Manitoba, R2V 4P6 Telephone: 204-334-5356 Fax: 204-339-7976	.	Sheet 1 of 1

Client: City of Winnipeg Project Services Branch	Job No.: 2012-1218	Logged By: Matthew Appleyard	Date: 8/6/12
Project: New 3,500 sq. ft., one-storey, community centre		Reviewed By: J. Block, P. Eng.	Time: 2:48 PM
Location: 40 Mayfair Place in Winnipeg, Manitoba	Elevation: 100.07m	Drawing Number: 5588	

Depth, ft	Sample Type	Sample Number	U S C S	Graphic Log	MATERIAL DESCRIPTION
0.0			CH		Black/grey, stiff, moist, silty CLAY FILL with granular
		61			
		62			
2.5		63	CH		Brown, alluvially deposited, stiff, moist, silty CLAY
		64			
5.0		65			
		66	CH		Brown, glaciolacustrine, stiff, moist, silty CLAY with silt and gypsum inclusions
7.5		67			
10.0		68			10' - End of test hole; - Groundwater and/or sloughed soil was not encountered in test hole
12.5					
15.0					
17.5					
20.0					
22.5					
25.0					



SAMPLE TYPE SYMBOLS

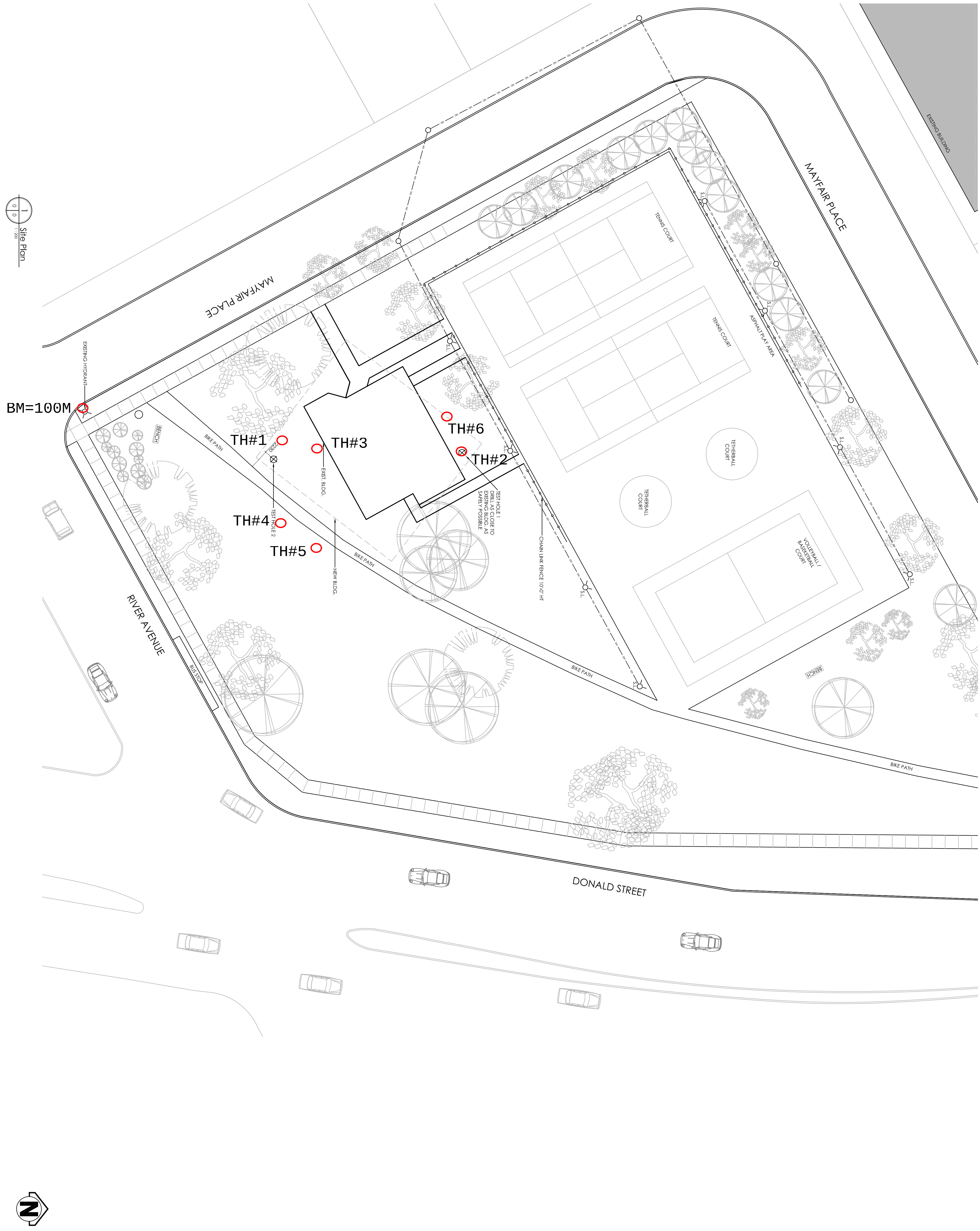
Split Spoon	Shelby Tube
Vane Shear	Auger Cuttings
Grab Sample	Rock Core

Drill Rig:	Acker truck mounted drill rig
Auger:	5" dia. continuous flight augers
Contractor:	Paddock Drilling Ltd.

WATER LEVELS

No Ground Water Encountered

TEST HOLE LOG 2012-1218-CITY OF WINNIPEG-40 MAYFAIR.GPJ M BLOCK ASSOC.GDT 11/6/12



Project:
MAYFAIR C.C.
40 MAYFAIR PL

Project Number: 1210

Drawing Title:
SITE PLAN

#	Issue/Revision	Date

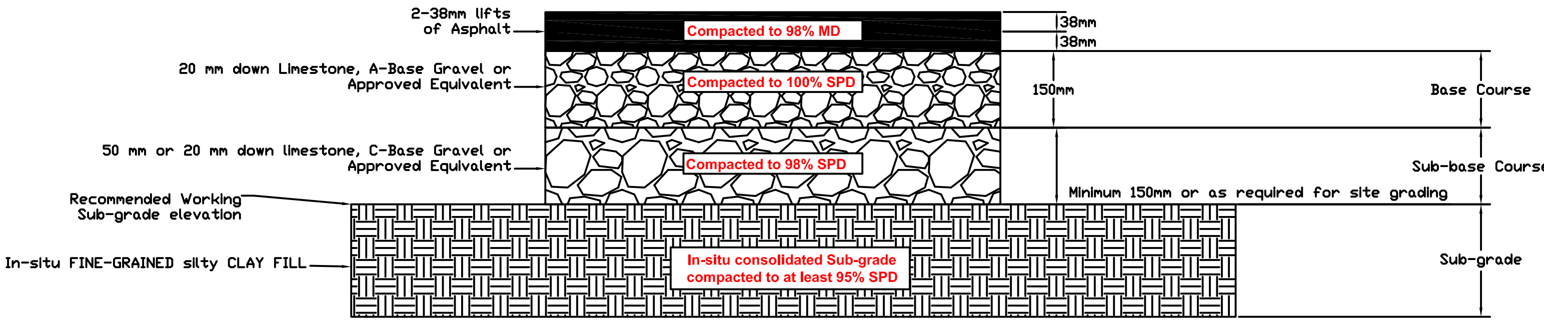
Sheet No:

678 MAIN STREET WINNIPEG, MB R3B 1E4
204 488 3857 tel. 204 488 0216 fax.
www.bridgmancollaborative.ca

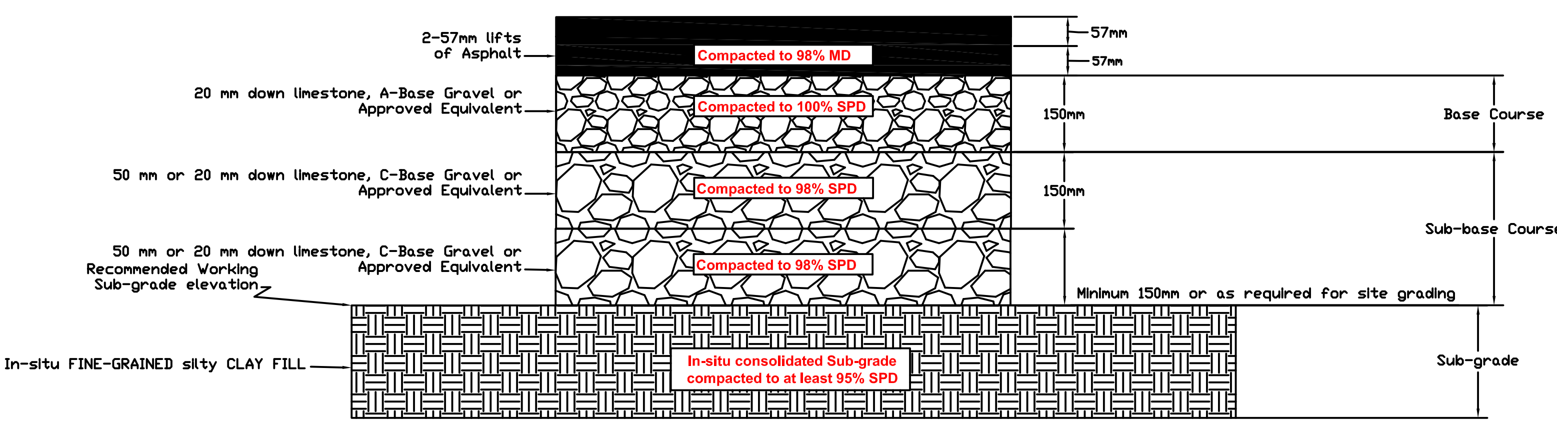
bridgmancollaborative ARCHITECTURE

PAVEMENT DETAILS

Car Traffic Areas



Truck Traffic Areas



M. Block & Associates Ltd.
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R2V 4P6
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Drawing: PAVEMENTS' STRUCTURES
Drawn By: J. Block, P. Eng.
Reviewed By: J. Block, P. Eng.

Project: New Community Centre, 40 Mayfair Pl.
Project Number: 2012-1218
Drawing Number: 5588

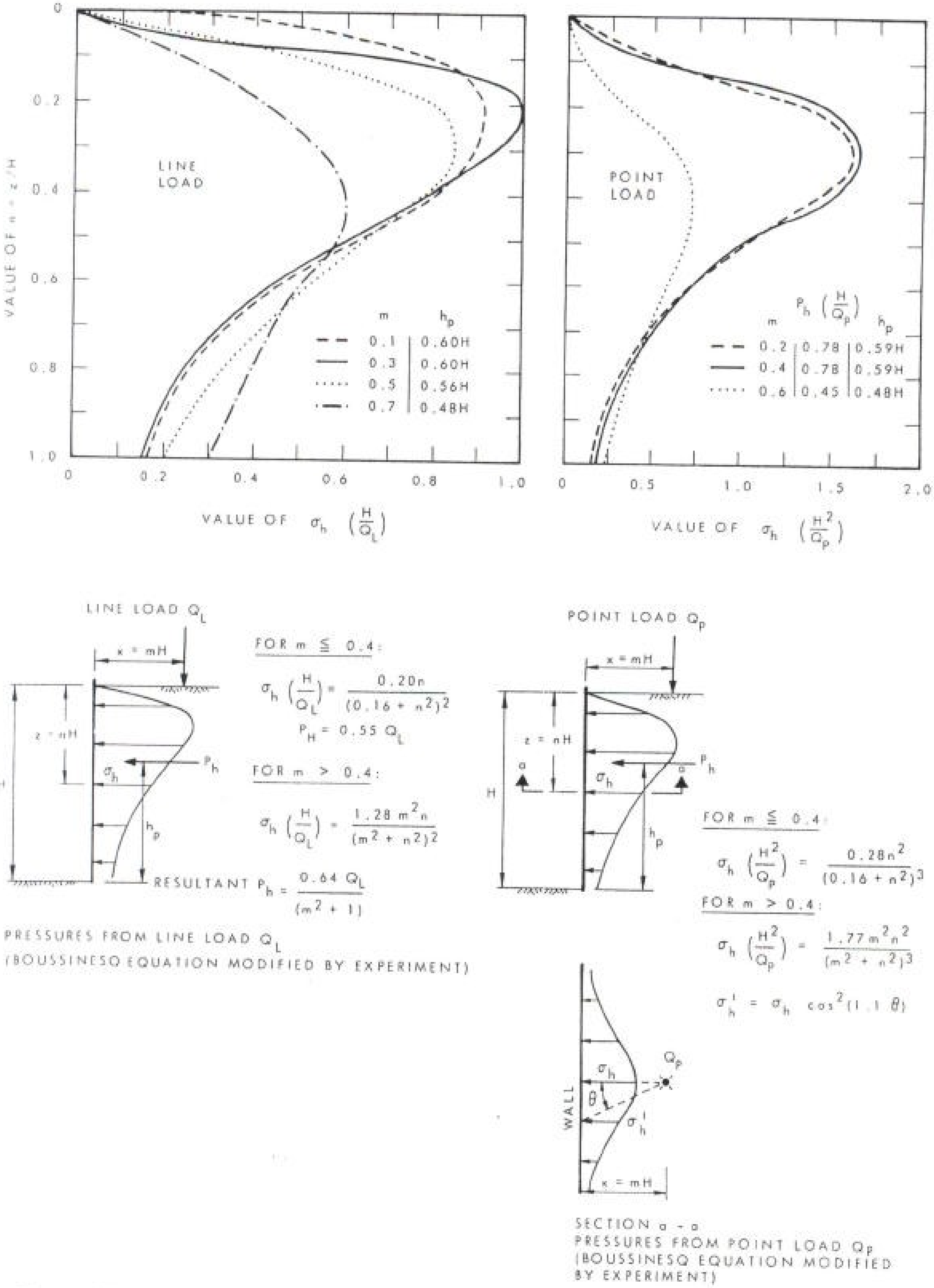
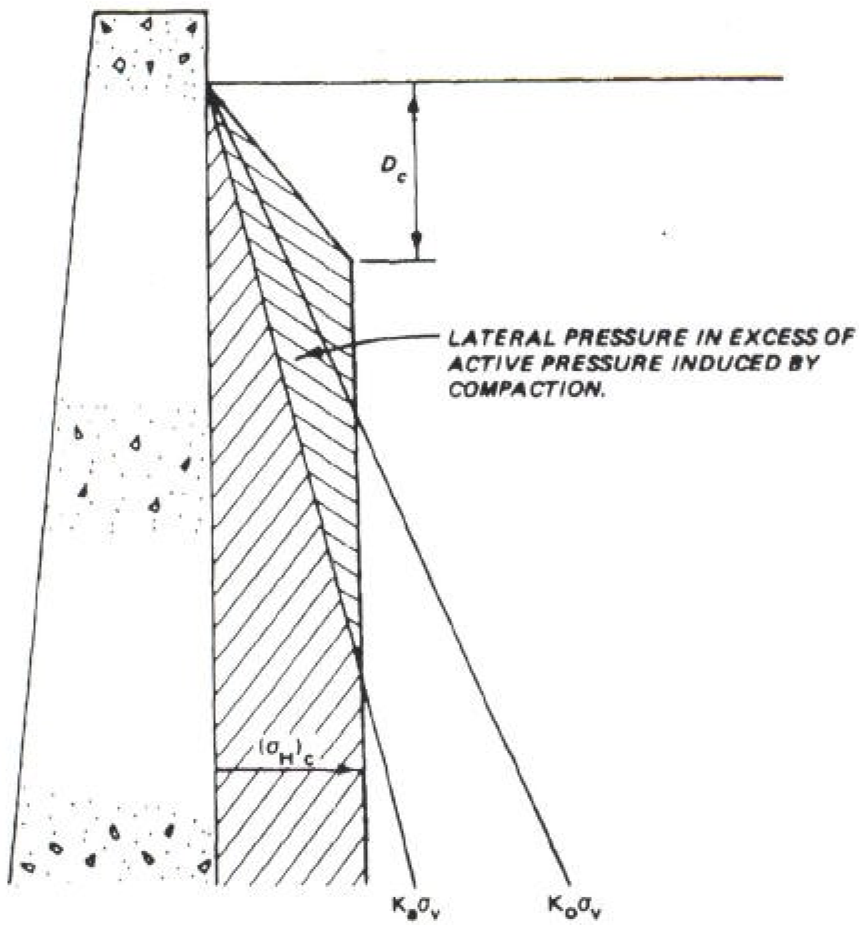


Figure 25.5: Horizontal pressures on a wall due to point and line load surcharges.



COMPACTION EQUIPMENT	CRITICAL DEPTH, D_c , ft	$(\sigma_H)_c$ psf
10-TON SMOOTH WHEEL ROLLER	1.9	420
3.2-TON VIBRATORY ROLLER	1.7	400
1.4-TON VIBRATORY ROLLER	1.2	260
400-KG VIBRATORY PLATE	1.5	340
120-KG VIBRATORY PLATE	1.0	240

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
1	1.0							38.2			
1	2.0							32.9			
1	3.0							31.5			
1	4.0							27.1			
1	5.0							34.8			
1	6.0							41.1			
1	8.0							57.5			
1	10.0							46.8			
1	12.5							54.0			
1	15.0							54.1			
1	16.0							53.8			
1	20.0							47.3			
1	25.0							50.2			
1	26.0							45.5			
1	30.0							50.0			
1	35.0							59.6			
1	36.0							53.2			
1	40.0							49.2			
1	45.0							33.8			
1	47.0							13.9			
2	1.0							30.4			
2	2.0							36.6			
2	3.0							36.9			
2	4.0							32.6			
2	5.0							35.5			
2	6.0							36.7			
2	8.0							47.1			
2	10.0							48.9			
2	15.0							53.4			
2	20.0							57.2			
2	25.0							49.2			
2	30.0							44.6			
2	35.0							51.1			
2	40.0							48.9			
2	45.0							58.3			
2	50.0							10.9			
3	1.0							41.6			
3	2.0							32.8			
3	3.0							26.4			
3	4.0							33.5			
3	5.0							36.5			
3	6.0							36.3			
3	8.0							47.5			

M. Block & Associates Ltd.
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Summary of Laboratory Results

Client: City of Winnipeg Project Services Branch
Project: New 3,500 sq. ft., one-storey, community centre
Location: 40 Mayfair Place in Winnipeg, Manitoba
Number: 2012-1218

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
3	10.0							50.9			
4	1.0							39.1			
4	2.0							34.1			
4	3.0							33.7			
4	4.0							26.0			
4	5.0							37.9			
4	6.0							39.0			
4	8.0							45.0			
4	10.0							47.3			
5	1.0							58.5			
5	2.0							39.9			
5	3.0							38.2			
5	4.0							39.4			
5	5.0							37.2			
5	6.0							42.8			
5	8.0							49.8			
5	10.0							53.1			
6	1.0							22.7			
6	2.0							36.5			
6	3.0							35.0			
6	4.0							35.9			
6	5.0							38.0			
6	6.0							32.9			
6	8.0							47.4			
6	10.0							48.4			

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Summary of Laboratory Results

Client: City of Winnipeg Project Services Branch
Project: New 3,500 sq. ft., one-storey, community centre
Location: 40 Mayfair Place in Winnipeg, Manitoba
Number: 2012-1218