

GEOCRES No:
30M16-29

**GEOTECHNICAL INVESTIGATION REPORT
FILL INVESTIGATION
HIGHWAY 401 – BURNHAM STREET BRIDGE REPLACEMENT
AND INTERCHANGE IMPROVEMENTS
COBOURG, ONTARIO
W.P. 678-90-00
SITE: 21-243**

Prepared For:

MCCORMICK RANKIN CORPORATION

Prepared by:

SHAHEEN & PEAKER LIMITED

**Project: SPT1018B
June 7, 2001**

**250 Galaxy Boulevard
Etobicoke, Ontario
M9W 5R8
Tel: (416) 213-1255
Fax: (416) 213-1260**

Table of Contents

1. INTRODUCTION	1
2. SITE DESCRIPTION AND PHYSIOGRAPHY	1
3. METHOD OF INVESTIGATION	2
4. SUBSURFACE CONDITIONS	3
APPENDIX A: Test Pit Location Plan	1
APPENDIX B: Test Pit Log Sheets	2 to 11
APPENDIX C: Laboratory Test Results	12 to 15

**GEOTECHNICAL INVESTIGATION REPORT
FILL INVESTIGATION
HIGHWAY 401 – BURNHAM STREET BRIDGE REPLACEMENT
AND INTERCHANGE IMPROVEMENTS
COBOURG, ONTARIO
W.P. 678-90-00
SITE: 21-243**

1. INTRODUCTION

As part of the planned widening of Highway 401 from four to six lanes, the existing Burnham Street Bridge over Highway 401 in Cobourg, will be replaced with a longer and wider structure.

Shaheen & Peaker Limited (S&P) was retained by McCormick Rankin Corporation (MRC) to carry out an investigation of existing stockpiled fill located at the southwest quadrant of the Highway 401 and Burnham Street Interchange (Interchange # 472). This work was performed in conjunction with the foundation investigation for the Burnham Street Bridge replacement.

The purpose of the investigation was to evaluate the nature and quality of the fill within the existing berm at the southwest quadrant and to determine its suitability for use as a structural fill.

2. SITE DESCRIPTION AND PHYSIOGRAPHY

The site is located at the intersection of Highway 401 and Burnham Street in Cobourg about four kilometers north of Lake Ontario

The interchange is located on the boundary of the Town of Cobourg and the Township of Hamilton in the County of Northumberland. This is one of the two interchanges providing access to the Town of Cobourg from Highway 401.

Burnham Street is a two-lane roadway at and north of the interchange and a recently upgraded 4-lane roadway immediately south of the interchange.

Burnham Street structure over Highway 401 was constructed in 1960 and is a 31.1 m long, single span structure that accommodates two lanes of traffic.

The Ministry recently constructed a concrete tall median barrier wall at the interchange area with a median drainage system. Fill from this operation was placed in the southwest quadrant area.

The study area is located in the physiographic region known as the "Iroquois Plain". The plain consists of drumlins and sand plain (Ref: Chapman and Putnam, 1984).

The lowermost bedrock in the general area (i.e. Northumberland County) consists of Precambrian rock, with upper layers of limestone. These limestone layers are made up of the Trenton Group bedrock formations and were deposited during the Middle Ordovician Period, during the Paleozoic seas, some 480 million years ago.

Glacio-lacustrine lake plain deposits of silt and clay with gently rolling terrain characterize the soils of the area.

The majority of the interchange is located on Schomberg soils. At the interchange site the soil is Smithfield, a silty clay loam of the Gray Brown Podzolic Group. Characteristics of this soil type are imperfect drainage, smooth to gently sloping topography, free of stones.

Cobourg Creek is located about 200 mm east of the Burnham Street Bridge and the grade at the site drops from west to east towards the creek valley. The watercourse flows northeast to southwest towards Lake Ontario and crosses under Highway 401 via an existing concrete arch culvert, 65.5 m in length. Highway 401 has a median storm sewer system which outlets to a detention pond with a sediment forebay, immediately adjacent to the creek.

3. METHOD OF INVESTIGATION

Ten exploratory test pits (Nos. 1 to 10) were excavated to depths ranging from 2.7 to 4.4 metres with a rubber tire backhoe by a sub-contractor under the direction and supervision of Shaheen & Peaker Limited personnel. Representative soil samples were retrieved at regular intervals of depth and the samples were logged in the field and returned to the Shaheen & Peaker Limited laboratory for detailed examination by the project engineer.

The soil samples were tested for moisture content and selected samples for grain size analysis and Atterberg limits. Standard Proctor Laboratory Density tests were also conducted on two bulk samples from the fill deposit.

Water level observations were made during excavation and in the open test pits at the completion of the fieldwork.

The ground surface elevations at the test pit locations were surveyed by MRC's surveyors J.D. Barnes, who also provided us with the test pit locations.

4. SUBSURFACE CONDITIONS

The subsurface conditions encountered in the test pits are shown in detail on the attached Test Pit Log sheets. These can be summarized as follows.

A topsoil veneer with thickness ranging from 100 to 300 mm was encountered at the surface in all test pits. Fill of variable quality was encountered below the surficial topsoil in all test pits and extended to depths ranging from 1.8 to 4.1 metres. The fill generally consisted of clayey silt with sand and traces of gravel. See Drawing 12 for typical Grain Size Distribution curves. The fill was typically of good quality in Test Pits 1, 5 and 8, and in the upper levels of Test Pits 2, 3 and 9. The remainder of the fill was of poor quality and contained varying amounts of topsoil/organics. In Test Pits 9 and 10, the fill consisted primarily of topsoil. Some corrugated pipe debris was encountered at Test Pit 3, however, the fill was typically free of construction debris at the test pit locations. The natural moisture content of the samples recovered from the fill ranged from 11 % to 24 %, but was more typically between 15 % and 24 %. The plastic limit of the fill ranged from 15 % to 17 % with a corresponding plasticity index ranging from 7 to 10, indicating a clayey soil of low plasticity. Atterberg limits test results are shown on Drawing 13. Laboratory Standard Proctor Density tests were carried out on composite samples of the fill from Test Pits 1 & 9 and Test Pits 5 & 8. The results are shown graphically on Drawings 14 and 15 and can be summarized as follows:

Sample	TP 1 & 9 clayey silt with sand, trace gravel	TP 5 & 8 clayey silt with sand, trace gravel
MAXIMUM DRY DENSITY	1875 kg/m ³	1856 kg/m ³
MAXIMUM WET DENSITY	2199 kg/m ³	2131 kg/m ³
OPTIMUM MOISTURE CONTENT	17.3 %	14.8 %

A buried topsoil layer was encountered below the fill in Test Pits 1 through 5, 8 and 10. The thickness of the topsoil layer ranged from 300 to 600 mm.

Underlying the topsoil in Test Pits 2, 3 and 5 and the fill in Test Pit 6, the natural soil consisted of clayey silt to silty clay. This deposit was furrowed and appeared to be a transition zone to the underlying glacial till.

The predominant subsurface glacial till deposit was encountered underlying the above materials in all test pits and extended to the maximum depth explored, i.e., 2.7 to 4.4 m. The till deposit consisted of a clayey silt to silty clay matrix with inclusions of sand and gravel, and a wet sand seam at 4.0 m in Test Pit 3. The brown till was typically in a moist state with a stiff to very stiff consistency.

All test pits were dry, except Test Pit 3, where the water level was at a depth of 4.0 m, on completion of the investigation.

Shaheen & Peaker Limited



Osbert Benjamin, P.Eng.

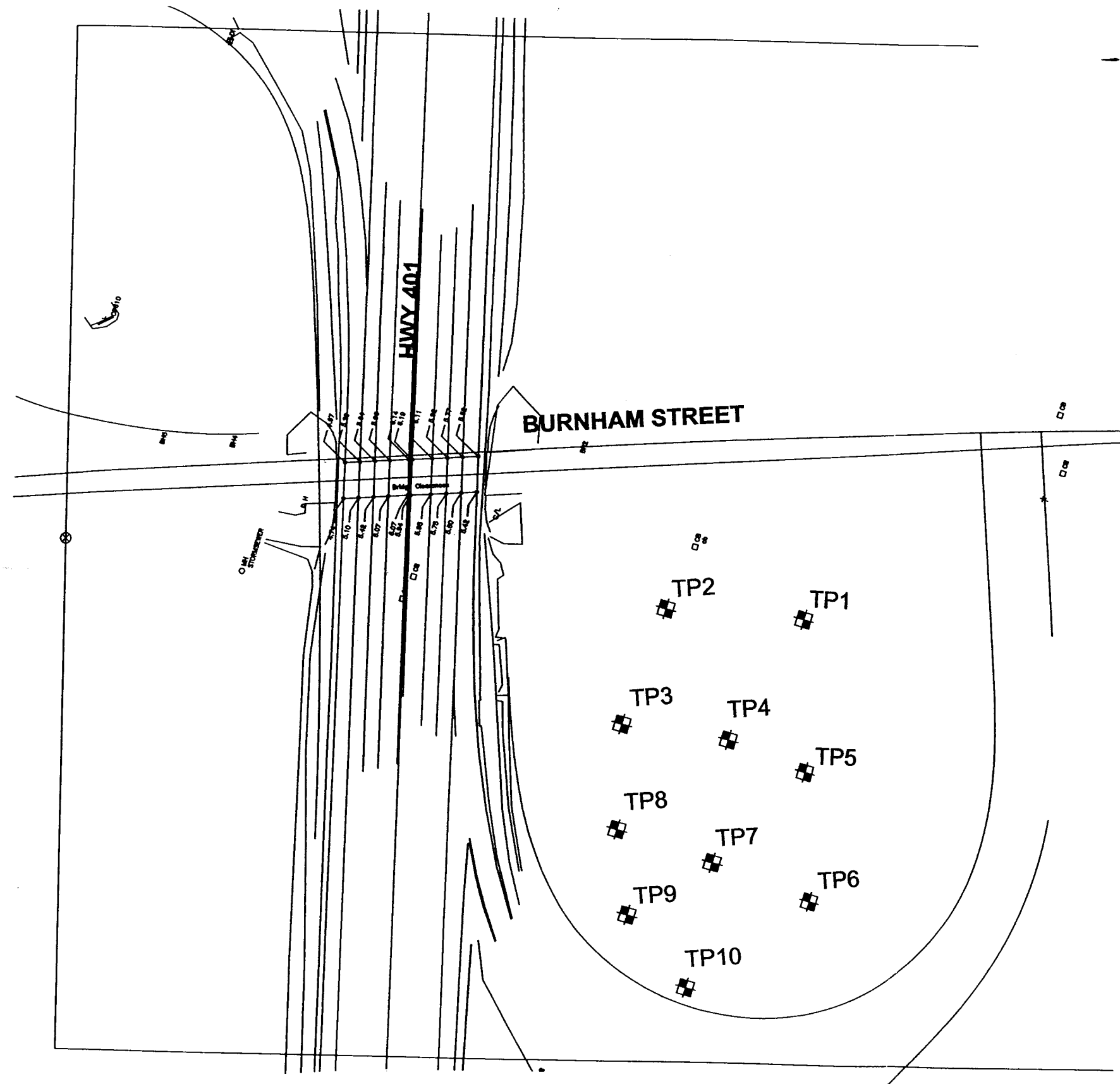


Zuhtu Ozden, P. Eng.



APPENDIX A

Test Pit Location Plan



SHAHEEN & PEAKER LIMITED		
TEST PIT LOCATION PLAN		
HWY 401 AT BURNHAM STREET, COBOURG, ONTARIO		
PROJECT: SPT1018	Scale: ~1:650	DRAWING NO. 1

APPENDIX B

Test Pit Log Sheets

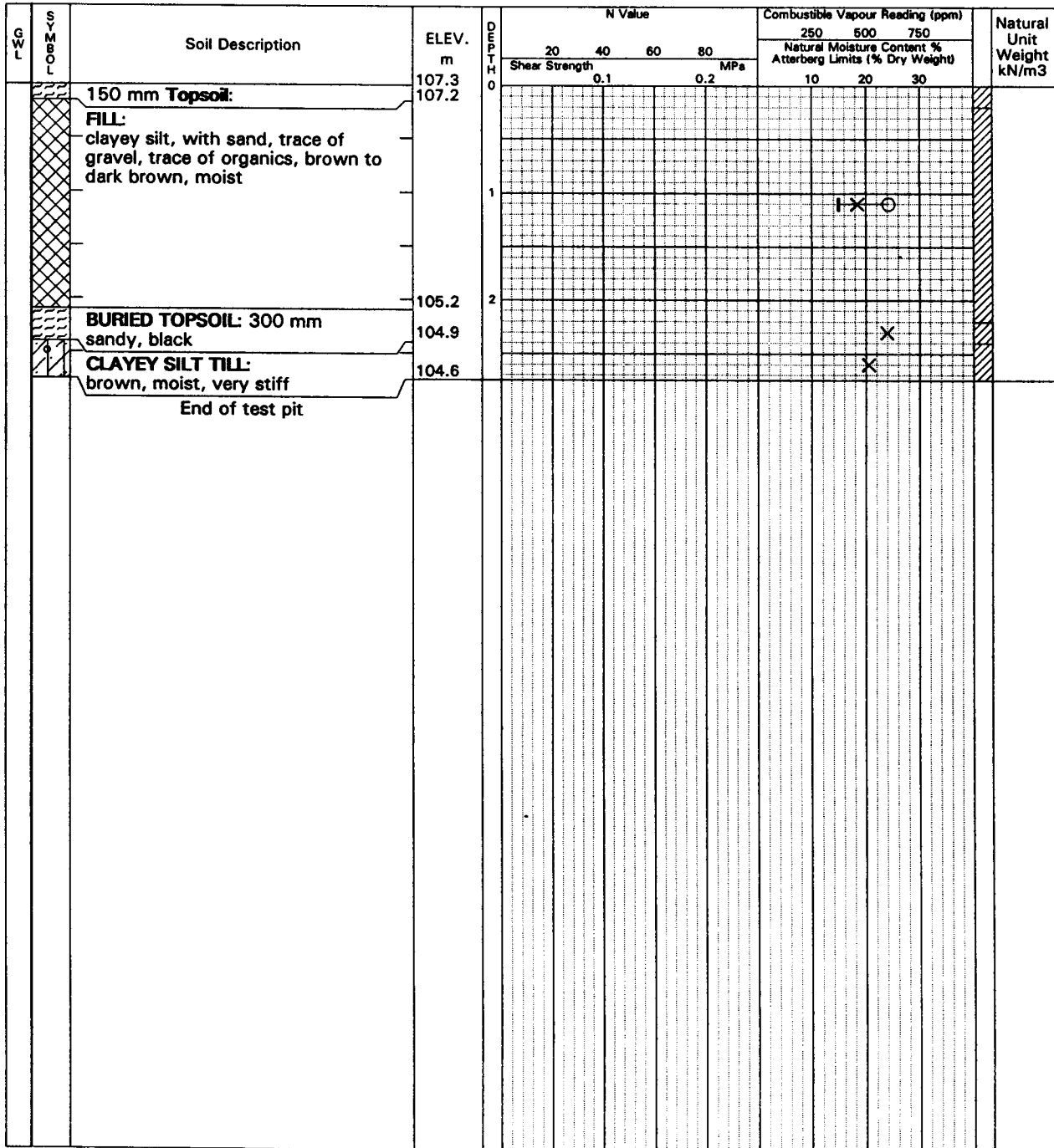
Project No. **SPT1018B**

Log of Test Pit TP1

Dwg No. **2**Project: **Hwy 401 Bridge Replacement**Sheet No. **1** of **1**Location: **Hwy 401 at Burnham Street, Cobourg, Ontario**Date Drilled: **December 21, 2000**Drill Type: **Rubber Tire Backhoe**Datum: **Geodetic**

Bag Sample ☒
SPT (N) Value ☐ ☒
Dynamic Cone Test ☐
Shelby Tube ☒
Field Vane Test ☐
Sensitivity ☐

Combustible Vapour Reading ☐
Natural Moisture ☒
Plastic and Liquid Limit ☐
Undrained Triaxial at % Strain at Failure ☐
Penetrometer ☒
Piezometric Water Level ☐



Shaheen and Peaker Limited
Consulting Engineers

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	

Project No. **SPT1018B**

Log of Test Pit TP2

Dwg No. **3**Project: **Hwy 401 Bridge Replacement**Sheet No. **1** of **1**Location: **Hwy 401 at Burnham Street, Cobourg, Ontario**Date Drilled: **December 21, 2000**Drill Type: **Rubber Tire Backhoe**Datum: **Geodetic**Bag Sample ☒SPT (N) Value ☐Dynamic Cone Test ☐Shelby Tube ☐Field Vane Test ☐Sensitivity ☐☒☐☐☐☐☐Combustible Vapour Reading ☐Natural Moisture ☒Plastic and Liquid Limit ☐Undrained Triaxial ☐at % Strain at Failure ☐Penetrometer ☐Piezometric Water Level ☐

GWL	SYM SOIL	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					MPa				Natural Moisture Content %			
					Shear Strength				Atterberg Limits (% Dry Weight)			
					0.1	0.2			10	20	30	
		100 mm Topsoil:	106.7	0								
		FILL:	106.6									
		clayey silt, with sand, trace of gravel, trace of organics, brown, moist										
				1								
		clayey silt, trace of sand, some organics, brown/dark brown, wet	105.2									
				2								
		TOPSOIL: 300 mm	104.3									
		sandy, black	104.0									
		CLAYEY SILT:	103.7									
		furrowed, brown, moist, stiff		3								
		CLAYEY SILT TILL	103.4									
		brown, moist, very stiff										
		End of test pit										

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	

S & PShaheen and Peaker Limited
Consulting Engineers

Project No. **SPT1018B**

Log of Test Pit TP3

Dwg No. **4**Project: **Hwy 401 Bridge Replacement**Sheet No. **1** of **1**Location: **Hwy 401 at Burnham Street, Cobourg, Ontario**Date Drilled: **December 21, 2000**Drill Type: **Rubber Tire Backhoe**Datum: **Geodetic**

Bag Sample ☒
 SPT (N) Value ☐ ☒
 Dynamic Cone Test ☐
 Shelby Tube ☒
 Field Vane Test ☐
 Sensitivity ☐ S
 Combustible Vapour Reading ☐
 Natural Moisture ☒
 Plastic and Liquid Limit ☐
 Undrained Triaxial at % Strain at Failure ☐
 Penetrometer ☒
 Piezometric Water Level ☐

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH m	N Value		Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	250	500	750	
					Shear Strength		Natural Moisture Content %			
					0.1		Atterberg Limits (% Dry Weight)			
					0.2		10			
					MPa		20			
							30			
		150 mm Topsoil:	107.2	0						
		FILL: clayey silt, with sand, trace of gravel, trace of organics, brown, moist	107.1							
				1						
		clayey silt, some sand, gravel, some organics/topsoil, dark brown/black, very moist	106.0							
		perched water from corrugated pipe at 1.5 m		2						
				3						
		TOPSOIL: 300 mm	104.2							
		CLAYEY SILT: furrowed, brown, moist, stiff	103.9							
		CLAYEY SILT TILL: brown, moist, wet sand seam at 4.0 m, very stiff	103.6							
			103.2	4						
		End of test pit	102.9							

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	4.0	



Shaheen and Peaker Limited
Consulting Engineers

Log of Test Pit TP4

Dwg No. 5

Project: **Hwy 401 Bridge Replacement**

Sheet No. 1 of 1

Location: Hwy 401 at Burnham Street, Cobourg, Ontario

Date Drilled: December 21, 2000

Drill Type: Rubber Tire Backhoe

Datum: Geodetic

Bag Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Sensitivity

Combustible Vapour Reading

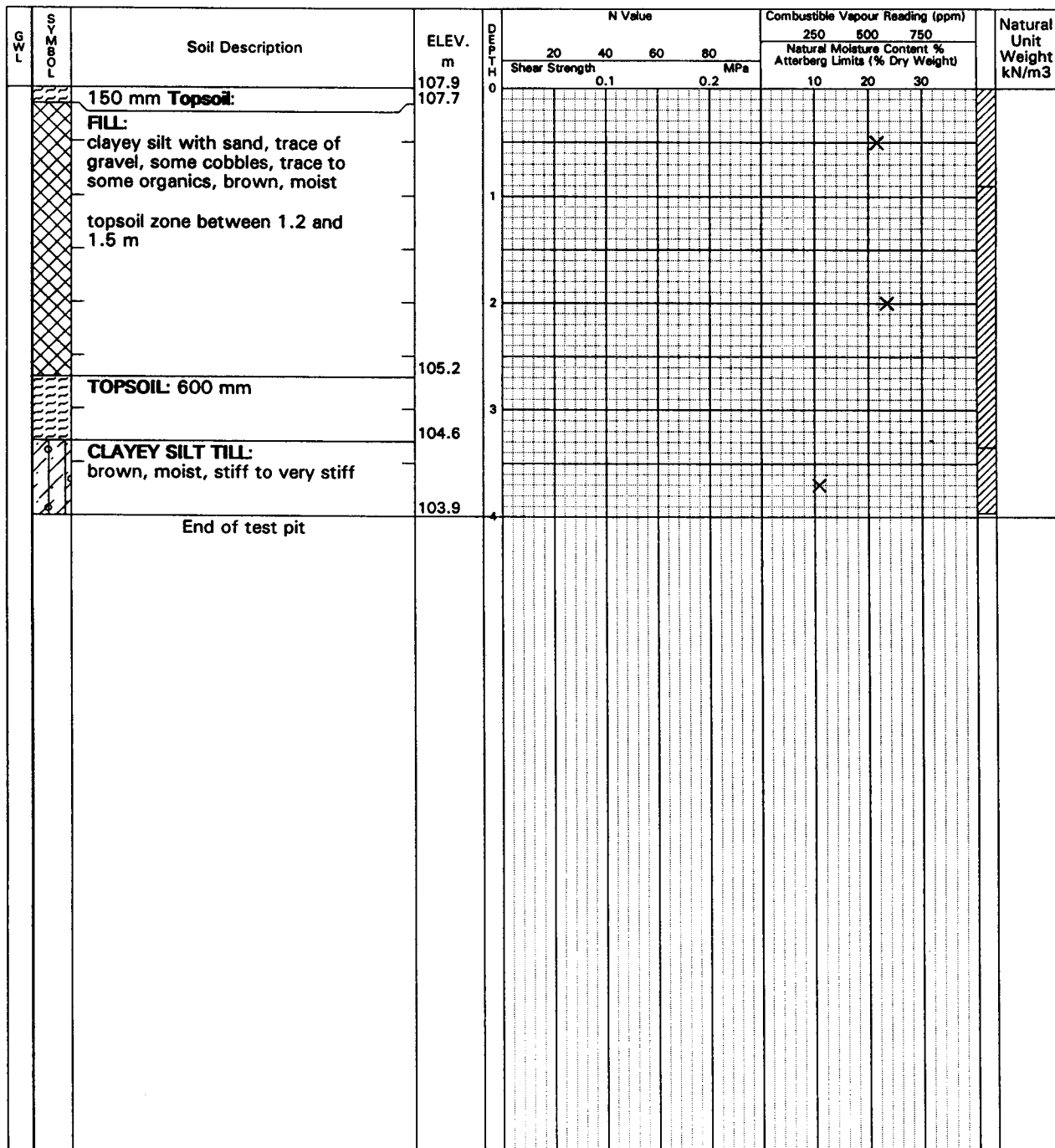
Natural Moisture

Plastic and Liquid Limit

**Undrained Triaxial
at % Strain at Failure**

Penetrometer

Piezometric Water Level



WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	

S & P

Shaheen and Peaker Limited
Consulting Engineers

Project No. SPT1018B

Log of Test Pit TP5

Dwg No. 6Project: Hwy 401 Bridge ReplacementSheet No. 1 of 1Location: Hwy 401 at Burnham Street, Cobourg, OntarioDate Drilled: December 21, 2000Drill Type: Rubber Tire BackhoeDatum: GeodeticBag Sample ☒SPT (N) Value ☐Dynamic Cone Test ☐Shelby Tube ☐Field Vane Test ☐Sensitivity ☐Combustible Vapour Reading ☐Natural Moisture ☐Plastic and Liquid Limit ☐Undrained Triaxial ☐at % Strain at Failure ☐Penetrometer ☐Piezometric Water Level ☐

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH m	N Value		Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	MPa	
		150 mm Topsoil:	107.9	0						
		FILL: clayey silt, with sand, trace of gravel, trace of organics, brown, moist	107.8							
		TOPSOIL: 300 mm sandy, black	105.9	2						
		CLAYEY SILT: furrowed, trace of gravel, rootlets, brown, moist, stiff	105.6							
		CLAYEY SILT TILL: brown, moist, very stiff	105.2							
		End of test pit	104.6	3						

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	



Shaheen and Peaker Limited
Consulting Engineers

Project No. **SPT1018B**

Log of Test Pit TP6

Dwg No. **7**Project: **Hwy 401 Bridge Replacement**Sheet No. **1** of **1**Location: **Hwy 401 at Burnham Street, Cobourg, Ontario**Date Drilled: **December 21, 2000**Drill Type: **Rubber Tire Backhoe**Datum: **Geodetic**

Bag Sample ☒
 SPT (N) Value ☐ ☒
 Dynamic Cone Test ☐
 Shelby Tube ☒
 Field Vane Test ☐
 Sensitivity ☐ S

Combustible Vapour Reading ☐
 Natural Moisture ☒
 Plastic and Liquid Limit ☐
 Undrained Triaxial at % Strain at Failure ☒
 Penetrometer ☒
 Piezometric Water Level ☐

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
					Shear Strength				10	20	30	
					0.1		0.2					
		200 mm Topsoil:	107.8	0								
		FILL:	107.6									
		clayey silt, with sand, trace of gravel, some topsoil, organics, dark brown, moist		1								
			106.0									
		CLAYEY SILT:		2								
		furrowed, brown, moist, stiff	105.4									
			105.0									
		CLAYEY SILT TILL:										
		brown, moist, very stiff	105.0									
		End of test pit										

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	



Shaheen and Peaker Limited
Consulting Engineers

Project No. **SPT1018B**

Log of Test Pit TP7

Dwg No. **8**Project: **Hwy 401 Bridge Replacement**Sheet No. **1** of **1**Location: **Hwy 401 at Burnham Street, Cobourg, Ontario**Date Drilled: **December 21, 2000**Drill Type: **Rubber Tire Backhoe**Datum: **Geodetic**

Bag Sample ☒
 SPT (N) Value ☐
 Dynamic Cone Test ☐
 Shelby Tube ☐
 Field Vane Test ☐
 Sensitivity ☐

Combustible Vapour Reading ☐
 Natural Moisture ☐
 Plastic and Liquid Limit ☐
 Undrained Triaxial at % Strain at Failure ☐
 Penetrometer ☐
 Piezometric Water Level ☐

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					MPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
					Shear Strength							
					0.1	0.2			10	20	30	
		200 mm Topsoil:	107.8	0								
		FILL:	107.6									
		clayey silt and sand, with topsoil, some cobbles, boulders, dark brown to black, moist		1								
				2								
				3								
		CLAYEY SILT TILL:	104.5									
		brown, moist, very stiff	104.1									
		End of test pit										

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	



Shaheen and Peaker Limited
Consulting Engineers

Project No. **SPT1018B**

Log of Test Pit TP8

Dwg No. **9**Project: **Hwy 401 Bridge Replacement**Sheet No. **1** of **1**Location: **Hwy 401 at Burnham Street, Cobourg, Ontario**Date Drilled: **December 21, 2000**Drill Type: **Rubber Tire Backhoe**Datum: **Geodetic**

Bag Sample ☒
 SPT (N) Value ☐ ☒
 Dynamic Cone Test ☐
 Shelby Tube ☒
 Field Vane Test ☐
 Sensitivity ☐ S

Combustible Vapour Reading ☐
 Natural Moisture ☒
 Plastic and Liquid Limit ☐
 Undrained Triaxial at % Strain at Failure ☒
 Penetrometer ☒
 Piezometric Water Level ☐

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					MPa				Natural Moisture Content %			
					Shear Strength				Atterberg Limits (% Dry Weight)			
					0.1	0.2			10	20	30	
		300 mm Topsoil:	107.3	0								
		FILL:	107.2									
		clayey silt, with sand, trace of gravel, cobbles, trace of topsoil, brown to grey brown, moist		1								
				2								
		TOPSOIL: 300 mm	104.7									
		CLAYEY SILT TILL:	104.4	3								
		brown, moist, stiff to very stiff										
		End of test pit	103.6									



Shaheen and Peaker Limited
 Consulting Engineers

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	

Project No. **SPT1018B**

Log of Test Pit TP9

Dwg No. **10**Project: **Hwy 401 Bridge Replacement**Sheet No. **1** of **1**Location: **Hwy 401 at Burnham Street, Cobourg, Ontario**Date Drilled: **December 21, 2000**Drill Type: **Rubber Tire Backhoe**Datum: **Geodetic**

Bag Sample ☒
 SPT (N) Value ☐
 Dynamic Cone Test ☐
 Shelby Tube ☒
 Field Vane Test ☐
 Sensitivity ☐

Combustible Vapour Reading ☐
 Natural Moisture ☒
 Plastic and Liquid Limit ☐
 Undrained Triaxial at % Strain at Failure ☐
 Penetrometer ☒
 Piezometric Water Level ☐

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m3		
									250	500	750			
					Shear Strength				Natural Moisture Content % Atterberg Limits (% Dry Weight)					
					20	40	60	80	MPa	10	20	30		
		200 mm Topsoil:	108.5	0										
		FILL:	108.4											
		clayey silt, some sand, trace of gravel, gravel, rootlets, brown, moist, compact	107.8	1							X			
		topsoil mixed with sand and gravel, some cobbles, moist		2										
				3										
			104.4	4										
		CLAYEY SILT TILL: brown, moist, stiff to very stiff	104.0										X	
		End of test pit												

WATER LEVEL RECORD:

Time	Water Level (m)	Depth to Cave (m)
on completion	dry	



Shaheen and Peaker Limited
Consulting Engineers

Project No. **SPT1018B**

Log of Test Pit TP10

Dwg No. **11**Project: **Hwy 401 Bridge Replacement**Sheet No. **1** of **1**Location: **Hwy 401 at Burnham Street, Cobourg, Ontario**Date Drilled: **December 21, 2000**Drill Type: **Rubber Tire Backhoe**Datum: **Geodetic**Bag Sample ☒SPT (N) Value ☐Dynamic Cone Test ☐Shelby Tube ☒Field Vane Test ☐Sensitivity ☐☒☐☐☒☐☐☐Combustible Vapour Reading ☐Natural Moisture ☒Plastic and Liquid Limit ☐Undrained Triaxial ☒at % Strain at Failure ☐Penetrometer ☒Piezometric Water Level ☐

GWL	SYMBOL	Soil Description	ELEV. m	DEPTH m	N Value				Combustible Vapour Reading (ppm)			Natural Unit Weight kN/m ³
					20	40	60	80	250	500	750	
					MPa				Natural Moisture Content %			
					MPa				Atterberg Limits (% Dry Weight)			
					0.1	0.2			10	20	30	
		100 mm Topsoil:	108.3	0								
		FILL:	108.2									
		topsoil mixed with sand, trace of gravel, occasional cobbles, grass, brown, moist		1								
				2								
				3								
		TOPSOIL: 300 mm	105.3									
		CLAYEY SILT TILL:	105.0									
		brown, moist, stiff to very stiff	104.7									
		End of test pit										

WATER LEVEL RECORD:

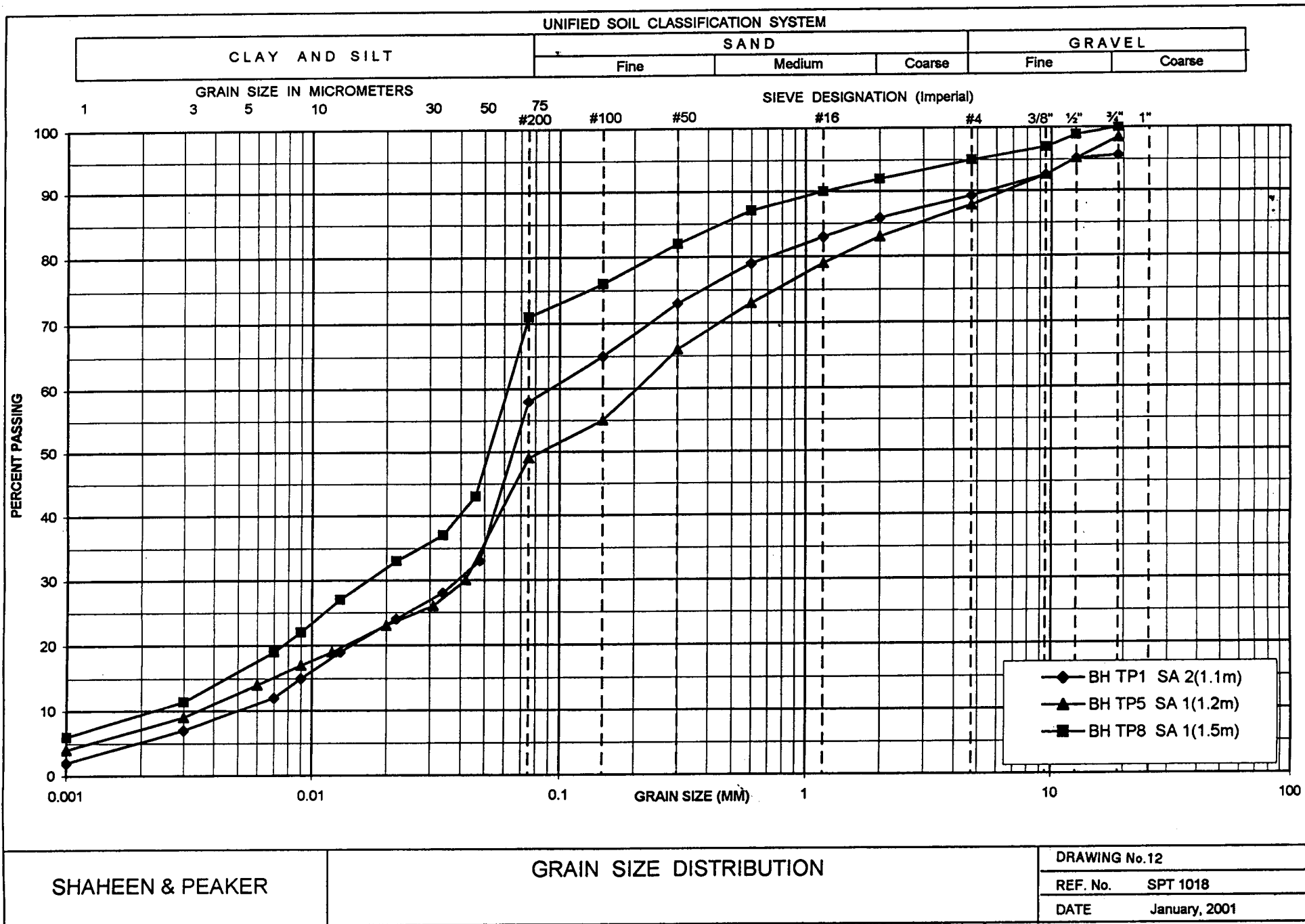
Time	Water Level (m)	Depth to Cave (m)
on completion	dry	



Shaheen and Peaker Limited
Consulting Engineers

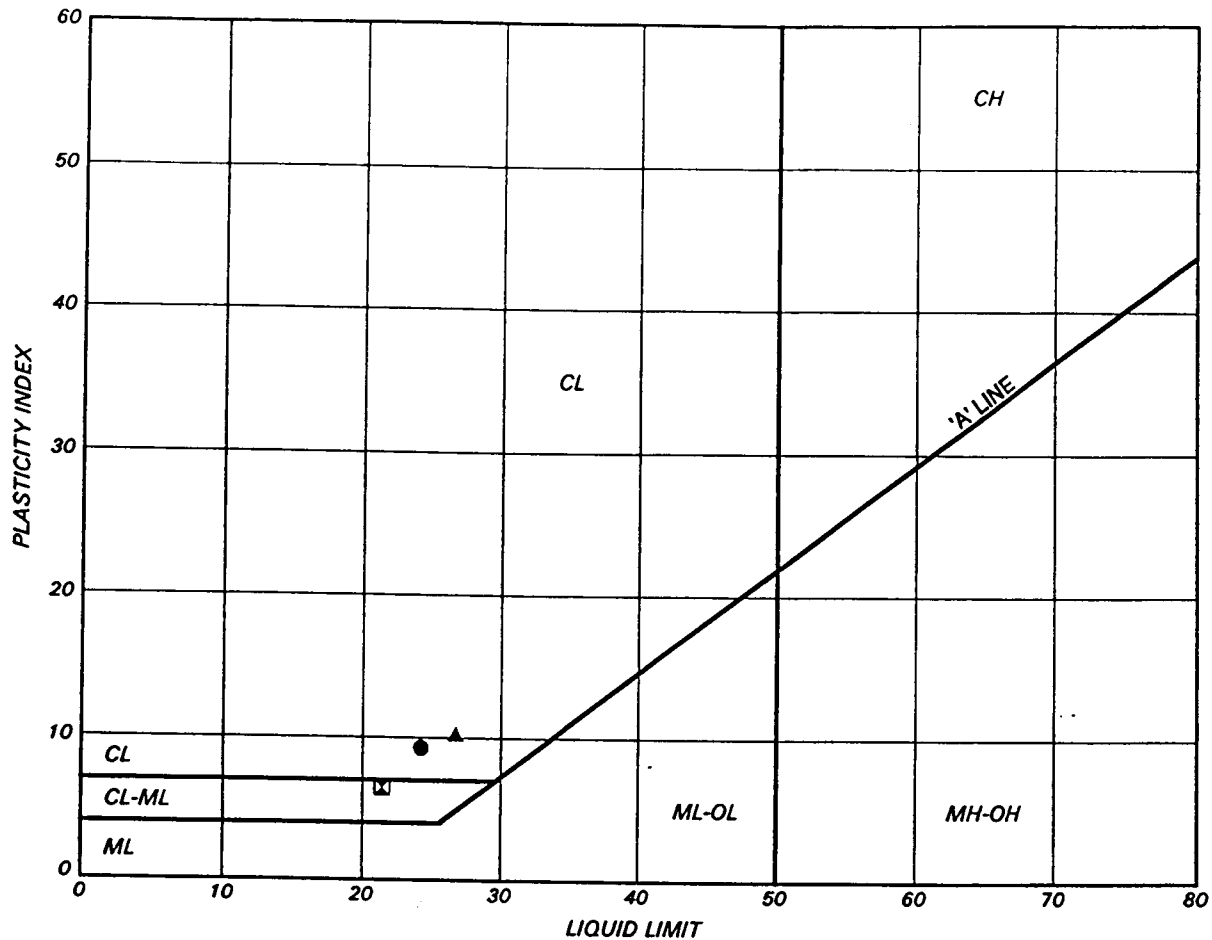
APPENDIX C

Laboratory Test Results



Hwy 401 Bridge Replacement
ATTERBERG LIMITS TEST RESULTS

DRAWING No.13



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TP1	1.1	107.3
⊠	TP5	1.2	107.9
▲	TP8	1.5	107.3

Date March 2001

Project SPT1018

Prep'd GT

Chkd. OB

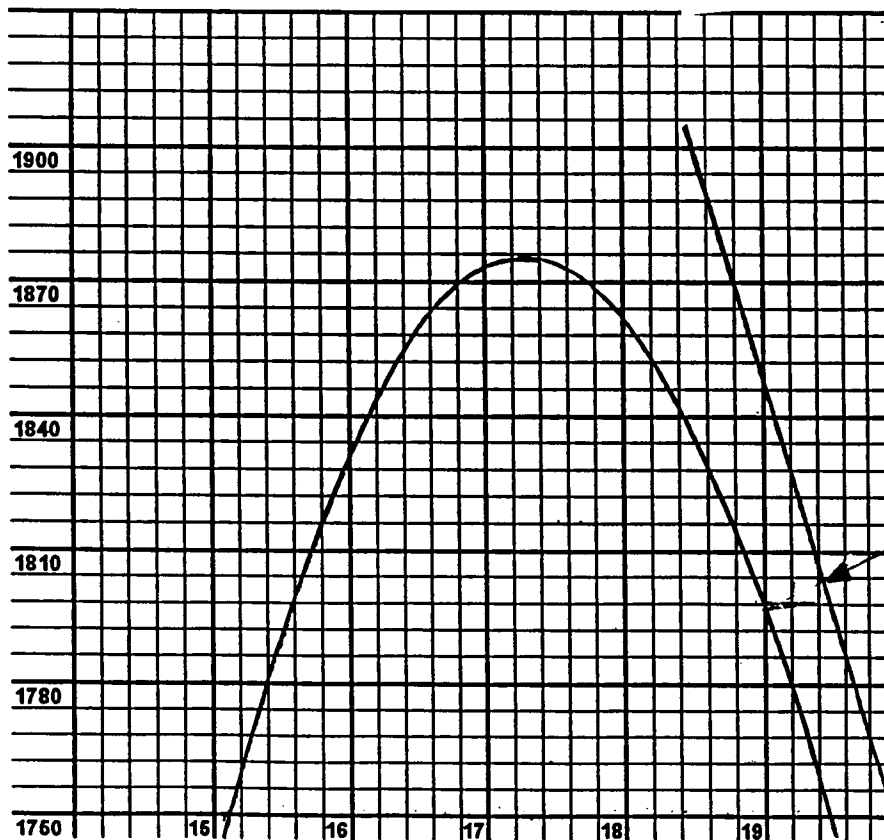
SHAHEEN & PEAKER LIMITED

Consulting Geo-Environmental and Construction Materials Engineers

PROCTOR TEST RESULT

Project Name:	Hwy401 Bridge Replacement	
Project No. :	SPT 1018	
Sample Supplier or Location :	TP1+ TP9	
Sampled By :	Ozzie Benjamin	
Date Sampled :	Dec.21/ 2001	
Laboratory No:	2830/1	
Proctor Method :	Standard	Method A
Sample Description:	Clayey silt with sand and trace of gravel	
Maximum Dry Density :	1875 kg/m3	
Optimum Moisture Content:	17.3 %	

DENSITY (kg/m³)



ZERO AIR VOID LINE

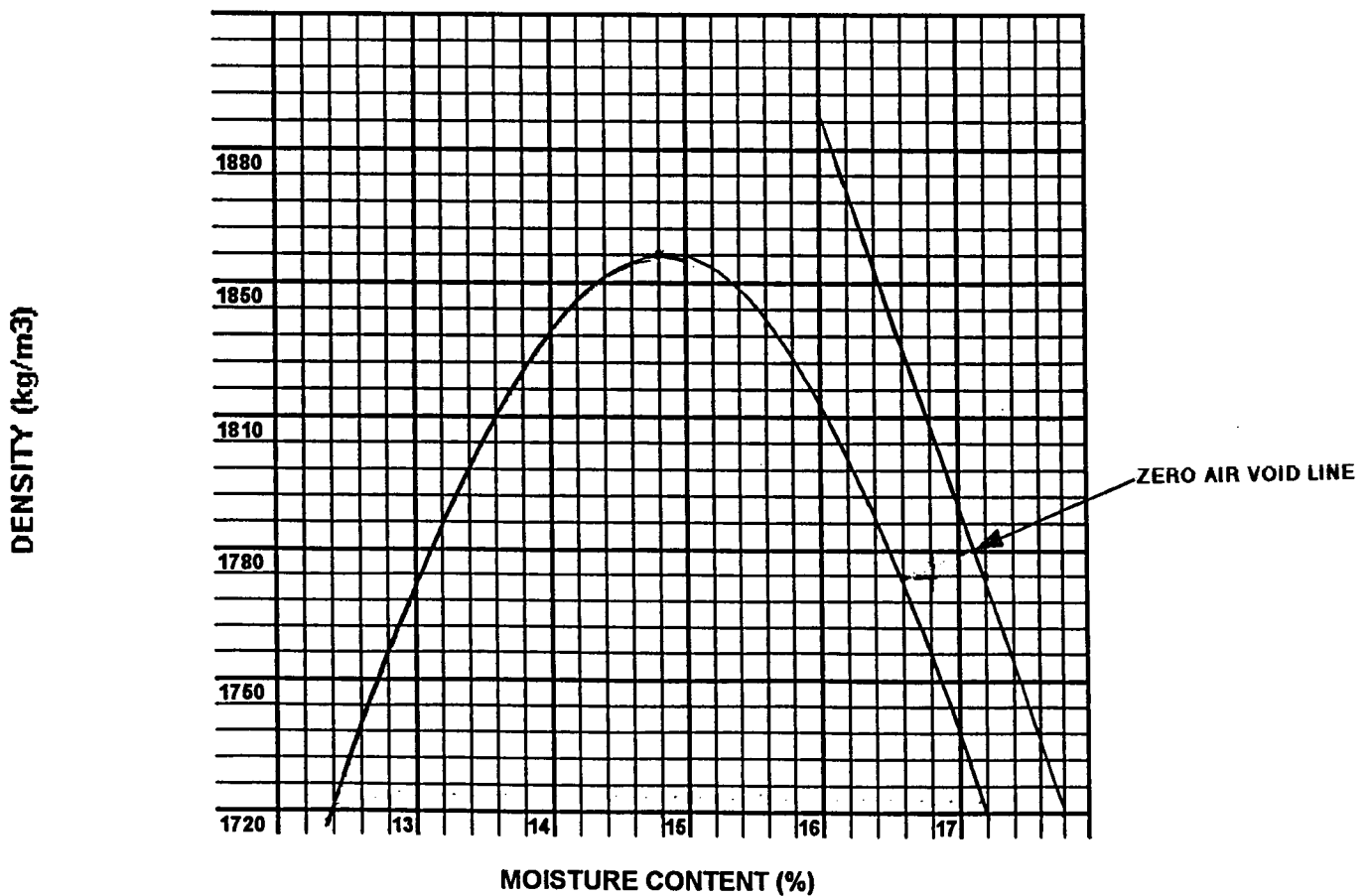
MOISTURE CONTENT (%)

SHAHEEN & PEAKER LIMITED

Consulting Geo-Environmental and Construction Materials Engineers

PROCTOR TEST RESULT

Project Name:	Hwy401 Bridge Replacement	
Project No. :	SPT 1018	
Sample Supplier or Location :	TP5+ TP8	
Sampled By :	Ozzie Benjamin	
Date Sampled :	Dec.21/ 2001	
Laboratory No:	2830/1	
Proctor Method :	Standard	Method A
Sample Description:	Clayey silt with sand and trace of gravel	
Maximum Dry Density :	1856 kg/m ³	
Optimum Moisture Content:	14.8 %	



**GEOTECHNICAL INVESTIGATION REPORT
FILL EVALUATION
HIGHWAY 401 – BURNHAM STREET BRIDGE REPLACEMENT
AND INTERCHANGE IMPROVEMENTS
COBOURG, ONTARIO
W.P. 678-90-00
SITE: 21-243**

Prepared For:

McCORMICK RANKIN CORPORATION

Prepared by:

SHAHEEN & PEAKER LIMITED

**Project: SPT1018B
June 7, 2001**

**250 Galaxy Boulevard
Etobicoke, Ontario
M9W 5R8
Tel: (416) 213-1255
Fax: (416) 213-1260**

Table of Contents

5.	DISCUSSION OF RESULTS	5
----	-----------------------	---

**GEOTECHNICAL INVESTIGATION REPORT
FILL EVALUATION
HIGHWAY 401 – BURNHAM STREET BRIDGE REPLACEMENT
AND INTERCHANGE IMPROVEMENTS
COBOURG, ONTARIO
W.P. 678-90-00
SITE: 21-243**

5. DISCUSSION OF RESULTS

The fill on the site is quite variable in quality and compactability. The quality of the fill is typically good in the upper 1.5 metres and poor, with increasing moisture content and/or organic content, below 1.5 metres. The following Table 1 summarizes the quality of the fill encountered in the test pits, based on visual and tactile observations.

**Table 1
Quality of Fill encountered in Test Pits**

Test Pit	Depth (m)	Quality of Fill
1	0.15 – 2.1	Good quality
2	0.1 – 1.5 1.5 – 2.4	Good quality Poor quality
3	0.15 – 1.2 1.2 – 3.0	Good quality Poor quality
4	0.15 – 2.7	Poor quality
5	0.15 – 2.0	Good quality
6	0.2 – 1.8	Poor quality
7	0.2 – 3.3	Poor quality
8	0.3 – 2.6	Good quality
9	0.2 – 0.7 0.7 – 4.1	Good quality Poor quality
10	0.1 – 3.0	Poor quality

A substantial quantity of the fill on the site contains an unfavourable amount of topsoil/organics (poor quality), thus making it susceptible to settlement and unsuitable for use as structural embankment backfill. The remainder of the fill is suitable for use as structural backfill, as detailed in Table 1, above. We recommend that a geotechnical consultant be retained during excavation to verify that the suitable material is separated for use as embankment fill.

The natural moisture content of the soil designated as good quality fill ranged from 11 % to 24 % at the time of investigation, but was more typically around 18 % to 20 %. The plastic limit of the fill samples tested was found to range from 15 to 17 and the optimum moisture content from the Standard Proctor tests carried out on the composite samples TP 1 & 9 and TP 5 & 8 was 17.3 % and 14.8 %, respectively. In our experience, for best compaction results, the moisture content of the soil to be utilized as fill should be at or within 3 % above the plastic limit. Most of the measured moisture contents of samples from the 'good quality' fill fall within this range (i.e. measured moisture contents were generally 18 to 20 % and the plastic limits were 15 to 17 %). Furthermore, the two Standard Proctor density tests show that the measured moisture contents of the 'good quality' fill samples fall within the acceptable range for 95 % compaction. Therefore, based on the in-situ natural moisture content of the soil at the time of our investigation and on our experience and engineering judgment, the portion of the existing fills which was classified as 'good quality' fill in Table 1 would be suitable for achieving an adequate level of compaction, using a reasonable compaction effort.

It should be noted that compaction results and the effort required to achieve adequate levels of compaction is directly linked to the seasonal conditions at the time of the operation. Hence, water may be required to increase the moisture content of soil which has been exposed to the elements for long durations during hot, dry weather, and material left exposed during wet or damp conditions may be too wet to compact and will have to be aerated and dried out.

The material to be compacted should be placed in layers not exceeding 200 mm and should be compacted using a suitable compactor for the type of soil (e.g. sheep's foot or pad foot with little or no vibration).

No visual or olfactory evidence of contamination was observed in the test pits, however, no chemical testing was carried and this was not part of our terms of reference. Should any evidence of contamination be discovered during excavation, it can be addressed at that time.

We trust that the information contained in this report is satisfactory.
Should you have any questions, please do not hesitate to contact this office.

Shaheen & Peaker Limited



Osbert Benjamin, P.Eng.



Zuhtu Ozden, P. Eng.

