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GEOTECHNICAL INVESTIGATION
MISSISSIPPI MILLS BUSINESS PARK
MISSISSIPPI MILLS, ONTARIO

Prepared For

Novatech Engineering Consultants Limited

October 22, 1999

Report No. G7488-1

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1.0 INTRODUCTION

At the request of Mr. Edson Donnelly, with Novatech Engineering Consultants Limited, this firm conducted a geotechnical investigation for a vacant parcel of industrial property located at the southwestern corner of County Road No. 17 and County Road No. 49, in the Town of Mississippi Mills, Ontario. The project was carried out in accordance with our letter of proposal, File: P2491-99, dated August 4, 1999.

A Phase I - Environmental Site Assessment (ESA) was also conducted by our firm in September of 1999. The Phase I - ESA was detailed in our Report No. E1809-1.PH1.

The subject property, which is currently vacant, forms part of the Town of Mississippi Mills Commercial/Industrial Park Lands. It is our understanding, that the initial phase of the development will consist of the extension of Industrial Drive from County Road No. 49 to County Road No.17. A secondary street is being proposed for the central portion of the site. The site location and proposed roadways are shown on Drawing No. G7488-1- Test Hole Location Plan, in Appendix 2 of this report.

The intent of the geotechnical investigation was to provide a general overview of the soil and bedrock profile beneath the subject land in order to assess issues related to the future development of the subject site.

This report has been prepared specifically and solely for the aforementioned project. It contains all of our findings and includes geotechnical recommendations pertaining to the design and construction of the project as it is understood.

2.0 METHODOLOGY

2.1 Fieldwork Program

The geotechnical investigation was conducted on September 16, 1999, and consisted of the placement of twenty-two (22) test pits. The test pits were placed throughout the property in order to determine the overall subsurface conditions.

The test pits were excavated using a subcontracted rubber-tired backhoe. All test pits were placed to practical refusal in the upper portion of the bedrock deposit. The field work was supervised by a technologist from our geotechnical department.

2.2 Sampling Program

The soil profile at each test pit was logged by direct examination of the sides of the pits. Soil samples were classified texturally in the field, then sealed in appropriate containers for further perusal and testing in our laboratory.

A total of 27 samples were acquired during the sampling program by means of grab samples. The depths at which the grab samples were recovered from the test pits are shown as "G" samples on the Soil Profile & Test Data sheets in Appendix 1.

Due to the shallow nature of the investigation (bedrock), it was not considered feasible to install piezometers or wells to monitor the groundwater levels. No groundwater was encountered in the test pits at the time of our fieldwork.

Sample Storage

All samples will be stored in the laboratory for a period of three months after issuance of this report. They will then be discarded unless we are otherwise directed.

2.3 Survey

The test pit locations were selected in the field by John D. Paterson and Associates Limited personnel. The actual test pit locations were determined by Novatech Engineering Consultants Ltd.

The Geodetic ground surface elevations at the test pit locations were also provided to our firm by Novatech Engineering Consultants Ltd. The elevations are shown on the Soil Profile & Test Data sheets and the Test Hole Location Plan.

3.0 OBSERVATIONS

3.1 Surface Conditions

Approximately half of the site was vegetated by trees with the remainder of the land covered by low-lying vegetation such as grass. There were three (3) obvious areas where fill placement was evident. These areas were delineated on the topographic plan prepared by Sury, Rowe & Smith Limited, and are shown on the Test Hole Location Plan.

No significant water courses or ponded water were observed on the subject land at the time of the fieldwork. No visual signs of surficial contamination were observed at the time of the investigation.

The topographical survey indicated that the north-central portion of the land was elevated above the remainder of the site, with the exception of the northern most property corner. The ground surface slopes gradually downwards away from the central plateau.

3.2 Subsurface Profile

In general, the soil profile encountered at the test pit locations was observed to consist of a topsoil layer over bedrock. An intermediate native silty sand/sandy silt layer was encountered in approximately half of the test pits, while fill materials were observed in Test Pits 12 and 13. All test pits were terminated in or on bedrock. Reference should be made to the Soil Profile & Test Data sheets for specific details of the soil profile at each test pit location.

The fill was observed to consist predominantly of soil particles with some concrete, wood and asphaltic concrete (minor construction debris). The fill encountered in Test Pits 12 and 13 was of the order of one (1) metre in thickness.

The limited in situ inorganic soil ranged from a silt to a silty sand and was considered to be compact in density. Based on the soil texture classification, all of the fill and in situ soils were considered to be frost susceptible.

All test pits were terminated in, or on, the bedrock deposit at relatively shallow depths. Occasionally the upper portion of the bedrock was weathered and could be excavated by means of the backhoe, although the deposit was generally competent near the surface. The quality of the rock will increase with increased depth.

According to published geological bedrock maps, the rock underlying the subject site consists of limestone of the Ottawa Formation.

The client should be aware that any information pertaining to the soils and all test pit logs are furnished as a matter of general information only, and test pit descriptions are not to be interpreted as descriptive of conditions at locations other than those described by the test locations themselves.

3.3 Groundwater

The majority of the test pits were terminated at very shallow depths. As a result, the groundwater table was not encountered. The groundwater table is expected to reside in the bedrock deposit during the majority of the year. However, a perched (elevated) water table may be present overlying competent bedrock surfaces during particularly wet seasons (spring time).

4.0 DESIGN AND CONSTRUCTION CONSIDERATIONS

4.1 Geotechnical Assessment

It is our understanding, that the subject land is being considered for future development. As a result, the nature of the geotechnical investigation was preliminary. The purpose of the investigation was to determine the general soil and bedrock profile beneath the subject land in order to assess founding conditions and construction procedures for future site development.

Based on our investigation, a relatively shallow bedrock deposit is present across the entire site. The bedrock is generally overlain by topsoil with an intermittent silty sand/sandy silt layer.

4.2 Site Grading and Preparation

All topsoil and fill materials within proposed building and roadway areas should be removed prior to the placement of engineered fill or concrete for footings. The fill may be re-used as backfill, provided that all deleterious materials (including organic matter/topsoil, construction debris, etc.) are removed and the material is approved by geotechnical personnel for its intended purpose.

All prepared bearing/subgrade surfaces should be inspected by geotechnical personnel prior to the placement of new fill material or concrete for footings.

Bedrock Excavation

It is expected that bedrock removal will be required for the installation of services and possibly future developments. In general, the bedrock deposit encountered in the test pits was observed to be competent and is expected to increase in quality with depth. As a result, the use of a hoe-ram and/or blasting techniques with or without the drilling of holes may be required. If blasting techniques are utilized, consideration should be given to a blast-monitoring program of existing near-by structures.

4.3 Foundation Design

Bearing Media/Allowable Bearing Pressures

Based on our findings, the bedrock deposit is expected to be the predominant bearing medium in the park. If the grades were raised significantly on the subject site, the silty sand/sandy silt deposits might be considered as bearing media.

Footings constructed on a clean, intact bedrock bearing surface can be designed to an allowable bearing pressure of 500 kPa. A clean bedrock bearing surface consists of one from which all soil, fill and loose rock, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

On a clean, surface-sounded bedrock bearing surface, footings can be designed to an allowable bearing pressure of 1000 kPa. A clean, surface sounded bedrock bearing surface meets the requirements for a clean bedrock bearing surface and, in addition, has no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Footings constructed on clean, undisturbed in situ soil bearing surfaces can be designed to an allowable bearing pressure of 100 kPa. A clean, undisturbed soil bearing surface consists of one from which all soil, fill and deleterious material such as frozen soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

It is strongly recommended that all footings for a single building structure be placed on a single bearing medium, in this case, the bedrock deposit. This will minimize the total settlement and differential settlements between footings bearing on varying founding materials.

It is recommended that the geotechnical consultant be retained to provide inspection services during construction, in order that the bearing medium can be evaluated upon exposure.

Lateral Support to Bearing Media

Lateral support to footings bearing on in situ soil is provided when a plane extending down and out from the bottom edge of the footings at a minimum slope of 1H:1V passes only through undisturbed in situ soil or a material of the same or higher capacity, such as engineered fill.

Lateral support to footings bearing on bedrock is provided when a plane extending down and out from the bottom edge of the footing at 60 degrees to the horizontal passes only through undisturbed bedrock or a material of the same or higher capacity as the rock, such as mass concrete.

Settlement

Footings designed to the allowable soil pressure detailed under this section will experience total and differential settlement. The allowable soil pressure has been chosen, based on an interpretation of our field observations, and our experience, to keep settlements within tolerable limits. The tolerable limits will ultimately depend on the nature of the proposed structures.

Footings constructed on undisturbed bedrock bearing surfaces will experience negligible settlements.

Frost Protection

Perimeter footings are required to be insulated against the destructive forces of frost action. A minimum of 1.5 metres of soil cover should be provided for exterior heated footings. Exterior unheated footings are more prone to deleterious movements associated with frost action than the exterior walls of the structure and will require additional protection, such as a soil cover of 2.1 metres or a combination of soil cover and rigid insulation. The latter soil cover requirement is obligatory for structural elements such as, exterior canopy pier footings, wing walls and retaining walls.

Based on the shallow nature of the bedrock deposit, it is considered possible that insulated foundation designs may be required. Insulation details and specifications were not included due to the general nature of the project.

The use of insulated footings, where insufficient soil cover is available, may be omitted if the underlying bedrock is determined to be non frost susceptible. To determine this, holes would have to be drilled into the bedrock and probed for soil seams to the anticipated frost penetration depth at each specific hole location.

Groundwater Control

Groundwater flow into most excavations is expected to range from low to moderate and should be controllable by pumping from open sumps. Higher groundwater flow rates should be anticipated in deeper excavations and/or during seasonally wet periods, particularly in the spring months.

Dykes placed at regular intervals along deeper service trenches can be used to control groundwater entering the working excavation through the granular bedding material from the completed portion of the service trench. A minimum dyke length of 1.0 metre (across the entire trench width) with a spacing, along trenches, of 50 metres or less is recommended to control groundwater.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding and/or subgrade media.

Winter Construction

In the event of construction during winter months, founding media are required to be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavation should be insulated from sub-zero temperatures immediately upon exposure, until the time that heat can be supplied to the building and foundations have sufficient soil cover to prevent freezing of the bearing medium.

4.4 Slab-on-Grade Construction

Based on the nature of the site development, it is anticipated that the majority of the buildings constructed in the business park will consist of slab-on-grade structures. With the removal of all fill, topsoil and disturbed in situ soil/bedrock, the native soils and/or bedrock strata are suitable subgrade media on which to backfill for slab-on-grade construction. It is recommended that the upper 300 mm of sub-slab fill consist of an OPSS Granular A(0-19 mm) crushed stone material.

4.5 Foundation Drainage and Backfill

For most building structures it is recommended that a perimeter drainage system be provided. Such a system should consist of a 100 mm diameter perforated corrugated plastic pipe, surrounded by 150 mm of 10 mm diameter clear crushed stone, placed adjacent to the exterior edge of the footing around the perimeter of the structure. The drainage tile/pipe should be provided with a filter cloth to prevent fine grained particles entering and clogging the pipe.

The foundation wall backfill should consist of a non-frost susceptible free-draining granular material such as sand or OPSS Granular B Type I material to provide adequate drainage of the foundation wall backfill. An alternative solution is to attach a prefabricated drainage membrane to the exterior of the foundation wall. It is also recommended that the exterior grade adjacent to any buildings be sloped to shed surface water away from the building foundations.

4.6 Pavement Design

With the complete removal of all deleterious fill and topsoil materials, the in situ soil and bedrock deposits are suitable subgrade media for pavement construction. Typical minimum pavement material thicknesses for parking lots and access roads are provided in Tables 1 and 2. All granular base and subbase materials are required to be compacted to a minimum of 95 percent of their standard Proctor maximum dry densities.

Table 1
Recommended Pavement Structure
Automobile Parking Only

Thickness (mm)	Material Description
50	**HL-3** - Asphaltic Concrete
150	**BASE** - OPSS Granular A crushed stone material
300	**SUBBASE** - OPSS Granular B Type II crushed stone material
-	**SUBGRADE** - Either in situ soils or OPSS Granular B Type II (or Type I) material placed over in-situ soils

Table 2
Recommended Pavement Structure
Industrial/Commercial Roadway

Thickness (mm)	Material Description
40	**HL-3**- Asphaltic Concrete
80	**HL-8**- Asphaltic Concrete
150	**BASE** - OPSS Granular A crushed stone material
450	**SUBBASE** - OPSS Granular B Type II crushed stone material
-	**SUBGRADE** - Either in situ soils or OPSS Granular B Type II (or Type I) material placed over in-situ soils

4.7 Site Servicing

Bedding Conditions for Services

The bedding conditions for services, which will likely be installed in the bedrock deposit, are favourable. Class B bedding is suitable for the support of service pipes in trenches through the above mentioned material. Below the groundwater level, 10 mm clear crushed stone is recommended for use as the bedding material if the bedding cannot be placed in the dry (i.e. if pumping from sumps cannot control the groundwater influx).

Backfill of Service Trenches

Site excavated soils, with the exception of the organic-rich topsoil, are considered to be suitable for re-use as backfill for trenches. Site excavated soil used for trench backfill should be more or less of the same composition as the adjacent soil (i.e. silty sand material as backfill in areas of existing silty sand, etc.) to provide for similar frost heave characteristics. Otherwise, the use of frost tapers should be considered to provide a transition between materials of different frost heave potential.

Large blocks of cohesive soils should be broken up prior to or during backfilling operations. The compaction of cohesive materials should be conducted by means of sheepsfoot or padfoot type compaction equipment. A minimum field density of 98 percent of the standard Proctor dry density at the in situ water content is recommended to reduce the propensity for differential settlement to occur between the trench and the adjacent unexcavated subgrade.

The use of imported OPSS Granular B Type I material, compacted to at least 95 percent of its standard Proctor maximum dry density (or as specified by the civil engineering consultant), is acceptable as an alternative to the re-use of site excavated soil as trench backfill.

5.0 INSPECTION SERVICES

The use of the allowable bearing pressures contained in this report for the design of foundations is conditional on footings being constructed on clean, undisturbed in situ soil and/or bedrock bearing surfaces, approved as such by this firm.

A geotechnical inspection program is recommended, whereby the following aspects of construction are inspected.

- Inspection of all bearing surfaces prior to placing concrete for footings.
- Inspection of in situ soil and bedrock subgrades prior to backfilling, and where necessary, follow up field density tests, to ensure that the specified level of compaction has been achieved.
- Inspection of the installation of subgrade insulation, if required.
- Testing of concrete used for structural elements (footings, foundation walls, etc.)

The completion of an inspection program of this type will result in the issuance of an engineering report confirming that these works have been completed in the correct manner.

6.0 CLOSURE

The recommendations made in this report are general in nature, based on the preliminary stage of the site development. As a result, it is recommended that each individual development within the industrial park be addressed on a singular basis, since requirement and design specifications may significantly alter our recommendations. The assessment of individual developments will likely require additional geotechnical investigation to provide adequate information at specific building locations. Of particular interest, will be the bedrock profile.

We trust that this report is to your satisfaction. Please contact our office should you have any questions regarding this report.

JOHN D. PATERSON AND ASSOCIATES LIMITED

LICENSED PROFESSIONAL ENGINEER
M. S. D'ARCY
PROVINCE OF ONTARIO

Mark S. D'Arcy, P. Eng.

Stephen J Walker

Stephen J. Walker, P.Eng.

Report Distribution:

- Mr. Edson Donnelly - Novatech Engineering Consultants Limited (3 copies)
- John D. Paterson and Associates Limited (1 copy)

APPENDIX 1

SOIL PROFILE & TEST DATA SHEETS

SYMBOLS AND TERMS

JOHN D. PATERSON & ASSOCIATES LTD.
Consulting Geotechnical and Environmental Engineers
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SOIL PROFILE & TEST DATA

Geotechnical Investigation
Mississippi Mill Business Park
County of Lanark, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

REMARKS

BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	138.40		
Silty sand TOPSOIL		G	1						
0.25									
Brown SILTY SAND, occasional cobbles		G	2						
0.65									
Weathered BEDROCK									
0.70									
End of Test Pit									
(TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

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REMARKS

BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP 2

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % (20 40 60 80)	PIEZOMETER CONSTRUCTION
GROUND SURFACE							0	138.96		
TOPSOIL	0.19									
Weathered BEDROCK, occasional silty sand seams	0.24		G	3						
End of Test Pit TP terminated on bedrock surface @ 0.24m depth. (TP dry upon completion)										

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

Geotechnical Investigation
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County of Lanark, Ontario

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.
REMARKS
BORINGS BY Backhoe
DATE 16 September 1999
FILE NO. G7488
HOLE NO. TP 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	140.17		
Silty sand TOPSOIL 0.30	■								
Weathered BEDROCK with silt seams 0.80	▤	G	4						
End of Test Pit TP terminated on bedrock surface @ 0.8m depth. (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

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REMARKS

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DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	139.70		
TOPSOIL 0.25									
Yellowish SILT to brown SILTY SAND 0.40		G	5						
Weathered BEDROCK 0.45									
End of Test Pit TP terminated on bedrock surface @ 0.45m depth. (TP dry upon completion)									

20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

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County of Lanark, Ontario

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REMARKS

BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

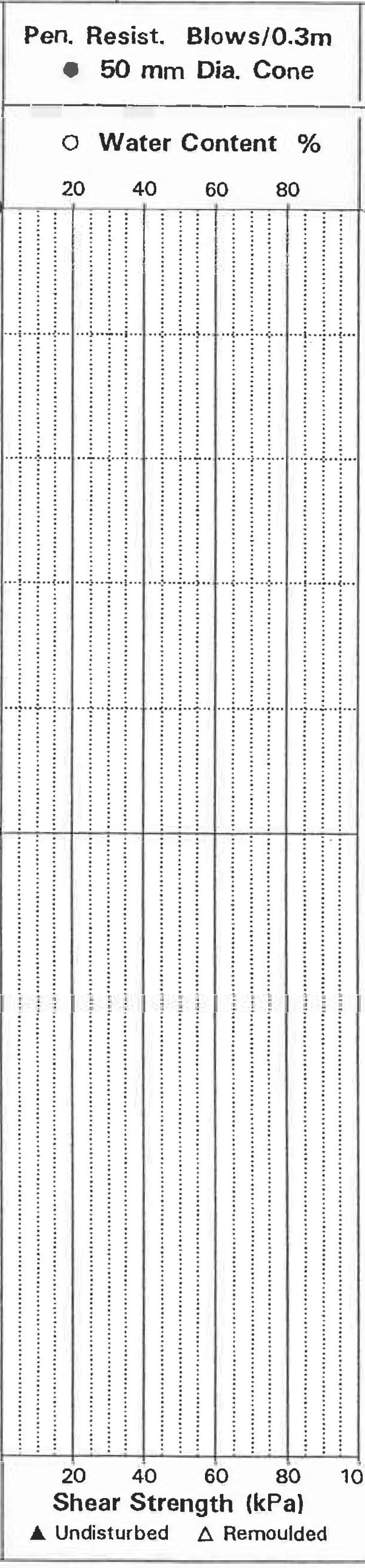
HOLE NO. TP 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	PIEZOMETER CONSTRUCTION
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			
GROUND SURFACE						0	140.09	
TOPSOIL 0.23	■							
Yellowish SANDY SILT, occasional boulders 0.70	▒	G	6					
Weathered BEDROCK with sandy silt seams 1.00	▤	G	7			1	139.09	

End of Test Pit

TP terminated on bedrock surface @ 1.0m depth.

(TP dry upon completion)



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SOIL PROFILE & TEST DATA

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REMARKS

BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	139.98
TOPSOIL 0.20							
Brown SILTY SAND, occasional cobbles and boulders 0.35		G	8				
End of Test Pit TP terminated on bedrock surface@ 0.35m depth. (TP dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

PIEZOMETER CONSTRUCTION

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

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REMARKS

BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP 7

SOIL DESCRIPTION		STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	PIEZOMETER CONSTRUCTION
			TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE							0	139.81		
TOPSOIL	0.08		G	9						
Weathered BEDROCK	0.12									
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)										

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

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REMARKS

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FILE NO. G7488

HOLE NO. TP 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	141.79		
TOPSOIL 0.18									
Brown **SANDY SILT**, some cobbles and gravel 0.33		G	10						
Weathered **BEDROCK** 0.50									
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	PIEZOMETER CONSTRUCTION
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	139.55		
TOPSOIL, occasional boulders 0.16									
Dark brown SILTY SAND 0.30		G	11						
Grey SANDY SILT, some gravel and cobbles 0.85		G	12						
Weathered BEDROCK 0.88									
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE & TEST DATA

Geotechnical Investigation
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FILE NO. G7488

HOLE NO. TP10

DATUM Ground surface elevations provided by Novatech Engineering Consultants Limited.

REMARKS

BORINGS BY Backhoe

DATE 16 September 1999

SOIL DESCRIPTION		SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	140.60
TOPSOIL	0.23						
Brown SILTY SAND, some cobbles	0.30	G	13				
Weathered BEDROCK	0.65	G	14				
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

PIEZOMETER CONSTRUCTION

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	PIEZOMETER CONSTRUCTION
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	138.28		
TOPSOIL 0.18									
Yellowish SILT, occasional cobbles 0.30		G	15						
Weathered BEDROCK 0.63									
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	PIEZOMETER CONSTRUCTION
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	138.84		
FILL: Mixture of clayey silt, concrete and asphalt blocks, occasional metal rods	▨	G	16						
1.00						1	137.84		
End of Test Pit TP terminated on weathered bedrock surface (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	138.84
FILL: Brown, mixture of silty sand, weathered bedrock and silty clay	▨	G	17				
1.00						1	137.84
Brown to grey SILTY SAND, occasional cobbles		G	18				
1.45							
End of Test Pit TP terminated on bedrock surface. (TP dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

PIEZOMETER CONSTRUCTION

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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FILE NO. G7488

HOLE NO. TP14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % (20 40 60 80)	PIEZOMETER CONSTRUCTION
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	137.36		
TOPSOIL 0.20	■								
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)		G	19						

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	PIEZOMETER CONSTRUCTION
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD			20 40 60 80	
GROUND SURFACE						0	138.90		
TOPSOIL 0.30									
Brown SILTY SAND, some silt and boulders 0.75		G	20						
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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REMARKS

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DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	138.52		
TOPSOIL									
0.12									
Weathered BEDROCK		G	21						
0.32									
End of Test Pit TP terminated on bedrock surface @ 0.75m depth. (TP dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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REMARKS

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DATE 16 September 1999

FILE NO. **G7488**

HOLE NO. **TP17**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	PIEZOMETER CONSTRUCTION
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	137.40		
TOPSOIL	■	G	22						
0.12									
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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REMARKS

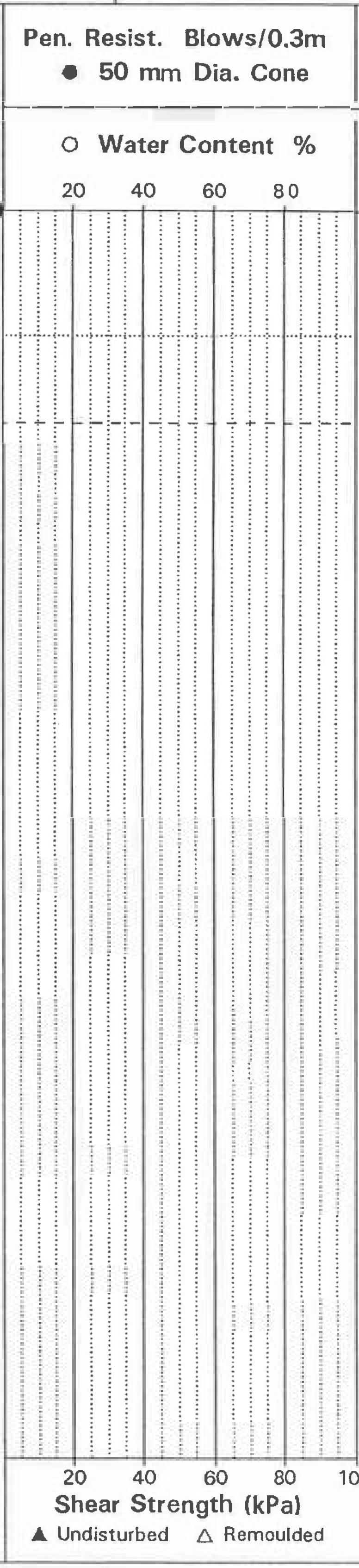
BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	137.29
TOPSOIL							
0.23							
Yellowish SANDY SILT, occasional cobbles		G	23				
0.34							
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)							



PIEZOMETER CONSTRUCTION

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REMARKS

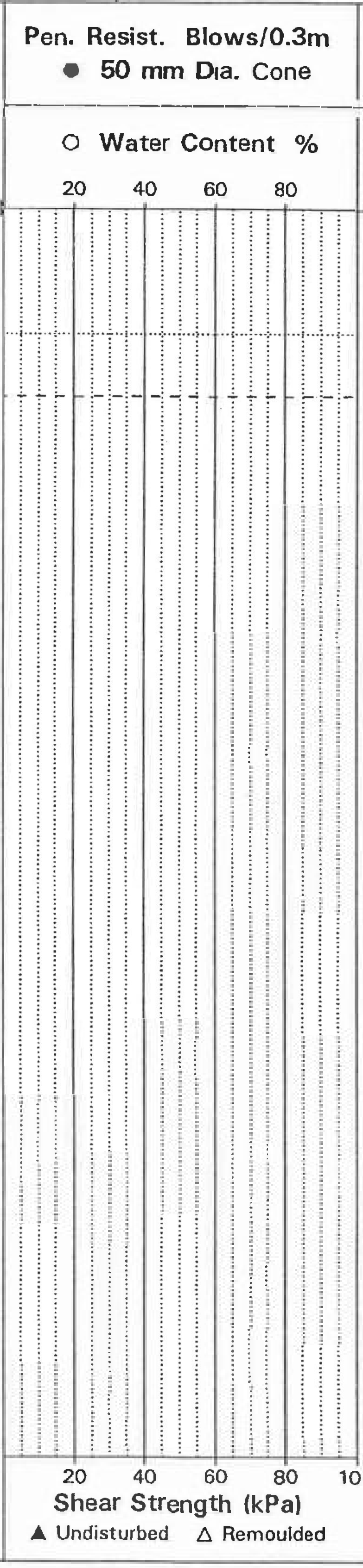
BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP19

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	136.38	
TOPSOIL 0.22								
Dark brown SILTY SAND, occasional cobbles 0.30		G	24					
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)								



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REMARKS

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DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	137.03		
TOPSOIL 0.20									
Yellowish **SILTY SAND,** occasional cobbles 0.58									
Weathered **BEDROCK** 0.79		G	25						
End of Test Pit TP terminated on bedrock surface (TP dry upon completion)									

Pen. Resist. / Water Content scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY Backhoe

DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	137.48		
TOPSOIL									
0.28 Weathered BEDROCK		G	26						
0.32 End of Test Pit									

TP terminated on bedrock surface

(TP dry upon completion)

Pen. Resist. / Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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DATE 16 September 1999

FILE NO. G7488

HOLE NO. TP22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	PIEZOMETER CONSTRUCTION
GROUND SURFACE						0	137.04		
TOPSOIL									
0.25									
Weathered BEDROCK		G	27						
0.30									
End of Test Pit									
T Pterminated on bedrock surface									
(TP dry upon completion)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also classified according to their "sensitivity". The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called "mechanical breaks") are easily distinguishable from the normal in-situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.) Rock core samples are obtained with the use of standard diamond drilling bits

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC%	-	Natural moisture content or water content of sample, %
LL	-	Liquid limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic limit, % (water content above which soil behaves plastically)
PI	-	Plasticity index, % (difference between LL and PL)
Dxx	-	Grain size at which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sand and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

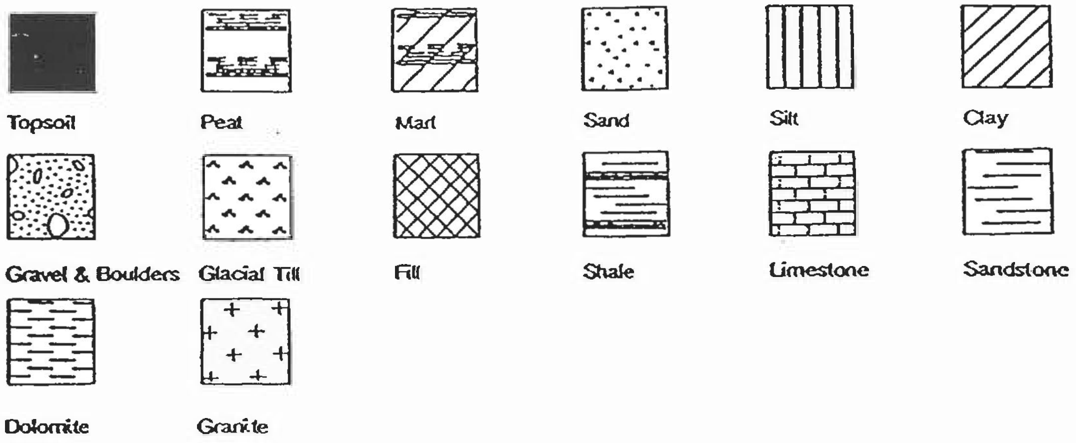
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidation ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

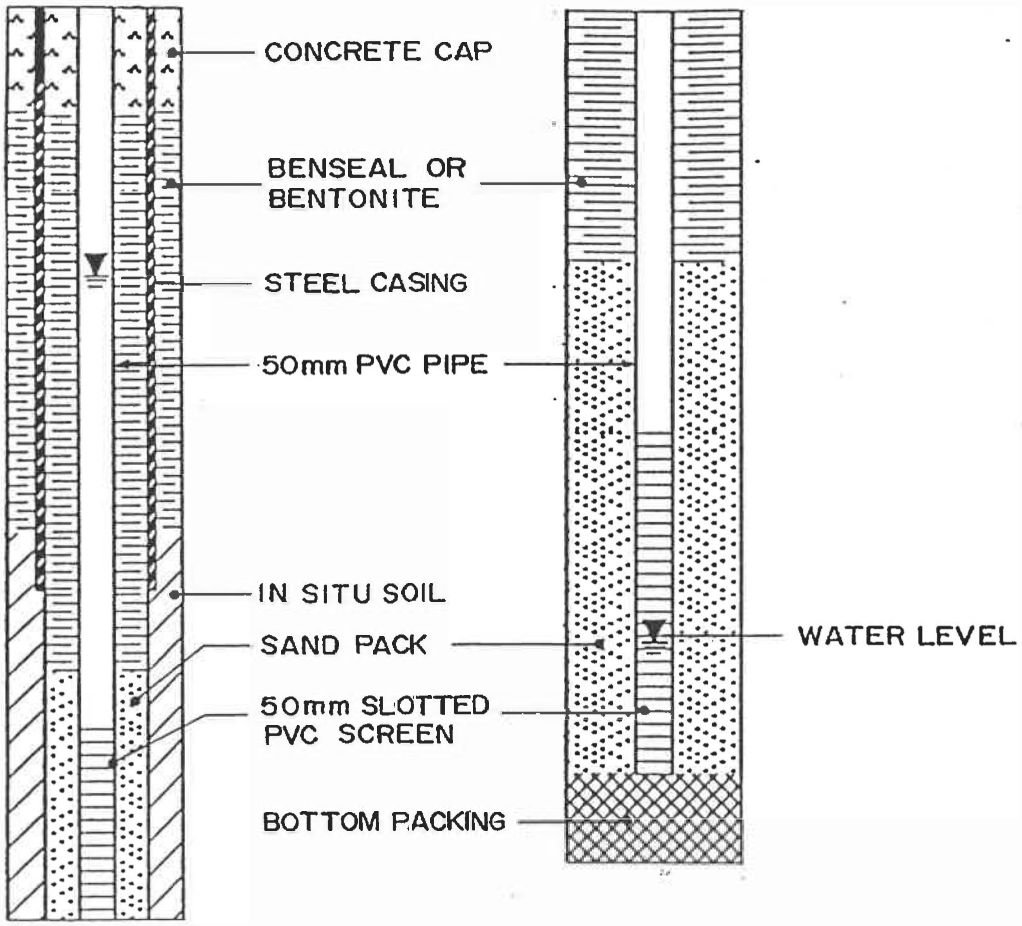
k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

SYMBOLS AND TERMS (continued)

STRATA PLOT



MONITORING WELL AND PIEZOMETER CONSTRUCTION


Monitoring Well Construction

Piezometer Construction

TEXTURAL SOIL CLASSIFICATION CHART

DESCRIPTION OF SOIL TEXTURE	SIZE OF PARTICLES	WEIGHT PERCENTAGE TO THE TOTAL DRY WEIGHT OF SOIL	DESCRIPTION OF SOIL TEXTURE	SIZE OF PARTICLES	WEIGHT PERCENTAGE TO THE TOTAL DRY WEIGHT OF SOIL
CLAY	Clay	50 to 100	SAND with a trace of Silt and Clay	Clay and Silt Sand and Gravel Gravel	5 to 12 88 to 95 0 to 10
LEAN CLAY	Clay Silt Sand and Gravel	30 to 50 0 to 50 0 to 50	GRAVEL with some Silt and Clay	Clay Silt Sand and Gravel Gravel	0 to 15 0 to 30 70 to 88 45 to 88
SILTY CLAY	Clay Silt Sand and Gravel	30 to 50 50 to 70 0 to 20	SAND - GRAVEL with some Silt and Clay	Clay Silt Sand and Gravel Gravel	0 to 15 0 to 30 70 to 88 10 to 45
SANDY CLAY	Clay Silt Sand and Gravel	30 to 50 0 to 20 50 to 70	SAND with some Silt and Clay	Clay Silt Sand and Gravel Gravel	0 to 15 0 to 30 70 to 88 0 to 10
SILT	Clay Silt Sand and Gravel	0 to 20 65 to 100 0 to 20	SILTY GRAVEL	Clay Silt Sand and Gravel Gravel	0 to 15 15 to 50 42.5 to 70 40 to 70
CLAYEY SILT	Clay Silt Sand and Gravel	15 to 30 50 to 80 0 to 35	SILTY SAND - GRAVEL	Clay Silt Sand and Gravel Gravel	0 to 15 15 to 50 42.5 to 70 10 to 40
SANDY SILT	Clay Silt Sand and Gravel	0 to 15 42.5 to 80 20 to 50	SILTY SAND	Clay Silt Sand and Gravel Gravel	0 to 15 15 to 50 42.5 to 70 0 to 10
CLAYEY SANDY SILT	Clay Silt Sand and Gravel	15 to 30 35 to 50 20 to 42.5	CLAYEY GRAVEL	Clay Silt Sand and Gravel Gravel	15 to 30 0 to 35 50 to 85 40 to 85
GRAVEL	Clay and Silt Sand and Gravel Gravel	0 to 5 95 to 100 50 to 100	CLAYEY SAND - GRAVEL	Clay Silt Sand and Gravel Gravel	15 to 30 0 to 35 50 to 85 10 to 40
SAND - GRAVEL	Clay and Silt Sand and Gravel Gravel	0 to 5 95 to 100 10 to 50	CLAYEY SAND	Clay Silt Sand and Gravel Gravel	15 to 30 0 to 35 50 to 85 0 to 10
SAND	Clay and Silt Sand and Gravel Gravel	0 to 5 95 to 100 0 to 10	CLAYEY SILTY GRAVEL	Clay Silt Sand and Gravel Gravel	15 to 30 20 to 42.5 35 to 50 30 to 50
GRAVEL with a trace of Silt and Clay	Clay and Silt Sand and Gravel Gravel	5 to 12 88 to 95 50 to 100	CLAYEY SILTY SAND - GRAVEL	Clay Silt Sand and Gravel Gravel	15 to 30 20 to 42.5 35 to 50 10 to 30
SAND - GRAVEL with a trace of Silt and Clay	Clay and Silt Sand and Gravel Gravel	5 to 12 88 to 95 10 to 50	CLAYEY SILTY SAND	Clay Silt Sand and Gravel Gravel	15 to 30 20 to 42.5 35 to 50 0 to 10

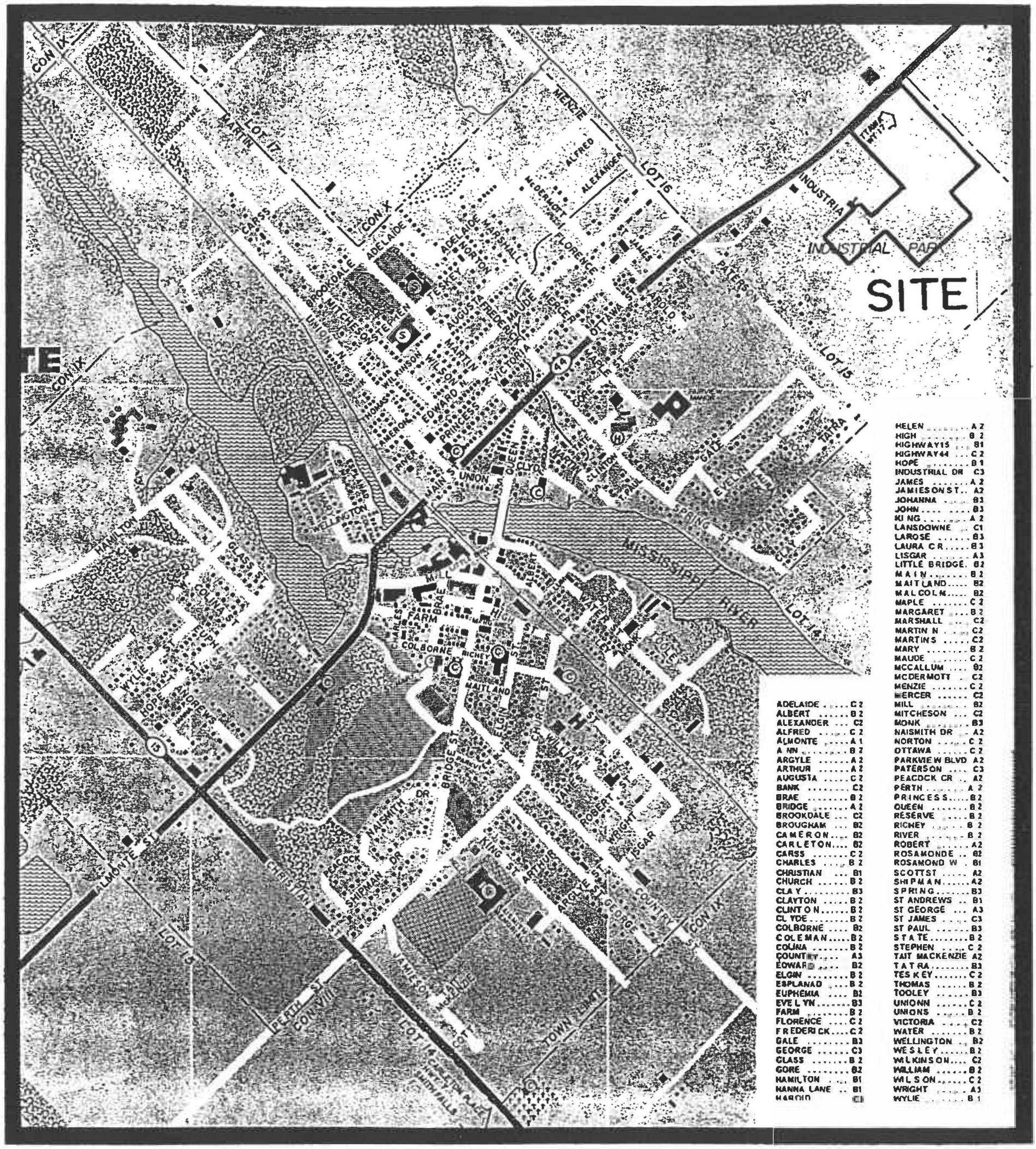
NOTE

FINE, MEDIUM and COARSE SAND are all described by "SAND".
However they respectively have at least 60% of the particles
in the 0.074 to 0.42 mm, 0.42 to 2.00 mm and 2.00 to 4.74 mm ranges.

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING NO. G7488-1 - TEST HOLE LOCATION PLAN



ADELAIDE	C 2
ALBERT	B 2
ALEXANDER	C2
ALFRED	C 2
ALMONTE	A 1
A NN	B 2
ARGYLE	A 2
ARTHUR	A 2
AUGUSTA	C 2
BANK	C2
BRAE	B 2
BRIDGE	A 2
BROOKDALE	C2
BROUGHAM	B2
CAMERON	B2
CARLETON	B2
CARSS	C 2
CHARLES	B 2
CHRISTIAN	B1
CHURCH	B 2
CLAY	B3
CLAYTON	B 2
CLINTON	B 2
CLYDE	B 2
COLBORNE	B2
COLEMAN	B 2
COLINA	B 2
COUNTRY	A3
EDWARD	B2
ELGIN	B 2
ESPLANAD	B 2
EUPHEMIA	B2
EVELYN	B3
FARM	B 2
FLORENCE	C 2
FREDERICK	C 2
GALE	B3
GEORGE	C3
GLASS	B 2
GORE	B2
HAMILTON	B1
HANNA LANE	B1
HAROLD	C3
HELEN	A 2
HIGH	B 2
HIGHWAY15	B1
HIGHWAY44	C 2
HOPE	B 1
INDUSTRIAL DR	C3
JAMES	A 2
JAMIESON ST	A2
JOHANNA	B3
JOHN	B3
KING	A 2
LANSDOWNE	C1
LAROSE	B3
LAURA CR	B3
LISGAR	A3
LITTLE BRIDGE	B2
MAIN	B 2
MAITLAND	B2
MALCOLM	B2
MAPLE	C 2
MARGARET	B 2
MARSHALL	C2
MARTIN N	C2
MARTIN S	C2
MARY	B 2
MAUDE	C 2
MCCALLUM	B2
MCDERMOTT	C2
MENZIE	C 2
MERCER	C2
MILL	B2
MITCHESON	C2
MONK	B3
NAISMITH DR	A2
NORTON	C 2
OTTAWA	C 2
PARKVIEW BLVD	A2
PATERSON	C3
PEACOCK CR	A2
PERTH	A 2
PRINCESS	B 2
QUEEN	B 2
RESERVE	B 2
RICHEY	B 2
RIVER	B 2
ROBERT	A2
ROSAMONDE	B2
ROSAMOND W	B1
SCOTT ST	A2
SHIPMAN	A2
SPRING	B3
ST ANDREWS	B1
ST GEORGE	A3
ST JAMES	C3
ST PAUL	B3
STATE	B 2
STEPHEN	C 2
TAIT MACKENZIE	A2
TATRA	B3
TESKEY	C 2
THOMAS	B 2
TOOLEY	B3
UNION N	C 2
UNION S	B 2
VICTORIA	C2
WATER	B 2
WELLINGTON	B2
WESLEY	B 2
WILKINSON	C2
WILLIAM	B 2
WILSON	C 2
WRIGHT	A3
WYLIE	B 1

FIGURE 1

KEY PLAN

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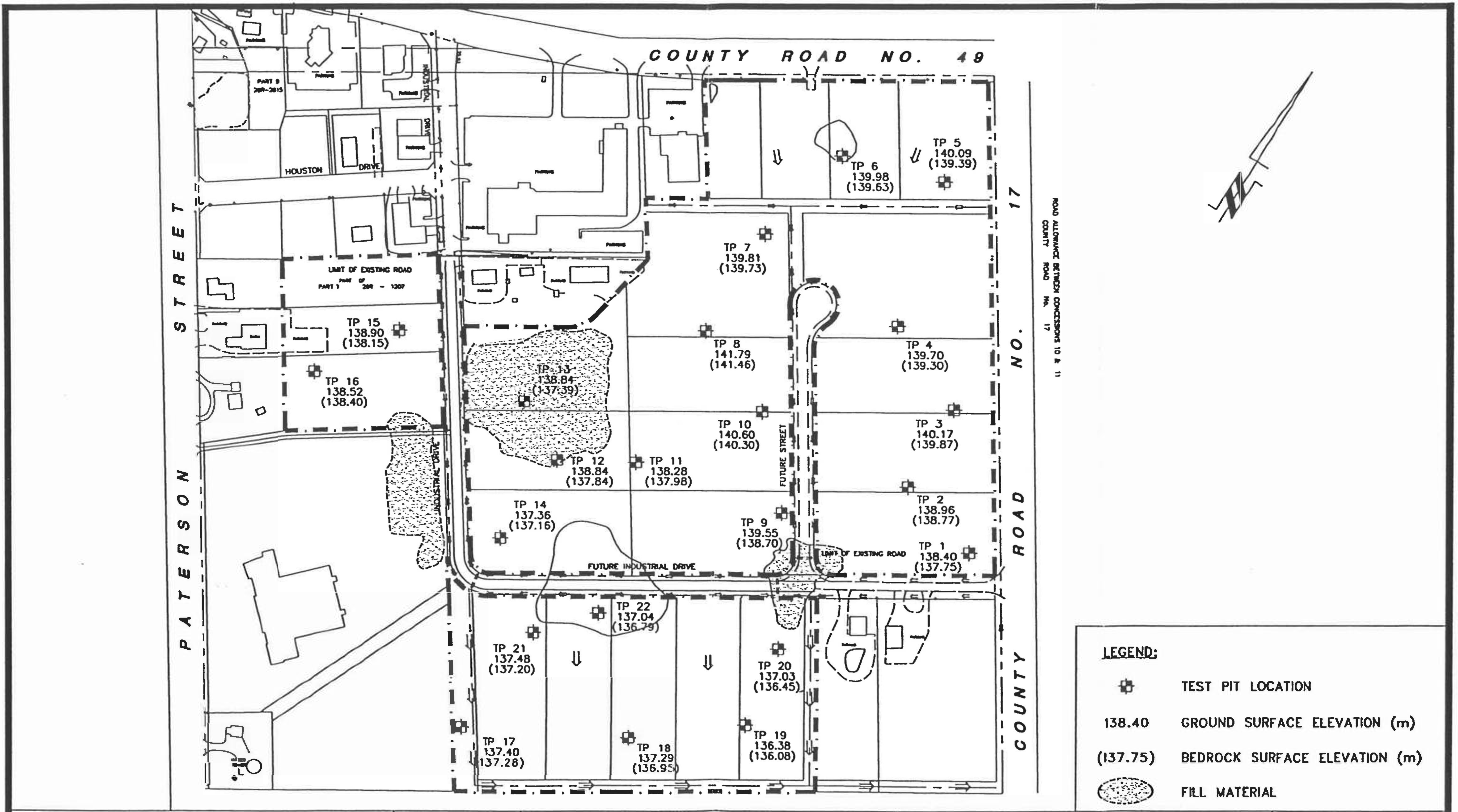

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Scale-	1:3000
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Dwn-	
Chkd-	MSD

NOVATECH ENGINEERING CONSULTANTS LIMITED
GEOTECHNICAL INVESTIGATION
MISSISSIPPI MILLS BUSINESS PARK
COUNTY OF LANARK, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No. G7488–1
Report No. G7488-99
Date- 99/10

11x17